CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS

TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART I

Prepared for
City of Del Rio

September 2023
Revision 1 March 2024
Revision 2 July 2024
Revision 3 March 2025



Prepared by
CP&Y, an STV company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
Dallas, TX 75240
214-638-0500

This document is intended for permitting purposes only.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION

PART I

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TCEQ PART I FORM

CORE DATA FORMS

- **CITY OF DEL RIO**
- **PLATFORM WASTE SOLUTIONS LLC**

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- **ENGLISH**
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PUBLIC INVOLVEMENT PLAN FORM

MAILING LABELS



TCEQ PART I FORM

Texas Commission on Environmental Quality

Part I Application Form for New Permit, Permit Amendment, or Registration for a Municipal Solid Waste Facility

Application Tracking Information

Facility Name: City of Del Rio Landfill

Permittee or Registrant Name: City of Del Rio

MSW Authorization Number: 207C

Initial Submission Date: 03/04/2024

Revision Date: 03/07/2025

Instructions for completing this Part I Application Form are provided in TCEQ 00650-instr[1]. Include a Core Data Form (TCEQ 10400)[2] with the application for the facility owner, and another Core Data Form for the operator if different from the owner. If you have questions, contact the Municipal Solid Waste Permits Section by email to mswper@tceq.texas.gov, or by phone at 512-239-2335.

Application Data

1. Submission Type

☐ Initial Submission ☒ Notice of Deficiency (NOD) Response

2. Authorization Type

☒ Permit ☐ Registration

3. Application Type

☐ New Permit

☒ Permit Major Amendment ☐ Permit Limited Scope Major Amendment

☐ New Registration

[1] www.tceq.texas.gov/downloads/permitting/waste-permits/msw/forms/00650-instr.pdf
[2] www.tceq.texas.gov/goto/coredata

4. Application Fee

Amount

☒ $2,050—New Landfill Permits, and Landfill Permit Major Amendments Described in 30 TAC 305.62(j)(1)

☐ $150—Other Permits, Landfill Limited Scope Major Amendments, Permit Amendments for Storage and Processing Facilities, and Registrations

Payment Method

☐ Check

☒ Online through ePay portal www3.tceq.texas.gov/epay/

If paid online, enter ePay Trace Number: 582EA000603033

5. Application URL

For applications other than those for arid exempt landfills, provide the URL address of a publicly accessible internet web site where the application and all revisions to the application will be posted.

http://www.cpypermits.com

6. Party Responsible for Publishing Notice

Indicate who will be responsible for publishing notice:

☒ Applicant ☐ Agent in Service ☐ Consultant

Contact Name: Gregory Velazquez

Title: Public Works Director Phone: 830-774-8535

Email Address: gvelazquez@cityofdelrio.com

7. Alternative Language Notice

Use the Alternative Language Checklist on Public Notice Verification Form TCEQ-20244-Waste-NORI, TCEQ-20244-Waste-NAPD, or TCEQ-20244-Waste-NAORPM available at www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw_notice.html to determine if an alternative language notice is required.

Is an alternative language notice required for this application?

☒ Yes ☐ No

Indicate the alternative language: Spanish

Permit or Approval	Received	Pending	Not Applicable
Ocean Dumping Permits under Marine Protection Research and Sanctuaries Act			X
Dredge or Fill Permits under Clean Water Act			X
Licenses under the Texas Radiation Control Act			X
Other (describe): TCEQ Air Quality Permit/Registration	X		
Other (describe):			

12. Facility General Information

Facility Name: City of Del Rio Landfill

Contact Name: Shawna Burkhart Title: City Manager

MSW Authorization Number (if existing): 207C

Regulated Entity Reference Number: **RN** 102143294

Physical or Street Address (if available): 1897 Railway Ave.

City: Del Rio County: Val Verde State: TX Zip Code: 78840

Phone Number: 830-774-8558

Latitude (Degrees, Minutes Seconds): 29° 21' 20.4241"

Longitude (Degrees, Minutes Seconds): -100° 51' 13.9300"

Benchmark Elevation (above mean sea level): 1051.10 feet

Description of facility location with respect to known or easily identifiable landmarks:

The landfill is located south of US-90, approximately 2.5 miles west of the intersection of US-90 and Loop 79, and approximately 2.25 miles east of the intersection of US-90 and US-277. The site entrance is located on Railway Ave after the intersection of S Longoria St and E Virginia St.

Access routes from the nearest United States or state highway to the facility:

The site is accessed via US-90. US-90 intersects E Bowie St, northwest of the landfill. From this intersection, vehicles will travel southwest on E Bowie St to S Longoria St and travel east on S Longoria St. In approximately 500 feet the road S Longoria St becomes the site entrance road Railway Ave to the facility.

Coastal Management Program

Is the facility within the Coastal Management Program boundary?

☐ Yes ■ No

17. Facility Contact Information

Site Operator (Permittee or Registrant)

Name: City of Del Rio

Customer Reference Number: **CN** 600756290

Contact Name: Shawna Burkhart Title: City Manager

Mailing Address: 114 W. Martin St.

City: Del Rio County: Val Verde State: TX Zip Code: 78840

Phone Number: 830-774-8558

Email Address: shawna.burkhart@cityofdelrio.com

Texas Secretary of State (SOS) Filing Number: _____

Operator (if different from *Site Operator*)

Name: Platform Waste Solutions LLC

Customer Reference Number: **CN** 606151371

Contact Name: Laken Burpo Title: General Manager

Mailing Address: 833 SW Lemans

City: Lee Summit County: Jackson State: MO Zip Code: 64082

Phone Number: 731-446-2436

Email Address: laken@platform-waste.com

Texas Secretary of State (SOS) Filing Number: 804609048

Consultant (if applicable)

Firm Name: CP&Y an STV company

Consultant Name: CP&Y an STV company

Texas Board of Professional Engineers Firm Registration Number: F-1741

Contact Name: Tewobista Metaferia, P.E. Title: Project Engineer

Mailing Address: 13155 Noel Road, Suite 200

City: Dallas County: Dallas State: TX Zip Code: 75240

Phone Number: (214)-589-6944

Email Address: tewobista.metaferia@stvinc.com

Agent in Service (required for out-of-state applicants)

Name: Not Applicable

Mailing Address: _____

City: _____ County: _____ State: TX Zip Code: _____

Phone Number: _____

Email Address: _____

Signature Page

Site Operator or Authorized Signatory

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Shawna D. Burkhart Title: City Manager

Email Address: shawna.burkhart@cityofdelrio.com

Signature: Shawna D Burkhart Date: 3/13/25

Operator or Principal Executive Officer Designation of Authorized Signatory

To be completed by the operator if the application is signed by an authorized representative for the operator.

I hereby designate Shawna D. Burkhart as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

Operator or Principal Executive Officer Name: Shawna D. Burkhart

Email Address: shawna.burkhart@cityofdelrio.com

Signature: Shawna D Burkhart Date: 3/13/25

Notary

SUBSCRIBED AND SWORN to before me by the said Shawna D. Burkhart

On this 13th day of March, 2025

My commission expires on the 03 day of 17, 2027

Notary Public in and for

Val Verde County, Texas

MARISOL ISABEL MENDOZA
Notary Public, State of Texas
Comm. Expires 03-17-2027
Notary ID 134258747

Note: Application Must Bear Signature & Seal of Notary Public

CORE DATA FORMS

City of Del Rio

☐ Dam Safety	☐ Districts	☐ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☒ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
☐ Sludge	☐ Storm Water	☐ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☐ Wastewater	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Tewobista Metaferia	41. Title:	Project Manager

42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address
(214) 589-6944		(214) 638-3723	tewobista.metaferia@stvinc.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	City of Del Rio	Job Title:	City Manager	
Name *(In Print)*:	Shawna Burkhart		Phone:	(830) 774- 8558
Signature:	Shawna D Burkhart		Date:	3/13/25

CITY OF CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS

TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART I/II – GENERAL APPLICATION REQUIREMENTS

Prepared for
City of Del Rio

September 2023
Revision 1 August 2024
Revision 2 March 2025



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destruction or adverse modification of a critical habitat, protected under the Endangered Species Act of 1973, or violate any requirement under the Marine Protection, Research, & Sanctuaries Act of 1972 for the protection of marine sanctuary.

11.0 FLOODPLAINS AND WETLANDS STATEMENT

11.1 Floodplains Statement

As shown on Figure I/II-11.1, the existing landfill permit boundary is not located within the 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM) for Val Verde County, Texas and incorporated areas.

Compliance with the floodplain location restriction is further discussed in Appendix I/IIC.

11.2 Wetlands Statement

The area within the permit boundary of the City of Del Rio Landfill was evaluated for compliance with wetlands provisions, including the determination and identification requirements in Title 30 TAC §330.61(m)(2) and (3) and the wetlands location restriction in §330.553(b). Although there are wetlands within the permit boundary of the City of Del Rio Landfill, the limit of waste is not located in wetlands.

The USACE has reviewed this project under the pre-construction notification procedures of Nationwide Permit General Condition 32 Federal Register, Vol. 86, No. 8, Wednesday. It was determined the discharge of dredged or fill materials into waters of the United States associated with this project appears to qualify for Nationwide Permit (NWP) 39 for Commercial and Institutional Developments. The permit approval letter is included in Appendix I/IIB. The project will adhere to all requirements outlined in NWP 39. In addition, all activities will comply with the water quality certification conditions of TCEQ. No waste will be placed within the wetland areas: therefore, the site is in compliance with the wetland's location restriction.

12.0 PROTECTION OF ENDANDGERED SPECIES

A written request regarding endangered or threatened species or their critical habitat with respect to the site was sent to the U.S. Fish and Wildlife Service (FWS) and the Texas Parks and Wildlife Department (TPWD). Correspondence with the FWS and TPWD is included in Appendix I/IIB. In addition, a site specific threatened and endangered species habitat assessment was completed by CP&Y (refer to the TPWD and FWS in Appendix I/IIB). Based on this study the TPWD has issued comments and recommendation listed in the following sections. The listed recommendations will prevent and minimize the destruction or adverse modification of the critical habitat of any federally listed threatened or endangered species, or cause or contribute to the taking of any federally listed threatened or endangered species. Given the above, the facility is in compliance with all applicable federal, state, and local laws regarding threatened or endangered species.

12.1 Construction Recommendations

During construction in the expansion area:

- Sediment control fence for the purpose of controlling erosion and protecting water quality on the downstream side of the construction area per the SWPPP.
- Site will be secured at the end of each day and check for wildlife that may need safe egress opportunities.
- Authorized individual will be available to translocate and handle any rare or state listed species that will not readily leave the work area to the proper distance and location.
- Erosion and seed/mulch stabilization material along with no-till drilling, hydromulching and/or hydroseeding when revegetation efforts may be needed to reduce the risk of wildlife entanglement hazard.
- If erosion control blankets or mats made of netting will be used and designed to TPWD standards to avoid wildlife entanglement.

12.2 Federal and State Regulations

The following TPWD recommendations will be followed during construction to meet the federal and state regulations.

- When practicable and necessary to comply with applicable laws and regulations, clearing of vegetation will take place outside of the general bird nesting season, March 15 through September 15. A qualified biologist will conduct nest surveys for active nests within nesting season when any vegetation is to be impacted. The recommended buffers will be implemented and remain in place for the appropriate amount of time when nests are observed to be inactive.
- Current TPWD annotated county list of rare species for Val Verde County was reviewed and construction contractor will be aware of listed rare species.
- Disturbance of the Texas horned lizard, its habitat, and primary food source. It will not be feasible for a biological monitor to be present during construction, but the Texas horned lizard will be allowed to safely leave the site on their own. It should be noted that harvester ants or their nests were not noted during the multiple field observations.

- BMPs will be used during times the Texas tortoise is active. It will not be feasible for a biological monitor to be present during all vegetation clearing, but if a Texas tortoise is located in imminent danger during clearing or construction it will be transported to the closest suitable habitat. Exclusion fences will be constructed per the general construction recommendations.
- Proper surveys will be conducted for any ground disturbing activities after the month of October. If tortoise or indications of tortoise presence is observed TPWD Ecological and Environmental Planning Program staff will be contacted.

13.0 LEGAL DESCRIPTION

A legal description of the 180.6-acre permit boundary is included on the following pages. This area is shown on the attached drawing.

The City of Del Rio has 100% ownership of the landfill. Current ownership records for the property may be found in Val Verde County Real Property records.

STATE OF TEXAS §
COUNTY OF VAL VERDE §

PROPERTY OWNER'S AFFIDAVIT

On this day, March 13, 2025 appeared before me. the undersigned notary public, and after I administered an oath to him, upon this oath he said:

"My name is Shawna Burkhart . I am the City Manager of the City of Del Rio, and I am authorized to make the following statements on behalf of the City of Del Rio.

The City of Del Rio is the owner of certain real property in Val Verde County, Texas, included the tract(s) described in Exhibit A attached hereto ("the Property"), which is included in the permitted area of its Del Rio Landfill municipal solid waste landfill facility ("the Facility"), pursuant to amendment of Texas Commission on Environmental quality Permit No. MSW-207C.

The City of Del Rio hereby acknowledges that the State of Texas may hold the property owner of record either jointly or severally responsible for the operation, maintenance, and closure and post-closure care of the Facility on the Property.

The City of Del Rio hereby acknowledges that the owner of the Property has the responsibility to file in the deed records of Val Verde County an affidavit to the public advising that the Property will be used for a solid waste facility prior to the time that the Facility actually begins operating as a municipal solid waste landfill facility on the Property, and to file a final recording upon completion of disposal operations and closure of the landfill units on the Property in accordance with 30 TAC §330.19.

The City of Del Rio hereby acknowledges that the Facility owner or operator and the State of Texas shall have access to the Property during the active life and post-closure care of the Facility for the purpose of inspection and maintenance.

Shawna D Burkhart

Shawna Burkhart
City Manager
City of Del Rio

SWORN TO AND SUBSCRIBED before me by Shawna D. Burkhart on the 13th day of March, 2025.

Mail

Notary Public

MARISOL ISABEL MENDOZA
Notary Public, State of Texas
Comm. Expires 03-17-2027
Notary ID 134258747

DELEGATED SIGNATORY AUTHORITY

Tony Baker
Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Dear Mr. Baker:

I am an Authorized Agent of the City of Del Rio.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

Shawna D Burkhart

Shawna Burkhart
City Manager

SWORN TO AND SUBSCRIBED BEFORE ME by Shawna D. Burkhart on the 13th day of March, 2025, which witness my hand and seal of office.

MARISOL ISABEL MENDOZA
Notary Public, State of Texas
Comm. Expires 03-17-2027
Notary ID 134258747

Mail

Notary Public in and for the State of Texas

Marisol Mendoza

Printed Name

My Commission Expires 03-17-2027

CITY OF CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PARTS I/II – GENERAL APPLICATION REQUIREMENTS

APPENDIX I/II B
COORDINATION DEMONSTRATION

Prepared for
City of Del Rio

Revision 1 August 2024
Revision 2 March 2025



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COORDINATION WITH
FEDERAL AVIATION ADMINISTRATION

- September 12, 2024 FAA Determination of No Hazard to Air Navigation Letter.
- August 14, 2024 Request for Review Letter regarding hazards to air navigation and hazards to air traffic due to birds.
- Del Rio International Airport notification letter.
- Laughlin Air Force Base notification letter.

U.S. Department of Transportation
Federal Aviation Administration

Federal Aviation Administration
Southwest Region, Airports Division
Safety and Standards Branch

10101 Hillwood Parkway
Fort Worth, Texas 76177

September 12, 2024

Tewobista Metaferia, P.E.
Engineer, Water Practice
Tewobista.Metaferia@stvinc.com

Subject: City of Del Rio Landfill
Type I Landfill – Amendment Application
Proposed Amendment Horizontal Expansion (1034' AMSL)
FAA File No. 2020-003-TX

Dear Tewobista Metaferia:

This letter is in response to your August 14, 2024 email advising us of the proposed horizontal expansion of the Del Rio Landfill. FAA Airspace Procedures evaluated the request for the horizontal expansion and set height restriction at 1034 AMSL. On August 14, 2024, the FAA forwarded a "Determination of No Hazard to Air Navigation" Letter to the Public Works Director for the City of Del Rio.

Using coordinates 29 21' 34.60" N and 100 51' 48.04" W, we determined there is one public-use airport 3.46 nm (Del Rio International) from the site boundary with the approach end of Runway 31 west northwest of the Landfill site. We also determined there is a military airport 4.48 nm (Laughlin Air Force Base) due east of the Landfill site. A 14 CFR Part 77 evaluation revealed no potential conflicts.

The Del Rio Landfill site was previously evaluated by FAA in 1989, 1994 and 2020 without objection. We have no objection to the proposed horizontal expansion of the Del Rio Landfill site. The current wildlife mitigation strategies are working well. In the event that these strategies become less effective in wildlife control please contact our office and we can assist. Our position of no objection is based on the application of our guidance for hazardous wildlife attractants on or near airports FAA Advisory Circular 150/5200-33C.

This site has been assigned our file No. 2020-003-TX. Please refer to this number in any future correspondence regarding this site. Thank you for coordinating this project with us. If there are any questions, you can contact me at 817-222-5671 or gary.loftus@faa.gov.

Sincerely,

GARY J LOFTUS

Digitally signed by GARY J LOFTUS
Date: 2024.09.12 11:03:30 -05'00'

Gary J. Loftus, A.A.E.
Airports Compliance Program Manager
Airport Certification Safety Inspector
FAA Southwest Region Airports Division

November 7, 2024

Juan C. Onofre
Airport Manager
Del Rio International Airport
1104 W. 10th Street
Del Rio, Texas 78840

Re: Compliance with Airport Location Restriction
Proposed City of Del Rio Municipal Landfill Permit Amendment
Val Verde County, Texas

Dear Mr. Onofre,

CP&Y an STV Company, is in the process of developing a major permit amendment application, on behalf of the City of Del Rio, to horizontally expand its existing landfill located in Val Verde County, Texas. The Texas Commission on Environmental Quality (TCEQ), per Title 30 Texas Administrative Code (TAC) §330.545(b), requires that all applicants that are undergoing a permit amendment for a lateral expansion located within a six-mile radius of any small general service airport runway and any large general public commercial airport runway and the Federal Aviation Administration (FAA). The purpose of this letter is to provide an overview of the proposed landfill expansion and demonstrate coordination with Laughlin Air Force Base to TCEQ consistent with TAC §330.545(b).

> *"Owners or operators proposing to site new municipal solid waste landfill units and lateral expansions located within a six-mile radius of any small general service airport runway end used by turbojet or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration. Owners or operators proposing to site new municipal solid waste landfill units and lateral expansions located within a five-mile radius of any large general public commercial airport runway end used by turbojet or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration."*

Project Background

The City of Del Rio Landfill is an existing Type I landfill in Del Rio, Texas that is owned by the City and operated by Platform Waste Solutions. The existing landfill (TCEQ Permit No. 207B) is a 105.6-acre facility with a waste footprint of approximately 79 acres.

The landfill has been servicing the residents of the City of Del Rio and the surrounding areas for over 40 years. The City of Del Rio Landfill started accepting waste in 1972 under Permit No. 207. Permit 207A was issued in 1989 for the current 105.6-acre facility. In 1994 the City submitted a Class I Permit Modification to upgrade the facility to meet the Subtitle-D requirements. The landfill was then

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Dallas, Texas 75235
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expanded vertically in 2022 under Permit No. 207B. Although the recent vertical expansion extended the site life of the facility, the lateral expansion project will allow the City to provide long-term disposal capacity for municipal solid waste to the residents of the City of Del Rio and the surrounding areas. Figure 1 in Attachment 1 shows the permitted landfill completion plan and the proposed expansion completion plan. This is a horizontal expansion that will increase the existing 105.6-acre permit boundary by 75 acres to 180.6 acres. The permitted limit of waste will be expanded by 53.64 acres from approximately 79 to approximately 132.64 acres.

Project Design Summary

The following information presents a summary of the design and operations of the proposed City of Del Rio Landfill expansion. The permit application will be submitted to TCEQ and undergo a detailed review by the TCEQ before the operative permit for the expansion of this facility is issued.

- Accepted wastes will remain consistent with the current MSW landfill permit. The major classifications of solid waste to be accepted at the City of Del Rio Landfill include household waste, commercial waste, industrial waste (nonhazardous), construction-demolition waste, and some special wastes.

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- Gas Monitoring System. The purpose of the landfill gas monitoring system is to verify that landfill gas does not migrate off-site. The existing system is sampled and tested periodically. The results are filed with the TCEQ and are public record. No change is anticipated to control landfill gas emissions. If gas collection and control system is need for the site per TCEQ requirements, the application will incorporate system into the landfill permit application.

- Site Operations. No change is anticipated to the existing site operations. The City of Del Rio Municipal Landfill will continue to be inspected by the TCEQ on a regular basis to ensure the site is in compliance with state regulations.

To assist the with review, please find the attached following information:

- Attachment 1: Permitted and Proposed Landfill Completion Plans

- Attachment 2: FAA Aeronautical Study Point Plan shows the six locations, which have been uploaded to the FAA Web page so that an aeronautical study can be performed. Note that the peak elevation of the landfill only occurs at 2022-ASW-23124. The FAA evaluation determined that the proposed structure at the points shown on Figure FAA do not exceed obstruction standards and would not be a hazard to air navigation. Based on this evaluation, marking and lighting are not necessary for aviation safety.

- Attachment 3: FAA No Objection Ltr - The FAA letter that notes no objection to the landfill expansion project is included as part of this letter.

Please note that the Site Operating Plan includes requirements to maintain the working face of the landfill, where waste is exposed, to as small of an area as practical. Specific working face sizes are listed in the permit documents to minimize the potential of the site to attract birds.

As noted above, this letter is being sent to meet the notification requirement noted in 330.545(b), so no additional coordination is required from Laughlin Air Force Base. Please do not hesitate to contact CP&Y an STV Company, if there are any questions or additional information is needed.

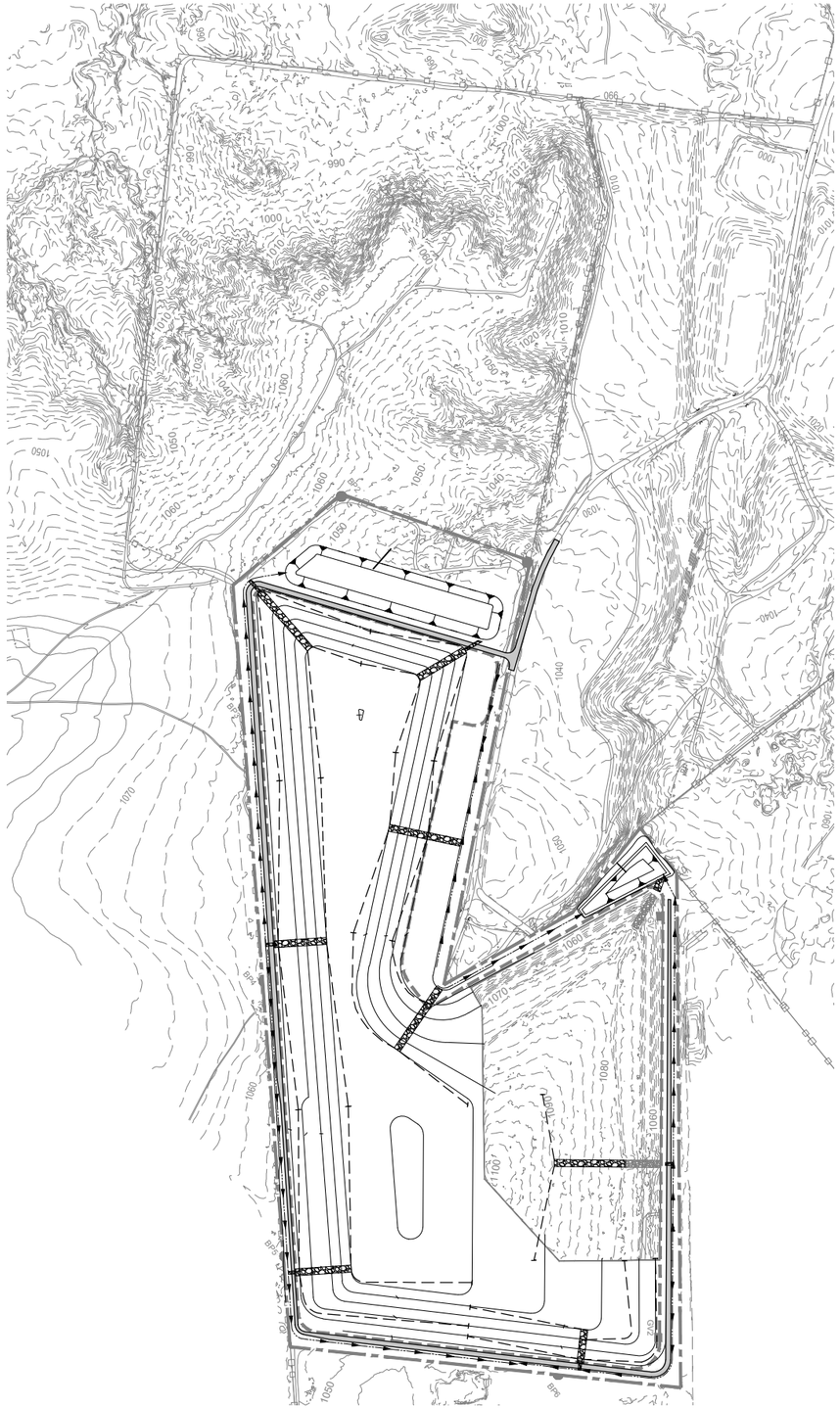
Sincerely,
CP&Y an STV Company.

Tewobista Metaferia, P.E.
Project Engineer

Attachments: Attachment 1: Landfill Completion Plan
Attachment 2: FAA Aeronautical Study Point Plan
Attachment 3: FAA No-Objection Letter

cc: Rene Maldonado, City of Del Rio Landfill Coordinator

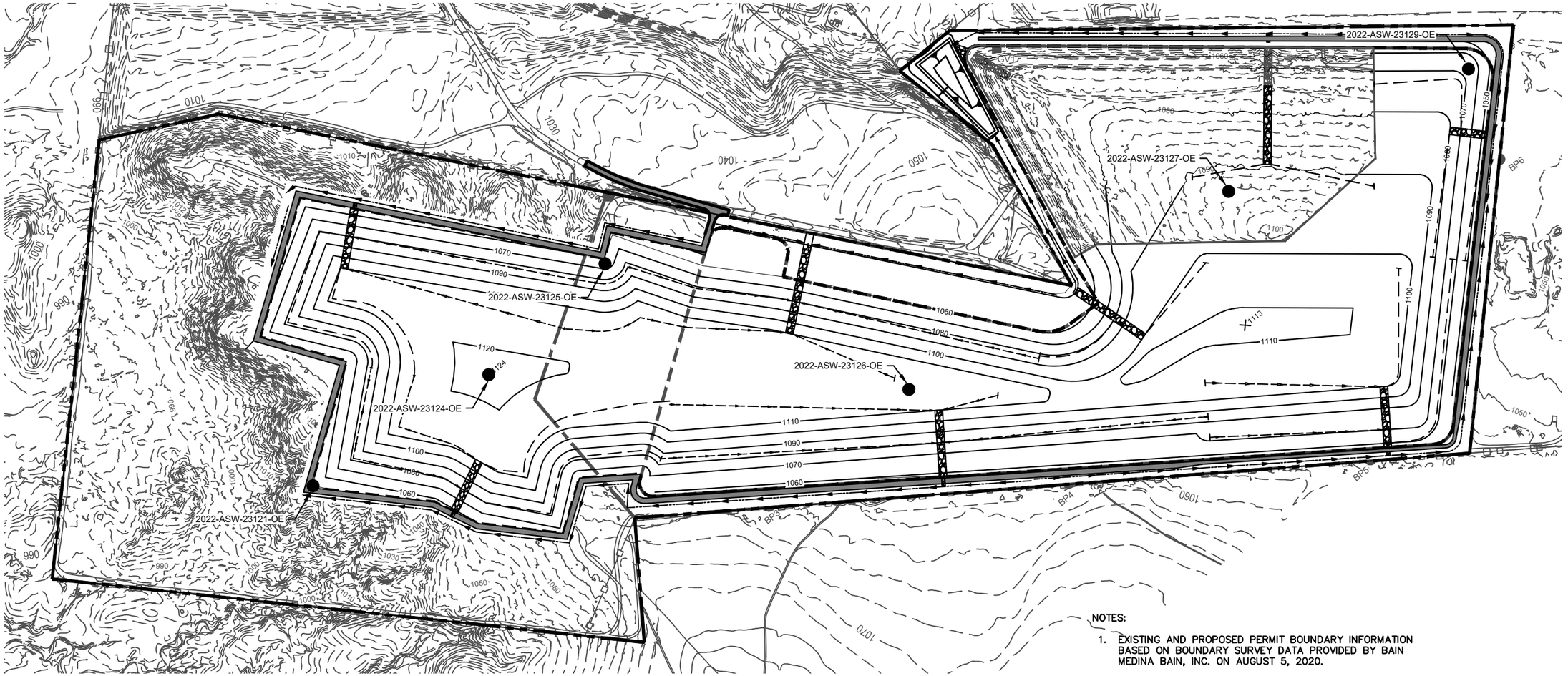
Attachment 1


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Attachment 2

LEGEND

- EXISTING PERMIT BOUNDARY
- EXISTING LIMIT OF WASTE
- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- EXISTING GRADES (1080)
- PROPOSED FINAL COVER GRADES (1010)
- FAA AERONAUTICAL STUDY POINT



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.

stv
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF Del Rio TEXAS

NO.	REVISION	BY	DATE

VERIFY SCALE 1" 0

BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY

CITY OF DEL RIO LANDFILL
VAL VERDE COUNTY

FAA AERONAUTICAL STUDY POINT PLAN

DESIGN:	T. METAFERIA
DRAWN:	J. TORRES
REVIEW:	B. HINDMAN
CP&Y:	DELR2000302
CLIENT:	CITY OF DEL RIO

FIGURE
FAA

PRINTED BY: MetafeT DATE: 7/5/2024
FILE PATH: C:\pwworkingfs\tvpw_stv\tmetaferia\d0943703\DELR2000302 FAA AERONAUTICAL STUDY.dwg

Attachment 3

U.S. Department of Transportation
Federal Aviation Administration

Federal Aviation Administration
Southwest Region, Airports Division
Safety and Standards Branch

10101 Hillwood Parkway
Fort Worth, Texas 76177

September 12, 2024

Tewobista Metaferia, P.E.
Engineer, Water Practice
Tewobista.Metaferia@stvinc.com

Subject: City of Del Rio Landfill
Type I Landfill – Amendment Application
Proposed Amendment Horizontal Expansion (1034' AMSL)
FAA File No. 2020-003-TX

Dear Tewobista Metaferia:

This letter is in response to your August 14, 2024 email advising us of the proposed horizontal expansion of the Del Rio Landfill. FAA Airspace Procedures evaluated the request for the horizontal expansion and set height restriction at 1034 AMSL. On August 14, 2024, the FAA forwarded a "Determination of No Hazard to Air Navigation" Letter to the Public Works Director for the City of Del Rio.

Using coordinates 29 21' 34.60" N and 100 51' 48.04" W, we determined there is one public-use airport 3.46 nm (Del Rio International) from the site boundary with the approach end of Runway 31 west northwest of the Landfill site. We also determined there is a military airport 4.48 nm (Laughlin Air Force Base) due east of the Landfill site. A 14 CFR Part 77 evaluation revealed no potential conflicts.

The Del Rio Landfill site was previously evaluated by FAA in 1989, 1994 and 2020 without objection. We have no objection to the proposed horizontal expansion of the Del Rio Landfill site. The current wildlife mitigation strategies are working well. In the event that these strategies become less effective in wildlife control please contact our office and we can assist. Our position of no objection is based on the application of our guidance for hazardous wildlife attractants on or near airports FAA Advisory Circular 150/5200-33C.

This site has been assigned our file No. 2020-003-TX. Please refer to this number in any future correspondence regarding this site. Thank you for coordinating this project with us. If there are any questions, you can contact me at 817-222-5671 or gary.loftus@faa.gov.

Sincerely,

GARY J LOFTUS

Digitally signed by GARY J LOFTUS
Date: 2024.09.12 11:03:30 -05'00'

Gary J. Loftus, A.A.E.
Airports Compliance Program Manager
Airport Certification Safety Inspector
FAA Southwest Region Airports Division

November 7, 2024

Laughlin Air Force Base
548 Laughlin Dr
Del Rio, Texas 78843

Re: Compliance with Airport Location Restriction
Proposed City of Del Rio Municipal Landfill Permit Amendment
Val Verde County, Texas

CP&Y an STV Company, is in the process of developing a major permit amendment application, on behalf of the City of Del Rio, to horizontally expand its existing landfill located in Val Verde County, Texas. The Texas Commission on Environmental Quality (TCEQ), per Title 30 Texas Administrative Code (TAC) §330.545(b), requires that all applicants that are undergoing a permit amendment for a lateral expansion located within a six-mile radius of any small general service airport runway and any large general public commercial airport runway and the Federal Aviation Administration (FAA). The purpose of this letter is to provide an overview of the proposed landfill expansion and demonstrate coordination with Laughlin Air Force Base to TCEQ consistent with TAC §330.545(b).

> *"Owners or operators proposing to site new municipal solid waste landfill units and lateral expansions located within a six-mile radius of any small general service airport runway end used by turbojet or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration. Owners or operators proposing to site new municipal solid waste landfill units and lateral expansions located within a five-mile radius of any large general public commercial airport runway end used by turbojet or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration."*

Project Background

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The landfill has been servicing the residents of the City of Del Rio and the surrounding areas for over 40 years. The City of Del Rio Landfill started accepting waste in 1972 under Permit No. 207. Permit 207A was issued in 1989 for the current 105.6-acre facility. In 1994 the City submitted a Class I Permit Modification to upgrade the facility to meet the Subtitle-D requirements. The landfill was then expanded vertically in 2022 under Permit No. 207B. Although the recent vertical expansion extended

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the site life of the facility, the lateral expansion project will allow the City to provide long-term disposal capacity for municipal solid waste to the residents of the City of Del Rio and the surrounding areas. Figure 1 in Attachment 1 shows the permitted landfill completion plan and the proposed expansion completion plan. This is a horizontal expansion that will increase the existing 105.6-acre permit boundary by 75 acres to 180.6 acres. The permitted limit of waste will be expanded by 53.64 acres from approximately 79 to approximately 132.64 acres.

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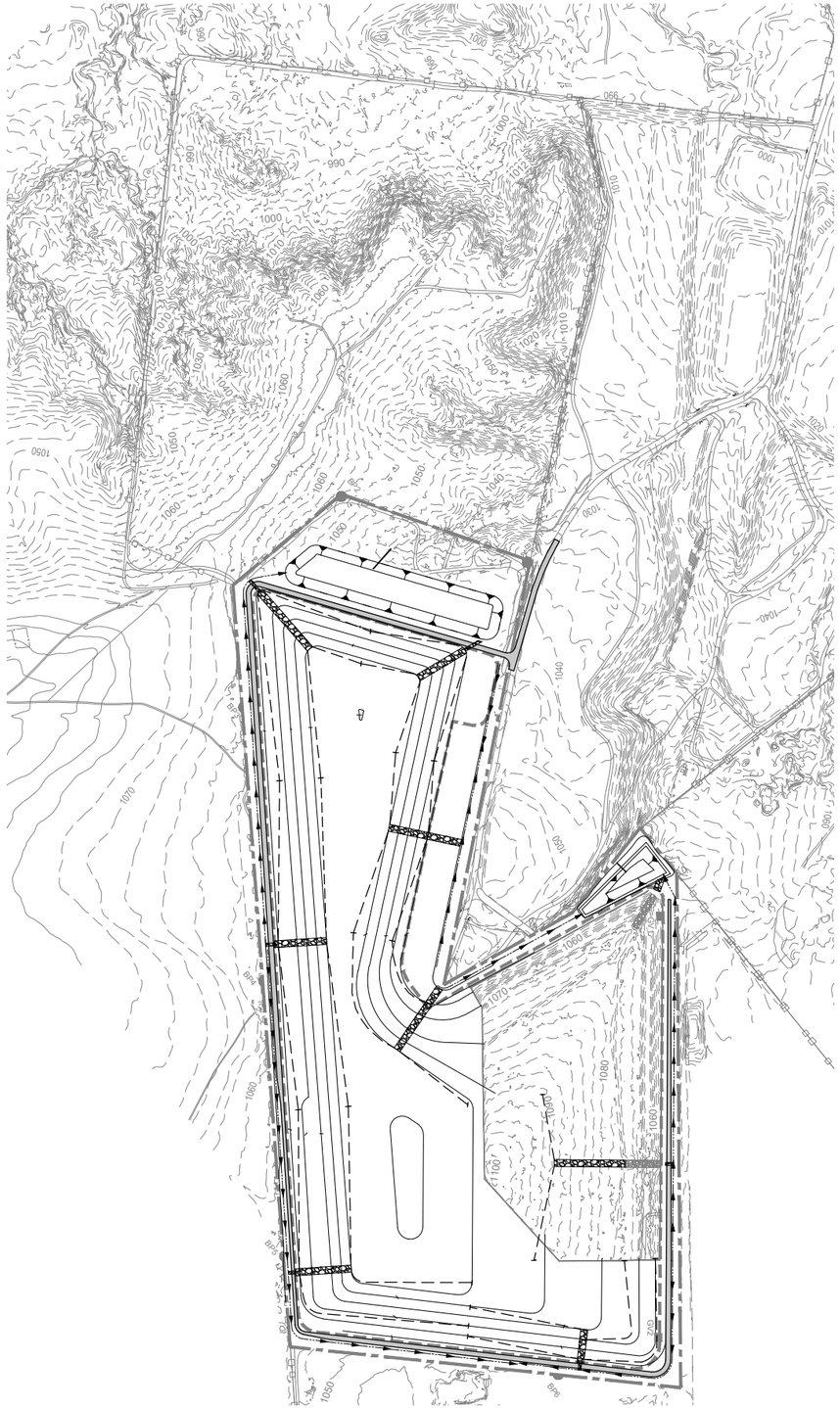
Sincerely,
CP&Y an STV Company.

Tewobista Metaferia, P.E.
Project Engineer

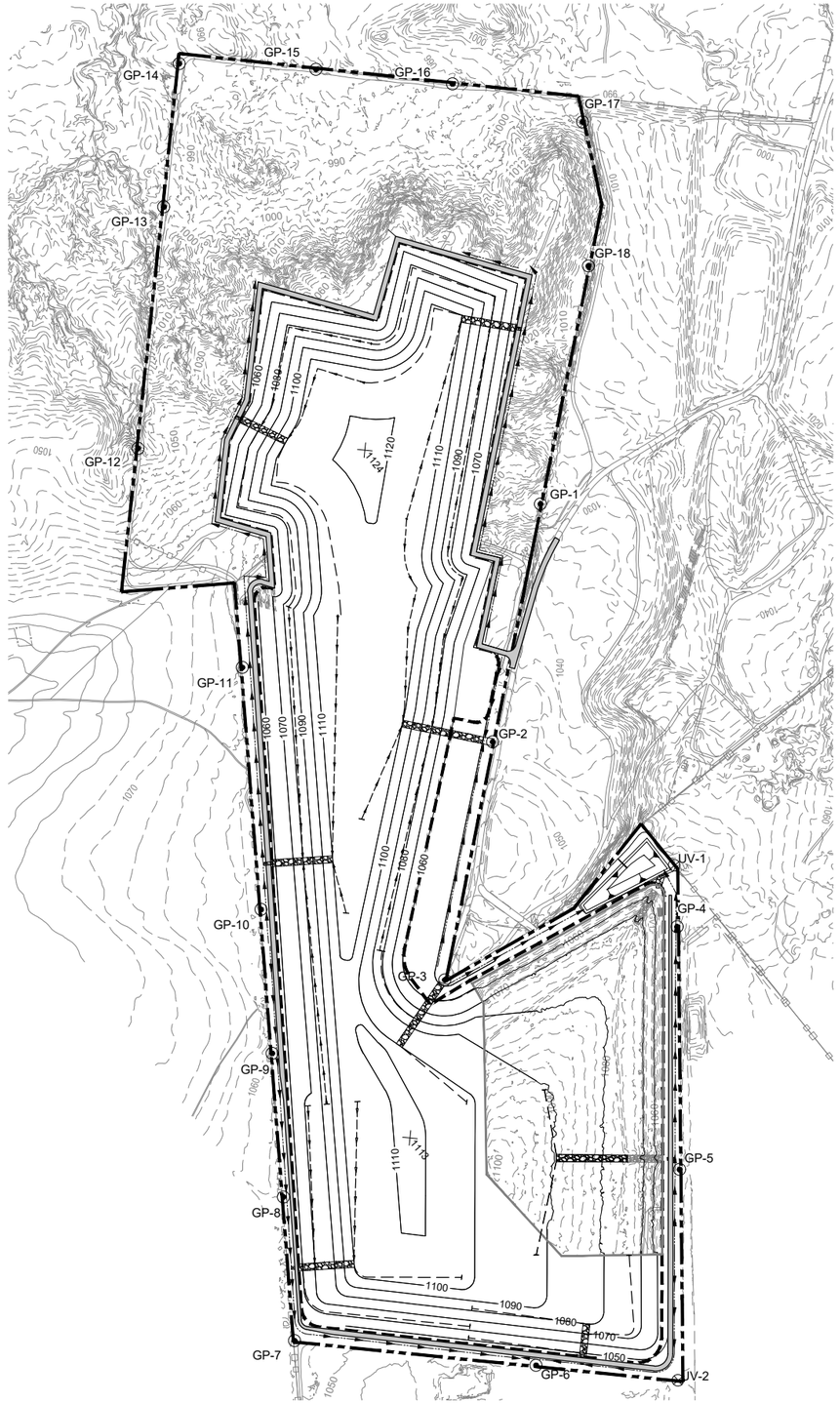
Attachments: Attachment 1: Landfill Completion Plan
Attachment 2: FAA Aeronautical Study Point Plan
Attachment 3: FAA No-Objection Letter

cc: Rene Maldonado, City of Del Rio Landfill Coordinator

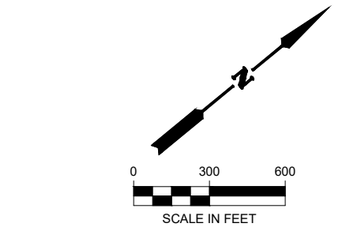
Attachment 1



PERMITTED LANDFILL COMPLETION PLAN
(TCEQ PERMIT NO. MSW-207B)



PROPOSED LANDFILL COMPLETION PLAN
(TCEQ PERMIT NO. MSW-207C)



LEGEND

- PERMITTED PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- 1090 — FINAL COVER GRADES
- 1084 — EXISTING GRADES
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 — EXISTING GAS PROBE
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 — EXISTING GAS VENT
- GP-5 — PROPOSED GAS PROBE
- UV-1 — PROPOSED GAS VENTS

I/IIIB-45d

sti
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF Del Rio TEXAS

NO	REVISION	BY	DATE

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY
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CITY OF DEL RIO LANDFILL
VAL VERDE COUNTY

PERMITTED VS PROPOSED SITE PLAN

DESIGN:	T. METAFERIA
DRAWN:	J. TORRES
REVIEW:	B. HINDMAN
CP&Y:	DELR2000302
CLIENT:	CITY OF DEL RIO

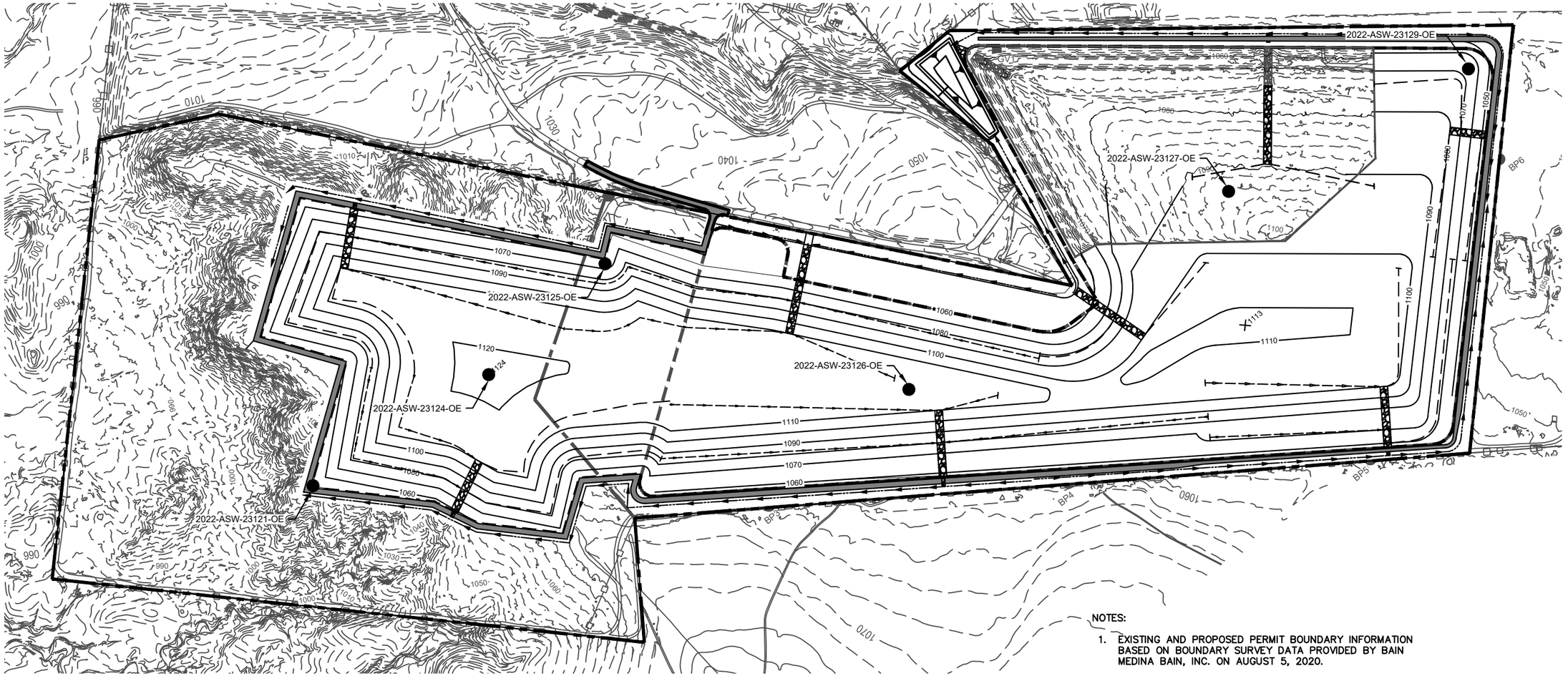
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Attachment 2

LEGEND

- EXISTING PERMIT BOUNDARY
- EXISTING LIMIT OF WASTE
- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- EXISTING GRADES (1080)
- PROPOSED FINAL COVER GRADES (1010)
- FAA AERONAUTICAL STUDY POINT



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1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.

TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF Del Rio TEXAS

NO.	REVISION	BY	DATE

VERIFY SCALE 1" 0

BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

CITY OF DEL RIO LANDFILL
VAL VERDE COUNTY

FAA AERONAUTICAL STUDY POINT PLAN

DESIGN:	T. METAFERIA
DRAWN:	J. TORRES
REVIEW:	B. HINDMAN
CP&Y:	DELR2000302
CLIENT:	CITY OF DEL RIO

FIGURE
FAA

PRINTED BY: MetafeT DATE: 7/5/2024
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Attachment 3

U.S. Department of Transportation
Federal Aviation Administration

Federal Aviation Administration
Southwest Region, Airports Division
Safety and Standards Branch

10101 Hillwood Parkway
Fort Worth, Texas 76177

September 12, 2024

Tewobista Metaferia, P.E.
Engineer, Water Practice
Tewobista.Metaferia@stvinc.com

Subject: City of Del Rio Landfill
Type I Landfill – Amendment Application
Proposed Amendment Horizontal Expansion (1034' AMSL)
FAA File No. 2020-003-TX

Dear Tewobista Metaferia:

This letter is in response to your August 14, 2024 email advising us of the proposed horizontal expansion of the Del Rio Landfill. FAA Airspace Procedures evaluated the request for the horizontal expansion and set height restriction at 1034 AMSL. On August 14, 2024, the FAA forwarded a "Determination of No Hazard to Air Navigation" Letter to the Public Works Director for the City of Del Rio.

Using coordinates 29 21' 34.60" N and 100 51' 48.04" W, we determined there is one public-use airport 3.46 nm (Del Rio International) from the site boundary with the approach end of Runway 31 west northwest of the Landfill site. We also determined there is a military airport 4.48 nm (Laughlin Air Force Base) due east of the Landfill site. A 14 CFR Part 77 evaluation revealed no potential conflicts.

The Del Rio Landfill site was previously evaluated by FAA in 1989, 1994 and 2020 without objection. We have no objection to the proposed horizontal expansion of the Del Rio Landfill site. The current wildlife mitigation strategies are working well. In the event that these strategies become less effective in wildlife control please contact our office and we can assist. Our position of no objection is based on the application of our guidance for hazardous wildlife attractants on or near airports FAA Advisory Circular 150/5200-33C.

This site has been assigned our file No. 2020-003-TX. Please refer to this number in any future correspondence regarding this site. Thank you for coordinating this project with us. If there are any questions, you can contact me at 817-222-5671 or gary.loftus@faa.gov.

Sincerely,

GARY J LOFTUS

Digitally signed by GARY J LOFTUS
Date: 2024.09.12 11:03:30 -05'00'

Gary J. Loftus, A.A.E.
Airports Compliance Program Manager
Airport Certification Safety Inspector
FAA Southwest Region Airports Division

COORDINATION WITH
TEXAS DEPARTMENT OF TRANSPORTATION

- September 24, 2024, TXDOT conclusion of no objections or concerns with potential traffic impact letter.
- July 5, 2024, Request for Review Letter.

Docusign Envelope ID: A61DA844-FBF3-4E69-B863-A8B60D880472

Texas Department of Transportation
1817 Bob Bullock Loop | Laredo, Texas 78043
956-712-7400
txdot.gov

September 24, 2024

Ms. Tewobista Metaferia P.E.
Project Manager
STV
13155 Noel Road, Suite 200
Dallas, Texas 75240

Re: Compliance with Traffic Location Restriction Information
Proposed City of Del Rio Municipal Landfill Permit Amendment
Val Verde County, Texas

Dear Ms. Metaferia:

We appreciate STV notifying us of the expansion of the municipal solid waste facility in Del Rio, Texas. The District has reviewed the site location map and the details provided in the notification letter. We do not have any objections or concerns with potential traffic impact to the highway facility.

Please let us know if additional information is required from TxDOT.

Sincerely,

DocuSigned by:
Epigmenio Gonzalez, P.E.
A5A9883ECD1E4F7...

Epigmenio Gonzalez, P.E.
Laredo District Engineer

cc: Hyung Ahn, Del Rio Area Engineer

Connecting You with Texas
An Equal Opportunity Employer

Certificate Of Completion

Envelope Id: A61DA844FBF34E69B863A8B60D880472 Status: Completed
Subject: Complete with Docusign: TxDOT Coordination Letter (003).pdf, TrashonTXDOTROW2024.pdf, TxDOT Res...
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Certificate Pages: 4 Initials: 0 Nancy Codero
AutoNav: Enabled 125 E. 11th Street
EnvelopeId Stamping: Enabled Austin, TX 78701
Time Zone: (UTC-06:00) Central Time (US & Canada) nancy.cordero@txdot.gov
IP Address: 204.64.21.232

Record Tracking

Status: Original Holder: Nancy Codero Location: DocuSign
9/24/2024 11:46:20 AM nancy.cordero@txdot.gov
Security Appliance Status: Connected Pool: StateLocal
Storage Appliance Status: Connected Pool: Texas Department of Transportation Location: DocuSign

Signer Events	Signature	Timestamp
Epi Gonzalez Epigmenio.Gonzalez@txdot.gov Laredo District Engineer Texas Department of Transportation Security Level: Email, Account Authentication (Optional)	DocuSigned by:  A5A9883ECD1E4F7... Signature Adoption: Uploaded Signature Image Using IP Address: 204.64.21.246	Sent: 9/24/2024 11:48:14 AM Viewed: 9/24/2024 12:32:27 PM Signed: 9/24/2024 12:40:25 PM

Electronic Record and Signature Disclosure:
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ID: 70371c49-5181-4041-b55a-b4173fc482e1

In Person Signer Events	Signature	Timestamp

Editor Delivery Events	Status	Timestamp

Agent Delivery Events	Status	Timestamp

Intermediary Delivery Events	Status	Timestamp

Certified Delivery Events	Status	Timestamp

Carbon Copy Events	Status	Timestamp

Witness Events	Signature	Timestamp

Notary Events	Signature	Timestamp

Envelope Summary Events	Status	Timestamps
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Signing Complete	Security Checked	9/24/2024 12:40:25 PM
Completed	Security Checked	9/24/2024 12:40:25 PM

Payment Events	Status	Timestamps

Electronic Record and Signature Disclosure

ELECTRONIC RECORD AND SIGNATURE DISCLOSURE

From time to time, Texas Department of Transportation (we, us or Company) may be required by law to provide to you certain written notices or disclosures. Described below are the terms and conditions for providing to you such notices and disclosures electronically through your DocuSign, Inc. (DocuSign) Express user account. Please read the information below carefully and thoroughly, and if you can access this information electronically to your satisfaction and agree to these terms and conditions, please confirm your agreement by clicking the 'I agree' button at the bottom of this document.

Getting paper copies

At any time, you may request from us a paper copy of any record provided or made available electronically to you by us. For such copies, as long as you are an authorized user of the DocuSign system you will have the ability to download and print any documents we send to you through your DocuSign user account for a limited period of time (usually 30 days) after such documents are first sent to you. After such time, if you wish for us to send you paper copies of any such documents from our office to you, you will be charged a $0.00 per-page fee. You may request delivery of such paper copies from us by following the procedure described below.

Withdrawing your consent

If you decide to receive notices and disclosures from us electronically, you may at any time change your mind and tell us that thereafter you want to receive required notices and disclosures only in paper format. How you must inform us of your decision to receive future notices and disclosure in paper format and withdraw your consent to receive notices and disclosures electronically is described below.

Consequences of changing your mind

If you elect to receive required notices and disclosures only in paper format, it will slow the speed at which we can complete certain steps in transactions with you and delivering services to you because we will need first to send the required notices or disclosures to you in paper format, and then wait until we receive back from you your acknowledgment of your receipt of such paper notices or disclosures. To indicate to us that you are changing your mind, you must withdraw your consent using the DocuSign 'Withdraw Consent' form on the signing page of your DocuSign account. This will indicate to us that you have withdrawn your consent to receive required notices and disclosures electronically from us and you will no longer be able to use your DocuSign Express user account to receive required notices and consents electronically from us or to sign electronically documents from us.

All notices and disclosures will be sent to you electronically

Unless you tell us otherwise in accordance with the procedures described herein, we will provide electronically to you through your DocuSign user account all required notices, disclosures, authorizations, acknowledgements, and other documents that are required to be provided or made available to you during the course of our relationship with you. To reduce the chance of you inadvertently not receiving any notice or disclosure, we prefer to provide all of the required notices and disclosures to you by the same method and to the same address that you have given us. Thus, you can receive all the disclosures and notices electronically or in paper format through the paper mail delivery system. If you do not agree with this process, please let us know as described below. Please also see the paragraph immediately above that describes the consequences of your electing not to receive delivery of the notices and disclosures electronically from us.

How to contact Texas Department of Transportation:

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Required hardware and software

Operating Systems:	Windows2000? or WindowsXP?
Browsers (for SENDERS):	Internet Explorer 6.0? or above
Browsers (for SIGNERS):	Internet Explorer 6.0?, Mozilla FireFox 1.0, NetScape 7.2 (or above)
Email:	Access to a valid email account
Screen Resolution:	800 x 600 minimum
Enabled Security Settings:	• Allow per session cookies

	• Users accessing the internet behind a Proxy Server must enable HTTP 1.1 settings via proxy connection

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COORDINATION WITH
TEXAS PARKS AND WILDLIFE DEPARTMENT

- October 2, 2024 – Response Letter to TPWD on recommendations.
- May 24, 2024 TPWD response letter.
- July 5, 2024, Request for Review Letter.

October 2, 2024

Mr. Russell Hooten
Ecological and Environmental Planning Program
Wildlife Division
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

via email: russell.hooten@tpwd.texas.gov

Re: Texas Parks and Wildlife Department Comments on the Proposed expansion of the City of Del Rio Landfill (Proposed Permit No 207C), Del Rio, Val Verde County, Texas

Dear Mr. Hooten,

STV Inc. (STV) has reviewed the Texas Parks and Wildlife Department (TPWD) comments and recommendations, dated May 24, 2024, regarding the proposed expansion of the City of Del Rio's landfill project located in Val Verde County, Texas. We appreciate your recommendations and provide the following responses.

Construction Recommendations

General Construction Recommendations

Recommendation: During development of the expansion area, TPWD recommends the judicious use and placement of sediment control fence to exclude wildlife from discrete expansion areas, when applicable. In many cases, sediment control fence placement for the purposes of controlling erosion and protecting water quality can be modified minimally to also provide the benefit of excluding wildlife access to areas being disturbed. The exclusion fence should be buried at least six inches and be at least 24 inches high. The exclusion fence should be maintained for the life of the project and should only be removed after construction is completed. Construction personnel should be encouraged to examine the inside of exclusion areas daily to determine if any wildlife species have been trapped inside the areas of impact and provide safe egress opportunities prior to initiation of construction activities. Exclusion fences are particularly effective in preventing reptile species from entering a construction area.

STV Response: STV will specify that the construction contractor shall maintain sediment control fence for the purpose of controlling erosion and protecting water quality on the downstream side of the construction area per the Stormwater Protection Plan. Contractor to secure the site at the end of each day and check for wildlife that may need safe egress opportunities.

Recommendation: For encounters with rare species that will not readily leave the work area, TPWD recommends an authorized individual translocate the animal. Translocations of reptiles should be the minimum distance possible from the work area. Ideally, individuals to be relocated should be transported to the closest suitable habitat outside of the active construction area; preferably within 100 to 200 yards and not greater than one mile from the capture site. State listed species may only be handled by persons with appropriate authorization from the TPWD Wildlife Permits Office. For more information regarding Wildlife Permits, please contact the Wildlife Permits Office at (512) 389-4647.

STV Response: STV will ensure an authorized individual will be available to translocate and handle any rare or state listed species that will not readily leave the work area to the proper distance and location. The contractor will be given contact information for the Wildlife Permits Office.

Recommendation: For soil stabilization and/or revegetation of disturbed areas, TPWD recommends erosion and seed/mulch stabilization materials that avoid entanglement hazards to snakes and other wildlife species. TPWD recommends the use of no-till drilling, hydromulching and/or hydroseeding due to a reduced risk to wildlife.

STV Response: STV will recommend that the construction contractor use erosion and seed/mulch stabilization material along with no-till drilling, hydromulching and/or hydroseeding when revegetation efforts may be needed to reduce the risk of wildlife entanglement hazard.

Recommendation: Because the mesh found in many erosion control blankets or mats pose an entanglement hazard to wildlife, TPWD recommends avoiding the use of plastic mesh matting. If erosion control blankets or mats containing netting must be used, the netting should be loosely woven, natural fiber material where the mesh design allows the threads to move, therefore allowing expansion of the mesh openings. Plastic mesh matting and hydromulch containing microplastics should be avoided.

STV Response: STV will recommend the construction contractor not use plastic mesh matting and if erosion control blankets or mats made of netting must be used, they will be designed to TPWD standards to avoid wildlife entanglement.

Federal Regulations

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) prohibits taking, attempting to take, capturing, killing, selling, purchasing, possessing, transporting, and importing of migratory birds, their eggs, parts, or nests, except when specifically authorized by the Department of the Interior. This protection applies to most native bird species, including ground nesting species. The U.S. Fish and Wildlife Service (USFWS) Migratory Bird Office can be contacted at (505) 248-7882 for more information on potential impacts to migratory birds.

Because landfills attract high numbers of birds such as vultures and gulls, it is very likely that any suitable habitat (e.g., trees, shrubs, overgrown grass) in the expansion area, immediately adjacent to the active landfill, is providing cover and roosting sites for birds.

Recommendation: TPWD recommends scheduling any vegetation clearing to occur outside of the general bird nesting season (March 15 through September 15) to avoid adverse impacts to birds. If disturbance within the expansion area must be scheduled to occur during the nesting season, TPWD recommends any vegetation to be impacted (trees, shrubs, and grasses) or bare ground where occupied nests may be located should be surveyed for active nests by a qualified biologist prior to clearing. Nest surveys should be conducted no more than five days prior to scheduled clearing in order to maximize the detection of active nests, including recently constructed nests. If active nests are observed during surveys, TPWD recommends a 100-foot radius buffer of vegetation remain around nests until eggs have hatched and the young have fledged; however, the size of the buffer zone is dependent on various factors and can be coordinated with the local or regional USFWS office.

STV Response: When practicable and necessary to comply with applicable laws and regulations, clearing of vegetation will take place outside of the general bird nesting season, March 15 through September 15. A qualified biologist will conduct nest surveys for active nests within nesting season when any vegetation is to

be impacted. The recommended buffers will be implemented and remain in place for the appropriate amount of time when nests are observed to be inactive.

State Law:

Parks and Wildlife Code - Chapter 64, Birds

Texas Parks and Wildlife Code (PWC), section 64.002, regarding the protection of nongame birds, provides that no person may catch, kill, injure, pursue, or possess a bird that is not a game bird. PWC section 64.003, regarding destroying nests or eggs, provides that, no person may destroy or take the nests, eggs, or young and any wild game bird, wild bird, or wild fowl. Although not documented in the Texas Natural Diversity Database (TXNDD), many bird species which are not listed as threatened or endangered are protected by chapter 64 of the PWC and are known to be year-round or seasonal residents or seasonal migrants through the proposed project area.

Recommendation: Please review the *Federal Law: Migratory Bird Treaty Act* section above for recommendations as they are also applicable for compliance with Chapter 64 of the PWC.

STV Response: Please see previous response regarding Migratory Bird Treaty Act recommendations.

Parks and Wildlife Code, Section 68.015

PWC regulates state listed threatened and endangered animal species. The capture, trap, take, or killing of state listed threatened and endangered animal species is unlawful unless expressly authorized under a permit issued by the USFWS or TPWD. A copy of TPWD Guidelines for Protection of State-Listed Species, which includes a list of penalties for take of species, can be found on the TPWD Wildlife Habitat Assessment Program website. State listed species may only be handled by persons with appropriate authorization from the TPWD Wildlife Permits Office. For more information regarding Wildlife Permits, please contact the Wildlife Permits Office at (512) 389-4647.

The potential occurrence of state listed species in the project area is primarily dependent upon the availability of suitable habitat. Direct impacts to high quality or suitable habitat therefore are directly proportional to the magnitude and potential to directly impact state listed species. State listed reptiles that are typically slow moving or unable to move due to cool temperatures are especially susceptible to being directly impacted (i.e., crushing by heavy equipment) during site preparation activities. Small wildlife such as lizards, turtles, and snakes are susceptible to falling into open pits, excavations, trenches, etc. left open and/or uncovered in a project area.

Please be aware that determining the actual presence of a species in a given area depends on many variables including daily and seasonal activity cycles, environmental activity cues, preferred habitat, transiency and population density (both wildlife and human). The absence of a species can be demonstrated only with great difficulty and then only with repeated negative observations, taking into account all the variable factors contributing to the lack of detectable presence.

Based on a review of the material provided, aerial imagery, the TXNDD, and online resources, it appears that the expansion area could provide habitat for the Texas horned lizard (Phrynosoma cornutum) and the Texas tortoise (Gopherus berlandieri), both state listed threatened species.

Recommendation: TPWD recommends reviewing the most current TPWD annotated county lists of rare species for Val Verde County. The annotated county lists are available online at the TPWD Wildlife Diversity website. Environmental documents prepared for the project should include an inventory of existing natural resources within the project area. Specific evaluations should be designed to predict project impacts upon these natural resources including potential impacts to state listed species.

STV Response: Current TPWD annotated county list of rare species for Val Verde County was reviewed and construction contractor will be aware of listed rare species.

Recommendation: For encounters with rare species that will not readily leave the work area, please see recommendations pertaining to translocating individuals under the General Construction Recommendations above.

STV Response: STV will ensure an authorized individual will be available to translocate and handle any rare or state listed species that will not readily leave the work area to the proper distance and location. The contractor will be given contact information for the Wildlife Permits Office.

Texas horned lizard

The Texas horned lizard can be found in open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees. If present in the general project area, the Texas horned lizard could be impacted by ground disturbing activities. Texas horned lizards may hibernate on-site in loose soils a few inches below ground during the cooler months from September/October to March/April. Construction in these areas could harm hibernating lizards. Horned lizards are active above ground when temperatures exceed 75 degrees Fahrenheit. If horned lizards (nesting, gravid females, newborn young, lethargic from cool temperatures or hibernation) cannot move away from noise and approaching construction equipment, they could be negatively affected by construction activities.

Recommendation: TPWD recommends avoiding disturbance of the Texas horned lizard, its burrows, and colonies of its primary food source, the harvester ant (Pogonomyrmex sp.), during clearing and construction. TPWD recommends a permitted biological monitor be present during construction to attempt to capture and relocate Texas horned lizards, if found. If the presence of a biological monitor is not feasible, Texas horned lizards observed during construction should be allowed to safely leave the site on their own.

STV Response: STV will inform the construction contractor and personnel to avoid disturbance of the Texas horned lizard, its habitat, and primary food source. It will not be feasible for a biological monitor to be present during construction, but the Texas horned lizard will be allowed to safely leave the site on their own. It should be noted that harvester ants or their nests were not noted during the multiple field observations.

Texas tortoise

The Texas tortoise occurs primarily in thornscrub and open woodlands and brush. It feeds primarily on fruits of prickly pear and succulent plants. Texas tortoises have low fecundity; individuals take over 10 years to reach maturity and females do not reproduce every year. Nesting occurs in spring and summer. The Texas tortoise has a home range of approximately five to ten acres. Tortoises are often found near or at the base of prickly pear cactus and may seek shade by crawling under parked vehicles.

Recommendation: TPWD recommends reviewing the Texas Tortoise Best Management Practices document available online at TPWD's Wildlife Habitat Assessment Program homepage. Contractors and other staff should be made aware that in south Texas, the Texas tortoise is generally inactive from December through January and is therefore likely to be undetectable in a project area during those months. TPWD recommends a biological monitor be on site during any vegetation clearing to inspect sites subject to disturbance that may provide cover for tortoises (e.g., bases of prickly pear cactus) or provide sites for tortoise pallets (shallow excavations typically at the base of vegetation that are opportunistically occupied by tortoises). As indicated above, tortoises may seek cover (shade) underneath parked vehicles; therefore, TPWD recommends that before driving vehicles that have been parked within the project area, contractors should check underneath the vehicles to ensure no tortoises are present.

If a tortoise is located at the project site, it should be relocated only if it is found in an area in which imminent danger is present. Individuals that must be relocated should be transported to the closest suitable habitat outside of the proposed disturbance area but preferably within its five to ten acre range. After tortoises are removed from the immediate project area, TPWD recommends constructing an exclusion fence as described under General Construction Recommendations above.

When inactive, tortoises may occupy the shallow depressions or pallets that are scratched out at the base of vegetative cover; tortoises may also be found sheltering in burrows.

STV Response: STV will require the Contractor to use BMPs during times the Texas tortoise is active. It will not be feasible for a biological monitor to be present during all vegetation clearing, but if a Texas tortoise is located in imminent danger during clearing or construction it will be transported to the closest suitable habitat. Exclusion fences will be constructed per the general construction recommendations.

Recommendation: If possible, TPWD recommends completing major ground disturbing activities before late fall or winter when reptiles become inactive and could be utilizing burrows in areas subject to disturbance. If ground disturbing construction activities must occur after October (e.g., to avoid migratory bird nesting season) in areas of suitable tortoise habitat, TPWD recommends surveying those areas for tortoises or indications of tortoise presence, e.g., the presence of burrows or pallets under prickly pear. If tortoises or indications of tortoise presence is observed, TPWD Ecological and Environmental Planning Program staff should be contacted.

STV Response: Proper surveys will be conducted for any ground disturbing activities after the month of October. If tortoise or indications of tortoise presence is observed TPWD Ecological and Environmental Planning Program staff will be contacted.

Please contact me if you have any additional comments or questions regarding the proposed project. I may be reached at (210) 789-2323, or via e-mail at amy.esguerra@stvinc.com.

Sincerely,



Amy S. Esguerra

Senior Environmental Project Manager

STV

Last Update: 8/22/2024

VAL VERDE COUNTY

AMPHIBIANS

Valdina Farms sinkhole salamander *Eurycea troglodytes*

Aquatic; springs, streams and caves with rocky or cobble beds.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G3 State Rank: S3S4

ARACHNIDS

No accepted common name *Chitrella major*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G1G2 State Rank: S1

No accepted common name *Cicurina holsingeri*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G1G2 State Rank: S1

No accepted common name *Cicurina patei*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G1G2 State Rank: S1

No accepted common name *Cicurina porteri*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G1G2 State Rank: S1

No accepted common name *Eidmannella delicata*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G1G2 State Rank: S1

No accepted common name *Dinocheirus cavicola*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G2G3 State Rank: S2

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VAL VERDE COUNTY

BIRDS

Baird's Sparrow *Centronyx bairdii*

Shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of State, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G4 State Rank: SUN

bald eagle *Haliaeetus leucocephalus*

Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Federal Status: DL State Status: SGCN: N
Endemic: N Global Rank: G5 State Rank: S3B,S3N

Bank Swallow *Riparia riparia*

Bank Swallows live in low areas along rivers, streams, ocean coasts, and reservoirs. Their territories usually include vertical cliffs or banks where they nest in colonies of 10 to 2,000 nests. Though in the past Bank Swallows were most commonly found around natural bluffs or eroding streamside banks, they now often nest in human-made sites, such as sand and gravel quarries or road cuts. They forage in open areas and avoid places with tree cover.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S2B,S4N

black-capped vireo *Vireo atricapilla*

Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer

Federal Status: DL State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S3B

Brewer's Blackbird *Euphagus cyanocephalus*

Shrubby and bushy areas (especially near water), riparian woodland, aspen parklands, cultivated lands, marshes, and around human habitation; in migration and winter also in pastures and fields (AOU 1983).

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S5

Cactus Wren *Campylorhynchus brunneicapillus*

Desert (especially with cholla cactus or yucca), mesquite, arid scrub, coastal sage scrub, and in trees in towns in arid regions (Tropical to Subtropical zones) (AOU 1983). Nests in OPUNTIA cactus, or in twiggy, thorny, trees and shrubs, sometimes in buildings. Nest may be relined and used as a winter roost.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S4B

chestnut-collared longspur *Calcarius ornatus*

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VAL VERDE COUNTY

BIRDS

Occurs in open shortgrass settings especially in patches with some bare ground. Also occurs in grain sorghum fields and Conservation Reserve Program lands

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S3

common black-hawk *Buteogallus anthracinus*

Cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain; formerly bred in south Texas

Federal Status: State Status: T SGCN: Y
Endemic: N Global Rank: G4G5 State Rank: S2B

Common Nighthawk *Chordeiles minor*

Common Nighthawks nest in both rural and urban habitats including coastal sand dunes and beaches, logged forest, recently burned forest, woodland clearings, prairies, plains, sagebrush, grasslands, open forests, and rock outcrops. They also nest on flat gravel rooftops, though less often as gravel roofs are being replaced by smooth, rubberized roofs that provide an unsuitable surface.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S4B

Elf Owl *Micrathene whitneyi*

In SW Texas and Coahuila, Mexico, nests in AGAVE-ACACIA-LEUCOPHYLLUM lowland desert, PROSOPIS-ACACIA-CELTIS-CHILOPSIS desert-wash woodland, POPULUS-SALIX-FRAXINUS-JUGLANS-ACER canyon riparian forest, and QUERCUS-PINUS-JUNIPERUS evergreen woodland; and in the lower Rio Grande valley of Texas and Tamaulipas and Nuevo Leon, Mexico, nests in ACACIA-PROSOPIS-CELTIS-DIOSPYRUS-BUMELIA subtropical thorn woodland and PITHECELLOBIUM-EHRETIA-ULMUS-LEUCAENA riparian woodland (Henry and Gehlbach 1999).

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S4B

Franklin's gull *Leucophaeus pipixcan*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. This species is only a spring and fall migrant throughout Texas. It does not breed in or near Texas. Winter records are unusual consisting of one or a few individuals at a given site (especially along the Gulf coastline). During migration, these gulls fly during daylight hours but often come down to wetlands, lake shore, or islands to roost for the night.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S2N

golden eagle *Aquila chrysaetos*

Golden eagles generally inhabit open and semi-open country such as prairies, sagebrush, savannah or sparse woodland, and barren areas, especially in hilly or mountainous regions, in areas with sufficient mammalian prey base and near suitable nesting sites.

Federal Status: State Status: SGCN: N
Endemic: N Global Rank: G5 State Rank: S3B

interior least tern *Sternula antillarum athalassos*

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VAL VERDE COUNTY

BIRDS

Sand beaches, flats, bays, inlets, lagoons, islands. Subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony

Federal Status: DL | State Status: E | SGCN: N

Endemic: N | Global Rank: G4T3Q | State Rank: S1B

lark bunting *Calamospiza melanocorys*

Overall, it's a generalist in most short grassland settings including ones with some brushy component plus certain agricultural lands that include grain sorghum. Short grasses include sideoats and blue gramas, sand dropseed, prairie junegrass (Koeleria), buffalograss also with patches of bluestem and other mid-grass species. This bunting will frequent smaller patches of grasses or disturbed patches of grasses including rural yards. It also uses weedy fields surrounding playas. This species avoids urban areas and cotton fields.

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G5 | State Rank: S4B

Least Tern *Sternula antillarum*

Sand beaches, flats, bays, inlets, lagoons, islands, river sandbars and flat gravel rooftops in urban areas.

Federal Status: DL | State Status: | SGCN: Y

Endemic: N | Global Rank: G4 | State Rank: S2B

Loggerhead Shrike *Lanius ludovicianus*

Loggerhead Shrikes inhabit open country with short vegetation and well-spaced shrubs or low trees, particularly those with spines or thorns. They frequent agricultural fields, pastures, old orchards, riparian areas, desert scrublands, savannas, prairies, golf courses, and cemeteries. Loggerhead Shrikes are often seen along mowed roadsides with access to fence lines and utility poles.

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G4 | State Rank: S4B

mountain plover *Charadrius montanus*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous.

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G3 | State Rank: S2

Northern Bobwhite *Colinus virginianus*

Inhabits a wide variety of vegetation types, particularly early successional stages. Occurs in croplands, grasslands, pastures, fallow fields, grass-brush rangelands, open pinelands, open mixed pine-hardwood forests, and habitat mosaics (Brennan 1999).

Federal Status: | State Status: | SGCN: Y

Endemic: N | Global Rank: G4G5 | State Rank: S4B

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VAL VERDE COUNTY

BIRDS

Pyrrhuloxia *Cardinalis sinuatus*

Pyrrhuloxias live in upland deserts, mesquite savannas, riparian (streamside) woodlands, desert scrublands, farm fields with hedgerows, and residential areas with nearby mesquite. When not breeding, some Pyrrhuloxias wander into urban habitats, mesquite-hackberry habitats, and riparian habitats with Arizona sycamore and cottonwood.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4B

Sanderling *Calidris alba*

Nonbreeding: primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers (AOU 1983) also on exposed reefs (Pratt et al. 1987). Sleeps/loafs on upper beach or on salt pond dike.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S5

Scaled Quail *Callipepla squamata*

In general, preferred habitat is arid-semiarid, mixed shrub-grassland. Common shrubs of preferred habitat include acacia (ACACIA spp.), sand sagebrush (ARTEMISIA FILIFOLIA), four-winged saltbush (ATRIPLEX CANESCENS), cacti (OPUNTIA spp.), honey mesquite (PROSOPIS GLANDULOSA), sumacs (RHUS AROMATICA, R. MICROPHYLLA, R. TRILOBATA), yucca (YUCCA spp.), and snakeweed (XANTHOCEPHALUM SAROTHRAE).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4B

Snowy Plover *Charadrius nivosus*

Algal flats appear to be the highest quality habitat. Some of the most important aspects of algal flats are their relative inaccessibility and their continuous availability throughout all tidal conditions. An optimal site characteristic would be large in size. The size of populations appear to be roughly proportional to the total area of suitable habitat used. Formerly an uncommon breeder in the Panhandle; potential migrant; winter along coast.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3B

Sprague's pipit *Anthus spragueii*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat during migration and in winter consists of pastures and weedy fields (AOU 1983), including grasslands with dense herbaceous vegetation or grassy agricultural fields.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S3N

tropical parula *Setophaga pitiayumi*

Semi-tropical evergreen woodland along rivers and resacas. Texas ebony, anacua and other trees with epiphytic plants hanging from them. Dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S3B

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VAL VERDE COUNTY

BIRDS

Varied Bunting *Passerina versicolor*

Arid thorn brush and thickets, dry washes and arid scrub (Tropical and Subtropical zones) (AOU 1983). Often near water. Often stays close to ground cover (Oberholser 1974). Nests usually low in tree, bush or vine, 0.5-1.5 m above ground (Terres 1980).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4B

western burrowing owl *Athene cunicularia hypugaea*

Open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

Federal Status:	State Status:	SGCN: N
Endemic: N	Global Rank: G4T4	State Rank: S2

white-faced ibis *Plegadis chihi*

The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; currently confined to near-coastal rookeries in so-called hog-wallow prairies. Nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.

Federal Status:	State Status: T	SGCN: N
Endemic: N	Global Rank: G5	State Rank: S4B

Willet *Tringa semipalmata*

Marshes, tidal mudflats, beaches, lake margins, mangroves, tidal channels, river mouths, coastal lagoons, sandy or rocky shores, and, less frequently, open grassland (AOU 1983, Stiles and Skutch 1989).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S5B

Wilson's Warbler *Cardellina pusilla*

Wilson’s warblers key in on forests and scrubby areas along streams to fatten up during migration. During the nonbreeding season they use many types of habitats from lowland thickets near streams to high-elevation cloud forests in Mexico and Central America.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4

yellow-billed cuckoo *Coccyzus americanus*

In Texas, the populations of concern are found breeding in riparian areas in the Trans Pecos (know as part of the Western Distinct Population Segment). It is the Western DPS that is on the U.S. ESA threatened list and includes the Texas counties Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio. Riparian woodlands below 6,000' in elevation consisting of cottonwoods and willows are prime habitat. This species is a long-distant migrant that summers in Texas, but winters mainly in South America. Breeding birds of the Trans Pecos populations typically arrive on their breeding grounds possibly in late April but the peak arrival time is in May. Threats to preferred habitat include hydrologic changes that don't promote the regeneration of cottonwoods and willows, plus livestock browsing and trampling of sapling trees in sensitive riparian areas.

Federal Status: T	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4S5B

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VAL VERDE COUNTY

BIRDS

zone-tailed hawk *Buteo albonotatus*

Arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G4	State Rank: S3B

CRUSTACEANS

Devil's Sinkhole amphipod *Stygobromus hadenoecus*

Subaquatic; subterranean obligate crustacean; in cave pools (enriched by bat guano?)

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1G2	State Rank: S2

No accepted common name *Artesia subterranea*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1G2	State Rank: S2

No accepted common name *Paramexiweckelia ruffoi*

Gravel bottom and lacks vegetation

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1G2	State Rank: S2

No accepted common name *Seborgia hershleri*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1G2	State Rank: S2

No accepted common name *Speocirolana hardeni*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G2G3	State Rank: S2

No accepted common name *Paraholsingerius smaragdinus*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: GNR	State Rank: S2

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VAL VERDE COUNTY

CRUSTACEANS

No accepted common name *Texanobathynella bowmani*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: GNR	State Rank: S2S4

No accepted common name *Bicornucandona fineganensis*

Spring obligate. Known only from two springs. Finegan Springs in Val Verde County and Blue Hole Springs in Val Verde County. Fine scale habitat requirements unknown.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: GNR	State Rank: SU

FISH

Conchos pupfish *Cyprinodon eximius*

Devils River and Alamito Creek. The Devils River and Alamito Creek populations are morphologically and biochemically distinct from the Rio Conchos (Mexico) populations. Shallow water (<25 cm) on bedrock shelves and in coves, sloughs, and backwaters over soft bottoms, all where current is negligible and bottom generally devoid of aquatic macrophytes.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S1

Devils River minnow *Dionda diaboli*

Devils River, San Felipe and Sycamore creeks in Val Verde County; Las Moras (extirpated) and Pinto creeks in Kinney County. Restricted to clear, spring-fed waters having little temperature variation. Found over gravel-cobble substrate, usually associated with aquatic macrophytes.

Federal Status: T	State Status: T	SGCN: Y
Endemic: N	Global Rank: G1	State Rank: S1

headwater catfish *Ictalurus lupus*

Originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S1S2

longnose dace *Rhinichthys cataractae*

Can only be found in the Big Bend portion of the Rio Grande. Occasionally taken in lakes and clear pools of rivers but prefers clear, flowing water in gravelly riffles.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S2

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VAL VERDE COUNTY

FISH

manantial roundnose minnow *Dionda argentosa*

Lower Pecos River, Devils River, San Felipe and Sycamore creeks. Val Verde County. Headwaters and runs of spring-influenced waters.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G3	State Rank: S2

Mexican blindcat *Prietella phreatophila*

Subterranean freshwater cave environments in the northern Coahuila, Mexico and Val Verde County, Texas portions of the Edwards-Trinity Aquifer. Usually found associated with a silt substrate in still pools at water temperatures of 21 - 31.5 Celsius.

Federal Status: E	State Status: E	SGCN: Y
Endemic: N	Global Rank: GNR	State Rank: S1

Mexican redhorse *Moxostoma austrinum*

Limited/uncertain distribution within the Rio Grande. Rocky runs and riffles of creeks and small to medium rivers; often near boulders in swift water.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S1

Pecos pupfish *Cyprinodon pecosensis*

Originally Pecos River basin, presently restricted to upper basin only; shallow margins of clear, vegetated spring waters high in calcium carbonate, as well as in sinkhole habitats

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G2	State Rank: S1

proserpine shiner *Cyprinella proserpina*

Limited range includes Devils and lower Pecos rivers, Las Moras, Pinto, and San Felipe creeks, and Independence Creek in the Rio Grande watershed in western Texas. Associated with spring-fed tributaries and spring-runs. May be found in flowing pools, swift runs and riffles.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S2

Rio Grande darter *Etheostoma grahami*

Essentially restricted to the mainstream and spring-fed tributaries of the Rio Grande and the lower Pecos River downstream to the Devils River and Dolan, San Felipe and Sycamore creeks. Gravel and rubble riffles

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G2G3	State Rank: S2

Rio Grande shiner *Notropis jemezanus*

Rio Grande drainage. Occurs over substrate of rubble, gravel and sand, often overlain with silt

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S1

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VAL VERDE COUNTY

FISH

speckled chub *Macrhybopsis aestivalis*

Found throughout the Rio Grande and lower Pecos River but occurs most frequently between the Río Conchos confluence and the Pecos River. Flowing water over coarse sand and fine gravel substrates in streams; typically found in raceways and runs.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S1S2

spotfin gambusia *Gambusia krumholzi*

Restricted to San Felipe and Sycamore creeks in Texas; also occurs in Mexico. Prefers densely vegetated, edge or quiet water habitats in close association with areas of swift flows.

Federal Status:	State Status: T	SGCN: Y
Endemic: Y	Global Rank: G1	State Rank: S1

Tamaulipas shiner *Notropis braytoni*

Restricted to the Rio Grande basin in Texas including the lower Pecos River. Typically found in large rivers and creeks associated with a variety of flowng-water habitats such as runs and riffles over gravel, cobble, and sand.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G4	State Rank: S1S2

Texas shiner *Notropis amabilis*

In Texas, it is found primarily in Edwards Plateau streams from the San Gabriel River in the east to the Pecos River in the west. Typical habitat includes rocky or sandy runs, as well as pools.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G4	State Rank: S4

INSECTS

American bumblebee *Bombus pensylvanicus*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic:	Global Rank: G3G4	State Rank: SNR

Comanche harvester ant *Pogonomyrmex comanche*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G2G3	State Rank: S2

Dolan Falls perdita *Perdita dolanensis*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1	State Rank: S1

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VAL VERDE COUNTY

INSECTS

No accepted common name *Ochrotrichia capitana*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1G3	State Rank: S2?

No accepted common name *Psychopomporus felipi*

Spring obligate. Known only from San Felipe Springs, Val Verde County. Fine scale habitat requirements unknown.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: GNR	State Rank: S1

No accepted common name *Caenis arwini*

West Texas; mayflies distinguished by aquatic larval stage; adult stage generally found in shoreline vegetation

Federal Status:	State Status:	SGCN: Y
Endemic:	Global Rank: G1G3	State Rank: S2?

No accepted common name *Latineosus cibola*

This species was recently described from Texas in only two localities (a creek and a water treatment plant on a major river) in Val Verde and Webb Cos. (Sun and McCafferty, 2008).

Federal Status:	State Status:	SGCN: Y
Endemic:	Global Rank: G1G2	State Rank: SNR

purse casemaker caddisfly *Hydroptila melia*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic:	Global Rank: G2G3	State Rank: S2?

Texas austrotinodes caddisfly *Austrotinodes texensis*

Appears endemic to the karst springs and spring runs of the Edwards Plateau region; flow in type locality swift but may drop significantly during periods of little drought; substrate coarse and ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along the streams

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G2	State Rank: S2

MAMMALS

black bear *Ursus americanus*

Generalist. Historically found throughout Texas. In Chisos, prefers higher elevations where pinyon-oaks predominate; also occasionally sighted in desert scrub of Trans-Pecos (Black Gap Wildlife Management Area) and Edwards Plateau in juniper-oak habitat. For ssp. luteolus, bottomland hardwoods, floodplain forests, upland hardwoods with mixed pine; marsh. Bottomland hardwoods and large tracts of inaccessible forested areas.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S3

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VAL VERDE COUNTY

MAMMALS

black-tailed prairie dog *Cynomys ludovicianus*

Dry, flat, short grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle; live in large family groups

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G4 State Rank: S3

cave myotis bat *Myotis velifer*

Colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G4G5 State Rank: S2S3

ghost-faced bat *Mormoops megalophylla*

Winter roosts are in large limestone caves. Buildings and rock crevasses provide roosts, as well.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S2

greater western mastiff bat *Eumops perotis californicus*

Arid canyons; roosts in crevices in rock walls of desert canyons, old buildings, hollow trees; roost site must have clearance for a three meter fall by exiting bats; colony size varies from several individuals to several dozen; males and females may remain together throughout the year; single offspring (occasionally twins) born June-July.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G4G5T4 State Rank: S3

hoary bat *Lasiurus cinereus*

Hoary bats are highly migratory, high-flying bats that have been noted throughout the state. Females are known to migrate to Mexico in the winter, males tend to remain further north and may stay in Texas year-round. Commonly associated with forests (foliage roosting species) but are found in unforested parts of the state and lowland deserts. Tend to be captured over water and large, open flyways.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G3G4 State Rank: S3

kit fox *Vulpes macrotis*

Open desert grassland; avoids rugged, rocky terrain and wooded areas.

Federal Status: State Status: SGCN: N
Endemic: N Global Rank: G4 State Rank: S1S2

mountain lion *Puma concolor*

Generalist; found in a wide range of habitats statewide. Found most frequently in rugged mountains & riparian zones.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S2S3

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VAL VERDE COUNTY

MAMMALS

pale Townsend's big-eared bat *Corynorhinus townsendii pallescens*

Habitat description is not available at this time.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4T3T4 State Rank: S3?

pocketed free-tailed bat *Nyctinomops femorosaccus*

Semiarid desert grasslands; roosts in caves cliff crevices under building roof tiles; feed on insects; females bear one pup per season Jul - Aug

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3

Townsend's big-eared bat *Corynorhinus townsendii*

In Texas, habitat ranges from desert scrub to pinyon-juniper woodland, consistently in areas with canyons or cliffs (Schmidly 1991). Roosts in caves, crevases, trees, and buildings in the Panhandle and Trans-Pecos.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4 State Rank: S3?

tricolored bat *Perimyotis subflavus*

Forest, woodland and riparian areas are important. Caves are very important to this species.

Federal Status: PE State Status: SGCN: Y

Endemic: N Global Rank: G3G4 State Rank: S2

Western mastiff bat *Eumops perotis*

Undisturbed rock crevices are essential to successful breeding. Ssp. californicus - arid canyons; roosts in crevices in rock walls of desert canyons, old buildings, hollow trees; roost site must have clearance for a three meter fall by exiting bats

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S3

Western pipistrelle *Parastrellus hesperus*

Desert to pine-oak woodland. Cliffs and rock crevices provide roosts.

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G5 State Rank: S3S4

western yellow bat *Lasiurus xanthinus*

Forages over water both perennial and intermittent sources, found at low elevations (< 6,000 feet), roosts in vegetation (yucca, hackberry, sycamore, cypress, and especially palm); also hibernates in palm; locally common in residential areas landscaped with palms in Tuscon and Phoenix, Arizona; young born in June; insectivore

Federal Status: State Status: SGCN: Y

Endemic: N Global Rank: G4G5 State Rank: S1

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VAL VERDE COUNTY

MAMMALS

white-nosed coati *Nasua narica*

Woodlands, riparian corridors and canyons.Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S1

Yuma myotis *Myotis yumanensis*

Caves, mines, tunnels and buildings in Trans-Pecos.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S3?

MOLLUSKS

crowned cavesnail *Phreatodrobia coronae*

Habitat description is not available at this time.

Federal Status:	State Status: T	SGCN: Y
Endemic: Y	Global Rank: G1G2	State Rank: S2

Mexican fawnsfoot *Truncilla cognata*

Occurs in large rivers but may also be found in medium-sized streams. Is commonly found in habitats with some flowing water, often in protected near shore areas such as banks and backwaters but also at the head of riffles; the latter more often supporting both sub-adults and adults. Typically occurs in substrates of mixed sand and gravel as well as soft unconsolidated sediments. Considered intolerant of reservoirs (Randklev et al. 2017b; Randklev et al. forthcoming). [Mussels of Texas 2019]

Federal Status: PE	State Status: T	SGCN: Y
Endemic: N	Global Rank: G1	State Rank: S1

Salina mucket *Potamilus metnecktayi*

Occurs in medium to large rivers, where it may be found in substrates composed of various combinations of mud, sand, gravel, and cobble, as well as under rocks. It occurs in areas with slow to moderate current, most often in stable littoral habitats dominated by boulder or bedrock habitat; not known from reservoirs (Randklev et al. 2017b; Randklev et al. forthcoming). [Mussels of Texas 2019]

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G1	State Rank: S1

striated hydrobe *Texapyrgus longleyi*

Habitat description is not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1	State Rank: S1

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VAL VERDE COUNTY

MOLLUSKS

Tampico Pearlymussel *Cyrtonaias tampicoensis*

Reported from streams to rivers, reservoirs, and canals. In riverine habitats often found in nearshore habitats such as banks and backwaters, to include pools and oxbows, in mud or sand or among cobble and boulders with still to moderate currents (Howells et al. 1996).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G5	State Rank: S4

Texas hornshell *Popenaias popeii*

Occurs in small streams to large rivers in slow to moderate current, often residing in rock crevices, travertine shelves, and under large boulders, where small-grained material, such as clay, silt, or sand gathers. Can also occur in riffles that are clean swept of soft silt; not known from reservoirs (Carman 2007; Inoue et al. 2014; Randklev et al. 2017b; Randklev et al. forthcoming). [Mussels of Texas 2019]

Federal Status: E	State Status: E	SGCN: Y
Endemic: N	Global Rank: G1	State Rank: S1

REPTILES

plateau spot-tailed earless lizard *Holbrookia lacerata*

Terrestrial: Habitats include moderately open prairie-brushland regions, particularly fairly flat areas free of vegetation or other obstructions (e.g., open meadows, old and new fields, graded roadways, cleared and disturbed areas, prairie savanna, and active agriculture including row crops); also, oak-juniper woodlands and mesquite-prickly pear associations (Axtell 1968, Bartlett and Bartlett 1999).

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: GNR	State Rank: S2

Rio Grande river cooter *Pseudemys gorzugi*

Aquatic: Habitat includes rivers and their more permanent spring-fed tributary streams, beaver ponds, and stock tanks (Garrett and Barker 1987). Occupied waters may have a muddy, sandy, or rocky bottom, and may or may not contain aquatic vegetation (Degenhardt et al. 1996).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S2

Tamaulipan spot-tailed earless lizard *Holbrookia subcaudalis*

Terrestrial: Habitats include moderately open prairie-brushland regions, particularly fairly flat areas free of vegetation or other obstructions (e.g., open meadows, old and new fields, graded roadways, cleared and disturbed areas, prairie savanna, and active agriculture including row crops); also, oak-juniper woodlands and mesquite-prickly pear associations (Axtell 1968, Bartlett and Bartlett 1999).

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: GNR	State Rank: S2

Texas horned lizard *Phrynosoma cornutum*

Terrestrial: Open habitats with sparse vegetation, including grass, prairie, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive. Occurs to 6000 feet, but largely limited below the pinyon-juniper zone on mountains in the Big Bend area.

Federal Status:	State Status: T	SGCN: Y
Endemic: N	Global Rank: G4G5	State Rank: S3

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VAL VERDE COUNTY

REPTILES

Texas tortoise *Gopherus berlandieri*

Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus; sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.

Federal Status: State Status: T SGCN: Y
Endemic: N Global Rank: G4 State Rank: S2

Trans-Pecos black-headed snake *Tantilla cucullata*

Terrestrial: Found rocky canyons or hillsides in mesquite-creosote and pinyon-juniper-oak forests, as well as grasslands.

Federal Status: State Status: T SGCN: Y
Endemic: Y Global Rank: G3 State Rank: S3

western box turtle *Terrapene ornata*

Terrestrial: Ornate or western box trutles inhabit prairie grassland, pasture, fields, sandhills, and open woodland. They are essentially terrestrial but sometimes enter slow, shallow streams and creek pools. For shelter, they burrow into soil (e.g., under plants such as yucca) (Converse et al. 2002) or enter burrows made by other species.

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5 State Rank: S3

PLANTS

Anacacho orchid tree *Bauhinia lunarioides*

Shrublands in draws on rocky limestone slopes and on limestone ledges along rivers; Perennial; Flowering March-Dec; Fruiting May-Oct

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G3 State Rank: S1

arrowleaf milkvine *Matelea sagittifolia*

Most consistently encountered in thornscrub in South Texas; Perennial; Flowering March-July; Fruiting April-July and Dec?

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G3 State Rank: S3

broadpod twistflower *Streptanthus platycarpus*

Western Edwards Plateau and the Trans-Pecos, seemingly disjunct in Llano Uplift area, occurring sparingly in various habitats; Biennial Annual; Flowering/Fruiting March-June

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G3 State Rank: S3

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VAL VERDE COUNTY

PLANTS

cliff bedstraw *Galium correllii*

Dry, steep or vertical limestone cliff faces of various exposures in Chihuahuan Desert along Rio Grande, Pecos River, and their tributaries, at elevations of 350-500 m (1150-1650 ft), resembles cliff swallow nests that are also found on limestone cliffs; flowering April-November, fruiting May-December

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G2 State Rank: S1

cliff thistle *Cirsium turneri*

Found mostly in fractures of vertical limestone cliff-faces in canyons along the Rio Grande; Perennial; Flowering April-Dec; Fruiting June-Oct

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G3 State Rank: S3

Correll's false dragon-head *Physostegia correllii*

Wet, silty clay loams on streamsides, in creek beds, irrigation channels and roadside drainage ditches; or seepy, mucky, sometimes gravelly soils along riverbanks or small islands in the Rio Grande; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas; flowering May-September

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G2 State Rank: S2

Devils River rock-daisy *Perityle lindheimeri var. halimifolia*

Limestone cliff-faces in Val Verde County eastward to central Texas; Perennial; Flowering April-Sept; Fruiting June-Aug

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G4T3Q State Rank: S3

dwarf broomspurge *Euphorbia jejuna*

According to specimen collections, found on grama-grass prairie on caliche uplands, also dry caliche slopes, and limestone hills; flowering late March through July

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G2 State Rank: S2

gravelbar brickellbush *Brickellia dentata*

Essentially restricted to frequently-scoured gravelly alluvial beds in creek and river bottoms; Perennial; Flowering June-Nov; Fruiting June-Oct

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G3G4 State Rank: S3S4

Heller's beardtongue *Penstemon triflorus var. integrifolius*

Occurs sparingly on rock outcrops and in grasslands associated with juniper-oak woodlands (Carr 2015).

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G3T2 State Rank: S2

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VAL VERDE COUNTY

PLANTS

longstalk heimia *Ammannia grayi*

Moist or subirrigated alkaline or gypsiferous clayey soils along unshaded margins of cienegas and other wetlands; occurs sparingly on an alkaline, somewhat saline silt loam on terraces of spring-fed streams in grassland; also occurs common in moderately alkaline clay along perennial stream and in subirrigated wetlands atop poorly-defined spring system; also occurs in low, wetland area along highway right-of-way; flowering May-September

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G2G3	State Rank: S2

Mexican hesperaloe *Hesperaloe funifera ssp. funifera*

Habitat description not available at this time.

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3TNR	State Rank: S1

Mexican mud-plantain *Heteranthera mexicana*

Wet clayey soils of resacas and ephemeral wetlands in South Texas and along margins of playas in the Panhandle; flowering June-December, only after sufficient rainfall

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G2G3	State Rank: S1

narrowleaf brickellbush *Brickellia eupatorioides var. gracillima*

Moist to dry gravelly alluvial soils along riverbanks but also on limestone slopes; Perennial; Flowering/Fruiting April-Nov

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G5T3	State Rank: S3

Palmer's milkwort *Hebecarpa palmeri*

Limestone slopes; Perennial; Flowering April-July; Fruiting June-Oct

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S2

perennial caltrop *Kallstroemia perennans*

Somewhat barren gypseous clays or limestone soils at low elevations in the Chihuahuan Desert; flowering late spring-early fall

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G1	State Rank: S1

Plateau loosestrife *Lythrum ovalifolium*

Banks and gravelly beds of perennial (or strong intermittent) streams on the Edwards Plateau, Llano Uplift and Lampasas Cutplain; Perennial; Flowering/Fruiting April-Nov

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3G4	State Rank: S3S4

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VAL VERDE COUNTY

PLANTS

rayless rock-daisy *Perityle angustifolia*

Crevices of limestone bluffs and cliff-faces; Perennial; Flowering April-Oct; Fruiting April-Sept

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: G3G4	State Rank: S3S4

red yucca *Hesperaloe parviflora*

Shrublands on dry limestone slopes; Perennial; Flowering April-May; Fruiting May-June

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3

rock grape *Vitis rupestris*

Occurs on rocky limestone slopes and in streambeds; Perennial; Flowering March-May; Fruiting May-July

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S1

Rydberg's scurfpea *Pediomelum humile*

Shortgrass grasslands or cenizo-guajillo shrublands on shallow, stony to gravelly clay soils on dry, open limestone or yellowish, eroding caliche hills; flowering March-May, however, plants often do not appear above the ground surface if there is not sufficient precipitation, flowering and fruit maturation are also dependent on rainfall

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G1	State Rank: S1

Sabinal prairie clover *Dalea sabinalis*

Information sketchy, but probably in rocky soils or on limestone outcrops in sparse grassland openings in juniper-oak woodlands; flowering April-May or May -June

Federal Status:	State Status:	SGCN: Y
Endemic: Y	Global Rank: GH	State Rank: SH

Shinner's brickellbush *Flyriella parryi*

Dry rocky limestone slopes; Perennial; Flowering/Fruiting April-June

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G3	State Rank: S3

springrun whitehead *Shinnersia rivularis*

In shallow, slow-moving water in small, usually spring-fed streams and rivers arising from calcareous outcrops; abandoned river channel fed by a strong perennial stream, rooted in fine-textured sediments, with stems entirely submerged and only the flowering branch tips appearing above water surface; in slowly flowing water up to 0.3-0.4 m deep but appeared to be absent from deeper water, shaded for most of the day; also in water 0.5-1 m deep, rooted in a mucky to gravelly bottom; flowering throughout the year, most reliably March-May

Federal Status:	State Status:	SGCN: Y
Endemic: N	Global Rank: G2G3	State Rank: S1

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VAL VERDE COUNTY

PLANTS

Texas almond *Prunus minutiflora*

Wide-ranging but scarce, in a variety of grassland and shrubland situations, mostly on calcareous soils underlain by limestone but occasionally in sandier neutral soils underlain by granite; Perennial; Flowering Feb-May and Oct; Fruiting Feb-Sept

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G3G4 State Rank: S3S4

Texas claret-cup cactus *Echinocereus coccineus var. paucispinus*

Mountains, hills, and mesas, igneous and limestone, oak-juniper-pinyon woodland or juniper woodland on limestone mesas, mostly rocky habitats but also in alluvial basins, grasslands, or among mesquite or other shrubs. Flowering March - April (Powell and Weedin 2004).

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G5T3 State Rank: S3

Texas greasebush *Glossopetalon texense*

Dry limestone ledges, chalk bluffs, and limestone outcrops; one population is on an extremely steep slope, inaccessible to most herbivores; flowering period uncertain, including at least June-December

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G1 State Rank: S1

Texas seymeria *Seymeria texana*

Found primarily in grassy openings in juniper-oak woodlands on dry rocky slopes but sometimes on rock outcrops in shaded canyons; Annual; Flowering May-Nov; Fruiting July-Nov

Federal Status: State Status: SGCN: Y
Endemic: Y Global Rank: G3 State Rank: S3

Texas snowbells *Styrax platanifolius ssp. texanus*

Limestone bluffs, boulder slopes, cliff faces, and gravelly streambeds, usually along perennial streams or intermittent drainages in canyon bottoms, in full sun or in partial shade of cliffs and/or Sycamore-Little walnut woodlands, oak-juniper woodlands, or mixed oak shrublands; flowering late March-April

Federal Status: E State Status: E SGCN: Y
Endemic: Y Global Rank: G3T1 State Rank: S1

Texas trumpets *Acleisanthes crassifolia*

Shallow, well-drained, calcareous, gravelly loams over caliche on gentle to moderate slopes, often in sparsely vegetated openings in cenizo (Leucophyllum frutescens) shrublands; known populations occur on Austin Chalk (Cretaceous) or Uvalde Gravel (Pleistocene); Perennial; Flowering March-November; Fruiting April-December

Federal Status: State Status: SGCN: Y
Endemic: N Global Rank: G2 State Rank: S2

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VAL VERDE COUNTY

PLANTS

Tobusch fishhook cactus *Sclerocactus brevihamatus ssp. tobuschii*

Shallow, moderately alkaline, stony clay and clay loams over massive fractured limestone; usually on level to slightly sloping hilltops; occasionally on relatively level areas on steeper slopes, and in rocky floodplains; usually open areas within a mosaic of oak-juniper woodlands, occasionally in pine-oak woodlands, rarely in cenizo shrublands or little bluestem grasslands; sites are usually open with only herbaceous cover, although the cactus may be somewhat protected by rocks, grasses, or spikemosses; flowering (late January-) February-March (rarely early April)

Federal Status: T | State Status: E | SGCN: Y
Endemic: Y | Global Rank: G4T3 | State Rank: S3

tree dodder *Cuscuta exaltata*

Parasitic on various Quercus, Juglans, Rhus, Vitis, Ulmus, and Diospyros species as well as Acacia berlandieri and other woody plants; Annual; Flowering May-Oct; Fruiting July-Oct

Federal Status: | State Status: | SGCN: Y
Endemic: N | Global Rank: G3 | State Rank: S3

Turner's hawthorn *Crataegus turnerorum*

Brush, dwarf oak scrub, stream banks, 300-600 m elevation; Perennial; Flowering April-June; Fruiting April-Sept

Federal Status: | State Status: | SGCN: Y
Endemic: Y | Global Rank: G3 | State Rank: S3

Warnock's rock-daisy *Perityle warnockii*

Crevices and solution pits in steep, dry, inaccessible limestone bluffs; flowering spring-fall

Federal Status: | State Status: | SGCN: Y
Endemic: Y | Global Rank: G1 | State Rank: S1

Wright's milkvetch *Astragalus wrightii*

On sandy or gravelly soils; Flowering/fruiting: April and May

Federal Status: | State Status: | SGCN: Y
Endemic: Y | Global Rank: G3 | State Rank: S3

Wright's trumpets *Acleisanthes wrightii*

Open semi-desert grasslands and shrublands on shallow stony soils over limestone on low hills and flats; Perennial; Flowering spring-fall, probably also in response to rains

Federal Status: | State Status: | SGCN: Y
Endemic: N | Global Rank: G2 | State Rank: S2

Wright's water-willow *Justicia wrightii*

Shortgrass grasslands and/or shrublands; dry gravelly clay soils over limestone on flats and low hills at elevations of 900-1500 m (2950-4900 ft); flowering April-August, or perhaps after periods of sufficient rainfall

Federal Status: | State Status: | SGCN: Y
Endemic: Y | Global Rank: G2 | State Rank: S1S2

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David Yoskowitz, Ph.D.
Executive Director

May 24, 2024

Texas Commission on Environmental Quality
Office of the Chief Clerk, MC-105
P.O. Box 13087
Austin, TX 78711-3087

RE: Proposed expansion of the City of Del Rio Landfill (Proposed Permit No 207C), Del Rio, Val Verde County, Texas

Dear Office of the Chief Clerk:

This letter is in response to your request for review of the proposed project referenced above. TPWD has reviewed the information provided and offers the following comments and recommendations.

Project Description

The City of Del Rio proposes to expand the existing City of Del Rio Landfill. The existing permit boundary and limit of waste would expand from 105.6 acres to 180.6 acres and from 79.0 acres to 110.3 acres, respectively. Additionally, the top deck of the landfill would be increased from 1113 feet to 1124 feet. The expansion area is undeveloped land that has been permitted as a landfill since 1972.

General Construction Recommendation

Potential impacts to state fish and wildlife resources may be minimized by incorporating beneficial management practices (BMP) during design, construction, and operation. To assist in project planning, TPWD provides the following BMP and general construction recommendations:

Recommendation: During development of the expansion area, TPWD recommends the judicious use and placement of sediment control fence to exclude wildlife from discrete expansion areas, when applicable. In many cases, sediment control fence placement for the purposes of controlling erosion and protecting water quality can be modified minimally to also provide the benefit of excluding wildlife access to areas being disturbed. The exclusion fence should be buried at least six inches and be at least 24 inches high. The exclusion fence should be maintained for the life of the project and should only be removed after construction is completed. Construction personnel should be encouraged to examine the inside of exclusion areas daily to determine if any wildlife species have been trapped inside the areas of impact and provide safe egress opportunities prior to initiation of construction activities. Exclusion fences are particularly effective in preventing reptile species from entering a construction area.

Recommendation: For encounters with rare species that will not readily leave the work area, TPWD recommends an authorized individual translocate the animal. Translocations of reptiles should be the minimum distance possible from the work

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.texas.gov

area. Ideally, individuals to be relocated should be transported to the closest suitable habitat outside of the active construction area; preferably within 100 to 200 yards and not greater than one mile from the capture site. State listed species may only be handled by persons with appropriate authorization from the TPWD Wildlife Permits Office. For more information regarding Wildlife Permits, please contact the Wildlife Permits Office at (512) 389-4647.

Recommendation: For soil stabilization and/or revegetation of disturbed areas, TPWD recommends erosion and seed/mulch stabilization materials that avoid entanglement hazards to snakes and other wildlife species. TPWD recommends the use of no-till drilling, hydromulching and/or hydroseeding due to a reduced risk to wildlife.

Recommendation: Because the mesh found in many erosion control blankets or mats pose an entanglement hazard to wildlife, TPWD recommends avoiding the use of plastic mesh matting. If erosion control blankets or mats containing netting must be used, the netting should be loosely woven, natural fiber material where the mesh design allows the threads to move, therefore allowing expansion of the mesh openings. Plastic mesh matting and hydromulch containing microplastics should be avoided.

Federal Regulations

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) prohibits taking, attempting to take, capturing, killing, selling, purchasing, possessing, transporting, and importing of migratory birds, their eggs, parts, or nests, except when specifically authorized by the Department of the Interior. This protection applies to most native bird species, including ground nesting species. The U.S. Fish and Wildlife Service (USFWS) Migratory Bird Office can be contacted at (505) 248-7882 for more information on potential impacts to migratory birds.

Because landfills attract high numbers of birds such as vultures and gulls, it is very likely that any suitable habitat (e.g., trees, shrubs, overgrown grass) in the expansion area, immediately adjacent to the active landfill, is providing cover and roosting sites for birds.

Recommendation: TPWD recommends scheduling any vegetation clearing to occur outside of the general bird nesting season (March 15 through September 15) to avoid adverse impacts to birds. If disturbance within the expansion area must be scheduled to occur during the nesting season, TPWD recommends any vegetation to be impacted (trees, shrubs, and grasses) or bare ground where occupied nests may be located should be surveyed for active nests by a qualified biologist prior to

clearing. Nest surveys should be conducted no more than five days prior to scheduled clearing in order to maximize the detection of active nests, including recently constructed nests. If active nests are observed during surveys, TPWD recommends a 100-foot radius buffer of vegetation remain around nests until eggs have hatched and the young have fledged; however, the size of the buffer zone is dependent on various factors and can be coordinated with the local or regional USFWS office.

State Regulations

Parks and Wildlife Code – Chapter 64, Birds

Texas Parks and Wildlife Code (PWC), section 64.002, regarding the protection of nongame birds, provides that no person may catch, kill, injure, pursue, or possess a bird that is not a game bird. PWC section 64.003, regarding destroying nests or eggs, provides that, no person may destroy or take the nests, eggs, or young and any wild game bird, wild bird, or wild fowl.

Although not documented in the Texas Natural Diversity Database (TXNDD), many bird species which are not listed as *threatened* or *endangered* are protected by chapter 64 of the PWC and are known to be year-round or seasonal residents or seasonal migrants through the proposed project area.

Recommendation: Please review the *Federal Regulations: Migratory Bird Treaty Act* section above for recommendations as they are applicable for compliance with chapter 64 of the PWC.

Parks and Wildlife Code, Section 68.015

PWC regulates state listed threatened and endangered animal species. The capture, trap, take, or killing of state listed threatened and endangered animal species is unlawful unless expressly authorized under a permit issued by the USFWS or TPWD. A copy of *TPWD Guidelines for Protection of State-Listed Species*, which includes a list of penalties for take of species, can be found on the TPWD Wildlife Habitat Assessment Program website. State listed species may only be handled by persons with appropriate authorization from the TPWD Wildlife Permits Office. For more information regarding Wildlife Permits, please contact the Wildlife Permits Office at (512) 389-4647.

The potential occurrence of state listed species in the project area is primarily dependent upon the availability of suitable habitat. Direct impacts to high quality or suitable habitat therefore are directly proportional to the magnitude and potential to directly impact state listed species. State listed reptiles that are typically slow moving or unable to move due to cool temperatures are especially susceptible to being directly

impacted (i.e., crushing by heavy equipment) during site preparation activities. Small wildlife such as lizards, turtles, and snakes are susceptible to falling into open pits, excavations, trenches, etc. left open and/or uncovered in a project area.

Please be aware that determining the actual presence of a species in a given area depends on many variables including daily and seasonal activity cycles, environmental activity cues, preferred habitat, transiency and population density (both wildlife and human). The absence of a species can be demonstrated only with great difficulty and then only with repeated negative observations, taking into account all the variable factors contributing to the lack of detectable presence.

Based on a review of the material provided, aerial imagery, the TXNDD, and online resources, it appears that the expansion area could provide habitat for the Texas horned lizard (*Phrynosoma cornutum*) and the Texas tortoise (*Gopherus berlandieri*), both state listed threatened species.

Recommendation: TPWD recommends reviewing the most current TPWD annotated county lists of rare species for Val Verde County. The annotated county lists are available online at the TPWD Wildlife Diversity website. Environmental documents prepared for the project should include an inventory of existing natural resources within the project area. Specific evaluations should be designed to predict project impacts upon these natural resources including potential impacts to state listed species.

Recommendation: For encounters with rare species that will not readily leave the work area, please see recommendations pertaining to translocating individuals under the *General Construction Recommendations* above.

Texas horned lizard

The Texas horned lizard can be found in open, arid, and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees. If present in the general project area, the Texas horned lizard could be impacted by ground disturbing activities. Texas horned lizards may hibernate on-site in loose soils a few inches below ground during the cooler months from September/October to March/April. Construction in these areas could harm hibernating lizards. Horned lizards are active above ground when temperatures exceed 75 degrees Fahrenheit. If horned lizards (nesting, gravid females, newborn young, lethargic from cool temperatures or hibernation) cannot move away from noise and approaching construction equipment, they could be negatively affected by construction activities.

Recommendation: TPWD recommends avoiding disturbance of the Texas horned lizard, its burrows, and colonies of its primary food source, the harvester ant (*Pogonomyrmex* sp.), during clearing and construction. TPWD recommends a

permitted biological monitor be present during construction to attempt to capture and relocate Texas horned lizards, if found. If the presence of a biological monitor is not feasible, Texas horned lizards observed during construction should be allowed to safely leave the site on their own.

Texas tortoise

The Texas tortoise occurs primarily in thornscrub and open woodlands and brush. It feeds primarily on fruits of prickly pear and succulent plants. Texas tortoises have low fecundity; individuals take over 10 years to reach maturity and females do not reproduce every year. Nesting occurs in spring and summer. The Texas tortoise has a home range of approximately five to ten acres. Tortoises are often found near or at the base of prickly pear cactus and may seek shade by crawling under parked vehicles.

Recommendation: TPWD recommends reviewing the *Texas Tortoise Best Management Practices* document available online at TPWD's Wildlife Habitat Assessment Program homepage. Contractors and other staff should be made aware that in south Texas, the Texas tortoise is generally inactive from December through January and is therefore likely to be undetectable in a project area during those months. TPWD recommends a biological monitor be on site during any vegetation clearing to inspect sites subject to disturbance that may provide cover for tortoises (e.g., bases of prickly pear cactus) or provide sites for tortoise pallets (shallow excavations typically at the base of vegetation that are opportunistically occupied by tortoises). As indicated above, tortoises may seek cover (shade) underneath parked vehicles; therefore, TPWD recommends that before driving vehicles that have been parked within the project area, contractors should check underneath the vehicles to ensure no tortoises are present.

If a tortoise is located at the project site, it should be relocated only if it is found in an area in which imminent danger is present. Individuals that must be relocated should be transported to the closest suitable habitat outside of the proposed disturbance area but preferably within its five to ten acre range. After tortoises are removed from the immediate project area, TPWD recommends constructing an exclusion fence as described under *General Construction Recommendations* above.

When inactive, tortoises may occupy the shallow depressions or pallets that are scratched out at the base of vegetative cover; tortoises may also be found sheltering in burrows.

Recommendation: If possible, TPWD recommends completing major ground disturbing activities before late fall or winter when reptiles become inactive and could be utilizing burrows in areas subject to disturbance. If ground disturbing construction activities must occur after October (e.g., to avoid migratory bird

nesting season) in areas of suitable tortoise habitat, TPWD recommends surveying those areas for tortoises or indications of tortoise presence, e.g., the presence of burrows or pallets under prickly pear. If tortoises or indications of tortoise presence is observed, TPWD Ecological and Environmental Planning Program staff should be contacted.

I appreciate the opportunity to review and comment on this project. Please contact me at (361) 431-6003 or **russell.hooten@tpwd.texas.gov** if we may be of further assistance.

Sincerely,

Russell Hooten

Russell Hooten
Ecological and Environmental Planning Program
Wildlife Division

/rh 52237

COORDINATION WITH
U.S. ARMY CORPS OF ENGINEERS

- March 3, 2025 USACE Letter Issuing a Nationwide Permit 39 for the project
- January 3, 2025 Nationwide Permit request application
- August 13, 2023, USACE determination that authorization pursuant to Section 404 is not required.
- August 2023, Jurisdictional Determination Report

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, FORT WORTH DISTRICT
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

March 3, 2025

Regulatory Division

SUBJECT: Project Number SWF-2023-00046, Del Rio Landfill Expansion Site

Mr. Gregory Velazquez
Assistant Director
City of Del Rio Public Works
114 West Martin Street
Del Rio, Texas 78440
gvelazquez@cityofdelrio.com

Dear Mr. Velazquez:

This letter is in regard to information received January 3, 2025, and subsequent information received January 30, 2025, concerning a proposal by the City of Del Rio Public Works to conduct landfill expansion activities in the city of Del Rio, Val Verde County, Texas. This project has been assigned Project Number SWF-2023-00046. Please include this number in all future correspondence concerning this project.

Under Section 404 of the Clean Water Act the U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged and fill material into waters of the United States, including wetlands. USACE responsibility under Section 10 of the Rivers and Harbors Act of 1899 is to regulate any work in, or affecting, navigable waters of the United States. Based on the description of the proposed work, and other information available to us, we have determined this project will involve activities subject to the requirements of Section 404.

We have reviewed this project under the pre-construction notification procedures of Nationwide Permit General Condition 32 Federal Register, Vol. 86, No. 8, Wednesday, January 13, 2021. We have determined the discharge of dredged or fill materials into waters of the United States associated with this project appears to qualify for Nationwide Permit 39 for Commercial and Institutional Developments. To use this permit, the person responsible for the project must ensure the work is in compliance with the specifications and conditions for the permit listed above, found at https://www.swf.usace.army.mil/Missions/Regulatory/Permitting/Nationwide-General-Permits/. Additionally, all activities must comply with the water quality certification conditions of the Texas Commission on Environmental Quality (TCEQ) located at https://www.swf.usace.army.mil/Portals/47/docs/regulatory/Permitting/General%20Permitting/TX_401_cert.pdf?ver=rIe8wttu6MRCA2s6Q4QQMg%3d%3d. Failure to comply with these specifications and conditions invalidates the authorization and may result in a violation.

Our verification for the construction of this activity under this nationwide permit is valid until March 14, 2026, unless prior to that date the nationwide permit is suspended, revoked, or modified such that the activity would no longer comply with the terms and conditions of the nationwide permit on a regional or national basis. The USACE will issue a public notice announcing the changes when they occur. Furthermore, activities that have commenced, or are under contract to commence, in reliance on a nationwide permit will remain authorized provided the activity is completed within 12 months of the date of the nationwide permit's expiration, modification, or revocation, unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 CFR 330.4(e) and 33 CFR 330.5(c) or (d). Continued confirmation that an activity complies with the specifications and conditions, and any changes to the nationwide permit, is the responsibility of the permittee.

The USACE based this decision on a preliminary jurisdictional determination (PJD) that there are waters of the United States on the project site. A PJD is not appealable. At any time you have the right to request and obtain an Approved Jurisdictional Determination (AJD), which can be appealed. If it is your intent to request an AJD, do not begin work until one is obtained.

Our review of this project also addressed its effects on threatened and endangered species. Based on the information provided, we have determined this project will not affect any species listed as threatened or endangered by the U.S. Fish and Wildlife Service within our permit area. However, please note you are responsible for meeting the requirements of General Condition 18 on endangered species.

The permittee must sign and submit to us the enclosed certification that the work, including any proposed mitigation, was completed in compliance with the nationwide permit. The permittee should submit the certification within 30 days of the completion of work.

This permit should not be considered as an approval of the design features of any activity authorized or an implication that such construction is considered adequate for the purpose intended. It does not authorize any damage to private property, invasion of property rights, or any infringement of federal, state, or local laws or regulations.

Thank you for your interest in our nation's water resources. If you have any questions concerning our regulatory program, please refer to our website at http://www.swf.usace.army.mil/Missions/Regulatory or contact Mr. Eric Dephouse at the address above, by telephone (817) 886-1820, or by email Eric.J.Dephouse@usace.army.mil, and refer to your assigned project number.

Please help the regulatory program improve its service by completing the survey on the following website: https://regulatory.ops.usace.army.mil/customer-service-survey/

Sincerely,



For: Brandon W. Mobley
Chief, Regulatory Division

Enclosure

Copy Furnished (With Enclosure):

Ms. Amy Esguerra, STV Inc., amy.esguerra@stvinc.com

PERMIT COMPLIANCE CERTIFICATION

U.S. Army Corps of Engineers Project Number: SWF-2023-00046

Type of Nationwide: Nationwide Permit 39 for Commercial and Institutional Developments

Name of Permittee: City of Del Rio Public Works

Date of Issuance: March 3, 2025

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

Regulatory Division
CESWF-RD
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Or email to: CESWF-Compliance@usace.army.mil

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit was completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee

3/11/2025
Date

Jurisdictional Determination Report

City of Del Rio Landfill Expansion Project
Val Verde County, Texas

Prepared for:

Prepared by:

One Countryside Place
12500 San Pedro, Ste. 450
San Antonio, Texas 78216

January 2025

Jurisdictional Determination Report

City of Del Rio Landfill Expansion Project
Val Verde County, Texas

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List of Preparers

Garrett Weiberg, Biologist	Field Work
Kameryn Strickland, Biologist	Field Work and Report Preparation
Amy Esguerra, Project Manager	Report QA/QC

Acronyms

CDR	City of Del Rio
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
GPS	Global Positioning System
NHD	National Hydrography Dataset
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OHWM	Ordinary High Water Mark
RGL	Regulatory Guidance Letter
TNW	Traditionally Navigable Waters
TPWD	Texas Parks and Wildlife Department
U.S.	United States
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WOUS	Waters of the United States

Summary

The City of Del Rio (CDR) is proposing a Landfill Expansion Project, which involves the environmental evaluation of an approximately 75-acre property southeast of Del Rio (**Figure 1**). This report is prepared as part of the environmental permitting process for work to be performed within the property. The property is north-adjacent to the existing landfill property and currently owned by the City of Del Rio. The entire property was examined as the designated project area for this waters and wetlands Jurisdictional Determination Report. The National Hydrography Dataset (NHD), National Wetland Inventory (NWI), United States Geological Survey (USGS) Topographic Map, and Federal Emergency Management Agency (FEMA) floodplain map were evaluated for relevant water resources within the project area.

The exhibits listed below show the project area and are provided in **Appendix A**. Area photographs are provided in **Appendix B**.

- Project Location Map (**Figure 1**)
- USGS Topographic Map (**Figure 2**)
- Mapped Water Resources (**Figure 3**)
- USGS Geologic Map (**Figure 4**)
- Natural Resources Conservation Service (NRCS) Soils Map (**Figure 5**)
- LiDAR (**Figure 6**)
- Field-Verified Waters Map (**Figure 7**)
- Photograph Location Map **(Figure 8)**

No mapped streams or wetlands are depicted within the project area. According to the FEMA floodplain map, the project area is outside of any mapped floodplain in the area.

Seventeen water features were assessed within the project area. Georeferenced data was taken during the field investigations using a Trimble GeoXT Global Positioning System (GPS) capable of sub-meter accuracy. GPS data such as locations of ordinary high water mark (OHWM) boundaries and OHWM widths were recorded during the field surveys. These data were later transferred into Geographic Information System (GIS) software for analysis purposes. Indicators that were used in delineating the OHWMs and wetland boundaries included the presence of a clear natural line, shelving, topography, and the absence of terrestrial vegetation.

Within the project area, there are 68 field-verified water features totaling approximately 18,713.15 linear feet (LF) and 1.56 acres of waters, including wetlands. None of the field-verified waters are shown on the USGS topographic map and five of the features held water during field investigations. The field verified features include: Pond 1, Wetland 1, Pond 2, Wetland 2, Stream 1, Stream 2, Drainages 1a-1b, 2a-2d, 3a-3p, 4a-4c, 5a-5r, 6a-6c, 7a-7h, 8a1-8f, and 9. Wetland 1 and Wetland 2 met all three criteria (hydrophytic vegetation, hydric soils, and wetland hydrology) required to be considered a wetland per U.S. Army Corps of Engineers (USACE) guidelines and are likely hydrologically connected through drainages to Calaveras Creek below the topographic gradient of the project area. In addition, the ponds, streams, and remaining 62 drainages are also likely hydrologically connected to Calaveras Creek below the topographic gradient of the project area. It should be noted that the USACE is the official agency that makes the final determination of the location and extent of jurisdictional waters.

The 1987 USACE Wetland Delineation Manual (USACE, 1987) along with the 2010 Regional Supplement for the Great Plains Region (USACE, 2010) were used to aid in determining any potential wetlands within the vicinity of the project. Wetland determination data forms are included in **Appendix C**.

GIS software was used to determine watercourse locations, analyze OHWMs, interpret land use, and prepare field maps and exhibits.

Preliminary Data Gathering and Synthesis

The waters and wetlands study for the CDR landfill Expansion Project began with a review of available maps and photographs. The USGS 7.5-minute topographic map (**Figure 2**) for the Val Verde SE quadrangle, the USGS NHD, and the U.S. Fish and Wildlife Service (USFWS) NWI digital data were reviewed to determine locations of potential wet areas and streams. According to the 2019 USGS topographic map for the Val Verde SE quadrangle, no streams, ponds, or wetlands are mapped within the project area.

According to the NWI data, there are no wetland areas mapped within the project area. The FEMA floodplain information provided by panel 48465C1755D (dated July 22, 2010) was also obtained. No floodplains are mapped within the project area. Mapped water resources are shown in **Figure 3**.

Aerial photographs used for this study are provided in the GeoSearch Historic Aerials Report (**Appendix D).**

Additional information used for this determination includes the following:

- 2019 USGS 7.5-min Topographic Map, Val Verde SE quadrangle, Texas
- Digital NWI data, USFWS webarea: http://www.fws.gov/wetlands/Data/Mapper.html

According to the Texas Parks and Wildlife Department (TPWD) Map of Texas Ecoregions, the project area is located within the southwestern reaches of the Edwards Plateau Ecoregion. Typical vegetation in the Edwards Plateau includes Ashe juniper (*Juniperus ashei*), plateau live oak (*Quercus fusiformis*), Mexican persimmon (*Diospyros texana*), prickly pear (*Opuntia engelmannii*), and little bluestem (*Schizachryrium scoparium*).

According to the USGS Geologic Database of Texas (USGS, BEG 2007), the project area is located over the Buda Limestone (Kbu), the Del Rio Clay (Kdr), and the Ulvalde Gravel (QTu) (**Figure 4**).

According to the NRCS Custom Soil Survey for Val Verde Counties (NRCS, 2023), four soil mapping units were identified within the project area (**Figure 5**): Acuna silty clay, 0 to 3 percent slopes (AcB); Coahuila clay loam, 0 to 3 percent slopes (CoB); Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG); and Zapata-Vinegarroon complex, 1 to 5 percent slopes (ZaC). None of the soils are listed as hydric (NRCS, 2020).

According to the U.S. Drought Monitor (http://droughtmonitor.unl.edu/), as of June 22 and 23, 2020 (the days of the initial field investigations), the project area was not in a drought, and conditions were typical for the season. The region experienced a light rainfall during the 2020 field investigations. However, the U.S. Drought Monitor determined that the project area was in a severe drought during the September 13, 2022, and March 2023 field investigations. Conditions were typical for the season these field investigation were completed.

ESRI ArcMap GIS software was used to determine watercourses, analyze potential OHWMs and potential wetland areas, and prepare field maps and exhibits.

Routine Determination

Field Investigations

The project area was surveyed on June 22 and 23, 2020, September 13, 2022, and March 21 and 22, 2023. Indicators listed in 33 Code of Federal Regulations 328.3I and the USACE Regulatory Guidance Letter (RGL) 05-05 were used in delineating the OHWM of waters found within the project area.

Georeferenced data was taken during the field investigations using a Trimble GeoXT GPS unit. GPS data such as locations of OHWM boundaries, OHWM widths, and soil stations were recorded during the field surveys. The general methodology of the field investigation was to walk the length of the water feature within the project area, measure and estimate widths of the OHWMs in the channels, estimate the elevation level of the OHWM from the existing grade, record GPS data, identify and record vegetative species, and take notes and photographs. Photographs of the project area are provided in **Appendix B**.

Soil Sample

Fourteen soil samples were taken during the field investigations and are shown on **Figure 6**. The corresponding wetland data forms are included in **Appendix C**. The soil was sampled near determined transects across the property and at all potential wetlands, where the area exhibited wetland hydrology and potentially hydrophytic vegetation. The soil pits were excavated to 16 inches unless a restrictive layer was present. Munsell Soil Color Charts were used to determine the matrix and chroma soil colors.

Identification and Delineation of Waters and Wetlands

Delineation fieldwork on the project area was conducted on June 22 and 23, 2020, September 13, 2022, and March 21 and 22, 2023. The 1987 USACE Wetland Delineation Manual along with the 2010 Regional Supplement for the Great Plains Region were used to aid in identifying any wetlands within the project area. Potential WOTUS in the project area were also delineated.

According to the NWI data, there are no wetland areas mapped within the project area. During the field effort, two areas were observed to display wetland hydrology and potentially hydrophytic vegetation. These areas were sampled for hydric soils and determined to meet the USACE criteria for hydric soil characteristics. Upland sample points were taken for reference against both wetland sample points. The soil sample points are shown on **Figure 6**. Wetland data sheets are provided in **Appendix C**.

In addition to the two wetland areas, 66 other water resources were delineated across the project area for a total of 68 field-verified waters: 62 drainage features, two unnamed tributaries to Calaveras Creek, and two ponds. Each feature is shown on **Figure 6** and discussed individually in the **Principal Findings of the Field Investigations** section below.

Conditions Documented Within the Project Area

Vegetation

The project area consists mainly of mesquite-cenizo shrubland, rocky bare ground, and disturbed grassland in the upland portions, and dried drainage features and poorly developed wetlands and pond areas in the lower-elevation portions of the project area. The project area is an undeveloped parcel where the herbaceous vegetation consists mainly of buffalo grass (*Bouteloua dactyloides*), various small muhly grasses (*Muhlenbergia spp*.), curly mesquite grass (*Hilaria belangeri*), sideoats gramma (*Bouteloua*

curtipendula), Gregg's dalea (*Dalea greggii*), green sprangletop (*Leptochloa dubia*), and diamanita (*Chrysactinia mexicana*). Notable woody and succulent species include mesquite (*Prosopis glandulosa*), cenizo (*Leucophyllum frutescens*), retama (*Parkinsonia aculeata*), huisache (*Vachellia farnesiana*), catclaw acacia (*Acacia greggii*), Texas ebony (*Ebano ebanopsis*), sotol (*Dasylirion wheeleri*), hackberry (*Celtis occidentalis*), black willow (*Salix nigra*), ephedra (*Ephedra trifurca*), claret cup cactus (*Echinocereus coccineus*), and Spanish dagger (*Yucca gloriosa*) No woody vines were noted within the project area.

Hydrology

According to the USGS topographic maps, there are no mapped waters depicted within the project area. However, two ephemeral streams were observed, and two potential wetland areas were delineated with in the project area based on hydrophytic vegetation, hydric soil samples, and wetland hydrology. The project area is outside of any mapped floodplain in the vicinity (**Figure 3**).

Geology

The project area is located over three geologic groups: the Buda Limestone (Kbu), the Del Rio Clay (Kdr), and the Uvalde Gravel (T-Qu) (**Figure 4**). Descriptions of the geologic units are provided below.

- T-Qu – Uvalde Gravel – Caliche-cemented gravel. Some boulders up to 1 foot in diameter. Well-rounded cobbler of chert, some cobbles of quartz, limestone, and igneous rock. Occupies topographically high areas not associated with present drainage. Thickness ranges from several feet of gravel lag to around 30 feet. Cretaceous in age.

- Kbu – Buda Limestone – Fine-grained, bioclastic, commonly glauconitic, pyritiferous, hard, massive, poorly bedded to nodular, thinner bedded and argillaceous near upper contact, light grey to pale orange. Weather dark grey to brown. Burrows filled with chalky marl, abundant pelecypods. Thickness 45-100 feet, thickens eastward. Cretaceous in age.

- Kdr – Del Rio Clay – calcareous and gypsiferous becoming less calcareous and more gypsiferous upward, pyrite common., blocky, medium grey, weathers light grey to yellowish gray. Some thin lenticular beds of highly calcareous siltstone. Marine megafossils include abundant *Exogyra arietina* and other pelesypods. Thickness up to 200 feet, feathers out northward. Cretaceous age unit.

Soils

According to the Val Verde Custom Soils Report (NRCS, 2023), four soil mapping units (**Table 1**) were identified within the project area. None of the soils in the project area are hydric. Soils mapped within the project area are presented in **Figure 5**.

Table 1. Soil Mapping Units

Mapping Unit	Permeability	Drainage Class	Listed as Hydric by NRCS
Acuna silty clay, 0 to 3 percent slopes (AcB)	0.57 to 1.98 in/hr	Well drained	No
Coahuila clay loam, 0 to 3 percent slopes (CoB)	0.57 to 1.98 in/hr	Well drained	No

Mapping Unit	Permeability	Drainage Class	Listed as Hydric by NRCS
Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG)	0.00 to 0.06 in/hr	Well drained	No
Zapata-Vinegarroon complex, 1 to 5 percent slopes (ZaC)	0.06 to 0.57 in/hr	Well drained	No

Principal Findings of the Field Investigations

A total of 68 features were mapped across the project area (**Figure 6**). Limits of the stream boundaries were recorded in the field using a sub-meter accuracy GPS unit. These data were later transferred into GIS software to analyze and measure. Indicators that were used in delineating the OHWMs included presence of a clear natural line, shelving, the absence of terrestrial vegetation, change in vegetation community, presence of stagnant or flowing water, and a change in topography. Wetlands were determined using the three indicators outlined in the USACE wetland delineation guidelines. The stream channel widths range from approximately 2 to 3 feet. Photographs of all water features delineated within the project area are provided in **Appendix B**. A map showing the location and direction of each photograph is available as **Figure 8** in **Appendix A**.

The waters that were field-verified and delineated within the project area are displayed in **Table 2** and additional details regarding these water features are listed below.

- **Pond 1** is in the easternmost portion of the project area and was field verified to be 0.17 acre within the project area. This pond is not mapped by the USGS. This pond consisted of an OHWM with water present at the time of the September 2022 and March 2023 field investigation. The average width of this feature within the project area is 21 feet (ft). Two wetland determination points were taken on both sides of the feature within the field observed OHWM to show the lack of wetland characteristics. This pond is likely the result of overland flow and appears to be hydrologically isolated. See **page 2** of **Figures 6** and **7** in **Appendix A**, **Photos 1-3** in **Appendix B** and **WPs 1 and 2** in **Appendix C**.
- **Pond 2** is in the eastern portion of the project area and was field verified to be 0.23 acre within the project area. This pond is not mapped by the USGS. This pond consisted of an OHWM with water present at the time of the June 2020, September 2022, and March 2023 field investigations. The average width of this feature within the project area is 68 ft. This pond is likely the result of overland flow; however, this pond would likely have a speculative effect on the physical, chemical, biological integrity of Calaveras Creek that occurs below the topographic gradient of the project area through a surface connection of a roadside drainage outside of the study area, Wetland 2, and Stream 1. See **page 2** of **Figures 6** and **7** in **Appendix A**, **Photos 4 and 5** in **Appendix B**.
- **Wetland 1** was field verified as a palustrine emergent wetland located as a fringe to Pond 2. This wetland was verified to be 0.04 acre within the project area. This wetland is not mapped by the USGS or on the NWI map. The average width of this feature is 15 ft. Vegetation within the sampled location met the dominance test and the hydric soil indicator, sandy redox (S5), was observed. Hydrology indicators met include surface water (A1), saturation (A3), and inundation visible on aerial imagery (B7). This feature met the three necessary criteria to be considered a wetland and is hydrologically connected through drainages to Calaveras Creek below the topographic gradient of the project area. See **pages 1** and **2** of **Figures 6** and **7** in **Appendix A**, **Photo 4** in **Appendix B**, and **WP 4** in **Appendix C**.
- **Drainages 1a-1b** are located in the eastern portion of the project area. These erosional rills are not mapped by the USGS. According to LiDAR data, these features occur at the bottom of a significant slope. These features consisted of erosional drainage with water present in Drainage 1a at the time of the September 2022 and March 2023 field investigations. The average width of Drainage 1a within the project area is 2 ft, while the average width of Drainage 1b is 1 ft. Drainage 1a was field verified to be 0.01 acre and 260.95 LF within the project area Drainage 1b was field verified to be less than 0.01 acre and 86.00 LF with the project area. A wetland determination point was taken within Drainage 1a to show the lack of wetland characteristics.

These features are likely the result of overland flow abrasion. See **page 1** of **Figures 6** and **7** in **Appendix A**, **Photos 6-8** in **Appendix B**, and **WP 5** in **Appendix C**.

- **Wetland 2** was field verified as a palustrine emergent wetland located within the northeastern portion of the project area at the bottom of a significant slope. This wetland was verified to be 0.21 acre within the project area. This wetland is not mapped by the USGS or on the NWI map. The average width of this feature is 25 ft. This feature is likely the result of surface runoff pooling at this low point within the project area. A wetland determination point was taken to determine if a wetland was present. Vegetation within the sampled location met the dominance test and the hydric soil indicator, depleted matrix (F3), was observed. Hydrology indicators included surface water (A1), high water table (A2), saturation (A3), saturation visible on aerial imagery (C9), geomorphic position (D2), and FAC-neutral test (D5). This feature met the three necessary criteria to be considered a wetland and is hydrologically connected through drainages and streams to Calaveras Creek below the topographic gradient of the project area. See **pages 2, 3,** and **4** of **Figures 6** and **7** in **Appendix A**, **Photos 9 and 10** in **Appendix B**, and **WP 7** in **Appendix C**.

- **Stream 1** is in the northeastern portion of the project area and was field verified to be 0.01 acre and 216.42 LF within the project area. This stream is not mapped by the USGS. This feature consisted of an OHWM with no water present at the time of the June 2020, September 2022, or March 2023 field investigations. This feature was field verified to have an ephemeral flow regime that flows from southeast to northwest and is likely formed from surface runoff channeled by the hilly topography. The average width of this feature within the project area is 2.5 ft. A wetland determination point was taken within the field observed OHWM to show the lack of wetland characteristics. This OHWM included sediment sorting, shelving, and scour which determined its defined bed and banks. This feature maintained a contiguous OHWM within the project area. See **pages 3** and **5** of **Figures 6** and **7** in **Appendix A**, **Photos 12-14** in **Appendix B**, and **WP 9** in **Appendix C**.

- **Drainages 2a-2d** are in the northeastern portion of the project area These erosional rills are not mapped by the USGS. According to LiDAR data, these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the time of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 2 ft. The acreages of these features range from less than 0.01 acre to 0.03 acre. The LF of these features range from 100.24 to 382.63 LF. Exact acreages and LF measurements can be reviewed in **Table 2**. These features are likely the result of overland flow abrasion. See **pages 3** and **5** of **Figures 6** and **7** in **Appendix A**, **Photos 15-18** in **Appendix B**.

- **Drainages 3a-3p** are in the northern portion of the project area. These erosional rills are not mapped by the USGS but according to LiDAR data, these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the time of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 1 ft. The acreages of these features range from less than 0.01 acre to 0.05 acre. The LF of these features range from 16.47 to 907.50 LF. Exact acreages and LF measurements can be reviewed in **Table 2.** A wetland determination point was taken within Drainage 3t to show the lack of wetland characteristics. These features are likely the result of overland flow abrasion. See **pages 3, 4, 5, 6,** and **7** of **Figures 6** and **7** in **Appendix A**, **Photos 19—36** in **Appendix B,** and **WP 10** in **Appendix C**.

- **Drainages 4a-4c** are in the northern portion of the project area. These erosional rills are not mapped by the USGS but according to LiDAR data, these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the time

of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 1 ft. The acreages of these features range from less than 0.01 acre to 0.03 acre. The LF of these features range from 145.67 to 381.33 LF. Exact acreages and LF measurements can be reviewed in **Table 2.** These features are likely the result of overland flow abrasion. See **page 6** of **Figures 6** and **7** in **Appendix A**, **Photos 37-39** in **Appendix B**.

- **Drainages 5a-5r** are in the northwestern portion of the project area. These erosional rills are not mapped by the USGS but according to LiDAR data, some of these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the time of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 2 ft. The acreages of these features range from less than 0.01 acre to 0.06 acre. The LF of these features range from 66.32 to 998.37 LF. Exact acreages and LF measurements can be reviewed in **Table 2.** A wetland determination point was taken between Drainages 5a and 5r to show the lack of wetland characteristics. These features are likely the result of overland flow abrasion. See **pages 6, 7, 8,** and **9** of **Figures 6** and **7** in **Appendix A**, **Photos 40 - 59** in **Appendix B, and WP 11 in Appendix C**.

- **Drainages 6a-6c** are in the northwestern portion of the project area. These erosional rills not mapped by the USGS but according to LiDAR data, some of these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the time of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 4 ft. The acreages of these features range from 0.01 acre to 0.06 acre. The LF of these features range from 139.70 to 431.17 LF. Exact acreages and LF measurements can be reviewed in **Table 2.** These features are likely the result of overland flow abrasion. See **pages 7** and **8** of **Figures 6** and **7** in **Appendix A**, **Photos 60 - 63** in **Appendix B.**

- **Drainages 7a-7h** are in the western portion of the project area. These erosional rills are not mapped by the USGS but according to LiDAR data, some of these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the time of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 2 ft. The acreages of these features range from less than 0.01 acre to 0.05 acre. The LF of these features range from 109.18 to 760.26 LF. Exact acreages and LF measurements can be reviewed in **Table 2.** These features are likely the result of overland flow abrasion. See **pages 8** and **9** of **Figures 6** and **7** in **Appendix A**, **Photos 64 - 73** in **Appendix B**.

- **Stream 2** is in the western portion of the project area and was field verified to be 0.01 acre and 72.00 LF within the project area. This stream is not mapped by the USGS. This feature consisted of an OHWM with no water present at the time of the June 2020 or the September 2022 field investigations. This feature was field verified to have an ephemeral flow regime that flows from southeast to northwest out of the project area and is likely formed from surface runoff channeled by the hilly topography within the project area. The average width of this feature within the project area is 2.5 ft. A wetland determination point was taken within the field observed OHWM to show the lack of wetland characteristics. This OHWM included sediment sorting, shelving, scour which determined its defined bed and banks. This feature maintained a contiguous OHWM within the project area and appears to converge with Calaveras Creek northwest of the project area outside of its boundaries. See **pages 8** and **9** of **Figures 6** and **7** in **Appendix A**, **Photos 74 and 75** in **Appendix B**, and **WP 12** in **Appendix C**.

- **Drainages 8a1-8f** are in the western portion of the project area. These erosional rills are not mapped by the USGS but according to LiDAR data, some of these features occur at the bottom of a significant slope. These features consisted of erosional drainage with no water present at the

time of the June 2020, September 2022, or March 2023 field investigations. The average width of these features within the project area is 2 ft. The acreages of these features range from 0.01 acre to 0.04 acre. The LF of these features range from 164.99 to 492.71 LF. Exact acreages and LF measurements can be reviewed in **Table 2.** These features are likely the result of overland flow abrasion. See **pages 9**, **10** and **11** of **Figures 6** and **7** in **Appendix A**, **Photos 77-83** in **Appendix B,** and **WP 13** in **Appendix C**.

- **Drainage 9** is in the southwestern portion of the project area and was field verified to be less than 0.01 acre and 83.23 LF within the project area. This erosional rill is not mapped by the USGS. This feature consisted of erosional drainage with water present at the time of the June 2020, September 2022, or March 2023 field investigations. The average width of this feature within the project area is 1 ft. This feature is likely the result of overland flow abrasion. See **page 11** of **Figures 6** and **7** in **Appendix A, Photos 84 and 85** in **Appendix B** and **WP 14** in **Appendix C**.

Table 2. Field-Verified Waters and Wetlands in Project Area

Feature Name	Flow Regime	Delineated Area (Acres/Linear Feet)
Pond 1	Pond	0.17 ac
Wetland 1	Palustrine Emergent Wetland	0.04 ac
Pond 2	Pond	0.23 ac
Drainage 1a	Drainage Feature	0.01 ac / 260.95 lf
Drainage 1b	Drainage Feature	<0.01 ac / 86.00 lf
Wetland 2	Palustrine Emergent Wetland	0.21 ac
Stream 1	Ephemeral Stream	0.01 ac / 216.42 lf
Drainage 2a	Drainage Feature	0.02 ac / 286.12 lf
Drainage 2b	Drainage Feature	<0.01 ac / 100.24 lf
Drainage 2c	Drainage Feature	0.01 ac / 280.89
Drainage 2d	Drainage Feature	0.03 ac / 382.63 lf
Drainage 2e	Drainage Feature	<0.01 ac / 95.95 lf
Drainage 3a	Drainage Feature	0.02 ac / 276.26 lf
Drainage 3b	Drainage Feature	0.02 ac / 461.73 lf
Drainage 3c	Drainage Feature	<0.01 ac / 97.86 lf
Drainage 3d	Drainage Feature	0.04 ac / 444.35 lf
Drainage 3e	Drainage Feature	0.02 ac / 907.50 lf
Drainage 3f	Drainage Feature	<0.01 ac / 166.41 lf
Drainage 3g	Drainage Feature	0.01 ac / 227.64 lf
Drainage 3h	Drainage Feature	0.01 ac / 125.85 lf
Drainage 3i	Drainage Feature	0.01 ac / 295.84 lf
Drainage 3j	Drainage Feature	<0.01 ac / 165.48 lf
Drainage 3k	Drainage Feature	0.05 ac / 556.16 lf
Drainage 3l	Drainage Feature	<0.01 ac / 133.13 lf
Drainage 3m	Drainage Feature	0.01 ac / 224.27 lf
Drainage 3n	Drainage Feature	0.01 ac / 99.03 lf
Drainage 3o	Drainage Feature	0.03 ac / 297.56 lf
Drainage 3p	Drainage Feature	0.01 ac / 186.97 lf
Drainage 4a	Drainage Feature	<0.01 ac / 145.67 lf
Drainage 4b	Drainage Feature	0.01 ac / 226.66 lfr
Drainage 4c	Drainage Feature	0.03 ac / 381.33 lf

Drainage 5a	Drainage Feature	0.06 ac / 998.37 lf
Drainage 5b	Drainage Feature	0.01 ac / 328.68 lf
Drainage 5c	Drainage Feature	0.01 ac / 234.16 lf
Drainage 5d	Drainage Feature	<0.01 ac / 129.16 lf
Drainage 5e	Drainage Feature	<0.01 ac / 194.81 lf
Drainage 5f	Drainage Feature	<0.01 ac / 155.19 lf
Drainage 5g	Drainage Feature	<0.01 ac / 35.49 lf
Drainage 5h	Drainage Feature	0.01 ac / 175.26 lf
Drainage 5i	Drainage Feature	0.02 ac / 824.18 lf
Drainage 5j	Drainage Feature	<0.01 ac / 152.83 lf
Drainage 5k	Drainage Feature	0.01 ac / 254.96 lf
Drainage 5l	Drainage Feature	<0.01 ac / 151.62 lf
Drainage 5m	Drainage Feature	0.02 ac / 519.92 lf
Drainage 5n	Drainage Feature	<0.01 ac / 66.32 lf
Drainage 5o	Drainage Feature	0.01 ac / 510.53 lf
Drainage 5p	Drainage Feature	0.01 ac / 483.90 lf
Drainage 5q	Drainage Feature	<0.01 ac / 78.61 lf
Drainage 5r	Drainage Feature	0.03 ac / 529.76 lf
Drainage 6a	Drainage Feature	0.06 ac / 431.17 lf
Drainage 6b	Drainage Feature	0.01 ac / 139.70 lf
Drainage 6c	Drainage Feature	0.02 ac / 234.27 lf
Drainage 7a	Drainage Feature	0.05 ac / 760.26 lf
Drainage 7b	Drainage Feature	<0.01 ac / 152.07 lf
Drainage 7c	Drainage Feature	0.01 ac / 271.87 lf
Drainage 7d	Drainage Feature	<0.01 ac / 109.18 lf
Drainage 7e	Drainage Feature	0.01 ac / 308.61 lf
Drainage 7f	Drainage Feature	0.02 ac / 502.45 lf
Drainage 7g	Drainage Feature	0.01 ac / 261.40 lf
Drainage 7h	Drainage Feature	0.01 ac / 241.22 lf
Stream 2	Drainage Feature	0.01 ac / 71.95 lf
Drainage 8a1	Drainage Feature	0.03 ac / 474.32 lf

Drainage 8a2	Drainage Feature	0.01 ac / 409.78 lf
Drainage 8b	Drainage Feature	0.03 ac / 352.83 lf
Drainage 8c	Drainage Feature	0.02 ac / 252.83 lf
Drainage 8d	Drainage Feature	0.01 ac / 164.99 lf
Drainage 8e	Drainage Feature	0.01 ac / 141.64 lf
Drainage 8f	Drainage Feature	0.04 ac / 492.71 lf
Drainage 9	Drainage Feature	<0.01 ac / 83.23 lf
	Total:	**1.56 ac / 18,713.15 lf**

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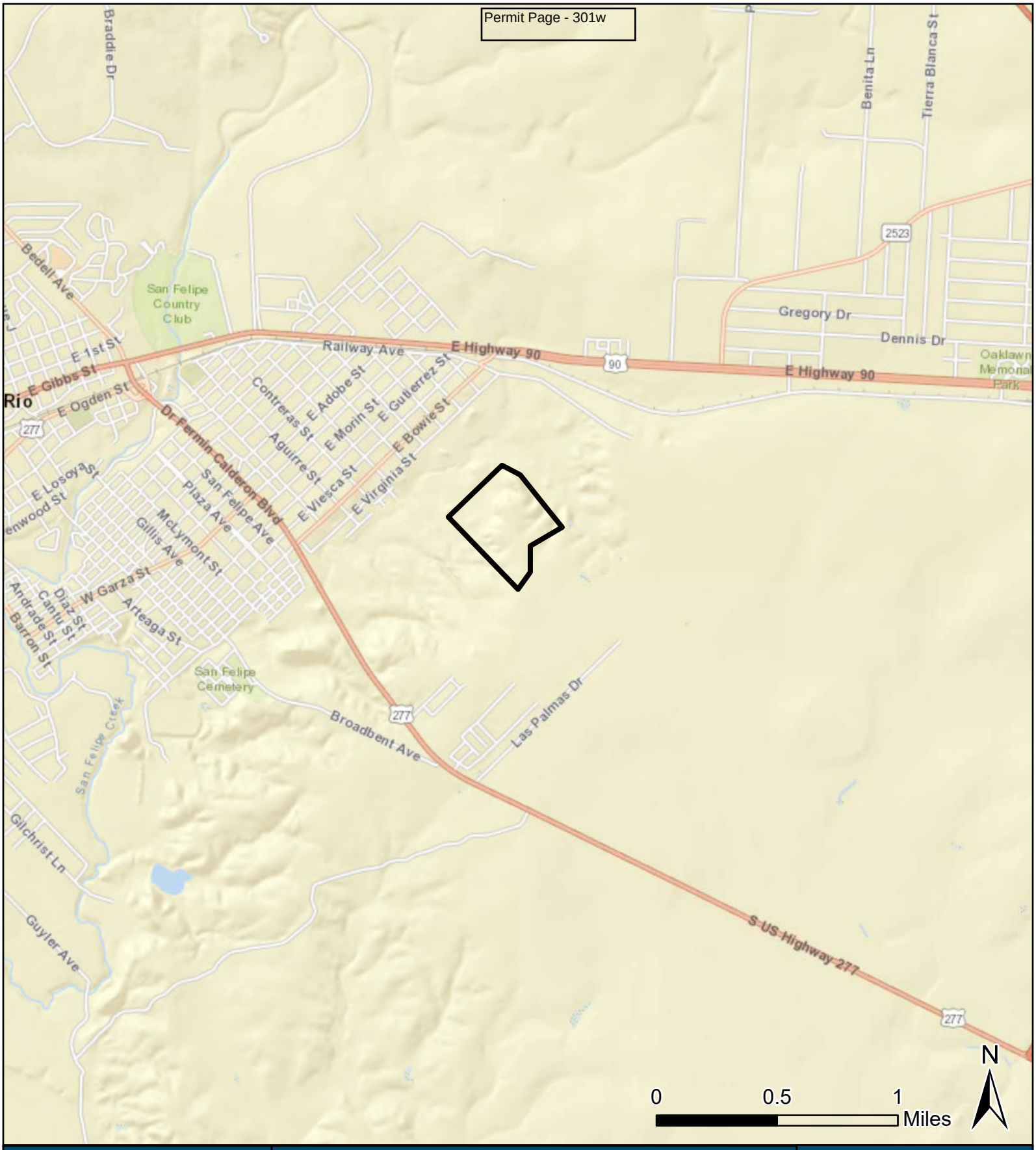
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U.S. Geological Survey. 2019. 7.5-Minute Topographic Quadrangle (1:24,000), Val Verde SE, Texas.

Appendix A – Figures





Project Location

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area

Figure No.: 1

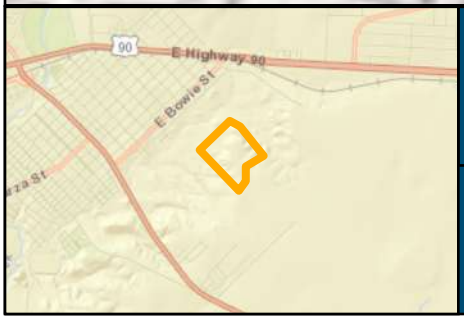
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Drawn By: CP&Y, an STV Company

Sources: ESRI World Streets

Permit Page - 301x





USGS Topographic Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area

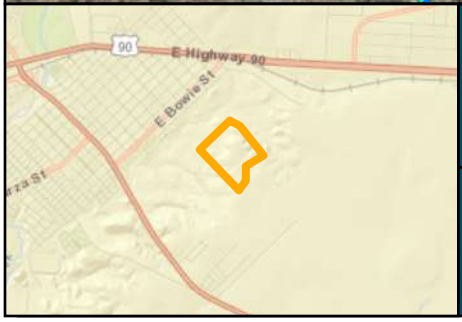
Figure No.: 2

Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: ESRI USA Topographic Map, Quadrangle Val Verde





Mapped Water Resources

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

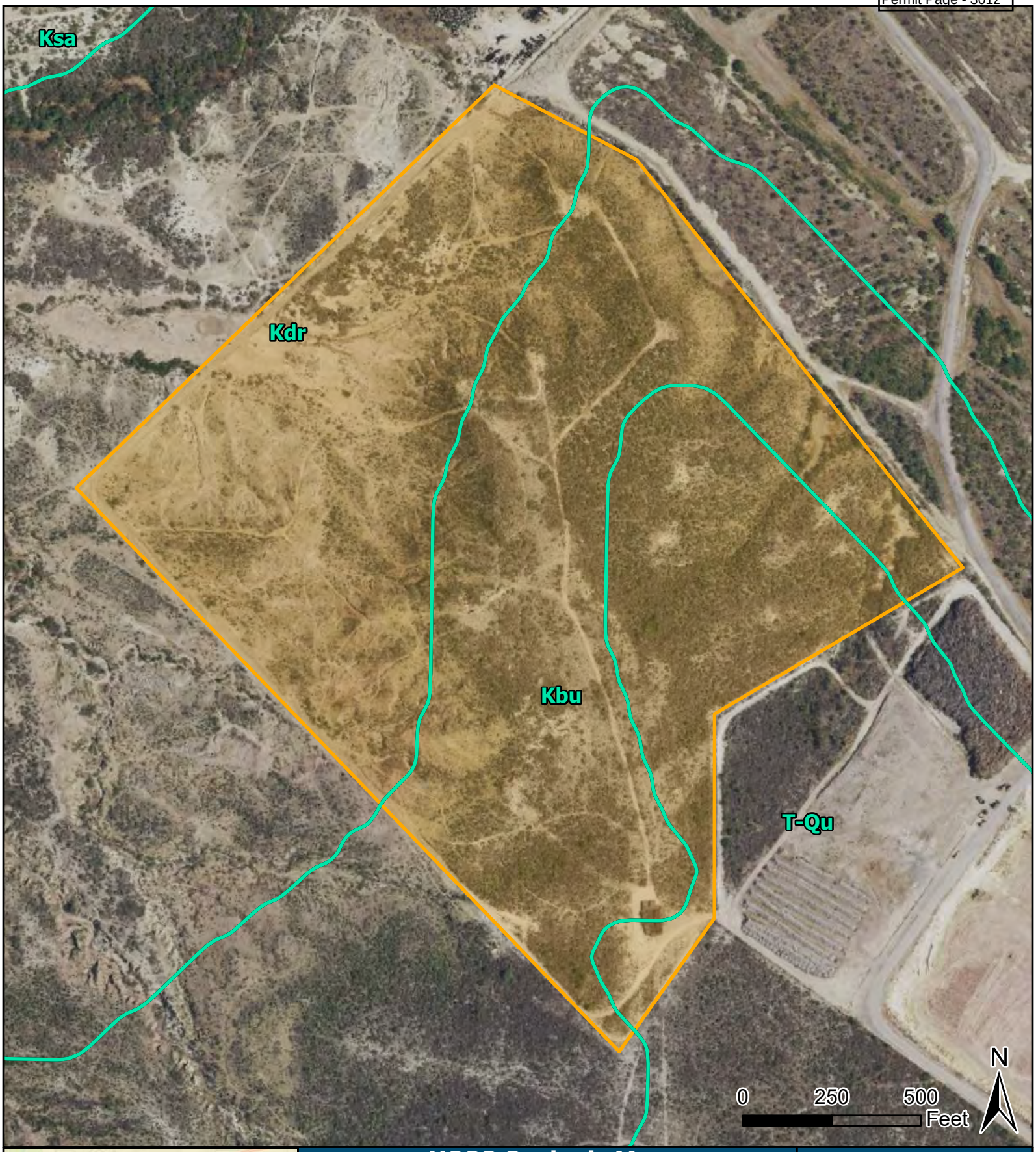
- Project Area
- River/Stream (NHD)
- NWI Mapped Wetland
- Waterbody
- 100-Year Floodzone
- 500-Year Floodzone

Figure No.: 3

Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019, NHD 2022, NWI 2022





USGS Geologic Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Geologic Unit

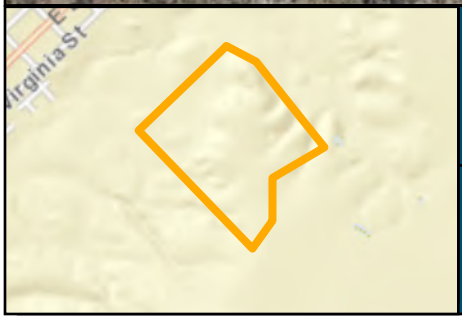
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019, USGS 2017





NRCS Soils Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

Project Area

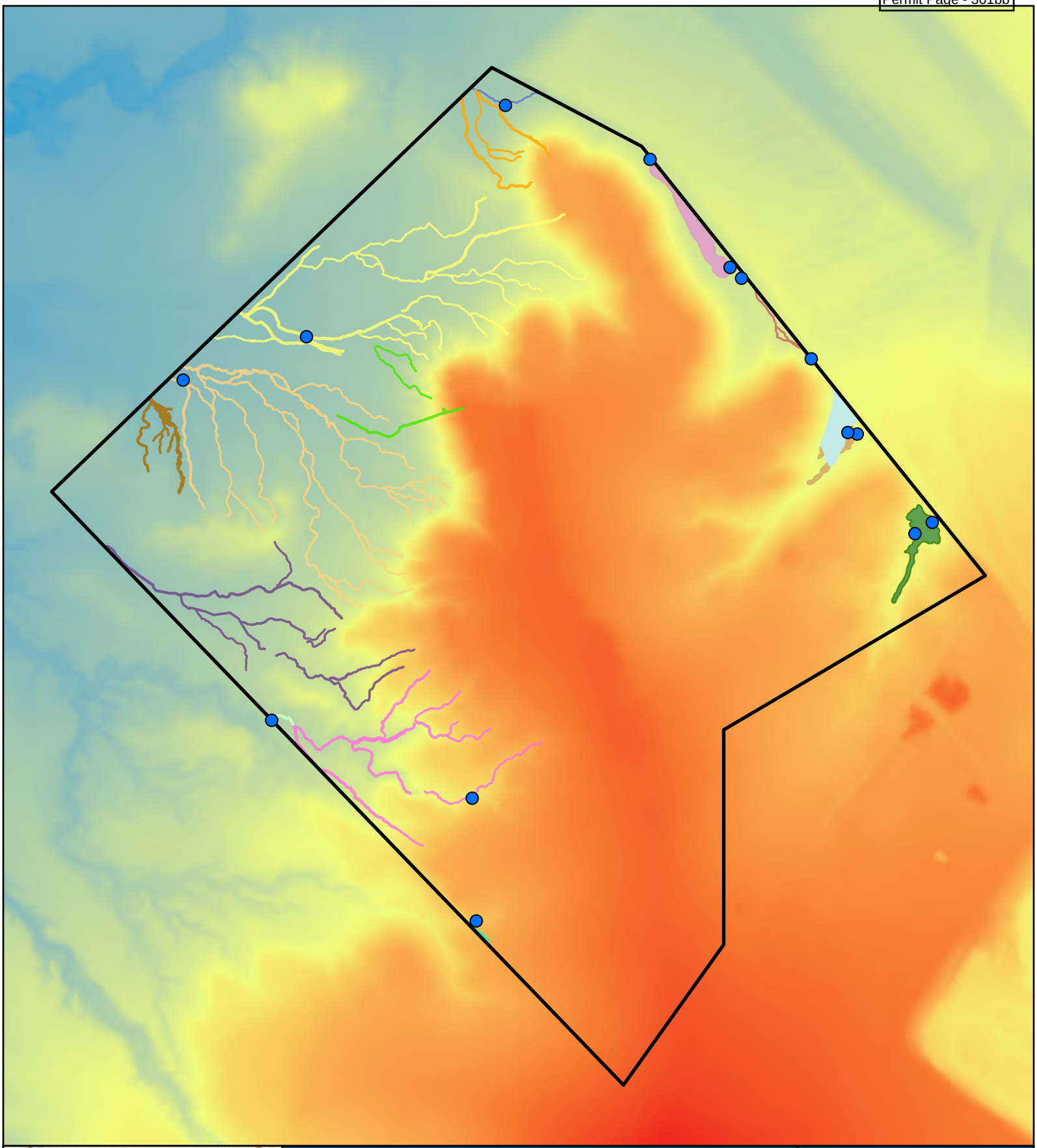
NRCS Soil Unit

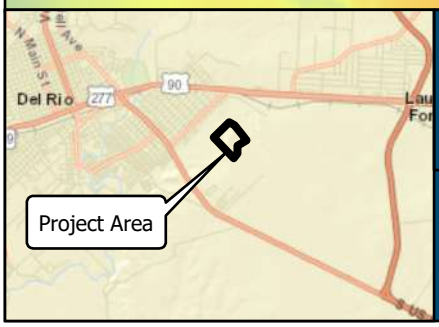
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Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: Google Imagery 2019, NRCS 2023





LiDAR

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

- Project Area
- Wetland Determination Point
- Drainage 1
- Drainage 2
- Drainage 3
- Drainage 4
- Drainage 5
- Drainage 6
- Drainage 7
- Drainage 8
- Drainage 9
- Pond 1
- Pond 2
- Stream 1
- Stream 2
- Wetland 1
- Wetland 2

Figure No.: 6, Overview

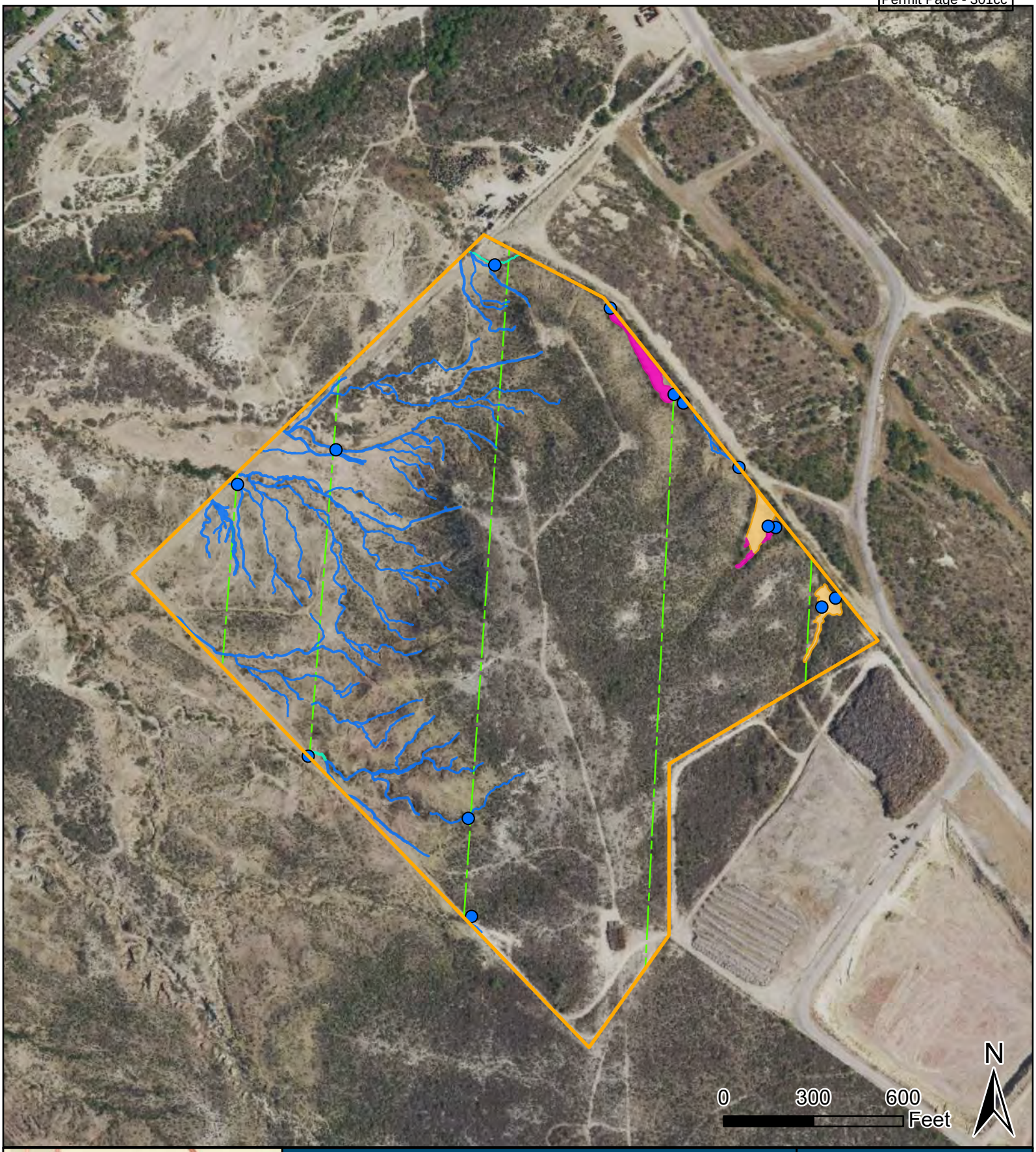
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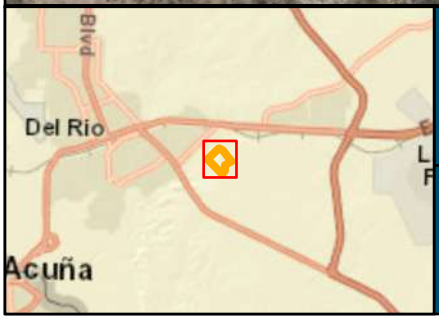
Drawn By: CP&Y, an STV Company

Sources: ESRI Terrain 2023

0 200 400

Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

- Page Extent
- Project Area
- Wetland Determination Point
- Ephemeral Stream
- Drainage Feature
- Palustrine Emergent Wetland
- Pond
- Transect

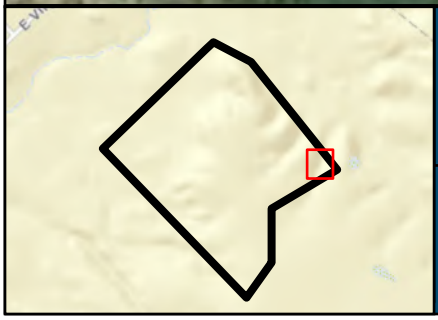
Figure No.: 7, Overview

Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

N

Project Area
Pond
Wetland Determination Point
Transect

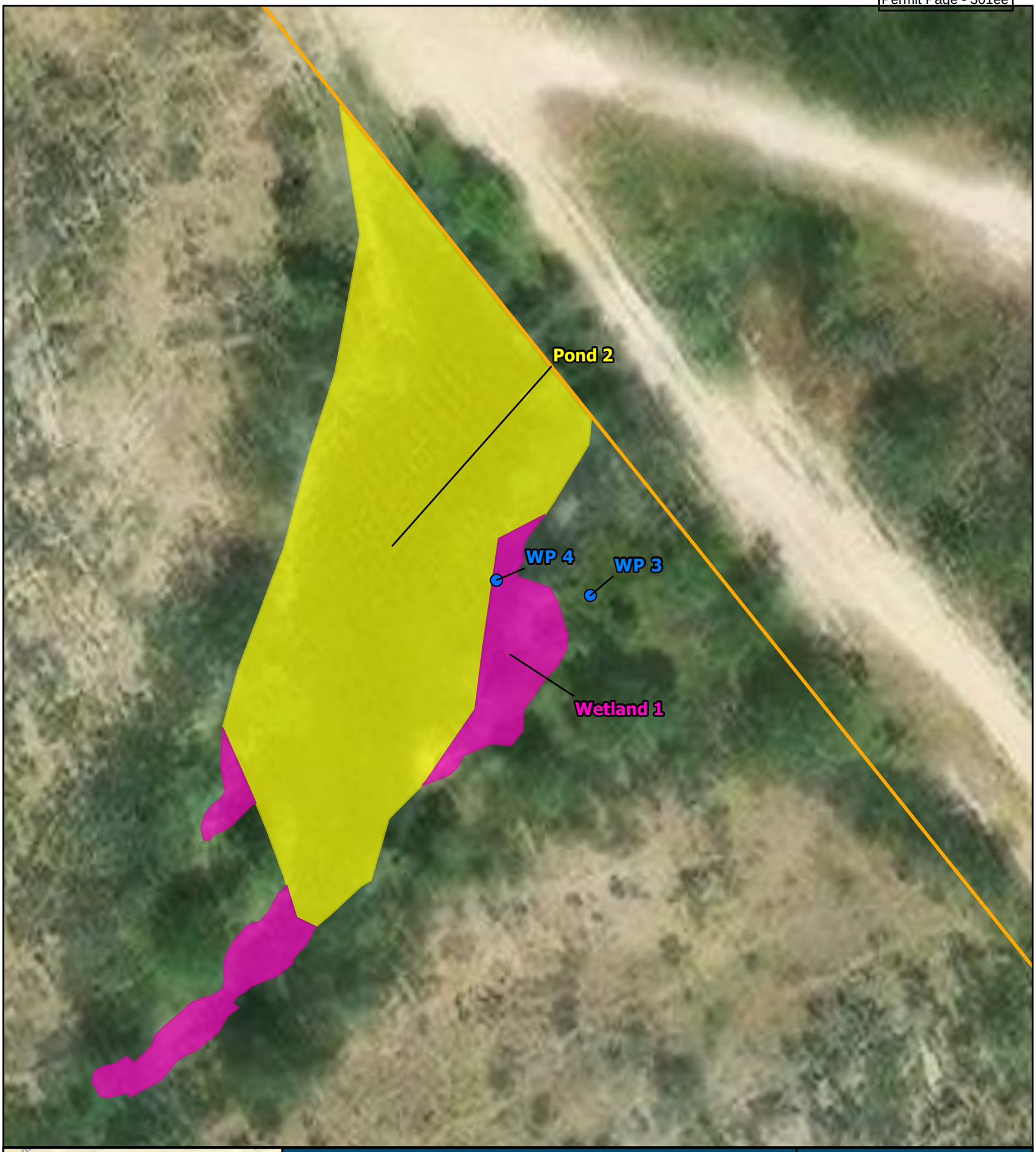
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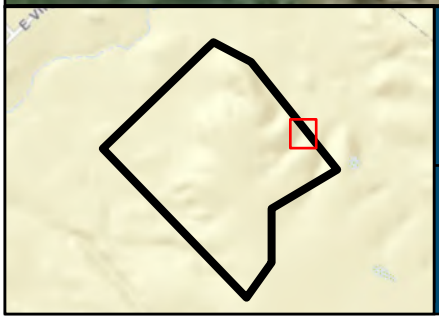
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 20 40
Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

Project Area
Pond
Wetland Determination Point
Transect
Palustrine Emergent Wetland

Figure No.: 7, Page 2 of 10

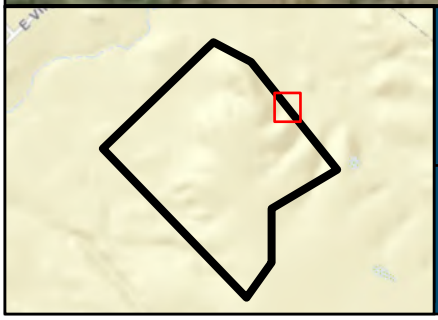
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 20 40 Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

N

Project Area
Wetland Determination Point
Drainage Feature

Figure No.: 7, Page 3 of 10

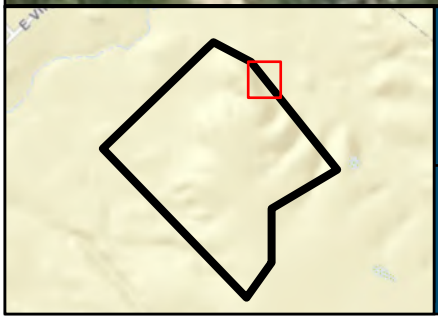
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Sources: TNRIS Imagery 2019

0 20 40 Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

Project Area

Wetland Determination Point

Palustrine Emergent Wetland

Transect

Figure No.: 7, Page 4 of 10

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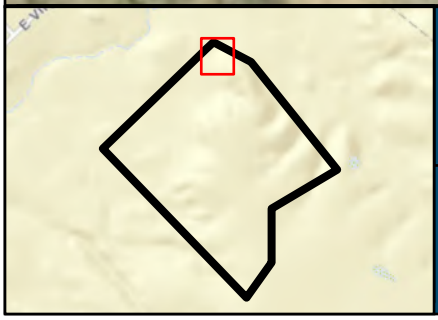
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Sources: TNRIS Imagery 2019

0 25 50

Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

Project Area
Drainage Feature
Wetland Determination Point
Transect
Ephemeral Stream

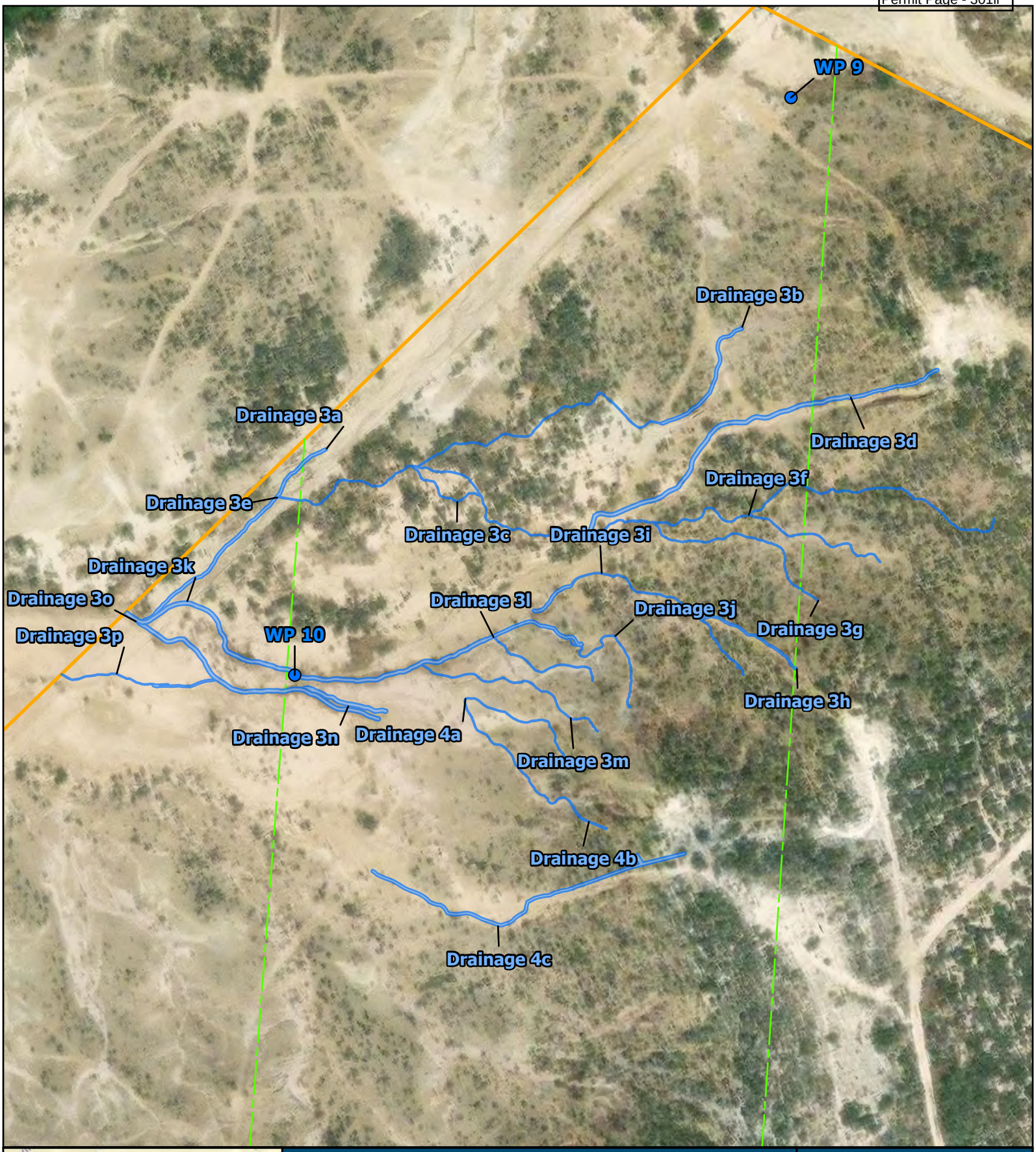
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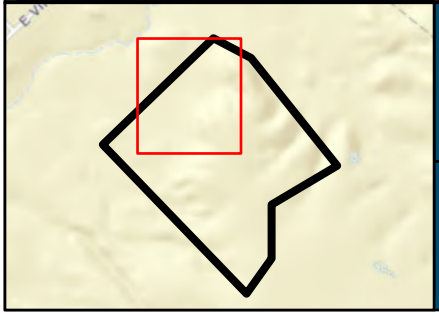
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 25 50 Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

Project Area

Drainage Feature

Wetland Determination Point

Transect

Figure No.: 7, Page 6 of 10

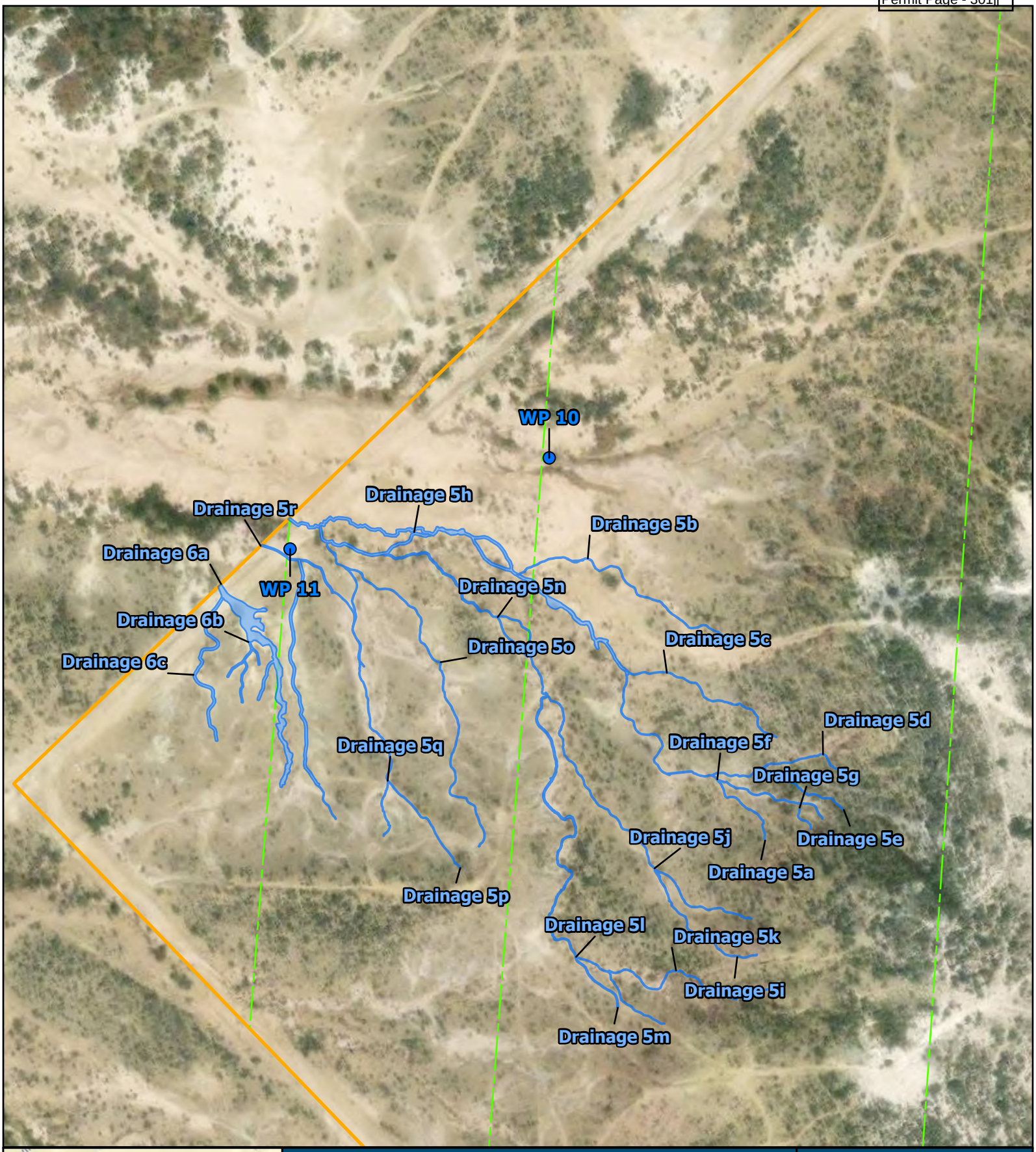
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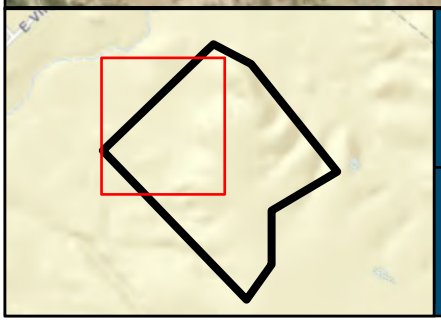
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Sources: TNRIS Imagery 2019

0 90 180

Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

Figure No.: 7, Page 7 of 10

Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

Project Area

Drainage Feature

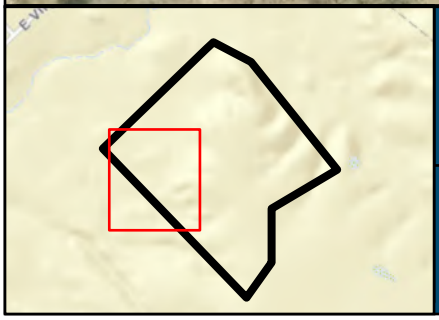
Wetland Determination Point

Transect

0 110 220

Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

N

Project Area
Drainage Feature
Wetland Determination Point
Transect

Figure No.: 7, Page 8 of 10

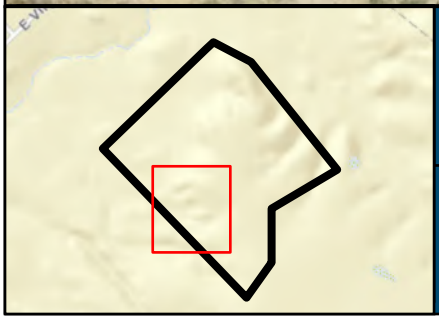
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 80 160
Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

- Project Area
- Drainage Feature
- Wetland Determination Point
- Transect
- Ephemeral Stream

Figure No.: 7, Page 9 of 10

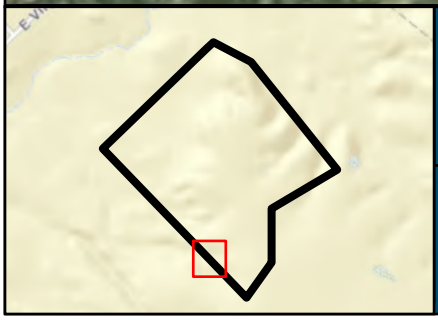
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 65 130 Feet





Field-Verified Waters Map

City of Del Rio
Landfill Expansion Project

Val Verde County, TX

N

Project Area
Drainage Feature
Wetland Determination Point
Transect

Figure No.: 7, Page 10 of 10

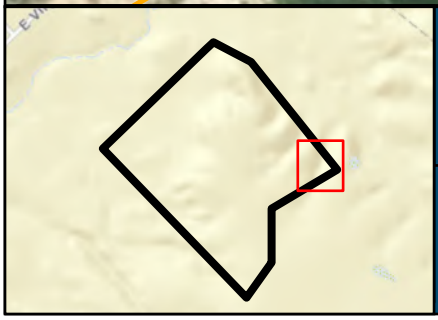
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 25 50 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Pond
Palustrine Emergent Wetland
Photo Location

Figure No.: 8, Page 1 of 9

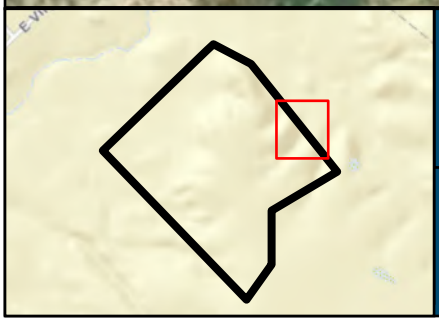
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 40 80 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Erosional Feature
Palustrine Emergent Wetland
Pond
Photo Location

Figure No.: 8, Page 2 of 9

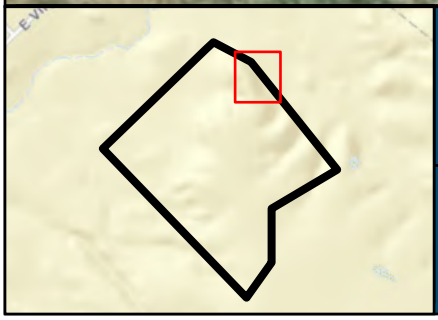
Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 45 90 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Erosional Feature
Palustrine Emergent Wetland
Photo Location

Figure No.: 8, Page 3 of 9

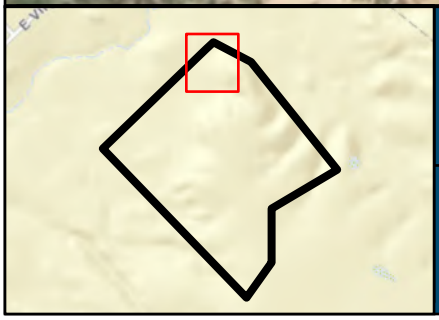
Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 40 80 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

N

Project Area
Erosional Feature
Ephemeral Stream
Photo Location

Figure No.: 8, Page 4 of 9

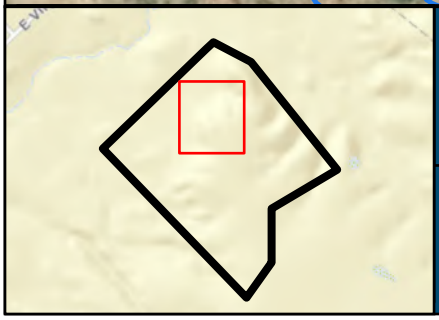
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 45 90 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Photo Location
Erosional Feature

Figure No.: 8, Page 5 of 9

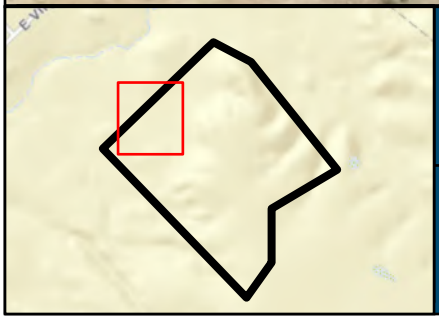
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Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 55 110 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Photo Location
Erosional Feature

Figure No.: 8, Page 6 of 9

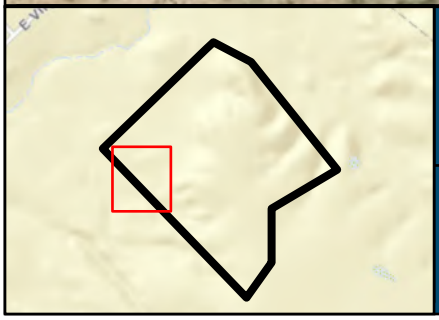
Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 55 110 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

N

Project Area
Erosional Feature
Ephemeral Stream
Photo Location

Figure No.: 8, Page 7 of 9

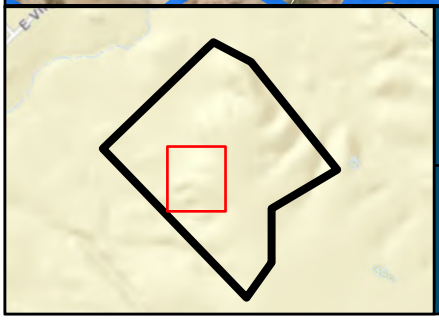
Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 50 100 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Photo Location
Erosional Feature

Figure No.: 8, Page 8 of 9

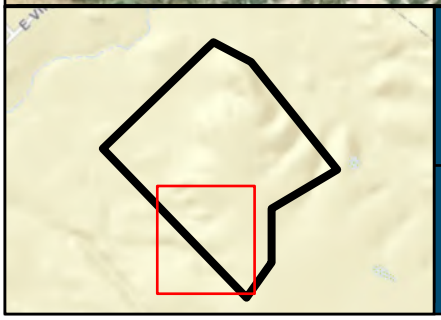
Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 50 100 Feet





Photolog Locations Map

City of Del Rio
Landfill Expansion Project
Val Verde County, TX

Project Area
Erosional Feature
Ephemeral Stream
Photo Location

Figure No.: 8, Page 9 of 9

Site Visit Date: June 22nd & 23rd, 2020, September 13th, 2022, March 22nd & 21st, 2023

Drawn By: CP&Y, an STV Company

Sources: TNRIS Imagery 2019

0 85 170 Feet

Appendix B – Area Photographs



Photograph 1: An east facing view of Pond 1 located in the easternmost portion of the project area.



Photograph 2: A view of wetland point (WP) 1 within Pond 1 located in the easternmost portion of the project area. This WP did not meet the three necessary criteria to be a wetland.



Photograph 3: A view of WP 2 along the northern boundary of Pond 1. This WP did not meet the three necessary criteria to be a wetland.



Photograph 4: A view of Wetland 1 along the fringe of Pond 2.



Photograph 5: A southwest facing view of Pond 2 located within the eastern portion of the project area.



Photograph 6: A view of WP 5 located within Drainage 1a. This WP did not meet the three necessary criteria to be a wetland.



Photograph 7: A northwest view of Drainage 1a.



Photograph 8: A northwest view of Drainage 1b.



Photograph 9: A view of WP 7 within Wetland 2. This WP met the three necessary criteria to be a wetland.



Photograph 10: A north facing view of Wetland 2 located within the northeastern portion of the project area.



Photograph 11: A view of WP 8 taken along a determined transect between Wetland 2 and Stream 1.



Photograph 12: An upstream facing view of Stream 1, an ephemeral stream located within the northeastern portion of the project area.



Photograph 13: A downstream facing view of Stream 1 outside of the project area.



Photograph 14: A view of WP 9 located along the banks of Stream 1. This WP did not meet the necessary criteria to be a wetland.



Photograph 15: An upstream view of Drainage 2a within the northeastern portion of the project area.



Photograph 16: A west-northwest view of Drainage 2b in the northern portion of the project area.



Photograph 17: A west facing view of Drainage 2c in the northern portion of the project area.



Photograph 18: A west-northwest facing view of Drainage 2d in the northern portion of the project area.



Photograph 19: A south facing view of the confluence of sections of Drainage 3.



Photograph 20: A north-northeast facing view of Drainage 3a in the northwestern portion of the project area.



Photograph 21: An east-southeast facing view of Drainage 3b in the northwest portion of the project area.



Photograph 22: A west facing view of Drainage 3c located within the northern portion of the project area.



Photograph 23: A west-southwest facing view of Drainage 3d.



Photograph 24: A west-southwest view of Drainage 3e in the northern portion of the project area.



Photograph 25: A west-northwest facing view of Drainage 3f in the northern portion of the project area.



Photograph 26: A southeast facing view of Drainage 3g.



Photograph 27: A north-northwest facing view of Drainage 3h in the northern portion of the project area.



Photograph 28: An east-southeast facing view of Drainage 3i in the northern portion of the project area.



Photograph 29: A southeast facing view of Drainage 3j in the northwestern portion of the project area.



Photograph 30: A northwest facing view of Drainage 3k in the western portion of the project area.



Photograph 31: A northeast facing view of Drainage 3a, 3k, and 3o in the western portion of the project area.



Photograph 32: A west-northwest facing view of Drainage 3l.



Photograph 33: An east facing view of Drainage 3m.



Photograph 34: A west facing view of Drainage 3n.



Photograph 35: A west facing view of Drainage 3o.



Photograph 36: A west-northwest facing view of Drainage 3p.



Photograph 37: A southeast facing view of Drainage 4a.



Photograph 38: An east-northeast facing view of the northwestern portion of Drainage 4b.



Photograph 39: A north facing view of Drainage 4c located within the north-central portion of project area.



Photograph 40: A northwest facing view of the middle portion of a Drainage 5 confluence.



Photograph 41: A southeast facing view of Drainage 5a and 5b.



Photograph 42: A northwest facing view of Drainage 5c.



Photograph 43: An east-northeast facing view of Drainage 5d.



Photograph 44: A west-northwest facing view of Drainage 5e.



Photograph 45: An east-southeast facing view of Drainage 5f.



Photograph 46: A west-northwest facing view of the southeastern portion of Drainage 5g.



Photograph 47: A west-northwest facing view of Drainage 5h.



Photograph 48: A west-northwest facing view of the southeastern portion of Drainage 5i.



Photograph 49: A west-northwest facing view of Drainage 5j.



Photograph 50: An east-southeast facing view of Drainage 5k.



Photograph 51: A northwest facing view of Drainage 5l.



Photograph 52: A south-southeast facing view of Drainage 5m.



Photograph 53: A south-southeast facing view of Drainage 5n.



Photograph 54: A north-northwest facing view of Drainage 5o.



Photograph 55: A west-northwest facing view of a confluence of Drainages 5l-5o.



Photograph 56: A north-northwest facing view of Drainage 5p.



Photograph 57: A south-southwest facing view of Drainages 5p and 5q.



Photograph 58: A view of WP 11 located along a determined transect between Drainage 5a and 5r. This WP did not meet the three necessary criteria to be a wetland.



Photograph 59: A south facing view of Drainage 5r located within the northwestern portion of the project area.



Photograph 60: A northwest facing view of Drainage 6a.



Photograph 61: A west-northwest facing view of Drainage 6b.



Photograph 62: A northwest facing view of Drainage 6c.



Photograph 63: A downstream view of Drainage 6a-6c. Drainage 6 convenes at a dirt road that follows the northwest edge of the project area.



Photograph 64: A west facing view of Drainage 7a.



Photograph 65: A south-southeast facing view of Drainages 7a and 7e.



Photograph 66: A south-southeast facing view of Drainage 7b.



Photograph 67: A west facing view of Drainage 7c.



Photograph 68: A west-southwest facing view of Drainage 7d.



Photograph 69: A south-southwest facing view of the western portion of Drainage 7e.



Photograph 70: An east facing view of Drainage 7f located within the western portion of the project area.



Photograph 71: A southwest facing view of the eastern portion of Drainages 7f.



Photograph 72: A west-southwest facing view of Drainage 7g.



Photograph 73: A north facing view of Drainage 7h.



Photograph 74: A view of WP 12 located within Stream 2. This WP did not meet the three necessary criteria to be a wetland. This area appeared to have been recently disturbed by heavy machinery.



Photograph 75: A west-facing view of the start of Stream 2, an ephemeral stream.



Photograph 76: A view of WP 13 located along a determined transect and southeast of Drainage 8a1. This WP did not meet the three necessary criteria to be a wetland.



Photograph 77: A west facing view looking towards Drainage 8a1.



Photograph 78: Southwest view of Drainage 8b.



Photograph 79: A south-southwest facing view of Drainage 8c.



Photograph 80: A southwest facing view of Drainage 8d.



Photograph 81: A south-southwest facing view of Drainage 8e.



Photograph 82: A southeast facing view of Drainage 8f.



Photograph 83: A southwest facing view of Drainage 8a2.



Photograph 84: An northwest facing view looking along a two-track where Drainage 9 runs adjacent, located within the southwest corner of the project area.



Photograph 85: A view of WP 14 located along a determined transect and near the southwest corner of the project area and Drainage 9. This WP did not meet the three necessary criteria to be a wetland.

Appendix C – Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 6/22/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 1

Investigator(s): C. Miller & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): ditch Local relief (concave, convex, none): concave Slope (%): 0-1%

Subregion (LRR): LRR I Lat: 29.359876 Long: -100.857815 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔ No _____	
Wetland Hydrology Present?	Yes ✔ No _____	

Remarks: The point was not a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitex agnus-castus	15	Y	UPL
2. Prosopis glandulosa	10	Y	FACU
3. Acacia greggii	10	Y	UPL
4. Salix nigra	5	N	FACW
	40	= Total Cover	
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1.			
2.			
3.			
4.			
5.			
	0	= Total Cover	
Herb Stratum (Plot size: 10' x 10')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	0	= Total Cover	
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0	= Total Cover	

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	5	x 2 =	10
FAC species	0	x 3 =	0
FACU species	10	x 4 =	40
UPL species	25	x 5 =	125
Column Totals:	40 (A)		175 (B)

Prevalence Index = B/A = 4.375

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10 YR 6/1	90	10 YR 5/6	10	C	M	sandy clay	
3-16	10 YR 5/2	80	10 YR 5/6	20	C	M	sandy clay	slightly wet

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ✔ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ____

Remarks:

Hydric soil was present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ✔ Surface Soil Cracks (B6)
- ✔ Sparsely Vegetated Concave Surface (B8)
- ✔ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ✔ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ____ No ✔ Depth (inches): _____

Water Table Present? Yes ____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✔ No ____ Depth (inches): at 4"

Wetland Hydrology Present? Yes ✔ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was present within the sample point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 6/22/2020

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 2

Investigator(s): C. Miller & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): ditch Local relief (concave, convex, none): concave Slope (%): 0-1%

Subregion (LRR): LRR I Lat: 29.359794 Long: -100.857957 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____ No ✔	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The point is not a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitex agnus-castus	20	Y	UPL
2.			
3.			
4.			
	20 = Total Cover		
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: 10' x 10')			
1. Cynodon dactylon	30	Y	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	30 = Total Cover		
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	50	x 5 =	250
Column Totals:	50 (A)		250 (B)

Prevalence Index = B/A = 5.0

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is not present at the sampling point.

SOIL

Sampling Point: WP 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10 YR 6/1	98	10 YR 5/6	2	C	M	sandy clay	rocky clay layer at 4"

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5) **(LRR F)**
___ 1 cm Muck (A9) **(LRR F, G, H)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) **(LRRI, J)**
___ Coast Prairie Redox (A16) **(LRR F, G, H)**
___ Dark Surface (S7) **(LRR G)**
___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
___ Reduced Vertic (F18)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: clay hardpan
Depth (inches): 4

Hydric Soil Present? Yes _____ No ✔

Remarks:
Hydric soil was not present at the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Water-Stained Leaves (B9)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
___ Presence of Reduced Iron (C4)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)
___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____
Water Table Present? Yes _____ No ✔ Depth (inches): _____
Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology is not present at the sample point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 6/22/2020

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 3

Investigator(s): C. Miller & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): ditch Local relief (concave, convex, none): concave Slope (%): 0-1%

Subregion (LRR): LRR I Lat: 29.360518 Long: -100.858450 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____ No ✔	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The point is not a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitex agnus-castus	10	Y	UPL
2. Acacia greggii	5	Y	UPL
3.			
4.			
	15 = Total Cover		
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1. Ephedra trifurca	15	Y	UPL
2.			
3.			
4.			
5.			
	15 = Total Cover		
Herb Stratum (Plot size: 10' x 10')			
1. Muhlenbergia emersleyi	30	Y	UPL
2. Phyla nodifera	5	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	35 = Total Cover		
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 20%

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	15
FACU species	0	x 4 =	0
UPL species	60	x 5 =	300
Column Totals:	65 (A)		315 (B)

Prevalence Index = B/A = 4.85

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is not present at the sampling point.

SOIL

Sampling Point: WP 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10 YR 6/1	100					sandy clay	rocky

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: rocky layer

Depth (inches): 2

Hydric Soil Present? Yes ____ No ✔

Remarks:

Hydric soil was not present at the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ✔ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ____ No ✔ Depth (inches): ____

Water Table Present? Yes ____ No ✔ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No ✔ Depth (inches): ____

Wetland Hydrology Present? Yes ____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology is not present at the sample point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 6/22/2020

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 4

Investigator(s): C. Miller & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): ditch Local relief (concave, convex, none): concave Slope (%): 0-1%

Subregion (LRR): LRR I Lat: 29.360521 Long: -100.858528 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔ No _____	**Is the Sampled Area within a Wetland?** Yes ✔ No _____
Hydric Soil Present?	Yes ✔ No _____	
Wetland Hydrology Present?	Yes ✔ No _____	

Remarks: The point is a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix nigra	20	Y	FACW
2.			
3.			
4.			
	20 = Total Cover		
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: 10' x 10')			
1. Setaria parviflora	10	Y	FAC
2. Sorghum halepense	5	Y	FACU
3. Phyla nodifera	5	Y	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	20 = Total Cover		
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 30%

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is not present at the sampling point.

SOIL

Sampling Point: WP 4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-0.5	10 YR 4/1	100					duff	organic duff layer
0.5-4	10 YR 6/1	90	10 YR 5/6	10	C	M	sandy clay	no resistance to shovel
4-16	10 YR 5/2	80	10 YR 5/6	20	C	M	sandy clay	some rocks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ✔ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ____

Remarks:

Hydric soil was present at the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✔ Surface Water (A1)
- ___ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ✔ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ✔ Surface Soil Cracks (B6)
- ✔ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ✔ No ____ Depth (inches): <1

Water Table Present? Yes ____ No ✔ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ✔ No ____ Depth (inches): at 2"

Wetland Hydrology Present? Yes ✔ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology is present at the sample point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 5

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Drainage ditch Local relief (concave, convex, none): concave Slope (%): 3

Subregion (LRR): LRR I Lat: 29.361062 Long: -100.858846 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____ No ✔	
Wetland Hydrology Present?	Yes ✔ No _____	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 15' x 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. Parkinsonia aculeata	15	Y	UPL
2.			
3.			
4.			
	15 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1. Prosopis glandulosa	5	Y	FACU
2.			
3.			
4.			
5.			
	5 = Total Cover		
Herb Stratum (Plot size: 15' x 15')			
1. Malvastrum coromandelianum	5	N	FAC
2. Sphaeralcea angustifolia	5	N	UPL
3. Sorghum halepense	30	Y	FACU
4. Bothriochloa ischaemum	55	Y	UPL
5. Chloris virgata	5	N	FACU
6.			
7.			
8.			
9.			
10.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 15' x 15')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	15
FACU species	40	x 4 =	160
UPL species	75	x 5 =	375
Column Totals:	120 (A)		550 (B)

Prevalence Index = B/A = 4.58

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0 - 4	10 YR 5/2	98	10 YR 5/6	2	C	M	Clay silt	Pebbles
4 - 16	10 YR 5/1	95	10 YR 5/6	5	C	M	Clay	Smaller pebbles and less

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Hydric soil was not present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✔ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ✔ No _____ Depth (inches): 2"

Water Table Present? Yes ✔ No _____ Depth (inches): 3"

Saturation Present? (includes capillary fringe) Yes ✔ No _____ Depth (inches): 3"

Wetland Hydrology Present? Yes ✔ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was present within the sample point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 6

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 1-3

Subregion (LRR): LRR I Lat: 29.361645 Long: -100.859439 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔ No _____	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The point was not within a wetland

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Prosopis velutina	30	Y	FACU
2.			
3.			
4.			
	30 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1. Tamarix ramosissima	5	Y	FACU
2.			
3.			
4.			
5.			
	5 = Total Cover		
Herb Stratum (Plot size: 5' x 5')			
1. Bothriochloa ischaemum	90	Y	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	90 = Total Cover		
Woody Vine Stratum (Plot size: 30' x 30')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 10

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	5	x 4 =	20
UPL species	90	x 5 =	450
Column Totals:	95 (A)		470 (B)

Prevalence Index = B/A = 4.9

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point

SOIL

Sampling Point: WP 6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 16	10 YR 5/2	80	10 YR 5/6	15	C	M	Clay	
	10 YR 6/1	5					Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ **No** ____

Remarks:

Hydric soil was present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ✔ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ____ No ✔ Depth (inches): _____

Water Table Present? Yes ____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was not present within the sample point

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 7

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 0-1

Subregion (LRR): LRR I Lat: 29.361723 Long: -100.859538 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔ No _____	**Is the Sampled Area within a Wetland?** Yes ✔ No _____
Hydric Soil Present?	Yes ✔ No _____	
Wetland Hydrology Present?	Yes ✔ No _____	

Remarks: The point was within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: 5' x 5')			
1. Eleocharis palustris	40	Y	OBL
2. Typha domingensis	20	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	60 = Total Cover		
Woody Vine Stratum (Plot size: 30' x 30')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 40

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was present within the sampling point

SOIL

Sampling Point: WP 7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 16	10 YR 5/1	90	10 YR 5/6	10	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ____

Remarks:

Hydric soil was present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✔ Surface Water (A1)
- ✔ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ✔ Saturation Visible on Aerial Imagery (C9)
- ✔ Geomorphic Position (D2)
- ✔ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ✔ No ____ Depth (inches): 2"

Water Table Present? Yes ✔ No ____ Depth (inches): 5"

Saturation Present? (includes capillary fringe) Yes ✔ No ____ Depth (inches): 5"

Wetland Hydrology Present? Yes ✔ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was present within the sample point

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 8

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Wetland Fringe Local relief (concave, convex, none): None Slope (%): 1 - 3

Subregion (LRR): LRR I Lat: 29.362506 Long: -100.860221 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔ No _____	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1. Prosopis glandulosa	25	Y	FACU
2. Prosopis velutina	10	Y	FACU
3. Parkinsonia aculeata	10	Y	FAC
4.			
5.			
	45 = Total Cover		
Herb Stratum (Plot size: 5' x 5')			
1. Bothriochloa ischaemum	40	Y	UPL
2. Tridens strictus	10	N	FAC
3. Tridens albescens	5	N	FAC
4. Ruellia nudiflora	5	N	UPL
5.			
6.			
7.			
8.			
9.			
10.			
	60 = Total Cover		
Woody Vine Stratum (Plot size: 30' x 30')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 40

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	25	x 3 =	75
FACU species	35	x 4 =	140
UPL species	45	x 5 =	225
Column Totals:	105 (A)		440 (B)

Prevalence Index = B/A = 4.2

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
1 - 13	10 YR 5/2	98	10 YR 5/4	2	C	PL	Clay	
13 - 16	10 YR 5/2	98	10 YR 5/4	1	C	M	Clay	
	10 YR 5/1	10 YR 5/1						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ____

Remarks:

Hydric soil was present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ✔ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ____ No ✔ Depth (inches): _____

Water Table Present? Yes ____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was not present within the sampling point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 9

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): stream bank Local relief (concave, convex, none): None Slope (%): 0

Subregion (LRR): LRR I Lat: 29.362885 Long: -100.861439 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1. Citharexylum brachyanthum	30	Y	UPL
2. Prosopis glandulosa	20	Y	FACU
3. Parkinsonia aculeata	10	N	UPL
4.			
5.			
	60 = Total Cover		
Herb Stratum (Plot size: 10' x 10')			
1. Bothriochloa ischaemum	60	Y	UPL
2. Ruellia nudiflora	35	Y	UPL
3. Cynodon dactylon	10	N	FACU
4. Tridens albescens	5	N	FAC
5.			
6.			
7.			
8.			
9.			
10.			
	110 = Total Cover		
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	15
FACU species	30	x 4 =	120
UPL species	135	x 5 =	675
Column Totals:	170 (A)		810 (B)

Prevalence Index = B/A = 4.7

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0 - 5	10 YR 5/2	100					Clayey sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Rock

Depth (inches): 5" +

Hydric Soil Present? Yes _____ No ✔

Remarks:

Hydric soil was not present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ✔ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Recent rainfall led to flowing water in channel.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 10

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR): LRR I Lat: 29.361165 Long: -100.863072 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1. Parkinsonia aculeata	60	Y	UPL
2. Larrea tridentata	30	Y	UPL
3.			
4.			
5.			
	90 = Total Cover		
Herb Stratum (Plot size: 10' x 10')			
1. Ruellia nudiflora	10	Y	UPL
2. Sorghum halepense	15	Y	FACU
3. Tridens albescens	10	Y	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	35 = Total Cover		
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 65

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 20 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	15	x 4 =	60
UPL species	100	x 5 =	500
Column Totals:	115 (A)		590 (B)

Prevalence Index = B/A = 5.1

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 -16	10 YR 4/3	70					Sandy clay	small sand pebbles
	10 YR 6/3	30					Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR F)**
- ___ 1 cm Muck (A9) **(LRR F, G, H)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRRI, J)**
- ___ Coast Prairie Redox (A16) **(LRR F, G, H)**
- ___ Dark Surface (S7) **(LRR G)**
- ___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Hydric soil was not present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
- ___ Presence of Reduced Iron (C4)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ✔ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✔ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)
- ___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was present within the sample point, but there was no flowing water.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 11

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRR I Lat: 29.360833 Long: -100.864099 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____ No ✔	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 15' x 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1. Parkinsonia aculeata	10	N	UPL
2. Citharexylum brachyanthum	5	N	UPL
3.			
4.			
5.			
	15 = Total Cover		
Herb Stratum (Plot size: 15' x 15')			
1. Bahia absinthifolia	5	N	UPL
2. Hoffmannseggia glauca	5	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	10 = Total Cover		
Woody Vine Stratum (Plot size: 15' x 15')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 90

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	15
FACU species	0	x 4 =	0
UPL species	20	x 5 =	100
Column Totals:	25 (A)		115 (B)

Prevalence Index = B/A = 4.6

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	10 YR 4/3	70					Clayey sand	
4 - 16	10 YR 6/3	30					Clayey sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5) **(LRR F)**
___ 1 cm Muck (A9) **(LRR F, G, H)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) **(LRRI, J)**
___ Coast Prairie Redox (A16) **(LRR F, G, H)**
___ Dark Surface (S7) **(LRR G)**
___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
___ Reduced Vertic (F18)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Hydric soil was not present within the sampling point and is dry clay.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Water-Stained Leaves (B9)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
___ Presence of Reduced Iron (C4)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)
___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was not present within the sampling point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 12

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Fence line Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRR I Lat: 29.358349 Long: -100.863312 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation ✔ Soil ✔, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔ No _____	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The site appeared to be disturbed by heavy machinery. The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10' x 10')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 10' x 10')			
1. Citharexylum brachyanthum	5	Y	UPL
2. Tiquilia canescens	5	Y	UPL
3.			
4.			
5.			
	10 = Total Cover		
Herb Stratum (Plot size: 10' x 10')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	0 = Total Cover		
Woody Vine Stratum (Plot size: 10' x 10')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 90

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	10	x 5 =	50
Column Totals:	10 (A)		50 (B)

Prevalence Index = B/A = 5

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point. This area has been heavily disturbed.

SOIL

Sampling Point: WP 12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 12	10 YR 4/2	76	10 YR 7/6	2			Clay	with sand pockets
	10 YR 3/3	20					Clay	
	10 YR 6/1	2					Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5) **(LRR F)**
___ 1 cm Muck (A9) **(LRR F, G, H)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
✔ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) **(LRRI, J)**
___ Coast Prairie Redox (A16) **(LRR F, G, H)**
___ Dark Surface (S7) **(LRR G)**
___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
___ Reduced Vertic (F18)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ____

Remarks:

Hydric soil was present within the sampling point but has been heavily disturbed. The soil pit was taken beneath the area of the new soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Water-Stained Leaves (B9)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
___ Presence of Reduced Iron (C4)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)
___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ____ No ✔ Depth (inches): _____

Water Table Present? Yes ____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Wetland hydrology was not present within the sampling point. This area has been heavily disturbed.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 13

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Hillslope/erosional feature Local relief (concave, convex, none): None Slope (%): 2 - 5

Subregion (LRR): LRR I Lat: 29.357801 Long: -100.861624 Datum: NAD 83

Soil Map Unit Name: Felipe and Zorra soils, very rocky, 8 to 40 percent slopes (FzG) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____ No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____ No ✔	
Wetland Hydrology Present?	Yes _____ No ✔	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' x 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1. Senegalia greggii	15	Y	UPL
2. Yucca constricta	15	Y	UPL
3. Guaiacum angustifolium	10	Y	UPL
4. Prosopis velutina	5	N	UPL
5. Ziziphus obtusifolia	5	N	UPL
	50 = Total Cover		
Herb Stratum (Plot size: 15' x 15')			
1. Hoffmannseggia glauca	10	Y	FAC
2. Wedelia acapulcensis	5	Y	UPL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	15 = Total Cover		
Woody Vine Stratum (Plot size: 30' x 30')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 85

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 1 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 20 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	0	x 4 =	0
UPL species	55	x 5 =	275
Column Totals:	65 (A)		305 (B)

Prevalence Index = B/A = 4.7

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 16	10 YR 5/3	92	10 YR 5/6	1	C	M	Clay	Mixed Matrix
	10 YR 5/2	5					Clay	
	10 YR 4/2	2					Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5) **(LRR F)**
___ 1 cm Muck (A9) **(LRR F, G, H)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) **(LRRI, J)**
___ Coast Prairie Redox (A16) **(LRR F, G, H)**
___ Dark Surface (S7) **(LRR G)**
___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
___ Reduced Vertic (F18)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Hydric soil was not present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Water-Stained Leaves (B9)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
___ Presence of Reduced Iron (C4)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)
___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was not present within the sampling point.

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: Del Rio Landfill Expansion City/County: Del Rio/Val Verde County Sampling Date: 9/13/2022

Applicant/Owner: City of Del Rio State: TX Sampling Point: WP 14

Investigator(s): G. Weiberg & K. Strickland (CP&Y, Inc.) Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): concave Slope (%): 0 - 1

Subregion (LRR): LRR I Lat: 29.356902 Long: -100.861574 Datum: NAD 83

Soil Map Unit Name: Zapata-Vinegarroon complex, 1 to 5 percent slopes (ZaC) NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____ Soil _____, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____ Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✔	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks: The point was not within a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 15' x 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' x 15')			
1. Prosopis velutina	30	Y	FACU
2. Ziziphus obtusifolia	10	Y	FACU
3. Prosopis glandulosa	5	N	FACU
4.			
5.			
	45 = Total Cover		
Herb Stratum (Plot size: 15' x 15')			
1. Bothriochloa ischaemum	10	Y	UPL
2. Tridens strictus	5	N	FAC
3. Wedelia acapulcensis	2	N	UPL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	17 = Total Cover		
Woody Vine Stratum (Plot size: 15' x 15')			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 10

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC-): 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	15
FACU species	45	x 4 =	180
UPL species	10	x 5 =	50
Column Totals:	60 (A)		245 (B)

Prevalence Index = B/A = 4.08

Hydrophytic Vegetation Indicators:

___ 1 – Rapid Test for Hydrophictic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✔

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation was not present within the sampling point.

SOIL

Sampling Point: WP 14

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 2	10 YR 5/2	100					Clay	
2 - 6	10 YR 5/2	97	10 YR 5/6	3	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5) **(LRR F)**
___ 1 cm Muck (A9) **(LRR F, G, H)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 2.5 cm Mucky Peat or Peat (S2) **(LRR G, H)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR F)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
✔ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ High Plains Depressions (F16) **(MLRA 72 & 73 of LRR H)**

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) **(LRRI, J)**
___ Coast Prairie Redox (A16) **(LRR F, G, H)**
___ Dark Surface (S7) **(LRR G)**
___ High Plains Depressions (F16) **(LRRH outside of MLRA 72 & 73)**
___ Reduced Vertic (F18)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Rock
Depth (inches): 6"

Hydric Soil Present? Yes ✔ No ____

Remarks:

Hydric soil was present within the sampling point.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Water-Stained Leaves (B9)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Dry-Season Water Table (C2)
___ Oxidized Rhizospheres on Living Roots (C3) **(where not tilled)**
___ Presence of Reduced Iron (C4)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
___ Drainage Patterns (B10)
___ Oxidized Rhizospheres on Living Roots (C3) **(where tilled)**
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
✔ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)
___ Frost-Heave Hummocks (D7) **(LRR F)**

Field Observations:

Surface Water Present? Yes ____ No ✔ Depth (inches): ____
Water Table Present? Yes ____ No ✔ Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes ____ No ✔ Depth (inches): ____

Wetland Hydrology Present? Yes ____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology was not present within the sampling point.

Appendix D – GeoSearch Historic Aerials

GeoSearch
On time. On target. In touch.™

Historical Aerial Photographs

***NEW:** GeoLens by Geosearch*

Target Property:

City of Del Rio Landfill Expansion

Del Rio, Val Verde, Texas 78840

Prepared For:

CP&Y-San Antonio

Order #: 148134
Job #: 356437
Project #:
Date: 6/16/2020

Target Property Summary

City of Del Rio Landfill Expansion

Del Rio, Val Verde, Texas 78840

USGS Quadrangle: ***DEL RIO SE***
Target Property Geometry: ***Area***

Target Property Longitude(s)/Latitude(s):
(-100.860304000, 29.355817000), (-100.859540000, 29.356654000), (-100.859505000, 29.358286000), (-100.858587000, 29.358837000), (-100.858155000, 29.358401000), (-100.857233000, 29.359548000), (-100.861007000, 29.363298000), (-100.861109000, 29.363466000), (-100.865051000, 29.359978000), (-100.860436000, 29.355744000)

Aerial Research Summary

Date	Source	Scale	Frame
2016	USDA	1" = 500'	N/A
2014	USDA	1" = 500'	N/A
2012	USDA	1" = 500'	N/A
2010	USDA	1" = 500'	N/A
2006	USDA	1" = 500'	N/A
2005	USDA	1" = 500'	N/A
2004	USDA	1" = 500'	N/A
02/08/2002	USGS	1" = 500'	N/A
03/10/1996	USGS	1" = 500'	N/A
01/14/1990	USGS	1" = 700'	2395-11
02/16/1985	USGS	1" = 700'	27-204
04/21/1976	USGS	1" = 500'	3-96
03/17/1971	USGS	1" = 500'	1-275
08/13/1964	FAIRCHILD	1" = 500'	38-3748
12/04/1957	AMS	1" = 500'	21019
05/21/1950	USFWS	1" = 500'	4-104

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N
W E
S

City of Del Rio Landfill Expansion
USDA
2016

GeoSearch

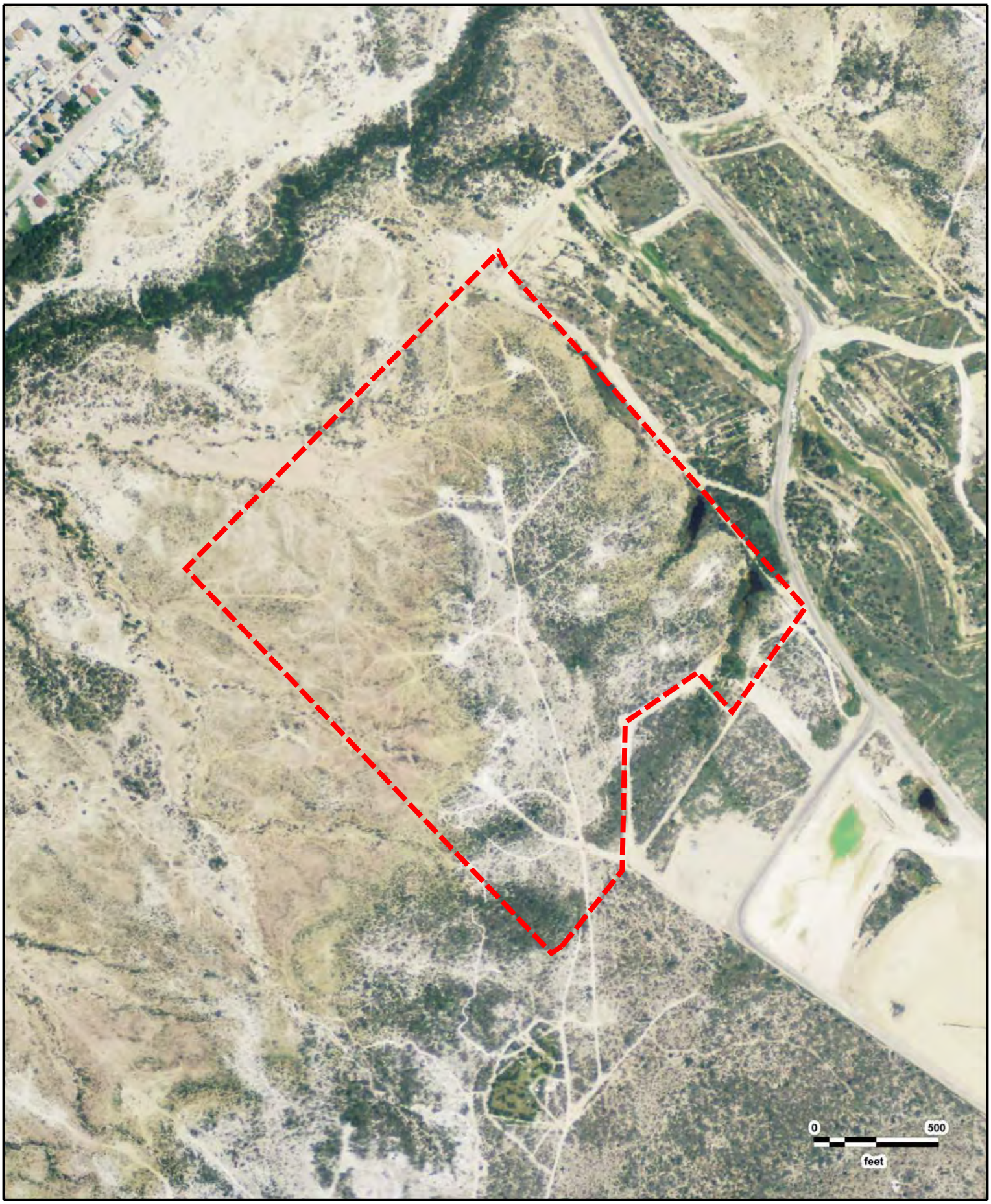
JOB #: 356437 - 06/16/2020



N
W E
S

City of Del Rio Landfill Expansion
USDA
2014

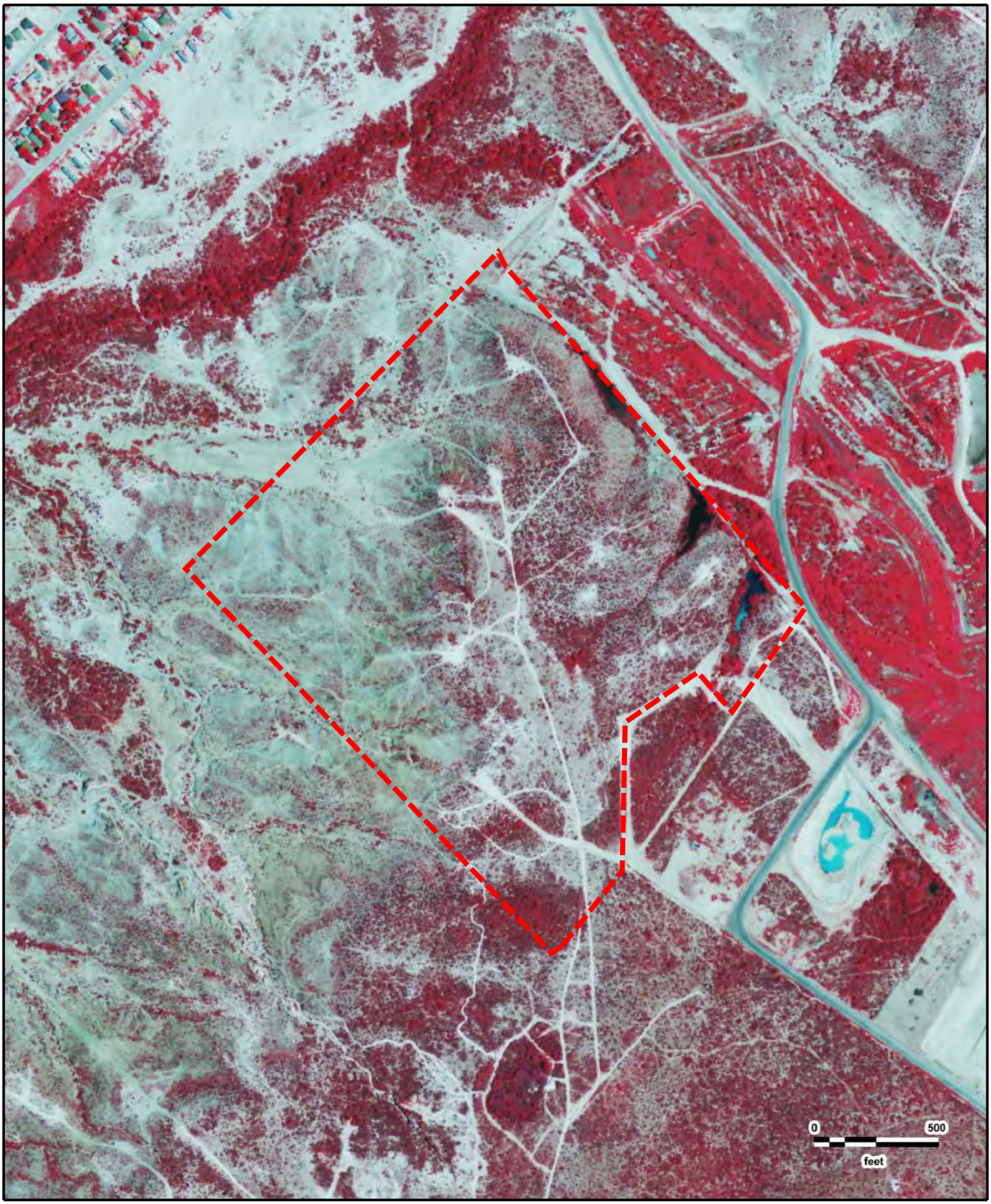
GeoSearch



N
W E
S

City of Del Rio Landfill Expansion
USDA
2012

GeoSearch



N
W E
S

City of Del Rio Landfill Expansion
USDA
2010

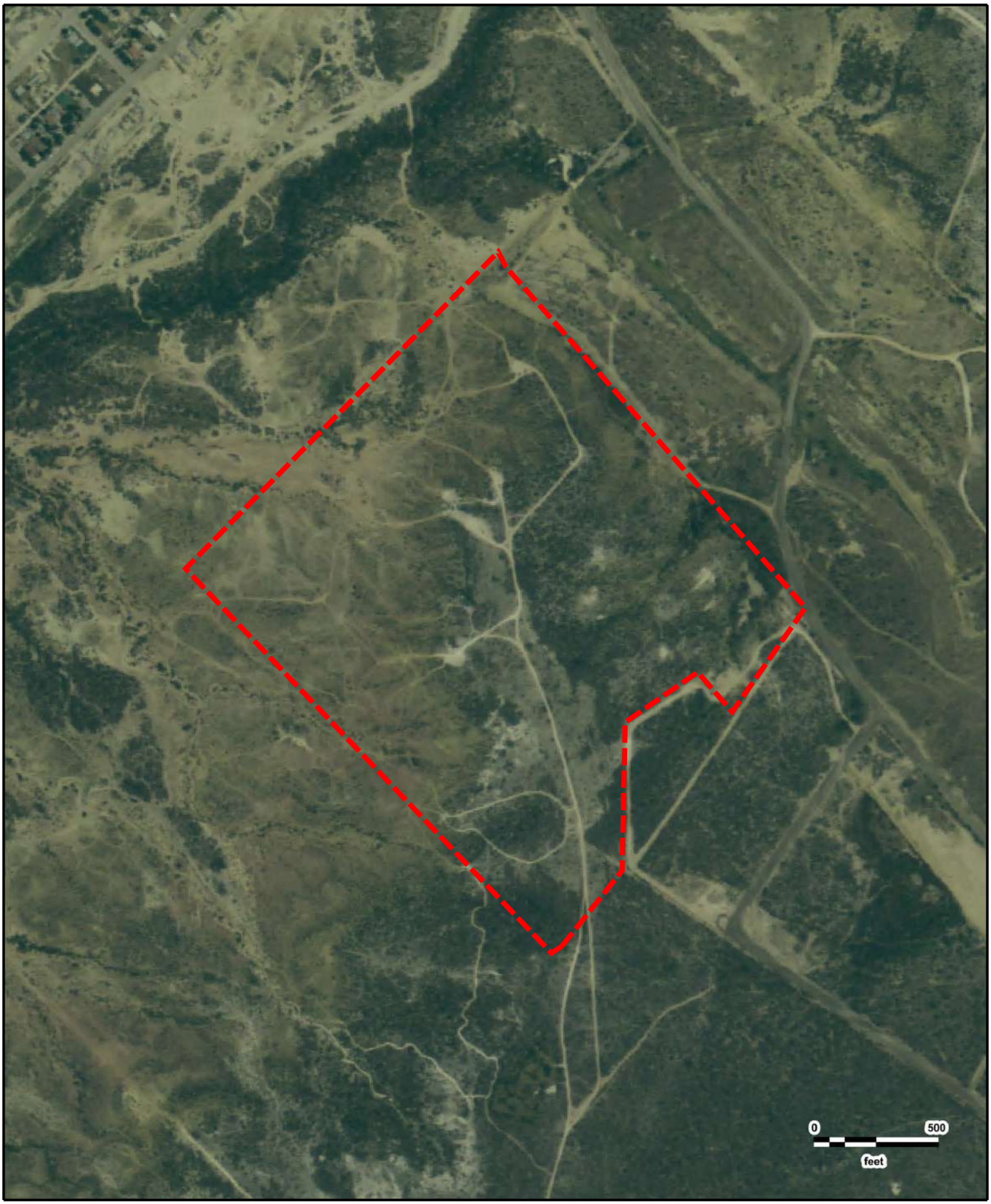
GeoSearch



N
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S

City of Del Rio Landfill Expansion
USDA
2006

GeoSearch

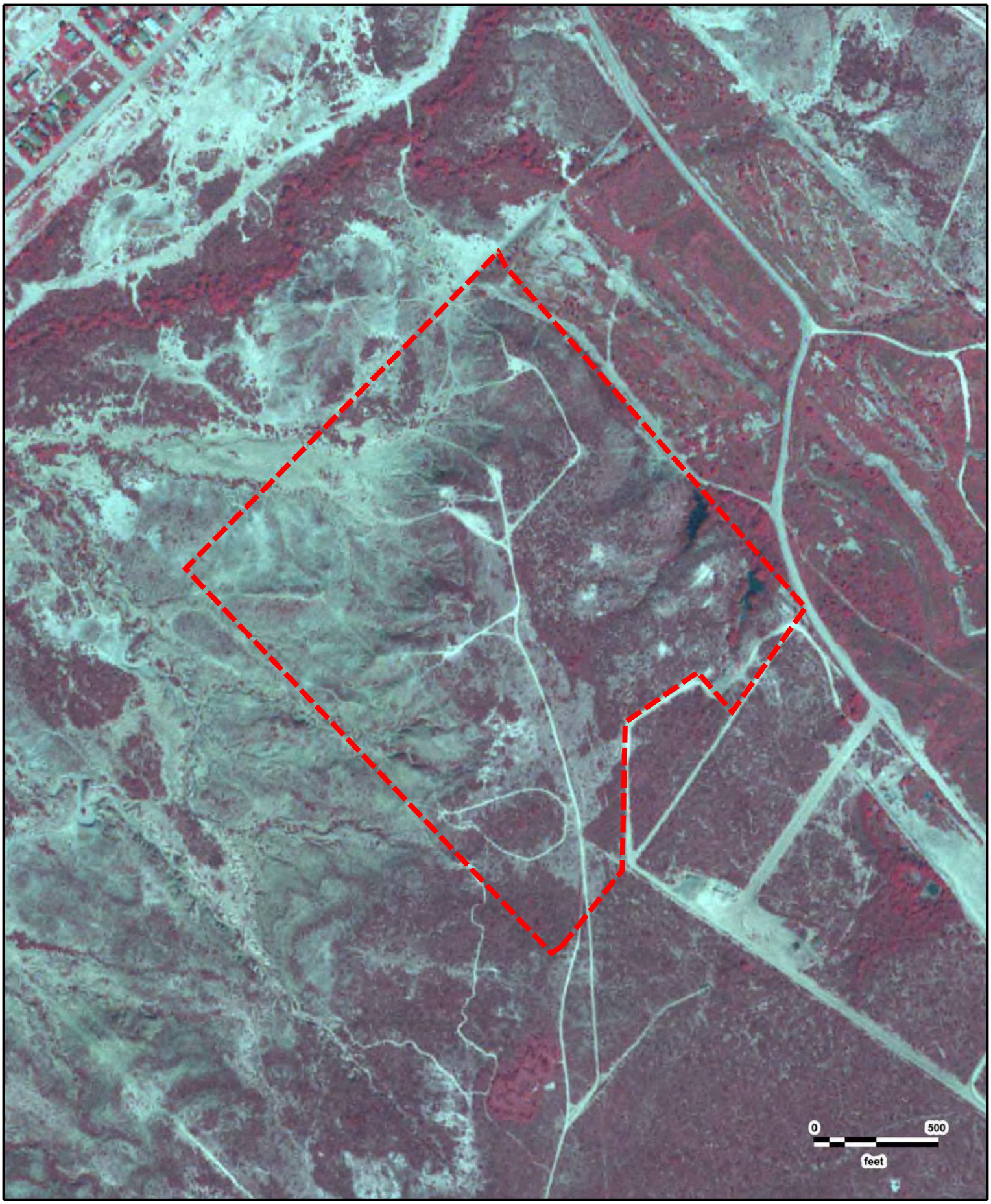


N
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S

City of Del Rio Landfill Expansion
USDA
2005

GeoSearch

JOB #: 356437 - 06/16/2020



N
W E
S

City of Del Rio Landfill Expansion
USDA
2004

GeoSearch



N
W E
S

City of Del Rio Landfill Expansion
USGS
02/08/2002

GeoSearch



N
W E
S

City of Del Rio Landfill Expansion
USGS
03/10/1996

GeoSearch

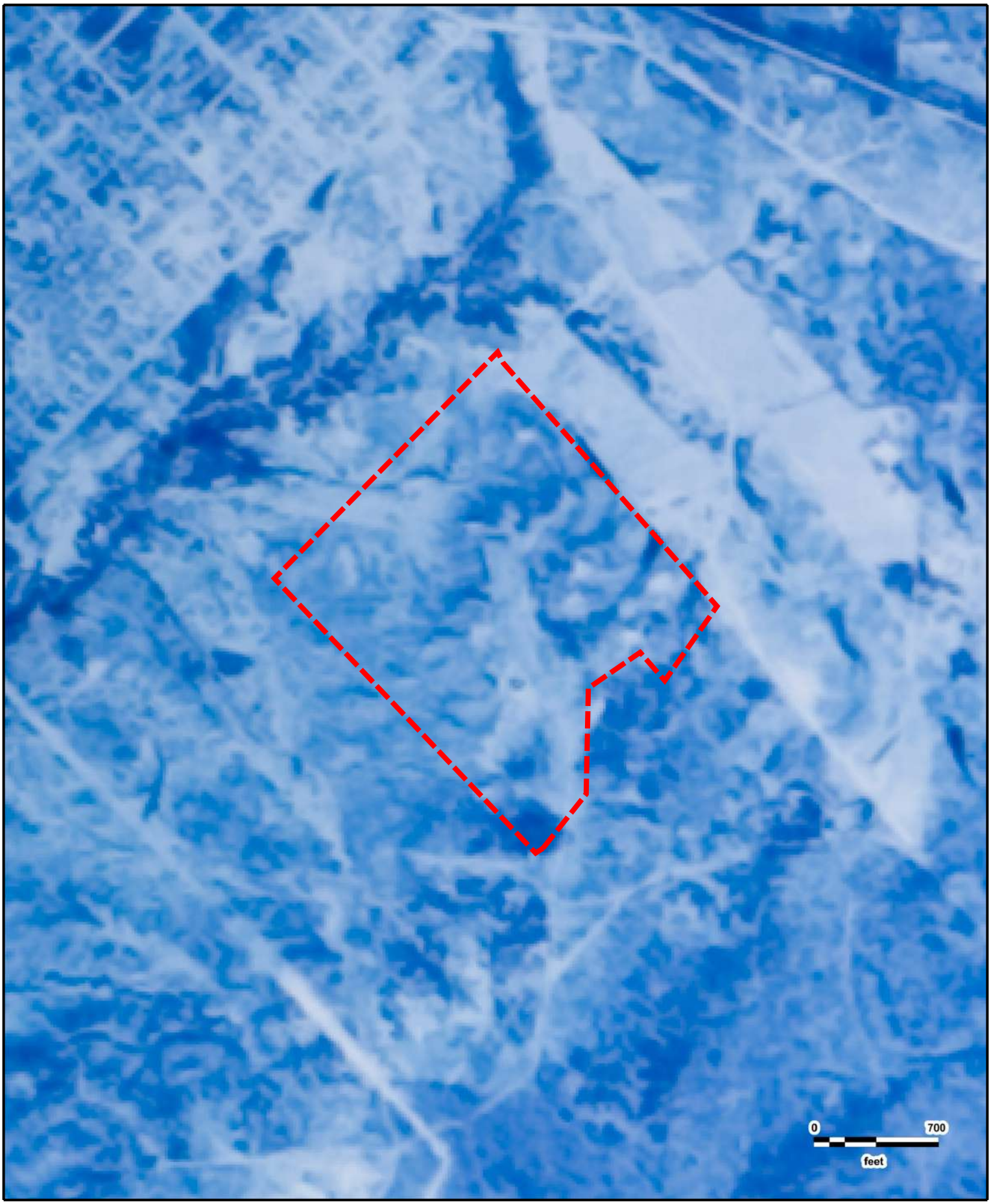


N
W E
S

City of Del Rio Landfill Expansion
USGS
01/14/1990

GeoSearch

JOB #: 356437 - 06/16/2020



N
W E
S

City of Del Rio Landfill Expansion
USGS
02/16/1985

GeoSearch



N
W E
S

City of Del Rio Landfill Expansion
USGS
04/21/1976

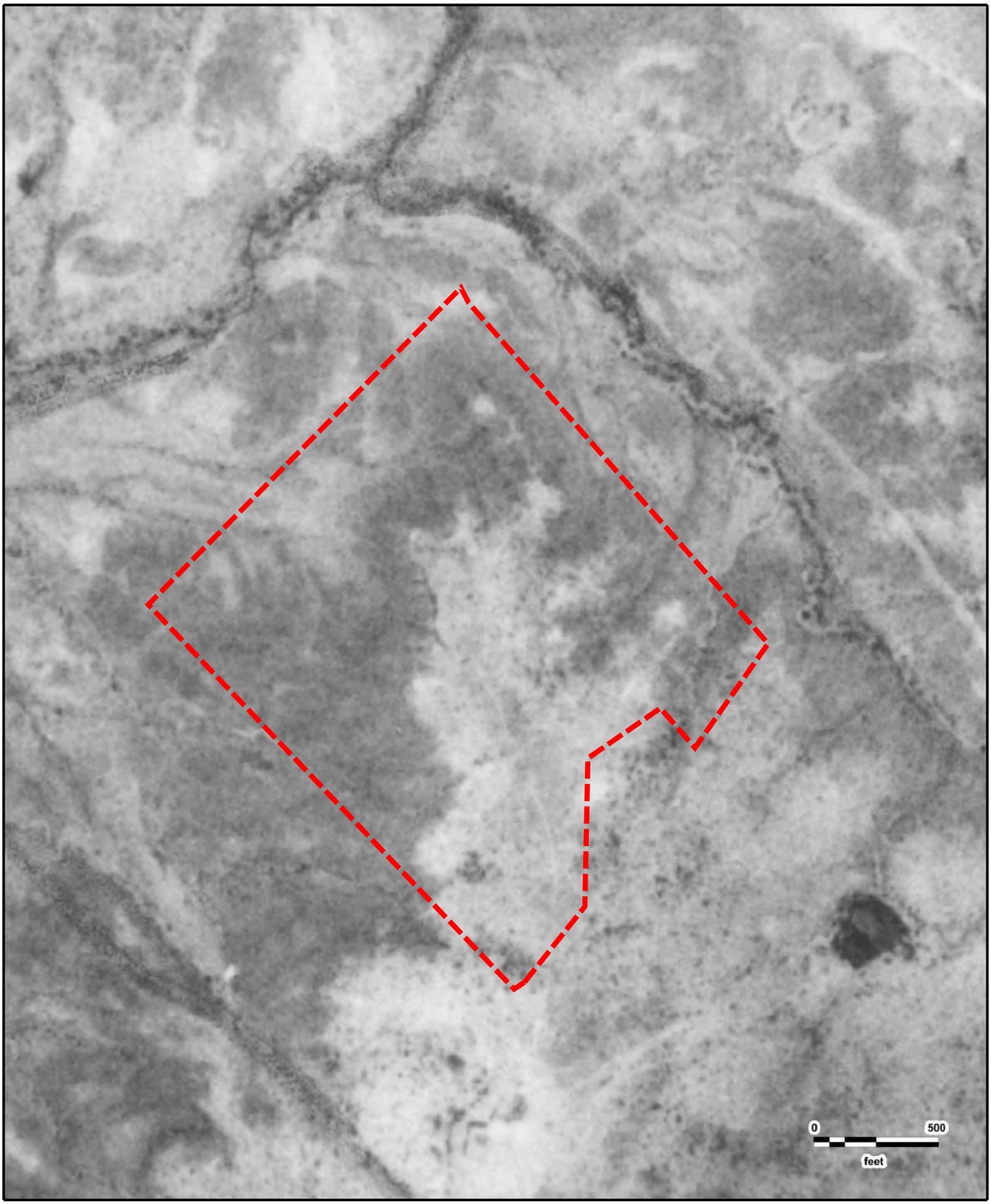
GeoSearch



N
W E
S

City of Del Rio Landfill Expansion
USGS
03/17/1971

GeoSearch



N
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S

City of Del Rio Landfill Expansion
FAIRCHILD
08/13/1964

GeoSearch

JOB #: 356437 - 06/16/2020

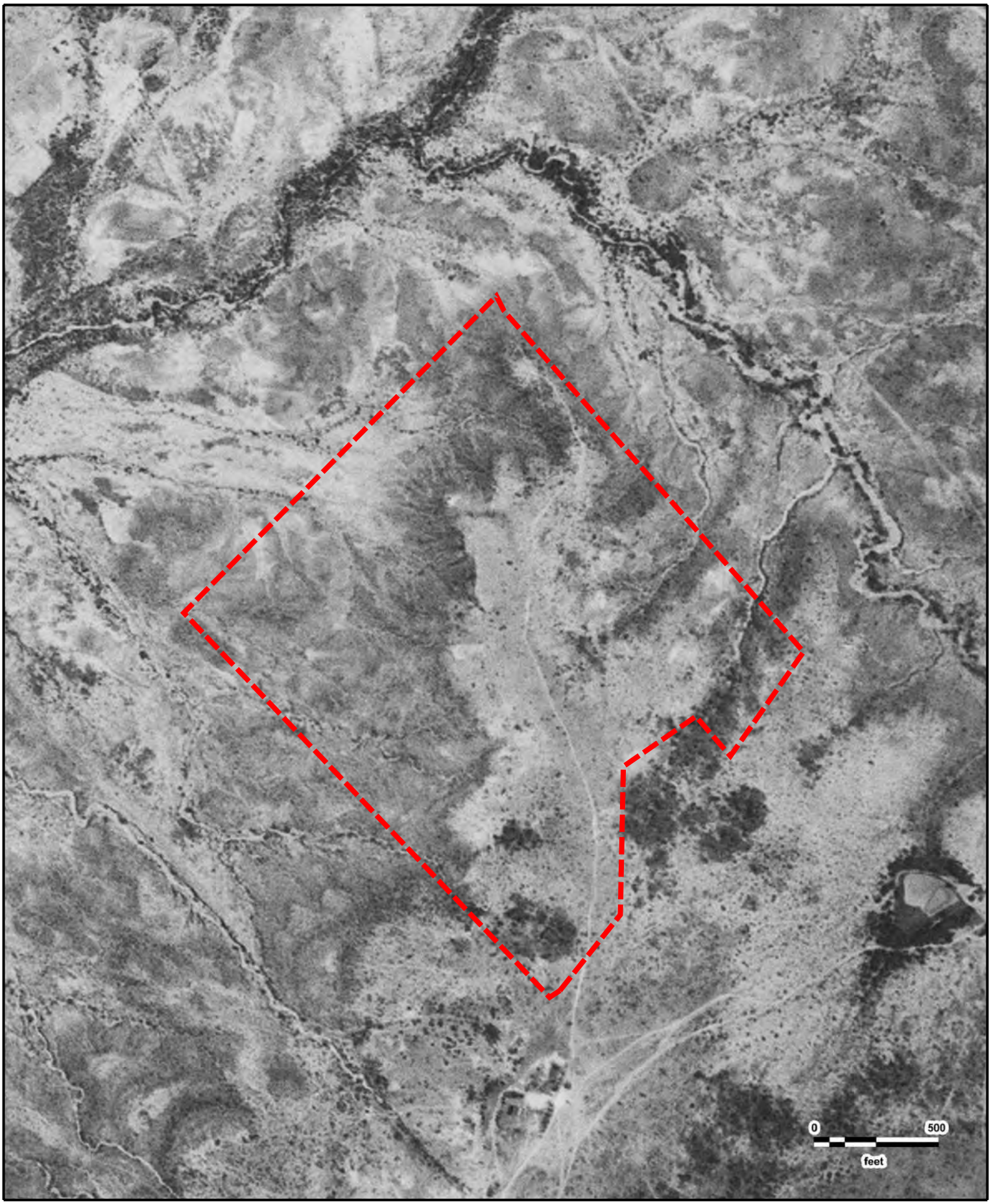


N
W E
S

City of Del Rio Landfill Expansion
AMS
12/04/1957

GeoSearch

JOB #: 356437 - 06/16/2020



N
W E
S

City of Del Rio Landfill Expansion
USFWS
05/21/1950

GeoSearch

COORDINATION WITH
MIDDLE RIO GRANDE DEVELOPMENT COUNCIL

- July 17, 2024 letter requesting MRGDC concurrence that the landfill expansion is consistent with the Regional Solid Waste Plan
- August 27, 2024 Board of Directors draft meeting minutes approving the landfill expansion project.

MIDDLE RIO GRANDE DEVELOPMENT COUNCIL
BOARD OF DIRECTORS MEETING
MINUTES

SSGT Willie de Leon Civic Center **Tuesday, August 27, 2024**
300 E Main St **1:00 PM**
Uvalde, Texas 78801

Members Present:
Hon. Bella Rubio, Real County Judge
Hon. Lewis Owens, Val Verde County Judge
Hon. Martha A. Gomez Ponce, Dimmit County Judge
Hon. Frank Moreno, Mayor of Crystal City
Hon. Ramsey English-Cantu, Maverick County Judge
Hon. Cindy Martinez Rivera, Zavala County Judge
Hon. Everado Zamora, Mayor of Uvalde
Hon. Hazel Pendley, Mayor of Leakey
Dr. Hector Gonzales, Southwest Texas Junior College
Mr. Jack Alba, La Salle County Member-at-Large
Mr. Jesus Sanchez, Maverick County Member-at-Large
Mr. Joe Cardenas, Uvalde County Member-at-Large
Hon. John P. Schuster, Kinney County Judge
Dr. Jorge Garza, Sul Ross State University
Hon. Sandra Luna, Mayor of Cotulla
Hon. Leodoro Martinez lll, La Salle County Judge
Ms. Otila Gonzalez, Val Verde County Member-at-Large
Commissioner Raul Gomez, Zavala County Member-at-Large
Ms. Rebecca Flores, Kinney County Member-at-Large
Dr. Rose Pearson, Carrizo Springs Superintendent Education Representative
Hon. James DeReus, City of Del Rio Councilperson-at-Large

Members Absent:
Hon. William R. Mitchell, Uvalde County Judge
Hon. Alvaro Arreola, Mayor of Del Rio
Hon. Michael Aguirre, Mayor of Brackettville
Hon. Juan Gomez, Real County Member-at-Large
Hon. Mario Dj Ruiz, Dimmit County Member-at-Large
Hon. Oscar Puente, Mayor of Carrizo Springs
Hon. Rolando Salinas, Mayor of Eagle Pass
Mr. William Davis, City of Eagle Pass Councilperson-at-Large

DRAFT

Guest Present:
Rodrigo Jaime, Workforce Board Member
Terry Allison, Motorola
Frank Puente, RZ Communication
Father Matthew DeLeon, Sacred Heart Church
Carmen Gutierrez, City of Del Rio Council Women
Tina Martinez, City of Del Rio Council Women
Gerardo Perez, Maverick County Food Pantry
Pierson Ray, Congressman Gonzales Office
Regina Aviles, Congressman Gonzales Office
Andi Dooley, US Senator John Cornyn Office
Robert Diaz, Carrizo Springs CSA
Chris Hiller, Workforce Board Member
W.B.Sansum, Real
Ginny Lewis Ford, TARC

MRGDC Staff:
Raul Diaz, Planning Director
Brenda Gonzales, CCS
Nadia Rivera, Public Safety
Brabara Lopez, Workforce Director
Michael Camarillo, PSO
Eric Martinez, Planning
Max Pereda, Fiscal
Betsy Prado, Controller
Josefina Castillo, Planning
Jose Hernandez, IT
Michelle Garcia, Executive Director
Ariana Gonzalez, HR
Roxanna Gonzalez, Workforce
Karina Aguirre, Planning
Michaela Ramirez, Admin/211
Silvia Moreno, WIOA

Workforce Staff:
Marcos Gonales, WFSMRG

I. ROLL CALL AND DETERMINATION OF QUORUM

DRAFT

Honorable Bella Rubio, called the regular board meeting of the Middle Rio Grande Development Council Board of Directors to order at 1:08 p.m.
The Middle Rio Grande Development Council Board of Directors met for their board meeting on Tuesday, August 27, 2024. Upon roll call, twenty-one (21) members listed above were determined to be present or represented by their official alternate. Having establish a quorum, the following business was conducted.

II. **INTRODUCTION OF GUESTS**
The guest listed above were introduced.

III. **APPROVAL OF MINUTES- JUNE 18, 2024**
A motion was made by Hon. Ramsey English Cantu to approve the minutes of June 18, 2024 as presented…motion seconded by Hon. Leodoro Martinez III…motion carried.

IV. **NEW BUSINESS**

1. **EXECUTIVE COMMITTEE: Presenter:**
Hon. Bella Rubio

a. **ACTION ITEMS:**

1. Discussion and/or action to authorize MRGDC's 2024-2025 Holiday Schedule.
A motion was made by Hon. Martha A. Gomez Ponce to approve MRGDC's 2024-2025 Holiday Schedule…motion seconded by Hon. John P. Schuster…motion carried.

2. Discussion and/or action to authorize to amend Salary Schedule.
A motion was made by Hon. John P. Schuster to approve to amend Salary Schedule…motion seconded by Hon. Martha A. Gomez Ponce…motion carried.

3. Discussion and/or action to approve MRGDC Board of Directors Meeting Schedule FY 2024-2025.
A motion was made by Hon. Martha A. Gomez Ponce to approve MRGDC Board of Directors Meeting Schedule FY 2024-2025…motion seconded by Hon. Leodoro Martinez III…motion carried.

4. Discussion and/or action to approve the extension of the Child Care Contract between the Middle Rio Grande Development Council and the Board. This extension begins October 1, 2024 to September 30, 2025. This is the 1st extension of a 4-year awarded contract.
A motion was made by Hon. Leodoro Martinez III to approve the extension of the Child Care Contract between the Middle Rio Grande Development Council and the Board. This extension begins October1, 2024 to September 30, 2025. This is the 1st extension of a 4-year awarded contract…motion seconded by Hon. John P. Schuster…motion carried.

DRAFT

5. Discussion and/or action to approve Audit RFP services for FY beginning on September 1, 2024 and ending September 30, 2028 to Garza and Gonzalez Associates.

A motion was made by Mr. Joe A. Cardenas to approve Audit RFP services for FY beginning on September 1, 2024 and ending September 30, 2028 to Garza and Gonzalez Associates in the estimated amount of $55,500…motion seconded by Hon. John P. Schuster…motion carried.

6. Discussion and/or action to approve changes to the MRGDC policies and procedures regarding the dress code.

A motion was made by Hon. Martha A. Gomez Ponce to approve changes to the MRGDC policies and procedures regarding the dress code…motion seconded by Hon. Leodoro Martinez III…motion carried.

7. Discussion and/or action to approve changes to the MRGDC policies and procedures regarding the holidays.

A motion was made by Hon. Leodoro Martinez III to approve changes to the MRGDC policies and procedures regarding the holidays…motion seconded by Hon. John P. Schuster…motion carried.

8. Discussion and/or action to approve Executive Director, Ms. Michelle Garcia, evaluation.

MRGDC Board of Directors will convene in closed session under the Texas Open Meetings Act, Texas Government Code Section 551.074 et seq. Chapter 551.074 – Personnel

MRGDC Board of Directors did not go into closed session for this item. A motion was made by Hon. Lewis Owens to approve Executive Director, Ms. Michelle Garcia, evaluation with approved raise…motion seconded by Hon. Ramsey English Cantu…motion carried.

b. **INFORMATION ITEM:**

1. Board of Directors Code of Conduct.

Hon. Bella Rubio informed the board of the Code of Conduct.

2. TDA Status Update.

Hon. Bella Rubio informed the board of the TDA Status Update.

3. Reminder of increased membership dues.

Hon. Bella Rubio informed the board that next FY the membership dues will be increased.

2. **BUDGET COMMITTEE:**

Presenter: President Hector Gonzales

a. **ACTION ITEM:**

DRAFT

b. Discussion and/or action to approve Budget for Fiscal Year beginning on October 1, 2024 and ending September 30, 2025.

A motion was made by President Hector Gonzales…to approve Budget for Fiscal Year beginning on October 1, 2024 and ending September 30, 2025…motion seconded by Mr. Joe Cardenas…motion carried.

3. **ADVISORY COMMITTEES**

a. **Area Advisory Committee on Aging**
Presenter: Hon. Bella Rubio

1. **INFORMATION ITEM:**

a. Area Agency on Aging Program Report.

Hon. Bella Rubio informed the board that the Area Agency on Aging Program Report is on page 27.

b. **2-1-1 Area Information Center**
Presenter: Hon. Bella Rubio

1. **ACTION ITEM:**

a. Discussion and/or action to ratify 211 Budget for a 3-year period in the amount of $1,059,723.16.
SFY24- $217,433.48
SFY25- $217,433.48
SFY26- $217,433.48

A motion was made by Hon. Bella Rubio to approve ratification of 211 Budget for a 3-year period in the amount of $1,059,723.16.
SFY24- $217,433.48
SFY25- $217,433.48
SFY26- $217,433.48…motion seconded by Hon. John P. Schuster…motion carried.

2. **INFORMATION ITEM:**

a. 2-1-1 I&R Program Report. Pg.31

Hon. Bella Rubio informed the board that the 2-1-1 I&R Program Report is on page 31.

b. Committee Member Nominations.

Hon. Bella Rubio informed the board that 2-1-1 will be taking committee nominations from each county Judge.

c. **9-1-1 Advisory Committee**
Presenter: Hon. John P. Schuster

1. **ACTION ITEM:**

DRAFT

a. Discussion and/or action on the upcoming Biennium Stage 1 Budget for 2026-2027 Year 1 Total base + Expectations $2,617,110 and Year 2 Total Base + Exceptions $1,698,921.

A motion was made by Hon. John P. Schuster too approve on the upcoming Biennium Stage 1 Budget for 2026-2027 Year 1 Total base + Expectations $2,617,110 and Year 2 Total Base + Exceptions $1,698,921…motion seconded by Hon. Leodoro Martinez III…motion carried.

b. Discussion and/or action to approve Intrado Viper Software Maintenance Service Renewal agreement of $69,444.00 for FY 24-25.

A motion was made by Hon. John P. Schuster to approve Intrado Viper Software Maintenance Service Renewal agreement of $69,444.00 for FY 24-25…motion seconded by Hon. Leodoro Martinez III…motion carried.

c. Discussion and/or action to approve Intrado ECats (MIS) Service Renewal agreement of $34,505.60 for FY 24-25.

A motion was made by Hon. John P. Schuster to approve Intrado ECats (MIS) Service Renewal agreement of $34,505.60 for FY 24-25…motion seconded by Mr. Joe A. Cardenas…motion carried.

d. Discussion and/or action to approve Western States Communications Inc. Hardware Equipment Maintenance Renewal agreement of $143,221.50 for FY 24-25.

A motion was made by Hon. John P. Schuster to approve Western States Communications Inc. Hardware Equipment Maintenance Renewal agreement of $143,221.50 for FY 24-25…motion seconded by Hon. Leodoro Martinez III…motion carried.

2. **INFORMATION ITEM:**

a. 9-1-1 Program Report.

Hon. John P. Schuster informed the board that the 9-1-1 Program Report is on page 88.

d. **<u>Homeland Security Committee</u>**
Presenter: Hon. William Mitchell

1. **ACTION ITEM:**

a. Discussion and/or action to accept Interlocal Agreement with the Governor's Office, Public Safety Division in the amount of $18,375.

A motion was made by Hon. Bella Rubio to accept Interlocal Agreement with the Governor's Office, Public Safety Division in the amount of $18,375…motion seconded by Hon. Ramsey English Cantu…motion carried.

2. **INFORMATION ITEM:**

a. Homeland Security Committee Report.

DRAFT

Hon. Bella Rubio informed the board that the Homeland Security Committee Report is on page 126.

e. **Criminal Justice Advisory Committee**
Presenter: Hon. Leodoro Martinez III

1. **ACTION ITEMS:**

a. Discussion and/or action to approve CJAC Policies.

A motion was made by Hon. Leodoro Martinez III to approve CJAC Policies…motion seconded by Hon. John P. Schuster…motion carried.

b. Discussion and/or action to ratify the Law Enforcement Contact to update Southwest Texas Jr. College to Southwest Texas College.

A motion was made by Hon. Leodoro Martinez III to ratify the Law Enforcement Contract to update Southwest Texas Jr. College to Southwest Texas College…motion seconded by Hon. John P. Schuster…motion carried.

b. Discussion and/or action to ratify the two-year Interlocal CJD Contract in the amount of $43,100.92.

A motion was made by Hon. Leodoro Martinez III to ratify the two-year Interlocal CJD Contract in the amount of $43,100.92…motion seconded by Hon. John P. Schuster…motion carried.

2. **INFORMATION ITEM:**

a. Criminal Justice Program Report.

Hon. Leodoro Martinez III informed the board that the Criminal Justice Program Report is on page 171.

f. **Solid Waste Advisory Committee**
Presenter: Mr. Joe Cardenas

1. **ACTION ITEM:**

a. Discussion and/or action on extension of Del Rio Landfill.

A motion was made by Mr. Joe A. Cardenas to approve extension of Del Rio Landfill…motion seconded by Hon. John P. Schuster…motion carried.

2. **INFORMATION ITEM:**

a. Solid Waste Program Report.

Mr. Joe A. Cardenas informed the board that the Solid Waste Program Report is on page 172.

4. **STANDING COMMITTEES**

a. **Community & Economic Development Committee**
Presenter: Hon. Alvaro Arreola

DRAFT

1. **INFORMATION ITEM:**

a. Planning and Operations Activity Report.

Hon. Bella Rubio informed the board that the Planning and Operations Activity Report is on page 174.

b. **Finance Committee**

Presenter: Mr. Joe Cardenas

1. **ACTION ITEM:**

a. Ratification of expenditures/obligations of goods and services over $25,000.

A motion was made by Mr. Joe A. Cardenas to approve ratification of expenditures/ obligations of goods and services over $25,000…motion seconded by Hon. John P. Schuster…President Hector Gonzales abstained…motion carried.

2. **INFORMATION ITEM:**

a. Finance Report update of "Statement of Expenditures".

Mr. Joe A. Cardenas informed the board that the Finance Report update of "Statement of Expenditures" is on page 177.

c. **Workforce Committee**

Presenter: Ms. Otila Gonzalez

1. **ACTION ITEMS:**

a. Discussion and or/action to accept Workforce Innovation and Opportunity Act-Adult #2724WOA001; from July 01, 2024 to June 30, 2026. Total Award Amount $878,332.

A motion was made by Ms. Otila Gonzalez to accept Workforce Innovation and Opportunity Act-Adult #2724WOA001; from July 01, 2024 to June 30, 2026. Total Award Amount $878,332…motion was seconded by Hon. Lewis Owens…motion carried.

b. Discussion and or action to accept Workforce Innovation and Opportunity Act-Dislocated Worker #2724WOD001; from July 01, 2024 to June 30, 2026. Total Award Amount $486,423.

A motion was made by Ms. Otila Gonzalez to accept Workforce Innovation and Opportunity Act- Dislocated Worker #2724WOD001; from July 01, 2024 to June 30, 2026. Total Award Amount $486,423…motion seconded by Hon. Leodoro Martinez III…motion carried.

c. Discussion and or/action to accept Workforce Innovation and Opportunity Act-Youth #2724WOY001; from July 01, 2024 to June 30, 2026. Total Award Amount $943,981.

A motion was made by Ms. Otila Gonzalez to accept Workforce Innovation and Opportunity Act- Youth #2724WOY001; from July 01, 2024 to June 30, 2026. Total Award Amount $943,981…motion seconded by Hon. John P. Schuster…motion carried.

DRAFT

d. Discussion and or/action to accept Workforce Innovation and Opportunity Act-Rapid Response #2724WOR001; July 01, 2024 to June 30, 2025. Total Award Amount $16,058.

A motion was made by Ms. Otila Gonzalez to accept Workforce Innovation and Opportunity Act-Rapid Response #2724WOR001; July 01, 2024 to June 30, 2025. Total Award Amount $16,058…motion seconded by Hon. Leodoro Martinez III…motion carried.

e. Discussion and or/action to accept Child Care Services Formula Allocation # 2725CCF001. Total Award Amount $10,107,312.

A motion was made by Ms. Otila Gonzalez to accept Child Care Services Formula Allocation # 2725CCF001. Total Award Amount $10,107,312…motion seconded by Hon. John P. Schuster…motion carried.

f. Discussion and/or action to accept Vocational Rehabilitation Integration Agency Contract #2723COL001 from September 1, 2024 to October 31, 2025 in the amount of $132,236.88.

A motion was made by Ms. Otila Gonzales to accept Vocational Rehabilitation Integration Agency Contract #2723COL001 from September 1, 2024 to October 31, 2025 in the amount of $132,236.88…motion seconded by Hon. Leodoro Martinez III…motion carried.

2. **INFORMATION ITEM:**

a. Workforce/ Child Care Report.

Ms. Otila Gonzalez informed the board that the Workforce/ Child Care Report is on page 190.

5. **NOMINATING COMMITTEE:**

Presenter: Hon. Martha A. Gomez Ponce

a. **ACTION ITEM:**

1. Discussion and/or action to authorize the recommended MRGDC's FY 2024-2025 Board Officers.

- President
- 1st Vice-President
- 2nd Vice-President
- 3rd Vice-President
- Secretary
- Treasurer
- Immediate Past President

A motion was made by Hon. Martha A. Gomez Ponce to approve the recommended MRGDC's FY 2024-2025 Board Officers as presented

- President- Hon. Lewis Owens
- 1st Vice-President- Hon. Martha A. Gomez Ponce
- 2nd Vice-President – Hon. Ramsey English Cantu
- 3rd Vice-President- Hon. Leodoro Martinez III

DRAFT

- Secretary- Hon. Cindy Martinez Rivera
- Treasurer- Hon. William R. Mitchell
- Immediate Past President- Hon. Bella Rubio

Motion seconded by Hon. Leodoro Martinez III…motion carried.

6. **ADMINISTRATIVE ACTIVITIES**

a. **INFORMATION ITEMS:**

1. **Workforce Board Executive Director's Report: Rosie Lozano**

Ms. Rosie Lozano was not present.

2. **MRGDC Executive Director's Report: Michelle Garcia**

Ms. Michelle Garcia informed the board that the Workforce board did a risk assessment on MRGDC and the results came back moderate. Ms. Michelle Garcia also thanked staff for all their hard work getting the annual board meeting set up.

V. **OTHER BUSINESS**

No other business was discussed.

VI. **ADJOURNMENT**

A motion was made by Hon. Lewis Owens to adjourn the meeting at 1:33 p.m.…. motion seconded by Hon. Martha A. Gomez Ponce…motion carried.

ATTEST:

_____

Hon. Lewis Owens
Board President

_____

Hon. Cindy Martinez Rivera
Secretary

DRAFT

CITY OF CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PARTS I/II – GENERAL APPLICATION REQUIREMENTS

APPENDIX I/II C
LOCATION RESTRICTION DEMONSTRATION

Prepared for
City of Del Rio

September 2023
Revision 1 August 2024
Revision 2 March 2025



Prepared by
CP&Y an STV Company.
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
Dallas, TX 75240
214-638-0500

This document is intended for permitting purposes only.

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7.0 WETLANDS

The area within the existing permit boundary of the City of Del Rio Landfill was evaluated for compliance with wetlands provisions, including the determination and identification requirements in Title 30 TAC §330.61(m)(2) and (3) and the wetlands location restriction in §330.553(b). The wetland delineation is shown on Figure I/IIC 7.1. Although there are wetlands within the permit boundary of the City of Del Rio Landfill, the limit of waste is not located in wetlands. There will be some areas of the wetlands that will be filled for perimeter channel and road grading. The USACE has reviewed this project under the pre-construction notification procedures of Nationwide Permit General Condition 32 Federal Register, Vol. 86, No. 8, Wednesday. It was determined the discharge of dredged or fill materials into waters of the United States associated with this project appears to qualify for Nationwide Permit (NWP) 39 for Commercial and Institutional Developments. The permit approval letter is included in Appendix I/IIB. The project will adhere to all requirements outlined in NWP 39. In addition, all activities will comply with the water quality certification conditions of TCEQ. No waste will be placed within the wetland areas: therefore, the site is in compliance with the wetland's location restriction.

CITY OF CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART I/II – GENERAL APPLICATION REQUIREMENTS

APPENDIX I/II E
TCEQ FORMS

Prepared for
City of Del Rio

Revision 1 August 2024
Revision 2 March 2025



Prepared by
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TCEQ FORM 20719
TRANSPORTATION DATA AND REPORT FORM

Texas Commission on Environmental Quality

Transportation Data and Coordination Report Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators of Municipal Solid Waste (MSW) Type I landfills to provide data and information to address the availability and adequacy of access roads to a landfill site, the volume of vehicular traffic on and generated by the facility on area roadways, and to provide coordination information as required under 30 TAC §330.61(i). Roadways that provide primary access to a landfill facility must be adequate and possess appropriate design capacity to safely accommodate the additional volumes and weights of traffic generated or expected to be generated by this landfill facility during its active life. Data provided in this form should correspond with data contained in the coordination documents submitted to the Texas Department of Transportation or other agency that has jurisdiction over affected area roads.

If you need assistance in completing this form, please contact the Municipal Solid Waste Permits Section of the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: **City of Del Rio Landfill**

MSW Permit No.: **207C**

Site Operator/Permittee Name and Mailing Address: **City of Del Rio**
114 W Martin St., Del Rio, TX 78840

II. Documentation of Coordination with the Texas Department of Transportation (TXDOT) for Traffic and Location Restrictions

1. A traffic study document and cover letter was submitted to TXDOT as Coordination for traffic and location restrictions for the subject facility and a copy of the documents submitted to TXDOT is attached herein: ☒ Yes ☐ No

   If you checked "No" , provide explanation:

2. Date of submission of the coordination documents to TXDOT: **07/05/2024**

3. TXDOT's response received? ☒ Yes ☐ No

   If "No" is checked in response to Item I.3 above, complete Items I.4 and I.5 below only after TxDOT's response is received.

4. Did TxDOT's response include recommendation of improvements to any of the roadways or intersections that lead to the site? ☐ Yes ☒ No

5. If you checked "Yes" in Item I.5 above, proceed to Section III., TxDOT's Recommended Roadway or Intersection Improvements (as applicable).

6. If you checked "No" in Item I.5 above, provide TxDOT's response to the traffic and location restrictions compliance coordination for the subject site: *(Enter TxDOT's response to coordination correspondence)* **TXDOT did not have any objections or concerns with potential traffic impact to the highway facility. Refer to Appendix I/IIB page I/IIB-132 for the TXDOT response letter.**

III. TxDOT Recommended Roadway or Intersection Improvements (as applicable)

Enter TxDOT's recommendations for improvement of roadways or intersections that lead to the site:

1. **None**

2.

3.

IV. Documentation of Coordination of Improvement Designs of Public Roadways (turning lanes, storage lanes, acceleration/deceleration lanes, etc.) at and Near the Site Entrances with Agencies that Exercise Maintenance Responsibility

1. Complete Table 1 with information regarding documentation of coordination of improvement designs for existing and proposed roads.

Table 1: Public Roadway Improvements Coordination

Existing and Proposed Roads Associated with the Site Entrance(s)	Agency Exercising Maintenance Responsibility	Date of Coordination Correspondence from the Applicant or Site Operator to the Agency Responsible	Date of the Coordination Response Letter from the Agency Responsible	Did the Agency Responsible Require Improvements to the Roadway(s) Associated with the Site Entrance(s) (check Yes or No as applicable)
Railway Ave	City of Del Rio	Landfill is Owned by the City	NA	☐Yes ☒No
US 90	TxDOT	July 5, 2024	Still waiting on response	☐Yes ☐No
US 277	TxDOT	July 5, 2024	Still waiting on response	☐Yes ☐No
				☐Yes ☐No

2. If you checked "Yes" in the last column of Table 1, indicating that improvements are required, address the following:

   (a) Briefly describe the improvements proposed for the public roadway(s) associated with the site entrance(s):

   (b) A copy of the proposed improvement design submitted to the agency exercising maintenance responsibility over the roadway is attached herein: ☐Yes ☐No. If you checked "No" please explain:

   (c) A copy of the response letter from the agency exercising maintenance responsibility over the roadway(s) associated with the site entrance(s) approving the improvement design is attached herein: ☐Yes ☐No. If you checked "No" please explain:

V. Facility Location and Operation Information Used in Estimating Transportation Data

1. Facility Location Information

   City of Del Rio Landfill
   1897 Railway Ave
   Del Rio, Val Verde County, Texas 78840

2. Waste Acceptance Rates

   (a) Initial Waste Acceptance Rate: **47,068 tons/year**

   (b) Estimated Maximum Waste Acceptance Rate at any Time During Facility Life: **76,752 tons/year**

3. Hours of Operation and Site Life

   (a) Operating Hours: **Monday - Friday 7:00 AM to 7:00 PM**
   Saturday 7:00 AM - 2:00 PM

   (b) Waste Acceptance Hours: **Monday - Friday 7:00 AM to 7:00 PM**
   Saturday 7:00 AM - 2:00 PM

   (c) Estimated Site Life: **44 years**

4. Other Information Used or Assumed in Estimating Transportation Data: **NA**

VI. Facility Daily Traffic Volume Data

1. Complete Table 2 with estimated existing daily volume of traffic generated by the facility.

Table 2: Estimated Existing Daily Volume of Traffic Generated

Vehicle Type	Traffic Volume to Facility (vehicles per day, vpd)	Traffic Volume from Facility (vpd)
Trucks	**224**	**224**
Employee Vehicles	**15**	**15**
Visitors Vehicles	**15** (assumed based on City personnel's comments)	**15** (assumed based on City personnel's comments)
Other Vehicles	**10** (assumed based on City personnel's comments)	**10** (assumed based on City personnel's comments)
Summation of Daily Volume of Traffic to and from the Facility		
Total Daily Volume of Traffic	**264**	**224**

(a) Describe the source(s) of or method(s) used to obtain the existing daily volume of traffic generated by the facility: **Truck traffic count based on scale house**

(b) Location(s) of traffic counts (if applicable): **Facility entrance**

2. Complete Table 3 with estimated future daily volume of traffic generated by the facility.

Table 3: Estimated Future Daily Volume of Traffic Generated

Vehicle Type	Traffic Volume to Facility (vpd)	Traffic Volume from Facility (vpd)
Trucks	**362**	**362**
Employee Vehicles	**25**	**25**
Visitors Vehicles	**15** (assumed based on City personnel's comments)	**15** (assumed based on City personnel's comments)
Other Vehicles	**10** (assumed based on City personnel's comments)	**10** (assumed based on City personnel's comments)
Summation of Daily Volume of Traffic to and from the Facility		
Total Daily Volume of Traffic	**412**	**412**

3. Describe the method(s) used to obtain the estimated future daily volume of traffic generated by the facility, including dates, traffic growth rates, and sources of the

growth rates: **The projected traffic volumes were obtained using projected growth rates for the surrounding population area growth rate**

4. Maps showing the facility boundary and roads within 1 mile of the facility that provide access to the site are attached herein. Yes ☒ No☐. If you checked "No" please explain:

VII.Availability and Adequacy of Roads

1. Complete Table 4 with information regarding the primary access roadways.

Table 4: Roadway Characteristics of the Primary Access Roadways

List the roads that the owner or operator will use as primary access to the site	Existing Annual Average Daily Traffic on Roadway (vpd)	Expected Annual Average Daily Traffic on Roadway (vpd)	Existing Roadway Capacity	Expected Roadway Capacity	Max Gross Weight Allowed (lbs)	Max/Min Posted Speed Limit (mph)	Min Vertical Clearance (ft)	Surface Type and No. of Lanes	Level of Service	Existing Traffic Generated by the Facility on Each Roadway	Expected Traffic Generated by the Facility on Each Roadway
Railway Ave	2,371	3,835				35	13' 10"	2-lane Asphalt		224	362
US 90	18,394	29,751				60		4-lane asphalt		224	362

2. Complete Table 5 with information regarding other access roadways within one mile.

Table 5: Roadway Characteristics of Other Access Roadways within One Mile of the Facility Boundary

List other access roadways within 1 mile of the facility	Existing Annual Average Daily Traffic on Roadway	Expected Annual Average Daily Traffic on Roadway	Existing Roadway Capacity	Expected Roadway Capacity	Max Gross Weight Allowed (lbs)	Max/Min Posted Speed Limit (mph)	Min Vertical Clearance (ft)	Surface Type and No. of Lanes	Level of Service	Existing Traffic Generated by the Facility on Each Roadway	Expected Traffic Generated by the Facility on Each Roadway
US 277	18,473	29,879				30		4-lane asphalt		224	362

3. Complete Table 6 with information regarding access roadway intersections within one mile.

Table 6: Roadway Intersection Characteristics

Please list major (signalized) roadway intersections for access roads within 1 mile of facility	Existing Capacity	Existing Level of Service
Railway Ave and US 90	NA	NA

4. (For applicants that conducted traffic counts) Peak period traffic counts were conducted at critical intersections and roadways in the area: ☐ Yes ☐ No

   If "No" is checked, please explain: **The traffic count coming into the facility is minimal when compared to the overall traffic on the road.**

VIII. Conclusions on the availability and adequacy of roads to be used for accessing the facility

Enter conclusions regarding the availability and adequacy of roads to be used for accessing the facility using information obtained from access roadway data; data on the volume of existing and expected vehicular traffic on the access roads within one mile of the facility; and the projection of the volume of traffic expected to be generated by the facility on the access roads:

Based on the traffic count provided by TxDOT for US 90 and US 277, the traffic volume created by the facility is minimal and will not adversely impact the availability and adequacy of the roads to be used for accessing the facility.

IX. Highway Beautification

Enter facility distance from interstate or primary highways and screening information as required by 30 TAC 330.23(a).

1. Distance of Facility from Interstate or Primary Highway: 0.5 miles

2. Type of Facility Screening Provided, if applicable: **Facility located far enough from US 90 and cannot be seen from the highway**.

Transcription Data and Coordination Report for MSW Type I Landfills
Facility Name: City of Del Rio Landfill Revision No.:1
Permit No: MSW-207C Date: March 7, 2025

X. Analysis of the Impact of the Facility upon Airports

Enter the Part, Appendix, Attachment, Section, and Page Number of the application where analysis of the impact of the facility upon airports is provided: **Parts I/II Section 8, page I/II-9**

XI. Documentation of Coordination with the Federal Aviation Administration for Compliance with Airport Location Restrictions

1. Applicant has submitted written information to FAA describing the facility location, maximum height of waste units, type of waste accepted at the facility, and other facility-relevant data and information as required: ☒ Yes ☐ No

   (a) Enter Date of Coordination Letter to FAA: **July 5, 2024**

   (b) Enter Date of FAA Response: **September 12, 2024**

2. Indicate FAA Response and Final Action:

   ☒ FAA Acknowledged No Adverse Impact.

   ☐ FAA Recommended Safety Improvements. (*Complete Section XII if you check this item.*)

3. A copy of the Documentation of Coordination with FAA for compliance with airport location restrictions is attached herein. ☒Yes ☐No. If you checked "No" please explain:

   Coordination with FAA is documented in Appendix I/IIB.

XII. FAA Recommended Changes or Improvements for Airport Safety, (as applicable)

Enter FAA's recommended changes or improvements to the facility for airport safety or for compliance with airport location restrictions.

No recommended changes or improvements to the facility for airport safety or compliance with the airport location restrictions were received from the FAA.

XIII. Attachments

- Maps showing the facility boundary and roads within 1 mile of the facility.
- Documentation of coordination of all designs of proposed public roadway improvements associated with site entrances with the agency exercising maintenance responsibility of the public roadway involved; and the response letter received from the agency, as applicable.
- Documentation of coordination with the Texas Department of Transportation (TxDOT) for traffic and location restrictions, including any traffic study report; and the response letter received from TxDOT.
- Documentation of coordination with the Federal Aviation Administration for compliance with airport location restrictions; and the response letter received from FAA.
- Other documents attached:

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

SITE DEVELOPMENT PLAN

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
Dallas, TX 75240
214-638-0500

This document is intended for permitting purposes only.

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APPENDIX IIIB – Site Life Calculations
APPENDIX IIIC – Leachate and Contaminated Water Management Plan

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
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PROFESSIONAL ENGINEER
03/07/2025

APPENDIX IIID – Liner Quality Control Plan
APPENDIX IIIE – Closure Plan
APPENDIX IIIF – Post-Closure Care Plan
APPENDIX IIIG – Closure and Post-Closure Care Cost Estimate
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4.3.4 Final Cover System

The final cover system will provide a low maintenance cover, protect against erosion, reduce rainfall percolation through the cover system, and subsequently minimize leachate generation within the landfill. As depicted on Appendix IIIA, Figure IIIA-A.2 - Landfill Completion Plan, a maximum of 5 percent topslopes and 4H:1V sideslopes are provided to minimize erosion and facilitate drainage of the landfill. A final cover will be constructed over the existing pre-Subtitle D and Subtitle D waste disposal areas. The final cover system components are described in Table 4-3 with layers listed from top to bottom. The maximum waste and final cover elevations are 1120.5 ft-msl and 1124 ft-msl, respectively.

A demonstration that the specified final cover design will provide effective long-term erosional stability is included in Part III, Appendix IIIH - Surface Water Drainage Plan (Appendix IIIH-D). The final cover system will be constructed as outlined in Appendix E – Closure Plan.

Table 4-3 Final Cover System Components

Top Slopes	Side Slopes
12-inch-thick erosion layer	24-inch-thick erosion layer
18-inch-thick compacted clay infiltration layer with K =10^{-7} cm/s	18-inch-thick compacted clay infiltration layer with K = 10^{-7} cm/s

The closed landfill cells (Cells 1 and 2) are built consistent with the final cover system shown in Table 4-3, which was approved as part of MSW Permit 207B.

4.4 Estimated Rate of Solid Waste Deposition (§330.63(d)(4)(D))

The City of Del Rio Landfill primary serves residences and businesses in the City of Del Rio and Val Verde County. The major classifications of solid waste to be accepted by this facility for disposal include both residential and commercial MSW. Such waste consists of household wastes, construction-demolition waste, and various non-hazardous industrial and special wastes as authorized by the TCEQ. Based on the 2022 fiscal year TCEQ Annual Report, the landfill waste inflow is 47,067 tons (152 tons per day based on a 309-day operating schedule).

After 2022, the waste inflow rate is assumed to increase consistent with the projected growth rate for the facility's general service area. The projected growth rate is based on the TWDB population growth projections for the area and may vary. Based on the projected yearly waste inflow over the site life of the facility, this service area will generate an average of approximately 60,486 tons per year (196 tons per day based on a 309-day operating schedule).

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIA
LANDFILL UNIT DESIGN INFORMATION

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
Dallas, TX 75240
214-638-0500

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4.0 FINAL COVER SYSTEM

Once the site reaches the permitted waste fill grades, a final cover system will be installed to limit the infiltration of stormwater into the landfill. The completion plan for the City of Del Rio Landfill is shown on Figure IIIA-A.2. The final cover system for the City of Del Rio Landfill is shown in Table IIIA 4-1. Details of the final cover system design is discussed in section below and shown on Figures IIIA-A.6 and IIIA-A.7.

Material specifications along with construction and testing procedures for the final cover system are provided in Appendix IIID.

Table 4-1 Final Cover System Components

Subtitle D Composite Final Cover System	
Top Slopes	Side Slopes
12-inch-thick erosion layer	24-inch-thick erosion layer
18-inch-thick compacted clay infiltration layer with $k \leq 10^{-7}$ cm/s	18-inch-thick compacted clay infiltration layer with $k \leq 10^{-7}$ cm/s

As part of the final cover construction, an erosion layer capable of sustaining native vegetation will be constructed. Areas that receive final cover will be seeded upon completion of final cover placement. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIH. The erosion layer will include a vegetation layer that provides for a 90 percent ground coverage. If there are areas that do not maintain at least 90 percent coverage they will be re-seeded until at least 90 percent coverage is maintained.

In addition, permanent final cover erosion control structures (swales and chutes) will be constructed upon installation of the final cover. The stormwater controls for the landfill have been designed consistent with the TCEQ regulations for Type I MSW landfills. The stormwater runon/runoff controls have been designed for a 25-year frequency storm event. These include drainage controls for the final cover, perimeter drainage channels, culverts, and detention ponds, including pond outfalls. The design details of the final cover system erosion control structures is provided in Appendix IIIH - Surface Water Drainage Report.

Final cover has been constructed over Cells 1, 2 and a portion of the pre-Subtitle D as shown in Figure IIIA-A.2. The TCEQ acceptance letter for the closure is included in Appendix IIID-A. The constructed final cover over the portion of the pre-Subtitle D and subtitled D areas will remain in place.

A stability analysis for the proposed excavation and proposed final cover systems is provided in Appendix IIIL - Geotechnical Report.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIA-A
LINER, OVERLINER AND FINAL COVER SYSTEM DETAILS

Prepared for
City of Del Rio

September 2023
Revision 1 August 2024
Revision 2 March 2025



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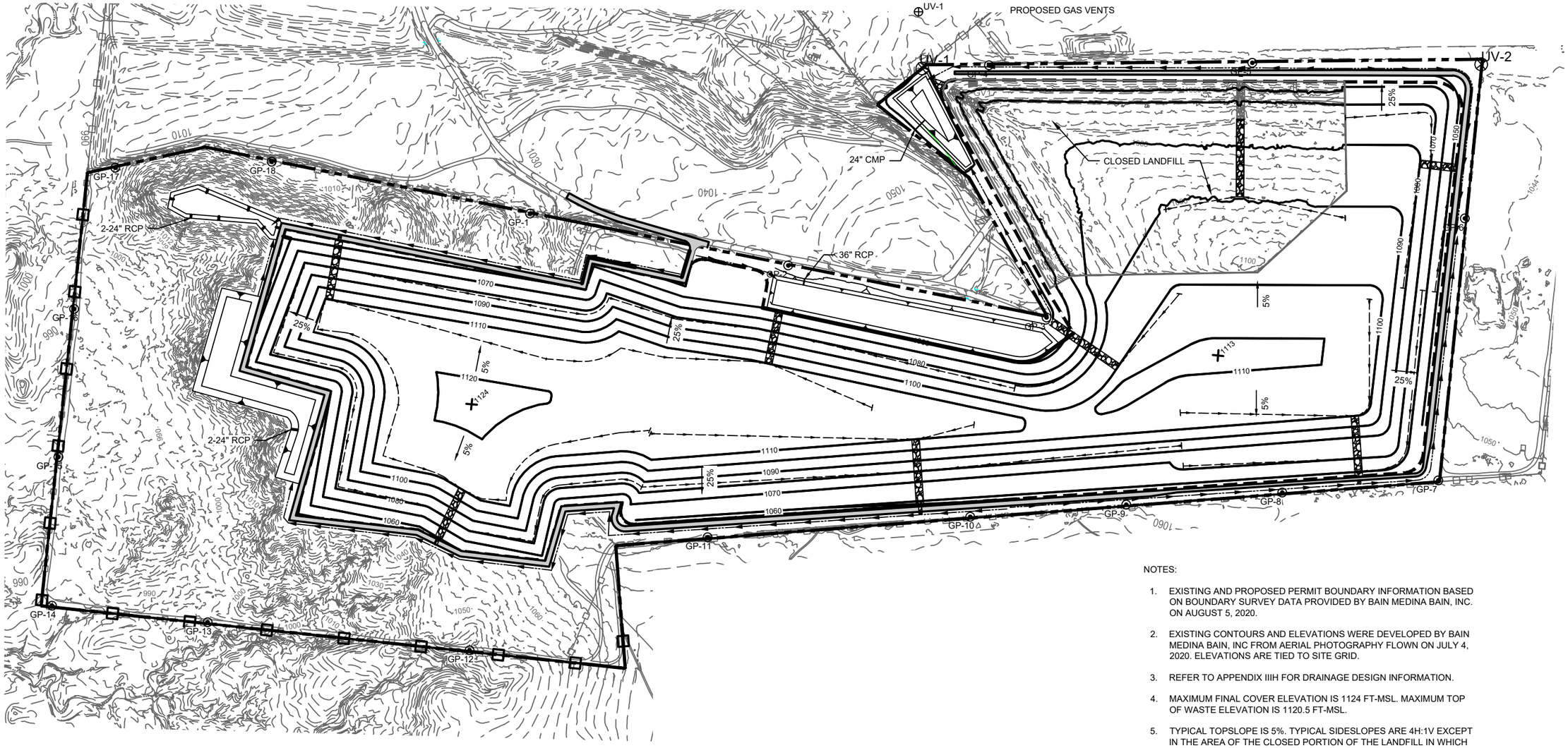
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- PERIMETER CHANNEL
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

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NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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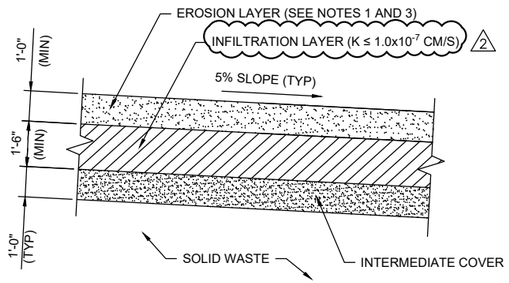
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LANDFILL COMPLETION PLAN

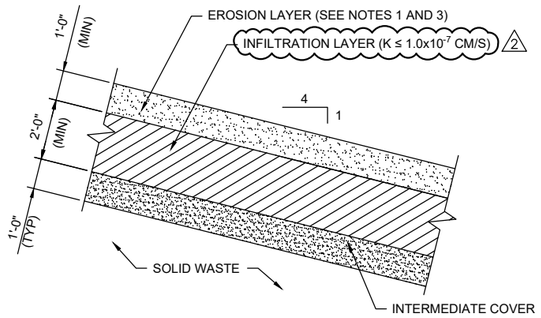
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FIGURE
IIIA-A.2

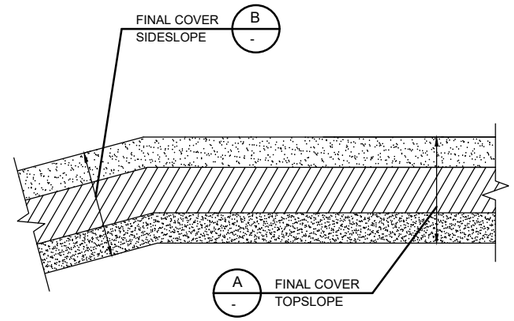
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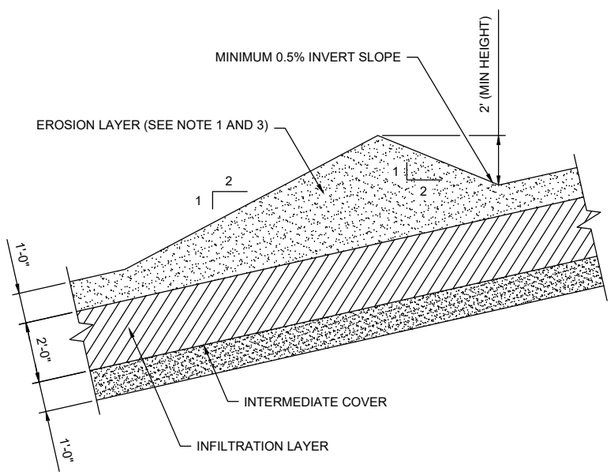
A FINAL COVER-TOPSLOPE
NTS



B FINAL COVER-SIDESLOPE
NTS



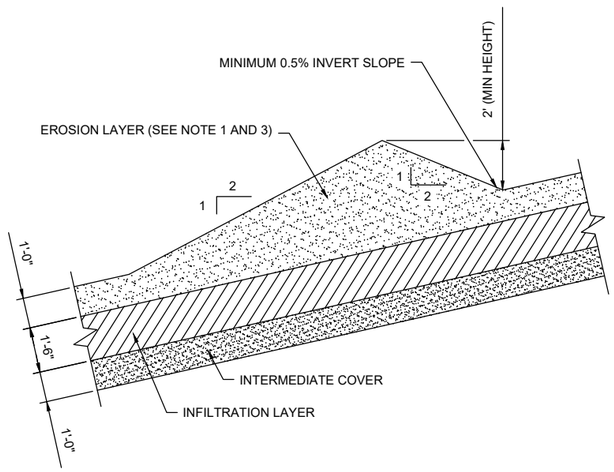
C FINAL COVER- TOP/SIDESLOPE TRANSITION
NTS



D SIDESLOPE SWALE (TYP)
NTS

NOTES:

1. FINAL COVER OF EROSION LAYER WILL BE CAPABLE OF SUSTAINING SELECTED VEGETATION.
2. FINAL COVER COMPONENTS WILL BE CONSTRUCTED ACCORDING TO FCSQCP (APPENDIX IIIJ-A).
3. EROSION LAYER MAY CONSIST OF BOTH ONSITE AND OFF-SITE SOILS. BORROW SOURCE TO BE SELECTED BY OWNER PRIOR TO CONSTRUCTION.



E TOP SLOPE SWALE (TYP)
NTS

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FIGURE
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CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIA-B
LANDFILL UNIT CROSS SECTIONS

Prepared for
City of Del Rio

September 2023
Revision 1 August 2024
Revision 2 March 2025



Prepared by
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Figure IIIA-B.8 - Typical Cross Section E

Figure IIIA-B.9 - Typical Cross Section F

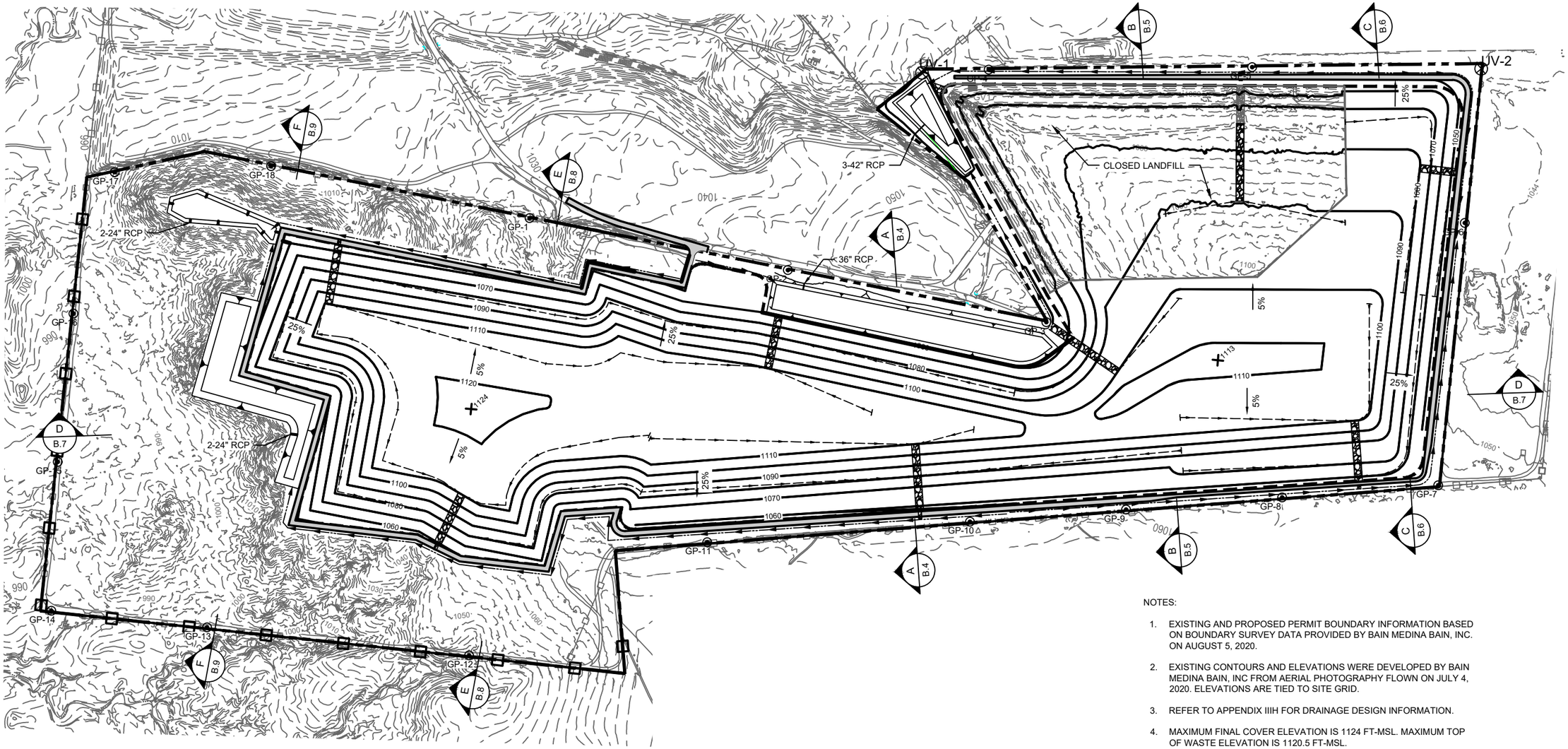


LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER GRADES
- 1084 EXISTING GRADES
- PERIMETER CHANNEL
- SWALES
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

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5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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LANDFILL COMPLETION PLAN

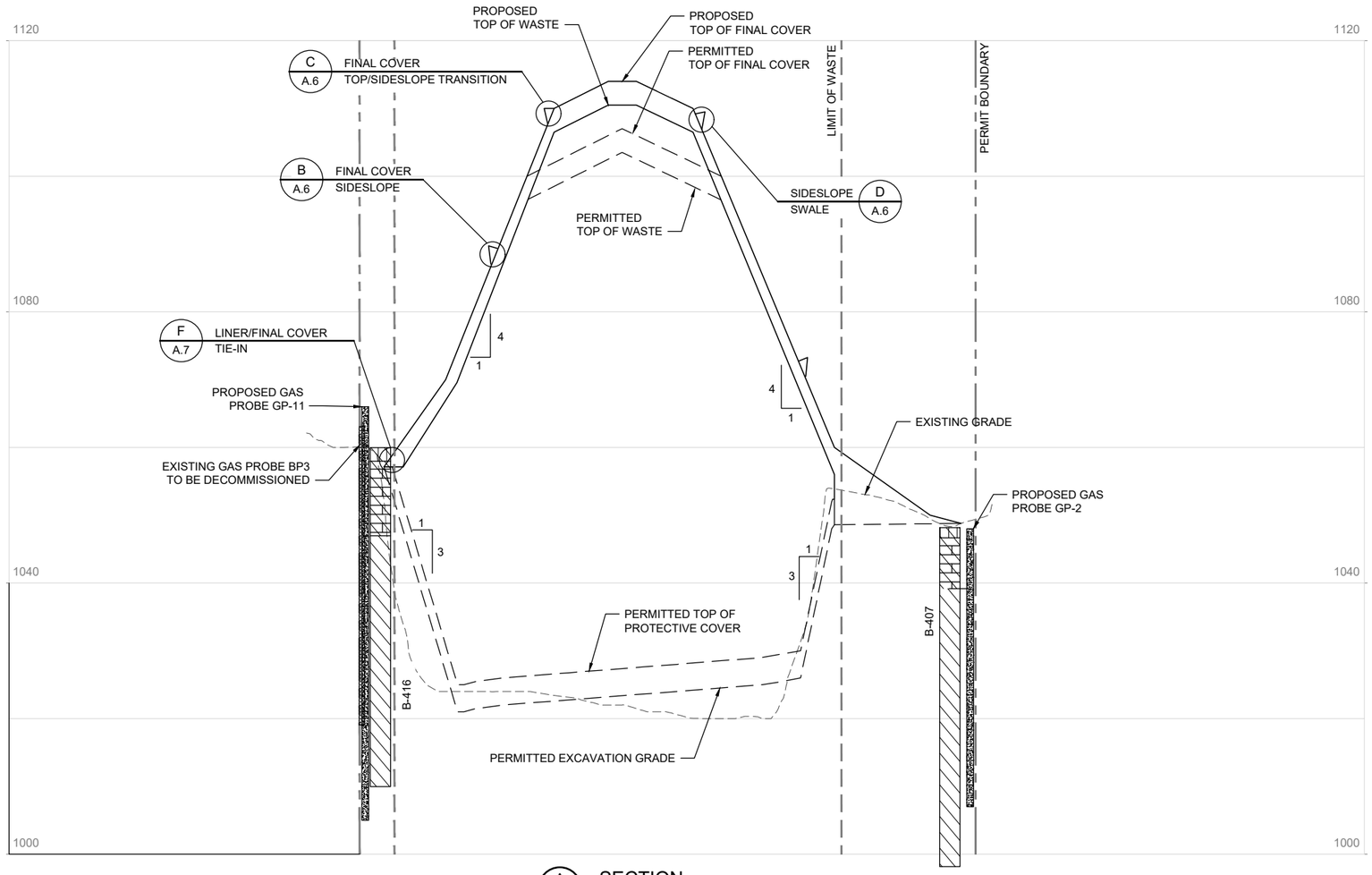
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FIGURE
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2. REFER TO APPENDIX IIIA-A FOR LINER, LEACHATE COLLECTION, AND FINAL COVER SYSTEM DETAILS.
3. SEE APPENDIX IIIG FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
4. AS SHOWN IN APPENDIX I/IIC, THE BUFFER ZONES VARY AROUND THE PERIMETER OF THE SITE, BUT IN NO CASE ARE THEY LESS THAN 50-FEET FOR EXISTING WASTE.
5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

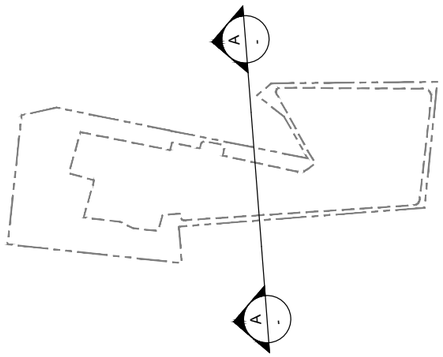


A B.2 SECTION

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KEY MAP

NTS

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY

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CITY OF DEL RIO LANDFILL NO. 207C
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CROSS SECTION A

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FIGURE
IIIA-B.4

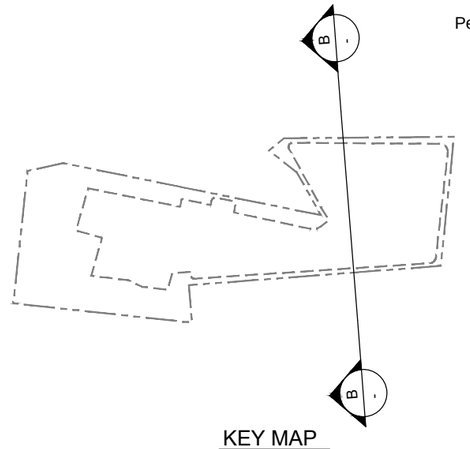
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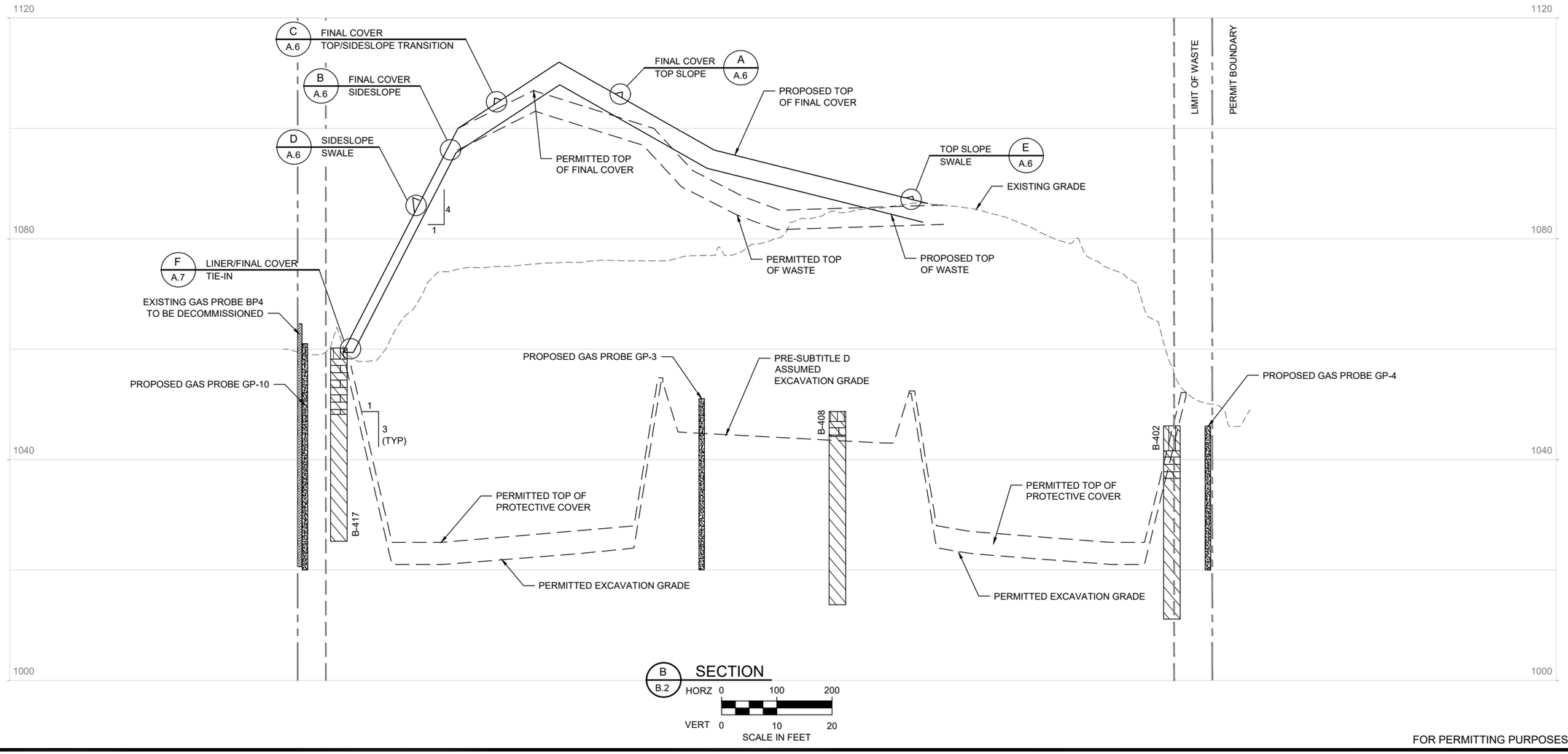
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2. REFER TO APPENDIX IIIA-A FOR LINER, LEACHATE COLLECTION, AND FINAL COVER SYSTEM DETAILS.
3. SEE APPENDIX IIIG FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
4. AS SHOWN IN APPENDIX I/IIC, THE BUFFER ZONES VARY AROUND THE PERIMETER OF THE SITE, BUT IN NO CASE ARE THEY LESS THAN 50-FEET FOR EXISTING WASTE.
5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
7. MAXIMUM TOP OF FINAL COVER ELEVATION IS 1124 FT-MSL.
8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY



KEY MAP
NTS



B B.2 SECTION

HORZ 0 100 200

VERT 0 10 20

SCALE IN FEET

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CITY OF DEL RIO TEXAS

STATE OF TEXAS TEMOBISTA METAFERIA 123183 LICENSED PROFESSIONAL ENGINEER 09/30/2025

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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CROSS SECTION B

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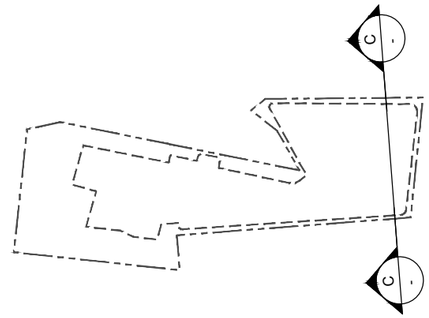
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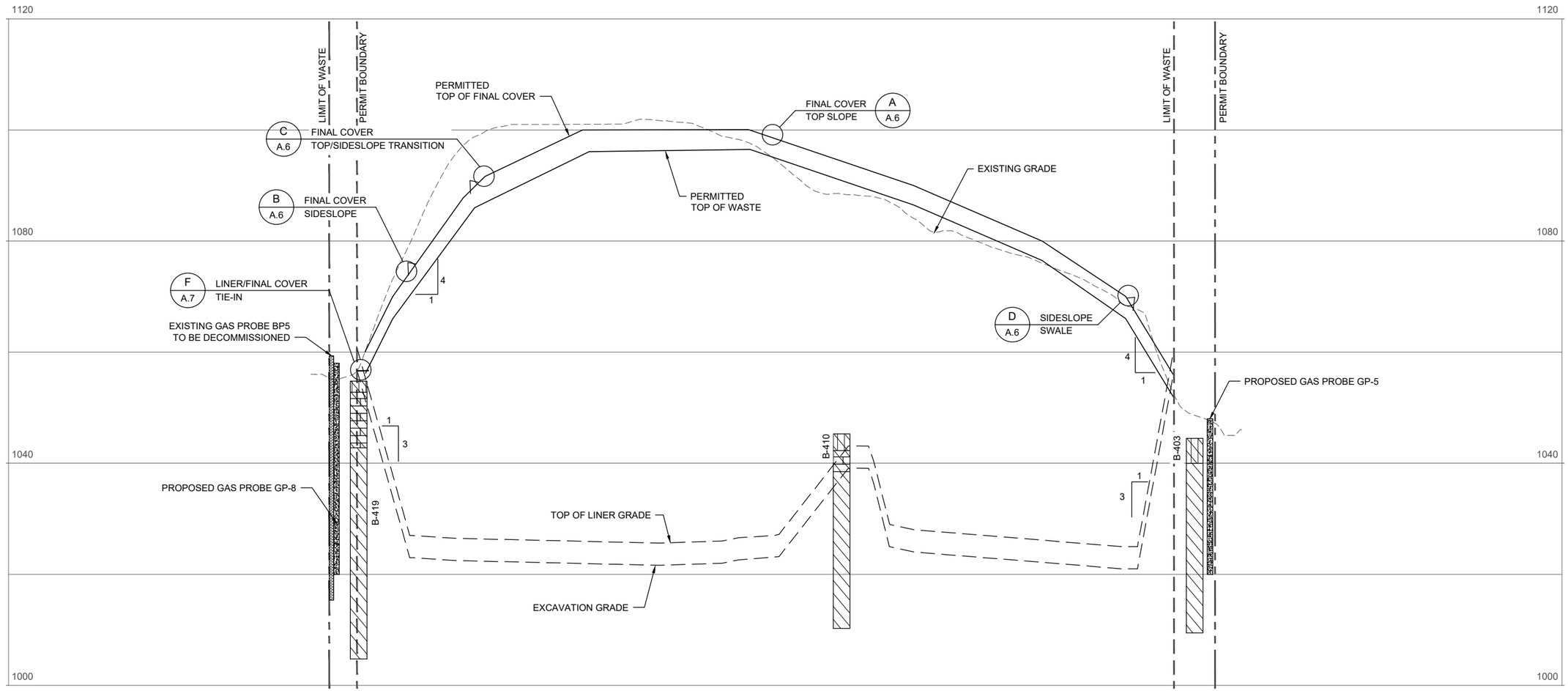
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3. SEE APPENDIX IIIG FOR BORING DATA. BORINGS PROJECTED INTO THE LINE OF SECTION.
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5. REFER TO APPENDIX IIIM, FOR DETAILS OF THE LANDFILL GAS MANAGEMENT PLAN.
6. DRAINAGE DESIGN INFORMATION IS PROVIDED IN APPENDIX IIIH-SURFACE WATER DRAINAGE PLAN.
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8. REFER TO APPENDIX IIIC FOR LEACHATE COLLECTION SYSTEM (LCS) INFORMATION.
9. THE SITE DOES NOT HAVE ANY GROUNDWATER MONITORING WELLS. GROUNDWATER HAS NOT BEEN ENCOUNTERED IN OF THE BORINGS OR DURING CONSTRUCTION OF CELLS 1 THROUGH 6.
10. THIS SITE DOES NOT ACCEPT ANY CLASS 1 WASTE.

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CLAY
- CLAY AND CALICHE
- SILTY CLAY



KEY MAP
NTS



C
B.2
SECTION

HORZ 0 100 200
VERT 0 10 20
SCALE IN FEET

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STATE OF TEXAS
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123183
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MAJOR PERMIT AMENDMENT

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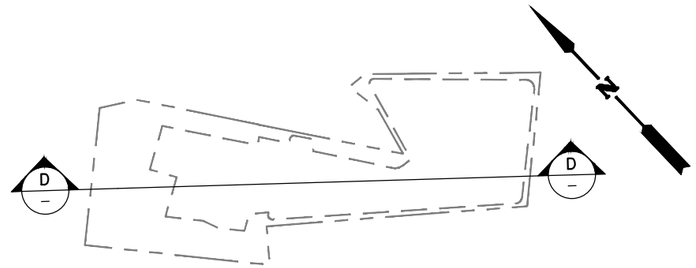
FIGURE
IIIA-B.6

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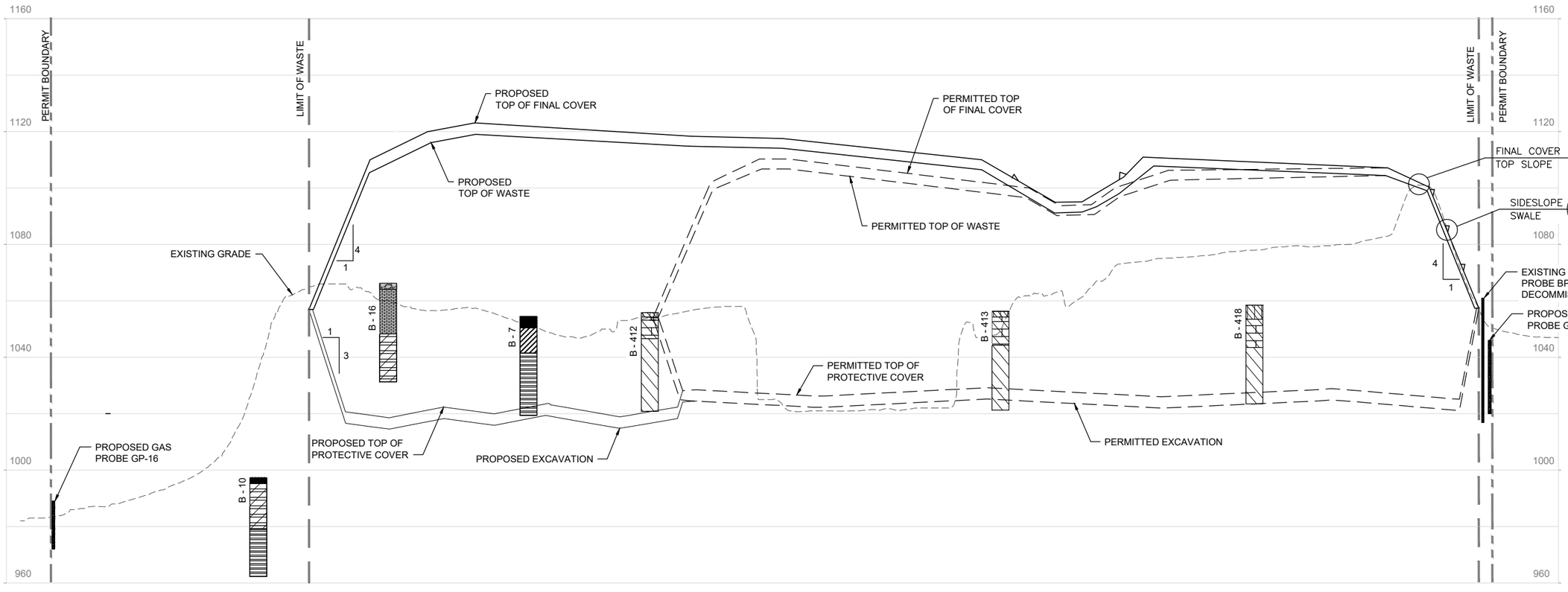
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- CLAY
- FAT CLAY
- WEATHERED CLAY-SHALE
- CLAY-SHALE



KEY MAP
NTS



D / B.2 SECTION

HORZ 0 200 400

VERT 0 20 40

SCALE IN FEET

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FIGURE
IIIA-B.7

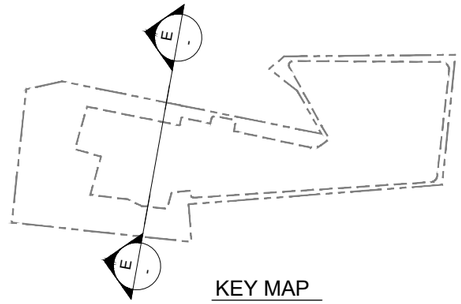
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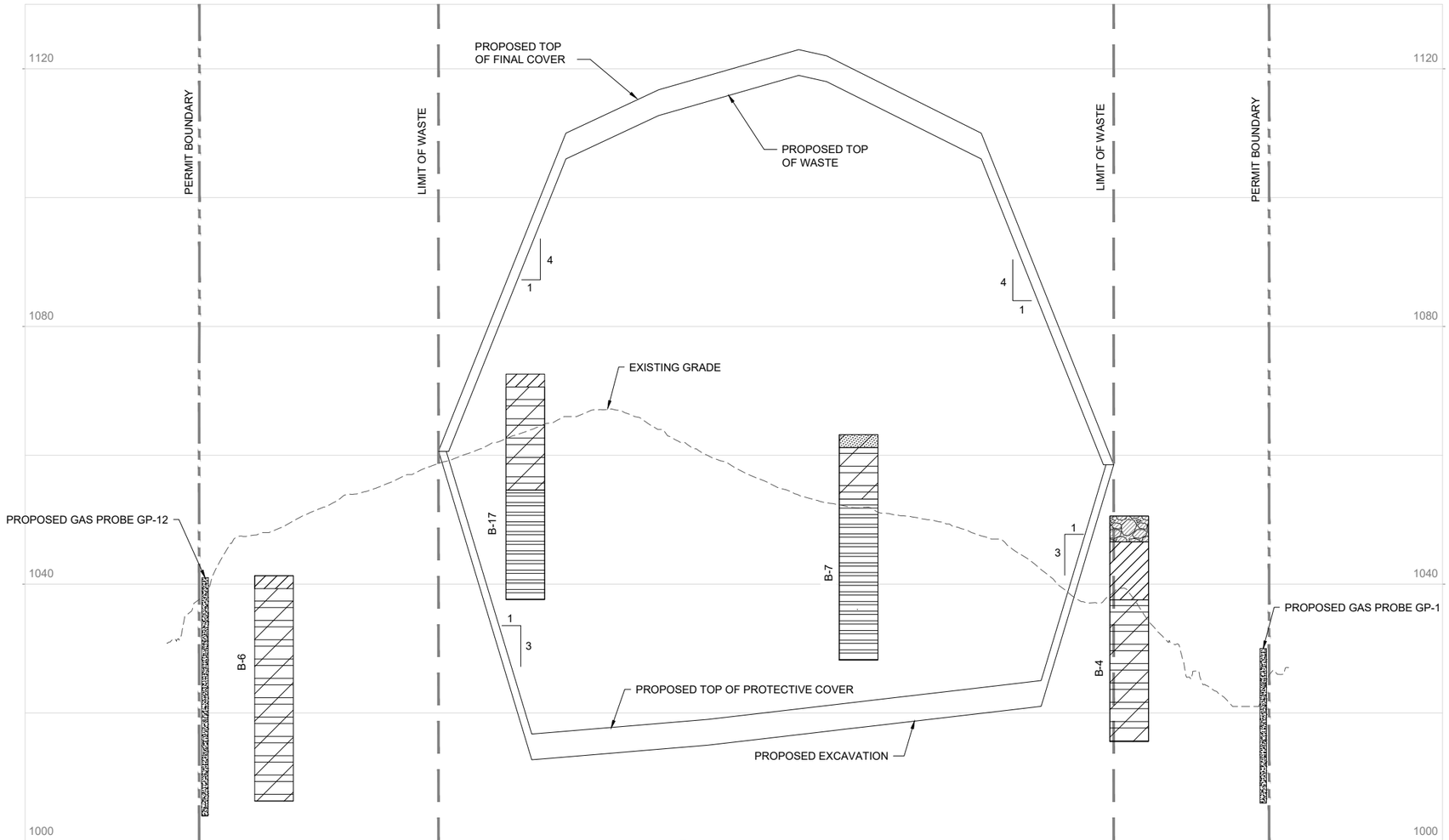
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- CLAY
- FAT CLAY
- WEATHERED CLAY-SHALE
- CLAY-SHALE



KEY MAP
NTS



E / B.2 SECTION

HORZ 0 100 200
VERT 0 10 20
SCALE IN FEET

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MAJOR PERMIT AMENDMENT

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FIGURE
IIIA-B.8

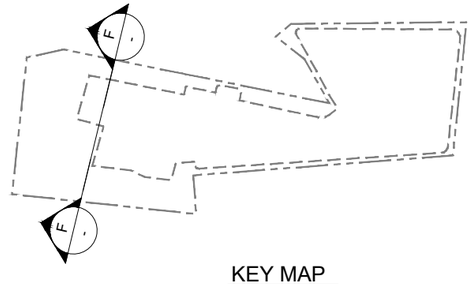
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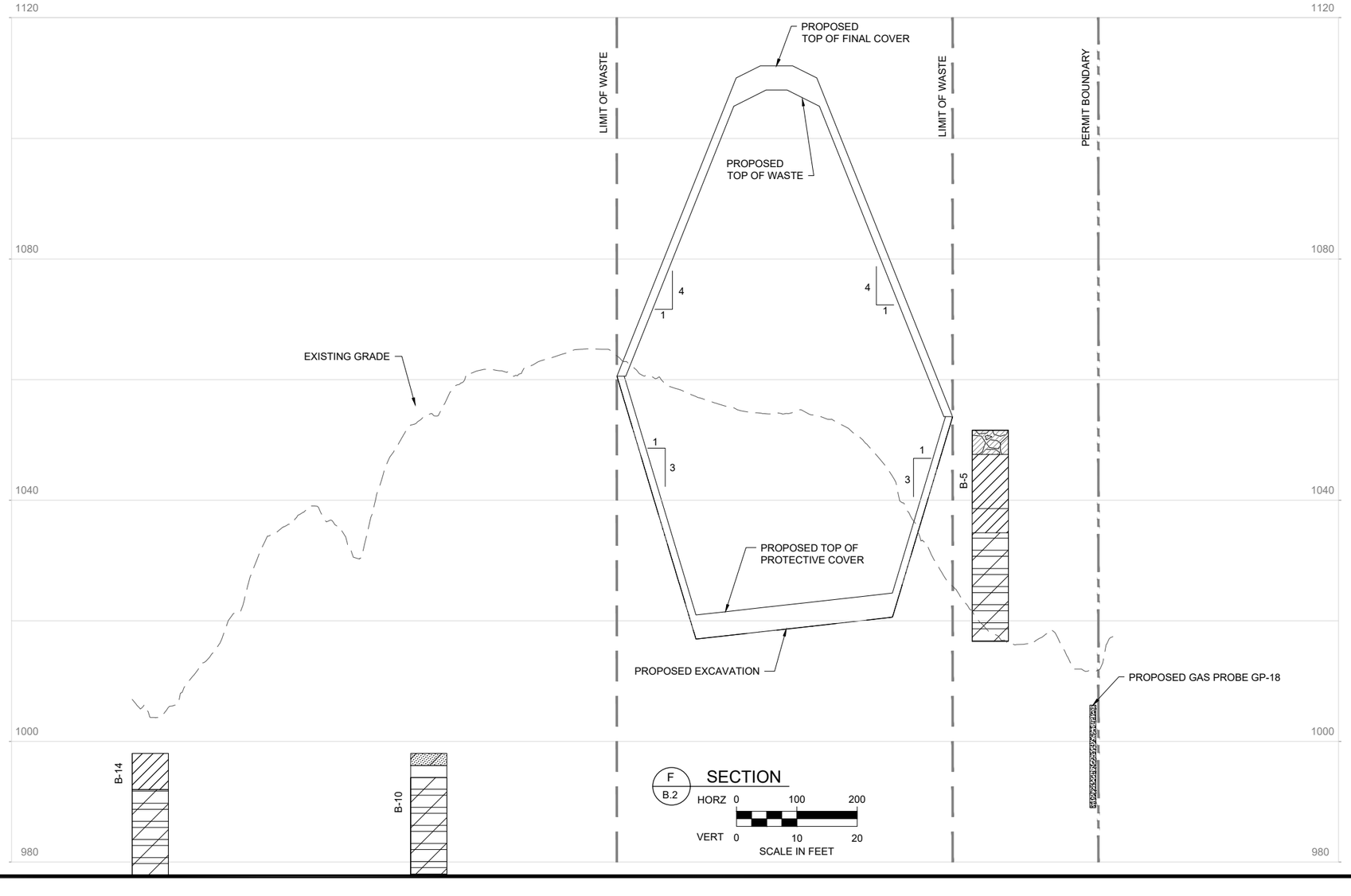
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- WEATHERED CLAY-SHALE
- CLAY-SHALE



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FIGURE
IIIA-B.9

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIC
LEACHATE AND CONTAINATED WATER MANAGEMENT PLAN

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
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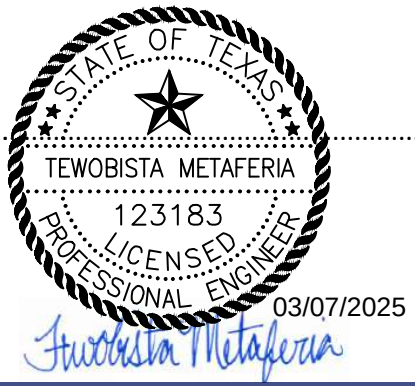
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1.0 INTRODUCTION

This Leachate and Contaminated Water Management Plan for the City of Del Rio Landfill was prepared consistent with Title 30 Texas Administrative Code (TAC) §§330.305(g), 330.177, 330.207, and 330.333. This plan provides the details of the collection, storage, treatment and disposal of contaminated water, and leachate generated during the active and post-closure periods of the landfill. The design details for the liner and final cover systems are included in Appendix IIIA-A - Liner, and Final Cover System Details.

2.0 LEACHATE AND CONTAMINATED WATER GENERATION

2.1 Generation Process

Leachate is generated when water percolates through the layers of solid waste as moisture is released from high moisture content waste. The capacity of solid waste to absorb moisture is known as field capacity. When the field capacity is exceeded, leachate is generated. However, leachate may also flow within the landfill through preferential pathways; therefore, some downward flow of leachate will occur before the field capacity of waste is reached. The quantity of leachate produced will depend upon the climate, site topography, type of cover, construction and landfilling procedures, and waste characteristics.

Contaminated water is defined in Title 30 TAC §330.3(36) as "leachate, gas condensate, or water that has come into contact with waste." Contaminated water is generated when stormwater runoff has come into contact with solid waste at the working face of the landfill or any other area at the site where water contacts solid waste, leachate, or gas condensate. The SOP outlines the locations where water may come into contact with solid waste, leachate, or gas condensate. Section 33 of the SOP details the measures for containing and disposing of contaminated water.

2.2 Leachate Generation and Contaminated Stormwater Modeling

The Hydrologic Evaluation of Landfill Performance (HELP) model, Version 4.0, was used to estimate the amount of leachate that will be generated at the City of Del Rio Landfill. The HELP model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of landfills. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, runoff, infiltration, percolation, soil-moisture storage, evapotranspiration, and lateral drainage.

Leachate generation was evaluated for both active and closed landfill conditions. An explanation of the assumed conditions, methodologies, models and printouts of the results are included as Appendix IIIC-A. The leachate generation rates produced by HELP are used for the leachate collection system (LCS) design.

2.3 Stormwater Management

The City of Del Rio Landfill will manage surface water throughout the active life of the landfill to minimize the amount of stormwater that will come in contact with waste or leachate. Uncontaminated surface water will be controlled through the use of diversion berms, and stormwater diversion ditches. To promote runoff and prevent ponding, the operational cover will be graded and maintained.

Stormwater that comes into contact with waste will be considered contaminated water and handled consistent with Title 30 TAC §330.207. Contaminated water will be contained by the containment berm

at the working face. At no time will contaminated water be allowed to discharge into waters of the United States. Storage of contaminated water and its disposal are discussed in Section 4 and Section 5.

The final cover has been designed to minimize infiltration and promote runoff. Uncontaminated surface water will be managed throughout the active life of the landfill to minimize infiltration into the filled areas and to minimize contact with solid waste. Also, daily and intermediate cover will be graded and maintained to promote runoff and prevent ponding as described in Part IV - Site Operating Plan (SOP).

Procedures for verifying the adequacy of daily cover placement to cover all waste material is discussed in SOP, Section 27.1. Runoff generated from fill areas covered with a minimum 6 inches of earthen daily cover having no exposed waste or 12 inches of intermediate cover will be considered as uncontaminated and allowed to drain to the perimeter drainage system. In the event that the 6 inches of daily cover does not prevent stormwater from contacting solid waste or leachate, this stormwater will be collected and managed as contaminated and disposed of in an authorized manner. Uncontaminated surface water runoff will be diverted around the working face.

3.0 LEACHATE COLLECTION SYSTEM

3.1 System Layout and Design Criteria

The LCS for the Subtitle D area will consist of: (1) a collection layer placed over the liner system, (2) the leachate collection piping, and (3) the leachate collection sumps and pumps. An overliner LCS will be placed above the overliner system geomembrane liner within the pre-Subtitle D area to collect leachate generated from the waste placed in the vertical expansion area. The plan for the LCS piping and grading is shown in Part III, Appendix IIIA-A, Figures IIIA-A.1 and IIIA-A.1a. LCS details are also provided in Part III, Appendix IIIA-A - Liner and Final Cover System Details.

3.1.1 Design Criteria

The leachate management system is designed and operated to collect and remove leachate from each cell, maintain leachate levels below 12 inches (or 30 cm) above the liner systems, channel leachate to designated collection sumps, and effectively manage leachate through collection and disposal. The system is designed to eliminate potential migration of landfill leachate into the environment and to meet the following requirements of Title 30 TAC §330.333:

- constructed of materials that are chemically resistant to the leachate expected to be generated;
- of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by equipment used at the facility; and
- designed to function through the scheduled closure and post-closure period of the facility.

The LCS is designed to maintain the maximum leachate depth on the liner to less than 12 inches, in accordance with 30 TAC §330.331(a)(1). The leachate levels will be monitored and manually pumped to maintain the required levels. The drainage geocomposite leachate collection layer is designed to convey the estimated peak leachate flow rate without the leachate level within the geocomposite exceeding the thickness of the geocomposite. The operation of the leachate sump and the conveyance capacity of the geocomposite leachate collection layer work in tandem to maintain compliance with the design standard listed in Title 30 TAC §330.331(a)(1). The LCS piping network is designed to convey collected leachate to the leachate collection sumps. The LCS piping is designed for post-settlement slopes and to meet each of the three criteria listed above.

The geotextiles used for the geocomposite drainage layer utilize 100% continuous-filament polyester or polypropylene. Extensive testing, including EPA 9090 for chemical resistance, has demonstrated that polyester and polypropylene are resistant to a wide range of chemical classes encountered in soil and to typical leachate. The LCS piping and the geonet portion of the geocomposite are constructed of polyethylene. Polyethylene is an industry standard material and is resistant to a wide range of chemical constituents, including those typically found in leachate.

3.1.2 Leachate Collection System Layout

The LCS layout is shown on Figure IIIC-3.1. Subtitle D Cells 1 - 6 have been constructed to date. For the constructed Subtitle D cells, the leachate collection layer includes a geocomposite placed over the liner system to collect and transfer leachate to the leachate collection pipes and sumps. The currently constructed LCS has been evaluated considering the leachate collection layer and leachate collection header pipe grades under the proposed landfill expansion conditions (i.e., after landfill foundation

3.4 Leachate Sumps and Pumps

The leachate collection sumps and pumps have been sized to comply with the regulatory design standard listed in §330.331(a)(1). The leachate collection sumps and pumps have been designed to maintain less than 12 inches (30 cm) depth of leachate over the liner. The leachate sump operating plan is included in Table 3-3.

Each leachate sump will be sized based on the amount of leachate generation taking into consideration the contributing area from the Subtitle D cells. The minimum sump size for the undeveloped cells and overliner will be 2 feet deep with minimum dimensions of approximately 27 by 27 feet at the landfill floor and 15 by 15 feet at the sump base and will store a minimum of 906 cubic feet of leachate. The size and capacity of the sumps are presented in Appendix IIIC-B. New sump will be backfilled with drainage stone meeting the gradation in accordance with ASTM D 448, size number 467 (nominal aggregate size is 2 inches to 3/16 inches). Each sump will be emptied by a submersible pump located in an 18-inch nominal diameter sidewall riser pipe which extends into the bottom of the sump and is perforated in the sump. Pumps will be operated manually. Control levels for the pump will be set to maintain sump liquid levels between the lip of the sump and pump intake. The objective of the pump operation is to ensure that a free-flowing condition is maintained in the LCS. If the pump malfunctions, the pump will be removed, repaired, and replaced, or a new pump will be used (see Table 3-3 for additional information). If it is determined that the pump is malfunctioning, it will be removed and replaced immediately. In addition, the pumps will be replaced when it is determined that a larger capacity pump is needed based on existing conditions. The leachate depth monitoring procedure and leachate removal will be the same for all disposal areas.

The specified pump will have the capacity to pump leachate at a rate of 20 gpm or 28,800 gpd. The maximum estimated flow to be pumped from the largest cell is 745 gpd. If the specified leachate sump pumps are not able to empty the sump and maintain less than 12 inches of head on the liner at reasonable cycle times, then a pump with more capacity will be used (refer to Section 4.1 for more information).

Table 3-3 Leachate Sump Operating Plan

Leachate Level Description	Condition	Action Required
Leachate level between lip of sump and pump intake at the bottom of the sump.	System is functioning as designed. The drainage geocomposite leachate collection layer installed on the floor of the landfill is designed to convey the estimated peak leachate flow rate without the leachate level within the geocomposite exceeding the thickness of the geocomposite. The operation of the leachate sump and the conveyance capacity of the geocomposite leachate collection layer work in tandem to maintain compliance with the design standard listed in §330.331(a)(1).	The depth of leachate in the sump is monitored by a landfill personnel at least 1 time per week. Leachate flow to the sump and sump pump capacity are listed in Table 4-1. The sump design is discussed in Section 3.4.
Leachate level between the lip of the sump and 0.02 inches (0.05 cm) above the lip of the sump.	The 0.02-inch design standard listed in Appendix IIIK per §330.331(a)(1) has not been exceeded.	For these two conditions, the sump operation will be monitored daily until the leachate is pumped out by the Operator. For both conditions, the leachate levels in the sump will be recorded daily. If it is determined that the pump is malfunctioning, it will be removed and replaced immediately. In addition, the pumps will be replaced when it is determined that a larger capacity pump is needed based on existing conditions.
Leachate level over 0.05 inches above the lip of the sump.	The design standard listed in Appendix IIIK per §330.331(a)(1) has been exceeded.	

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIC-A
HELP MODEL ANALYSIS

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
Dallas, TX 75240

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2.3 Landfill Profile

The landfill profiles for various stages of the landfill development are presented in the attached HELP Model summary sheets. The profile presented below includes a clay liner with a standard Subtitle D final cover system.

2.3.1 Liner Systems

The Subtitle D clay liner designed for developed and undeveloped cells consists of a 24-inch-thick compacted clay liner with a hydraulic conductivity of $1x10^{-7}$ cm/s. Default soil characteristics from the HELP model were selected for the compacted clay liner.

2.3.2 Leachate Collection System

Developed Subtitle D Cells 1 through 6 were constructed with an LCS that includes a 200-mil thick single-sided geocomposite for floor grades and double-sided geocomposite for the sideslopes. Cells 7 through 10 will be constructed with a 250-mil thick single-sided geocomposite for floor grades and double-sided geocomposite for the sideslopes.

2.3.3 Waste Layers

Various waste thicknesses were modeled to represent the various stages of landfill development in the Subtitle D and pre-subtitle D areas. A default wilting point was selected from HELP to represent municipal solid waste. The waste column was split into two layers. The top 50-foot layer was modeled with a hydraulic conductivity of $1x10^{-3}$ cm/s. The moisture content, field capacity, and porosity values were selected as discussed previously.

2.3.4 Intermediate Cover

The intermediate cover consists of a 12-inch-thick layer of soil placed over the waste. Default soil characteristics were selected from HELP to represent the available onsite soils with a hydraulic conductivity of $6.4x10^{-5}$ cm/s.

2.3.5 Final Cover

The final cover over the Subtitle D and pre-Subtitle D areas consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation and an 18-inch infiltration layer. The infiltration layer consists of compacted soil with a hydraulic conductivity of $1x10^{-7}$ cm/s. The site is modeled using $1x10^{-5}$ hydraulic conductivity and provides a conservative design.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIE
CLOSURE PLAN

Prepared for
City of Del Rio



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Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200 Dallas, TX 75240
214-638-0500

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2.0 FINAL COVER SYSTEM

2.1 Introduction

The final cover system for the City of Del Rio Landfill has been developed to incorporate the requirements of Title 30 TAC §330.457(f)(4). The rules state that the owner or operator of a MSW landfill unit shall complete closure activities for the unit in accordance with the approved closure plan within 180 days following the initiation of closure activities (closure activities for MSW landfill units shall begin no later than 30 days after the date on which the unit receives the known final recent receipt of wastes, or, if the unit has remaining capacity and there is a reasonable likelihood that the unit will receive additional wastes, no later than one year after the most receipt of wastes). Such a system will include installation of a final cover system and a storm water runoff control system. The storm water runoff controls are addressed in Appendix IIIH – Surface Water Drainage Plan. The final cover system design is discussed below and is also detailed in Appendix IIIA-A. Cross-sections are provided in Appendix IIIA-B.

2.2 Final Cover System Design

The final cover system will consist of a cover system for both pre-Subtitle D and Subtitle D areas. The final cover system will provide a low maintenance cover, protect against erosion, reduce rainfall percolation through the cover system and subsequently minimize leachate generation within the landfill. As depicted on Figure IIIE-1, a maximum slope of 5 percent is provided for the top slopes. Side slopes of the final cover for all above-ground disposal areas are 4H:1V and will not exceed a 25% grade. The top and side slopes specified are sufficient grades to preclude ponding of surface water when total fill height and expected subsidence are taken into consideration.

Subtitle D Composite Final Cover System

- An erosion layer consisting of a earthen material capable of sustaining vegetative growth. The vegetation will consist of native or introduced grasses, as well as a mixture of Bermuda, vetch, rye, wheat grass, wildflowers, and other flowering plants capable of providing 90 percent coverage over the cover system. The erosion layer will be 12-in thick on the top slope and 24-in thick on the sideslopes.
- An 18-inch-thick compacted clay infiltration layer with a coefficient of permeability of less than or equal to $1x10^{-7}$ cm/s.

The low permeability component of the final cover system (the 18-inch-thick clay infiltration layer) is designed to minimize infiltration of surface water into the underlying waste material. Details of the final cover system are shown on Drawings A.6 and A.7 in Appendix IIIA-A. Material specifications, construction, and testing procedures are provided in Appendix IIIE-A Final Cover System Quality Control Plan.

Vegetation will be established over the installed final cover system to minimize the erosion potential of the cover slopes. The erosion layer was evaluated using the universal soil loss equation (USLE) developed by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The evaluation is presented in Appendix IIIH – Surface Water Drainage Plan.

Landfill gas generated in the landfill will be managed as discussed in Appendix IIIM – Landfill Gas Management Plan. The landfill gas system will monitor the gas generated by deposited waste.

Similar to the proposed final cover areas, permanent final cover erosion control structures include swales and chutes that will be constructed on the existing final cover. Swales shall be constructed at every 180 feet or less and shall not exceed a length of 578 feet. The design of the final cover system erosion control structures is provided in Appendix IIIH-B. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIH-D – Erosion Layer Evaluation. A minimum of 90% vegetation cover shall be maintained for final cover.

2.3 Installation Methods and Procedures

The final cover system will be constructed in accordance with the requirements listed on the permit drawings in Appendix IIIA-A and the Final Cover System Quality Control Plan presented in Appendix IIIE-A. Testing and evaluation of the final cover system during construction will be in accordance with Appendix IIIE-A.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIE-A
FINAL COVER SYSTEM QUALITY CONTROL PLAN

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
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- Liquid Limit equal to or greater than 30.
- Percent passing the No. 200 mesh sieve equal to or greater than 30 percent.
- Percent passing the 1-inch screen equal to 100 percent.
- Coefficient of permeability of less than or equal to $1x10^{-7}$ cm/s.

The soil infiltration layer material will consist of relatively homogeneous clay, and clayey soils. The soil will be free of debris, rock greater than 1 inch in diameter, vegetative matter, frozen materials, foreign objects, and organics. Testing will be performed in accordance with Section 2.4 (refer to Table 2-1 for test methods) for each borrow source. A permeability test will be conducted on samples from each borrow source. The permeability test specimens will be prepared by laboratory compaction to a dry density of approximately 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at a moisture content at or above the optimum moisture content. One Proctor moisture-density relationship and remolded permeability test will be required for each different material as determined by a change in the liquid limit or plasticity index of more than 10 points.

The material will be compacted to a minimum of 95 percent of the maximum dry density determined by Standard Proctor (ASTM D 698) at a moisture content between the Standard Proctor optimum and 5 percentage points above optimum. The CQA monitor, earthwork contractor, and/or Operator will identify the clay material during excavation, and the clay material will be stockpiled separately, if stockpiling is required.

Because of possible variability of the available clay materials, additional stockpile testing will be performed if different physical properties of the borrow soil (color, texture, etc.) are observed by the CQA monitor, and the materials vary by more than ten points in either liquid limit or plasticity index from previously evaluated materials.

The clay materials to be used for infiltration layer will require processing to achieve the required moisture content for compaction. The physical characteristics of the clay materials will be evaluated through visual observation before and during construction. To add moisture to the material properly, the clod sizes will first be crushed into manageable sizes of 1 inch in diameter or less. Rocks within the infiltration layer should be less than 1 inch in diameter and will not total more than 10 percent by weight.

Clod-size reduction, if necessary, may be achieved using a disc harrow or soil pulverizer. To efficiently break down the clods, multiple passes of the processing equipment in two directions are recommended. Water will be applied as necessary to the material and worked into the material with the processing or compacting equipment. If necessary, to achieve even moisture distribution or break down clod, the material will be watered and processed in the stockpile prior to placing in the infiltration layer to allow the soil adequate time to hydrate. Water used for the soil infiltration layer must be clean and not contaminated by waste or any objectionable material. Collected onsite stormwater may be utilized if it has not come into contact with the solid waste.

The soil infiltration layer must be compacted with a pad/tamping-foot or prong-foot (sheepsfoot) roller. The lift thickness will be controlled so that there is total penetration through the loose lift under compaction into the top of the previously compacted lift; therefore, the lift thickness must not be greater than the pad or prong length. The top of intermediate cover will be scarified a minimum of two inches prior to placement of the first lift of soil infiltration layer. Use of pad/tamping foot or prong-foot rollers will provide sufficient roughening of soil infiltration layer lift's surface for bonding between lifts. These procedures are necessary to achieve adequate bonding between lifts and reduce seepage pathways.

Appendix IIIE-B TCEQ FORM 20720

C. Drawings Showing Details of the Waste Management Units at Closure

Table 4. Location of the Drawings showing Details of the Waste Management Units at Closure (outlines, dimensions, maximum elevations of waste and final cover of landfill units, and waste storage or processing units or operations at closure of the facility).

Drawing Location in the SDP	Drawing Figure Number	Drawing Title	Waste Management Units Details Shown
Part III, App. IIIA-B	**B.2**	**Excavation Plan**	**Waste footprint, permit boundary, and dimensions of the landfill cells**
Part III, App. IIIA-B	**B.3**	**Completion Plan**	**Final cover plan, maximum elevations of waste and final cover of the landfill, waste footprint, permit boundary**

III. Description of the Final Cover System Design

A. Types and Descriptions of the Final Cover Systems

Table 5. Types and Descriptions of the Final Cover Systems Permitted or Proposed for Closure of the Landfill Units.

Landfill Unit Name or Descriptor	Type of Final Cover System	Final Cover System Components Description	Other Information (Enter other information as applicable)
City of Del Rio Landfill	**Low-permeability soil**	**The final cover is comprised of 18” low permeability ($1x10^{-7}$ cm/sec) soil infiltration layer and a 12” erosion layer.**	

Closure Plan for Type I Landfill Unit and Facility

Facility Name: City of Del Rio Landfill | Revision No.:2

Permit No: 207C | Date:03/07/2025

VII. Professional Engineer's Statement, Seal, and Signature

Name: **Tewobista Metaferia**

Title: **Project Engineer**

Date: **March 7, 2025**

Company Name: **CP&Y an STV Company**

Firm Registration Number: **F-1741**

Professional Engineer's Seal



Signature

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIF
POST-CLOSURE CARE PLAN

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
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throughout the post-closure care period. TCEQ staff will have access to the site to conduct inspection or investigation that may be necessary during the period.

2. Inspection Activities and Correction of Problems

The site operator will conduct inspection of the closed landfill units at the frequencies indicated in Table 3 below, utilizing the inspection protocol maintained in the site operating record, and will correct all identified problems as needed.

Table 3: Inspection Activities Schedule

Post-Closure Care Inspection Item	Frequency of Inspection	Types of Deficiency Conditions to be looked for during Inspection
Final Cover Condition	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout post-closure care period. Correct problems as needed.**
Vegetation	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout post-closure care period. Correct problems as needed. A minimum of 90% vegetation cover shall be maintained.**
Leachate Management Systems	**Weekly for sump and monthly for caps**	**Measure depth of leachate in sump, as required and Inspect the caps and piping of the cleanout riser and sump riser of the leachate collection system to prevent potential odor escape.**
Landfill Gas Monitoring and Control Systems	**Quarterly**	**Samples of gas from probes installed at evenly spaced intervals not to exceed 1000 feet will be analyzed and checked against the allowable maximum of the LEL (lower explosive limit). Methane detection for on-site structures is also conducted in accordance with the Methane Detection Plan.**
Groundwater Monitoring Systems	**N/A**	**Site currently does not have a groundwater monitoring system.**
Drainage Structures	**Weekly and within 72-hours of a rainfall event of 0.5 inches or more.**	**Inspect perimeter channels and berms/dikes to verify that they are functioning as designed.**

Post-Closure Care Plan for Type I Landfill Units and Facility

Facility Name: City of Del Rio Landfill Revision No.:2

Permit No: 207C Date: 03/07/2025

XI. Engineer's Seal and Signature

Name: **Tewobista Metaferia, P.E.** Title: **Project Manager**

Date: 03/07/2025

Company Name: **CP&Y an STV Company** Firm Registration Number: **F-1741**

Professional Engineer's Seal



Signature

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIG
CLOSURE AND POST-CLOSURE CARE COST ESTIMATE

Prepared for
City of Del Rio



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Appendix IIIG-A. TCEQ Forms 20721 and 20723

Texas Commission on Environmental Quality

Post-Closure Care Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide post-closure care cost estimates for post-closure care of MSW Type I landfills to meet the requirements in 30 Texas Administrative Code (TAC) Chapter 330, Section 330.63(j) and 30 TAC Chapter 330 Subchapter L. The costs to be provided herein are cost estimates for hiring a third party to conduct post-closure care of the largest waste fill area that has been certified closed in writing by the TCEQ executive director.

If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

I. General Information

Facility Name: **City of Del Rio Landfill**

MSW Permit No.: **207C**

Date: **03/07/2025**

Revision Number: **2**

Site Operator/Permittee Name and Mailing Address: **City of Del Rio 114 W Martin St Del Rio, TX 78840**

Total Post-Closure Care Cost Estimate (2023 Dollar Amount): **$2,269,302.30**

II. Professional Engineer's Statement, Seal, and Signature

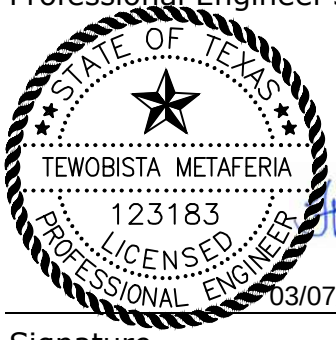
I am a licensed professional engineer in the State of Texas. To the best of my knowledge, this Post- Closure Care Cost Estimate has been completed in substantial conformance with the facility Post-Closure Care Plan and, in my professional opinion, is in compliance with Title 30 of the Texas Administrative Code, Chapter 330.

Name: **Tewobista Metaferia, P.E.** Title: **Project Engineer**

Date: **03/07/2025**

Company Name: **CP&Y as STV Company** Firm Registration Number: **F-1741**

Professional Engineer's Seal



Tewobista Metaferia 03/07/2025

Signature

Post-Closure Care Cost Estimate for MSW Type I Landfills

Facility Name: City of Del Rio Landfill | Revision No.: 2

Permit No: 207C | Date: 03/07/2025

Item No.	Item Description	Units	Annual Qty.	Unit Cost	Annual Cost	Source of Unit Cost Estimate[i]
4.0 Sum of Engineering, Construction, and Leachate Management Costs						
4.1	Sum of Engineering, Construction, and Leachate Management Cost Subtotals				$2,017,157.60	
5.0 Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)				$201,715.76	
6.0 Third Party Administration and Project Management Costs						
6.1	Third Party Administration and Project Management Costs (2.5% of Sum of Engineering, Construction, and Leachate Management Cost Subtotals)				$50,428.94	
7. Total Post-Closure Cost						
7.1	Total Annual Post-Closure Cost (Sum of amounts in Sections 4, 5, and 6)				$75,643.41	
7.2	30 Year Post-Closure Costs (Total Annual Post-Closure Cost x 30)				$2,269,302.30	

[i] Sources of Unit Cost Estimates may include:
(1) Published Cost Estimator Manuals (e.g., RS Means);
(2) Third Party Quotes (e.g., Environmental Field Services Contractors); or
(3) Verifiable Data based on Actual Operations

[ii] Example Description for Item No. 1.1 – "Includes costs for site inspection performed at least annually for identification of areas experiencing settlement or subsidence, erosion or other drainage-related problems, inspection of the leachate collection system, gas monitoring system and LFG monitoring system."

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS

TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIH
SURFACE WATER DRAINAGE PLAN

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
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1.0 INTRODUCTION

The Surface Water Drainage Plan is prepared as part of a permit amendment application for the Del Rio Landfill consistent with Title 30 Texas Administrative Code (TAC) Chapter 330. This plan addresses surface water drainage design and erosion control. Permit level plans and details are presented for the proposed drainage system in this appendix. This appendix also includes a demonstration consistent with Title 30 TAC §330.305(a) that the proposed landfill development will not adversely alter permitted drainage patterns. Parts I/II, Section 11.1 includes a demonstration showing that the site is in compliance with the floodplain location restriction. The 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA) is shown in Figure I/II.

This appendix includes the design of the final cover erosion layer and drainage structures (i.e., letdown and swales), perimeter drainage channels, detention pond, as well as hydrologic and hydraulic calculations. Consistent with Title 30 TAC §330.63(c) and §330.305(b) and (c), these facilities are designed to convey run-off produced from the 25-year storm event. In addition, an Erosion Control Plan for all phases of landfill development is included in Appendix IIIH-E. All drainage facilities will be constructed and maintained in accordance with this plan.

This appendix also includes a demonstration that shows that the proposed landfill development will not adversely alter the existing permitted drainage patterns. As noted in Section 4, the proposed condition represents the proposed configuration of the site after the landfill has been completely developed. Consistent with Title 30 TAC §330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a), the proposed completion condition is compared to the existing permitted condition to demonstrate that the continued development of the Del Rio Landfill will not adversely alter the existing permitted drainage patterns.

2.0 SITE STORMWATER MANAGEMENT

2.1 Drainage System Layout

Stormwater runoff collected in swales located on the top dome and side slopes of the landfill will be conveyed to drainage letdown structures (chutes) down the slopes to the perimeter channels. The perimeter channels collect runoff from drainage letdowns and convey the runoff to stormwater detention ponds. The perimeter channels will be constructed before fill is placed above existing grade in each adjacent landfill sector.

The Del Rio Landfill permit boundary is located southeast of Calaveras Creek. A portion of the site drains northwest to Calaveras Creek. The other portion of the site drains southeast to the Zorro Creek. Both the Calaveras and Zorro Creeks discharge into the Rio Grande.

For the proposed expansion, the final cover system will include erosion control structures to effectively minimize erosion of final cover soils. The proposed drainage system also includes a perimeter channel system that will convey stormwater collected from the landfill area to a detention pond or directly into an existing drainage channel that feeds the Calaveras and Zorro Creeks. The stormwater detention pond is designed to attenuate stormwater flow before stormwater is discharged into existing drainage features located downstream of the site.

The facility has been designed to prevent discharge of pollutants into waters of the State or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, respectively. Del Rio Landfill has a current Texas Pollution Discharge Elimination System (TPDES) multi-sector general permit

(MSGP) for industrial activity as stipulated under Section 402 of the Clean Water Act and under Chapter 26 of the Texas Water Code, the TPDES program. A copy of the multi-sector permit is included in Parts I/II, Appendix I/IID. Any stormwater that has become contaminated by contact with the working face or with leachate will be handled in accordance with Appendix IIIC - Leachate and Contaminated Water Management Plan. The facility maintains a current Stormwater Pollution Prevention Plan prepared consistent with the provisions of TPDES MSGP TXR050000.

2.2 Erosion and Sedimentation Control Plan

The Del Rio Landfill will use various interim and permanent erosion and sedimentation controls during all phases of site development to provide effective erosion stability for the external sideslopes and top dome surfaces. The interim controls will be used around active areas and external embankment sideslopes and top dome surfaces. These controls will include soil berms and seeding of intermediate cover areas to minimize the erosion potential. These interim controls will be used during all phases of landfill development to provide effective erosion stability for the external sideslopes and top dome surfaces until final cover is installed.

Permanent controls include swales and chutes that will be constructed upon completion of the final cover installation. As part of the final cover construction, an erosion layer capable of sustaining vegetation will be constructed. Areas that receive final cover will be vegetated in accordance with Appendix IIIE - Closure Plan upon completion of final cover placement. Final cover vegetation will protect the erosion layer soil against erosive runoff velocities. A soil loss and sheet flow velocity demonstration for the erosion layer is included in Appendix IIIH-E. The erosion layer will include a vegetation layer that provides for a 90 percent ground coverage, to keep soil loss below the required design values. If there are areas that do not maintain at least 90 percent vegetative coverage, vegetation in these areas will be reestablished to maintain at least 90 percent vegetative cover.

Erosion will be controlled by vegetation in drainage structures with flow velocities less than or equal to 5 feet per second (fps). For drainage structures with flow velocities greater than 5 fps, rock riprap, gabions, or other surface reinforcing materials as designed will be used for surface reinforcement.

During site development, non-structured and structural best management practices (BMPs) will be employed to control erosion and sedimentation ponds will be installed to prevent sediment discharge from the site. BMPs may include the use of temporary rock riprap, silt fences, straw bales, check dams, interceptor swales and berms, temporary and permanent seeding and sodding, surface roughening, matting and mulching, sediment traps, and surface wetting for dust control (refer to Appendix IIIH-F for more information).

Runoff volume (25-year, 24-hour storm event) from the active fill area (i.e., working face of the landfill operation) will be contained by the containment berm (refer to Part III, Appendix IIIC - C for details) to prevent potential discharge of contaminated runoff from the site.

2.3 Stormwater System Maintenance Plan

In accordance with Title 30 TAC §330.305(e)(1), the constructed stormwater systems such as channels, drainage swales, and chutes will be repaired and restored in the event of wash-out or failure from extreme storm events. Stormwater BMPs installed during all phases of landfill development will also be replaced or repaired in the event of failure. Excessive sediment will be removed, as needed, so that the drainage structures, such as the perimeter channels and detention ponds, function as designed. Site inspections by

landfill personnel will be performed weekly or within 24 hours after any significant rainfall event of 0.5 inches or more, or as soon as the areas are accessible. Documentation of the inspection will be included in the Site Operating Record.

The following items will be evaluated during the inspections as further discussed in Appendix IIIH-E and Part IV - SOP:

- Erosion of daily and intermediate cover areas, final cover areas, perimeter ditches, chutes, swales, detention ponds, berms, and other drainage features.
- Settlement of intermediate cover areas, final cover areas, perimeter ditches, chutes, swales, and other drainage features.
- Silt and sediment build-up in perimeter ditches, chutes, swales, and detention ponds. Removed silt and sediment used as daily cover or to replenish intermediate cover soils.
- Obstructions in drainage features.
- Presence of erosion or sediment discharge at offsite stormwater discharge locations.
- Presence of sediment discharges along the site boundary in areas which have been disturbed by site activities.

Maintenance activities will be performed to correct damaged or deficient items noted during the site inspections. These activities will be performed as soon as possible after the inspection. The time frame for correction of damaged or deficient items will vary based on weather, ground conditions, and other site-specific conditions.

Maintenance activities will consist of the following, as needed:

- Vegetation reestablishment.
- Placement, grading, and stabilization of additional soils in eroded areas or in areas which have settled.
- Replacement or repair of riprap or other surface lining materials.
- Placement of additional riprap in eroded areas.
- Removal of obstructions from drainage features.
- Removal of silt and sediment build-up from drainage features.
- Repairs to erosion and sedimentation controls.
- Installation of additional erosion and sedimentation controls.

3.0 DRAINAGE SYSTEM DESIGN

3.1 Methodology

Drainage calculations for the final cover system erosion control structures and perimeter drainage system are based on the peak flow rates resulting from the 25-year frequency rainfall event for the area. 100-year frequency rainfall calculations are also included in this analysis as a point of comparison to the currently permitted condition. The United States Army Corps of Engineers (USACE) HEC-1 computer program was used to compute peak flow rates produced from the design storm. The hydraulic methods employed in this study are consistent with those presented in the TCEQ Guidelines for Preparing a Surface Water Drainage Report for Municipal Solid Waste Facility (RG-417, May 2018) and TxDOT Hydraulic Manual, September 201.

Water surface profiles were determined for the perimeter channels using the Channel Analysis Program (Bentley FlowMaster V8i) that is based on Manning's formula for uniform flow. The perimeter channels are designed to collect and route runoff from the 25-year frequency storm event to the detention pond.

3.2 Hydrologic Analysis

3.2.1 Description of Computer Program

HEC-1 was developed by the USACE Hydrologic Engineering Center to simulate the surface runoff response of a watershed. The HEC-1 model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of stream-flow hydrographs at desired locations in the watershed. The hydrologic analysis for the proposed (post-development) condition is presented in Appendix IIIH-B. The hydrologic analysis for the permitted landfill completion condition is included in Appendix IIIH-A.

3.2.2 Watershed Subareas and Schematization

The landfill areas that contribute flow to each discharge point were delineated into subareas to derive peak flow rates for the design of the perimeter channel and final cover drainage letdowns. Hydrographs are developed for each subarea and appropriately combined and routed through the swales and perimeter channels. The subareas are shown on Drawing IIIH-A-16 for the permitted condition and Drawing IIIH-B-4 for the proposed completion condition.

Offsite areas (areas outside the permit boundary) incorporated into the hydrologic analyses as appropriate have been delineated using topography obtained from the United States Geological Survey 7.5-Minute Quadrangle for Del Rio, TX. The offsite drainage area delineation is shown on Drawing IIIH-A-15 in Appendix IIIH-A.

3.2.3 Time Step

The time step, or the program computation interval, is the time interval at which the flow rates for the hydrographs are generated by the program. Time step used for a design storm event hydrograph generation is 5 minutes.

3.2.4 Hypothetical Precipitation

The hypothetical storm data used in the post-project analysis was obtained from the National Oceanic and Atmospheric Administration Atlas Precipitation-Frequency Atlas 14 of the United Sates, Volume 11

Version 2.0 for the project area. This data is different from the data used to create the existing permitted analysis. To make the comparison between existing and proposed, the existing permitted condition was modified to be consistent with the hypothetical precipitation data in the post-development condition. For both conditions design storm event analysis, a return period (frequency) of 25 years and a duration of 24 hours is used. Additionally, a 100-year storm evaluation has also been included. The precipitation is assumed to be evenly distributed over the entire area modeled for each time interval.

3.2.5 Precipitation Losses

Precipitation losses (the precipitation that does not contribute to the runoff) are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. CN is a function of soil cover, land use, and antecedent moisture conditions. A CN of 86 was selected to represent the final cover side slopes, and a CN of 85 was selected for final cover top dome surfaces. A CN of 100 was used for the detention pond areas. Further discussion on selection of CN values is provided in Appendix IIIH-A and IIIH-B for the permitted and post-development conditions respectively.

3.2.6 Hydrograph Information

Two different types of hydrograph generation methods have been used in the drainage analyses: distributed runoff methods and the Snyder unit hydrograph method using the Espey "10-Minute" method for parameter estimation. Muskingum-Cunge and pond storage discharge methods were used for hydrograph routings. Example hydrograph development information for both distributed runoff and Snyder unit hydrograph methods is provided in Appendix IIIH-A and Appendix IIIH-B.

3.2.6.1 Distributed Runoff Methods

The distributed runoff method (e.g., kinematic wave method) is applicable to small-water catchments with uniformly sloped overland flow plains that drain into channels. Landfill final cover areas consist of relatively short (typically 120 feet on 4H:IV or 5H:IV side slopes) overland flow lengths that drain into landfill final cover swales. Distributed runoff estimation methods are applicable to landfill final cover areas because of the following:

- These methods were developed for uniform slopes that drain to collection channels. For a landfill final cover area, this translates to an overland flow segment of final cover that drains to a swale.
- These methods were developed for a network of relatively small drainage areas. Typically, to design the various perimeter channels, landfill drainage areas need to be subdivided to determine a peak flow at several points.
- These methods are also inherently conservative because it is based on watershed dimensions as opposed to other methods that use empirical information. Also, this method is conservative because flow attenuation is not accounted for.
- This method is also more conservative than the rational method because watershed lag time is computed as a function of real flow time without any limitations such as using a minimum time of concentration (i.e., 10 minutes), which is common practice for the rational method.

The kinematic wave method has been used for estimating peak runoff rates from the landfill final cover areas. A hydrograph from each drainage area with channelized flow (e.g., landfill final cover areas to swales) was developed using the kinematic wave method to simulate both overland and channelized flow. This method utilizes a simplified form of the energy equation and is based on the characteristics of the

drainage area, swale, or channel. This method uses physical (measurable) characteristics (e.g., flow lengths, slopes, surface roughness coefficients, channel cross sections) of a watershed to estimate peak discharges.

3.2.6.2 Snyder Unit Hydrograph Method

The Snyder unit hydrograph method has been used mainly for non-landfill drainage areas (e.g., offsite drainage areas). The method is applicable to drainage areas with a wide range of characteristics. Several different methods have been developed to estimate Snyder unit hydrograph parameters (watershed lag and peaking coefficient). Espey "10-Minute" method was used in this project to estimate Snyder unit hydrograph parameters. The Espey "10-Minute" method was developed using flow records from 41 different watersheds in Texas and other states. The main advantage of the Espey "10-Minute" method is that it is one of the most widely used and accepted methods for determining hydrograph input values for small-size drainage areas.

3.2.6.3 Hydrograph Routing

The Muskingum-Cunge Method (RD record in HEC-1) was used for routing of the flood wave through the drainage channels. This method is capable of accounting for hydrograph attenuation based on physical channel properties such as length, bottom slope, channel shape, and channel roughness.

Hydrographs at pond outlets were generated by routing the combined incoming flow hydrographs through the ponds. Pond routings (RS - Storage Routing record in HEC-1) were performed by using storage/elevation relationships for each pond by defining pond surface area versus depth. Additionally, discharge structure (low level outlet and spillway) characteristics of each pond are used for pond routing.

3.3 Hydraulic Analysis

3.3.1 Swale and Channel Analysis

Drainage structure details are illustrated on Drawings IIIH.3 through IIIH.6. The swales and channels are designed to convey the peak flow rate generated by the design storm event. These swales and channels will also reduce maintenance at the site after closure by minimizing erosion.

Hydraulic analyses of the swales and channels are conducted using Manning's uniform flow formula. The uniform flow assumption is applicable to long prismatic channels of uniform slope, as proposed at the site.

The general form of Manning's equation is:

$$V = \frac{1.49\ R^{0.667}\ S^{0.5}}{n}$$

In which,

$V = Velocity\ of\ flow, fps\ (feet\ per\ second)$

$n = Manning's$ n $(unitless)$

$R = \frac{A}{P} = Hydraulic\ Radius, ft\ (feet)$

$S = Friction\ slope\ for\ nonuniform\ flow\ or\ channel\ slope\ for\ uniform\ flow, ft/ft$

$A = Area\ of\ water\ perpendicular\ to\ direction\ of\ flow, sf\ (square\ feet)$

$P = Wetted\ perimeter, ft$

Using the relationship:

$Q = V\ A$

$Q = Flow, cfs\ (cubic\ foot\ per\ second)$

Manning's equation can be written as:

$$Q = \frac{1.49\ A\ R^{0.667}\ S^{0.5}}{n}$$

The uniform flow assumption equates the channel slope to the friction slope; therefore, the slope of the channel can be used for "S" in Manning's formula for computation of uniform flow.

Typical values for Manning's "n" are presented in the 2019 TXDOT Bridge Division Hydraulic Manual ("Suggested Manning's Roughness Coefficients" Table, Chapter 6, Section 1). A value of 0.030 is used for "n" for swales, a value of 0.040 is used for gabion-lined chutes, and a value of 0.030 is used for perimeter channels. These values represent typical roughness coefficients to the proposed drainage structures, after vegetation has become established.

3.3.2 Drainage Letdown Structure (or Chute) Analysis

A typical chute detail is illustrated on Drawing IIIH.3. The final cover drainage letdown structures are designed to convey the flow rate generated by the design storm event. Hydraulic analysis of the letdown structures is conducted under the principles of tumbling flow. Tumbling flow is a function of channel slope, discharge, spacing and sizing of energy dissipating elements. The tumbling flow regime consists of a series of hydraulic jumps and overfalls that maintain critical velocity down the chute. The spacing and sizing of the energy dissipators controls the velocity and flow of the water in the chutes, thereby reducing erosive conditions at slope transitions with the perimeter road low water crossings and chute/perimeter channel confluences.

4.0 DRAINAGE PATTERNS

Consistent with Title 30 TAC §330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a), this section provides a demonstration showing that the proposed landfill development will not adversely alter the existing permitted landfill completion condition drainage patterns. The appendices containing the two drainage conditions analyzed are listed below.

- Appendix IIIH-A (Permitted Condition Hydrologic Calculations) This appendix contains the updated HEC-1 modeling based on the new permit boundary. Section 4.3.1 includes a discussion of additional analyses performed to facilitate a comparison between the existing permitted and post-development conditions.
- Appendix IIIH-B (Post-Development Condition Hydrologic Calculations) - This appendix contains analysis and supporting calculations for the proposed configuration of the site after development of the expanded landfill is complete.

The following two sections discuss: (1) site drainage patterns and (2) effect of the proposed development on peak flows, volumes, and velocities discharged from the site.

4.1 Site Drainage Patterns

The permitted and post-development site drainage patterns are detailed on Figure IIIH.1 – Site Drainage Patterns. As shown on Figure IIIH.1, the post-development drainage patterns are consistent with the currently permitted drainage patterns. The drainage patterns that include the discharge points at the permit boundary and individual runon locations (locations where upstream offsite areas flow onto the permit boundary) for both the permitted and proposed conditions are the same.

4.2 Comparison of Permitted and Post-Development Analyses

As noted in Section 1.2, to comply with Title 30 TAC §330.63(c)(1)(C), the proposed landfill completion condition is compared to the existing permitted condition of the landfill to demonstrate that the continued development of the landfill will not adversely alter the existing permitted drainage patterns. The permitted condition hydrologic models that were developed in 2020 did not take into account the 75-acre expansion area. The expansion area will add a discharge point for the site and change the flow rates at some of the permitted discharge points. Therefore, to develop a direct comparison between the permitted and post-development conditions, new hydrologic models were developed for the existing condition utilizing the new drainage area boundary. This analysis is included in Appendix IIIH-A. The volume and velocity calculations for the existing condition have been updated based on the new hydrologic modeling.

The methods and input parameters used for the permitted and the post-development condition analysis are consistent with those used in recently approved TCEQ applications. To evaluate the impacts of the proposed improvements on the existing drainage patterns, a 25-year and 100-year hydrologic models were prepared to compare between the two site conditions. The peak flow rates at the permit boundary are calculated for the 25-year and 100-year return periods. The existing permitted and proposed hydrologic models are included in Appendix IIIH-A and IIIH-B respectively. To retain consistency, offsite areas OA1 and OA2 were assumed to be the same for both analyzed conditions. The peak flow rates, volumes, and velocities for the 25-year and 100-year return periods are shown and summarized in Table 4-1 and Figure IIIH.1 respectively.

4.2.1 Peak Flow Rates

As shown on Figure IIIH.1 and Table 4-1, the peak flow rates entering the permit boundary from OA1 and OA2 are identical for the permitted and post-development conditions. As discussed above, the offsite drainage areas are assumed to be identical for both conditions. Stormwater that enters the site from an off-site area and stormwater that is generated from within the permit boundary discharges at five separate locations along the permit boundary (DC1, DC2, DC3, DC4 and DC5 as shown on Figure IIIH.1). At these discharge points, the peak flow rates from the 25-year and 100-year frequency storm events that are discharged from the site for the post-development condition are all less than the permitted conditions.

4.2.2 Volumes

As shown on Figure IIIH.1, the volumes entering the permit boundary are consistent for the permitted and post-development landfill conditions. Runoff volumes are obtained from the hydrologic models and tabulated for each discharge point. The volume calculations are provided in Appendix IIIH-A and IIIH-B for the existing and post-development conditions respectively. As shown in Table 4-1, all the proposed condition volume runoff are less than the permitted condition. Therefore, the expansion does not adversely alter the existing volume runoff condition in this area.

4.2.3 Velocities

A summary of the 100-year frequency storm peak flow velocities that enter and exit the site are shown on Figure IIIH.1. As shown, the velocities at each discharge point are lower for the post-development condition compared to the permitted conditions except Discharge Point 4. Rip rap apron will be placed at the outlet structure to decrease the velocity prior to leaving the permit boundary. The calculations for the erosion control methods are included in Appendix IIIH-C. No adverse condition is created by the proposed condition. Velocity calculations are provided in Appendices IIIH-A and IIIH-B for the permitted conditions and post-development, respectively.

4.2.4 Summary

From the hydrologic evaluations of the permitted and proposed conditions, the existing drainage conditions at the permit boundary will not be adversely altered by the proposed development. Given that: (1) drainage patterns are not adversely altered, (2) design stormwater peak discharge rate at each of the discharge locations is less than the permitted discharge rate (and the post-development peak flows entering the site are equal to the permitted peak flows entering the site), (3) total volume of stormwater entering and leaving the permit boundary does not increase, and (4) the stormwater discharge outfall locations are consistent with the permitted configuration, it is concluded that the proposed landfill development will not adversely alter permitted drainage patterns consistent with Title 30 TAC 330.63(c)(1)(C), §330.63(c)(1)(D)(iii), and §330.305(a).

Table 4-1 Summary of 25-Year Hydrologic Analysis

	Discharge Point 1		Discharge Point 2		Discharge Point 3		Discharge Point 4		Discharge Point 5	
	Exist	Prop	Exist	Prop	Exist	Prop	Exist	Prop	Exist	Prop
Q – Flow Rate (cfs)	293.6	263.1	337.5	337.1	224.2	189.6	79.7	65.1	100.5	71.0
V – Velocity (fps)	4.1	3.9	4.6	4.6	7.8	6.6	6.0	9.2	5.2	4.6
Vol – Runoff Volume (ac-ft)	68.1	66.8	59.8	60.6	20.6	18.8	4.6	3.6	10.5	7.4

DISCHARGE POINT #1
Q_{100} = 425.0 CFS
V_{100} = 4.75 FPS
VOL_{100} = 112.4 AC-FT

DISCHARGE POINT #5
Q_{100} = 149.0 CFS
V_{100} = 5.82 FPS
VOL_{100} = 17.4 AC-FT

1-24" RCP

OA2
Q_{100} = 253.8 CFS
V_{100} = 3.75 FPS
VOL_{100} = 40.3 AC-FT

DISCHARGE POINT #4
Q_{100} = 121.4 CFS
V_{100} = 6.7 FPS
VOL_{100} = 7.6 AC-FT

DISCHARGE POINT #3
Q_{100} = 322.54 CFS
V_{100} = 11.2 FPS
VOL_{100} = 33.8 AC-FT

3-42" RCP

OA1
Q_{100} = 460.7 CFS
V_{100} = 4.52 FPS
VOL_{100} = 78.2 AC-FT

DISCHARGE POINT #2
Q_{100} = 510.2 CFS
V_{100} = 5.2 FPS
VOL_{100} = 99.1 AC-FT

DISCHARGE #1
Q_{100} = 375.3 CFS
V_{100} = 4.49 FPS
VOL_{100} = 110.2 AC-FT

GP-14 GP-15 GP-16 GP-17 GP-18 GP-13 GP-12 GP-1 GP-2 GP-3 GP-4 GP-5 GP-6 GP-7 GP-8 GP-9 GP-10

2-24" RCP

DISCHARGE #5
Q_{100} = 105.2 CFS
V_{100} = 5.2 FPS
VOL_{100} = 12.3 AC-FT

OA2
Q_{100} = 253.8 CFS
V_{100} = 3.75 FPS
VOL_{100} = 40.3 AC-FT

DISCHARGE #4
Q_{100} = 72.4 CFS
V_{100} = 10.2 FPS
VOL_{100} = 5.8 AC-FT

DISCHARGE #3
Q_{100} = 288.9 CFS
V_{100} = 10.0 FPS
VOL_{100} = 30.7 AC-FT

1-36" RCP
3-42" RCP

UV-1 UV-2

OA1
Q_{100} = 460.7 CFS
V_{100} = 4.52 FPS
VOL_{100} = 78.2 AC-FT

DISCHARGE #2
Q_{100} = 510.0 CFS
V_{100} = 5.2 FPS
VOL_{100} = 100.4 AC-FT

0 300 600
SCALE IN FEET

LEGEND

- PERMITTED PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- PERMITTED LIMIT OF WASTE
- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMIT OF WASTE
- 1090 — FINAL COVER GRADES
- 1084 — EXISTING GRADES
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 — EXISTING GAS PROBE
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 — EXISTING GAS VENT
- GP-5 — PROPOSED GAS PROBE
- UV-1 — PROPOSED GAS VENTS

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CITY OF DEL RIO TEXAS

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
2.	2ND TECHNICAL NOD	STV	03/ 2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

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CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

SITE DRAINAGE PATTERNS
RUNON/RUNOFF

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.1

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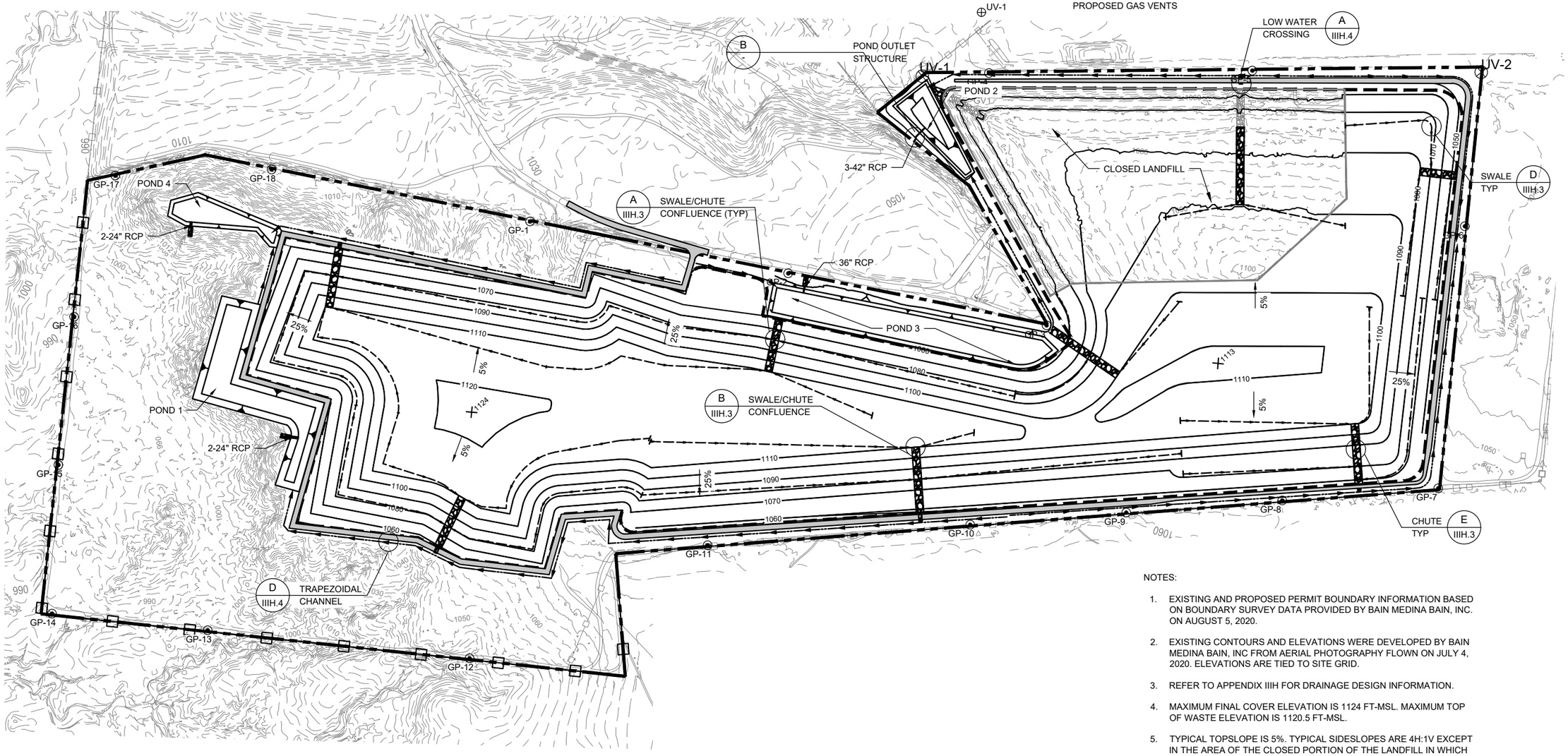
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- PERIMETER CHANNEL
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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TEXAS REGISTERED ENGINEERING FIRM TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS TEWOBSTA METAFERIA 123183 LICENSED PROFESSIONAL ENGINEER 03/07/2025

NO.	BY	DATE	REVISION
2.	STV	03/ 2025	2ND TECHNICAL NOD
1.	STV	08/ 2024	1ST TECHNICAL NOD

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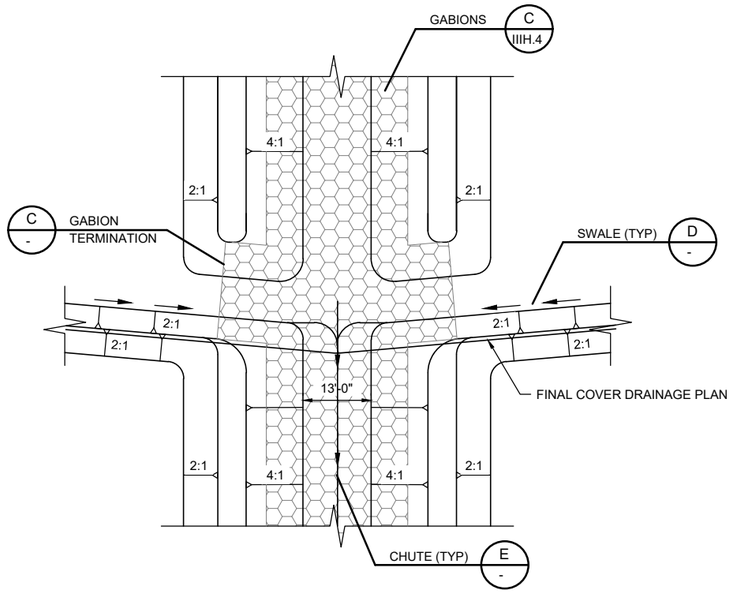
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MAJOR PERMIT AMENDMENT

DRAINAGE STRUCTURE PLAN

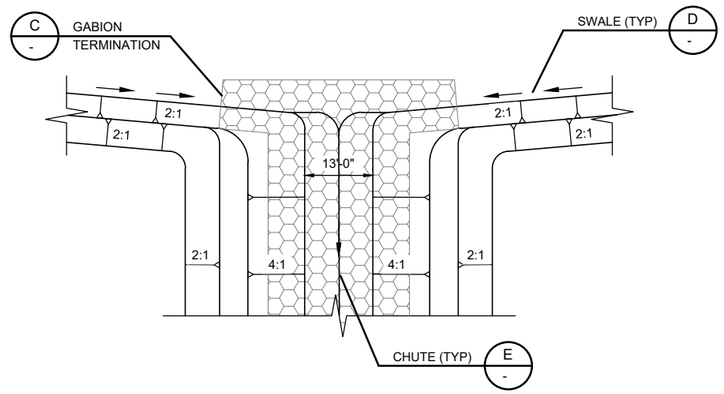
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DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.2

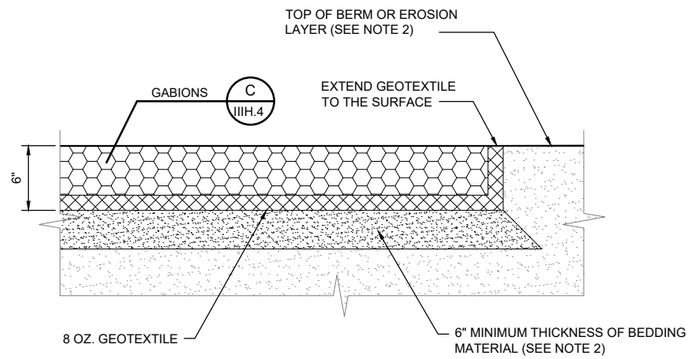
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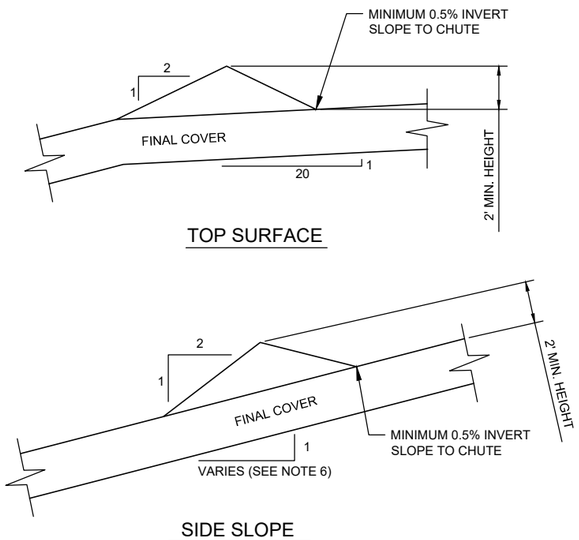
A SWALE/CHUTE CONFLUENCE (TYP)
NTS



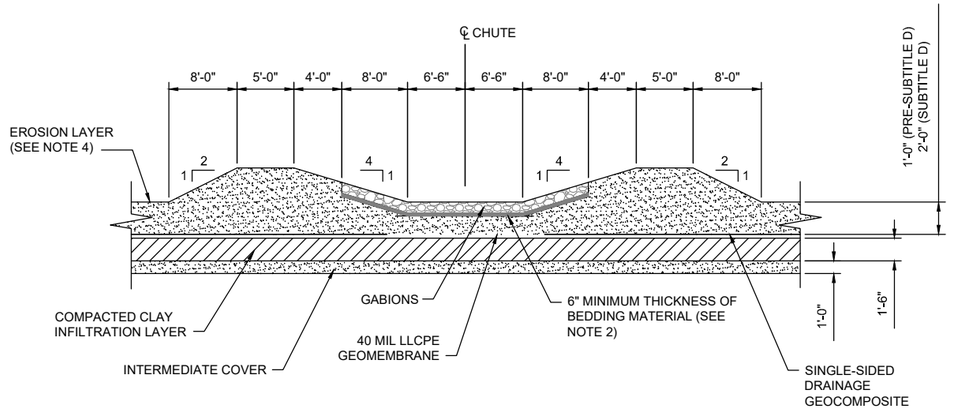
B SWALE/CHUTE CONFLUENCE (TYP)
NTS



C GABION TERMINATION
NTS



D SWALE (TYP)
NTS



E CHUTE DETAIL
NTS

NOTES:

1. REFER TO DRAWING IIIH.2 DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.
2. BEDDING MATERIAL WILL CONSIST OF CLAYEY SOILS COMPACTED TO PROVIDE FIRM BASE THAT WILL OVERLAIN BY 8 OZ/SY GEOTEXTILE PRIOR TO PLACEMENT OF GABIONS.
3. CHUTE DETAILS ARE SHOWN WITH 13 FEET OF BOTTOM WIDTH.
4. EROSION LAYER WILL BE CAPABLE OF SUSTAINING VEGETATIVE GROWTH.
5. THE EDGES OF THE INSTALLED GABIONS TIE EITHER TO THE TOP OF THE EROSION LAYER. (I.E., AT UPSTREAM END OF DRAINAGE LETDOWN) OR TO SOIL BERMS THAT ESTABLISH THE TOP OF THE DRAINAGE LETDOWN SIDE SLOPES.
6. THE SIDE SLOPES OF THE LANDFILL VARY FROM 20% TO 25% AS SHOWN ON FIGURE IIIH.2. SWALE CALCULATIONS ARE INCLUDED IN APPENDIX IIIH-D.

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08/07/2024
STATE OF TEXAS
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123183
LICENSED
PROFESSIONAL ENGINEER

NO	REVISION	BY	DATE
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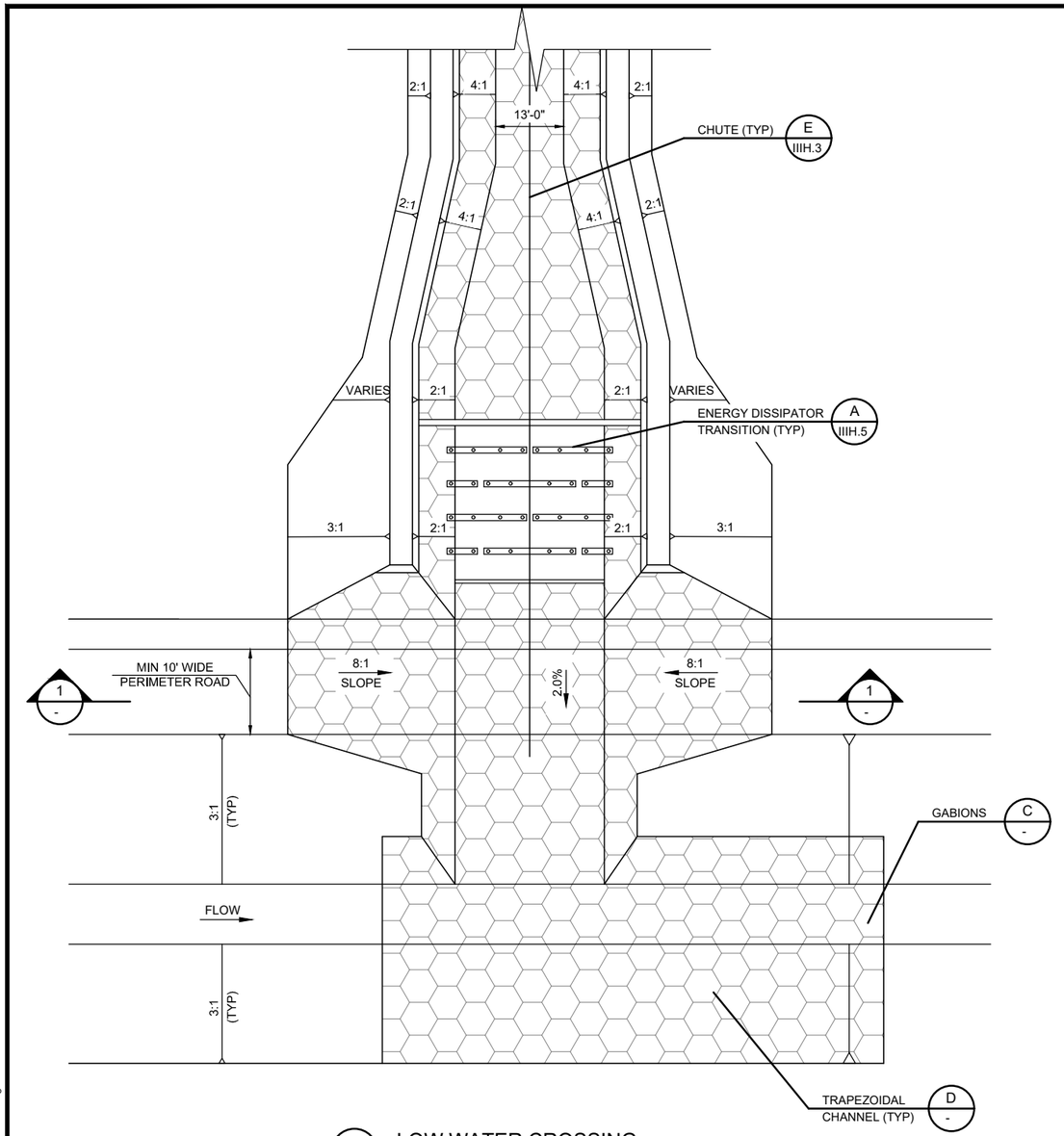
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

DRAINAGE DETAILS I

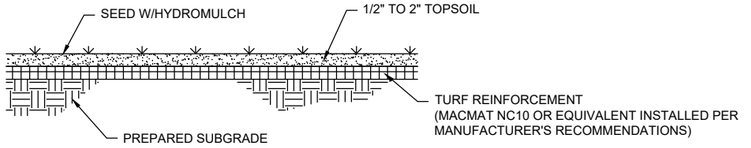
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DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.3

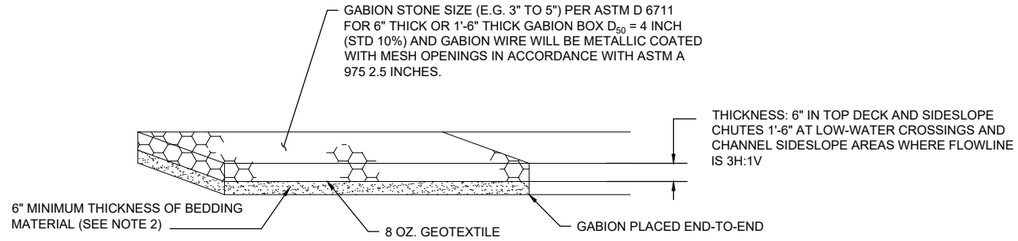
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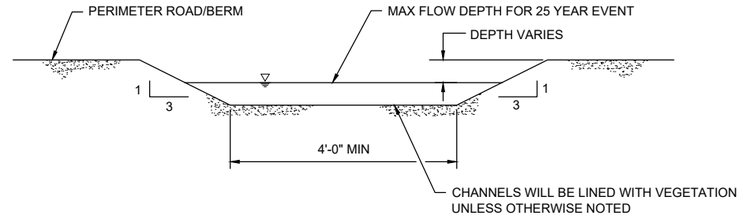
A LOW WATER CROSSING
NTS



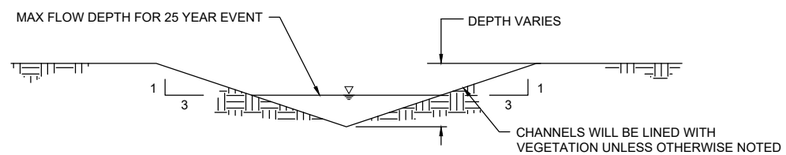
B TURF REINFORCEMENT
NTS



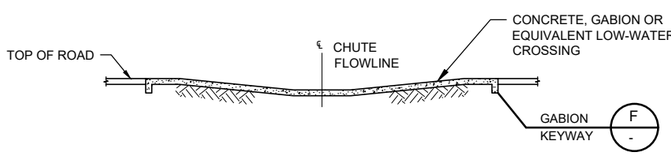
C GABIONS
NTS



D TRAPEZOIDAL CHANNEL (TYP)
NTS



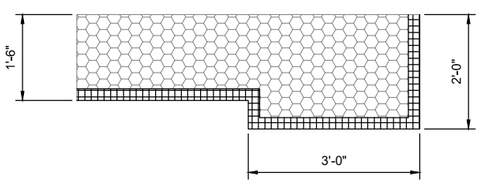
E "V" CHANNEL (TYP)
NTS



1 LOW-WATER CROSSING SECTION
NTS

NOTES:

1. REFER TO DRAWING IIIH-1 DRAINAGE STRUCTURE PLAN FOR LOCATION OF DETAILS.
2. BEDDING MATERIAL WILL CONSIST OF CLAYEY SOILS COMPACTED TO PROVIDE A FIRM BASE THAT WILL BE OVERLAIN BY 8 OZ/SY GEOTEXTILE PRIOR TO PLACEMENT OF GABIONS.



F GABION KEYWAY
NTS

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08/07/2024
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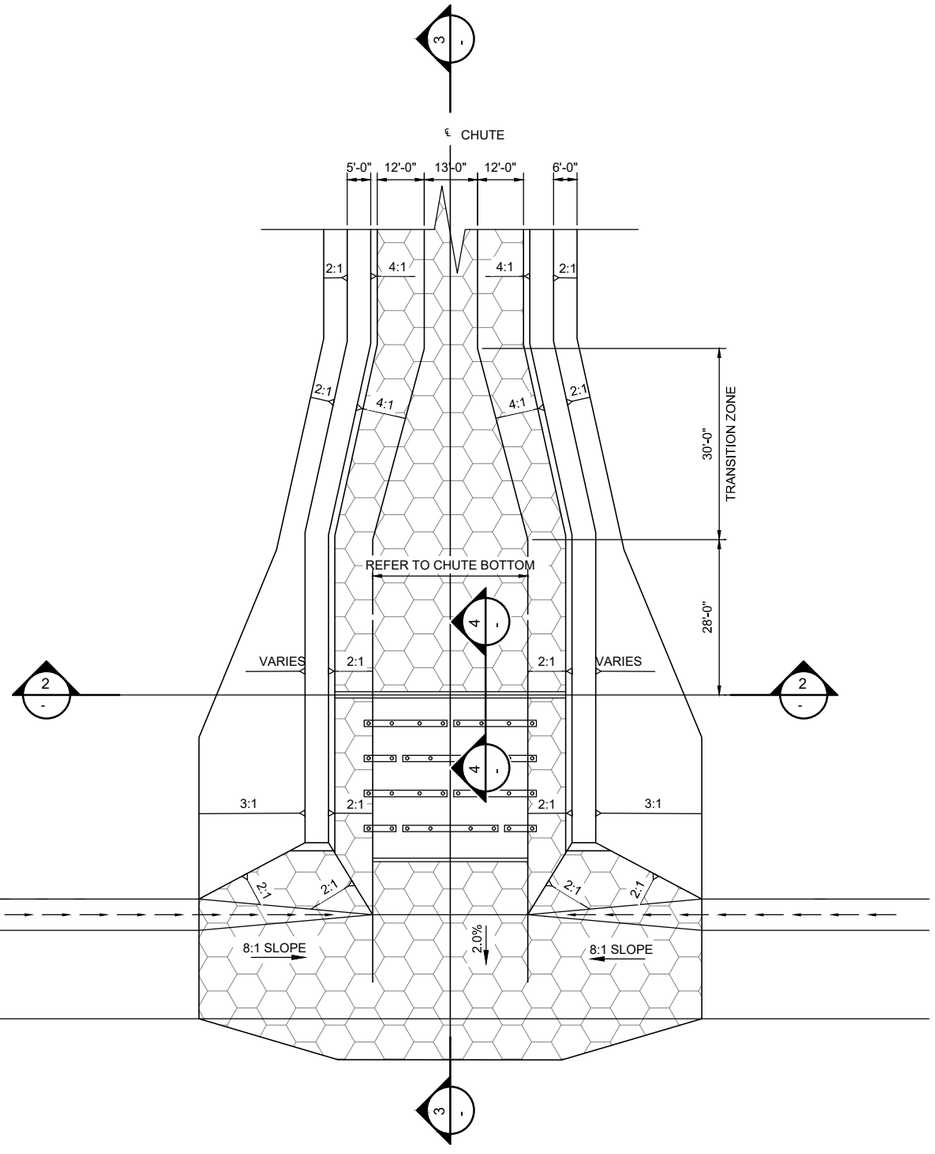
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DRAINAGE DETAILS II

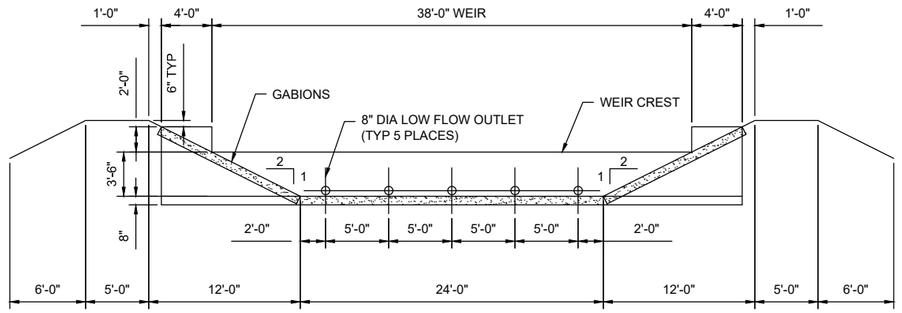
DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH.4

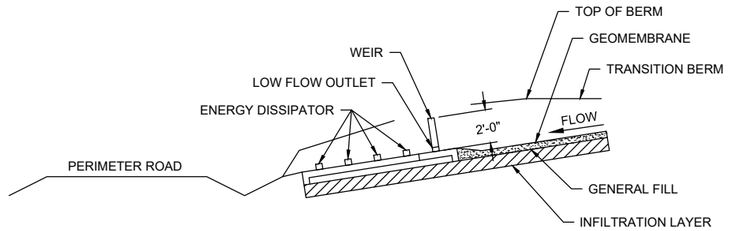
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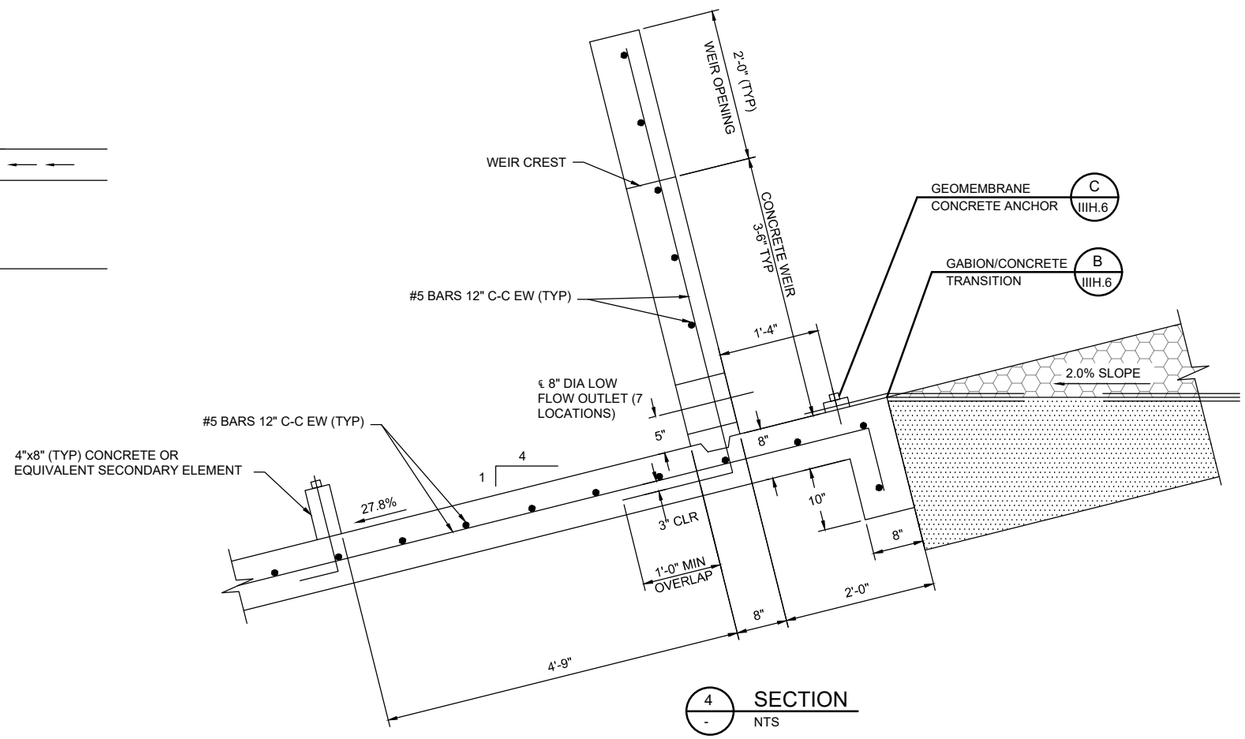
A ENERGY DISSIPATOR TRANSITION (TYP)
NTS



2 SECTION
NTS



3 SECTION
NTS



4 SECTION
NTS

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1" DRAWING. VERIFY LENGTH ON THIS SHEET
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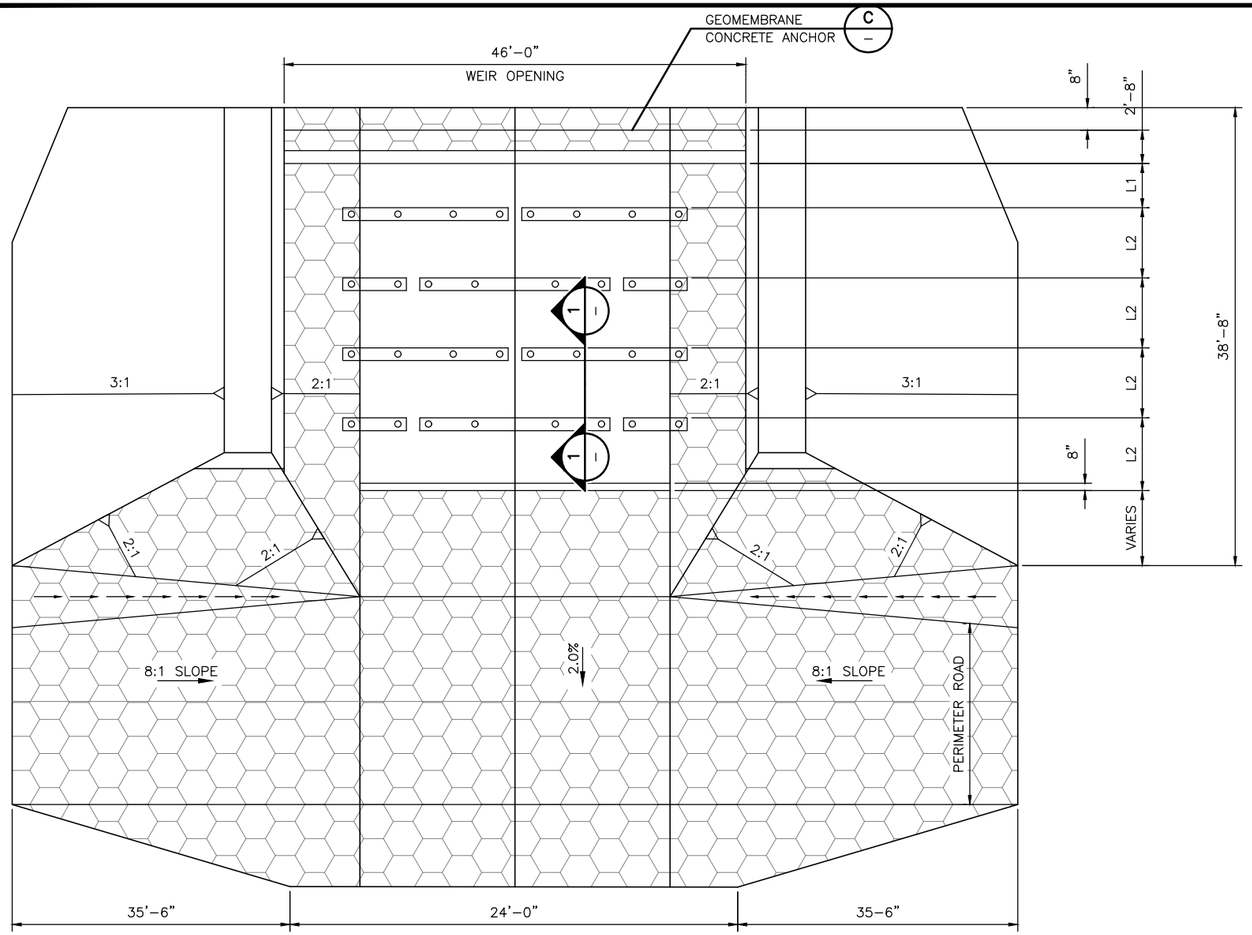
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DRAINAGE DETAILS III

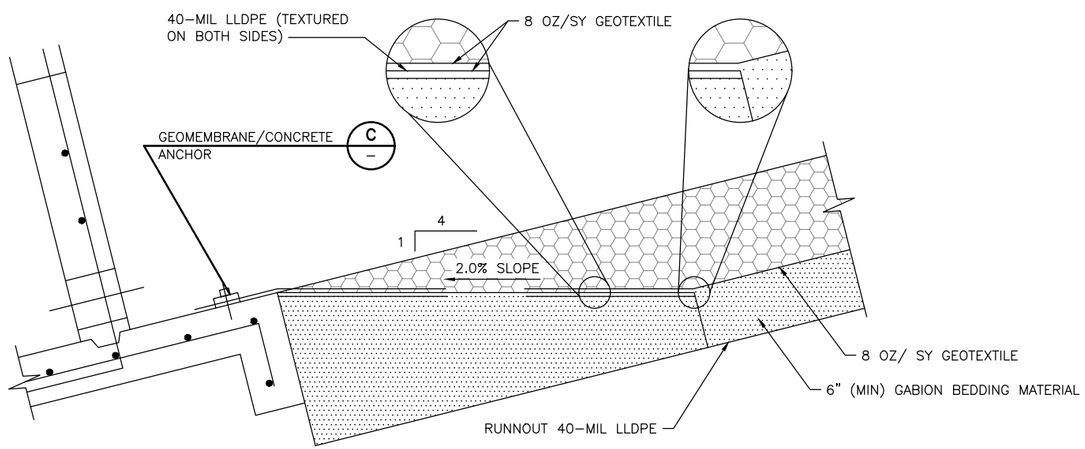
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DRAWN: T. METAFERIA
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CP&Y: DELR200302
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FIGURE
IIIH.5

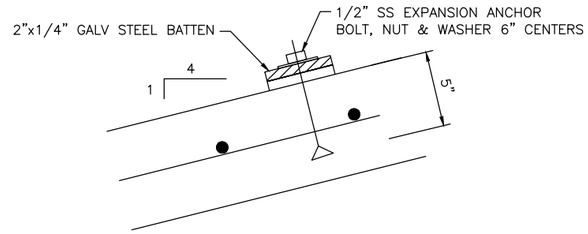
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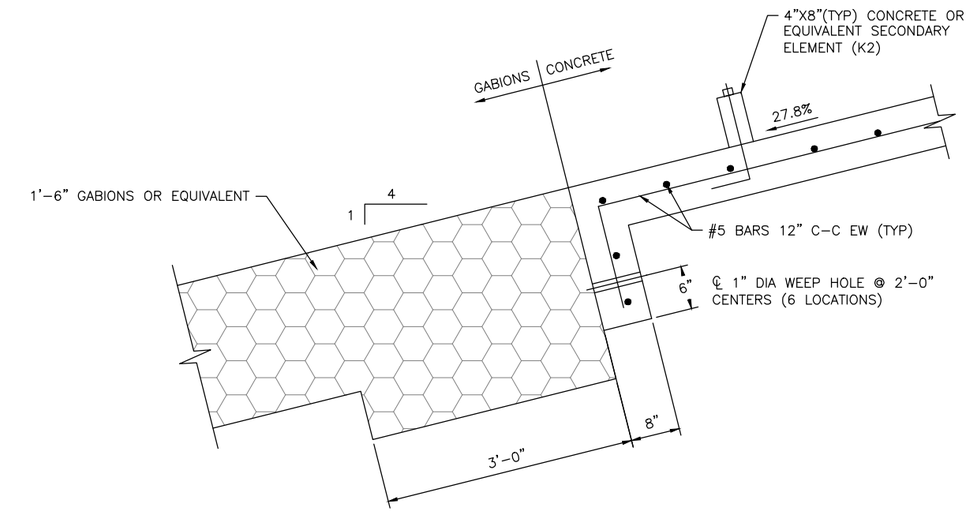
A ENERGY DISSIPATOR
NTS



B GABION/CONCRETE TRANSITION
NTS



C GEOMEMBRANE/CONCRETE ANCHOR
NTS



1 DISSIPATOR SECTION
NTS

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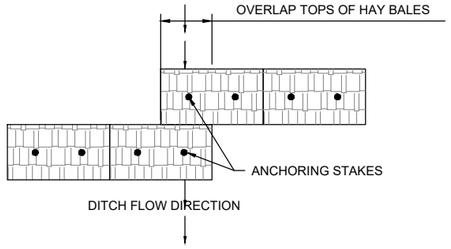
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DRAINAGE DETAILS IV

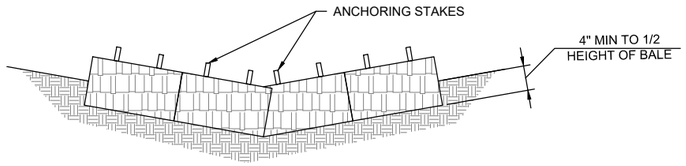
DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH.6

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FILE PATH: C:\pwworking\stv\pw_stvltmetaferia\d0942276\DELR2000302 Figure IIIH.6.dwg

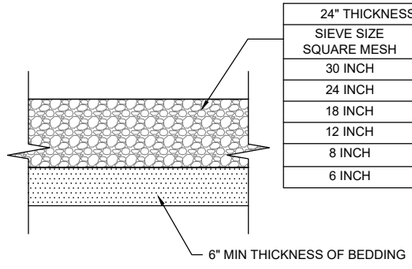


PLAN

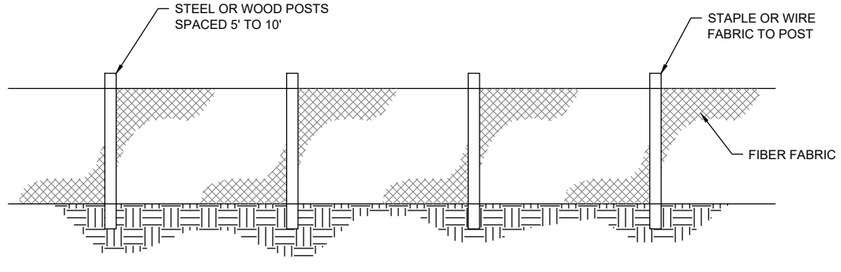


A BALED HAY FOR EROSION CONTROL
NTS

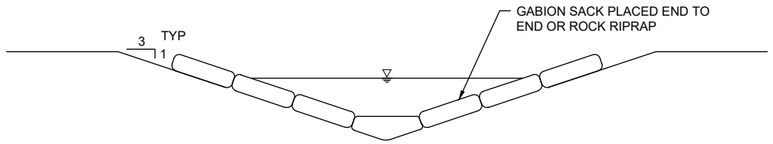
24" THICKNESS OF RIPRAP	
SIEVE SIZE SQUARE MESH	PERCENT PASSING
30 INCH	100
24 INCH	65-100
18 INCH	45-75
12 INCH	25-50
8 INCH	10-30
6 INCH	0-15



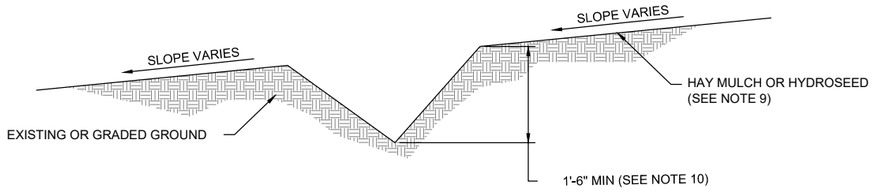
B ROCK RIPRAP
NTS



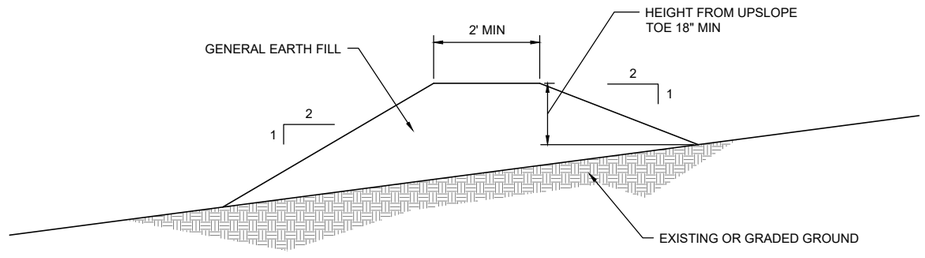
C TEMPORARY SEDIMENT CONTROL FENCE
NTS



D ROCK CHECK DAM
NTS



E TEMPORARY DIVERSION CHANNEL
NTS



F TEMPORARY DIVERSION BERM
NTS

NOTES:

1. BALED HAY MAY BE USED IN NEWLY ESTABLISHED COVER AREAS OR DISTURBED/REGRADED SURFACES TO MAINTAIN SHEET FLOW UNTIL VEGETATION IS ESTABLISHED.
2. ROCK RIPRAP MAY BE USED IN AREAS WHERE CONCENTRATED FLOW WITH HIGH VELOCITIES MAY OCCUR (E.G., CULVERT INLETS/OUTLETS).
3. A TEMPORARY SEDIMENT CONTROL FENCE MAY BE USED IN CAPTURING SEDIMENT TRANSPORTED BY SHEET FLOW AND FOR DIVERSION OF FLOW FOR CONTROLLING SEDIMENT DISCHARGE.
4. TURF REINFORCEMENT MAY BE USED ON NEWLY ESTABLISHED SURFACES SUCH AS INTERMEDIATE COVER AND IN CHANNELS WHERE MODERATELY HIGH FLOW VELOCITIES ARE EXPECTED.
5. A ROCK CHECK DAM MAY BE USED IN CHANNELS TO SLOW DOWN FLOW VELOCITIES AND IMPROVE SEDIMENT CAPTURE.
6. A TEMPORARY DIVERSION CHANNEL MAY BE USED FOR SHORTENING SHEET FLOW DISTANCES IN UNDEVELOPED AREAS OR IN LARGER CHANNELS TO PROVIDE MEANDERING AND SLOWER FLOW VELOCITIES TO PREVENT IN-CHANNEL EROSION.
7. A TEMPORARY DIVERSION BERM MAY BE USED IN ARES TO DIVERT FLOW FROM ENTERING STEEP SLOPED AREAS (E.G., TOP OF EXCAVATION) AND TO REDUCE SHEET FLOW LENGTHS.
8. A SWALE MAY BE USED IN AREAS TO DIVERT FLOW FORM ENTERING STEEP SLOPED AREAS (E.G., TOP OF EXCAVATION) AND TO REDUCE SHEET FLOW LENGTHS.
9. HAY MULCH AND HYDROSEED MAY ALSO BE USED FOR NEWLY ESTABLISHED SURFACES TO PROMOTE VEGETATION ESTABLISHMENT AND PREVENT EROSION.
10. THE VALUE SHOWN IS AT THE TIME OF CHANNEL INSTALLATION; CHANNEL WIDTH AND DEPTH MAY VARY.

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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
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DRAINAGE DETAILS V

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DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH.7

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FILE PATH: C:\pwworking\stv\pw_stv\metaferiaid0942276\DELR2000302 Figure IIIH.7.dwg

Appendix IIIH-A. Permitted Condition Hydrologic Calculations



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Velocity Calculations	IIIH-A-127

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Off Site Drainage Areas	IIIH-A-15
Permitted Condition Drainage Areas	IIIH-A-16



HYPOTHETICAL STORM DATA

Hypothetical Storm Data

Client: City of Del Rio
Project: Major Permit Amendment
Description: Hypothetical Storm Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - To collect data for hypothetical rainfall amounts.

Hypothetical Storm Data:

Time	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24 hr
25-Year	1.02	2.04	3.70	4.71	5.34	6.32	7.10	7.85
100-Year	1.43	2.76	5.19	6.82	7.90	9.54	10.80	11.90

Precipitation-Frequency Atlas of the United States, Volume 11 Version 2.0 (*National Oceanic and Atmospheric Administration Atlas 14, 2018*) was used to estimate precipitation storm events.

PRECIPITATION LOSS DATA

Precipitation Loss Data

Client: City of Del Rio
Project: Major Permit Amendment
Description: Precipitation Loss Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the SCS curve numbers for both on-site and off-site drainage areas for use in the HEC-1 analysis.**

Precipitation Loss Data:

Based on the soil survey information found on the *United StatesDepartment of Agriculture, National Resource Conservation Service, Web Soil Survey for Del Rio Country, Texas (http://websoilsurvey.nrcs.usda.gov)* , hydrologic group D soils predominate the soils within the permit boundary drainage area (see pages IIIH-A-5 through IIIH-A-8).

All on-site drainage areas and off-site drainage areas near the site (01, 02, DA1, and DA2) were considered pasture land in fair conditions. A curve number was selected using the table on page IIIH-A-11.

Approximate non landfill areas within the permit boundary on SCS map (page IIIH-A-5).

Use:	84

The final cover system was assumed to be in place and the erosion layer will control precipitation loss. A curve number that is corrected for the surface slope of the erosion layer may be computed first using the chart on page IIIH-A-11 to select an un-adjusted curve number.

Calculate the adjusted curve number.

Using equation 34 from *The Hydrolic Evaluation of Landfill Performance (HELP) Model - Engineering Documentation for version 3. EPA/600/R-94/168b,September 1994* (see page IIIH-A-10).

$$CN_{II} = 100 - (100 - CN_{IIo}) * (\frac{L^{*2}}{S^*})^{(CN_{IIo}^{-0.81})}$$

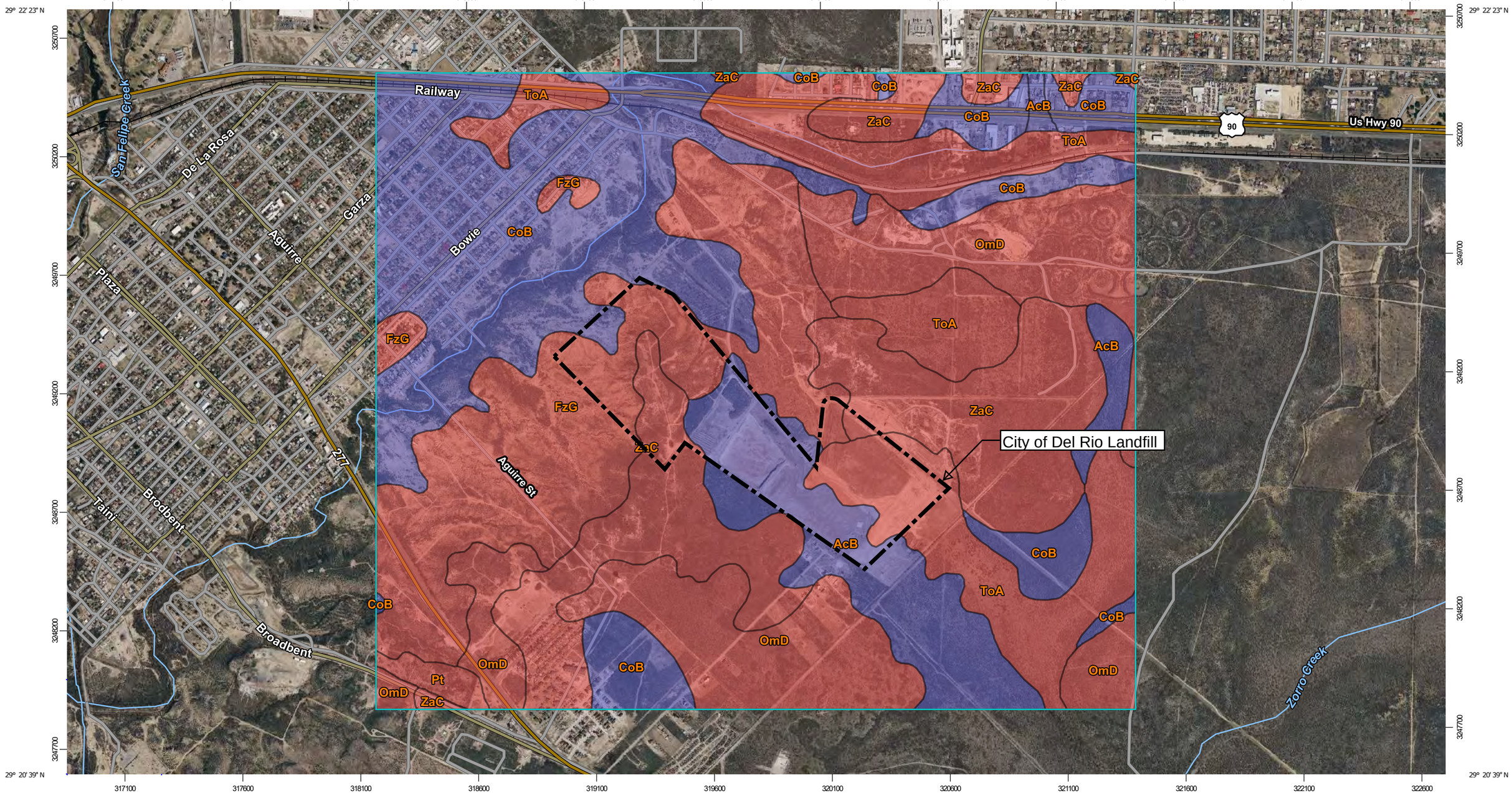
Use:	CN_{IIo} = 84	L* = 0.6	S* =	1.25	For top dome surfaces
Use:	CN_{IIo} = 84	L* = 0.4	S* =	6.25	For side slopes

Calculate:	CN = 85	For top dome surfaces
Calculate:	CN = 86	For side slopes

The pond areas are assumed to collect all precipitation for their areas:

Use:	CN = 100

Hydrologic Soil Group—Val Verde County, Texas



Map Scale: 1:15,700 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

IIIH-A-5

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Val Verde County, Texas
Survey Area Data: Version 20, Aug 24, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 11, 2021—Nov 23, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AcB	Acuna silty clay, 0 to 3 percent slopes	B	188.8	8.8%
CoB	Coahuila clay loam, 0 to 3 percent slopes	B	537.2	25.1%
FzG	Felipe and Zorra soils, very rocky, 8 to 40 percent slopes	D	380.9	17.8%
OmD	Olmos very gravelly loam, 1 to 8 percent slopes	D	346.6	16.2%
Pt	Pits	D	14.0	0.7%
ToA	Tobosa clay, 0 to 1 percent slopes	D	318.6	14.9%
ZaC	Zapata-Vinegarroon complex, 1 to 5 percent slopes	D	356.1	16.6%
Totals for Area of Interest			**2,142.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

where

CN_{II_o} = AMC-II curve number for mild slope (unadjusted for slope)

C_0 = regression constant for a given level of vegetation

C_1 = regression constant for a given level of vegetation

C_2 = regression constant for a given level of vegetation

IR = infiltration correlation parameter for given soil type

The relationship between CN_{II_o}, the vegetative cover and default soil texture is shown graphically in Figure 8. Table 7 gives values of C_0, C_1 *and* C_2 for the five types of vegetative cover built into the HELP program.

4.2.3 Adjustment of Curve Number for Surface Slope

A regression equation was developed to adjust the AMC-II curve number for surface slope conditions. The regression was developed based on kinematic wave theory where

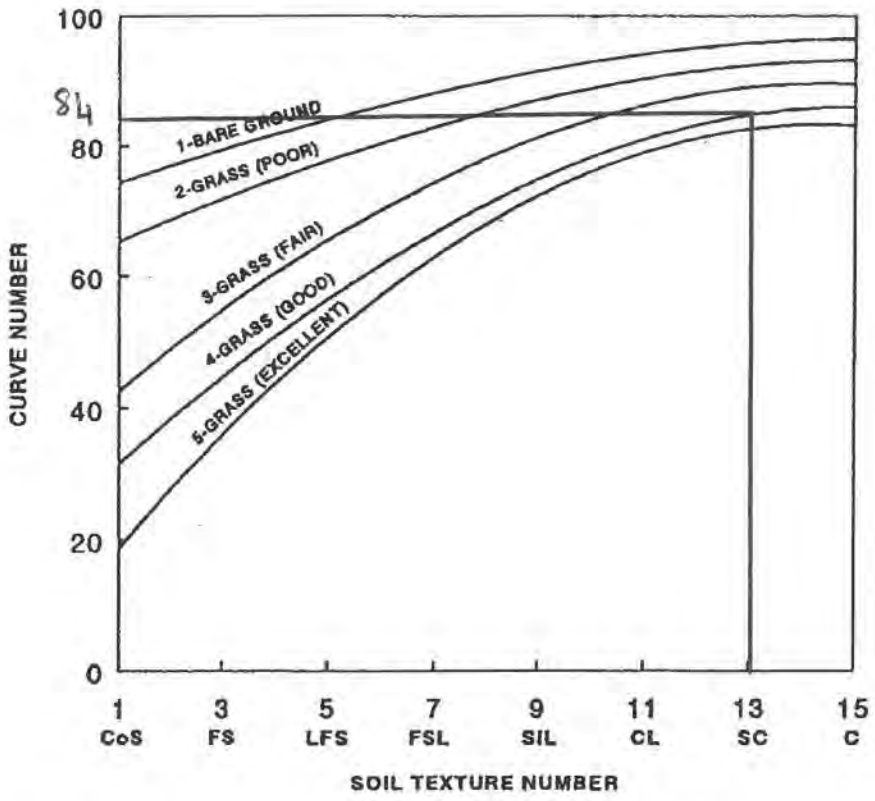


Figure 8. Relation between SCS Curve Number and Default Soil Texture Number for Various Levels of Vegetation

loam, and clayey loam as specified by saturated hydraulic conductivity, capillary drive, porosity, and maximum relative saturation. Two levels of vegetation were described--a good stand of grass (bluegrass sod) and a poor stand of grass (clipped range). Slopes of 0.04, 0.10, 0.20, 0.35, and 0.50 ft/ft and slope lengths of 50, 100, 250, and 500 ft were used. Rainfalls of 1.1 inches, 1-hour duration and 2nd quartile Huff distribution and of 3.8 inches, 6-hour duration and balanced distribution were modeled.

The resulting regression equation used for adjusting the AMC-II curve number computed for default soils and vegetation placed at mild slopes, CN_{II_o}, is:

$$CN_{II} = 100 - (100 - CN_{II_o}) \cdot \left(\frac{L^{*2}}{S^*}\right)^{CN_{II_o}^{-0.81}} \quad (34)$$

where

L^* = standardized dimensionless length, (L/500 ft)

S^* = standardized dimensionless slope, (S/0.04)

This same equation is used to adjust user-specified AMC-II curve numbers for surface slope conditions by substituting the user value for CN_{II_o} in Equation 34.

4.2.4 Adjustment of Curve Number for Frozen Soil

When the HELP program predicts frozen conditions to exist, the value of CN_{II} is increased, resulting in a higher calculated runoff. Knisel et al. (1985) found that this type of curve number adjustment in the CREAMS model resulted in improved predictions of annual runoff for several test watersheds. If the CN_{II} for unfrozen soil is less than or equal to 80, the CN_{II} for frozen soil conditions is set at 95. When the unfrozen soil CN_{II} is greater than 80, the CN_{II} is reset to be 98 on days when the program has determined the soil to be frozen. This adjustment results in an increase in CN_I and consequently a decrease in S_{mx} and S' (Equations 19, 26, and 30).

From Equations 19 and 21, it is apparent that as S' approaches zero, Q approaches P. In other words, as S' decreases, the calculated runoff becomes closer to being equal to the net rainfall which is most often, when frozen soil conditions exist, predominantly snowmelt. This will result in a decrease in infiltration under frozen soil conditions, which has been observed in numerous studies.

4.2.5 Summary of Daily Runoff Computation

The HELP model determines daily runoff by the following procedure:

TABLE 5.3 Values of SCS Curve Number for Rural Areas

Source: (McCuen, 1982)

Land Use Description	Hydrologic Soil Group			
	A	B	C	D
Fallow:				
Straight Row	77	86	91	94
Row Crops:				
Straight Row, Poor Condition	72	81	88	91
Straight Row, Good Condition	67	78	85	89
Contoured, Poor Condition	70	79	84	88
Contoured, Good Condition	65	75	82	86
Contoured and Terraced, Poor Condition	66	74	80	82
Contoured and Terraced, Good Condition	62	71	78	81
Small Grain:				
Straight Row, Poor Condition	65	76	84	88
Straight Row, Good Condition	63	75	83	87
Contoured, Poor Condition	63	74	82	85
Contoured, Good Condition	61	73	81	84
Contoured and Terraced, Poor Condition	61	72	79	82
Contoured and Terraced, Good Condition	59	70	78	81
Close-Seeded Legumes or Rotation Meadow				
Straight Row, Poor Condition	66	77	85	89
Straight Row, Good Condition	58	72	81	85
Contoured, Poor Condition	64	75	83	85
Contoured, Good Condition	55	69	78	83
Contoured and Terraced, Poor Condition	63	73	80	83
Contoured and Terraced, Good Condition	51	67	76	80
Pasture or Range:				
Poor Condition	68	79	86	89
Fair Condition	49	69	79	84
Good Condition	39	61	74	80
Contoured, Poor Condition	47	67	81	88
Contoured, Fair Condition	25	59	75	83
Contoured, Good Condition	6	35	70	79
Meadow, Good Condition	30	58	71	78
Woods or Forest Land:				
Poor Condition	45	66	77	83
Fair Condition	36	60	73	79
Good Condition	25	55	70	77
Farmsteads:	59	74	82	86

Initial and Uniform Loss Rate

An initial loss in inches (*STRTL*) and a constant loss rate (*CNSTL*) in inches per hour are specified for this method. All rainfall is lost until the volume of initial loss is satisfied. After the initial loss is satisfied, rainfall is lost at the constant rate.

This section provides guidance in selecting the values used for the initial loss and uniform loss rate in two ways:

1. By consulting previous studies of actual rainfall events for a particular watershed or region.
2. By relating the parameters to the SCS Curve Number, which can be estimated using the information presented earlier in this chapter.

Previous studies by the U.S. Army Corps of Engineers or other public agencies may provide guidance on selecting appropriate values for the initial loss and uniform loss rate for a particular location. Tables 5.4 through 5.6 list the values of initial and

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HYDROGRAPH DEVELOPMENT INFORMATION

1.0 HYDROGRAPH DEVELOPMENT INFORMATION

1.1 Landfill Areas

Direct runoff methods, (i.e., kinematic wave) have been used for the majority of the landfill final cover areas. The kinematic wave method has been used to model the 5 percent topslope areas and 25 percent side slope areas before the flow is intercepted by the drainage swales. The kinematic wave method is a physically based method using slope, surface roughness, catchment lengths and areas. This method does not consider attenuation for flood wave; as a consequence, this method provides for a conservative analysis. The following typical parameters for the kinematic wave method have been developed for landfill areas.

Kinematic wave parameters for overland flow:

Slope: Varies from 0.05 to 0.25 ft/ft landfill slopes

N: 0.30 Manning's friction coefficient (based on using a value between dense grass (N = 0.24) and Bermuda grass (N = 0.41) listed in Soil Conservation Services TR-55)

L: Represents a typical distance between swales for overland flow for each drainage area. For example, the swale spacing on 4H:1V sideslopes is 120 feet.

Percentage of drainage area represented by this element is 100 percent.

Kinematic Wave routing for channels:

- Channel length (ft): The length of the channel section.
- Channel slope (ft/ft): 0.0015 (0.005 for swales).
- Channel roughness coefficient: 0.03 for grass lined channels and swales.
- Channel type: A trapezoidal channel was used with varying width and 3:1 side slope ("V" ditch with varying side slopes for swales).

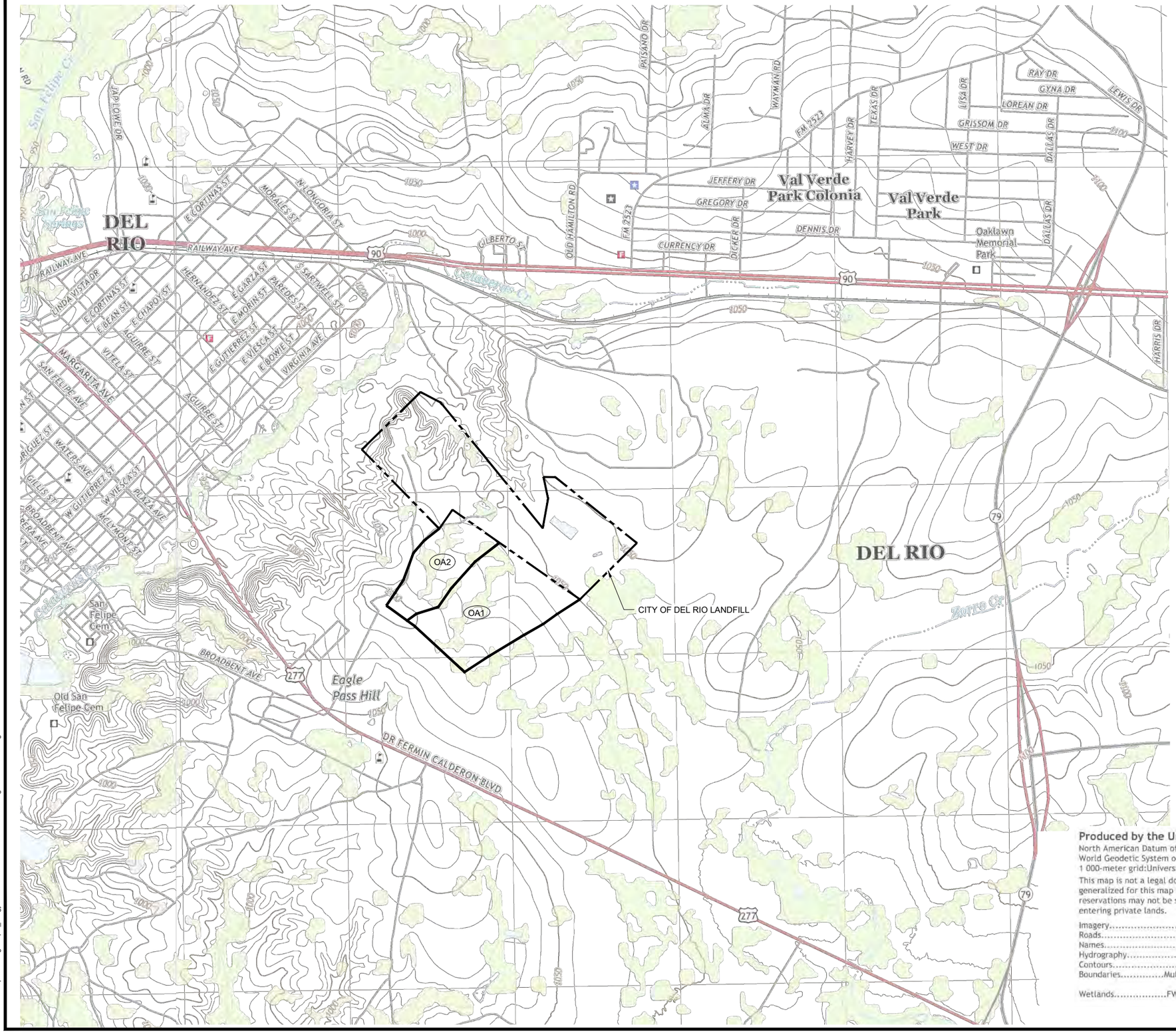
1.2 Non-Landfill Final Cover Areas

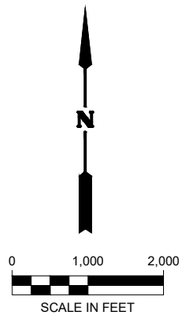
Hydrographs for the majority of non-landfill final cover areas within and near the permit boundary (e.g., pond areas) were developed using the Snyder unit hydrograph method. Espey "10-Minute" method has been used to estimate Snyder parameters. Snyder parameter estimations are provided on pages IIIH-B-19 through IIIH-A-20.

As discussed in Section 2 of Appendix IIIH, hydrographs for the areas outside of the permit boundary (01 and 02), and larger areas inside the permit boundary were developed using the Snyder unit hydrograph method. The percent imperviousness ranges from 2 percent to 89 percent, for the majority of the non-landfill on-site and off-site areas, which represents the majority of the watershed as undeveloped. Pond area are assumed to be 100 percent impervious, and areas with significant channel surface or paved surfaces were assigned higher percentages of impervious area.

1.3 Drainage Areas

The drainage areas used for this analysis are shown on Sheet IIIH-B-26. The routing scheme for the post-development condition is shown in the HEC-1 output file presented on pages IIIH-B-28 through IIIH-B-81.





LEGEND

- PROPERTY BOUNDARY
- DRAINAGE AREA BOUNDARY
- OA1 — DRAINAGE AREA DESIGNATION

DRAINAGE AREA NO.	AREA (ACRES)
OA1	94.95
OA2	48.93
TOTAL	143.88

Produced by the United States Geological Survey

North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 14R

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, August 2016 - November 2016
Roads.....U.S. Census Bureau, 2015 - 2018
Names.....GNIS, 1979 - 2008
Hydrography.....National Hydrography Dataset, 2003 - 2018
Contours.....National Elevation Dataset, 2006 - 2012
Boundaries.....Multiple sources; see metadata file 2016 - 2017

Wetlands.....FWS National Wetlands Inventory 1985

FOR PERMITTING PURPOSES ONLY

CP&Y
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS
TIMOTHY A. METAFERIA
123163
LICENSED
PROFESSIONAL ENGINEER
09/29/2023

NO.	REVISION	BY	DATE
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL
1" DRAWING. VERIFY LENGTH ON THIS SHEET
0 AND ADJUST SCALE ACCORDINGLY.

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

OFF SITE DRAINAGE AREAS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-A-15

PRINTED BY: MetaleT DATE: 9/21/2023
FILE PATH: C:\pwworking\stv\pw_stv\gjohnson\d0942276\DELR2000302 Figure IIIH-A-15.dwg

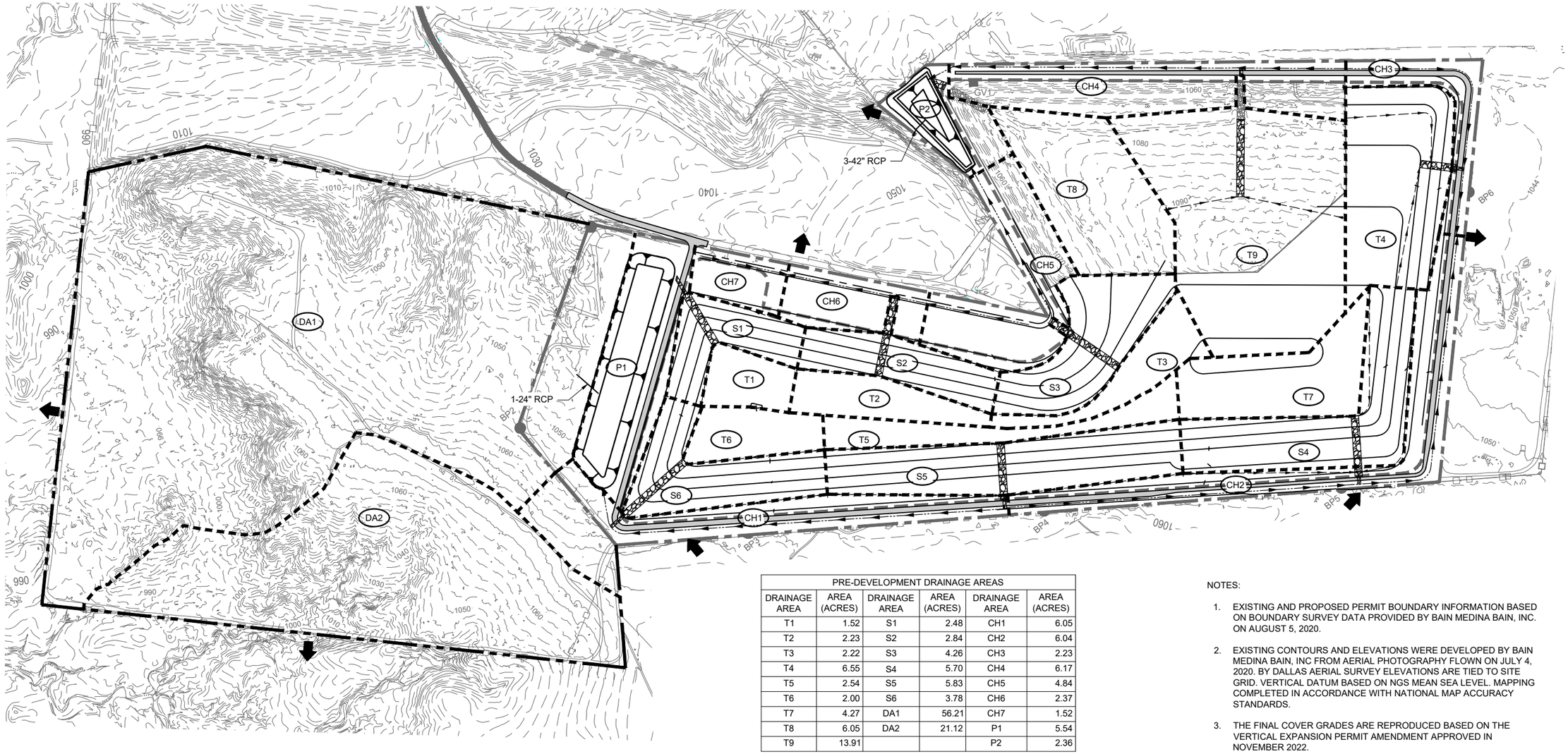
LEGEND

- T7 — DRAINAGE AREA DESIGNATION
- DRAINAGE BOUNDARY
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTES
- CHUTES
- PERMITTED PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- PERMITTED LIMIT OF WASTE
- 1090 — PERMITTED FINAL COVER GRADES
- 1060 — EXISTING GRADES
- SWALES
- PERIMETER CHANNEL

N

0 200 400

SCALE IN FEET



PRE-DEVELOPMENT DRAINAGE AREAS					
DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)
T1	1.52	S1	2.48	CH1	6.05
T2	2.23	S2	2.84	CH2	6.04
T3	2.22	S3	4.26	CH3	2.23
T4	6.55	S4	5.70	CH4	6.17
T5	2.54	S5	5.83	CH5	4.84
T6	2.00	S6	3.78	CH6	2.37
T7	4.27	DA1	56.21	CH7	1.52
T8	6.05	DA2	21.12	P1	5.54
T9	13.91			P2	2.36

NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE FINAL COVER GRADES ARE REPRODUCED BASED ON THE VERTICAL EXPANSION PERMIT AMENDMENT APPROVED IN NOVEMBER 2022.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

08/07/2024

NO.	REVISION	BY	DATE
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE 1" 0

BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

PERMITTED CONDITION
DRAINAGE AREAS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-A-16

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stv\pw_stv\tmetaferia\d0942276\DELR2000302 Figure IIIH-A-16_R.dwg

ESPEY 10-MINUTE METHOD PARAMETERS

ESPEY 10-Minute Method

Client: City of Del Rio
Project: Major Permit Amendment
Description: Unit Hydrograph Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Unit Hydrograph Data

Area No.	Area (acres)	Max. Flow Length (L) (ft)	S (ft/ft)	I (%)	Manning "n"[1]	ϕ[1]	T_r[2] (min)	T_{lag}[3] (min)	T_{lag} (hr)	Area (sq mi)	q_p[4] (cfs/sq mi)	C_p[5]
OA1	94.95	2461	0.016	2	0.04	0.86	36.4	33.9	0.57	0.1484	727.7	0.64
OA2	48.93	2336	0.017	2	0.04	0.86	35.5	33.0	0.55	0.0765	767.5	0.66
DA1	56.21	2420	0.031	2	0.04	0.86	30.8	28.3	0.47	0.0878	890.0	0.66
DA2	21.20	791	0.076	2	0.04	0.86	19.1	16.6	0.28	0.0331	1542.7	0.67

[1] Conveyance efficiency coefficient from Dodson & Associates Inc., *ProHec-1 Program Documentation* , 1995, pages 6-19 and 6-20.

[2] $T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\varphi^{1.57})$

[3] $T_{lag} = T_r - 5/2$

[4] $q_p = 31600(A^{-0.04})(T_r^{-1.07})$

[5] $C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

T_r = Surface runoff to unit hydrograph peak (min)
L = Distance along main channel from study point to watershed boundry (ft)
S = Main channel slope (ft/ft)
I = Impervious cover within the watershed (%)
T_{lag} = Watershed lag time (min)
q_p = Unit hydrograph peak discharge (cfs/sq mi)
C_p = Snyder's peaking coefficient

ESPEY 10-Minute Method

Client: City of Del Rio
Project: Major Permit Amendment
Description: Unit Hydrograph Data

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Unit Hydrograph Data: Sample Calculations

Drainage area "0A1" is used in this example.
Estimated Watershed specific parameters:

A =	94.95	acres	Watershed Area (acres)
L =	2461.0	ft	Maximum flow length with this watershed (ft)
S =	0.016	ft/ft	Watershed Slope (ft/ft)
I =	2	percent (%)	Watershed imperviousness
n =	0.04		Manning's coefficient

Calculate T_r, time beginning of surface runoff to the unit hydrograph peak in minutes:

$$Tr = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\phi^{1.57})$$

φ = 0.86 Estimate conveyance efficiency coefficient, see Figure 6.12 on page IIIF-A-20 for estimating. For 2 percent impervious cover and n = 0.04.

T_r = 36.4 minutes

Calculate T_{lag}, watershed lag time:

T_{lag} = Tr - (Δt/2) Δt is the calculation interval, and 5 minutes is used in the HEC-1 modeling in this project.

T_{lag} = 33.9 minutes
T_{lag} = 0.57 hours

A = A/640
A = 0.1484 sq. miles

Calculate q_p, peak discharge of unit hydrograph per unit area (cfs/sq. mi):

$$q_p = 31600(A^{-0.04})(T_r^{-1.07})$$

q_p = 727.7 cfs/sq.mi

Calculate peaking coefficient, C_p:

$$C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$$

C_p = 0.64

DISTRIBUTED RUNOFF METHOD KINEMATIC WAVE EXAMPLE

Kinematic Wave Method

Client: City of Del Rio
Project: Major Permit Amendment
Description: Kinematic Wave

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - Ditributed Runoff Method - Kinematic Wave Example:

Watershed Specific Parameters for drainage area T3

A =	8.99	acres	Watershed Area (acres)
A =	0.0140	sq-miles	Watershed Area (sq-miles)
CN =	85		SCS Curve Number (see sheet IIIH-H-4 for more information)

Kinematic Wave Parameters for overland flow:

L =	0	ft	Typical overland flow (ft)
S =	0.050	ft/ft	Landfill slope (ft/ft)
N =	0.30		Manning's Coefficient

Percentage of the drainage area represented by this element is 100 percent.

Kinematic Wave routing data for the swale:

L =	0	ft	Typicalswale length (ft)
S =	0.005	ft/ft	Swale bottom slope (ft/ft)
N =	0.03		Manning's Coefficient
Channel =	TRAP		Swale Type*

*A trapezoidal channel with no bottom width was used to simulate a triangular channel.

HEC-1 OUTPUT – PERMITTED 100-YEAR 24-HOURS STORM EVENT

```
1****************************************                 ****************************************
 *                                      *                 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                 *    U.S. ARMY CORPS OF ENGINEERS      *
 *        JUN 1998 AND FEB 2010         *                 *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1R              *                 *          609 SECOND STREET           *
 *       RGMHEC2000 WWW.HEC-1.COM       *                 *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   01AUG24  TIME  09:26:52   *                 *           (916) 756-1104             *
 *                                      *                 *                                      *
 ****************************************                 ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX  X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1           ID  DEL RIO LF EXPANSION
            2           ID  100-YR 24-HR
                        *DIAGRAM
            3           IT       5       0    2400     416       0       0
            4           IO       3       0       0
                        *

            5           KK      T6
            6           PH               0    1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90
            7           KO       0       0       0       7      21
            8           BA  0.0031
            9           LS       0      85
           10           UK     179    0.05     0.3     100
           11           RD     312   0.005    0.03            TRAP       0       2      NO
                        *

           12           KK      S6
           13           KO       0       0       0       7      21
           14           BA  0.0059
           15           LS       0      85
           16           UK   139.6    0.25     0.3     100
           17           RD   540.7   0.005    0.03            TRAP       0       2      NO
                        *

           18           KK    C/S6
           19           KO       0       0       0       7      21
           20           HC       2
                        *

           21           KK      T5
           22           KO       0       0       0       7      21
           23           BA  0.0040
           24           LS       0      85
           25           UK   175.7    0.05     0.3     100
           26           RD   437.6   0.005    0.03            TRAP       0       2      NO
                        *

           27           KK      S5
           28           KO       0       0       0       7      21
           29           BA  0.0091
           30           LS       0      86
           31           UK     160    0.25     0.3     100
           32           RD   437.6   0.005    0.03            TRAP       0       2      NO
                        *

           33           KK    C/S5
           34           KO       0       0       0       7      21
```

```
          35          HC       2
                      *
1                                        HEC-1 INPUT                                        PAGE  2

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          36          KK     OA2
          37          KO       0       0       7      21
          38          BA  0.0791
          39          LS       0      84
          40          US    0.55    0.66
                      *

          41          KK   C/CH1
          42          KO       0       0       7      21
          43          HC       3
                      *

          44          KK     CH1
          45          KO       0       0       7      21
          46          BA  0.0095
          47          LS       0      86
          48          UK      47    0.25     0.3     100
          49          RD    3079    0.02    0.03            TRAP      10       3     YES
                      *

          50          KK      T1
          51          KO       0       0       7      21
          52          BA  0.0024
          53          LS       0      85
          54          UK   166.5    0.05     0.3     100
          55          RD     305   0.005    0.03            TRAP       0       2      NO
                      *

          56          KK      S1
          57          KO       0       0       7      21
          58          BA  0.0039
          59          LS       0      86
          60          UK   158.6    0.25     0.3     100
          61          RD   521.8   0.005    0.03            TRAP       0       2      NO
                      *

          62          KK    C/S1
          63          KO       0       0       7      21
          64          HC       2
                      *

          65          KK      P1
          66          KO       0       0       7      21
          67          BA  0.0087
          68          LS       0     100
          69          UD       0
                      *

          70          KK    C/P1
          71          KO       0       0       7      21
          72          HC       3
                      *
1                                        HEC-1 INPUT                                        PAGE  3

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          73          KK    R/P1
          74          KO       0       0       7      21
          75          RS       1    ELEV    1044
          76          SA       0    1.58    1.85    2.10    2.35    2.61    2.87    3.14    3.41
          77          SE    1044  1044.2    1046    1048    1050    1052    1054    1056    1058
          78          SS  1056.5      10     2.6     1.5
          79          SL    1041    3.14     0.6     0.5
                      *

          80          KK     DA1
          81          KO       0       0       7      21
          82          BA  0.0878
          83          LS       0      84
          84          US     .32     .66
                      *

          85          KK  C/DP#1
          86          KO       0       0       7      21
          87          HC       2
```

```
                *
 88             KK      T7
 89             KO       0       0       0       7      21
 90             BA  0.0067
 91             LS       0      85
 92             UK   244.1    0.05     0.3     100
 93             RD   437.6   0.005    0.03            TRAP       0       2      NO
                *

 94             KK      S4
 95             KO       0       0       0       7      21
 96             BA  0.0089
 97             LS       0      86
 98             UK   175.6    0.25     0.3     100
 99             RD   643.6   0.005    0.03            TRAP       0       2      NO
                *

100             KK    C/S4
101             KO       0       0       0       7      21
102             HC       2
                *

103             KK     OA1
104             KO       0       0       0       7      21
105             BA  0.1492
106             LS       0      84
107             US    0.56    0.64
                *
1                                        HEC-1 INPUT                                        PAGE  4

           LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

108             KK   C/CH2
109             KO       0       0       0       7      21
110             HC       2
                *

111             KK     CH2
112             KO       0       0       0       7      21
113             BA  0.0094
114             LS       0      86
115             UK      47    0.25     0.3     100
116             RD     865    0.01    0.03            TRAP      10       3     YES
                *

117             KK      T4
118             KO       0       0       0       7      21
119             BA  0.0102
120             LS       0      86
121             UK   175.6    0.25     0.3     100
122             RD   696.8   0.005    0.03            TRAP       0       2      NO
                *

123             KK     CH3
124             KO       0       0       0       7      21
125             BA  0.0035
126             LS       0      86
127             UK   155.7    0.25     0.3     100
128             RD    1456    0.01    0.03            TRAP      10       3     YES
                *

129             KK  C/DP#2
130             KO       0       0       0       7      21
131             HC       2
                *

132             KK      T9
133             KO       0       0       7      21
134             BA  0.0217
135             LS       0      85
136             UK   919.3    0.05     0.3     100
137             RD     232   0.005    0.03            TRAP       0       2      NO
                *

138             KK     CH4
139             KO       0       0       0       7      21
140             BA  0.0096
141             LS       0      86
142             UK   155.8    0.25     0.3     100
143             RD    1064    0.01    0.03            TRAP      10       3     YES
                *
```

```
1                                        HEC-1 INPUT                                                PAGE  5

          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

           144      KK      T8
           145      KO       0       0       0       7      21
           146      BA  0.0095
           147      LS       0      85
           148      UK   359.7    0.05     0.3     100
           149      RD   720.5   0.005    0.03            TRAP       0       2      NO
                    *

           150      KK      T3
           151      KO       0       0       0       7      21
           152      BA  0.0035
           153      LS       0      85
           154      UK      49    0.05     0.3     100
           155      RD     535   0.005    0.03            TRAP       0       2      NO
                    *

           156      KK      S3
           157      KO       0       0       0       7      21
           158      BA  0.0067
           159      LS       0      86
           160      UK     160    0.25     0.3     100
           161      RD     304   0.005    0.03            TRAP       0       2      NO
                    *

           162      KK    C/S3
           163      KO       0       0       0       7      21
           164      HC       2
                    *

           165      KK     CH5
           166      KO       0       0       0       7      21
           167      BA  0.0076
           168      LS       0      86
           169      UK     200    0.25     0.3     100
           170      RD    1996    0.01    0.03            TRAP       2       2     YES
                    *

           171      KK      P2
           172      KO       0       0       0       7      21
           173      BA  0.0037
           174      LS       0     100
           175      UD       0
                    *

           176      KK    C/P2
           177      KO       0       0       0       7      21
           178      HC       4
                    *
1                                        HEC-1 INPUT                                                PAGE  6

          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

           179      KK    R/P2
           180      KO       0       0       0       7      21
           181      RS       1    ELEV    1034
           182      SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
           183      SE    1034  1034.2    1035    1036    1037    1038    1040    1042
           184      SS    1040      10     2.6     1.5
           185      SL  103328.86338     0.6     0.5
                    *

           186      KK      T2
           187      KO       0       0       0       7      21
           188      BA  0.0035
           189      LS       0      85
           190      UK      49    0.05     0.3     100
           191      RD     434   0.005    0.03            TRAP       0       2      NO
                    *

           192      KK      S2
           193      KO       0       0       0       7      21
           194      BA  0.0044
           195      LS       0      86
           196      UK     160    0.25     0.3     100
           197      RD     434   0.005    0.03            TRAP       0       2      NO
                    *
```

```
          198          KK    C/S2
          199          KO       0       0       0       7      21
          200          HC       2
                       *

          201          KK     CH6
          202          KO       0       0       0       7      21
          203          BA  0.0037
          204          LS       0      86
          205          UK     200    0.05     0.3     100
          206          RD     537    0.01    0.03            TRAP       2       2     YES
                       *

          207          KK     CH7
          208          KO      00       0       7      21
          209          BA  0.0024
          210          LS       0      86
          211          UK     210    0.05     0.3     100
          212          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

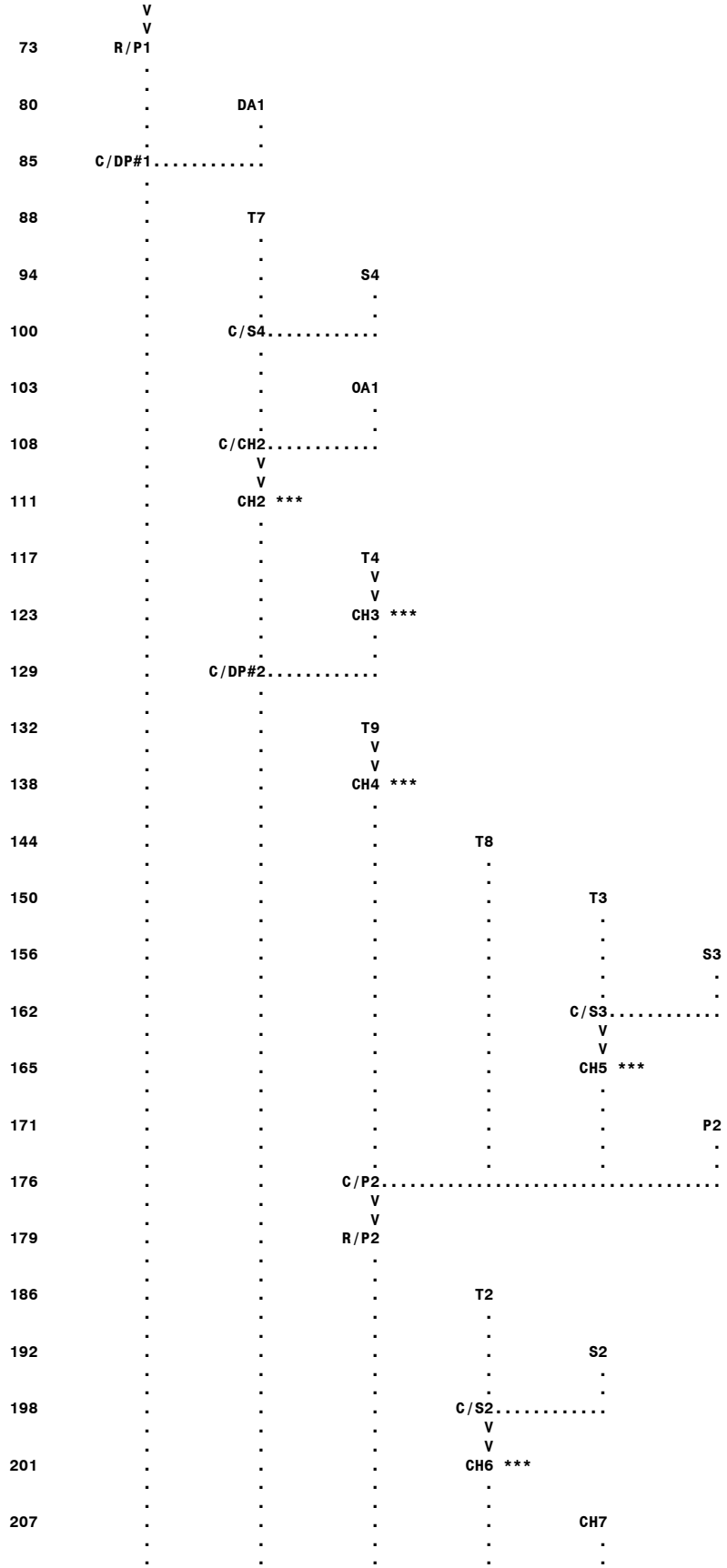
          213          KK  C/DP#4
          214          KO       0       0       0       7      21
          215          HC       2
                       *
1                                                HEC-1 INPUT                                                PAGE  7

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          216          KK  DP#5/DA2
          217          KO       0       0       0       7      21
          218          BA  0.0330
          219          LS       0      84
          220          US    0.29    0.66
          221          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

     5          T6
                .
                .
    12          .          S6
                .           .
                .           .
    18        C/S6...........
                .
                .
    21          .          T5
                .           .
                .           .
    27          .           .          S5
                .           .           .
                .           .           .
    33          .        C/S5...........
                .           .
                .           .
    36          .           .         OA2
                .           .           .
                .           .           .
    41       C/CH1.........................
                V
                V
    44         CH1 ***
                .
                .
    50          .          T1
                .           .
                .           .
    56          .           .          S1
                .           .           .
                .           .           .
    62          .        C/S1...........
                .           .
                .           .
    65          .           .          P1
                .           .           .
                .           .           .
    70        C/P1.........................
```


V
V
73 R/P1
80 DA1
85 C/DP#1
88 T7
94 S4
100 C/S4
103 OA1
108 C/CH2
111 CH2 ***
117 T4
123 CH3 ***
129 C/DP#2
132 T9
138 CH4 ***
144 T8
150 T3
156 S3
162 C/S3
165 CH5 ***
171 P2
176 C/P2
179 R/P2
186 T2
192 S2
198 C/S2
201 CH6 ***
207 CH7

```
  213          .          .          .     C/DP#4.............
               .          .          .          .
               .          .          .          .
  216          .          .          .          .      DP#5/D

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                                  ****************************************
*                                      *                                  *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                  *    U.S. ARMY CORPS OF ENGINEERS      *
*        JUN 1998 AND FEB 2010         *                                  *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1R              *                                  *          609 SECOND STREET           *
*       RGMHEC2000 WWW.HEC-1.COM       *                                  *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   17AUG24  TIME  09:26:52  *                                  *           (916) 756-1104             *
*                                      *                                  *                                      *
****************************************                                  ****************************************



                        DEL RIO LF EXPANSION
                        100-YR 24-HR

   4 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME         0000  STARTING TIME
                          NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      3    0  ENDING DATE
                      NDTIME        1035  ENDING TIME
                      ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   34.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
   5 KK      *        T6  *
             *            *
             **************

   7 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   8 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

   9 LS          SCS LOSS RATE
```

```
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  10 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L        179.  OVERLAND FLOW LENGTH
                        S       .0500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  11 RD           MAIN CHANNEL
                        L        312.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .00  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.10     35.80     28.14    724.81     10.01       .60
                    MAIN          1.63      1.33       1.40    312.00     26.46    724.88      8.83      3.71


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1656E+01 OUTFLOW= .1459E+01 BASIN STORAGE= .2888E-03 PERCENT ERROR=  11.8


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00                26.41    725.00      8.84

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T6

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     26.41     12.08                   2.63         .74         .51          .51
                         (INCHES)     7.889       8.840       8.842        8.842
                          (AC-FT)      1.30        1.46        1.46         1.46

                         CUMULATIVE AREA =    .00310 SQ MI   ACRES=            1.9840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
   12 KK      *         S6 *
              *            *
              **************

   13 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   14 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA
```

```
 6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .01

 15 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 16 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        140.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 17 RD            MAIN CHANNEL
                         L        541.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                               PEAK                  CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .51     27.92     61.36    724.63     10.01       .95
                   MAIN          1.63      1.33       1.99    270.35     60.39    724.73      9.82      4.53

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3152E+01 OUTFLOW= .3091E+01 BASIN STORAGE= .3316E-03 PERCENT ERROR=   1.9

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00               58.27    725.00      9.88

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S6

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     58.27     12.08                   5.46        1.57        1.09         1.09
                         (INCHES)     8.604       9.878       9.879        9.879
                          (AC-FT)      2.71        3.11        3.11         3.11

                         CUMULATIVE AREA =    .00590 SQ MI   ACRES=            3.7760


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                ***************
                *             *
 18 KK          *       C/S6  *
                *             *
                ***************

 19 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
```

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                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


  20 HC          HYDROGRAPH COMBINATION
                    ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION     C/S6

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    84.68     12.08                8.09        2.30        1.60         1.60
                     (INCHES)     8.357       9.520       9.521        9.521
                      (AC-FT)      4.01        4.57        4.57         4.57

                    CUMULATIVE AREA =    .00900 SQ MI   ACRES=            5.7600


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
  21 KK     *        T5  *
            *            *
            **************

  22 KO          OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  23 BA          SUBBASIN CHARACTERISTICS
                    TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                           STORM AREA =     .00

  24 LS          SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  25 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        176.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  26 RD            MAIN CHANNEL
                          L        438.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
```

```
                                        COMPUTATION TIME STEP
                  ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                  CELERITY
                                                    (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                 PLANE1        1.11      1.67       1.03     35.14     36.10    724.66      10.01       .59
                 MAIN          1.63      1.33       1.85    218.80     35.15    725.64       9.88      3.95

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2137E+01 OUTFLOW= .2108E+01 BASIN STORAGE= .3904E-03 PERCENT ERROR=   1.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN          1.63      1.33       5.00                 34.09    725.00      9.88

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       T5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     34.09     12.08                3.68        1.06         .74          .74
                        (INCHES)     8.550       9.877       9.878        9.878
                         (AC-FT)     1.82        2.11        2.11         2.11

                        CUMULATIVE AREA =    .00400 SQ MI   ACRES=            2.5600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   27 KK     *         S5 *
             *            *
             **************

   28 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   29 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

   30 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   31 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        160.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   32 RD            MAIN CHANNEL
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                        L        438.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                        COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                COMPUTATION TIME STEP
     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                     PEAK               CELERITY
                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

    PLANE1        2.48      1.67        .62     32.00     94.50    724.51      10.14      1.00
    MAIN          1.63      1.33       1.45    437.60     90.12    724.01       8.81      5.05

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4924E+01 OUTFLOW= .4276E+01 BASIN STORAGE= .3388E-03 PERCENT ERROR=  13.2

                                     INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00               88.10    725.00      8.82

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     88.10     12.08                 7.75        2.16        1.50         1.50
                        (INCHES)     7.922       8.818       8.819        8.819
                         (AC-FT)      3.84        4.28        4.28         4.28

                        CUMULATIVE AREA =    .00910 SQ MI   ACRES=            5.8240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
    33 KK    *      C/S5  *
             *            *
             **************

    34 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


    35 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S5

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    122.19     12.08                11.43        3.22        2.23         2.23
                        (INCHES)     8.112       9.141       9.142        9.142
                         (AC-FT)      5.67        6.39        6.39         6.39
```

```
                    CUMULATIVE AREA =    .01310 SQ MI   ACRES=           8.3840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  36 KK   *       OA2  *
          *            *
          **************

  37 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  38 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .08  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .08

  39 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  40 US          SNYDER UNITGRAPH
                        TP         .55  LAG
                        CP         .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                       ***

                                              UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .64 HR,       R=   .45 HR
                                         SNYDER   TP=   .55 HR,      CP=   .67

                                                  UNIT HYDROGRAPH
                                              33 END-OF-PERIOD ORDINATES
                    3.       13.       25.       38.       51.       59.       62.       59.       51.       43.
                   35.       29.       24.       20.       17.       14.       12.       10.        8.        7.
                    5.        5.        4.        3.        3.        2.        2.        1.        1.        1.
                    1.        1.        1.

        ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION      OA2

       TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
  +   (CFS)       (HR)
                          (CFS)
  +   253.41     12.58                 71.69       20.92       14.52       14.52
                           (INCHES)     8.426       9.837       9.837       9.837
                            (AC-FT)     35.55       41.50       41.50       41.50

                          CUMULATIVE AREA =    .07910 SQ MI   ACRES=           50.6240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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            **************
            *            *
   41 KK    *     C/CH1  *
            *            *
            **************

   42 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   43 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION    C/CH1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   306.04     12.08                91.10       26.45       18.35        18.35
                        (INCHES)     8.369       9.719       9.719        9.719
                         (AC-FT)    45.17       52.45       52.46        52.46

                       CUMULATIVE AREA =    .10120 SQ MI   ACRES=           64.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   44 KK    *       CH1  *
            *            *
            **************

   45 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   46 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

   47 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   48 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          47.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
```

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                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
   49 RD          MAIN CHANNEL
                         L      3079.  CHANNEL LENGTH
                         S      .0200  SLOPE
                         N       .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA        .01  CONTRIBUTING AREA
                     SHAPE       TRAP  CHANNEL SHAPE
                        WD      10.00  BOTTOM WIDTH OR DIAMETER
                         Z       3.00  SIDE SLOPE
                    RUPSTQ        YES  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
          MCUNGE FATAL ERROR - NUMBER OF ORDINATES FOR CONSTANT TIME STEP OVERLAND FLOW EXCEEDS ARRAY DIMENSIONS - REDUCE DURATION OF RUN
ON IT - RECORD
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .27      9.40    100.26    723.03     10.14       .62
                     MAIN          1.95      1.42       4.73   1539.50    324.04    728.86      9.77     10.84


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5246E+02  EXCESS= .5141E+01 OUTFLOW= .5767E+02 BASIN STORAGE= .9415E-01 PERCENT ERROR=   -.3


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.95      1.42       5.00              315.97    730.00      9.76

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH1

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                    (CFS)
+    315.97     12.17                99.68       28.96       20.17        20.17
                 (INCHES)     8.372       9.728       9.765        9.765
                  (AC-FT)     49.43       57.44       57.65        57.65

                 CUMULATIVE AREA =    .11070 SQ MI   ACRES=           70.8480


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   50 KK      *        T1  *
              *            *
              **************

   51 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   52 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00
```

```
                                                STORM AREA =     .00

  53 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  54 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        167.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  55 RD            MAIN CHANNEL
                          L        305.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.03     33.30     22.07    724.77     10.02       .59
                    MAIN          1.63      1.33       1.45    305.00     21.24    724.71      8.83      3.51


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1282E+01 OUTFLOW= .1130E+01 BASIN STORAGE= .2446E-03 PERCENT ERROR=  11.8


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00               21.09    725.00      8.85

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T1

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     21.09     12.08                   2.03         .57         .40          .40
                         (INCHES)     7.874       8.853       8.854        8.854
                          (AC-FT)      1.01        1.13        1.13         1.13

                         CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  56 KK       *        S1  *
              *            *
              **************

  57 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS
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             SUBBASIN RUNOFF DATA

  58 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                           DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                          STORM AREA =     .00

  59 LS        SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  60 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L         159.  OVERLAND FLOW LENGTH
                        S        .2500  SLOPE
                        N         .300  ROUGHNESS COEFFICIENT
                       PA        100.0  PERCENT OF SUBBASIN
                     DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  61 RD          MAIN CHANNEL
                        L         522.  CHANNEL LENGTH
                        S        .0050  SLOPE
                        N         .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA          .00  CONTRIBUTING AREA
                    SHAPE         TRAP  CHANNEL SHAPE
                       WD          .00  BOTTOM WIDTH OR DIAMETER
                        Z         2.00  SIDE SLOPE
                   RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .60     31.72     40.65    724.75     10.15      1.00
                    MAIN          1.63      1.33       2.13    260.90     38.23    725.34      9.97      4.09


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2110E+01 OUTFLOW= .2075E+01 BASIN STORAGE= .3091E-03 PERCENT ERROR=   1.7


                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00              37.89    725.00     10.00

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       S1

      TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     37.89     12.08                 3.64        1.05         .73          .73
                         (INCHES)     8.670      10.002      10.002       10.002
                          (AC-FT)     1.80        2.08        2.08         2.08

                         CUMULATIVE AREA =    .00390 SQ MI   ACRES=            2.4960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   62 KK      *      C/S1  *
              *            *
              **************
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  63 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  64 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION     C/S1

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     58.98     12.08                 5.67        1.62        1.12         1.12
                       (INCHES)     8.366       9.564       9.565        9.565
                        (AC-FT)      2.81        3.21        3.21         3.21

                      CUMULATIVE AREA =    .00630 SQ MI   ACRES=            4.0320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  65 KK     *        P1  *
            *            *
            **************

  66 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  67 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  68 LS          SCS LOSS RATE
                      STRTL         .00  INITIAL ABSTRACTION
                     CRVNBR      100.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  69 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .00  LAG

                                                        ***

                                                    UNIT HYDROGRAPH
                                                  5 END-OF-PERIOD ORDINATES
                  50.       14.        3.        1.        0.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       P1
```

```
     TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    83.99     12.08                8.92        2.78        1.93         1.93
                     (INCHES)     9.533      11.897      11.900       11.900
                      (AC-FT)      4.42        5.52        5.52         5.52

                     CUMULATIVE AREA =    .00870 SQ MI   ACRES=            5.5680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   70 KK    *      C/P1  *
            *            *
            **************

   71 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   72 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   440.83     12.08              113.99       33.33       23.23        23.23
                     (INCHES)     8.432       9.860       9.902        9.902
                      (AC-FT)     56.53       66.10       66.39        66.39

                     CUMULATIVE AREA =    .12570 SQ MI   ACRES=           80.4480


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   73 KK    *      R/P1  *
            *            *
            **************

   74 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA

   75 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1044.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT
```

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  76 SA              AREA          .0       1.6       1.9       2.1       2.3       2.6       2.9       3.1       3.4

  77 SE          ELEVATION     1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

  79 SL          LOW-LEVEL OUTLET
                      ELEVL     1041.00  ELEVATION AT CENTER OF OUTLET
                      CAREA        3.14  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

  78 SS          SPILLWAY
                       CREL     1056.50  SPILLWAY CREST ELEVATION
                      SPWID       10.00  SPILLWAY WIDTH
                       COQW        2.60  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

                                                 ***

                                          COMPUTED STORAGE-ELEVATION DATA

           STORAGE        .00       .11      3.19      7.14     11.58     16.54     22.02     28.03     34.58
         ELEVATION    1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

           OUTFLOW        .00     27.91     29.89     32.18     34.84     37.99     41.76     46.37     52.12     59.49
         ELEVATION    1044.00   1044.41   1044.91   1045.54   1046.32   1047.32   1048.64   1050.42   1052.90   1056.50

           OUTFLOW      59.66     60.24     61.48     63.65     66.98     71.74     78.17     86.54     97.08    110.06
         ELEVATION    1056.53   1056.58   1056.66   1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE        .00       .11       .44      1.27      2.35      3.19      3.78      5.74      7.14      8.51
           OUTFLOW      26.17     27.03     27.91     29.89     32.18     33.79     34.84     37.99     39.98     41.76
         ELEVATION    1044.00   1044.20   1044.41   1044.91   1045.54   1046.00   1046.32   1047.32   1048.00   1048.64

           STORAGE      11.58     12.58     16.54     18.93     22.02     28.03     29.61     29.70     29.87     30.13
           OUTFLOW      45.33     46.37     50.11     52.12     54.48     58.52     59.49     59.66     60.24     61.48
         ELEVATION    1050.00   1050.42   1052.00   1052.90   1054.00   1056.00   1056.50   1056.53   1056.58   1056.66

           STORAGE      30.48     30.93     31.46     32.09     32.82     33.65     34.58
           OUTFLOW      63.65     66.98     71.74     78.17     86.54     97.08    110.06
         ELEVATION    1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     R/P1

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     93.44     13.92                65.70       41.23       36.62       36.62
                         (INCHES)     4.859      12.199      15.614      15.614
                          (AC-FT)     32.58       81.78      104.67      104.67

  PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+   (AC-FT)      (HR)
     33.361     13.92                28.03       10.09        7.00        6.97

   PEAK STAGE    TIME                      MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+    (FEET)      (HR)
    1057.64     13.92              1055.96     1048.60     1047.19     1047.19

                        CUMULATIVE AREA =    .12570 SQ MI   ACRES=          80.4480


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  80 KK     *       DA1  *
            *            *
            **************

  81 KO          OUTPUT CONTROL VARIABLES
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                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

  82 BA       SUBBASIN CHARACTERISTICS
                    TAREA        .09  SUBBASIN AREA

              PRECIPITATION DATA

   6 PH                           DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .09

  83 LS       SCS LOSS RATE
                   STRTL        .38  INITIAL ABSTRACTION
                  CRVNBR       84.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

  84 US       SNYDER UNITGRAPH
                     TP         .32  LAG
                     CP         .66  PEAKING COEFFICIENT

              SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                           UNIT HYDROGRAPH PARAMETERS
                                      CLARK   TC=   .38 HR,       R=   .26 HR
                                     SNYDER   TP=   .32 HR,      CP=   .66

                                               UNIT HYDROGRAPH
                                           19 END-OF-PERIOD ORDINATES
                 14.       49.       89.      114.      109.       85.       61.       44.       32.       23.
                 17.       12.        9.        6.        5.        3.        2.        2.        1.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION      DA1

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                  (CFS)
+   376.56     12.33                79.79       23.22       16.12       16.12
                         (INCHES)     8.449       9.836       9.836       9.836
                          (AC-FT)     39.56       46.06       46.06       46.06

                         CUMULATIVE AREA =    .08780 SQ MI   ACRES=          56.1920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  85 KK       *    C/DP#1  *
              *            *
              **************

  86 KO       OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                      IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS
```

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  87 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   C/DP#1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   425.02     12.33              138.90       64.45       52.74        52.74
                     (INCHES)      6.049      11.227      13.238       13.238
                      (AC-FT)     68.87      127.84      150.73       150.73

                     CUMULATIVE AREA =    .21350 SQ MI   ACRES=          136.6400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  88 KK    *        T7  *
           *            *
           **************

  89 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  90 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .01

  91 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  92 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        244.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  93 RD            MAIN CHANNEL
                          L        438.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
```

```
                                                                                    PEAK                CELERITY
                                                (MIN)       (FT)      (CFS)       (MIN)       (IN)       (FPS)

                    PLANE1          1.11        1.67        1.33       48.82       56.10      724.85      10.01        .66
                    MAIN            1.63        1.33        1.65      437.60       53.57      725.31       8.80       4.41

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3579E+01 OUTFLOW= .3145E+01 BASIN STORAGE= .6710E-03 PERCENT ERROR=  12.1

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN            1.63        1.33        5.00                52.29      725.00       8.82

       ***              ***              ***              ***              ***

                          HYDROGRAPH AT STATION       T7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     52.29     12.08                   5.70        1.59        1.10         1.10
                         (INCHES)     7.907       8.814       8.817        8.817
                          (AC-FT)      2.83        3.15        3.15         3.15

                         CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   94 KK      *         S4 *
              *            *
              **************

   95 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   96 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

   97 LS           SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
   98 UK             OVERLAND-FLOW ELEMENT NO. 1
                           L        176.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
   99 RD             MAIN CHANNEL
                           L        644.  CHANNEL LENGTH
                           S       .0050  SLOPE
```

```
                    N        .030  CHANNEL ROUGHNESS COEFFICIENT
                   CA         .01  CONTRIBUTING AREA
                SHAPE        TRAP  CHANNEL SHAPE
                   WD         .00  BOTTOM WIDTH OR DIAMETER
                    Z        2.00  SIDE SLOPE
               RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                       PEAK               CELERITY
                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                PLANE1        2.48      1.67        .69     35.12     92.81    724.92     10.15      1.05
                MAIN          1.63      1.33       2.14    321.80     89.43    724.97      9.91      5.02

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4816E+01 OUTFLOW= .4706E+01 BASIN STORAGE= .4555E-03 PERCENT ERROR=   2.3

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN          1.63      1.33       5.00                89.07    725.00      9.99

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       S4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     89.07     12.08                   8.34        2.39        1.66         1.66
                         (INCHES)     8.716       9.988       9.989        9.989
                          (AC-FT)      4.14        4.74        4.74         4.74

                        CUMULATIVE AREA =    .00890 SQ MI   ACRES=            5.6960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   100 KK    *      C/S4  *
             *            *
             **************

   101 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   102 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/S4

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    141.36     12.08                  14.04        3.98        2.76         2.76
                         (INCHES)     8.366       9.484       9.486        9.486
                          (AC-FT)      6.96        7.89        7.89         7.89

                        CUMULATIVE AREA =    .01560 SQ MI   ACRES=            9.9840
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 103 KK   *       OA1  *
          *            *
          **************

 104 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 105 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .15  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .15

 106 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 107 US          SNYDER UNITGRAPH
                        TP         .56  LAG
                        CP         .64  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .64 HR,       R=   .49 HR
                                            SNYDER   TP=   .56 HR,      CP=   .64

                                                    UNIT HYDROGRAPH
                                                36 END-OF-PERIOD ORDINATES
                      6.       22.       44.       68.       90.      105.      112.      107.       94.       79.
                     67.       57.       48.       40.       34.       29.       24.       20.       17.       15.
                     12.       10.        9.        7.        6.        5.        4.        4.        3.        3.
                      2.        2.        2.        1.        1.        1.

      ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION      OA1

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   460.68     12.58               135.12       39.47       27.39       27.39
                         (INCHES)    8.420       9.838       9.838       9.838
                          (AC-FT)   67.00       78.28       78.28       78.28

                         CUMULATIVE AREA =    .14920 SQ MI   ACRES=          95.4880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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108 KK     *     C/CH2  *
           *            *
           **************

109 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


110 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/CH2

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   481.90     12.58              149.06       43.44       30.15        30.15
                   (INCHES)       8.410       9.804       9.804        9.804
                    (AC-FT)       73.91       86.17       86.17        86.17

                   CUMULATIVE AREA =    .16480 SQ MI   ACRES=          105.4720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
111 KK     *       CH2  *
           *            *
           **************

112 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

113 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

115 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
115 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L          47.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
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 116 RD           MAIN CHANNEL
                        L       865.  CHANNEL LENGTH
                        S      .0100  SLOPE
                        N       .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA        .01  CONTRIBUTING AREA
                    SHAPE       TRAP  CHANNEL SHAPE
                       WD      10.00  BOTTOM WIDTH OR DIAMETER
                        Z       3.00  SIDE SLOPE
                   RUPSTQ        YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
         MCUNGE FATAL ERROR - NUMBER OF ORDINATES FOR CONSTANT TIME STEP OVERLAND FLOW EXCEEDS ARRAY DIMENSIONS - REDUCE DURATION OF RUN
ON IT - RECORD
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .27      9.40     99.22    723.03      10.14       .62
                    MAIN          1.38      1.42       1.60    432.50    491.89    756.09       9.86      9.00


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8617E+02  EXCESS= .5087E+01 OUTFLOW= .9159E+02 BASIN STORAGE= .4916E-01 PERCENT ERROR=   -.4


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.38      1.42       5.00              489.94    755.00      9.86

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION      CH2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   489.94     12.58               157.73       45.99       32.05       32.05
                         (INCHES)    8.418       9.818       9.860       9.860
                          (AC-FT)   78.21       91.22       91.61       91.61

                         CUMULATIVE AREA =    .17420 SQ MI   ACRES=          111.4880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 117 KK       *        T4  *
              *            *
              **************

 118 KO           OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 119 BA           SUBBASIN CHARACTERISTICS
                       TAREA        .01  SUBBASIN AREA

                  PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01
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```
 120 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 121 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        176.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 122 RD            MAIN CHANNEL
                          L        697.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .69     35.12    106.37    724.92     10.15      1.05
                     MAIN          1.63      1.33       2.24    348.40    102.30    725.01      9.90      5.19

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5520E+01 OUTFLOW= .5383E+01 BASIN STORAGE= .4973E-03 PERCENT ERROR=   2.5

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00              102.25    725.00      9.97

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    102.25     12.08                 9.55        2.73        1.90         1.90
                          (INCHES)    8.708       9.966       9.966        9.966
                           (AC-FT)    4.74        5.42        5.42         5.42

                          CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
 123 KK        *       CH3  *
               *            *
               **************

 124 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 125 BA          SUBBASIN CHARACTERISTICS
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                    TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                          STORM AREA =     .00

  126 LS       SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  127 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L        156.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  128 RD         MAIN CHANNEL
                       L       1456.  CHANNEL LENGTH
                       S       .0100  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .00  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD       10.00  BOTTOM WIDTH OR DIAMETER
                       Z        3.00  SIDE SLOPE
                  RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                            COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .65     31.14     36.40    724.45     10.15      1.00
                    MAIN          1.38      1.42       3.93    728.00    107.79    727.41      9.91      6.17

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5422E+01  EXCESS= .1894E+01 OUTFLOW= .7239E+01 BASIN STORAGE= .1090E-02 PERCENT ERROR=   1.0

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.38      1.42       5.00               97.16    730.00      9.86

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH3

      TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                          (CFS)
 +    97.16     12.17                 12.69        3.63        2.52         2.52
                         (INCHES)     8.610       9.859       9.860        9.860
                          (AC-FT)      6.29        7.20        7.20         7.20

                         CUMULATIVE AREA =    .01370 SQ MI   ACRES=            8.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  129 KK      *    C/DP#2  *
              *            *
              **************

  130 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
```

```
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


  131 HC          HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION   C/DP#2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   510.21     12.58              170.34       49.62       34.57        34.57
                   (INCHES)      8.429       9.821       9.860        9.860
                    (AC-FT)      84.47       98.42       98.81        98.81

                   CUMULATIVE AREA =    .18790 SQ MI   ACRES=          120.2560


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  132 KK    *        T9  *
            *            *
            **************

  133 KO          OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         7.  HYDROGRAPH PLOT SCALE
                    IPNCH         21  PUNCH COMPUTED HYDROGRAPH
                     IOUT          0  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  134 BA          SUBBASIN CHARACTERISTICS
                    TAREA        .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .02

  135 LS          SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  136 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        919.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  137 RD            MAIN CHANNEL
                           L        232.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .02  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
```

```
                        Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                            PEAK              CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       3.43    183.86    111.47    732.11       9.99       .91
                    MAIN          1.63      1.33        .74    232.00    110.02    730.53       9.44      5.25

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1159E+02 OUTFLOW= .1093E+02 BASIN STORAGE= .1005E-01 PERCENT ERROR=   5.7

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00              109.67    730.00      9.44

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION       T9

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    109.67     12.17               19.60        5.51        3.82         3.82
                       (INCHES)     8.398       9.436       9.441        9.441
                        (AC-FT)      9.72       10.92       10.93        10.93

                       CUMULATIVE AREA =    .02170 SQ MI   ACRES=           13.8880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   138 KK    *       CH4  *
             *            *
             **************

   139 KO          OUTPUT CONTROL VARIABLES
                        IPRNT          3  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
                        IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                         IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   140 BA          SUBBASIN CHARACTERISTICS
                        TAREA        .01  SUBBASIN AREA

                   PRECIPITATION DATA

     6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ............ TP-49 ............
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                  STORM AREA =     .01

   141 LS          SCS LOSS RATE
                        STRTL        .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                   KINEMATIC WAVE
   142 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L       156.  OVERLAND FLOW LENGTH
                            S      .2500  SLOPE
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                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
 143 RD             MAIN CHANNEL
                          L       1064.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD       10.00  BOTTOM WIDTH OR DIAMETER
                          Z        3.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                       ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        2.48      1.67        .54     31.16    100.62    725.00     10.14       .99
                       MAIN          1.38      1.42       2.58    532.00    166.69    726.36      9.58      6.86


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1093E+02  EXCESS= .5195E+01 OUTFLOW= .1599E+02 BASIN STORAGE= .8624E-03 PERCENT ERROR=    .8


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                       MAIN          1.38      1.42       5.00              165.86    725.00      9.57

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    165.86     12.08                28.45        8.05        5.59         5.59
                        (INCHES)     8.452       9.567       9.572        9.572
                         (AC-FT)     14.11       15.97       15.98        15.98

                        CUMULATIVE AREA =    .03130 SQ MI   ACRES=           20.0320


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 144 KK       *         T8 *
              *            *
              **************

 145 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

 146 BA            SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

   6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00
```

```
                                          STORM AREA =     .01

  147 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  148 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        360.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  149 RD            MAIN CHANNEL
                           L        721.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       1.81     71.94     69.91    724.93     10.01       .73
                     MAIN          1.63      1.33       2.58    360.25     66.96    727.97      9.84      4.65

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5075E+01 OUTFLOW= .4985E+01 BASIN STORAGE= .1508E-02 PERCENT ERROR=   1.7

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00                64.47    725.00      9.84

          ***            ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T8

        TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

      PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                             6-HR       24-HR       72-HR     34.58-HR
    +   (CFS)       (HR)
                      (CFS)
    +    64.47     12.08                    8.75        2.51        1.74         1.74
                  (INCHES)     8.559       9.839       9.843        9.843
                   (AC-FT)     4.34        4.98        4.99         4.99

                  CUMULATIVE AREA =    .00950 SQ MI   ACRES=            6.0800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
      150 KK   *         T3 *
               *            *
               **************

      151 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                  SUBBASIN RUNOFF DATA
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 152 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

 153 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 154 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         49.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 155 RD            MAIN CHANNEL
                          L        535.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                            PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67        .56      9.80     36.55    724.52     10.01       .39
                    MAIN          1.63      1.33       2.24    267.50     35.31    723.77      9.84      3.98

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1870E+01 OUTFLOW= .1836E+01 BASIN STORAGE= .2948E-03 PERCENT ERROR=   1.8

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00              32.50    725.00      9.82

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T3

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
 +   (CFS)       (HR)
                          (CFS)
 +    32.50     12.08                3.21         .92         .64          .64
                         (INCHES)     8.518       9.823       9.823        9.823
                          (AC-FT)     1.59        1.83        1.83         1.83

                         CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                ***************
                *             *
 156 KK         *        S3   *
                *             *
                ***************

 157 KO          OUTPUT CONTROL VARIABLES
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```
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


          SUBBASIN RUNOFF DATA

158 BA      SUBBASIN CHARACTERISTICS
                 TAREA        .01  SUBBASIN AREA

            PRECIPITATION DATA

 6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
            ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
            5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
             1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .01

159 LS      SCS LOSS RATE
                 STRTL        .33  INITIAL ABSTRACTION
                CRVNBR       86.00  CURVE NUMBER
                 RTIMP         .00  PERCENT IMPERVIOUS AREA

            KINEMATIC WAVE
160 UK        OVERLAND-FLOW ELEMENT NO. 1
                    L        160.  OVERLAND FLOW LENGTH
                    S       .2500  SLOPE
                    N        .300  ROUGHNESS COEFFICIENT
                   PA       100.0  PERCENT OF SUBBASIN
                 DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
            MUSKINGUM-CUNGE
161 RD        MAIN CHANNEL
                    L        304.  CHANNEL LENGTH
                    S       .0050  SLOPE
                    N        .030  CHANNEL ROUGHNESS COEFFICIENT
                   CA         .01  CONTRIBUTING AREA
                SHAPE        TRAP  CHANNEL SHAPE
                   WD         .00  BOTTOM WIDTH OR DIAMETER
                    Z        2.00  SIDE SLOPE
               RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                 ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                  CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                 PLANE1        2.48      1.67        .62     32.00     69.58    724.51      10.14      1.00
                 MAIN          1.63      1.33       1.08    304.00     68.14    725.01       8.93      4.68


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3626E+01 OUTFLOW= .3190E+01 BASIN STORAGE= .2383E-03 PERCENT ERROR=  12.0


                                      INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN          1.63      1.33       5.00               68.12    725.00      8.99

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       S3

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    68.12     12.08                 5.82        1.62        1.12         1.12
                      (INCHES)     8.074       8.985       8.985        8.985
                       (AC-FT)      2.88        3.21        3.21         3.21

                     CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  162 KK    *      C/S3  *
            *            *
            **************

  163 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  164 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S3

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                             (CFS)
+   100.63     12.08                 9.02        2.54        1.76         1.76
                          (INCHES)     8.226       9.272       9.273        9.273
                           (AC-FT)     4.48        5.04        5.04         5.04

                          CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


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            *            *
  165 KK    *       CH5  *
            *            *
            **************

  166 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  167 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

  168 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  169 UK            OVERLAND-FLOW ELEMENT NO. 1
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                          L        200.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
 170 RD             MAIN CHANNEL
                          L       1996.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                            PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)    (MIN)       (IN)     (FPS)

                    PLANE1        2.48      1.67        .70     40.00     77.80    724.67      10.14      1.09
                    MAIN          2.16      1.35       4.36    998.00    135.39    727.81       9.52      7.63

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5045E+01  EXCESS= .4113E+01 OUTFLOW= .9036E+01 BASIN STORAGE= .9904E-03 PERCENT ERROR=   1.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.16      1.35       5.00              126.29    725.00      9.49

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    126.29     12.08               15.98        4.54        3.15         3.15
                       (INCHES)     8.346       9.485       9.486        9.486
                        (AC-FT)      7.92        9.00        9.00         9.00

                       CUMULATIVE AREA =    .01780 SQ MI   ACRES=           11.3920


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             *            *
 171 KK      *        P2  *
             *            *
             **************

 172 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 173 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
```

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                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

  174 LS          SCS LOSS RATE
                       STRTL         .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  175 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .00  LAG

                                                          ***

                                                      UNIT HYDROGRAPH
                                                   5 END-OF-PERIOD ORDINATES
                21.        6.        1.        0.        0.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       P2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     35.72     12.08                   3.79        1.18         .82          .82
                         (INCHES)     9.533      11.897      11.900       11.900
                          (AC-FT)      1.88        2.35        2.35         2.35

                        CUMULATIVE AREA =    .00370 SQ MI   ACRES=            2.3680


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             *            *
  176 KK     *      C/P2  *
             *            *
             **************

  177 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


  178 HC          HYDROGRAPH COMBINATION
                       ICOMP          4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/P2

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    392.34     12.08                  56.86       16.26       11.31        11.31
                         (INCHES)     8.486       9.707       9.727        9.727
                          (AC-FT)     28.20       32.25       32.32        32.32

                        CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


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             *            *
  179 KK     *      R/P2  *
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          *           *
          **************

 180 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

 181 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     1034.00  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 182 SA              AREA          .0       .2       .2       .2       .3       .3       .4       .5

 183 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

 185 SL          LOW-LEVEL OUTLET
                      ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                      CAREA       28.86  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 184 SS          SPILLWAY
                       CREL     1040.00  SPILLWAY CREST ELEVATION
                      SPWID       10.00  SPILLWAY WIDTH
                       COQW        2.60  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00       .01       .16       .39       .66       .96      1.70      2.62
          ELEVATION    1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

            OUTFLOW        .00    149.21    161.17    175.22    191.96    212.23    237.29    269.07    310.66    367.47
          ELEVATION    1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

            OUTFLOW     392.69    399.17    406.61    415.06    424.58    435.23    447.05    460.12    474.49    490.21
          ELEVATION    1040.56   1040.67   1040.80   1040.94   1041.09   1041.25   1041.42   1041.60   1041.80   1042.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
            OUTFLOW     138.89    149.21    152.14    161.17    175.22    191.96    196.42    212.23    237.29    240.57
          ELEVATION    1034.00   1034.15   1034.20   1034.35   1034.59   1034.91   1035.00   1035.33   1035.92   1036.00

            STORAGE        .59       .66       .96      1.70      1.95      2.00      2.06      2.12      2.19      2.26
            OUTFLOW     269.07    277.78    310.57    367.47    392.69    399.17    406.61    415.06    424.58    435.23
          ELEVATION    1036.75   1037.00   1038.00   1040.00   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25

            STORAGE       2.34      2.43      2.52      2.62
            OUTFLOW     447.05    460.12    474.49    490.21
          ELEVATION    1041.42   1041.60   1041.80   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      139. TO      175.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     R/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   322.54     12.17                148.91      141.39      140.63       140.63
                         (INCHES)    22.223      84.406     120.967      120.967
                          (AC-FT)     73.84      280.45      401.93       401.93
```

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 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
     1.115     12.17                  .00         .00         .00         -.46

  PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1038.42     12.17               1034.22     1034.06     1034.04     1034.04

                       CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  186 KK    *        T2  *
            *            *
            **************

  187 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  188 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

  189 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  190 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          49.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  191 RD            MAIN CHANNEL
                           L         434.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67        .56      9.80     36.55    724.52     10.01        .39
                     MAIN          1.63      1.33       1.82    217.00     34.90    723.46      9.86       3.98
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 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1870E+01 OUTFLOW= .1840E+01 BASIN STORAGE= .2401E-03 PERCENT ERROR=   1.6

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00              34.70    725.00      9.88

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     34.70     12.08                 3.22         .93         .65          .65
                          (INCHES)    8.563       9.878       9.879        9.879
                           (AC-FT)    1.60        1.84        1.84         1.84

                         CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  192 KK     *        S2  *
             *            *
             **************

  193 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  194 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

  195 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  196 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        160.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  197 RD            MAIN CHANNEL
                           L        434.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH
```

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                                                  ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .62     32.00     45.69    724.51     10.14      1.00
                    MAIN          1.63      1.33       1.72    217.00     43.97    725.24      9.98      4.21

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2381E+01 OUTFLOW= .2343E+01 BASIN STORAGE= .2786E-03 PERCENT ERROR=   1.6

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00               43.74    725.00     10.00

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION       S2

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     43.74     12.08                 4.10        1.18         .82          .82
                        (INCHES)     8.661       9.996       9.997        9.997
                         (AC-FT)      2.03        2.35        2.35         2.35

                        CUMULATIVE AREA =    .00440 SQ MI   ACRES=            2.8160


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             **************
             *            *
   198 KK    *      C/S2  *
             *            *
             **************

   199 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   200 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION     C/S2

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     78.44     12.08                 7.32        2.11        1.47         1.47
                        (INCHES)     8.618       9.944       9.944        9.944
                         (AC-FT)      3.63        4.19        4.19         4.19

                        CUMULATIVE AREA =    .00790 SQ MI   ACRES=            5.0560


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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201 KK     *       CH6  *
           *            *
           **************

202 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

203 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .00

204 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
205 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        200.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
206 RD            MAIN CHANNEL
                         L        537.  CHANNEL LENGTH
                         S       .0100  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        2.00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                  ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                  CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                  PLANE1        1.11      1.67       1.14     40.00     32.23    725.63     10.15       .62
                  MAIN          2.16      1.35       1.33    268.50    104.01    726.53      9.97      6.73


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .419OE+01  EXCESS= .2OO2E+01 OUTFLOW= .6167E+01 BASIN STORAGE= .4051E-03 PERCENT ERROR=    .4


                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN          2.16      1.35       5.00              101.22    725.00      9.98

       ***            ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH6

     TOTAL RAINFALL =   11.9O, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    101.22     12.08                10.79        3.11        2.16         2.16
                         (INCHES)     8.652       9.977       9.979        9.979
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                    (AC-FT)      5.35        6.17        6.17         6.17

                   CUMULATIVE AREA =    .01160 SQ MI   ACRES=            7.4240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 207 KK   *       CH7  *
          *            *
          **************

 208 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          7.  HYDROGRAPH PLOT SCALE
                      IPNCH          21  PUNCH COMPUTED HYDROGRAPH
                       IOUT           0  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 209 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

 210 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 211 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        210.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 212 RD            MAIN CHANNEL
                          L        317.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        1.11      1.67       1.15     42.00     21.34    725.09     10.15       .63
                   MAIN          2.16      1.35       1.21    158.50     20.24    724.94      9.94      4.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1299E+01 OUTFLOW= .1272E+01 BASIN STORAGE= .2699E-03 PERCENT ERROR=   2.0

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          2.16      1.35       5.00                20.23    725.00      9.95

      ***            ***             ***             ***             ***
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                        HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+    20.23     12.08                  2.23         .64         .45          .45
                        (INCHES)     8.625       9.948       9.950        9.950
                         (AC-FT)      1.10        1.27        1.27         1.27

                        CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360

 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  213 KK     *    C/DP#4  *
             *            *
             **************

  214 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  215 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   C/DP#4

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   121.45     12.08                 13.02         3.75        2.61         2.61
                        (INCHES)     8.647       9.972       9.974        9.974
                         (AC-FT)      6.46        7.45        7.45         7.45

                        CUMULATIVE AREA =    .01400 SQ MI   ACRES=            8.9600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
             **************
             *            *
  216 KK     *    DP#5/D  *     A2
             *            *
             **************

  217 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  218 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .03  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00
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                                                STORM AREA =     .03

  219 LS          SCS LOSS RATE
                       STRTL        .38  INITIAL ABSTRACTION
                      CRVNBR      84.00  CURVE NUMBER
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

  220 US          SNYDER UNITGRAPH
                         TP        .29  LAG
                         CP        .66  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                      ***

                                              UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=   .34 HR,       R=   .24 HR
                                          SNYDER   TP=   .29 HR,      CP=   .66

                                                UNIT HYDROGRAPH
                                            18 END-OF-PERIOD ORDINATES
                  6.       22.       40.       47.       41.       29.       21.       15.       10.        7.
                  5.        4.        3.        2.        1.        1.        1.        0.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   DP#5/D

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   148.99     12.33               30.01        8.73        6.06         6.06
                         (INCHES)   8.456       9.843       9.843        9.843
                          (AC-FT)   14.88       17.32       17.32        17.32

                        CUMULATIVE AREA =    .03300 SQ MI   ACRES=           21.1200
1
                                                RUNOFF SUMMARY
                                          FLOW IN CUBIC FEET PER SECOND
                                         TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION   FLOW    PEAK                                           AREA      STAGE     MAX STAGE
+                                                      6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                            T6    26.41   12.08          3.          1.          1.        .00

          HYDROGRAPH AT
+                            S6    58.27   12.08          5.          2.          1.        .01

          2 COMBINED AT
+                          C/S6    84.68   12.08          8.          2.          2.        .01

          HYDROGRAPH AT
+                            T5    34.09   12.08          4.          1.          1.        .00

          HYDROGRAPH AT
+                            S5    88.10   12.08          8.          2.          1.        .01

          2 COMBINED AT
+                          C/S5   122.19   12.08         11.          3.          2.        .01

          HYDROGRAPH AT
+                           OA2   253.41   12.58         72.         21.         15.        .08

          3 COMBINED AT
+                         C/CH1   306.04   12.08         91.         26.         18.        .10

          HYDROGRAPH AT
+                           CH1   315.97   12.17        100.         29.         20.        .11

          HYDROGRAPH AT
+                            T1    21.09   12.08          2.          1.          0.        .00

          HYDROGRAPH AT
+                            S1    37.89   12.08          4.          1.          1.        .00

          2 COMBINED AT
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+                    C/S1      58.98   12.08          6.          2.          1.        .01
         HYDROGRAPH AT
+                      P1      83.99   12.08          9.          3.          2.        .01
         3 COMBINED AT
+                    C/P1     440.83   12.08        114.         33.         23.        .13
         ROUTED TO
+                    R/P1      93.44   13.92         66.         41.         37.        .13
+                                                                                  1057.64        13.92
         HYDROGRAPH AT
+                     DA1     376.56   12.33         80.         23.         16.        .09
         2 COMBINED AT
+                  C/DP#1     425.02   12.33        139.         64.         53.        .21
         HYDROGRAPH AT
+                      T7      52.29   12.08          6.          2.          1.        .01
         HYDROGRAPH AT
+                      S4      89.07   12.08          8.          2.          2.        .01
         2 COMBINED AT
+                    C/S4     141.36   12.08         14.          4.          3.        .02
         HYDROGRAPH AT
+                     OA1     460.68   12.58        135.         39.         27.        .15
         2 COMBINED AT
+                   C/CH2     481.90   12.58        149.         43.         30.        .16
         HYDROGRAPH AT
+                     CH2     489.94   12.58        158.         46.         32.        .17
         HYDROGRAPH AT
+                      T4     102.25   12.08         10.          3.          2.        .01
         HYDROGRAPH AT
+                     CH3      97.16   12.17         13.          4.          3.        .01
         2 COMBINED AT
+                  C/DP#2     510.21   12.58        170.         50.         35.        .19
         HYDROGRAPH AT
+                      T9     109.67   12.17         20.          6.          4.        .02
         HYDROGRAPH AT
+                     CH4     165.86   12.08         28.          8.          6.        .03
         HYDROGRAPH AT
+                      T8      64.47   12.08          9.          3.          2.        .01
         HYDROGRAPH AT
+                      T3      32.50   12.08          3.          1.          1.        .00
         HYDROGRAPH AT
+                      S3      68.12   12.08          6.          2.          1.        .01
         2 COMBINED AT
+                    C/S3     100.63   12.08          9.          3.          2.        .01
         HYDROGRAPH AT
+                     CH5     126.29   12.08         16.          5.          3.        .02
         HYDROGRAPH AT
+                      P2      35.72   12.08          4.          1.          1.        .00
         4 COMBINED AT
+                    C/P2     392.34   12.08         57.         16.         11.        .06
         ROUTED TO
+                    R/P2     322.54   12.17        149.        141.        141.        .06
+                                                                                  1038.42        12.17
         HYDROGRAPH AT
+                      T2      34.70   12.08          3.          1.          1.        .00
         HYDROGRAPH AT
+                      S2      43.74   12.08          4.          1.          1.        .00
         2 COMBINED AT
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+                          C/S2      78.44   12.08          7.          2.          1.        .01

         HYDROGRAPH AT
+                           CH6     101.22   12.08         11.          3.          2.        .01

         HYDROGRAPH AT
+                           CH7      20.23   12.08          2.          1.          0.        .00

         2 COMBINED AT
+                         C/DP#4     121.45   12.08         13.          4.          3.        .01

         HYDROGRAPH AT
+                         DP#5/D     148.99   12.33         30.          9.          6.        .03
1
                                      SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                          (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                  INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                     PEAK                                    PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

                T6  MANE         1.40     26.46    724.88      8.83      5.00     26.41    725.00        8.84

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1656E+01 OUTFLOW= .1459E+01 BASIN STORAGE= .2888E-03 PERCENT ERROR=  11.8

                S6  MANE         1.99     60.39    724.73      9.82      5.00     58.27    725.00        9.88

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3152E+01 OUTFLOW= .3091E+01 BASIN STORAGE= .3316E-03 PERCENT ERROR=   1.9

                T5  MANE         1.85     35.15    725.64      9.88      5.00     34.09    725.00        9.88

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2137E+01 OUTFLOW= .2108E+01 BASIN STORAGE= .3904E-03 PERCENT ERROR=   1.3

                S5  MANE         1.45     90.12    724.01      8.81      5.00     88.10    725.00        8.82

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4924E+01 OUTFLOW= .4276E+01 BASIN STORAGE= .3388E-03 PERCENT ERROR=  13.2

               CH1  MANE         4.73    324.04    728.86      9.77      5.00    315.97    730.00        9.76

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5246E+02 EXCESS= .5141E+01 OUTFLOW= .5767E+02 BASIN STORAGE= .9415E-01 PERCENT ERROR=   -.3

                T1  MANE         1.45     21.24    724.71      8.83      5.00     21.09    725.00        8.85

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1282E+01 OUTFLOW= .1130E+01 BASIN STORAGE= .2446E-03 PERCENT ERROR=  11.8

                S1  MANE         2.13     38.23    725.34      9.97      5.00     37.89    725.00       10.00

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2110E+01 OUTFLOW= .2075E+01 BASIN STORAGE= .3091E-03 PERCENT ERROR=   1.7

                T7  MANE         1.65     53.57    725.31      8.80      5.00     52.29    725.00        8.82

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3579E+01 OUTFLOW= .3145E+01 BASIN STORAGE= .6710E-03 PERCENT ERROR=  12.1

                S4  MANE         2.14     89.43    724.97      9.91      5.00     89.07    725.00        9.99

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4816E+01 OUTFLOW= .4706E+01 BASIN STORAGE= .4555E-03 PERCENT ERROR=   2.3

               CH2  MANE         1.60    491.89    756.09      9.86      5.00    489.94    755.00        9.86

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8617E+02 EXCESS= .5087E+01 OUTFLOW= .9159E+02 BASIN STORAGE= .4916E-01 PERCENT ERROR=   -.4
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              T4  MANE         2.24    102.30    725.01      9.90      5.00    102.25    725.00        9.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5520E+01 OUTFLOW= .5383E+01 BASIN STORAGE= .4973E-03 PERCENT ERROR=   2.5

              CH3  MANE         3.93    107.79    727.41      9.91      5.00     97.16    730.00        9.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5422E+01 EXCESS= .1894E+01 OUTFLOW= .7239E+01 BASIN STORAGE= .1090E-02 PERCENT ERROR=   1.0

              T9  MANE          .74    110.02    730.53      9.44      5.00    109.67    730.00        9.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1159E+02 OUTFLOW= .1093E+02 BASIN STORAGE= .1005E-01 PERCENT ERROR=   5.7

              CH4  MANE         2.58    166.69    726.36      9.58      5.00    165.86    725.00        9.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1093E+02 EXCESS= .5195E+01 OUTFLOW= .1599E+02 BASIN STORAGE= .8624E-03 PERCENT ERROR=    .8

              T8  MANE         2.58     66.96    727.97      9.84      5.00     64.47    725.00        9.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5075E+01 OUTFLOW= .4985E+01 BASIN STORAGE= .1508E-02 PERCENT ERROR=   1.7

              T3  MANE         2.24     35.31    723.77      9.84      5.00     32.50    725.00        9.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1870E+01 OUTFLOW= .1836E+01 BASIN STORAGE= .2948E-03 PERCENT ERROR=   1.8

              S3  MANE         1.08     68.14    725.01      8.93      5.00     68.12    725.00        8.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3626E+01 OUTFLOW= .3190E+01 BASIN STORAGE= .2383E-03 PERCENT ERROR=  12.0

              CH5  MANE         4.36    135.39    727.81      9.52      5.00    126.29    725.00        9.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5045E+01 EXCESS= .4113E+01 OUTFLOW= .9036E+01 BASIN STORAGE= .9904E-03 PERCENT ERROR=   1.3

              T2  MANE         1.82     34.90    723.46      9.86      5.00     34.70    725.00        9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1870E+01 OUTFLOW= .1840E+01 BASIN STORAGE= .2401E-03 PERCENT ERROR=   1.6

              S2  MANE         1.72     43.97    725.24      9.98      5.00     43.74    725.00       10.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2381E+01 OUTFLOW= .2343E+01 BASIN STORAGE= .2786E-03 PERCENT ERROR=   1.6

              CH6  MANE         1.33    104.01    726.53      9.97      5.00    101.22    725.00        9.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4190E+01 EXCESS= .2002E+01 OUTFLOW= .6167E+01 BASIN STORAGE= .4051E-03 PERCENT ERROR=    .4

              CH7  MANE         1.21     20.24    724.94      9.94      5.00     20.23    725.00        9.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1299E+01 OUTFLOW= .1272E+01 BASIN STORAGE= .2699E-03 PERCENT ERROR=   2.0


*** NORMAL END OF HEC-1 ***
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HEC-1 OUTPUT- PERMITTED 25-YEAR 24-HOUR STORM EVENT

```
1****************************************
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *        JUN 1998 AND FEB 2010         *
 *            VERSION 4.1R              *
 *       RGMHEC2000 WWW.HEC-1.COM       *
 *  RUN DATE   01AUG24  TIME  09:30:39  *
 *                                      *
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*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1          ID  DEL RIO LF EXPANSION
   2          ID  25-YR, 24-HR
              *DIAGRAM
   3          IT       5       0    2400     416       0       0
   4          IO       3       0       0
              *

   5          KK      T6
   6          PH               0    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85
   7          KO       0       0       0       7      21
   8          BA  0.0031
   9          LS       0      85
  10          UK     179    0.05     0.3     100
  11          RD     312   0.005    0.03            TRAP       0       2      NO
              *

  12          KK      S6
  13          KO       0       0       0       7      21
  14          BA  0.0059
  15          LS       0      85
  16          UK   139.6    0.25     0.3     100
  17          RD   540.7   0.005    0.03            TRAP       0       2      NO
              *

  18          KK    C/S6
  19          KO       0       0       0       7      21
  20          HC       2
              *

  21          KK      T5
  22          KO       0       0       0       7      21
  23          BA  0.0040
  24          LS       0      85
  25          UK   175.7    0.05     0.3     100
  26          RD   437.6   0.005    0.03            TRAP       0       2      NO
              *

  27          KK      S5
  28          KO       0       0       0       7      21
  29          BA  0.0091
  30          LS       0      86
  31          UK     160    0.25     0.3     100
  32          RD   437.6   0.005    0.03            TRAP       0       2      NO
              *
```

```
  33          KK    C/S5
  34          KO       0       0       0       7      21
  35          HC       2
              *
1                                    HEC-1 INPUT                                    PAGE  2

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  36          KK     OA2
  37          KO       0       0       0       7      21
  38          BA  0.0791
  39          LS       0      84
  40          US    0.55    0.66
              *

  41          KK   C/CH1
  42          KO       0       0       0       7      21
  43          HC       3
              *

  44          KK     CH1
  45          KO       0       0       0       7      21
  46          BA  0.0095
  47          LS       0      86
  48          UK      47    0.25     0.3     100
  49          RD    3079    0.02    0.03            TRAP      10       3     YES
              *

  50          KK      T1
  51          KO       0       0       0       7      21
  52          BA  0.0024
  53          LS       0      85
  54          UK   166.5    0.05     0.3     100
  55          RD     305   0.005    0.03            TRAP       0       2      NO
              *

  56          KK      S1
  57          KO       0       0       0       7      21
  58          BA  0.0039
  59          LS       0      86
  60          UK   158.6    0.25     0.3     100
  61          RD   521.8   0.005    0.03            TRAP       0       2      NO
              *

  62          KK    C/S1
  63          KO       0       0       0       7      21
  64          HC       2
              *

  65          KK      P1
  66          KO       0       0       0       7      21
  67          BA  0.0087
  68          LS       0     100
  69          UD       0
              *

  70          KK    C/P1
  71          KO       0       0       0       7      21
  72          HC       3
              *
1                                    HEC-1 INPUT                                    PAGE  3

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  73          KK    R/P1
  74          KO       0       0       0       7      21
  75          RS       1    ELEV    1044
  76          SA       0    1.58    1.85    2.10    2.35    2.61    2.87    3.14    3.41
  77          SE    1044  1044.2    1046    1048    1050    1052    1054    1056    1058
  78          SS  1056.5      10     2.6     1.5
  79          SL    1041    3.14     0.6     0.5
              *

  80          KK     DA1
  81          KO       0       0       0       7      21
  82          BA  0.0878
  83          LS       0      84
  84          US     .32     .66
              *

  85          KK  C/DP#1
```

```
 86          KO       0       0       0       7      21
 87          HC       2
             *

 88          KK      T7
 89          KO       0       0       0       7      21
 90          BA  0.0067
 91          LS       0      85
 92          UK   244.1    0.05     0.3     100
 93          RD   437.6   0.005    0.03            TRAP       0       2      NO
             *

 94          KK      S4
 95          KO       0       0       0       7      21
 96          BA  0.0089
 97          LS       0      86
 98          UK   175.6    0.25     0.3     100
 99          RD   643.6   0.005    0.03            TRAP       0       2      NO
             *

100          KK    C/S4
101          KO       0       0       0       7      21
102          HC       2
             *

103          KK     OA1
104          KO       0       0       0       7      21
105          BA  0.1492
106          LS       0      84
107          US    0.56    0.64
             *
1                                    HEC-1 INPUT                                    PAGE  4

        LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

108          KK   C/CH2
109          KO       0       0       0       7      21
110          HC       2
             *

111          KK     CH2
112          KO       0       0       0       7      21
113          BA  0.0094
114          LS       0      86
115          UK      47    0.25     0.3     100
116          RD     865    0.01    0.03            TRAP      10       3     YES
             *

117          KK      T4
118          KO       0       0       0       7      21
119          BA  0.0102
120          LS       0      86
121          UK   175.6    0.25     0.3     100
122          RD   696.8   0.005    0.03            TRAP       0       2      NO
             *

123          KK     CH3
124          KO       0       0       0       7      21
125          BA  0.0035
126          LS       0      86
127          UK   155.7    0.25     0.3     100
128          RD    1456    0.01    0.03            TRAP      10       3     YES
             *

129          KK  C/DP#2
130          KO       0       0       0       7      21
131          HC       2
             *

132          KK      T9
133          KO       0       0       7      21
134          BA  0.0217
135          LS       0      85
136          UK   919.3    0.05     0.3     100
137          RD     232   0.005    0.03            TRAP       0       2      NO
             *

138          KK     CH4
139          KO       0       0       0       7      21
140          BA  0.0096
141          LS       0      86
142          UK   155.8    0.25     0.3     100
```

```
          143          RD    1064    0.01    0.03           TRAP      10       3     YES
                       *
1                                          HEC-1 INPUT                                          PAGE  5

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          144          KK      T8
          145          KO       0       0       7      21
          146          BA  0.0095
          147          LS       0      85
          148          UK   359.7    0.05     0.3     100
          149          RD   720.5   0.005    0.03           TRAP       0       2      NO
                       *

          150          KK      T3
          151          KO       0       0       7      21
          152          BA  0.0035
          153          LS       0      85
          154          UK      49    0.05     0.3     100
          155          RD     535   0.005    0.03           TRAP       0       2      NO
                       *

          156          KK      S3
          157          KO       0       0       7      21
          158          BA  0.0067
          159          LS       0      86
          160          UK     160    0.25     0.3     100
          161          RD     304   0.005    0.03           TRAP       0       2      NO
                       *

          162          KK    C/S3
          163          KO       0       0       7      21
          164          HC       2
                       *

          165          KK     CH5
          166          KO       0       0       7      21
          167          BA  0.0076
          168          LS       0      86
          169          UK     200    0.25     0.3     100
          170          RD    1996    0.01    0.03           TRAP       2       2     YES
                       *

          171          KK      P2
          172          KO       0       0       7      21
          173          BA  0.0037
          174          LS       0     100
          175          UD       0
                       *

          176          KK    C/P2
          177          KO       0       0       7      21
          178          HC       4
                       *
1                                          HEC-1 INPUT                                          PAGE  6

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          179          KK    R/P2
          180          KO       0       0       7      21
          181          RS       1    ELEV    1034
          182          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          183          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          184          SS    1040      10     2.6     1.5
          185          SL  103328.86338     0.6     0.5
                       *

          186          KK      T2
          187          KO       0       0       7      21
          188          BA  0.0035
          189          LS       0      85
          190          UK      49    0.05     0.3     100
          191          RD     434   0.005    0.03           TRAP       0       2      NO
                       *

          192          KK      S2
          193          KO       0       0       7      21
          194          BA  0.0044
          195          LS       0      86
          196          UK     160    0.25     0.3     100
          197          RD     434   0.005    0.03           TRAP       0       2      NO
```

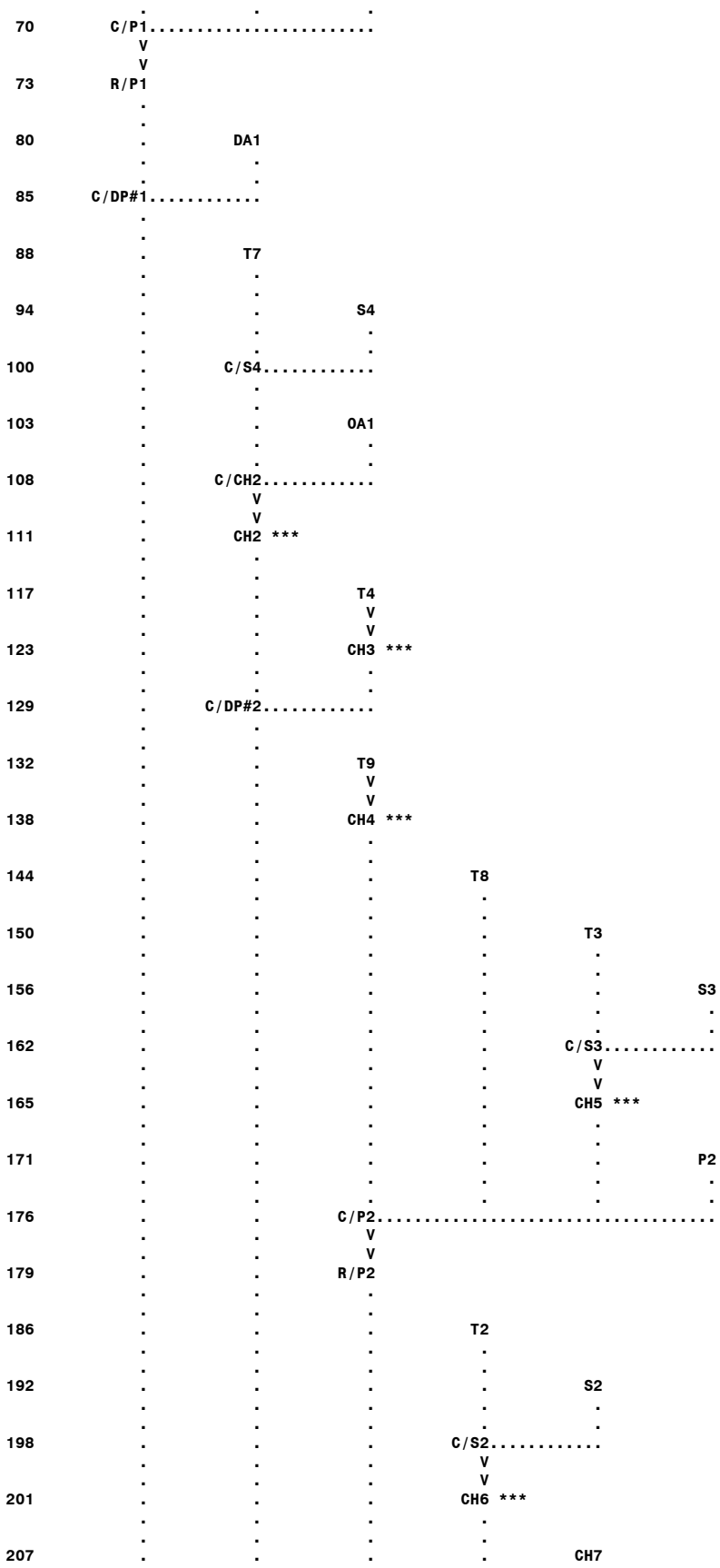
```
                *
          198   KK    C/S2
          199   KO       0       0       0       7      21
          200   HC       2
                *
          201   KK     CH6
          202   KO       0       0       0       7      21
          203   BA  0.0037
          204   LS       0      86
          205   UK     200    0.05     0.3     100
          206   RD     537    0.01    0.03            TRAP       2       2     YES
                *
          207   KK     CH7
          208   KO      00       0       7      21
          209   BA  0.0024
          210   LS       0      86
          211   UK     210    0.05     0.3     100
          212   RD     317    0.01    0.03            TRAP       2       2      NO
                *
          213   KK  C/DP#4
          214   KO       0       0       0       7      21
          215   HC       2
                *
1                                          HEC-1 INPUT                                          PAGE  7

         LINE   ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          216   KK  DP#5/DA2
          217   KO       0       0       0       7      21
          218   BA  0.0330
          219   LS       0      84
          220   US    0.29    0.66
          221   ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     5          T6
                 .
                 .
    12           .          S6
                 .           .
                 .           .
    18        C/S6............
                 .
                 .
    21           .          T5
                 .           .
                 .           .
    27           .           .          S5
                 .           .           .
                 .           .           .
    33           .        C/S5............
                 .           .
                 .           .
    36           .           .         OA2
                 .           .           .
                 .           .           .
    41       C/CH1.........................
                 V
                 V
    44         CH1 ***
                 .
                 .
    50           .          T1
                 .           .
                 .           .
    56           .           .          S1
                 .           .           .
                 .           .           .
    62           .        C/S1............
                 .           .
                 .           .
    65           .           .          P1
                 .           .           .
```


70 C/P1
73 R/P1
80 DA1
85 C/DP#1
88 T7
94 S4
100 C/S4
103 OA1
108 C/CH2
111 CH2 ***
117 T4
123 CH3 ***
129 C/DP#2
132 T9
138 CH4 ***
144 T8
150 T3
156 S3
162 C/S3
165 CH5 ***
171 P2
176 C/P2
179 R/P2
186 T2
192 S2
198 C/S2
201 CH6 ***
207 CH7

```
                .          .          .          .          .
                .          .          .          .          .
  213           .          .          .      C/DP#4.....
                .          .          .          .
                .          .          .          .
  216           .          .          .          .      DP#5/D

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                    ****************************************
 *                                       *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *        JUN 1998 AND FEB 2010          *                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1R               *                    *          609 SECOND STREET           *
 *       RGMHEC2000 WWW.HEC-1.COM        *                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   17AUG24  TIME  09:30:39   *                    *           (916) 756-1104             *
 *                                       *                    *                                      *
 *****************************************                    ****************************************



                        DEL RIO LF EXPANSION
                        25-YR, 24-HR

   4 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      3    0  ENDING DATE
                      NDTIME        1035  ENDING TIME
                      ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   34.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   5 KK     *        T6  *
            *            *
            **************

   7 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   8 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
```

```
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .00

    9 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   10 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        179.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   11 RD            MAIN CHANNEL
                           L        312.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       1.26     35.80     18.13    724.93      6.07       .50
                     MAIN          1.63      1.33       1.57    156.00     17.29    726.21      6.01      3.31

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1003E+01 OUTFLOW= .9942E+00 BASIN STORAGE= .2899E-03 PERCENT ERROR=    .9

                                              INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00               16.83    725.00      6.01

       ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION       T6

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     16.83     12.08                   1.76         .50         .35          .35
                         (INCHES)     5.274       6.013       6.014        6.014
                          (AC-FT)       .87         .99         .99          .99

                         CUMULATIVE AREA =    .00310 SQ MI   ACRES=            1.9840


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   12 KK      *         S6 *
              *            *
              **************

   13 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS
```

```
             SUBBASIN RUNOFF DATA

   14 BA       SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

   15 LS       SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
   16 UK         OVERLAND-FLOW ELEMENT NO. 1
                        L        140.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
   17 RD         MAIN CHANNEL
                        L        541.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .70     27.92     41.27    724.94      6.07       .81
                     MAIN          1.63      1.33       2.20    270.35     37.80    723.63      5.96      4.10

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1909E+01 OUTFLOW= .1874E+01 BASIN STORAGE= .3379E-03 PERCENT ERROR=   1.8

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00               37.16    725.00      5.95

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       S6

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                  (CFS)
+     37.16     12.08                   3.32         .94         .65          .65
                (INCHES)     5.231       5.948       5.948       5.948
                 (AC-FT)      1.65        1.87        1.87        1.87

                CUMULATIVE AREA =    .00590 SQ MI   ACRES=            3.7760


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
   18 KK       *      C/S6  *
               *            *
               **************
```

```
   19 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   20 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S6

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    53.99     12.08                  5.08         1.44        1.00         1.00
                        (INCHES)     5.246        5.970       5.971        5.971
                         (AC-FT)      2.52         2.87        2.87         2.87

                       CUMULATIVE AREA =    .00900 SQ MI   ACRES=            5.7600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *             *
   21 KK    *         T5  *
            *             *
            **************

   22 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   23 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

   24 LS          SCS LOSS RATE
                       STRTL          .35  INITIAL ABSTRACTION
                      CRVNBR        85.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   25 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         176.  OVERLAND FLOW LENGTH
                           S        .0500  SLOPE
                           N         .300  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   26 RD            MAIN CHANNEL
                           L         438.  CHANNEL LENGTH
                           S        .0050  SLOPE
```

```
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .00  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        1.11      1.67       1.21     35.14     23.32    725.38       6.07       .50
                   MAIN          1.63      1.33       2.06    218.80     22.40    724.94       6.00      3.54

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1295E+01 OUTFLOW= .1280E+01 BASIN STORAGE= .3915E-03 PERCENT ERROR=   1.1

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00                22.38    725.00       6.02

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                  (CFS)
+     22.38     12.08                   2.28         .65         .45          .45
                (INCHES)     5.289       6.020       6.021       6.021
                 (AC-FT)      1.13        1.28        1.28        1.28

                CUMULATIVE AREA =    .00400 SQ MI   ACRES=            2.5600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
   27 KK     *        S5  *
             *            *
             **************

   28 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   29 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .01

   30 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA
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                KINEMATIC WAVE
   31 UK          OVERLAND-FLOW ELEMENT NO. 1
                         L        160.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
   32 RD          MAIN CHANNEL
                         L        438.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .77     32.00     62.97    724.49       6.18       .85
                     MAIN          1.63      1.33       1.60    437.60     60.23    725.29       5.36      4.56

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3002E+01 OUTFLOW= .2602E+01 BASIN STORAGE= .3265E-03 PERCENT ERROR=  13.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00               59.78    725.00      5.38

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       S5

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

    PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                          (CFS)
+      59.78     12.08                  4.79        1.32         .91          .91
                         (INCHES)     4.892       5.384       5.384        5.384
                          (AC-FT)      2.37        2.61        2.61         2.61

                         CUMULATIVE AREA =    .00910 SQ MI   ACRES=            5.8240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
   33 KK      *      C/S5  *
              *            *
              **************

   34 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   35 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION     C/S5
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  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    82.16     12.08                 7.06        1.96        1.36         1.36
                      (INCHES)      5.012       5.578       5.578        5.578
                       (AC-FT)      3.50        3.90        3.90         3.90

                     CUMULATIVE AREA =    .01310 SQ MI   ACRES=            8.3840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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           *            *
  36 KK    *       OA2  *
           *            *
           **************

  37 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  38 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .08  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .08

  39 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  40 US          SNYDER UNITGRAPH
                         TP         .55  LAG
                         CP         .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                      ***

                                               UNIT HYDROGRAPH PARAMETERS
                                            CLARK   TC=   .64 HR,       R=   .45 HR
                                           SNYDER   TP=   .55 HR,      CP=   .67

                                                   UNIT HYDROGRAPH
                                               33 END-OF-PERIOD ORDINATES
                    3.       13.       25.       38.       51.       59.       62.       59.       51.       43.
                   35.       29.       24.       20.       17.       14.       12.       10.        8.        7.
                    5.        5.        4.        3.        3.        2.        2.        1.        1.        1.
                    1.        1.        1.

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION      OA2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   168.13     12.58                43.84       12.60        8.74         8.74
                      (INCHES)      5.153       5.923       5.923        5.923
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                     (AC-FT)     21.74       24.99       24.99        24.99

                    CUMULATIVE AREA =    .07910 SQ MI   ACRES=           50.6240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  41 KK   *     C/CH1  *
          *            *
          **************

  42 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  43 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/CH1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   193.42     12.08               55.94       16.01       11.11        11.11
                    (INCHES)      5.139       5.882       5.882        5.882
                     (AC-FT)     27.74       31.75       31.75        31.75

                    CUMULATIVE AREA =    .10120 SQ MI   ACRES=           64.7680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  44 KK   *       CH1  *
          *            *
          **************

  45 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  46 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

  47 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
```

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                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  48 UK             OVERLAND-FLOW ELEMENT NO. 1
                           L         47.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  49 RD             MAIN CHANNEL
                           L       3079.  CHANNEL LENGTH
                           S       .0200  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .36      9.40     68.18    724.96       6.18       .54
                     MAIN          1.95      1.42       5.00   1539.50    217.30    730.00       5.90      9.51


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3175E+02  EXCESS= .3134E+01 OUTFLOW= .3485E+02 BASIN STORAGE= .1750E-02 PERCENT ERROR=    .1


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.95      1.42       5.00              217.30    730.00      5.90

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH1

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                          (CFS)
+     217.30     12.17                 61.40       17.57       12.19        12.19
                          (INCHES)     5.157       5.903       5.903        5.903
                           (AC-FT)     30.45       34.85       34.85        34.85

                          CUMULATIVE AREA =    .11070 SQ MI   ACRES=           70.8480


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  50 KK       *        T1  *
              *            *
              **************

  51 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                 SUBBASIN RUNOFF DATA

  52 BA            SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA
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              PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

   53 LS      SCS LOSS RATE
                   STRTL         .35  INITIAL ABSTRACTION
                  CRVNBR       85.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
   54 UK        OVERLAND-FLOW ELEMENT NO. 1
                     L         167.  OVERLAND FLOW LENGTH
                     S        .0500  SLOPE
                     N         .300  ROUGHNESS COEFFICIENT
                    PA        100.0  PERCENT OF SUBBASIN
                  DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
   55 RD        MAIN CHANNEL
                     L         305.  CHANNEL LENGTH
                     S        .0050  SLOPE
                     N         .030  CHANNEL ROUGHNESS COEFFICIENT
                    CA          .00  CONTRIBUTING AREA
                 SHAPE         TRAP  CHANNEL SHAPE
                    WD          .00  BOTTOM WIDTH OR DIAMETER
                     Z         2.00  SIDE SLOPE
                RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.16     33.30     14.09    725.54      6.07       .49
                    MAIN          1.63      1.33       1.62    152.50     13.83    725.33      6.02      3.13

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7767E+00 OUTFLOW= .7699E+00 BASIN STORAGE= .2497E-03 PERCENT ERROR=    .9

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00                13.52    725.00      6.02

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                           (CFS)
+     13.52     12.08                   1.36         .39         .27          .27
                         (INCHES)      5.283       6.018       6.019        6.019
                          (AC-FT)        .68         .77         .77          .77

                         CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   56 KK      *        S1  *
              *            *
              **************

   57 KO      OUTPUT CONTROL VARIABLES
                   IPRNT            3  PRINT CONTROL
                   IPLOT            0  PLOT CONTROL
                   QSCAL           0.  HYDROGRAPH PLOT SCALE
                   IPNCH            7  PUNCH COMPUTED HYDROGRAPH
```

```
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  58 BA        SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .00

  59 LS        SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  60 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L         159.  OVERLAND FLOW LENGTH
                        S        .2500  SLOPE
                        N         .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  61 RD          MAIN CHANNEL
                        L         522.  CHANNEL LENGTH
                        S        .0050  SLOPE
                        N         .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA          .00  CONTRIBUTING AREA
                    SHAPE         TRAP  CHANNEL SHAPE
                       WD          .00  BOTTOM WIDTH OR DIAMETER
                        Z         2.00  SIDE SLOPE
                   RUPSTQ           NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .71     31.72     27.04    724.50      6.19       .85
                    MAIN          1.63      1.33       2.36    260.90     25.00    723.69      6.08      3.69


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1287E+01 OUTFLOW= .1265E+01 BASIN STORAGE= .3119E-03 PERCENT ERROR=   1.7


                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00                24.36    725.00      6.08

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION       S1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     24.36     12.08                 2.24         .64         .44          .44
                         (INCHES)     5.337       6.076       6.076        6.076
                          (AC-FT)      1.11        1.26        1.26         1.26

                         CUMULATIVE AREA =    .00390 SQ MI   ACRES=            2.4960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          **************
          *            *
  62 KK   *      C/S1  *
          *            *
          **************

  63 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  64 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/S1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    37.88     12.08                3.60        1.03         .71          .71
                       (INCHES)     5.315       6.054       6.055        6.055
                        (AC-FT)     1.79        2.03        2.03         2.03

                       CUMULATIVE AREA =    .00630 SQ MI   ACRES=           4.0320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
  65 KK   *        P1  *
          *            *
          **************

  66 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  67 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

  68 LS          SCS LOSS RATE
                      STRTL          .00  INITIAL ABSTRACTION
                     CRVNBR       100.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

  69 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG          .00  LAG

                                                        ***

                                                   UNIT HYDROGRAPH
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                                                  5 END-OF-PERIOD ORDINATES
               50.       14.        3.        1.        0.

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       P1

    TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+    60.46     12.08                 5.91        1.84        1.27         1.27
                         (INCHES)   6.316       7.848       7.850        7.850
                          (AC-FT)    2.93        3.64        3.64         3.64

                        CUMULATIVE AREA =    .00870 SQ MI   ACRES=            5.5680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   70 KK    *      C/P1  *
            *            *
            **************

   71 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   72 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                         ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   282.19     12.08                70.68       20.41       14.18        14.18
                         (INCHES)   5.228       6.038       6.045        6.045
                          (AC-FT)   35.05       40.48       40.53        40.53

                        CUMULATIVE AREA =    .12570 SQ MI   ACRES=           80.4480


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   73 KK    *      R/P1  *
            *            *
            **************

   74 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA
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  75 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     1044.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  76 SA               AREA          .0       1.6       1.9       2.1       2.3       2.6       2.9       3.1       3.4

  77 SE          ELEVATION     1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

  79 SL          LOW-LEVEL OUTLET
                       ELEVL     1041.00  ELEVATION AT CENTER OF OUTLET
                       CAREA        3.14  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  78 SS          SPILLWAY
                        CREL     1056.50  SPILLWAY CREST ELEVATION
                       SPWID       10.00  SPILLWAY WIDTH
                        COQW        2.60  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED STORAGE-ELEVATION DATA

            STORAGE       .00       .11      3.19      7.14     11.58     16.54     22.02     28.03     34.58
          ELEVATION    1044.00   1044.20   1046.00   1048.00   1050.00   1052.00   1054.00   1056.00   1058.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

            OUTFLOW       .00     27.91     29.89     32.18     34.84     37.99     41.76     46.37     52.12     59.49
          ELEVATION    1044.00   1044.41   1044.91   1045.54   1046.32   1047.32   1048.64   1050.42   1052.90   1056.50

            OUTFLOW     59.66     60.24     61.48     63.65     66.98     71.74     78.17     86.54     97.08    110.06
          ELEVATION    1056.53   1056.58   1056.66   1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE       .00       .11       .44      1.27      2.35      3.19      3.78      5.74      7.14      8.51
            OUTFLOW     26.17     27.03     27.91     29.89     32.18     33.79     34.84     37.99     39.98     41.76
          ELEVATION    1044.00   1044.20   1044.41   1044.91   1045.54   1046.00   1046.32   1047.32   1048.00   1048.64

            STORAGE     11.58     12.58     16.54     18.93     22.02     28.03     29.61     29.70     29.87     30.13
            OUTFLOW     45.33     46.37     50.11     52.12     54.48     58.52     59.49     59.66     60.24     61.48
          ELEVATION    1050.00   1050.42   1052.00   1052.90   1054.00   1056.00   1056.50   1056.53   1056.58   1056.66

            STORAGE     30.48     30.93     31.46     32.09     32.82     33.65     34.58
            OUTFLOW     63.65     66.98     71.74     78.17     86.54     97.08    110.06
          ELEVATION    1056.77   1056.91   1057.07   1057.26   1057.48   1057.73   1058.00

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION     R/P1

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                              (CFS)
+     52.25     14.00          48.30       33.14       31.01       31.01
                          (INCHES)      3.573       9.805      13.220      13.220
                           (AC-FT)      23.95       65.73       88.63       88.63

  PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+   (AC-FT)      (HR)
     19.110     14.00          14.82        4.32        3.00        2.97

   PEAK STAGE    TIME                      MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+    (FEET)      (HR)
    1052.96     14.00        1051.27     1046.21     1045.54     1045.54

                          CUMULATIVE AREA =    .12570 SQ MI   ACRES=          80.4480


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *           *
 80 KK    *      DA1  *
          *           *
          *************

 81 KO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

 82 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .09  SUBBASIN AREA

               PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .09

 83 LS         SCS LOSS RATE
                    STRTL         .38  INITIAL ABSTRACTION
                   CRVNBR       84.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

 84 US         SNYDER UNITGRAPH
                      TP         .32  LAG
                      CP         .66  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .38 HR,       R=   .26 HR
                                    SNYDER   TP=   .32 HR,      CP=   .66

                                              UNIT HYDROGRAPH
                                          19 END-OF-PERIOD ORDINATES
                14.       49.       89.      114.      109.       85.       61.       44.       32.       23.
                17.       12.        9.        6.        5.        3.        2.        2.        1.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      DA1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   252.98     12.33                48.75       13.98        9.70         9.70
                         (INCHES)     5.163       5.922       5.922        5.922
                          (AC-FT)     24.18       27.73       27.73        27.73

                        CUMULATIVE AREA =    .08780 SQ MI   ACRES=          56.1920


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 85 KK    *    C/DP#1  *
          *            *
          **************

 86 KO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
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                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


  87 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   C/DP#1

  PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   293.57     12.33                93.71       47.12       40.71       40.71
                         (INCHES)     4.081       8.208      10.219      10.219
                          (AC-FT)     46.47       93.47      116.36      116.36

                        CUMULATIVE AREA =    .21350 SQ MI   ACRES=          136.6400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *             *
  88 KK      *        T7   *
             *             *
             **************

  89 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  90 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .01

  91 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  92 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        244.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  93 RD            MAIN CHANNEL
                          L        438.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
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                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                 PEAK                CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                  PLANE1        1.11      1.67       1.60     48.82     35.46    725.18       6.06       .54
                  MAIN          1.63      1.33       1.85    218.80     34.36    726.41       5.99      3.94

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2168E+01 OUTFLOW= .2140E+01 BASIN STORAGE= .6671E-03 PERCENT ERROR=   1.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.63      1.33       5.00                32.26    725.00      5.99

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T7

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     32.26     12.08                3.78        1.08         .75          .75
                          (INCHES)   5.248       5.985       5.986        5.986
                           (AC-FT)    1.88        2.14        2.14         2.14

                         CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   94 KK     *        S4  *
             *            *
             **************

   95 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   96 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

   97 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   98 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        176.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
```

```
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  99 RD           MAIN CHANNEL
                       L        644.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                 ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                  CELERITY
                                                    (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                 PLANE1        2.48      1.67        .70     35.12     60.99    724.49      6.18       .88
                 MAIN          1.63      1.33       2.37    321.80     57.79    724.09      6.05      4.52

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2936E+01 OUTFLOW= .2870E+01 BASIN STORAGE= .4313E-03 PERCENT ERROR=   2.2

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                 MAIN          1.63      1.33       5.00               55.58    725.00      6.04

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       S4

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    55.58     12.08                 5.10        1.45        1.00         1.00
                         (INCHES)    5.323       6.041       6.042        6.042
                          (AC-FT)    2.53        2.87        2.87         2.87

                        CUMULATIVE AREA =    .00890 SQ MI   ACRES=           5.6960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  100 KK    *      C/S4  *
            *            *
            **************

  101 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  102 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/S4

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
```

```
+    87.84     12.08                 8.87        2.52        1.75        1.75
                         (INCHES)     5.289       6.017       6.018       6.018
                          (AC-FT)     4.40        5.01        5.01        5.01

                        CUMULATIVE AREA =    .01560 SQ MI   ACRES=           9.9840


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  103 KK    *       OA1  *
            *            *
            **************

  104 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  105 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .15  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .15

  106 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  107 US          SNYDER UNITGRAPH
                         TP         .56  LAG
                         CP         .64  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                       ***

                                              UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=    .64 HR,       R=    .49 HR
                                         SNYDER   TP=    .56 HR,      CP=    .64

                                                  UNIT HYDROGRAPH
                                              36 END-OF-PERIOD ORDINATES
                    6.       22.       44.       68.       90.      105.      112.      107.       94.       79.
                   67.       57.       48.       40.       34.       29.       24.       20.       17.       15.
                   12.       10.        9.        7.        6.        5.        4.        4.        3.        3.
                    2.        2.        2.        1.        1.        1.

        ***            ***            ***            ***            ***

                           HYDROGRAPH AT STATION      OA1

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                           (CFS)
+   304.79     12.58                82.65       23.76       16.49       16.49
                         (INCHES)     5.150       5.923       5.923       5.923
                          (AC-FT)     40.98       47.13       47.13       47.13

                        CUMULATIVE AREA =    .14920 SQ MI   ACRES=          95.4880
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  108 KK    *     C/CH2  *
            *            *
            **************

  109 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  110 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION    C/CH2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   319.42     12.58                91.48       26.29       18.24        18.24
                         (INCHES)     5.161       5.932       5.932        5.932
                          (AC-FT)     45.36       52.14       52.14        52.14

                         CUMULATIVE AREA =    .16480 SQ MI   ACRES=          105.4720


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            *            *
  111 KK    *       CH2  *
            *            *
            **************

  112 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  113 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

  114 LS          SCS LOSS RATE
                       STRTL          .33  INITIAL ABSTRACTION
                      CRVNBR        86.00  CURVE NUMBER
                       RTIMP          .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  115 UK            OVERLAND-FLOW ELEMENT NO. 1
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                         L        47.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                   MUSKINGUM-CUNGE
 116 RD              MAIN CHANNEL
                         L        865.  CHANNEL LENGTH
                         S       .0100  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD       10.00  BOTTOM WIDTH OR DIAMETER
                         Z        3.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .36      9.40     67.47    724.96       6.18       .54
                     MAIN          1.38      1.42       1.81    432.50    324.98    756.24       5.94      7.97

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5214E+02  EXCESS= .3101E+01 OUTFLOW= .5522E+02 BASIN STORAGE= .6339E-03 PERCENT ERROR=    .0

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.38      1.42       5.00              323.44    755.00      5.94

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    323.44     12.58               96.83       27.83       19.31        19.31
                      (INCHES)      5.168       5.942       5.942        5.942
                       (AC-FT)      48.02       55.20       55.20        55.20

                      CUMULATIVE AREA =    .17420 SQ MI   ACRES=          111.4880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
 117 KK      *        T4  *
             *            *
             **************

 118 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 119 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
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                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

  120 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  121 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        176.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  122 RD            MAIN CHANNEL
                           L        697.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .70     35.12     69.90    724.49      6.18       .88
                     MAIN          1.63      1.33       2.48    348.40     67.46    725.31      6.04      4.68

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3365E+01 OUTFLOW= .3288E+01 BASIN STORAGE= .4782E-03 PERCENT ERROR=   2.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00               66.21    725.00      6.05

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T4

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     66.21     12.08                   5.86        1.66        1.15         1.15
                         (INCHES)     5.340       6.054       6.054        6.054
                          (AC-FT)      2.90        3.29        3.29         3.29

                         CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280

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              *            *
  123 KK      *       CH3  *
              *            *
              **************

  124 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA
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 125 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

 126 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 127 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        156.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 128 RD            MAIN CHANNEL
                           L       1456.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .75     31.14     24.33    724.48      6.18       .84
                     MAIN          1.38      1.42       4.47    728.00     73.82    729.14      6.06      5.42

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3293E+01  EXCESS= .1155E+01 OUTFLOW= .4428E+01 BASIN STORAGE= .1084E-02 PERCENT ERROR=    .4

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.38      1.42       5.00               70.27    730.00      6.07

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH3

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     70.27     12.17                 7.90        2.24        1.55         1.55
                           (INCHES)     5.364       6.069       6.070        6.070
                            (AC-FT)     3.92        4.43        4.43         4.43

                           CUMULATIVE AREA =    .01370 SQ MI   ACRES=            8.7680

 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

                 **************
                 *              *
 129 KK          *    C/DP#2    *
                 *              *
                 **************

 130 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
```

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                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7   PUNCH COMPUTED HYDROGRAPH
                     IOUT         21   SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1   FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416   LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083   TIME INTERVAL IN HOURS


  131 HC          HYDROGRAPH COMBINATION
                    ICOMP          2   NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION   C/DP#2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+   337.46     12.58              104.70        30.07       20.87        20.87
                  (INCHES)        5.181        5.951       5.951        5.951
                   (AC-FT)        51.92        59.64       59.64        59.64

                  CUMULATIVE AREA =    .18790 SQ MI   ACRES=          120.2560


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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            *            *
  132 KK    *        T9  *
            *            *
            **************

  133 KO          OUTPUT CONTROL VARIABLES
                    IPRNT          3   PRINT CONTROL
                    IPLOT          0   PLOT CONTROL
                    QSCAL          7.  HYDROGRAPH PLOT SCALE
                    IPNCH         21   PUNCH COMPUTED HYDROGRAPH
                     IOUT          0   SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1   FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416   LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083   TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  134 BA          SUBBASIN CHARACTERISTICS
                    TAREA        .02   SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                           STORM AREA =     .02

  135 LS          SCS LOSS RATE
                    STRTL         .35   INITIAL ABSTRACTION
                   CRVNBR       85.00   CURVE NUMBER
                    RTIMP         .00   PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  136 UK            OVERLAND-FLOW ELEMENT NO. 1
                      L          919.   OVERLAND FLOW LENGTH
                      S         .0500   SLOPE
                      N          .300   ROUGHNESS COEFFICIENT
                     PA         100.0   PERCENT OF SUBBASIN
                   DXMIN             5   MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  137 RD            MAIN CHANNEL
                      L          232.   CHANNEL LENGTH
                      S         .0050   SLOPE
                      N          .030   CHANNEL ROUGHNESS COEFFICIENT
                     CA           .02   CONTRIBUTING AREA
                   SHAPE          TRAP   CHANNEL SHAPE
                      WD          .00   BOTTOM WIDTH OR DIAMETER
                       Z         2.00   SIDE SLOPE
                  RUPSTQ            NO   ROUTE UPSTREAM HYDROGRAPH
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                                                  ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                 PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        1.11      1.67       4.25    183.86     68.27    734.73       6.05       .74
                   MAIN          1.63      1.33        .83    232.00     67.88    735.01       5.67      4.65

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7023E+01 OUTFLOW= .6563E+01 BASIN STORAGE= .8647E-02 PERCENT ERROR=   6.4

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00               67.87    735.00      5.67

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       T9

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     67.87     12.25               11.91        3.31        2.30         2.30
                         (INCHES)     5.104       5.670       5.673        5.673
                          (AC-FT)     5.91        6.56        6.57         6.57

                         CUMULATIVE AREA =    .02170 SQ MI   ACRES=           13.8880

 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

             **************
             *            *
  138 KK     *       CH4  *
             *            *
             **************

  139 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  140 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .01

  141 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  142 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        156.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
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 143 RD           MAIN CHANNEL
                        L       1064.  CHANNEL LENGTH
                        S       .0100  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD       10.00  BOTTOM WIDTH OR DIAMETER
                        Z        3.00  SIDE SLOPE
                   RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .75     31.16     66.82    724.50      6.18       .84
                     MAIN          1.38      1.42       3.00    532.00    101.18    726.67      5.78      5.91


CONTINUITY SUMMARY (AC-FT) - INFLOW= .6565E+01  EXCESS= .3167E+01 OUTFLOW= .9653E+01 BASIN STORAGE= .8531E-03 PERCENT ERROR=    .8


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.38      1.42       5.00               99.36    725.00      5.77

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     99.36     12.08                17.35        4.86        3.37         3.37
                         (INCHES)     5.153       5.769       5.771        5.771
                          (AC-FT)     8.60        9.63        9.63         9.63

                         CUMULATIVE AREA =    .03130 SQ MI   ACRES=           20.0320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
  144 KK      *         T8 *
              *            *
              **************

  145 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  146 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                   PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                             STORM AREA =     .01

  147 LS           SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA
```

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                KINEMATIC WAVE
  148 UK          OVERLAND-FLOW ELEMENT NO. 1
                          L        360.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  149 RD          MAIN CHANNEL
                          L        721.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       2.12     71.94     43.17    726.29       6.06       .60
                     MAIN          1.63      1.33       2.89    360.25     41.79    729.22       5.96      4.15

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3075E+01 OUTFLOW= .3021E+01 BASIN STORAGE= .1484E-02 PERCENT ERROR=   1.7

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00                40.84    730.00      5.95

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       T8

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

    PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                    (CFS)
+      40.84     12.17                    5.35        1.52        1.06         1.06
                          (INCHES)     5.233       5.952       5.955        5.955
                           (AC-FT)      2.65        3.02        3.02         3.02

                          CUMULATIVE AREA =    .00950 SQ MI   ACRES=            6.0800

 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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              *            *
  150 KK      *        T3  *
              *            *
              **************

  151 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  152 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
```

```
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .00

  153 LS        SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  154 UK          OVERLAND-FLOW ELEMENT NO. 1
                         L         49.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  155 RD          MAIN CHANNEL
                         L        535.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                            PEAK                CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67        .55      9.80     24.62    724.64       6.07       .33
                    MAIN          1.63      1.33       2.48    267.50     23.56    725.26       5.97      3.60

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1133E+01 OUTFLOW= .1115E+01 BASIN STORAGE= .3026E-03 PERCENT ERROR=   1.6

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00               23.32    725.00      5.98

       ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION       T3

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     23.32     12.08                1.98         .56         .39          .39
                         (INCHES)     5.269       5.982       5.982        5.982
                          (AC-FT)      .98        1.12        1.12         1.12

                         CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


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              *            *
  156 KK      *        S3  *
              *            *
              **************

  157 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS
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              SUBBASIN RUNOFF DATA

  158 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .01

  159 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  160 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        160.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  161 RD            MAIN CHANNEL
                           L        304.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                           COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .77     32.00     46.36    724.49      6.18       .85
                     MAIN          1.63      1.33       1.20    304.00     44.71    725.21      5.42      4.22

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2210E+01 OUTFLOW= .1937E+01 BASIN STORAGE= .2307E-03 PERCENT ERROR=  12.3

                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00               44.55    725.00      5.44

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION       S3

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     44.55     12.08                   3.56         .98         .68          .68
                         (INCHES)     4.941       5.441       5.441        5.441
                          (AC-FT)      1.77        1.94        1.94         1.94

                         CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
  162 KK      *      C/S3  *
              *            *
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          **************

  163 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  164 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/S3

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    67.88     12.08                 5.54         1.54        1.07         1.07
                         (INCHES)     5.053        5.626       5.627        5.627
                          (AC-FT)     2.75         3.06        3.06         3.06

                       CUMULATIVE AREA =    .01020 SQ MI   ACRES=            6.5280


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  165 KK  *       CH5  *
          *            *
          **************

  166 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  167 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

  168 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  169 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        200.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  170 RD            MAIN CHANNEL
                           L       1996.  CHANNEL LENGTH
```

```
                         S       .0100  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        2.00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                      COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK               CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .86     40.00     51.86    724.82      6.19       .92
                    MAIN          2.16      1.35       4.84    998.00     91.44    726.52      5.80      6.87


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3061E+01  EXCESS= .2507E+01 OUTFLOW= .5509E+01 BASIN STORAGE= .1029E-02 PERCENT ERROR=   1.0


                                           INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          2.16      1.35       5.00                83.96    730.00      5.80

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     83.96     12.17                 9.90        2.78        1.93         1.93
                        (INCHES)     5.173       5.801       5.801        5.801
                         (AC-FT)      4.91        5.51        5.51         5.51

                        CUMULATIVE AREA =    .01780 SQ MI   ACRES=           11.3920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   171 KK    *         P2 *
             *            *
             **************

   172 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   173 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                   PRECIPITATION DATA

     6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                   ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                   5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                 STORM AREA =     .00

   174 LS          SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA
```

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  175 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .00  LAG

                                                        ***

                                                    UNIT HYDROGRAPH
                                                  5 END-OF-PERIOD ORDINATES
                21.        6.        1.        0.        0.

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       P2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    25.72     12.08                 2.51         .78         .54          .54
                         (INCHES)     6.316       7.848       7.850        7.850
                          (AC-FT)     1.25         1.55        1.55         1.55

                        CUMULATIVE AREA =    .00370 SQ MI   ACRES=            2.3680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  176 KK     *      C/P2  *
             *            *
             **************

  177 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  178 HC          HYDROGRAPH COMBINATION
                        ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/P2

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   244.85     12.08                35.00        9.91        6.90         6.90
                         (INCHES)    5.224       5.915       5.931        5.931
                          (AC-FT)    17.36       19.65       19.71        19.71

                        CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  179 KK     *      R/P2  *
             *            *
             **************

  180 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
```

```
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


          HYDROGRAPH ROUTING DATA

181 RS      STORAGE ROUTING
                 NSTPS           1  NUMBER OF SUBREACHES
                  ITYP        ELEV  TYPE OF INITIAL CONDITION
                 RSVRIC     1034.00  INITIAL CONDITION
                     X         .00 WORKING R AND D COEFFICIENT

182 SA          AREA          .0       .2       .2       .2       .3       .3       .4       .5

183 SE      ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

185 SL      LOW-LEVEL OUTLET
                 ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                 CAREA       28.86  CROSS-SECTIONAL AREA
                  COQL         .60  COEFFICIENT
                  EXPL         .50  EXPONENT OF HEAD

184 SS      SPILLWAY
                  CREL     1040.00  SPILLWAY CREST ELEVATION
                 SPWID       10.00  SPILLWAY WIDTH
                  COQW        2.60  WEIR COEFFICIENT
                  EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                        COMPUTED STORAGE-ELEVATION DATA

          STORAGE       .00       .01       .16       .39       .66       .96      1.70      2.62
        ELEVATION    1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

                                        COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW       .00    149.21    161.17    175.22    191.96    212.23    237.29    269.07    310.66    367.47
        ELEVATION    1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

          OUTFLOW     392.69    399.17    406.61    415.06    424.58    435.23    447.05    460.12    474.49    490.21
        ELEVATION    1040.56   1040.67   1040.80   1040.94   1041.09   1041.25   1041.42   1041.60   1041.80   1042.00


                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
          OUTFLOW     138.89    149.21    152.14    161.17    175.22    191.96    196.42    212.23    237.29    240.57
        ELEVATION    1034.00   1034.15   1034.20   1034.35   1034.59   1034.91   1035.00   1035.33   1035.92   1036.00

          STORAGE       .59       .66       .96      1.70      1.95      2.00      2.06      2.12      2.19      2.26
          OUTFLOW     269.07    277.78    310.57    367.47    392.69    399.17    406.61    415.06    424.58    435.23
        ELEVATION    1036.75   1037.00   1038.00   1040.00   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25

          STORAGE      2.34      2.43      2.52      2.62
          OUTFLOW    447.05    460.12    474.49    490.21
        ELEVATION    1041.42   1041.60   1041.80   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      139. TO      175.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     R/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   224.25     12.17                141.52      139.55      139.35       139.35
                         (INCHES)    21.120      83.304     119.865      119.865
                          (AC-FT)     70.18      276.79      398.27       398.27

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
      .303     12.17                  .00         .00         .00         -.47

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     34.58-HR
```

```
+   (FEET)      (HR)
   1035.61     12.17              1034.05     1034.01     1034.01      1034.01

                      CUMULATIVE AREA =    .06230 SQ MI   ACRES=           39.8720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 186 KK    *        T2  *
           *            *
           **************

 187 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 188 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .00

 189 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 190 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L          49.  OVERLAND FLOW LENGTH
                          S       .0500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 191 RD            MAIN CHANNEL
                          L         434.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                   PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        1.11      1.67        .55      9.80     24.62    724.64      6.07       .33
                   MAIN          1.63      1.33       2.01    217.00     24.21    724.89      5.98      3.60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1133E+01 OUTFLOW= .1116E+01 BASIN STORAGE= .2449E-03 PERCENT ERROR=   1.4

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00                23.84    725.00      6.02
```

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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       T2

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    23.84     12.08                2.00         .57         .39          .39
                     (INCHES)     5.306       6.024       6.024        6.024
                      (AC-FT)       .99        1.12        1.12         1.12

                     CUMULATIVE AREA =    .00350 SQ MI   ACRES=            2.2400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  192 KK   *        S2  *
           *            *
           **************

  193 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  194 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

  195 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  196 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        160.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  197 RD            MAIN CHANNEL
                           L        434.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        2.48      1.67        .77     32.00     30.45    724.49      6.18       .85
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                  MAIN          1.63      1.33       1.90    217.00     29.22    725.42      6.09      3.80

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1452E+01 OUTFLOW= .1430E+01 BASIN STORAGE= .2734E-03 PERCENT ERROR=   1.5

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.63      1.33       5.00               28.89    725.00      6.10

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       S2

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+    28.89     12.08                 2.53         .72         .50          .50
                     (INCHES)     5.356       6.101       6.102        6.102
                      (AC-FT)      1.26        1.43        1.43         1.43

                     CUMULATIVE AREA =    .00440 SQ MI   ACRES=            2.8160


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  198 KK    *      C/S2  *
            *            *
            **************

  199 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  200 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     C/S2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+    52.73     12.08                 4.53        1.29         .89          .89
                     (INCHES)     5.334       6.067       6.067        6.067
                      (AC-FT)      2.25        2.56        2.56         2.56

                     CUMULATIVE AREA =    .00790 SQ MI   ACRES=            5.0560


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  201 KK    *       CH6  *
            *            *
            **************

  202 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
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                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 203 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .00  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .00

 204 LS        SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 205 UK          OVERLAND-FLOW ELEMENT NO. 1
                       L        200.  OVERLAND FLOW LENGTH
                       S       .0500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                   DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 206 RD          MAIN CHANNEL
                       L        537.  CHANNEL LENGTH
                       S       .0100  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .00  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD        2.00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.28     40.00     21.29    725.13       6.18       .52
                    MAIN          2.16      1.35       1.48    268.50     70.34    726.18       6.08      6.06


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2556E+01  EXCESS= .1221E+01 OUTFLOW= .3761E+01 BASIN STORAGE= .4156E-03 PERCENT ERROR=    .4


                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          2.16      1.35       5.00                66.95    725.00      6.09

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH6

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     66.95     12.08                 6.68        1.90        1.32         1.32
                        (INCHES)     5.357       6.088       6.088        6.088
                         (AC-FT)      3.31        3.77        3.77         3.77

                        CUMULATIVE AREA =    .0116O SQ MI   ACRES=            7.4240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          **************
          *            *
207 KK    *       CH7  *
          *            *
          **************

208 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          7.  HYDROGRAPH PLOT SCALE
                     IPNCH          21  PUNCH COMPUTED HYDROGRAPH
                      IOUT           0  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

209 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .00

210 LS          SCS LOSS RATE
                     STRTL          .33  INITIAL ABSTRACTION
                    CRVNBR        86.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
211 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        210.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
212 RD            MAIN CHANNEL
                         L        317.  CHANNEL LENGTH
                         S       .0100  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        2.00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.34     42.00     13.40    724.99       6.18       .52
                    MAIN          2.16      1.35       1.35    158.50     13.09    726.04       6.07      3.90


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7918E+00 OUTFLOW= .7772E+00 BASIN STORAGE= .2553E-03 PERCENT ERROR=   1.8


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          2.16      1.35       5.00                12.75    725.00      6.07

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
```

```
                    (CFS)
+    12.75     12.08                1.38         .39         .27          .27
                  (INCHES)     5.343       6.072       6.073        6.073
                   (AC-FT)       .68         .78         .78          .78

                  CUMULATIVE AREA =    .00240 SQ MI   ACRES=            1.5360


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  213 KK    *    C/DP#4  *
            *            *
            **************

  214 KO          OUTPUT CONTROL VARIABLES
                IPRNT           3  PRINT CONTROL
                IPLOT           0  PLOT CONTROL
                QSCAL          0.  HYDROGRAPH PLOT SCALE
                IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                 IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
               TIMINT        .083  TIME INTERVAL IN HOURS


  215 HC          HYDROGRAPH COMBINATION
                ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                      ***

       ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   C/DP#4

  PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                 6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+    79.70     12.08                8.06        2.29        1.59         1.59
                  (INCHES)     5.354       6.085       6.086        6.086
                   (AC-FT)      4.00        4.54        4.54         4.54

                  CUMULATIVE AREA =    .01400 SQ MI   ACRES=            8.9600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  216 KK    *    DP#5/D  *     A2
            *            *
            **************

  217 KO          OUTPUT CONTROL VARIABLES
                IPRNT           3  PRINT CONTROL
                IPLOT           0  PLOT CONTROL
                QSCAL          0.  HYDROGRAPH PLOT SCALE
                IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                 IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
               TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  218 BA          SUBBASIN CHARACTERISTICS
                TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

    6 PH                           DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .03
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 219 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 220 US          SNYDER UNITGRAPH
                        TP         .29  LAG
                        CP         .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                               UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .34 HR,       R=   .24 HR
                                        SNYDER   TP=   .29 HR,      CP=   .66

                                                  UNIT HYDROGRAPH
                                               18 END-OF-PERIOD ORDINATES
                 6.       22.       40.       47.       41.       29.       21.       15.       10.        7.
                 5.        4.        3.        2.        1.        1.        1.        0.

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   DP#5/D

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)        (HR)
                        (CFS)
+    100.53      12.33                18.34        5.26        3.65         3.65
                       (INCHES)      5.167       5.926       5.926        5.926
                        (AC-FT)       9.09       10.43       10.43        10.43

                       CUMULATIVE AREA =    .03300 SQ MI   ACRES=           21.1200
1
                                               RUNOFF SUMMARY
                                          FLOW IN CUBIC FEET PER SECOND
                                         TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK    TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD       BASIN     MAXIMUM     TIME OF
          OPERATION      STATION     FLOW     PEAK                                            AREA      STAGE     MAX STAGE
+                                                                 6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                           T6      16.83   12.08           2.          1.          0.        .00

          HYDROGRAPH AT
+                           S6      37.16   12.08           3.          1.          1.        .01

          2 COMBINED AT
+                         C/S6      53.99   12.08           5.          1.          1.        .01

          HYDROGRAPH AT
+                           T5      22.38   12.08           2.          1.          0.        .00

          HYDROGRAPH AT
+                           S5      59.78   12.08           5.          1.          1.        .01

          2 COMBINED AT
+                         C/S5      82.16   12.08           7.          2.          1.        .01

          HYDROGRAPH AT
+                          OA2     168.13   12.58          44.         13.          9.        .08

          3 COMBINED AT
+                        C/CH1     193.42   12.08          56.         16.         11.        .10

          HYDROGRAPH AT
+                          CH1     217.30   12.17          61.         18.         12.        .11

          HYDROGRAPH AT
+                           T1      13.52   12.08           1.          0.          0.        .00

          HYDROGRAPH AT
+                           S1      24.36   12.08           2.          1.          0.        .00

          2 COMBINED AT
+                         C/S1      37.88   12.08           4.          1.          1.        .01
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          HYDROGRAPH AT
+                          P1      60.46   12.08          6.          2.          1.        .01
          3 COMBINED AT
+                        C/P1     282.19   12.08         71.         20.         14.        .13
          ROUTED TO
+                        R/P1      52.25   14.00         48.         33.         31.        .13
+                                                                                      1052.96       14.00
          HYDROGRAPH AT
+                         DA1     252.98   12.33         49.         14.         10.        .09
          2 COMBINED AT
+                      C/DP#1     293.57   12.33         94.         47.         41.        .21
          HYDROGRAPH AT
+                          T7      32.26   12.08          4.          1.          1.        .01
          HYDROGRAPH AT
+                          S4      55.58   12.08          5.          1.          1.        .01
          2 COMBINED AT
+                        C/S4      87.84   12.08          9.          3.          2.        .02
          HYDROGRAPH AT
+                         OA1     304.79   12.58         83.         24.         16.        .15
          2 COMBINED AT
+                       C/CH2     319.42   12.58         91.         26.         18.        .16
          HYDROGRAPH AT
+                         CH2     323.44   12.58         97.         28.         19.        .17
          HYDROGRAPH AT
+                          T4      66.21   12.08          6.          2.          1.        .01
          HYDROGRAPH AT
+                         CH3      70.27   12.17          8.          2.          2.        .01
          2 COMBINED AT
+                      C/DP#2     337.46   12.58        105.         30.         21.        .19
          HYDROGRAPH AT
+                          T9      67.87   12.25         12.          3.          2.        .02
          HYDROGRAPH AT
+                         CH4      99.36   12.08         17.          5.          3.        .03
          HYDROGRAPH AT
+                          T8      40.84   12.17          5.          2.          1.        .01
          HYDROGRAPH AT
+                          T3      23.32   12.08          2.          1.          0.        .00
          HYDROGRAPH AT
+                          S3      44.55   12.08          4.          1.          1.        .01
          2 COMBINED AT
+                        C/S3      67.88   12.08          6.          2.          1.        .01
          HYDROGRAPH AT
+                         CH5      83.96   12.17         10.          3.          2.        .02
          HYDROGRAPH AT
+                          P2      25.72   12.08          3.          1.          1.        .00
          4 COMBINED AT
+                        C/P2     244.85   12.08         35.         10.          7.        .06
          ROUTED TO
+                        R/P2     224.25   12.17        142.        140.        139.        .06
+                                                                                      1035.61       12.17
          HYDROGRAPH AT
+                          T2      23.84   12.08          2.          1.          0.        .00
          HYDROGRAPH AT
+                          S2      28.89   12.08          3.          1.          1.        .00
          2 COMBINED AT
+                        C/S2      52.73   12.08          5.          1.          1.        .01
```

```
          HYDROGRAPH AT
+                         CH6      66.95   12.08           7.          2.          1.        .01

          HYDROGRAPH AT
+                         CH7      12.75   12.08           1.          0.          0.        .00

          2 COMBINED AT
+                       C/DP#4     79.70   12.08           8.          2.          2.        .01

          HYDROGRAPH AT
+                       DP#5/D    100.53   12.33          18.          5.          4.        .03
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                 INTERPOLATED TO
                                                                               COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME       DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                     PEAK

                                 (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

                 T6  MANE         1.57     17.29    726.21      6.01      5.00     16.83    725.00        6.01

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1003E+01 OUTFLOW= .9942E+00 BASIN STORAGE= .2899E-03 PERCENT ERROR=    .9

                 S6  MANE         2.20     37.80    723.63      5.96      5.00     37.16    725.00        5.95

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1909E+01 OUTFLOW= .1874E+01 BASIN STORAGE= .3379E-03 PERCENT ERROR=   1.8

                 T5  MANE         2.06     22.40    724.94      6.00      5.00     22.38    725.00        6.02

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1295E+01 OUTFLOW= .1280E+01 BASIN STORAGE= .3915E-03 PERCENT ERROR=   1.1

                 S5  MANE         1.60     60.23    725.29      5.36      5.00     59.78    725.00        5.38

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3002E+01 OUTFLOW= .2602E+01 BASIN STORAGE= .3265E-03 PERCENT ERROR=  13.3

                CH1  MANE         5.00    217.30    730.00      5.90      5.00    217.30    730.00        5.90

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3175E+02 EXCESS= .3134E+01 OUTFLOW= .3485E+02 BASIN STORAGE= .1750E-02 PERCENT ERROR=    .1

                 T1  MANE         1.62     13.83    725.33      6.02      5.00     13.52    725.00        6.02

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7767E+00 OUTFLOW= .7699E+00 BASIN STORAGE= .2497E-03 PERCENT ERROR=    .9

                 S1  MANE         2.36     25.00    723.69      6.08      5.00     24.36    725.00        6.08

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1287E+01 OUTFLOW= .1265E+01 BASIN STORAGE= .3119E-03 PERCENT ERROR=   1.7

                 T7  MANE         1.85     34.36    726.41      5.99      5.00     32.26    725.00        5.99

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2168E+01 OUTFLOW= .2140E+01 BASIN STORAGE= .6671E-03 PERCENT ERROR=   1.3

                 S4  MANE         2.37     57.79    724.09      6.05      5.00     55.58    725.00        6.04

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2936E+01 OUTFLOW= .2870E+01 BASIN STORAGE= .4313E-03 PERCENT ERROR=   2.2

                CH2  MANE         1.81    324.98    756.24      5.94      5.00    323.44    755.00        5.94

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5214E+02 EXCESS= .3101E+01 OUTFLOW= .5522E+02 BASIN STORAGE= .6339E-03 PERCENT ERROR=    .0

                 T4  MANE         2.48     67.46    725.31      6.04      5.00     66.21    725.00        6.05
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3365E+01 OUTFLOW= .3288E+01 BASIN STORAGE= .4782E-03 PERCENT ERROR=   2.3

              CH3  MANE         4.47     73.82    729.14      6.06      5.00     70.27    730.00        6.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3293E+01 EXCESS= .1155E+01 OUTFLOW= .4428E+01 BASIN STORAGE= .1084E-02 PERCENT ERROR=    .4

               T9  MANE          .83     67.88    735.01      5.67      5.00     67.87    735.00        5.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7023E+01 OUTFLOW= .6563E+01 BASIN STORAGE= .8647E-02 PERCENT ERROR=   6.4

              CH4  MANE         3.00    101.18    726.67      5.78      5.00     99.36    725.00        5.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6565E+01 EXCESS= .3167E+01 OUTFLOW= .9653E+01 BASIN STORAGE= .8531E-03 PERCENT ERROR=    .8

               T8  MANE         2.89     41.79    729.22      5.96      5.00     40.84    730.00        5.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3075E+01 OUTFLOW= .3021E+01 BASIN STORAGE= .1484E-02 PERCENT ERROR=   1.7

               T3  MANE         2.48     23.56    725.26      5.97      5.00     23.32    725.00        5.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1133E+01 OUTFLOW= .1115E+01 BASIN STORAGE= .3026E-03 PERCENT ERROR=   1.6

               S3  MANE         1.20     44.71    725.21      5.42      5.00     44.55    725.00        5.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2210E+01 OUTFLOW= .1937E+01 BASIN STORAGE= .2307E-03 PERCENT ERROR=  12.3

              CH5  MANE         4.84     91.44    726.52      5.80      5.00     83.96    730.00        5.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3061E+01 EXCESS= .2507E+01 OUTFLOW= .5509E+01 BASIN STORAGE= .1029E-02 PERCENT ERROR=   1.0

               T2  MANE         2.01     24.21    724.89      5.98      5.00     23.84    725.00        6.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1133E+01 OUTFLOW= .1116E+01 BASIN STORAGE= .2449E-03 PERCENT ERROR=   1.4

               S2  MANE         1.90     29.22    725.42      6.09      5.00     28.89    725.00        6.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1452E+01 OUTFLOW= .1430E+01 BASIN STORAGE= .2734E-03 PERCENT ERROR=   1.5

              CH6  MANE         1.48     70.34    726.18      6.08      5.00     66.95    725.00        6.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2556E+01 EXCESS= .1221E+01 OUTFLOW= .3761E+01 BASIN STORAGE= .4156E-03 PERCENT ERROR=    .4

              CH7  MANE         1.35     13.09    726.04      6.07      5.00     12.75    725.00        6.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7918E+00 OUTFLOW= .7772E+00 BASIN STORAGE= .2553E-03 PERCENT ERROR=   1.8

*** NORMAL END OF HEC-1 ***
```

VOLUME CALCULATIONS

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Permitted Volume Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 25-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

Use the excessive rainfall data generated by the HEC-1 analysis for the 25-year storm to determine the volume produced by the site for the existing condition.

Existing Condition

1. Volume at Discharge Point #1

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T6	0.0031	6.07	2.00	1.0
S6	0.0059	6.07	3.78	1.9
T5	0.0040	6.07	2.54	1.3
S5	0.0091	6.19	5.83	3.0
CH1	0.0095	6.19	6.05	3.1
OA2	0.0765	5.95	48.93	24.3
T1	0.0024	6.07	1.52	0.8
S1	0.0039	6.19	2.48	1.3
P1	0.0087	7.85	5.54	3.6
DA1	0.0878	5.95	56.21	27.9
			Total Volume at Discharge Point 1 =	68.1

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T7	0.0067	6.07	4.27	2.2
S4	0.0089	6.19	5.70	2.9
T4	0.0102	6.19	6.55	3.4
OA1	0.1483	5.95	94.94	47.1
CH2	0.0094	6.19	6.04	3.1
CH3	0.0035	6.19	2.23	1.2
			Total Volume at Discharge Point #2 =	59.8

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T9	0.0217	6.07	13.91	7.0
T8	0.0095	6.07	6.05	3.1
T3	0.0035	6.07	2.22	1.1
S3	0.0067	6.19	4.26	2.2
P2	0.0037	7.85	2.36	1.5
CH4	0.0096	6.19	6.17	3.2
CH5	0.0076	6.19	4.84	2.5
			Total Volume at Discharge Point #3 =	20.6

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Permitted Volume Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 25-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

4. Volume at Discharge Point #4

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T2	0.0035	6.07	2.23	1.1
S2	0.0044	6.19	2.84	1.5
CH6	0.0037	6.19	2.37	1.2
CH7	0.0024	6.19	1.52	0.8
			Total Volume at Discharge Point #4 =	4.6

5. Volume at Discharge Point #5

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
DA2	0.0330	5.95	21.12	10.5
			Total Volume at Discharge Point #4 =	10.5

Total Volume Exiting Permit Boundary = 163.7 acre-ft

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: #REF!

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - Determine the 100-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.

Use the excessive rainfall data generated by the HEC-1 analysis for the 100-year storm to determine the volume produced by the site for the existing condition.

Existing Condition

1. Volume at Discharge Point #1

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T6	0.0031	10.02	2.00	1.7
S6	0.0059	10.02	3.78	3.2
T5	0.0040	10.02	2.54	2.1
S5	0.0091	10.15	5.83	4.9
CH1	0.0095	10.15	6.05	5.1
OA2	0.0765	9.88	48.93	40.3
T1	0.0024	10.02	1.52	1.3
S1	0.0039	10.15	2.48	2.1
P1	0.0087	11.90	5.54	5.5
DA1	0.0878	9.88	56.21	46.3
			Total Volume at Discharge Point 1 =	112.4

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T7	0.0067	10.02	4.27	3.6
S4	0.0089	10.15	5.70	4.8
T4	0.0102	10.15	6.55	5.5
OA1	0.1483	9.88	94.94	78.2
CH2	0.0094	10.15	6.04	5.1
CH3	0.0035	10.15	2.23	1.9
			Total Volume at Discharge Point #2 =	99.1

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T9	0.0217	10.02	13.91	11.6
T8	0.0095	10.02	6.05	5.1
T3	0.0035	10.02	2.22	1.9
S3	0.0067	10.15	4.26	3.6
P2	0.0037	11.90	2.36	2.3
CH4	0.0096	10.15	6.17	5.2
CH5	0.0076	10.15	4.84	4.1
			Total Volume at Discharge Point #3 =	33.8

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: #REF!

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 100-year 24-hour storm volume generated by the existing permitted site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

4. Volume at Discharge Point #4

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T2	0.0035	10.02	2.23	1.9
S2	0.0044	10.15	2.84	2.4
CH6	0.0037	10.15	2.37	2.0
CH7	0.0024	10.15	1.52	1.3
			Total Volume at Discharge Point #4 =	7.6

5. Volume at Discharge Point #5

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
DA2	0.0330	9.88	21.12	17.4
			Total Volume at Discharge Point #4 =	17.4

Total Volume Exiting Permit Boundary = 270.2 acre-ft

VELOCITY CALCULATIONS

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose : Determine the flow velocities entering and exiting the permit boundary using FlowMaster for the flows calculated for the 100-year and 25- year storm event in the HEC-1 analysis.

1. Flow Velocity entering the landfill permit boundary

OA1

Q_{100} = 460.7 cfs
Q_{25} = 304.8 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	461	0.017	0.03	50.00	50.00	100.00	0.74	4.52
25	305	0.017	0.03	50.00	50.00	100.00	0.59	3.97

OA2

Q_{100} = 253.8 cfs
Q_{25} = 168.1 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	254	0.018	0.03	50.00	50.00	100.00	0.53	3.75
25	168	0.018	0.03	50.00	50.00	100.00	0.42	3.27

2. Flow Velocity exiting the landfill permit boundary

Discharge #1

Q_{100} = 425.0 cfs
Q_{25} = 293.6 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	425	0.052	0.03	50.00	50.00	300.00	0.28	4.75
25	294	0.052	0.03	50.00	50.00	300.00	0.23	4.13

Discharge #2

Q_{100} = 510.2 cfs
Q_{25} = 337.5 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	510	0.003	0.03	3.00	3.00	12.00	4.08	5.15
25	337	0.003	0.03	3.00	3.00	12.00	3.33	4.61

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 9/29/2023
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose : **Determine the flow velocities entering and exiting the permit boundary using FlowMaster for the flows calculated for the 100-year and 25- year storm event in the HEC-1 analysis.**

Discharge #3

Q_{100} = 322.5 cfs
Q_{25} = 224.3 cfs

Low Water Outlet

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Length of 3-42" RCP (ft)	Flow Velocity (fps)
100	323	0.038	52.00	11.18
25	224	0.038	52.00	7.77

Discharge #4

Q_{100} = 121.5 cfs
Q_{25} = 79.7 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	121	0.015	0.03	3.00	3.00	0.00	2.45	6.71
25	80	0.015	0.03	3.00	3.00	0.00	2.10	6.05

Discharge #5

Q_{100} = 149.0 cfs
Q_{25} = 100.5 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	149	0.071	0.03	50.00	50.00	50.00	0.37	5.82
25	101	0.071	0.03	50.00	50.00	50.00	0.30	5.16

Appendix IIIH-B. Post-Development Conditions Hydrologic Calculations



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HEC-1 Output — Post-Development 100-Year, 24-Hour Storm Event	IIIH-B-10
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Velocity Calculations	IIIH-B-120

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HYDROGRAPH DEVELOPMENT INFORMATION

1.0 HYDROGRAPH DEVELOPMENT INFORMATION

1.1 Landfill Areas

Direct runoff methods, (i.e., kinematic wave) have been used for the majority of the landfill final cover areas. The kinematic wave method has been used to model the 5 percent topslope areas and 25 percent side slope areas before the flow is intercepted by the drainage swales. The kinematic wave method is a physically based method using slope, surface roughness, catchment lengths and areas. This method does not consider attenuation for flood wave; as a consequence, this method provides for a conservative analysis. The following typical parameters for the kinematic wave method have been developed for landfill areas.

Kinematic wave parameters for overland flow:

Slope: Varies from 0.05 to 0.25 ft/ft landfill slopes

N: 0.30 Manning's friction coefficient (based on using a value between dense grass (N = 0.24) and Bermuda grass (N = 0.41) listed in Soil Conservation Services TR-55)

L: Represents a typical distance between swales for overland flow for each drainage area. For example, the swale spacing on 4H:1V sideslopes is 160 feet.

Percentage of drainage area represented by this element is 100 percent.

Kinematic Wave routing for channels:

- Channel length (ft): The length of the channel section.
- Channel slope (ft/ft): 0.0015 (0.005 for swales).
- Channel roughness coefficient: 0.03 for grass lined channels and swales.
- Channel type: A trapezoidal channel was used with varying width and 2 or 3:1 side slopes ("V" ditch with varying side slopes for swales).

1.2 Non-Landfill Final Cover Areas

Hydrographs for the majority of non-landfill final cover areas within and near the permit boundary (e.g., pond areas) were developed using the Snyder unit hydrograph method. Espey "10-Minute" method has been used to estimate Snyder parameters. Snyder parameter estimations are provided on the following pages.

As discussed in Section 2 of Appendix IIIH, hydrographs for the areas outside of the permit boundary (01 and 02), and larger areas inside the permit boundary were developed using the Snyder unit hydrograph method. The percent imperviousness ranges from 2 percent to 89 percent, for the majority of the non-landfill on-site and off-site areas, which represents the majority of the watershed as undeveloped. Pond area are assumed to be 100 percent impervious, and areas with significant channel surface or paved surfaces were assigned higher percentages of impervious area.

1.3 Drainage Areas

The drainage areas used for this analysis are shown on Sheet IIIH-B-4. The routing scheme for the post-development condition is shown in the HEC-1 output file presented on pages IIIH-B-28 through IIIH-B-81.

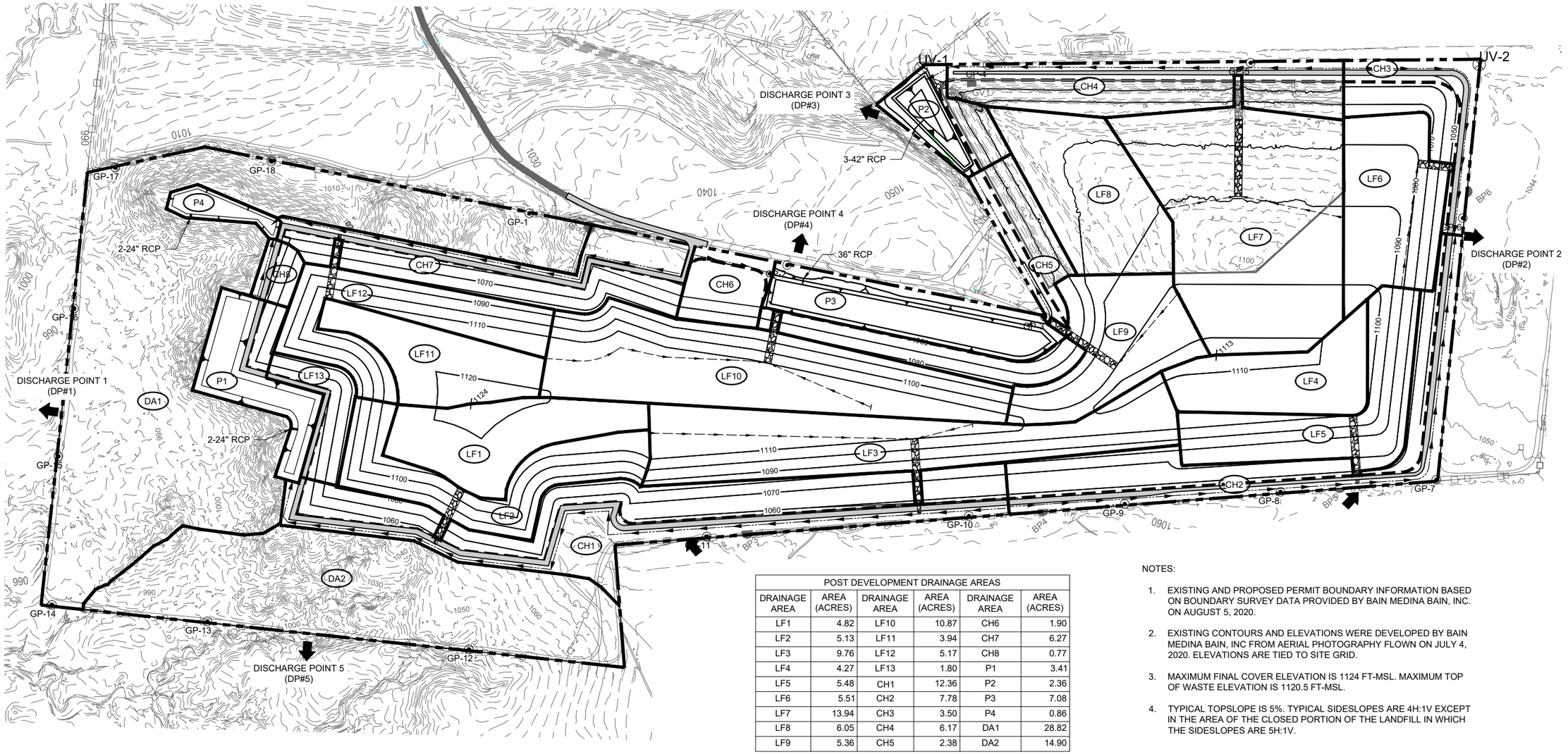
LEGEND

T7 — DRAINAGE AREA DESIGNATION
DRAINAGE BOUNDARY
PERIMETER CHANNEL
GP-5 — PROPOSED GAS PROBE
UV-1 — PROPOSED GAS VENTS

PERMIT BOUNDARY
CLOSED CELL BOUNDARY
LIMIT OF WASTE
1090 — FINAL COVER CONTOURS
1060 — EXISTING CONTOURS
SWALES
EXISTING SITE FENCE
PROPOSED SITE FENCE
EXISTING CHUTE
CHUTES

N

0 200 400
SCALE IN FEET



POST DEVELOPMENT DRAINAGE AREAS					
DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)
LF1	4.82	LF10	10.87	CH6	1.90
LF2	5.13	LF11	3.94	CH7	6.27
LF3	9.76	LF12	5.17	CH8	0.77
LF4	4.27	LF13	1.80	P1	3.41
LF5	5.48	CH1	12.36	P2	2.36
LF6	5.51	CH2	7.78	P3	7.08
LF7	13.94	CH3	3.50	P4	0.86
LF8	6.05	CH4	6.17	DA1	28.82
LF9	5.36	CH5	2.38	DA2	14.90

NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
4. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO
TEXAS

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
08/07/2024

NO.	REVISION	BY	DATE
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

POST-DEVELOPMENT CONDTION
DRAINAGE AREAS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-B-4

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stvipw_stv1\metaferiald0842276\DELR2003302 Figure IIIH-B-4.dwg

ESPEY 10-MINUTE METHOD PARAMETERS

Hydrograph Development Information

Client: City of Del Rio
Project: Major Permit Amendment
Description: Unit Hydrograph Data

Date: 8/7/2024
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Unit Hydrograph Data

Area No.	Area (acres)	Max. Flow Length (L) (ft)	S (ft/ft)	I (%)	Manning "n"[1]	ϕ[1]	T_r[2] (min)	T_{lag}[3] (min)	T_{lag} (hr)	Area (sq mi)	q_p[4] (cfs/sq mi)	C_p[5]
OA1	94.95	2474.3	0.017	2	0.04	0.86	36.1	33.6	0.56	0.1484	735.2	0.64
OA2	48.93	2357.3	0.018	2	0.04	0.86	35.3	32.8	0.55	0.0765	774.0	0.66
DA1	14.91	808.1	0.026	2	0.04	0.86	25.1	22.6	0.38	0.0233	1168.6	0.69
DA2	30.36	1652.0	0.027	2	0.04	0.86	29.4	26.9	0.45	0.0474	958.9	0.67

[1] Conveyance efficiency coefficient from Dodson & Associates Inc., *ProHec-1 Program Documentation* , 1995, pages 6-19 and 6-20.

[2] $T_r = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\varphi^{1.57})$

[3] $T_{lag} = T_r - 5/2$

[4] $q_p = 31600(A^{-0.04})(T_r^{-1.07})$

[5] $C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$

T_r = Surface runoff to unit hydrograph peak (min)
L = Distance along main channel from study point to watershed boundry (ft)
S = Main channel slope (ft/ft)
I = Impervious cover within the watershed (%)
T_{lag} = Watershed lag time (min)
q_p = Unit hydrograph peak discharge (cfs/sq mi)
C_p = Snyder's peaking coefficient

Hydrograph Development Information

Client: City of Del Rio
Project: Major Permit Amendment
Description: Unit Hydrograph Data

Date: 8/7/2024
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Unit Hydrograph Data: Sample Calculations

Drainage area "0A1" is used in this example.
Estimated Watershed specific parameters:

A =	95.5	acres	Watershed Area (acres)
L =	2474.3	ft	Maximum flow length with this watershed (ft)
S =	0.017	ft/ft	Watershed Slope (ft/ft)
I =	2	percent (%)	Watershed imperviousness
n =	0.04		Manning's coefficient

Calculate T_r, time beginning of surface runoff to the unit hydrograph peak in minutes:

$$Tr = 3.1(L^{0.23})(S^{-0.25})(I^{-0.18})(\phi^{1.57})$$

φ = 0.86 Estimate conveyance efficiency coefficient, see Figure 6.12 on page IIIF-A-20 for estimating. For 2 percent impervious cover and n = 0.04.

T_r = 36.1 minutes

Calculate T_{lag}, watershed lag time:

T_{lag} = Tr - (Δt/2) Δt is the calculation interval, and 5 minutes is used in the HEC-1 modeling in this project.

T_{lag} = 33.6 minutes
T_{lag} = 0.56 hours

A = A/640
A = 0.1492 sq. miles

Calculate q_p, peak discharge of unit hydrograph per unit area (cfs/sq. mi):

$$q_p = 31600(A^{-0.04})(T_r^{-1.07})$$

q_p = 735.1 cfs/sq.mi

Calculate peaking coefficient, C_p:

$$C_p = 49.375(A^{-0.04})(T_r^{-1.07})(T_{lag})$$

C_p = 0.64

DISTRIBUTED RUNOFF METHOD
KINEMATIC WAVE EXAMPLE

Hydrograph Development Information

Client: City of Del Rio
Project: Major Permit Amendment
Description: Kinematic Wave

Date: 8/7/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - Ditributed Runoff Method - Kinematic Wave Example:

Watershed Specific Parameters for drainage area LF9

A =	3.94	acres	Watershed Area (acres)
A =	0.0062	sq-miles	Watershed Area (sq-miles)
CN =	85		SCS Curve Number (see sheet IIIH-H-4 for more information)

Kinematic Wave Parameters for overland flow:

L =	148	ft	Typical overland flow (ft)
S =	0.050	ft/ft	Landfill slope (ft/ft)
N =	0.30		Manning's Coefficient

Percentage of the drainage area represented by this element is 100 percent.

Kinematic Wave routing data for the swale:

L =	830	ft	Typical swale length (ft)
S =	0.005	ft/ft	Swale bottom slope (ft/ft)
N =	0.03		Manning's Coefficient
Channel =	TRAP		Swale Type*

*A trapezoidal channel with no bottom width was used to simulate a triangular channel.

HEC-1 OUTPUT – PROPOSED 100-YEAR 24-HOURS STORM EVENT

```
1****************************************                ****************************************
*                                      *                *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                *    U.S. ARMY CORPS OF ENGINEERS      *
*        JUN 1998 AND FEB 2010         *                *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1R              *                *          609 SECOND STREET           *
*       RGMHEC2000 WWW.HEC-1.COM       *                *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   01AUG24  TIME  11:43:17   *                *           (916) 756-1104             *
*                                      *                *                                      *
****************************************                ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX  X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1           ID  DEL RIO LF EXPANSION
            2           ID  100-YR, 24-HR -  PROPOSED
                        *DIAGRAM
            3           IT       5       0    2400     416       0       0
            4           IO       3       0       0
                        *

            5           KK     LF1
            6           PH               0    1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90
            7           KO       0       0       0       7      21
            8           BA  0.0075
            9           LS       0      85
           10           UK     100    0.05     0.3     100
           11           RD     820   0.005    0.03            TRAP       0       2      NO
                        *

           12           KK     LF2
           13           KO       0       0       0       7      21
           14           BA  0.00802
           15           LS       0      85
           16           UK     218    0.25     0.3     100
           17           RD     885   0.005    0.03            TRAP       0       2      NO
                        *

           18           KK     LD1
           19           KO       0       0       0       7      21
           20           HC       2
                        *

           21           KK  LF3/LD2
           22           KO       0       0       0       7      21
           23           BA  0.01525
           24           LS       0      85
           25           UK     287    0.05     0.3     100
           26           RD     977   0.005    0.03            TRAP       0       2      NO
                        *

           27           KK     0A2
           28           KO       0       0       0       7      21
           29           BA  0.0791
           30           LS       0      84
           31           US    0.55    0.66
                        *

           32           KK   C/CH1
```

```
     33          KO       0       0       0       7      21
     34          HC       3
                 *

     35          KK     CH1
     36          KO       0       0       0       7      21
     37          BA   0.019
     38          LS       0      86
     39          UK      47    0.25     0.3     100
     40          RD    3079    0.02    0.03            TRAP      10       3     YES
                 *
1                                          HEC-1 INPUT                                                  PAGE  2

   LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

     41          KK    LF13
     42          KO       0       0       0       7      21
     43          BA  0.00286
     44          LS       0      85
     45          UK     142    0.25     0.3     100
     46          RD     200   0.005    0.03            TRAP       0       2      NO
                 *

     47          KK      P1
     48          KO       0       0       0       7      21
     49          BA  0.0017
     50          LS       0     100
     51          UD       0
                 *

     52          KK    C/P1
     53          KO       0       0       0       7      21
     54          HC       3
                 *

     55          KK    R/P1
     56          KO       0       0       0       7      21
     57          RS       1    ELEV    1048
     58          SA       0    2.75     3.0    3.25     3.5    3.75
     59          SE    1048    1049    1050    1052    1054    1056
     60          SS  1055.5     150     2.6     1.5
     61          SL    1047    6.28     0.6     0.5
                 *

     62          KK    LF11
     63          KO       0       0       0       7      21
     64          BA  0.00616
     65          LS       0      85
     66          UK     148    0.05     0.3     100
     67          RD     830   0.005    0.03            TRAP       0       2      NO
                 *

     68          KK    LF12
     69          KO       0       0       0       7      21
     70          BA  0.008082
     71          LS       0      85
     72          UK     189    0.25     0.3     100
     73          RD     829   0.005    0.03            TRAP       0       2      NO
                 *

     74          KK     LD9
     75          KO       0       0       0       7      21
     76          HC       2
                 *
1                                          HEC-1 INPUT                                                  PAGE  3

   LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

     77          KK     CH7
     78          KO       0       0       0       7      21
     79          BA  0.00980
     80          LS       0      86
     81          UK     156    0.25     0.3     100
     82          RD    1639    0.02    0.03            TRAP       3       3     YES
                 *

     83          KK     CH8
     84          KO       0       0       0       7      21
     85          BA   0.001
     86          LS       0      86
     87          UK     137    0.25     0.3     100
```

```
 88          RD     234    0.02    0.03           TRAP       3       3      NO
             *

 89          KK      P4
 90          KO       0       0       7      21
 91          BA  0.0013
 92          LS       0     100
 93          UD       0
             *

 94          KK    C/P4
 95          KO       0       0       7      21
 96          HC       3
             *

 97          KK    R/P4
 98          KO       0       0       7      21
 99          RS       1    ELEV  1046.5
100          SA       0   0.092    0.15    0.19    0.21    0.31
101          SE  1046.5    1047    1048    1049    1050    1052
102          SS    1051      25     2.6     1.5
103          SL    1044    6.28     0.6     0.5
             *

104          KK     DA1
105          KO       0       0       7      21
106          BA   0.047
107          LS       0      84
108          US    0.38    0.69
             *

109          KK    DC#1
110          KO       0       0       7      21
111          HC       3
             *
1                                    HEC-1 INPUT                                    PAGE  4

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

112          KK  DC#5/DA2
113          KO       0       0       7      21
114          BA  0.0233
115          LS       0      84
116          US    0.29    0.66
             *

117          KK     LF4
118          KO       0       0       7      21
119          BA  0.0067
120          LS       0      85
121          UK   244.1    0.05     0.3     100
122          RD     437   0.005    0.03           TRAP       0       2      NO
             *

123          KK     LF5
124          KO       0       0       7      21
125          BA  0.0086      86
126          LS       0      85
127          UK   175.6    0.25     0.3     100
128          RD   643.6   0.005    0.03           TRAP       0       2      NO
             *

129          KK   C/LD3
130          KO       0       0       7      21
131          HC       2
             *

132          KK     OA1
133          KO       0       0       7      21
134          BA  0.1492
135          LS       0      84
136          US    0.56    0.64
             *

137          KK   C/CH2
138          KO       0       0       7      21
139          HC       2
             *

140          KK     CH2
141          KO       0       0       7      21
142          BA    0.01
```

```
          143          LS       0      85
          144          UK      47    0.25     0.3     100
          145          RD     865    0.01    0.03            TRAP      10       3     YES
                       *

          146          KK     LF6
          147          KO       0       0       0       7      21
          148          BA  0.0083      86
          149          LS       0      85
          150          UK   175.6    0.25     0.3     100
          151          RD   696.8   0.005    0.03            TRAP       0       2      NO
                       *
1                                                HEC-1 INPUT                                                 PAGE  5

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          152          KK     CH3
          153          KO       0       0       0       7      21
          154          BA  0.0054
          155          LS       0      85
          156          UK   155.7    0.25     0.3     100
          157          RD    1456    0.01    0.03            TRAP      10       3     YES
                       *

          158          KK  C/DP#2
          159          KO       0       0       0       7      21
          160          HC       2
                       *

          161          KK     LF7
          162          KO       0       0       0       7      21
          163          BA  0.0217
          164          LS       0      85
          165          UK   919.3    0.05     0.3     100
          166          RD     232   0.005    0.03            TRAP       0       2      NO
                       *

          167          KK     CH4
          168          KO       0       0       0       7      21
          169          BA  0.0096
          170          LS       0      86
          171          UK   155.8    0.25     0.3     100
          172          RD    1064    0.01    0.03            TRAP      10       3     YES
                       *

          173          KK     LF8
          174          KO       0       0       0       7      21
          175          BA  0.0095
          176          LS       0      85
          177          UK   359.7    0.05     0.3     100
          178          RD   720.5   0.005    0.03            TRAP       0       2      NO
                       *

          179          KK     LF9
          180          KO       0       0       0       7      21
          181          BA  0.0084
          182          LS       0      85
          183          UK   359.7    0.25     0.3     100
          184          RD     535   0.005    0.03            TRAP       0       2      NO
                       *

          185          KK     CH5
          186          KO       0       0       0       7      21
          187          BA  0.00372
          188          LS       0      86
          189          UK     200    0.25     0.3     100
          190          RD    1996    0.01    0.03            TRAP       2       2     YES
                       *
1                                                HEC-1 INPUT                                                 PAGE  6

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          191          KK      P2
          192          KO       0       0       0       7      21
          193          BA  0.0037
          194          LS       0     100
          195          UD       0
                       *

          196          KK    C/P2
          197          KO       0       0       0       7      21
```

```
          198          HC       4
                       *

          199          KK    R/P2
          200          KO       0       0       0       7      21
          201          RS       1    ELEV    1034
          202          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          203          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          204          SS    1040      10     2.6     1.5
          205          SL    1033   28.86     0.6     0.5
                       *

          206          KK     CH7
          207          KO       0       0       0       7      21
          208          BA  0.0098
          209          LS       0      86
          210          UK     210    0.05     0.3     100
          211          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

          212          KK    LF10
          213          KO       0       0       0       7      21
          214          BA   0.017
          215          LS       0      85
          216          UK     138    0.25     0.3     100
          217          RD     907   0.005    0.03            TRAP       0       2      NO
                       *

          218          KK      P3
          219          KO       0       0       0       7      21
          220          BA   0.011
          221          LS       0     100
          222          UD       0
                       *

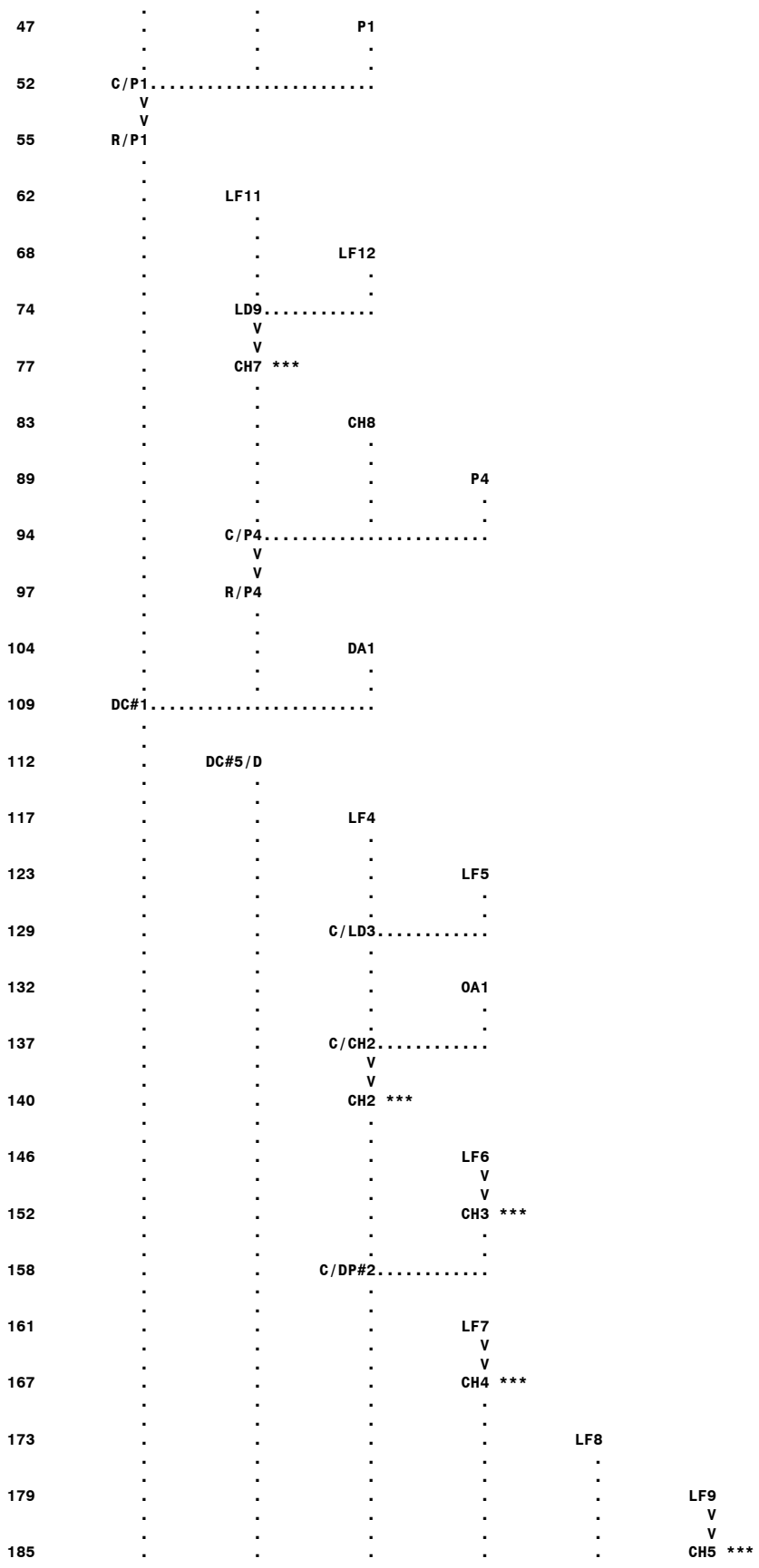
          223          KK    C/P3
          224          KO       0       0       0       7      21
          225          HC       3
                       *
1                                                HEC-1 INPUT                                                PAGE  7

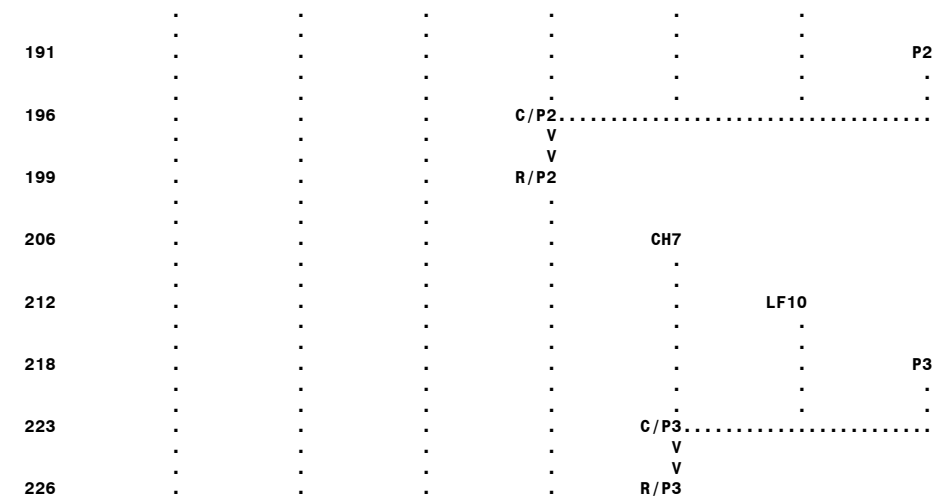
         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          226          KK    R/P3
          227          KO       0       0       0       7      21
          228          RS       1    ELEV    1052
          229          SA       0    2.51    2.67    2.83    2.99    3.15
          230          SE    1052    1053    1054    1055    1056    1057
          231          SS  1056.5      10     2.6     1.5
          232          SL    1050   7.065     0.6     0.5
                       *
          233          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     5         LF1
                 .
                 .
    12           .         LF2
                 .           .
                 .           .
    18         LD1............
                 .
                 .
    21           .      LF3/LD
                 .           .
                 .           .
    27           .           .         OA2
                 .           .           .
                 .           .           .
    32       C/CH1.........................
                 V
                 V
    35         CH1 ***
                 .
                 .
    41           .        LF13
                 .           .
```


47
P1
52
C/P1
55
R/P1
62
LF11
68
LF12
74
LD9
77
CH7 ***
83
CH8
89
P4
94
C/P4
97
R/P4
104
DA1
109
DC#1
112
DC#5/D
117
LF4
123
LF5
129
C/LD3
132
OA1
137
C/CH2
140
CH2 ***
146
LF6
152
CH3 ***
158
C/DP#2
161
LF7
167
CH4 ***
173
LF8
179
LF9
185
CH5 ***




```
 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *    U.S. ARMY CORPS OF ENGINEERS      *
*        JUN 1998 AND FEB 2010         *                    *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1R              *                    *         609 SECOND STREET            *
*       RGMHEC2000 WWW.HEC-1.COM       *                    *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   19AUG24  TIME  11:43:17  *                    *          (916) 756-1104              *
*                                      *                    *                                      *
****************************************                    ****************************************
```

```
                      DEL RIO LF EXPANSION
                      100-YR, 24-HR -  PROPOSED

  4 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN           5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      3    0  ENDING DATE
                    NDTIME        1035  ENDING TIME
                    ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   34.58 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  5 KK    *       LF1  *
          *            *
          **************

  7 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
```

```
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7   PUNCH COMPUTED HYDROGRAPH
                    IOUT          21   SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1   FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416   LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083   TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

   8 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .01   SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                           DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                          STORM AREA =     .01

   9 LS        SCS LOSS RATE
                    STRTL         .35   INITIAL ABSTRACTION
                   CRVNBR       85.00   CURVE NUMBER
                    RTIMP         .00   PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  10 UK          OVERLAND-FLOW ELEMENT NO. 1
                       L         100.   OVERLAND FLOW LENGTH
                       S       .0500   SLOPE
                       N        .300   ROUGHNESS COEFFICIENT
                      PA       100.0   PERCENT OF SUBBASIN
                    DXMIN           5   MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  11 RD          MAIN CHANNEL
                       L         820.   CHANNEL LENGTH
                       S       .0050   SLOPE
                       N        .030   CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01   CONTRIBUTING AREA
                   SHAPE        TRAP   CHANNEL SHAPE
                      WD         .00   BOTTOM WIDTH OR DIAMETER
                       Z        2.00   SIDE SLOPE
                  RUPSTQ          NO   ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67        .75     20.00     76.06    724.86     10.01        .51
                    MAIN          1.63      1.33       2.86    410.00     64.99    723.44      9.76       4.78

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4006E+01 OUTFLOW= .3904E+01 BASIN STORAGE= .5625E-03 PERCENT ERROR=   2.5

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00               64.59    725.00      9.73

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF1

      TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                     (CFS)
+     64.59     12.08                   6.84        1.96        1.36         1.36
                     (INCHES)         8.479       9.725       9.726        9.726
                      (AC-FT)         3.39        3.89        3.89         3.89

                     CUMULATIVE AREA =    .0075O SQ MI   ACRES=            4.8000


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          *            *
 12 KK    *       LF2  *
          *            *
          **************

 13 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 14 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA
                      SNAP 20000000.00  NORMAL ANNUAL PRECIPITATION
                     RATIO         .00  RATIO OF HYDROGRAPH

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

 15 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 16 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        218.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 17 RD            MAIN CHANNEL
                         L        885.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .79     43.60     81.38    724.93     10.02      1.12
                   MAIN          1.63      1.33       3.04    442.50     73.04    723.90      9.76      4.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4273E+01 OUTFLOW= .4164E+01 BASIN STORAGE= .5936E-03 PERCENT ERROR=   2.5

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00                69.58    725.00      9.72

     ***            ***             ***             ***             ***

                        HYDROGRAPH AT STATION      LF2

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02
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  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+    69.58     12.08                 7.30         2.09         1.45         1.45
                     (INCHES)      8.479        9.718        9.718        9.718
                      (AC-FT)      3.62         4.15         4.15         4.15

                     CUMULATIVE AREA =    .00800 SQ MI   ACRES=            5.1200


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  18 KK    *       LD1  *
           *            *
           **************

  19 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  20 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      LD1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   134.17     12.08                14.13         4.05         2.81         2.81
                     (INCHES)      8.479        9.721        9.722        9.722
                      (AC-FT)      7.01         8.04         8.04         8.04

                     CUMULATIVE AREA =    .01550 SQ MI   ACRES=            9.9200


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  21 KK    *    LF3/LD  *     2
           *            *
           **************

  22 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  23 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .02  SUBBASIN AREA
                       SNAP 50000000.00  NORMAL ANNUAL PRECIPITATION
                      RATIO         .00  RATIO OF HYDROGRAPH

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
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                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .02

  24 LS         SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
  25 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L        287.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
  26 RD           MAIN CHANNEL
                         L        977.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .02  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.43     57.40    119.47    725.86     10.01       .68
                    MAIN          1.63      1.33       3.06    488.50    115.91    726.30      9.80      5.31

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .8119E+01 OUTFLOW= .7942E+01 BASIN STORAGE= .1877E-02 PERCENT ERROR=   2.2

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00              107.26    725.00      9.78

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION   LF3/LD

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    107.26     12.08                 13.94        4.00        2.77         2.77
                          (INCHES)     8.526       9.776       9.779        9.779
                           (AC-FT)      6.91        7.92        7.93         7.93

                          CUMULATIVE AREA =    .01520 SQ MI   ACRES=            9.7280


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
  27 KK        *       OA2  *
               *            *
               **************

  28 KO        OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
```

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                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

   29 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .08  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .08

   30 LS          SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   31 US          SNYDER UNITGRAPH
                          TP          .55  LAG
                          CP          .66  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                       ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .64 HR,       R=   .45 HR
                                            SNYDER   TP=   .55 HR,      CP=   .67

                                                   UNIT HYDROGRAPH
                                            33 END-OF-PERIOD ORDINATES
                     3.       13.       25.       38.       51.       59.       62.       59.       51.       43.
                    35.       29.       24.       20.       17.       14.       12.       10.        8.        7.
                     5.        5.        4.        3.        3.        2.        2.        1.        1.        1.
                     1.        1.        1.

        ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      OA2

        TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

      PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     34.58-HR
    +   (CFS)       (HR)
                      (CFS)
    +   253.41     12.58                 71.69       20.92       14.52       14.52
                            (INCHES)     8.426       9.837       9.837       9.837
                             (AC-FT)     35.55       41.50       41.50       41.50

                           CUMULATIVE AREA =    .07910 SQ MI   ACRES=          50.6240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                  **************
                  *            *
   32 KK          *     C/CH1  *
                  *            *
                  **************

   33 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


   34 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                       ***
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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/CH1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   340.60     12.08                 99.65       28.97       20.10        20.10
                         (INCHES)    8.438       9.812       9.813        9.813
                          (AC-FT)   49.41       57.46       57.46        57.46

                        CUMULATIVE AREA =    .10980 SQ MI   ACRES=          70.2720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
   35 KK     *       CH1  *
             *            *
             **************

   36 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   37 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .02

   38 LS          SCS LOSS RATE
                        STRTL          .33  INITIAL ABSTRACTION
                       CRVNBR        86.00  CURVE NUMBER
                        RTIMP          .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   39 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          47.  OVERLAND FLOW LENGTH
                           S        .2500  SLOPE
                           N         .300  ROUGHNESS COEFFICIENT
                          PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   40 RD            MAIN CHANNEL
                           L       3079.  CHANNEL LENGTH
                           S       .0200  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .02  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                                ***
         MCUNGE FATAL ERROR - NUMBER OF ORDINATES FOR CONSTANT TIME STEP OVERLAND FLOW EXCEEDS ARRAY DIMENSIONS - REDUCE DURATION OF
RUN ON IT - RECORD
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                        ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                       PEAK                CELERITY
                                                                 (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)
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                PLANE1        2.48      1.67       .27      9.40    200.50    723.03     10.14       .62
                MAIN          1.95      1.42      4.35   1539.50    398.19    726.34      9.88     11.80

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5746E+02  EXCESS= .1028E+02 OUTFLOW= .6786E+02 BASIN STORAGE= .1013E+00 PERCENT ERROR=   -.3

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN          1.95      1.42      5.00              393.14    725.00      9.88

      ***           ***           ***           ***           ***

                        HYDROGRAPH AT STATION      CH1

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   393.14     12.08               117.34       34.11       23.75       23.75
                         (INCHES)    8.470       9.849       9.881       9.881
                          (AC-FT)   58.18       67.65       67.88       67.88

                        CUMULATIVE AREA =    .12880 SQ MI   ACRES=           82.4320


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   41 KK    *      LF13  *
            *            *
            **************

   42 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   43 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA
                        SNAP 60000000.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

   44 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   45 UK            OVERLAND-FLOW ELEMENT NO. 1
                             L        142.  OVERLAND FLOW LENGTH
                             S       .2500  SLOPE
                             N        .300  ROUGHNESS COEFFICIENT
                            PA       100.0  PERCENT OF SUBBASIN
                          DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   46 RD            MAIN CHANNEL
                             L        200.  CHANNEL LENGTH
                             S       .0050  SLOPE
                             N        .030  CHANNEL ROUGHNESS COEFFICIENT
```

```
                    CA         .00  CONTRIBUTING AREA
                 SHAPE        TRAP  CHANNEL SHAPE
                    WD         .00  BOTTOM WIDTH OR DIAMETER
                     Z        2.00  SIDE SLOPE
                RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
          ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                        PEAK                 CELERITY
                                             (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

          PLANE1        2.48      1.67        .51     28.40     29.09    724.58     10.01       .95
          MAIN          1.63      1.33        .89    200.00     28.63    724.49      8.94      3.76

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1496E+01 OUTFLOW= .1334E+01 BASIN STORAGE= .1308E-03 PERCENT ERROR=  10.8

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

          MAIN          1.63      1.33       5.00               27.76    725.00      8.96

       ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION     LF13

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                    (CFS)
+     27.76     12.08                 2.41         .67         .47          .47
                (INCHES)     7.997       8.962       8.963       8.963
                 (AC-FT)      1.19        1.34        1.34        1.34

                CUMULATIVE AREA =    .00280 SQ MI   ACRES=            1.7920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   47 KK    *        P1  *
            *            *
            **************

   48 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   49 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

   50 LS          SCS LOSS RATE
                       STRTL         .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

   51 UD          SCS DIMENSIONLESS UNITGRAPH
```

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                    TLAG         .00  LAG

                                                        ***

                                                    UNIT HYDROGRAPH
                                                5 END-OF-PERIOD ORDINATES
               10.        3.        1.        0.        0.

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION       P1

    TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    16.41     12.08                1.74         .54         .38          .38
                    (INCHES)      9.533      11.897      11.900       11.900
                     (AC-FT)        .86        1.08        1.08         1.08

                    CUMULATIVE AREA =    .00170 SQ MI   ACRES=            1.0880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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           *            *
   52 KK   *      C/P1  *
           *            *
           **************

   53 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   54 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     C/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+   437.31     12.08              121.43       35.32       24.59        24.59
                    (INCHES)      8.470       9.853       9.888        9.888
                     (AC-FT)      60.22       70.05       70.29        70.29

                    CUMULATIVE AREA =    .13330 SQ MI   ACRES=           85.3120


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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           *            *
   55 KK   *      R/P1  *
           *            *
           **************

   56 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
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                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

  57 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1048.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  58 SA               AREA          .0       2.8       3.0       3.3       3.5       3.8

  59 SE          ELEVATION     1048.00   1049.00   1050.00   1052.00   1054.00   1056.00

  61 SL          LOW-LEVEL OUTLET
                      ELEVL     1047.00  ELEVATION AT CENTER OF OUTLET
                      CAREA        6.28  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

  60 SS          SPILLWAY
                       CREL     1055.50  SPILLWAY CREST ELEVATION
                      SPWID      150.00  SPILLWAY WIDTH
                       COQW        2.60  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

                                                 ***

                                          COMPUTED STORAGE-ELEVATION DATA

           STORAGE        .00       .92      3.79     10.04     16.79     24.04
         ELEVATION    1048.00   1049.00   1050.00   1052.00   1054.00   1056.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

           OUTFLOW        .00     32.60     35.38     38.69     42.68     47.59     53.77     61.80     72.64     88.10
         ELEVATION    1048.00   1048.16   1048.37   1048.64   1048.99   1049.48   1050.17   1051.18   1052.78   1055.50

           OUTFLOW      88.33     89.50     92.42     97.86    106.66    119.57    137.45    161.02    191.12    228.54
         ELEVATION    1055.51   1055.52   1055.55   1055.58   1055.63   1055.68   1055.75   1055.82   1055.91   1056.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE        .00       .00       .05       .24       .90      2.26      3.79      4.29      7.42     10.04
           OUTFLOW      30.22     32.60     35.38     38.69     42.68     47.59     52.34     53.77     61.80     67.57
         ELEVATION    1048.00   1048.16   1048.37   1048.64   1048.99   1049.48   1050.00   1050.17   1051.18   1052.00

           STORAGE      12.61     16.79     22.18     22.26     22.35     22.48     22.65     22.85     23.09     23.37
           OUTFLOW      72.64     79.95     88.10     89.50     92.42     97.86    106.66    119.57    137.45    161.02
         ELEVATION    1052.78   1054.00   1055.50   1055.52   1055.55   1055.58   1055.63   1055.68   1055.75   1055.82

           STORAGE      23.68     24.04
           OUTFLOW     191.12    228.54
         ELEVATION    1055.91   1056.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       30. TO       33.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

 WARNING --- ROUTED OUTFLOW (    235.) IS GREATER THAN MAXIMUM OUTFLOW (    229.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    246.) IS GREATER THAN MAXIMUM OUTFLOW (    229.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    240.) IS GREATER THAN MAXIMUM OUTFLOW (    229.) IN STORAGE-OUTFLOW TABLE

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     R/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                             (CFS)
+    246.22     13.00                99.23       50.13       44.04        44.04
                             (INCHES)     6.921      13.987      17.704       17.704
                              (AC-FT)     49.21       99.44      125.87       125.87

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
```

```
    24.202     13.00                17.50        4.75        3.29         3.25

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1056.04     13.00               1054.16     1049.78     1049.23      1049.23

                       CUMULATIVE AREA =    .13330 SQ MI   ACRES=           85.3120


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   62 KK    *      LF11  *
            *            *
            **************

   63 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   64 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA
                        SNAP 60000000.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                  PRECIPITATION DATA

    6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

   65 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   66 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        148.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   67 RD            MAIN CHANNEL
                           L        830.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67        .90     29.60     57.99    724.84     10.01        .57
                     MAIN          1.63      1.33       3.13    415.00     54.95    725.22      9.82       4.43


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3258E+01 OUTFLOW= .3195E+01 BASIN STORAGE= .6478E-03 PERCENT ERROR=   1.9
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                                    INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.63      1.33       5.00              53.95    725.00      9.88

       ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION     LF11

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     53.95     12.08                5.65        1.62        1.12         1.12
                        (INCHES)     8.607       9.877       9.878        9.878
                         (AC-FT)     2.80        3.21        3.21         3.21

                        CUMULATIVE AREA =    .00610 SQ MI   ACRES=           3.9040


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   68 KK    *      LF12  *
            *            *
            **************

   69 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   70 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA
                        SNAP 82000000.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

   71 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   72 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        189.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   73 RD            MAIN CHANNEL
                           L        829.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH
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                                                ***
                          COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                  COMPUTATION TIME STEP
     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                    PEAK                CELERITY
                                          (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

     PLANE1        2.48      1.67        .70     37.80     82.04    724.84     10.01      1.07
     MAIN          1.63      1.33       2.84    414.50     70.83    723.33      9.75      4.87

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4273E+01 OUTFLOW= .4160E+01 BASIN STORAGE= .5368E-03 PERCENT ERROR=   2.6

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

     MAIN          1.63      1.33       5.00        69.81    725.00      9.71

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     LF12

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     69.81     12.08                 7.29        2.09        1.45         1.45
                        (INCHES)     8.475       9.714       9.715        9.715
                         (AC-FT)      3.62        4.14        4.14         4.14

                        CUMULATIVE AREA =    .00800 SQ MI   ACRES=            5.1200


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
    74 KK    *       LD9  *
             *            *
             **************

    75 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


    76 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LD9

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    123.77     12.08                12.94        3.71        2.57         2.57
                        (INCHES)     8.531       9.784       9.786        9.786
                         (AC-FT)      6.42        7.36        7.36         7.36

                        CUMULATIVE AREA =    .01410 SQ MI   ACRES=            9.0240


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 77 KK     *       CH7  *
           *            *
           **************

 78 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 79 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .01

 80 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 81 UK           OVERLAND-FLOW ELEMENT NO. 1
                         L        156.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 82 RD           MAIN CHANNEL
                         L       1639.  CHANNEL LENGTH
                         S       .0200  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        3.00  BOTTOM WIDTH OR DIAMETER
                         Z        3.00  SIDE SLOPE
                    RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .55     31.20    102.61    724.92     10.14       .99
                    MAIN          2.69      1.35       2.83    819.50    187.39    726.39      9.83      9.66


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7359E+01  EXCESS= .5303E+01 OUTFLOW= .1253E+02 BASIN STORAGE= .7128E-03 PERCENT ERROR=   1.0


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          2.69      1.35       5.00              183.86    725.00      9.80

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   183.86     12.08                 21.94        6.30        4.37         4.37
                         (INCHES)    8.537       9.798       9.799        9.799
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                    (AC-FT)     10.88       12.49       12.49        12.49

                   CUMULATIVE AREA =    .02390 SQ MI   ACRES=          15.2960


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 83 KK    *       CH8  *
          *            *
          **************

 84 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 85 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .00  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

 86 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 87 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        137.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 88 RD            MAIN CHANNEL
                         L        234.  CHANNEL LENGTH
                         S       .0200  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        3.00  BOTTOM WIDTH OR DIAMETER
                         Z        3.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .57     27.40     10.47    724.54     10.15       .95
                    MAIN          2.69      1.35        .90    117.00     10.38    724.86      9.91      4.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5412E+00 OUTFLOW= .5286E+00 BASIN STORAGE= .9498E-04 PERCENT ERROR=   2.3

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.69      1.35       5.00                10.17    725.00      9.95

     ***             ***             ***             ***             ***
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                        HYDROGRAPH AT STATION      CH8

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    10.17     12.08                   .93         .27         .19          .19
                         (INCHES)     8.668       9.951       9.952        9.952
                          (AC-FT)       .46         .53         .53          .53

                        CUMULATIVE AREA =    .00100 SQ MI   ACRES=             .6400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *             *
   89 KK    *        P4   *
            *             *
            **************

   90 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   91 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                               DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .00

   92 LS          SCS LOSS RATE
                       STRTL         .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

   93 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .00  LAG

                                                      ***

                                                  UNIT HYDROGRAPH
                                               5 END-OF-PERIOD ORDINATES
                  7.        2.        0.        0.        0.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION       P4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    12.55     12.08                  1.33         .42         .29          .29
                         (INCHES)     9.533      11.897      11.900       11.900
                          (AC-FT)       .66         .82         .83          .83

                        CUMULATIVE AREA =    .00130 SQ MI   ACRES=             .8320
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   94 KK    *      C/P4  *
            *            *
            **************

   95 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   96 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/P4

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    206.57     12.08               24.20        6.97        4.84         4.84
                      (INCHES)     8.587       9.900       9.909        9.909
                       (AC-FT)     12.00       13.83       13.85        13.85

                      CUMULATIVE AREA =    .02620 SQ MI   ACRES=           16.7680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   97 KK    *      R/P4  *
            *            *
            **************

   98 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA

   99 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1046.50  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  100 SA               AREA          .0        .1        .2        .2        .3        .3

  101 SE          ELEVATION     1046.50   1047.00   1048.00   1049.00   1050.00   1052.00

  103 SL          LOW-LEVEL OUTLET
                       ELEVL     1044.00  ELEVATION AT CENTER OF OUTLET
                       CAREA        6.28  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  102 SS          SPILLWAY
                        CREL     1051.00  SPILLWAY CREST ELEVATION
                       SPWID       25.00  SPILLWAY WIDTH
                        COQW        2.60  WEIR COEFFICIENT
```

```
                    EXPW        1.50  EXPONENT OF HEAD

                                                ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00       .02       .14       .30       .50      1.02
        ELEVATION    1046.50   1047.00   1048.00   1049.00   1050.00   1052.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00     50.02     52.47     55.18     58.19     61.54     65.30     69.55     74.39     79.95
        ELEVATION    1046.50   1046.74   1047.02   1047.33   1047.71   1048.15   1048.67   1049.30   1050.06   1051.00

          OUTFLOW      80.32     81.28     83.19     86.38     91.18     97.89    106.86    118.40    132.82    150.47
        ELEVATION    1051.02   1051.06   1051.12   1051.19   1051.28   1051.39   1051.51   1051.66   1051.82   1052.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .00       .02       .02       .05       .09       .14       .16       .24       .30
          OUTFLOW      47.78     50.02     52.34     52.47     55.18     58.19     60.44     61.54     65.30     67.57
        ELEVATION    1046.50   1046.74   1047.00   1047.02   1047.33   1047.71   1048.00   1048.15   1048.67   1049.00

          STORAGE        .36       .50       .52       .74       .74       .75       .77       .79       .81       .84
          OUTFLOW      69.55     74.02     74.39     79.95     80.32     81.28     83.19     86.38     91.18     97.89
        ELEVATION    1049.30   1050.00   1050.06   1051.00   1051.02   1051.06   1051.12   1051.19   1051.28   1051.39

          STORAGE        .88       .92       .97      1.02
          OUTFLOW      106.86    118.40    132.82    150.47
        ELEVATION    1051.51   1051.66   1051.82   1052.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       48. TO      150.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

 WARNING --- ROUTED OUTFLOW (    183.) IS GREATER THAN MAXIMUM OUTFLOW (    150.) IN STORAGE-OUTFLOW TABLE

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     R/P4

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   182.62     12.17                53.24       49.14       48.73        48.73
                         (INCHES)    18.892      69.760      99.668       99.668
                          (AC-FT)    26.40       97.48      139.27       139.27

 PEAK STORAGE   TIME                      MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
     1.121     12.17                 .00         .00         .00         -.15

  PEAK STAGE    TIME                      MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1052.33     12.17              1046.96     1046.61     1046.58      1046.58

                        CUMULATIVE AREA =    .0262O SQ MI   ACRES=           16.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  104 KK    *       DA1  *
            *            *
            **************

  105 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS
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              SUBBASIN RUNOFF DATA

  106 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .05  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                               DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .05

  107 LS          SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  108 US          SNYDER UNITGRAPH
                          TP          .38  LAG
                          CP          .69  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .46 HR,       R=   .28 HR
                                            SNYDER   TP=   .38 HR,      CP=   .69

                                                    UNIT HYDROGRAPH
                                                21 END-OF-PERIOD ORDINATES
                  5.       18.       35.       49.       55.       50.       39.       29.       22.       16.
                 12.        9.        7.        5.        4.        3.        2.        1.        1.        1.
                  1.

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      DA1

      TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                        (CFS)
+     190.31     12.42                42.70       12.43        8.63         8.63
                        (INCHES)     8.446       9.836       9.836        9.836
                         (AC-FT)     21.17       24.65       24.65        24.65

                        CUMULATIVE AREA =    .04700 SQ MI   ACRES=           30.0800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  109 KK      *      DC#1  *
              *            *
              **************

  110 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  111 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***
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                        HYDROGRAPH AT STATION     DC#1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   375.32     13.00               191.40      111.71      101.39       101.39
                       (INCHES)     8.618      20.118      26.313       26.313
                        (AC-FT)    94.91       221.57      289.79       289.79

                       CUMULATIVE AREA =    .20650 SQ MI   ACRES=          132.1600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  112 KK    *    DC#5/D  *     A2
            *            *
            **************

  113 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  114 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .02

  115 LS          SCS LOSS RATE
                       STRTL         .38  INITIAL ABSTRACTION
                      CRVNBR       84.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  116 US          SNYDER UNITGRAPH
                         TP          .29  LAG
                         CP          .66  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                        ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .34 HR,       R=   .24 HR
                                       SNYDER   TP=   .29 HR,      CP=   .66

                                                  UNIT HYDROGRAPH
                                              18 END-OF-PERIOD ORDINATES
                  4.       16.       28.       33.       29.       21.       15.       10.       7.        5.
                  4.        3.        2.        1.        1.        1.        0.        0.

       ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   DC#5/D

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   105.20     12.33               21.19       6.17        4.28         4.28
                       (INCHES)     8.457      9.843       9.843        9.843
                        (AC-FT)    10.51       12.23       12.23        12.23
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                    CUMULATIVE AREA =    .02330 SQ MI   ACRES=          14.9120


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
117 KK    *       LF4  *
          *            *
          **************

118 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

119 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

120 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
121 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        244.  OVERLAND FLOW LENGTH
                         S       .0500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
122 RD            MAIN CHANNEL
                         L        437.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.33     48.82     56.10    724.85     10.01       .66
                    MAIN          1.63      1.33       1.65    437.00     53.23    725.96      8.79      4.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3579E+01 OUTFLOW= .3142E+01 BASIN STORAGE= .6706E-03 PERCENT ERROR=  12.2

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00                51.02    725.00      8.80

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                        HYDROGRAPH AT STATION      LF4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    51.02     12.08                 5.68        1.58        1.10         1.10
                         (INCHES)   7.886       8.793       8.796        8.796
                          (AC-FT)    2.82        3.14        3.14         3.14

                        CUMULATIVE AREA =    .00670 SQ MI   ACRES=            4.2880


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  123 KK    *       LF5  *
            *            *
            **************

  124 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  125 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA
                        SNAP       86.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  126 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  127 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        176.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  128 RD            MAIN CHANNEL
                           L        644.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        2.48      1.67        .70     35.12     89.03    724.90     10.01      1.05
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                  MAIN          1.63      1.33       2.16    321.80     86.99    724.98      9.80      4.96

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4594E+01 OUTFLOW= .4495E+01 BASIN STORAGE= .4410E-03 PERCENT ERROR=   2.1

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.63      1.33       5.00               86.72    725.00      9.88

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION      LF5

    TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+    86.72     12.08                  7.99        2.28        1.59         1.59
                       (INCHES)     8.635       9.880       9.880        9.880
                        (AC-FT)      3.96        4.53        4.53         4.53

                       CUMULATIVE AREA =    .0086O SQ MI   ACRES=            5.5040


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  129 KK    *     C/LD3  *
            *            *
            **************

  130 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           O  PLOT CONTROL
                       QSCAL          O.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  131 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/LD3

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   137.74     12.08                 13.67        3.87        2.69         2.69
                       (INCHES)     8.306       9.404       9.405        9.405
                        (AC-FT)      6.78        7.67        7.67         7.67

                       CUMULATIVE AREA =    .0153O SQ MI   ACRES=            9.7920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  132 KK    *       OA1  *
            *            *
            **************

  133 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           O  PLOT CONTROL
                       QSCAL          O.  HYDROGRAPH PLOT SCALE
```

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                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  134 BA       SUBBASIN CHARACTERISTICS
                    TAREA        .15  SUBBASIN AREA

               PRECIPITATION DATA

    6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                          STORM AREA =     .15

  135 LS       SCS LOSS RATE
                    STRTL        .38  INITIAL ABSTRACTION
                   CRVNBR       84.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

  136 US       SNYDER UNITGRAPH
                      TP         .56  LAG
                      CP         .64  PEAKING COEFFICIENT

               SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .64 HR,       R=   .49 HR
                                    SNYDER   TP=   .56 HR,      CP=   .64

                                             UNIT HYDROGRAPH
                                          36 END-OF-PERIOD ORDINATES
                      6.       22.       44.       68.       90.      105.      112.      107.       94.       79.
                     67.       57.       48.       40.       34.       29.       24.       20.       17.       15.
                     12.       10.        9.        7.        6.        5.        4.        4.        3.        3.
                      2.        2.        2.        1.        1.        1.

        ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION      OA1

       TOTAL RAINFALL =   11.90, TOTAL LOSS =    2.02, TOTAL EXCESS =    9.88

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
  +   (CFS)       (HR)
                    (CFS)
  +   460.68     12.58             135.12       39.47       27.39       27.39
                 (INCHES)          8.420       9.838       9.838       9.838
                  (AC-FT)         67.00       78.28       78.28       78.28

                 CUMULATIVE AREA =    .14920 SQ MI   ACRES=          95.4880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
  137 KK       *     C/CH2  *
               *            *
               **************

  138 KO       OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS
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  139 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION    C/CH2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   481.46     12.58               148.70       43.34       30.07        30.07
                       (INCHES)     8.405       9.797       9.797        9.797
                        (AC-FT)    73.74       85.95       85.96        85.96

                       CUMULATIVE AREA =    .16450 SQ MI   ACRES=          105.2800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  140 KK    *       CH2  *
            *            *
            **************

  141 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  142 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

  143 LS          SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  144 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L          47.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  145 RD            MAIN CHANNEL
                           L        865.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                          ***
           MCUNGE FATAL ERROR - NUMBER OF ORDINATES FOR CONSTANT TIME STEP OVERLAND FLOW EXCEEDS ARRAY DIMENSIONS - REDUCE DURATION OF
RUN ON IT - RECORD
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
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```
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                   PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)    (MIN)       (IN)      (FPS)

                    PLANE1       2.48      1.67        .41      9.40    104.72   724.76      10.01       .64
                    MAIN         1.38      1.42       1.60    432.50    491.94   756.01       9.84      9.00

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8596E+02  EXCESS= .5342E+01 OUTFLOW= .9159E+02 BASIN STORAGE= .4592E-01 PERCENT ERROR=   -.4

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN         1.38      1.42       5.00              490.11   755.00      9.84

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH2

      TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                            MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                      (CFS)
+    490.11     12.58             157.89       46.03       32.06       32.06
                   (INCHES)       8.413       9.809       9.845       9.845
                    (AC-FT)      78.29       91.29       91.62       91.62

                   CUMULATIVE AREA =    .17450 SQ MI   ACRES=          111.6800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  146 KK     *       LF6  *
             *            *
             **************

  147 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  148 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA
                        SNAP       86.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  149 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  150 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        176.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
```

```
 151 RD           MAIN CHANNEL
                        L       697.  CHANNEL LENGTH
                        S      .0050  SLOPE
                        N       .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA        .01  CONTRIBUTING AREA
                    SHAPE       TRAP  CHANNEL SHAPE
                       WD        .00  BOTTOM WIDTH OR DIAMETER
                        Z       2.00  SIDE SLOPE
                    RUPSTQ         NO  ROUTE UPSTREAM HYDROGRAPH

                                                ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .70     35.12     85.92    724.90      10.01      1.05
                     MAIN          1.63      1.33       2.36    348.40     77.68    725.67       9.79      4.91

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4434E+01 OUTFLOW= .4333E+01 BASIN STORAGE= .4665E-03 PERCENT ERROR=   2.3

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00                76.89    725.00      9.79

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF6

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     76.89     12.08                 7.63        2.19        1.52         1.52
                          (INCHES)    8.551       9.794       9.795        9.795
                           (AC-FT)    3.79        4.34        4.34         4.34

                          CUMULATIVE AREA =    .00830 SQ MI   ACRES=            5.3120


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 152 KK      *       CH3  *
             *            *
             **************

 153 KO           OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

 154 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ............ TP-49 ............
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

 155 LS          SCS LOSS RATE
                       STRTL        .35  INITIAL ABSTRACTION
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                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 156 UK             OVERLAND-FLOW ELEMENT NO. 1
                           L        156.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
 157 RD             MAIN CHANNEL
                           L       1456.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .64     31.14     55.77    724.54      10.01       .99
                    MAIN          1.38      1.42       3.99    728.00    108.23    725.38       9.80      6.09


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4336E+01  EXCESS= .2884E+01 OUTFLOW= .7161E+01 BASIN STORAGE= .1118E-02 PERCENT ERROR=    .8


                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.38      1.42       5.00              104.91    725.00      9.85

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH3

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    104.91     12.08                12.71        3.63        2.52         2.52
                        (INCHES)     8.626       9.848       9.848        9.848
                         (AC-FT)      6.30        7.20        7.20         7.20

                        CUMULATIVE AREA =    .01370 SQ MI   ACRES=            8.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 158 KK      *    C/DP#2  *
             *            *
             **************

 159 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


 160 HC           HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

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      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   C/DP#2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                        (CFS)
+   510.00     12.58               170.54       49.65       34.57        34.57
                       (INCHES)     8.425       9.812       9.845        9.845
                        (AC-FT)     84.57       98.49       98.82        98.82

                       CUMULATIVE AREA =    .18820 SQ MI   ACRES=          120.4480


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  161 KK    *       LF7  *
            *            *
            **************

  162 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  163 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .02

  164 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  165 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        919.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  166 RD            MAIN CHANNEL
                           L        232.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .02  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                                (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       3.43    183.86    111.47    732.11       9.99       .91
                     MAIN          1.63      1.33        .74    232.00    110.02    730.53       9.44      5.25
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 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1159E+02 OUTFLOW= .1093E+02 BASIN STORAGE= .1005E-01 PERCENT ERROR=   5.7

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00              109.67    730.00      9.44

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    109.67     12.17                19.60        5.51        3.82         3.82
                         (INCHES)     8.398       9.436       9.441        9.441
                          (AC-FT)     9.72        10.92       10.93        10.93

                         CUMULATIVE AREA =    .0217O SQ MI   ACRES=           13.8880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  167 KK     *       CH4  *
             *            *
             **************

  168 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           O  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  169 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                               DEPTHS FOR   O-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-4O ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  6O-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  1O-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  17O LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  171 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        156.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       1OO.O  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  172 RD            MAIN CHANNEL
                           L       1064.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH
```

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                                                  ***
                          COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                  COMPUTATION TIME STEP
                ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                PLANE1        2.48      1.67        .54     31.16    100.62    725.00      10.14       .99
                MAIN          1.38      1.42       2.58    532.00    166.69    726.36       9.58      6.86

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1093E+02  EXCESS= .5195E+01 OUTFLOW= .1599E+02 BASIN STORAGE= .8624E-03 PERCENT ERROR=    .8

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                MAIN          1.38      1.42       5.00              165.86    725.00      9.57

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                             (CFS)
+   165.86     12.08                28.45        8.05        5.59         5.59
                           (INCHES)     8.452       9.567       9.572        9.572
                            (AC-FT)     14.11       15.97       15.98        15.98

                          CUMULATIVE AREA =    .03130 SQ MI   ACRES=           20.0320


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  173 KK     *       LF8  *
             *            *
             **************

  174 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  175 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  176 LS          SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  177 UK            OVERLAND-FLOW ELEMENT NO. 1
                            L        360.  OVERLAND FLOW LENGTH
                            S       .0500  SLOPE
                            N        .300  ROUGHNESS COEFFICIENT
                           PA       100.0  PERCENT OF SUBBASIN
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                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 178 RD           MAIN CHANNEL
                         L        721.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                       COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        1.11      1.67       1.81     71.94     69.91    724.93      10.01       .73
                   MAIN          1.63      1.33       2.58    360.25     66.96    727.97       9.84      4.65

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5075E+01 OUTFLOW= .4985E+01 BASIN STORAGE= .1508E-02 PERCENT ERROR=   1.7

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00                64.47    725.00      9.84

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION      LF8

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     64.47     12.08                 8.75        2.51        1.74         1.74
                        (INCHES)     8.559       9.839       9.843        9.843
                         (AC-FT)      4.34        4.98        4.99         4.99

                        CUMULATIVE AREA =    .00950 SQ MI   ACRES=            6.0800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  179 KK     *       LF9  *
             *            *
             **************

  180 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  181 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01
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 182 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 183 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        360.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 184 RD            MAIN CHANNEL
                          L        535.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67       1.08     71.94     78.12    724.87      10.01      1.31
                    MAIN          1.63      1.33       1.86    267.50     75.59    725.18       9.83      4.80

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4487E+01 OUTFLOW= .4405E+01 BASIN STORAGE= .5675E-03 PERCENT ERROR=   1.8

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00                74.57    725.00      9.86

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF9

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     74.57     12.08                 7.76        2.23        1.55         1.55
                        (INCHES)     8.591       9.862       9.863        9.863
                         (AC-FT)      3.85        4.42        4.42         4.42

                        CUMULATIVE AREA =    .00840 SQ MI   ACRES=            5.3760


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 185 KK      *       CH5  *
             *            *
             **************

 186 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 187 BA          SUBBASIN CHARACTERISTICS
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                    TAREA         .00  SUBBASIN AREA
                     SNAP 20000000.00  NORMAL ANNUAL PRECIPITATION
                    RATIO         .00  RATIO OF HYDROGRAPH

               PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                              STORM AREA =     .00

188 LS         SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
189 UK           OVERLAND-FLOW ELEMENT NO. 1
                        L        200.  OVERLAND FLOW LENGTH
                        S       .2500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
190 RD           MAIN CHANNEL
                        L       1996.  CHANNEL LENGTH
                        S       .0100  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .00  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD        2.00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                            PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .70     40.00     37.88    724.67      10.14      1.09
                    MAIN          2.16      1.35       4.91    998.00     80.65    727.02       9.89      6.77

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4419E+01  EXCESS= .2002E+01 OUTFLOW= .6379E+01 BASIN STORAGE= .9119E-03 PERCENT ERROR=    .6

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.16      1.35       5.00               78.56    730.00      9.88

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH5

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+     78.56     12.17                11.19        3.22        2.23         2.23
                         (INCHES)     8.599       9.882       9.884        9.884
                          (AC-FT)      5.55        6.38        6.38         6.38

                         CUMULATIVE AREA =    .01210 SQ MI   ACRES=            7.7440


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 191 KK       *        P2  *
              *            *
              **************

 192 KO           OUTPUT CONTROL VARIABLES
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                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


          SUBBASIN RUNOFF DATA

193 BA       SUBBASIN CHARACTERISTICS
                   TAREA         .00  SUBBASIN AREA

             PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
             ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
             5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
              1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .00

194 LS       SCS LOSS RATE
                   STRTL         .00  INITIAL ABSTRACTION
                  CRVNBR      100.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

195 UD       SCS DIMENSIONLESS UNITGRAPH
                    TLAG         .00  LAG

                                                       ***

                                                   UNIT HYDROGRAPH
                                                5 END-OF-PERIOD ORDINATES
                21.        6.        1.        0.        0.

     ***            ***            ***            ***            ***

                      HYDROGRAPH AT STATION       P2

   TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+    35.72     12.08                  3.79        1.18         .82          .82
                     (INCHES)     9.533      11.897      11.900       11.900
                      (AC-FT)      1.88        2.35        2.35         2.35

                     CUMULATIVE AREA =    .00370 SQ MI   ACRES=            2.3680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
196 KK     *      C/P2  *
           *            *
           **************

197 KO       OUTPUT CONTROL VARIABLES
                   IPRNT           3  PRINT CONTROL
                   IPLOT           0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE
                   IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


198 HC       HYDROGRAPH COMBINATION
                   ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                       ***

     ***            ***            ***            ***            ***
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                        HYDROGRAPH AT STATION     C/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   337.38     12.08                52.09       14.94       10.39       10.39
                     (INCHES)      8.557       9.814       9.836       9.836
                      (AC-FT)     25.83       29.62       29.69       29.69

                    CUMULATIVE AREA =    .05660 SQ MI   ACRES=          36.2240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  199 KK   *      R/P2  *
           *            *
           **************

  200 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA

  201 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1034.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

  202 SA              AREA          .0        .2        .2        .2        .3        .3        .4        .5

  203 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

  205 SL          LOW-LEVEL OUTLET
                       ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                       CAREA       28.86  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  204 SS          SPILLWAY
                        CREL     1040.00  SPILLWAY CREST ELEVATION
                       SPWID       10.00  SPILLWAY WIDTH
                        COQW        2.60  WEIR COEFFICIENT
                        EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00       .01       .16       .39       .66       .96      1.70      2.62
          ELEVATION    1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

            OUTFLOW        .00    149.19    161.15    175.20    191.94    212.21    237.27    269.03    310.63    367.43
          ELEVATION    1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

            OUTFLOW     392.63    399.11    406.56    415.00    424.53    435.17    447.00    460.07    474.44    490.16
          ELEVATION    1040.56   1040.67   1040.80   1040.94   1041.09   1041.25   1041.42   1041.60   1041.80   1042.00

                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
            OUTFLOW     138.87    149.19    152.13    161.15    175.20    191.94    196.40    212.21    237.27    240.54
          ELEVATION    1034.00   1034.15   1034.20   1034.35   1034.59   1034.91   1035.00   1035.33   1035.92   1036.00

            STORAGE        .59       .66       .96      1.70      1.95      2.00      2.06      2.12      2.19      2.26
            OUTFLOW     269.03    277.75    310.53    367.43    392.63    399.11    406.56    415.00    424.53    435.17
          ELEVATION    1036.75   1037.00   1038.00   1040.00   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25
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            STORAGE       2.34      2.43      2.52      2.62
            OUTFLOW     447.00    460.07    474.44    490.16
          ELEVATION    1041.42   1041.60   1041.80   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      139. TO      175.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     R/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   288.92     12.17                146.54      140.79      140.20       140.20
                        (INCHES)    24.071      92.509     132.748      132.748
                         (AC-FT)     72.66      279.25      400.72       400.72

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
      .760     12.17                  .00         .00         .00         -.46

  PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1037.34     12.17               1034.16     1034.04     1034.03      1034.03

                       CUMULATIVE AREA =    .0566O SQ MI   ACRES=           36.2240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  206 KK    *       CH7  *
            *            *
            **************

  207 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           O  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  208 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   O-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-4O ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  6O-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  1O-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .01

  209 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  21O UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        21O.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       1OO.O  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  211 RD            MAIN CHANNEL
```

```
                        L        317.  CHANNEL LENGTH
                        S       .0100  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD        2.00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                 ***
                              COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                     COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.15     42.00     87.16    725.09      10.14       .63
                    MAIN          2.16      1.35        .84    158.50     83.01    725.29       9.87      6.27

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5303E+01 OUTFLOW= .5158E+01 BASIN STORAGE= .6779E-03 PERCENT ERROR=   2.7

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.16      1.35       5.00                82.71    725.00      9.87

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =   11.90, TOTAL LOSS =    1.75, TOTAL EXCESS =   10.15

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     82.71     12.08                 9.09        2.60        1.81         1.81
                        (INCHES)     8.627       9.870       9.873        9.873
                         (AC-FT)      4.51        5.16        5.16         5.16

                        CUMULATIVE AREA =    .00980 SQ MI   ACRES=           6.2720


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  212 KK     *      LF10  *
             *            *
             **************

  213 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

  214 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                 STORM AREA =     .02

  215 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
```

```
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 216 UK          OVERLAND-FLOW ELEMENT NO. 1
                       L        138.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 217 RD          MAIN CHANNEL
                       L        907.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .02  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                              PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .57     27.60    176.92    724.73     10.01       .95
                    MAIN          1.63      1.33       2.56    453.50    173.10    724.73      9.76      5.90


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .9081E+01 OUTFLOW= .8849E+01 BASIN STORAGE= .6272E-03 PERCENT ERROR=   2.5


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00              167.42    725.00      9.79

       ***             ***             ***             ***             ***


                          HYDROGRAPH AT STATION     LF1O

     TOTAL RAINFALL =   11.9O, TOTAL LOSS =    1.88, TOTAL EXCESS =   10.02

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    167.42     12.08              15.68        4.48        3.11         3.11
                         (INCHES)   8.578       9.790       9.791        9.791
                          (AC-FT)    7.78        8.88        8.88         8.88

                         CUMULATIVE AREA =    .01700 SQ MI   ACRES=           10.8800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 218 KK       *         P3 *
              *            *
              **************

 219 KO           OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

 22O BA           SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA
```

```
  6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

  221 LS          SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  222 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .00  LAG

                                                      ***

                                                   UNIT HYDROGRAPH
                                                5 END-OF-PERIOD ORDINATES
                  63.       18.        3.        1.        0.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION       P3

     TOTAL RAINFALL =   11.90, TOTAL LOSS =     .00, TOTAL EXCESS =   11.90

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   106.19     12.08                  11.28        3.52        2.44         2.44
                         (INCHES)     9.533      11.897      11.900       11.900
                          (AC-FT)      5.59        6.98        6.98         6.98

                         CUMULATIVE AREA =    .01100 SQ MI   ACRES=            7.0400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  223 KK      *      C/P3  *
              *            *
              **************

  224 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  225 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                      ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/P3

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   356.32     12.08                  35.99       10.58        7.35         7.35
                         (INCHES)     8.853      10.408      10.426       10.426
                          (AC-FT)     17.85       20.98       21.02        21.02

                         CUMULATIVE AREA =    .03780 SQ MI   ACRES=           24.1920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          **************
          *            *
226 KK    *      R/P3  *
          *            *
          **************

227 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

228 RS          STORAGE ROUTING
                     NSTPS           1  NUMBER OF SUBREACHES
                      ITYP        ELEV  TYPE OF INITIAL CONDITION
                    RSVRIC     1052.00  INITIAL CONDITION
                         X         .00 WORKING R AND D COEFFICIENT

229 SA               AREA          .0       2.5       2.7       2.8       3.0       3.2

230 SE          ELEVATION     1052.00   1053.00   1054.00   1055.00   1056.00   1057.00

232 SL          LOW-LEVEL OUTLET
                     ELEVL     1050.00  ELEVATION AT CENTER OF OUTLET
                     CAREA        7.07  CROSS-SECTIONAL AREA
                      COQL         .60  COEFFICIENT
                      EXPL         .50  EXPONENT OF HEAD

231 SS          SPILLWAY
                      CREL     1056.50  SPILLWAY CREST ELEVATION
                     SPWID       10.00  SPILLWAY WIDTH
                      COQW        2.60  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

                                                  ***

                                          COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00       .84      3.43      6.18      9.09     12.16
          ELEVATION    1052.00   1053.00   1054.00   1055.00   1056.00   1057.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

            OUTFLOW        .00     50.58     53.36     56.46     59.94     63.88     68.38     73.55     79.58     86.68
          ELEVATION    1052.00   1052.21   1052.46   1052.76   1053.11   1053.53   1054.05   1054.68   1055.48   1056.50

            OUTFLOW      87.30     87.75     88.36     89.15     90.15     91.39     92.88     94.65     96.73     99.14
          ELEVATION    1056.55   1056.58   1056.61   1056.65   1056.69   1056.74   1056.80   1056.86   1056.93   1057.00


                                          COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .01       .08       .36       .84      1.11      2.19      3.43      3.55      5.28
            OUTFLOW      48.08     50.58     53.36     56.46     58.88     59.94     63.88     67.99     68.38     73.55
          ELEVATION    1052.00   1052.21   1052.46   1052.76   1053.00   1053.11   1053.53   1054.00   1054.05   1054.68

            STORAGE       6.18      7.55      9.09     10.60     10.76     10.84     10.94     11.06     11.19     11.35
            OUTFLOW      76.02     79.58     83.27     86.68     87.30     87.75     88.36     89.15     90.15     91.39
          ELEVATION    1055.00   1055.48   1056.00   1056.50   1056.55   1056.58   1056.61   1056.65   1056.69   1056.74

            STORAGE      11.52     11.72     11.93     12.16
            OUTFLOW      92.88     94.65     96.73     99.14
          ELEVATION    1056.80   1056.86   1056.93   1057.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       48. TO       51.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     R/P3

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
```

```
                          (CFS)
+    72.36     12.42                54.65       49.72       49.22       49.22
                        (INCHES)    13.443      48.920      69.779      69.779
                         (AC-FT)    27.10       98.62       140.68      140.68

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
     4.883     12.42                 .96         .18         .13          .03

  PEAK STAGE    TIME                       MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1054.53     12.42              1052.66     1052.16     1052.11     1052.11

                       CUMULATIVE AREA =    .03780 SQ MI   ACRES=          24.1920
1
                                                RUNOFF SUMMARY
                                           FLOW IN CUBIC FEET PER SECOND
                                          TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION      STATION    FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                                6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                           LF1     64.59   12.08          7.          2.          1.        .01
          HYDROGRAPH AT
+                           LF2     69.58   12.08          7.          2.          1.        .01
          2 COMBINED AT
+                           LD1    134.17   12.08         14.          4.          3.        .02
          HYDROGRAPH AT
+                        LF3/LD    107.26   12.08         14.          4.          3.        .02
          HYDROGRAPH AT
+                           OA2    253.41   12.58         72.         21.         15.        .08
          3 COMBINED AT
+                         C/CH1    340.60   12.08        100.         29.         20.        .11
          HYDROGRAPH AT
+                           CH1    393.14   12.08        117.         34.         24.        .13
          HYDROGRAPH AT
+                          LF13     27.76   12.08          2.          1.          0.        .00
          HYDROGRAPH AT
+                            P1     16.41   12.08          2.          1.          0.        .00
          3 COMBINED AT
+                          C/P1    437.31   12.08        121.         35.         25.        .13
          ROUTED TO
+                          R/P1    246.22   13.00         99.         50.         44.        .13
+                                                                                          1056.04      13.00
          HYDROGRAPH AT
+                          LF11     53.95   12.08          6.          2.          1.        .01
          HYDROGRAPH AT
+                          LF12     69.81   12.08          7.          2.          1.        .01
          2 COMBINED AT
+                           LD9    123.77   12.08         13.          4.          3.        .01
          HYDROGRAPH AT
+                           CH7    183.86   12.08         22.          6.          4.        .02
          HYDROGRAPH AT
+                           CH8     10.17   12.08          1.          0.          0.        .00
          HYDROGRAPH AT
+                            P4     12.55   12.08          1.          0.          0.        .00
          3 COMBINED AT
+                          C/P4    206.57   12.08         24.          7.          5.        .03
          ROUTED TO
+                          R/P4    182.62   12.17         53.         49.         49.        .03
+                                                                                          1052.33      12.17
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          HYDROGRAPH AT
+                        DA1     190.31   12.42          43.         12.          9.        .05
          3 COMBINED AT
+                       DC#1     375.32   13.00         191.        112.        101.        .21
          HYDROGRAPH AT
+                      DC#5/D    105.20   12.33          21.          6.          4.        .02
          HYDROGRAPH AT
+                        LF4      51.02   12.08           6.          2.          1.        .01
          HYDROGRAPH AT
+                        LF5      86.72   12.08           8.          2.          2.        .01
          2 COMBINED AT
+                      C/LD3     137.74   12.08          14.          4.          3.        .02
          HYDROGRAPH AT
+                        OA1     460.68   12.58         135.         39.         27.        .15
          2 COMBINED AT
+                      C/CH2     481.46   12.58         149.         43.         30.        .16
          HYDROGRAPH AT
+                        CH2     490.11   12.58         158.         46.         32.        .17
          HYDROGRAPH AT
+                        LF6      76.89   12.08           8.          2.          2.        .01
          HYDROGRAPH AT
+                        CH3     104.91   12.08          13.          4.          3.        .01
          2 COMBINED AT
+                     C/DP#2     510.00   12.58         171.         50.         35.        .19
          HYDROGRAPH AT
+                        LF7     109.67   12.17          20.          6.          4.        .02
          HYDROGRAPH AT
+                        CH4     165.86   12.08          28.          8.          6.        .03
          HYDROGRAPH AT
+                        LF8      64.47   12.08           9.          3.          2.        .01
          HYDROGRAPH AT
+                        LF9      74.57   12.08           8.          2.          2.        .01
          HYDROGRAPH AT
+                        CH5      78.56   12.17          11.          3.          2.        .01
          HYDROGRAPH AT
+                         P2      35.72   12.08           4.          1.          1.        .00
          4 COMBINED AT
+                      C/P2     337.38   12.08          52.         15.         10.        .06
          ROUTED TO
+                      R/P2     288.92   12.17         147.        141.        140.        .06
+                                                                                      1037.34       12.17
          HYDROGRAPH AT
+                        CH7      82.71   12.08           9.          3.          2.        .01
          HYDROGRAPH AT
+                       LF10     167.42   12.08          16.          4.          3.        .02
          HYDROGRAPH AT
+                         P3     106.19   12.08          11.          4.          2.        .01
          3 COMBINED AT
+                      C/P3     356.32   12.08          36.         11.          7.        .04
          ROUTED TO
+                      R/P3      72.36   12.42          55.         50.         49.        .04
+                                                                                      1054.53       12.42
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                 INTERPOLATED TO
                                                                               COMPUTATION INTERVAL
     ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
```

			PEAK				PEAK	
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
LF1	MANE	2.86	64.99	723.44	9.76	5.00	64.59	725.00	9.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4006E+01 OUTFLOW= .3904E+01 BASIN STORAGE= .5625E-03 PERCENT ERROR= 2.5

LF2	MANE	3.04	73.04	723.90	9.76	5.00	69.58	725.00	9.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4273E+01 OUTFLOW= .4164E+01 BASIN STORAGE= .5936E-03 PERCENT ERROR= 2.5

LF3/LD	MANE	3.06	115.91	726.30	9.80	5.00	107.26	725.00	9.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8119E+01 OUTFLOW= .7942E+01 BASIN STORAGE= .1877E-02 PERCENT ERROR= 2.2

CH1	MANE	4.35	398.19	726.34	9.88	5.00	393.14	725.00	9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5746E+02 EXCESS= .1028E+02 OUTFLOW= .6786E+02 BASIN STORAGE= .1013E+00 PERCENT ERROR= -.3

LF13	MANE	.89	28.63	724.49	8.94	5.00	27.76	725.00	8.96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1496E+01 OUTFLOW= .1334E+01 BASIN STORAGE= .1308E-03 PERCENT ERROR= 10.8

LF11	MANE	3.13	54.95	725.22	9.82	5.00	53.95	725.00	9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3258E+01 OUTFLOW= .3195E+01 BASIN STORAGE= .6478E-03 PERCENT ERROR= 1.9

LF12	MANE	2.84	70.83	723.33	9.75	5.00	69.81	725.00	9.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4273E+01 OUTFLOW= .4160E+01 BASIN STORAGE= .5368E-03 PERCENT ERROR= 2.6

CH7	MANE	2.83	187.39	726.39	9.83	5.00	183.86	725.00	9.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7359E+01 EXCESS= .5303E+01 OUTFLOW= .1253E+02 BASIN STORAGE= .7128E-03 PERCENT ERROR= 1.0

CH8	MANE	.90	10.38	724.86	9.91	5.00	10.17	725.00	9.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5412E+00 OUTFLOW= .5286E+00 BASIN STORAGE= .9498E-04 PERCENT ERROR= 2.3

LF4	MANE	1.65	53.23	725.96	8.79	5.00	51.02	725.00	8.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3579E+01 OUTFLOW= .3142E+01 BASIN STORAGE= .6706E-03 PERCENT ERROR= 12.2

LF5	MANE	2.16	86.99	724.98	9.80	5.00	86.72	725.00	9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4594E+01 OUTFLOW= .4495E+01 BASIN STORAGE= .4410E-03 PERCENT ERROR= 2.1

CH2	MANE	1.60	491.94	756.01	9.84	5.00	490.11	755.00	9.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8596E+02 EXCESS= .5342E+01 OUTFLOW= .9159E+02 BASIN STORAGE= .4592E-01 PERCENT ERROR= -.4

LF6	MANE	2.36	77.68	725.67	9.79	5.00	76.89	725.00	9.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4434E+01 OUTFLOW= .4333E+01 BASIN STORAGE= .4665E-03 PERCENT ERROR= 2.3

CH3	MANE	3.99	108.23	725.38	9.80	5.00	104.91	725.00	9.85

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4336E+01 EXCESS= .2884E+01 OUTFLOW= .7161E+01 BASIN STORAGE= .1118E-02 PERCENT ERROR=    .8

              LF7  MANE          .74    110.02    730.53      9.44      5.00    109.67    730.00        9.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1159E+02 OUTFLOW= .1093E+02 BASIN STORAGE= .1005E-01 PERCENT ERROR=   5.7

              CH4  MANE         2.58    166.69    726.36      9.58      5.00    165.86    725.00        9.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1093E+02 EXCESS= .5195E+01 OUTFLOW= .1599E+02 BASIN STORAGE= .8624E-03 PERCENT ERROR=    .8

              LF8  MANE         2.58     66.96    727.97      9.84      5.00     64.47    725.00        9.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5075E+01 OUTFLOW= .4985E+01 BASIN STORAGE= .1508E-02 PERCENT ERROR=   1.7

              LF9  MANE         1.86     75.59    725.18      9.83      5.00     74.57    725.00        9.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4487E+01 OUTFLOW= .4405E+01 BASIN STORAGE= .5675E-03 PERCENT ERROR=   1.8

              CH5  MANE         4.91     80.65    727.02      9.89      5.00     78.56    730.00        9.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4419E+01 EXCESS= .2002E+01 OUTFLOW= .6379E+01 BASIN STORAGE= .9119E-03 PERCENT ERROR=    .6

              CH7  MANE          .84     83.01    725.29      9.87      5.00     82.71    725.00        9.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5303E+01 OUTFLOW= .5158E+01 BASIN STORAGE= .6779E-03 PERCENT ERROR=   2.7

             LF10  MANE         2.56    173.10    724.73      9.76      5.00    167.42    725.00        9.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9081E+01 OUTFLOW= .8849E+01 BASIN STORAGE= .6272E-03 PERCENT ERROR=   2.5


*** NORMAL END OF HEC-1 ***
```

HEC-1 OUTPUT- PROPOSED 25-YEAR 24-HOUR STORM EVENT

```
1****************************************                ****************************************
*                                      *                *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                *    U.S. ARMY CORPS OF ENGINEERS      *
*        JUN 1998 AND FEB 2010         *                *    HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.1R              *                *         609 SECOND STREET            *
*       RGMHEC2000 WWW.HEC-1.COM       *                *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE   01AUG24  TIME  11:39:29  *                *          (916) 756-1104              *
*                                      *                *                                      *
****************************************                ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X                X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX

 THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

 THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                          HEC-1 INPUT                                          PAGE  1

          LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

             1          ID  DEL RIO LF EXPANSION
             2          ID  25-YR, 24-HR -  PROPOSED
                        *DIAGRAM
             3          IT       5       0    2400     416       0       0
             4          IO       3       0       0
                        *
             5          KK     LF1
             6          PH               0    1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85
             7          KO       0       0       0       7      21
             8          BA  0.0075
             9          LS       0      85
            10          UK     100    0.05     0.3     100
            11          RD     820   0.005    0.03            TRAP       0       2      NO
                        *
            12          KK     LF2
            13          KO       0       0       0       7      21
            14          BA  0.00802
            15          LS       0      85
            16          UK     218    0.25     0.3     100
            17          RD     885   0.005    0.03            TRAP       0       2      NO
                        *
            18          KK     LD1
            19          KO       0       0       0       7      21
            20          HC       2
                        *
            21          KK  LF3/LD2
            22          KO       0       0       0       7      21
            23          BA  0.01525
            24          LS       0      85
            25          UK     287    0.05     0.3     100
            26          RD     977   0.005    0.03            TRAP       0       2      NO
                        *
            27          KK     0A2
            28          KO       0       0       0       7      21
            29          BA  0.0791
            30          LS       0      84
            31          US    0.55    0.66
                        *
            32          KK   C/CH1
            33          KO       0       0       0       7      21
```

```
          34          HC       3
                      *

          35          KK     CH1
          36          KO       0       0       0       7      21
          37          BA   0.019
          38          LS       0      86
          39          UK      47    0.25     0.3     100
          40          RD    3079    0.02    0.03            TRAP      10       3     YES
                      *
1                                          HEC-1 INPUT                                          PAGE  2

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          41          KK    LF13
          42          KO       0       0       0       7      21
          43          BA  0.00286
          44          LS       0      85
          45          UK     142    0.25     0.3     100
          46          RD     200   0.005    0.03            TRAP       0       2      NO
                      *

          47          KK      P1
          48          KO       0       0       0       7      21
          49          BA  0.0017
          50          LS       0     100
          51          UD       0
                      *

          52          KK    C/P1
          53          KO       0       0       0       7      21
          54          HC       3
                      *

          55          KK    R/P1
          56          KO       0       0       0       7      21
          57          RS       1    ELEV    1048
          58          SA       0    2.75     3.0    3.25     3.5    3.75
          59          SE    1048    1049    1050    1052    1054    1056
          60          SS  1055.5     150     2.6     1.5
          61          SL    1047    6.28     0.6     0.5
                      *

          62          KK    LF11
          63          KO       0       0       0       7      21
          64          BA  0.00616
          65          LS       0      85
          66          UK     148    0.05     0.3     100
          67          RD     830   0.005    0.03            TRAP       0       2      NO
                      *

          68          KK    LF12
          69          KO       0       0       0       7      21
          70          BA  0.008082
          71          LS       0      85
          72          UK     189    0.25     0.3     100
          73          RD     829   0.005    0.03            TRAP       0       2      NO
                      *

          74          KK     LD9
          75          KO       0       0       0       7      21
          76          HC       2
                      *
1                                          HEC-1 INPUT                                          PAGE  3

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          77          KK     CH7
          78          KO       0       0       0       7      21
          79          BA  0.00980
          80          LS       0      86
          81          UK     156    0.25     0.3     100
          82          RD    1639    0.02    0.03            TRAP       3       3     YES
                      *

          83          KK     CH8
          84          KO       0       0       0       7      21
          85          BA   0.001
          86          LS       0      86
          87          UK     137    0.25     0.3     100
          88          RD     234    0.02    0.03            TRAP       3       3      NO
                      *
```

```
 89          KK      P4
 90          KO       0       0       0       7      21
 91          BA  0.0013
 92          LS       0     100
 93          UD       0
             *

 94          KK    C/P4
 95          KO       0       0       0       7      21
 96          HC       3
             *

 97          KK    R/P4
 98          KO       0       0       0       7      21
 99          RS       1    ELEV  1046.5
100          SA       0   0.092    0.15    0.19    0.21    0.31
101          SE  1046.5    1047    1048    1049    1050    1052
102          SS    1051      25     2.6     1.5
103          SL    1044    6.28     0.6     0.5
             *

104          KK     DA1
105          KO       0       0       0       7      21
106          BA   0.047
107          LS       0      84
108          US    0.38    0.69
             *

109          KK    DC#1
110          KO       0       0       0       7      21
111          HC       3
             *
1                                      HEC-1 INPUT                                    PAGE  4

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

112          KK  DC#5/DA2
113          KO       0       0       0       7      21
114          BA  0.0233
115          LS       0      84
116          US    0.29    0.66
             *

117          KK     LF4
118          KO       0       0       0       7      21
119          BA  0.0067
120          LS       0      85
121          UK   244.1    0.05     0.3     100
122          RD     437   0.005    0.03            TRAP       0       2      NO
             *

123          KK     LF5
124          KO       0       0       0       7      21
125          BA  0.0086      86
126          LS       0      85
127          UK   175.6    0.25     0.3     100
128          RD   643.6   0.005    0.03            TRAP       0       2      NO
             *

129          KK   C/LD3
130          KO       0       0       0       7      21
131          HC       2
             *

132          KK     OA1
133          KO       0       0       0       7      21
134          BA  0.1492
135          LS       0      84
136          US    0.56    0.64
             *

137          KK   C/CH2
138          KO       0       0       0       7      21
139          HC       2
             *

140          KK     CH2
141          KO       0       0       0       7      21
142          BA    0.01
143          LS       0      85
144          UK      47    0.25     0.3     100
145          RD     865    0.01    0.03            TRAP      10       3     YES
```

```
                *
          146   KK     LF6
          147   KO       0       0       0       7      21
          148   BA  0.0083      86
          149   LS       0      85
          150   UK   175.6    0.25     0.3     100
          151   RD   696.8   0.005    0.03            TRAP       0       2      NO
                *
1                                        HEC-1 INPUT                                                    PAGE  5

         LINE   ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          152   KK     CH3
          153   KO       0       0       0       7      21
          154   BA  0.0054
          155   LS       0      85
          156   UK   155.7    0.25     0.3     100
          157   RD    1456    0.01    0.03            TRAP      10       3     YES
                *
          158   KK  C/DP#2
          159   KO       0       0       0       7      21
          160   HC       2
                *
          161   KK     LF7
          162   KO       0       0       0       7      21
          163   BA  0.0217
          164   LS       0      85
          165   UK   919.3    0.05     0.3     100
          166   RD     232   0.005    0.03            TRAP       0       2      NO
                *
          167   KK     CH4
          168   KO       0       0       0       7      21
          169   BA  0.0096
          170   LS       0      86
          171   UK   155.8    0.25     0.3     100
          172   RD    1064    0.01    0.03            TRAP      10       3     YES
                *
          173   KK     LF8
          174   KO       0       0       0       7      21
          175   BA  0.0095
          176   LS       0      85
          177   UK   359.7    0.05     0.3     100
          178   RD   720.5   0.005    0.03            TRAP       0       2      NO
                *
          179   KK     LF9
          180   KO       0       0       0       7      21
          181   BA  0.0084
          182   LS       0      85
          183   UK   359.7    0.25     0.3     100
          184   RD     535   0.005    0.03            TRAP       0       2      NO
                *
          185   KK     CH5
          186   KO       0       0       0       7      21
          187   BA  0.00372
          188   LS       0      86
          189   UK     200    0.25     0.3     100
          190   RD    1996    0.01    0.03            TRAP       2       2     YES
                *
1                                        HEC-1 INPUT                                                    PAGE  6

         LINE   ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          191   KK      P2
          192   KO       0       0       0       7      21
          193   BA  0.0037
          194   LS       0     100
          195   UD       0
                *
          196   KK    C/P2
          197   KO       0       0       0       7      21
          198   HC       4
                *
          199   KK    R/P2
```

```
          200          KO       0       0       0       7      21
          201          RS       1    ELEV    1034
          202          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          203          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          204          SS    1040      10     2.6     1.5
          205          SL    1033   28.86     0.6     0.5
                       *

          206          KK     CH7
          207          KO       0       0       0       7      21
          208          BA  0.0098
          209          LS       0      86
          210          UK     210    0.05     0.3     100
          211          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

          212          KK    LF10
          213          KO       0       0       0       7      21
          214          BA   0.017
          215          LS       0      85
          216          UK     138    0.25     0.3     100
          217          RD     907   0.005    0.03            TRAP       0       2      NO
                       *

          218          KK      P3
          219          KO       0       0       0       7      21
          220          BA   0.011
          221          LS       0     100
          222          UD       0
                       *

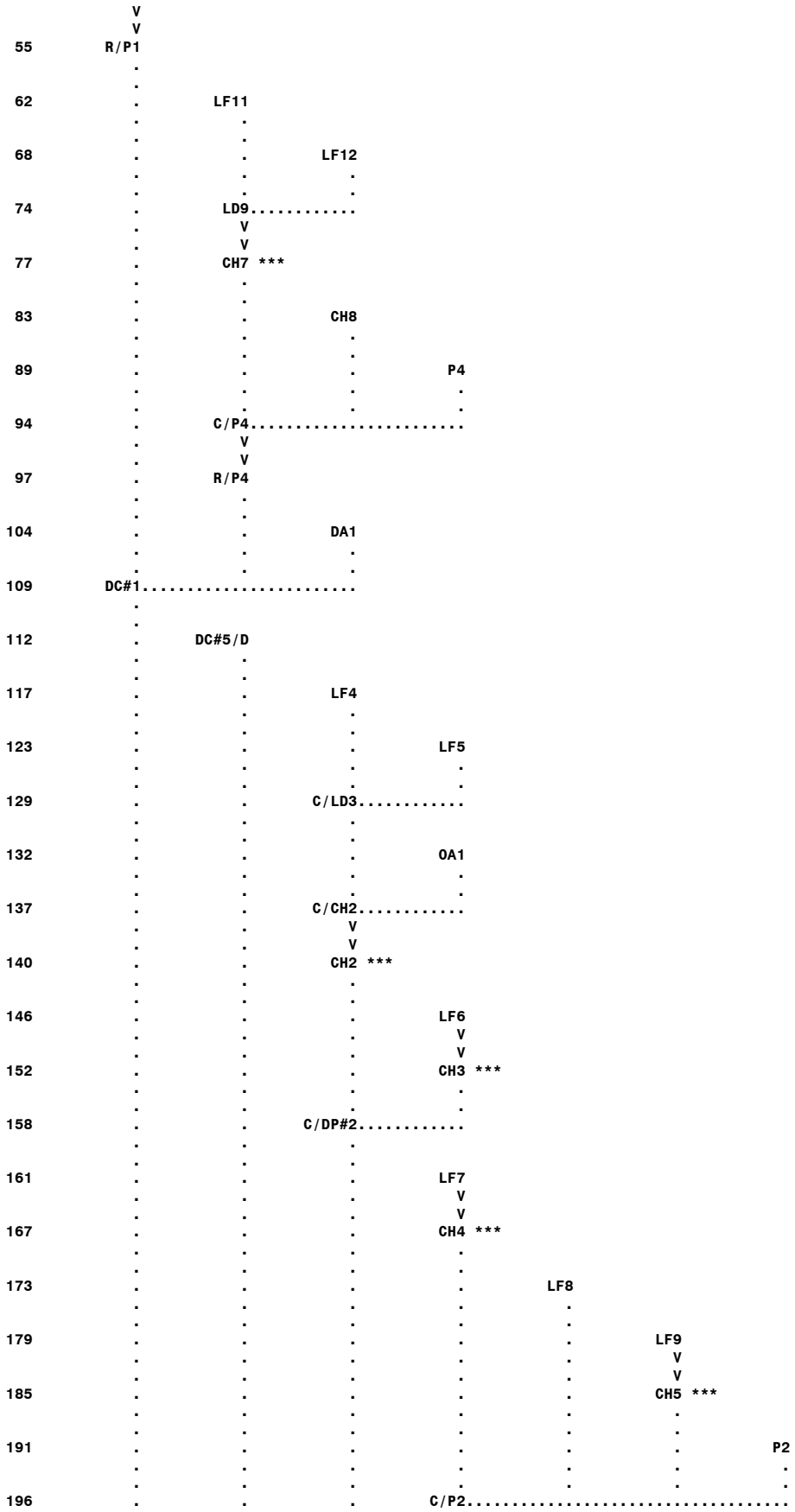
          223          KK    C/P3
          224          KO       0       0       0       7      21
          225          HC       3
                       *
1                                                HEC-1 INPUT                                                PAGE  7

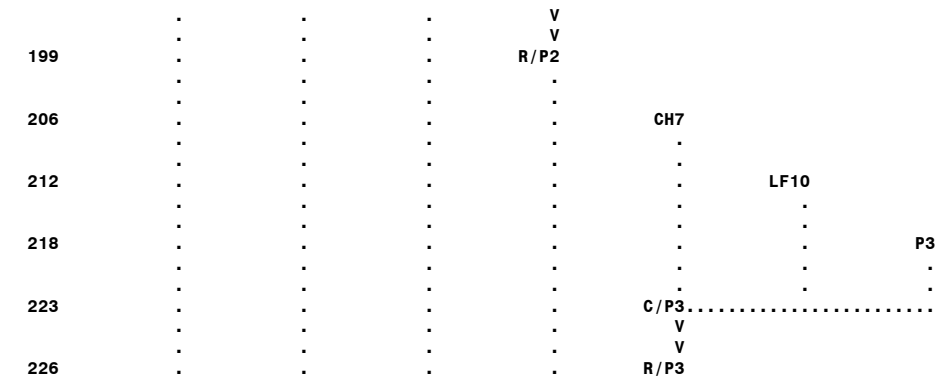
        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          226          KK    R/P3
          227          KO       0       0       0       7      21
          228          RS       1    ELEV    1052
          229          SA       0    2.51    2.67    2.83    2.99    3.15
          230          SE    1052    1053    1054    1055    1056    1057
          231          SS  1056.5      10     2.6     1.5
          232          SL    1050   7.065     0.6     0.5
                       *
          233          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     5         LF1
               .
               .
    12           .         LF2
                 .           .
                 .           .
    18         LD1............
               .
               .
    21           .      LF3/LD
                 .           .
                 .           .
    27           .           .         OA2
                 .           .           .
                 .           .           .
    32       C/CH1.........................
                 V
                 V
    35         CH1 ***
               .
               .
    41           .        LF13
                 .           .
                 .           .
    47           .           .          P1
                 .           .           .
                 .           .           .
    52       C/P1.........................
```


V
V
55 R/P1
62 LF11
68 LF12
74 LD9
77 CH7 ***
83 CH8
89 P4
94 C/P4
97 R/P4
104 DA1
109 DC#1
112 DC#5/D
117 LF4
123 LF5
129 C/LD3
132 OA1
137 C/CH2
140 CH2 ***
146 LF6
152 CH3 ***
158 C/DP#2
161 LF7
167 CH4 ***
173 LF8
179 LF9
185 CH5 ***
191 P2
196 C/P2



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*        JUN 1998 AND FEB 2010         *
*            VERSION 4.1R              *
*       RGMHEC2000 WWW.HEC-1.COM       *
*  RUN DATE   19AUG24  TIME  11:39:29   *
*                                    *
**************************************
```

```
**************************************
*                                    *
*    U.S. ARMY CORPS OF ENGINEERS    *
*    HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```

```
                      DEL RIO LF EXPANSION
                      25-YR, 24-HR -  PROPOSED

   4 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT           HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         416  NUMBER OF HYDROGRAPH ORDINATES
                      NDATE      3    0  ENDING DATE
                      NTIME        1035  ENDING TIME
                      ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   34.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   5 KK     *       LF1  *
            *            *
            **************

   7 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS
```

```
            SUBBASIN RUNOFF DATA

 8 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

              PRECIPITATION DATA

 6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                            STORM AREA =     .01

 9 LS         SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

              KINEMATIC WAVE
10 UK           OVERLAND-FLOW ELEMENT NO. 1
                       L        100.  OVERLAND FLOW LENGTH
                       S       .0500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
11 RD           MAIN CHANNEL
                       L        820.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                 ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                        PEAK                CELERITY
                                                  (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                 PLANE1        1.11      1.67        .85     20.00     49.56    724.71      6.07       .42
                 MAIN          1.63      1.33       3.20    410.00     45.35    725.96      5.93      4.27


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2427E+01 OUTFLOW= .2372E+01 BASIN STORAGE= .5642E-03 PERCENT ERROR=   2.2

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                 MAIN          1.63      1.33       5.00               43.63    725.00      5.92

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    43.63     12.08                  4.21        1.19         .83          .83
                         (INCHES)    5.218       5.919       5.919        5.919
                          (AC-FT)     2.09        2.37        2.37         2.37

                        CUMULATIVE AREA =    .0075O SQ MI   ACRES=           4.8000


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 12 KK        *       LF2  *
              *            *
              **************
```

```
 13 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 14 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA
                      SNAP 20000000.00  NORMAL ANNUAL PRECIPITATION
                     RATIO         .00  RATIO OF HYDROGRAPH

                PRECIPITATION DATA

  6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .01

 15 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 16 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        218.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 17 RD            MAIN CHANNEL
                         L        885.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                               PEAK                  CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .81     43.60     52.32    725.26       6.07       .93
                   MAIN          1.63      1.33       3.39    442.50     49.86    725.65       5.93      4.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2589E+01 OUTFLOW= .2531E+01 BASIN STORAGE= .6028E-03 PERCENT ERROR=   2.2

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.63      1.33       5.00                47.77    725.00      5.95

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION      LF2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                   (CFS)
+     47.77     12.08                   4.52        1.28         .89          .89
                        (INCHES)      5.251       5.946       5.947        5.947
                         (AC-FT)       2.24        2.54        2.54         2.54

                        CUMULATIVE AREA =    .00800 SQ MI   ACRES=           5.1200
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  18 KK    *       LD1  *
           *            *
           **************

  19 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


  20 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION      LD1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+    91.40     12.08                 8.73        2.47        1.72         1.72
                  (INCHES)         5.235       5.933       5.933        5.933
                   (AC-FT)          4.33        4.90        4.91         4.91

                  CUMULATIVE AREA =    .01550 SQ MI   ACRES=            9.9200


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  21 KK    *    LF3/LD  *     2
           *            *
           **************

  22 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  23 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .02  SUBBASIN AREA
                       SNAP 50000000.00  NORMAL ANNUAL PRECIPITATION
                      RATIO         .00  RATIO OF HYDROGRAPH

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ................ TP-40 ................   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .02

  24 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA
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              KINEMATIC WAVE
  25 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L        287.  OVERLAND FLOW LENGTH
                       S       .0500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
              MUSKINGUM-CUNGE
  26 RD         MAIN CHANNEL
                       L        977.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .02  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.76     57.40     75.12    726.32       6.06       .56
                    MAIN          1.63      1.33       3.43    488.50     74.01    727.03       5.94      4.75

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .4919E+01 OUTFLOW= .4818E+01 BASIN STORAGE= .1920E-02 PERCENT ERROR=   2.0

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00        68.13    730.00       5.93

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION   LF3/LD

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                    (CFS)
+     68.13     12.17                 8.57        2.42        1.68         1.68
                (INCHES)             5.242       5.931       5.932        5.932
                 (AC-FT)              4.25        4.81        4.81         4.81

                CUMULATIVE AREA =    .01520 SQ MI   ACRES=            9.7280


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  27 KK       *       OA2  *
              *            *
              **************

  28 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  29 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .08  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
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                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .08

  30 LS         SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  31 US         SNYDER UNITGRAPH
                        TP         .55  LAG
                        CP         .66  PEAKING COEFFICIENT

                SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                      ***

                                                UNIT HYDROGRAPH PARAMETERS
                                           CLARK   TC=   .64 HR,       R=   .45 HR
                                          SNYDER   TP=   .55 HR,      CP=   .67

                                                   UNIT HYDROGRAPH
                                              33 END-OF-PERIOD ORDINATES
                  3.       13.       25.       38.       51.       59.       62.       59.       51.       43.
                 35.       29.       24.       20.       17.       14.       12.       10.        8.        7.
                  5.        5.        4.        3.        3.        2.        2.        1.        1.        1.
                  1.        1.        1.

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION      OA2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    168.13     12.58              43.84       12.60        8.74         8.74
                       (INCHES)     5.153       5.923       5.923        5.923
                        (AC-FT)     21.74       24.99       24.99        24.99

                       CUMULATIVE AREA =    .07910 SQ MI   ACRES=          50.6240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   32 KK      *     C/CH1  *
              *            *
              **************

   33 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   34 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                     ***

      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION    C/CH1

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    215.24     12.08              61.10       17.49       12.14        12.14
                       (INCHES)     5.174       5.925       5.925        5.925
                        (AC-FT)     30.30       34.70       34.70        34.70
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                    CUMULATIVE AREA =    .1098O SQ MI   ACRES=          70.2720


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 35 KK    *       CH1  *
          *            *
          **************

 36 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 37 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .02  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .02

 38 LS          SCS LOSS RATE
                     STRTL          .33  INITIAL ABSTRACTION
                    CRVNBR        86.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 39 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L          47.  OVERLAND FLOW LENGTH
                         S        .2500  SLOPE
                         N         .300  ROUGHNESS COEFFICIENT
                        PA        100.0  PERCENT OF SUBBASIN
                      DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 40 RD            MAIN CHANNEL
                         L        3079.  CHANNEL LENGTH
                         S        .0200  SLOPE
                         N         .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA          .02  CONTRIBUTING AREA
                     SHAPE         TRAP  CHANNEL SHAPE
                        WD        10.00  BOTTOM WIDTH OR DIAMETER
                         Z         3.00  SIDE SLOPE
                    RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .36      9.40    136.36    724.96       6.18       .54
                    MAIN          1.95      1.42       4.94   1539.50    250.19    726.51       5.95     10.38


CONTINUITY SUMMARY (AC-FT) - INFLOW= .3470E+02  EXCESS= .6268E+01 OUTFLOW= .4087E+02 BASIN STORAGE= .1748E-02 PERCENT ERROR=    .2


                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.95      1.42       5.00              248.38    730.00      5.95

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH1
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     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   248.38     12.17              71.97       20.60       14.30        14.30
                   (INCHES)      5.195       5.949       5.949        5.949
                    (AC-FT)     35.69       40.87       40.87        40.87

                   CUMULATIVE AREA =    .12880 SQ MI   ACRES=           82.4320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
   41 KK   *      LF13  *
           *            *
           **************

   42 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

   43 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA
                        SNAP 60000000.00  NORMAL ANNUAL PRECIPITATION
                       RATIO         .00  RATIO OF HYDROGRAPH

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

   44 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   45 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        142.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
   46 RD            MAIN CHANNEL
                           L        200.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .00  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .70     28.40     19.34    725.08       6.07       .82
                     MAIN          1.63      1.33        .98    200.00     18.97    724.52       5.42      3.40
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 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .9062E+00 OUTFLOW= .8087E+00 BASIN STORAGE= .1285E-03 PERCENT ERROR=  10.7

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00               18.60    725.00      5.43

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     LF13

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                             (CFS)
+    18.60     12.08                1.47         .41         .28          .28
                            (INCHES)     4.877       5.433       5.433        5.433
                             (AC-FT)       .73         .81         .81          .81

                           CUMULATIVE AREA =    .00280 SQ MI   ACRES=            1.7920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *              *
   47 KK     *         P1   *
             *              *
             **************

   48 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   49 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

   50 LS          SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   51 UD          SCS DIMENSIONLESS UNITGRAPH
                         TLAG         .00  LAG

                                                      ***

                                                  UNIT HYDROGRAPH
                                                5 END-OF-PERIOD ORDINATES
                 10.        3.        1.        0.        0.

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION       P1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
```

```
                    (CFS)
+    11.82     12.08                1.15         .36         .25         .25
                  (INCHES)      6.316       7.848       7.850       7.850
                   (AC-FT)        .57         .71         .71         .71

                  CUMULATIVE AREA =    .00170 SQ MI   ACRES=           1.0880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
   52 KK   *      C/P1  *
           *            *
           **************

   53 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   54 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                      ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     C/P1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+   270.34     12.08               74.54       21.36       14.83       14.83
                  (INCHES)      5.199       5.960       5.963       5.963
                   (AC-FT)      36.96       42.37       42.39       42.39

                  CUMULATIVE AREA =    .13330 SQ MI   ACRES=          85.3120


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
   55 KK   *      R/P1  *
           *            *
           **************

   56 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              HYDROGRAPH ROUTING DATA

   57 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     1048.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

   58 SA              AREA          .0       2.8       3.0       3.3       3.5       3.8

   59 SE          ELEVATION     1048.00   1049.00   1050.00   1052.00   1054.00   1056.00

   61 SL          LOW-LEVEL OUTLET
                       ELEVL     1047.00  ELEVATION AT CENTER OF OUTLET
```

```
                    CAREA        6.28  CROSS-SECTIONAL AREA
                     COQL         .60  COEFFICIENT
                     EXPL         .50  EXPONENT OF HEAD

  60 SS          SPILLWAY
                     CREL     1055.50  SPILLWAY CREST ELEVATION
                    SPWID      150.00  SPILLWAY WIDTH
                     COQW        2.60  WEIR COEFFICIENT
                     EXPW        1.50  EXPONENT OF HEAD

                                                ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00       .92      3.79     10.04     16.79     24.04
        ELEVATION    1048.00   1049.00   1050.00   1052.00   1054.00   1056.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW        .00     32.60     35.38     38.69     42.68     47.59     53.77     61.80     72.64     88.10
        ELEVATION    1048.00   1048.16   1048.37   1048.64   1048.99   1049.48   1050.17   1051.18   1052.78   1055.50

          OUTFLOW      88.33     89.50     92.42     97.86    106.66    119.57    137.45    161.02    191.12    228.54
        ELEVATION    1055.51   1055.52   1055.55   1055.58   1055.63   1055.68   1055.75   1055.82   1055.91   1056.00


                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .00       .05       .24       .90      2.26      3.79      4.29      7.42     10.04
          OUTFLOW      30.22     32.60     35.38     38.69     42.68     47.59     52.34     53.77     61.80     67.57
        ELEVATION    1048.00   1048.16   1048.37   1048.64   1048.99   1049.48   1050.00   1050.17   1051.18   1052.00

          STORAGE      12.61     16.79     22.18     22.26     22.35     22.48     22.65     22.85     23.09     23.37
          OUTFLOW      72.64     79.95     88.10     89.50     92.42     97.86    106.66    119.57    137.45    161.02
        ELEVATION    1052.78   1054.00   1055.50   1055.52   1055.55   1055.58   1055.63   1055.68   1055.75   1055.82

          STORAGE      23.68     24.04
          OUTFLOW     191.12    228.54
        ELEVATION    1055.91   1056.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       30. TO       33.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     R/P1

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                  (CFS)
+     79.37     13.67                66.61       39.79       36.86        36.86
                       (INCHES)     4.646      11.100      14.818       14.818
                        (AC-FT)     33.03       78.91      105.35       105.35

  PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                      6-HR        24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
     16.454     13.67                10.14        2.51        1.75         1.70

   PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR        24-HR       72-HR     34.58-HR
+    (FEET)      (HR)
    1053.90     13.67              1051.98     1049.03     1048.72      1048.72

                       CUMULATIVE AREA =    .13330 SQ MI   ACRES=          85.3120


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   62 KK    *      LF11  *
            *            *
            **************

   63 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
```

```
                    IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  64 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA
                     SNAP 60000000.00  NORMAL ANNUAL PRECIPITATION
                    RATIO         .00  RATIO OF HYDROGRAPH

               PRECIPITATION DATA

   6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                        STORM AREA =     .01

  65 LS        SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  66 UK          OVERLAND-FLOW ELEMENT NO. 1
                        L        148.  OVERLAND FLOW LENGTH
                        S       .0500  SLOPE
                        N        .300  ROUGHNESS COEFFICIENT
                       PA       100.0  PERCENT OF SUBBASIN
                     DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  67 RD          MAIN CHANNEL
                        L        830.  CHANNEL LENGTH
                        S       .0050  SLOPE
                        N        .030  CHANNEL ROUGHNESS COEFFICIENT
                       CA         .01  CONTRIBUTING AREA
                    SHAPE        TRAP  CHANNEL SHAPE
                       WD         .00  BOTTOM WIDTH OR DIAMETER
                        Z        2.00  SIDE SLOPE
                   RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.04     29.60     36.92    724.71       6.07       .47
                    MAIN          1.63      1.33       3.47    415.00     35.46    724.77       5.97      3.99

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .1974E+01 OUTFLOW= .1942E+01 BASIN STORAGE= .6134E-03 PERCENT ERROR=   1.6

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00                35.17    725.00      6.00

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     LF11

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+     (CFS)       (HR)
                     (CFS)
+      35.17     12.08                  3.47         .98         .68          .68
                            (INCHES)   5.287       6.003       6.004        6.004
                             (AC-FT)    1.72        1.95        1.95         1.95

                           CUMULATIVE AREA =    .00610 SQ MI   ACRES=            3.9040


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          *            *
 68 KK    *      LF12  *
          *            *
          **************

 69 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 70 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA
                      SNAP 82000000.00  NORMAL ANNUAL PRECIPITATION
                     RATIO         .00  RATIO OF HYDROGRAPH

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                            STORM AREA =     .01

 71 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 72 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        189.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
 73 RD            MAIN CHANNEL
                         L        829.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .72     37.80     54.39    724.74      6.07       .89
                   MAIN          1.63      1.33       3.15    414.50     48.54    723.80      5.92      4.39


CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2589E+01 OUTFLOW= .2525E+01 BASIN STORAGE= .5354E-03 PERCENT ERROR=   2.5


                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          1.63      1.33       5.00               46.83    725.00      5.89

     ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     LF12

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
```

```
+   (CFS)       (HR)
                  (CFS)
+    46.83     12.08                4.47        1.27         .88          .88
                      (INCHES)     5.196       5.890       5.891        5.891
                       (AC-FT)      2.22        2.51        2.51         2.51

                      CUMULATIVE AREA =    .00800 SQ MI   ACRES=            5.1200


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
   74 KK    *       LD9  *
            *            *
            **************

   75 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


   76 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION      LD9

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                  (CFS)
+    82.00     12.08                7.94        2.25        1.56         1.56
                      (INCHES)     5.236       5.939       5.940        5.940
                       (AC-FT)      3.94        4.47        4.47         4.47

                      CUMULATIVE AREA =    .01410 SQ MI   ACRES=            9.0240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   77 KK    *       CH7  *
            *            *
            **************

   78 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA

   79 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                             STORM AREA =     .01
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  80 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  81 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L         156.  OVERLAND FLOW LENGTH
                          S        .2500  SLOPE
                          N         .300  ROUGHNESS COEFFICIENT
                         PA        100.0  PERCENT OF SUBBASIN
                       DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  82 RD            MAIN CHANNEL
                          L        1639.  CHANNEL LENGTH
                          S        .0200  SLOPE
                          N         .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA          .01  CONTRIBUTING AREA
                      SHAPE         TRAP  CHANNEL SHAPE
                         WD         3.00  BOTTOM WIDTH OR DIAMETER
                          Z         3.00  SIDE SLOPE
                     RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .63     31.20     68.38    724.56       6.18       .84
                    MAIN          2.69      1.35       3.15    819.50    123.26    727.31       5.99      8.68

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4467E+01  EXCESS= .3233E+01 OUTFLOW= .7629E+01 BASIN STORAGE= .7193E-03 PERCENT ERROR=    .9

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.69      1.35       5.00              123.17    725.00      5.98

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+    123.17     12.08                13.57        3.85        2.67         2.67
                       (INCHES)     5.279       5.984       5.985        5.985
                        (AC-FT)      6.73        7.63        7.63         7.63

                       CUMULATIVE AREA =    .02390 SQ MI   ACRES=           15.2960


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  83 KK      *       CH8  *
             *            *
             **************

  84 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  85 BA          SUBBASIN CHARACTERISTICS
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                    TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

 6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .00

 86 LS         SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 87 UK           OVERLAND-FLOW ELEMENT NO. 1
                       L        137.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 88 RD           MAIN CHANNEL
                       L        234.  CHANNEL LENGTH
                       S       .0200  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .00  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD        3.00  BOTTOM WIDTH OR DIAMETER
                       Z        3.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .61     27.40      7.05    724.58      6.18       .80
                    MAIN          2.69      1.35       1.00    117.00      6.98    724.93      6.05      3.91

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3299E+00 OUTFLOW= .3227E+00 BASIN STORAGE= .9557E-04 PERCENT ERROR=   2.1

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.69      1.35       5.00                6.92    725.00      6.09

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH8

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
+    (CFS)        (HR)
                    (CFS)
+      6.92     12.08                    .58         .16         .11          .11
                         (INCHES)     5.377       6.086       6.086        6.086
                          (AC-FT)       .29         .32         .32          .32

                         CUMULATIVE AREA =    .00100 SQ MI   ACRES=             .6400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 89 KK        *         P4 *
              *            *
              **************

 90 KO         OUTPUT CONTROL VARIABLES
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
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```
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


            SUBBASIN RUNOFF DATA

  91 BA       SUBBASIN CHARACTERISTICS
                    TAREA        .00  SUBBASIN AREA

              PRECIPITATION DATA

   6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
               1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

  92 LS       SCS LOSS RATE
                    STRTL        .00  INITIAL ABSTRACTION
                   CRVNBR      100.00  CURVE NUMBER
                    RTIMP        .00  PERCENT IMPERVIOUS AREA

  93 UD       SCS DIMENSIONLESS UNITGRAPH
                     TLAG        .00  LAG

                                                       ***

                                                   UNIT HYDROGRAPH
                                                5 END-OF-PERIOD ORDINATES
              7.        2.        0.        0.        0.

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION       P4

    TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+     9.04     12.08                  .88         .27         .19          .19
                     (INCHES)     6.316       7.848       7.850        7.850
                      (AC-FT)       .44         .54         .54          .54

                     CUMULATIVE AREA =    .00130 SQ MI   ACRES=             .8320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  94 KK     *      C/P4  *
            *            *
            **************

  95 KO       OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


  96 HC       HYDROGRAPH COMBINATION
                    ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                       ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION     C/P4

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
```

```
+   (CFS)       (HR)
                      (CFS)
+   139.12     12.08                15.01        4.28        2.97        2.97
                       (INCHES)     5.328       6.074       6.081       6.081
                        (AC-FT)      7.45        8.49        8.50        8.50

                      CUMULATIVE AREA =    .02620 SQ MI   ACRES=          16.7680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  97 KK    *      R/P4  *
           *            *
           **************

  98 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

  99 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     1046.50  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 100 SA              AREA          .0        .1        .2        .2        .3        .3

 101 SE          ELEVATION     1046.50   1047.00   1048.00   1049.00   1050.00   1052.00

 103 SL          LOW-LEVEL OUTLET
                      ELEVL     1044.00  ELEVATION AT CENTER OF OUTLET
                      CAREA        6.28  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 102 SS          SPILLWAY
                       CREL     1051.00  SPILLWAY CREST ELEVATION
                      SPWID       25.00  SPILLWAY WIDTH
                       COQW        2.60  WEIR COEFFICIENT
                       EXPW        1.50  EXPONENT OF HEAD

                                                 ***

                                          COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00       .02       .14       .30       .50      1.02
          ELEVATION    1046.50   1047.00   1048.00   1049.00   1050.00   1052.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

            OUTFLOW        .00     50.02     52.47     55.18     58.19     61.54     65.30     69.55     74.39     79.95
          ELEVATION    1046.50   1046.74   1047.02   1047.33   1047.71   1048.15   1048.67   1049.30   1050.06   1051.00

            OUTFLOW      80.32     81.28     83.19     86.38     91.18     97.89    106.86    118.40    132.82    150.47
          ELEVATION    1051.02   1051.06   1051.12   1051.19   1051.28   1051.39   1051.51   1051.66   1051.82   1052.00

                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00       .00       .02       .02       .05       .09       .14       .16       .24       .30
            OUTFLOW      47.78     50.02     52.34     52.47     55.18     58.19     60.44     61.54     65.30     67.57
          ELEVATION    1046.50   1046.74   1047.00   1047.02   1047.33   1047.71   1048.00   1048.15   1048.67   1049.00

            STORAGE        .36       .50       .52       .74       .74       .75       .77       .79       .81       .84
            OUTFLOW      69.55     74.02     74.39     79.95     80.32     81.28     83.19     86.38     91.18     97.89
          ELEVATION    1049.30   1050.00   1050.06   1051.00   1051.02   1051.06   1051.12   1051.19   1051.28   1051.39

            STORAGE        .88       .92       .97      1.02
            OUTFLOW     106.86    118.40    132.82    150.47
          ELEVATION    1051.51   1051.66   1051.82   1052.00
```

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 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       48. TO      150.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION     R/P4

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    81.85     12.25                49.91       48.31       48.15        48.15
                         (INCHES)    17.711      68.579      98.487       98.487
                          (AC-FT)    24.75       95.83      137.62       137.62

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
      .758     12.25                 .00         .00         .00         -.15

  PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1051.08     12.25              1046.78     1046.57     1046.55      1046.55

                       CUMULATIVE AREA =    .02620 SQ MI   ACRES=           16.7680


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  104 KK   *       DA1  *
           *            *
           **************

  105 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  106 BA          SUBBASIN CHARACTERISTICS
                       TAREA        .05  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .05

  107 LS          SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  108 US          SNYDER UNITGRAPH
                          TP          .38  LAG
                          CP          .69  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                      ***

                                               UNIT HYDROGRAPH PARAMETERS
                                         CLARK   TC=   .46 HR,       R=   .28 HR
                                        SNYDER   TP=   .38 HR,      CP=   .69

                                                  UNIT HYDROGRAPH
                                               21 END-OF-PERIOD ORDINATES
                  5.       18.       35.       49.       55.       50.       39.       29.       22.       16.
```

```
                12.        9.        7.        5.        4.        3.        2.        1.        1.        1.
                 1.

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION      DA1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                  (CFS)
+   127.82     12.42              26.09        7.48        5.19         5.19
                (INCHES)     5.162       5.922       5.922        5.922
                 (AC-FT)     12.94       14.84       14.84        14.84

                         CUMULATIVE AREA =    .04700 SQ MI   ACRES=           30.0800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  109 KK     *      DC#1  *
             *            *
             **************

  110 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  111 HC           HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     DC#1

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                  (CFS)
+   263.11     12.42             141.08       95.58       90.20        90.20
                (INCHES)     6.352       17.214      23.409       23.409
                 (AC-FT)     69.96       189.58      257.81       257.81

                         CUMULATIVE AREA =    .20650 SQ MI   ACRES=          132.1600


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  112 KK     *    DC#5/D  *     A2
             *            *
             **************

  113 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA
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 114 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .02

 115 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 116 US          SNYDER UNITGRAPH
                        TP         .29  LAG
                        CP         .66  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                      ***

                                                UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=   .34 HR,       R=   .24 HR
                                            SNYDER   TP=   .29 HR,      CP=   .66

                                                    UNIT HYDROGRAPH
                                                18 END-OF-PERIOD ORDINATES
                 4.       16.       28.       33.       29.       21.       15.       10.       7.        5.
                 4.        3.        2.        1.        1.        1.        0.        0.

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   DC#5/D

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    70.99     12.33                12.95        3.71        2.58         2.58
                     (INCHES)      5.167       5.926       5.926        5.926
                      (AC-FT)       6.42        7.36        7.36         7.36

                     CUMULATIVE AREA =    .02330 SQ MI   ACRES=           14.9120


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 117 KK    *       LF4  *
           *            *
           **************

 118 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 119 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00
```

```
                                          STORM AREA =     .01

  120 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  121 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        244.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  122 RD            MAIN CHANNEL
                           L        437.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.60     48.82     35.46    725.18       6.06       .54
                    MAIN          1.63      1.33       1.85    218.50     33.82    727.26       5.99      3.94

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2168E+01 OUTFLOW= .2140E+01 BASIN STORAGE= .6673E-03 PERCENT ERROR=   1.3

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.63      1.33       5.00                32.49    725.00      5.99

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF4

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                            (CFS)
+     32.49     12.08                 3.78        1.08         .75          .75
                           (INCHES)   5.252       5.989       5.991        5.991
                            (AC-FT)    1.88        2.14        2.14         2.14

                          CUMULATIVE AREA =    .00670 SQ MI   ACRES=           4.2880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  123 KK      *       LF5  *
              *            *
              **************

  124 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA
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```
 125 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA
                       SNAP       86.00  NORMAL ANNUAL PRECIPITATION
                      RATIO         .00  RATIO OF HYDROGRAPH

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

 126 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 127 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        176.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 128 RD            MAIN CHANNEL
                           L        644.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                        ***
                                    COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                            COMPUTATION TIME STEP
                      ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                      PLANE1        2.48      1.67        .71     35.12     58.18    724.51      6.07       .87
                      MAIN          1.63      1.33       2.40    321.80     53.67    725.76      5.93      4.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2783E+01 OUTFLOW= .2721E+01 BASIN STORAGE= .4492E-03 PERCENT ERROR=   2.2

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                      MAIN          1.63      1.33       5.00                52.81    725.00      5.94

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      LF5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     52.81     12.08                 4.85        1.37         .95          .95
                          (INCHES)    5.239       5.936       5.936        5.936
                           (AC-FT)     2.40        2.72        2.72         2.72

                          CUMULATIVE AREA =    .00860 SQ MI   ACRES=           5.5040


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                ***************
                *             *
 129 KK         *     C/LD3   *
                *             *
                ***************

 130 KO          OUTPUT CONTROL VARIABLES
```

```
                    IPRNT           3  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                     IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT        .083  TIME INTERVAL IN HOURS


  131 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION    C/LD3

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                       (CFS)
+    85.30     12.08                 8.63        2.45        1.70         1.70
                      (INCHES)      5.244       5.959       5.960        5.960
                       (AC-FT)      4.28        4.86        4.86         4.86

                      CUMULATIVE AREA =    .01530 SQ MI   ACRES=            9.7920


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  132 KK    *       OA1  *
            *            *
            **************

  133 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  134 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .15  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .15

  135 LS          SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  136 US          SNYDER UNITGRAPH
                          TP          .56  LAG
                          CP          .64  PEAKING COEFFICIENT

                  SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                          ***

                                               UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .64 HR,       R=   .49 HR
                                         SNYDER   TP=   .56 HR,      CP=   .64

                                                   UNIT HYDROGRAPH
                                               36 END-OF-PERIOD ORDINATES
```

```
                6.       22.       44.       68.       90.      105.      112.      107.       94.       79.
               67.       57.       48.       40.       34.       29.       24.       20.       17.       15.
               12.       10.        9.        7.        6.        5.        4.        4.        3.        3.
                2.        2.        2.        1.        1.        1.

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      OA1

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.90, TOTAL EXCESS =    5.95

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   304.79     12.58                82.65       23.76       16.49        16.49
                         (INCHES)     5.150       5.923       5.923        5.923
                          (AC-FT)    40.98       47.13       47.13        47.13

                         CUMULATIVE AREA =    .14920 SQ MI   ACRES=           95.4880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  137 KK    *     C/CH2  *
            *            *
            **************

  138 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


  139 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION    C/CH2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+   319.10     12.58                91.24       26.21       18.19        18.19
                         (INCHES)     5.157       5.926       5.926        5.926
                          (AC-FT)    45.25       51.99       51.99        51.99

                         CUMULATIVE AREA =    .16450 SQ MI   ACRES=          105.2800


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            *            *
  140 KK    *       CH2  *
            *            *
            **************

  141 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS
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             SUBBASIN RUNOFF DATA

  142 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

  143 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  144 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L         47.  OVERLAND FLOW LENGTH
                           S       .2500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  145 RD            MAIN CHANNEL
                           L        865.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       10.00  BOTTOM WIDTH OR DIAMETER
                           Z        3.00  SIDE SLOPE
                      RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .35      9.40     70.85    724.74      6.07       .53
                     MAIN          1.38      1.42       1.81    432.50    325.01    756.21      5.93      7.97


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5199E+02  EXCESS= .3236E+01 OUTFLOW= .5520E+02 BASIN STORAGE= .6363E-03 PERCENT ERROR=    .0


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                     MAIN          1.38      1.42       5.00              323.50    755.00      5.93

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH2

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+    323.50     12.58                96.84       27.83       19.31        19.31
                         (INCHES)     5.160       5.930       5.930        5.930
                          (AC-FT)     48.02       55.19       55.19        55.19

                         CUMULATIVE AREA =    .17450 SQ MI   ACRES=          111.6800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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              *            *
  146 KK      *       LF6  *
              *            *
              **************

  147 KO          OUTPUT CONTROL VARIABLES
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                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  148 BA         SUBBASIN CHARACTERISTICS
                      TAREA        .01  SUBBASIN AREA
                       SNAP      86.00  NORMAL ANNUAL PRECIPITATION
                      RATIO        .00  RATIO OF HYDROGRAPH

                 PRECIPITATION DATA

    6 PH                            DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

  149 LS         SCS LOSS RATE
                      STRTL        .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP        .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  150 UK           OVERLAND-FLOW ELEMENT NO. 1
                          L         176.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  151 RD           MAIN CHANNEL
                          L         697.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD         .00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                       ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                      PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                       PLANE1        2.48      1.67        .71     35.12     56.15    724.51      6.07       .87
                       MAIN          1.63      1.33       2.63    348.40     54.45    724.52      5.94      4.42

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2686E+01 OUTFLOW= .2629E+01 BASIN STORAGE= .4661E-03 PERCENT ERROR=   2.1

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                       MAIN          1.63      1.33       5.00                52.55    725.00      5.95

          ***             ***             ***             ***             ***

                            HYDROGRAPH AT STATION      LF6

        TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

      PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     34.58-HR
    +   (CFS)       (HR)
                      (CFS)
    +    52.55     12.08                  4.69        1.33         .92          .92
                          (INCHES)     5.257       5.953       5.954        5.954
                           (AC-FT)      2.33        2.64        2.64         2.64

                          CUMULATIVE AREA =    .00830 SQ MI   ACRES=            5.3120
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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          *            *
152 KK    *       CH3  *
          *            *
          **************

153 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

154 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

155 LS          SCS LOSS RATE
                     STRTL          .35  INITIAL ABSTRACTION
                    CRVNBR        85.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
156 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L         156.  OVERLAND FLOW LENGTH
                         S        .2500  SLOPE
                         N         .300  ROUGHNESS COEFFICIENT
                        PA        100.0  PERCENT OF SUBBASIN
                     DXMIN            5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
157 RD            MAIN CHANNEL
                         L        1456.  CHANNEL LENGTH
                         S        .0100  SLOPE
                         N         .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA          .01  CONTRIBUTING AREA
                     SHAPE         TRAP  CHANNEL SHAPE
                        WD        10.00  BOTTOM WIDTH OR DIAMETER
                         Z         3.00  SIDE SLOPE
                    RUPSTQ          YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67        .63     31.14     37.00    725.10      6.07       .83
                   MAIN          1.38      1.42       4.49    728.00     69.03    726.88      5.91      5.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2635E+01  EXCESS= .1748E+01 OUTFLOW= .4318E+01 BASIN STORAGE= .1105E-02 PERCENT ERROR=   1.5

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                   MAIN          1.38      1.42       5.00                62.19    725.00      5.90

     ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION      CH3

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07
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```
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+    62.19     12.08                 7.68        2.17        1.51         1.51
                         (INCHES)    5.215       5.896       5.896        5.896
                          (AC-FT)    3.81        4.31        4.31         4.31

                        CUMULATIVE AREA =    .01370 SQ MI   ACRES=            8.7680


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  158 KK     *    C/DP#2  *
             *            *
             **************

  159 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


  160 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   C/DP#2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                         (CFS)
+   337.06     12.58               104.50       30.00       20.82        20.82
                         (INCHES)    5.163       5.928       5.928        5.928
                          (AC-FT)    51.82       59.50       59.50        59.50

                        CUMULATIVE AREA =    .18820 SQ MI   ACRES=          120.4480


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  161 KK     *       LF7  *
             *            *
             **************

  162 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

  163 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .02  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00
```

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                                          STORM AREA =     .02

  164 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  165 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        919.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                  MUSKINGUM-CUNGE
  166 RD            MAIN CHANNEL
                           L        232.  CHANNEL LENGTH
                           S       .0050  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .02  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD         .00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                        (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        1.11      1.67       4.25    183.86     68.27    734.73      6.05       .74
                     MAIN          1.63      1.33        .83    232.00     67.88    735.01      5.67      4.65

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .7023E+01 OUTFLOW= .6563E+01 BASIN STORAGE= .8647E-02 PERCENT ERROR=   6.4

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00               67.87    735.00      5.67

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      LF7

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     67.87     12.25                11.91        3.31        2.30         2.30
                        (INCHES)     5.104       5.670       5.673        5.673
                         (AC-FT)      5.91        6.56        6.57         6.57

                        CUMULATIVE AREA =    .02170 SQ MI   ACRES=          13.8880


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  167 KK     *       CH4  *
             *            *
             **************

  168 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


                SUBBASIN RUNOFF DATA
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 169 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

 170 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 171 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        156.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 172 RD            MAIN CHANNEL
                          L       1064.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD       10.00  BOTTOM WIDTH OR DIAMETER
                          Z        3.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .75     31.16     66.82    724.50       6.18       .84
                    MAIN          1.38      1.42       3.00    532.00    101.18    726.67       5.78      5.91

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6565E+01  EXCESS= .3167E+01 OUTFLOW= .9653E+01 BASIN STORAGE= .8531E-03 PERCENT ERROR=    .8

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          1.38      1.42       5.00               99.36    725.00      5.77

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      CH4

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                        (CFS)
+     99.36     12.08                17.35        4.86        3.37         3.37
                       (INCHES)     5.153       5.769       5.771        5.771
                        (AC-FT)      8.60        9.63        9.63         9.63

                       CUMULATIVE AREA =    .0313O SQ MI   ACRES=           20.0320


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 173 KK       *       LF8  *
              *            *
              **************

 174 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
```

```
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 175 BA        SUBBASIN CHARACTERISTICS
                    TAREA        .01  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                          STORM AREA =     .01

 176 LS        SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 177 UK          OVERLAND-FLOW ELEMENT NO. 1
                       L        360.  OVERLAND FLOW LENGTH
                       S       .0500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
 178 RD          MAIN CHANNEL
                       L        721.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .01  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK               CELERITY
                                                     (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       2.12     71.94     43.17    726.29       6.06       .60
                    MAIN          1.63      1.33       2.89    360.25     41.79    729.22       5.96      4.15

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3075E+01 OUTFLOW= .3021E+01 BASIN STORAGE= .1484E-02 PERCENT ERROR=   1.7

                                       INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.63      1.33       5.00                40.84    730.00      5.95

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION      LF8

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

   PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                  (CFS)
+     40.84     12.17                     5.35        1.52        1.06         1.06
                      (INCHES)     5.233       5.952       5.955       5.955
                       (AC-FT)      2.65        3.02        3.02        3.02

                      CUMULATIVE AREA =    .00950 SQ MI   ACRES=           6.0800


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          **************
          *            *
179 KK    *       LF9  *
          *            *
          **************

180 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           3  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT        .083  TIME INTERVAL IN HOURS


               SUBBASIN RUNOFF DATA

181 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

                PRECIPITATION DATA

  6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

182 LS          SCS LOSS RATE
                     STRTL         .35  INITIAL ABSTRACTION
                    CRVNBR       85.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
183 UK            OVERLAND-FLOW ELEMENT NO. 1
                         L        360.  OVERLAND FLOW LENGTH
                         S       .2500  SLOPE
                         N        .300  ROUGHNESS COEFFICIENT
                        PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                MUSKINGUM-CUNGE
184 RD            MAIN CHANNEL
                         L        535.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .030  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .01  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD         .00  BOTTOM WIDTH OR DIAMETER
                         Z        2.00  SIDE SLOPE
                    RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                   ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                  PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                   PLANE1        2.48      1.67       1.23     71.94     50.62    724.99       6.07      1.10
                   MAIN          1.63      1.33       2.06    267.50     48.13    724.71       5.97      4.32


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .2719E+01 OUTFLOW= .2672E+01 BASIN STORAGE= .5929E-03 PERCENT ERROR=   1.7


                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                   MAIN          1.63      1.33       5.00                 47.98    725.00       5.98

      ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      LF9

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
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                    (CFS)
+    47.98     12.08                4.76        1.35         .94          .94
                  (INCHES)      5.267       5.978       5.978        5.978
                   (AC-FT)       2.36        2.68        2.68         2.68

                  CUMULATIVE AREA =    .00840 SQ MI   ACRES=           5.3760


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 185 KK   *       CH5  *
          *            *
          **************

 186 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

 187 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA
                       SNAP 20000000.00  NORMAL ANNUAL PRECIPITATION
                      RATIO         .00  RATIO OF HYDROGRAPH

                 PRECIPITATION DATA

   6 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .00

 188 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 189 UK            OVERLAND-FLOW ELEMENT NO. 1
                          L        200.  OVERLAND FLOW LENGTH
                          S       .2500  SLOPE
                          N        .300  ROUGHNESS COEFFICIENT
                         PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 190 RD            MAIN CHANNEL
                          L       1996.  CHANNEL LENGTH
                          S       .0100  SLOPE
                          N        .030  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        2.00  SIDE SLOPE
                     RUPSTQ         YES  ROUTE UPSTREAM HYDROGRAPH

                                                  ***
                                 COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                        COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        2.48      1.67        .86     40.00     25.25    724.82      6.19        .92
                    MAIN          2.16      1.35       5.00    998.00     57.83    730.00      6.00       6.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2678E+01  EXCESS= .1221E+01 OUTFLOW= .3871E+01 BASIN STORAGE= .9272E-03 PERCENT ERROR=    .7

                                        INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL
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```
                  MAIN          2.16      1.35       5.00              57.83    730.00      6.00

       ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION      CH5

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+    57.83     12.17                  6.89        1.95        1.35         1.35
                  (INCHES)     5.290       5.998       5.999        5.999
                   (AC-FT)      3.41        3.87        3.87         3.87

                  CUMULATIVE AREA =    .01210 SQ MI   ACRES=            7.7440


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  191 KK    *        P2  *
            *            *
            **************

  192 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                       IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                        IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

  193 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA

    6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                  5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                   1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .00

  194 LS          SCS LOSS RATE
                       STRTL         .00  INITIAL ABSTRACTION
                      CRVNBR      100.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  195 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .00  LAG

                                                        ***

                                                    UNIT HYDROGRAPH
                                                  5 END-OF-PERIOD ORDINATES
                 21.        6.        1.        0.        0.

       ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION       P2

     TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                    (CFS)
+    25.72     12.08                  2.51         .78         .54          .54
                  (INCHES)     6.316       7.848       7.850        7.850
                   (AC-FT)      1.25        1.55        1.55         1.55

                  CUMULATIVE AREA =    .00370 SQ MI   ACRES=            2.3680
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 196 KK    *      C/P2  *
           *            *
           **************

 197 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


 198 HC          HYDROGRAPH COMBINATION
                      ICOMP           4  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION     C/P2

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                     (CFS)
+   210.10     12.08              31.99        9.08        6.32         6.32
                   (INCHES)      5.255       5.968       5.987        5.987
                    (AC-FT)      15.86       18.02       18.07        18.07

                   CUMULATIVE AREA =    .05660 SQ MI   ACRES=           36.2240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 199 KK    *      R/P2  *
           *            *
           **************

 200 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


             HYDROGRAPH ROUTING DATA

 201 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                     RSVRIC     1034.00  INITIAL CONDITION
                          X         .00 WORKING R AND D COEFFICIENT

 202 SA              AREA          .0        .2        .2        .2        .3        .3        .4        .5

 203 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

 205 SL          LOW-LEVEL OUTLET
                      ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                      CAREA       28.86  CROSS-SECTIONAL AREA
                       COQL         .60  COEFFICIENT
                       EXPL         .50  EXPONENT OF HEAD

 204 SS          SPILLWAY
                       CREL     1040.00  SPILLWAY CREST ELEVATION
```

```
                    SPWID       10.00  SPILLWAY WIDTH
                     COQW        2.60  WEIR COEFFICIENT
                     EXPW        1.50  EXPONENT OF HEAD

                                                ***

                                          COMPUTED STORAGE-ELEVATION DATA

          STORAGE       .00       .01       .16       .39       .66       .96      1.70      2.62
        ELEVATION   1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW       .00    149.19    161.15    175.20    191.94    212.21    237.27    269.03    310.63    367.43
        ELEVATION   1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

          OUTFLOW    392.63    399.11    406.56    415.00    424.53    435.17    447.00    460.07    474.44    490.16
        ELEVATION   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25   1041.42   1041.60   1041.80   1042.00


                                    COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
          OUTFLOW    138.87    149.19    152.13    161.15    175.20    191.94    196.40    212.21    237.27    240.54
        ELEVATION   1034.00   1034.15   1034.20   1034.35   1034.59   1034.91   1035.00   1035.33   1035.92   1036.00

          STORAGE       .59       .66       .96      1.70      1.95      2.00      2.06      2.12      2.19      2.26
          OUTFLOW    269.03    277.75    310.53    367.43    392.63    399.11    406.56    415.00    424.53    435.17
        ELEVATION   1036.75   1037.00   1038.00   1040.00   1040.56   1040.67   1040.80   1040.94   1041.09   1041.25

          STORAGE      2.34      2.43      2.52      2.62
          OUTFLOW    447.00    460.07    474.44    490.16
        ELEVATION   1041.42   1041.60   1041.80   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      139. TO      175.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

       ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION     R/P2

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                          (CFS)
+    189.58     12.25               140.27      139.22      139.12       139.12
                         (INCHES)    23.042      91.480     131.719      131.719
                          (AC-FT)    69.56       276.15      397.61       397.61

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                      6-HR        24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
       .136     12.25                .00          .00         .00         -.47

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR        24-HR       72-HR     34.58-HR
+    (FEET)      (HR)
    1034.87     12.25              1034.02     1034.01     1034.00      1034.00

                        CUMULATIVE AREA =    .0566O SQ MI   ACRES=           36.2240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  206 KK     *       CH7  *
             *            *
             **************

  207 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                       IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                        IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                       ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                       ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                      TIMINT       .083  TIME INTERVAL IN HOURS
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             SUBBASIN RUNOFF DATA

 208 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                                STORM AREA =     .01

 209 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 210 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        210.  OVERLAND FLOW LENGTH
                           S       .0500  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                        DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
 211 RD            MAIN CHANNEL
                           L        317.  CHANNEL LENGTH
                           S       .0100  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD        2.00  BOTTOM WIDTH OR DIAMETER
                           Z        2.00  SIDE SLOPE
                      RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                      ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                         COMPUTATION TIME STEP
                    ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                    PEAK                CELERITY
                                                      (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                    PLANE1        1.11      1.67       1.34     42.00     54.72    724.99       6.18       .52
                    MAIN          2.16      1.35        .94    158.50     53.66    725.91       6.03      5.62

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .3233E+01 OUTFLOW= .3149E+01 BASIN STORAGE= .6207E-03 PERCENT ERROR=   2.6

                                         INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                    MAIN          2.16      1.35       5.00                52.23    725.00      6.03

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION      CH7

     TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.66, TOTAL EXCESS =    6.19

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                         (CFS)
+     52.23     12.08                 5.61        1.59        1.10         1.10
                         (INCHES)    5.320       6.026       6.027        6.027
                          (AC-FT)     2.78        3.15        3.15         3.15

                         CUMULATIVE AREA =    .00980 SQ MI   ACRES=           6.2720


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
 212 KK       *      LF10  *
              *            *
              **************

 213 KO          OUTPUT CONTROL VARIABLES
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```
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE
                    IPNCH          7  PUNCH COMPUTED HYDROGRAPH
                     IOUT         21  SAVE HYDROGRAPH ON THIS UNIT
                    ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                    ISAV2        416  LAST ORDINATE PUNCHED OR SAVED
                   TIMINT       .083  TIME INTERVAL IN HOURS


             SUBBASIN RUNOFF DATA

  214 BA       SUBBASIN CHARACTERISTICS
                    TAREA        .02  SUBBASIN AREA

               PRECIPITATION DATA

    6 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .02

  215 LS       SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
  216 UK         OVERLAND-FLOW ELEMENT NO. 1
                       L        138.  OVERLAND FLOW LENGTH
                       S       .2500  SLOPE
                       N        .300  ROUGHNESS COEFFICIENT
                      PA       100.0  PERCENT OF SUBBASIN
                    DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
               MUSKINGUM-CUNGE
  217 RD         MAIN CHANNEL
                       L        907.  CHANNEL LENGTH
                       S       .0050  SLOPE
                       N        .030  CHANNEL ROUGHNESS COEFFICIENT
                      CA         .02  CONTRIBUTING AREA
                   SHAPE        TRAP  CHANNEL SHAPE
                      WD         .00  BOTTOM WIDTH OR DIAMETER
                       Z        2.00  SIDE SLOPE
                  RUPSTQ          NO  ROUTE UPSTREAM HYDROGRAPH

                                                    ***
                                  COMPUTED MUSKINGUM-CUNGE PARAMETERS
                                          COMPUTATION TIME STEP
                     ELEMENT    ALPHA       M         DT        DX       PEAK    TIME TO     VOLUME    MAXIMUM
                                                                                     PEAK                CELERITY
                                                       (MIN)      (FT)     (CFS)     (MIN)       (IN)      (FPS)

                     PLANE1        2.48      1.67        .63     27.60    118.11    724.52       6.07       .80
                     MAIN          1.63      1.33       2.83    453.50    109.24    725.52       5.89      5.33

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00  EXCESS= .5502E+01 OUTFLOW= .5342E+01 BASIN STORAGE= .6158E-03 PERCENT ERROR=   2.9

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                     MAIN          1.63      1.33       5.00              106.89    725.00      5.90

       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION     LF10

      TOTAL RAINFALL =    7.85, TOTAL LOSS =    1.78, TOTAL EXCESS =    6.07

    PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     34.58-HR
  +   (CFS)       (HR)
                     (CFS)
  +   106.89     12.08                  9.57        2.70        1.87         1.87
                           (INCHES)     5.236       5.898       5.898        5.898
                            (AC-FT)      4.75        5.35        5.35         5.35

                           CUMULATIVE AREA =    .01700 SQ MI   ACRES=           10.8800
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 218 KK    *        P3  *
           *            *
           **************

 219 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS


              SUBBASIN RUNOFF DATA

 220 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  SUBBASIN AREA

                 PRECIPITATION DATA

   6 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                 1.02    2.04    3.71    4.71    5.34    6.32    7.10    7.85     .00     .00     .00     .00

                                              STORM AREA =     .01

 221 LS          SCS LOSS RATE
                      STRTL         .00  INITIAL ABSTRACTION
                     CRVNBR      100.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 222 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .00  LAG

                                                      ***

                                                  UNIT HYDROGRAPH
                                               5 END-OF-PERIOD ORDINATES
               63.       18.        3.        1.        0.

     ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION       P3

    TOTAL RAINFALL =    7.85, TOTAL LOSS =     .00, TOTAL EXCESS =    7.85

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                      (CFS)
+    76.45     12.08                 7.47        2.32        1.61         1.61
                     (INCHES)     6.316       7.848       7.850        7.850
                      (AC-FT)      3.71        4.60        4.61         4.61

                     CUMULATIVE AREA =    .01100 SQ MI   ACRES=            7.0400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 223 KK    *      C/P3  *
           *            *
           **************

 224 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                       IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT        .083  TIME INTERVAL IN HOURS
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  225 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

       ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     C/P3

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     34.58-HR
+    (CFS)       (HR)
                              (CFS)
+    235.57     12.08             22.56        6.59        4.58         4.58
                             (INCHES)     5.549       6.485       6.500        6.500
                              (AC-FT)     11.19       13.07       13.10        13.10

                             CUMULATIVE AREA =    .03780 SQ MI   ACRES=           24.1920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
  226 KK     *      R/P3  *
             *            *
             **************

  227 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           7  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         416  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS


                HYDROGRAPH ROUTING DATA

  228 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     1052.00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

  229 SA               AREA          .0       2.5       2.7       2.8       3.0       3.2

  230 SE          ELEVATION     1052.00   1053.00   1054.00   1055.00   1056.00   1057.00

  232 SL          LOW-LEVEL OUTLET
                        ELEVL     1050.00  ELEVATION AT CENTER OF OUTLET
                        CAREA        7.07  CROSS-SECTIONAL AREA
                         COQL         .60  COEFFICIENT
                         EXPL         .50  EXPONENT OF HEAD

  231 SS          SPILLWAY
                         CREL     1056.50  SPILLWAY CREST ELEVATION
                        SPWID       10.00  SPILLWAY WIDTH
                         COQW        2.60  WEIR COEFFICIENT
                         EXPW        1.50  EXPONENT OF HEAD

                                                        ***

                                              COMPUTED STORAGE-ELEVATION DATA

            STORAGE        .00       .84      3.43      6.18      9.09     12.16
          ELEVATION    1052.00   1053.00   1054.00   1055.00   1056.00   1057.00

                                              COMPUTED OUTFLOW-ELEVATION DATA

            OUTFLOW        .00     50.58     53.36     56.46     59.94     63.88     68.38     73.55     79.58     86.68
          ELEVATION    1052.00   1052.21   1052.46   1052.76   1053.11   1053.53   1054.05   1054.68   1055.48   1056.50

            OUTFLOW      87.30     87.75     88.36     89.15     90.15     91.39     92.88     94.65     96.73     99.14
          ELEVATION    1056.55   1056.58   1056.61   1056.65   1056.69   1056.74   1056.80   1056.86   1056.93   1057.00

                                           COMPUTED STORAGE-OUTFLOW-ELEVATION DATA
```

STORAGE	.00	.01	.08	.36	.84	1.11	2.19	3.43	3.55	5.28
OUTFLOW	48.08	50.58	53.36	56.46	58.88	59.94	63.88	67.99	68.38	73.55
ELEVATION	1052.00	1052.21	1052.46	1052.76	1053.00	1053.11	1053.53	1054.00	1054.05	1054.68
STORAGE	6.18	7.55	9.09	10.60	10.76	10.84	10.94	11.06	11.19	11.35
OUTFLOW	76.02	79.58	83.27	86.68	87.30	87.75	88.36	89.15	90.15	91.39
ELEVATION	1055.00	1055.48	1056.00	1056.50	1056.55	1056.58	1056.61	1056.65	1056.69	1056.74
STORAGE	11.52	11.72	11.93	12.16						
OUTFLOW	92.88	94.65	96.73	99.14						
ELEVATION	1056.80	1056.86	1056.93	1057.00						

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 48. TO 51.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION R/P3

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	34.58-HR
+ (CFS)	(HR)				
		(CFS)			
+ 65.12	12.33	50.96	48.80	48.58	48.58
		(INCHES) 12.534	48.012	68.871	68.871
		(AC-FT) 25.27	96.79	138.84	138.84

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	34.58-HR
+ (AC-FT)	(HR)				
2.565	12.33	.21	.00	.00	-.10

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	34.58-HR
+ (FEET)	(HR)				
1053.67	12.33	1052.27	1052.07	1052.05	1052.05

CUMULATIVE AREA = .03780 SQ MI ACRES= 24.1920

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		LF1	43.63	12.08	4.	1.	1.	.01		
	HYDROGRAPH AT									
+		LF2	47.77	12.08	5.	1.	1.	.01		
	2 COMBINED AT									
+		LD1	91.40	12.08	9.	2.	2.	.02		
	HYDROGRAPH AT									
+		LF3/LD	68.13	12.17	9.	2.	2.	.02		
	HYDROGRAPH AT									
+		OA2	168.13	12.58	44.	13.	9.	.08		
	3 COMBINED AT									
+		C/CH1	215.24	12.08	61.	17.	12.	.11		
	HYDROGRAPH AT									
+		CH1	248.38	12.17	72.	21.	14.	.13		
	HYDROGRAPH AT									
+		LF13	18.60	12.08	1.	0.	0.	.00		
	HYDROGRAPH AT									
+		P1	11.82	12.08	1.	0.	0.	.00		
	3 COMBINED AT									
+		C/P1	270.34	12.08	75.	21.	15.	.13		
	ROUTED TO									
+		R/P1	79.37	13.67	67.	40.	37.	.13		
+									1053.90	13.67
	HYDROGRAPH AT									

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+                    LF11      35.17   12.08          3.          1.          1.        .01
         HYDROGRAPH AT
+                    LF12      46.83   12.08          4.          1.          1.        .01
         2 COMBINED AT
+                     LD9      82.00   12.08          8.          2.          2.        .01
         HYDROGRAPH AT
+                     CH7     123.17   12.08         14.          4.          3.        .02
         HYDROGRAPH AT
+                     CH8       6.92   12.08          1.          0.          0.        .00
         HYDROGRAPH AT
+                      P4       9.04   12.08          1.          0.          0.        .00
         3 COMBINED AT
+                     C/P4     139.12   12.08         15.          4.          3.        .03
         ROUTED TO
+                     R/P4      81.85   12.25         50.         48.         48.        .03
+                                                                                  1051.08       12.25
         HYDROGRAPH AT
+                      DA1     127.82   12.42         26.          7.          5.        .05
         3 COMBINED AT
+                     DC#1     263.11   12.42        141.         96.         90.        .21
         HYDROGRAPH AT
+                   DC#5/D      70.99   12.33         13.          4.          3.        .02
         HYDROGRAPH AT
+                      LF4      32.49   12.08          4.          1.          1.        .01
         HYDROGRAPH AT
+                      LF5      52.81   12.08          5.          1.          1.        .01
         2 COMBINED AT
+                    C/LD3      85.30   12.08          9.          2.          2.        .02
         HYDROGRAPH AT
+                      OA1     304.79   12.58         83.         24.         16.        .15
         2 COMBINED AT
+                    C/CH2     319.10   12.58         91.         26.         18.        .16
         HYDROGRAPH AT
+                     CH2      323.50   12.58         97.         28.         19.        .17
         HYDROGRAPH AT
+                      LF6      52.55   12.08          5.          1.          1.        .01
         HYDROGRAPH AT
+                     CH3       62.19   12.08          8.          2.          2.        .01
         2 COMBINED AT
+                   C/DP#2     337.06   12.58        105.         30.         21.        .19
         HYDROGRAPH AT
+                      LF7      67.87   12.25         12.          3.          2.        .02
         HYDROGRAPH AT
+                     CH4       99.36   12.08         17.          5.          3.        .03
         HYDROGRAPH AT
+                      LF8      40.84   12.17          5.          2.          1.        .01
         HYDROGRAPH AT
+                      LF9      47.98   12.08          5.          1.          1.        .01
         HYDROGRAPH AT
+                     CH5       57.83   12.17          7.          2.          1.        .01
         HYDROGRAPH AT
+                      P2       25.72   12.08          3.          1.          1.        .00
         4 COMBINED AT
+                     C/P2     210.10   12.08         32.          9.          6.        .06
         ROUTED TO
+                     R/P2     189.58   12.25        140.        139.        139.        .06
+                                                                                  1034.87       12.25
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          HYDROGRAPH AT
+                          CH7      52.23   12.08           6.          2.          1.        .01
          HYDROGRAPH AT
+                         LF10     106.89   12.08          10.          3.          2.        .02
          HYDROGRAPH AT
+                           P3      76.45   12.08           7.          2.          2.        .01
          3 COMBINED AT
+                         C/P3     235.57   12.08          23.          7.          5.        .04
          ROUTED TO
+                         R/P3      65.12   12.33          51.         49.         49.        .04
+                                                                                          1053.67       12.33
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                 COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO      VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                      PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

                LF1  MANE         3.20     45.35    725.96      5.93      5.00     43.63    725.00        5.92

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2427E+01 OUTFLOW= .2372E+01 BASIN STORAGE= .5642E-03 PERCENT ERROR=   2.2

                LF2  MANE         3.39     49.86    725.65      5.93      5.00     47.77    725.00        5.95

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2589E+01 OUTFLOW= .2531E+01 BASIN STORAGE= .6028E-03 PERCENT ERROR=   2.2

             LF3/LD  MANE         3.43     74.01    727.03      5.94      5.00     68.13    730.00        5.93

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4919E+01 OUTFLOW= .4818E+01 BASIN STORAGE= .1920E-02 PERCENT ERROR=   2.0

                CH1  MANE         4.94    250.19    726.51      5.95      5.00    248.38    730.00        5.95

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3470E+02 EXCESS= .6268E+01 OUTFLOW= .4087E+02 BASIN STORAGE= .1748E-02 PERCENT ERROR=    .2

               LF13  MANE          .98     18.97    724.52      5.42      5.00     18.60    725.00        5.43

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9062E+00 OUTFLOW= .8087E+00 BASIN STORAGE= .1285E-03 PERCENT ERROR=  10.7

               LF11  MANE         3.47     35.46    724.77      5.97      5.00     35.17    725.00        6.00

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1974E+01 OUTFLOW= .1942E+01 BASIN STORAGE= .6134E-03 PERCENT ERROR=   1.6

               LF12  MANE         3.15     48.54    723.80      5.92      5.00     46.83    725.00        5.89

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2589E+01 OUTFLOW= .2525E+01 BASIN STORAGE= .5354E-03 PERCENT ERROR=   2.5

                CH7  MANE         3.15    123.26    727.31      5.99      5.00    123.17    725.00        5.98

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4467E+01 EXCESS= .3233E+01 OUTFLOW= .7629E+01 BASIN STORAGE= .7193E-03 PERCENT ERROR=    .9

                CH8  MANE         1.00      6.98    724.93      6.05      5.00      6.92    725.00        6.09

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3299E+00 OUTFLOW= .3227E+00 BASIN STORAGE= .9557E-04 PERCENT ERROR=   2.1

                LF4  MANE         1.85     33.82    727.26      5.99      5.00     32.49    725.00        5.99
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2168E+01 OUTFLOW= .2140E+01 BASIN STORAGE= .6673E-03 PERCENT ERROR=   1.3

              LF5  MANE         2.40     53.67    725.76      5.93      5.00     52.81    725.00        5.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2783E+01 OUTFLOW= .2721E+01 BASIN STORAGE= .4492E-03 PERCENT ERROR=   2.2

              CH2  MANE         1.81    325.01    756.21      5.93      5.00    323.50    755.00        5.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5199E+02 EXCESS= .3236E+01 OUTFLOW= .5520E+02 BASIN STORAGE= .6363E-03 PERCENT ERROR=    .0

              LF6  MANE         2.63     54.45    724.52      5.94      5.00     52.55    725.00        5.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2686E+01 OUTFLOW= .2629E+01 BASIN STORAGE= .4661E-03 PERCENT ERROR=   2.1

              CH3  MANE         4.49     69.03    726.88      5.91      5.00     62.19    725.00        5.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2635E+01 EXCESS= .1748E+01 OUTFLOW= .4318E+01 BASIN STORAGE= .1105E-02 PERCENT ERROR=   1.5

              LF7  MANE          .83     67.88    735.01      5.67      5.00     67.87    735.00        5.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7023E+01 OUTFLOW= .6563E+01 BASIN STORAGE= .8647E-02 PERCENT ERROR=   6.4

              CH4  MANE         3.00    101.18    726.67      5.78      5.00     99.36    725.00        5.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6565E+01 EXCESS= .3167E+01 OUTFLOW= .9653E+01 BASIN STORAGE= .8531E-03 PERCENT ERROR=    .8

              LF8  MANE         2.89     41.79    729.22      5.96      5.00     40.84    730.00        5.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3075E+01 OUTFLOW= .3021E+01 BASIN STORAGE= .1484E-02 PERCENT ERROR=   1.7

              LF9  MANE         2.06     48.13    724.71      5.97      5.00     47.98    725.00        5.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2719E+01 OUTFLOW= .2672E+01 BASIN STORAGE= .5929E-03 PERCENT ERROR=   1.7

              CH5  MANE         5.00     57.83    730.00      6.00      5.00     57.83    730.00        6.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2678E+01 EXCESS= .1221E+01 OUTFLOW= .3871E+01 BASIN STORAGE= .9272E-03 PERCENT ERROR=    .7

              CH7  MANE          .94     53.66    725.91      6.03      5.00     52.23    725.00        6.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3233E+01 OUTFLOW= .3149E+01 BASIN STORAGE= .6207E-03 PERCENT ERROR=   2.6

             LF10  MANE         2.83    109.24    725.52      5.89      5.00    106.89    725.00        5.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5502E+01 OUTFLOW= .5342E+01 BASIN STORAGE= .6158E-03 PERCENT ERROR=   2.9


*** NORMAL END OF HEC-1 ***
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VOLUME CALCULATIONS

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 8/1/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 25-year 24-hour storm volume generated by the site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

Use the excessive rainfall data generated by the HEC-1 analysis to determine the volume produced by the site for the proposed expansion conditions.

Proposed Expansion Conditions

1. Volume at Discharge Point #1

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LF1	0.0075	6.07	4.82	2.4
LF2	0.0080	6.07	5.13	2.6
LF3	0.0153	6.07	9.76	4.9
OA2	0.0765	5.95	48.93	24.3
CH1	0.0193	6.19	12.36	6.4
LF13	0.0028	6.07	1.80	0.9
P1	0.0060	7.85	3.41	2.2
LF11	0.0062	6.07	3.94	2.0
LF12	0.0081	6.07	5.17	2.6
CH7	1.0060	6.19	6.27	3.2
CH8	0.0012	6.19	0.77	0.4
P4	0.0013	7.85	0.86	0.6
DA1	0.0450	5.95	28.82	14.3
			Total Volume at Discharge Point 1 =	66.8

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LF4	0.0067	6.07	4.27	2.2
LF5	0.0086	6.07	5.48	2.8
OA1	0.1483	5.95	94.94	47.1
CH2	0.0122	6.19	7.78	4.0
LF6	0.0086	6.07	5.51	2.8
CH3	0.0055	6.07	3.50	1.8
			Total Volume at Discharge Point #2 =	60.6

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LF7	0.0218	6.07	13.94	7.1
CH4	0.0096	6.19	6.17	3.2
LF8	0.0095	6.07	6.05	3.1
LF9	0.0084	6.07	5.36	2.7
CH5	0.0037	6.19	2.39	1.2
P2	0.0037	7.87	2.36	1.5
			Total Volume at Discharge Point #3 =	18.8

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 8/1/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine the 25-year 24-hour storm volume generated by the site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.**

4. Volume at Discharge Point #4

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
CH7	0.0035	6.19	2.23	1.2
LF10	0.0044	6.07	2.84	1.4
P3	0.0024	7.87	1.52	1.0
Total Volume Discharging into Discharge #4				3.6

4. Volume at Discharge Point #5

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
DA2	0.0233	5.95	14.90	7.4
Total Volume Discharging into Discharge #5				7.4

Total Volume Exiting Permit Boundary = 157.2 acre-ft

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 8/1/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - Determine the 100-year 24-hour storm volume generated by the site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.

Use the excessive rainfall data generated by the HEC-1 analysis for the 100-year storm to determine the volume produced by the site for the proposed expansion conditions.

Proposed Expansion Conditions

1. Volume at Discharge Point #1

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LF1	0.008	10.02	4.82	4.0
LF2	0.008	10.02	5.13	4.3
LF3	0.015	10.02	9.76	8.1
OA2	0.076	9.88	48.93	40.3
CH1	0.019	10.15	12.36	10.5
LF13	0.003	10.02	1.80	1.5
P1	0.006	11.90	3.41	3.4
LF11	0.006	10.02	3.94	3.3
LF12	0.008	10.02	5.17	4.3
CH7	1.006	10.15	6.27	5.3
CH8	0.001	10.15	0.77	0.7
P4	0.001	11.90	0.86	0.9
DA1	0.045	9.88	28.82	23.7
			Total Volume at Discharge Point 1 =	110.2

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LF4	0.007	10.02	4.27	3.6
LF5	0.008	10.02	5.48	4.6
OA1	0.148	9.88	94.94	78.2
CH2	0.012	10.15	7.78	6.6
LF6	0.009	10.02	5.51	4.6
CH3	0.005	10.02	3.50	2.9
			Total Volume at Discharge Point #2 =	100.4

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LF7	0.022	10.02	13.94	11.6
CH4	0.010	10.15	6.17	5.2
LF8	0.009	10.02	6.05	5.1
LF9	0.008	10.02	5.36	4.5
CH5	0.004	10.15	2.39	2.0
P2	0.004	11.90	2.36	2.3
			Total Volume at Discharge Point #3 =	30.7

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 8/1/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - Determine the 100-year 24-hour storm volume generated by the site and offsite areas using the excess rainfall calculated in the HEC-1 analysis of the proposed expansion site conditions.

4. Volume at Discharge Point #4

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
CH7	0.003	10.15	2.23	1.9
LF10	0.004	10.02	2.84	2.4
P3	0.002	11.90	1.52	1.5
Total Volume Discharging into Discharge #4				5.8

4. Volume at Discharge Point #5

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
DA2	0.023	9.88	14.90	12.3
Total Volume Discharging into Discharge #5				12.3

Total Volume Exiting Permit Boundary = 259.4 acre-ft

VELOCITY CALCULATIONS

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 8/1/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose : **Determine the flow velocities entering and exiting the permit boundary using FlowMaster for the flows calculated for the 100-year and 25- year storm event in the HEC-1 analysis.**

1. Flow Velocity entering the landfill permit boundary

OA1

Q_{100} = 460.7 cfs
Q_{25} = 304.8 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	461	0.017	0.03	50.00	50.00	100.00	0.74	4.52
25	305	0.017	0.03	50.00	50.00	100.00	0.59	3.97

OA2

Q_{100} = 253.8 cfs
Q_{25} = 168.1 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	254	0.018	0.03	50.00	50.00	100.00	0.53	3.75
25	168	0.018	0.03	50.00	50.00	100.00	0.42	3.27

2. Flow Velocity exiting the landfill permit boundary

Discharge #1

Q_{100} = 375.3 cfs
Q_{25} = 263.1 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	375	0.052	0.03	50.00	50.00	300.00	0.26	4.49
25	263	0.052	0.03	50.00	50.00	300.00	0.21	3.95

Discharge #2

Q_{100} = 510.0 cfs
Q_{25} = 337.1 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	510	0.003	0.03	3.00	3.00	12.00	4.08	5.15
25	337	0.003	0.03	3.00	3.00	12.00	3.33	4.61

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 8/1/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose : **Determine the flow velocities entering and exiting the permit boundary using FlowMaster for the flows calculated for the 100-year and 25- year storm event in the HEC-1 analysis.**

Discharge #3

Q_{100} = 288.9 cfs
Q_{25} = 189.6 cfs

Low Water Outlet

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Length of 3-42" RCP (ft)	Flow Velocity (fps)
100	289	0.038	52.00	10.01
25	190	0.038	52.00	6.57

Discharge #4

Q_{100} = 72.4 cfs
Q_{25} = 65.1 cfs

Low Water Outlet

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Length of 36" RCP (ft)	Flow Velocity (fps)
100	72	0.029	68.00	10.25
25	65	0.029	68.00	9.22

Discharge #5

Q_{100} = 105.2 cfs
Q_{25} = 71.0 cfs

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Velocity (fps)
100	105	0.071	0.03	50.00	50.00	50.00	0.31	5.22
25	71	0.071	0.03	50.00	50.00	50.00	0.25	4.61

Appendix IIIH-C. Channel and Pond Design



LIST OF FIGURES

Perimeter Channel Plan	IIIH-C-4
Channel 1 Profile and Cross Sections	IIIH-C-5
Channel 2 Profile and Cross Sections	IIIH-C-6
Channel 3 Profile and Cross Sections	IIIH-C-7
Channel 4 Profile and Cross Sections	IIIH-C-8
Channel 5 Profile and Cross Sections	IIIH-C-9
Channel 6 Profile and Cross Sections	IIIH-C-10
Channel 7A Profile and Cross Sections	IIIH-C-11A
Channel 7B Profile and Cross Section	IIIH-C-11B
Channel 8 Profile and Cross Sections	IIIH-C-12
Pond Plan	IIIH-C-16
Pond 1 Section	IIIH-C-17
Pond 2 Section	IIIH-C-18
Pond 3 Section	IIIH-C-19
Pond 4 Section	IIIH-C-20



Client: City of Del Rio
Project: Major Permit Amendment
Description: Perimeter Channel Design

Date: 8/1/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - To design perimeter channels to contain stormwater runoff from the 25-year frequency storm events.

Perimeter channels have been designed to contain stormwater runoff from the 25-year frequency storm events.

Channel	Station		Flow Rate (cfs)	Bottom Slope %	Bottom Width (ft)	Side Slope (ft/ft) Right	Left	Normal Depth (ft)	Flow Vel. (fps)	Fronde No.	Vel. Head (ft)	Specific Energy (ft)	Flow Area (sq.ft.)	Top width of Flow (ft)
CH1	0+00.00	31+29.16	246.2	0.25%	10	3	3	3.16	4.00	0.48	0.25	3.41	61.51	29.98
CH2	0+00.00	7+67.69	323.4	0.65%	10	2	2	3.07	5.76	0.66	0.52	3.87	56.16	23.44
	7+67.69	8+72.43	323.4	1.50%	10	2	2	2.46	8.81	1.14	1.20	3.37	36.73	19.84
	8+72.43	9+35.38	323.4	1.30%	10	2	2	2.56	8.37	1.07	1.09	3.65	38.66	20.23
	9+35.38	11+53.65	323.4	0.85%	10	2	2	2.86	7.19	0.87	0.80	3.66	45.01	21.45
	11+53.65	24.+63.99	87.8	0.46%	10	2	2	1.67	3.95	0.60	0.24	1.91	22.24	16.67
CH3	0+00.00	10+66.16	70.3	0.43%	10	3	3	1.44	3.41	0.57	0.18	1.62	20.59	18.63
CH4	0+00.00	15+71.63	99.4	0.35%	10	3	2	1.87	3.61	0.53	0.20	2.08	27.52	19.37
CH5	0+00.00	6+64.79	84.0	0.50%	6	3	3	1.84	3.96	0.63	0.24	2.08	21.21	17.05
CH6	0+00.00	2+59.26	12.8	1.00%	0	3	3	1.14	3.29	0.77	0.17	1.31	3.89	6.84
CH7A[4]	0+00.00	3+55.95	12.2	0.10%	10	3	3	0.82	1.20	0.26	0.02	0.84	10.17	14.90
CH7B	0+00.00	11+34.72	123.2	0.68%	3	3	3	2.41	4.99	0.74	0.39	2.80	24.67	17.47
	0+00.00	12+21.50	123.2	0.20%	3	3	3	3.14	3.16	0.42	0.16	3.29	38.96	21.83
CH8	0+00.00	2+20.77	6.6	1.00%	0	3	3	0.90	2.82	0.74	0.12	1.03	2.45	5.43

Note:

1. Calculations were performed using Bentley FlowMaster.
2. n = 0.03 (Manning Coefficient) is used for the calculations.
3. Flow rates used for the perimeter channel design were taken from the HEC-1 analysis included in Appendix IIIH-B.
4. The drainag area for Channel 7A is shown on sheet IIIH-C-4. Q=CIA was used to calulate the flow rate for Channel 7A. The flow rate for 7B is obtained from HEC-1 analysis included in Appendix IIIH-B which includes the Channel 7A area.

Channel Erosion Control Design:

Channel erosion controls have been designed for flow velocities resulted from the 25-year frequency flow rates. As shown on above velocities in the perimeter channels range from

The following was used to select the type of channel lining material.

- Vegetation - used in all areas where velocities are less than 5 ft/s for channels.
- Turf reinforcement matting - used in channels for velocities between 5 ft/s and 13 ft/s.

Perimeter Channel

Client: City of Del Rio
Project: Major Permit Amendment
Description: Perimeter Channel Design

Date: 8/1/2024
Job No: DELR20000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **To design perimeter channels to contain stormwater runoff from the 25-year frequency storm events.**

Example Calculation: Calculate the 25-year normal depth for Channel 6.

Where:

Q_d = Design flow rate for channel, cfs
R = Hydraulic radius, ft
n = Manning's roughness coefficient
S = channel slope, ft/ft
b = Bottom width of channel, ft
z_r = z-ratio (ratio of run to rise for channel sideslope) for right sideslope of swale
z_l = z-ratio (ratio of run to rise for channel sideslope) for left sideslope of swale
A_f = Flow area, sf
g = gravitational acceleration = 32.2 ft/s^2
T = Top width of flow, ft
d = Normal depth of swale, ft

The program uses an iterative process to calculate the normal depth of the chute to satisfy Manning's Equation:

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Where:

Q_d =	12.8	cfs (from page IIIH-D-8)
S =	0.01	ft/ft
b =	0	ft
z =	3	(H) : 1 (V)
n =	0.03	

Step 1 - Based on the geometry of the swale cross-section, solve for R and A_f:

$$R = \frac{bd + 0.5d^2(z)}{b + 2d(z^2 + 1)^{0.5}}$$

$$A_f = bd + d^2(z)$$

Assume:

d =	1.14	ft
R =	0.54	ft
A_f =	3.899	sf

Solve for Q:

Q = 12.80

If Q is not equal to Qd, select a new d and repeat calculations.

Perimeter Channel

Client: City of Del Rio
Project: Major Permit Amendment
Description: Perimeter Channel Design

Date: 8/1/2024
Job No: DELR20000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **To design perimeter channels to contain stormwater runoff from the 25-year frequency storm events.**

Step 2 - Solve for velocity, T, Froude number, velocity head, and energy head.

$Q = VA$ $V = Q/A$

$V =$ 3.29 ft/s

$T = b + 2(z \times d)$

$T =$ 6.81 ft

$$F_r = \frac{V}{(g A / T)^{0.5}}$$

$F_r =$ 0.77

$$\text{Velocity Head} = \frac{V^2}{2g}$$

Velocity Head = 0.17 ft

Energy Head = Water Elevation (normal depth) + Velocity Head

Specific Energy = 1.31 ft

LEGEND

- PERIMETER CHANNEL
- GP-5 — PROPOSED GAS PROBE
- UV-1 — PROPOSED GAS VENTS
- EXISTING CHUTE
- CHUTES
- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 — FINAL COVER CONTOURS
- 1060 — EXISTING CONTOURS
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE

N

0 200 400
SCALE IN FEET

START CHANNEL 4
STA 0+00.00
ELEV. 1042.11

CHANNEL PI
STA 1+09.56
ELEV. 1042.49

CHANNEL 4
IIIH-C-8

END CHANNEL 4
STA 15+71.63
ELEV. 1047.60

END CHANNEL 3
STA 10+66.16
ELEV. 1047.58

CHANNEL 3
IIIH-C-7

CHANNEL PI
STA 6+72.04
ELEV. 1045.88

CHANNEL PI
STA 5+35.92
ELEV. 1045.33

POND 2

UV-1

EXISTING ASPHALT ACCESS ROAD

START CHANNEL 5
STA 0+00.00
ELEV. 1044.66

CLOSED LANDFILL

CH7 CHANNEL 7
IIH-C-11

CH6 CHANNEL 6
IIH-C-10

CH5 CHANNEL 5
IIH-C-9

3-42" RCP

GP-17 GP-18

POND 4

START CHANNEL 7
STA 0+00.00

END CHANNEL7
STA 12+40.32

END CHANNEL7
STA 11+41.86

END CHANNEL6
STA 3+32.75

END CHANNEL7
STA 15+98.22

2-24" RCP

START CHANNEL 8
STA 0+00.00

CH8 CHANNEL 8
IIH-C-12

END CHANNEL 8
STA 2+15.00

GP-16

CH7A

START CHANNEL 6
STA 0+00.00

36" RCP

POND 3

CHANNEL PI
STA 4+16.51
ELEV. 1046.74

CHANNEL PI
STA 6+12.00
ELEV. 1047.71

END CHANNEL 5
STA 6+64.79
ELEV. 1048.00

START CHANNEL 3
STA 0+00.00
ELEV. 1043.04

START CHANNEL 2
STA 0+00.00
ELEV. 1041.35

POND 1

2-24" RCP

GP-15

BEGIN CHANNEL 1
STA 0+00.00
ELEV. 1056

CHANNEL PI
STA 13+88.70

CHANNEL PI
STA 15+46.07

CHANNEL PI
STA 8+72.82
ELEV. 1048.45

CHANNEL PI
STA 9+42.33
ELEV. 1049.27

GP-8 GP-7

GP-9

GP-10

GP-11

CHANNEL PI
STA 16+35.77

END CHANNEL 1
STA 31+29.16
ELEV. 1057.80

END CHANNEL 2
STA 24+63.99
ELEV. 1056.58

CHANNEL 2
IIIH-C-6

CH1 CHANNEL 1
IIIH.C-5

CHANNEL PI
STA 1+63.27

CHANNEL PI
STA 6+40.10

CHANNEL PI
STA 8+25.64

CHANNEL PI
STA 11+71.26

GP-14 GP-13 GP-12

NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
4. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS
TIMOBISTA METAFERIA
123163
LICENSED
PROFESSIONAL ENGINEER
09/27/2025

NO.	REVISION	BY	DATE
2.	2nd TECHNICAL NOD	STV	03/2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

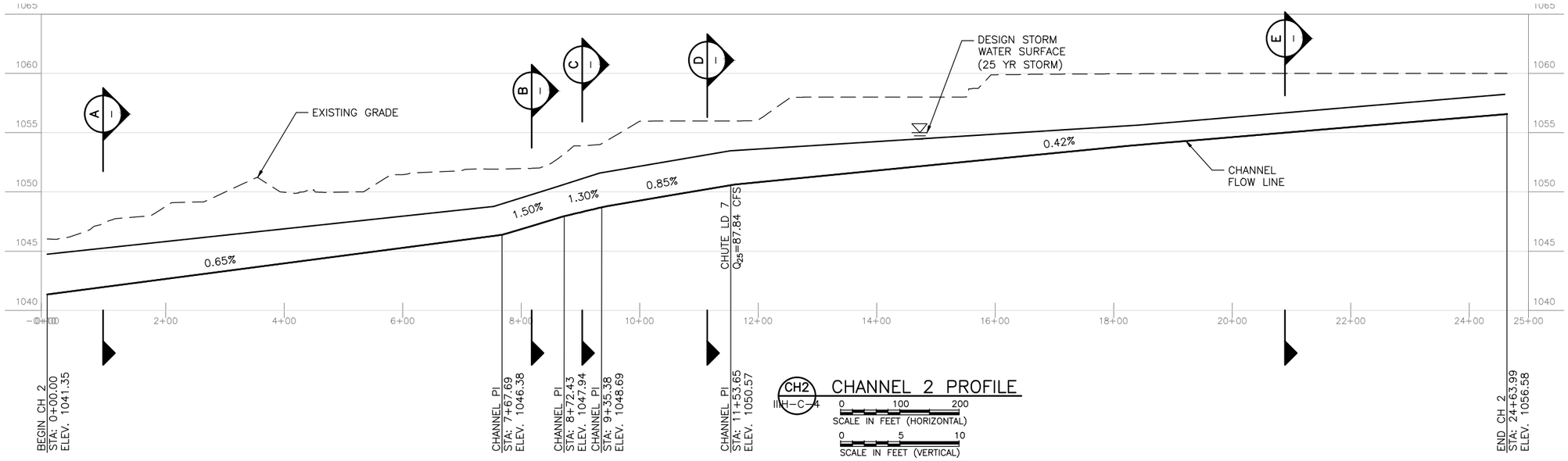
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

PERIMETER CHANNEL PLAN

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

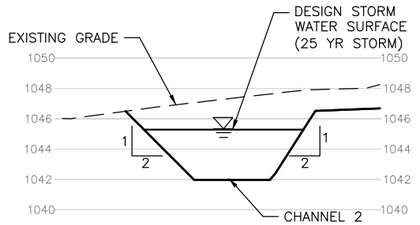
FIGURE
IIIH-C-4

PRINTED BY: MetafeT DATE: 8/18/2024
FILE PATH: C:\pwworking\stv\pw_stv1metaferia\d0942276\DELR2003302 Figure IIIH-C-4.dwg



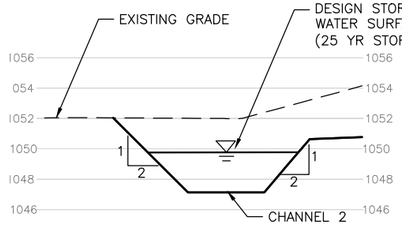
CH2 IIIH-C-4 CHANNEL 2 PROFILE

0 100 200
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)



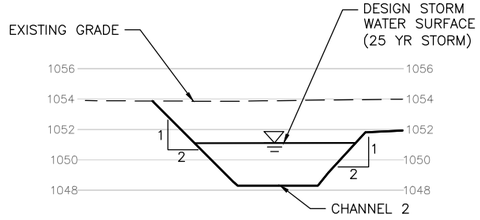
A SECTION

0 10 20
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)



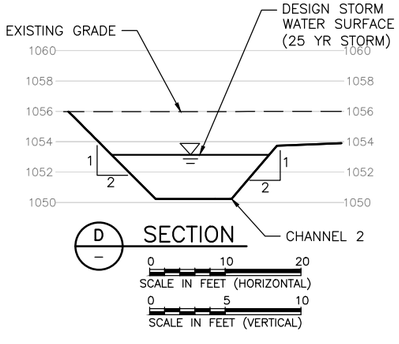
B SECTION

0 10 20
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)



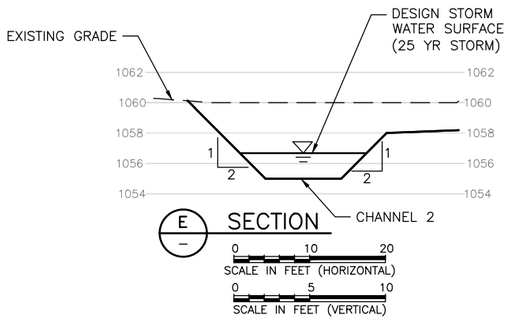
C SECTION

0 10 20
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)



D SECTION

0 10 20
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)



E SECTION

0 10 20
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)

Channel	Station	Bottom Width (ft)	Flow Rate (cfs)	Bottom Slope %	Flow Vel. (fps)	Normal Depth (ft)
0+00.00	7+67.69	10	323.4	0.65%	5.76	3.36
7+67.69	8+72.43	10	323.4	1.50%	8.81	2.46
8+72.43	9+35.38	10	323.4	1.30%	8.37	2.56
9+35.38	11+53.65	10	323.4	0.85%	7.19	2.86
11+53.65	24.+63.99	10	87.8	0.46%	3.95	1.67

THE FOLLOWING WAS USED TO SELECT THE TYPE OF CHANNEL LINING MATERIAL
- VEGETATION WILL BE USED IN ALL AREAS WHERE VELOCITIES ARE LESS THAN 5 FT/S.
- TURF REINFORCEMENT MATTING WILL BE USED IN CHANNEL SECTIONS THAT HAVE VELOCITIES BETWEEN 5 FT/S AND 13 FT/S.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS · TEMOBISTA METAFERIA · 123183 · LICENSED PROFESSIONAL ENGINEER · 03/07/2025

NO.	REVISION	BY	DATE
2.	2ND TECHNICAL NOD	STV	03/ 2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

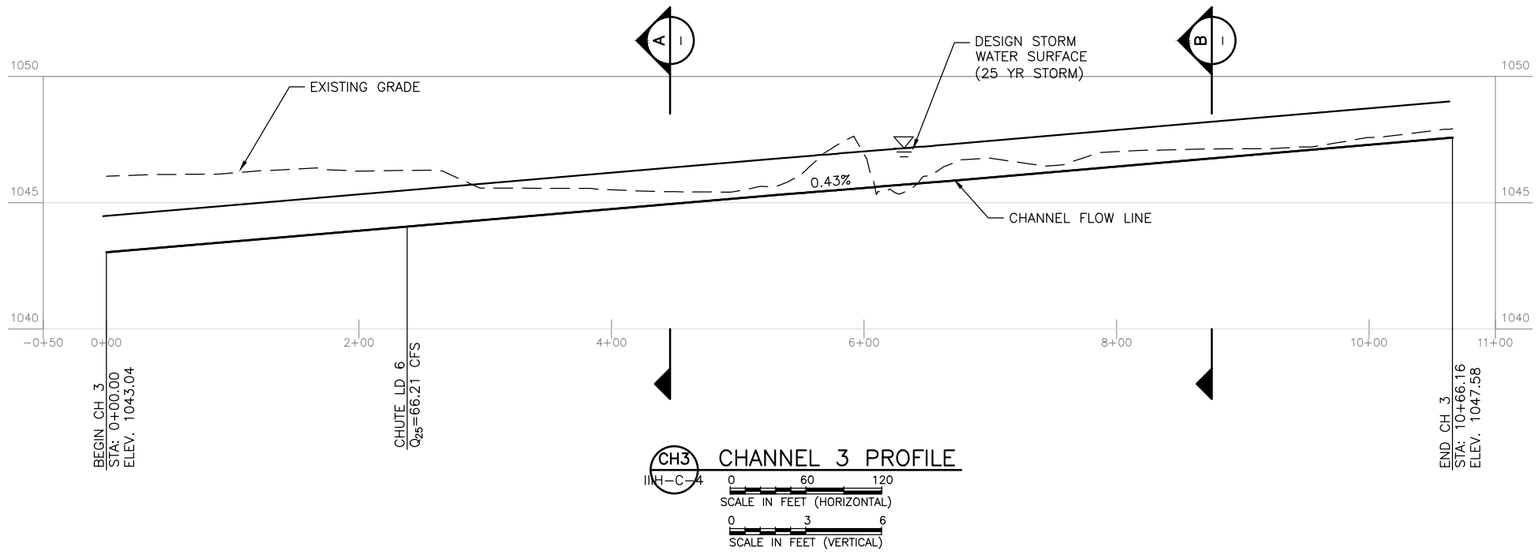
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CHANNEL 2 PROFILE AND CROSS SECTIONS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW:B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

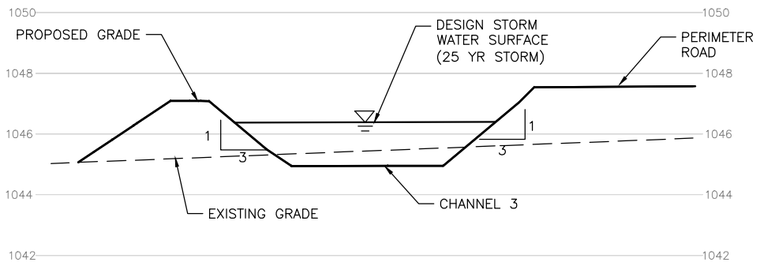
FIGURE
IIIH-C-6

PRINTED BY: Metafe1
FILE PATH: C:\pwworking\stv\pw_stv1\metaferia\d0942276\DELR2000302 Figure IIIH-C-6.dwg



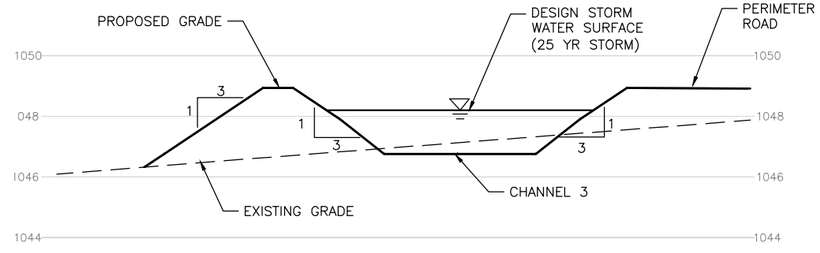
CH3 CHANNEL 3 PROFILE
IIIH−C−4

SCALE IN FEET (HORIZONTAL): 0 60 120
SCALE IN FEET (VERTICAL): 0 3 6



A SECTION
−

SCALE IN FEET (HORIZONTAL): 0 5 10
SCALE IN FEET (VERTICAL): 0 2.5 5



B SECTION
−

SCALE IN FEET (HORIZONTAL): 0 5 10
SCALE IN FEET (VERTICAL): 0 2.5 5

Channel Station		Bottom	Peak Flow	Slope	Velocity	Flow Depth
From	To	Width (ft)	(cfs)	(%)	(ft/s)	(ft)
0+00.00	10+66.16	10	70.3	0.43	3.41	1.44

THE FOLLOWING WAS USED TO SELECT THE TYPE OF CHANNEL LINING MATERIAL
- VEGETATION WILL BE USED IN ALL AREAS WHERE VELOCITIES ARE LESS THAN 5 FT/S.
- TURF REINFORCEMENT MATTING WILL BE USED IN CHANNEL SECTIONS THAT HAVE VELOCITIES BETWEEN 5 FT/S AND 13 FT/S.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
2.	2ND TECHNICAL NOD	STV	03/ 2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY
0 1"

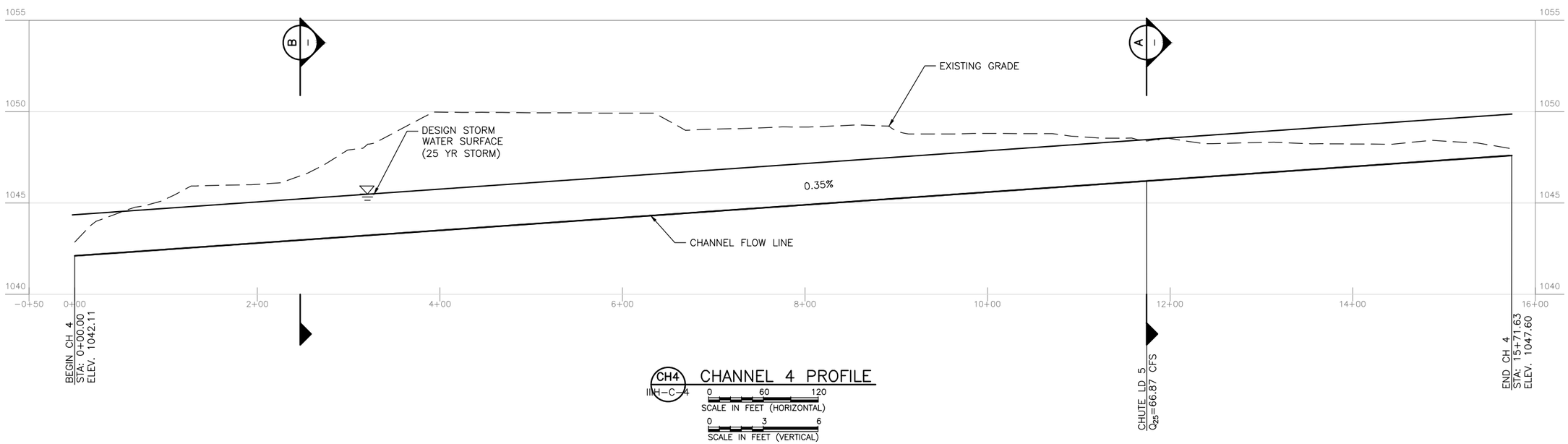
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CHANNEL 3 PROFILE AND
CROSS SECTIONS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-7

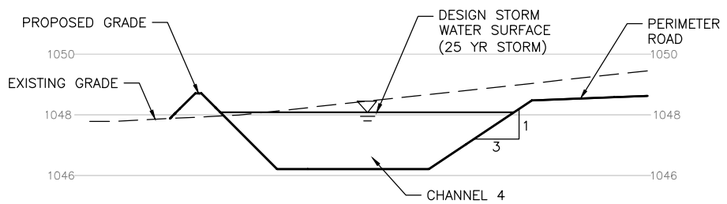
PRINTED BY: MetafeT
FILE PATH: C:\pwworkingdir\pw_stv1\metaferiad\d0942276\DELR2000302 Figure IIIH-C-7.dwg



CH4 IIIH-C-4 CHANNEL 4 PROFILE

SCALE IN FEET (HORIZONTAL): 0 60 120

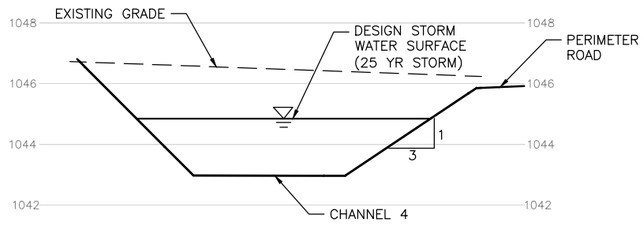
SCALE IN FEET (VERTICAL): 0 3 6



A – SECTION

SCALE IN FEET (HORIZONTAL): 0 5 10

SCALE IN FEET (VERTICAL): 0 2.5 5



B – SECTION

SCALE IN FEET (HORIZONTAL): 0 5 10

SCALE IN FEET (VERTICAL): 0 2.5 5

Channel	Station	Bottom Width (ft)	Flow Rate (cfs)	Bottom Slope %	Flow Vel. (fps)	Normal Depth (ft)
0+00.00	15+71.63	10	99.4	0.35%	3.61	1.87

THE FOLLOWING WAS USED TO SELECT THE TYPE OF CHANNEL LINING MATERIAL
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CITY OF DEL RIO

STATE OF TEXAS — TEMOBISTA METAFERIA — 123183 — LICENSED PROFESSIONAL ENGINEER — 03/07/2025

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VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

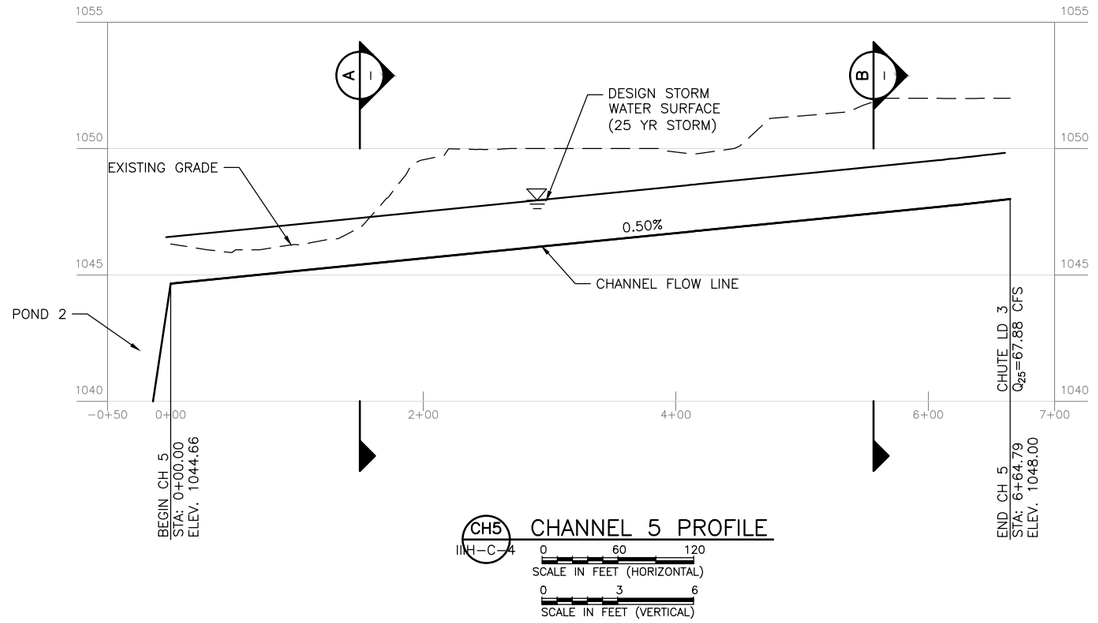
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CHANNEL 4 PROFILE AND CROSS SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-8

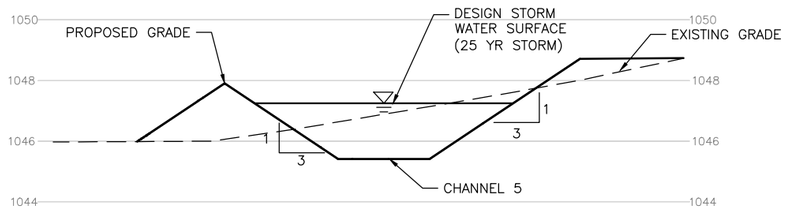
PRINTED BY: MetafeT
FILE PATH: C:\pwworkingstv\pw_stv1\metaferiat\d0942276\DELR200302 Figure IIIH-C-8.dwg



CH5 IIIH−C−4 **CHANNEL 5 PROFILE**

SCALE IN FEET (HORIZONTAL): 0 60 120

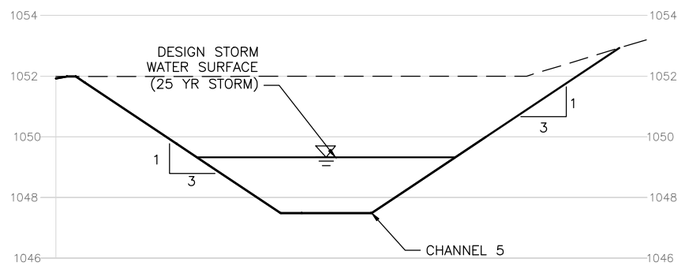
SCALE IN FEET (VERTICAL): 0 3 6



A − **SECTION**

SCALE IN FEET (HORIZONTAL): 0 5 10

SCALE IN FEET (VERTICAL): 0 2.5 5



B − **SECTION**

SCALE IN FEET (HORIZONTAL): 0 5 10

SCALE IN FEET (VERTICAL): 0 2.5 5

Channel Station		Bottom	Peak Flow	Slope	Velocity	Flow Depth
From	To	Width (ft)	(cfs)	(%)	(ft/s)	(ft)
0+00.00	6+64.79	6	84	0.5	3.96	1.84

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PRINTED BY: MetafeT
FILE PATH: C:\pwworkingistv\pw_stv\metaferiald\8942276\DELR2000302 Figure IIIH-C-9.dwg

TEXAS REGISTERED ENGINEERING FIRM TBPE F-1741

NO.	REVISION	BY	DATE
2.	2ND TECHNICAL NOD	STV	03/ 2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

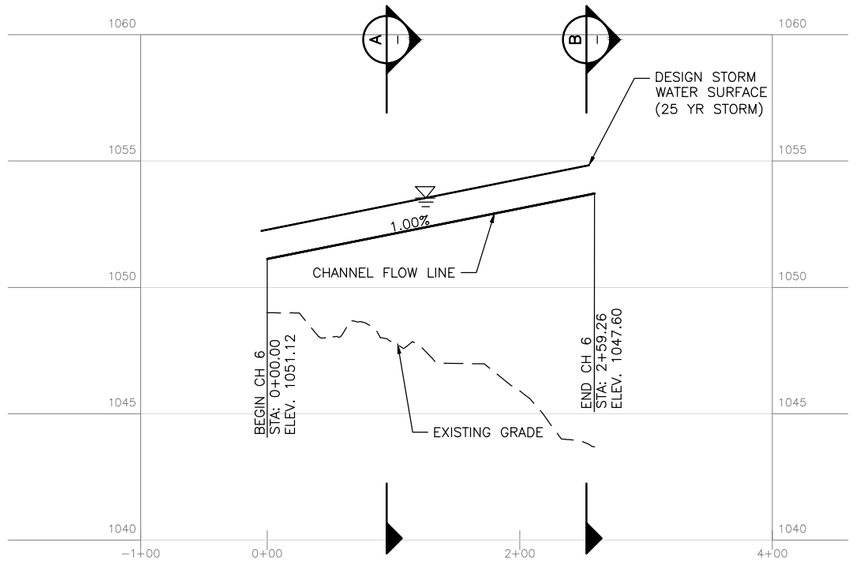
CHANNEL 5 PROFILE AND CROSS SECTIONS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

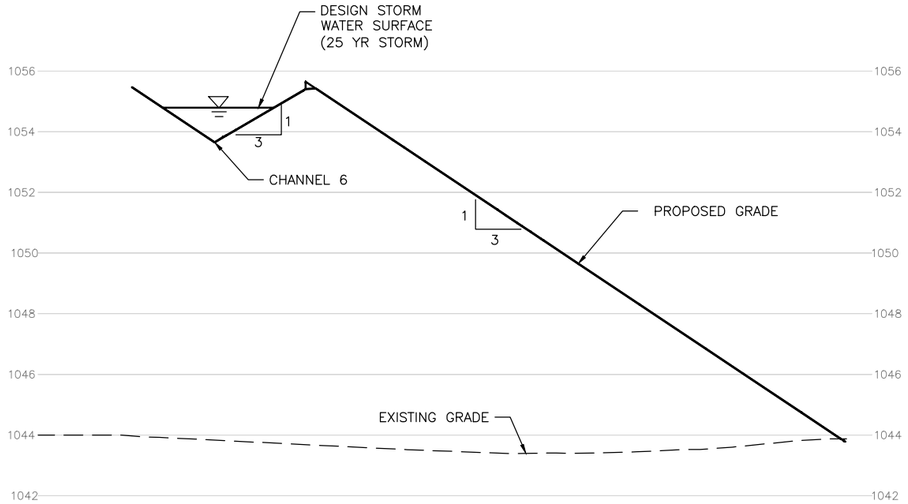
FIGURE
IIIH-C-9

Channel	Station		Flow Rate (cfs)	Bottom Slope %	Bottom Width (ft)	Normal Depth (ft)
CH6	0+00.00	2+59.26	12.8	1.00%	0	1.14

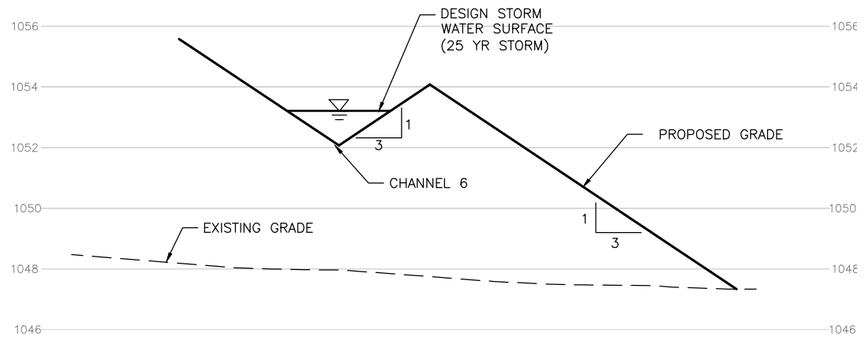
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CH6 CHANNEL 6 PROFILE
IIIH−C−4
0 60 120
SCALE IN FEET (HORIZONTAL)
0 3 6
SCALE IN FEET (VERTICAL)



A SECTION
0 5 10
SCALE IN FEET (HORIZONTAL)
0 2.5 5
SCALE IN FEET (VERTICAL)



B SECTION
0 5 10
SCALE IN FEET (HORIZONTAL)
0 2.5 5
SCALE IN FEET (VERTICAL)

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TEXAS REGISTERED ENGINEERING FIRM TBPE F-1741

CITY OF DEL RIO TEXAS

STATE OF TEXAS — TOMOBISTA METAFERIA — 123183 — LICENSED PROFESSIONAL ENGINEER — 03/07/2025

NO.	REVISION	BY	DATE
1.	2nd TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CHANNEL 6 PROFILE AND CROSS SECTION

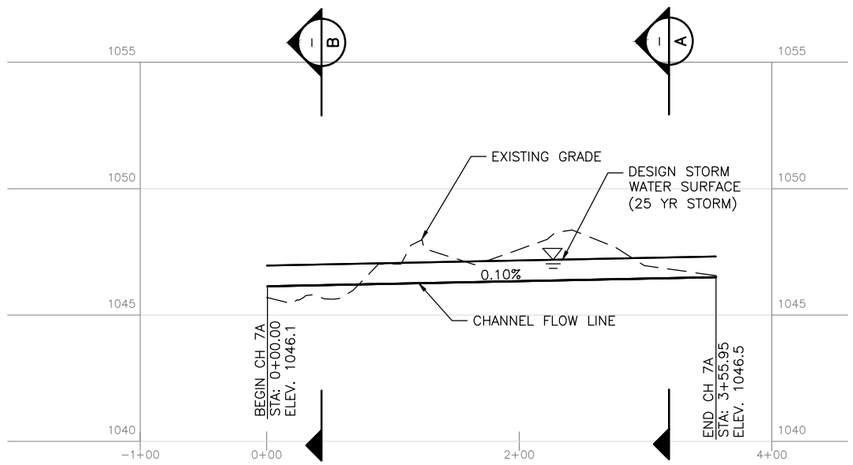
DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-10

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FILE PATH: C:\pwworkingstv\pw_stv1\metaferia\d0942276\DELR200302 Figure IIIH-C-10.dwg

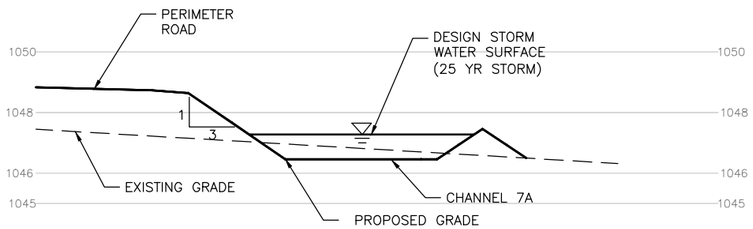
Channel	Station		Flow Rate (cfs)	Bottom Slope %	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
CH7A	0+00.00	3+55.95	12.2	0.10%	10	0.82	1.20

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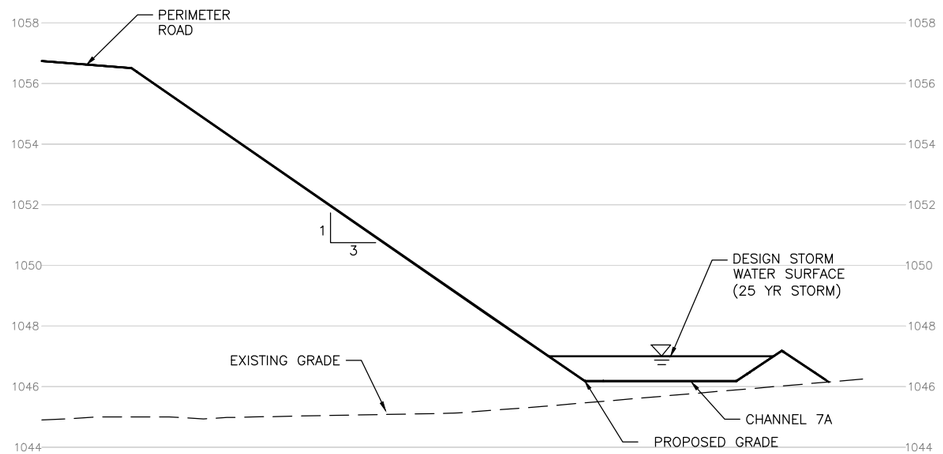
CH7A — CHANNEL 7A PROFILE
IIIH−C−4

SCALE IN FEET (HORIZONTAL): 0 60 120
SCALE IN FEET (VERTICAL): 0 3 6



A — SECTION

SCALE IN FEET (HORIZONTAL): 0 5 10
SCALE IN FEET (VERTICAL): 0 2.5 5



B — SECTION

SCALE IN FEET (HORIZONTAL): 0 5 10
SCALE IN FEET (VERTICAL): 0 2.5 5

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City of Del Rio, Texas

STATE OF TEXAS — TIMOTHY METAFERIA — 123183 — LICENSED PROFESSIONAL ENGINEER — 03/07/2025

NO.	REVISION	BY	DATE
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VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL 1" DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

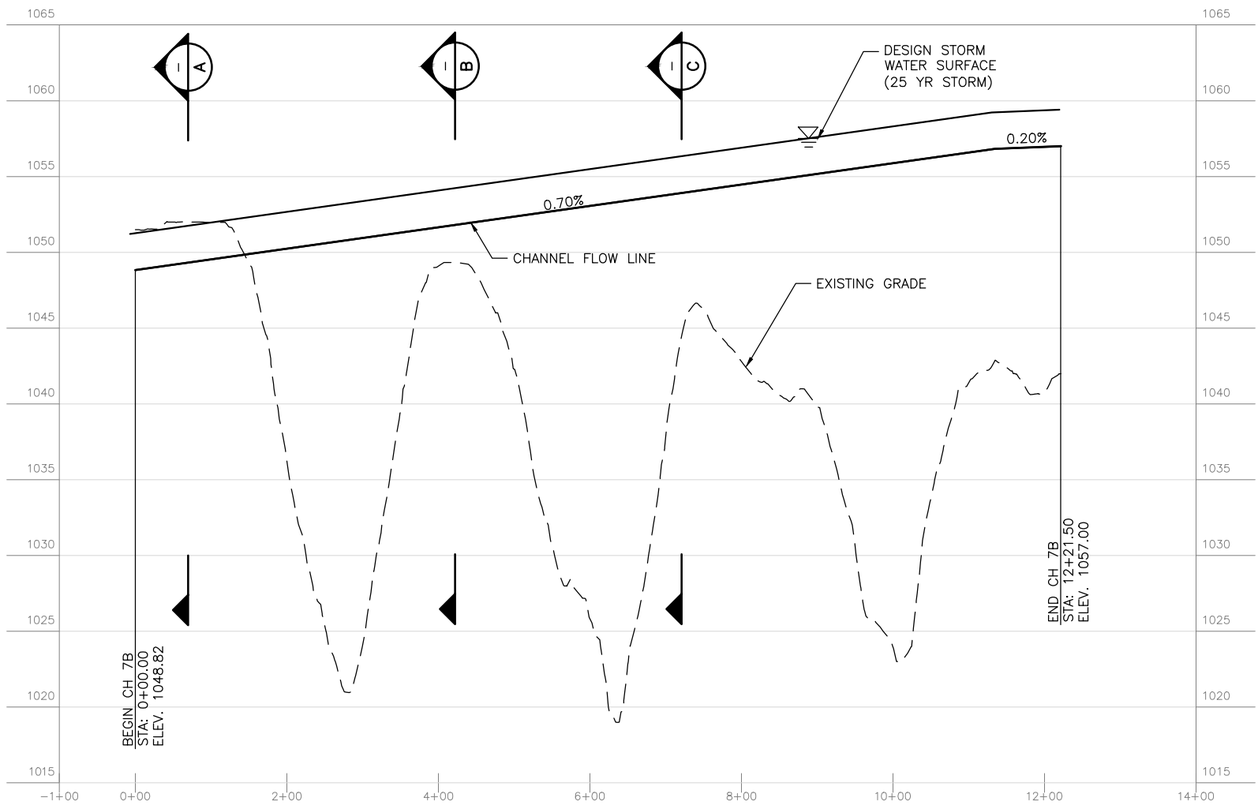
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CHANNEL 7A PROFILE AND CROSS SECTION

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH-C-11

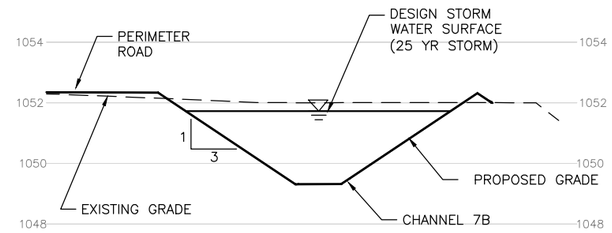
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FILE PATH: C:\pwworking\stv\pw_stv1\metaferia\d0942276\DELR200302 Figure IIIH-C-11.dwg



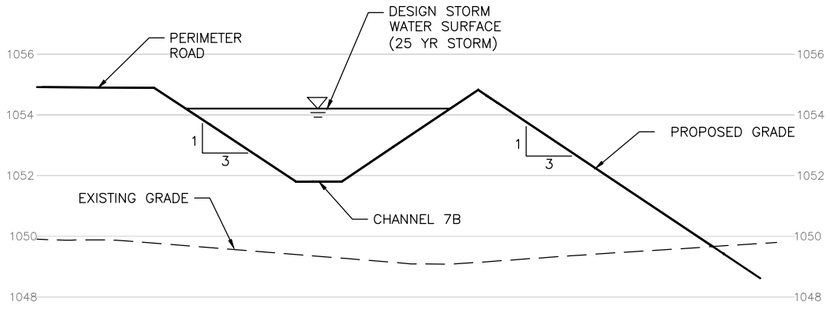
CH7B CHANNEL 7B PROFILE
IIIH–C–4
0 100 200
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)

Channel	Station		Flow Rate (cfs)	Bottom Slope %	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
CH7B	0+00.00	11+34.72	123.2	0.68%	3	2.41	4.99
	0+00.00	12+21.50	123.2	0.20%	3	3.14	3.16

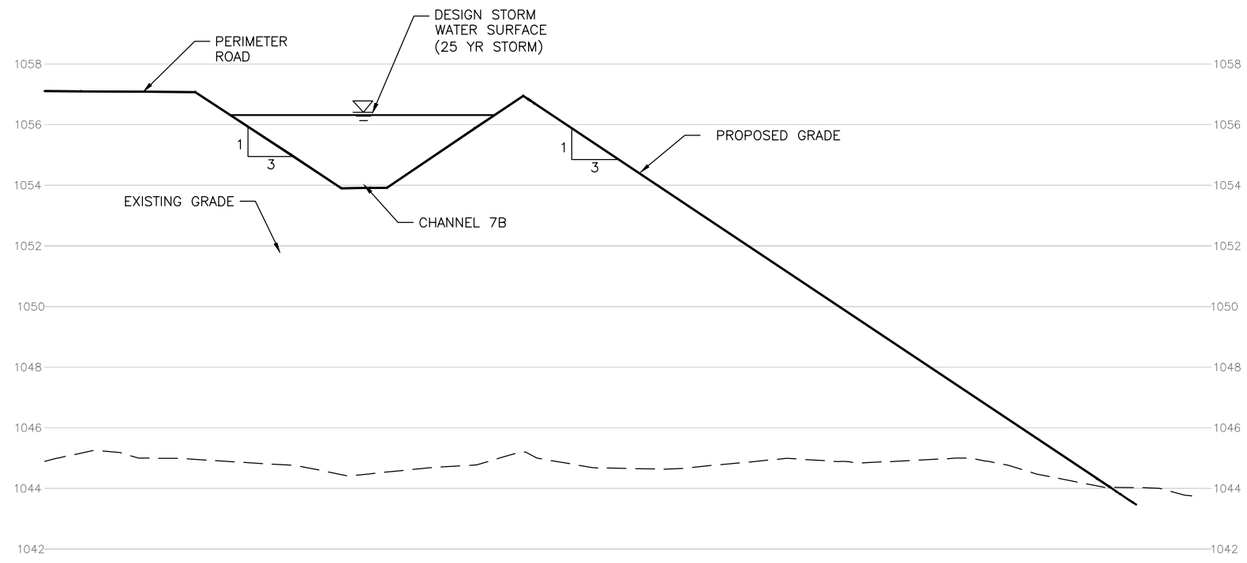
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A SECTION
0 5 10
SCALE IN FEET (HORIZONTAL)
0 2.5 5
SCALE IN FEET (VERTICAL)



B SECTION
0 5 10
SCALE IN FEET (HORIZONTAL)
0 2.5 5
SCALE IN FEET (VERTICAL)



C SECTION
0 5 10
SCALE IN FEET (HORIZONTAL)
0 2.5 5
SCALE IN FEET (VERTICAL)

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TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO, TEXAS
TEMBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

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VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
1"
0

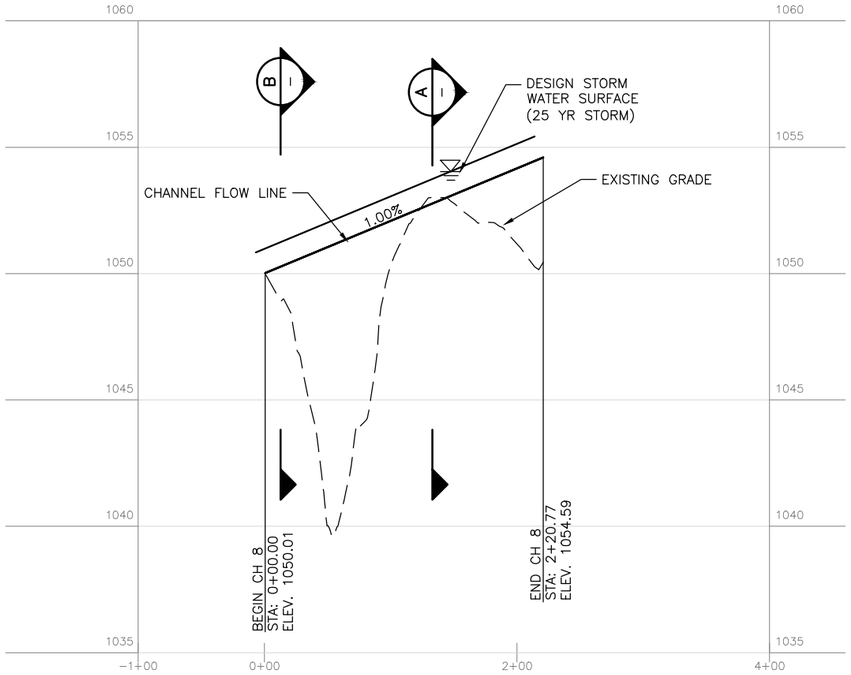
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

CHANNEL 7B PROFILE AND CROSS SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-11A

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CH8 — CHANNEL 8 PROFILE

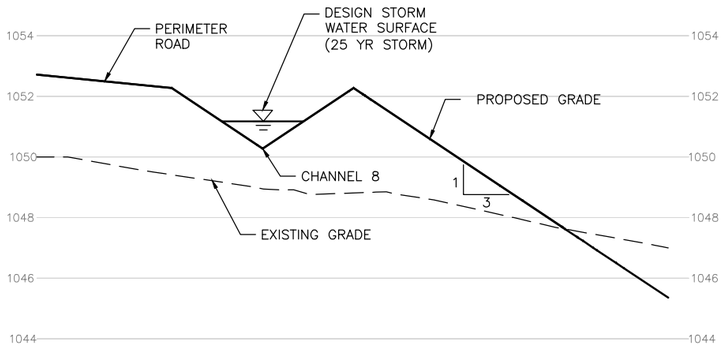
IIIH-C-4

SCALE IN FEET (HORIZONTAL): 0 60 120

SCALE IN FEET (VERTICAL): 0 3 6

Channel	Station		Flow Rate (cfs)	Bottom Slope %	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
CH8	0+00.00	3+27.78	6.6	1.00%	0	0.90	2.82

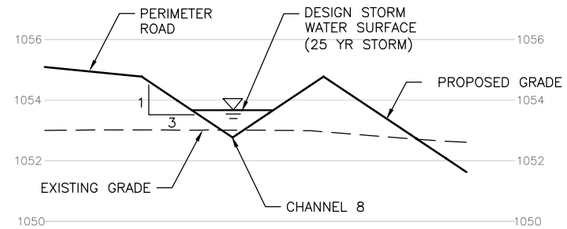
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A — SECTION

SCALE IN FEET (HORIZONTAL): 0 5 10

SCALE IN FEET (VERTICAL): 0 2.5 5



B — SECTION

SCALE IN FEET (HORIZONTAL): 0 5 10

SCALE IN FEET (VERTICAL): 0 2.5 5

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TBPE F-1741

CITY OF DEL RIO

STATE OF TEXAS — TOMOBISTA METAFERIA — 123183 — LICENSED PROFESSIONAL ENGINEER — 03/07/2025

NO.	REVISION	BY	DATE
1.	2nd TECHNICAL NOD	STV	03/ 2025

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0 1"

CITY OF DEL RIO LANDFILL NO. 207C
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CHANNEL 8 PROFILE AND CROSS SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-12

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Detention Pond and Outlet Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Detention Pond Design

Date: 8/1/2024
Job No: DELR20000302
By: T. Metaferia
Checked By: B. Hindman

Detention Pond Design

Detention ponds have been analyzed by using HEC-1, storage routing method. The input parameters for the model are presented in Appendix IIIH-B. A summary of HEC-1 results are presented below. As can be seen on the table, during the 25-year storm event, the ponds will not have flow over their spillways.

	P1	P2	P3	P4
Bottom ELEV, ft	1048.0	1034.0	1052.0	1046.5
Spillway ELEV, ft	1055.5	1040.0	1056.5	1051.0
Spillway Length, ft	150.0	10.0	10.0	25.0
Top of Berm, ft	1056.0	1042.0	1057.0	1052.0
Discharge Pipe Downstream Invert ELEV, ft	1055.5	1033.0	1050.0	1051.0
Peak Inflow Q_{25}, cfs	276.63	210.10	235.57	139.12
Peak Outflow Q_{25}, cfs	78.62	189.58	65.12	81.85
Peak Stage in Pond Q_{25}, ft	1053.78	1034.87	1053.67	1051.08
Est. Flow (Q_{25}) over Spillway, cfs	--	--	--	--

Detention Pond and Outlet Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Detention Pond Design

Date: 8/1/2024
Job No: DELR20000302
By: T. Metaferia
Checked By: B. Hindman

Detention Pond Outlet Structure Erosion Protection Calculations

Determine the minimum length and median diameter of riprap required at the detention pond outlet structures to control erosion in the detention pond outlet channels.

The riprap will be designed for the 25-year flow rates at the detention pond outlet structures.

The flow rate through the low water outlet (LWO) is summarized below.

Flow Structure	Pond Bottom Elev (ft-msl)	LWO Invert Elev.		LWO Diameter (in)	25-Year Flow Rate[2] (cfs)	25-Year Outlet Velocity[1] (ft/s)
		Upstream (ft-msl)	Downstream (ft-msl)			
P1	1048.0	1048.0	1055.5	2 - 24	78.62	12.52
P2	1034.0	1034.0	1033.0	3 - 42	189.58	4.81
P3	1052.0	1052.0	1050.0	2 - 24	65.12	10.42
P4	1046.5	1046.5	1051.0	1 - 36	81.85	11.59

1. The flowrates for all low water outlets are the peak discharges for the respective areas as calculated by HEC-1 since the spillway crest is not overtopped in the 25-year event. The total 25-year flowrate discharging front Pond 1 is 51.76 cfs / 1 pipe = 16.48 cfs per pipe and from Pond 2 = 138.89 cfs / 3 pipes = 4.81 cfs per pipe.

The nomograph used for design of the length of the rip rap and the median diameter are shown on page IIIH-C-18 (Figure 5.25).

The minimum riprap length and diameter for each outlet is summarized below. The length of the riprap is increased by 20 percent to provide for a conservative design.

Pond	Riprap Design Flowrate (cfs)	Pipe Diameter (in)	Riprap Length (ft)	Adjusted Length Lx 1.2 (ft)	Median Rock Diameter (ft)
P1	78.62	2 - 24	32	38	0.80
P2	189.58	3 - 42	42	50	0.30
P3	65.12	2 - 24	31	37	0.75
P4	81.85	1 - 36	32	38	0.80

Apron width required for the ponds (e.g., width of erosion protection in outlet channel) are:
W_{req} LWO diameter + 0.4*(RipRap Length)

Pond	W_{req} (ft)
P1	14.8
P2	20.3
P3	15.9
P4	16.3

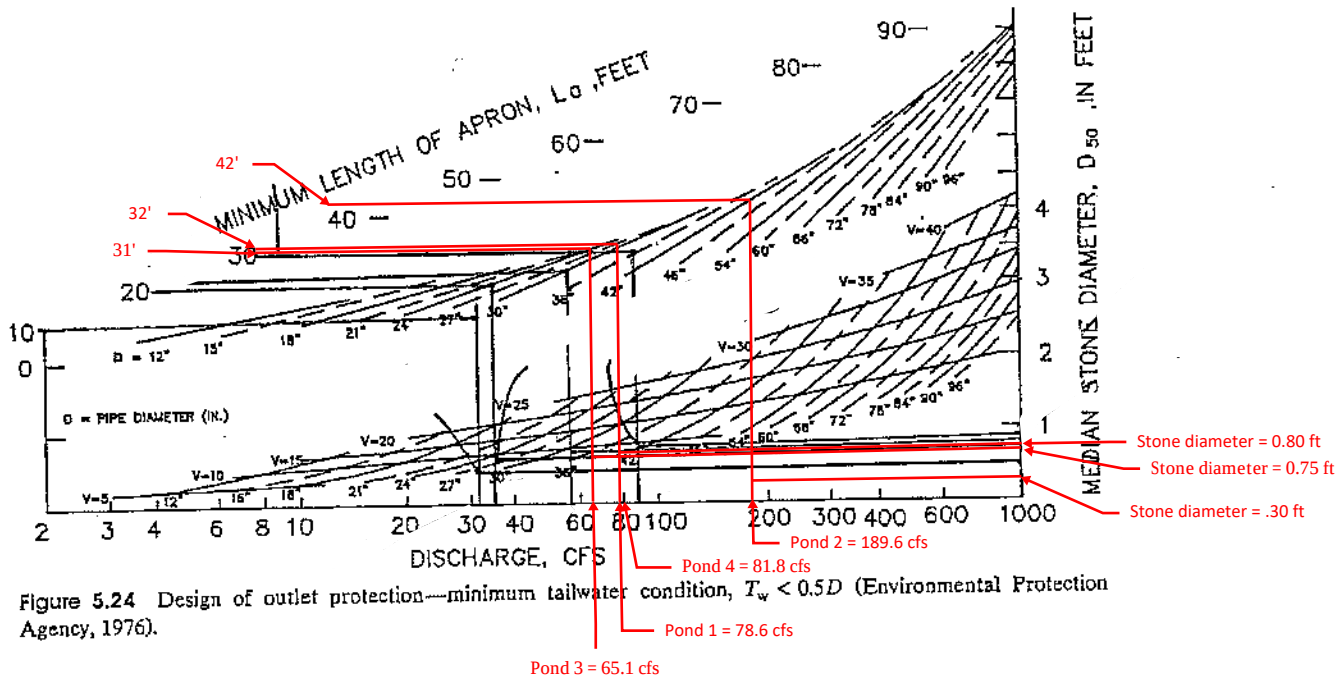


Figure 5.24 Design of outlet protection—minimum tailwater condition, $T_w < 0.5D$ (Environmental Protection Agency, 1976).

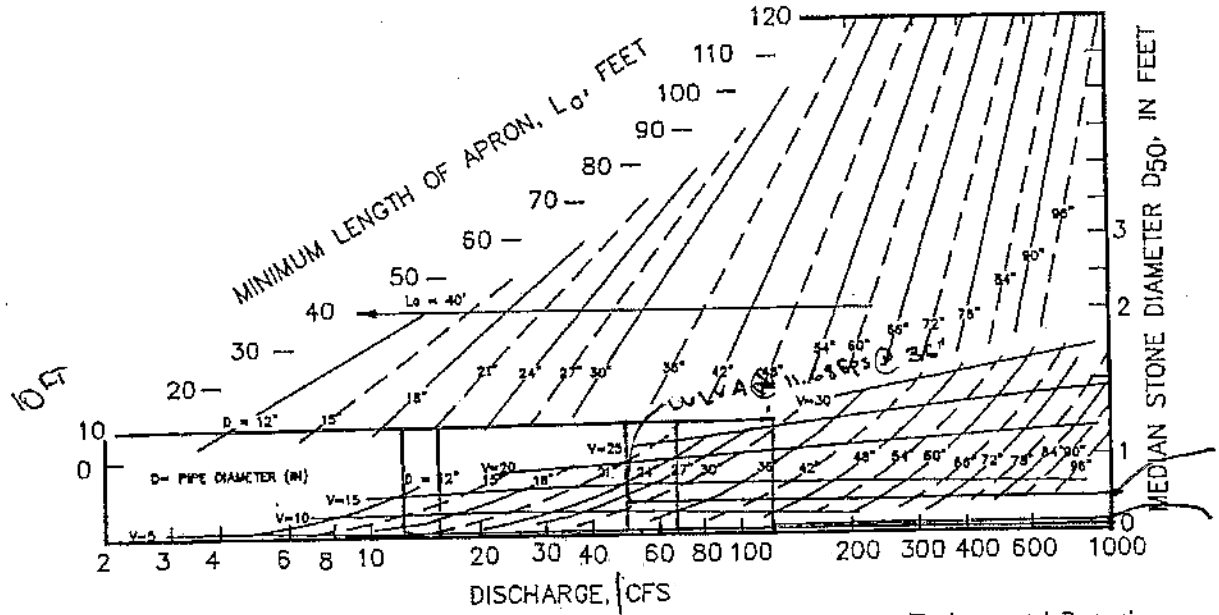


Figure 5.25 Design of outlet protection—maximum tailwater condition, $T_w \geq 0.5D$ (Environmental Protection Agency, 1976).

into the riser 3 ft below its top, what discharge will pass through the four holes with the water level at 1, 2, 4, and 8 ft above the riser? (c) What is the total discharge through the pipe? (d) How might the orifices be sized to provide better stormwater control? (e) Explain whether you would expect two rows (each consisting of four holes) of 8-in.-diameter holes to provide better results? Assume that one row is 2 ft below the riser invert and the other row is 4 ft below the riser invert.

(5.6) A gravel roadway is constructed in a low-lying area such that the roadway is frequently overtopped as a result of severe storms. The roadway is 40 ft wide, and its elevation is 36 ft. (a) If the water level upstream of the roadway is 2 ft above the crest of the roadway, what is the discharge across the roadway? (b) If the roadway is paved, what upstream depth would be required to carry the same flow? (c) Would paving reduce flooding problems?

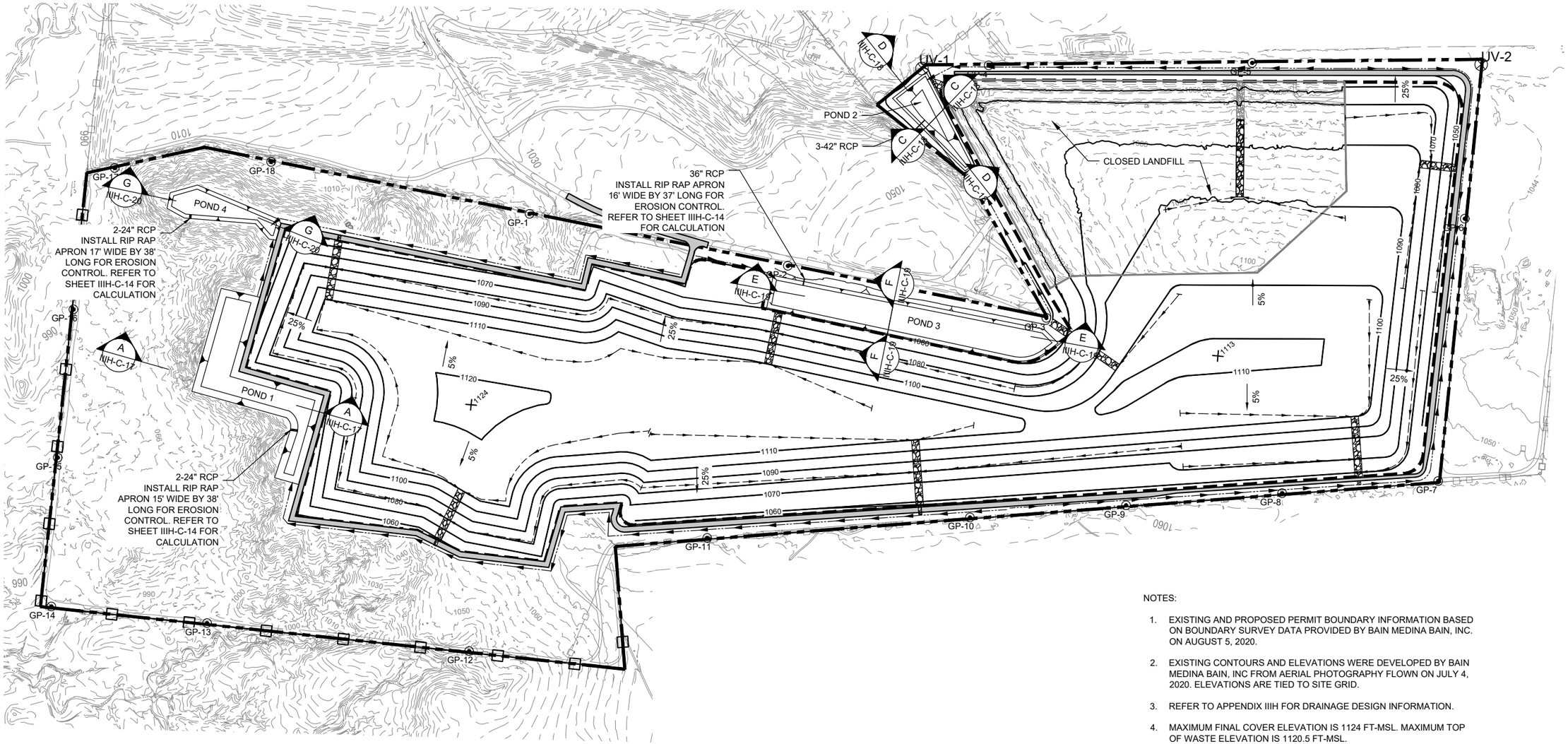
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 — FINAL COVER GRADES
- 1084 — EXISTING GRADES
- PERIMETER CHANNEL
- SWALES
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 — PROPOSED GAS PROBE
- UV-1 — PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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TBPE F-1741

CITY OF DEL RIO
TEXAS

STATE OF TEXAS
TEWOBSTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
1.	2ND TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

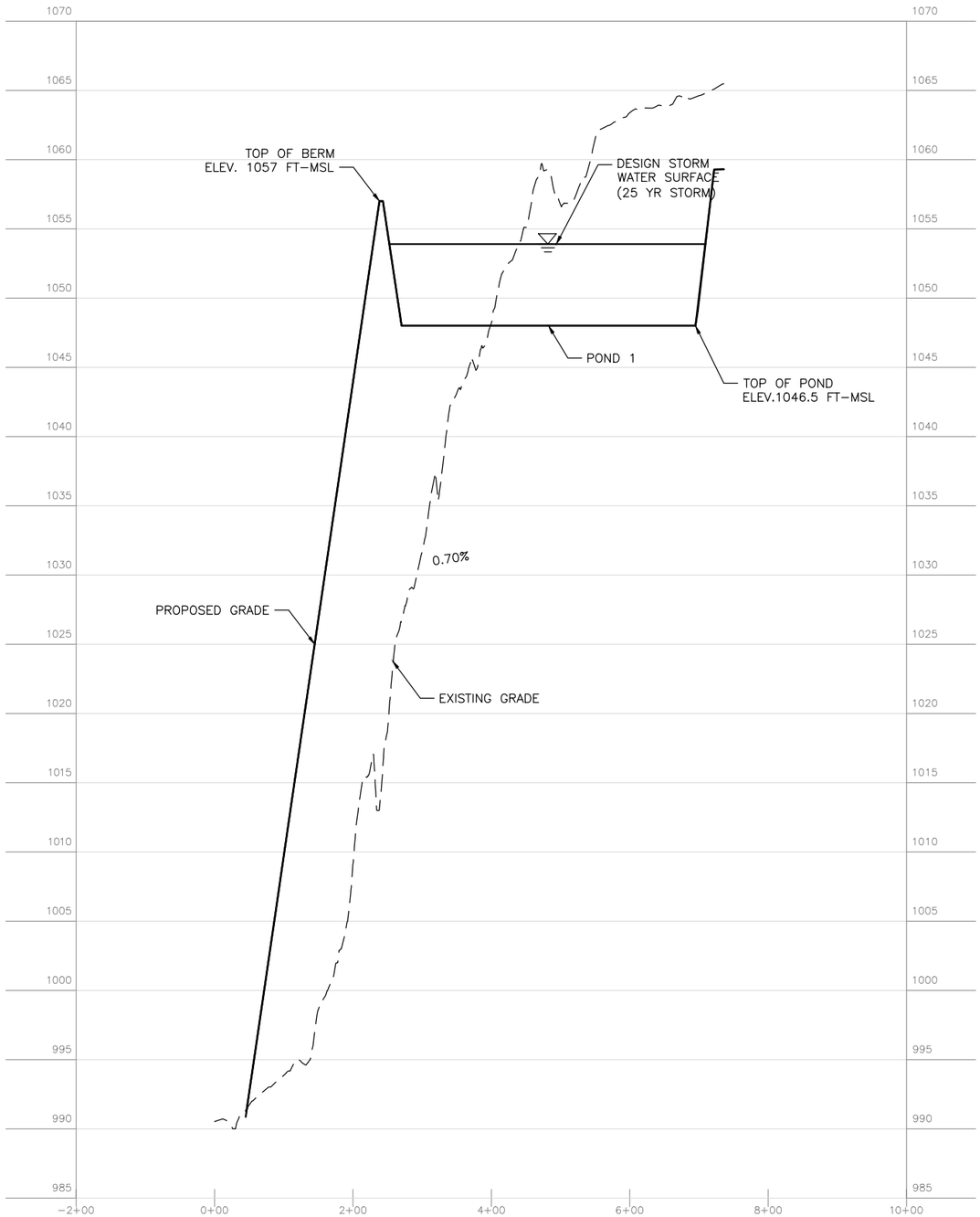
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

POND PLAN

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH-C-16

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FILE PATH: C:\pwworking\stvipw_stv1\metaferiald0942276\DELR2000302 Figure IIIH-C-16.dwg



P1 POND 1 SECTION
IIIH-C-16

0 100 200
SCALE IN FEET (HORIZONTAL)

0 5 10
SCALE IN FEET (VERTICAL)

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FILE PATH: C:\pwworkingstv\pw_stv1\metaferia\d0942276\DELR200302 Figure IIIH-C-17.dwg

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STATE OF TEXAS
TOMOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
1.	2nd TECHNICAL NOD	STV	03/ 2025

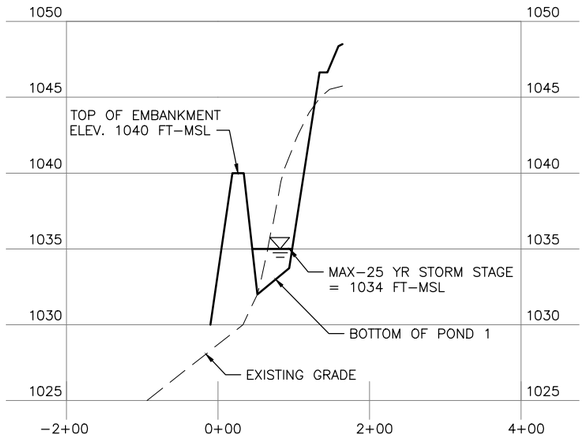
VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL
1" DRAWING. VERIFY LENGTH ON THIS SHEET
0 AND ADJUST SCALE ACCORDINGLY.

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

POND 1 SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

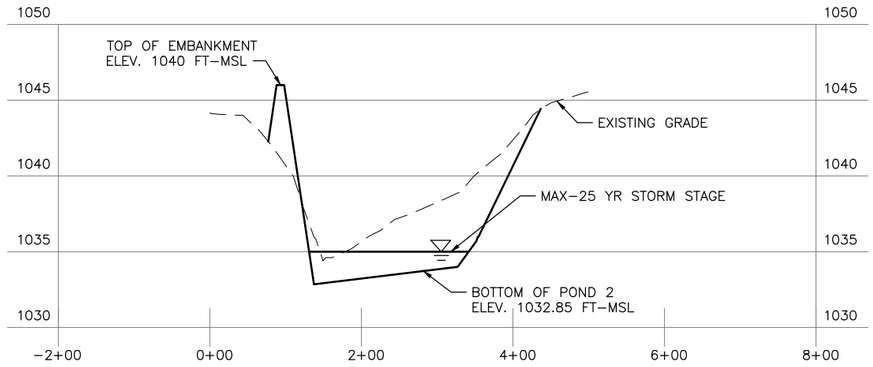
FIGURE
IIIH-C-17



C POND 2 SECTION C
IIIH–C–16

0 100 200
SCALE IN FEET (HORIZONTAL)

0 5 10
SCALE IN FEET (VERTICAL)



D POND 2 SECTION D
IIIH–C–16

0 100 200
SCALE IN FEET (HORIZONTAL)

0 5 10
SCALE IN FEET (VERTICAL)

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PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stv\pw_stv\metaferia\d0942276\DELR1900546 Figure IIIH-C-18.dwg

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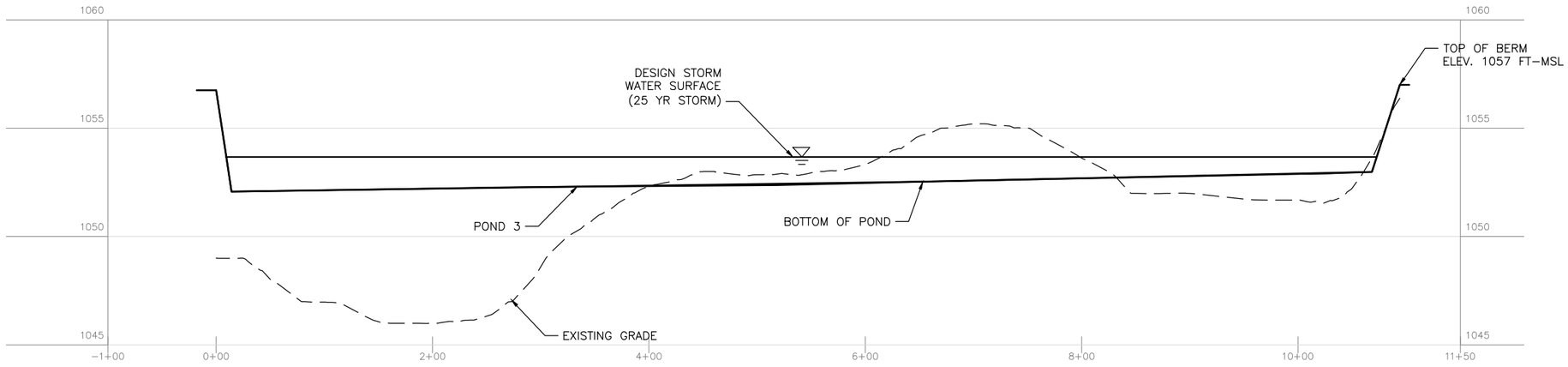
VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL
IF NOT, DRAWING \VERIFY LENGTH ON THIS SHEET
AND ADJUST SCALE ACCORDINGLY
0 1"

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POND 2 SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

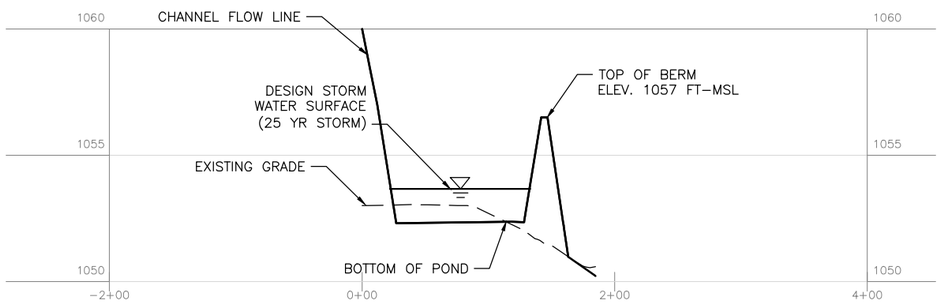
FIGURE
IIIH-C-18



E IIIH-C-16 POND 3 SECTION E

0 60 120
SCALE IN FEET (HORIZONTAL)

0 3 6
SCALE IN FEET (VERTICAL)



F IIIH-C-16 POND 3 SECTION F

0 60 120
SCALE IN FEET (HORIZONTAL)

0 3 6
SCALE IN FEET (VERTICAL)

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1.	2nd TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
1"
0

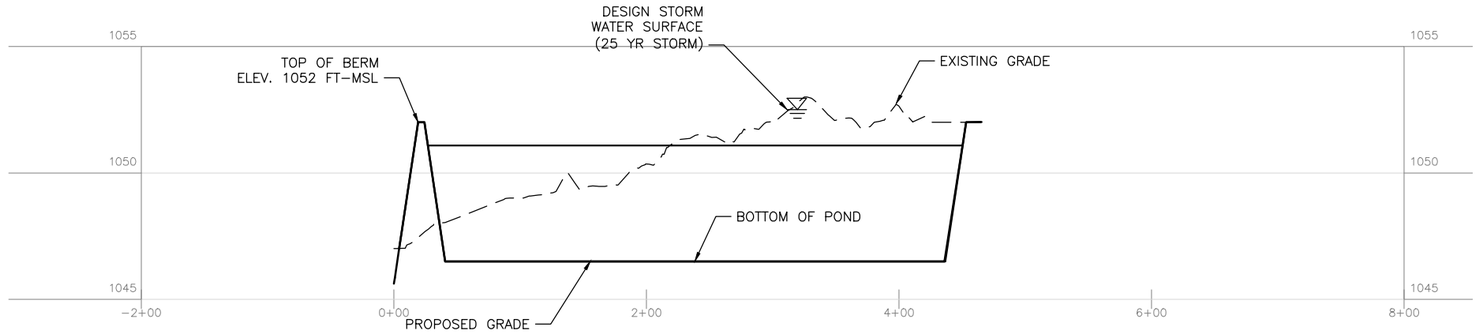
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POND 3 SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-19

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FILE PATH: C:\pwworkingfa\tv\pw_stv\tmetaferia\d0942276\DELR2000302 Figure IIIH-C-19.dwg



G IIIH-C-16 POND 4 SECTION F

0 60 120
SCALE IN FEET (HORIZONTAL)

0 3 6
SCALE IN FEET (VERTICAL)

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FILE PATH: C:\pwworkingistv\pw_stv\metaferiald\d9422761DELR2000302 Figure IIIH-C-20.dwg

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03/07/2025

NO.	REVISION	BY	DATE
1.	2nd TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

POND 4 SECTION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-C-20

Appendix IIIH-D. Final Cover Erosion Control Structure Design



TABLE OF CONTENTS

Drainage Swale Design IIIH-D-1

Drainage Letdown/Chute Design IIIH-D-7

LIST OF FIGURES

Typical Swale Drainage Areas IIIH-D-2
Letdown Drainage Areas IIIH-C-8



1.0 DRAINAGE SWALE DESIGN

Typical Swale Design Summary:

- Typical swale drainage areas analyzed are shown on sheet IIIH-D-2.
- Hydraulic calculations are summarized on page IIIH-D-4.
- Maximum normal depth is 1.47 feet (Drainage Area SW4).
- Maximum flow velocity is 2.75 fps (Drainage Area SW4).
- Vegetation will be established on the swales to protect against erosion.

Typical swale drainage areas were selected such that all slope conditions (5% and 25%) are included in this analysis. Additionally, swales with large individual drainage areas and short and long swale lengths are included in this analysis. In addition, swales shall be constructed at every 180 feet or less and shall not exceed a length of 578 feet.

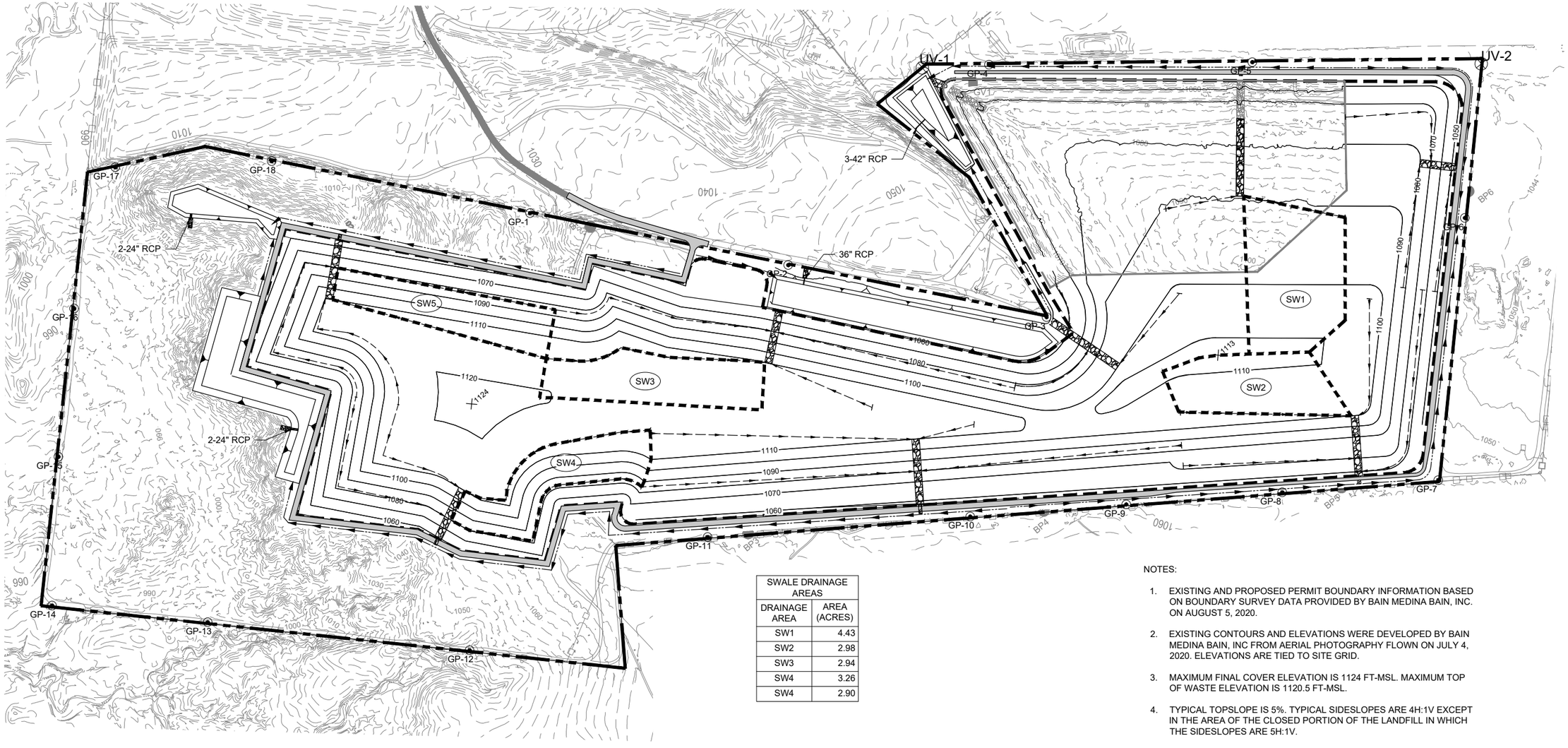
LEGEND

T7	DRAINAGE AREA DESIGNATION
	DRAINAGE BOUNDARY
	PERIMETER CHANNEL
GP-5	PROPOSED GAS PROBE
UV-1	PROPOSED GAS VENTS
	PERMIT BOUNDARY
	CLOSED CELL BOUNDARY
	LIMIT OF WASTE
1090	FINAL COVER CONTOURS
1060	EXISTING CONTOURS
	SWALES
	EXISTING SITE FENCE
	PROPOSED SITE FENCE
	EXISTING CHUTE
	CHUTES

N

0 200 400

SCALE IN FEET



SWALE DRAINAGE AREAS	
DRAINAGE AREA	AREA (ACRES)
SW1	4.43
SW2	2.98
SW3	2.94
SW4	3.26
SW4	2.90

NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
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4. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE 1" 0

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

TYPICAL SWALE
DRAINAGE AREAS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIH-D-2

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stv\pw_stv\tmetaferia\d0942276\DELR2000302 Figure IIIH-D-2.dwg

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Swale Analysis

Date: 7/24/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **Analyze typical swales to determine the adequacy of the swale design. See sheet IIIH-D-2 for typical swale draiage areas.**

Determine the 25-year intensity flow rates.

$$Q = CIA$$

Where:

C = Runoff Coefficient of 0.7 (*State of Texas, Department of Transportation, Bridge Division, Hydraulic Design Manual* , July 2016.)
I = Intensity, in/hr
A = Drainage Area, acre

$$I = \frac{b}{(t_c + d)^e}$$

b =	124.19	Based on TxDOT Refrence for Val Verde County
d =	15.51	
e =	0.8522	
t_c =	10	Assumed to be 10 minutes.
I =	7.86	in/hr

Swale	Area (ac)	Flow Rate (cfs)
SW1	4.43	24.4
SW2	2.98	16.4
SW3	2.94	16.2
SW4	3.26	17.9
SW5	2.90	16.0

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Swale Analysis

Date: 7/24/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **Analyze typical swales to determine the adequacy of the swale design. See sheet IIIH-D-2 for typical swale draiage areas.**

Swale	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n-value	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude No.	Velocity Head (ft)	Specific Energy (ft)	Flow Area (sq. ft.)	Top Width of Flow (ft)
SW1	24.4	0.005	0.03	2	20	0	1.01	2.20	0.55	0.07	1.08	11.11	22.11
SW2	16.4	0.005	0.03	2	20	0	0.87	2.00	0.53	0.06	0.93	8.25	19.05
SW3	16.2	0.005	0.03	2	20	0	0.86	1.98	0.53	0.06	0.92	8.17	18.96
SW4	17.9	0.005	0.03	2	4	0	1.47	2.75	0.56	0.12	1.59	6.52	8.84
SW5	16.0	0.005	0.03	2	4	0	1.41	2.67	0.56	0.11	1.52	5.99	8.48

Note: Calculations were performed using Bentely FlowMaster.

Maximum flow depth is 1.57 ft < 2.0 ft (swale height).

Design is okay.

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Swale Analysis

Date: 7/24/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Example Calculation: **Calculate the normal depth for the swale for drainage area SW5 (see sheet IILH-D-4).**

Example Calculation: Calculate the normal depth for the swale for drainage area SW1 (see sheet IIH-D-2).

Where:

Q_d = Design flow rate for channel, cfs
R = Hydraulic radius, ft
n = Manning's roughness coefficient
S = Channel slope, ft/ft
b = Bottom width of channel, ft
z_r = z-ratio (ratio of run to rise for channel sideslope) for right sideslope of swale
z_l = z-ratio (ratio of run to rise for channel sideslope) for left sideslope of swale
A_f = Flow area, sf
g = Gravitational acceleration = 32.2 ft/s^2
T = Top width of flow, ft
d = Normal depth of swale, ft

The program uses an iterative process to calculate the normal depth of the swale to satisfy Manning's Equation:

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Where:

Q_d =	24.37	cfs (from page IIIH-D-3)
S =	0.005	ft/ft
b =	0	ft
z_r =	2	(H) : 1 (V)
z_l =	20	(H) : 1 (V)
n =	0.03	

Step 1 - Based on the geometry of the swale cross-section, solve for R and A_f:

$$R = \frac{bd + 0.5d^2(z_r + z_l)}{b + d((z_l^2 + 1)^{0.5} + (z_r^2 + 1))}$$

$$A_f = bd + 0.5d^2(z_r + z_l)$$

Assume:

$d =$ 1.01 ft

$R =$ 0.670 ft

$A_f =$ 11.110 sf

Solve for Q:

$Q =$ 24.37

If Q is not equal to Qd, select a new d and repeat calculations.

Step 2 - Solve for velocity, T, Froude number, velocity head, and energy head.

$Q = VA$ $V = Q/A$

$V =$ 2.19 ft/s

$T = b + d(z_l + z_r)$

$T =$ 22.24 ft

$$F_r = \frac{V}{(g\,A\,/\,T)^{0.5}}$$

$F_r =$ 0.55

$$\text{Velocity Head} = \frac{V^2}{2\,g}$$

Velocity Head = 0.07 ft

Energy Head = Water Elevation (normal depth) + Velocity Head

Specific Energy = 1.08 ft

2.0 DRAINAGE LETDOWN/CHUTE DESIGN

The letdown structures are designed using gabions as a liner. Bedding for the gabions will be prepared subgrade soil overlain by 8 oz/sy geotextile. The gabions are placed along the entire chute to protect the chute bottom and the final cover from erosion due to potential erosive velocities. Tumbling flow concrete energy dissipators will be placed at the bottom end of the letdown structure to dissipate excess energy present in the water as it travels down the two and three percent slopes in the low-water crossings over the perimeter road.

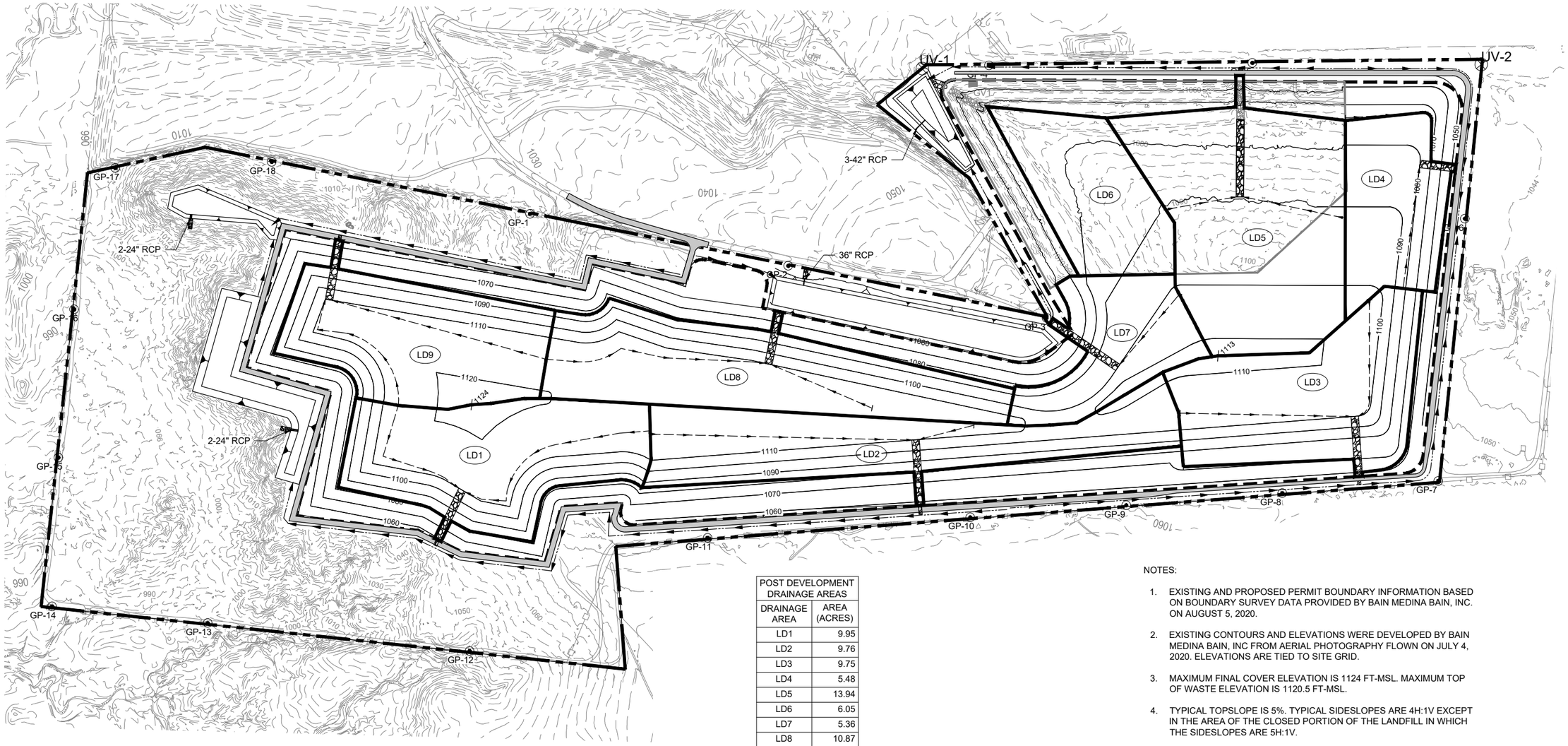
The following design information is included in this Appendix:

- 25-year Flow rates used in the chutes are presented in the HEC-1 computer program output file, pages IIIH-B-63 to IIIH-B-115.
- Chute layouts and drainage areas are shown on Sheet IIIH-D-8.

LEGEND

LD2	DRAINAGE AREA DESIGNATION
	DRAINAGE BOUNDARY
	PERIMETER CHANNEL
GP-5	PROPOSED GAS PROBE
UV-1	PROPOSED GAS VENTS
	PERMIT BOUNDARY
	CLOSED CELL BOUNDARY
	LIMIT OF WASTE
1090	FINAL COVER CONTOURS
1060	EXISTING CONTOURS
	SWALES
	EXISTING SITE FENCE
	PROPOSED SITE FENCE
	EXISTING CHUTE
	CHUTES

0 200 400
SCALE IN FEET



POST DEVELOPMENT DRAINAGE AREAS	
DRAINAGE AREA	AREA (ACRES)
LD1	9.95
LD2	9.76
LD3	9.75
LD4	5.48
LD5	13.94
LD6	6.05
LD7	5.36
LD8	10.87
LD9	9.11

NOTES:

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4. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

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CP&Y an STV company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO
TEXAS

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
2.	2ND TECHNICAL NOD	STV	03/ 2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LETDOWN DRAINAGE AREAS

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH-D-8

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stvipw_stv1\metaferiald0842276\DELR200302 Figure IIIH-D-8.dwg

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Drainage Letdown/Chute Design

Date: 7/24/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

The letdown structures are designed using gabions as a liner. Bedding for the gabions will be prepared subgrade soil overlain by 8 oz/sy geotextile. The gabions are placed along the entire chute to protect the chute bottom and the final cover from erosion due to potential erosive velocities. Tumbling flow concrete energy dissipators will be placed at the bottom end of the letdown structure to dissipate excess energy present in the water as it travels down the two and three percent slopes in the low-water crossings over the perimeter road.

Normal Depth Calculations for Chutes

Drainage Area	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n-value	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)	Froude No.	Velocity Head (ft)	Specific Energy (ft)	Flow Area (sq. ft.)	Top Width of Flow (ft)
TOP SLOPE (5%) AREAS													
LD5	67.87	0.05	0.04	4	4	13	0.72	5.93	1.34	0.55	1.27	11.44	18.76
TOP SLOPE (25%) AREAS													
LD1	91.40	0.25	0.04	4	4	13	0.54	11.19	2.87	1.95	2.49	8.17	17.31
LD2	18.60	0.25	0.04	4	4	13	0.21	6.33	2.50	0.62	0.84	2.94	14.70
LD3	85.30	0.25	0.04	4	4	13	0.52	10.93	2.86	1.86	2.38	7.80	17.14
LD4	51.98	0.20	0.04	4	4	13	0.39	9.20	2.74	1.32	1.70	5.65	16.11
LD5	67.87	0.20	0.04	4	4	13	0.45	10.11	2.80	1.59	2.04	6.71	16.63
LD6	40.84	0.20	0.04	4	4	13	0.34	8.44	2.68	1.11	1.45	4.84	15.70
LD7	47.98	0.25	0.04	4	4	13	0.37	8.94	2.72	1.24	1.61	5.36	15.96
LD8	106.89	0.25	0.04	4	4	13	0.59	11.80	2.91	2.16	2.75	9.06	17.72
LD9	82.00	0.25	0.04	4	4	13	0.51	10.79	2.85	1.81	2.32	7.60	17.05
LOW WATER CROSSING (2%) AREAS													
LD1	91.40	0.02	0.04	8	8	6	1.27	4.44	0.89	0.31	1.58	20.59	26.36
LD5	67.87	0.02	0.04	8	8	13	0.87	3.91	0.86	0.24	1.11	17.36	26.92
LD6	40.84	0.02	0.04	8	8	13	0.66	3.34	0.83	0.17	0.83	11.96	23.49
LD7	47.98	0.02	0.04	8	8	20	0.59	3.28	0.82	0.17	0.76	14.61	29.45
LD8	106.89	0.02	0.04	8	8	20	0.92	4.23	0.88	0.28	1.20	25.24	34.75
LD9	82.00	0.02	0.04	8	8	10	0.80	3.90	0.86	0.24	1.03	21.02	32.75

Note:
Calculations were performed using Bentley FlowMaster.

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Drainage Letdown/Chute Design

Date: 7/24/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Example Calculation: Calculate the normal depth for the chute for the 5% slope portion of drainage area LD3.

Where:

Q_d = Design flow rate for channel, cfs
R = Hydraulic radius, ft
n = Manning's roughness coefficient
S = channel slope, ft/ft
b = Bottom width of channel, ft
z_r = z-ratio (ratio of run to rise for channel sideslope) for right sideslope of swale
z_l = z-ratio (ratio of run to rise for channel sideslope) for left sideslope of swale
A_f = Flow area, sf
g = gravitational acceleration = 32.2 ft/s^2
T = Top width of flow, ft
d = Normal depth of swale, ft

The program uses an iterative process to calculate the normal depth of the chute to satisfy Manning's Equation:

$$Q = \frac{1.486}{n} A R^{0.67} S^{0.5}$$

Where:

Q_d =	18.60	cfs (from page IIIH-D-8)
S =	0.25	ft/ft
b =	13	ft
z =	4	(H) : 1 (V)
n =	0.04	

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Drainage Letdown/Chute Design

Date: 7/24/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Example Calculation: Calculate the normal depth for the chute for the 5% slope portion of drainage area LD3.

Step 1 - Based on the geometry of the swale cross-section, solve for R and A_f:

$$R = \frac{bd + 0.5d^2(z)}{b + 2d(z^2 + 1)^{0.5}}$$

$$A_f = bd + d^2(z)$$

Assume:

d =	0.54	ft
R =	0.470	ft
A_f =	8.170	sf

Solve for Q:

Q =	91.40	

If Q is not equal to Qd, select a new d and repeat calculations.

Step 2 - Solve for velocity, T, Froude number, velocity head, and energy head.

$Q = VA$ $\quad V = Q/A$

V =	10.93	ft/s

$T = b + 2(z \times d)$

T =	17.29	ft

$$F_r = \frac{V}{(g\,A\,/\,T)^{0.5}}$$

F_r =	2.80	

$$\text{Velocity Head} = \frac{V^2}{2g}$$

Velocity Head =	1.86	ft

Energy Head = Water Elevation (normal depth) + Velocity Head

Specific Energy =	2.38	ft

Appendix IIIH-E. Erosion Layer Evaluation



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3.1 Surface Water Diversions IIIH-E-3
3.2 Erosion Control Best Management Practices (BMPs) IIIH-E-4
3.3 Schedule, Maintenance and Recordkeeping IIIH-E-4
4.0 DAILY COVER AND NON-EXTERNAL SIDE SLOPES EROSION AND SEDIMNTATIONAL CONTROL IIIH-E-5

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1.0 INTRODUCTION

This appendix has been developed to address the requirements identified in Title 30 Texas Administrative Code (30 TAC) §330.305.

As required by 30 TAC §330.305(d), the landfill has been designed to provide effective erosional stability to top dome surfaces and external side slopes during all phases of landfill operation, closure, and post-closure care. Top dome surfaces and external side slopes are:

- those above grade slopes that directly drain to the facility surface water management system (i.e., areas where the surface water directly flows to a perimeter channel or surface water pond);.
- have received intermediate or final cover; and
- have either reached their permitted elevation, or will subsequently remain inactive for longer than 180 days.

Slopes that drain to areas of ongoing waste placement, pre-excavated areas, areas that have received only weekly cover, or areas under construction which have not received waste are not considered external side slopes.

The top dome surfaces and external side slopes will be covered with daily cover, intermediate cover, or final cover. Daily cover as defined in 30 TAC §330.165(a) will consists of six inches of well-compacted earthen material (or approved alternative) not previously mixed with garbage, rubbish, or other solid waste.

Intermediate cover is defined in 30 TAC §330.165(c) as at least 12 inches of suitable earthen material and is graded and maintained to prevent erosion and ponding of water. All areas that have received waste but will be inactive for longer than 180 days will be provided with intermediate cover. Information regarding the erosion and sediment control practices for intermediate cover is provided in Section 2 of this Plan. Additional information regarding placement, maintenance, inspection, and recordkeeping requirements for intermediate cover is located in Section 3.3 of this appendix.

Final cover is defined in 30 TAC §330, Subchapter K. As areas of the landfill reach final grade, the final cover system and the permanent surface water management system will be installed, which includes vegetated top dome and side slopes, swales, letdowns, and channels. The long-term erosional stability of the final cover slopes is presented in Appendix IIIH-D. Maintenance requirements for areas with final cover during operations and after closure are addressed in the SOP and the Post-Closure Care Plan.

2.0 FINAL COVER EROSION LAYER EVALUATION

This appendix presents the supporting documentation for evaluation of the thickness of the erosion layer for the final cover system at the Del Rio Landfill. The evaluation is based on the premise of adding excess soil to increase the time required before maintenance is needed as recommended in the EPA Solid Waste Disposal Facility Criteria Technical Manual (EPA 530-R-93-017, November 1993). The design procedure is as follows:

- Minimum thickness of the erosion layer at the end of the 30-year post-closure period is evaluated based on the depth of frost penetration or 6 inches, whichever is greater. For Val Verde County, the approximate depth of frost penetration is approximately 0.5 inches (see IIIH-E-14). Therefore, the minimum erosion layer thickness is 6.0 inches.
- Soil loss is calculated using the Universal Soil Loss Equation (USLE) by following SCS procedures. The soil loss is adjusted by a safety factor of 2 and is then converted to a thickness. The thickness of the soil loss over a 30-year post-closure period is added to the minimum thickness of the erosion layer (from Step 1) to yield an initial thickness to be placed at closure of the site. According to the USLE, the typical 5 percent topslope and 25 percent side slope require a minimum of 6.0 inches for the erosion layer. These USLE requirements include the 6-inch minimum required by regulations. Conservatively, a 12-inch erosion layer is proposed over final cover.
- Stormwater flows over the final cover system by (1) sheet flow over the topslope and sideslopes and (2) channelized flow in the drainage berms (or swales). The letdown structures are lined with gabions to prevent erosion given that the velocities in the letdowns are over 5 ft/sec.
- Sheet flow velocities for the topslope and sideslope cases for a 25-year storm event are calculated to be less than permissible nonerosive velocities. A permissible nonerosive velocity is defined as 5.0 ft/sec or less.
- Channelized flow for drainage swales is also calculated to be less than permissible nonerosive velocities. The supporting calculations are presented on pages IIIH-D-4.
- Vegetation for the site will be native and introduced grasses with root depths of 6 inches to 8 inches. The erosion layer shall also include a mixture of Bermuda, vetch, rye, wheat grass, wildflowers, and flowering plants. The TxDOT seeding for Val Verde County (Laredo District) is shown on pages IIIH-E-20 through IIIH-E-23.
- Native and introduced grasses will be hydroseeded with fertilizer on the disked (parallel to contours) erosion layer upon final grading. Temporary cold weather vegetation will be established if needed. Irrigation will be employed for 6 to 8 weeks or until vegetation is well established. Erosion control measures such as silt fences and straw bales will be used to minimize erosion until the vegetation is established. Areas that experience erosion or do not readily vegetate after hydroseeding will be reseeded until vegetation is established or the soil will be replaced with soil that will support the grasses.
- Swales shall be constructed at every 180 feet or less and shall not exceed a length of 578 feet.
- A minimum of 90% vegetation cover shall be maintained for final cover.

3.0 INTERMEDIATE COVER EROSION AND SEDIMENTATION CONTROL

Erosion control for above grade top dome surfaces and external embankment side slopes that drain directly to the site perimeter stormwater management system, have received intermediate cover, and either reached their permitted configuration or will remain inactive for longer than 180 days will be managed using a system of nonstructural and structural erosion and sediment controls to meet rule requirements for the intermediate cover phase of landfill construction.

The structural controls will consist of a combination of vegetation, temporary add-on swales, and chute structures. These structural controls will be configured in a manner that will result in a permissible soil loss of 50 tons/acre/year or less from the external slopes. The purpose will be to establish the vegetative cover percentage and swale spacing distance on all external top dome surfaces and external embankment slopes. These criteria will result in a net soil loss of 50/tons/acres/year or less for each drainage swale and chute combination specified in Appendix IIIH-D.

Mulch will be used as a layer placed over the intermediate cover to protect the exposed soil surface from erosive forces and conserve soil moisture until vegetation can be established. The mulch will be used to stabilize recently graded or seeded areas. If needed, the mulch will be spread evenly over a recently seeded area and tracked into the surface to protect the soil from erosion and moisture loss, and provide additional erosional stability to the intermediate cover surface during the establishment of vegetation. This material is not required for the establishment of vegetation on the intermediate cover unless it is needed to provide additional erosional stability to the intermediate cover surface. The mulch will be placed so as not to inhibit the growth of vegetation. In the event that the indicated vegetative ground cover required for a specific swale spacing distance is not obtained within 180 days after intermediate cover is placed on a top dome external side slope, mulch will be used as a secondary measure to limit soil loss to 50 tons/acre/year or less until vegetation is established. In the above reference cases, other erosion protection measures will only be used upon prior written authorization by TCEQ. Stormwater discharge from the site must comply with the current Texas Pollutant Discharge Elimination System for the site.

3.1 Surface Water Diversions

The type, size, and number of chute will be determined based on the size of the drainage area using the design information specified in Appendix IIIH-D.

If vegetative coverage and swale spacing configuration results in a soil loss greater than 50 ton/acre/year, the following procedure will be used to verify that an acceptable intermediate cover thickness is maintained.

- Intermediate cover areas will be inspected to detect erosion gullies and vegetation loss.
- After identifying the areas requiring additional soil, these areas will be replenished with additional soil and graded to provide uniform surfaces prior to reseeding.
- Any damaged concentrated flow drainage structures such as swales will be repaired to eliminate uncontrolled concentrated flow.

Temporary open channel chute will be inspected for erosion/hollowing through and under the lining materials (gabions, grouted riprap, and turf reinforcement) and repaired as necessary to ensure the chute is functioning as designed.

3.2 Erosion Control Best Management Practices (BMPs)

Other BMPs used in conjunction with the above erosion control measures are listed below

- Silt fences – These structures will be used in capturing sediment transported by sheet flow and for diversion of flow for controlling sediment discharge.
- Berms – These structures will be used to intercept and filter sheet flow and can be constructed from soil or a mix of mulch and compost.
- Check dams – These structures will be used in channels to slow down flow velocities and improve sediment capture.
- Biodegradable logs/filter socks – These structures consist of a biodegradable core material contained in a synthetic mesh sock or tube and are installed above, across, or below slopes to intercept and filter sheet flow.

Nonstructural controls used at the site to minimize erosion loss will include:

- plans and designs to minimize disruption of the natural features, drainage, topography, and vegetative cover features;
- phased development to minimize the area of bare soil exposed at any given time;
- plans to disturb only the smallest area necessary to perform current activities;
- scheduling of construction activities during the time of year with the least erosion potential; and
- specific plans for the stabilization of exposed surfaces in a timely manner.

3.3 Schedule, Maintenance and Recordkeeping

After an external side slope or top dome surface reaches the final permitted grade or will remain inactive for longer than 180 days, the structural erosion control features and chutes will be in place within 180 days from when intermediate cover is placed. During this 180-day period, the structural erosion control structures will be constructed, and vegetation stablished. In place of vegetation establishment, mulch may be used at the site.

At the end of the 180-day period, the cover log will be updated to document the external side slope and top dome surface area, the structural controls that were installed, and demonstration showing how the structural controls meet the 50 tons/acre/year or less soil loss requirement. Inspection requirements and schedules are listed in the SOP for all drainage features, including intermediate cover areas. Inspection and maintenance of the erosion and sediment control structures of the top dome surfaces and external embankment side slopes will follow the same schedule and methods as described in facility's SOP.

During the inspection of structural controls, if significant soil loss is identified in a given intermediate cover area, impacted areas will be replenished with additional soil. Prior to application of temporary erosion

control and seeding, the area will be graded to eliminate preferential pathways or any other uneven surface due to settlement to prevent concentrated flow over the intermediate cover areas.

Occasionally, top dome surfaces and external side slopes that have been stabilized through the use of swales, chutes and compliances with the minimum required vegetation cover specification will be disturbed due to various construction activities such as the installation or repair of a landfill gas system, regrading of an area due to ponded water caused by uneven waste settlement, the repair of erosion rills, or damage due to an extreme storm event or natural disaster. Each of these events will be documented in the SOP. Recorded information will include the date of construction, approximate area disturbed, and the date re-seeding of the disturbed area occurred. In accordance with TAC §330.165(g), previously stabilized surfaces will be repaired within 5 days of detection of the disturbances of these surfaces.

4.0 DAILY COVER AND NON-EXTERNAL SIDE SLOPES EROSION AND SEDIMNTATIONAL CONTROL

BMPs will include the use of temporary silt fences, check dams, interceptor swale and berms, temporary and permanent seeding and sodding, surface roughening, matting and mulching, sediment traps, and surface wetting for dust control. The following general guidelines provide how the erosion control features will minimize sediment discharge from the site.

- Vegetation and mulch will be used on intermediate cover areas that remain inactive to minimize erosion potential.
- Typically, uncontaminated stormwater runoff from the site will be channeled through the perimeter channel system to detention ponds before being discharged from the site. Sediment that collects in the channels and detention ponds will be removed. Erosion will be controlled by vegetation in drainage structures with flow velocities less than or equal to 5 ft/sec. For drainage structures with flow velocities greater than 5 ft/sec, rock riprap or gabions will be used for surface reinforcement.

Typical erosion control features inspection items and schedules are listed in the SOP for all drainage features, daily cover, and intermediate cover areas.

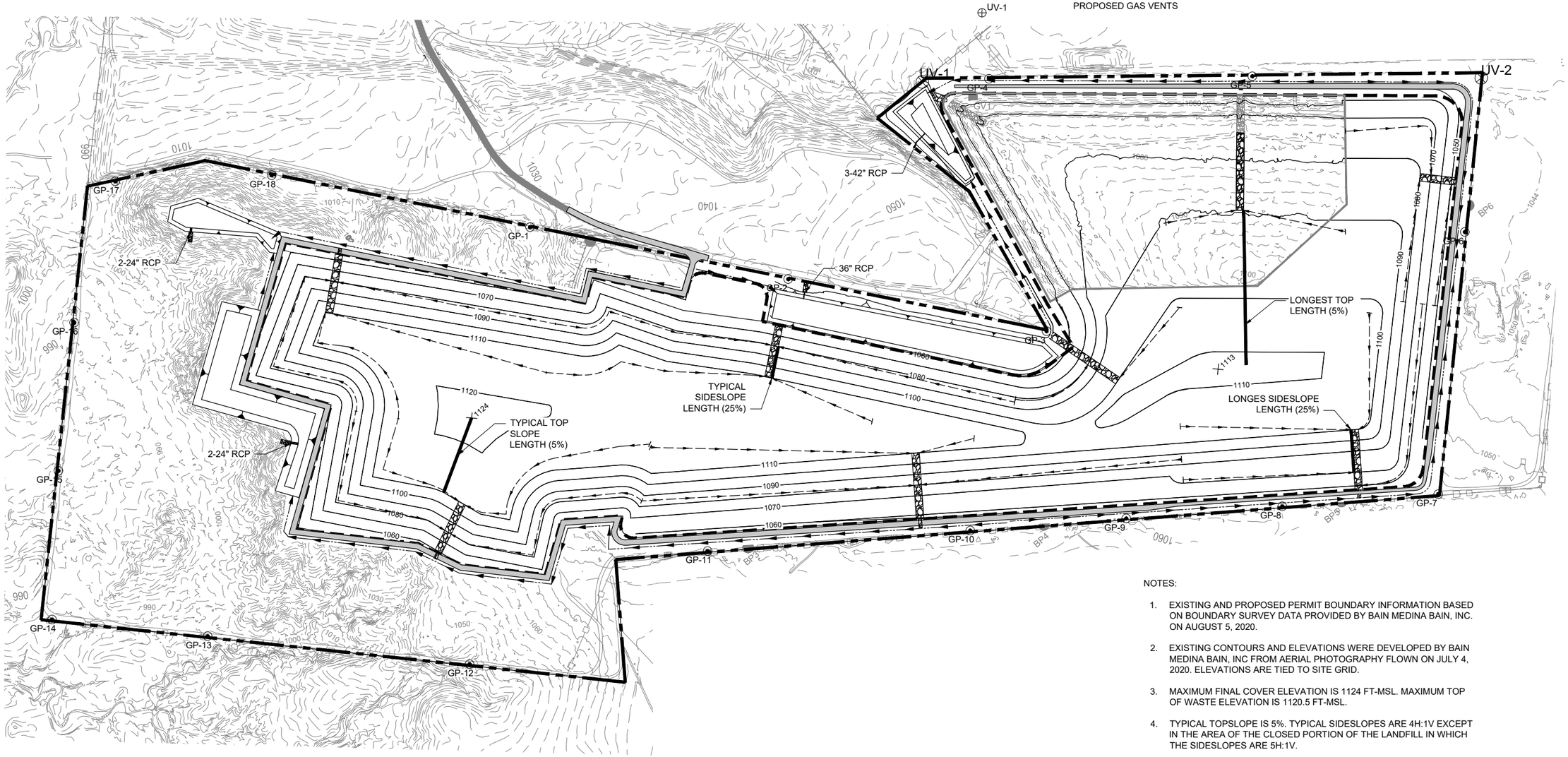
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 — FINAL COVER CONTOURS
- 1060 — EXISTING CONTOURS
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- PERIMETER CHANNEL
- GP-5 — PROPOSED GAS PROBE
- UV-1 — PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
4. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

DEL RIO TEXAS

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
2.	2ND TECHNICAL NOD	STV	03/ 2025
1.	1ST TECHNICAL NOD	STV	08/ 2024

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.

0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

LONGEST AND TYPICAL FLOW LENGTHS

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIH-E-6

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stvipw_stv1\metaferia\d0842276\DELR2000302 Figure IIIH-E-6.dwg

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 7/24/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine expected soil loss and minimum thickness for the erosion layer.**

Soil Loss Equation - $A = RKL_SCP$

Where:
A = Soil loss (tons/ac/yr)
R = Rainfall factor
K = Soil erodibility factor
Ls = Slope length/slope gradient factor
C = Plant cover or cropping management factor
P = Erosion practice factor

The rainfall factor R, represents the average intensity for the maximum intensity, 30 min storm over a 22-year period of record compiled by SCS. Using Figure 1 in the TNRCC, *Use of the USLE in Final Cover/Configuration Design* , 1993. The R factor for Val Verde County is:

R = 150

The soil erodibility factor, K represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assume an organic matter content of 2% to determine the K factor. The top soil will consist of sandy clay with high organic content. Clean compost as a soil amendment may be added to final cover top soil as necessary to protect against erosion. Therefore, the following is a K calue for the site.

K = 0.29

The slope length/slope gradient factor, Ls, represents the erosion of the soil due to both slope length and degree fo slope. The slopes of intrest are the typical side slope and top slope condition

Case 1.	Typical Top Slope	Case 2.	Longest Top Slope
Slope =	5%	Slope =	5%
Length =	298	Length =	578
Case 3.	Typical Side Slope	Case 4.	Longest Side Slope
Slope =	25%	Slope =	25%
Length =	120	Length =	160

The L_s factors were determined using the TNRCC, *Use of the USLE in Final Cover/Configuration Design* , 1993.

Case	Slope (%)	Slope Length (ft)	L_s
1. Typical Top Slope	5	298	0.9
2. Longest Top Slope	5	578	1.5
3. Typical Side Slope	25	120	6.5
4. Longest Side Slope	25	160	8.0

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 7/24/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

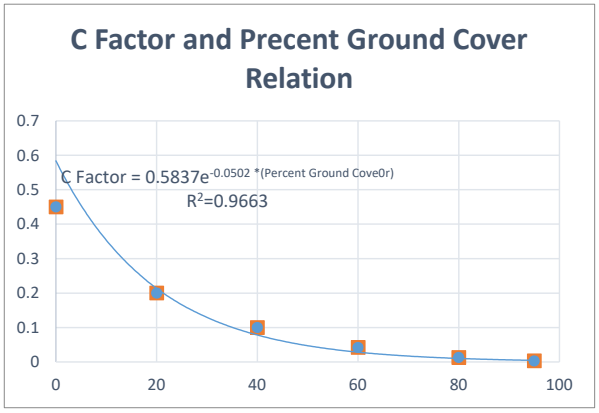
Purpose - Determine expected soil loss and minimum thickness for the erosion layer.

The plant cover or cropping management factor C, represents the percentage of soil loss that would occur if surfaces were partially protected by some combination of cover and management paractives. C factor for Permanet Pasture, Range, and Idle Land with No Appreciable Canopy has the follwoing relation with precent ground cover (GC) based on TNRCC, *Use of the USLE in Final Cover/Configuration Design* , 1993.

% GC	C Factor
0	0.45
20	0.2
40	0.1
60	0.042
80	0.013
95	0.003

$C = 0.5837e^{-0.0502*\%GC}$

C = 0.0064 (for 90% ground cover)



Erosion contro practice factor, P measures the effect of control practicesdone on site. These practices could involve drainage patterns, runoff concentration, and runoff velocity.

P = 1.00

Slope Condition	R	K	L_s	C	P	A (tons/ac/yr)
1. Typical Top Slope 5% slope 250 ft length	150	0.29	0.9	0.0064	1	0.25
2. Longest Top Slope 5% slope 415 ft length	150	0.29	1.5	0.0064	1	0.42
3. Typical Side Slope 25% slope 120 ft length	150	0.29	6.5	0.0064	1	1.81
4. Longest Side Slope 25% slope 163 ft length	150	0.29	8	0.0064	1	2.23

Note: Erosion layer will be maintained to provide 90% ground coverage

Erosion layer thickness calculations:

Minimum thickness of the erosion layer at the end of the 30-year post-closure period is evaluated based on the depth of frost penetration or 6 inches, whichever is greater. For Val Verde County, the approximate depth of frost penetration is approximately 0.5 inches (see IIIH-E-14). Therefore, the minimum erosion layer thickness is 6.0 inches.

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 7/24/2024
Job No: DELR2000302
By: A. Gardner
Checked By: T. Metaferia

Purpose - **Determine expected soil loss and minimum thickness for the erosion layer.**

1. Typical Top Slope Thickness:		
T_{el} Required Thickness =	6.00	in
Total Estimated Soil Loss =	0.00	in
Specified Thickness =	12.00	in
2. Longest Top Slope Thickness:		
T_{el} Required Thickness =	6.00	in
Total Estimated Soil Loss =	0.00	in
Specified Thickness =	12.00	in
3. Typical Side Slope Thickness:		
T_{el} Required Thickness =	6.00	in
Total Estimated Soil Loss =	0.00	in
Specified Thickness =	12.00	in
4. Longest Side Slope Thickness:		
T_{el} Required Thickness =	6.00	in
Total Estimated Soil Loss =	0.00	in
Specified Thickness =	12.00	in

Conculsion:

Calculated erosion losses are shown above. The erosion layer will be a minimum of 12 inches thick. As shown above, this is a conservative design considering the maximum expected soil loss for a 30 year period is 0.67 inches

Soil Loss Estimate Summary Table

Case	Slope (%)	Length (ft)	L_s	Percent Ground Cover	C Factor	A (tons/ac/yr)
Top Slope	5	298	0.90	70	0.017	0.71
Top Slope	5	298	0.90	80	0.013	0.54
Top Slope	5	298	0.90	90	0.0064	0.27
Top Slope	5	578	1.5	70	0.017	1.18
Top Slope	5	578	1.5	80	0.013	0.90
Top Slope	5	578	1.5	90	0.0064	0.45
Side Slope	25	120	6.5	70	0.017	5.13
Side Slope	25	120	6.5	80	0.013	3.92
Side Slope	25	120	6.5	90	0.0064	1.93
Side Slope	25	160	8.0	70	0.017	6.31
Side Slope	25	160	8.0	80	0.013	4.83
Side Slope	25	160	8.0	90	0.0064	2.38

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Sheet Flow Velocity

Date: 7/24/2024
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose - **Determinethe sheet flow velocity for the final cover system design and compare to the permissible non-erodible flow velocity.**

Use the typical case scenarios from the USLE calculation to determine the time of conentration.

Case 1: Typical top slope		
slope =	0.05	ft/ft
Length =	298	ft

Case 2: Longest top slope		
slope =	0.05	ft/ft
Length =	578	ft

Case 3: Typical side slope		
slope =	0.25	ft/ft
Length =	120	ft

Case 4: Longest side slope		
slope =	0.25	ft/ft
Length =	160	ft

Time of Concentration:

$$t_c = (0.007(nL)^{0.8})/((P_{2,24})^{0.5}*s^{0.4})$$

Where:

t_c = time of concentration (hr)
n = Manning's roughness coefficient
L = slope length
$P_{2,24}$ = 2-year, 24-hour rainfall depth (in)
S = slope (ft/ft)

Determine $P_{2,24}$: Use the TxDot, *Bridge Division Hydraulic Manual* , December 2016.

$P_{2,24}$ = 4.34 in

Calculate t_c :

Case 1:		
n =	0.24	
L =	298	ft
$P_{2,24}$ =	4.34	in
S =	0.05	ft/ft
t_c =	0.34	hr
	20.35	min

Case 2:		
n =	0.24	
L =	578	ft
$P_{2,24}$ =	4.34	in
S =	0.05	ft/ft
t_c =	0.58	hr
	34.56	min

Case 3:		
n =	0.24	
L =	120	ft
$P_{2,24}$ =	4.34	in
S =	0.25	ft/ft
t_c =	0.09	hr
	5.16	min

Case 4:		
n =	0.24	
L =	160	ft
$P_{2,24}$ =	4.34	in
S =	0.25	ft/ft
t_c =	0.11	hr
	6.50	min

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Sheet Flow Velocity

Date: 7/24/2024
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose - **Determinethe sheet flow velocity for the final cover system design and compare to the permissible non-erodible flow velocity.**

Calculate the design 25-year frequency for each condition:

$Q = CiA$

$i = b/(t_c + d)^e$

Q = Flow rate (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr)
A = draiange area (ac)

i = rainfall intensity (in/hr)
b = 124.19
d = 15.51
e = 0.8522
t_c = time of concentration (min)

A = L*W/43560

Case 1:

C =	0.7	
t_c =	20.35	min
i =	5.88	in/hr
Length =	298	ft
A =	0.0068	ac
Q =	0.028	cfs

Case 2:

C =	0.7	
t_c =	34.56	min
i =	4.42	in/hr
Length =	578	ft
A =	0.0133	ac
Q =	0.041	cfs

Case 3:

C =	0.7	
t_c =	5.16	min
i =	9.40	in/hr
Length =	120	ft
A =	0.0028	ac
Q =	0.018	cfs

Case 4:

C =	0.7	
t_c =	6.50	min
i =	8.91	in/hr
Length =	160	ft
A =	0.0037	ac
Q =	0.023	cfs

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Sheet Flow Velocity

Date: 7/24/2024
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose - **Determinethe sheet flow velocity for the final cover system design and compare to the permissible non-erodible flow velocity.**

Approximating depth of fow:

Manning's Equation

$V = (1.49/n)y^{0.67} S^{0.5}$

$V = Q/A$

$A = y*1$

$y = (Q*n/1.49S^{0.5})^{0.6}$

Case 1:

Q =	0.028	cfs
n =	0.24	
S =	0.05	ft/ft
y =	0.096	ft/ft

Case 2:

Q =	0.041	cfs
n =	0.24	
S =	0.05	ft/ft
y =	0.121	ft/ft

Case 2:

Q =	0.018	cfs
n =	0.24	
S =	0.25	ft/ft
y =	0.046	ft/ft

Case 2:

Q =	0.023	cfs
n =	0.24	
S =	0.25	ft/ft
y =	0.053	ft/ft

Determining Sheet Flow Velocity.

V = Q/A (assume unit flow widith for the flow area, A)

Case 1:

Q =	0.028	cfs
A =	0.096	sf
V =	0.292	ft/s

Case 2:

Q =	0.041	cfs
A =	0.121	sf
V =	0.340	ft/s

Case 3:

Q =	0.018	cfs
A =	0.046	sf
V =	0.397	ft/s

Case 4:

Q =	0.023	cfs
A =	0.053	sf
V =	0.436	ft/s

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 3/7/2025
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose - **Evaluate the expected soil loss from the Intermediate Cover consistent with 30 TAC §330.305(d)(2).**

Soil Loss Equation - $A = RKL_SCP$

Where:

A = Soil loss (tons/ac/yr)
R = Rainfall factor
K = Soil erodibility factor
Ls = Slope length/slope gradient factor
C = Plant cover or cropping management factor
P = Erosion practice factor

The rainfall factor R, represents the average intensity for the maximum intensity, 30 min storm over a 22-year period of record compiled by SCS. Using Figure 1 in the TNRCC, *Use of the USLE in Final Cover/Configuration Design* , 1993. The R factor for Val Verde County is:

R = 150

The soil erodibility factor, K represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assume an organic matter content of 2% to determine the K factor. The top soil will consist of sandy clay with high organic content. Clean compost as a soil amendment may be added to final cover top soil as necessary to protect against erosion. Therefore, the following is a K calue for the site.

K = 0.29

The slope length/slope gradient factor, Ls, represents the erosion of the soil due to both slope length and degree of slope. The slopes of intrest are the typical side slope and top slope condition

Case 1.	Typical Top Slope	Case 2.	Longest Top Slope
Slope =	5%	Slope =	5%
Length =	298	Length =	578
Case 3.	Typical Side Slope	Case 4.	Longest Side Slope
Slope =	25%	Slope =	25%
Length =	120	Length =	160

The L_s factors were determined using the TNRCC, *Use of the USLE in Final Cover/Configuration Design* , 1993.

Case	Slope (%)	Slope Length (ft)	L_s
Longest Top Slope	5	578	1.5
Longest Side Slope	25	160	8.0

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 3/7/2025
Job No: DELR2000302
By: A. Gardner
Checked By: B. Hindman

Purpose - **Evaluate the expected soil loss from the Intermediate Cover consistent with 30 TAC §330.305(d)(2).**

Cover Management Factor

The C factor represents the effects of plants, soil cover, soil biomass, and soil disturbing activities on erosion. For intermediate cover the City will seed or sod the cover. For intermediate cover a conservative 60% cover was assumed. Additionally, while establishing intermediate cover vegetation, the city will use mulch to reduce erosion until a 60% vegetative cover can be established.

C = 0.042 60% ground cover
C = 0.050 Mulch

Erosion contro practice factor, P measures the effect of control practicesdone on site. These practices could involve drainage patterns, runoff concentration, and runoff velocity. For purposes of calculating soil loss, the P factor is:

P = 1.00

Interim Slope Condition	R	K	L_s	C	P	A (tons/ac/yr)
1. Longest Top Slope 60% Vegetated 5% slope 415 ft length	150	0.29	1.5	0.042	1	2.74
2. Longest Top Slope Mulched 5% slope 415 ft length	150	0.29	1.5	0.05	1	3.26
3. Longest Side Slope 60% Vegetated 25% slope 163 ft length	150	0.29	8.0	0.042	1	14.62
4. Longest Side Slope Mulched 25% slope 163 ft length	150	0.29	8	0.05	1	17.40

As shown, the soil loss for both the top dome and sideslope is less than the permissible soil loss of 50 tons/acre/year for intermediate cover.

EPA

Solid Waste Disposal Facility Criteria

Technical Manual

Printed on Recycled Paper

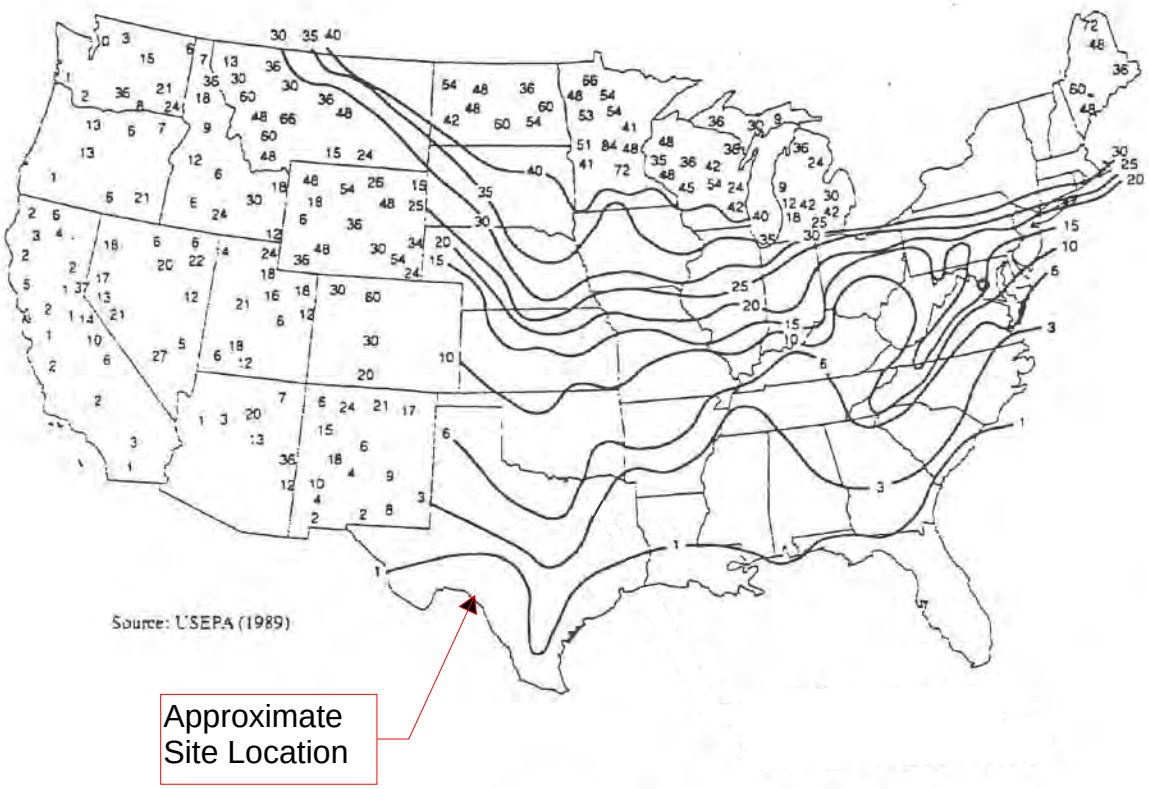


Figure 6-4
Regional Depth of Frost Penetration in Inches

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

USE OF THE UNIVERSAL SOIL LOSS EQUATION IN FINAL COVER/CONFIGURATION DESIGN

PROCEDURAL HANDBOOK

PERMITS SECTION
MUNICIPAL SOLID WASTE DIVISION

OCTOBER 1993

Table 1 Approximate Values of Factor K for USDA Textural Classes

Texture Class	Organic Matter Content		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine Sand	0.16	0.14	0.10
Very Fine Sand	0.42	0.36	0.28
Loamy Sand	0.12	0.10	0.08
Loamy Fine Sand	0.24	0.20	0.16
Loamy Very Fine Sand	0.44	0.38	0.30
Sandy Loam	0.27	0.24	0.19
Fine Sandy Loam	0.35	0.30	0.24
Very Fine Sandy Loam	0.47	0.41	0.33
Loam	0.38	0.32	0.29
Silt Loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy Clay Loam	0.27	0.25	0.21
Clay Loam	0.28	0.25	0.21
Silty Clay Loam	0.37	0.32	0.26
Sandy Clay	0.14	0.13	0.12
Silty Clay	0.25	0.23	0.19
Clay	0.13 - 0.29		K=.29

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

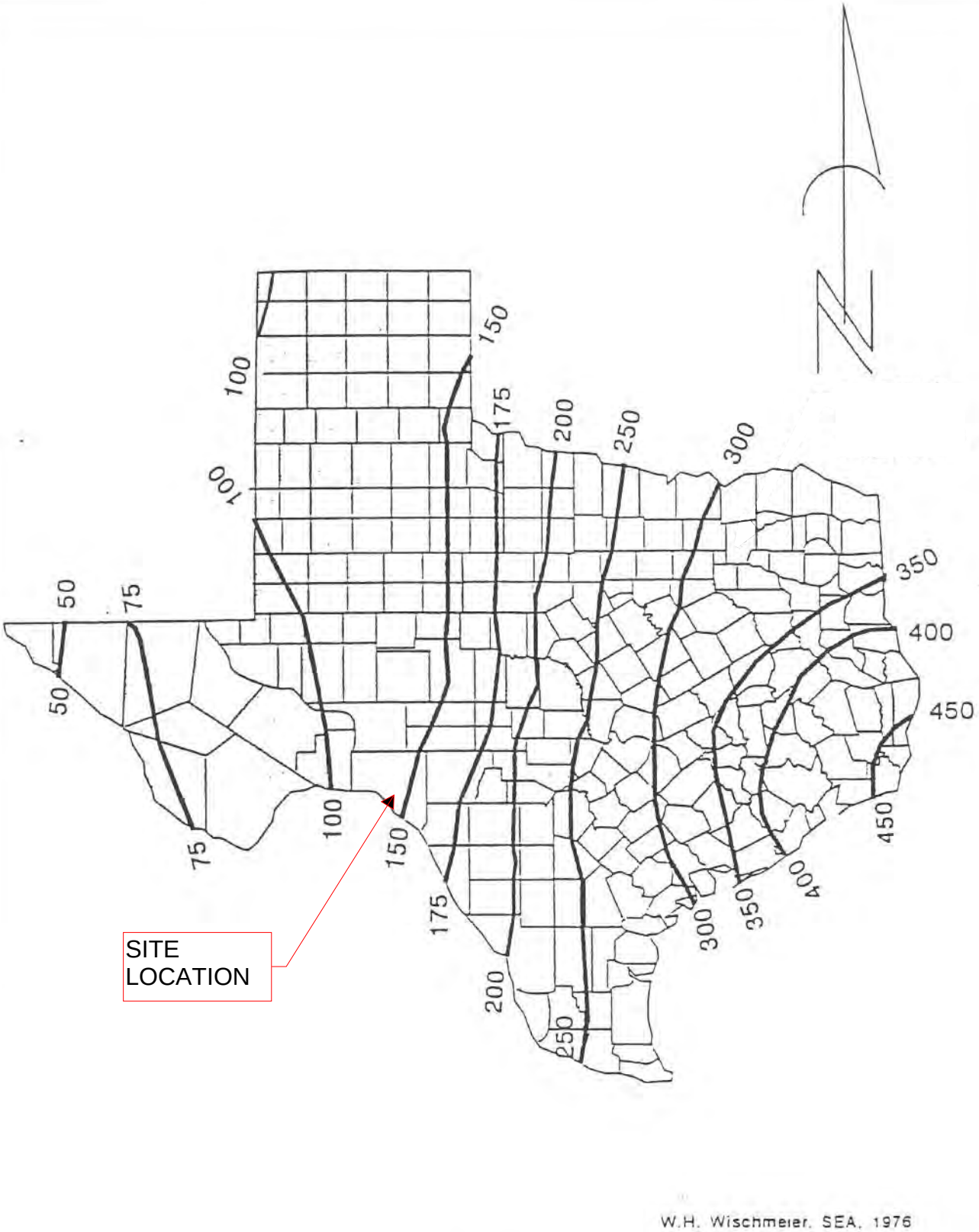


FIGURE 1. - AVERAGE ANNUAL VALUES OF THE RAINFALL EROSION INDEX

Table 2 Factor C for permanent pasture, range, and idle land[1]

Vegetative Canopy		Cover that contacts the soil surface					
Type and height[2]	Percent cover[3]	Percent ground cover					
		0	20	40	60	80	95+
No Appreciable Canopy		0.45	0.20	0.10	0.042	0.013	0.003
Tall weeds or short brush with average drop fall height of 20 in.	25	0.36	0.17	0.09	0.038	0.013	0.011
	50	0.26	0.13	0.07	0.035	0.012	0.003
	75	0.17	0.10	0.06	0.032	0.011	0.003

Extracted from:
United States Department of Agriculture, AGRICULTURE HANDBOOK NUMBER 537

1 The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.

2 Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

3 Portions of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

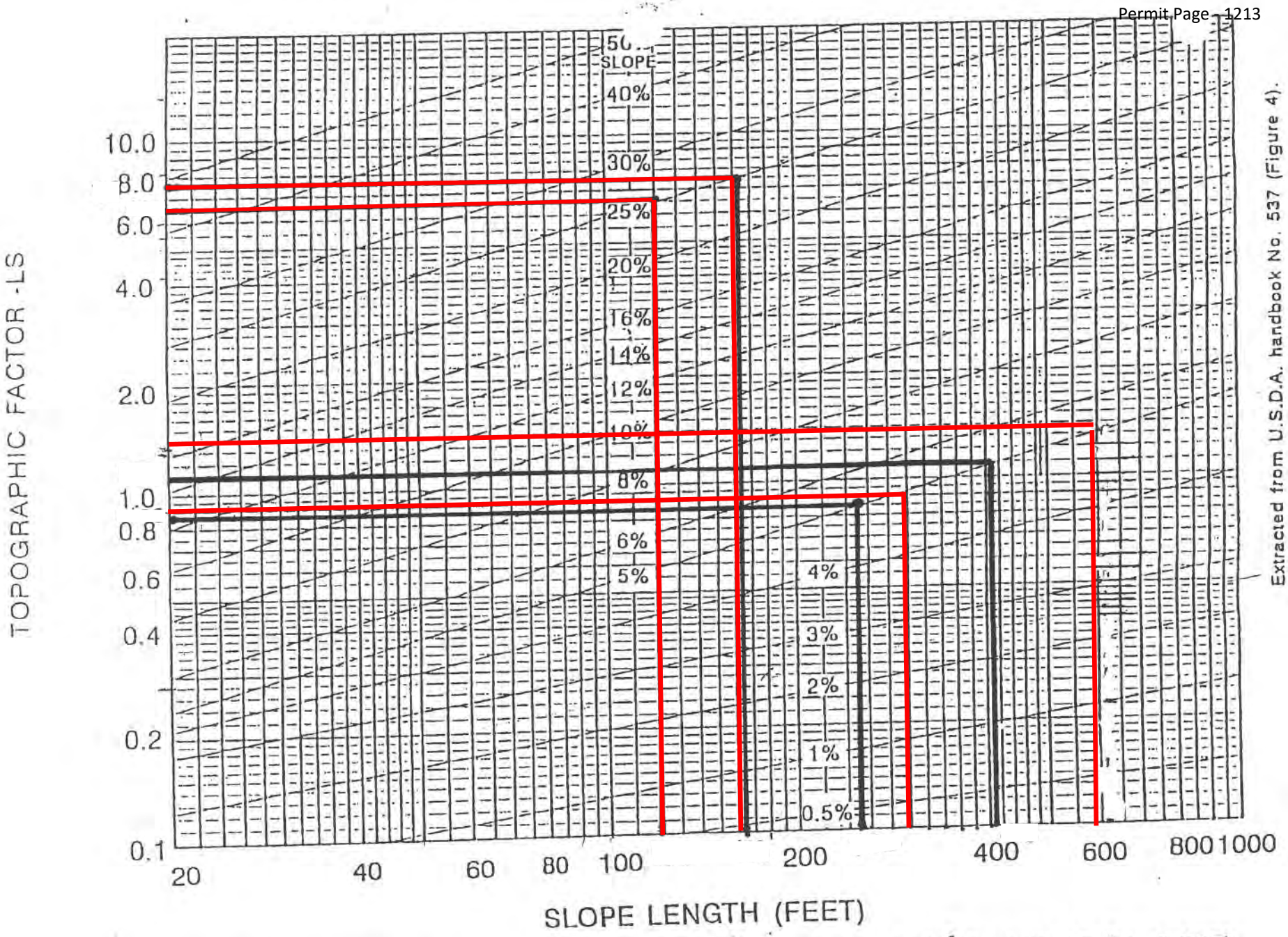


FIGURE 2.- Slope effect chart (topographic factor, LS). LS = (λ/72.6)‴ 65.41 $\sin^2$ ()=4.56 sin ()+ 0.065) where λ= slope lenght in feet ;()=angle of slope; and m = 0.2 for gradients <1 percent, 0.3 for 1 to 3 slopes; 0.4 for 3.5 to 4.5 percent slopes, and 0.5 for slopes of 5 percent or steeper.



Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

Adopted by the
Texas Department of Transportation

November 1, 2014

Table 1 (continued)

Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
18 (Dallas) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Purple Prairie Clover (Cuero) Engelmann Daisy (Eldorado) Illinois Bundleflower Awnless Bushsunflower (Plateau)	1.0 1.0 1.0 0.4 0.2 0.8 0.6 0.75 1.3 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Slender Grama (Dilley) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover	1.0 0.2 0.2 0.4 1.0 0.2 0.2 0.6 0.8 0.75 0.3
19 (Atlanta) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Illinois Bundleflower	0.3 2.4 4.5 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Lance-Leaf Coreopsis	0.3 2.1 7.5 0.6 1.0
20 (Beaumont) Jan. 15–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Illinois Bundleflower	0.3 2.7 4.1 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Lance-Leaf Coreopsis	0.3 2.1 7.5 0.6 1.0
21 (Pharr) Jan. 15–May 15	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Hooded Windmillgrass (Mariah) Arizona Cottontop (La Salle)	1.0 1.0 1.0 1.0 0.2 0.6 0.2 0.2 0.1 0.2 0.2	Green Sprangletop (Van Horn) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Plains Bristlegrass (Catarina Blend) Hooded Windmillgrass (Mariah) Multi-flowered False Rhoades Grass (Hidalgo) Arizona Cottontop (La Salle)	1.0 2.0 0.6 0.4 0.6 0.2 0.3 0.1 0.2
22 (Laredo) Jan. 15–May 1	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Hooded Windmillgrass (Mariah) Arizona Cottontop (La Salle)	1.0 1.0 1.0 1.0 0.2 0.6 0.2 0.2 0.1 0.2 0.2	Green Sprangletop (Van Horn) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Plains Bristlegrass (Catarina Blend) Hooded Windmillgrass (Mariah) Multi-flowered False Rhoades Grass (Hidalgo) Arizona Cottontop (La Salle)	1.0 2.0 0.6 0.4 0.6 0.2 0.3 0.1 0.2
23 (Brownwood) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Blue Grama (Hachita) Western Wheatgrass (Barton) Galleta Grass (Viva) Engelmann Daisy (Eldorado) Awnless Bushsunflower (Plateau)	0.6 1.0 1.0 0.4 0.2 0.8 0.4 1.2 0.6 0.75 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover (Cuero)	1.0 0.2 0.2 0.4 0.2 0.2 0.6 0.8 0.75 0.3

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
9 (Waco) Feb. 1–May 15	Green Sprangletop Bermudagrass Buffalograss (Texoka) Sideoats Grama (Haskell)	0.3 1.8 1.6 4.5	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
10 (Tyler) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
11 (Lufkin) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
12 (Houston) Jan. 15–May 15	Green Sprangletop Sideoats Grama (Haskell) Bermudagrass	0.3 4.5 2.4	Green Sprangletop Bermudagrass	0.3 5.4
13 (Yoakum) Jan. 15–May 15	Green Sprangletop Sideoats Grama (South Texas) Bermudagrass	0.3 4.5 2.4	Green Sprangletop Bermudagrass	0.3 5.4
14 (Austin) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (South Texas) Buffalograss (Texoka)	0.3 2.4 3.6 1.6	Green Sprangletop Bermudagrass Buffalograss (Texoka)	0.3 4.8 1.6
15 (San Antonio) Feb. 1–May 1	Green Sprangletop Sideoats Grama (South Texas) Bermudagrass Buffalograss (Texoka)	0.3 3.6 2.4 1.6	Green Sprangletop Bermudagrass Buffalograss (Texoka)	0.3 4.8 1.6
16 (Corpus Christi) Jan. 1–May 1	Green Sprangletop Sideoats Grama (South Texas) Bermudagrass Buffalograss (Texoka)	0.3 3.6 2.4 1.6	Green Sprangletop Bermudagrass Buffalograss (Texoka)	0.3 4.8 1.6
17 (Bryan) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
18 (Dallas) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Buffalograss (Texoka) Bermudagrass	0.3 3.6 1.6 2.4	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
19 (Atlanta) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
20 (Beaumont) Jan. 15–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
21 (Pharr) Jan. 15–May 15	Green Sprangletop Sideoats Grama (South Texas) Buffalograss (Texoka) Bermudagrass	0.3 3.6 1.6 2.4	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
22 (Laredo) Jan. 15–May 1	Green Sprangletop Sideoats Grama (South Texas) Buffalograss (Texoka) Bermudagrass	0.3 4.5 1.6 1.8	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed	0.3 1.6 3.6 0.4
23 (Brownwood) Feb. 1–May 15	Green Sprangletop Sideoats Grama (Haskell) Bermudagrass Blue Grama (Hachita)	0.3 3.6 1.2 0.9	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
24 (El Paso) Feb. 1–May 15	Green Sprangletop Sideoats Grama (South Texas) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Buffalograss (Texoka) Sand Dropseed (Borden Co.) Blue Grama (Hachita)	0.3 1.6 0.4 1.8
25 (Childress) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sand Dropseed (Borden Co.) Buffalograss (Texoka) Bermudagrass	0.3 0.4 1.6 1.8

Table 3
Temporary Cool Season Seeding

Districts	Dates	Seed Mix and Rates (lb. PLS/acre)	
Paris (1), Amarillo (4), Lubbock (5), Dallas (18)	September 1–November 30	Tall Fescue Western Wheatgrass Wheat (Red, Winter)	4.5 5.6 34
Odessa (6), San Angelo (7), El Paso (24)	September 1–November 30	Western Wheatgrass Wheat (Red, Winter)	8.4 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1–November 30	Tall Fescue Oats Wheat	4.5 24 34
Houston (12), Yoakum (13), Corpus Christi (16), Beaumont (20), Pharr (21), Laredo (22)	September 1–November 30	Oats	72
Ft. Worth (2), Wichita Falls (3), Abilene (8), Brownwood (23), Childress (25)	September 1–November 30	Tall Fescue Western Wheatgrass Cereal Rye	4.5 5.6 34

Table 4
Temporary Warm Season Seeding

Districts	Dates	Seed Mix and Rates (lb. PLS/acre)	
All	May 1–August 31	Foxtail Millet	34

2.2. **Fertilizer**. Use fertilizer in conformance with Article 166.2., "Materials."

2.3. **Vegetative Watering**. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

2.4. **Mulch**.

2.4.1. **Straw or Hay Mulch**. Use straw or hay mulch in conformance with Section 162.2.5., "Mulch."

2.4.2. **Cellulose Fiber Mulch**. Use only cellulose fiber mulches that are on the Approved Products List, *Erosion Control Approved Products*. (http://www.txdot.gov/business/resources/erosion-control.html) Submit one full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.

2.5. **Tacking Methods**. Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or hay mulch operations. Use tacking agents as approved or as specified on the plans.

3. CONSTRUCTION

Cultivate the area to a depth of 4 in. before placing the seed unless otherwise directed. Use approved equipment to vertically track the seedbed as shown on the plans or as directed. Cultivate the seedbed to a depth of 4 in. or mow the area before placement of the permanent seed when performing permanent seeding after an established temporary seeding. Plant the seed specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans.

3.1. **Broadcast Seeding**. Distribute the seed or seed mixture uniformly over the areas shown on the plans using hand or mechanical distribution or hydro-seeding on top of the soil unless otherwise directed. Apply the mixture to the area to be seeded within 30 min. of placement of components in the equipment when seed and water are to be distributed as a slurry during hydro-seeding. Roll the planted area with a light roller or other suitable equipment. Roll sloped areas along the contour of the slopes.

CITY OF DEL RIO LANDFILL
VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW 207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIJ
GEOLOGY REPORT



Prepared by:

WSP USA Environment & Infrastructure Inc.
16414 San Pedro Avenue, Suite 425
San Antonio, Texas 78232

Project No. 5020210002
February 2023
Revision 1, August 2024
Revision 2, December 2024

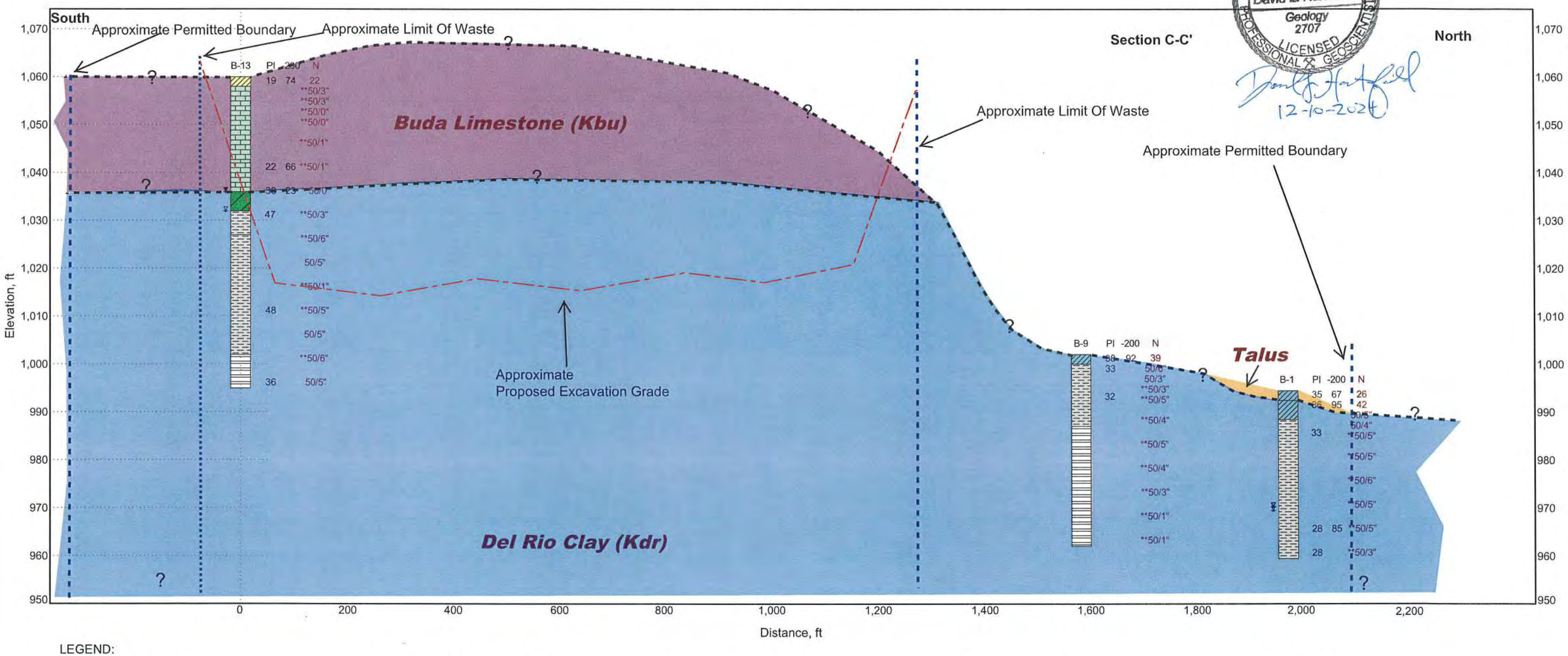
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APPENDIX IIIJ-D

Site Stratigraphic Cross-Sections

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND:

- Gravelly Fat Clay
- USCS High Plasticity Clay
- Clay Shale
- Clay-Shale
- USCS Low Plasticity Clay
- Limestone
- USCS Clayey Sand

NOTES:

The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

STATE OF TEXAS
David L. Hartsfield
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12-10-2024

Project Mngr:	SKM
Drawn By:	MEB
Checked By:	JRM
Reviewed By:	SKM
Project No.	2020-221
Scale:	AS SHOWN
Date:	12-04-2024

GENERALIZED STRATIGRAPHY

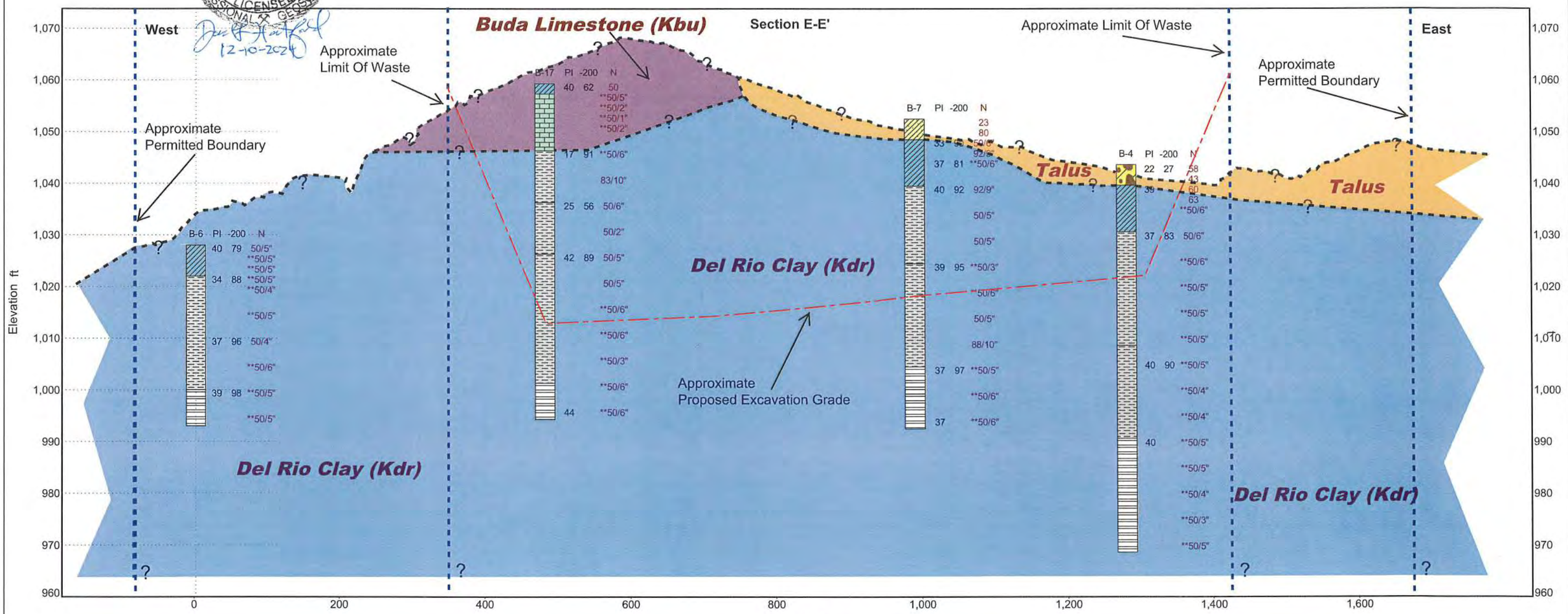
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12-10-2024

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND:

- USCS Clayey Gravel
- USCS High Plasticity Clay
- Clay Shale
- Clay-Shale
- USCS Low Plasticity Sandy Clay
- Gravelly Fat Clay
- Limestone

NOTES:

The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

wsp

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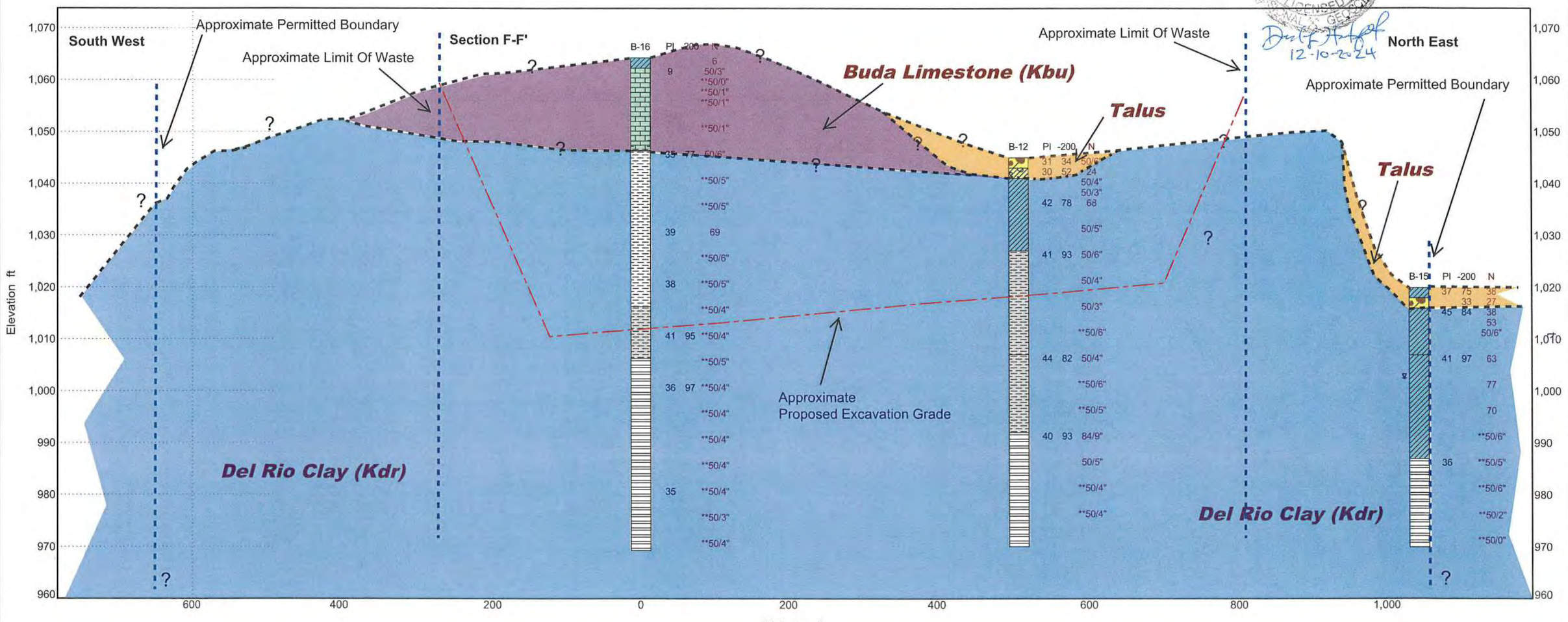
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Del Rio Landfill Expansion

Del Rio, Texas



LEGEND:

- Clayey Gravel (GC)
- Gravelly Lean Clay (CL)
- Fat Clay (CH)
- Clay Shale
- Clay-Shale
- Gravelly Fat Clay (CH)
- Limestone

NOTES:

The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data.
The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle.
PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

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GENERALIZED STRATIGRAPHY

City of Del Rio Landfill Expansion Project

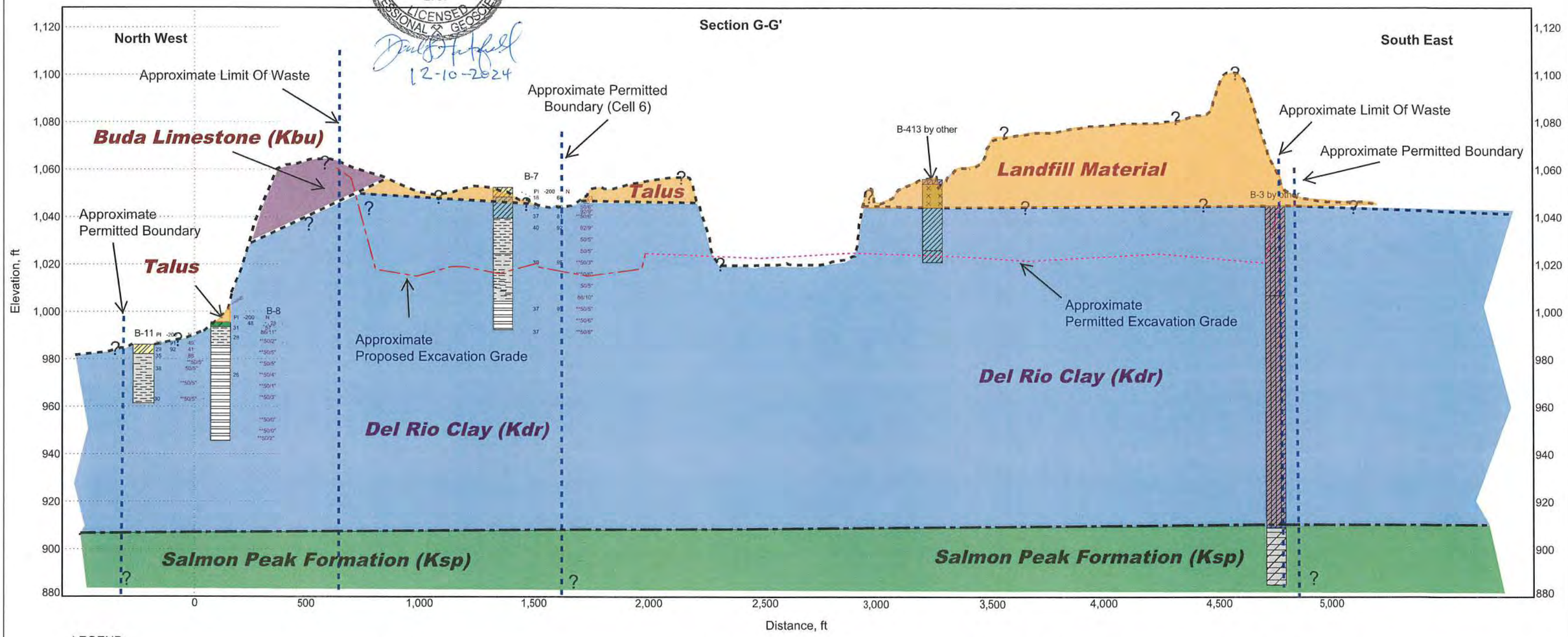
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Del Rio Landfill Expansion

Del Rio, Texas

Section G-G'



LEGEND:

- Silty Clay
- Clay Shale
- USCS Low Plasticity Sandy Clay
- USCS High Plasticity Clay
- Clay-Shale
- Marl
- USGS Clayey Sand
- USCS Low Plasticity Clay
- Clay and Caliche

NOTES:

The represented stratigraphy is based on the geotechnical engineer's interpretation of field and laboratory data. The depth where water was first encountered during drilling is depicted with an open triangle; the depth where water rose is depicted with a solid triangle. PI and -200 represent plasticity index and fines content for the sampled interval, with data shown at the top of interval indicated on the boring logs.

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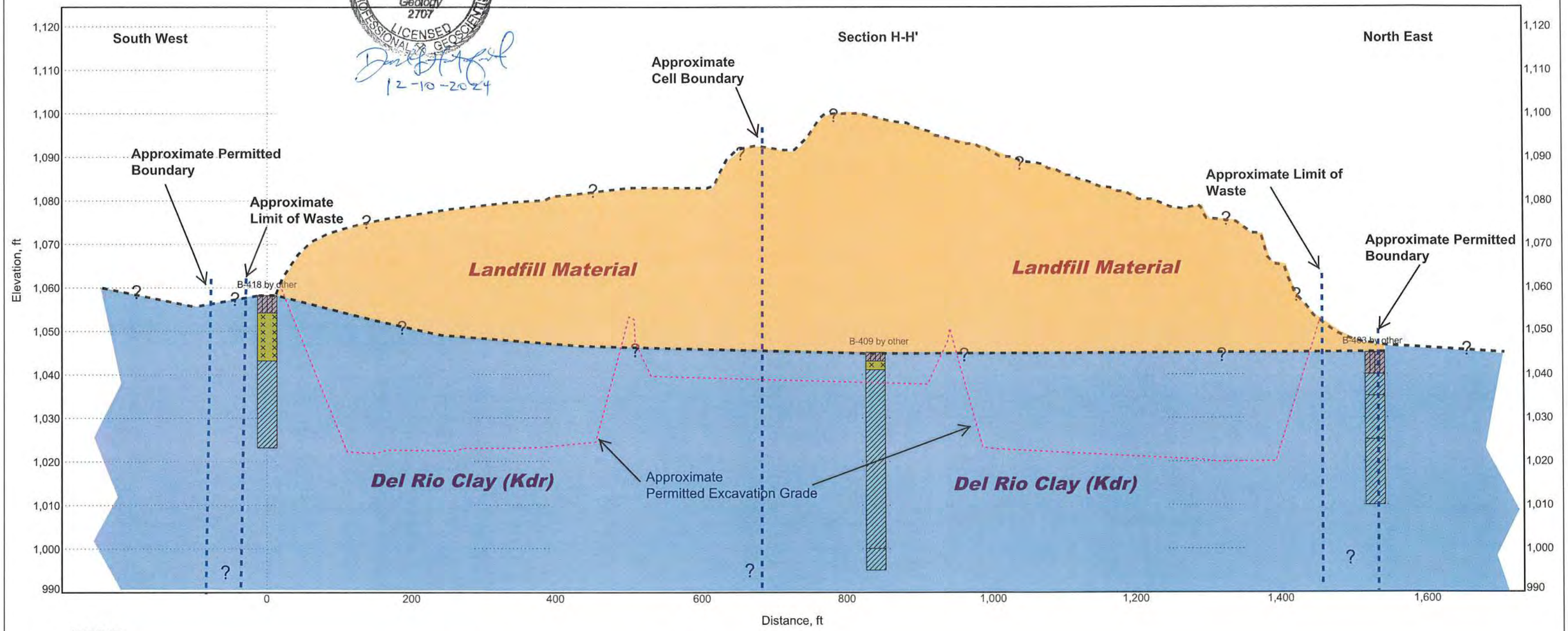
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12-10-2024

Del Rio Landfill Expansion

Del Rio, Texas



LEGEND:

- Silty Clay
- USCS High Plasticity Clay
- Clay and Caliche

wsp	Project Mngr: SKM Drawn By: MEB Checked By: JRM Reviewed By: SKM	Project No. 2020-221 Scale: AS SHOWN Date: 12-04-2024	**GENERALIZED STRATIGRAPHY** **City of Del Rio Landfill Expansion Project** Del Rio, Val Verde County, Texas

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS

TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIK
WASTE CONTAINMENT POINT OF COMPLIANCE

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
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Table 3-1 – Typical Chemical Constituent Concentrations in Leachate

Constituent	MCL Listed in §330.331(a)(1) (mg/l)	Leachate Quality Information Historically Used for POC Demonstrations in Texas (mg/l)[1])[1]	Minimum Dilution Attenuation Factor
Arsenic	0.05	5.0	100
Barium	1.0	100.0	100
Benzene	0.005	0.814	163
Cadmium	0.01	1.0	100
Carbon tetrachloride	0.005	0.5	100
Chromium (hexavalent)	0.05	5.0	100
2,4-Dichlorophenoxy acetic acid	0.1	10.0	100
1,4-Dichlorobenzene	0.075	7.5	100
1,2-Dichloroethane	0.005	0.5	100
1,1-Dichloroethylene	0.007	0.7	100
Endrin	0.0002	0.05	250
Fluoride	4		
Lindane	0.004	0.4	100
Lead	0.05	5.0	100
Mercury	0.002	0.2	100
Methoxychlor	0.1		
Nitrate	10		
Selenium	0.01	1.0	100
Silver	0.05	5.0	100
Toxaphene	0.005	0.5	100
1,1,1-Trichloroethane	0.2		
Trichloroethylene	0.005	1.3	260
2,4,5-Trichlorophenoxy acetic acid	0.01	1.0	100
Vinyl Chloride	0.002	0.2	100

[1.] Estimated leachate concentration values reported from the Texas Water Commission Alternative Liner Design Handbook, August 1993.

The second data used to calculate the DAF is the Del Rio Landfill leachate concentration. Table 3-2 lists the MCL's listed in 330.331(a)(1) and the site-specific leachate constituent levels. The leachate constituent's concentration for the Del Rio Landfill are at or below the MCL's set forth in 330.331(a)(1). The leachate sampling was done in 2021 and the results are included in Appendix IIIK-D.

The highest listed DAF based on the site's leachate quality is 1, which indicates that Mercery, Toxaphene, and Selenium concentration would have to be reduced by a factor of 1 prior to the constituent reaching the POC to meet the MCL listed in the TAC. The calculated DAF for the other constituents in Table 3-2 is less than one.

Table 3-2 – Chemical Constituent MCLs and Del Rio LF Leachate Quality

Constituent	MCL Listed in §330.331(a)(1) (mg/l)	Del Rio Landfill Leachate Quality Information[1] (mg/l)	Minimum Dilution Attenuation Factor
Arsenic	0.05	0.010	
Barium	1.0	0.047	
Benzene	0.005	0.001	
Cadmium	0.01	0.005	
Carbon tetrachloride	0.005	0.001	
Chromium (hexavalent)	0.05	0.003	
2,4-Dichlorophenoxy acetic acid	0.1		
1,4-Dichlorobenzene	0.075	0.001	
1,2-Dichloroethane	0.005	0.001	
1,1-Dichloroethylene	0.007	0.001	
Endrin	0.0002	0.00005	
Fluoride	4	2.44	
Lindane	0.004		
Lead	0.05	0.005	
Mercury	0.002	0.002	1.00
Methoxychlor	0.1	0.00005	
Nitrate	10	0.2	
Selenium	0.01	0.010	1.00
Silver	0.05	0.010	
Toxaphene	0.005	0.005	1.00
1,1,1-Trichloroethane	0.2	0.001	
Trichloroethylene	0.005	0.001	
2,4,5-Trichlorophenoxy acetic acid	0.01	0.002	
Vinyl Chloride	0.002	0.001	

1. Data was obtained from the leachate sampling was done in September 2021.

4.0 SITE GEOLOGY

Multiple site investigations have been conducted at the City of Del Rio Landfill facility to characterize the subsurface conditions at the site. A summary of the borings from the previous and current site investigation is included in Appendix IIIJ.

5.2.2 Groundwater Investigation 2020

Arias Geoprofessionals , Inc. (Arias) installed seventeen (17) boring of which ten (10) were converted to piezometers in November 2020 on a 75-ac tract of land located adjacent to the landfill. During installation, water was encountered at three of the 10 piezometer locations as follows:

- B-1
- B-15
- B-13

No water was observed in the other seven (7) piezometers over the two-year monitoring period. Based on the analysis of the boring logs prepared by Arias, and taking the local topography into account, shallow groundwater encountered during the boring and sampling operations in borings B-1, B-15 and B-13 occurs in three distinct, vertically separated perched groundwater systems within the Del Rio Clay. Refer to Appendix IIIN Section 4.3 for additional information.

Generally speaking, the upper 80 feet of the subsurface tends to be fractured. This can be due to a combination of conditions such as shrinking and swelling of clay-rich formations, formation of desiccation cracks, and/or elastic behavior caused by erosion and removal overburden pressure over time. Fracturing provides a flow pathway for seepage from the surface to migrate downward into perched groundwater zones. The recharge to these perched groundwater systems occurs as the result of precipitation events and vertical seepage from the surface downward.

Groundwater flow in shallow groundwater systems closely mimics surface topography. Consequently, flow in each of the perched groundwater systems encountered at the site will generally be to the southwest where flow exits to the surface in Calaveras Creek. All three of the perched systems occur at elevations that are above the elevation of Calaveras Creek which is at an elevation of approximately 960 feet above mean sea level. Perched groundwater is found in porous saturated zones at an elevation that is higher than the local or regional groundwater table. The three perched zones identified for this project all occur within the Del Rio Confining Unit at elevations that are higher than the regional potentiometric surface of the Edwards Hydrologic Unit. All three zones daylight into the creek which supports the interpretation that these zones are perched.

5.3 Groundwater Waiver

The City is requesting to extend the groundwater waiver as part of this Major Permit Amendment Application. Refer to Appendix IIIC Alternative Liner Design.

Appendix IIIK-A. LEACHATE GENERATION MODEL



LANDFILL PROFILE

The landfill profiles for various stages of the landfill development are presented in the attached HELP Model summary sheets. The profile presented below includes a clay liner with a standard Subtitle D final cover system.

Liner Systems

The Subtitle D clay liner designed for developed and undeveloped cells consists of a 24-inch-thick compacted clay liner with a hydraulic conductivity of 1x10-7 cm/s. Default soil characteristics from the HELP model were selected for the compacted clay liner.

OverLiner Systems

The overliner system consists of a GCL and 40-mil LLDPE geomembrane. The geomembrane liner was modeled for a good quality installation quality, 4 construction defects per acre, and a production pinhole density of 1 hole/acre. Default soil characteristic from the HELP Model were selected for the LLDPE geomembrane hydraulic conductivity.

Leachate Collection System

Developed Subtitle D Cells 1 through 5 were constructed with an LCS that includes a 200-mil thick single-sided geocomposite (floor grades).

Waste Layers

A default wilting point was selected from HELP to represent municipal solid waste. The waste layer was modeled with a hydraulic conductivity of $1x10^{-3}$ cm/s, which is the default HELP number for MSW. The moisture content, field capacity, and porosity values were selected as discussed previously.

Intermediate Cover

The intermediate cover consists of a 12-inch-thick layer of soil placed over the waste. Default soil characteristics were selected from HELP to represent the available onsite soils with a hydraulic conductivity of $6.4x10^{-5}$ cm/s.

Final Cover

The final cover over the Subtitle D and pre-Subtitle D areas consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation and an 18-inch infiltration layer. The infiltration layer consists of compacted soil with a hydraulic conductivity of $1x10^{-7}$ cm/s. The site is modeled using $1x10^{-5}$ hydraulic conductivity and provides a conservative design.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIL
GEOTECHINCAL REPORT

Prepared for
City of Del Rio



September 2023
Revision 1 March 2025

Prepared by
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Appendix IIIL-A – Slope Stability Analysis

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1.0 INTRODUCTION

This report presents the geotechnical analysis and design for the proposed major permit amendment concerning the vertical expansion of the Del Rio Landfill. The analysis is based on the geotechnical data collected from previous subsurface investigations at the site.

This report contains a compilation of geotechnical testing and design information, including:

- Slope stability analyses based on the geotechnical testing results and subsurface conditions including groundwater as well as landfill excavation and completion plans; and
- Settlement and heave analyses, which are also based on the landfill excavation and completion plans.

Additionally, the report provides geotechnical recommendations for the construction of landfill components, such as the bottom liner and the final cover system with a clay liner. Details regarding construction quality control, as well as material and construction specifications for the groundwater protection components, are outlined in Appendix IIID – Liner Quality Control Plan.

2.0 Laboratory Testing

2.1 Introduction

Previous geological investigations have been conducted at the Del Rio Landfill, including the sampling and geotechnical testing of materials collected during these studies. The following paragraphs provide a brief overview of the geological and geotechnical characteristics of the site. Further details on the geology and hydrogeology can be found in Appendix IIIJ – Geology Report of this application.

Three distinct geological subunits have been identified at the landfill, and for consistency with previous geological investigations, these units are numbered from the surface downward as Stratum I through Stratum III:

- Stratum I consists of silty clays with some sand and gravel.
- Stratum II consists of caliche and clay soils with some gravel content. Clay is the predominant constituent.
- Stratum III consists of clay and weathered shale, grading into unweathered shale, containing some limestones/siltstone seams, caliche, and gypsum. These soils comprise the Del Rio Clay formation.

Additional description of the above geological units is provided in Section 3.

Laboratory tests were conducted on select samples recovered from the borings drilled to evaluate the physical and engineering properties of the different strata. Laboratory tests were performed in accordance with ASTM procedures. Available laboratory testing results from the previous (1989) investigations completed by Raba-Kistner Consultants, Inc., (1994) Trinity Engineering Testing Corporation, and (2020) Arias & Associates, Inc are provided in Appendix IIIJ – Geology Report , and summarized in Tables 3-1, 3-2, and 3-3.

The laboratory testing meets the requirements of Title 30 TAC §330.63(e)(5)(A) regarding sampling each stratum. A summary of the laboratory tests performed is given in Table 2-1.

Table 2-1 Geotechnical Test Methods Performed

Test	Test Method
Sieve Analysis (Passing No. 200)	ASTM D 1140
Atterberg Limits (Liquid & Plastic Limit)	ASTM D 4318
Moisture Content	ASTM D 2216
Unconfined Compression	ASTM D 2166 & Pocket Penetrometer
Coefficient of Permeability (Hydraulic Conductivity)	Field Methods (vertical and horizontal permeability)
Consolidation	ASTM D 2435
Standard Proctor	ASTM D 698

2.2 Classification Tests

Classification tests consisting of Atterberg limits, percent passing the number 200 sieve, dry unit weight, and moisture content were performed on selected soil and shale samples recovered from boreholes. These test results are presented in Appendix IIIJ – Geology Report and are summarized in Tables 3-1, 3-2, and 3-3. Classification tests were used to classify the soils according to the Unified Soil Classification System (USCS) and to evaluate physical properties of the soils.

2.2.1 Material Strength Tests

Material strength tests were performed to provide general strength information and were used to evaluate the soils at the site. Unconfined compression tests were performed in the field using a hand penetrometer. Additional laboratory unconfined Compression tests (ASTM D 3080) were conducted for selected samples. Shear strength correlations for each layer were developed from correlating the field and laboratory test results. Additionally, extensive field penetrometer testing was performed during investigations, as documented on boring logs included in Appendix IIIJ – Geology Report and summarized in Table 3-1, 3-2, and 3-3. The results of field penetrometer testing were used to develop total and effective stress parameters required for stability analysis of the landfill and foundation strata.

2.2.2 Coefficient of Permeability Tests

Field slug and falling head tests were performed in the field to evaluate the hydrogeological properties of the soils and shale at the site, as well as laboratory tests that were performed of samples collected during investigations. These tests were performed to assist in evaluation of the hydrogeologic properties of the geological units at the site. The results of permeability testing performed in the field and laboratory are presented in Appendix IIIJ – Geology Report of this application and in Tables 3-1, 3-2, and 3-3.

2.2.3 Consolidation Tests

Consolidation testing was performed in the laboratory on representative soil samples obtained during field investigations. The results of the consolidation testing were utilized in settlement and heave analyses performed for this application.

2.2.4 Moisture-Density Relationships

Standard Proctor laboratory compaction tests were performed during previous liner construction activities at the site. The tests were performed to evaluate the moisture-density relationship of the

materials. Remolded samples for coefficient of permeability tests were compacted by static loading the sample to approximately 95 percent of the Standard Proctor maximum dry density at approximately the optimum moisture content determined from the Proctor test. The results to date demonstrate that the clays on site are suitable for liner construction, and able to achieve the 1x10-7 cm/sec permeability criteria. Sufficient soil quantities suitable for liner and final cover construction is available on-site, although alternatively clayey soils may be imported from off-site borrow areas.

2.3 Conclusion of Laboratory Testing

Classification testing along with unit weight, moisture content, and sieve analysis results were used to support field observations during subsurface explorations. Testing results were also used to support the subsurface characterization which includes the three formations that exist generally across the site. Additionally, soil strength parameters from both field and laboratory were conservatively generalized and selected for use in the geotechnical stability analysis. Finally, consolidation testing on representative samples obtained during field investigations were used to perform settlement and heave analyses for this application.

3.0 PROPERTIES OF SITE SOILS AND LANDFILL COMPONENTS

3.1 General

This section of the report includes the generalized stratigraphy for the site, typical properties of subsurface soils, potential uses of materials that may be excavated during construction, and soil material requirements for various components of the landfill. The laboratory test results for soil samples obtained from the site are summarized in Tables 3-1, 3-2, and 3-3. Refer to Appendix IIIJ for the results of the geotechnical testing performed on the site soils.

3.2 Generalized Site Stratigraphy

The subsurface materials encountered at the site are discussed in detail in the Appendix J – Geology Report. In general, the subsurface at the site is characterized by three units. The principal geologic formation at the site is the Del Rio Clay Formation. It is overlain in some portions of the site by residual soils and remnants of the overlying Buda Limestone, and by secondary “caliche” soil and/or harder caliche layers. The specific soil stratigraphy can be divided into three generalized soil zones.

3.2.1 Stratum I

Stratum I consists of silty clays with some sand and gravel. This layer is a “topsoil” zone and likely is a residual soil intermixed with erosional remnants of the overlaying Buda Limestone. This layer is very thin (1.5 to 4.5 feet) and absent in some areas of the site.

3.2.2 Stratum II

Stratum II consists of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cementious material, primarily calcium carbonate, and is intermixed with the soil or as thin hard interbedded layers. This layer is also fairly thin (2.0 to 11.0 feet) and absent in some areas of the site.

3.2.3 Stratum III

Stratum III consists of clay and weathered shale, grading into unweathered shale, containing some limestones/siltstone seams, caliche, and gypsum. These soils comprise the Del Rio Clay formation.

3.3 Material Requirements for Landfill Components

Construction of the landfill will require clay or clayey soils which can be compacted to have an in-place hydraulic conductivity of $1x10^{-7}$ cm/s or less for the soil liner and an in-place hydraulic conductivity of $1x10^{-7}$ cm/s for the soil infiltration layer of the composite final cover system.

Soil will also be required for protective cover on the liner, operational cover (daily cover, intermediate cover) the infiltration and erosion layer components of the composite final cover, berm construction, and other miscellaneous general fill. Granular material (i.e., gravel) will be used for the leachate collection sumps, leachate collection chimney drains and may be used for groundwater dewatering collection trenches. Typical material requirements for various soil structures are summarized in Table 3-4.

Testing requirements and construction quality control and quality assurance for liner soils are detailed in Appendix IIID - Liner Quality Control Plan. Testing requirements and construction quality control and quality assurance for final cover soils are detailed in Appendix IIIE - Closure Plan and in Appendix IIIE-A - Final Cover System Quality Control Plan. Liner and final cover details are presented in Appendix IIIA-A - Liner and Final Cover System Details.

Table 3-1 Summary of Stratum I - Existing Geotechnical Data

Boring No.	Depth (ft-bgs)	LL	PI	Passing #200 sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horiz. Perm. (cm/sec)	Vertical Perm. (cm/sec)
Stratum I – Raba-Kisther Consultants, Inc. (1989)								
B-401	15	68	20.5	92.1	15	110.9	5.2E-09	N/A
B-402	1.5	49	20.5	95.3	17	109		N/A
B-403	6	72	20.5	91.7	20.5	105.9		N/A
B-404	N/A							
B-405	0.5	34	20	42.1	5	121.4		N/A
B-406	N/A							
B-407	6	55	19.5	82	19.5	106.7		N/A
B-408	N/A							
B-409	N/A							
B-410	N/A							
B-411	0.5	58.5	22.5	93.6	20.5	105.9		N/A
B-412	8.5	59	20.5	95	12	113.8		N/A
B-413	N/A							
B-414	N/A							
B-415	N/A							
B-416	1	39.5	21	93.1	11	114.9		N/A
B-417	N/A							
B-418	N/A							
B-419	N/A							
B-420	N/A							
B-3	4.5	39.5	18.5	85	8	118.1		N/A
Stratum I – Trinity Engineering Testing Corp (1994)								
B-1	5	54	38	95	11	118		1.9E-09
B-2	1	N/A	N/A	N/A	25	98		N/A
B-3	N/A							
B-4	N/A							
Stratum I – Arias and Associates, Inc (2020)								
B-1	2	53	35	67	9			
B-2	N/A							
B-3	N/A							
B-4	4	39	22	27	2			
B-5	4	42	24	68	6			
B-6	N/A							
B-7	4	37	18	68	5			
B-8	2	45	28	48	2			
B-9	N/A							
B-10	N/A							
B-11	N/A							
B-12	2	49	31	34	4			
B-13	2	36	19	74	4			
B-14	N/A							
B-15	4	58	37	75	7			
B-16	N/A							
B-17	2	61	40	62	4			
COMPUTATIONS – Stratum I								
Mean		49.9	25.0	73.0	10.4	111.1	5.20E-09	1.90E-09
Minimum		34	18	27	2	98	5.2E-09	1.9E-09
Maximum		72	40	95.3	25	121.4	5.2E-09	1.9E-09
Standard Deviation		11.2	7.4	21.9	7.0	6.9	N/A	N/A
Number of Tests		19	19	19	20	11	1	1

Table 3-2 Summary of Stratum II - Existing Geotechnical Data

Boring No.	Depth (ft-bgs)	LL	PI	Passing #200 sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horiz. Perm. (cm/sec)	Vertical Perm. (cm/sec)
Stratum II – Raba-Kisther Consultants, Inc. (1989)								
B-401	N/A							
B-402	N/A							
B-403	N/A							
B-404	25.1	77	21	92.6	19.5	106.7	N/A	N/A
B-405	20.5	69	21.5	96.6	19	107.1	N/A	N/A
B-406	25.1	60.5	19.5	96.7	14.5	111.4	N/A	N/A
B-407	20.5	69.5	20	95.5	15	110.9	2.1E-09	N/A
B-408	N/A							
B-409	15.5	62	20	82.1	16	109.9	N/A	1.6E-09
B-410	20.5	69.5	21.5	93.4	16.5	109.4	N/A	N/A
B-411	10.5	75.5	22.5	97.5	22.5	104.1	2.1E-09	N/A
B-412	15.5	68	23	95.6	19.5	106.7	4E-08	N/A
B-413	N/A							
B-414	15.5	78	23	97.5	19.5	106.7	N/A	N/A
B-415	N/A							
B-416	N/A							
B-417	15.5	64.5	21.5	95.2	10.5	115.4	3.5E-09	N/A
B-418	10.5	51.5	19.5	78.2	12.5	113.3	N/A	N/A
B-419	N/A							
B-420	N/A							
B-3	9.5	51.5	19	86	12.5	113.3	N/A	N/A
Stratum II – Trinity Engineering Testing Corp (1994)								
B-1	10	57	40	95	15	116	2.7E-09	N/A
B-2	20.5	57	38	97	18	114	N/A	N/A
B-3	10	N/A	N/A	N/A	13	118	N/A	N/A
B-4	15	N/A	N/A	N/A	15	118	N/A	N/A
Stratum II – Arias and Associates, Inc (2020)								
B-1	6	55	36	95	13			
B-2	N/A							
B-3	4	37	21	82	4			
B-4	13	57	37	83	9			
B-5	13	63	42	77	11	104.7	6.5E-07	
B-6	6	61	40	79	9			
B-7	13	56	37	81	9			
B-8	N/A							
B-9	N/A							
B-10	2	54	35	62	4			
B-11	N/A							
B-12	4	48	30	52	6			
B-13	N/A							
B-14	2	57	35	96	12			
B-15	13	67	45	84	11			
B-16	18	53	35	77	11			
B-17	N/A							
COMPUTATIONS – Stratum II								
Mean		60.7	28.9	86.7	13.2	110.9	1.16E-07	1.60E-09
Minimum		37	19	52	4	104.1	2.10E-09	1.60E-09
Maximum		78	45	97.5	22.5	118	6.47E-07	1.60E-09
Standard Deviation		9.6	8.9	11.7	4.8	4.5	2.60E-07	N/A
Number of Tests		25	25	25	27	17	6	1

Table 3-3 Summary of Stratum III - Existing Geotechnical Data

Boring No.	Depth (ft-bgs)	LL	PI	Passing #200 sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horiz. Perm. (cm/sec)	Vertical Perm. (cm/sec)
Stratum III – Raba-Kisther Consultants, Inc. (1989)								
B-401	42.5	N/A	N/A	95.4	18.5	107.6	N/A	3.3E-10
B-402	25.5	63	20	91.6	15	110.9	N/A	5.6E-10
B-403	23.5	62	20	89.6	18.5	107.6	N/A	N/A
B-404	N/A							
B-405	45.5	61.5	20.5	97.1	15	110.9	N/A	N/A
B-406	N/A							
B-407	N/A							
B-408	N/A							
B-409	26	69	20.5	90	18.5	107.6	N/A	1.4E-09
B-410	N/A							
B-411	49.5	65	22	98.2	18.5	107.6	N/A	N/A
B-412	N/A							
B-413	N/A							
B-414	35.5	40.5	20	89.8	10.5	115.4	N/A	7.4E-09
B-415	N/A							
B-416	N/A							
B-417	N/A							
B-418	N/A							
B-419	25.5	68	23.5	99.2	19.5	106.7	N/A	N/A
B-420	25.5	59.5	21	84.3	13	112.8	N/A	N/A
B-3	N/A							
Stratum III – Trinity Engineering Testing Corp (1994)								
B-1	15	N/A	N/A	N/A	18	117	1.9E-09	N/A
B-2	30	67	43	97	18	102.8	2.7E-09	N/A
B-3	29.5	75	52	98	17	109	2.9E-09	N/A
B-3A	49.5	68	44	96	15	116.4	1.7E-09	N/A
B-4	30	62	41	98	15	118	N/A	N/A
B-4A	55	57	37	97	14	116	2.9E-09	N/A
Stratum III – Arias and Associates, Inc (2020)								
B-1	35	45	28	85	10			
B-2	N/A	54	32	88	11			
B-3	90	61	41	87	12			
B-4	75	62	40	90	14			
B-5	55	62	42	74	14			
B-6	35	60	37	96	14	105.9	1.16E-08	
B-7	60	57	37	97	13			
B-8	50	43	26		8			
B-9	40	60	38	92	12			
B-10	45	61	40	93	12			
B-11	25	46	29	92	8			
B-12	75	61	40	93	13			
B-13	65	39	22	66	8			
B-14	30	55	34	97	12			
B-15	50	62	41	97	16	92.1	1.32E-08	
B-16	95	57	36	97	12			
B-17	65	64	42	89	13			
COMPUTATIONS – Stratum III								
Mean		58.9	33.0	91.8	13.9	109.7	5.27E-09	2.42E-09
Minimum		39	20	66	8	92.1	1.70E-09	3.30E-10
Maximum		75	52	99.2	19.5	118	1.32E-08	7.40E-09
Standard Deviation		8.6	9.4	7.3	3.3	6.4	4.91E-09	3.35E-09
Number of Tests		30	30	30	32	17	7	4

Table 3-4 Typical Soil Requirements for Landfill Construction

Landfill Component	Soil Description	Classification	Test Parameters				Material Source
			LL	PI	% - 200	Coefficient of Permeability CM/s	
Soil Liner	clayey sand, sandy clay, or clay	SC, CL, CH	30 min	15 min	30 min	$1x10^{-7}$ max	On site[1]
Final Cover infiltration Layer	clayey sand, sandy clay, or clay	SC, CL, CH	30 min	15 min	30 min	$1x10^{-7}$ max	On site
Liner Protective Cover	sand or sand with silt and clay	SP-SM, SP, SP-SC, SW, SME OR SM-SC				$1x10^{-4}$ max	On site[3]
Final Cover Erosion Layer	clayey sand, sandy clay, or clay	SC, CL, SM	Suitable to support plant growth				On site
Operational Cover (Daily Cover and Intermediate Cover)	sand, clayey sand, sandy clay, or clay	SP, SC, CL, CH	(2)	(2)	(2)	(2)	On site
Earth Fill Perimeter Berm and Subgrade Preparation	clayey sand, sandy clay, or clay	SC, CL, CH	--	--	--	--	On site

[1] If onsite materials meeting the required properties do not exist, an off-site material source can be used for liner soil.
[2] Refer to Section 4 for material requirements for the various final cover components.
[3] If onsite material does not meet the hydraulic conductivity criteria, leachate collection chimney drains will be extended through the protective cover at selected locations and will be exposed adequately for transmission of leachate to the collection system.

4.0 CONSTRUCTION CONSIDERATIONS

4.1 General

This section contains recommendations for excavation of the landfill, and soil liner, leachate collection layer, and final cover materials and construction. Additionally, operational cover soils, final cover construction, and perimeter embankment construction related recommendations are included in this section.

The existing permitted area, covering Cells 1 through 6, has been fully constructed. The expansion will extend the current 105.6-acre permit boundary by 75.0 acres, bringing the total to 180.6 acres. The waste limit will increase by 31.3 acres, expanding from approximately 79.0 acres to approximately 110.3 acres. Cells 7 through 10 have been designed within this expanded waste limit of waste and will be constructed using the same liner system as the permitted cells.

4.2 Landfill Excavation

The landfill base grades for cells will be founded primarily in the Stratum III. The excavation for the liner construction will be performed in a manner that will achieve reasonable segregation of liner quality material from soils that are not suitable for a liner. Soil materials to be used for liner construction will be stockpiled separately, according to construction material properties outlined in Section 3 and visual observation during excavation.

Excavation of the soils encountered will be achieved with equipment such as excavators. Blasting of hard rock will not be required and will not be used at this site.

Excavation side slopes will be graded no steeper than 3 horizontal to 1 vertical. Excavation cut slopes around the perimeter of future cells may require erosion protection if an extended period of time occurs between excavation and liner construction. Interim erosion protection can be accomplished by diverting runoff away from the slopes. "Track walking" with a bulldozer up and down the slopes will create the effect of "mini-dikes" with the bulldozer tracks, which will reduce erosion.

Prior to beginning construction of the liner components, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The liner base grades will be proof-rolled with heavy, rubber-tired construction equipment or equivalent to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill, as discussed in Section 2 of Appendix IIID – Liner Quality Control Plant. Preparation of the liner base grades will result in a surface that is stable and that does not exhibit significant rutting from the construction traffic. The prepared liner base grades will be approved by a Professional of Record (POR), tested to verify that it meets the requirements outlined in Section 4.3, and surveyed to verify grades.

4.3 Clay Liner Construction

The bottom and sides of the landfill excavation consists of 2-foot-thick compacted clay liner. The clay liner will have a maximum hydraulic conductivity of $1x10^{-7}$ cm/s. Details for the liner system are provided in Appendix IIIA– Landfill Unit Design Information (Appendix IIIA-A). Adequate soil liner material will be available from proposed landfill excavations, onsite, or offsite borrow sources to provide material for the liner construction. Preconstruction laboratory tests may be performed to verify that a borrow source soil material is adequate to meet the compacted clay liner requirements listed in Title 30 TAC §330.339(c)(5) prior to using any soil borrow source as liner.

The soils used for liner construction will have the minimum soil property values listed in Table 4-1 that will be verified by preconstruction testing in a soils laboratory. The following soil liner properties are included in Appendix IIID.

Table 4-1 Soil Liner Properties

Test	Specifications
Hydraulic Conductivity of Remolded Soils'	1.0 x 10^{-7} cm/s or less
Plasticity Index	15 minimum
Liquid Limit	30 minimum
Percent Passing No. 200 Mesh Sieve	30 minimum
Percent Passing 1-inch Sieve	100

[1] A hydraulic conductivity test will be performed on soil samples remolded per ASTM D 698 in accordance with Appendix IIID.

Representative preliminary sampling will be performed on the materials that will be used for soil liner construction. Laboratory tests of samples recovered from soil borings indicate that some soils which will achieve a coefficient of permeability of less than 1x10^{-7} cm/s exist at the site. Prior to construction of each new liner area, conformance tests that include liquid limit, plastic limit, percent passing the No. 200 sieve, Standard Proctor (ASTM D 698) and remolded hydraulic conductivity tests will be performed for the soils used for liner. Additional conformance tests will be conducted if there are visual changes in the borrow material or the liquid limit or plasticity index vary by more than 10 points. The soil liner construction and testing procedures are outlined in Appendix IIID.

4.4 Drainage Materials

The Leachate Collection System (LCS) drainage material will consist of a drainage geocomposite over the entire liner bottom and side slopes. Each sector will have a bottom slope toward an LCS trench (i.e., pipe enveloped in gravel and geotextile) that will collect leachate from the bottom and sideslopes. The leachate collection system details are illustrated in Appendix IIIA– Landfill Unit Design Information (Appendix IIIA-A). The material specifications and construction procedures for the LCS components are presented in Appendix IIID - LQCP. The LCS design and demonstrations are provided in Appendix IIIC - Leachate and Contaminated Water Management Plan.

4.5 Liner Protective Cover

The liner protective cover is required to be a minimum of 24 inches thick for the sideslopes and the floor area. The purpose of the protective cover is to protect the drainage geocomposite from solid waste placed over the liner system. To ensure passage of leachate into the LCS, drainage passages (chimney drains) will be constructed through the protective cover. The chimney drains will be installed over the LCS collection pipes as shown in Appendix IIIA– Landfill Unit Design Information (Appendix IIIA-A). The protective cover will be placed with construction equipment in one lift such that it covers the leachate collection layer completely. The protective cover material will be free of solid waste and will not require compaction under the density-controlled construction procedures.

4.6 Operational Cover Soils

Operational cover soils include daily cover (placed over the waste each day) and intermediate cover (placed over waste in areas that will not receive additional fill for at least 6 months). All soils excavated at the site may be used for operational cover.

4.7 Final Cover Construction

4.7.1 Final Cover Infiltration Layer Construction

The infiltration layer of the final cover system will be constructed with clayey material and will be a minimum of 18 inches thick. As specified in Appendix IIIE – Closure Plan, the infiltration layer will consist of 18 inches of earthen material with a coefficient of permeability equal to or less than $1x10^{-7}$ cm/s. The purpose of this layer is to reduce infiltration of surface water into the fill. The final cover components material and construction requirements will be in accordance with Appendix IIIE-A.

4.7.2 Final Cover Erosion Layer Construction

As shown in Appendix IIIA-A, the final cover system will include a 12-inch-thick erosion layer for the top slope and a 24-inch thick erosion layer for the sideslopes. The erosion layer will protect the infiltration layer and will support vegetative growth. The top 6 inches of the erosion layer will consist of (1) topsoil stockpiled during the excavation process, (2) other on-site excavated soils amended as necessary to be capable of sustaining vegetation, and/or (3) imported soil materials. Whether placed in a single lift or two lifts, the erosion layer (top of final cover) will be selected to sustain vegetative growth.

4.8 Perimeter Embankment Construction

Perimeter embankments (berms) will be constructed as needed to prevent surface water flow from entering the landfill excavation. The embankment will have side slopes no steeper than 3 horizontal to 1 vertical (3H:1V). A sufficient amount of soil is available from the landfill excavations to construct the perimeter embankment and other features that require stable soil fill material.

The embankments will be constructed of onsite soils free of organic or other objectionable materials. Prior to beginning embankment fill, the subgrade area will be stripped to a depth sufficient to remove all topsoil and vegetation. Topsoil will be stockpiled for later use. The subgrade area will be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill. The subgrade preparation will result in a subgrade surface that is stable and does not exhibit significant rutting from construction equipment traffic. As necessary, the outside slope of all embankment construction above ground level will be vegetated to minimize erosion and desiccation.

The general fill placed below the liner (e.g., over excavated areas within the liner construction area) will be spread in maximum 8-inch-thick, loose, horizontal lifts and compacted to a minimum of 95 percent of maximum Standard Proctor dry density within a range of moisture content provided at or above 95 percent compaction as determined by Standard Proctor. A minimum of one Standard Proctor test (ASTM D 698) will be performed on each representative soil used as clay fill material. Each lift will receive a minimum of four passes with a heavy tamping roller unless adequate compaction can be demonstrated with fewer passes. Moisture-density field-testing and full-time third party construction quality assurance monitoring during construction will be performed in accordance with Appendix IIID.

5.0 SLOPE STABILITY ANALYSIS

5.1 General

This slope stability analysis has been developed to analyze excavation slope and landfill completion slopes using critical sections for each condition. Slide2 was used to analyze the stability of excavation slopes and the final configuration of the site. Slide is an industry standard computer program developed by Rocscience Inc. and has been used widely in several slope stability application for dams, embankments, excavations, retaining walls and soil slopes.

The input file for the program includes:

- Slope surface geometry.
- Subsurface information to identify different types of soil materials in horizontal and vertical directions so that each subsurface segment is identified with corresponding soil strength parameters.
- Groundwater information. The program is capable of modeling multiple groundwater surfaces that may be applicable to various subsurface soil components identified in the second bullet.
- Material strength information. Each soil section (horizontal or vertical) identified in the second bullet is assigned with strength parameters including cohesion and friction angle.
- Model control and simulation user interface of the model that allows selection of the method of analysis (e.g., Simplified Bishop) and identifying simulation control parameters.

Automatic failure surface generation functions, that use either initiation/termination ranges of the failure surface or use search boxes to define failure surface location, are used to locate the critical failure surface. The two methods employed for this slope stability analysis are described below.

- Simplified Janbu Method - This method uses the method of slices to determine the stability of the mass above a failure surface.
- Simplified Bishop Method - This method uses the method of slices to discretize the soil mass for determining the factor of safety.

In general, the stability of various worst case critical sections were analyzed under static condition for short-term (construction) and long-term (after construction) safety. The slope stability analyses are provided in Appendix IIIL-A.

The stability analysis has been conducted by demonstrating that, for each analyzed section, the forces resisting slope movement are greater than those potentially causing movement. The ratio of forces resisting movement to those creating movement is referred to as the factor of safety (FS). A slope is considered stable when the FS is equal to or greater than 1.0. For slope stability, an FS greater than 1.0 is preferred.

To account for increased uncertainty in the system, the FS value is adjusted accordingly. A factor of safety of 1.5 is applied to slopes expected to remain stable over the long term, including both excavation and final cover configurations. An FS of 1.3 is considered acceptable for total stress conditions that are temporary. Section Selected for Analysis

Slope stability analyses were conducted on the worst-case critical sections to assess the stability of the excavation, overliner, and the final cover configuration slopes. The slope geometries analyzed were derived from a review of the proposed excavation and the proposed final contour plan. Evaluation locations were chosen to focus on worst case critical slopes, including profiles that encompass the landfill configuration and natural materials at the toe and beneath the landfill excavation.

5.2 Configurations Analyzed

The excavation, overliner, and final landfill configurations were modeled to reflect worst case critical slope conditions, and the analysis was conducted using both circular and block failure surfaces. The maximum final fill slopes will be 4 horizontal to 1 vertical (4H:1V), while excavation slopes will be 3H:1V. A copy of the top-of-liner plan and final completion plan, which show the locations of the selected cross sections for analysis, can be found in Appendix IIIL-A. Additionally, the configurations analyzed are illustrated graphically in Appendix IIIL-A.

It is assumed that the horizontal length of an interim slope will not exceed that of the final cover condition. Should the horizontal length of an actual interim slope be greater than that of the final cover during site operations, an additional analysis will be performed if deemed necessary by a registered engineer, and the results will be maintained in the Site Operating Record.

5.3 Input Parameters

The soil parameters were selected based on a review of the boring logs and laboratory test results from the subsurface investigation studies at the site, along with engineering judgment and experience with similar materials. To ensure representative properties for the various soil groups, the unit weight for Stratum II and III used in the model is based on the average unit weight for each stratum, as outlined in Tables 3-1, 3-2, and 3-3. Since groundwater is not present at the site, no groundwater surface is modeled.

Table 5-1 summarizes the unit weights and strength parameters used in the stability analyses for the evaluated landfill slopes, including excavation, overliner, and final cover slopes. The selected strength parameters for both the liner and final cover systems are based on industry standards and are representative of the material properties that will be utilized during construction. These parameters will be verified during prior to construction.

5.4 Infinite Slope Stability Analysis

The infinite slope stability analysis for the liner and final cover system is detailed in Appendix IIIL-A. This analysis covers the stability of the anchor trench design, the stability of cover and drainage materials placed on anchored geosynthetics, and the shear forces within the liner system. Additionally, the final cover slope stability analysis specifically addresses the shear forces within the final cover system.

As demonstrated in the calculations presented in Appendix IIIL-A, both the liner and final cover systems are structurally stable when using industry-standard strength parameters. These parameters will be verified during the construction. Prior to the construction liner, overliner, and/or final cover, the POR will perform interface strength testing with the actual materials that will be used during.

Table 5-1 Summary of Material Weight and Strength Parameters Used in the Slope Stability Analysis

<table>
<tr><th colspan="3">Strength Parameters</th><th>Comments</th></tr>
<tr><td colspan="3">Linter System</td><td rowspan="4">For The liner system includes a 2-foot-thick compacted clay layer, drainage geocomposite (single-sided on floor grades and double-sided on 3H:IV sideslopes), and a 2-foot-thick protective cover soil layer. This system is modeled as two layers for the global stability analysis: the 2-foot-thick compacted clay liner and the soil protective cover.

For the rotational global stability analysis, the liner system is modeled as two layers: the compacted clay liner and the soil protective cover layer. The drainage geocomposite layer is not included in the global analysis because it provides a negligible contribution to the forces that are resisting movement. The strength values selected for the liner system represent strength values typically used in the industry and these same strength values have been used in various permit applications approved by TCEQ. Duncan and Wright (2005) provide a comprehensive discussion regarding strength parameters for a liner system. In Chapter 5 - Shear Strengths of Soil and Municipal Solid Waste, a significant amount of data are presented and evaluated for compacted clay liners. The results indicate that the lowest cohesion value for compacted cohesive soils is 9 kPa (187 lb/ft2) and the lowest reported friction angle value is 19 degrees. Therefore, selected values of 100 lb/ft2 for cohesion and 16 degrees of friction angle conservatively represent the liner system. Soil properties used in the slope stability analysis are subject to verification at the time of each liner construction. Appendix IIID - LQCP includes the material strength tests required for soil used for liner construction. Protective cover and compacted clay liner soil unit weight values are based on experience with liner system construction. The global stability analysis is included in Appendices IIIL-A.</td></tr>
<tr><td colspan="3">Soil Material Strength Parameters</td></tr>
<tr><td>Cohesion (lb/ft^2)</td><td>Friction Angle (degrees)</td><td>Unit Weight (lb/ft^3)</td></tr>
<tr><td>Clay Liner
100 (Effective)
1000 (Total)

Protective Cover
100 (Effective)
1000 (Total)

Overliner (GCL)
100 (Effective)
1000 (Total)</td><td>Clay Liner
16 (Effective)
0 (Total)

Protective Cover
16 (Effective)
0 (Total)

Overliner (GCL)
16 (Effective)
0 (Total)</td><td>120</td></tr>
<tr><td colspan="3">Final Cover System</td><td rowspan="3">The final cover system includes the erosion layer and compacted clay infiltration layer.

For the rotational global stability analysis, the final cover system is modeled as a single layer and the strength parameters represent the compacted clay infiltration layer and the erosion layer. The strength values selected for the final cover system represent strength values typically used in the industry and these same strength values have been used in various permit applications approved by TCEQ. The global stability analysis for rotational failure analysis uses the soil material strength parameters (i.e., cohesion of 100 lb/ft^2 and a friction angle of 16 degrees). The global stability analysis is included in Appendix IIIL-A.</td></tr>
<tr><td colspan="3">Soil Material Strength Parameters</td></tr>
<tr><td>Cohesion (lb/ft^2)</td><td>Friction Angle (degrees)</td><td>Unit Weight (lb/ft^3)</td></tr>
<tr><td>100</td><td>16</td><td>120</td></tr>
<tr><td colspan="3">Solid Waste</td><td rowspan="3">The strength parameters for solid waste were based on information contained in the following references: Pagotto and Rimoldi (1987), Landva and Clark (1990), and Richardson and Reynolds (1991). These sources list cohesion and friction angle values that range from 210 lb/ft^2 to 605 lb/ft^2 and 18° (for residual strength or large displacement for direct shear test which requires a factor of safety of 1) to 43°, respectively. The selected strength values (cohesion = 288 psf and friction angle = 23°) are conservatively selected to represent peak strength for MSW. The unit weight of waste was obtained from Appendix IIIB - Site Life Calculations.</td></tr>
<tr><td colspan="3">Material Strength Parameters</td></tr>
<tr><td>Cohesion (lb/ft^2)</td><td>Friction Angle (degrees)</td><td>Unit Weight (lb/ft^3)</td></tr>
<tr><td>288</td><td>23</td><td>47</td></tr>
</table>

5.5 Results of Stability Analysis

The stability analysis results, obtained using the computer program, show that both the proposed excavation and final configuration slopes are stable under the analyzed conditions. Tables 5-2 and 5-3 summarize the stability analysis results for the landfill slopes, comparing the calculated factor of safety to the recommended minimum factors of safety. The recommended minimum factors of safety for the analyzed conditions were based on guidelines from the U.S. Corps of Engineers' "Design and Construction of Levees" manual (EM 1110-2-1913) and the EPA's "Technical Guidance Manual for the Design of Solid Waste Disposal Facilities." Specifically, a factor of safety of 1.3 was used for short-term slope stability (excavation slopes), while a factor of safety of 1.5 was applied for long-term slope stability (overliner and final cover slopes).

Table 5-2 Summary of Slope Stability Analysis for Excavation Slopes

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated		Recommended Minimum of Safety		Acceptable Factor of Safety Met?
		Effective Stress	Total Stress	Effective Stress	Total Stress	
Excavation Slope A-1	Bishop-Circular	1.8	1.9	1.5	1.3	YES
Excavation Slope A-2	Janbu/Randkine	1.7	1.8	1.5	1.3	YES
Excavation Slope B-1	Bishop-Circular	1.8	1.9	1.5	1.3	YES
Excavation Slope B-2	Janbu/Randkine	1.8	1.9	1.5	1.3	YES

Table 5-3 Summary of Slope Stability Analysis for the Final Landfill Configuration

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated		Recommended Minimum of Safety		Acceptable Factor of Safety Met?
		Effective Stress	Total Stress	Effective Stress	Total Stress	
Final Cover C-1	Bishop-Circular	2.4	2.4	1.5	1.3	YES
Final Cover C-2	Janbu/Randkine	2.0	2.0	1.5	1.3	YES
Final Cover D-1	Bishop-Circular	3.1	3.1	1.5	1.3	YES
Final Cover D-2	Janbu/Randkine	3.1	3.1	1.5	1.3	YES
Overliner E-1	Bishop-Circular	2.9	3.3	1.5	1.3	YES
Overliner E-2	Janbu/Randkine	2.9	2.9	1.5	1.3	YES

The computer-generated slope stability analysis output is included in Appendix IIIL-A. As shown in Tables 5-2 and 5-3:

- the minimum calculated factor of safety for excavation slopes is 1.7, which exceeds the acceptable minimum factor of safety of 1.5;
- minimum calculated factor of safety for final cover slopes is 2.0, which is well above the acceptable minimum factor of safety of 1.5;
- minimum calculated factor of safety for overliner slopes is 2.4, which is well above the acceptable minimum factor of safety of 1.5.

The stability analysis results demonstrate that all analyzed conditions have an acceptable factor of safety.

6.0 SETTLEMENT, STRAIN, AND HEAVE ANALYSIS

6.1 General

The purpose of the settlement and heave analysis is to ensure that the liner system will not be negatively affected by foundation settlement. This analysis also evaluates the settlement of the final cover system to confirm that the proposed design can accommodate the potential strain caused by waste settlement.

Settlement of the liner system will result from the consolidation of foundation materials under the weight of the landfill components, including the protective cover, solid waste, daily cover, and final cover systems. Laboratory consolidation tests show that the foundation soils have low compressibility. Settlement of the final cover system will occur as a result of both foundation soil consolidation and consolidation within the solid waste. Total consolidation of the final cover includes primary and secondary consolidation of the deposited waste. Appendix IIIL-B provides detailed information on the foundation heave, settlement, and final cover settlement analyses.

6.2 Foundation Heave

Potential heave (rebound) resulting from the excavation of overburden above the excavation base was estimated using standard consolidation theory for soils and the recompression index obtained from the rebound portion of the consolidation tests. To estimate the potential for heave, the load is reduced, reflecting the projected weight of the excavated soil, rather than increasing the load on the soils. With a maximum excavation depth of approximately 78 feet (calculated as the difference between the existing ground elevation and the bottom of excavation at a given location), a heave of approximately 5.36 feet was calculated.

The heave estimate provided is considered overly conservative, as it assumes that the underlying shale will heave in accordance with both the limited consolidation testing performed on the shale and the rebound curve from the consolidation test results. In reality, the actual heave is expected to be significantly less. This will be monitored during construction through surveying of excavation and protective cover grades. The depth of floor grade excavation for each sector (liner area draining to an LCS sump) is generally consistent, meaning the depth of soil to be removed does not vary significantly within each sector. Where excavation depth is shallower, heave will also be less and can be considered negligible.

These calculations are included in Appendix IIIL-B-1. Heave will occur shortly after excavation (before and during liner construction) and will not negatively impact the performance of the liner system.

6.3 Foundation Settlement and Strain

The potential for foundation settlement has been evaluated using consolidation test results for Stratum III. These test results indicate that the shale in this stratum exhibits characteristics of over-consolidation, meaning that the previous stresses on the unit were greater than the current vertical stresses acting on it. The pre-consolidation pressure is typically considered to represent the maximum vertical overburden stress the soil layer has experienced in the past. For this analysis, the pre-consolidation stresses were incorporated into the settlement and strain evaluations.

The results of these analyses are presented in Appendix IIIL-B. As shown in Appendix IIIL-B, settlement within the foundation geological unit at the site is negligible and will not negatively impact the performance of the leachate collection system or cause harmful strain on the liner system components.

6.4 Final Cover Settlement and Strain

Settlement of the landfill final cover occurs due to both the settlement of foundation soils and the settlement of waste materials. Generally, the settlement of the foundation soils is minimal compared to the settlement of the deposited waste. Waste settlement consists of both primary and secondary settlement.

Solid waste settlement begins rapidly as it is placed and continues over an extended period of time. Initially, municipal solid waste undergoes primary settlement due to its own weight, the weight of the final cover, equipment, and other factors. Primary settlement occurs quickly, typically within the first month after waste placement. At this point, the weight of the final cover system becomes the only contributing factor to primary consolidation. By the time the final cover construction is completed, settlement of the waste due to the cover's weight will have been fully realized.

Secondary settlement persists at significant rates well beyond the primary settlement phase. This is driven by a combination of mechanical secondary compression, physico-chemical reactions, and bio-chemical decay. The settlement analysis for the final cover system is detailed in Appendix IIIL-B-3.

A strain analysis has been incorporated into the final cover settlement analysis presented in Appendix IIIL-B-3. The goal of the settlement and strain analysis is to ensure that the final cover system will remain stable as designed and maintain positive drainage. Assuming uniform waste settlement, the sideslopes are expected to maintain positive drainage. Based on the settlement estimates for both the maximum waste thickness (where the most significant settlement is expected to occur on the landfill's top deck) and the minimum waste thickness (where minimal settlement is anticipated), the final cover will experience a maximum strain of -0.008 percent. This strain is well below the allowable strain for the final cover soil infiltration layer. The strain demonstration in Appendix IIIL-B-3 confirms that the top deck areas of the final cover will remain stable and maintain a minimum slope of 2.29%, ensuring positive drainage after settlement.

7.0 CONCLUSIONS NAD RECOMMENDATIONS

This geotechnical analysis was developed based on (1) geotechnical data from testing performed on soil samples collected at the site, (2) the general soil stratigraphy of the project area, and (3) the known geotechnical characteristics of solid waste and soils used in landfill components. Based on this analysis, it is concluded that the proposed landfill and its components (such as the leachate collection system) will be geotechnically stable and will function as designed. The key findings of the geotechnical analysis are summarized below:

- All geotechnical engineering tests were conducted in accordance with industry standards and recognized procedures (e.g., ASTM standards).
- The stability of the proposed landfill excavation slopes and final cover is acceptable as designed (refer to Appendix IIIL-A).
- Foundation settlement after filling is expected to be negligible and well within the strain limits of the liner system (see Appendix IIIL-B).
- Settlement of the final cover system will not negatively impact its performance, and the system will function as intended (see Appendix IIIL-B).

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIL-A
SLOPE STABLITY ANALYSIS

Prepared for
City of Del Rio

September 2023
Revision 1 March 2025



Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
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Dallas, TX 75240
214-638-0500

This document is intended for permitting purposes only.

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Figure IIIL-A-88 – Final Cover Slope Stability Section Location IIIL-A-88
Figure IIIL-A-89 – Final Cover Slope Cross Sections IIIL-A-89



1.0 INTRODUCTION

This appendix includes the slope stability analysis for the landfill slopes during various phases of the site development and the final landfill configuration. General slope stability for the excavation and closed conditions were evaluated by using the Slide 2D computer program. The Simplified Bishop method was used for circular failure surfaces, and the Simplified Janbu method using Rankine Block was used for the translational slope stability analysis. Soil profiles analyzed for each configuration for the slope stability analysis are provided in the sub-appendices, along with the Slide computer output files as applicable. The stability analysis for the site is provided in the following appendices.

- The slope stability analysis for the excavated landfill condition is shown on pages IIIL-A-4 through IIIL-A-86.
- The slope stability analysis for the closed landfill conditions are shown on pages IIIL-A-87 through IIIL-A-215.

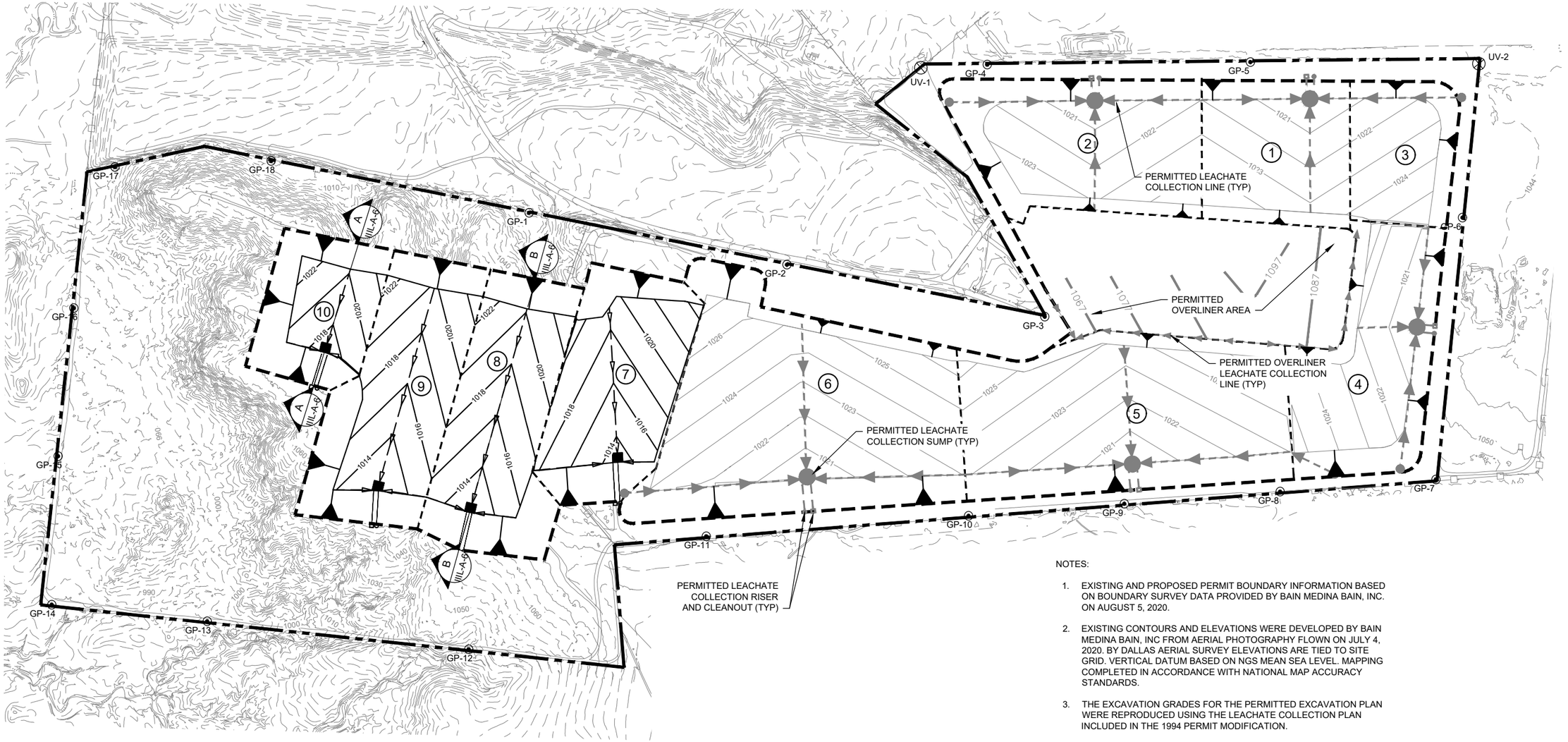
EXCAVATION CONFIGURATION
STABILITY ANALYSIS

LEGEND

GP-5 — PROPOSED GAS PROBE
UV-1 — PROPOSED GAS VENTS
CUT/FILL MARKERS
PROPOSED PERMIT BOUNDARY
PROPOSED LIMIT OF WASTE
CELL BOUNDARY
1080 — EXISTING GRADES
1010 — PROPOSED EXCAVATION GRADES
1022 — PERMITTED EXCAVATION GRADES
1087 — PERMITTED OVERLINER GRADES
10 — CELL DESIGNATION
PROPOSED LEACHATE COLLECTION RISER
PROPOSED LEACHATE COLLECTION CLEANOUT
PROPOSED LEACHATE COLLECTION SUMP
PROPOSED LEACHATE COLLECTION LINE

N

0 200 400
SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE EXCAVATION GRADES FOR THE PERMITTED EXCAVATION PLAN WERE REPRODUCED USING THE LEACHATE COLLECTION PLAN INCLUDED IN THE 1994 PERMIT MODIFICATION.
4. EXCAVATION SLOPES ARE TYPICALLY 3H:1V.
5. MINIMUM EXCAVATION ELEVATION AT LEACHATE COLLECTION SYSTEM SUMP IS 1007 FT-MSL.
6. LINER AND LEACHATE COLLECTION SYSTEM DETAILS ARE INCLUDED IN APPENDIX IIIA-A.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO, TEXAS
TOMBSTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
1.	1ST TECHNICAL NOD	STV	03/2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

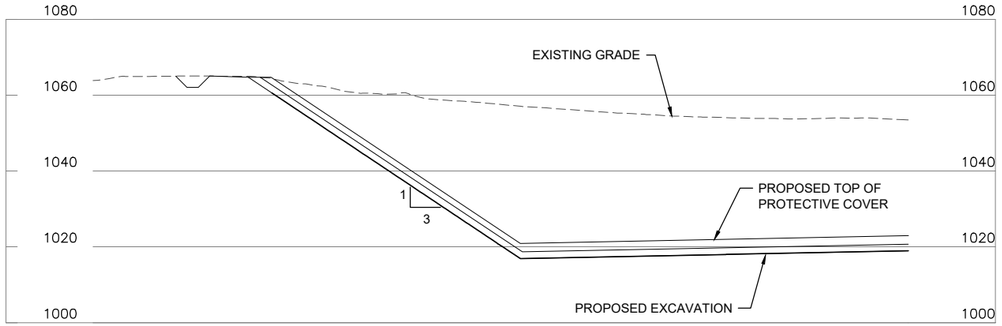
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

EXCAVATION SLOPE STABILITY
SECTION LOCATION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIL-A-5

PRINTED BY: MetafeT
FILE PATH: C:\pwworkingistv\pw_stv\metaferiald\9422279\DELR2000302 Figure IIIL-A-5.dwg



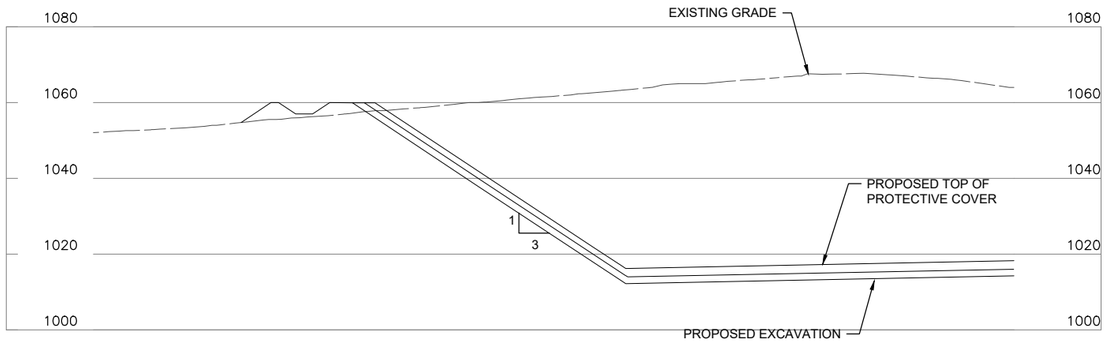
A
IIIL-A-5

EXCAVATION SECTION

HORZ 0 40 80

VERT 0 4 8

SCALE IN FEET



B
IIIL-A-5

EXCAVATION SECTION

HORZ 0 40 80

VERT 0 4 8

SCALE IN FEET

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TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

City of Del Rio Texas

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
03/07/2025

NO	REVISION	BY	DATE
1.	1ST TECHNICAL NOD	STV	03/2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL
1" DRAWING. VERIFY LENGTH ON THIS SHEET
0 AND ADJUST SCALE ACCORDINGLY.

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

EXCAVATION SLOPE
SECTION LOCATION

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIL-A-6

PRINTED BY: MetafeT
FILE PATH: C:\pwworkingstv\pw_stvltmetaferia\d0942279\DELR2000302 Slope Stability Cross Section.dwg

Excavation Landfill Configuration Stability Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Excavation Configuration Stability Analysis

Date: 3/7/2025
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Purpose - Evaluate the slope stability of the permitted landfill excavation configuration slope.

1 The location of the critical section selected for the stability analysis for the slope is shown on Sheet IIIL-A-5.

2 The soil profile used for each analysis was based on boring log data from site investigations conducted 1989, 1994, and 2020 (Refer to Appendix IIIJ).

3 A summary table of the assumed material weight and strength properties is provided on Sheets IIIL-A-8. The material weight and strength parameter determination for each material type was based on previous laboratory testing results (Atterberg limits, natural moisture contents, unit weight, percent passing #200 sieve, standard Proctor, and strength testing), field strength testing (pocket penetrometer and standard penetration testing (SPT)), and engineering judgment from previous experience with similar materials. Laboratory testing results for the site soils are included in Appendix IIIJ.

Reference

1 Bowles, Joseph E., Foundation Analyses and Design, 4th Ed., Mc-Graw-Hill, 1988.

2 Duncan, J.M. and Buchignani, A.L., An Engineering Manual for Slope Stability Studies, Department of Civil Engineering-University of California-Berkeley, 1975.

3 Slide 2D 2018 (computer program for slope stability analyses), Interactive Software.

Excavation Landfill Configuration Stability Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Excavation Configuration Stability Analysis

Date: 3/7/2025
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Derivation of Slope Stability Parameters:

Laboratory testing data and field testing results are provided on logs included in Appendix IIIJ. The following includes material strength properties based on the laboratory testing results and field test results for each subsurface unit.

Material/Unit	Unit Weight (pcf)
Stratum I	111.1
Stratum II	110.9
Stratum III	109.7

The strength parameters used for analysis of the in-situ soils were selected based on the following:

Stratum II

The summary of the calculated cohesion and friction angles are shown on Pages IIIL-A-9. There is no groundwater at the site, therefore the soil parameters used for all the slope stability analysis for Stratum II and III only utilize effective stress. The liner soil parameters were modeled using the total and effective stress shown on Table 5-1 on page IIIL-14.

	Total Stress		Effective Stress	
	Cohesion (lb/ft^2)	Friction Angle (phi)	Cohesion (lb/ft^2)	Friction Angle (phi)
Stratum II	4000.0	0.0	206.0	26

Stratum III

	Total Stress		Effective Stress	
	Cohesion	Friction Angle	Cohesion	Friction Angle
Stratum III	2800.0	0.0	150.0	24

Factor of Safety Summary for Excavation Slope Stability Analysis

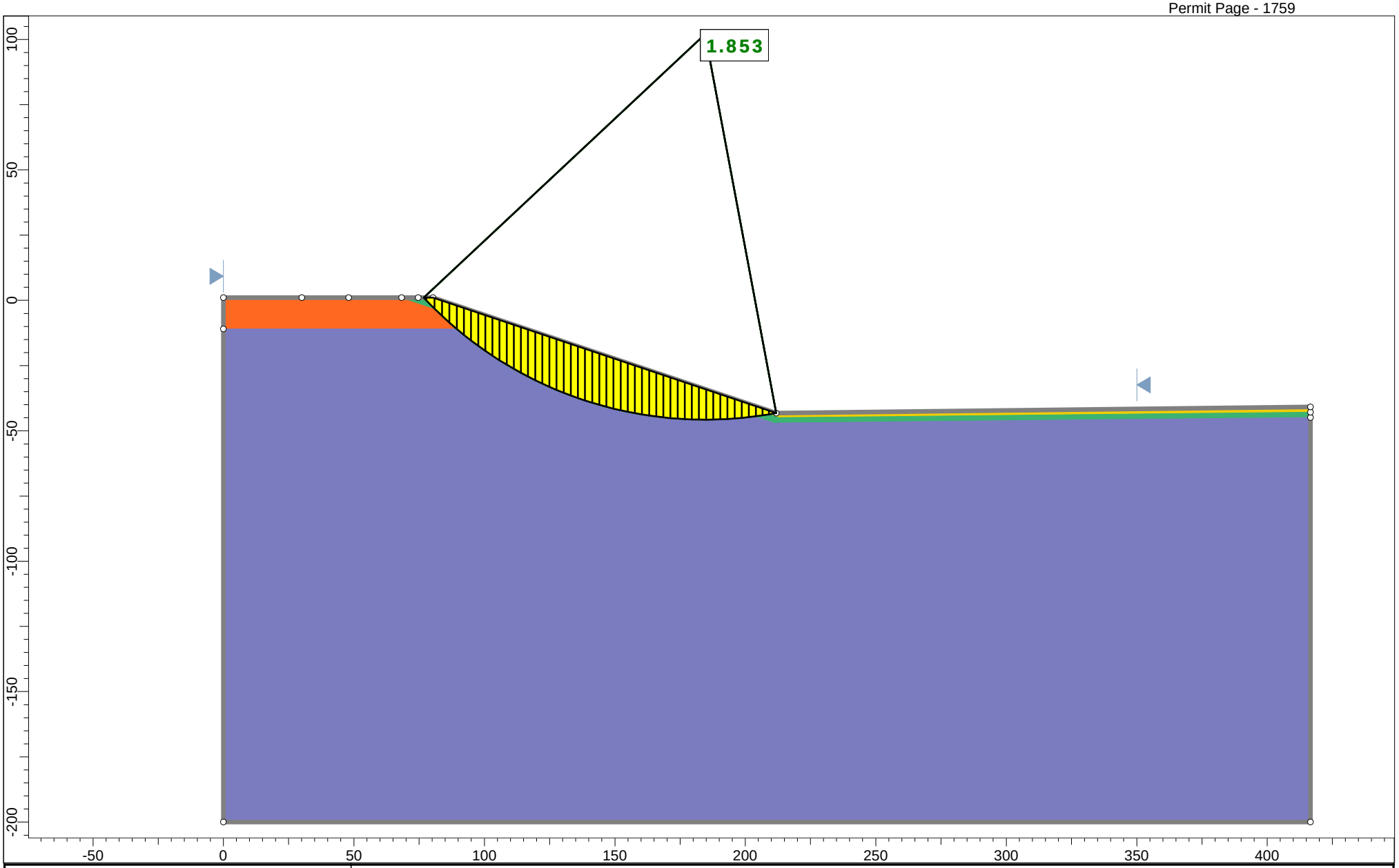
Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Effective Stress	Total Stress	Effective Stress	Total Stress	Effective Stress	Total Stress
Excavation A-1	Bishop-Circular	1.8	1.9	1.5	1.3	YES	YES
Excavation A-2	Janbu - Non Circular	1.7	1.8	1.5	1.3	YES	YES
Excavation B-1	Bishop-Circular	1.8	1.9	1.5	1.3	YES	YES
Excavation B-2	Janbu - Non Circular	1.8	1.9	1.5	1.3	YES	YES

Summary of Stratum II - Arias Geotechnical Calculations

Boring No.	Cohesion c' (psf)	Friction Angle (phi)	Cohesion c' (psf)	Friction Angle (phi)
Stratum II – Arias and Associates, Inc (2020)				
B-1	100	25	2500	0
B-3	500	33	8000	0
B-4	100	24	2500	0
B-5	100	25	2800	0
B-6	150	24	2800	0
B-7	100	25	2800	0
B-11	150	26	3000	0
B-12	150	25	3500	0
B-16	500	30	8000	0
COMPUTATIONS – Stratum II				
Mean	206	26	4000	0

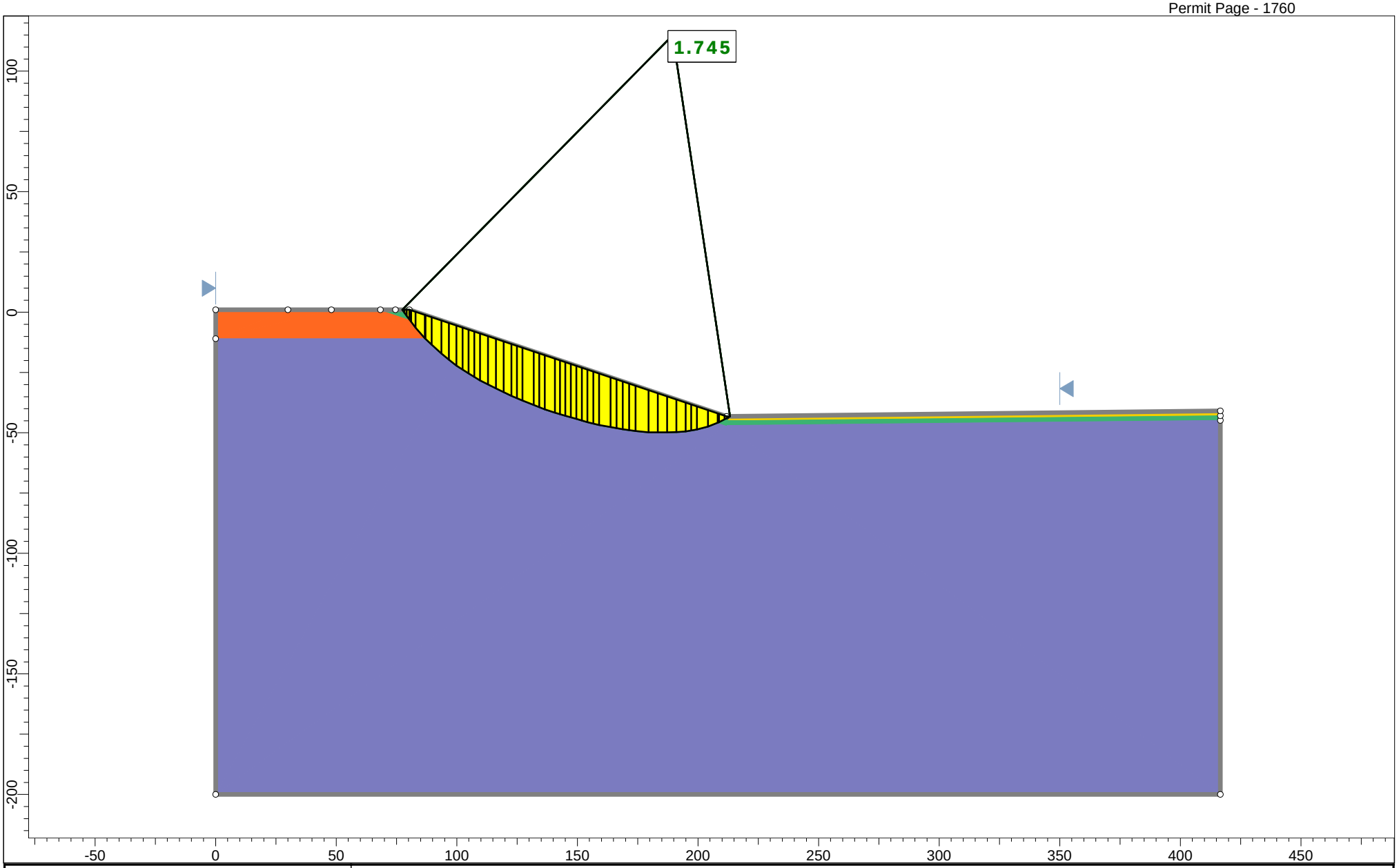
Summary of Stratum III - Arias Geotechnical Calculations

Boring No.	Cohesion c' (psf)	Friction Angle (phi)	Cohesion c' (psf)	Friction Angle (phi)
Stratum III – Arias and				
B-1	150	24	3000	0
B-2	150	23	3000	0
B-3	150	23	3000	0
B-4	150	24	3000	0
B-5	150	24	2800	0
B-6	150	24	2800	0
B-7	150	24	2800	0
B-8	150	24	3500	0
B-9	150	24	2800	0
B-10	150	24	2800	0
B-11	150	24	2800	0
B-12	150	24	2800	0
B-13	150	24	2800	0
B-14	150	24	2800	0
B-15	150	24	2800	0
B-16	150	24	2800	0
B-17	150	24	2800	0
COMPUTATIONS – Stratum III				
Mean	150	24	2888	0



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
	Date		File Name: Slide2-Excavation Section A_Effective Stress.slmd

SLIDEINTERPRET 9.018



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Excavation Section A_Effective Stress.slmd

Materials

Protective Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Clay Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Effective Stress	Simplified Janbu Method - Effective Stress
Protective Cover	✓	✓
Clay Liner	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Bishop Method - Effective Stress

Method: bishop simplified

FS	1.853080
Center:	184.582, 101.980
Radius:	147.714
Left Slip Surface Endpoint:	76.774, 1.000
Right Slip Surface Endpoint:	211.829, -43.200
Resisting Moment:	1.64336e+07 lb-ft
Driving Moment:	8.86825e+06 lb-ft
Total Slice Area:	1824.16 ft2
Surface Horizontal Width:	135.055 ft
Surface Average Height:	13.5068 ft

Simplified Janbu Method - Effective Stress

Method: janbu simplified

FS	1.744990
Axis Location:	189.526, 114.811
Left Slip Surface Endpoint:	77.392, 1.000
Right Slip Surface Endpoint:	213.294, -43.183
Resisting Horizontal Force:	120474 lb
Driving Horizontal Force:	69040.2 lb
Total Slice Area:	2212.88 ft2
Surface Horizontal Width:	135.902 ft
Surface Average Height:	16.2829 ft

Global Minimum Coordinates

Simplified Janbu Method - Effective Stress

Method: janbu simplified

X	Y
77.392	1
79.2296	-1.52586
81.067	-3.96686
82.9045	-6.40795
86.777	-10.7674
89.6038	-13.4705
93.6198	-17.1254
96.7486	-19.6478
99.8775	-22.1702
104.901	-25.3637
109.638	-28.2389
116.18	-31.5964
122.661	-34.6977
127.22	-36.5906
131.838	-38.4222
136.457	-40.2538
140.702	-41.6794
144.947	-42.9077
149.561	-44.2431
154.176	-45.5786
158.965	-46.7492
163.753	-47.6209
168.749	-48.5303
174.142	-49.2182
179.535	-49.7769
183.383	-49.8031
187.231	-49.757
191.063	-49.7111
194.895	-49.4422
199.514	-48.5774
204.134	-47.4572
208.714	-45.6182
213.294	-43.1832

Valid and Invalid Surfaces

Simplified Bishop Method - Effective Stress

Method: bishop simplified

Number of Valid Surfaces:	10745
Number of Invalid Surfaces:	0

Simplified Janbu Method - Effective Stress

Method: janbu simplified

Number of Valid Surfaces:	23329
Number of Invalid Surfaces:	1727

Error Codes
Error Code -106 reported for 5 surfaces
Error Code -108 reported for 40 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 502 surfaces
Error Code -112 reported for 357 surfaces
Error Code -121 reported for 209 surfaces
Error Code -124 reported for 4 surfaces
Error Code -145 reported for 69 surfaces
Error Code -1000 reported for 540 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = Safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-124 = A slice has a width less than the minimum acceptable value.

-145 = Slip surface was clipped vertically by a weak layer in a region of compression. Such a surface cannot be evaluated using Limit Equilibrium. For more information, see Help Documentation on weak layers.

-1000 = No valid slip surface is generated

Interslice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.85308

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	76.7738	1	0	0	0
2	77.7717	-0.0549318	-48.9926	0	0
3	80.8775	-3.21003	381.914	0	0
4	83.7262	-5.94445	835.252	0	0
5	86.575	-8.53787	1539.35	0	0
6	89.4238	-11	2438.04	0	0
7	92.1533	-13.2437	3585.79	0	0
8	94.8828	-15.3811	4826.73	0	0
9	97.6124	-17.4178	6129.36	0	0
10	100.342	-19.3591	7466.17	0	0
11	103.071	-21.2092	8813.13	0	0
12	105.801	-22.9724	10149.5	0	0
13	108.53	-24.6522	11458.2	0	0
14	111.26	-26.252	12723	0	0
15	113.99	-27.7746	13930.1	0	0
16	116.719	-29.2228	15067.1	0	0
17	119.449	-30.599	16123.8	0	0
18	122.178	-31.9054	17091.3	0	0
19	124.908	-33.1441	17962.1	0	0
20	127.637	-34.3169	18730.3	0	0
21	130.367	-35.4254	19390.9	0	0
22	133.096	-36.4713	19940.2	0	0
23	135.826	-37.4559	20375.6	0	0
24	138.555	-38.3806	20695.4	0	0
25	141.285	-39.2464	20898.9	0	0
26	144.014	-40.0545	20986.3	0	0
27	146.744	-40.8059	20958.7	0	0
28	149.473	-41.5015	20817.9	0	0
29	152.203	-42.142	20566.8	0	0
30	154.932	-42.7281	20208.8	0	0
31	157.662	-43.2607	19748.2	0	0
32	160.391	-43.7402	19190	0	0
33	163.121	-44.1671	18540.2	0	0
34	165.851	-44.5419	17805.2	0	0
35	168.58	-44.8651	16992.5	0	0
36	171.31	-45.1369	16110.1	0	0
37	174.039	-45.3577	15167	0	0
38	176.769	-45.5276	14173	0	0
39	179.498	-45.6469	13138.5	0	0
40	182.228	-45.7156	12074.9	0	0
41	184.957	-45.7339	10994.5	0	0
42	187.687	-45.7017	9910.39	0	0
43	190.416	-45.6191	8836.77	0	0
44	193.146	-45.4859	7788.71	0	0
45	195.875	-45.302	6782.33	0	0
46	198.605	-45.0672	5834.87	0	0
47	201.334	-44.7813	4964.72	0	0
48	204.064	-44.444	4191.49	0	0
49	206.531	-44.0945	3760.66	0	0
50	208.999	-43.7024	3425.13	0	0
51	211.829	-43.1997	0	0	0

Query 1 (bishop simplified) - Safety Factor: 1.85308

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	76.7738	1	0	0	0
2	77.7717	-0.0549318	-48.9926	0	0
3	80.8775	-3.21003	381.914	0	0
4	83.7262	-5.94445	835.252	0	0
5	86.575	-8.53787	1539.35	0	0
6	89.4238	-11	2438.04	0	0
7	92.1533	-13.2437	3585.79	0	0
8	94.8828	-15.3811	4826.73	0	0
9	97.6124	-17.4178	6129.36	0	0
10	100.342	-19.3591	7466.17	0	0
11	103.071	-21.2092	8813.13	0	0
12	105.801	-22.9724	10149.5	0	0
13	108.53	-24.6522	11458.2	0	0
14	111.26	-26.252	12723	0	0
15	113.99	-27.7746	13930.1	0	0
16	116.719	-29.2228	15067.1	0	0
17	119.449	-30.599	16123.8	0	0
18	122.178	-31.9054	17091.3	0	0
19	124.908	-33.1441	17962.1	0	0
20	127.637	-34.3169	18730.3	0	0
21	130.367	-35.4254	19390.9	0	0
22	133.096	-36.4713	19940.2	0	0
23	135.826	-37.4559	20375.6	0	0
24	138.555	-38.3806	20695.4	0	0
25	141.285	-39.2464	20898.9	0	0
26	144.014	-40.0545	20986.3	0	0
27	146.744	-40.8059	20958.7	0	0
28	149.473	-41.5015	20817.9	0	0
29	152.203	-42.142	20566.8	0	0
30	154.932	-42.7281	20208.8	0	0
31	157.662	-43.2607	19748.2	0	0
32	160.391	-43.7402	19190	0	0
33	163.121	-44.1671	18540.2	0	0
34	165.851	-44.5419	17805.2	0	0
35	168.58	-44.8651	16992.5	0	0
36	171.31	-45.1369	16110.1	0	0
37	174.039	-45.3577	15167	0	0
38	176.769	-45.5276	14173	0	0
39	179.498	-45.6469	13138.5	0	0
40	182.228	-45.7156	12074.9	0	0
41	184.957	-45.7339	10994.5	0	0
42	187.687	-45.7017	9910.39	0	0
43	190.416	-45.6191	8836.77	0	0
44	193.146	-45.4859	7788.71	0	0
45	195.875	-45.302	6782.33	0	0
46	198.605	-45.0672	5834.87	0	0
47	201.334	-44.7813	4964.72	0	0
48	204.064	-44.444	4191.49	0	0
49	206.531	-44.0945	3760.66	0	0
50	208.999	-43.7024	3425.13	0	0
51	211.829	-43.1997	0	0	0

Simplified Janbu Method - Effective Stress

Global Minimum Query (janbu simplified) - Safety Factor: 1.74499

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	77.392	1	0	0	0
2	78.2833	-0.225111	-55.7091	0	0
3	79.2296	-1.52586	26.7257	0	0
4	80.3693	-3.03994	307.44	0	0
5	81.067	-3.96686	423.742	0	0
6	82.9045	-6.40795	930.778	0	0
7	86.777	-10.7674	2512.1	0	0
8	87.0203	-11	2616.3	0	0
9	89.6038	-13.4705	4026.52	0	0
10	93.6198	-17.1254	6532.67	0	0
11	96.7486	-19.6478	8477.53	0	0
12	99.8775	-22.1702	10648.7	0	0
13	102.389	-23.7669	11946.4	0	0
14	104.901	-25.3637	13310.3	0	0
15	107.269	-26.8013	14549.2	0	0
16	109.638	-28.2389	15838.5	0	0
17	112.909	-29.9177	17157.1	0	0
18	116.18	-31.5964	18522.7	0	0
19	119.421	-33.1471	19706	0	0
20	122.661	-34.6977	20921.6	0	0
21	124.94	-35.6442	21503.3	0	0
22	127.22	-36.5906	22091.4	0	0
23	131.838	-38.4222	23119.5	0	0
24	134.148	-39.338	23640.3	0	0
25	136.457	-40.2538	24165.6	0	0
26	140.702	-41.6794	24575.1	0	0
27	142.824	-42.2935	24558.5	0	0
28	144.947	-42.9077	24541.2	0	0
29	147.254	-43.5754	24521.6	0	0
30	149.561	-44.2431	24501.1	0	0
31	151.869	-44.9108	24479.7	0	0
32	154.176	-45.5786	24457.5	0	0
33	156.571	-46.1639	24194.4	0	0
34	158.965	-46.7492	23931.9	0	0
35	163.753	-47.6209	22747.6	0	0
36	166.251	-48.0756	22140.5	0	0
37	168.749	-48.5303	21540.8	0	0
38	171.446	-48.8743	20589.3	0	0
39	174.142	-49.2182	19658.4	0	0
40	179.535	-49.7769	17601.4	0	0
41	183.383	-49.8031	15485	0	0
42	187.231	-49.757	13369	0	0
43	191.063	-49.7111	11411.5	0	0
44	194.895	-49.4422	9263.1	0	0
45	197.205	-49.0098	7677.75	0	0
46	199.514	-48.5774	6233.83	0	0
47	204.134	-47.4572	3499.55	0	0
48	208.195	-45.8268	1194.45	0	0
49	208.714	-45.6182	1019.74	0	0
50	211.04	-44.3815	311.688	0	0
51	213.294	-43.1832	0	0	0

Query 1 (janbu simplified) - Safety Factor: 1.74499

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	77.392	1	0	0	0
2	78.2833	-0.225111	-55.7091	0	0
3	79.2296	-1.52586	26.7257	0	0
4	80.3693	-3.03994	307.44	0	0
5	81.067	-3.96686	423.742	0	0
6	82.9045	-6.40795	930.778	0	0
7	86.777	-10.7674	2512.1	0	0
8	87.0203	-11	2616.3	0	0
9	89.6038	-13.4705	4026.52	0	0
10	93.6198	-17.1254	6532.67	0	0
11	96.7486	-19.6478	8477.53	0	0
12	99.8775	-22.1702	10648.7	0	0
13	102.389	-23.7669	11946.4	0	0
14	104.901	-25.3637	13310.3	0	0
15	107.269	-26.8013	14549.2	0	0
16	109.638	-28.2389	15838.5	0	0
17	112.909	-29.9177	17157.1	0	0
18	116.18	-31.5964	18522.7	0	0
19	119.421	-33.1471	19706	0	0
20	122.661	-34.6977	20921.6	0	0
21	124.94	-35.6442	21503.3	0	0
22	127.22	-36.5906	22091.4	0	0
23	131.838	-38.4222	23119.5	0	0
24	134.148	-39.338	23640.3	0	0
25	136.457	-40.2538	24165.6	0	0
26	140.702	-41.6794	24575.1	0	0
27	142.824	-42.2935	24558.5	0	0
28	144.947	-42.9077	24541.2	0	0
29	147.254	-43.5754	24521.6	0	0
30	149.561	-44.2431	24501.1	0	0
31	151.869	-44.9108	24479.7	0	0
32	154.176	-45.5786	24457.5	0	0
33	156.571	-46.1639	24194.4	0	0
34	158.965	-46.7492	23931.9	0	0
35	163.753	-47.6209	22747.6	0	0
36	166.251	-48.0756	22140.5	0	0
37	168.749	-48.5303	21540.8	0	0
38	171.446	-48.8743	20589.3	0	0
39	174.142	-49.2182	19658.4	0	0
40	179.535	-49.7769	17601.4	0	0
41	183.383	-49.8031	15485	0	0
42	187.231	-49.757	13369	0	0
43	191.063	-49.7111	11411.5	0	0
44	194.895	-49.4422	9263.1	0	0
45	197.205	-49.0098	7677.75	0	0
46	199.514	-48.5774	6233.83	0	0
47	204.134	-47.4572	3499.55	0	0
48	208.195	-45.8268	1194.45	0	0
49	208.714	-45.6182	1019.74	0	0
50	211.04	-44.3815	311.688	0	0
51	213.294	-43.1832	0	0	0

Discharge Sections

Entity Information

Simplified Bishop Method - Effective Stress

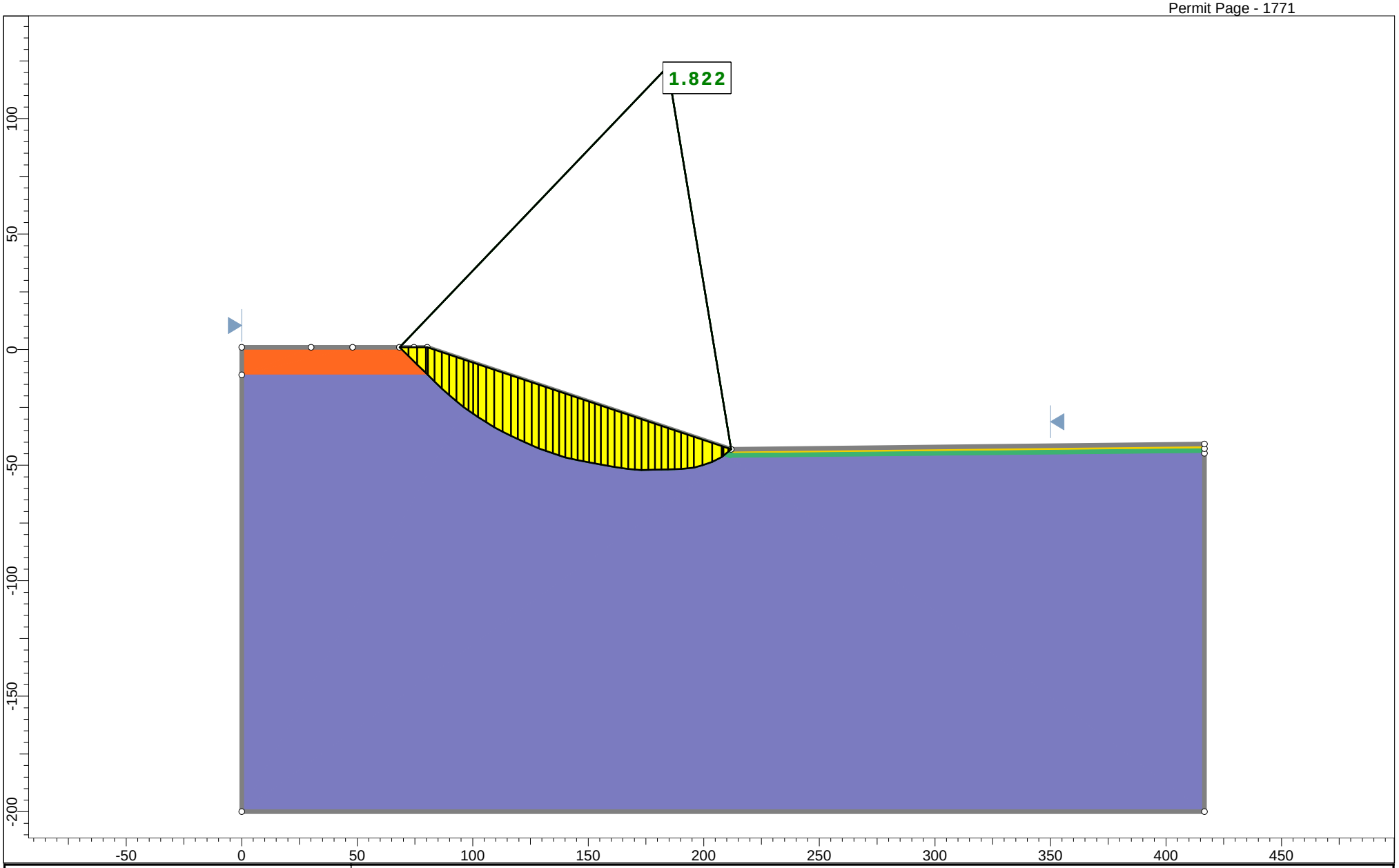
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11

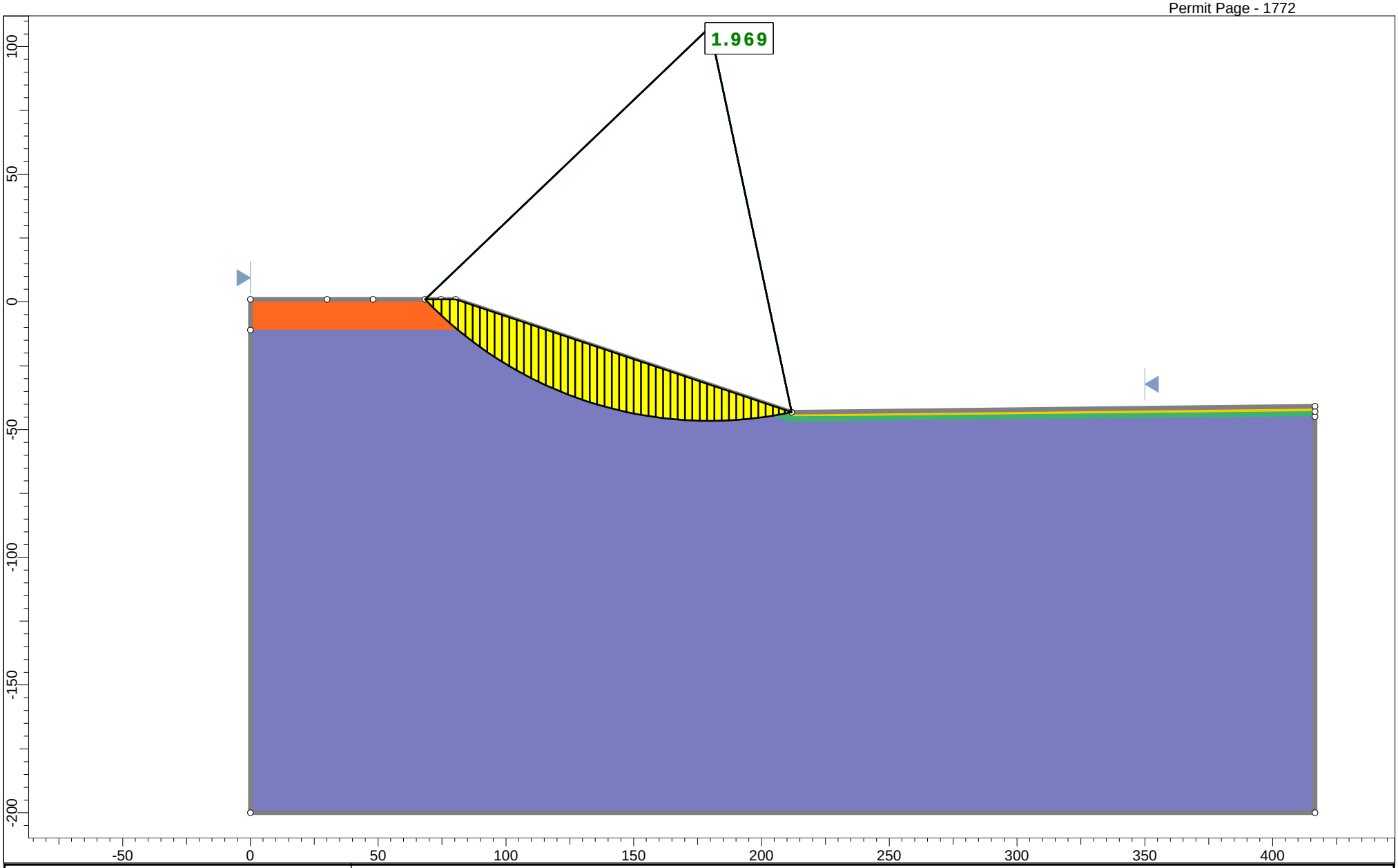
Simplified Janbu Method - Effective Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Excavation Section A_Total Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
	Date		File Name: Slide2-Excavation Section A_Total Stress.slmd

SLIDEINTERPRET 9.018

Materials

Protective Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Clay Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Janbu Method - Total Stress	Simplified Bishop Method - Total Stress
Protective Cover	✓	✓
Clay Liner	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Janbu Method - Total Stress

Method: janbu simplified

FS	1.821540
Axis Location:	184.278, 122.345
Left Slip Surface Endpoint:	68.355, 1.000
Right Slip Surface Endpoint:	211.800, -43.200
Resisting Horizontal Force:	152817 lb
Driving Horizontal Force:	83894.6 lb
Total Slice Area:	2811.48 ft2
Surface Horizontal Width:	143.445 ft
Surface Average Height:	19.5997 ft

Simplified Bishop Method - Total Stress

Method: bishop simplified

FS	1.969100
Center:	179.690, 107.484
Radius:	154.058
Left Slip Surface Endpoint:	68.356, 1.000
Right Slip Surface Endpoint:	211.783, -43.194
Resisting Moment:	2.16623e+07 lb-ft
Driving Moment:	1.10011e+07 lb-ft
Total Slice Area:	2241.39 ft2
Surface Horizontal Width:	143.427 ft
Surface Average Height:	15.6274 ft

Global Minimum Coordinates

Simplified Janbu Method - Total Stress

Method: janbu simplified

X	Y
68.3552	1
72.1544	-2.72053
75.9343	-6.4221
79.7081	-10.1178
83.482	-13.8135
86.6416	-16.9077
89.8012	-19.6817
92.9303	-22.2877
96.0558	-24.8909
102.316	-29.2232
105.775	-31.4253
109.234	-33.6273
112.897	-35.555
116.56	-37.296
122.38	-39.9797
128.55	-42.8184
134.721	-44.9278
140.036	-46.7447
145.351	-47.8325
150.377	-48.7768
155.403	-49.7212
161.32	-50.7647
167.236	-51.7139
173.032	-52.1397
178.828	-51.978
184.476	-51.8205
190.149	-51.6622
195.653	-51.0914
199.403	-50.0233
203.578	-48.6318
207.726	-46.551
211.8	-43.2

Valid and Invalid Surfaces

Simplified Janbu Method - Total Stress

Method: janbu simplified

Number of Valid Surfaces:	23279
Number of Invalid Surfaces:	1778

Error Codes

Error Code -106 reported for 6 surfaces
Error Code -108 reported for 51 surfaces
Error Code -111 reported for 597 surfaces
Error Code -112 reported for 427 surfaces
Error Code -121 reported for 217 surfaces
Error Code -124 reported for 2 surfaces
Error Code -145 reported for 67 surfaces
Error Code -1000 reported for 411 surfaces

Simplified Bishop Method - Total Stress

Method: bishop simplified

Number of Valid Surfaces:	10140
Number of Invalid Surfaces:	0

Slice Data

Simplified Janbu Method - Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 1.82154

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.79921	806.411	-44.4006	Stratum II	206	26	134.624	245.224	80.421	0	80.421	212.258	212.258
2	3.77984	2401.55	-44.4006	Stratum II	206	26	224.378	408.714	415.625	0	415.625	635.356	635.356
3	3.77384	3989.09	-44.4006	Stratum II	206	26	313.831	571.656	749.706	0	749.706	1057.04	1057.04
4	0.900866	1185.42	-44.4006	Stratum II	206	26	368.737	671.67	954.766	0	954.766	1315.87	1315.87
5	2.87297	4181.9	-44.4006	Stratum III	150	24	353.514	643.94	1109.41	0	1109.41	1455.6	1455.6
6	3.15963	5261.09	-44.4006	Stratum III	150	24	394.83	719.199	1278.44	0	1278.44	1665.1	1665.1
7	3.15963	5899.33	-41.2813	Stratum III	150	24	443.533	807.913	1477.7	0	1477.7	1867.09	1867.09
8	3.12903	6392.78	-39.7897	Stratum III	150	24	483.328	880.402	1640.51	0	1640.51	2043.06	2043.06
9	3.12555	6908.54	-39.7897	Stratum III	150	24	517.302	942.287	1779.5	0	1779.5	2210.35	2210.35
10	2.08679	4870.03	-34.6843	Stratum III	150	24	558.331	1017.02	1947.36	0	1947.36	2333.74	2333.74
11	2.08679	5036.13	-34.6843	Stratum III	150	24	574.971	1047.33	2015.44	0	2015.44	2413.34	2413.34
12	2.08679	5202.23	-34.6843	Stratum III	150	24	591.611	1077.64	2083.52	0	2083.52	2492.93	2492.93
13	3.45889	8953.34	-32.4822	Stratum III	150	24	618.756	1127.09	2194.58	0	2194.58	2588.5	2588.5
14	3.45889	9343.97	-32.4822	Stratum III	150	24	642.643	1170.6	2292.31	0	2292.31	2701.43	2701.43
15	3.66307	10241.9	-27.7559	Stratum III	150	24	678.481	1235.88	2438.94	0	2438.94	2795.99	2795.99
16	3.66307	10482.5	-25.421	Stratum III	150	24	700.44	1275.88	2528.75	0	2528.75	2861.66	2861.66
17	2.90979	8465.24	-24.7568	Stratum III	150	24	713.061	1298.87	2580.4	0	2580.4	2909.23	2909.23
18	2.90979	8580.5	-24.7568	Stratum III	150	24	721.763	1314.72	2616	0	2616	2948.84	2948.84
19	3.08528	9223.3	-24.7043	Stratum III	150	24	730.86	1331.29	2653.23	0	2653.23	2989.46	2989.46
20	3.08528	9351.73	-24.7043	Stratum III	150	24	740.006	1347.95	2690.65	0	2690.65	3031.08	3031.08
21	3.08528	9418.83	-18.8724	Stratum III	150	24	764.644	1392.83	2791.45	0	2791.45	3052.83	3052.83
22	3.08528	9424.62	-18.8724	Stratum III	150	24	765.067	1393.6	2793.18	0	2793.18	3054.71	3054.71
23	2.65761	8122.87	-18.8724	Stratum III	150	24	765.462	1394.32	2794.79	0	2794.79	3056.46	3056.46
24	2.65761	8127.17	-18.8724	Stratum III	150	24	765.825	1394.98	2796.28	0	2796.28	3058.07	3058.07
25	2.65761	8078.65	-11.5659	Stratum III	150	24	786.033	1431.79	2878.95	0	2878.95	3039.82	3039.82
26	2.65761	7977.33	-11.5659	Stratum III	150	24	777.161	1415.63	2842.64	0	2842.64	3001.69	3001.69
27	2.51302	7444.33	-10.6416	Stratum III	150	24	770.996	1404.4	2817.44	0	2817.44	2962.31	2962.31
28	2.51302	7342.2	-10.6416	Stratum III	150	24	761.504	1387.11	2778.58	0	2778.58	2921.67	2921.67
29	2.51302	7240.07	-10.6416	Stratum III	150	24	752.007	1369.81	2739.73	0	2739.73	2881.03	2881.03
30	2.51302	7137.94	-10.6416	Stratum III	150	24	742.509	1352.51	2700.87	0	2700.87	2840.39	2840.39
31	2.95854	8267	-10.0014	Stratum III	150	24	733.714	1336.49	2664.89	0	2664.89	2794.28	2794.28

32	2.95854	8114.44	-10.0014	Stratum III	150	24	721.626	1314.47	2615.45	0	2615.45	2742.71	2742.71
33	2.95805	7952.98	-9.1148	Stratum III	150	24	711.596	1296.2	2574.42	0	2574.42	2688.58	2688.58
34	2.95805	7785.28	-9.1148	Stratum III	150	24	698.266	1271.92	2519.87	0	2519.87	2631.89	2631.89
35	2.89796	7424.7	-4.20197	Stratum III	150	24	696.076	1267.93	2510.9	0	2510.9	2562.04	2562.04
36	2.89796	7184.14	-4.20197	Stratum III	150	24	676.142	1231.62	2429.36	0	2429.36	2479.03	2479.03
37	2.89796	6897.19	1.59796	Stratum III	150	24	668.643	1217.96	2398.67	0	2398.67	2380.02	2380.02
38	2.89796	6563.83	1.59796	Stratum III	150	24	640.332	1166.39	2282.85	0	2282.85	2264.99	2264.99
39	2.82392	6075.44	1.59796	Stratum III	150	24	612.384	1115.48	2168.51	0	2168.51	2151.43	2151.43
40	2.82392	5758.91	1.59796	Stratum III	150	24	584.798	1065.23	2055.65	0	2055.65	2039.33	2039.33
41	2.83617	5465.31	1.59796	Stratum III	150	24	557.153	1014.88	1942.54	0	1942.54	1927	1927
42	2.83617	5146.02	1.59796	Stratum III	150	24	529.447	964.409	1829.19	0	1829.19	1814.42	1814.42
43	2.75218	4657.07	5.92101	Stratum III	150	24	508.847	926.885	1744.91	0	1744.91	1692.14	1692.14
44	2.75218	4293.82	5.92101	Stratum III	150	24	475.747	866.593	1609.49	0	1609.49	1560.15	1560.15
45	3.74987	5126.92	15.899	Stratum III	150	24	447.701	815.506	1494.75	0	1494.75	1367.23	1367.23
46	4.17564	4542.83	18.4294	Stratum III	150	24	379.147	690.632	1214.28	0	1214.28	1087.94	1087.94
47	4.14716	3094.51	26.6447	Stratum III	150	24	301.735	549.623	897.568	0	897.568	746.176	746.176
48	0.761683	387.446	39.4356	Stratum III	150	24	258.681	471.198	721.423	0	721.423	508.671	508.671
49	2.07117	655.722	39.4356	Clay Liner	1000	0	548.986	1000	768.106	0	768.106	316.593	316.593
50	1.24161	107.162	39.4356	Protective Cover	1000	0	548.986	1000	537.822	0	537.822	86.309	86.309

Query 1 (janbu simplified) - Safety Factor: 1.82154

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.79921	806.411	-44.4006	Stratum II	206	26	134.624	245.224	80.421	0	80.421	212.258	212.258
2	3.77984	2401.55	-44.4006	Stratum II	206	26	224.378	408.714	415.625	0	415.625	635.356	635.356
3	3.77384	3989.09	-44.4006	Stratum II	206	26	313.831	571.656	749.706	0	749.706	1057.04	1057.04
4	0.900866	1185.42	-44.4006	Stratum II	206	26	368.737	671.67	954.766	0	954.766	1315.87	1315.87
5	2.87297	4181.9	-44.4006	Stratum III	150	24	353.514	643.94	1109.41	0	1109.41	1455.6	1455.6
6	3.15963	5261.09	-44.4006	Stratum III	150	24	394.83	719.199	1278.44	0	1278.44	1665.1	1665.1
7	3.15963	5899.33	-41.2813	Stratum III	150	24	443.533	807.913	1477.7	0	1477.7	1867.09	1867.09
8	3.12903	6392.78	-39.7897	Stratum III	150	24	483.328	880.402	1640.51	0	1640.51	2043.06	2043.06
9	3.12555	6908.54	-39.7897	Stratum III	150	24	517.302	942.287	1779.5	0	1779.5	2210.35	2210.35
10	2.08679	4870.03	-34.6843	Stratum III	150	24	558.331	1017.02	1947.36	0	1947.36	2333.74	2333.74
11	2.08679	5036.13	-34.6843	Stratum III	150	24	574.971	1047.33	2015.44	0	2015.44	2413.34	2413.34
12	2.08679	5202.23	-34.6843	Stratum III	150	24	591.611	1077.64	2083.52	0	2083.52	2492.93	2492.93
13	3.45889	8953.34	-32.4822	Stratum III	150	24	618.756	1127.09	2194.58	0	2194.58	2588.5	2588.5
14	3.45889	9343.97	-32.4822	Stratum III	150	24	642.643	1170.6	2292.31	0	2292.31	2701.43	2701.43
15	3.66307	10241.9	-27.7559	Stratum III	150	24	678.481	1235.88	2438.94	0	2438.94	2795.99	2795.99
16	3.66307	10482.5	-25.421	Stratum III	150	24	700.44	1275.88	2528.75	0	2528.75	2861.66	2861.66
17	2.90979	8465.24	-24.7568	Stratum III	150	24	713.061	1298.87	2580.4	0	2580.4	2909.23	2909.23
18	2.90979	8580.5	-24.7568	Stratum III	150	24	721.763	1314.72	2616	0	2616	2948.84	2948.84
19	3.08528	9223.3	-24.7043	Stratum III	150	24	730.86	1331.29	2653.23	0	2653.23	2989.46	2989.46
20	3.08528	9351.73	-24.7043	Stratum III	150	24	740.006	1347.95	2690.65	0	2690.65	3031.08	3031.08
21	3.08528	9418.83	-18.8724	Stratum III	150	24	764.644	1392.83	2791.45	0	2791.45	3052.83	3052.83
22	3.08528	9424.62	-18.8724	Stratum III	150	24	765.067	1393.6	2793.18	0	2793.18	3054.71	3054.71
23	2.65761	8122.87	-18.8724	Stratum III	150	24	765.462	1394.32	2794.79	0	2794.79	3056.46	3056.46
24	2.65761	8127.17	-18.8724	Stratum III	150	24	765.825	1394.98	2796.28	0	2796.28	3058.07	3058.07
25	2.65761	8078.65	-11.5659	Stratum III	150	24	786.033	1431.79	2878.95	0	2878.95	3039.82	3039.82
26	2.65761	7977.33	-11.5659	Stratum III	150	24	777.161	1415.63	2842.64	0	2842.64	3001.69	3001.69
27	2.51302	7444.33	-10.6416	Stratum III	150	24	770.996	1404.4	2817.44	0	2817.44	2962.31	2962.31
28	2.51302	7342.2	-10.6416	Stratum III	150	24	761.504	1387.11	2778.58	0	2778.58	2921.67	2921.67
29	2.51302	7240.07	-10.6416	Stratum III	150	24	752.007	1369.81	2739.73	0	2739.73	2881.03	2881.03
30	2.51302	7137.94	-10.6416	Stratum III	150	24	742.509	1352.51	2700.87	0	2700.87	2840.39	2840.39
31	2.95854	8267	-10.0014	Stratum III	150	24	733.714	1336.49	2664.89	0	2664.89	2794.28	2794.28
32	2.95854	8114.44	-10.0014	Stratum III	150	24	721.626	1314.47	2615.45	0	2615.45	2742.71	2742.71
33	2.95805	7952.98	-9.1148	Stratum III	150	24	711.596	1296.2	2574.42	0	2574.42	2688.58	2688.58
34	2.95805	7785.28	-9.1148	Stratum III	150	24	698.266	1271.92	2519.87	0	2519.87	2631.89	2631.89
35	2.89796	7424.7	-4.20197	Stratum III	150	24	696.076	1267.93	2510.9	0	2510.9	2562.04	2562.04

36	2.89796	7184.14	-4.20197	Stratum III	150	24	676.142	1231.62	2429.36	0	2429.36	2479.03	2479.03
37	2.89796	6897.19	1.59796	Stratum III	150	24	668.643	1217.96	2398.67	0	2398.67	2380.02	2380.02
38	2.89796	6563.83	1.59796	Stratum III	150	24	640.332	1166.39	2282.85	0	2282.85	2264.99	2264.99
39	2.82392	6075.44	1.59796	Stratum III	150	24	612.384	1115.48	2168.51	0	2168.51	2151.43	2151.43
40	2.82392	5758.91	1.59796	Stratum III	150	24	584.798	1065.23	2055.65	0	2055.65	2039.33	2039.33
41	2.83617	5465.31	1.59796	Stratum III	150	24	557.153	1014.88	1942.54	0	1942.54	1927	1927
42	2.83617	5146.02	1.59796	Stratum III	150	24	529.447	964.409	1829.19	0	1829.19	1814.42	1814.42
43	2.75218	4657.07	5.92101	Stratum III	150	24	508.847	926.885	1744.91	0	1744.91	1692.14	1692.14
44	2.75218	4293.82	5.92101	Stratum III	150	24	475.747	866.593	1609.49	0	1609.49	1560.15	1560.15
45	3.74987	5126.92	15.899	Stratum III	150	24	447.701	815.506	1494.75	0	1494.75	1367.23	1367.23
46	4.17564	4542.83	18.4294	Stratum III	150	24	379.147	690.632	1214.28	0	1214.28	1087.94	1087.94
47	4.14716	3094.51	26.6447	Stratum III	150	24	301.735	549.623	897.568	0	897.568	746.176	746.176
48	0.761683	387.446	39.4356	Stratum III	150	24	258.681	471.198	721.423	0	721.423	508.671	508.671
49	2.07117	655.722	39.4356	Clay Liner	1000	0	548.986	1000	768.106	0	768.106	316.593	316.593
50	1.24161	107.162	39.4356	Protective Cover	1000	0	548.986	1000	537.822	0	537.822	86.309	86.309

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.9691

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.2169	598.669	-45.4231	Stratum II	206	26	120.442	237.163	63.8929	0	63.8929	186.127	186.127
2	3.2169	1761.73	-43.7427	Stratum II	206	26	194.231	382.461	361.798	0	361.798	547.687	547.687
3	3.2169	2861.07	-42.1083	Stratum II	206	26	265.488	522.772	649.48	0	649.48	889.437	889.437
4	3.2169	3884.37	-40.5151	Stratum II	206	26	333.193	656.09	922.821	0	922.821	1207.55	1207.55
5	2.86565	4029.49	-39.0421	Stratum III	150	24	333.055	655.819	1136.09	0	1136.09	1406.2	1406.2
6	2.86565	4431.93	-37.6826	Stratum III	150	24	362.563	713.922	1266.59	0	1266.59	1546.63	1546.63
7	2.86565	4800.74	-36.3476	Stratum III	150	24	390.081	768.108	1388.29	0	1388.29	1675.34	1675.34
8	2.86565	5137.65	-35.0352	Stratum III	150	24	415.671	818.497	1501.47	0	1501.47	1792.9	1792.9
9	2.86565	5444.2	-33.7435	Stratum III	150	24	439.388	865.198	1606.36	0	1606.36	1899.88	1899.88
10	2.86565	5721.76	-32.471	Stratum III	150	24	461.282	908.311	1703.19	0	1703.19	1996.74	1996.74
11	2.86565	5971.57	-31.2163	Stratum III	150	24	481.402	947.928	1792.18	0	1792.18	2083.91	2083.91
12	2.86565	6194.75	-29.978	Stratum III	150	24	499.788	984.132	1873.49	0	1873.49	2161.79	2161.79
13	2.86565	6394.89	-28.7549	Stratum III	150	24	516.662	1017.36	1948.12	0	1948.12	2231.63	2231.63
14	2.86565	6572.93	-27.5461	Stratum III	150	24	532.064	1047.69	2016.24	0	2016.24	2293.76	2293.76
15	2.86565	6727.06	-26.3504	Stratum III	150	24	545.842	1074.82	2077.17	0	2077.17	2347.54	2347.54
16	2.86565	6858.04	-25.1669	Stratum III	150	24	558.024	1098.81	2131.05	0	2131.05	2393.25	2393.25
17	2.86565	6966.55	-23.9948	Stratum III	150	24	568.639	1119.71	2178	0	2178	2431.11	2431.11
18	2.86565	7053.21	-22.8333	Stratum III	150	24	577.709	1137.57	2218.11	0	2218.11	2461.35	2461.35
19	2.86565	7118.6	-21.6817	Stratum III	150	24	585.252	1152.42	2251.48	0	2251.48	2484.16	2484.16
20	2.86565	7163.23	-20.5391	Stratum III	150	24	591.296	1164.32	2278.2	0	2278.2	2499.74	2499.74
21	2.86565	7187.57	-19.4051	Stratum III	150	24	595.851	1173.29	2298.34	0	2298.34	2508.23	2508.23
22	2.86565	7192.06	-18.2789	Stratum III	150	24	598.928	1179.35	2311.96	0	2311.96	2509.8	2509.8
23	2.86565	7177.1	-17.16	Stratum III	150	24	600.548	1182.54	2319.13	0	2319.13	2504.57	2504.57
24	2.86565	7143.05	-16.0478	Stratum III	150	24	600.721	1182.88	2319.89	0	2319.89	2492.69	2492.69
25	2.86565	7090.23	-14.9417	Stratum III	150	24	599.452	1180.38	2314.28	0	2314.28	2474.25	2474.25
26	2.86565	7018.95	-13.8414	Stratum III	150	24	596.755	1175.07	2302.34	0	2302.34	2449.37	2449.37
27	2.86565	6929.47	-12.7462	Stratum III	150	24	592.626	1166.94	2284.09	0	2284.09	2418.14	2418.14
28	2.86565	6822.04	-11.6557	Stratum III	150	24	587.08	1156.02	2259.55	0	2259.55	2380.65	2380.65
29	2.86565	6696.88	-10.5695	Stratum III	150	24	580.111	1142.3	2228.73	0	2228.73	2336.98	2336.98
30	2.86565	6554.2	-9.48715	Stratum III	150	24	571.724	1125.78	2191.64	0	2191.64	2287.18	2287.18
31	2.86565	6394.15	-8.40819	Stratum III	150	24	561.918	1106.47	2148.27	0	2148.27	2231.33	2231.33
32	2.86565	6216.91	-7.33223	Stratum III	150	24	550.69	1084.36	2098.61	0	2098.61	2169.47	2169.47
33	2.86565	6022.59	-6.25886	Stratum III	150	24	538.037	1059.45	2042.66	0	2042.66	2101.67	2101.67
34	2.86565	5811.32	-5.1877	Stratum III	150	24	523.953	1031.72	1980.37	0	1980.37	2027.94	2027.94

35	2.86565	5583.19	-4.11835	Stratum III	150	24	508.431	1001.15	1911.72	0	1911.72	1948.33	1948.33
36	2.86565	5338.28	-3.05044	Stratum III	150	24	491.462	967.738	1836.67	0	1836.67	1862.86	1862.86
37	2.86565	5076.64	-1.98358	Stratum III	150	24	473.035	931.453	1755.17	0	1755.17	1771.56	1771.56
38	2.86565	4798.32	-0.917416	Stratum III	150	24	453.138	892.274	1667.17	0	1667.17	1674.43	1674.43
39	2.86565	4503.34	0.148432	Stratum III	150	24	431.756	850.171	1572.61	0	1572.61	1571.49	1571.49
40	2.86565	4191.7	1.21433	Stratum III	150	24	408.874	805.113	1471.41	0	1471.41	1462.74	1462.74
41	2.86565	3863.4	2.28065	Stratum III	150	24	384.472	757.064	1363.49	0	1363.49	1348.18	1348.18
42	2.86565	3518.41	3.34776	Stratum III	150	24	358.531	705.983	1248.76	0	1248.76	1227.79	1227.79
43	2.86565	3156.68	4.41604	Stratum III	150	24	331.027	651.825	1127.12	0	1127.12	1101.55	1101.55
44	2.86565	2778.15	5.48586	Stratum III	150	24	301.936	594.542	998.457	0	998.457	969.459	969.459
45	2.86565	2382.73	6.5576	Stratum III	150	24	271.229	534.077	862.654	0	862.654	831.475	831.475
46	2.86565	1970.32	7.63165	Stratum III	150	24	238.877	470.372	719.566	0	719.566	687.559	687.559
47	2.86565	1540.82	8.7084	Stratum III	150	24	204.845	403.36	569.055	0	569.055	537.679	537.679
48	2.33133	910.038	9.6873	Clay Liner	1000	0	507.846	1000	477.025	0	477.025	390.333	390.333
49	2.33133	574.307	10.5681	Clay Liner	1000	0	507.846	1000	341.071	0	341.071	246.323	246.323
50	2.67391	231.6	11.5166	Protective Cover	1000	0	507.846	1000	190.068	0	190.068	86.5926	86.5926

Query 1 (bishop simplified) - Safety Factor: 1.9691

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.2169	598.669	-45.4231	Stratum II	206	26	120.442	237.163	63.8929	0	63.8929	186.127	186.127
2	3.2169	1761.73	-43.7427	Stratum II	206	26	194.231	382.461	361.798	0	361.798	547.687	547.687
3	3.2169	2861.07	-42.1083	Stratum II	206	26	265.488	522.772	649.48	0	649.48	889.437	889.437
4	3.2169	3884.37	-40.5151	Stratum II	206	26	333.193	656.09	922.821	0	922.821	1207.55	1207.55
5	2.86565	4029.49	-39.0421	Stratum III	150	24	333.055	655.819	1136.09	0	1136.09	1406.2	1406.2
6	2.86565	4431.93	-37.6826	Stratum III	150	24	362.563	713.922	1266.59	0	1266.59	1546.63	1546.63
7	2.86565	4800.74	-36.3476	Stratum III	150	24	390.081	768.108	1388.29	0	1388.29	1675.34	1675.34
8	2.86565	5137.65	-35.0352	Stratum III	150	24	415.671	818.497	1501.47	0	1501.47	1792.9	1792.9
9	2.86565	5444.2	-33.7435	Stratum III	150	24	439.388	865.198	1606.36	0	1606.36	1899.88	1899.88
10	2.86565	5721.76	-32.471	Stratum III	150	24	461.282	908.311	1703.19	0	1703.19	1996.74	1996.74
11	2.86565	5971.57	-31.2163	Stratum III	150	24	481.402	947.928	1792.18	0	1792.18	2083.91	2083.91
12	2.86565	6194.75	-29.978	Stratum III	150	24	499.788	984.132	1873.49	0	1873.49	2161.79	2161.79
13	2.86565	6394.89	-28.7549	Stratum III	150	24	516.662	1017.36	1948.12	0	1948.12	2231.63	2231.63
14	2.86565	6572.93	-27.5461	Stratum III	150	24	532.064	1047.69	2016.24	0	2016.24	2293.76	2293.76
15	2.86565	6727.06	-26.3504	Stratum III	150	24	545.842	1074.82	2077.17	0	2077.17	2347.54	2347.54
16	2.86565	6858.04	-25.1669	Stratum III	150	24	558.024	1098.81	2131.05	0	2131.05	2393.25	2393.25
17	2.86565	6966.55	-23.9948	Stratum III	150	24	568.639	1119.71	2178	0	2178	2431.11	2431.11
18	2.86565	7053.21	-22.8333	Stratum III	150	24	577.709	1137.57	2218.11	0	2218.11	2461.35	2461.35
19	2.86565	7118.6	-21.6817	Stratum III	150	24	585.252	1152.42	2251.48	0	2251.48	2484.16	2484.16
20	2.86565	7163.23	-20.5391	Stratum III	150	24	591.296	1164.32	2278.2	0	2278.2	2499.74	2499.74
21	2.86565	7187.57	-19.4051	Stratum III	150	24	595.851	1173.29	2298.34	0	2298.34	2508.23	2508.23
22	2.86565	7192.06	-18.2789	Stratum III	150	24	598.928	1179.35	2311.96	0	2311.96	2509.8	2509.8
23	2.86565	7177.1	-17.16	Stratum III	150	24	600.548	1182.54	2319.13	0	2319.13	2504.57	2504.57
24	2.86565	7143.05	-16.0478	Stratum III	150	24	600.721	1182.88	2319.89	0	2319.89	2492.69	2492.69
25	2.86565	7090.23	-14.9417	Stratum III	150	24	599.452	1180.38	2314.28	0	2314.28	2474.25	2474.25
26	2.86565	7018.95	-13.8414	Stratum III	150	24	596.755	1175.07	2302.34	0	2302.34	2449.37	2449.37
27	2.86565	6929.47	-12.7462	Stratum III	150	24	592.626	1166.94	2284.09	0	2284.09	2418.14	2418.14
28	2.86565	6822.04	-11.6557	Stratum III	150	24	587.08	1156.02	2259.55	0	2259.55	2380.65	2380.65
29	2.86565	6696.88	-10.5695	Stratum III	150	24	580.111	1142.3	2228.73	0	2228.73	2336.98	2336.98
30	2.86565	6554.2	-9.48715	Stratum III	150	24	571.724	1125.78	2191.64	0	2191.64	2287.18	2287.18
31	2.86565	6394.15	-8.40819	Stratum III	150	24	561.918	1106.47	2148.27	0	2148.27	2231.33	2231.33
32	2.86565	6216.91	-7.33223	Stratum III	150	24	550.69	1084.36	2098.61	0	2098.61	2169.47	2169.47
33	2.86565	6022.59	-6.25886	Stratum III	150	24	538.037	1059.45	2042.66	0	2042.66	2101.67	2101.67
34	2.86565	5811.32	-5.1877	Stratum III	150	24	523.953	1031.72	1980.37	0	1980.37	2027.94	2027.94
35	2.86565	5583.19	-4.11835	Stratum III	150	24	508.431	1001.15	1911.72	0	1911.72	1948.33	1948.33

36	2.86565	5338.28	-3.05044	Stratum III	150	24	491.462	967.738	1836.67	0	1836.67	1862.86	1862.86
37	2.86565	5076.64	-1.98358	Stratum III	150	24	473.035	931.453	1755.17	0	1755.17	1771.56	1771.56
38	2.86565	4798.32	-0.917416	Stratum III	150	24	453.138	892.274	1667.17	0	1667.17	1674.43	1674.43
39	2.86565	4503.34	0.148432	Stratum III	150	24	431.756	850.171	1572.61	0	1572.61	1571.49	1571.49
40	2.86565	4191.7	1.21433	Stratum III	150	24	408.874	805.113	1471.41	0	1471.41	1462.74	1462.74
41	2.86565	3863.4	2.28065	Stratum III	150	24	384.472	757.064	1363.49	0	1363.49	1348.18	1348.18
42	2.86565	3518.41	3.34776	Stratum III	150	24	358.531	705.983	1248.76	0	1248.76	1227.79	1227.79
43	2.86565	3156.68	4.41604	Stratum III	150	24	331.027	651.825	1127.12	0	1127.12	1101.55	1101.55
44	2.86565	2778.15	5.48586	Stratum III	150	24	301.936	594.542	998.457	0	998.457	969.459	969.459
45	2.86565	2382.73	6.5576	Stratum III	150	24	271.229	534.077	862.654	0	862.654	831.475	831.475
46	2.86565	1970.32	7.63165	Stratum III	150	24	238.877	470.372	719.566	0	719.566	687.559	687.559
47	2.86565	1540.82	8.7084	Stratum III	150	24	204.845	403.36	569.055	0	569.055	537.679	537.679
48	2.33133	910.038	9.6873	Clay Liner	1000	0	507.846	1000	477.025	0	477.025	390.333	390.333
49	2.33133	574.307	10.5681	Clay Liner	1000	0	507.846	1000	341.071	0	341.071	246.323	246.323
50	2.67391	231.6	11.5166	Protective Cover	1000	0	507.846	1000	190.068	0	190.068	86.5926	86.5926

Interslice Data

Simplified Janbu Method - Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 1.82154

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3552	1	0	0	0
2	72.1544	-2.72053	-212.258	0	0
3	75.9343	-6.4221	478.093	0	0
4	79.7081	-10.1178	2064.43	0	0
5	80.609	-11	2574.55	0	0
6	83.482	-13.8135	4680.2	0	0
7	86.6416	-16.9077	7388.44	0	0
8	89.8012	-19.6817	10086.1	0	0
9	92.9303	-22.2877	12849.1	0	0
10	96.0558	-24.8909	15864.5	0	0
11	98.1426	-26.335	17511.6	0	0
12	100.229	-27.7791	19222.3	0	0
13	102.316	-29.2232	20996.6	0	0
14	105.775	-31.4253	23689	0	0
15	109.234	-33.6273	26513.9	0	0
16	112.897	-35.555	28730.1	0	0
17	116.56	-37.296	30566.9	0	0
18	119.47	-38.6379	31954.6	0	0
19	122.38	-39.9797	33364.7	0	0
20	125.465	-41.3991	34875.6	0	0
21	128.55	-42.8184	36411.5	0	0
22	131.636	-43.8731	36996.4	0	0
23	134.721	-44.9278	37581.8	0	0
24	137.378	-45.8362	38086.5	0	0
25	140.036	-46.7447	38591.6	0	0
26	142.694	-47.2886	38068.5	0	0
27	145.351	-47.8325	37549.1	0	0
28	147.864	-48.3047	36942	0	0
29	150.377	-48.7768	36340.3	0	0
30	152.89	-49.249	35744.2	0	0
31	155.403	-49.7212	35153.5	0	0
32	158.362	-50.243	34373.2	0	0
33	161.32	-50.7647	33602.9	0	0
34	164.278	-51.2393	32719.7	0	0
35	167.236	-51.7139	31850.1	0	0
36	170.134	-51.9268	30367.5	0	0
37	173.032	-52.1397	28925.3	0	0
38	175.93	-52.0589	26793.7	0	0
39	178.828	-51.978	24753.5	0	0
40	181.652	-51.8992	22853.3	0	0
41	184.476	-51.8205	21040	0	0
42	187.312	-51.7413	19306.1	0	0
43	190.149	-51.6622	17659.8	0	0
44	192.901	-51.3768	15761.3	0	0
45	195.653	-51.0914	13992.6	0	0
46	199.403	-50.0233	10717.2	0	0
47	203.578	-48.6318	7444.41	0	0
48	207.726	-46.551	4325.42	0	0
49	208.487	-45.9246	3676.46	0	0
50	210.558	-44.2212	1230.99	0	0
51	211.8	-43.2	0	0	0

Query 1 (janbu simplified) - Safety Factor: 1.82154

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3552	1	0	0	0
2	72.1544	-2.72053	-212.258	0	0
3	75.9343	-6.4221	478.093	0	0
4	79.7081	-10.1178	2064.43	0	0
5	80.609	-11	2574.55	0	0
6	83.482	-13.8135	4680.2	0	0
7	86.6416	-16.9077	7388.44	0	0
8	89.8012	-19.6817	10086.1	0	0
9	92.9303	-22.2877	12849.1	0	0
10	96.0558	-24.8909	15864.5	0	0
11	98.1426	-26.335	17511.6	0	0
12	100.229	-27.7791	19222.3	0	0
13	102.316	-29.2232	20996.6	0	0
14	105.775	-31.4253	23689	0	0
15	109.234	-33.6273	26513.9	0	0
16	112.897	-35.555	28730.1	0	0
17	116.56	-37.296	30566.9	0	0
18	119.47	-38.6379	31954.6	0	0
19	122.38	-39.9797	33364.7	0	0
20	125.465	-41.3991	34875.6	0	0
21	128.55	-42.8184	36411.5	0	0
22	131.636	-43.8731	36996.4	0	0
23	134.721	-44.9278	37581.8	0	0
24	137.378	-45.8362	38086.5	0	0
25	140.036	-46.7447	38591.6	0	0
26	142.694	-47.2886	38068.5	0	0
27	145.351	-47.8325	37549.1	0	0
28	147.864	-48.3047	36942	0	0
29	150.377	-48.7768	36340.3	0	0
30	152.89	-49.249	35744.2	0	0
31	155.403	-49.7212	35153.5	0	0
32	158.362	-50.243	34373.2	0	0
33	161.32	-50.7647	33602.9	0	0
34	164.278	-51.2393	32719.7	0	0
35	167.236	-51.7139	31850.1	0	0
36	170.134	-51.9268	30367.5	0	0
37	173.032	-52.1397	28925.3	0	0
38	175.93	-52.0589	26793.7	0	0
39	178.828	-51.978	24753.5	0	0
40	181.652	-51.8992	22853.3	0	0
41	184.476	-51.8205	21040	0	0
42	187.312	-51.7413	19306.1	0	0
43	190.149	-51.6622	17659.8	0	0
44	192.901	-51.3768	15761.3	0	0
45	195.653	-51.0914	13992.6	0	0
46	199.403	-50.0233	10717.2	0	0
47	203.578	-48.6318	7444.41	0	0
48	207.726	-46.551	4325.42	0	0
49	208.487	-45.9246	3676.46	0	0
50	210.558	-44.2212	1230.99	0	0
51	211.8	-43.2	0	0	0

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.9691

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3562	1	0	0	0
2	71.5731	-2.26477	-178.772	0	0
3	74.79	-5.3435	310.418	0	0
4	78.0069	-8.25104	1344.94	0	0
5	81.2238	-11	2810.12	0	0
6	84.0894	-13.324	4496.22	0	0
7	86.9551	-15.5375	6260.98	0	0
8	89.8207	-17.6462	8070.88	0	0
9	92.6864	-19.6553	9896.67	0	0
10	95.552	-21.5696	11712.9	0	0
11	98.4177	-23.3932	13497.2	0	0
12	101.283	-25.1298	15230.3	0	0
13	104.149	-26.7828	16895.3	0	0
14	107.015	-28.3553	18478.4	0	0
15	109.88	-29.85	19967.6	0	0
16	112.746	-31.2694	21352.2	0	0
17	115.612	-32.6159	22622.8	0	0
18	118.477	-33.8914	23771.8	0	0
19	121.343	-35.098	24792.9	0	0
20	124.208	-36.2373	25681.3	0	0
21	127.074	-37.311	26433.2	0	0
22	129.94	-38.3204	27046.1	0	0
23	132.805	-39.267	27518.5	0	0
24	135.671	-40.1518	27850.1	0	0
25	138.537	-40.9761	28041.3	0	0
26	141.402	-41.7409	28093.6	0	0
27	144.268	-42.4469	28009.5	0	0
28	147.134	-43.0952	27792.2	0	0
29	149.999	-43.6863	27445.9	0	0
30	152.865	-44.221	26975.6	0	0
31	155.731	-44.6999	26387.1	0	0
32	158.596	-45.1235	25687.2	0	0
33	161.462	-45.4922	24883.3	0	0
34	164.328	-45.8065	23983.8	0	0
35	167.193	-46.0667	22997.9	0	0
36	170.059	-46.273	21935.6	0	0
37	172.924	-46.4257	20808.1	0	0
38	175.79	-46.525	19627	0	0
39	178.656	-46.5708	18405.2	0	0
40	181.521	-46.5634	17156.6	0	0
41	184.387	-46.5027	15895.8	0	0
42	187.253	-46.3886	14638.6	0	0
43	190.118	-46.2209	13402.1	0	0
44	192.984	-45.9996	12204.3	0	0
45	195.85	-45.7244	11064.4	0	0
46	198.715	-45.395	10003.1	0	0
47	201.581	-45.011	9042.47	0	0
48	204.447	-44.5721	8205.8	0	0
49	206.778	-44.1741	6832.26	0	0
50	209.109	-43.7392	5500.2	0	0
51	211.783	-43.1943	0	0	0

Query 1 (bishop simplified) - Safety Factor: 1.9691

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3562	1	0	0	0
2	71.5731	-2.26477	-178.772	0	0
3	74.79	-5.3435	310.418	0	0
4	78.0069	-8.25104	1344.94	0	0
5	81.2238	-11	2810.12	0	0
6	84.0894	-13.324	4496.22	0	0
7	86.9551	-15.5375	6260.98	0	0
8	89.8207	-17.6462	8070.88	0	0
9	92.6864	-19.6553	9896.67	0	0
10	95.552	-21.5696	11712.9	0	0
11	98.4177	-23.3932	13497.2	0	0
12	101.283	-25.1298	15230.3	0	0
13	104.149	-26.7828	16895.3	0	0
14	107.015	-28.3553	18478.4	0	0
15	109.88	-29.85	19967.6	0	0
16	112.746	-31.2694	21352.2	0	0
17	115.612	-32.6159	22622.8	0	0
18	118.477	-33.8914	23771.8	0	0
19	121.343	-35.098	24792.9	0	0
20	124.208	-36.2373	25681.3	0	0
21	127.074	-37.311	26433.2	0	0
22	129.94	-38.3204	27046.1	0	0
23	132.805	-39.267	27518.5	0	0
24	135.671	-40.1518	27850.1	0	0
25	138.537	-40.9761	28041.3	0	0
26	141.402	-41.7409	28093.6	0	0
27	144.268	-42.4469	28009.5	0	0
28	147.134	-43.0952	27792.2	0	0
29	149.999	-43.6863	27445.9	0	0
30	152.865	-44.221	26975.6	0	0
31	155.731	-44.6999	26387.1	0	0
32	158.596	-45.1235	25687.2	0	0
33	161.462	-45.4922	24883.3	0	0
34	164.328	-45.8065	23983.8	0	0
35	167.193	-46.0667	22997.9	0	0
36	170.059	-46.273	21935.6	0	0
37	172.924	-46.4257	20808.1	0	0
38	175.79	-46.525	19627	0	0
39	178.656	-46.5708	18405.2	0	0
40	181.521	-46.5634	17156.6	0	0
41	184.387	-46.5027	15895.8	0	0
42	187.253	-46.3886	14638.6	0	0
43	190.118	-46.2209	13402.1	0	0
44	192.984	-45.9996	12204.3	0	0
45	195.85	-45.7244	11064.4	0	0
46	198.715	-45.395	10003.1	0	0
47	201.581	-45.011	9042.47	0	0
48	204.447	-44.5721	8205.8	0	0
49	206.778	-44.1741	6832.26	0	0
50	209.109	-43.7392	5500.2	0	0
51	211.783	-43.1943	0	0	0

Discharge Sections

Entity Information

Simplified Janbu Method - Total Stress

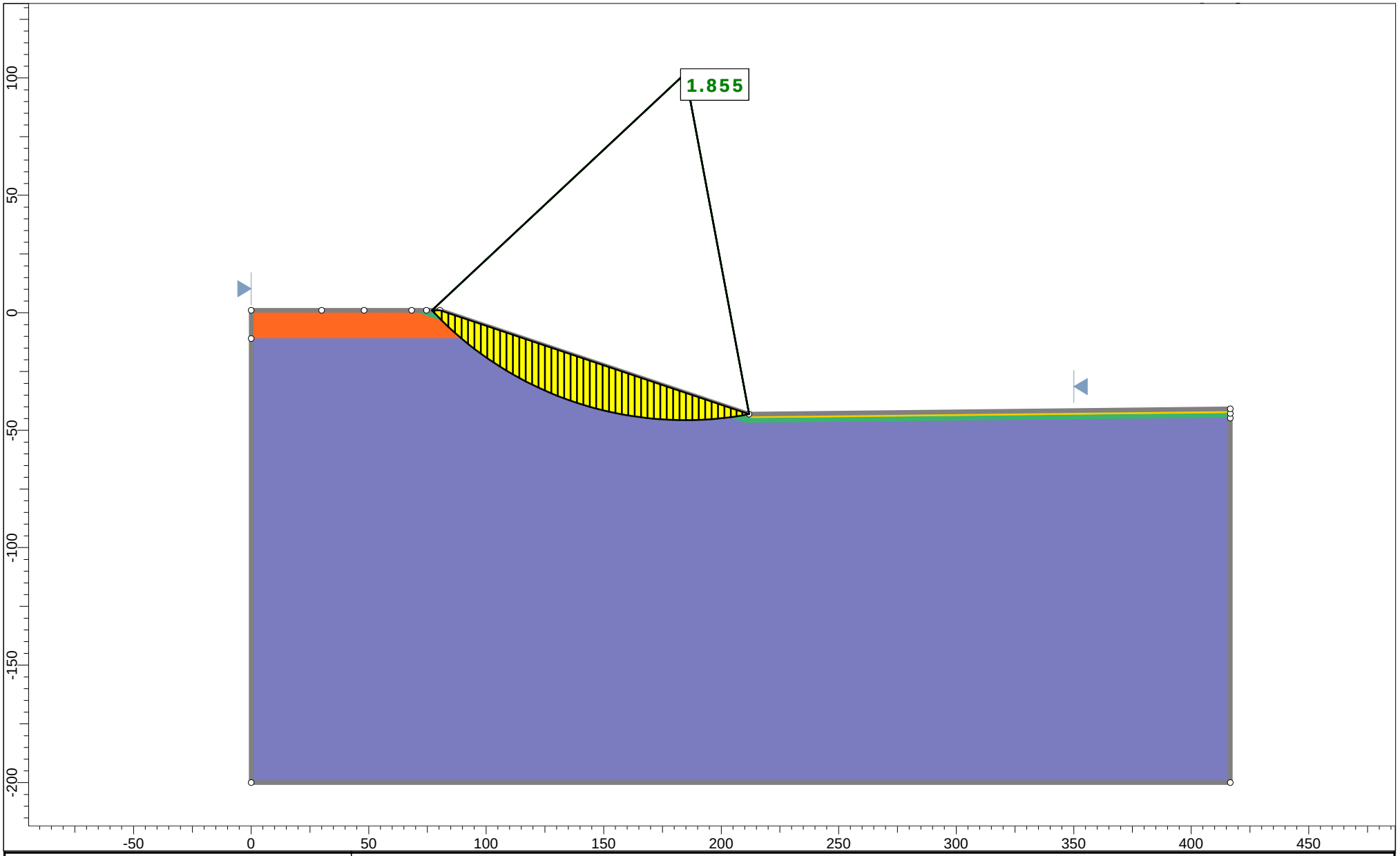
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11

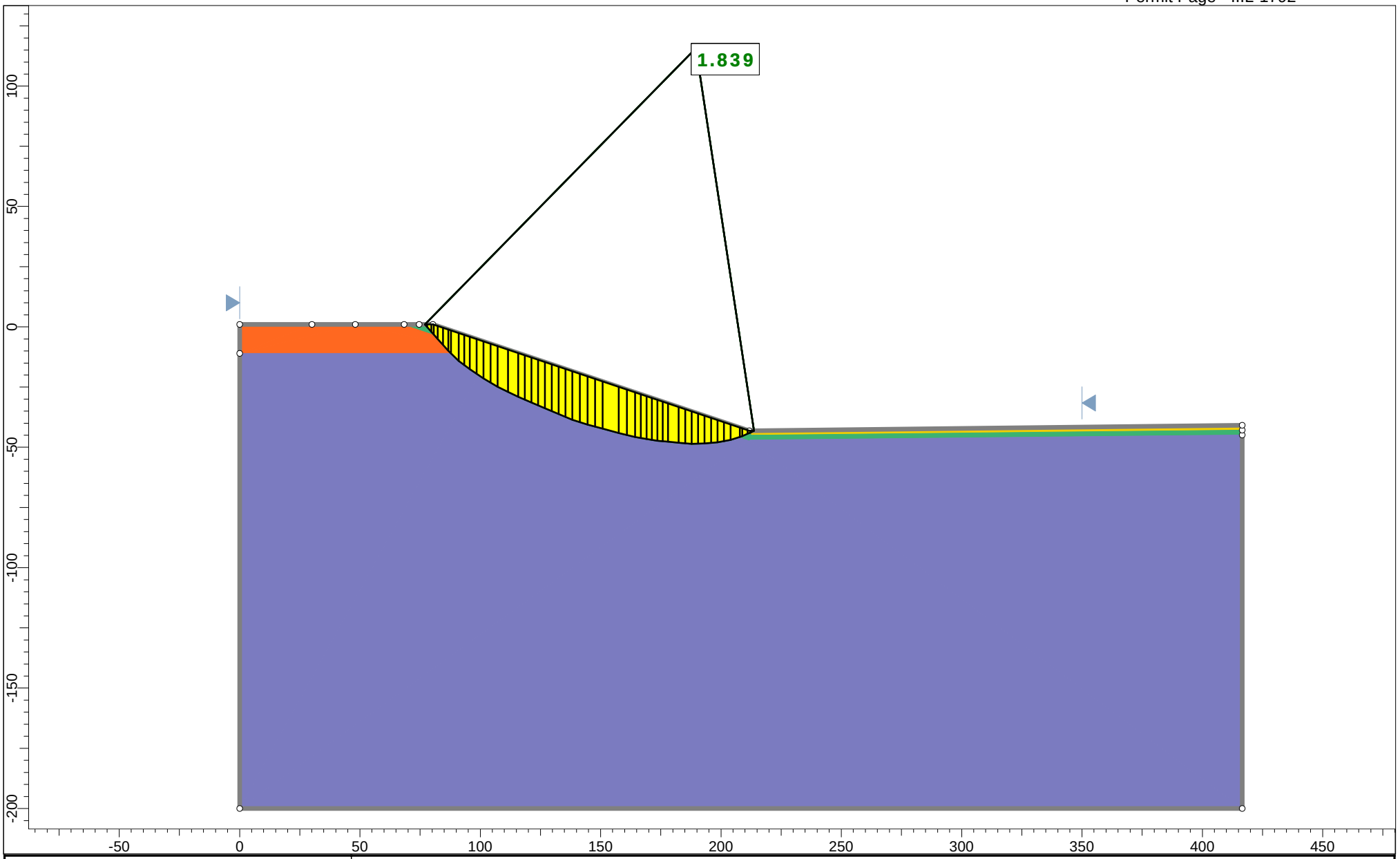
Simplified Bishop Method - Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Excavation Section B_Effective Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Excavation Section B_Effective Stress.slmd

Materials

Protective Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Clay Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Effective Stress	Simplified Janbu Method - Effective Stress
Protective Cover	✓	✓
Clay Liner	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Bishop Method - Effective Stress

Method: bishop simplified

FS	1.855010
Center:	184.661, 101.885
Radius:	147.605
Left Slip Surface Endpoint:	76.914, 1.000
Right Slip Surface Endpoint:	211.824, -43.200
Resisting Moment:	1.63832e+07 lb-ft
Driving Moment:	8.83184e+06 lb-ft
Total Slice Area:	1817.33 ft2
Surface Horizontal Width:	134.91 ft
Surface Average Height:	13.4707 ft

Simplified Janbu Method - Effective Stress

Method: bishop simplified

FS	1.838660
Axis Location:	189.510, 115.695
Left Slip Surface Endpoint:	76.939, 1.000
Right Slip Surface Endpoint:	213.724, -43.178
Resisting Moment:	1.95202e+07 lb-ft
Driving Moment:	1.06165e+07 lb-ft
Total Slice Area:	1989.13 ft2
Surface Horizontal Width:	136.784 ft
Surface Average Height:	14.5421 ft

Method: janbu simplified

FS	1.750040
Axis Location:	189.594, 114.640
Left Slip Surface Endpoint:	77.545, 1.000
Right Slip Surface Endpoint:	213.276, -43.183
Resisting Horizontal Force:	120351 lb
Driving Horizontal Force:	68770.4 lb
Total Slice Area:	2208.63 ft2
Surface Horizontal Width:	135.731 ft
Surface Average Height:	16.2721 ft

Global Minimum Coordinates

Simplified Janbu Method - Effective Stress

Method: bishop simplified

X	Y
76.9391	1
79.6292	-2.02007
82.3192	-5.04013
86.6899	-9.94703
91.061	-14.1425
95.5768	-17.5868
101.314	-21.3685
107.191	-24.9031
111.46	-26.9781
115.729	-28.9919
121.187	-31.4122
126.874	-33.799
132.562	-36.1857
138.249	-38.5724
144.512	-40.6212
150.775	-42.2977
157.538	-44.1078
164.301	-45.7776
169.104	-46.5589
173.538	-47.2803
177.973	-47.7184
182.414	-48.1573
187.79	-48.5844
193.177	-48.3931
198.564	-47.9687
203.951	-46.9863
208.837	-45.3959
213.724	-43.1784

Method: janbu simplified

X	Y
77.5451	1
80.9067	-3.4551
84.307	-7.96156
87.7069	-11.8763
90.9221	-15.3751
96.0756	-18.8526
100.544	-21.8212
105.185	-24.9047
110.283	-28.1219
115.381	-31.298
120.233	-34.1242
125.621	-36.135
131.008	-38.1459
136.395	-40.0662
141.783	-41.9864
148.7	-44.0779
155.617	-45.9925
160.365	-46.8419
165.114	-47.6912
170.509	-48.6563
176.108	-49.4964
181.732	-50.2401
186.809	-49.8795
191.918	-49.3343
197.496	-48.7391
203.074	-47.9937
206.193	-46.9518
209.312	-45.843
213.276	-43.1834

Valid and Invalid Surfaces

Simplified Bishop Method - Effective Stress

Method: bishop simplified

Number of Valid Surfaces:	10783
Number of Invalid Surfaces:	0

Simplified Janbu Method - Effective Stress

Method: bishop simplified

Number of Valid Surfaces:	23446
Number of Invalid Surfaces:	26664

Error Codes

Error Code -106 reported for 8 surfaces
Error Code -108 reported for 36 surfaces
Error Code -109 reported for 2 surfaces
Error Code -111 reported for 438 surfaces
Error Code -112 reported for 434 surfaces
Error Code -121 reported for 406 surfaces
Error Code -124 reported for 8 surfaces
Error Code -145 reported for 59 surfaces
Error Code -1000 reported for 25273 surfaces

Method: janbu simplified

Number of Valid Surfaces:	23477
Number of Invalid Surfaces:	26633

Error Codes

Error Code -106 reported for 8 surfaces
Error Code -108 reported for 40 surfaces
Error Code -109 reported for 2 surfaces
Error Code -111 reported for 502 surfaces
Error Code -112 reported for 330 surfaces
Error Code -121 reported for 406 surfaces
Error Code -124 reported for 8 surfaces
Error Code -145 reported for 59 surfaces
Error Code -1000 reported for 25278 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = Safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-124 = A slice has a width less than the minimum acceptable value.

-145 = Slip surface was clipped vertically by a weak layer in a region of compression. Such a surface cannot be evaluated using Limit Equilibrium. For more information, see Help Documentation on weak layers.

-1000 = No valid slip surface is generated

Slice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.85501

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.06254	71.5927	-46.584	Protective Cover	100	16	55.2923	102.568	8.95518	0	8.95518	67.3924	67.3924
2	3.11089	996.031	-45.4236	Clay Liner	100	16	89.3814	165.803	229.483	0	229.483	320.196	320.196
3	2.82419	1636.39	-43.8038	Stratum II	206	26	210.361	390.221	377.708	0	377.708	579.464	579.464
4	2.82419	2165.63	-42.3032	Stratum II	206	26	252.311	468.039	537.258	0	537.258	766.869	766.869
5	2.82419	2652.97	-40.8375	Stratum II	206	26	291.751	541.201	687.263	0	687.263	939.43	939.43
6	2.72607	2980.69	-39.428	Stratum III	150	24	286.724	531.876	857.708	0	857.708	1093.46	1093.46
7	2.72607	3353.84	-38.0709	Stratum III	150	24	316.635	587.361	982.328	0	982.328	1230.34	1230.34
8	2.72607	3696.29	-36.7386	Stratum III	150	24	344.58	639.199	1098.76	0	1098.76	1355.96	1355.96
9	2.72607	4009.63	-35.429	Stratum III	150	24	370.617	687.498	1207.24	0	1207.24	1470.91	1470.91
10	2.72607	4295.29	-34.1404	Stratum III	150	24	394.799	732.356	1307.99	0	1307.99	1575.7	1575.7
11	2.72607	4555.53	-32.8712	Stratum III	150	24	417.249	774.001	1401.53	0	1401.53	1671.16	1671.16
12	2.72607	4793.95	-31.6199	Stratum III	150	24	438.201	812.868	1488.82	0	1488.82	1758.62	1758.62
13	2.72607	5008.4	-30.3852	Stratum III	150	24	457.458	848.589	1569.06	0	1569.06	1837.29	1837.29
14	2.72607	5199.54	-29.166	Stratum III	150	24	475.034	881.192	1642.28	0	1642.28	1907.4	1907.4
15	2.72607	5368.2	-27.961	Stratum III	150	24	490.962	910.739	1708.65	0	1708.65	1969.27	1969.27
16	2.72607	5515.13	-26.7694	Stratum III	150	24	505.273	937.286	1768.27	0	1768.27	2023.16	2023.16
17	2.72607	5641.03	-25.5901	Stratum III	150	24	517.994	960.884	1821.28	0	1821.28	2069.35	2069.35
18	2.72607	5746.52	-24.4224	Stratum III	150	24	529.151	981.581	1867.76	0	1867.76	2108.04	2108.04
19	2.72607	5832.19	-23.2654	Stratum III	150	24	538.767	999.418	1907.82	0	1907.82	2139.47	2139.47
20	2.72607	5898.55	-22.1183	Stratum III	150	24	546.861	1014.43	1941.55	0	1941.55	2163.81	2163.81
21	2.72607	5946.1	-20.9805	Stratum III	150	24	553.453	1026.66	1969.01	0	1969.01	2181.25	2181.25
22	2.72607	5975.25	-19.8513	Stratum III	150	24	558.558	1036.13	1990.28	0	1990.28	2191.94	2191.94
23	2.72607	5986.42	-18.7301	Stratum III	150	24	562.189	1042.87	2005.41	0	2005.41	2196.03	2196.03
24	2.72607	5979.97	-17.6163	Stratum III	150	24	564.361	1046.9	2014.46	0	2014.46	2193.67	2193.67
25	2.72607	5956.24	-16.5094	Stratum III	150	24	565.083	1048.24	2017.47	0	2017.47	2184.96	2184.96
26	2.72607	5915.52	-15.4087	Stratum III	150	24	564.365	1046.9	2014.47	0	2014.47	2170.02	2170.02
27	2.72607	5858.11	-14.3138	Stratum III	150	24	562.211	1042.91	2005.5	0	2005.5	2148.95	2148.95
28	2.72607	5784.24	-13.2243	Stratum III	150	24	558.629	1036.26	1990.58	0	1990.58	2121.86	2121.86
29	2.72607	5694.15	-12.1396	Stratum III	150	24	553.623	1026.98	1969.72	0	1969.72	2088.8	2088.8
30	2.72607	5588.05	-11.0593	Stratum III	150	24	547.193	1015.05	1942.93	0	1942.93	2049.88	2049.88
31	2.72607	5466.12	-9.98292	Stratum III	150	24	539.342	1000.48	1910.22	0	1910.22	2005.15	2005.15

32	2.72607	5328.53	-8.91013	Stratum III	150	24	530.066	983.278	1871.57	0	1871.57	1954.67	1954.67
33	2.72607	5175.42	-7.84048	Stratum III	150	24	519.365	963.428	1826.99	0	1826.99	1898.51	1898.51
34	2.72607	5006.91	-6.77358	Stratum III	150	24	507.234	940.924	1776.44	0	1776.44	1836.69	1836.69
35	2.72607	4823.12	-5.70903	Stratum III	150	24	493.667	915.757	1719.92	0	1719.92	1769.27	1769.27
36	2.72607	4624.15	-4.64646	Stratum III	150	24	478.656	887.911	1657.38	0	1657.38	1696.28	1696.28
37	2.72607	4410.06	-3.58549	Stratum III	150	24	462.192	857.371	1588.78	0	1588.78	1617.74	1617.74
38	2.72607	4180.92	-2.52575	Stratum III	150	24	444.265	824.116	1514.09	0	1514.09	1533.69	1533.69
39	2.72607	3936.78	-1.46687	Stratum III	150	24	424.861	788.122	1433.25	0	1433.25	1444.13	1444.13
40	2.72607	3677.66	-0.408492	Stratum III	150	24	403.967	749.362	1346.19	0	1346.19	1349.07	1349.07
41	2.72607	3403.57	0.649745	Stratum III	150	24	381.565	707.806	1252.85	0	1252.85	1248.52	1248.52
42	2.72607	3114.51	1.7082	Stratum III	150	24	357.636	663.418	1153.16	0	1153.16	1142.49	1142.49
43	2.72607	2810.48	2.76725	Stratum III	150	24	332.16	616.161	1047.02	0	1047.02	1030.96	1030.96
44	2.72607	2491.42	3.82724	Stratum III	150	24	305.115	565.991	934.333	0	934.333	913.921	913.921
45	2.72607	2157.31	4.88854	Stratum III	150	24	276.474	512.862	815.004	0	815.004	791.358	791.358
46	2.72607	1808.06	5.95153	Stratum III	150	24	246.21	456.722	688.908	0	688.908	663.241	663.241
47	2.72607	1443.61	7.01658	Stratum III	150	24	214.292	397.514	555.926	0	555.926	529.552	529.552
48	2.46987	964.694	8.03379	Clay Liner	100	16	116.833	216.726	407.072	0	407.072	390.582	390.582
49	2.46987	608.991	9.00326	Clay Liner	100	16	94.3321	174.987	261.511	0	261.511	246.565	246.565
50	2.82926	243.739	10.0463	Protective Cover	100	16	69.1173	128.213	98.3911	0	98.3911	86.1463	86.1463

Simplified Janbu Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.83866

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.984737	65.3207	-48.3079	Protective Cover	100	16	55.0873	101.287	4.48738	0	4.48738	66.3331	66.3331
2	1.7053	422.124	-48.3079	Clay Liner	100	16	79.136	145.504	158.692	0	158.692	247.537	247.537
3	0.979902	417.878	-48.3079	Clay Liner	100	16	102.881	189.162	310.946	0	310.946	426.449	426.449
4	1.71013	951.745	-48.3079	Stratum II	206	26	200.081	367.881	331.905	0	331.905	556.533	556.533
5	2.18534	1587.45	-48.3079	Stratum II	206	26	234.803	431.723	462.799	0	462.799	726.409	726.409
6	2.18534	2003.98	-48.3079	Stratum II	206	26	273.76	503.352	609.661	0	609.661	917.009	917.009
7	1.09705	1152.17	-43.8254	Stratum II	206	26	311.358	572.481	751.395	0	751.395	1050.24	1050.24
8	3.27408	3923.65	-43.8254	Stratum III	150	24	301.66	554.651	908.86	0	908.86	1198.4	1198.4
9	2.25789	3071.6	-37.3337	Stratum III	150	24	346.922	637.872	1095.78	0	1095.78	1360.39	1360.39
10	2.25789	3305.34	-37.3337	Stratum III	150	24	368.082	676.777	1183.16	0	1183.16	1463.91	1463.91
11	2.86881	4490.35	-33.3889	Stratum III	150	24	397.205	730.325	1303.43	0	1303.43	1565.23	1565.23
12	2.86881	4774.73	-33.3889	Stratum III	150	24	417.905	768.385	1388.91	0	1388.91	1664.36	1664.36
13	2.93848	5158.37	-31.0245	Stratum III	150	24	442.253	813.153	1489.47	0	1489.47	1755.46	1755.46
14	2.93848	5405.4	-31.0245	Stratum III	150	24	460.021	845.823	1562.84	0	1562.84	1839.52	1839.52
15	4.269	8182.98	-25.9221	Stratum III	150	24	488.272	897.767	1679.51	0	1679.51	1916.84	1916.84
16	4.269	8466.29	-25.254	Stratum III	150	24	504.216	927.082	1745.35	0	1745.35	1983.2	1983.2
17	2.72897	5541.61	-23.9155	Stratum III	150	24	517.709	951.891	1801.08	0	1801.08	2030.66	2030.66
18	2.72897	5628.63	-23.9155	Stratum III	150	24	524.682	964.712	1829.87	0	1829.87	2062.55	2062.55
19	2.84359	5947.14	-22.7662	Stratum III	150	24	533.772	981.425	1867.41	0	1867.41	2091.42	2091.42
20	2.84359	6020.65	-22.7662	Stratum III	150	24	539.454	991.873	1890.88	0	1890.88	2117.27	2117.27
21	2.84359	6094.15	-22.7662	Stratum III	150	24	545.137	1002.32	1914.34	0	1914.34	2143.12	2143.12
22	2.84359	6167.66	-22.7662	Stratum III	150	24	550.82	1012.77	1937.81	0	1937.81	2168.97	2168.97
23	2.84359	6241.18	-22.7662	Stratum III	150	24	556.502	1023.22	1961.28	0	1961.28	2194.82	2194.82
24	2.84359	6314.69	-22.7662	Stratum III	150	24	562.184	1033.67	1984.75	0	1984.75	2220.68	2220.68
25	3.1316	6989.87	-18.114	Stratum III	150	24	576.408	1059.82	2043.49	0	2043.49	2232.04	2232.04
26	3.1316	6980.1	-18.114	Stratum III	150	24	575.708	1058.53	2040.6	0	2040.6	2228.92	2228.92
27	3.13161	6938.56	-14.9848	Stratum III	150	24	580.475	1067.3	2060.28	0	2060.28	2215.65	2215.65
28	3.13161	6865.23	-14.9848	Stratum III	150	24	575.15	1057.51	2038.29	0	2038.29	2192.24	2192.24
29	6.76264	14575.2	-14.9848	Stratum III	150	24	566.738	1042.04	2003.56	0	2003.56	2155.25	2155.25
30	3.38132	7146.42	-13.8696	Stratum III	150	24	559.887	1029.44	1975.26	0	1975.26	2113.5	2113.5
31	3.38132	7035.07	-13.8696	Stratum III	150	24	552.362	1015.61	1944.18	0	1944.18	2080.57	2080.57
32	2.40154	4902.46	-9.23978	Stratum III	150	24	554.073	1018.75	1951.25	0	1951.25	2041.38	2041.38
33	2.40154	4793.34	-9.23978	Stratum III	150	24	543.487	999.287	1907.53	0	1907.53	1995.94	1995.94
34	2.21722	4328.56	-9.23978	Stratum III	150	24	533.307	980.57	1865.49	0	1865.49	1952.25	1952.25
35	2.21722	4235.54	-9.23978	Stratum III	150	24	523.533	962.6	1825.13	0	1825.13	1910.29	1910.29

36	2.21722	4125.42	-5.64276	Stratum III	150	24	519.695	955.543	1809.28	0	1809.28	1860.63	1860.63
37	2.21722	3998.18	-5.64276	Stratum III	150	24	506.123	930.589	1753.23	0	1753.23	1803.24	1803.24
38	4.44165	7626.6	-5.64276	Stratum III	150	24	485.743	893.117	1669.07	0	1669.07	1717.06	1717.06
39	2.68767	4359.31	-4.5432	Stratum III	150	24	465.383	855.681	1584.99	0	1584.99	1621.97	1621.97
40	2.68767	4157.11	-4.5432	Stratum III	150	24	447.51	822.818	1511.17	0	1511.17	1546.73	1546.73
41	2.69351	3917.83	2.03427	Stratum III	150	24	437.559	804.523	1470.08	0	1470.08	1454.54	1454.54
42	2.69351	3623.82	2.03427	Stratum III	150	24	410.899	755.504	1359.98	0	1359.98	1345.39	1345.39
43	2.69356	3312.78	4.5038	Stratum III	150	24	386.774	711.145	1260.35	0	1260.35	1229.89	1229.89
44	2.69356	2984.56	4.5038	Stratum III	150	24	356.693	655.838	1136.13	0	1136.13	1108.04	1108.04
45	2.69354	2615.36	10.3358	Stratum III	150	24	331.333	609.209	1031.4	0	1031.4	970.971	970.971
46	2.69354	2205.21	10.3358	Stratum III	150	24	292.757	538.281	872.095	0	872.095	818.703	818.703
47	3.90819	2351.25	18.0282	Stratum III	150	24	246.706	453.608	681.916	0	681.916	601.622	601.622
48	0.978266	412.675	18.0282	Clay Liner	100	16	126.601	232.777	463.048	0	463.048	421.844	421.844
49	2.22175	617	24.409	Clay Liner	100	16	105.138	193.313	325.422	0	325.422	277.709	277.709
50	2.66467	199.996	24.409	Protective Cover	100	16	71.1263	130.777	107.332	0	107.332	75.0547	75.0547

Global Minimum Query (janbu simplified) - Safety Factor: 1.75004

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.986792	77.4317	-52.9639	Protective Cover	100	16	57.5101	100.645	2.24945	0	2.24945	78.4679	78.4679
2	2.13725	695.891	-52.9639	Clay Liner	100	16	90.7787	158.866	205.291	0	205.291	325.601	325.601
3	0.237518	117.565	-52.9639	Stratum II	206	26	186.7	326.732	247.538	0	247.538	494.972	494.972
4	3.40032	2361.48	-52.9639	Stratum II	206	26	227.306	397.794	393.236	0	393.236	694.486	694.486
5	2.63888	2639.55	-49.0258	Stratum II	206	26	300.16	525.292	654.644	0	654.644	1000.25	1000.25
6	0.761022	877.537	-49.0258	Stratum III	150	24	293.189	513.093	815.52	0	815.52	1153.1	1153.1
7	3.21521	4235.76	-47.4194	Stratum III	150	24	329.619	576.846	958.712	0	958.712	1317.41	1317.41
8	2.57674	3851.92	-34.0104	Stratum III	150	24	397.745	696.069	1226.49	0	1226.49	1494.88	1494.88
9	2.57674	4092.68	-34.0104	Stratum III	150	24	418.033	731.574	1306.24	0	1306.24	1588.31	1588.31
10	2.23404	3740.39	-33.6002	Stratum III	150	24	437.683	765.963	1383.48	0	1383.48	1674.28	1674.28
11	2.23404	3915.73	-33.6002	Stratum III	150	24	454.763	795.854	1450.61	0	1450.61	1752.76	1752.76
12	2.32055	4253.03	-33.6	Stratum III	150	24	472.175	826.325	1519.05	0	1519.05	1832.76	1832.76
13	2.32055	4442.54	-33.6	Stratum III	150	24	489.948	857.429	1588.91	0	1588.91	1914.43	1914.43
14	2.5491	5089.68	-32.2535	Stratum III	150	24	511.556	895.244	1673.85	0	1673.85	1996.66	1996.66
15	2.5491	5298.46	-32.2535	Stratum III	150	24	529.511	926.666	1744.42	0	1744.42	2078.56	2078.56
16	2.54907	5504.34	-31.9226	Stratum III	150	24	548.188	959.351	1817.83	0	1817.83	2159.35	2159.35
17	2.54907	5707.42	-31.9226	Stratum III	150	24	565.683	989.968	1886.6	0	1886.6	2239.02	2239.02
18	2.42602	5607.5	-30.2196	Stratum III	150	24	586.801	1026.93	1969.61	0	1969.61	2311.4	2311.4
19	2.42602	5765.45	-30.2196	Stratum III	150	24	601.227	1052.17	2026.31	0	2026.31	2376.51	2376.51
20	2.69368	6503.89	-20.4684	Stratum III	150	24	639.279	1118.76	2175.88	0	2175.88	2414.49	2414.49
21	2.69368	6533.15	-20.4684	Stratum III	150	24	641.803	1123.18	2185.8	0	2185.8	2425.36	2425.36
22	5.38737	13154.1	-20.4684	Stratum III	150	24	645.589	1129.81	2200.67	0	2200.67	2441.64	2441.64
23	2.69366	6614.22	-19.6181	Stratum III	150	24	651.346	1139.88	2223.31	0	2223.31	2455.47	2455.47
24	2.69366	6630.18	-19.6181	Stratum III	150	24	652.727	1142.3	2228.74	0	2228.74	2461.4	2461.4
25	5.38733	13308.2	-19.6181	Stratum III	150	24	654.8	1145.93	2236.89	0	2236.89	2470.29	2470.29
26	3.4585	8541.86	-16.8234	Stratum III	150	24	663.053	1160.37	2269.33	0	2269.33	2469.82	2469.82
27	3.4585	8497.66	-16.8234	Stratum III	150	24	660.036	1155.09	2257.47	0	2257.47	2457.04	2457.04
28	3.4585	8436.81	-15.4723	Stratum III	150	24	659.865	1154.79	2256.79	0	2256.79	2439.44	2439.44
29	3.4585	8359.29	-15.4723	Stratum III	150	24	654.536	1145.46	2235.85	0	2235.85	2417.03	2417.03
30	2.37426	5663.69	-10.1411	Stratum III	150	24	662.453	1159.32	2266.96	0	2266.96	2385.45	2385.45
31	2.37426	5566.98	-10.1411	Stratum III	150	24	652.54	1141.97	2228	0	2228	2344.72	2344.72
32	2.37426	5470.27	-10.1411	Stratum III	150	24	642.628	1124.63	2189.04	0	2189.04	2303.99	2303.99
33	2.37426	5373.56	-10.1411	Stratum III	150	24	632.716	1107.28	2150.08	0	2150.08	2263.25	2263.25
34	2.69786	5988.57	-10.1411	Stratum III	150	24	622.129	1088.75	2108.47	0	2108.47	2219.75	2219.75
35	2.69786	5863.7	-10.1411	Stratum III	150	24	610.867	1069.04	2064.2	0	2064.2	2173.46	2173.46

36	2.79959	5940.47	-8.533	Stratum III	150	24	602.548	1054.48	2031.5	0	2031.5	2121.91	2121.91
37	2.79959	5781.38	-8.533	Stratum III	150	24	588.622	1030.11	1976.76	0	1976.76	2065.08	2065.08
38	5.62304	11100.7	-7.53329	Stratum III	150	24	568.818	995.455	1898.92	0	1898.92	1974.15	1974.15
39	2.53859	4709.78	4.06189	Stratum III	150	24	567.975	993.979	1895.61	0	1895.61	1855.27	1855.27
40	2.53859	4423.69	4.06189	Stratum III	150	24	538.776	942.88	1780.84	0	1780.84	1742.58	1742.58
41	2.55456	4150.04	6.0911	Stratum III	150	24	512.943	897.671	1679.3	0	1679.3	1624.56	1624.56
42	2.55456	3834.95	6.0911	Stratum III	150	24	480.687	841.221	1552.51	0	1552.51	1501.21	1501.21
43	5.57806	7278.67	6.0911	Stratum III	150	24	429.342	751.366	1350.69	0	1350.69	1304.87	1304.87
44	2.78901	3064.52	7.61152	Stratum III	150	24	378.11	661.707	1149.31	0	1149.31	1098.78	1098.78
45	2.78901	2666.11	7.61152	Stratum III	150	24	340.488	595.868	1001.43	0	1001.43	955.934	955.934
46	3.11926	2403.6	18.4689	Stratum III	150	24	307.917	538.867	873.408	0	873.408	770.567	770.567
47	2.60084	1452.76	19.5697	Stratum III	150	24	250.471	438.335	647.61	0	647.61	558.571	558.571
48	0.518402	227.582	19.5697	Clay Liner	100	16	137.056	239.854	487.73	0	487.73	439.008	439.008
49	2.02909	598.363	33.8587	Clay Liner	100	16	118.485	207.354	374.387	0	374.387	294.892	294.892
50	1.93495	152.576	33.8587	Protective Cover	100	16	78.7149	137.754	131.665	0	131.665	78.8532	78.8532

Interslice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.85501

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	76.9137	1	0	0	0
2	77.9763	-0.122978	-48.6802	0	0
3	81.0872	-3.28022	397.864	0	0
4	83.9113	-5.98889	826.993	0	0
5	86.7355	-8.55899	1495.4	0	0
6	89.5597	-11	2349.25	0	0
7	92.2858	-13.2415	3490.31	0	0
8	95.0119	-15.3767	4724.89	0	0
9	97.7379	-17.4115	6021.53	0	0
10	100.464	-19.3509	7352.76	0	0
11	103.19	-21.1994	8694.58	0	0
12	105.916	-22.9611	10026.4	0	0
13	108.642	-24.6395	11330.9	0	0
14	111.368	-26.2379	12592.2	0	0
15	114.094	-27.7593	13796.1	0	0
16	116.82	-29.2064	14930.6	0	0
17	119.547	-30.5816	15985.3	0	0
18	122.273	-31.8872	16951.3	0	0
19	124.999	-33.125	17821.2	0	0
20	127.725	-34.2971	18588.9	0	0
21	130.451	-35.4051	19249.7	0	0
22	133.177	-36.4505	19799.6	0	0
23	135.903	-37.4347	20236.2	0	0
24	138.629	-38.359	20557.6	0	0
25	141.355	-39.2246	20763.2	0	0
26	144.081	-40.0326	20853.2	0	0
27	146.807	-40.7839	20828.6	0	0
28	149.533	-41.4795	20691.3	0	0
29	152.259	-42.1201	20444	0	0
30	154.985	-42.7065	20090.2	0	0
31	157.711	-43.2393	19634.1	0	0
32	160.438	-43.7192	19080.7	0	0
33	163.164	-44.1465	18436	0	0
34	165.89	-44.5219	17706.3	0	0
35	168.616	-44.8457	16899.1	0	0
36	171.342	-45.1182	16022.3	0	0
37	174.068	-45.3398	15085	0	0
38	176.794	-45.5106	14096.7	0	0
39	179.52	-45.6309	13068	0	0
40	182.246	-45.7007	12010.1	0	0
41	184.972	-45.7201	10935.3	0	0
42	187.698	-45.6892	9856.62	0	0
43	190.424	-45.6079	8788.16	0	0
44	193.15	-45.4761	7744.92	0	0
45	195.876	-45.2938	6742.96	0	0
46	198.603	-45.0606	5799.43	0	0
47	201.329	-44.7764	4932.62	0	0
48	204.055	-44.4409	4162.06	0	0
49	206.525	-44.0923	3731.66	0	0
50	208.994	-43.701	3396.39	0	0
51	211.824	-43.1997	0	0	0

Simplified Janbu Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.83866

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	76.9391	1	0	0	0
2	77.9239	-0.105552	-49.2854	0	0
3	79.6292	-2.02007	119.582	0	0
4	80.6091	-3.12019	360.849	0	0
5	82.3192	-5.04013	655.923	0	0
6	84.5045	-7.49358	1278.26	0	0
7	86.6899	-9.94703	2175.77	0	0
8	87.7869	-11	2625.4	0	0
9	91.061	-14.1425	4493.84	0	0
10	93.3189	-15.8647	5597.63	0	0
11	95.5768	-17.5868	6804.13	0	0
12	98.4456	-19.4777	8129.2	0	0
13	101.314	-21.3685	9556.52	0	0
14	104.253	-23.1358	10889.3	0	0
15	107.191	-24.9031	12299.6	0	0
16	111.46	-26.9781	13700.1	0	0
17	115.729	-28.9919	15062.3	0	0
18	118.458	-30.202	15829.2	0	0
19	121.187	-31.4122	16611.8	0	0
20	124.031	-32.6056	17322.5	0	0
21	126.874	-33.799	18045	0	0
22	129.718	-34.9923	18779.4	0	0
23	132.562	-36.1857	19525.6	0	0
24	135.405	-37.3791	20283.6	0	0
25	138.249	-38.5724	21053.5	0	0
26	141.38	-39.5968	21341.8	0	0
27	144.512	-40.6212	21629.4	0	0
28	147.644	-41.4595	21538.5	0	0
29	150.775	-42.2977	21445.9	0	0
30	157.538	-44.1078	21239.9	0	0
31	160.919	-44.9427	20995.9	0	0
32	164.301	-45.7776	20751.3	0	0
33	166.702	-46.1682	20183	0	0
34	169.104	-46.5589	19623	0	0
35	171.321	-46.9196	19113.4	0	0
36	173.538	-47.2803	18611	0	0
37	175.755	-47.4994	17855.1	0	0
38	177.973	-47.7184	17116.9	0	0
39	182.414	-48.1573	15691.9	0	0
40	185.102	-48.3709	14779.6	0	0
41	187.79	-48.5844	13899.6	0	0
42	190.483	-48.4888	12580.4	0	0
43	193.177	-48.3931	11343.5	0	0
44	195.87	-48.1809	10034.3	0	0
45	198.564	-47.9687	8832.47	0	0
46	201.257	-47.4775	7433.34	0	0
47	203.951	-46.9863	6216.38	0	0
48	207.859	-45.7143	4384.83	0	0
49	208.837	-45.3959	4113.55	0	0
50	211.059	-44.3876	3551.85	0	0
51	213.724	-43.1784	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.75004

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	77.5451	1	0	0	0
2	78.5319	-0.307801	-53.8088	0	0
3	80.6692	-3.14031	333.663	0	0
4	80.9067	-3.4551	367.24	0	0
5	84.307	-7.96156	1366.43	0	0
6	86.9459	-11	2563.45	0	0
7	87.7069	-11.8763	3054.92	0	0
8	90.9221	-15.3751	5349.56	0	0
9	93.4989	-17.1139	6457.19	0	0
10	96.0756	-18.8526	7651.2	0	0
11	98.3097	-20.3369	8726.89	0	0
12	100.544	-21.8212	9864.08	0	0
13	102.864	-23.363	11110.4	0	0
14	105.185	-24.9047	12423.2	0	0
15	107.734	-26.5133	13811.7	0	0
16	110.283	-28.1219	15268	0	0
17	112.832	-29.7099	16757.4	0	0
18	115.381	-31.298	18311.5	0	0
19	117.807	-32.7111	19671.1	0	0
20	120.233	-34.1242	21075.9	0	0
21	122.927	-35.1296	21541.5	0	0
22	125.621	-36.135	22010.4	0	0
23	131.008	-38.1459	22957.7	0	0
24	133.702	-39.106	23337.8	0	0
25	136.395	-40.0662	23719.4	0	0
26	141.783	-41.9864	24487.2	0	0
27	145.241	-43.0321	24567.1	0	0
28	148.7	-44.0779	24645.1	0	0
29	152.158	-45.0352	24523.4	0	0
30	155.617	-45.9925	24400.1	0	0
31	157.991	-46.4172	23790	0	0
32	160.365	-46.8419	23186.9	0	0
33	162.739	-47.2665	22590.8	0	0
34	165.114	-47.6912	22001.6	0	0
35	167.811	-48.1738	21340.7	0	0
36	170.509	-48.6563	20688.7	0	0
37	173.309	-49.0764	19855.2	0	0
38	176.108	-49.4964	19037.6	0	0
39	181.732	-50.2401	17251.2	0	0
40	184.27	-50.0598	15467.6	0	0
41	186.809	-49.8795	13778.8	0	0
42	189.363	-49.6069	12010.7	0	0
43	191.918	-49.3343	10359.6	0	0
44	197.496	-48.7391	7160.65	0	0
45	200.285	-48.3664	5677.75	0	0
46	203.074	-47.9937	4354.88	0	0
47	206.193	-46.9518	2484.49	0	0
48	208.794	-46.0273	1234.29	0	0
49	209.312	-45.843	1073.36	0	0
50	211.342	-44.4816	323.259	0	0
51	213.276	-43.1834	0	0	0

Discharge Sections

Entity Information

Simplified Bishop Method - Effective Stress

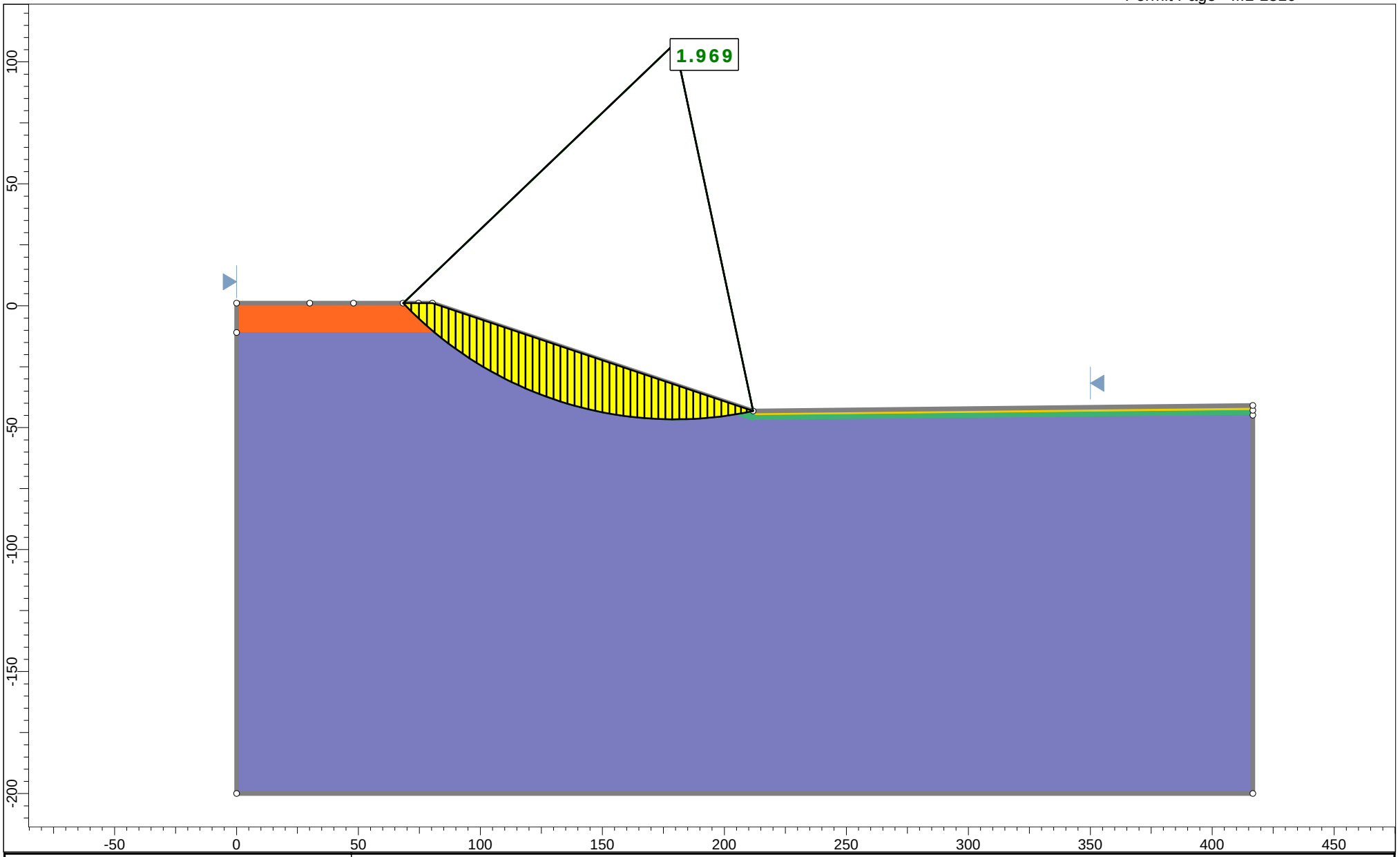
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11

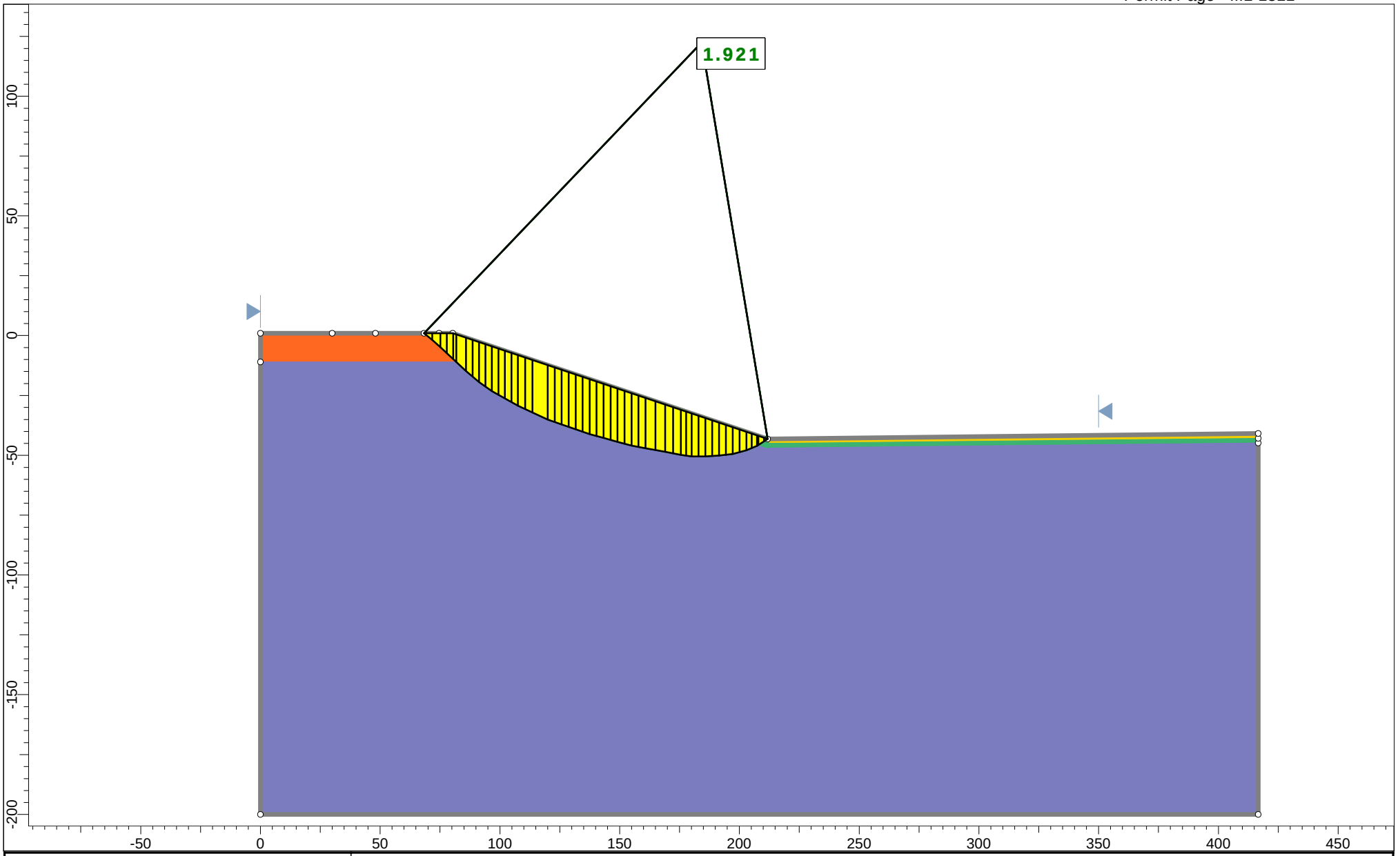
Simplified Janbu Method - Effective Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Excavation Section B_Total Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
	Date		File Name: Slide2-Excavation Section B_Total Stress.slmd

SLIDEINTERPRET 9.018

Materials

Protective Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Clay Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Total Stress	Simplified Janbu Method - Total Stress
Protective Cover	✓	✓
Clay Liner	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Bishop Method - Total Stress

Method: bishop simplified

FS	1.969100
Center:	179.690, 107.484
Radius:	154.058
Left Slip Surface Endpoint:	68.356, 1.000
Right Slip Surface Endpoint:	211.783, -43.194
Resisting Moment:	2.16623e+07 lb-ft
Driving Moment:	1.10011e+07 lb-ft
Total Slice Area:	2241.39 ft2
Surface Horizontal Width:	143.427 ft
Surface Average Height:	15.6274 ft

Simplified Janbu Method - Total Stress

Method: bishop simplified

FS	1.920900
Axis Location:	184.250, 122.400
Left Slip Surface Endpoint:	68.300, 1.000
Right Slip Surface Endpoint:	211.800, -43.200
Resisting Moment:	2.51954e+07 lb-ft
Driving Moment:	1.31164e+07 lb-ft
Total Slice Area:	2435.68 ft2
Surface Horizontal Width:	143.5 ft
Surface Average Height:	16.9734 ft

Method: janbu simplified

FS	1.821540
Axis Location:	184.278, 122.345
Left Slip Surface Endpoint:	68.355, 1.000
Right Slip Surface Endpoint:	211.800, -43.200
Resisting Horizontal Force:	152817 lb
Driving Horizontal Force:	83894.6 lb
Total Slice Area:	2811.48 ft2
Surface Horizontal Width:	143.445 ft
Surface Average Height:	19.5997 ft

Global Minimum Coordinates

Simplified Janbu Method - Total Stress

Method: bishop simplified

X	Y
68.3	1
71.7098	-1.83776
75.1369	-4.87372
80.5071	-9.81862
85.8774	-14.848
91.2492	-19.4054
96.6198	-23.2062
102.081	-26.2403
107.542	-29.266
113.613	-32.1252
119.972	-35.0674
125.801	-37.1131
131.63	-39.149
137.458	-41.1894
143.287	-42.7764
149.116	-44.3586
154.945	-45.9434
160.772	-47.0772
164.9	-47.8208
169.029	-48.5643
175.578	-49.7938
180.028	-50.4683
185.746	-50.4633
191.467	-50.1254
197.178	-49.4786
202.888	-47.9418
207.399	-46.0147
211.8	-43.2

Method: janbu simplified

X	Y
68.3552	1
72.1544	-2.72053
75.9343	-6.4221
79.7081	-10.1178
83.482	-13.8135
86.6416	-16.9077
89.8012	-19.6817
92.9303	-22.2877
96.0558	-24.8909
102.316	-29.2232
105.775	-31.4253
109.234	-33.6273
112.897	-35.555
116.56	-37.296
122.38	-39.9797
128.55	-42.8184
134.721	-44.9278
140.036	-46.7447
145.351	-47.8325
150.377	-48.7768
155.403	-49.7212
161.32	-50.7647
167.236	-51.7139
173.032	-52.1397
178.828	-51.978
184.476	-51.8205
190.149	-51.6622
195.653	-51.0914
199.403	-50.0233
203.578	-48.6318
207.726	-46.551
211.8	-43.2

Valid and Invalid Surfaces

Simplified Bishop Method - Total Stress

Method: bishop simplified

Number of Valid Surfaces:	10140
Number of Invalid Surfaces:	0

Simplified Janbu Method - Total Stress

Method: bishop simplified

Number of Valid Surfaces:	23312
Number of Invalid Surfaces:	26801

Error Codes

Error Code -106 reported for 10 surfaces
Error Code -108 reported for 49 surfaces
Error Code -111 reported for 489 surfaces
Error Code -112 reported for 642 surfaces
Error Code -121 reported for 400 surfaces
Error Code -124 reported for 5 surfaces
Error Code -145 reported for 98 surfaces
Error Code -1000 reported for 25108 surfaces

Method: janbu simplified

Number of Valid Surfaces:	23280
Number of Invalid Surfaces:	26833

Error Codes

Error Code -106 reported for 10 surfaces
Error Code -108 reported for 51 surfaces
Error Code -111 reported for 597 surfaces
Error Code -112 reported for 427 surfaces
Error Code -121 reported for 400 surfaces
Error Code -124 reported for 5 surfaces
Error Code -145 reported for 98 surfaces
Error Code -1000 reported for 25245 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = Safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-124 = A slice has a width less than the minimum acceptable value.

-145 = Slip surface was clipped vertically by a weak layer in a region of compression. Such a surface cannot be evaluated using Limit Equilibrium. For more information, see Help Documentation on weak layers.

-1000 = No valid slip surface is generated

Slice Data

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.9691

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.2169	598.669	-45.4231	Stratum II	206	26	120.442	237.163	63.8929	0	63.8929	186.127	186.127
2	3.2169	1761.73	-43.7427	Stratum II	206	26	194.231	382.461	361.798	0	361.798	547.687	547.687
3	3.2169	2861.07	-42.1083	Stratum II	206	26	265.488	522.772	649.48	0	649.48	889.437	889.437
4	3.2169	3884.37	-40.5151	Stratum II	206	26	333.193	656.09	922.821	0	922.821	1207.55	1207.55
5	2.86565	4029.49	-39.0421	Stratum III	150	24	333.055	655.819	1136.09	0	1136.09	1406.2	1406.2
6	2.86565	4431.93	-37.6826	Stratum III	150	24	362.563	713.922	1266.59	0	1266.59	1546.63	1546.63
7	2.86565	4800.74	-36.3476	Stratum III	150	24	390.081	768.108	1388.29	0	1388.29	1675.34	1675.34
8	2.86565	5137.65	-35.0352	Stratum III	150	24	415.671	818.497	1501.47	0	1501.47	1792.9	1792.9
9	2.86565	5444.2	-33.7435	Stratum III	150	24	439.388	865.198	1606.36	0	1606.36	1899.88	1899.88
10	2.86565	5721.76	-32.471	Stratum III	150	24	461.282	908.311	1703.19	0	1703.19	1996.74	1996.74
11	2.86565	5971.57	-31.2163	Stratum III	150	24	481.402	947.928	1792.18	0	1792.18	2083.91	2083.91
12	2.86565	6194.75	-29.978	Stratum III	150	24	499.788	984.132	1873.49	0	1873.49	2161.79	2161.79
13	2.86565	6394.89	-28.7549	Stratum III	150	24	516.662	1017.36	1948.12	0	1948.12	2231.63	2231.63
14	2.86565	6572.93	-27.5461	Stratum III	150	24	532.064	1047.69	2016.24	0	2016.24	2293.76	2293.76
15	2.86565	6727.06	-26.3504	Stratum III	150	24	545.842	1074.82	2077.17	0	2077.17	2347.54	2347.54
16	2.86565	6858.04	-25.1669	Stratum III	150	24	558.024	1098.81	2131.05	0	2131.05	2393.25	2393.25
17	2.86565	6966.55	-23.9948	Stratum III	150	24	568.639	1119.71	2178	0	2178	2431.11	2431.11
18	2.86565	7053.21	-22.8333	Stratum III	150	24	577.709	1137.57	2218.11	0	2218.11	2461.35	2461.35
19	2.86565	7118.6	-21.6817	Stratum III	150	24	585.252	1152.42	2251.48	0	2251.48	2484.16	2484.16
20	2.86565	7163.23	-20.5391	Stratum III	150	24	591.296	1164.32	2278.2	0	2278.2	2499.74	2499.74
21	2.86565	7187.57	-19.4051	Stratum III	150	24	595.851	1173.29	2298.34	0	2298.34	2508.23	2508.23
22	2.86565	7192.06	-18.2789	Stratum III	150	24	598.928	1179.35	2311.96	0	2311.96	2509.8	2509.8
23	2.86565	7177.1	-17.16	Stratum III	150	24	600.548	1182.54	2319.13	0	2319.13	2504.57	2504.57
24	2.86565	7143.05	-16.0478	Stratum III	150	24	600.721	1182.88	2319.89	0	2319.89	2492.69	2492.69
25	2.86565	7090.23	-14.9417	Stratum III	150	24	599.452	1180.38	2314.28	0	2314.28	2474.25	2474.25
26	2.86565	7018.95	-13.8414	Stratum III	150	24	596.755	1175.07	2302.34	0	2302.34	2449.37	2449.37
27	2.86565	6929.47	-12.7462	Stratum III	150	24	592.626	1166.94	2284.09	0	2284.09	2418.14	2418.14
28	2.86565	6822.04	-11.6557	Stratum III	150	24	587.08	1156.02	2259.55	0	2259.55	2380.65	2380.65
29	2.86565	6696.88	-10.5695	Stratum III	150	24	580.111	1142.3	2228.73	0	2228.73	2336.98	2336.98
30	2.86565	6554.2	-9.48715	Stratum III	150	24	571.724	1125.78	2191.64	0	2191.64	2287.18	2287.18
31	2.86565	6394.15	-8.40819	Stratum III	150	24	561.918	1106.47	2148.27	0	2148.27	2231.33	2231.33

32	2.86565	6216.91	-7.33223	Stratum III	150	24	550.69	1084.36	2098.61	0	2098.61	2169.47	2169.47
33	2.86565	6022.59	-6.25886	Stratum III	150	24	538.037	1059.45	2042.66	0	2042.66	2101.67	2101.67
34	2.86565	5811.32	-5.1877	Stratum III	150	24	523.953	1031.72	1980.37	0	1980.37	2027.94	2027.94
35	2.86565	5583.19	-4.11835	Stratum III	150	24	508.431	1001.15	1911.72	0	1911.72	1948.33	1948.33
36	2.86565	5338.28	-3.05044	Stratum III	150	24	491.462	967.738	1836.67	0	1836.67	1862.86	1862.86
37	2.86565	5076.64	-1.98358	Stratum III	150	24	473.035	931.453	1755.17	0	1755.17	1771.56	1771.56
38	2.86565	4798.32	-0.917416	Stratum III	150	24	453.138	892.274	1667.17	0	1667.17	1674.43	1674.43
39	2.86565	4503.34	0.148432	Stratum III	150	24	431.756	850.171	1572.61	0	1572.61	1571.49	1571.49
40	2.86565	4191.7	1.21433	Stratum III	150	24	408.874	805.113	1471.41	0	1471.41	1462.74	1462.74
41	2.86565	3863.4	2.28065	Stratum III	150	24	384.472	757.064	1363.49	0	1363.49	1348.18	1348.18
42	2.86565	3518.41	3.34776	Stratum III	150	24	358.531	705.983	1248.76	0	1248.76	1227.79	1227.79
43	2.86565	3156.68	4.41604	Stratum III	150	24	331.027	651.825	1127.12	0	1127.12	1101.55	1101.55
44	2.86565	2778.15	5.48586	Stratum III	150	24	301.936	594.542	998.457	0	998.457	969.459	969.459
45	2.86565	2382.73	6.5576	Stratum III	150	24	271.229	534.077	862.654	0	862.654	831.475	831.475
46	2.86565	1970.32	7.63165	Stratum III	150	24	238.877	470.372	719.566	0	719.566	687.559	687.559
47	2.86565	1540.82	8.7084	Stratum III	150	24	204.845	403.36	569.055	0	569.055	537.679	537.679
48	2.33133	910.038	9.6873	Clay Liner	1000	0	507.846	1000	477.025	0	477.025	390.333	390.333
49	2.33133	574.307	10.5681	Clay Liner	1000	0	507.846	1000	341.071	0	341.071	246.323	246.323
50	2.67391	231.6	11.5166	Protective Cover	1000	0	507.846	1000	190.068	0	190.068	86.5926	86.5926

Query 1 (bishop simplified) - Safety Factor: 1.9691

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.2169	598.669	-45.4231	Stratum II	206	26	120.442	237.163	63.8929	0	63.8929	186.127	186.127
2	3.2169	1761.73	-43.7427	Stratum II	206	26	194.231	382.461	361.798	0	361.798	547.687	547.687
3	3.2169	2861.07	-42.1083	Stratum II	206	26	265.488	522.772	649.48	0	649.48	889.437	889.437
4	3.2169	3884.37	-40.5151	Stratum II	206	26	333.193	656.09	922.821	0	922.821	1207.55	1207.55
5	2.86565	4029.49	-39.0421	Stratum III	150	24	333.055	655.819	1136.09	0	1136.09	1406.2	1406.2
6	2.86565	4431.93	-37.6826	Stratum III	150	24	362.563	713.922	1266.59	0	1266.59	1546.63	1546.63
7	2.86565	4800.74	-36.3476	Stratum III	150	24	390.081	768.108	1388.29	0	1388.29	1675.34	1675.34
8	2.86565	5137.65	-35.0352	Stratum III	150	24	415.671	818.497	1501.47	0	1501.47	1792.9	1792.9
9	2.86565	5444.2	-33.7435	Stratum III	150	24	439.388	865.198	1606.36	0	1606.36	1899.88	1899.88
10	2.86565	5721.76	-32.471	Stratum III	150	24	461.282	908.311	1703.19	0	1703.19	1996.74	1996.74
11	2.86565	5971.57	-31.2163	Stratum III	150	24	481.402	947.928	1792.18	0	1792.18	2083.91	2083.91
12	2.86565	6194.75	-29.978	Stratum III	150	24	499.788	984.132	1873.49	0	1873.49	2161.79	2161.79
13	2.86565	6394.89	-28.7549	Stratum III	150	24	516.662	1017.36	1948.12	0	1948.12	2231.63	2231.63
14	2.86565	6572.93	-27.5461	Stratum III	150	24	532.064	1047.69	2016.24	0	2016.24	2293.76	2293.76
15	2.86565	6727.06	-26.3504	Stratum III	150	24	545.842	1074.82	2077.17	0	2077.17	2347.54	2347.54
16	2.86565	6858.04	-25.1669	Stratum III	150	24	558.024	1098.81	2131.05	0	2131.05	2393.25	2393.25
17	2.86565	6966.55	-23.9948	Stratum III	150	24	568.639	1119.71	2178	0	2178	2431.11	2431.11
18	2.86565	7053.21	-22.8333	Stratum III	150	24	577.709	1137.57	2218.11	0	2218.11	2461.35	2461.35
19	2.86565	7118.6	-21.6817	Stratum III	150	24	585.252	1152.42	2251.48	0	2251.48	2484.16	2484.16
20	2.86565	7163.23	-20.5391	Stratum III	150	24	591.296	1164.32	2278.2	0	2278.2	2499.74	2499.74
21	2.86565	7187.57	-19.4051	Stratum III	150	24	595.851	1173.29	2298.34	0	2298.34	2508.23	2508.23
22	2.86565	7192.06	-18.2789	Stratum III	150	24	598.928	1179.35	2311.96	0	2311.96	2509.8	2509.8
23	2.86565	7177.1	-17.16	Stratum III	150	24	600.548	1182.54	2319.13	0	2319.13	2504.57	2504.57
24	2.86565	7143.05	-16.0478	Stratum III	150	24	600.721	1182.88	2319.89	0	2319.89	2492.69	2492.69
25	2.86565	7090.23	-14.9417	Stratum III	150	24	599.452	1180.38	2314.28	0	2314.28	2474.25	2474.25
26	2.86565	7018.95	-13.8414	Stratum III	150	24	596.755	1175.07	2302.34	0	2302.34	2449.37	2449.37
27	2.86565	6929.47	-12.7462	Stratum III	150	24	592.626	1166.94	2284.09	0	2284.09	2418.14	2418.14
28	2.86565	6822.04	-11.6557	Stratum III	150	24	587.08	1156.02	2259.55	0	2259.55	2380.65	2380.65
29	2.86565	6696.88	-10.5695	Stratum III	150	24	580.111	1142.3	2228.73	0	2228.73	2336.98	2336.98
30	2.86565	6554.2	-9.48715	Stratum III	150	24	571.724	1125.78	2191.64	0	2191.64	2287.18	2287.18
31	2.86565	6394.15	-8.40819	Stratum III	150	24	561.918	1106.47	2148.27	0	2148.27	2231.33	2231.33
32	2.86565	6216.91	-7.33223	Stratum III	150	24	550.69	1084.36	2098.61	0	2098.61	2169.47	2169.47
33	2.86565	6022.59	-6.25886	Stratum III	150	24	538.037	1059.45	2042.66	0	2042.66	2101.67	2101.67
34	2.86565	5811.32	-5.1877	Stratum III	150	24	523.953	1031.72	1980.37	0	1980.37	2027.94	2027.94
35	2.86565	5583.19	-4.11835	Stratum III	150	24	508.431	1001.15	1911.72	0	1911.72	1948.33	1948.33

36	2.86565	5338.28	-3.05044	Stratum III	150	24	491.462	967.738	1836.67	0	1836.67	1862.86	1862.86
37	2.86565	5076.64	-1.98358	Stratum III	150	24	473.035	931.453	1755.17	0	1755.17	1771.56	1771.56
38	2.86565	4798.32	-0.917416	Stratum III	150	24	453.138	892.274	1667.17	0	1667.17	1674.43	1674.43
39	2.86565	4503.34	0.148432	Stratum III	150	24	431.756	850.171	1572.61	0	1572.61	1571.49	1571.49
40	2.86565	4191.7	1.21433	Stratum III	150	24	408.874	805.113	1471.41	0	1471.41	1462.74	1462.74
41	2.86565	3863.4	2.28065	Stratum III	150	24	384.472	757.064	1363.49	0	1363.49	1348.18	1348.18
42	2.86565	3518.41	3.34776	Stratum III	150	24	358.531	705.983	1248.76	0	1248.76	1227.79	1227.79
43	2.86565	3156.68	4.41604	Stratum III	150	24	331.027	651.825	1127.12	0	1127.12	1101.55	1101.55
44	2.86565	2778.15	5.48586	Stratum III	150	24	301.936	594.542	998.457	0	998.457	969.459	969.459
45	2.86565	2382.73	6.5576	Stratum III	150	24	271.229	534.077	862.654	0	862.654	831.475	831.475
46	2.86565	1970.32	7.63165	Stratum III	150	24	238.877	470.372	719.566	0	719.566	687.559	687.559
47	2.86565	1540.82	8.7084	Stratum III	150	24	204.845	403.36	569.055	0	569.055	537.679	537.679
48	2.33133	910.038	9.6873	Clay Liner	1000	0	507.846	1000	477.025	0	477.025	390.333	390.333
49	2.33133	574.307	10.5681	Clay Liner	1000	0	507.846	1000	341.071	0	341.071	246.323	246.323
50	2.67391	231.6	11.5166	Protective Cover	1000	0	507.846	1000	190.068	0	190.068	86.5926	86.5926

Simplified Janbu Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.9209

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.40985	554.261	-39.7681	Stratum II	206	26	122.606	235.513	60.5116	0	60.5116	162.547	162.547
2	3.42706	1708.93	-41.5371	Stratum II	206	26	190.913	366.724	329.532	0	329.532	498.658	498.658
3	2.68511	2184.09	-42.6389	Stratum II	206	26	254.314	488.512	579.237	0	579.237	813.409	813.409
4	2.68511	2941.43	-42.6389	Stratum II	206	26	312.359	600.01	807.839	0	807.839	1095.46	1095.46
5	1.26144	1602.79	-43.123	Stratum II	206	26	347.277	667.085	945.366	0	945.366	1270.6	1270.6
6	4.10879	5940.1	-43.123	Stratum III	150	24	339.484	652.114	1127.77	0	1127.77	1445.7	1445.7
7	2.68591	4439.62	-40.3106	Stratum III	150	24	385.418	740.35	1325.95	0	1325.95	1652.93	1652.93
8	2.68591	4837.73	-40.3106	Stratum III	150	24	414.128	795.498	1449.81	0	1449.81	1801.15	1801.15
9	2.68529	5179.29	-35.2875	Stratum III	150	24	451.139	866.592	1609.49	0	1609.49	1928.77	1928.77
10	2.68529	5466.66	-35.2875	Stratum III	150	24	472.447	907.523	1701.42	0	1701.42	2035.78	2035.78
11	2.73045	5791.44	-29.0565	Stratum III	150	24	504.714	969.506	1840.64	0	1840.64	2121.06	2121.06
12	2.73045	5964.94	-29.0565	Stratum III	150	24	517.762	994.569	1896.93	0	1896.93	2184.6	2184.6
13	2.73045	6137.96	-28.99	Stratum III	150	24	530.939	1019.88	1953.78	0	1953.78	2247.97	2247.97
14	2.73045	6313.61	-28.99	Stratum III	150	24	544.152	1045.26	2010.79	0	2010.79	2312.3	2312.3
15	3.03563	7185.31	-25.2171	Stratum III	150	24	565.037	1085.38	2100.9	0	2100.9	2366.99	2366.99
16	3.03563	7320.58	-25.2171	Stratum III	150	24	574.348	1103.27	2141.07	0	2141.07	2411.55	2411.55
17	6.35905	15755.4	-24.8291	Stratum III	150	24	589.176	1131.75	2205.04	0	2205.04	2477.64	2477.64
18	2.91443	7355.42	-19.3392	Stratum III	150	24	613.176	1177.85	2308.59	0	2308.59	2523.79	2523.79
19	2.91443	7369.03	-19.3392	Stratum III	150	24	614.176	1179.77	2312.91	0	2312.91	2528.46	2528.46
20	2.91443	7381.86	-19.2534	Stratum III	150	24	615.342	1182.01	2317.93	0	2317.93	2532.86	2532.86
21	2.91443	7393.92	-19.2534	Stratum III	150	24	616.227	1183.71	2321.76	0	2321.76	2537	2537
22	2.91443	7406.32	-19.2922	Stratum III	150	24	617.039	1185.27	2325.26	0	2325.26	2541.25	2541.25
23	2.91443	7419.08	-19.2922	Stratum III	150	24	617.981	1187.08	2329.31	0	2329.31	2545.63	2545.63
24	2.91441	7395.78	-15.2307	Stratum III	150	24	626.722	1203.87	2367.02	0	2367.02	2537.66	2537.66
25	2.91441	7336.53	-15.2307	Stratum III	150	24	622.286	1195.35	2347.9	0	2347.9	2517.33	2517.33
26	2.91441	7276.9	-15.1866	Stratum III	150	24	617.94	1187	2329.14	0	2329.14	2496.87	2496.87
27	2.91441	7216.89	-15.1866	Stratum III	150	24	613.447	1178.37	2309.76	0	2309.76	2476.28	2476.28
28	2.91441	7157.08	-15.2102	Stratum III	150	24	608.912	1169.66	2290.2	0	2290.2	2455.76	2455.76
29	2.91441	7097.48	-15.2102	Stratum III	150	24	604.456	1161.1	2270.96	0	2270.96	2435.3	2435.3
30	2.91332	6999.51	-11.0119	Stratum III	150	24	607.559	1167.06	2284.36	0	2284.36	2402.59	2402.59
31	2.91332	6868.45	-11.0119	Stratum III	150	24	597.583	1147.9	2241.31	0	2241.31	2357.6	2357.6
32	4.12886	9496.22	-10.2089	Stratum III	150	24	586.688	1126.97	2194.31	0	2194.31	2299.96	2299.96
33	4.12886	9206.03	-10.2089	Stratum III	150	24	571.05	1096.93	2126.84	0	2126.84	2229.68	2229.68
34	3.27419	7098.56	-10.634	Stratum III	150	24	556.386	1068.76	2063.57	0	2063.57	2168.04	2168.04
35	3.27419	6925.03	-10.634	Stratum III	150	24	544.613	1046.15	2012.78	0	2012.78	2115.04	2115.04

36	2.22516	4597.5	-8.61795	Stratum III	150	24	538.08	1033.6	1984.59	0	1984.59	2066.14	2066.14
37	2.22516	4497.81	-8.61795	Stratum III	150	24	528.048	1014.33	1941.31	0	1941.31	2021.34	2021.34
38	2.859	5564.8	0.050085	Stratum III	150	24	529.337	1016.8	1946.87	0	1946.87	1946.41	1946.41
39	2.859	5264.42	0.050085	Stratum III	150	24	504.98	970.017	1841.79	0	1841.79	1841.35	1841.35
40	2.86074	4941.01	3.38054	Stratum III	150	24	485.058	931.747	1755.83	0	1755.83	1727.18	1727.18
41	2.86074	4588.36	3.38054	Stratum III	150	24	456.088	876.1	1630.85	0	1630.85	1603.91	1603.91
42	2.85502	4203.52	6.46173	Stratum III	150	24	430.651	827.238	1521.1	0	1521.1	1472.33	1472.33
43	2.85502	3804.13	6.46173	Stratum III	150	24	397.353	763.276	1377.44	0	1377.44	1332.43	1332.43
44	2.855	3335.47	15.064	Stratum III	150	24	372.089	714.745	1268.44	0	1268.44	1168.29	1168.29
45	2.855	2797.59	15.064	Stratum III	150	24	325.515	625.282	1067.5	0	1067.5	979.891	979.891
46	2.25552	1786.01	23.1317	Stratum III	150	24	290.374	557.779	915.887	0	915.887	791.842	791.842
47	2.25552	1362.66	23.1317	Stratum III	150	24	242.089	465.028	707.566	0	707.566	604.148	604.148
48	0.466567	226.512	32.5991	Stratum III	150	24	223.786	429.87	628.598	0	628.598	485.486	485.486
49	2.4596	778.944	32.5991	Clay Liner	1000	0	520.589	1000	649.616	0	649.616	316.697	316.697
50	1.47527	127.402	32.5991	Protective Cover	1000	0	520.589	1000	419.278	0	419.278	86.3584	86.3584

Query 1 (bishop simplified) - Safety Factor: 1.9209

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.40985	554.261	-39.7681	Stratum II	206	26	122.606	235.513	60.5116	0	60.5116	162.547	162.547
2	3.42706	1708.93	-41.5371	Stratum II	206	26	190.913	366.724	329.532	0	329.532	498.658	498.658
3	2.68511	2184.09	-42.6389	Stratum II	206	26	254.314	488.512	579.237	0	579.237	813.409	813.409
4	2.68511	2941.43	-42.6389	Stratum II	206	26	312.359	600.01	807.839	0	807.839	1095.46	1095.46
5	1.26144	1602.79	-43.123	Stratum II	206	26	347.277	667.085	945.366	0	945.366	1270.6	1270.6
6	4.10879	5940.1	-43.123	Stratum III	150	24	339.484	652.114	1127.77	0	1127.77	1445.7	1445.7
7	2.68591	4439.62	-40.3106	Stratum III	150	24	385.418	740.35	1325.95	0	1325.95	1652.93	1652.93
8	2.68591	4837.73	-40.3106	Stratum III	150	24	414.128	795.498	1449.81	0	1449.81	1801.15	1801.15
9	2.68529	5179.29	-35.2875	Stratum III	150	24	451.139	866.592	1609.49	0	1609.49	1928.77	1928.77
10	2.68529	5466.66	-35.2875	Stratum III	150	24	472.447	907.523	1701.42	0	1701.42	2035.78	2035.78
11	2.73045	5791.44	-29.0565	Stratum III	150	24	504.714	969.506	1840.64	0	1840.64	2121.06	2121.06
12	2.73045	5964.94	-29.0565	Stratum III	150	24	517.762	994.569	1896.93	0	1896.93	2184.6	2184.6
13	2.73045	6137.96	-28.99	Stratum III	150	24	530.939	1019.88	1953.78	0	1953.78	2247.97	2247.97
14	2.73045	6313.61	-28.99	Stratum III	150	24	544.152	1045.26	2010.79	0	2010.79	2312.3	2312.3
15	3.03563	7185.31	-25.2171	Stratum III	150	24	565.037	1085.38	2100.9	0	2100.9	2366.99	2366.99
16	3.03563	7320.58	-25.2171	Stratum III	150	24	574.348	1103.27	2141.07	0	2141.07	2411.55	2411.55
17	6.35905	15755.4	-24.8291	Stratum III	150	24	589.176	1131.75	2205.04	0	2205.04	2477.64	2477.64
18	2.91443	7355.42	-19.3392	Stratum III	150	24	613.176	1177.85	2308.59	0	2308.59	2523.79	2523.79
19	2.91443	7369.03	-19.3392	Stratum III	150	24	614.176	1179.77	2312.91	0	2312.91	2528.46	2528.46
20	2.91443	7381.86	-19.2534	Stratum III	150	24	615.342	1182.01	2317.93	0	2317.93	2532.86	2532.86
21	2.91443	7393.92	-19.2534	Stratum III	150	24	616.227	1183.71	2321.76	0	2321.76	2537	2537
22	2.91443	7406.32	-19.2922	Stratum III	150	24	617.039	1185.27	2325.26	0	2325.26	2541.25	2541.25
23	2.91443	7419.08	-19.2922	Stratum III	150	24	617.981	1187.08	2329.31	0	2329.31	2545.63	2545.63
24	2.91441	7395.78	-15.2307	Stratum III	150	24	626.722	1203.87	2367.02	0	2367.02	2537.66	2537.66
25	2.91441	7336.53	-15.2307	Stratum III	150	24	622.286	1195.35	2347.9	0	2347.9	2517.33	2517.33
26	2.91441	7276.9	-15.1866	Stratum III	150	24	617.94	1187	2329.14	0	2329.14	2496.87	2496.87
27	2.91441	7216.89	-15.1866	Stratum III	150	24	613.447	1178.37	2309.76	0	2309.76	2476.28	2476.28
28	2.91441	7157.08	-15.2102	Stratum III	150	24	608.912	1169.66	2290.2	0	2290.2	2455.76	2455.76
29	2.91441	7097.48	-15.2102	Stratum III	150	24	604.456	1161.1	2270.96	0	2270.96	2435.3	2435.3
30	2.91332	6999.51	-11.0119	Stratum III	150	24	607.559	1167.06	2284.36	0	2284.36	2402.59	2402.59
31	2.91332	6868.45	-11.0119	Stratum III	150	24	597.583	1147.9	2241.31	0	2241.31	2357.6	2357.6
32	4.12886	9496.22	-10.2089	Stratum III	150	24	586.688	1126.97	2194.31	0	2194.31	2299.96	2299.96
33	4.12886	9206.03	-10.2089	Stratum III	150	24	571.05	1096.93	2126.84	0	2126.84	2229.68	2229.68
34	3.27419	7098.56	-10.634	Stratum III	150	24	556.386	1068.76	2063.57	0	2063.57	2168.04	2168.04
35	3.27419	6925.03	-10.634	Stratum III	150	24	544.613	1046.15	2012.78	0	2012.78	2115.04	2115.04
36	2.22516	4597.5	-8.61795	Stratum III	150	24	538.08	1033.6	1984.59	0	1984.59	2066.14	2066.14

37	2.22516	4497.81	-8.61795	Stratum III	150	24	528.048	1014.33	1941.31	0	1941.31	2021.34	2021.34
38	2.859	5564.8	0.050085	Stratum III	150	24	529.337	1016.8	1946.87	0	1946.87	1946.41	1946.41
39	2.859	5264.42	0.050085	Stratum III	150	24	504.98	970.017	1841.79	0	1841.79	1841.35	1841.35
40	2.86074	4941.01	3.38054	Stratum III	150	24	485.058	931.747	1755.83	0	1755.83	1727.18	1727.18
41	2.86074	4588.36	3.38054	Stratum III	150	24	456.088	876.1	1630.85	0	1630.85	1603.91	1603.91
42	2.85502	4203.52	6.46173	Stratum III	150	24	430.651	827.238	1521.1	0	1521.1	1472.33	1472.33
43	2.85502	3804.13	6.46173	Stratum III	150	24	397.353	763.276	1377.44	0	1377.44	1332.43	1332.43
44	2.855	3335.47	15.064	Stratum III	150	24	372.089	714.745	1268.44	0	1268.44	1168.29	1168.29
45	2.855	2797.59	15.064	Stratum III	150	24	325.515	625.282	1067.5	0	1067.5	979.891	979.891
46	2.25552	1786.01	23.1317	Stratum III	150	24	290.374	557.779	915.887	0	915.887	791.842	791.842
47	2.25552	1362.66	23.1317	Stratum III	150	24	242.089	465.028	707.566	0	707.566	604.148	604.148
48	0.466567	226.512	32.5991	Stratum III	150	24	223.786	429.87	628.598	0	628.598	485.486	485.486
49	2.4596	778.944	32.5991	Clay Liner	1000	0	520.589	1000	649.616	0	649.616	316.697	316.697
50	1.47527	127.402	32.5991	Protective Cover	1000	0	520.589	1000	419.278	0	419.278	86.3584	86.3584

Global Minimum Query (janbu simplified) - Safety Factor: 1.82154

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.79921	806.411	-44.4006	Stratum II	206	26	134.624	245.224	80.421	0	80.421	212.258	212.258
2	3.77984	2401.55	-44.4006	Stratum II	206	26	224.378	408.714	415.625	0	415.625	635.356	635.356
3	3.77384	3989.09	-44.4006	Stratum II	206	26	313.831	571.656	749.706	0	749.706	1057.04	1057.04
4	0.900866	1185.42	-44.4006	Stratum II	206	26	368.737	671.67	954.766	0	954.766	1315.87	1315.87
5	2.87297	4181.9	-44.4006	Stratum III	150	24	353.514	643.94	1109.41	0	1109.41	1455.6	1455.6
6	3.15963	5261.09	-44.4006	Stratum III	150	24	394.83	719.199	1278.44	0	1278.44	1665.1	1665.1
7	3.15963	5899.33	-41.2813	Stratum III	150	24	443.533	807.913	1477.7	0	1477.7	1867.09	1867.09
8	3.12903	6392.78	-39.7897	Stratum III	150	24	483.328	880.402	1640.51	0	1640.51	2043.06	2043.06
9	3.12555	6908.54	-39.7897	Stratum III	150	24	517.302	942.287	1779.5	0	1779.5	2210.35	2210.35
10	2.08679	4870.03	-34.6843	Stratum III	150	24	558.331	1017.02	1947.36	0	1947.36	2333.74	2333.74
11	2.08679	5036.13	-34.6843	Stratum III	150	24	574.971	1047.33	2015.44	0	2015.44	2413.34	2413.34
12	2.08679	5202.23	-34.6843	Stratum III	150	24	591.611	1077.64	2083.52	0	2083.52	2492.93	2492.93
13	3.45889	8953.34	-32.4822	Stratum III	150	24	618.756	1127.09	2194.58	0	2194.58	2588.5	2588.5
14	3.45889	9343.97	-32.4822	Stratum III	150	24	642.643	1170.6	2292.31	0	2292.31	2701.43	2701.43
15	3.66307	10241.9	-27.7559	Stratum III	150	24	678.481	1235.88	2438.94	0	2438.94	2795.99	2795.99
16	3.66307	10482.5	-25.421	Stratum III	150	24	700.44	1275.88	2528.75	0	2528.75	2861.66	2861.66
17	2.90979	8465.24	-24.7568	Stratum III	150	24	713.061	1298.87	2580.4	0	2580.4	2909.23	2909.23
18	2.90979	8580.5	-24.7568	Stratum III	150	24	721.763	1314.72	2616	0	2616	2948.84	2948.84
19	3.08528	9223.3	-24.7043	Stratum III	150	24	730.86	1331.29	2653.23	0	2653.23	2989.46	2989.46
20	3.08528	9351.73	-24.7043	Stratum III	150	24	740.006	1347.95	2690.65	0	2690.65	3031.08	3031.08
21	3.08528	9418.83	-18.8724	Stratum III	150	24	764.644	1392.83	2791.45	0	2791.45	3052.83	3052.83
22	3.08528	9424.62	-18.8724	Stratum III	150	24	765.067	1393.6	2793.18	0	2793.18	3054.71	3054.71
23	2.65761	8122.87	-18.8724	Stratum III	150	24	765.462	1394.32	2794.79	0	2794.79	3056.46	3056.46
24	2.65761	8127.17	-18.8724	Stratum III	150	24	765.825	1394.98	2796.28	0	2796.28	3058.07	3058.07
25	2.65761	8078.65	-11.5659	Stratum III	150	24	786.033	1431.79	2878.95	0	2878.95	3039.82	3039.82
26	2.65761	7977.33	-11.5659	Stratum III	150	24	777.161	1415.63	2842.64	0	2842.64	3001.69	3001.69
27	2.51302	7444.33	-10.6416	Stratum III	150	24	770.996	1404.4	2817.44	0	2817.44	2962.31	2962.31
28	2.51302	7342.2	-10.6416	Stratum III	150	24	761.504	1387.11	2778.58	0	2778.58	2921.67	2921.67
29	2.51302	7240.07	-10.6416	Stratum III	150	24	752.007	1369.81	2739.73	0	2739.73	2881.03	2881.03
30	2.51302	7137.94	-10.6416	Stratum III	150	24	742.509	1352.51	2700.87	0	2700.87	2840.39	2840.39
31	2.95854	8267	-10.0014	Stratum III	150	24	733.714	1336.49	2664.89	0	2664.89	2794.28	2794.28
32	2.95854	8114.44	-10.0014	Stratum III	150	24	721.626	1314.47	2615.45	0	2615.45	2742.71	2742.71
33	2.95805	7952.98	-9.1148	Stratum III	150	24	711.596	1296.2	2574.42	0	2574.42	2688.58	2688.58
34	2.95805	7785.28	-9.1148	Stratum III	150	24	698.266	1271.92	2519.87	0	2519.87	2631.89	2631.89
35	2.89796	7424.7	-4.20197	Stratum III	150	24	696.076	1267.93	2510.9	0	2510.9	2562.04	2562.04

36	2.89796	7184.14	-4.20197	Stratum III	150	24	676.142	1231.62	2429.36	0	2429.36	2479.03	2479.03
37	2.89796	6897.19	1.59796	Stratum III	150	24	668.643	1217.96	2398.67	0	2398.67	2380.02	2380.02
38	2.89796	6563.83	1.59796	Stratum III	150	24	640.332	1166.39	2282.85	0	2282.85	2264.99	2264.99
39	2.82392	6075.44	1.59796	Stratum III	150	24	612.384	1115.48	2168.51	0	2168.51	2151.43	2151.43
40	2.82392	5758.91	1.59796	Stratum III	150	24	584.798	1065.23	2055.65	0	2055.65	2039.33	2039.33
41	2.83617	5465.31	1.59796	Stratum III	150	24	557.153	1014.88	1942.54	0	1942.54	1927	1927
42	2.83617	5146.02	1.59796	Stratum III	150	24	529.447	964.409	1829.19	0	1829.19	1814.42	1814.42
43	2.75218	4657.07	5.92101	Stratum III	150	24	508.847	926.885	1744.91	0	1744.91	1692.14	1692.14
44	2.75218	4293.82	5.92101	Stratum III	150	24	475.747	866.593	1609.49	0	1609.49	1560.15	1560.15
45	3.74987	5126.92	15.899	Stratum III	150	24	447.701	815.506	1494.75	0	1494.75	1367.23	1367.23
46	4.17564	4542.83	18.4294	Stratum III	150	24	379.147	690.632	1214.28	0	1214.28	1087.94	1087.94
47	4.14716	3094.51	26.6447	Stratum III	150	24	301.735	549.623	897.568	0	897.568	746.176	746.176
48	0.761683	387.446	39.4356	Stratum III	150	24	258.681	471.198	721.423	0	721.423	508.671	508.671
49	2.07117	655.722	39.4356	Clay Liner	1000	0	548.986	1000	768.106	0	768.106	316.593	316.593
50	1.24161	107.162	39.4356	Protective Cover	1000	0	548.986	1000	537.822	0	537.822	86.309	86.309

Query 1 (janbu simplified) - Safety Factor: -1000

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	N/A	Protective Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Interslice Data

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.9691

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3562	1	0	0	0
2	71.5731	-2.26477	-178.772	0	0
3	74.79	-5.3435	310.418	0	0
4	78.0069	-8.25104	1344.94	0	0
5	81.2238	-11	2810.12	0	0
6	84.0894	-13.324	4496.22	0	0
7	86.9551	-15.5375	6260.98	0	0
8	89.8207	-17.6462	8070.88	0	0
9	92.6864	-19.6553	9896.67	0	0
10	95.552	-21.5696	11712.9	0	0
11	98.4177	-23.3932	13497.2	0	0
12	101.283	-25.1298	15230.3	0	0
13	104.149	-26.7828	16895.3	0	0
14	107.015	-28.3553	18478.4	0	0
15	109.88	-29.85	19967.6	0	0
16	112.746	-31.2694	21352.2	0	0
17	115.612	-32.6159	22622.8	0	0
18	118.477	-33.8914	23771.8	0	0
19	121.343	-35.098	24792.9	0	0
20	124.208	-36.2373	25681.3	0	0
21	127.074	-37.311	26433.2	0	0
22	129.94	-38.3204	27046.1	0	0
23	132.805	-39.267	27518.5	0	0
24	135.671	-40.1518	27850.1	0	0
25	138.537	-40.9761	28041.3	0	0
26	141.402	-41.7409	28093.6	0	0
27	144.268	-42.4469	28009.5	0	0
28	147.134	-43.0952	27792.2	0	0
29	149.999	-43.6863	27445.9	0	0
30	152.865	-44.221	26975.6	0	0
31	155.731	-44.6999	26387.1	0	0
32	158.596	-45.1235	25687.2	0	0
33	161.462	-45.4922	24883.3	0	0
34	164.328	-45.8065	23983.8	0	0
35	167.193	-46.0667	22997.9	0	0
36	170.059	-46.273	21935.6	0	0
37	172.924	-46.4257	20808.1	0	0
38	175.79	-46.525	19627	0	0
39	178.656	-46.5708	18405.2	0	0
40	181.521	-46.5634	17156.6	0	0
41	184.387	-46.5027	15895.8	0	0
42	187.253	-46.3886	14638.6	0	0
43	190.118	-46.2209	13402.1	0	0
44	192.984	-45.9996	12204.3	0	0
45	195.85	-45.7244	11064.4	0	0
46	198.715	-45.395	10003.1	0	0
47	201.581	-45.011	9042.47	0	0
48	204.447	-44.5721	8205.8	0	0
49	206.778	-44.1741	6832.26	0	0
50	209.109	-43.7392	5500.2	0	0
51	211.783	-43.1943	0	0	0

Query 1 (bishop simplified) - Safety Factor: 1.9691

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3562	1	0	0	0
2	71.5731	-2.26477	-178.772	0	0
3	74.79	-5.3435	310.418	0	0
4	78.0069	-8.25104	1344.94	0	0
5	81.2238	-11	2810.12	0	0
6	84.0894	-13.324	4496.22	0	0
7	86.9551	-15.5375	6260.98	0	0
8	89.8207	-17.6462	8070.88	0	0
9	92.6864	-19.6553	9896.67	0	0
10	95.552	-21.5696	11712.9	0	0
11	98.4177	-23.3932	13497.2	0	0
12	101.283	-25.1298	15230.3	0	0
13	104.149	-26.7828	16895.3	0	0
14	107.015	-28.3553	18478.4	0	0
15	109.88	-29.85	19967.6	0	0
16	112.746	-31.2694	21352.2	0	0
17	115.612	-32.6159	22622.8	0	0
18	118.477	-33.8914	23771.8	0	0
19	121.343	-35.098	24792.9	0	0
20	124.208	-36.2373	25681.3	0	0
21	127.074	-37.311	26433.2	0	0
22	129.94	-38.3204	27046.1	0	0
23	132.805	-39.267	27518.5	0	0
24	135.671	-40.1518	27850.1	0	0
25	138.537	-40.9761	28041.3	0	0
26	141.402	-41.7409	28093.6	0	0
27	144.268	-42.4469	28009.5	0	0
28	147.134	-43.0952	27792.2	0	0
29	149.999	-43.6863	27445.9	0	0
30	152.865	-44.221	26975.6	0	0
31	155.731	-44.6999	26387.1	0	0
32	158.596	-45.1235	25687.2	0	0
33	161.462	-45.4922	24883.3	0	0
34	164.328	-45.8065	23983.8	0	0
35	167.193	-46.0667	22997.9	0	0
36	170.059	-46.273	21935.6	0	0
37	172.924	-46.4257	20808.1	0	0
38	175.79	-46.525	19627	0	0
39	178.656	-46.5708	18405.2	0	0
40	181.521	-46.5634	17156.6	0	0
41	184.387	-46.5027	15895.8	0	0
42	187.253	-46.3886	14638.6	0	0
43	190.118	-46.2209	13402.1	0	0
44	192.984	-45.9996	12204.3	0	0
45	195.85	-45.7244	11064.4	0	0
46	198.715	-45.395	10003.1	0	0
47	201.581	-45.011	9042.47	0	0
48	204.447	-44.5721	8205.8	0	0
49	206.778	-44.1741	6832.26	0	0
50	209.109	-43.7392	5500.2	0	0
51	211.783	-43.1943	0	0	0

Simplified Janbu Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 1.9209

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3	1	0	0	0
2	71.7098	-1.83776	-246.349	0	0
3	75.1369	-4.87372	99.8294	0	0
4	77.822	-7.34617	849.099	0	0
5	80.5071	-9.81862	2007.72	0	0
6	81.7686	-11	2686.49	0	0
7	85.8774	-14.848	5631.31	0	0
8	88.5633	-17.1267	7617.51	0	0
9	91.2492	-19.4054	9808.85	0	0
10	93.9345	-21.3058	11656.1	0	0
11	96.6198	-23.2062	13620.9	0	0
12	99.3502	-24.7232	15035.1	0	0
13	102.081	-26.2403	16499.1	0	0
14	104.811	-27.7532	18005.2	0	0
15	107.542	-29.266	19561.6	0	0
16	110.577	-30.6956	20849.7	0	0
17	113.613	-32.1252	22167	0	0
18	119.972	-35.0674	24908.1	0	0
19	122.886	-36.0903	25482.4	0	0
20	125.801	-37.1131	26058.2	0	0
21	128.715	-38.1311	26624.4	0	0
22	131.63	-39.149	27191.9	0	0
23	134.544	-40.1692	27765.8	0	0
24	137.458	-41.1894	28341	0	0
25	140.373	-41.9829	28392.7	0	0
26	143.287	-42.7764	28442.2	0	0
27	146.202	-43.5675	28483.8	0	0
28	149.116	-44.3586	28523.2	0	0
29	152.031	-45.151	28563.3	0	0
30	154.945	-45.9434	28601.2	0	0
31	157.858	-46.5103	28126.2	0	0
32	160.772	-47.0772	27655.9	0	0
33	164.9	-47.8208	26865.2	0	0
34	169.029	-48.5643	26088.8	0	0
35	172.303	-49.1791	25535.7	0	0
36	175.578	-49.7938	24989.9	0	0
37	177.803	-50.1311	24461.9	0	0
38	180.028	-50.4683	23941.6	0	0
39	182.887	-50.4658	22423.3	0	0
40	185.746	-50.4633	20975	0	0
41	188.607	-50.2943	19290.7	0	0
42	191.467	-50.1254	17710.3	0	0
43	194.323	-49.802	15989	0	0
44	197.178	-49.4786	14409.1	0	0
45	200.033	-48.7102	12372.1	0	0
46	202.888	-47.9418	10622.5	0	0
47	205.143	-46.9783	9085.04	0	0
48	207.399	-46.0147	7857.24	0	0
49	207.865	-45.7164	7565.28	0	0
50	210.325	-44.1434	5263.04	0	0
51	211.8	-43.2	0	0	0

Query 1 (bishop simplified) - Safety Factor: 1.9209

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3	1	0	0	0
2	71.7098	-1.83776	-246.349	0	0
3	75.1369	-4.87372	99.8294	0	0
4	77.822	-7.34617	849.099	0	0
5	80.5071	-9.81862	2007.72	0	0
6	81.7686	-11	2686.49	0	0
7	85.8774	-14.848	5631.31	0	0
8	88.5633	-17.1267	7617.51	0	0
9	91.2492	-19.4054	9808.85	0	0
10	93.9345	-21.3058	11656.1	0	0
11	96.6198	-23.2062	13620.9	0	0
12	99.3502	-24.7232	15035.1	0	0
13	102.081	-26.2403	16499.1	0	0
14	104.811	-27.7532	18005.2	0	0
15	107.542	-29.266	19561.6	0	0
16	110.577	-30.6956	20849.7	0	0
17	113.613	-32.1252	22167	0	0
18	119.972	-35.0674	24908.1	0	0
19	122.886	-36.0903	25482.4	0	0
20	125.801	-37.1131	26058.2	0	0
21	128.715	-38.1311	26624.4	0	0
22	131.63	-39.149	27191.9	0	0
23	134.544	-40.1692	27765.8	0	0
24	137.458	-41.1894	28341	0	0
25	140.373	-41.9829	28392.7	0	0
26	143.287	-42.7764	28442.2	0	0
27	146.202	-43.5675	28483.8	0	0
28	149.116	-44.3586	28523.2	0	0
29	152.031	-45.151	28563.3	0	0
30	154.945	-45.9434	28601.2	0	0
31	157.858	-46.5103	28126.2	0	0
32	160.772	-47.0772	27655.9	0	0
33	164.9	-47.8208	26865.2	0	0
34	169.029	-48.5643	26088.8	0	0
35	172.303	-49.1791	25535.7	0	0
36	175.578	-49.7938	24989.9	0	0
37	177.803	-50.1311	24461.9	0	0
38	180.028	-50.4683	23941.6	0	0
39	182.887	-50.4658	22423.3	0	0
40	185.746	-50.4633	20975	0	0
41	188.607	-50.2943	19290.7	0	0
42	191.467	-50.1254	17710.3	0	0
43	194.323	-49.802	15989	0	0
44	197.178	-49.4786	14409.1	0	0
45	200.033	-48.7102	12372.1	0	0
46	202.888	-47.9418	10622.5	0	0
47	205.143	-46.9783	9085.04	0	0
48	207.399	-46.0147	7857.24	0	0
49	207.865	-45.7164	7565.28	0	0
50	210.325	-44.1434	5263.04	0	0
51	211.8	-43.2	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.82154

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	68.3552	1	0	0	0
2	72.1544	-2.72053	-212.258	0	0
3	75.9343	-6.4221	478.093	0	0
4	79.7081	-10.1178	2064.43	0	0
5	80.609	-11	2574.55	0	0
6	83.482	-13.8135	4680.2	0	0
7	86.6416	-16.9077	7388.44	0	0
8	89.8012	-19.6817	10086.1	0	0
9	92.9303	-22.2877	12849.1	0	0
10	96.0558	-24.8909	15864.5	0	0
11	98.1426	-26.335	17511.6	0	0
12	100.229	-27.7791	19222.3	0	0
13	102.316	-29.2232	20996.6	0	0
14	105.775	-31.4253	23689	0	0
15	109.234	-33.6273	26513.9	0	0
16	112.897	-35.555	28730.1	0	0
17	116.56	-37.296	30566.9	0	0
18	119.47	-38.6379	31954.6	0	0
19	122.38	-39.9797	33364.7	0	0
20	125.465	-41.3991	34875.6	0	0
21	128.55	-42.8184	36411.5	0	0
22	131.636	-43.8731	36996.4	0	0
23	134.721	-44.9278	37581.8	0	0
24	137.378	-45.8362	38086.5	0	0
25	140.036	-46.7447	38591.6	0	0
26	142.694	-47.2886	38068.5	0	0
27	145.351	-47.8325	37549.1	0	0
28	147.864	-48.3047	36942	0	0
29	150.377	-48.7768	36340.3	0	0
30	152.89	-49.249	35744.2	0	0
31	155.403	-49.7212	35153.5	0	0
32	158.362	-50.243	34373.2	0	0
33	161.32	-50.7647	33602.9	0	0
34	164.278	-51.2393	32719.7	0	0
35	167.236	-51.7139	31850.1	0	0
36	170.134	-51.9268	30367.5	0	0
37	173.032	-52.1397	28925.3	0	0
38	175.93	-52.0589	26793.7	0	0
39	178.828	-51.978	24753.5	0	0
40	181.652	-51.8992	22853.3	0	0
41	184.476	-51.8205	21040	0	0
42	187.312	-51.7413	19306.1	0	0
43	190.149	-51.6622	17659.8	0	0
44	192.901	-51.3768	15761.3	0	0
45	195.653	-51.0914	13992.6	0	0
46	199.403	-50.0233	10717.2	0	0
47	203.578	-48.6318	7444.41	0	0
48	207.726	-46.551	4325.42	0	0
49	208.487	-45.9246	3676.46	0	0
50	210.558	-44.2212	1230.99	0	0
51	211.8	-43.2	0	0	0

Query 1 (janbu simplified) - Safety Factor: -1000

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	N/A	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A	N/A
8	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A
11	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	N/A	N/A
21	N/A	N/A	N/A	N/A	N/A
22	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A
26	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	N/A	N/A	N/A
28	N/A	N/A	N/A	N/A	N/A

Discharge Sections

Entity Information

Simplified Bishop Method - Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11

Simplified Janbu Method - Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, -200 416.6, -200 416.6, -44.9 416.6, -42.9 416.6, -40.9 211.8, -43.2 80.3, 1 74.6, 1 68.3, 1 48, 1 30, 1 0, 1 0, -11
Material Boundary	74.6, 1 212.9, -45 416.6, -42.9
Material Boundary	68.3, 1 104.15, -11 211.7, -47 416.6, -44.9
Material Boundary	0, -11 104.15, -11

OVERLINER AND FINAL CONFIGURATION STABILITY ANALYSIS

Permit Page - IIIL-1838

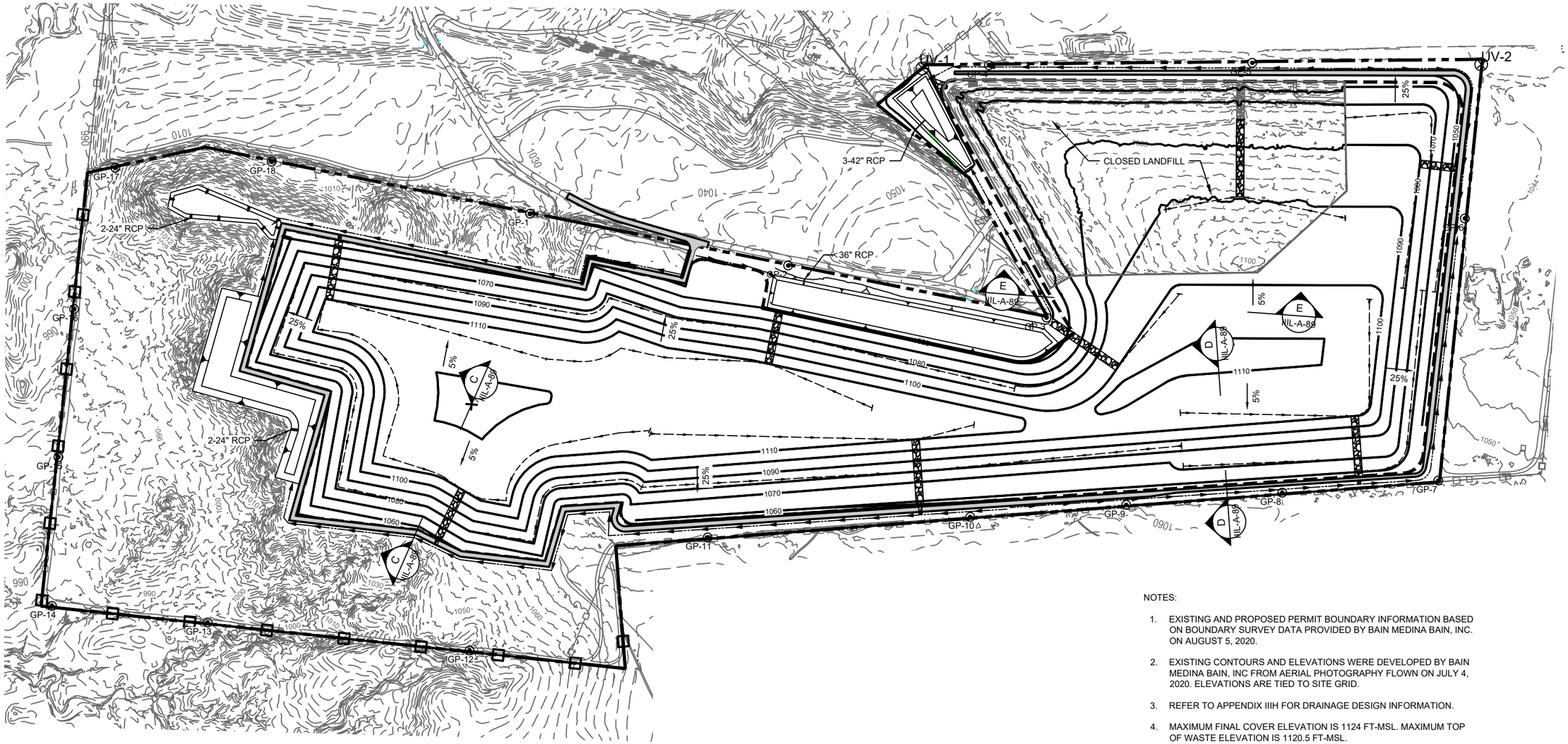
LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER GRADES
- 1084 EXISTING GRADES
- PERIMETER CHANNEL
- SWALES
- PROPOSED SITE FENCE
- EXISTING CHUTE
- CHUTES
- GP-5 PROPOSED GAS PROBE
- UV-1 PROPOSED GAS VENTS

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM TBPE F-1741

CITY OF DEL RIO
TEMOBISTA METAFERIA 123163 LICENSED PROFESSIONAL ENGINEER STATE OF TEXAS 03/07/2025

NO.	REVISION	BY	DATE
1.	2ND TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY

1"

0

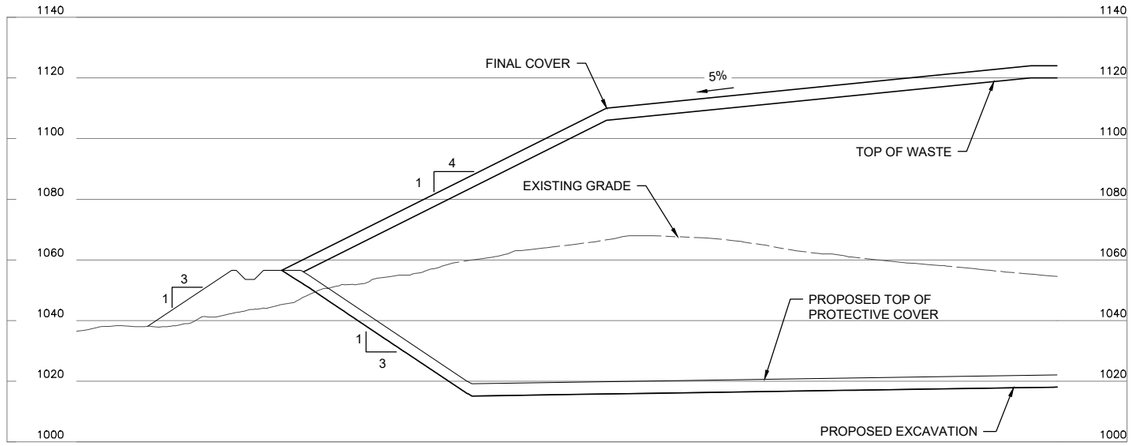
CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

FINAL COVER & OVERLINER SLOPE STABILITY SECTION LOCATION

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

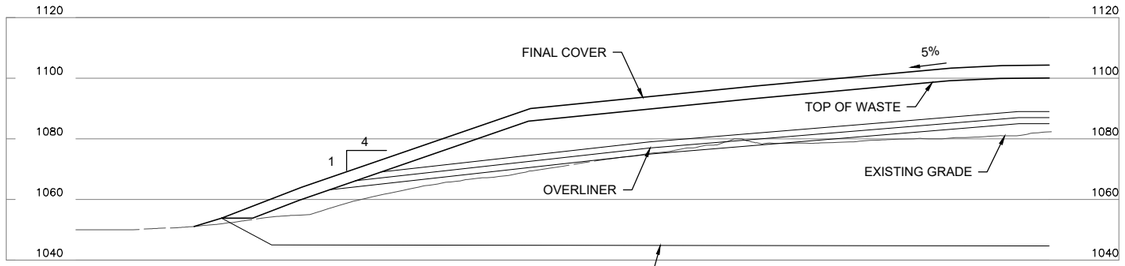
FIGURE
IIIL-A-88

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stvipw_stv1\metaferiald0842279\DELR2000302 Figure IIIL-A-XX.dwg



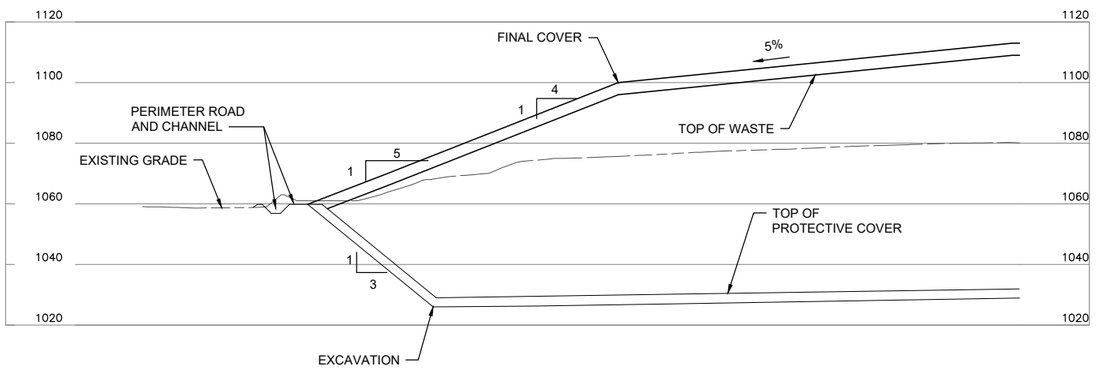
C IIIL-A-5 FINAL COVER SECTION

HORZ 0 50 100
VERT 0 5 10
SCALE IN FEET



E IIIL-A-5 OVERLINER

HORZ 0 50 100
VERT 0 5 10
SCALE IN FEET



D IIIL-A-5 FINAL COVER SECTION

HORZ 0 50 100
VERT 0 5 10
SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO, TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL
ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
1.	1ST TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

OVERLINER AND FINAL COVER SLOPE CROSS SECTIONS

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIL-A-89

PRINTED BY: Metafe1T
FILE PATH: C:\pwworkingstv\pw_stv1\metaferia\d0942279\DELR200302 Slope Stability Cross Section.dwg

Overliner & Final Cover Landfill Configuration Stability Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Overliner and Final Configuration Stability Analysis

Date: 3/7/2025
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **Evaluate the slope stability of the proposed landfill overliner and final cover configuration slope.**

1 The location of the critical section selected for the stability analysis for the slope is shown on Sheet IIIL-A-88. The cross sections are shown on IIIL-A-89.

2 The soil profile used for each analysis was based on boring log data from previous site investigations (see Appendix IIIJ).

3 A summary table of the assumed material weight and strength properties is provided on Sheet IIIL-A-91. The material weight and strength parameter determination for each material type was based on previous laboratory testing results (Atterberg limits, natural moisture contents, unit weight, percent passing #200 sieve, standard Proctor, and strength testing), field strength testing (pocket penetrometer and standard penetration testing (SPT)), and engineering judgment from previous experience with similar materials. Laboratory testing results for the site soils are included in Appendix IIIL-C.

Reference

1 Bowles, Joseph E., Foundation Analyses and Design, 4th Ed., Mc-Graw-Hill, 1988.

2 Duncan, J.M. and Buchignani, A.L., An Engineering Manual for Slope Stability Studies, Department of Civil Engineering-University of California-Berkeley, 1975.

3 Slide 2D 2018 (computer program for slope stability analyses), Interactive Software.

Overliner and Final Cover Landfill Configuration Stability Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Overliner & Final Cover Configuration Stability Analysis

Date: 3/7/2025
Job No: DELR200302
By: T. Metaferia
Checked By: B. Hindman

Derivation of Slope Stability Parameters:

Laboratory testing data and field testing results are provided on logs included in Appendix IIIJ. The following includes material strength properties based on the laboratory testing results and field test results for each subsurface unit.

Material/Unit	Unit Weight (pcf)
Stratum I	111.1
Stratum II	110.9
Stratum III	109.7

The strength parameters used for analysis of the in-situ soils were selected based on the following:

Stratum II

The summary of the calculated cohesion and friction angles are shown on Pages IIIL-A-9 . There is no groundwater at the site, therefore the soil parameters used for all the slope stability analysis for Stratum II and III only utilize effective stress. The liner soil parameters were modeled using the total and effective stress shown on Table 5-1 on page IIIL-14.

	Total Stress		Effective Stress	
	Cohesion (lb/ft^2)	Friction Angle (phi)	Cohesion (lb/ft^2)	Friction Angle (phi)
Stratum II	4000.0	0.0	206.0	26

Stratum III

	Total Stress		Effective Stress	
	Cohesion (lb/ft^2)	Friction Angle (phi)	Cohesion (lb/ft^2)	Friction Angle (phi)
Stratum III	2800.0	0.0	150.0	24

Solid Waste Input Parameters:

Soil Description	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Solid Waste	59.0	288.0	23.0

The above information was derived from several references. Reference 3 provides a summary of several studies that have been completed to develop the shear strength parameters for MSW (refer to Chapter 6.7 in Ref. 3). MSW shear strength parameters reported in technical literature references vary widely, with friction angles as low as 10° and as high as 53°, and cohesion values varying from 0 psf to 1,400 psf. Many of the lower values are directly contradicted by observations of actual stable landfill slopes. A summary list of a few of the studies completed is provided below.

Reference	Data Type	Results
Pagotto & Rimoldi (1987)	Back-calculation from plate bearing tests	$\phi = 22^{\circ}$ c = 605 psf (29 kPa)
Landva & Clark (1990)	Laboratory direct shear tests on MSW	$\phi = 24^{\circ}$, c = 460 psf (22 kPa) to $\phi = 39^{\circ}$, c = 400 psf (19 kPa)
Richardson & Reynolds (1991)	Large direct shear tests performed in-situ	$\phi = 18^{\circ}$ to 43° c = 210 psf (10 kPa)

To provide for a conservative analysis, a cohesion value of 288 psf and a friction angle of 23° were selected.

The moist unit weight is estimated at the midpoint of the average depth to represent the average unit weight of waste/cover soil within the landfill, consistent with what is used in the site life calculations in Appendix IIIB

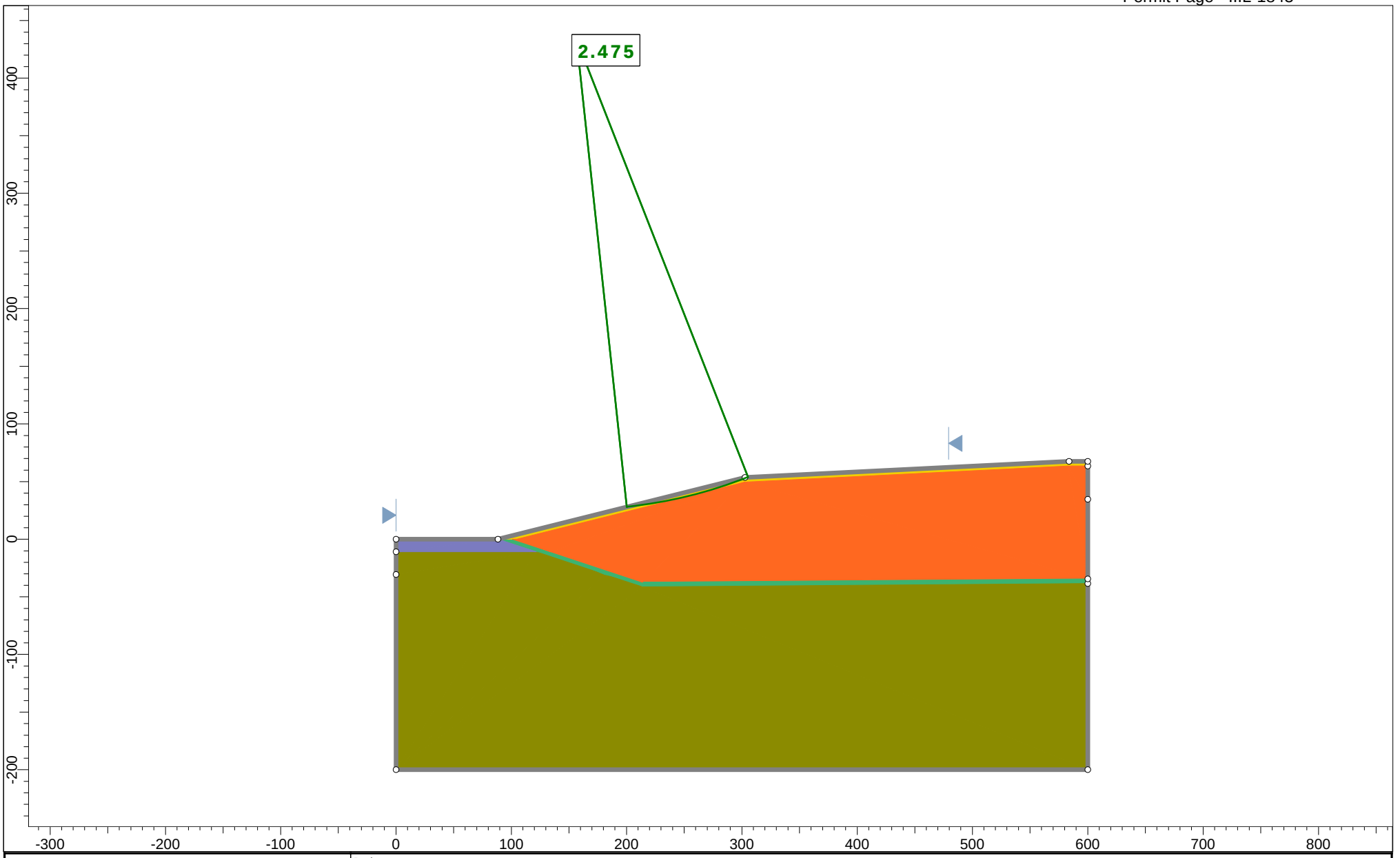
Factor of Safety Summary for Final Slope Stability Analysis

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Effective	Total	Effective	Total	Effective	Total
Final Cover C-1	Bishop-Circular	2.4	2.4	1.5	1.3	YES	YES
Final Cover D-1	Bishop-Circular	3.1	3.1	1.5	1.3	YES	YES
Overliner E-1	Bishop-Circular	2.9	3.3	1.5	1.3	YES	YES

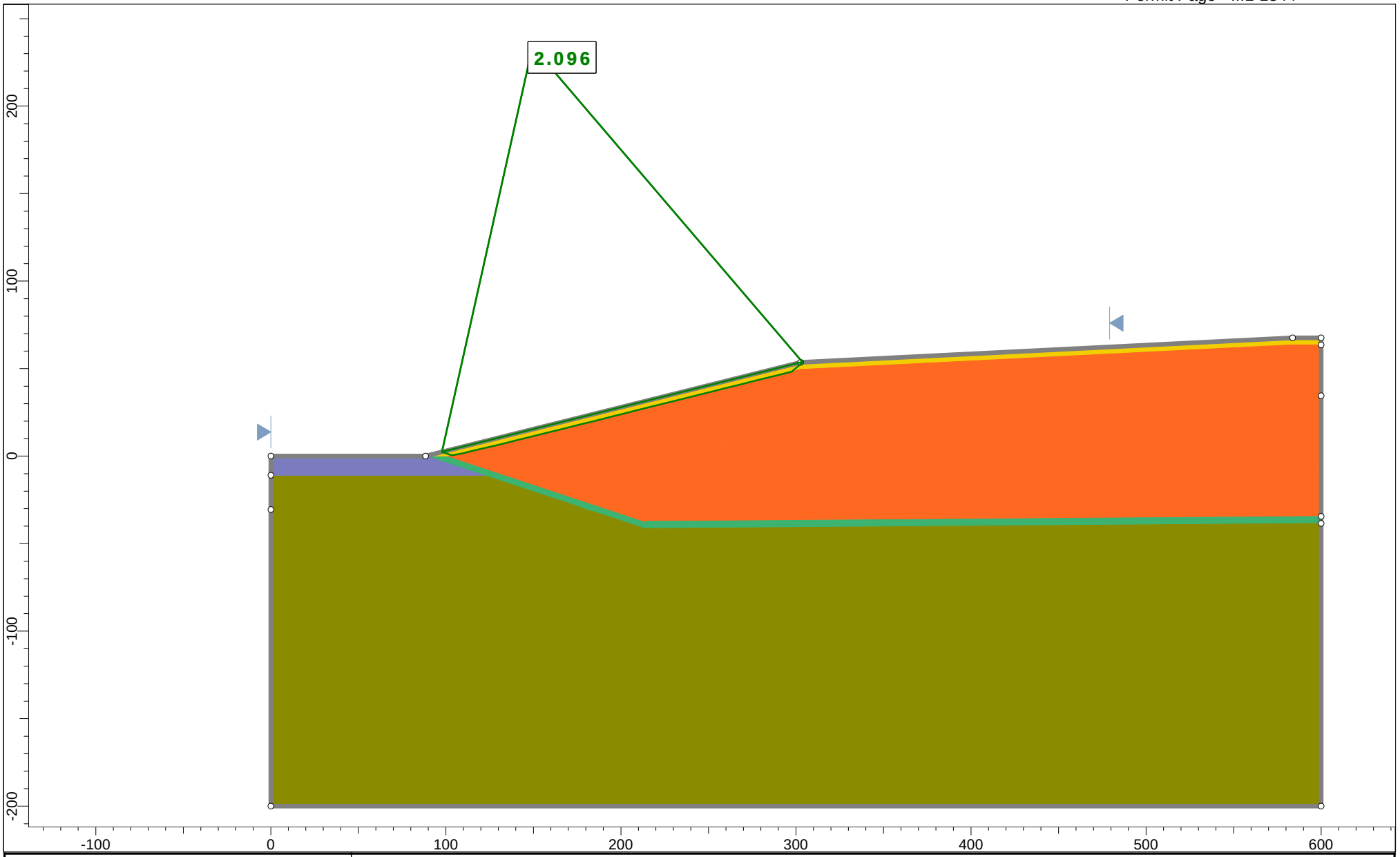
Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Effective	Total	Effective	Total	Effective	Total
Final Cover C-2	Janbu	2.0	2.0	1.5	1.3	YES	YES
Final Cover D-2	Janbu	3.1	3.1	1.5	1.3	YES	YES
Overliner E-2	Janbu	2.9	2.9	1.5	1.3	YES	YES

Minimum Required Interface Strength Parameters

Landfill Component	Interface	Peak		Residual	
		Adhesion (psf)	Friction Angle (degrees)	Adhesion (psf)	Friction Angle (degrees)
Liner	Protective Cover/ Geocomposite	100.0	18.0	80.0	14.0
Liner	Geocomposite/ Textured Geomembrane	100.0	21.0	80.0	10.0
Liner	Textured Geomembrane/ Geosynthetic Clay Liner	100.0	18.0	80.0	10.0



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-FC Section C_Effective Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-FC Section C_Effective Stress.slmd

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	47
Cohesion [psf]	288
Friction Angle [deg]	23
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109.7
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Effective Stress	Simplified Janbu Method - Effective Stress
Final Cover	✓	✓
Liner	✓	✓
Waste	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Bishop Method - Effective Stress

Method: bishop simplified

FS	2.474790
Center:	156.527, 433.638
Radius:	408.086
Left Slip Surface Endpoint:	200.091, 27.884
Right Slip Surface Endpoint:	305.279, 53.628
Resisting Moment:	8.35479e+06 lb-ft
Driving Moment:	3.37595e+06 lb-ft
Total Slice Area:	287.057 ft2
Surface Horizontal Width:	105.188 ft
Surface Average Height:	2.72898 ft

Simplified Janbu Method - Effective Stress

Method: janbu simplified

FS	2.096190
Axis Location:	149.584, 234.059
Left Slip Surface Endpoint:	97.751, 2.335
Right Slip Surface Endpoint:	303.864, 53.558
Resisting Horizontal Force:	46434.8 lb
Driving Horizontal Force:	22153.7 lb
Total Slice Area:	796.01 ft2
Surface Horizontal Width:	206.113 ft
Surface Average Height:	3.862 ft

Global Minimum Coordinates

Simplified Janbu Method - Effective Stress

Method: janbu simplified

X	Y
97.7513	2.33455
103.434	0.353304
109.977	1.63821
113.248	2.46138
116.52	3.28455
123.609	4.92752
130.698	6.53972
140.245	8.90932
149.367	11.1864
158.952	13.5837
164.345	14.9293
170.764	16.5325
177.195	18.1407
183.625	19.7469
190.056	21.3543
196.486	22.96
202.194	24.3874
207.902	25.8147
214.543	27.4745
221.184	29.1343
227.824	30.7921
234.465	32.4498
240.482	33.9554
246.477	35.4555
254.171	37.3783
259.574	38.732
264.233	39.8945
269.409	41.1843
276.135	42.865
282.86	44.5442
290.229	46.3853
297.597	48.225
303.864	53.558

Valid and Invalid Surfaces

Simplified Bishop Method - Effective Stress

Method: bishop simplified

Number of Valid Surfaces:	12000
Number of Invalid Surfaces:	0

Simplified Janbu Method - Effective Stress

Method: janbu simplified

Number of Valid Surfaces:	23144
Number of Invalid Surfaces:	1915

Error Codes
Error Code -106 reported for 7 surfaces
Error Code -108 reported for 46 surfaces
Error Code -111 reported for 485 surfaces
Error Code -112 reported for 444 surfaces
Error Code -121 reported for 100 surfaces
Error Code -124 reported for 1 surface
Error Code -145 reported for 82 surfaces
Error Code -1000 reported for 750 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = Safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-124 = A slice has a width less than the minimum acceptable value.

-145 = Slip surface was clipped vertically by a weak layer in a region of compression. Such a surface cannot be evaluated using Limit Equilibrium. For more information, see Help Documentation on weak layers.

-1000 = No valid slip surface is generated

Slice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 2.47479

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.10377	37.0869	6.27669	Final Cover	100	16	41.9167	103.735	13.0259	0	13.0259	17.6363	17.6363
2	2.10377	109.866	6.57393	Final Cover	100	16	45.8472	113.462	46.9483	0	46.9483	52.2319	52.2319
3	2.10377	179.852	6.87134	Final Cover	100	16	49.6212	122.802	79.5206	0	79.5206	85.5002	85.5002
4	2.10377	247.04	7.16895	Final Cover	100	16	53.2388	131.755	110.742	0	110.742	117.438	117.438
5	2.10377	311.425	7.46675	Final Cover	100	16	56.6998	140.32	140.613	0	140.613	148.044	148.044
6	2.10377	373.001	7.76475	Final Cover	100	16	60.0043	148.498	169.133	0	169.133	177.315	177.315
7	2.10377	431.763	8.06296	Final Cover	100	16	63.1522	156.288	196.301	0	196.301	205.247	205.247
8	2.10377	487.703	8.36139	Final Cover	100	16	66.1435	163.691	222.118	0	222.118	231.84	231.84
9	2.10377	540.817	8.66005	Final Cover	100	16	68.9781	170.706	246.582	0	246.582	257.088	257.088
10	2.10377	591.096	8.95895	Final Cover	100	16	71.6558	177.333	269.692	0	269.692	280.989	280.989
11	2.10377	638.535	9.2581	Final Cover	100	16	74.1766	183.572	291.449	0	291.449	303.54	303.54
12	2.10377	683.127	9.5575	Final Cover	100	16	76.5404	189.421	311.849	0	311.849	324.737	324.737
13	2.10377	724.863	9.85716	Final Cover	100	16	78.747	194.882	330.894	0	330.894	344.577	344.577
14	2.10377	763.736	10.1571	Final Cover	100	16	80.7964	199.954	348.581	0	348.581	363.056	363.056
15	2.10377	799.738	10.4573	Final Cover	100	16	82.6882	204.636	364.909	0	364.909	380.17	380.17
16	2.10377	832.861	10.7578	Final Cover	100	16	84.4225	208.928	379.876	0	379.876	395.917	395.917
17	2.10377	863.097	11.0586	Final Cover	100	16	85.9988	212.829	393.482	0	393.482	410.29	410.29
18	2.10377	890.436	11.3597	Final Cover	100	16	87.4171	216.339	405.724	0	405.724	423.287	423.287
19	2.10377	914.87	11.6612	Final Cover	100	16	88.6774	219.458	416.601	0	416.601	434.902	434.902
20	2.10377	936.389	11.9629	Final Cover	100	16	89.7793	222.185	426.11	0	426.11	445.132	445.132
21	2.10377	954.983	12.265	Final Cover	100	16	90.7224	224.519	434.249	0	434.249	453.972	453.972
22	2.10377	970.644	12.5675	Final Cover	100	16	91.5068	226.46	441.017	0	441.017	461.417	461.417
23	2.10377	983.359	12.8703	Final Cover	100	16	92.1315	228.006	446.412	0	446.412	467.462	467.462
24	2.10377	993.12	13.1735	Final Cover	100	16	92.5974	229.159	450.43	0	450.43	472.103	472.103
25	2.10377	999.914	13.477	Final Cover	100	16	92.9028	229.915	453.069	0	453.069	475.333	475.333
26	2.10377	1003.73	13.7809	Final Cover	100	16	93.0487	230.276	454.326	0	454.326	477.149	477.149
27	2.10377	1004.56	14.0853	Final Cover	100	16	93.0342	230.24	454.2	0	454.2	477.543	477.543
28	2.10377	1002.39	14.39	Final Cover	100	16	92.8588	229.806	452.687	0	452.687	476.512	476.512
29	2.10377	997.203	14.6951	Final Cover	100	16	92.5222	228.973	449.783	0	449.783	474.048	474.048

30	2.10377	988.993	15.0007	Final Cover	100	16	92.0244	227.741	445.487	0	445.487	470.146	470.146
31	2.10377	977.745	15.3067	Final Cover	100	16	91.3649	226.109	439.794	0	439.794	464.8	464.8
32	2.10377	963.445	15.6132	Final Cover	100	16	90.543	224.075	432.701	0	432.701	458.003	458.003
33	2.10377	946.081	15.9201	Final Cover	100	16	89.5587	221.639	424.204	0	424.204	449.75	449.75
34	2.10377	925.638	16.2275	Final Cover	100	16	88.4111	218.799	414.301	0	414.301	440.032	440.032
35	2.10377	902.101	16.5354	Final Cover	100	16	87.0999	215.554	402.986	0	402.986	428.845	428.845
36	2.10377	875.457	16.8437	Final Cover	100	16	85.625	211.904	390.257	0	390.257	416.18	416.18
37	2.10377	845.69	17.1526	Final Cover	100	16	83.9857	207.847	376.109	0	376.109	402.03	402.03
38	2.10377	812.784	17.462	Final Cover	100	16	82.1815	203.382	360.537	0	360.537	386.389	386.389
39	2.10377	776.724	17.7719	Final Cover	100	16	80.2121	198.508	343.539	0	343.539	369.248	369.248
40	2.10377	737.494	18.0823	Final Cover	100	16	78.0766	193.223	325.107	0	325.107	350.6	350.6
41	2.10377	695.076	18.3933	Final Cover	100	16	75.7746	187.526	305.24	0	305.24	330.437	330.437
42	2.10377	649.454	18.7049	Final Cover	100	16	73.3055	181.416	283.931	0	283.931	308.75	308.75
43	2.10377	600.609	19.017	Final Cover	100	16	70.6689	174.891	261.175	0	261.175	285.532	285.532
44	2.10377	548.525	19.3297	Final Cover	100	16	67.8641	167.95	236.968	0	236.968	260.774	260.774
45	2.10377	493.182	19.6431	Final Cover	100	16	64.8906	160.59	211.304	0	211.304	234.466	234.466
46	2.10377	434.562	19.957	Final Cover	100	16	61.7475	152.812	184.178	0	184.178	206.6	206.6
47	2.10377	372.644	20.2716	Final Cover	100	16	58.4345	144.613	155.584	0	155.584	177.167	177.167
48	2.10377	307.409	20.5868	Final Cover	100	16	54.9506	135.991	125.517	0	125.517	146.157	146.157
49	2.10377	236.13	20.9026	Final Cover	100	16	51.1526	126.592	92.7374	0	92.7374	112.273	112.273
50	2.10377	89.8717	21.2191	Final Cover	100	16	43.4076	107.425	25.8934	0	25.8934	42.7468	42.7468

Query 1 (bishop simplified) - Safety Factor: 2.47479

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.10377	37.0869	6.27669	Final Cover	100	16	41.9167	103.735	13.0259	0	13.0259	17.6363	17.6363
2	2.10377	109.866	6.57393	Final Cover	100	16	45.8472	113.462	46.9483	0	46.9483	52.2319	52.2319
3	2.10377	179.852	6.87134	Final Cover	100	16	49.6212	122.802	79.5206	0	79.5206	85.5002	85.5002
4	2.10377	247.04	7.16895	Final Cover	100	16	53.2388	131.755	110.742	0	110.742	117.438	117.438
5	2.10377	311.425	7.46675	Final Cover	100	16	56.6998	140.32	140.613	0	140.613	148.044	148.044
6	2.10377	373.001	7.76475	Final Cover	100	16	60.0043	148.498	169.133	0	169.133	177.315	177.315
7	2.10377	431.763	8.06296	Final Cover	100	16	63.1522	156.288	196.301	0	196.301	205.247	205.247
8	2.10377	487.703	8.36139	Final Cover	100	16	66.1435	163.691	222.118	0	222.118	231.84	231.84
9	2.10377	540.817	8.66005	Final Cover	100	16	68.9781	170.706	246.582	0	246.582	257.088	257.088
10	2.10377	591.096	8.95895	Final Cover	100	16	71.6558	177.333	269.692	0	269.692	280.989	280.989
11	2.10377	638.535	9.2581	Final Cover	100	16	74.1766	183.572	291.449	0	291.449	303.54	303.54
12	2.10377	683.127	9.5575	Final Cover	100	16	76.5404	189.421	311.849	0	311.849	324.737	324.737
13	2.10377	724.863	9.85716	Final Cover	100	16	78.747	194.882	330.894	0	330.894	344.577	344.577
14	2.10377	763.736	10.1571	Final Cover	100	16	80.7964	199.954	348.581	0	348.581	363.056	363.056
15	2.10377	799.738	10.4573	Final Cover	100	16	82.6882	204.636	364.909	0	364.909	380.17	380.17
16	2.10377	832.861	10.7578	Final Cover	100	16	84.4225	208.928	379.876	0	379.876	395.917	395.917
17	2.10377	863.097	11.0586	Final Cover	100	16	85.9988	212.829	393.482	0	393.482	410.29	410.29
18	2.10377	890.436	11.3597	Final Cover	100	16	87.4171	216.339	405.724	0	405.724	423.287	423.287
19	2.10377	914.87	11.6612	Final Cover	100	16	88.6774	219.458	416.601	0	416.601	434.902	434.902
20	2.10377	936.389	11.9629	Final Cover	100	16	89.7793	222.185	426.11	0	426.11	445.132	445.132
21	2.10377	954.983	12.265	Final Cover	100	16	90.7224	224.519	434.249	0	434.249	453.972	453.972
22	2.10377	970.644	12.5675	Final Cover	100	16	91.5068	226.46	441.017	0	441.017	461.417	461.417
23	2.10377	983.359	12.8703	Final Cover	100	16	92.1315	228.006	446.412	0	446.412	467.462	467.462
24	2.10377	993.12	13.1735	Final Cover	100	16	92.5974	229.159	450.43	0	450.43	472.103	472.103
25	2.10377	999.914	13.477	Final Cover	100	16	92.9028	229.915	453.069	0	453.069	475.333	475.333
26	2.10377	1003.73	13.7809	Final Cover	100	16	93.0487	230.276	454.326	0	454.326	477.149	477.149
27	2.10377	1004.56	14.0853	Final Cover	100	16	93.0342	230.24	454.2	0	454.2	477.543	477.543
28	2.10377	1002.39	14.39	Final Cover	100	16	92.8588	229.806	452.687	0	452.687	476.512	476.512
29	2.10377	997.203	14.6951	Final Cover	100	16	92.5222	228.973	449.783	0	449.783	474.048	474.048
30	2.10377	988.993	15.0007	Final Cover	100	16	92.0244	227.741	445.487	0	445.487	470.146	470.146
31	2.10377	977.745	15.3067	Final Cover	100	16	91.3649	226.109	439.794	0	439.794	464.8	464.8
32	2.10377	963.445	15.6132	Final Cover	100	16	90.543	224.075	432.701	0	432.701	458.003	458.003
33	2.10377	946.081	15.9201	Final Cover	100	16	89.5587	221.639	424.204	0	424.204	449.75	449.75

34	2.10377	925.638	16.2275	Final Cover	100	16	88.4111	218.799	414.301	0	414.301	440.032	440.032
35	2.10377	902.101	16.5354	Final Cover	100	16	87.0999	215.554	402.986	0	402.986	428.845	428.845
36	2.10377	875.457	16.8437	Final Cover	100	16	85.625	211.904	390.257	0	390.257	416.18	416.18
37	2.10377	845.69	17.1526	Final Cover	100	16	83.9857	207.847	376.109	0	376.109	402.03	402.03
38	2.10377	812.784	17.462	Final Cover	100	16	82.1815	203.382	360.537	0	360.537	386.389	386.389
39	2.10377	776.724	17.7719	Final Cover	100	16	80.2121	198.508	343.539	0	343.539	369.248	369.248
40	2.10377	737.494	18.0823	Final Cover	100	16	78.0766	193.223	325.107	0	325.107	350.6	350.6
41	2.10377	695.076	18.3933	Final Cover	100	16	75.7746	187.526	305.24	0	305.24	330.437	330.437
42	2.10377	649.454	18.7049	Final Cover	100	16	73.3055	181.416	283.931	0	283.931	308.75	308.75
43	2.10377	600.609	19.017	Final Cover	100	16	70.6689	174.891	261.175	0	261.175	285.532	285.532
44	2.10377	548.525	19.3297	Final Cover	100	16	67.8641	167.95	236.968	0	236.968	260.774	260.774
45	2.10377	493.182	19.6431	Final Cover	100	16	64.8906	160.59	211.304	0	211.304	234.466	234.466
46	2.10377	434.562	19.957	Final Cover	100	16	61.7475	152.812	184.178	0	184.178	206.6	206.6
47	2.10377	372.644	20.2716	Final Cover	100	16	58.4345	144.613	155.584	0	155.584	177.167	177.167
48	2.10377	307.409	20.5868	Final Cover	100	16	54.9506	135.991	125.517	0	125.517	146.157	146.157
49	2.10377	236.13	20.9026	Final Cover	100	16	51.1526	126.592	92.7374	0	92.7374	112.273	112.273
50	2.10377	89.8717	21.2191	Final Cover	100	16	43.4076	107.425	25.8934	0	25.8934	42.7468	42.7468

Simplified Janbu Method - Effective Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.09619

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	5.68302	1159.34	-19.2198	Final Cover	100	16	79.3906	166.418	231.627	0	231.627	203.949	203.949
2	6.5426	2806.18	11.111	Final Cover	100	16	103.599	217.164	408.601	0	408.601	428.947	428.947
3	3.2713	1470.21	14.1243	Final Cover	100	16	105.558	221.269	422.915	0	422.915	449.477	449.477
4	3.2713	1467.66	14.1243	Final Cover	100	16	105.455	221.053	422.162	0	422.162	448.698	448.698
5	7.08904	3231.66	13.0486	Final Cover	100	16	106.689	223.641	431.187	0	431.187	455.913	455.913
6	3.54452	1659.56	12.8124	Final Cover	100	16	108.387	227.2	443.601	0	443.601	468.25	468.25
7	3.54452	1693.07	12.8124	Final Cover	100	16	109.642	229.83	452.77	0	452.77	477.705	477.705
8	4.7737	2304.75	13.9388	Final Cover	100	16	110.022	230.626	455.547	0	455.547	482.853	482.853
9	4.7737	2308.74	13.9388	Final Cover	100	16	110.132	230.857	456.354	0	456.354	483.688	483.688
10	4.56118	2207.9	14.0152	Final Cover	100	16	110.168	230.933	456.616	0	456.616	484.115	484.115
11	4.56118	2208	14.0152	Final Cover	100	16	110.171	230.939	456.638	0	456.638	484.137	484.137
12	4.7924	2319.34	14.0428	Final Cover	100	16	110.147	230.889	456.462	0	456.462	484.012	484.012
13	4.7924	2318.04	14.0428	Final Cover	100	16	110.111	230.813	456.201	0	456.201	483.742	483.742
14	5.39247	2607.77	14.0107	Final Cover	100	16	110.107	230.805	456.172	0	456.172	483.647	483.647
15	5.18812	2509	14.0224	Final Cover	100	16	110.105	230.801	456.158	0	456.158	483.656	483.656
16	1.23119	595.356	14.0224	Final Cover	100	16	110.1	230.79	456.118	0	456.118	483.615	483.615
17	0.730512	353.229	14.0412	Final Cover	100	16	110.091	230.772	456.056	0	456.056	483.589	483.589
18	5.70006	2755.25	14.0412	Final Cover	100	16	110.069	230.726	455.896	0	455.896	483.424	483.424
19	6.43057	3107.08	14.0239	Final Cover	100	16	110.048	230.681	455.738	0	455.738	483.225	483.225
20	3.21529	1553.2	14.0341	Final Cover	100	16	110.031	230.646	455.617	0	455.617	483.12	483.12
21	3.21529	1552.82	14.0341	Final Cover	100	16	110.015	230.613	455.499	0	455.499	482.999	482.999
22	3.21529	1552.59	14.02	Final Cover	100	16	110.01	230.601	455.461	0	455.461	482.93	482.93
23	3.21529	1552.53	14.02	Final Cover	100	16	110.007	230.596	455.443	0	455.443	482.911	482.911
24	5.70779	2755.17	14.0403	Final Cover	100	16	109.981	230.542	455.252	0	455.252	482.756	482.756
25	5.70779	2753.51	14.0403	Final Cover	100	16	109.943	230.461	454.972	0	454.972	482.466	482.466
26	6.64089	3201.94	14.0326	Final Cover	100	16	109.911	230.394	454.735	0	454.735	482.206	482.206
27	3.32045	1600.41	14.0326	Final Cover	100	16	109.888	230.347	454.572	0	454.572	482.037	482.037
28	3.32045	1600.04	14.0326	Final Cover	100	16	109.874	230.316	454.464	0	454.464	481.925	481.925
29	3.32045	1599.86	14.0164	Final Cover	100	16	109.871	230.31	454.446	0	454.446	481.873	481.873
30	3.32045	1599.89	14.0164	Final Cover	100	16	109.872	230.312	454.452	0	454.452	481.88	481.88
31	6.12742	2952.43	14.0164	Final Cover	100	16	109.873	230.315	454.463	0	454.463	481.891	481.891
32	0.513472	247.412	14.0164	Final Cover	100	16	109.874	230.316	454.465	0	454.465	481.893	481.893

33	0.347453	167.414	14.0488	Final Cover	100	16	109.863	230.294	454.392	0	454.392	481.883	481.883
34	5.66945	2730.55	14.0488	Final Cover	100	16	109.836	230.237	454.192	0	454.192	481.676	481.676
35	5.99475	2884.79	14.0485	Final Cover	100	16	109.783	230.125	453.801	0	453.801	481.271	481.271
36	7.69368	3699.79	14.032	Final Cover	100	16	109.743	230.042	453.512	0	453.512	480.939	480.939
37	5.40377	2596.41	14.064	Final Cover	100	16	109.681	229.912	453.057	0	453.057	480.534	480.534
38	4.65832	2237.07	14.0113	Final Cover	100	16	109.662	229.872	452.919	0	452.919	480.284	480.284
39	5.17661	2486.92	13.9912	Final Cover	100	16	109.691	229.934	453.135	0	453.135	480.466	480.466
40	3.36264	1615.8	14.0311	Final Cover	100	16	109.694	229.939	453.152	0	453.152	480.565	480.565
41	3.36264	1615.45	14.0311	Final Cover	100	16	109.68	229.911	453.054	0	453.054	480.463	480.463
42	3.36264	1615.26	14.0193	Final Cover	100	16	109.676	229.901	453.019	0	453.019	480.404	480.404
43	3.36264	1615.21	14.0193	Final Cover	100	16	109.674	229.897	453.005	0	453.005	480.389	480.389
44	3.68436	1769.54	14.0285	Final Cover	100	16	109.664	229.877	452.936	0	452.936	480.337	480.337
45	3.68436	1769.21	14.0285	Final Cover	100	16	109.652	229.852	452.85	0	452.85	480.247	480.247
46	3.64631	1750.76	14.018	Final Cover	100	16	109.649	229.845	452.822	0	452.822	480.197	480.197
47	3.64631	1750.75	14.018	Final Cover	100	16	109.648	229.843	452.819	0	452.819	480.194	480.194
48	0.0760875	36.5325	14.018	Final Cover	100	16	109.648	229.843	452.815	0	452.815	480.19	480.19
49	3.13353	1150.27	40.3966	Final Cover	100	16	87.7276	183.894	292.571	0	292.571	367.224	367.224
50	3.13353	425.497	40.3966	Final Cover	100	16	59.3812	124.474	85.3523	0	85.3523	135.884	135.884

Query 1 (janbu simplified) - Safety Factor: 2.09619

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	5.68302	1159.34	-19.2198	Final Cover	100	16	79.3906	166.418	231.627	0	231.627	203.949	203.949
2	6.5426	2806.18	11.111	Final Cover	100	16	103.599	217.164	408.601	0	408.601	428.947	428.947
3	3.2713	1470.21	14.1243	Final Cover	100	16	105.558	221.269	422.915	0	422.915	449.477	449.477
4	3.2713	1467.66	14.1243	Final Cover	100	16	105.455	221.053	422.162	0	422.162	448.698	448.698
5	7.08904	3231.66	13.0486	Final Cover	100	16	106.689	223.641	431.187	0	431.187	455.913	455.913
6	3.54452	1659.56	12.8124	Final Cover	100	16	108.387	227.2	443.601	0	443.601	468.25	468.25
7	3.54452	1693.07	12.8124	Final Cover	100	16	109.642	229.83	452.77	0	452.77	477.705	477.705
8	4.7737	2304.75	13.9388	Final Cover	100	16	110.022	230.626	455.547	0	455.547	482.853	482.853
9	4.7737	2308.74	13.9388	Final Cover	100	16	110.132	230.857	456.354	0	456.354	483.688	483.688
10	4.56118	2207.9	14.0152	Final Cover	100	16	110.168	230.933	456.616	0	456.616	484.115	484.115
11	4.56118	2208	14.0152	Final Cover	100	16	110.171	230.939	456.638	0	456.638	484.137	484.137
12	4.7924	2319.34	14.0428	Final Cover	100	16	110.147	230.889	456.462	0	456.462	484.012	484.012
13	4.7924	2318.04	14.0428	Final Cover	100	16	110.111	230.813	456.201	0	456.201	483.742	483.742
14	5.39247	2607.77	14.0107	Final Cover	100	16	110.107	230.805	456.172	0	456.172	483.647	483.647
15	5.18812	2509	14.0224	Final Cover	100	16	110.105	230.801	456.158	0	456.158	483.656	483.656
16	1.23119	595.356	14.0224	Final Cover	100	16	110.1	230.79	456.118	0	456.118	483.615	483.615
17	0.730512	353.229	14.0412	Final Cover	100	16	110.091	230.772	456.056	0	456.056	483.589	483.589
18	5.70006	2755.25	14.0412	Final Cover	100	16	110.069	230.726	455.896	0	455.896	483.424	483.424
19	6.43057	3107.08	14.0239	Final Cover	100	16	110.048	230.681	455.738	0	455.738	483.225	483.225
20	3.21529	1553.2	14.0341	Final Cover	100	16	110.031	230.646	455.617	0	455.617	483.12	483.12
21	3.21529	1552.82	14.0341	Final Cover	100	16	110.015	230.613	455.499	0	455.499	482.999	482.999
22	3.21529	1552.59	14.02	Final Cover	100	16	110.01	230.601	455.461	0	455.461	482.93	482.93
23	3.21529	1552.53	14.02	Final Cover	100	16	110.007	230.596	455.443	0	455.443	482.911	482.911
24	5.70779	2755.17	14.0403	Final Cover	100	16	109.981	230.542	455.252	0	455.252	482.756	482.756
25	5.70779	2753.51	14.0403	Final Cover	100	16	109.943	230.461	454.972	0	454.972	482.466	482.466
26	6.64089	3201.94	14.0326	Final Cover	100	16	109.911	230.394	454.735	0	454.735	482.206	482.206
27	3.32045	1600.41	14.0326	Final Cover	100	16	109.888	230.347	454.572	0	454.572	482.037	482.037
28	3.32045	1600.04	14.0326	Final Cover	100	16	109.874	230.316	454.464	0	454.464	481.925	481.925
29	3.32045	1599.86	14.0164	Final Cover	100	16	109.871	230.31	454.446	0	454.446	481.873	481.873
30	3.32045	1599.89	14.0164	Final Cover	100	16	109.872	230.312	454.452	0	454.452	481.88	481.88
31	6.12742	2952.43	14.0164	Final Cover	100	16	109.873	230.315	454.463	0	454.463	481.891	481.891
32	0.513472	247.412	14.0164	Final Cover	100	16	109.874	230.316	454.465	0	454.465	481.893	481.893
33	0.347453	167.414	14.0488	Final Cover	100	16	109.863	230.294	454.392	0	454.392	481.883	481.883

34	5.66945	2730.55	14.0488	Final Cover	100	16	109.836	230.237	454.192	0	454.192	481.676	481.676
35	5.99475	2884.79	14.0485	Final Cover	100	16	109.783	230.125	453.801	0	453.801	481.271	481.271
36	7.69368	3699.79	14.032	Final Cover	100	16	109.743	230.042	453.512	0	453.512	480.939	480.939
37	5.40377	2596.41	14.064	Final Cover	100	16	109.681	229.912	453.057	0	453.057	480.534	480.534
38	4.65832	2237.07	14.0113	Final Cover	100	16	109.662	229.872	452.919	0	452.919	480.284	480.284
39	5.17661	2486.92	13.9912	Final Cover	100	16	109.691	229.934	453.135	0	453.135	480.466	480.466
40	3.36264	1615.8	14.0311	Final Cover	100	16	109.694	229.939	453.152	0	453.152	480.565	480.565
41	3.36264	1615.45	14.0311	Final Cover	100	16	109.68	229.911	453.054	0	453.054	480.463	480.463
42	3.36264	1615.26	14.0193	Final Cover	100	16	109.676	229.901	453.019	0	453.019	480.404	480.404
43	3.36264	1615.21	14.0193	Final Cover	100	16	109.674	229.897	453.005	0	453.005	480.389	480.389
44	3.68436	1769.54	14.0285	Final Cover	100	16	109.664	229.877	452.936	0	452.936	480.337	480.337
45	3.68436	1769.21	14.0285	Final Cover	100	16	109.652	229.852	452.85	0	452.85	480.247	480.247
46	3.64631	1750.76	14.018	Final Cover	100	16	109.649	229.845	452.822	0	452.822	480.197	480.197
47	3.64631	1750.75	14.018	Final Cover	100	16	109.648	229.843	452.819	0	452.819	480.194	480.194
48	0.0760875	36.5325	14.018	Final Cover	100	16	109.648	229.843	452.815	0	452.815	480.19	480.19
49	3.13353	1150.27	40.3966	Final Cover	100	16	87.7276	183.894	292.571	0	292.571	367.224	367.224
50	3.13353	425.497	40.3966	Final Cover	100	16	59.3812	124.474	85.3523	0	85.3523	135.884	135.884

Interslice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 2.47479

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	200.091	27.8836	0	0	0
2	202.194	28.115	85.026	0	0
3	204.298	28.3574	169.939	0	0
4	206.402	28.6109	254.002	0	0
5	208.506	28.8755	336.519	0	0
6	210.609	29.1513	416.838	0	0
7	212.713	29.4381	494.351	0	0
8	214.817	29.7361	568.491	0	0
9	216.921	30.0453	638.735	0	0
10	219.025	30.3658	704.603	0	0
11	221.128	30.6974	765.66	0	0
12	223.232	31.0404	821.512	0	0
13	225.336	31.3946	871.811	0	0
14	227.44	31.7601	916.251	0	0
15	229.543	32.137	954.572	0	0
16	231.647	32.5253	986.556	0	0
17	233.751	32.925	1012.03	0	0
18	235.855	33.3362	1030.88	0	0
19	237.958	33.7588	1043	0	0
20	240.062	34.193	1048.37	0	0
21	242.166	34.6388	1047.01	0	0
22	244.27	35.0961	1038.95	0	0
23	246.373	35.5651	1024.31	0	0
24	248.477	36.0458	1003.24	0	0
25	250.581	36.5382	975.935	0	0
26	252.685	37.0424	942.637	0	0
27	254.789	37.5584	903.644	0	0
28	256.892	38.0862	859.297	0	0
29	258.996	38.626	809.989	0	0
30	261.1	39.1777	756.164	0	0
31	263.204	39.7414	698.313	0	0
32	265.307	40.3172	636.983	0	0
33	267.411	40.9051	572.769	0	0
34	269.515	41.5052	506.32	0	0
35	271.619	42.1175	438.34	0	0
36	273.722	42.7421	369.586	0	0
37	275.826	43.379	300.868	0	0
38	277.93	44.0283	233.054	0	0
39	280.034	44.6901	167.068	0	0
40	282.138	45.3644	103.892	0	0
41	284.241	46.0513	44.5641	0	0
42	286.345	46.7509	-9.81537	0	0
43	288.449	47.4631	-58.0874	0	0
44	290.553	48.1882	-99.0315	0	0
45	292.656	48.9262	-131.364	0	0
46	294.76	49.6771	-153.739	0	0
47	296.864	50.441	-164.745	0	0
48	298.968	51.218	-162.904	0	0
49	301.071	52.0082	-146.671	0	0
50	303.175	52.8117	-113.743	0	0
51	305.279	53.6285	0	0	0

Query 1 (bishop simplified) - Safety Factor: 2.47479

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	200.091	27.8836	0	0	0
2	202.194	28.115	85.026	0	0
3	204.298	28.3574	169.939	0	0
4	206.402	28.6109	254.002	0	0
5	208.506	28.8755	336.519	0	0
6	210.609	29.1513	416.838	0	0
7	212.713	29.4381	494.351	0	0
8	214.817	29.7361	568.491	0	0
9	216.921	30.0453	638.735	0	0
10	219.025	30.3658	704.603	0	0
11	221.128	30.6974	765.66	0	0
12	223.232	31.0404	821.512	0	0
13	225.336	31.3946	871.811	0	0
14	227.44	31.7601	916.251	0	0
15	229.543	32.137	954.572	0	0
16	231.647	32.5253	986.556	0	0
17	233.751	32.925	1012.03	0	0
18	235.855	33.3362	1030.88	0	0
19	237.958	33.7588	1043	0	0
20	240.062	34.193	1048.37	0	0
21	242.166	34.6388	1047.01	0	0
22	244.27	35.0961	1038.95	0	0
23	246.373	35.5651	1024.31	0	0
24	248.477	36.0458	1003.24	0	0
25	250.581	36.5382	975.935	0	0
26	252.685	37.0424	942.637	0	0
27	254.789	37.5584	903.644	0	0
28	256.892	38.0862	859.297	0	0
29	258.996	38.626	809.989	0	0
30	261.1	39.1777	756.164	0	0
31	263.204	39.7414	698.313	0	0
32	265.307	40.3172	636.983	0	0
33	267.411	40.9051	572.769	0	0
34	269.515	41.5052	506.32	0	0
35	271.619	42.1175	438.34	0	0
36	273.722	42.7421	369.586	0	0
37	275.826	43.379	300.868	0	0
38	277.93	44.0283	233.054	0	0
39	280.034	44.6901	167.068	0	0
40	282.138	45.3644	103.892	0	0
41	284.241	46.0513	44.5641	0	0
42	286.345	46.7509	-9.81537	0	0
43	288.449	47.4631	-58.0874	0	0
44	290.553	48.1882	-99.0315	0	0
45	292.656	48.9262	-131.364	0	0
46	294.76	49.6771	-153.739	0	0
47	296.864	50.441	-164.745	0	0
48	298.968	51.218	-162.904	0	0
49	301.071	52.0082	-146.671	0	0
50	303.175	52.8117	-113.743	0	0
51	305.279	53.6285	0	0	0

Simplified Janbu Method - Effective Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.09619

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	97.7513	2.33455	0	0	0
2	103.434	0.353304	909.24	0	0
3	109.977	1.63821	1060.76	0	0
4	113.248	2.46138	1057.3	0	0
5	116.52	3.28455	1054.11	0	0
6	123.609	4.92752	1100.59	0	0
7	127.153	5.73362	1126.46	0	0
8	130.698	6.53972	1149.38	0	0
9	135.471	7.72452	1133.87	0	0
10	140.245	8.90932	1117.93	0	0
11	144.806	10.0478	1099.62	0	0
12	149.367	11.1864	1081.29	0	0
13	154.16	12.385	1061.02	0	0
14	158.952	13.5837	1040.88	0	0
15	164.345	14.9293	1019.71	0	0
16	169.533	16.225	998.829	0	0
17	170.764	16.5325	993.879	0	0
18	171.494	16.7152	990.832	0	0
19	177.195	18.1407	967.157	0	0
20	183.625	19.7469	941.503	0	0
21	186.84	20.5506	928.445	0	0
22	190.056	21.3543	915.43	0	0
23	193.271	22.1571	902.81	0	0
24	196.486	22.96	890.197	0	0
25	202.194	24.3874	866.951	0	0
26	207.902	25.8147	843.887	0	0
27	214.543	27.4745	817.662	0	0
28	217.863	28.3044	804.611	0	0
29	221.184	29.1343	791.601	0	0
30	224.504	29.9632	779.052	0	0
31	227.824	30.7921	766.501	0	0
32	233.952	32.3216	743.332	0	0
33	234.465	32.4498	741.39	0	0
34	234.813	32.5368	739.984	0	0
35	240.482	33.9554	717.173	0	0
36	246.477	35.4555	693.334	0	0
37	254.171	37.3783	664.062	0	0
38	259.574	38.732	642.325	0	0
39	264.233	39.8945	625.721	0	0
40	269.409	41.1843	608.02	0	0
41	272.772	42.0246	595.388	0	0
42	276.135	42.865	582.794	0	0
43	279.497	43.7046	570.545	0	0
44	282.86	44.5442	558.3	0	0
45	286.544	45.4647	544.63	0	0
46	290.229	46.3853	530.997	0	0
47	293.875	47.2956	517.836	0	0
48	297.521	48.206	504.678	0	0
49	297.597	48.225	504.403	0	0
50	300.731	50.8915	-1.36486	0	0
51	303.864	53.558	0	0	0

Query 1 (janbu simplified) - Safety Factor: 2.09619

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	97.7513	2.33455	0	0	0
2	103.434	0.353304	909.24	0	0
3	109.977	1.63821	1060.76	0	0
4	113.248	2.46138	1057.3	0	0
5	116.52	3.28455	1054.11	0	0
6	123.609	4.92752	1100.59	0	0
7	127.153	5.73362	1126.46	0	0
8	130.698	6.53972	1149.38	0	0
9	135.471	7.72452	1133.87	0	0
10	140.245	8.90932	1117.93	0	0
11	144.806	10.0478	1099.62	0	0
12	149.367	11.1864	1081.29	0	0
13	154.16	12.385	1061.02	0	0
14	158.952	13.5837	1040.88	0	0
15	164.345	14.9293	1019.71	0	0
16	169.533	16.225	998.829	0	0
17	170.764	16.5325	993.879	0	0
18	171.494	16.7152	990.832	0	0
19	177.195	18.1407	967.157	0	0
20	183.625	19.7469	941.503	0	0
21	186.84	20.5506	928.445	0	0
22	190.056	21.3543	915.43	0	0
23	193.271	22.1571	902.81	0	0
24	196.486	22.96	890.197	0	0
25	202.194	24.3874	866.951	0	0
26	207.902	25.8147	843.887	0	0
27	214.543	27.4745	817.662	0	0
28	217.863	28.3044	804.611	0	0
29	221.184	29.1343	791.601	0	0
30	224.504	29.9632	779.052	0	0
31	227.824	30.7921	766.501	0	0
32	233.952	32.3216	743.332	0	0
33	234.465	32.4498	741.39	0	0
34	234.813	32.5368	739.984	0	0
35	240.482	33.9554	717.173	0	0
36	246.477	35.4555	693.334	0	0
37	254.171	37.3783	664.062	0	0
38	259.574	38.732	642.325	0	0
39	264.233	39.8945	625.721	0	0
40	269.409	41.1843	608.02	0	0
41	272.772	42.0246	595.388	0	0
42	276.135	42.865	582.794	0	0
43	279.497	43.7046	570.545	0	0
44	282.86	44.5442	558.3	0	0
45	286.544	45.4647	544.63	0	0
46	290.229	46.3853	530.997	0	0
47	293.875	47.2956	517.836	0	0
48	297.521	48.206	504.678	0	0
49	297.597	48.225	504.403	0	0
50	300.731	50.8915	-1.36486	0	0
51	303.864	53.558	0	0	0

Discharge Sections

Entity Information

Simplified Bishop Method - Effective Stress

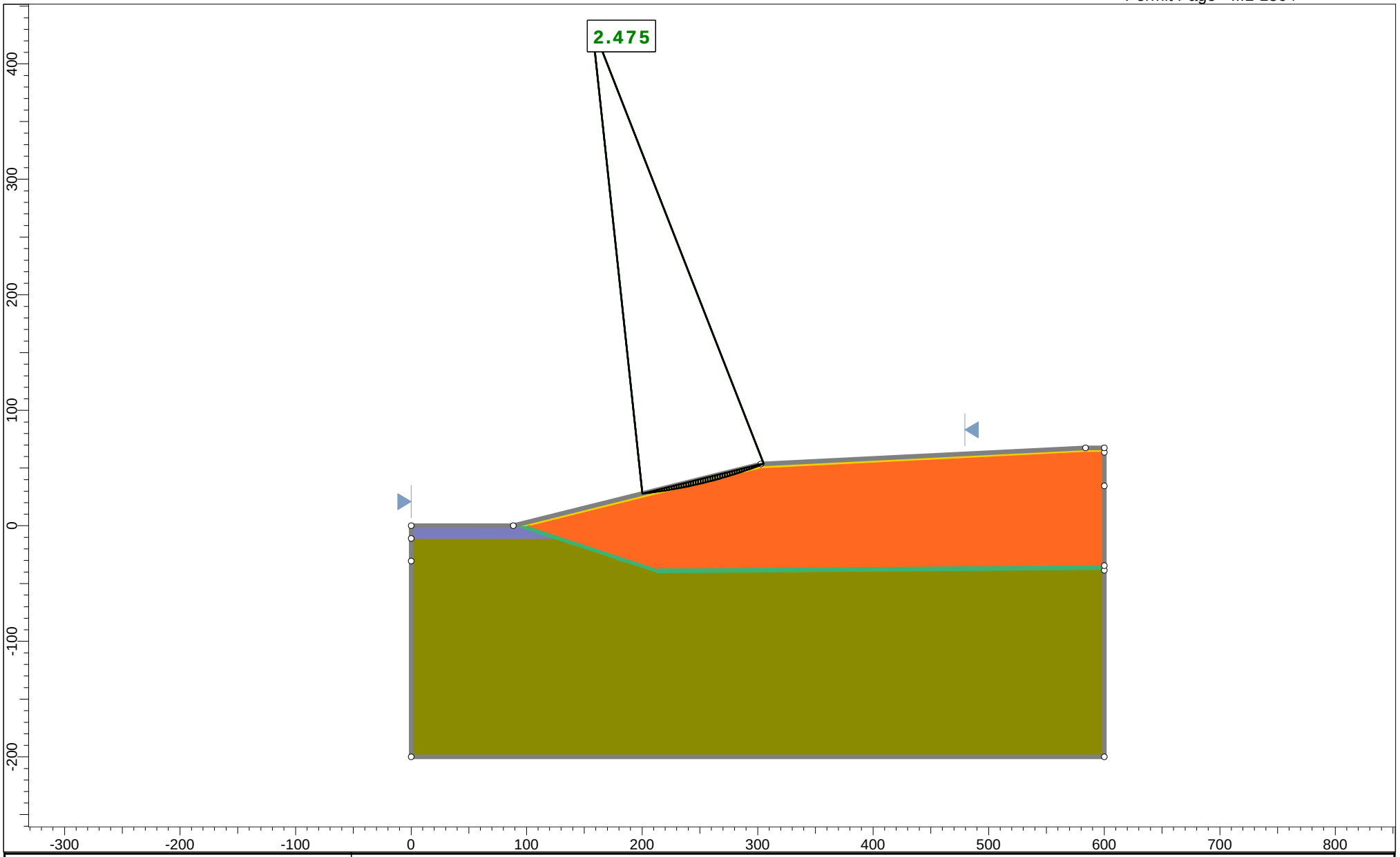
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -30.6081 0, -200 600, -200 600, -38.5 600, -34.5 600, 34.5 600, 63.5 600, 67.5 583.7, 67.5 302.7, 53.5 88.4, 0
Material Boundary	101, 0 134.147, -11 213.7, -37.4 600, -34.5
Material Boundary	88.4, 0 121.692, -11 181.037, -30.6081 213.7, -41.4 600, -38.5
Material Boundary	88.4, 0 101, 0 104.6, 0 302.7, 49.5 582.7, 63.5 600, 63.5
Material Boundary	0, -11 121.692, -11

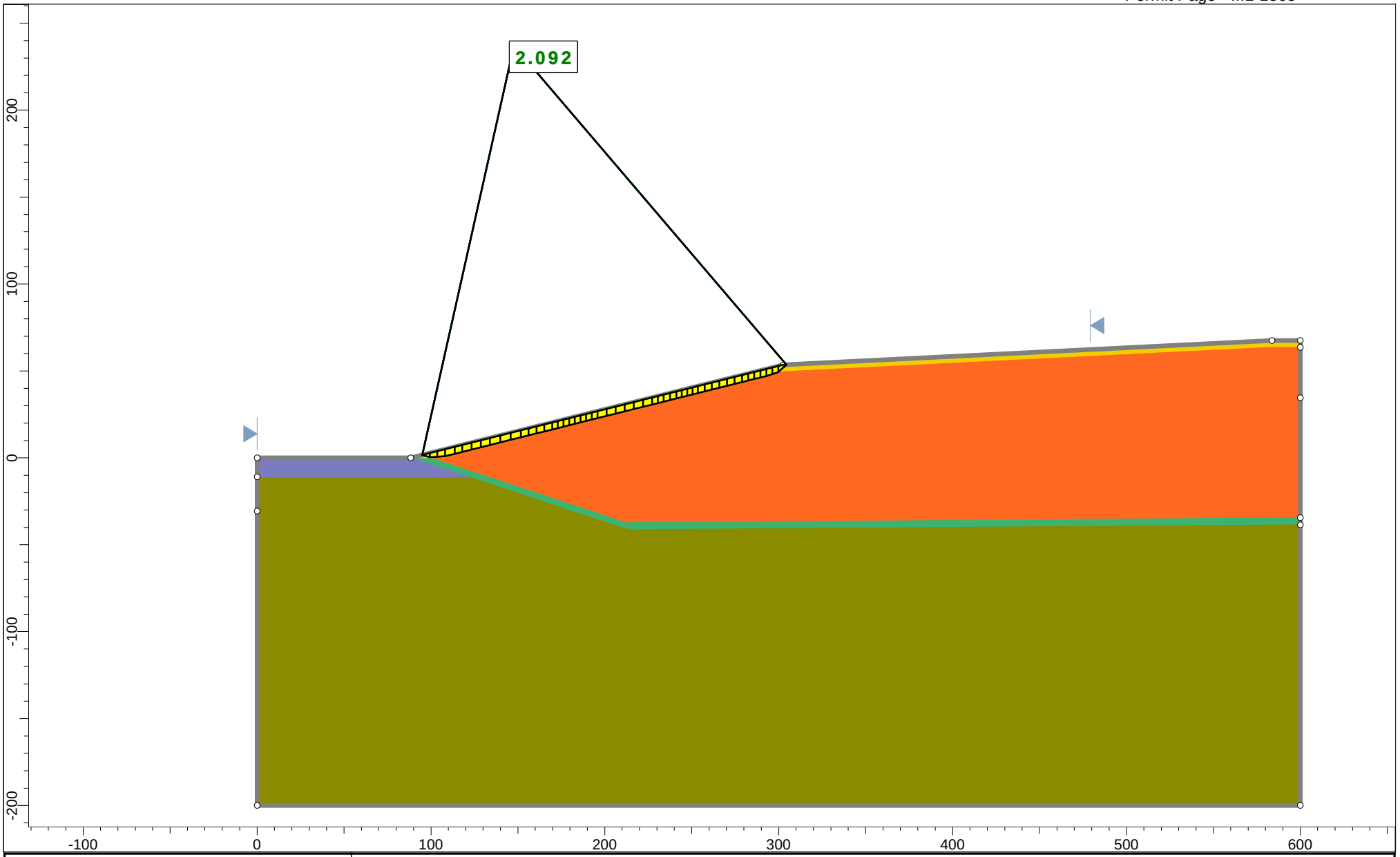
Simplified Janbu Method - Effective Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -30.6081 0, -200 600, -200 600, -38.5 600, -34.5 600, 34.5 600, 63.5 600, 67.5 583.7, 67.5 302.7, 53.5 88.4, 0
Material Boundary	101, 0 134.147, -11 213.7, -37.4 600, -34.5
Material Boundary	88.4, 0 121.692, -11 181.037, -30.6081 213.7, -41.4 600, -38.5
Material Boundary	88.4, 0 101, 0 104.6, 0 302.7, 49.5 582.7, 63.5 600, 63.5
Material Boundary	0, -11 121.692, -11



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-FC Section C_Total Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method -Total Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-FC Section C_Total Stress.slmd

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	116
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	47
Cohesion [psf]	288
Friction Angle [deg]	23
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109.7
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Total Stress	Simplified Janbu Method - Total Stress
Final Cover	✓	✓
Liner	✓	✓
Waste	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Bishop Method - Total Stress

Method: bishop simplified

FS	2.474790
Center:	156.527, 433.638
Radius:	408.086
Left Slip Surface Endpoint:	200.091, 27.884
Right Slip Surface Endpoint:	305.279, 53.628
Resisting Moment:	8.35479e+06 lb-ft
Driving Moment:	3.37595e+06 lb-ft
Total Slice Area:	287.057 ft2
Surface Horizontal Width:	105.188 ft
Surface Average Height:	2.72898 ft

Simplified Janbu Method -Total Stress

Method: janbu simplified

FS	2.091650
Axis Location:	147.713, 236.938
Left Slip Surface Endpoint:	94.986, 1.644
Right Slip Surface Endpoint:	304.312, 53.580
Resisting Horizontal Force:	47166.8 lb
Driving Horizontal Force:	22551.4 lb
Total Slice Area:	808.795 ft2
Surface Horizontal Width:	209.326 ft
Surface Average Height:	3.8638 ft

Global Minimum Coordinates

Simplified Janbu Method -Total Stress

Method: janbu simplified

X	Y
94.9862	1.64424
99.2463	0.28007
103.649	0.620349
108.051	0.960628
113.656	2.2954
117.928	3.35967
128.703	6.04447
133.887	7.33681
139.866	8.82912
145.845	10.3214
151.654	11.772
160.657	14.0202
169.661	16.2684
176.178	17.8958
182.695	19.5231
189.212	21.1505
195.729	22.7778
206.135	25.3763
216.659	28.0041
227.191	30.6341
233.8	32.2844
241.154	34.1218
247.318	35.662
253.442	37.1923
261.433	39.1893
270.185	41.3763
278.951	43.5669
285.922	45.3092
292.884	47.0489
299.726	49.312
304.312	53.5803

Valid and Invalid Surfaces

Simplified Bishop Method - Total Stress

Method: bishop simplified

Number of Valid Surfaces:	11996
Number of Invalid Surfaces:	0

Simplified Janbu Method -Total Stress

Method: janbu simplified

Number of Valid Surfaces:	23721
Number of Invalid Surfaces:	1349

Error Codes
Error Code -106 reported for 9 surfaces
Error Code -108 reported for 46 surfaces
Error Code -111 reported for 492 surfaces
Error Code -112 reported for 356 surfaces
Error Code -121 reported for 97 surfaces
Error Code -124 reported for 1 surface
Error Code -145 reported for 71 surfaces
Error Code -1000 reported for 277 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = Safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-124 = A slice has a width less than the minimum acceptable value.

-145 = Slip surface was clipped vertically by a weak layer in a region of compression. Such a surface cannot be evaluated using Limit Equilibrium. For more information, see Help Documentation on weak layers.

-1000 = No valid slip surface is generated

Slice Data

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 2.47479

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.10377	37.0869	6.27669	Final Cover	100	16	41.9167	103.735	13.0259	0	13.0259	17.6363	17.6363
2	2.10377	109.866	6.57393	Final Cover	100	16	45.8472	113.462	46.9483	0	46.9483	52.2319	52.2319
3	2.10377	179.852	6.87134	Final Cover	100	16	49.6212	122.802	79.5206	0	79.5206	85.5002	85.5002
4	2.10377	247.04	7.16895	Final Cover	100	16	53.2388	131.755	110.742	0	110.742	117.438	117.438
5	2.10377	311.425	7.46675	Final Cover	100	16	56.6998	140.32	140.613	0	140.613	148.044	148.044
6	2.10377	373.001	7.76475	Final Cover	100	16	60.0043	148.498	169.133	0	169.133	177.315	177.315
7	2.10377	431.763	8.06296	Final Cover	100	16	63.1522	156.288	196.301	0	196.301	205.247	205.247
8	2.10377	487.703	8.36139	Final Cover	100	16	66.1435	163.691	222.118	0	222.118	231.84	231.84
9	2.10377	540.817	8.66005	Final Cover	100	16	68.9781	170.706	246.582	0	246.582	257.088	257.088
10	2.10377	591.096	8.95895	Final Cover	100	16	71.6558	177.333	269.692	0	269.692	280.989	280.989
11	2.10377	638.535	9.2581	Final Cover	100	16	74.1766	183.572	291.449	0	291.449	303.54	303.54
12	2.10377	683.127	9.5575	Final Cover	100	16	76.5404	189.421	311.849	0	311.849	324.737	324.737
13	2.10377	724.863	9.85716	Final Cover	100	16	78.747	194.882	330.894	0	330.894	344.577	344.577
14	2.10377	763.736	10.1571	Final Cover	100	16	80.7964	199.954	348.581	0	348.581	363.056	363.056
15	2.10377	799.738	10.4573	Final Cover	100	16	82.6882	204.636	364.909	0	364.909	380.17	380.17
16	2.10377	832.861	10.7578	Final Cover	100	16	84.4225	208.928	379.876	0	379.876	395.917	395.917
17	2.10377	863.097	11.0586	Final Cover	100	16	85.9988	212.829	393.482	0	393.482	410.29	410.29
18	2.10377	890.436	11.3597	Final Cover	100	16	87.4171	216.339	405.724	0	405.724	423.287	423.287
19	2.10377	914.87	11.6612	Final Cover	100	16	88.6774	219.458	416.601	0	416.601	434.902	434.902
20	2.10377	936.389	11.9629	Final Cover	100	16	89.7793	222.185	426.11	0	426.11	445.132	445.132
21	2.10377	954.983	12.265	Final Cover	100	16	90.7224	224.519	434.249	0	434.249	453.972	453.972
22	2.10377	970.644	12.5675	Final Cover	100	16	91.5068	226.46	441.017	0	441.017	461.417	461.417
23	2.10377	983.359	12.8703	Final Cover	100	16	92.1315	228.006	446.412	0	446.412	467.462	467.462
24	2.10377	993.12	13.1735	Final Cover	100	16	92.5974	229.159	450.43	0	450.43	472.103	472.103
25	2.10377	999.914	13.477	Final Cover	100	16	92.9028	229.915	453.069	0	453.069	475.333	475.333
26	2.10377	1003.73	13.7809	Final Cover	100	16	93.0487	230.276	454.326	0	454.326	477.149	477.149
27	2.10377	1004.56	14.0853	Final Cover	100	16	93.0342	230.24	454.2	0	454.2	477.543	477.543
28	2.10377	1002.39	14.39	Final Cover	100	16	92.8588	229.806	452.687	0	452.687	476.512	476.512
29	2.10377	997.203	14.6951	Final Cover	100	16	92.5222	228.973	449.783	0	449.783	474.048	474.048

30	2.10377	988.993	15.0007	Final Cover	100	16	92.0244	227.741	445.487	0	445.487	470.146	470.146
31	2.10377	977.745	15.3067	Final Cover	100	16	91.3649	226.109	439.794	0	439.794	464.8	464.8
32	2.10377	963.445	15.6132	Final Cover	100	16	90.543	224.075	432.701	0	432.701	458.003	458.003
33	2.10377	946.081	15.9201	Final Cover	100	16	89.5587	221.639	424.204	0	424.204	449.75	449.75
34	2.10377	925.638	16.2275	Final Cover	100	16	88.4111	218.799	414.301	0	414.301	440.032	440.032
35	2.10377	902.101	16.5354	Final Cover	100	16	87.0999	215.554	402.986	0	402.986	428.845	428.845
36	2.10377	875.457	16.8437	Final Cover	100	16	85.625	211.904	390.257	0	390.257	416.18	416.18
37	2.10377	845.69	17.1526	Final Cover	100	16	83.9857	207.847	376.109	0	376.109	402.03	402.03
38	2.10377	812.784	17.462	Final Cover	100	16	82.1815	203.382	360.537	0	360.537	386.389	386.389
39	2.10377	776.724	17.7719	Final Cover	100	16	80.2121	198.508	343.539	0	343.539	369.248	369.248
40	2.10377	737.494	18.0823	Final Cover	100	16	78.0766	193.223	325.107	0	325.107	350.6	350.6
41	2.10377	695.076	18.3933	Final Cover	100	16	75.7746	187.526	305.24	0	305.24	330.437	330.437
42	2.10377	649.454	18.7049	Final Cover	100	16	73.3055	181.416	283.931	0	283.931	308.75	308.75
43	2.10377	600.609	19.017	Final Cover	100	16	70.6689	174.891	261.175	0	261.175	285.532	285.532
44	2.10377	548.525	19.3297	Final Cover	100	16	67.8641	167.95	236.968	0	236.968	260.774	260.774
45	2.10377	493.182	19.6431	Final Cover	100	16	64.8906	160.59	211.304	0	211.304	234.466	234.466
46	2.10377	434.562	19.957	Final Cover	100	16	61.7475	152.812	184.178	0	184.178	206.6	206.6
47	2.10377	372.644	20.2716	Final Cover	100	16	58.4345	144.613	155.584	0	155.584	177.167	177.167
48	2.10377	307.409	20.5868	Final Cover	100	16	54.9506	135.991	125.517	0	125.517	146.157	146.157
49	2.10377	236.13	20.9026	Final Cover	100	16	51.1526	126.592	92.7374	0	92.7374	112.273	112.273
50	2.10377	89.8717	21.2191	Final Cover	100	16	43.4076	107.425	25.8934	0	25.8934	42.7468	42.7468

Query 1 (bishop simplified) - Safety Factor: 2.47479

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.10377	37.0869	6.27669	Final Cover	100	16	41.9167	103.735	13.0259	0	13.0259	17.6363	17.6363
2	2.10377	109.866	6.57393	Final Cover	100	16	45.8472	113.462	46.9483	0	46.9483	52.2319	52.2319
3	2.10377	179.852	6.87134	Final Cover	100	16	49.6212	122.802	79.5206	0	79.5206	85.5002	85.5002
4	2.10377	247.04	7.16895	Final Cover	100	16	53.2388	131.755	110.742	0	110.742	117.438	117.438
5	2.10377	311.425	7.46675	Final Cover	100	16	56.6998	140.32	140.613	0	140.613	148.044	148.044
6	2.10377	373.001	7.76475	Final Cover	100	16	60.0043	148.498	169.133	0	169.133	177.315	177.315
7	2.10377	431.763	8.06296	Final Cover	100	16	63.1522	156.288	196.301	0	196.301	205.247	205.247
8	2.10377	487.703	8.36139	Final Cover	100	16	66.1435	163.691	222.118	0	222.118	231.84	231.84
9	2.10377	540.817	8.66005	Final Cover	100	16	68.9781	170.706	246.582	0	246.582	257.088	257.088
10	2.10377	591.096	8.95895	Final Cover	100	16	71.6558	177.333	269.692	0	269.692	280.989	280.989
11	2.10377	638.535	9.2581	Final Cover	100	16	74.1766	183.572	291.449	0	291.449	303.54	303.54
12	2.10377	683.127	9.5575	Final Cover	100	16	76.5404	189.421	311.849	0	311.849	324.737	324.737
13	2.10377	724.863	9.85716	Final Cover	100	16	78.747	194.882	330.894	0	330.894	344.577	344.577
14	2.10377	763.736	10.1571	Final Cover	100	16	80.7964	199.954	348.581	0	348.581	363.056	363.056
15	2.10377	799.738	10.4573	Final Cover	100	16	82.6882	204.636	364.909	0	364.909	380.17	380.17
16	2.10377	832.861	10.7578	Final Cover	100	16	84.4225	208.928	379.876	0	379.876	395.917	395.917
17	2.10377	863.097	11.0586	Final Cover	100	16	85.9988	212.829	393.482	0	393.482	410.29	410.29
18	2.10377	890.436	11.3597	Final Cover	100	16	87.4171	216.339	405.724	0	405.724	423.287	423.287
19	2.10377	914.87	11.6612	Final Cover	100	16	88.6774	219.458	416.601	0	416.601	434.902	434.902
20	2.10377	936.389	11.9629	Final Cover	100	16	89.7793	222.185	426.11	0	426.11	445.132	445.132
21	2.10377	954.983	12.265	Final Cover	100	16	90.7224	224.519	434.249	0	434.249	453.972	453.972
22	2.10377	970.644	12.5675	Final Cover	100	16	91.5068	226.46	441.017	0	441.017	461.417	461.417
23	2.10377	983.359	12.8703	Final Cover	100	16	92.1315	228.006	446.412	0	446.412	467.462	467.462
24	2.10377	993.12	13.1735	Final Cover	100	16	92.5974	229.159	450.43	0	450.43	472.103	472.103
25	2.10377	999.914	13.477	Final Cover	100	16	92.9028	229.915	453.069	0	453.069	475.333	475.333
26	2.10377	1003.73	13.7809	Final Cover	100	16	93.0487	230.276	454.326	0	454.326	477.149	477.149
27	2.10377	1004.56	14.0853	Final Cover	100	16	93.0342	230.24	454.2	0	454.2	477.543	477.543
28	2.10377	1002.39	14.39	Final Cover	100	16	92.8588	229.806	452.687	0	452.687	476.512	476.512
29	2.10377	997.203	14.6951	Final Cover	100	16	92.5222	228.973	449.783	0	449.783	474.048	474.048
30	2.10377	988.993	15.0007	Final Cover	100	16	92.0244	227.741	445.487	0	445.487	470.146	470.146
31	2.10377	977.745	15.3067	Final Cover	100	16	91.3649	226.109	439.794	0	439.794	464.8	464.8
32	2.10377	963.445	15.6132	Final Cover	100	16	90.543	224.075	432.701	0	432.701	458.003	458.003
33	2.10377	946.081	15.9201	Final Cover	100	16	89.5587	221.639	424.204	0	424.204	449.75	449.75

34	2.10377	925.638	16.2275	Final Cover	100	16	88.4111	218.799	414.301	0	414.301	440.032	440.032
35	2.10377	902.101	16.5354	Final Cover	100	16	87.0999	215.554	402.986	0	402.986	428.845	428.845
36	2.10377	875.457	16.8437	Final Cover	100	16	85.625	211.904	390.257	0	390.257	416.18	416.18
37	2.10377	845.69	17.1526	Final Cover	100	16	83.9857	207.847	376.109	0	376.109	402.03	402.03
38	2.10377	812.784	17.462	Final Cover	100	16	82.1815	203.382	360.537	0	360.537	386.389	386.389
39	2.10377	776.724	17.7719	Final Cover	100	16	80.2121	198.508	343.539	0	343.539	369.248	369.248
40	2.10377	737.494	18.0823	Final Cover	100	16	78.0766	193.223	325.107	0	325.107	350.6	350.6
41	2.10377	695.076	18.3933	Final Cover	100	16	75.7746	187.526	305.24	0	305.24	330.437	330.437
42	2.10377	649.454	18.7049	Final Cover	100	16	73.3055	181.416	283.931	0	283.931	308.75	308.75
43	2.10377	600.609	19.017	Final Cover	100	16	70.6689	174.891	261.175	0	261.175	285.532	285.532
44	2.10377	548.525	19.3297	Final Cover	100	16	67.8641	167.95	236.968	0	236.968	260.774	260.774
45	2.10377	493.182	19.6431	Final Cover	100	16	64.8906	160.59	211.304	0	211.304	234.466	234.466
46	2.10377	434.562	19.957	Final Cover	100	16	61.7475	152.812	184.178	0	184.178	206.6	206.6
47	2.10377	372.644	20.2716	Final Cover	100	16	58.4345	144.613	155.584	0	155.584	177.167	177.167
48	2.10377	307.409	20.5868	Final Cover	100	16	54.9506	135.991	125.517	0	125.517	146.157	146.157
49	2.10377	236.13	20.9026	Final Cover	100	16	51.1526	126.592	92.7374	0	92.7374	112.273	112.273
50	2.10377	89.8717	21.2191	Final Cover	100	16	43.4076	107.425	25.8934	0	25.8934	42.7468	42.7468

Simplified Janbu Method -Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.09165

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.2601	620.536	-17.7561	Final Cover	100	16	70.8849	148.266	168.325	0	168.325	145.626	145.626
2	4.40251	1483	4.41972	Final Cover	100	16	93.0046	194.533	329.676	0	329.676	336.865	336.865
3	4.40251	1883.88	4.41972	Final Cover	100	16	105.357	220.37	419.778	0	419.778	427.922	427.922
4	5.60493	2675.28	13.3951	Final Cover	100	16	109.669	229.389	451.232	0	451.232	477.349	477.349
5	4.27206	2056.2	13.989	Final Cover	100	16	110.04	230.166	453.942	0	453.942	481.356	481.356
6	5.38724	2594.49	13.9921	Final Cover	100	16	110.078	230.244	454.214	0	454.214	481.643	481.643
7	5.38724	2596.12	13.9921	Final Cover	100	16	110.118	230.328	454.507	0	454.507	481.947	481.947
8	5.18467	2499.91	13.9965	Final Cover	100	16	110.153	230.401	454.761	0	454.761	482.218	482.218
9	5.97866	2883.57	14.015	Final Cover	100	16	110.166	230.428	454.857	0	454.857	482.355	482.355
10	5.97866	2883.76	14.015	Final Cover	100	16	110.17	230.437	454.888	0	454.888	482.387	482.387
11	5.80911	2801.96	14.0204	Final Cover	100	16	110.168	230.433	454.874	0	454.874	482.384	482.384
12	4.50173	2171.21	14.0204	Final Cover	100	16	110.163	230.423	454.841	0	454.841	482.349	482.349
13	4.50173	2171.07	14.0204	Final Cover	100	16	110.159	230.415	454.81	0	454.81	482.318	482.318
14	4.50173	2170.93	14.0204	Final Cover	100	16	110.156	230.407	454.782	0	454.782	482.289	482.289
15	4.50173	2170.8	14.0204	Final Cover	100	16	110.151	230.398	454.752	0	454.752	482.258	482.258
16	3.25854	1571.23	14.0204	Final Cover	100	16	110.148	230.391	454.726	0	454.726	482.231	482.231
17	3.25854	1571.16	14.0204	Final Cover	100	16	110.145	230.385	454.706	0	454.706	482.209	482.209
18	3.25854	1571.09	14.0204	Final Cover	100	16	110.142	230.379	454.685	0	454.685	482.188	482.188
19	3.25854	1571.01	14.0204	Final Cover	100	16	110.139	230.373	454.664	0	454.664	482.166	482.166
20	3.25853	1570.94	14.0204	Final Cover	100	16	110.136	230.367	454.644	0	454.644	482.146	482.146
21	3.25853	1570.87	14.0204	Final Cover	100	16	110.134	230.361	454.623	0	454.623	482.124	482.124
22	3.25853	1570.8	14.0204	Final Cover	100	16	110.131	230.355	454.602	0	454.602	482.102	482.102
23	3.25853	1570.73	14.0204	Final Cover	100	16	110.128	230.349	454.578	0	454.578	482.078	482.078
24	5.20312	2507.94	14.0204	Final Cover	100	16	110.124	230.341	454.552	0	454.552	482.051	482.051
25	5.20312	2507.76	14.0204	Final Cover	100	16	110.119	230.331	454.519	0	454.519	482.016	482.016
26	5.26183	2535.87	14.0204	Final Cover	100	16	110.115	230.321	454.485	0	454.485	481.981	481.981
27	5.26183	2535.68	14.0204	Final Cover	100	16	110.11	230.311	454.45	0	454.45	481.945	481.945
28	5.266	2537.51	14.0204	Final Cover	100	16	110.105	230.302	454.416	0	454.416	481.91	481.91
29	5.266	2537.32	14.0204	Final Cover	100	16	110.101	230.292	454.383	0	454.383	481.875	481.875
30	3.3046	1592.16	14.0205	Final Cover	100	16	110.097	230.284	454.354	0	454.354	481.846	481.846
31	3.3046	1592.08	14.0205	Final Cover	100	16	110.093	230.277	454.331	0	454.331	481.822	481.822
32	3.67714	1771.37	14.0277	Final Cover	100	16	110.084	230.258	454.264	0	454.264	481.768	481.768

33	3.67714	1771.06	14.0277	Final Cover	100	16	110.073	230.235	454.183	0	454.183	481.684	481.684
34	3.08175	1484.03	14.0303	Final Cover	100	16	110.061	230.209	454.095	0	454.095	481.598	481.598
35	3.08175	1483.75	14.0303	Final Cover	100	16	110.049	230.185	454.007	0	454.007	481.507	481.507
36	3.06195	1473.95	14.0303	Final Cover	100	16	110.038	230.16	453.921	0	453.921	481.418	481.418
37	3.06195	1473.68	14.0303	Final Cover	100	16	110.026	230.136	453.839	0	453.839	481.333	481.333
38	3.99579	1922.72	14.0303	Final Cover	100	16	110.013	230.108	453.74	0	453.74	481.231	481.231
39	3.99579	1922.26	14.0303	Final Cover	100	16	109.997	230.076	453.628	0	453.628	481.115	481.115
40	4.3757	2104.48	14.0308	Final Cover	100	16	109.981	230.041	453.508	0	453.508	480.992	480.992
41	4.3757	2103.91	14.0308	Final Cover	100	16	109.963	230.005	453.382	0	453.382	480.862	480.862
42	4.38295	2106.83	14.0308	Final Cover	100	16	109.946	229.969	453.256	0	453.256	480.731	480.731
43	4.38295	2106.25	14.0308	Final Cover	100	16	109.929	229.933	453.13	0	453.13	480.601	480.601
44	3.48577	1674.69	14.0314	Final Cover	100	16	109.913	229.899	453.012	0	453.012	480.48	480.48
45	3.48577	1674.31	14.0314	Final Cover	100	16	109.898	229.869	452.906	0	452.906	480.371	480.371
46	3.48078	1671.53	14.0314	Final Cover	100	16	109.884	229.839	452.801	0	452.801	480.262	480.262
47	3.48078	1671.15	14.0314	Final Cover	100	16	109.869	229.808	452.695	0	452.695	480.152	480.152
48	3.42125	1585.44	18.301	Final Cover	100	16	106.516	222.795	428.237	0	428.237	463.466	463.466
49	3.42125	1471.55	18.301	Final Cover	100	16	102.15	213.662	396.388	0	396.388	430.172	430.172
50	4.58589	1005.55	42.9459	Final Cover	100	16	69.0701	144.47	155.087	0	155.087	219.374	219.374

Query 1 (janbu simplified) - Safety Factor: 2.09165

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.2601	620.536	-17.7561	Final Cover	100	16	70.8849	148.266	168.325	0	168.325	145.626	145.626
2	4.40251	1483	4.41972	Final Cover	100	16	93.0046	194.533	329.676	0	329.676	336.865	336.865
3	4.40251	1883.88	4.41972	Final Cover	100	16	105.357	220.37	419.778	0	419.778	427.922	427.922
4	5.60493	2675.28	13.3951	Final Cover	100	16	109.669	229.389	451.232	0	451.232	477.349	477.349
5	4.27206	2056.2	13.989	Final Cover	100	16	110.04	230.166	453.942	0	453.942	481.356	481.356
6	5.38724	2594.49	13.9921	Final Cover	100	16	110.078	230.244	454.214	0	454.214	481.643	481.643
7	5.38724	2596.12	13.9921	Final Cover	100	16	110.118	230.328	454.507	0	454.507	481.947	481.947
8	5.18467	2499.91	13.9965	Final Cover	100	16	110.153	230.401	454.761	0	454.761	482.218	482.218
9	5.97866	2883.57	14.015	Final Cover	100	16	110.166	230.428	454.857	0	454.857	482.355	482.355
10	5.97866	2883.76	14.015	Final Cover	100	16	110.17	230.437	454.888	0	454.888	482.387	482.387
11	5.80911	2801.96	14.0204	Final Cover	100	16	110.168	230.433	454.874	0	454.874	482.384	482.384
12	4.50173	2171.21	14.0204	Final Cover	100	16	110.163	230.423	454.841	0	454.841	482.349	482.349
13	4.50173	2171.07	14.0204	Final Cover	100	16	110.159	230.415	454.81	0	454.81	482.318	482.318
14	4.50173	2170.93	14.0204	Final Cover	100	16	110.156	230.407	454.782	0	454.782	482.289	482.289
15	4.50173	2170.8	14.0204	Final Cover	100	16	110.151	230.398	454.752	0	454.752	482.258	482.258
16	3.25854	1571.23	14.0204	Final Cover	100	16	110.148	230.391	454.726	0	454.726	482.231	482.231
17	3.25854	1571.16	14.0204	Final Cover	100	16	110.145	230.385	454.706	0	454.706	482.209	482.209
18	3.25854	1571.09	14.0204	Final Cover	100	16	110.142	230.379	454.685	0	454.685	482.188	482.188
19	3.25854	1571.01	14.0204	Final Cover	100	16	110.139	230.373	454.664	0	454.664	482.166	482.166
20	3.25853	1570.94	14.0204	Final Cover	100	16	110.136	230.367	454.644	0	454.644	482.146	482.146
21	3.25853	1570.87	14.0204	Final Cover	100	16	110.134	230.361	454.623	0	454.623	482.124	482.124
22	3.25853	1570.8	14.0204	Final Cover	100	16	110.131	230.355	454.602	0	454.602	482.102	482.102
23	3.25853	1570.73	14.0204	Final Cover	100	16	110.128	230.349	454.578	0	454.578	482.078	482.078
24	5.20312	2507.94	14.0204	Final Cover	100	16	110.124	230.341	454.552	0	454.552	482.051	482.051
25	5.20312	2507.76	14.0204	Final Cover	100	16	110.119	230.331	454.519	0	454.519	482.016	482.016
26	5.26183	2535.87	14.0204	Final Cover	100	16	110.115	230.321	454.485	0	454.485	481.981	481.981
27	5.26183	2535.68	14.0204	Final Cover	100	16	110.11	230.311	454.45	0	454.45	481.945	481.945
28	5.266	2537.51	14.0204	Final Cover	100	16	110.105	230.302	454.416	0	454.416	481.91	481.91
29	5.266	2537.32	14.0204	Final Cover	100	16	110.101	230.292	454.383	0	454.383	481.875	481.875
30	3.3046	1592.16	14.0205	Final Cover	100	16	110.097	230.284	454.354	0	454.354	481.846	481.846
31	3.3046	1592.08	14.0205	Final Cover	100	16	110.093	230.277	454.331	0	454.331	481.822	481.822
32	3.67714	1771.37	14.0277	Final Cover	100	16	110.084	230.258	454.264	0	454.264	481.768	481.768
33	3.67714	1771.06	14.0277	Final Cover	100	16	110.073	230.235	454.183	0	454.183	481.684	481.684

34	3.08175	1484.03	14.0303	Final Cover	100	16	110.061	230.209	454.095	0	454.095	481.598	481.598
35	3.08175	1483.75	14.0303	Final Cover	100	16	110.049	230.185	454.007	0	454.007	481.507	481.507
36	3.06195	1473.95	14.0303	Final Cover	100	16	110.038	230.16	453.921	0	453.921	481.418	481.418
37	3.06195	1473.68	14.0303	Final Cover	100	16	110.026	230.136	453.839	0	453.839	481.333	481.333
38	3.99579	1922.72	14.0303	Final Cover	100	16	110.013	230.108	453.74	0	453.74	481.231	481.231
39	3.99579	1922.26	14.0303	Final Cover	100	16	109.997	230.076	453.628	0	453.628	481.115	481.115
40	4.3757	2104.48	14.0308	Final Cover	100	16	109.981	230.041	453.508	0	453.508	480.992	480.992
41	4.3757	2103.91	14.0308	Final Cover	100	16	109.963	230.005	453.382	0	453.382	480.862	480.862
42	4.38295	2106.83	14.0308	Final Cover	100	16	109.946	229.969	453.256	0	453.256	480.731	480.731
43	4.38295	2106.25	14.0308	Final Cover	100	16	109.929	229.933	453.13	0	453.13	480.601	480.601
44	3.48577	1674.69	14.0314	Final Cover	100	16	109.913	229.899	453.012	0	453.012	480.48	480.48
45	3.48577	1674.31	14.0314	Final Cover	100	16	109.898	229.869	452.906	0	452.906	480.371	480.371
46	3.48078	1671.53	14.0314	Final Cover	100	16	109.884	229.839	452.801	0	452.801	480.262	480.262
47	3.48078	1671.15	14.0314	Final Cover	100	16	109.869	229.808	452.695	0	452.695	480.152	480.152
48	3.42125	1585.44	18.301	Final Cover	100	16	106.516	222.795	428.237	0	428.237	463.466	463.466
49	3.42125	1471.55	18.301	Final Cover	100	16	102.15	213.662	396.388	0	396.388	430.172	430.172
50	4.58589	1005.55	42.9459	Final Cover	100	16	69.0701	144.47	155.087	0	155.087	219.374	219.374

Interslice Data

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 2.47479

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	200.091	27.8836	0	0	0
2	202.194	28.115	85.026	0	0
3	204.298	28.3574	169.939	0	0
4	206.402	28.6109	254.002	0	0
5	208.506	28.8755	336.519	0	0
6	210.609	29.1513	416.838	0	0
7	212.713	29.4381	494.351	0	0
8	214.817	29.7361	568.491	0	0
9	216.921	30.0453	638.735	0	0
10	219.025	30.3658	704.603	0	0
11	221.128	30.6974	765.66	0	0
12	223.232	31.0404	821.512	0	0
13	225.336	31.3946	871.811	0	0
14	227.44	31.7601	916.251	0	0
15	229.543	32.137	954.572	0	0
16	231.647	32.5253	986.556	0	0
17	233.751	32.925	1012.03	0	0
18	235.855	33.3362	1030.88	0	0
19	237.958	33.7588	1043	0	0
20	240.062	34.193	1048.37	0	0
21	242.166	34.6388	1047.01	0	0
22	244.27	35.0961	1038.95	0	0
23	246.373	35.5651	1024.31	0	0
24	248.477	36.0458	1003.24	0	0
25	250.581	36.5382	975.935	0	0
26	252.685	37.0424	942.637	0	0
27	254.789	37.5584	903.644	0	0
28	256.892	38.0862	859.297	0	0
29	258.996	38.626	809.989	0	0
30	261.1	39.1777	756.164	0	0
31	263.204	39.7414	698.313	0	0
32	265.307	40.3172	636.983	0	0
33	267.411	40.9051	572.769	0	0
34	269.515	41.5052	506.32	0	0
35	271.619	42.1175	438.34	0	0
36	273.722	42.7421	369.586	0	0
37	275.826	43.379	300.868	0	0
38	277.93	44.0283	233.054	0	0
39	280.034	44.6901	167.068	0	0
40	282.138	45.3644	103.892	0	0
41	284.241	46.0513	44.5641	0	0
42	286.345	46.7509	-9.81537	0	0
43	288.449	47.4631	-58.0874	0	0
44	290.553	48.1882	-99.0315	0	0
45	292.656	48.9262	-131.364	0	0
46	294.76	49.6771	-153.739	0	0
47	296.864	50.441	-164.745	0	0
48	298.968	51.218	-162.904	0	0
49	301.071	52.0082	-146.671	0	0
50	303.175	52.8117	-113.743	0	0
51	305.279	53.6285	0	0	0

Query 1 (bishop simplified) - Safety Factor: 2.47479

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	200.091	27.8836	0	0	0
2	202.194	28.115	85.026	0	0
3	204.298	28.3574	169.939	0	0
4	206.402	28.6109	254.002	0	0
5	208.506	28.8755	336.519	0	0
6	210.609	29.1513	416.838	0	0
7	212.713	29.4381	494.351	0	0
8	214.817	29.7361	568.491	0	0
9	216.921	30.0453	638.735	0	0
10	219.025	30.3658	704.603	0	0
11	221.128	30.6974	765.66	0	0
12	223.232	31.0404	821.512	0	0
13	225.336	31.3946	871.811	0	0
14	227.44	31.7601	916.251	0	0
15	229.543	32.137	954.572	0	0
16	231.647	32.5253	986.556	0	0
17	233.751	32.925	1012.03	0	0
18	235.855	33.3362	1030.88	0	0
19	237.958	33.7588	1043	0	0
20	240.062	34.193	1048.37	0	0
21	242.166	34.6388	1047.01	0	0
22	244.27	35.0961	1038.95	0	0
23	246.373	35.5651	1024.31	0	0
24	248.477	36.0458	1003.24	0	0
25	250.581	36.5382	975.935	0	0
26	252.685	37.0424	942.637	0	0
27	254.789	37.5584	903.644	0	0
28	256.892	38.0862	859.297	0	0
29	258.996	38.626	809.989	0	0
30	261.1	39.1777	756.164	0	0
31	263.204	39.7414	698.313	0	0
32	265.307	40.3172	636.983	0	0
33	267.411	40.9051	572.769	0	0
34	269.515	41.5052	506.32	0	0
35	271.619	42.1175	438.34	0	0
36	273.722	42.7421	369.586	0	0
37	275.826	43.379	300.868	0	0
38	277.93	44.0283	233.054	0	0
39	280.034	44.6901	167.068	0	0
40	282.138	45.3644	103.892	0	0
41	284.241	46.0513	44.5641	0	0
42	286.345	46.7509	-9.81537	0	0
43	288.449	47.4631	-58.0874	0	0
44	290.553	48.1882	-99.0315	0	0
45	292.656	48.9262	-131.364	0	0
46	294.76	49.6771	-153.739	0	0
47	296.864	50.441	-164.745	0	0
48	298.968	51.218	-162.904	0	0
49	301.071	52.0082	-146.671	0	0
50	303.175	52.8117	-113.743	0	0
51	305.279	53.6285	0	0	0

Simplified Janbu Method -Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.09165

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	94.9862	1.64424	0	0	0
2	99.2463	0.28007	531.117	0	0
3	103.649	0.620349	827.734	0	0
4	108.051	0.960628	1147.98	0	0
5	113.656	2.2954	1159.39	0	0
6	117.928	3.35967	1145.62	0	0
7	123.316	4.70207	1127.95	0	0
8	128.703	6.04447	1110.1	0	0
9	133.887	7.33681	1092.59	0	0
10	139.866	8.82912	1071.39	0	0
11	145.845	10.3214	1050.18	0	0
12	151.654	11.772	1029.31	0	0
13	156.156	12.8961	1013.15	0	0
14	160.657	14.0202	997.006	0	0
15	165.159	15.1443	980.878	0	0
16	169.661	16.2684	964.765	0	0
17	172.919	17.0821	953.111	0	0
18	176.178	17.8958	941.465	0	0
19	179.436	18.7095	929.827	0	0
20	182.695	19.5231	918.197	0	0
21	185.953	20.3368	906.574	0	0
22	189.212	21.1505	894.959	0	0
23	192.471	21.9642	883.352	0	0
24	195.729	22.7778	871.752	0	0
25	200.932	24.0771	853.247	0	0
26	206.135	25.3763	834.762	0	0
27	211.397	26.6902	816.088	0	0
28	216.659	28.0041	797.434	0	0
29	221.925	29.3191	778.786	0	0
30	227.191	30.6341	760.158	0	0
31	230.496	31.4592	748.476	0	0
32	233.8	32.2844	736.802	0	0
33	237.477	33.2031	723.617	0	0
34	241.154	34.1218	710.465	0	0
35	244.236	34.8919	699.407	0	0
36	247.318	35.662	688.378	0	0
37	250.38	36.4272	677.449	0	0
38	253.442	37.1923	666.55	0	0
39	257.438	38.1908	652.372	0	0
40	261.433	39.1893	638.243	0	0
41	265.809	40.2828	622.814	0	0
42	270.185	41.3763	607.447	0	0
43	274.568	42.4716	592.117	0	0
44	278.951	43.5669	576.85	0	0
45	282.436	44.438	564.736	0	0
46	285.922	45.3092	552.663	0	0
47	289.403	46.179	540.648	0	0
48	292.884	47.0489	528.676	0	0
49	296.305	48.1805	407.945	0	0
50	299.726	49.312	308.339	0	0
51	304.312	53.5803	0	0	0

Query 1 (janbu simplified) - Safety Factor: 2.09165

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	94.9862	1.64424	0	0	0
2	99.2463	0.28007	531.117	0	0
3	103.649	0.620349	827.734	0	0
4	108.051	0.960628	1147.98	0	0
5	113.656	2.2954	1159.39	0	0
6	117.928	3.35967	1145.62	0	0
7	123.316	4.70207	1127.95	0	0
8	128.703	6.04447	1110.1	0	0
9	133.887	7.33681	1092.59	0	0
10	139.866	8.82912	1071.39	0	0
11	145.845	10.3214	1050.18	0	0
12	151.654	11.772	1029.31	0	0
13	156.156	12.8961	1013.15	0	0
14	160.657	14.0202	997.006	0	0
15	165.159	15.1443	980.878	0	0
16	169.661	16.2684	964.765	0	0
17	172.919	17.0821	953.111	0	0
18	176.178	17.8958	941.465	0	0
19	179.436	18.7095	929.827	0	0
20	182.695	19.5231	918.197	0	0
21	185.953	20.3368	906.574	0	0
22	189.212	21.1505	894.959	0	0
23	192.471	21.9642	883.352	0	0
24	195.729	22.7778	871.752	0	0
25	200.932	24.0771	853.247	0	0
26	206.135	25.3763	834.762	0	0
27	211.397	26.6902	816.088	0	0
28	216.659	28.0041	797.434	0	0
29	221.925	29.3191	778.786	0	0
30	227.191	30.6341	760.158	0	0
31	230.496	31.4592	748.476	0	0
32	233.8	32.2844	736.802	0	0
33	237.477	33.2031	723.617	0	0
34	241.154	34.1218	710.465	0	0
35	244.236	34.8919	699.407	0	0
36	247.318	35.662	688.378	0	0
37	250.38	36.4272	677.449	0	0
38	253.442	37.1923	666.55	0	0
39	257.438	38.1908	652.372	0	0
40	261.433	39.1893	638.243	0	0
41	265.809	40.2828	622.814	0	0
42	270.185	41.3763	607.447	0	0
43	274.568	42.4716	592.117	0	0
44	278.951	43.5669	576.85	0	0
45	282.436	44.438	564.736	0	0
46	285.922	45.3092	552.663	0	0
47	289.403	46.179	540.648	0	0
48	292.884	47.0489	528.676	0	0
49	296.305	48.1805	407.945	0	0
50	299.726	49.312	308.339	0	0
51	304.312	53.5803	0	0	0

Discharge Sections

Entity Information

Simplified Bishop Method - Total Stress

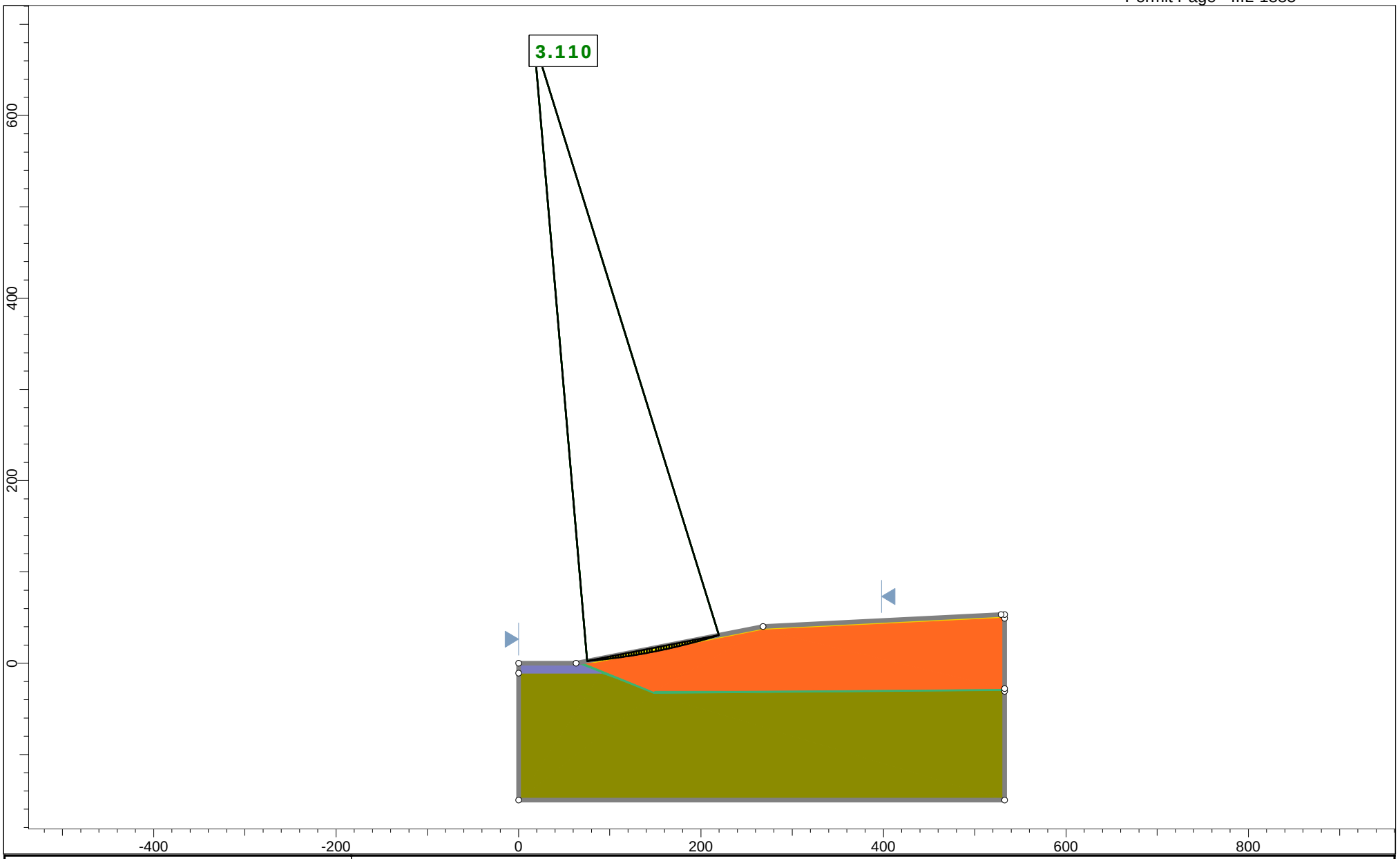
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -30.6081 0, -200 600, -200 600, -38.5 600, -34.5 600, 34.5 600, 63.5 600, 67.5 583.7, 67.5 302.7, 53.5 88.4, 0
Material Boundary	101, 0 134.147, -11 213.7, -37.4 600, -34.5
Material Boundary	88.4, 0 121.692, -11 181.037, -30.6081 213.7, -41.4 600, -38.5
Material Boundary	88.4, 0 101, 0 104.6, 0 302.7, 49.5 582.7, 63.5 600, 63.5
Material Boundary	0, -11 121.692, -11

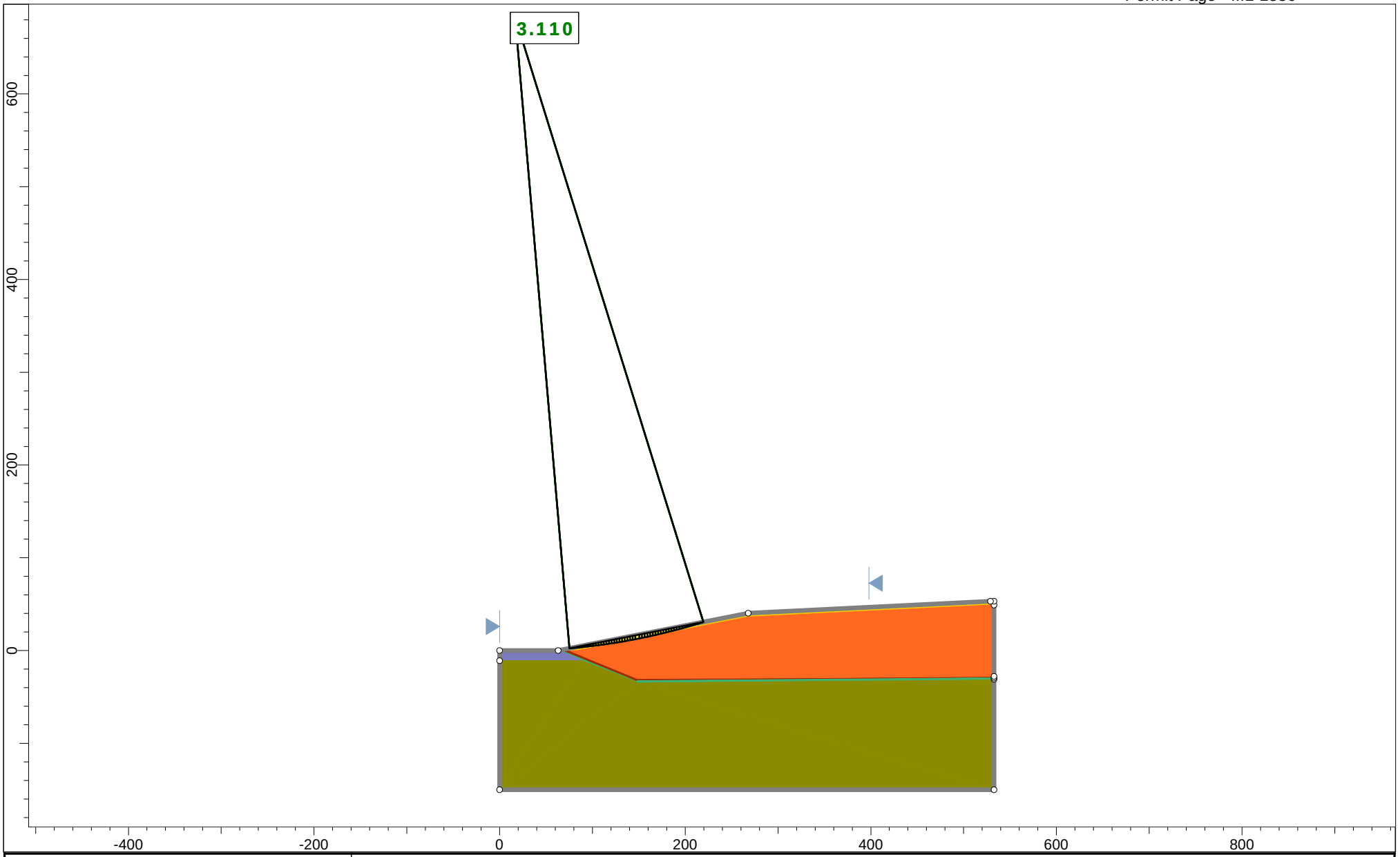
Simplified Janbu Method -Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -30.6081 0, -200 600, -200 600, -38.5 600, -34.5 600, 34.5 600, 63.5 600, 67.5 583.7, 67.5 302.7, 53.5 88.4, 0
Material Boundary	101, 0 134.147, -11 213.7, -37.4 600, -34.5
Material Boundary	88.4, 0 121.692, -11 181.037, -30.6081 213.7, -41.4 600, -38.5
Material Boundary	88.4, 0 101, 0 104.6, 0 302.7, 49.5 582.7, 63.5 600, 63.5
Material Boundary	0, -11 121.692, -11



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-FC Section D_Effective Stress.slmd



rocscience	*Project*	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Effective Stress	*Scenario* Master Scenario
	Drawn By		*Company*
SLIDEINTERPRET 9.018	*Date*		*File Name* Slide2-FC Section D_Effective Stress.slmd

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	47
Cohesion [psf]	288
Friction Angle [deg]	23
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0
Protective Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Effective Stress	Simplified Janbu Method - Effective Stress
Final Cover	✓	✓
Liner	✓	✓
Waste	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓
Protective Cover	✗	✓

Global Minimums

Simplified Bishop Method - Effective Stress

Method: bishop simplified

FS	3.110460
Center:	16.676, 682.842
Radius:	682.974
Left Slip Surface Endpoint:	75.096, 2.372
Right Slip Surface Endpoint:	219.577, 30.704
Resisting Moment:	1.9096e+07 lb-ft
Driving Moment:	6.13928e+06 lb-ft
Total Slice Area:	390.64 ft2
Surface Horizontal Width:	144.482 ft
Surface Average Height:	2.70373 ft

Simplified Janbu Method - Effective Stress

Method: bishop simplified

FS	3.110460
Center:	16.676, 682.842
Radius:	682.974
Left Slip Surface Endpoint:	75.096, 2.372
Right Slip Surface Endpoint:	219.577, 30.704
Resisting Moment:	1.9096e+07 lb-ft
Driving Moment:	6.13928e+06 lb-ft
Total Slice Area:	390.64 ft2
Surface Horizontal Width:	144.482 ft
Surface Average Height:	2.70373 ft

Valid and Invalid Surfaces

Simplified Bishop Method - Effective Stress

Method: bishop simplified

Number of Valid Surfaces:	10946
Number of Invalid Surfaces:	0

Simplified Janbu Method - Effective Stress

Method: bishop simplified

Number of Valid Surfaces:	10946
Number of Invalid Surfaces:	0

Slice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764

30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236
33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604
34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764
30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236
33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604

34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Simplified Janbu Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764
30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236

33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604
34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764
30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236
33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604

34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Interslice Data

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Simplified Janbu Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Discharge Sections

Entity Information

Simplified Bishop Method - Effective Stress

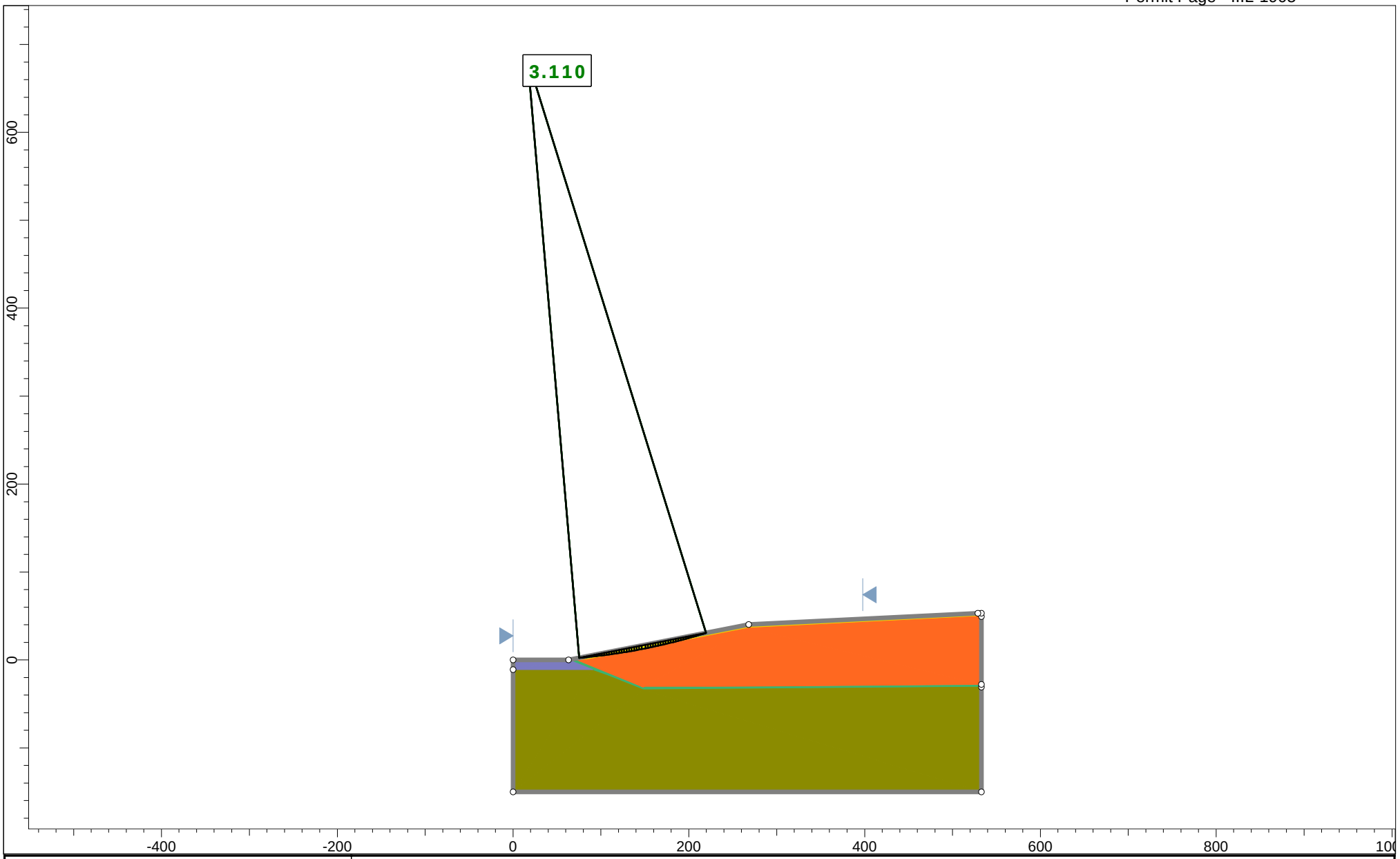
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -150 532.8, -150 532.8, -30.9 532.8, -27.9 532.8, 49.2 532.8, 53.2 528.8, 53.2 268, 40.2 63, 0
Material Boundary	63, 0 72.5, 0 148, -30.9 532.8, -27.9
Material Boundary	63, 0 90.5811, -11 148, -33.9 532.8, -30.9
Material Boundary	72.5, 0 83.8, 0 268, 36.2 528, 49.2 532.8, 49.2
Material Boundary	0, -11 90.5811, -11

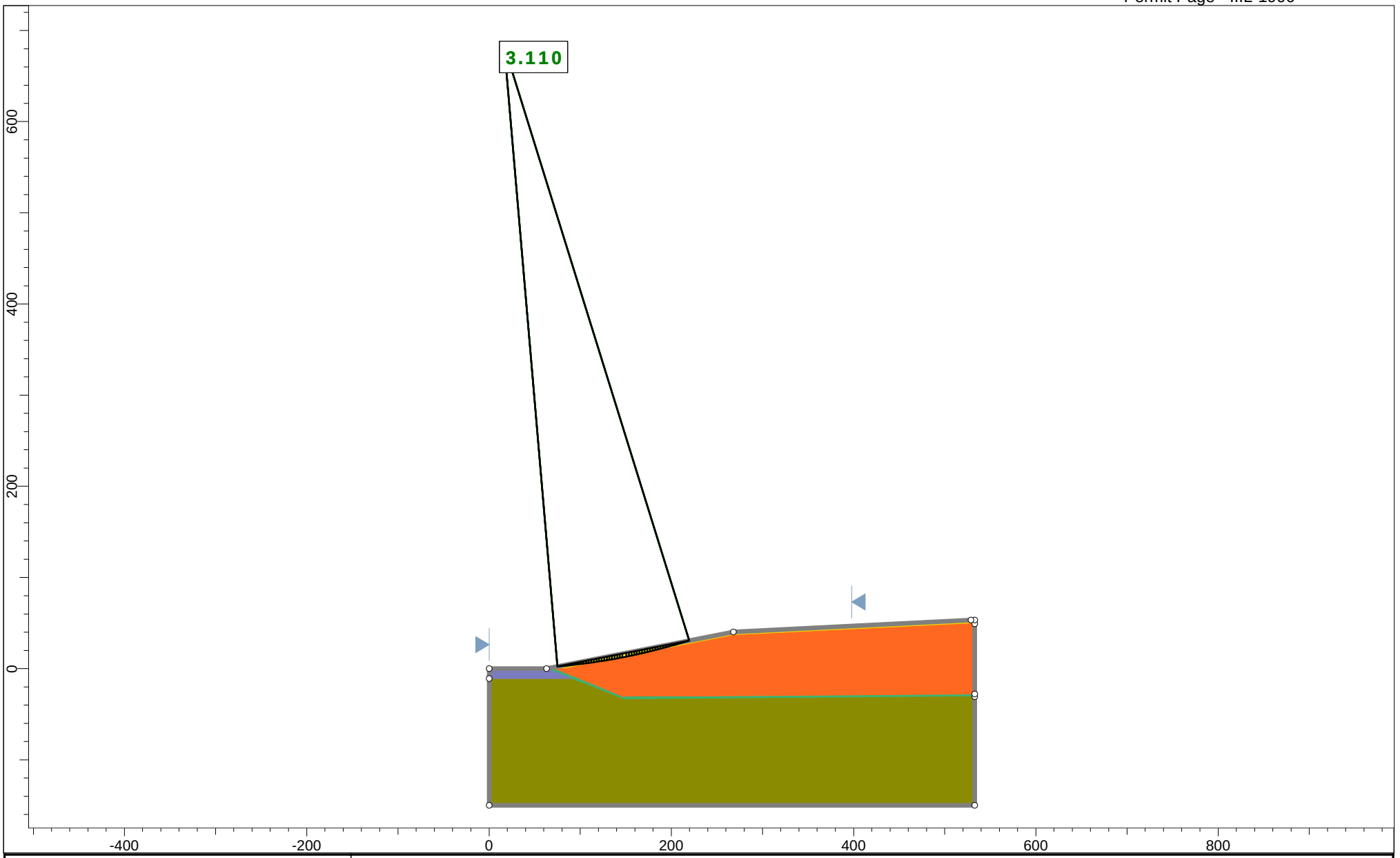
Simplified Janbu Method - Effective Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -150 532.8, -150 532.8, -30.9 532.8, -29.4243 532.8, -27.9 532.8, 49.2 532.8, 53.2 528.8, 53.2 268, 40.2 63, 0
Material Boundary	63, 0 68.213, 0 72.5, 0 148, -30.9 532.8, -27.9
Material Boundary	63, 0 90.5811, -11 148, -33.9 532.8, -30.9
Material Boundary	72.5, 0 83.8, 0 268, 36.2 528, 49.2 532.8, 49.2
Material Boundary	0, -11 90.5811, -11
Material Boundary	68.213, 0 147.921, -32.362 532.8, -29.4243



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-FC Section D_Total Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
	Date		File Name: Slide2-FC Section D_Total Stress.slmd

SLIDEINTERPRET 9.018

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	116
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	47
Cohesion [psf]	288
Friction Angle [deg]	23
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Simplified Bishop Method - Total Stress	Simplified Janbu Method - Total Stress
Final Cover	✓	✓
Liner	✓	✓
Waste	✓	✓
Stratum II	✓	✓
Stratum III	✓	✓

Global Minimums

Simplified Bishop Method - Total Stress

Method: bishop simplified

FS	3.110460
Center:	16.676, 682.842
Radius:	682.974
Left Slip Surface Endpoint:	75.096, 2.372
Right Slip Surface Endpoint:	219.577, 30.704
Resisting Moment:	1.9096e+07 lb-ft
Driving Moment:	6.13928e+06 lb-ft
Total Slice Area:	390.64 ft2
Surface Horizontal Width:	144.482 ft
Surface Average Height:	2.70373 ft

Simplified Janbu Method - Total Stress

Method: bishop simplified

FS	3.110460
Center:	16.676, 682.842
Radius:	682.974
Left Slip Surface Endpoint:	75.096, 2.372
Right Slip Surface Endpoint:	219.577, 30.704
Resisting Moment:	1.9096e+07 lb-ft
Driving Moment:	6.13928e+06 lb-ft
Total Slice Area:	390.64 ft2
Surface Horizontal Width:	144.482 ft
Surface Average Height:	2.70373 ft

Valid and Invalid Surfaces

Simplified Bishop Method - Total Stress

Method: bishop simplified

Number of Valid Surfaces:	10945
Number of Invalid Surfaces:	0

Simplified Janbu Method - Total Stress

Method: bishop simplified

Number of Valid Surfaces:	10945
Number of Invalid Surfaces:	0

Slice Data

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764

30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236
33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604
34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764
30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236
33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604

34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Simplified Janbu Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764
30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236

33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604
34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.84463	52.5032	5.02672	Final Cover	100	16	33.5792	104.447	15.5074	0	15.5074	18.461	18.461
2	2.84463	155.463	5.26632	Final Cover	100	16	36.8748	114.698	51.2569	0	51.2569	54.6558	54.6558
3	2.84463	254.326	5.50602	Final Cover	100	16	40.0364	124.531	85.5517	0	85.5517	89.411	89.411
4	2.84463	349.088	5.74582	Final Cover	100	16	43.0638	133.948	118.391	0	118.391	122.724	122.724
5	2.84463	439.745	5.98572	Final Cover	100	16	45.957	142.947	149.776	0	149.776	154.594	154.594
6	2.84463	526.29	6.22572	Final Cover	100	16	48.7161	151.529	179.705	0	179.705	185.019	185.019
7	2.84463	608.718	6.46583	Final Cover	100	16	51.341	159.694	208.178	0	208.178	213.996	213.996
8	2.84463	687.023	6.70606	Final Cover	100	16	53.8316	167.441	235.195	0	235.195	241.525	241.525
9	2.84463	761.2	6.9464	Final Cover	100	16	56.188	174.77	260.756	0	260.756	267.602	267.602
10	2.84463	831.242	7.18687	Final Cover	100	16	58.41	181.682	284.859	0	284.859	292.225	292.225
11	2.84463	897.143	7.42747	Final Cover	100	16	60.4977	188.176	307.505	0	307.505	315.392	315.392
12	2.84463	958.896	7.6682	Final Cover	100	16	62.451	194.251	328.693	0	328.693	337.101	337.101
13	2.84463	1016.49	7.90906	Final Cover	100	16	64.2697	199.908	348.422	0	348.422	357.35	357.35
14	2.84463	1069.93	8.15006	Final Cover	100	16	65.9539	205.147	366.69	0	366.69	376.135	376.135
15	2.84463	1119.2	8.39121	Final Cover	100	16	67.5032	209.966	383.496	0	383.496	393.454	393.454
16	2.84463	1164.28	8.63251	Final Cover	100	16	68.9181	214.367	398.843	0	398.843	409.305	409.305
17	2.84463	1205.19	8.87397	Final Cover	100	16	70.1977	218.347	412.727	0	412.727	423.687	423.687
18	2.84463	1241.9	9.11558	Final Cover	100	16	71.3425	221.908	425.145	0	425.145	436.592	436.592
19	2.84463	1274.41	9.35735	Final Cover	100	16	72.3523	225.049	436.099	0	436.099	448.021	448.021
20	2.84463	1302.71	9.5993	Final Cover	100	16	73.2271	227.77	445.587	0	445.587	457.971	457.971
21	2.84463	1326.79	9.84142	Final Cover	100	16	73.9662	230.069	453.605	0	453.605	466.436	466.436
22	2.84463	1346.64	10.0837	Final Cover	100	16	74.57	231.947	460.152	0	460.152	473.413	473.413
23	2.84463	1362.25	10.3262	Final Cover	100	16	75.0381	233.403	465.232	0	465.232	478.904	478.904
24	2.84463	1373.62	10.5689	Final Cover	100	16	75.3705	234.437	468.836	0	468.836	482.898	482.898
25	2.84463	1380.73	10.8117	Final Cover	100	16	75.567	235.048	470.968	0	470.968	485.399	485.399
26	4.33239	2106.16	11.1184	Final Cover	100	16	75.5981	235.145	471.306	0	471.306	486.163	486.163
27	2.87639	1395.03	11.4267	Final Cover	100	16	75.4557	234.702	469.761	0	469.761	485.012	485.012
28	2.87639	1386.83	11.673	Final Cover	100	16	75.1673	233.805	466.631	0	466.631	482.161	482.161
29	2.87639	1374.17	11.9195	Final Cover	100	16	74.7391	232.473	461.987	0	461.987	477.764	477.764
30	2.87639	1357.05	12.1662	Final Cover	100	16	74.1707	230.705	455.823	0	455.823	471.814	471.814
31	2.87639	1335.46	12.4132	Final Cover	100	16	73.4621	228.501	448.136	0	448.136	464.306	464.306
32	2.87639	1309.37	12.6604	Final Cover	100	16	72.6131	225.86	438.924	0	438.924	455.236	455.236
33	2.87639	1278.79	12.9078	Final Cover	100	16	71.6232	222.781	428.189	0	428.189	444.604	444.604

34	2.87639	1243.69	13.1555	Final Cover	100	16	70.4925	219.264	415.923	0	415.923	432.399	432.399
35	2.87639	1204.06	13.4035	Final Cover	100	16	69.2206	215.308	402.13	0	402.13	418.625	418.625
36	2.87639	1159.89	13.6516	Final Cover	100	16	67.8073	210.912	386.799	0	386.799	403.268	403.268
37	2.87639	1111.16	13.9001	Final Cover	100	16	66.2523	206.075	369.929	0	369.929	386.325	386.325
38	2.87639	1057.86	14.1488	Final Cover	100	16	64.5554	200.797	351.519	0	351.519	367.793	367.793
39	2.87639	999.97	14.3978	Final Cover	100	16	62.7161	195.076	331.569	0	331.569	347.669	347.669
40	2.87639	937.482	14.6471	Final Cover	100	16	60.7343	188.911	310.071	0	310.071	325.945	325.945
41	2.87639	870.377	14.8966	Final Cover	100	16	58.6095	182.303	287.023	0	287.023	302.615	302.615
42	2.87639	798.638	15.1465	Final Cover	100	16	56.3416	175.248	262.422	0	262.422	277.673	277.673
43	2.87639	722.25	15.3966	Final Cover	100	16	53.9302	167.748	236.265	0	236.265	251.116	251.116
44	2.87639	641.196	15.6471	Final Cover	100	16	51.375	159.8	208.547	0	208.547	222.937	222.937
45	2.87639	555.459	15.8978	Final Cover	100	16	48.6756	151.404	179.265	0	179.265	193.129	193.129
46	2.87639	465.022	16.1489	Final Cover	100	16	45.8316	142.558	148.416	0	148.416	161.687	161.687
47	2.87639	369.866	16.4002	Final Cover	100	16	42.8428	133.261	115.995	0	115.995	128.604	128.604
48	2.87639	269.974	16.6519	Final Cover	100	16	39.7088	123.513	81.9979	0	81.9979	93.8748	93.8748
49	2.87639	165.327	16.904	Final Cover	100	16	36.4291	113.311	46.4218	0	46.4218	57.4925	57.4925
50	2.87639	55.9063	17.1564	Final Cover	100	16	33.0034	102.656	9.26151	0	9.26151	19.4502	19.4502

Interslice Data

Simplified Bishop Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Simplified Janbu Method - Total Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Query 1 (bishop simplified) - Safety Factor: 3.11046

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	75.0955	2.3719	0	0	0
2	77.9402	2.62211	91.5096	0	0
3	80.7848	2.88431	182.822	0	0
4	83.6294	3.15852	273.096	0	0
5	86.474	3.44475	361.541	0	0
6	89.3187	3.74302	447.42	0	0
7	92.1633	4.05334	530.045	0	0
8	95.0079	4.37572	608.777	0	0
9	97.8526	4.7102	683.033	0	0
10	100.697	5.05677	752.276	0	0
11	103.542	5.41547	816.026	0	0
12	106.386	5.78631	873.849	0	0
13	109.231	6.16931	925.366	0	0
14	112.076	6.56449	970.249	0	0
15	114.92	6.97188	1008.22	0	0
16	117.765	7.39149	1039.06	0	0
17	120.61	7.82336	1062.59	0	0
18	123.454	8.26749	1078.7	0	0
19	126.299	8.72392	1087.32	0	0
20	129.144	9.19267	1088.43	0	0
21	131.988	9.67377	1082.08	0	0
22	134.833	10.1672	1068.36	0	0
23	137.677	10.6731	1047.41	0	0
24	140.522	11.1914	1019.45	0	0
25	143.367	11.7222	984.716	0	0
26	146.211	12.2654	943.531	0	0
27	150.544	13.1168	869.322	0	0
28	153.42	13.6982	812.956	0	0
29	156.296	14.2925	751.571	0	0
30	159.173	14.8996	685.75	0	0
31	162.049	15.5198	616.136	0	0
32	164.926	16.1529	543.434	0	0
33	167.802	16.799	468.407	0	0
34	170.678	17.4582	391.882	0	0
35	173.555	18.1305	314.744	0	0
36	176.431	18.8159	237.945	0	0
37	179.308	19.5146	162.496	0	0
38	182.184	20.2264	89.4726	0	0
39	185.06	20.9515	20.0155	0	0
40	187.937	21.6899	-44.6708	0	0
41	190.813	22.4417	-103.316	0	0
42	193.69	23.2068	-154.584	0	0
43	196.566	23.9855	-197.07	0	0
44	199.442	24.7776	-229.305	0	0
45	202.319	25.5832	-249.748	0	0
46	205.195	26.4025	-256.791	0	0
47	208.072	27.2353	-248.755	0	0
48	210.948	28.0819	-223.89	0	0
49	213.824	28.9423	-180.373	0	0
50	216.701	29.8164	-116.311	0	0
51	219.577	30.7044	0	0	0

Discharge Sections

Entity Information

Simplified Bishop Method - Total Stress

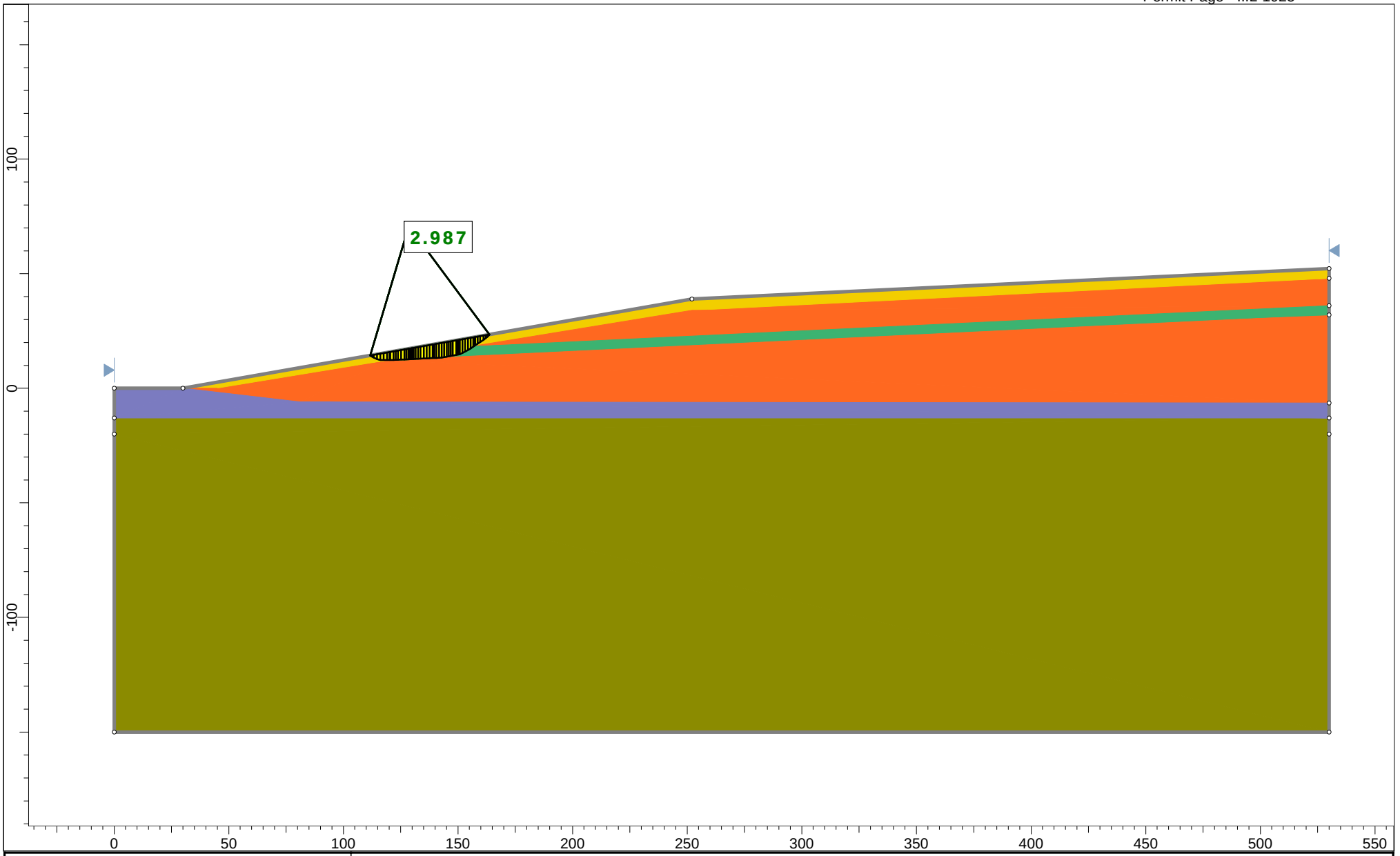
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -150 532.8, -150 532.8, -30.9 532.8, -27.9 532.8, 49.2 532.8, 53.2 528.8, 53.2 268, 40.2 63, 0
Material Boundary	63, 0 72.5, 0 148, -30.9 532.8, -27.9
Material Boundary	63, 0 90.5811, -11 148, -33.9 532.8, -30.9
Material Boundary	72.5, 0 83.8, 0 268, 36.2 528, 49.2 532.8, 49.2
Material Boundary	0, -11 90.5811, -11

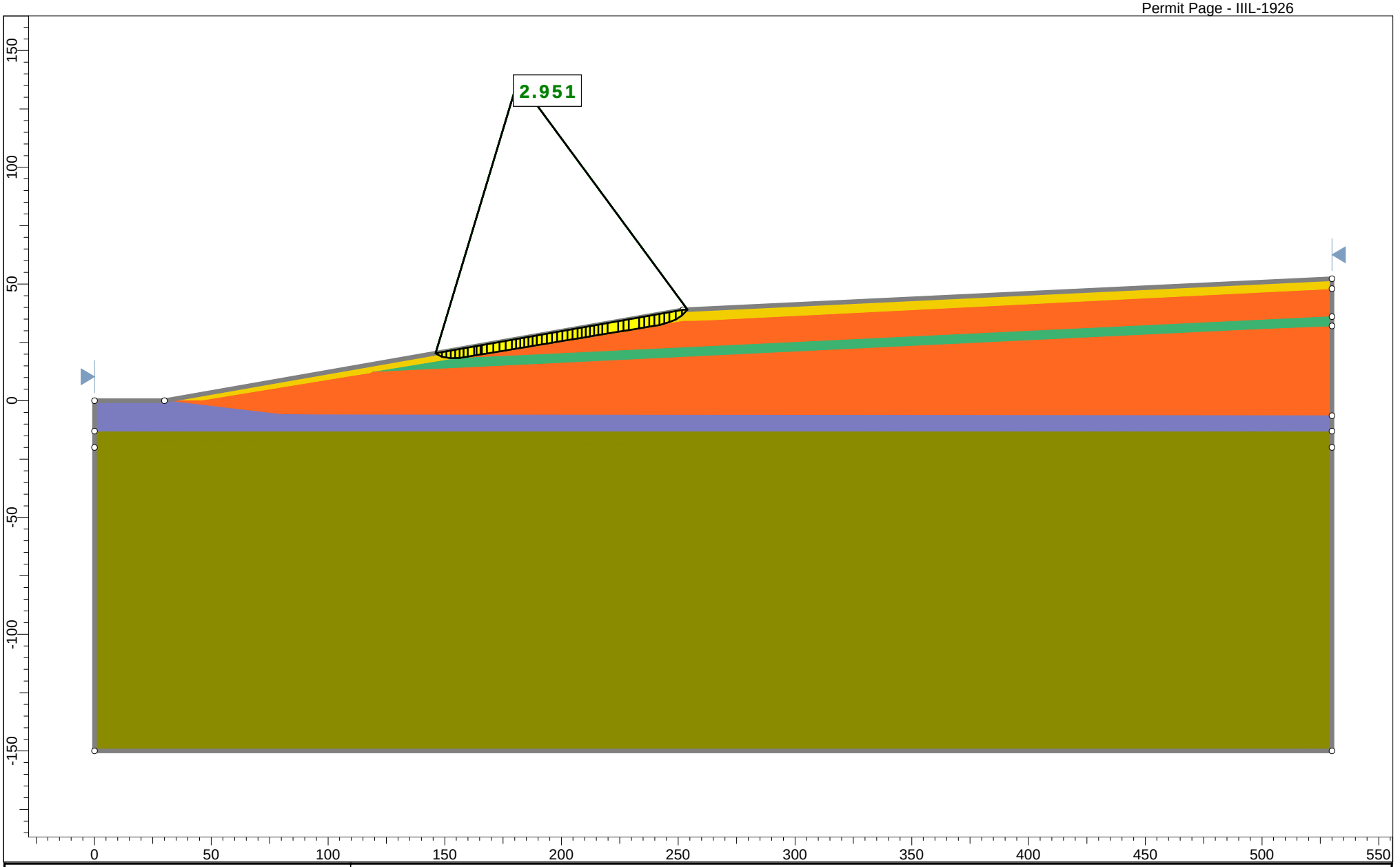
Simplified Janbu Method - Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -11 0, -150 532.8, -150 532.8, -30.9 532.8, -27.9 532.8, 49.2 532.8, 53.2 528.8, 53.2 268, 40.2 63, 0
Material Boundary	63, 0 72.5, 0 148, -30.9 532.8, -27.9
Material Boundary	63, 0 90.5811, -11 148, -33.9 532.8, -30.9
Material Boundary	72.5, 0 83.8, 0 268, 36.2 528, 49.2 532.8, 49.2
Material Boundary	0, -11 90.5811, -11



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Overliner Section E_Effective Stress.slmd



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Effective Stress	Scenario: Master Scenario
	Drawn By		Company
	Date		File Name: Slide2-Overliner Section E_Effective Stress.slmd

SLIDEINTERPRET 9.018

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	47
Cohesion [psf]	288
Friction Angle [deg]	23
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109.7
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Global Minimums

Simplified Janbu Method - Effective Stress

Method: janbu simplified

FS	2.986750
Axis Location:	128.533, 70.857
Left Slip Surface Endpoint:	111.646, 14.306
Right Slip Surface Endpoint:	163.641, 23.417
Resisting Horizontal Force:	12955.8 lb
Driving Horizontal Force:	4337.75 lb
Total Slice Area:	228.916 ft2
Surface Horizontal Width:	51.9954 ft
Surface Average Height:	4.40262 ft

Simplified Bishop Method - Effective Stress

Method: bishop simplified

FS	3.003630
Axis Location:	181.346, 137.517
Left Slip Surface Endpoint:	146.073, 20.339
Right Slip Surface Endpoint:	253.925, 38.992
Resisting Moment:	2.96572e+06 lb-ft
Driving Moment:	987379 lb-ft
Total Slice Area:	430.169 ft2
Surface Horizontal Width:	107.852 ft
Surface Average Height:	3.98851 ft

Method: janbu simplified

FS	2.950560
Axis Location:	181.346, 137.517
Left Slip Surface Endpoint:	146.073, 20.339
Right Slip Surface Endpoint:	253.925, 38.992
Resisting Horizontal Force:	25168 lb
Driving Horizontal Force:	8529.9 lb
Total Slice Area:	430.169 ft2
Surface Horizontal Width:	107.852 ft
Surface Average Height:	3.98851 ft

Global Minimum Coordinates

Simplified Janbu Method - Effective Stress

Method: janbu simplified

X	Y
111.646	14.3064
113.163	13.3598
114.62	12.7579
116.08	12.3726
117.54	12.3655
119	12.371
120.406	12.3763
121.895	12.3848
123.761	12.4571
125.189	12.5197
126.637	12.5863
128.333	12.6679
129.902	12.7433
131.471	12.8187
133.643	12.9231
135.115	12.9939
136.308	13.0512
138.886	13.1751
140.572	13.2562
142.836	13.4155
145.1	13.7729
147.734	14.2856
149.253	14.586
150.771	14.8996
153.13	15.9615
155.463	17.392
157.537	18.7541
159.651	20.1414
161.1	21.093
162.922	22.522
163.641	23.4173

Simplified Bishop Method - Effective Stress

Method: bishop simplified

X	Y
146.073	20.3389
148.773	18.8221
152.543	18.2245
156.312	18.3683
159.844	18.8973
162.595	19.3481
165.347	19.7989
168.072	20.2459
170.782	20.6911
176.053	21.5608
178.754	22.0075
182.301	22.5939
185.843	23.1796
189.385	23.7652
193.761	24.4888
198.137	25.2123
202.513	25.9359
206.889	26.6595
210.426	27.2444
213.963	27.8293
217.501	28.4142
219.762	28.7882
224.258	29.5315
228.754	30.275
233.251	31.0185
237.603	31.7381
241.903	32.4491
246.202	33.7312
248.897	34.7506
251.591	36.5354
253.925	38.9921

Method: janbu simplified

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.758572	27.591	-31.9606	Final Cover	100	16	39.3289	117.466	60.9099	0	60.9099	36.3721	36.3721
2	0.758572	82.7729	-31.9606	Final Cover	100	16	46.7578	139.654	138.29	0	138.29	109.117	109.117
3	1.45684	286.881	-22.4484	Final Cover	100	16	54.5504	162.928	219.458	0	219.458	196.92	196.92
4	1.46021	418.82	-14.782	Final Cover	100	16	62.6037	186.982	303.341	0	303.341	286.821	286.821
5	1.46019	498.03	-0.280686	Final Cover	100	16	66.2574	197.894	341.398	0	341.398	341.073	341.073
6	1.46018	543.008	0.215677	Final Cover	100	16	69.1584	206.559	371.615	0	371.615	371.876	371.876
7	1.04515	415.605	0.215677	Final Cover	100	16	71.632	213.947	397.38	0	397.38	397.65	397.65
8	0.3605	148.566	0.215677	Liner	100	16	73.0198	218.092	411.836	0	411.836	412.111	412.111
9	1.48942	641.886	0.330178	Liner	100	16	74.8148	223.453	430.532	0	430.532	430.963	430.963
10	0.93291	423.306	2.21794	Liner	100	16	76.7583	229.258	450.775	0	450.775	453.748	453.748
11	0.93291	437.561	2.21794	Liner	100	16	78.2198	233.623	465.999	0	465.999	469.028	469.028
12	1.42754	696.53	2.51056	Liner	100	16	79.9879	238.904	484.415	0	484.415	487.922	487.922
13	1.44807	739.097	2.63494	Liner	100	16	82.1197	245.271	506.622	0	506.622	510.401	510.401
14	0.848228	447.948	2.75196	Liner	100	16	83.7951	250.275	524.07	0	524.07	528.098	528.098
15	0.848228	458.926	2.75196	Liner	100	16	85.0319	253.969	536.954	0	536.954	541.041	541.041
16	0.784305	434.11	2.75196	Liner	100	16	86.2221	257.524	549.352	0	549.352	553.497	553.497
17	0.784305	443.496	2.75196	Liner	100	16	87.3659	260.94	561.265	0	561.265	565.464	565.464
18	0.784305	452.882	2.75196	Liner	100	16	88.5096	264.356	573.178	0	573.178	577.432	577.432
19	0.784305	462.269	2.75196	Liner	100	16	89.6533	267.772	585.09	0	585.09	589.4	589.4
20	1.08612	655.659	2.75196	Liner	100	16	91.017	271.845	599.294	0	599.294	603.669	603.669
21	1.08612	673.659	2.75196	Liner	100	16	92.6007	276.575	615.792	0	615.792	620.243	620.243
22	1.4722	941.858	2.75196	Liner	100	16	94.4662	282.147	635.221	0	635.221	639.761	639.761
23	1.19346	787.803	2.75196	Liner	100	16	96.4095	287.951	655.465	0	655.465	660.099	660.099
24	1.28886	875.184	2.75196	Liner	100	16	98.2195	293.357	674.316	0	674.316	679.037	679.037
25	1.28886	900.531	2.75196	Liner	100	16	100.099	298.971	693.892	0	693.892	698.704	698.704
26	0.843015	602.73	2.75196	Liner	100	16	101.653	303.613	710.083	0	710.083	714.97	714.97
27	0.843015	613.574	2.75196	Liner	100	16	102.883	307.285	722.887	0	722.887	727.832	727.832
28	1.13183	839.123	4.02627	Liner	100	16	103.956	310.49	734.067	0	734.067	741.384	741.384
29	1.13183	855.24	4.02627	Liner	100	16	105.314	314.546	748.21	0	748.21	755.623	755.623
30	1.13183	864.629	8.97128	Liner	100	16	105.227	314.287	747.309	0	747.309	763.921	763.921
31	1.13183	867.297	8.97128	Liner	100	16	105.45	314.953	749.631	0	749.631	766.278	766.278
32	0.87824	673.114	11.0132	Liner	100	16	105.1	313.906	745.98	0	745.98	766.435	766.435
33	0.87824	671.319	11.0132	Liner	100	16	104.907	313.331	743.974	0	743.974	764.391	764.391
34	0.87824	669.523	11.0132	Liner	100	16	104.714	312.756	741.968	0	741.968	762.347	762.347
35	1.51837	1152.85	11.1906	Liner	100	16	104.392	311.794	738.615	0	738.615	759.268	759.268
36	0.759152	573.751	11.6698	Liner	100	16	103.979	310.558	734.303	0	734.303	755.779	755.779
37	0.759152	571.586	11.6698	Liner	100	16	103.71	309.756	731.505	0	731.505	752.926	752.926
38	1.17948	863.431	24.2338	Liner	100	16	99.4636	297.073	687.274	0	687.274	732.045	732.045
39	1.17948	817.538	24.2338	Liner	100	16	95.8828	286.378	649.977	0	649.977	693.137	693.137
40	1.16633	749.983	31.5188	Liner	100	16	89.9215	268.573	587.885	0	587.885	643.029	643.029
41	1.16633	677.288	31.5188	Liner	100	16	84.2705	251.695	529.023	0	529.023	580.702	580.702
42	1.19202	604.476	33.2839	Liner	100	16	77.2944	230.859	456.36	0	456.36	507.102	507.102
43	0.406039	188.08	33.2839	Waste	288	23	148.41	443.264	365.778	0	365.778	463.206	463.206
44	0.4768	212.183	33.2839	Final Cover	100	16	71.687	214.111	397.953	0	397.953	445.014	445.014
45	1.05666	423.44	33.2839	Final Cover	100	16	67.688	202.167	356.3	0	356.3	400.736	400.736
46	1.05666	358.961	33.2839	Final Cover	100	16	62.177	185.707	298.896	0	298.896	339.714	339.714
47	1.44962	387.548	33.2839	Final Cover	100	16	55.6411	166.186	230.818	0	230.818	267.345	267.345
48	0.911055	175.101	38.1059	Final Cover	100	16	48.2966	144.25	154.318	0	154.318	192.195	192.195
49	0.911055	114.438	38.1059	Final Cover	100	16	42.3518	126.494	92.3961	0	92.3961	125.611	125.611
50	0.718708	33.1751	51.2427	Final Cover	100	16	33.8631	101.141	3.97794	0	3.97794	46.1595	46.1595

Query 1 (janbu simplified) - Safety Factor: 2.98675

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.758572	27.591	-31.9606	Final Cover	100	16	39.3289	117.466	60.9099	0	60.9099	36.3721	36.3721
2	0.758572	82.7729	-31.9606	Final Cover	100	16	46.7578	139.654	138.29	0	138.29	109.117	109.117
3	1.45684	286.881	-22.4484	Final Cover	100	16	54.5504	162.928	219.458	0	219.458	196.92	196.92
4	1.46021	418.82	-14.782	Final Cover	100	16	62.6037	186.982	303.341	0	303.341	286.821	286.821
5	1.46019	498.03	-0.280686	Final Cover	100	16	66.2574	197.894	341.398	0	341.398	341.073	341.073
6	1.46018	543.008	0.215677	Final Cover	100	16	69.1584	206.559	371.615	0	371.615	371.876	371.876
7	1.04515	415.605	0.215677	Final Cover	100	16	71.632	213.947	397.38	0	397.38	397.65	397.65
8	0.3605	148.566	0.215677	Liner	100	16	73.0198	218.092	411.836	0	411.836	412.111	412.111
9	1.48942	641.886	0.330178	Liner	100	16	74.8148	223.453	430.532	0	430.532	430.963	430.963
10	0.93291	423.306	2.21794	Liner	100	16	76.7583	229.258	450.775	0	450.775	453.748	453.748
11	0.93291	437.561	2.21794	Liner	100	16	78.2198	233.623	465.999	0	465.999	469.028	469.028
12	1.42754	696.53	2.51056	Liner	100	16	79.9879	238.904	484.415	0	484.415	487.922	487.922
13	1.44807	739.097	2.63494	Liner	100	16	82.1197	245.271	506.622	0	506.622	510.401	510.401
14	0.848228	447.948	2.75196	Liner	100	16	83.7951	250.275	524.07	0	524.07	528.098	528.098
15	0.848228	458.926	2.75196	Liner	100	16	85.0319	253.969	536.954	0	536.954	541.041	541.041
16	0.784305	434.11	2.75196	Liner	100	16	86.2221	257.524	549.352	0	549.352	553.497	553.497
17	0.784305	443.496	2.75196	Liner	100	16	87.3659	260.94	561.265	0	561.265	565.464	565.464
18	0.784305	452.882	2.75196	Liner	100	16	88.5096	264.356	573.178	0	573.178	577.432	577.432
19	0.784305	462.269	2.75196	Liner	100	16	89.6533	267.772	585.09	0	585.09	589.4	589.4
20	1.08612	655.659	2.75196	Liner	100	16	91.017	271.845	599.294	0	599.294	603.669	603.669
21	1.08612	673.659	2.75196	Liner	100	16	92.6007	276.575	615.792	0	615.792	620.243	620.243
22	1.4722	941.858	2.75196	Liner	100	16	94.4662	282.147	635.221	0	635.221	639.761	639.761
23	1.19346	787.803	2.75196	Liner	100	16	96.4095	287.951	655.465	0	655.465	660.099	660.099
24	1.28886	875.184	2.75196	Liner	100	16	98.2195	293.357	674.316	0	674.316	679.037	679.037
25	1.28886	900.531	2.75196	Liner	100	16	100.099	298.971	693.892	0	693.892	698.704	698.704
26	0.843015	602.73	2.75196	Liner	100	16	101.653	303.613	710.083	0	710.083	714.97	714.97
27	0.843015	613.574	2.75196	Liner	100	16	102.883	307.285	722.887	0	722.887	727.832	727.832
28	1.13183	839.123	4.02627	Liner	100	16	103.956	310.49	734.067	0	734.067	741.384	741.384
29	1.13183	855.24	4.02627	Liner	100	16	105.314	314.546	748.21	0	748.21	755.623	755.623
30	1.13183	864.629	8.97128	Liner	100	16	105.227	314.287	747.309	0	747.309	763.921	763.921
31	1.13183	867.297	8.97128	Liner	100	16	105.45	314.953	749.631	0	749.631	766.278	766.278
32	0.87824	673.114	11.0132	Liner	100	16	105.1	313.906	745.98	0	745.98	766.435	766.435
33	0.87824	671.319	11.0132	Liner	100	16	104.907	313.331	743.974	0	743.974	764.391	764.391
34	0.87824	669.523	11.0132	Liner	100	16	104.714	312.756	741.968	0	741.968	762.347	762.347
35	1.51837	1152.85	11.1906	Liner	100	16	104.392	311.794	738.615	0	738.615	759.268	759.268
36	0.759152	573.751	11.6698	Liner	100	16	103.979	310.558	734.303	0	734.303	755.779	755.779
37	0.759152	571.586	11.6698	Liner	100	16	103.71	309.756	731.505	0	731.505	752.926	752.926
38	1.17948	863.431	24.2338	Liner	100	16	99.4636	297.073	687.274	0	687.274	732.045	732.045
39	1.17948	817.538	24.2338	Liner	100	16	95.8828	286.378	649.977	0	649.977	693.137	693.137
40	1.16633	749.983	31.5188	Liner	100	16	89.9215	268.573	587.885	0	587.885	643.029	643.029
41	1.16633	677.288	31.5188	Liner	100	16	84.2705	251.695	529.023	0	529.023	580.702	580.702
42	1.19202	604.476	33.2839	Liner	100	16	77.2944	230.859	456.36	0	456.36	507.102	507.102
43	0.406039	188.08	33.2839	Waste	288	23	148.41	443.264	365.778	0	365.778	463.206	463.206
44	0.4768	212.183	33.2839	Final Cover	100	16	71.687	214.111	397.953	0	397.953	445.014	445.014
45	1.05666	423.44	33.2839	Final Cover	100	16	67.688	202.167	356.3	0	356.3	400.736	400.736
46	1.05666	358.961	33.2839	Final Cover	100	16	62.177	185.707	298.896	0	298.896	339.714	339.714
47	1.44962	387.548	33.2839	Final Cover	100	16	55.6411	166.186	230.818	0	230.818	267.345	267.345
48	0.911055	175.101	38.1059	Final Cover	100	16	48.2966	144.25	154.318	0	154.318	192.195	192.195
49	0.911055	114.438	38.1059	Final Cover	100	16	42.3518	126.494	92.3961	0	92.3961	125.611	125.611
50	0.718708	33.1751	51.2427	Final Cover	100	16	33.8631	101.141	3.97794	0	3.97794	46.1595	46.1595

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.00363

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.69992	322.359	-29.3277	Final Cover	100	16	47.2241	141.844	145.927	0	145.927	119.396	119.396
2	1.88489	521.24	-9.00743	Final Cover	100	16	60.6101	182.05	286.143	0	286.143	276.535	276.535
3	1.88489	663.527	-9.00743	Final Cover	100	16	67.9275	204.029	362.792	0	362.792	352.024	352.024
4	1.88487	763.881	2.18526	Final Cover	100	16	71.7212	215.424	402.532	0	402.532	405.269	405.269
5	1.88487	822.316	2.18526	Final Cover	100	16	74.6703	224.282	433.422	0	433.422	436.272	436.272
6	1.76558	802.397	8.51908	Final Cover	100	16	75.5982	227.069	443.143	0	443.143	454.467	454.467
7	1.76558	811.911	8.51908	Final Cover	100	16	76.1056	228.593	448.456	0	448.456	459.856	459.856
8	2.75155	1277.9	9.30466	Final Cover	100	16	76.4348	229.582	451.905	0	451.905	464.428	464.428
9	1.01687	474.884	9.30466	Final Cover	100	16	76.6769	230.309	454.442	0	454.442	467.004	467.004
10	1.73468	813.358	9.30466	Final Cover	100	16	76.8533	230.839	456.289	0	456.289	468.881	468.881
11	0.499716	235.067	9.31544	Final Cover	100	16	76.9948	231.264	457.771	0	457.771	470.401	470.401
12	2.22527	1050.85	9.31544	Final Cover	100	16	77.167	231.781	459.578	0	459.578	472.236	472.236
13	2.71075	1289	9.32763	Final Cover	100	16	77.4736	232.702	462.788	0	462.788	475.513	475.513
14	2.63533	1262.1	9.36943	Final Cover	100	16	77.7879	233.646	466.079	0	466.079	478.914	478.914
15	2.63533	1270.62	9.36943	Final Cover	100	16	78.0918	234.559	469.262	0	469.262	482.147	482.147
16	2.70138	1311.16	9.38892	Final Cover	100	16	78.3915	235.459	472.404	0	472.404	485.366	485.366
17	1.77333	865.415	9.38892	Final Cover	100	16	78.6408	236.208	475.014	0	475.014	488.017	488.017
18	1.77333	869.142	9.38892	Final Cover	100	16	78.8383	236.801	477.082	0	477.082	490.118	490.118
19	1.77091	871.673	9.38892	Final Cover	100	16	79.0357	237.394	479.149	0	479.149	492.218	492.218
20	1.77091	875.389	9.38892	Final Cover	100	16	79.2328	237.986	481.215	0	481.215	494.316	494.316
21	1.77091	879.105	9.38892	Final Cover	100	16	79.4302	238.579	483.281	0	483.281	496.415	496.415
22	1.77091	882.822	9.38892	Final Cover	100	16	79.6273	239.171	485.347	0	485.347	498.514	498.514
23	2.188	1095.88	9.38892	Final Cover	100	16	79.8477	239.833	487.656	0	487.656	500.859	500.859
24	2.188	1101.55	9.38892	Final Cover	100	16	80.0914	240.565	490.208	0	490.208	503.451	503.451
25	2.188	1107.23	9.38892	Final Cover	100	16	80.3351	241.297	492.76	0	492.76	506.044	506.044
26	2.188	1112.9	9.38892	Final Cover	100	16	80.5788	242.029	495.313	0	495.313	508.636	508.636
27	2.188	1118.57	9.38892	Final Cover	100	16	80.8225	242.761	497.865	0	497.865	511.229	511.229
28	2.188	1124.25	9.38892	Final Cover	100	16	81.0662	243.493	500.417	0	500.417	513.821	513.821
29	2.188	1129.92	9.38892	Final Cover	100	16	81.3099	244.225	502.969	0	502.969	516.414	516.414
30	2.188	1135.59	9.38892	Final Cover	100	16	81.5537	244.957	505.526	0	505.526	519.011	519.011
31	1.76869	922.11	9.38892	Final Cover	100	16	81.7737	245.618	507.831	0	507.831	521.353	521.353
32	1.76869	925.817	9.38892	Final Cover	100	16	81.9708	246.21	509.895	0	509.895	523.449	523.449

33	1.76869	929.524	9.38892	Final Cover	100	16	82.1679	246.802	511.958	0	511.958	525.545	525.545
34	1.76869	933.231	9.38892	Final Cover	100	16	82.3647	247.393	514.022	0	514.022	527.641	527.641
35	1.76869	936.938	9.38892	Final Cover	100	16	82.5618	247.985	516.085	0	516.085	529.737	529.737
36	1.76869	940.645	9.38892	Final Cover	100	16	82.7589	248.577	518.148	0	518.148	531.832	531.832
37	2.2615	1208.14	9.38892	Final Cover	100	16	82.9833	249.251	520.498	0	520.498	534.219	534.219
38	4.49554	2419.61	9.38892	Final Cover	100	16	83.3595	250.381	524.441	0	524.441	538.225	538.225
39	2.24819	1219.01	9.38892	Final Cover	100	16	83.735	251.509	528.372	0	528.372	542.218	542.218
40	2.24819	1225	9.38892	Final Cover	100	16	83.9854	252.261	530.996	0	530.996	544.883	544.883
41	4.49688	2468.25	9.38892	Final Cover	100	16	84.3609	253.389	534.93	0	534.93	548.879	548.879
42	2.17593	1202.93	9.38892	Final Cover	100	16	84.7325	254.505	538.822	0	538.822	552.833	552.833
43	2.17593	1208.54	9.38892	Final Cover	100	16	84.9748	255.233	541.361	0	541.361	555.412	555.412
44	2.14982	1199.55	9.38892	Final Cover	100	16	85.2156	255.956	543.884	0	543.884	557.974	557.974
45	2.14982	1205.02	9.38892	Final Cover	100	16	85.4553	256.676	546.394	0	546.394	560.524	560.524
46	2.14981	1173.66	16.6044	Final Cover	100	16	83.0472	249.443	521.169	0	521.169	545.933	545.933
47	2.14981	1105.46	16.6044	Final Cover	100	16	80.1024	240.598	490.322	0	490.322	514.209	514.209
48	2.69419	1254.18	20.7245	Final Cover	100	16	75.0239	225.344	437.126	0	437.126	465.512	465.512
49	2.69419	953.494	33.5241	Final Cover	100	16	63.0892	189.497	312.113	0	312.113	353.908	353.908
50	2.33409	327.123	46.4654	Final Cover	100	16	42.4112	127.388	95.5121	0	95.5121	140.15	140.15

Query 1 (bishop simplified) - Safety Factor: 3.00368

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
28	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	Final Cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Global Minimum Query (janbu simplified) - Safety Factor: 2.95056

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.69992	322.359	-29.3277	Final Cover	100	16	48.1232	141.99	146.438	0	146.438	119.402	119.402
2	1.88489	521.24	-9.00743	Final Cover	100	16	61.7175	182.101	286.321	0	286.321	276.538	276.538
3	1.88489	663.527	-9.00743	Final Cover	100	16	69.1686	204.086	362.991	0	362.991	352.026	352.026
4	1.88487	763.881	2.18526	Final Cover	100	16	73.0065	215.41	402.483	0	402.483	405.269	405.269
5	1.88487	822.316	2.18526	Final Cover	100	16	76.0083	224.267	433.371	0	433.371	436.271	436.271
6	1.76558	802.397	8.51908	Final Cover	100	16	76.9383	227.011	442.94	0	442.94	454.464	454.464
7	1.76558	811.911	8.51908	Final Cover	100	16	77.4544	228.534	448.251	0	448.251	459.853	459.853
8	2.75155	1277.9	9.30466	Final Cover	100	16	77.7879	229.518	451.683	0	451.683	464.428	464.428
9	1.01687	474.884	9.30466	Final Cover	100	16	78.034	230.244	454.217	0	454.217	467.002	467.002
10	1.73468	813.358	9.30466	Final Cover	100	16	78.2136	230.774	456.063	0	456.063	468.878	468.878
11	0.499716	235.067	9.31544	Final Cover	100	16	78.3577	231.199	457.546	0	457.546	470.399	470.399
12	2.22527	1050.85	9.31544	Final Cover	100	16	78.5329	231.716	459.347	0	459.347	472.229	472.229
13	2.71075	1289	9.32763	Final Cover	100	16	78.845	232.637	462.558	0	462.558	475.509	475.509
14	2.63533	1262.1	9.36943	Final Cover	100	16	79.1646	233.58	465.851	0	465.851	478.913	478.913
15	2.63533	1270.62	9.36943	Final Cover	100	16	79.4741	234.493	469.033	0	469.033	482.146	482.146
16	2.70138	1311.16	9.38892	Final Cover	100	16	79.7791	235.393	472.171	0	472.171	485.362	485.362
17	1.77333	865.415	9.38892	Final Cover	100	16	80.0326	236.141	474.78	0	474.78	488.014	488.014
18	1.77333	869.142	9.38892	Final Cover	100	16	80.2336	236.734	476.848	0	476.848	490.115	490.115
19	1.77091	871.673	9.38892	Final Cover	100	16	80.4346	237.327	478.915	0	478.915	492.215	492.215
20	1.77091	875.389	9.38892	Final Cover	100	16	80.6352	237.919	480.981	0	480.981	494.314	494.314
21	1.77091	879.105	9.38892	Final Cover	100	16	80.8358	238.511	483.046	0	483.046	496.412	496.412
22	1.77091	882.822	9.38892	Final Cover	100	16	81.0365	239.103	485.111	0	485.111	498.511	498.511
23	2.188	1095.88	9.38892	Final Cover	100	16	81.2608	239.765	487.422	0	487.422	500.858	500.858
24	2.188	1101.55	9.38892	Final Cover	100	16	81.5089	240.497	489.974	0	489.974	503.451	503.451
25	2.188	1107.23	9.38892	Final Cover	100	16	81.757	241.229	492.521	0	492.521	506.04	506.04
26	2.188	1112.9	9.38892	Final Cover	100	16	82.0048	241.96	495.074	0	495.074	508.633	508.633
27	2.188	1118.57	9.38892	Final Cover	100	16	82.2529	242.692	497.626	0	497.626	511.226	511.226
28	2.188	1124.25	9.38892	Final Cover	100	16	82.5009	243.424	500.178	0	500.178	513.819	513.819
29	2.188	1129.92	9.38892	Final Cover	100	16	82.749	244.156	502.73	0	502.73	516.413	516.413
30	2.188	1135.59	9.38892	Final Cover	100	16	82.9968	244.887	505.282	0	505.282	519.006	519.006
31	1.76869	922.11	9.38892	Final Cover	100	16	83.2212	245.549	507.589	0	507.589	521.35	521.35
32	1.76869	925.817	9.38892	Final Cover	100	16	83.4215	246.14	509.652	0	509.652	523.446	523.446
33	1.76869	929.524	9.38892	Final Cover	100	16	83.6221	246.732	511.715	0	511.715	525.542	525.542

34	1.76869	933.231	9.38892	Final Cover	100	16	83.8224	247.323	513.777	0	513.777	527.637	527.637
35	1.76869	936.938	9.38892	Final Cover	100	16	84.023	247.915	515.84	0	515.84	529.733	529.733
36	1.76869	940.645	9.38892	Final Cover	100	16	84.2233	248.506	517.903	0	517.903	531.829	531.829
37	2.2615	1208.14	9.38892	Final Cover	100	16	84.4518	249.18	520.254	0	520.254	534.218	534.218
38	4.49554	2419.61	9.38892	Final Cover	100	16	84.8347	250.31	524.193	0	524.193	538.221	538.221
39	2.24819	1219.01	9.38892	Final Cover	100	16	85.217	251.438	528.126	0	528.126	542.217	542.217
40	2.24819	1225	9.38892	Final Cover	100	16	85.4716	252.189	530.746	0	530.746	544.879	544.879
41	4.49688	2468.25	9.38892	Final Cover	100	16	85.8539	253.317	534.68	0	534.68	548.876	548.876
42	2.17593	1202.93	9.38892	Final Cover	100	16	86.2321	254.433	538.573	0	538.573	552.831	552.831
43	2.17593	1208.54	9.38892	Final Cover	100	16	86.4788	255.161	541.107	0	541.107	555.407	555.407
44	2.14982	1199.55	9.38892	Final Cover	100	16	86.7239	255.884	543.631	0	543.631	557.971	557.971
45	2.14982	1205.02	9.38892	Final Cover	100	16	86.9676	256.603	546.137	0	546.137	560.517	560.517
46	2.14981	1173.66	16.6044	Final Cover	100	16	84.4982	249.317	520.732	0	520.732	545.929	545.929
47	2.14981	1105.46	16.6044	Final Cover	100	16	81.5022	240.477	489.903	0	489.903	514.207	514.207
48	2.69419	1254.18	20.7245	Final Cover	100	16	76.3248	225.201	436.626	0	436.626	465.504	465.504
49	2.69419	953.494	33.5241	Final Cover	100	16	64.1545	189.292	311.398	0	311.398	353.899	353.899
50	2.33409	327.123	46.4654	Final Cover	100	16	43.1024	127.176	94.7746	0	94.7746	140.14	140.14

Query 1 (janbu simplified) - Safety Factor: 2.95056

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.69992	322.359	-29.3277	Final Cover	100	16	48.1232	141.99	146.438	0	146.438	119.402	119.402
2	1.88489	521.24	-9.00743	Final Cover	100	16	61.7175	182.101	286.321	0	286.321	276.538	276.538
3	1.88489	663.527	-9.00743	Final Cover	100	16	69.1686	204.086	362.991	0	362.991	352.026	352.026
4	1.88487	763.881	2.18526	Final Cover	100	16	73.0065	215.41	402.483	0	402.483	405.269	405.269
5	1.88487	822.316	2.18526	Final Cover	100	16	76.0083	224.267	433.371	0	433.371	436.271	436.271
6	1.76558	802.397	8.51908	Final Cover	100	16	76.9383	227.011	442.94	0	442.94	454.464	454.464
7	1.76558	811.911	8.51908	Final Cover	100	16	77.4544	228.534	448.251	0	448.251	459.853	459.853
8	2.75155	1277.9	9.30466	Final Cover	100	16	77.7879	229.518	451.683	0	451.683	464.428	464.428
9	1.01687	474.884	9.30466	Final Cover	100	16	78.034	230.244	454.217	0	454.217	467.002	467.002
10	1.73468	813.358	9.30466	Final Cover	100	16	78.2136	230.774	456.063	0	456.063	468.878	468.878
11	0.499716	235.067	9.31544	Final Cover	100	16	78.3577	231.199	457.546	0	457.546	470.399	470.399
12	2.22527	1050.85	9.31544	Final Cover	100	16	78.5329	231.716	459.347	0	459.347	472.229	472.229
13	2.71075	1289	9.32763	Final Cover	100	16	78.845	232.637	462.558	0	462.558	475.509	475.509
14	2.63533	1262.1	9.36943	Final Cover	100	16	79.1646	233.58	465.851	0	465.851	478.913	478.913
15	2.63533	1270.62	9.36943	Final Cover	100	16	79.4741	234.493	469.033	0	469.033	482.146	482.146
16	2.70138	1311.16	9.38892	Final Cover	100	16	79.7791	235.393	472.171	0	472.171	485.362	485.362
17	1.77333	865.415	9.38892	Final Cover	100	16	80.0326	236.141	474.78	0	474.78	488.014	488.014
18	1.77333	869.142	9.38892	Final Cover	100	16	80.2336	236.734	476.848	0	476.848	490.115	490.115
19	1.77091	871.673	9.38892	Final Cover	100	16	80.4346	237.327	478.915	0	478.915	492.215	492.215
20	1.77091	875.389	9.38892	Final Cover	100	16	80.6352	237.919	480.981	0	480.981	494.314	494.314
21	1.77091	879.105	9.38892	Final Cover	100	16	80.8358	238.511	483.046	0	483.046	496.412	496.412
22	1.77091	882.822	9.38892	Final Cover	100	16	81.0365	239.103	485.111	0	485.111	498.511	498.511
23	2.188	1095.88	9.38892	Final Cover	100	16	81.2608	239.765	487.422	0	487.422	500.858	500.858
24	2.188	1101.55	9.38892	Final Cover	100	16	81.5089	240.497	489.974	0	489.974	503.451	503.451
25	2.188	1107.23	9.38892	Final Cover	100	16	81.757	241.229	492.521	0	492.521	506.04	506.04
26	2.188	1112.9	9.38892	Final Cover	100	16	82.0048	241.96	495.074	0	495.074	508.633	508.633
27	2.188	1118.57	9.38892	Final Cover	100	16	82.2529	242.692	497.626	0	497.626	511.226	511.226
28	2.188	1124.25	9.38892	Final Cover	100	16	82.5009	243.424	500.178	0	500.178	513.819	513.819
29	2.188	1129.92	9.38892	Final Cover	100	16	82.749	244.156	502.73	0	502.73	516.413	516.413
30	2.188	1135.59	9.38892	Final Cover	100	16	82.9968	244.887	505.282	0	505.282	519.006	519.006
31	1.76869	922.11	9.38892	Final Cover	100	16	83.2212	245.549	507.589	0	507.589	521.35	521.35
32	1.76869	925.817	9.38892	Final Cover	100	16	83.4215	246.14	509.652	0	509.652	523.446	523.446
33	1.76869	929.524	9.38892	Final Cover	100	16	83.6221	246.732	511.715	0	511.715	525.542	525.542

34	1.76869	933.231	9.38892	Final Cover	100	16	83.8224	247.323	513.777	0	513.777	527.637	527.637
35	1.76869	936.938	9.38892	Final Cover	100	16	84.023	247.915	515.84	0	515.84	529.733	529.733
36	1.76869	940.645	9.38892	Final Cover	100	16	84.2233	248.506	517.903	0	517.903	531.829	531.829
37	2.2615	1208.14	9.38892	Final Cover	100	16	84.4518	249.18	520.254	0	520.254	534.218	534.218
38	4.49554	2419.61	9.38892	Final Cover	100	16	84.8347	250.31	524.193	0	524.193	538.221	538.221
39	2.24819	1219.01	9.38892	Final Cover	100	16	85.217	251.438	528.126	0	528.126	542.217	542.217
40	2.24819	1225	9.38892	Final Cover	100	16	85.4716	252.189	530.746	0	530.746	544.879	544.879
41	4.49688	2468.25	9.38892	Final Cover	100	16	85.8539	253.317	534.68	0	534.68	548.876	548.876
42	2.17593	1202.93	9.38892	Final Cover	100	16	86.2321	254.433	538.573	0	538.573	552.831	552.831
43	2.17593	1208.54	9.38892	Final Cover	100	16	86.4788	255.161	541.107	0	541.107	555.407	555.407
44	2.14982	1199.55	9.38892	Final Cover	100	16	86.7239	255.884	543.631	0	543.631	557.971	557.971
45	2.14982	1205.02	9.38892	Final Cover	100	16	86.9676	256.603	546.137	0	546.137	560.517	560.517
46	2.14981	1173.66	16.6044	Final Cover	100	16	84.4982	249.317	520.732	0	520.732	545.929	545.929
47	2.14981	1105.46	16.6044	Final Cover	100	16	81.5022	240.477	489.903	0	489.903	514.207	514.207
48	2.69419	1254.18	20.7245	Final Cover	100	16	76.3248	225.201	436.626	0	436.626	465.504	465.504
49	2.69419	953.494	33.5241	Final Cover	100	16	64.1545	189.292	311.398	0	311.398	353.899	353.899
50	2.33409	327.123	46.4654	Final Cover	100	16	43.1024	127.176	94.7746	0	94.7746	140.14	140.14

Interslice Data

Simplified Janbu Method - Effective Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.98675

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	111.646	14.3064	0	0	0
2	112.404	13.8331	58.6613	0	0
3	113.163	13.3598	159.58	0	0
4	114.62	12.7579	371.145	0	0
5	116.08	12.3726	579.44	0	0
6	117.54	12.3655	678.63	0	0
7	119	12.371	777.571	0	0
8	120.046	12.3749	850.874	0	0
9	120.406	12.3763	876.638	0	0
10	121.895	12.3848	984.373	0	0
11	122.828	12.421	1039.69	0	0
12	123.761	12.4571	1095.83	0	0
13	125.189	12.5197	1179.69	0	0
14	126.637	12.5863	1264.85	0	0
15	127.485	12.6271	1314.56	0	0
16	128.333	12.6679	1364.79	0	0
17	129.118	12.7056	1411.7	0	0
18	129.902	12.7433	1459.07	0	0
19	130.686	12.781	1506.88	0	0
20	131.471	12.8187	1555.13	0	0
21	132.557	12.8709	1622.7	0	0
22	133.643	12.9231	1691.13	0	0
23	135.115	12.9939	1785.25	0	0
24	136.308	13.0512	1862.71	0	0
25	137.597	13.1132	1947.52	0	0
26	138.886	13.1751	2033.55	0	0
27	139.729	13.2157	2090.47	0	0
28	140.572	13.2562	2147.91	0	0
29	141.704	13.3358	2207.08	0	0
30	142.836	13.4155	2266.67	0	0
31	143.968	13.5942	2252.24	0	0
32	145.1	13.7729	2237.65	0	0
33	145.978	13.9438	2202.44	0	0
34	146.856	14.1147	2167.42	0	0
35	147.734	14.2856	2132.56	0	0
36	149.253	14.586	2069.2	0	0
37	150.012	14.7428	2033	0	0
38	150.771	14.8996	1997.03	0	0
39	151.95	15.4305	1749.46	0	0
40	153.13	15.9615	1517.47	0	0
41	154.296	16.6767	1201.86	0	0
42	155.463	17.392	921.762	0	0
43	156.655	18.1745	656.782	0	0
44	157.061	18.441	619.542	0	0
45	157.537	18.7541	529.159	0	0
46	158.594	19.4477	353.528	0	0
47	159.651	20.1414	211.892	0	0
48	161.1	21.093	72.8949	0	0
49	162.011	21.8075	6.63383	0	0
50	162.922	22.522	-20.7994	0	0
51	163.641	23.4173	0	0	0

Query 1 (janbu simplified) - Safety Factor: 2.98675

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	111.646	14.3064	0	0	0
2	112.404	13.8331	58.6613	0	0
3	113.163	13.3598	159.58	0	0
4	114.62	12.7579	371.145	0	0
5	116.08	12.3726	579.44	0	0
6	117.54	12.3655	678.63	0	0
7	119	12.371	777.571	0	0
8	120.046	12.3749	850.874	0	0
9	120.406	12.3763	876.638	0	0
10	121.895	12.3848	984.373	0	0
11	122.828	12.421	1039.69	0	0
12	123.761	12.4571	1095.83	0	0
13	125.189	12.5197	1179.69	0	0
14	126.637	12.5863	1264.85	0	0
15	127.485	12.6271	1314.56	0	0
16	128.333	12.6679	1364.79	0	0
17	129.118	12.7056	1411.7	0	0
18	129.902	12.7433	1459.07	0	0
19	130.686	12.781	1506.88	0	0
20	131.471	12.8187	1555.13	0	0
21	132.557	12.8709	1622.7	0	0
22	133.643	12.9231	1691.13	0	0
23	135.115	12.9939	1785.25	0	0
24	136.308	13.0512	1862.71	0	0
25	137.597	13.1132	1947.52	0	0
26	138.886	13.1751	2033.55	0	0
27	139.729	13.2157	2090.47	0	0
28	140.572	13.2562	2147.91	0	0
29	141.704	13.3358	2207.08	0	0
30	142.836	13.4155	2266.67	0	0
31	143.968	13.5942	2252.24	0	0
32	145.1	13.7729	2237.65	0	0
33	145.978	13.9438	2202.44	0	0
34	146.856	14.1147	2167.42	0	0
35	147.734	14.2856	2132.56	0	0
36	149.253	14.586	2069.2	0	0
37	150.012	14.7428	2033	0	0
38	150.771	14.8996	1997.03	0	0
39	151.95	15.4305	1749.46	0	0
40	153.13	15.9615	1517.47	0	0
41	154.296	16.6767	1201.86	0	0
42	155.463	17.392	921.762	0	0
43	156.655	18.1745	656.782	0	0
44	157.061	18.441	619.542	0	0
45	157.537	18.7541	529.159	0	0
46	158.594	19.4477	353.528	0	0
47	159.651	20.1414	211.892	0	0
48	161.1	21.093	72.8949	0	0
49	162.011	21.8075	6.63383	0	0
50	162.922	22.522	-20.7994	0	0
51	163.641	23.4173	0	0	0

Simplified Bishop Method - Effective Stress

Global Minimum Query (bishop simplified) - Safety Factor: 3.00363

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	146.073	20.3389	0	0	0
2	148.773	18.8221	348.848	0	0
3	150.658	18.5233	548.588	0	0
4	152.543	18.2245	785.022	0	0
5	154.428	18.2964	891.256	0	0
6	156.312	18.3683	1000.83	0	0
7	158.078	18.6328	1017.1	0	0
8	159.844	18.8973	1032.87	0	0
9	162.595	19.3481	1039.46	0	0
10	163.612	19.5147	1041.72	0	0
11	165.347	19.7989	1045.35	0	0
12	165.846	19.8809	1046.31	0	0
13	168.072	20.2459	1050.27	0	0
14	170.782	20.6911	1054.23	0	0
15	173.418	21.126	1056.56	0	0
16	176.053	21.5608	1058.31	0	0
17	178.754	22.0075	1059.06	0	0
18	180.528	22.3007	1059.24	0	0
19	182.301	22.5939	1059.15	0	0
20	184.072	22.8867	1058.81	0	0
21	185.843	23.1796	1058.22	0	0
22	187.614	23.4724	1057.37	0	0
23	189.385	23.7652	1056.26	0	0
24	191.573	24.127	1054.54	0	0
25	193.761	24.4888	1052.43	0	0
26	195.949	24.8506	1049.93	0	0
27	198.137	25.2123	1047.04	0	0
28	200.325	25.5741	1043.76	0	0
29	202.513	25.9359	1040.08	0	0
30	204.701	26.2977	1036.02	0	0
31	206.889	26.6595	1031.57	0	0
32	208.657	26.9519	1027.69	0	0
33	210.426	27.2444	1023.55	0	0
34	212.195	27.5369	1019.15	0	0
35	213.963	27.8293	1014.5	0	0
36	215.732	28.1218	1009.6	0	0
37	217.501	28.4142	1004.44	0	0
38	219.762	28.7882	997.47	0	0
39	224.258	29.5315	982.38	0	0
40	226.506	29.9032	974.215	0	0
41	228.754	30.275	965.638	0	0
42	233.251	31.0185	947.246	0	0
43	235.427	31.3783	937.755	0	0
44	237.603	31.7381	927.878	0	0
45	239.753	32.0936	917.74	0	0
46	241.903	32.4491	907.225	0	0
47	244.052	33.0901	751.656	0	0
48	246.202	33.7312	609.531	0	0
49	248.897	34.7506	366.067	0	0
50	251.591	36.5354	-21.0384	0	0
51	253.925	38.9921	0	0	0

Query 1 (bishop simplified) - Safety Factor: 3.00368

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	N/A	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A	N/A
8	N/A	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A
11	N/A	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	N/A	N/A
21	N/A	N/A	N/A	N/A	N/A
22	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A
26	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	N/A	N/A	N/A
28	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A
31	N/A	N/A	N/A	N/A	N/A

Global Minimum Query (janbu simplified) - Safety Factor: 2.95056

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	146.073	20.3389	0	0	0
2	148.773	18.8221	352.079	0	0
3	150.658	18.5233	553.985	0	0
4	152.543	18.2245	792.845	0	0
5	154.428	18.2964	901.535	0	0
6	156.312	18.3683	1013.66	0	0
7	158.078	18.6328	1032.39	0	0
8	159.844	18.8973	1050.62	0	0
9	162.595	19.3481	1061.08	0	0
10	163.612	19.5147	1064.78	0	0
11	165.347	19.7989	1070.86	0	0
12	165.846	19.8809	1072.52	0	0
13	168.072	20.2459	1079.65	0	0
14	170.782	20.6911	1087.47	0	0
15	173.418	21.126	1093.58	0	0
16	176.053	21.5608	1099.11	0	0
17	178.754	22.0075	1103.77	0	0
18	180.528	22.3007	1106.51	0	0
19	182.301	22.5939	1109	0	0
20	184.072	22.8867	1111.23	0	0
21	185.843	23.1796	1113.22	0	0
22	187.614	23.4724	1114.96	0	0
23	189.385	23.7652	1116.45	0	0
24	191.573	24.127	1117.95	0	0
25	193.761	24.4888	1119.06	0	0
26	195.949	24.8506	1119.8	0	0
27	198.137	25.2123	1120.15	0	0
28	200.325	25.5741	1120.12	0	0
29	202.513	25.9359	1119.72	0	0
30	204.701	26.2977	1118.93	0	0
31	206.889	26.6595	1117.76	0	0
32	208.657	26.9519	1116.54	0	0
33	210.426	27.2444	1115.07	0	0
34	212.195	27.5369	1113.35	0	0
35	213.963	27.8293	1111.39	0	0
36	215.732	28.1218	1109.17	0	0
37	217.501	28.4142	1106.7	0	0
38	219.762	28.7882	1103.19	0	0
39	224.258	29.5315	1095	0	0
40	226.506	29.9032	1090.3	0	0
41	228.754	30.275	1085.2	0	0
42	233.251	31.0185	1073.79	0	0
43	235.427	31.3783	1067.69	0	0
44	237.603	31.7381	1061.22	0	0
45	239.753	32.0936	1054.45	0	0
46	241.903	32.4491	1047.32	0	0
47	244.052	33.0901	895.193	0	0
48	246.202	33.7312	756.385	0	0
49	248.897	34.7506	516.979	0	0
50	251.591	36.5354	134.058	0	0
51	253.925	38.9921	0	0	0

Query 1 (janbu simplified) - Safety Factor: 2.95056

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	146.073	20.3389	0	0	0
2	148.773	18.8221	352.079	0	0
3	150.658	18.5233	553.985	0	0
4	152.543	18.2245	792.845	0	0
5	154.428	18.2964	901.535	0	0
6	156.312	18.3683	1013.66	0	0
7	158.078	18.6328	1032.39	0	0
8	159.844	18.8973	1050.62	0	0
9	162.595	19.3481	1061.08	0	0
10	163.612	19.5147	1064.78	0	0
11	165.347	19.7989	1070.86	0	0
12	165.846	19.8809	1072.52	0	0
13	168.072	20.2459	1079.65	0	0
14	170.782	20.6911	1087.47	0	0
15	173.418	21.126	1093.58	0	0
16	176.053	21.5608	1099.11	0	0
17	178.754	22.0075	1103.77	0	0
18	180.528	22.3007	1106.51	0	0
19	182.301	22.5939	1109	0	0
20	184.072	22.8867	1111.23	0	0
21	185.843	23.1796	1113.22	0	0
22	187.614	23.4724	1114.96	0	0
23	189.385	23.7652	1116.45	0	0
24	191.573	24.127	1117.95	0	0
25	193.761	24.4888	1119.06	0	0
26	195.949	24.8506	1119.8	0	0
27	198.137	25.2123	1120.15	0	0
28	200.325	25.5741	1120.12	0	0
29	202.513	25.9359	1119.72	0	0
30	204.701	26.2977	1118.93	0	0
31	206.889	26.6595	1117.76	0	0
32	208.657	26.9519	1116.54	0	0
33	210.426	27.2444	1115.07	0	0
34	212.195	27.5369	1113.35	0	0
35	213.963	27.8293	1111.39	0	0
36	215.732	28.1218	1109.17	0	0
37	217.501	28.4142	1106.7	0	0
38	219.762	28.7882	1103.19	0	0
39	224.258	29.5315	1095	0	0
40	226.506	29.9032	1090.3	0	0
41	228.754	30.275	1085.2	0	0
42	233.251	31.0185	1073.79	0	0
43	235.427	31.3783	1067.69	0	0
44	237.603	31.7381	1061.22	0	0
45	239.753	32.0936	1054.45	0	0
46	241.903	32.4491	1047.32	0	0
47	244.052	33.0901	895.193	0	0
48	246.202	33.7312	756.385	0	0
49	248.897	34.7506	516.979	0	0
50	251.591	36.5354	134.058	0	0
51	253.925	38.9921	0	0	0

Discharge Sections

Entity Information

Simplified Janbu Method - Effective Stress

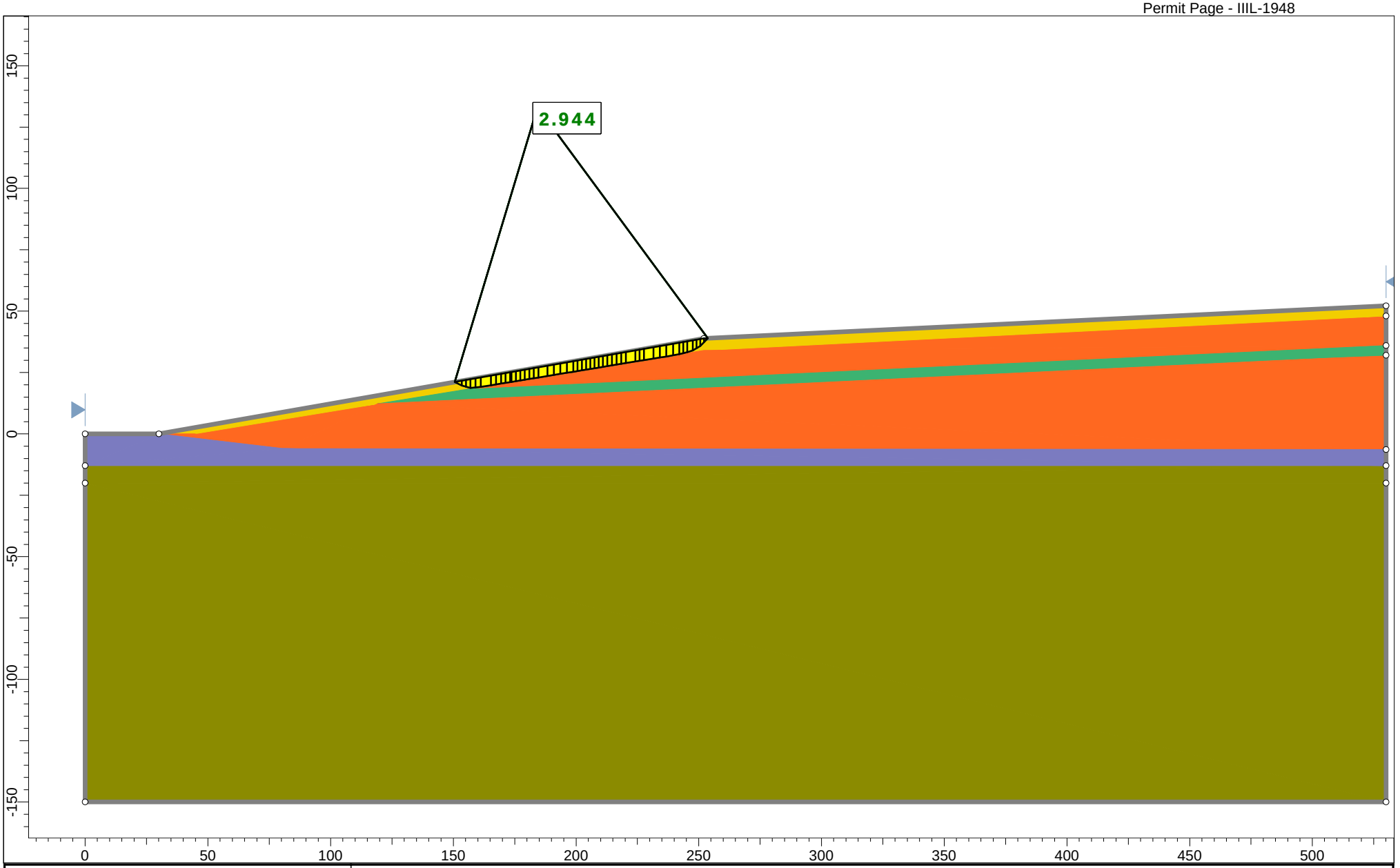
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -13 0, -20.047 0, -150 530, -150 530, -20.047 530, -13 530, -6.4 530, 32 530, 36 530, 48 530, 52.2 252, 38.9 30, 0
Material Boundary	30, 0 44.535, 0 119.116, 12.2226 154.932, 18.0923 252, 34 530, 48
Material Boundary	119.116, 12.2226 530, 32
Material Boundary	154.932, 18.0923 530, 36
Material Boundary	30, 0 81, -6 530, -6.4
Material Boundary	0, -13 530, -13

Simplified Bishop Method - Effective Stress

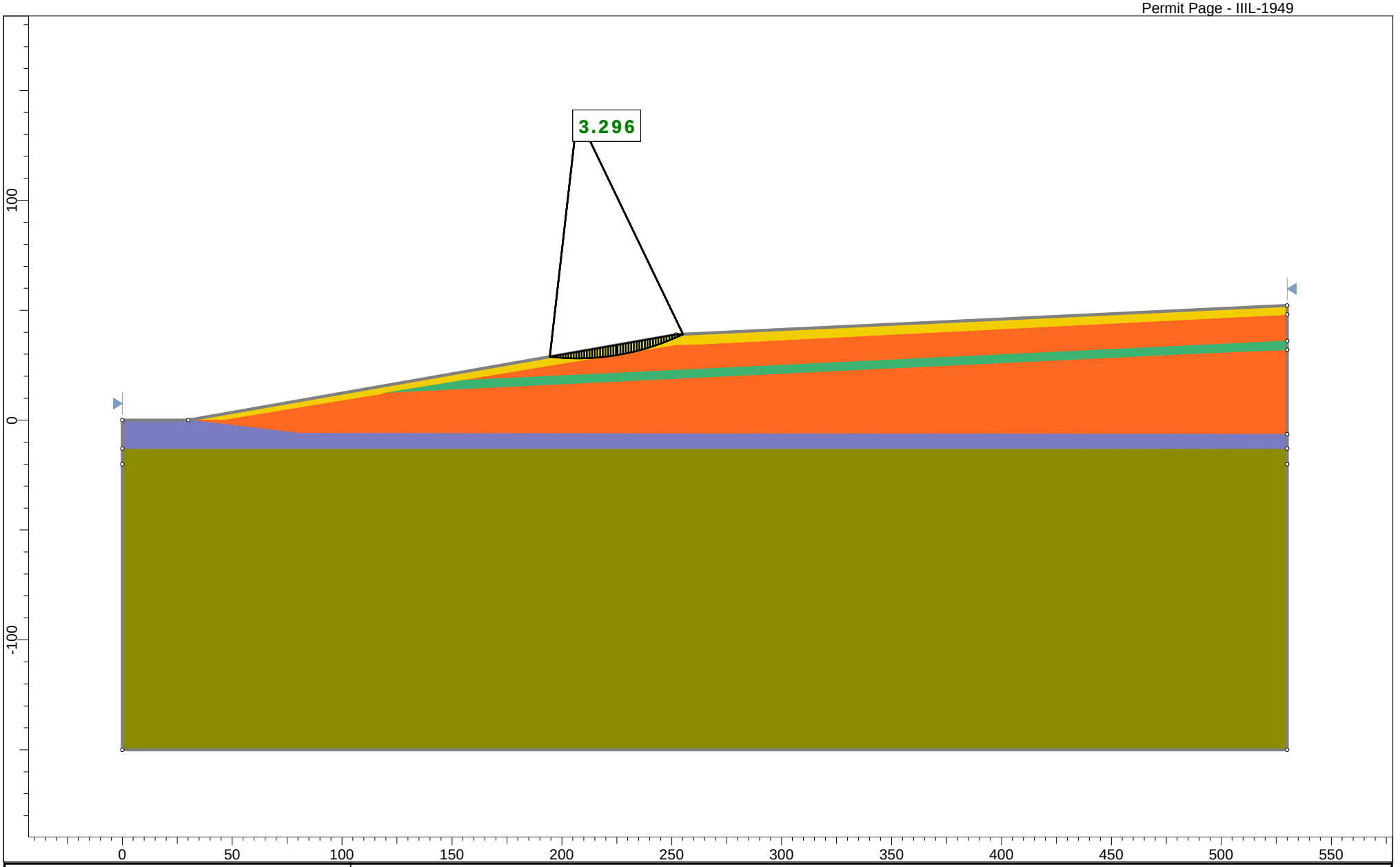
Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -13 0, -20.047 0, -150 530, -150 530, -20.047 530, -13 530, -6.4 530, 32 530, 36 530, 48 530, 52.2 252, 38.9 30, 0
Material Boundary	30, 0 44.535, 0 119.116, 12.2226 154.932, 18.0923 252, 34 530, 48
Material Boundary	119.116, 12.2226 530, 32
Material Boundary	154.932, 18.0923 530, 36
Material Boundary	30, 0 81, -6 530, -6.4
Material Boundary	0, -13 530, -13



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Janbu Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
	Date		File Name: Slide2-Overliner Section E_Total Stress.slmd

SLIDEINTERPRET 9.018



rocscience	Project	SLIDE - An Interactive Slope Stability Program	
	Group	Simplified Bishop Method - Total Stress	Scenario: Master Scenario
	Drawn By		Company
SLIDEINTERPRET 9.018	Date		File Name: Slide2-Overliner Section E_Total Stress.slmd

Materials

Final Cover	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	Assigned per scenario
Ru Value	0
Liner	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	1000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Waste	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	47
Cohesion [psf]	288
Friction Angle [deg]	23
Water Surface	Assigned per scenario
Ru Value	0
Stratum II	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	110.9
Cohesion [psf]	206
Friction Angle [deg]	26
Water Surface	Assigned per scenario
Ru Value	0
Stratum III	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	109.7
Cohesion [psf]	150
Friction Angle [deg]	24
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Global Minimums

Simplified Janbu Method - Total Stress

Method: janbu simplified

FS	2.944100
Axis Location:	184.287, 133.127
Left Slip Surface Endpoint:	150.599, 21.132
Right Slip Surface Endpoint:	253.670, 38.980
Resisting Horizontal Force:	24223.6 lb
Driving Horizontal Force:	8227.82 lb
Total Slice Area:	416.166 ft2
Surface Horizontal Width:	103.071 ft
Surface Average Height:	4.03764 ft

Simplified Bishop Method - Total Stress

Method: janbu simplified

FS	3.295620
Center:	207.056, 138.940
Radius:	110.828
Left Slip Surface Endpoint:	194.504, 28.825
Right Slip Surface Endpoint:	255.056, 39.046
Resisting Horizontal Force:	12390.2 lb
Driving Horizontal Force:	3759.6 lb
Total Slice Area:	189.419 ft2
Surface Horizontal Width:	60.5516 ft
Surface Average Height:	3.12823 ft

Global Minimum Coordinates

Simplified Janbu Method - Total Stress

Method: janbu simplified

X	Y
150.599	21.132
153.401	19.6822
156.924	18.7008
161.163	19.1416
165.288	19.7912
169.412	20.4662
173.525	21.1391
177.27	21.7549
180.954	22.3607
184.629	22.9649
188.317	23.5713
190.961	24.0061
193.605	24.4408
196.249	24.8756
198.893	25.3103
202.339	25.8769
205.789	26.4441
209.238	27.0113
212.688	27.5785
216.497	28.2049
220.325	28.8342
224.152	29.4635
227.638	30.0367
231.484	30.6691
234.117	31.102
236.716	31.5294
239.548	31.9951
242.086	32.4653
245.26	33.2683
247.523	34.0298
250.587	35.828
253.67	38.9799

Slice Data

Simplified Janbu Method - Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.9441

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.80193	326.263	-27.3574	Final Cover	100	16	47.7117	140.468	141.129	0	141.129	116.442	116.442
2	1.76177	494.794	-15.5642	Final Cover	100	16	63.03	185.567	298.406	0	298.406	280.85	280.85
3	1.76177	663.801	-15.5642	Final Cover	100	16	72.6337	213.841	397.011	0	397.011	376.78	376.78
4	2.11923	919.324	5.93792	Final Cover	100	16	75.4526	222.14	425.953	0	425.953	433.8	433.8
5	2.11923	957.706	5.93792	Final Cover	100	16	77.1988	227.281	443.882	0	443.882	451.911	451.911
6	4.12483	1919.52	8.94974	Final Cover	100	16	78.0925	229.912	453.058	0	453.058	465.356	465.356
7	2.06241	971.771	9.29337	Final Cover	100	16	78.605	231.421	458.319	0	458.319	471.182	471.182
8	2.06241	977.686	9.29337	Final Cover	100	16	78.8798	232.23	461.142	0	461.142	474.049	474.049
9	1.8707	891.919	9.29337	Final Cover	100	16	79.142	233.002	463.833	0	463.833	476.784	476.784
10	1.8707	896.786	9.29337	Final Cover	100	16	79.3913	233.736	466.394	0	466.394	479.385	479.385
11	0.370871	178.367	9.29337	Final Cover	100	16	79.5404	234.175	467.925	0	467.925	480.941	480.941
12	0.168149	80.9314	9.33731	Final Cover	100	16	79.5696	234.261	468.224	0	468.224	481.307	481.307
13	1.78852	863.102	9.33731	Final Cover	100	16	79.6916	234.62	469.475	0	469.475	482.579	482.579
14	1.78852	867.248	9.33731	Final Cover	100	16	79.9137	235.274	471.757	0	471.757	484.896	484.896
15	1.84197	897.496	9.33731	Final Cover	100	16	80.1393	235.938	474.072	0	474.072	487.249	487.249
16	1.84197	901.893	9.33731	Final Cover	100	16	80.3682	236.612	476.422	0	476.422	489.636	489.636
17	1.83742	904.046	9.33731	Final Cover	100	16	80.5968	237.285	478.768	0	478.768	492.021	492.021
18	1.83742	908.422	9.33731	Final Cover	100	16	80.825	237.957	481.112	0	481.112	494.402	494.402
19	3.68798	1836.55	9.33731	Final Cover	100	16	81.1681	238.967	484.636	0	484.636	497.982	497.982
20	2.64406	1327.55	9.33731	Final Cover	100	16	81.5614	240.125	488.676	0	488.676	502.087	502.087
21	2.64406	1336.61	9.33731	Final Cover	100	16	81.8899	241.092	492.05	0	492.05	505.514	505.514
22	2.64406	1345.67	9.33731	Final Cover	100	16	82.2187	242.06	495.42	0	495.42	508.938	508.938
23	2.64406	1354.73	9.33731	Final Cover	100	16	82.5471	243.027	498.793	0	498.793	512.366	512.366
24	1.72304	887.706	9.33731	Final Cover	100	16	82.8182	243.825	501.579	0	501.579	515.196	515.196
25	1.72304	891.553	9.33731	Final Cover	100	16	83.0325	244.456	503.777	0	503.777	517.429	517.429
26	1.72477	896.301	9.33731	Final Cover	100	16	83.2465	245.086	505.976	0	505.976	519.663	519.663
27	1.72477	900.157	9.33731	Final Cover	100	16	83.4608	245.717	508.176	0	508.176	521.899	521.899
28	1.72477	904.012	9.33731	Final Cover	100	16	83.6751	246.348	510.376	0	510.376	524.134	524.134
29	1.72477	907.868	9.33731	Final Cover	100	16	83.8895	246.979	512.576	0	512.576	526.37	526.37

30	1.72479	911.73	9.33731	Final Cover	100	16	84.1038	247.61	514.776	0	514.776	528.605	528.605
31	1.72479	915.585	9.33731	Final Cover	100	16	84.3181	248.241	516.976	0	516.976	530.84	530.84
32	1.90486	1015.66	9.33731	Final Cover	100	16	84.5433	248.904	519.291	0	519.291	533.192	533.192
33	1.90486	1020.36	9.33731	Final Cover	100	16	84.7801	249.601	521.721	0	521.721	535.661	535.661
34	1.91368	1029.82	9.33731	Final Cover	100	16	85.0172	250.299	524.154	0	524.154	538.133	538.133
35	1.91368	1034.56	9.33731	Final Cover	100	16	85.2549	250.999	526.598	0	526.598	540.616	540.616
36	3.82735	2083.37	9.33731	Final Cover	100	16	85.6116	252.049	530.259	0	530.259	544.336	544.336
37	1.74294	955.037	9.33731	Final Cover	100	16	85.9577	253.068	533.812	0	533.812	547.945	547.945
38	1.74294	958.974	9.33731	Final Cover	100	16	86.1744	253.706	536.036	0	536.036	550.205	550.205
39	3.84587	2129.94	9.33731	Final Cover	100	16	86.5215	254.728	539.599	0	539.599	553.825	553.825
40	2.63309	1469.33	9.33731	Final Cover	100	16	86.924	255.913	543.732	0	543.732	558.024	558.024
41	2.59939	1459.34	9.33731	Final Cover	100	16	87.2491	256.87	547.069	0	547.069	561.415	561.415
42	2.8321	1599.95	9.33731	Final Cover	100	16	87.5864	257.863	550.533	0	550.533	564.934	564.934
43	2.53708	1434.04	10.5003	Final Cover	100	16	87.4393	257.43	549.023	0	549.023	565.229	565.229
44	1.58722	882.95	14.1955	Final Cover	100	16	86.0273	253.273	534.526	0	534.526	556.287	556.287
45	1.58722	859.451	14.1955	Final Cover	100	16	84.6201	249.13	520.077	0	520.077	541.482	541.482
46	2.26336	1159.26	18.5946	Final Cover	100	16	81.1912	239.035	484.871	0	484.871	512.187	512.187
47	1.53175	693.045	30.412	Final Cover	100	16	73.8137	217.315	409.126	0	409.126	452.453	452.453
48	1.53175	577.116	30.412	Final Cover	100	16	66.841	196.787	337.535	0	337.535	376.769	376.769
49	1.54174	401.617	45.629	Final Cover	100	16	53.965	158.878	205.333	0	205.333	260.496	260.496
50	1.54174	138.96	45.629	Final Cover	100	16	38.8745	114.45	50.3946	0	50.3946	90.1321	90.1321

Query 1 (janbu simplified) - Safety Factor: 2.9441

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.80193	326.263	-27.3574	Final Cover	100	16	47.7117	140.468	141.129	0	141.129	116.442	116.442
2	1.76177	494.794	-15.5642	Final Cover	100	16	63.03	185.567	298.406	0	298.406	280.85	280.85
3	1.76177	663.801	-15.5642	Final Cover	100	16	72.6337	213.841	397.011	0	397.011	376.78	376.78
4	2.11923	919.324	5.93792	Final Cover	100	16	75.4526	222.14	425.953	0	425.953	433.8	433.8
5	2.11923	957.706	5.93792	Final Cover	100	16	77.1988	227.281	443.882	0	443.882	451.911	451.911
6	4.12483	1919.52	8.94974	Final Cover	100	16	78.0925	229.912	453.058	0	453.058	465.356	465.356
7	2.06241	971.771	9.29337	Final Cover	100	16	78.605	231.421	458.319	0	458.319	471.182	471.182
8	2.06241	977.686	9.29337	Final Cover	100	16	78.8798	232.23	461.142	0	461.142	474.049	474.049
9	1.8707	891.919	9.29337	Final Cover	100	16	79.142	233.002	463.833	0	463.833	476.784	476.784
10	1.8707	896.786	9.29337	Final Cover	100	16	79.3913	233.736	466.394	0	466.394	479.385	479.385
11	0.370871	178.367	9.29337	Final Cover	100	16	79.5404	234.175	467.925	0	467.925	480.941	480.941
12	0.168149	80.9314	9.33731	Final Cover	100	16	79.5696	234.261	468.224	0	468.224	481.307	481.307
13	1.78852	863.102	9.33731	Final Cover	100	16	79.6916	234.62	469.475	0	469.475	482.579	482.579
14	1.78852	867.248	9.33731	Final Cover	100	16	79.9137	235.274	471.757	0	471.757	484.896	484.896
15	1.84197	897.496	9.33731	Final Cover	100	16	80.1393	235.938	474.072	0	474.072	487.249	487.249
16	1.84197	901.893	9.33731	Final Cover	100	16	80.3682	236.612	476.422	0	476.422	489.636	489.636
17	1.83742	904.046	9.33731	Final Cover	100	16	80.5968	237.285	478.768	0	478.768	492.021	492.021
18	1.83742	908.422	9.33731	Final Cover	100	16	80.825	237.957	481.112	0	481.112	494.402	494.402
19	3.68798	1836.55	9.33731	Final Cover	100	16	81.1681	238.967	484.636	0	484.636	497.982	497.982
20	2.64406	1327.55	9.33731	Final Cover	100	16	81.5614	240.125	488.676	0	488.676	502.087	502.087
21	2.64406	1336.61	9.33731	Final Cover	100	16	81.8899	241.092	492.05	0	492.05	505.514	505.514
22	2.64406	1345.67	9.33731	Final Cover	100	16	82.2187	242.06	495.42	0	495.42	508.938	508.938
23	2.64406	1354.73	9.33731	Final Cover	100	16	82.5471	243.027	498.793	0	498.793	512.366	512.366
24	1.72304	887.706	9.33731	Final Cover	100	16	82.8182	243.825	501.579	0	501.579	515.196	515.196
25	1.72304	891.553	9.33731	Final Cover	100	16	83.0325	244.456	503.777	0	503.777	517.429	517.429
26	1.72477	896.301	9.33731	Final Cover	100	16	83.2465	245.086	505.976	0	505.976	519.663	519.663
27	1.72477	900.157	9.33731	Final Cover	100	16	83.4608	245.717	508.176	0	508.176	521.899	521.899
28	1.72477	904.012	9.33731	Final Cover	100	16	83.6751	246.348	510.376	0	510.376	524.134	524.134
29	1.72477	907.868	9.33731	Final Cover	100	16	83.8895	246.979	512.576	0	512.576	526.37	526.37
30	1.72479	911.73	9.33731	Final Cover	100	16	84.1038	247.61	514.776	0	514.776	528.605	528.605
31	1.72479	915.585	9.33731	Final Cover	100	16	84.3181	248.241	516.976	0	516.976	530.84	530.84
32	1.90486	1015.66	9.33731	Final Cover	100	16	84.5433	248.904	519.291	0	519.291	533.192	533.192
33	1.90486	1020.36	9.33731	Final Cover	100	16	84.7801	249.601	521.721	0	521.721	535.661	535.661

34	1.91368	1029.82	9.33731	Final Cover	100	16	85.0172	250.299	524.154	0	524.154	538.133	538.133
35	1.91368	1034.56	9.33731	Final Cover	100	16	85.2549	250.999	526.598	0	526.598	540.616	540.616
36	3.82735	2083.37	9.33731	Final Cover	100	16	85.6116	252.049	530.259	0	530.259	544.336	544.336
37	1.74294	955.037	9.33731	Final Cover	100	16	85.9577	253.068	533.812	0	533.812	547.945	547.945
38	1.74294	958.974	9.33731	Final Cover	100	16	86.1744	253.706	536.036	0	536.036	550.205	550.205
39	3.84587	2129.94	9.33731	Final Cover	100	16	86.5215	254.728	539.599	0	539.599	553.825	553.825
40	2.63309	1469.33	9.33731	Final Cover	100	16	86.924	255.913	543.732	0	543.732	558.024	558.024
41	2.59939	1459.34	9.33731	Final Cover	100	16	87.2491	256.87	547.069	0	547.069	561.415	561.415
42	2.8321	1599.95	9.33731	Final Cover	100	16	87.5864	257.863	550.533	0	550.533	564.934	564.934
43	2.53708	1434.04	10.5003	Final Cover	100	16	87.4393	257.43	549.023	0	549.023	565.229	565.229
44	1.58722	882.95	14.1955	Final Cover	100	16	86.0273	253.273	534.526	0	534.526	556.287	556.287
45	1.58722	859.451	14.1955	Final Cover	100	16	84.6201	249.13	520.077	0	520.077	541.482	541.482
46	2.26336	1159.26	18.5946	Final Cover	100	16	81.1912	239.035	484.871	0	484.871	512.187	512.187
47	1.53175	693.045	30.412	Final Cover	100	16	73.8137	217.315	409.126	0	409.126	452.453	452.453
48	1.53175	577.116	30.412	Final Cover	100	16	66.841	196.787	337.535	0	337.535	376.769	376.769
49	1.54174	401.617	45.629	Final Cover	100	16	53.965	158.878	205.333	0	205.333	260.496	260.496
50	1.54174	138.96	45.629	Final Cover	100	16	38.8745	114.45	50.3946	0	50.3946	90.1321	90.1321

Simplified Bishop Method - Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 3.29562

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.20542	24.7311	-6.18935	Final Cover	100	16	32.4345	106.892	24.0348	0	24.0348	20.5174	20.5174
2	1.20542	73.2298	-5.56287	Final Cover	100	16	35.9337	118.424	64.2512	0	64.2512	60.7514	60.7514
3	1.20542	119.805	-4.93705	Final Cover	100	16	39.2863	129.473	102.783	0	102.783	99.3895	99.3895
4	1.20542	164.462	-4.31183	Final Cover	100	16	42.4932	140.041	139.641	0	139.641	136.437	136.437
5	1.20542	207.207	-3.68712	Final Cover	100	16	45.5551	150.132	174.832	0	174.832	171.897	171.897
6	1.20542	248.043	-3.06285	Final Cover	100	16	48.4729	159.748	208.367	0	208.367	205.774	205.774
7	1.20542	286.974	-2.43894	Final Cover	100	16	51.2473	168.892	240.253	0	240.253	238.07	238.07
8	1.20542	324.003	-1.81532	Final Cover	100	16	53.8787	177.564	270.497	0	270.497	268.79	268.79
9	1.20542	359.133	-1.19192	Final Cover	100	16	56.3679	185.767	299.105	0	299.105	297.933	297.933
10	1.20542	392.365	-0.568655	Final Cover	100	16	58.7153	193.503	326.084	0	326.084	325.501	325.501
11	1.20542	423.701	0.0545394	Final Cover	100	16	60.9212	200.773	351.439	0	351.439	351.497	351.497
12	1.20542	453.139	0.677741	Final Cover	100	16	62.9863	207.579	375.174	0	375.174	375.919	375.919
13	1.20542	480.681	1.30102	Final Cover	100	16	64.911	213.922	397.292	0	397.292	398.767	398.767
14	1.20542	506.325	1.92446	Final Cover	100	16	66.6952	219.802	417.799	0	417.799	420.04	420.04
15	1.20542	530.068	2.54812	Final Cover	100	16	68.3395	225.221	436.697	0	436.697	439.738	439.738
16	1.20542	551.91	3.17209	Final Cover	100	16	69.8436	230.178	453.986	0	453.986	457.857	457.857
17	1.20542	571.846	3.79643	Final Cover	100	16	71.2085	234.676	469.67	0	469.67	474.395	474.395
18	1.20542	589.873	4.42122	Final Cover	100	16	72.4334	238.713	483.75	0	483.75	489.35	489.35
19	1.20542	605.987	5.04655	Final Cover	100	16	73.5188	242.29	496.226	0	496.226	502.718	502.718
20	1.20542	620.181	5.67247	Final Cover	100	16	74.4649	245.408	507.096	0	507.096	514.493	514.493
21	1.20542	632.451	6.29908	Final Cover	100	16	75.2711	248.065	516.363	0	516.363	524.672	524.672
22	1.20542	642.789	6.92644	Final Cover	100	16	75.9375	250.261	524.023	0	524.023	533.248	533.248
23	1.20542	651.189	7.55464	Final Cover	100	16	76.4642	251.997	530.075	0	530.075	540.216	540.216
24	1.20542	657.642	8.18375	Final Cover	100	16	76.8505	253.27	534.517	0	534.517	545.569	545.569
25	1.20542	662.139	8.81386	Final Cover	100	16	77.0966	254.081	537.345	0	537.345	549.3	549.3
26	0.679171	374.375	9.30707	Final Cover	100	16	77.2031	254.432	538.568	0	538.568	551.22	551.22
27	1.23904	683.775	9.81001	Final Cover	100	16	77.1976	254.414	538.506	0	538.506	551.855	551.855
28	1.23904	683.121	10.4607	Final Cover	100	16	77.075	254.01	537.097	0	537.097	551.327	551.327
29	1.23904	680.302	11.1128	Final Cover	100	16	76.8025	253.112	533.965	0	533.965	549.051	549.051
30	1.23904	675.303	11.7664	Final Cover	100	16	76.3799	251.719	529.107	0	529.107	545.017	545.017
31	1.23904	668.108	12.4215	Final Cover	100	16	75.8061	249.828	522.513	0	522.513	539.21	539.21
32	1.23904	658.702	13.0783	Final Cover	100	16	75.0809	247.438	514.176	0	514.176	531.618	531.618

33	1.23904	647.067	13.7368	Final Cover	100	16	74.203	244.545	504.088	0	504.088	522.228	522.228
34	1.23904	633.185	14.3972	Final Cover	100	16	73.1723	241.148	492.24	0	492.24	511.024	511.024
35	1.23904	617.036	15.0595	Final Cover	100	16	71.9871	237.242	478.621	0	478.621	497.99	497.99
36	1.23904	598.6	15.7239	Final Cover	100	16	70.6471	232.826	463.22	0	463.22	483.11	483.11
37	1.23904	577.853	16.3905	Final Cover	100	16	69.1512	227.896	446.026	0	446.026	466.366	466.366
38	1.23904	554.774	17.0594	Final Cover	100	16	67.4981	222.448	427.027	0	427.027	447.74	447.74
39	1.23904	529.338	17.7306	Final Cover	100	16	65.6866	216.478	406.209	0	406.209	427.211	427.211
40	1.23904	501.518	18.4044	Final Cover	100	16	63.7158	209.983	383.557	0	383.557	404.757	404.757
41	1.23904	471.286	19.0809	Final Cover	100	16	61.5842	202.958	359.056	0	359.056	380.358	380.358
42	1.23904	438.614	19.7601	Final Cover	100	16	59.29	195.397	332.69	0	332.69	353.989	353.989
43	1.23904	403.471	20.4422	Final Cover	100	16	56.8323	187.298	304.443	0	304.443	325.626	325.626
44	1.23904	365.824	21.1274	Final Cover	100	16	54.2092	178.653	274.295	0	274.295	295.242	295.242
45	1.23904	325.638	21.8158	Final Cover	100	16	51.419	169.457	242.227	0	242.227	262.81	262.81
46	1.23904	282.879	22.5074	Final Cover	100	16	48.4601	159.706	208.219	0	208.219	228.299	228.299
47	1.23904	237.506	23.2026	Final Cover	100	16	45.3304	149.392	172.25	0	172.25	191.681	191.681
48	1.23904	186.931	23.9014	Final Cover	100	16	41.8556	137.94	132.314	0	132.314	150.863	150.863
49	1.23904	116.085	24.604	Final Cover	100	16	37.0197	122.003	76.7333	0	76.7333	93.6854	93.6854
50	1.23904	39.1557	25.3105	Final Cover	100	16	31.7847	104.75	16.5664	0	16.5664	31.5981	31.5981

Query 1 (janbu simplified) - Safety Factor: 3.29562

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.20542	24.7311	-6.18935	Final Cover	100	16	32.4345	106.892	24.0348	0	24.0348	20.5174	20.5174
2	1.20542	73.2298	-5.56287	Final Cover	100	16	35.9337	118.424	64.2512	0	64.2512	60.7514	60.7514
3	1.20542	119.805	-4.93705	Final Cover	100	16	39.2863	129.473	102.783	0	102.783	99.3895	99.3895
4	1.20542	164.462	-4.31183	Final Cover	100	16	42.4932	140.041	139.641	0	139.641	136.437	136.437
5	1.20542	207.207	-3.68712	Final Cover	100	16	45.5551	150.132	174.832	0	174.832	171.897	171.897
6	1.20542	248.043	-3.06285	Final Cover	100	16	48.4729	159.748	208.367	0	208.367	205.774	205.774
7	1.20542	286.974	-2.43894	Final Cover	100	16	51.2473	168.892	240.253	0	240.253	238.07	238.07
8	1.20542	324.003	-1.81532	Final Cover	100	16	53.8787	177.564	270.497	0	270.497	268.79	268.79
9	1.20542	359.133	-1.19192	Final Cover	100	16	56.3679	185.767	299.105	0	299.105	297.933	297.933
10	1.20542	392.365	-0.568655	Final Cover	100	16	58.7153	193.503	326.084	0	326.084	325.501	325.501
11	1.20542	423.701	0.0545394	Final Cover	100	16	60.9212	200.773	351.439	0	351.439	351.497	351.497
12	1.20542	453.139	0.677741	Final Cover	100	16	62.9863	207.579	375.174	0	375.174	375.919	375.919
13	1.20542	480.681	1.30102	Final Cover	100	16	64.911	213.922	397.292	0	397.292	398.767	398.767
14	1.20542	506.325	1.92446	Final Cover	100	16	66.6952	219.802	417.799	0	417.799	420.04	420.04
15	1.20542	530.068	2.54812	Final Cover	100	16	68.3395	225.221	436.697	0	436.697	439.738	439.738
16	1.20542	551.91	3.17209	Final Cover	100	16	69.8436	230.178	453.986	0	453.986	457.857	457.857
17	1.20542	571.846	3.79643	Final Cover	100	16	71.2085	234.676	469.67	0	469.67	474.395	474.395
18	1.20542	589.873	4.42122	Final Cover	100	16	72.4334	238.713	483.75	0	483.75	489.35	489.35
19	1.20542	605.987	5.04655	Final Cover	100	16	73.5188	242.29	496.226	0	496.226	502.718	502.718
20	1.20542	620.181	5.67247	Final Cover	100	16	74.4649	245.408	507.096	0	507.096	514.493	514.493
21	1.20542	632.451	6.29908	Final Cover	100	16	75.2711	248.065	516.363	0	516.363	524.672	524.672
22	1.20542	642.789	6.92644	Final Cover	100	16	75.9375	250.261	524.023	0	524.023	533.248	533.248
23	1.20542	651.189	7.55464	Final Cover	100	16	76.4642	251.997	530.075	0	530.075	540.216	540.216
24	1.20542	657.642	8.18375	Final Cover	100	16	76.8505	253.27	534.517	0	534.517	545.569	545.569
25	1.20542	662.139	8.81386	Final Cover	100	16	77.0966	254.081	537.345	0	537.345	549.3	549.3
26	0.679171	374.375	9.30707	Final Cover	100	16	77.2031	254.432	538.568	0	538.568	551.22	551.22
27	1.23904	683.775	9.81001	Final Cover	100	16	77.1976	254.414	538.506	0	538.506	551.855	551.855
28	1.23904	683.121	10.4607	Final Cover	100	16	77.075	254.01	537.097	0	537.097	551.327	551.327
29	1.23904	680.302	11.1128	Final Cover	100	16	76.8025	253.112	533.965	0	533.965	549.051	549.051
30	1.23904	675.303	11.7664	Final Cover	100	16	76.3799	251.719	529.107	0	529.107	545.017	545.017
31	1.23904	668.108	12.4215	Final Cover	100	16	75.8061	249.828	522.513	0	522.513	539.21	539.21
32	1.23904	658.702	13.0783	Final Cover	100	16	75.0809	247.438	514.176	0	514.176	531.618	531.618
33	1.23904	647.067	13.7368	Final Cover	100	16	74.203	244.545	504.088	0	504.088	522.228	522.228

34	1.23904	633.185	14.3972	Final Cover	100	16	73.1723	241.148	492.24	0	492.24	511.024	511.024
35	1.23904	617.036	15.0595	Final Cover	100	16	71.9871	237.242	478.621	0	478.621	497.99	497.99
36	1.23904	598.6	15.7239	Final Cover	100	16	70.6471	232.826	463.22	0	463.22	483.11	483.11
37	1.23904	577.853	16.3905	Final Cover	100	16	69.1512	227.896	446.026	0	446.026	466.366	466.366
38	1.23904	554.774	17.0594	Final Cover	100	16	67.4981	222.448	427.027	0	427.027	447.74	447.74
39	1.23904	529.338	17.7306	Final Cover	100	16	65.6866	216.478	406.209	0	406.209	427.211	427.211
40	1.23904	501.518	18.4044	Final Cover	100	16	63.7158	209.983	383.557	0	383.557	404.757	404.757
41	1.23904	471.286	19.0809	Final Cover	100	16	61.5842	202.958	359.056	0	359.056	380.358	380.358
42	1.23904	438.614	19.7601	Final Cover	100	16	59.29	195.397	332.69	0	332.69	353.989	353.989
43	1.23904	403.471	20.4422	Final Cover	100	16	56.8323	187.298	304.443	0	304.443	325.626	325.626
44	1.23904	365.824	21.1274	Final Cover	100	16	54.2092	178.653	274.295	0	274.295	295.242	295.242
45	1.23904	325.638	21.8158	Final Cover	100	16	51.419	169.457	242.227	0	242.227	262.81	262.81
46	1.23904	282.879	22.5074	Final Cover	100	16	48.4601	159.706	208.219	0	208.219	228.299	228.299
47	1.23904	237.506	23.2026	Final Cover	100	16	45.3304	149.392	172.25	0	172.25	191.681	191.681
48	1.23904	186.931	23.9014	Final Cover	100	16	41.8556	137.94	132.314	0	132.314	150.863	150.863
49	1.23904	116.085	24.604	Final Cover	100	16	37.0197	122.003	76.7333	0	76.7333	93.6854	93.6854
50	1.23904	39.1557	25.3105	Final Cover	100	16	31.7847	104.75	16.5664	0	16.5664	31.5981	31.5981

Interslice Data

Simplified Janbu Method - Total Stress

Global Minimum Query (janbu simplified) - Safety Factor: 2.9441

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	150.599	21.132	0	0	0
2	153.401	19.6822	338.285	0	0
3	155.163	19.1915	595.76	0	0
4	156.924	18.7008	918.54	0	0
5	159.044	18.9212	984.554	0	0
6	161.163	19.1416	1050.32	0	0
7	165.288	19.7912	1078.13	0	0
8	167.35	20.1287	1085.57	0	0
9	169.412	20.4662	1092.62	0	0
10	171.283	20.7723	1098.68	0	0
11	173.154	21.0785	1104.43	0	0
12	173.525	21.1391	1105.53	0	0
13	173.693	21.1668	1105.97	0	0
14	175.481	21.4609	1110.43	0	0
15	177.27	21.7549	1114.63	0	0
16	179.112	22.0578	1118.66	0	0
17	180.954	22.3607	1122.41	0	0
18	182.791	22.6628	1125.85	0	0
19	184.629	22.9649	1129.01	0	0
20	188.317	23.5713	1134.47	0	0
21	190.961	24.0061	1137.67	0	0
22	193.605	24.4408	1140.28	0	0
23	196.249	24.8756	1142.29	0	0
24	198.893	25.3103	1143.7	0	0
25	200.616	25.5936	1144.29	0	0
26	202.339	25.8769	1144.63	0	0
27	204.064	26.1605	1144.72	0	0
28	205.789	26.4441	1144.56	0	0
29	207.513	26.7277	1144.14	0	0
30	209.238	27.0113	1143.46	0	0
31	210.963	27.2949	1142.53	0	0
32	212.688	27.5785	1141.35	0	0
33	214.593	27.8917	1139.75	0	0
34	216.497	28.2049	1137.84	0	0
35	218.411	28.5196	1135.6	0	0
36	220.325	28.8342	1133.06	0	0
37	224.152	29.4635	1127.02	0	0
38	225.895	29.7501	1123.86	0	0
39	227.638	30.0367	1120.44	0	0
40	231.484	30.6691	1111.97	0	0
41	234.117	31.102	1105.44	0	0
42	236.716	31.5294	1098.42	0	0
43	239.548	31.9951	1090.1	0	0
44	242.086	32.4653	1053.77	0	0
45	243.673	32.8668	975.709	0	0
46	245.26	33.2683	901.211	0	0
47	247.523	34.0298	715.761	0	0
48	249.055	34.9289	460.978	0	0
49	250.587	35.828	259.883	0	0
50	252.129	37.4039	19.4853	0	0
51	253.67	38.9799	0	0	0

Query 1 (janbu simplified) - Safety Factor: 2.9441

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	150.599	21.132	0	0	0
2	153.401	19.6822	338.285	0	0
3	155.163	19.1915	595.76	0	0
4	156.924	18.7008	918.54	0	0
5	159.044	18.9212	984.554	0	0
6	161.163	19.1416	1050.32	0	0
7	165.288	19.7912	1078.13	0	0
8	167.35	20.1287	1085.57	0	0
9	169.412	20.4662	1092.62	0	0
10	171.283	20.7723	1098.68	0	0
11	173.154	21.0785	1104.43	0	0
12	173.525	21.1391	1105.53	0	0
13	173.693	21.1668	1105.97	0	0
14	175.481	21.4609	1110.43	0	0
15	177.27	21.7549	1114.63	0	0
16	179.112	22.0578	1118.66	0	0
17	180.954	22.3607	1122.41	0	0
18	182.791	22.6628	1125.85	0	0
19	184.629	22.9649	1129.01	0	0
20	188.317	23.5713	1134.47	0	0
21	190.961	24.0061	1137.67	0	0
22	193.605	24.4408	1140.28	0	0
23	196.249	24.8756	1142.29	0	0
24	198.893	25.3103	1143.7	0	0
25	200.616	25.5936	1144.29	0	0
26	202.339	25.8769	1144.63	0	0
27	204.064	26.1605	1144.72	0	0
28	205.789	26.4441	1144.56	0	0
29	207.513	26.7277	1144.14	0	0
30	209.238	27.0113	1143.46	0	0
31	210.963	27.2949	1142.53	0	0
32	212.688	27.5785	1141.35	0	0
33	214.593	27.8917	1139.75	0	0
34	216.497	28.2049	1137.84	0	0
35	218.411	28.5196	1135.6	0	0
36	220.325	28.8342	1133.06	0	0
37	224.152	29.4635	1127.02	0	0
38	225.895	29.7501	1123.86	0	0
39	227.638	30.0367	1120.44	0	0
40	231.484	30.6691	1111.97	0	0
41	234.117	31.102	1105.44	0	0
42	236.716	31.5294	1098.42	0	0
43	239.548	31.9951	1090.1	0	0
44	242.086	32.4653	1053.77	0	0
45	243.673	32.8668	975.709	0	0
46	245.26	33.2683	901.211	0	0
47	247.523	34.0298	715.761	0	0
48	249.055	34.9289	460.978	0	0
49	250.587	35.828	259.883	0	0
50	252.129	37.4039	19.4853	0	0
51	253.67	38.9799	0	0	0

Query 1 (janbu simplified) - Safety Factor: 3.29562

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	194.504	28.8253	0	0	0
2	195.71	28.6945	42.2481	0	0
3	196.915	28.5771	93.1166	0	0
4	198.12	28.473	151.186	0	0
5	199.326	28.3821	215.112	0	0
6	200.531	28.3045	283.618	0	0
7	201.737	28.24	355.501	0	0
8	202.942	28.1886	429.625	0	0
9	204.147	28.1504	504.921	0	0
10	205.353	28.1253	580.385	0	0
11	206.558	28.1134	655.079	0	0
12	207.764	28.1145	728.128	0	0
13	208.969	28.1288	798.721	0	0
14	210.175	28.1561	866.108	0	0
15	211.38	28.1966	929.6	0	0
16	212.585	28.2503	988.57	0	0
17	213.791	28.3171	1042.45	0	0
18	214.996	28.3971	1090.74	0	0
19	216.202	28.4903	1132.99	0	0
20	217.407	28.5967	1168.81	0	0
21	218.612	28.7165	1197.87	0	0
22	219.818	28.8495	1219.92	0	0
23	221.023	28.996	1234.74	0	0
24	222.229	29.1558	1242.19	0	0
25	223.434	29.3292	1242.19	0	0
26	224.64	29.5161	1234.71	0	0
27	225.319	29.6274	1227.21	0	0
28	226.558	29.8416	1207.52	0	0
29	227.797	30.0704	1180.17	0	0
30	229.036	30.3138	1145.4	0	0
31	230.275	30.5719	1103.5	0	0
32	231.514	30.8448	1054.85	0	0
33	232.753	31.1326	999.898	0	0
34	233.992	31.4355	939.177	0	0
35	235.231	31.7536	873.297	0	0
36	236.47	32.087	802.95	0	0
37	237.709	32.4358	728.916	0	0
38	238.948	32.8002	652.064	0	0
39	240.187	33.1805	573.354	0	0
40	241.426	33.5766	493.838	0	0
41	242.665	33.9889	414.669	0	0
42	243.904	34.4175	337.103	0	0
43	245.143	34.8626	262.5	0	0
44	246.382	35.3244	192.331	0	0
45	247.621	35.8032	128.185	0	0
46	248.861	36.2992	71.7708	0	0
47	250.1	36.8126	24.9255	0	0
48	251.339	37.3437	-10.3807	0	0
49	252.578	37.8928	-31.1617	0	0
50	253.817	38.4602	-28.8192	0	0
51	255.056	39.0462	0	0	0

Discharge Sections

Entity Information

Simplified Janbu Method - Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -13 0, -20.047 0, -150 530, -150 530, -20.047 530, -13 530, -6.4 530, 32 530, 36 530, 48 530, 52.2 252, 38.9 30, 0
Material Boundary	30, 0 44.535, 0 119.116, 12.2226 154.932, 18.0923 252, 34 530, 48
Material Boundary	119.116, 12.2226 530, 32
Material Boundary	154.932, 18.0923 530, 36
Material Boundary	30, 0 81, -6 530, -6.4
Material Boundary	0, -13 530, -13

Simplified Bishop Method - Total Stress

Shared Entities

Type	Coordinates (x,y)
External Boundary	0, 0 0, -13 0, -20.047 0, -150 530, -150 530, -20.047 530, -13 530, -6.4 530, 32 530, 36 530, 48 530, 52.2 252, 38.9 30, 0
Material Boundary	30, 0 44.535, 0 119.116, 12.2226 154.932, 18.0923 252, 34 530, 48
Material Boundary	119.116, 12.2226 530, 32
Material Boundary	154.932, 18.0923 530, 36
Material Boundary	30, 0 81, -6 530, -6.4
Material Boundary	0, -13 530, -13

INFINITE SLOPE

STABILITY ANALYSIS

STABILITY ANALYSIS OF THE LINER/OVERLINER/FINAL COVER SYSTEMS

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - Evaluate the stability of the liner/overliner/final cover system components.

References:

1 Koerner, Robert M., Designing with Geosynthetics , 3rd Edition, Prentice-Hall Inc., 1994.

2 Duncan, J.M. and Buchignani, A. L., An Engineering Manual for Slope Stability Studies, Department of Civil Engineering - University of California-Berkeley, 1975.

3 USACE, Slope Stability, Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.

4 Koerner, Robert M., Analysis and Design of Veneer Cover Soils, 1998 Sixth International Conference of Geosynthetics.

5 Koerner, George R. and Narejo, Dhani, Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces, GRI Report #30, June 14, 2005.

6 Gilbert, Robert B., Peak Versus Residual Strength for Waste Containment Systems, Proceedings of the 15th GRI Conference, December 13, 2001.

7 NAVFAC Design Manual 7.01, September 1986.

STABILITY ANALYSIS OF THE LINER/OVERLINER/FINAL COVER SYSTEMS

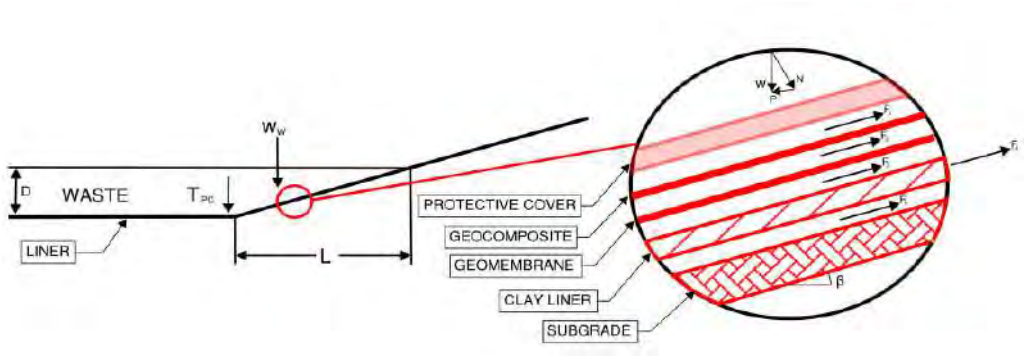
Client: City of Del Rio
Project: Major Permit Amendment
Description: Liner System Stability
Infinite Slope - Stability Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - Evaluate the stability of the liner/overliner/final cover system components.

A. Liner System Stability - Anchor Trench Design

The liner system includes a 2-foot-thick protective cover, drainage geocomposite, and a 2-foot-thick compacted clay liner (CCL).



1. Verify that tensile stress in liner system is less than yield stress for the liner system.

Clay Liner

Definition of terms/variables:

W_E = Weight of equipment, lb/ft

Assume a Caterpillar D8T WH Track-Type Tractor

Operational Weight	=	85,150 lb
Number of Tracks	=	2
Track Width	=	1.84 ft
W_W	=	Weight of solid waste, lb/ft
W_{PC}	=	Weight of protective cover, lb/ft
W_T	=	Combined weight of equipment, solid waste, and protective cover, lb/ft
T_{PC}	=	Friction force on edge of protective cover, lb/ft
W	=	Net force of equipment, waste, and protective cover on liner system, lb/ft
N	=	Normal force on liner system, lb/ft
P	=	Shearing force on liner system, lb/ft
β	=	Slope angle, degree
F_N	=	Resisting force, lb/ft

$$F_N = (N\ (\tan \Delta_n)) + \frac{C_{an} L}{\cos \beta}$$

F_1 = Resistance of protective cover/geocomposite interface, lb/ft
F_2 = Resistance of geocomposite/textured geomembrane interface, lb/ft
F_3 = Resistance of textured geomembrane/geosynthetic clay liner interface, lb/ft
F_4 = Resistance of internal geosynthetic clay liner, lb/ft
F_5 = Resistance of geosynthetic clay liner/foundation layer interface, lb/ft
F_6 = Resistance of textured geocomposite/clay liner interface, lb/ft
F_7 = Resistance of internal clay liner, lb/ft
F_8 = Resistance of clay liner/subgrade interface, lb/ft
Δ_n = Interface friction angle of interface "n", degree
C_{an} = Adhesion of interface "n", psf
ϕ_n = Internal friction angle of material "n", degree
C_n = Cohesion of material "n", psf
γ_{was} = Unit weight of solid waste (including daily cover), pcf
D_{was} = Individual lift height, ft
ϕ_{was} = Internal friction angle of waste, degree
γ_{pc} = Unit weight of protective cover, pcf
D_{pc} = Thickness of protective cover, ft
ϕ_{pc} = Internal friction angle of protective cover, degree
L = Horizontal length of lift, ft

Parameters:

$\beta_{sideslope}$	=	14.04	degree	Δ_7	=	18	degree
Δ_1	=	16	degree	C_{a7}	=	200	psf
C_{a1}	=	100	psf	Δ_8	=	16	degree
Δ_2	=	16	degree	C_{a8}	=	100	psf
C_{a2}	=	100	psf	γ_{was}	=	59	pcf
Δ_3	=	16	degree	D_{was}	=	10	ft
C_{a3}	=	100	psf	ϕ_{was}	=	21	deg
ϕ_4	=	16	degree	γ_{pc}	=	120	pcf
C_{a4}	=	100	psf	D_{pc}	=	2	ft
Δ_5	=	16	degree	ϕ_{pc}	=	16	deg
C_{a5}	=	100	psf	L	=	30	ft
ϕ_6	=	16	degree				
C_{a6}	=	100	psf				

Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

Weight of Equipment

$$W_E = \frac{Operational\ Weight}{Number\ of\ tracks\ x\ Width\ of\ track}$$

W_E = 23,139 lb/ft

Weight of Solid Waste

$$W_W = \frac{D_{was}\ L\ \gamma_{was}}{2}$$

W_W = 8,850 lb/ft

Weight of Protective Cover

$$W_{PC} = D_{pc}\ \gamma_{pc}\ \frac{L}{\cos\beta_{sideslope}}$$

W_{PC} = 7,422 lb/ft

Combined Weight of Equipment, Solid Waste, and Protective Cover

$$W_T = W_E + W_W + W_{PC}$$

W_T = 39,410 lb/ft

Friction Force on Edge of Protective Cover

$$T_{PC} = k_o\ \sigma_v(\tan\phi_{pc})D_{pc}$$

Where: $k_o = 1 - \sin\phi_{pc}$

$$\sigma_v = \frac{D_{pc}\ \gamma_{pc}}{2}$$

T_{PC} = 50 lb/ft

Net Force of Equipment, Solid Waste, and Protective Cover on Liner System

$$W = W_T - T_{PC}$$

W = 39,360 lb/ft

$$N = W\ (\cos\beta_{sideslope})$$

N = 38,185 lb/ft

$$P_{sideslope} = W\ (\sin\beta_{sideslope})$$

$P_{sideslope}$ = 9,549 lb/ft

Compacted Clay Liner Option (Subititle D Cells)

Resistance of protective cover/geocomposite interface, lb/ft F_1 = 14,042 lb/ft

$P_{sideslope} < F_1$ Therefore, protective cover soil is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

Resistance of geocomposite/textured geomembrane interface, lb/ft F_2 = 14,042 lb/ft

$P_{sideslope} < F_2$ Therefore, geocomposite is stable on the geomembrane and a driving force equal to P is transferred to the next interface.

Resistance of textured geocomposite/clay liner interface, lb/ft F_6 = 14,042 lb/ft

$P_{sideslope} < F_7$ Therefore, the geocomposite is stable on the clay liner and a driving force equal to P is transferred to the next interface.

Resistance of internal clay liner, lb/ft F_7 = 18,592 lb/ft

$P_{sideslope} < F_8$ Therefore, the clay liner internally is stable and a driving force equal to P is transferred to the next interface.

Resistance of clay liner/subgrade interface, lb/ft F_8 = 14,042 lb/ft

$P_{sideslope} < F_6$ Therefore, the clay liner is stable on the subgrade and a driving force equal to P is transferred to the next interface.

The Actual Tensile Force on liner system T_{act} = 0

Gosynthetic Clay Liner Option (Overliner)

Resistance of protective cover/geocomposite interface, lb/ft F_1 = 14,042

$P_{sideslope} < F_1$ Therefore, protective cover soil is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

Resistance of geocomposite/textured geomembrane interface, lb/ft F_2 = 14,042

$P_{sideslope} < F_2$ Therefore, geocomposite is stable on the geomembrane and a driving force equal to P is transferred to the next interface.

Resistance of textured geomembrane/geosynthetic clay liner interface F_3 = 14,042

$P_{sideslope} < F_3$ Therefore, geomembrane is stable on the geosynthetic clay liner and a driving force equal to P is transferred to the next interface.

Resistance of internal geosynthetic clay liner, lb/ft F_4 = 14,042

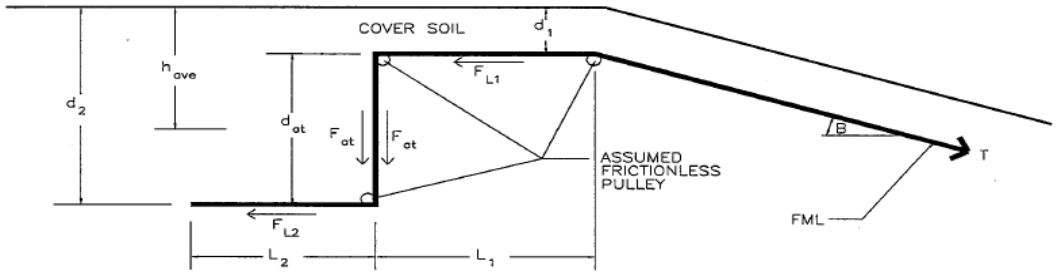
$P_{sideslope} < F_4$ Therefore, the geosynthetic clay liner internally is stable and a driving force equal to P is transferred to the next interface.

Resistance of geosynthetic clay liner/foundation layer interface, lb/ft F_5 = 14,042

$P_{sideslope} < F_5$ Therefore, the clay liner is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

The Actual Tensile Force on liner system, lb/ft T_{act} = 0

2. Verify that tensile stress in liner system is less than yield stress for the liner system.



$$T = F_{L1} + F_{L2} + F_{at}$$

Where:

T = Tensile Force necessary for pullout, lb/ft

$$F_{L1} = (q_1 \tan \Delta)\, L_1$$

q_1 = d_1 x γ_{soil} Surcharge Pressure, psf
d_1 = Depth of soil, ft
γ_{soil} = Unit weight of soil, pcf
Δ = Interface friction angle, degrees
L_1 = Length of runout, ft

$$F_{L2} = (q_2 \tan \Delta)\, L_2$$

q_2 = d_2 x γ_{soil} Surcharge Pressure, psf
d_2 = Depth of soil, ft
γ_{soil} = Unit weight of soil, pcf
Δ = Interface friction angle, degrees
L_2 = Length of runout, ft

$$F_{at} = (V \tan \Delta)\, d_{at}$$

V = K_o x y Average horizontal stress, psf
K_o = 1 - sin(r)
r = Internal friction angle of soil, degrees
y = γ_{soil} x h_{ave}
h_{ave} = Average depth of trench, ft
γ_{soil} = Unit weight of soil, pcf
Δ = Interface friction angle, degrees
d_{at} = Depth of trench, ft

Parameters:

γ_{soil}	=	120	pcf
Δ	=	15	degree
r	=	16	degree
d_1	=	2.0	ft
L_1	=	6.0	ft
d_2	=	4.0	ft
L_2	=	2.0	ft
d_{at}	=	2.0	ft
h_{ave}	=	3.0	ft
F_{L1}	=	385.8	lb/ft
F_{L2}	=	257.2	lb/ft
F_{at}	=	139.7	lb/ft
T	=	782.8	lb/ft

Compare force required for pullout (T) with the actual tensile force in the geomembrane from Part 1:

T	=	783	lb/ft
T_{ac}	=	0	lb/ft

$T > T_{ac}$ Therefore, the runout lengths are sufficient to prevent pullout.

B. Infinite Slope Stability Analysis

Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

The liner, overliner, and final cover systems are described below.

Liner System

The liner system includes a 2-foot-thick protective cover, drainage geocomposite, and a 2-foot-thick compacted clay liner (CCL).

Overliner System

The overliner system includes a 2-foot-thick protective cover, drainage geocomposite, geomembrane, GCL, and prepared subgrade.

Final Cover System

The final cover system includes a 1-foot-thick erosion layer and an 18-inch-thick clay infiltration layer.

1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the liner, overliner, and final cover systems using peak and residual shear strength values.

The factor of safety is calculated using the following equation:

$$F.S. = A\,\frac{\tan\Delta}{\tan\beta} + B\,\frac{C_a}{\gamma H}$$

Where:

Δ	=	Interface friction angle, degrees
β	=	Slope angle, degrees
A	=	Parameter A from chart on page IIIL-B-222
B	=	Parameter B from chart on page IIIL-B-222
C_a	=	Adhesion, psf
γ	=	Unit weight of soil, pcf
H	=	Thickness of material above interface, ft

An example using the protective cover/geocomposite interface of the liner system is provided below.

A. Define the shear strength parameters (peak shear strength parameters will be used for this example).

Δ	=	18	degree
C_a	=	100	psf

B. Calculate the pore pressure (r_u) using the following equation:

$$r_u = \frac{T\,\gamma_w\,cos^2\,b}{H\,\gamma}$$

Where:

H	=	Thickness of material above interface, ft
β	=	Slope angle, degrees
γ_w	=	Unit weight of water, pcf
T	=	Maximum head above interface, ft
γ	=	Unit weight of soil, pcf
b	=	cot(β) Slope ratio

Parameters:

H	=	2	feet
β	=	18.43	degree (3H:1V)
γ_w	=	62.4	pcf
T	=	0	ft
γ	=	120	pcf
b	=	3.0	
r_u	=	0.0	

Since T=0, there is no pore pressure build-up in the protective cover. If the soil material is assumed to be saturated, use a unit weight of 125 pcf for soil.

C. Using r_u and b, determine Parameters A and B from the charts on page IIIL-B-222.

A	=	1.0
B	=	3.3

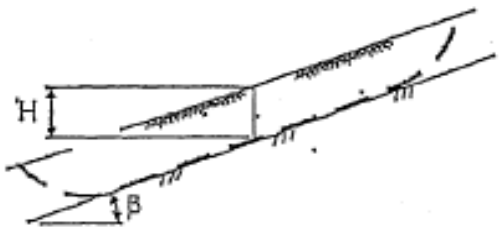
D. Calculate the factor of safety and compare against the minimum recommended factor of safety.

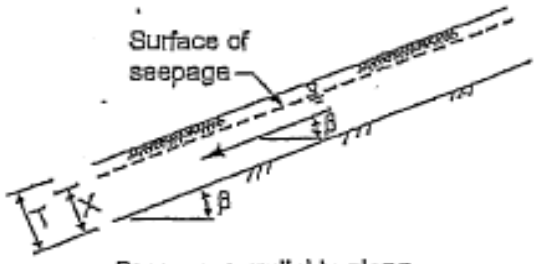
F.S.	=	2.35
$F.S._{min}$	=	1.5
F.S.	>	$F.S._{min}$

Infinite Slope Stability Analysis Summary

Landfill Component/ Interface	Strength Parameters				H (ft)	ɣ (pcf)	β (degree)	T (ft)	r_u	b	A	B	Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
	Cohesion/Adhesion (psf)		Friction Angle (degrees)															
	Peak	Residual	Peak	Residual									Peak	Residual	Peak	Residual	Peak	Residual
Liner System (3H:1V Slope)																		
Clay Liner																		
Protective Cover/ Geocomposite	100	80	18	14	2	120	18.43	0.0	0.0	3.0	1.0	3.3	2.35	1.85	1.5	1.0	Yes	Yes
Geocomposite/ Clay Liner	100	80	15	10	2	120	18.43	0.0	0.0	3.0	1.0	3.3	2.18	1.63	1.5	1.0	Yes	Yes
Clay Liner Internal	100	-	16	-	2	120	18.43	0.0	0.0	3.0	1.0	3.3	2.24	-	1.5	-	Yes	-
Overliner System (25 Percent Maximum Slope)																		
Protective Cover/ Geocomposite	100	80	18	14	2	120	11.31	0.0	0.0	5.0	1.0	5.3	3.83	3.01	1.5	1.0	Yes	Yes
Textured Geomembrane	100	80	21	10	2	120	11.31	0.0	0.0	5.0	1.0	5.3	4.13	2.65	1.5	1.0	Yes	Yes
Geomembrane/ Geosynthetic Clay	100	80	18	10	2	120	11.31	0.0	0.0	5.0	1.0	5.3	3.83	2.65	1.5	1.0	Yes	Yes
Geosynthetic Clay Liner Internal	100	80	24	-	2	120	11.31	0.0	0.0	5.0	1.0	5.3	4.43	-	1.5	1.0	Yes	Yes
Geosynthetic Clay Liner/ Subgrade	100	80	25	12	2	120	11.31	0.0	0.0	5.0	1.0	5.3	4.54	2.83	1.5	1.0	Yes	Yes

Landfill Component/ Interface	Strength Parameters				H (ft)	ɣ (pcf)	β (degree)	T (ft)	r_u	b	A	B	Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
	Cohesion/Adhesion (psf)		Friction Angle (degrees)															
	Peak	Residual	Peak	Residual									Peak	Residual	Peak	Residual	Peak	Residual
Final Cover System (25 Percent Sideslope)																		
Composite Final Cover (Saturated Erosion Layer)																		
Erosion Layer/ Clay Infiltration Liner	100	80	18	14	1	116	14.04	0.0	0.00	4.0	1.00	4.3	5.01	3.96	1.5	1.0	Yes	Yes
Clay Infiltration Liner Internal	100	-	16	-	1	116	14.04	0.0	0.00	4.0	1.00	4.3	4.85	-	1.5	-		-
Final Cover System (5 Percent Top Slope)																		
Composite Final Cover (Saturated Erosion Layer)																		
Erosion Layer/ Clay Infiltration Liner	100	80	18	14	1	116	3.43	0.0	0.00	16.7	1.00	6.3	10.85	8.50	1.5	1.0	Yes	Yes
Clay Infiltration Liner Internal	100	-	16	-	1	116	3.43	0.0	0.00	16.7	1.00	6.3	10.22	-	1.5	-		-





γ = total unit weight of soil

γ_w = unit weight of water

c' = cohesion intercept

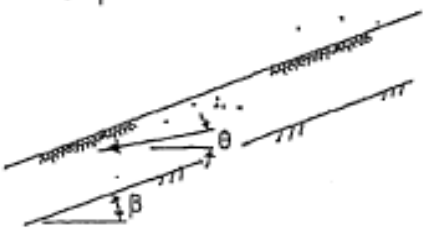
ϕ' = friction angle

r_u = pore pressure ratio = $u/\gamma H$

u = pore pressure at depth H

Seepage parallel to slope

$$r_u = \frac{X}{T}\frac{\gamma_w}{\gamma}\cos^2\beta$$

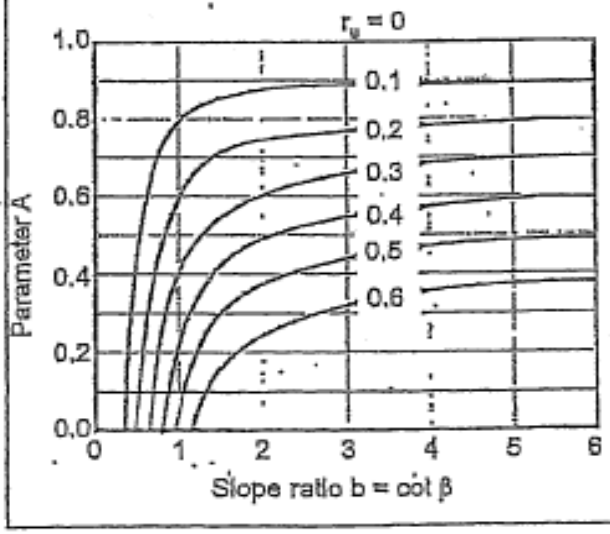


Seepage emerging from slope

$$r_u = \frac{\gamma_w}{\gamma}\frac{1}{1+\tan\beta\tan\theta}$$

Steps:

1. Determine r_u from measured pore pressure or formulas at right.
2. Determine A and B from charts below.
3. Calculate $F = A\dfrac{\tan\phi'}{\tan\beta} + B\dfrac{c'}{\gamma H}$



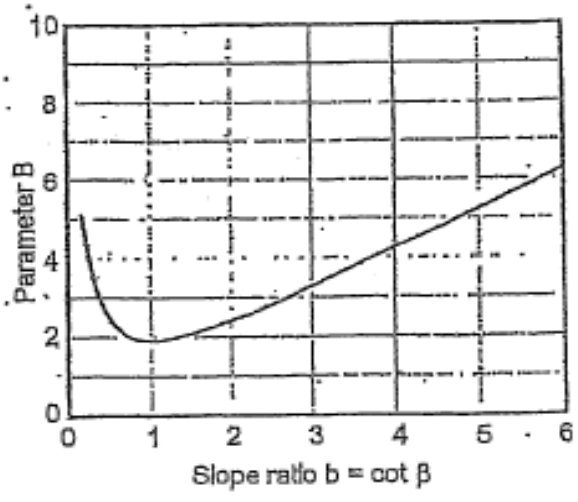


Figure E-7. Slope stability charts for infinite slopes (after Duncan, Buchignani, and DeWet 1987)

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III – SITE DEVELOPMENT

APPENDIX IIIL-B
SETTLEMENT AND HEAVE ANALYSIS

Prepared for
City of Del Rio

September 2023
Revision 1 August 2024



Prepared by
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This document is intended for permitting purposes only.

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Figure IIIL-B-88 – Foundation Settlement Evaluation Points IIIL-B-2
Figure IIIL-B-89 – Final Cover Settlement Evaluation Points..... IIIL-B-18



1.0 INTRODUCTION

This appendix includes the settlement, strain and heave analyses for the foundation soils and the settlement and strain analyses for the final cover system.

FOUNDATION SETTLEMENT AND HEAVE ANALYSIS

Foundation Settlement and Heave Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose -
Estimate the settlement of landfill subgrade.
Estimate the amount of heave or uplift resulting from excavations for liner construction.
Calculate the post-settlement strain in the leachate collection system and liner.

Step 1 - Select critical location for settlement.

Waste filling and liner and final cover installation will result in loading of the foundation soils, causing consolidation. The magnitude of consolidation will be a function of the net stress increase and properties of the foundation soils. Net stress increase is assumed to be the addition of the load to the excavation grades.

The evaluation points were chosen at specific locations to analyze the post-settlement slopes of the leachate collection system and liner system. Evaluation point locations are shown on Sheet IIIL-B-2.

Permit Page - IIIL-1983

LEGEND

GP-5 PROPOSED GAS PROBE

UV-1 PROPOSED GAS VENTS

CUT/FILL MARKERS

1 SETTLEMENT EVALUATION POINT

PROPOSED PERMIT BOUNDARY

PROPOSED LIMIT OF WASTE

CELL BOUNDARY

1080 EXISTING GRADES

1010 PROPOSED EXCAVATION GRADES

1022 PERMITTED EXCAVATION GRADES

1087 PERMITTED OVERLINER GRADES

10 CELL DESIGNATION

PROPOSED LEACHATE COLLECTION RISER

PROPOSED LEACHATE COLLECTION CLEANOUT

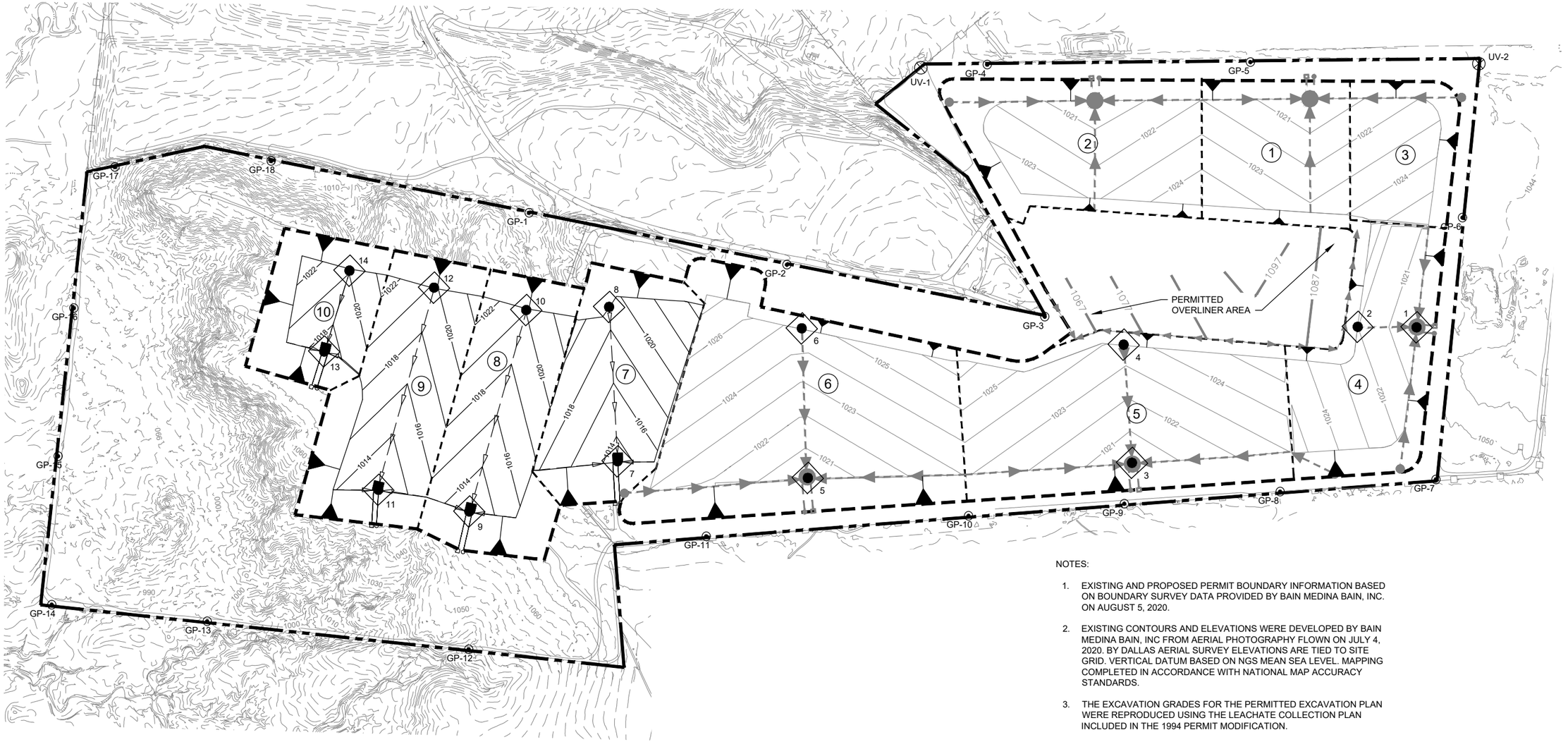
PROPOSED LEACHATE COLLECTION SUMP

PROPOSED LEACHATE COLLECTION LINE

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. BY DALLAS AERIAL SURVEY ELEVATIONS ARE TIED TO SITE GRID. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY STANDARDS.
3. THE EXCAVATION GRADES FOR THE PERMITTED EXCAVATION PLAN WERE REPRODUCED USING THE LEACHATE COLLECTION PLAN INCLUDED IN THE 1994 PERMIT MODIFICATION.
4. EXCAVATION SLOPES ARE TYPICALLY 3H:1V.
5. MINIMUM EXCAVATION ELEVATION AT LEACHATE COLLECTION SYSTEM SUMP IS 1007 FT-MSL.
6. LINER AND LEACHATE COLLECTION SYSTEM DETAILS ARE INCLUDED IN APPENDIX IIIA-A.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
1.	2nd TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

FOUNDATION SETTLEMENT EVALUATION POINTS

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
IIIL-B-2

PRINTED BY: MetafeT
FILE PATH: C:\pwworkingistv\pw_stv\metaferiald\9422279\DELR2000302 Figure IIIL-B-4.dwg

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Step 2 - Estimate the settlement of the landfill subgrade at critical locations:

The following equation was used to calculate the effective overburden stress for each n, number of layers in the landfill system components (i.e., liner system, waste etc.). There was no groundwater encountered at the site, therefore unsaturated and the moist unit weight is used.

$$p_{o(n)} = 0.5H_{o(n)}\gamma_n + \sum_{i=1}^{i=n-1}\left(H_{o(i)}\gamma_i\right)$$

The following equation was used to calculate the increase in overburden stress due to the development of the landfill using moist unit weights for the liner, protective cover, waste, and final cover:

$$\Delta P = H_{liner}\gamma_{liner} + H_{pc}\gamma_{pc} + H_{waste}\gamma_{waste} + H_{fc}\gamma_{fc}$$

The following equations were used to calculate the settlement:

If $p_o + \Delta p < p_c$:

$$S = \frac{C_o H_o}{1+e_o}\log\left(\frac{p_o + \Delta p}{p_c}\right) + \frac{C_r H_o}{1+e_o}\log\left(\frac{p_c}{p_o}\right)$$

If $p_o + \Delta p > p_c$:

$$S = \frac{C_r H_o}{1+e_o}\log\left(\frac{p_o + \Delta p}{p_c}\right)$$

The following equation was used to calculate the final height of each layer after settlement:

$$H_f = H_o - S$$

Where:

H_o	=	Initial thickness of sublayer, ft
γ_d	=	Dry unit weight, pcf
γ_m	=	Moist unit weight, pcf
γ_{sat}	=	Saturated unit weight, pcf
γ_w	=	Unit weight of water, pcf
γ_{waste}	=	Unit weight of waste, pcf
e_o	=	In-situ void ratio
p_o	=	Initial average effective overburden pressure, psf
Δp	=	Increase in vertical pressure, psf
p_c	=	Preconsolidation Pressure, psf
S	=	Settlement, ft
C_c	=	Compression Index
C_r	=	Recompression Index
H_f	=	Final Thickness of Sublayer, ft
pc	=	Protective Cover
liner	=	Liner
waste	=	Waste
n	=	Number of Layers including Landfill System Components
fc	=	Final Cover

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
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Increase in overburden stress due to development of landfill.

Note: Weights of materials above the evaluated strata are assumed to have moist units weights for the purpose of calculating the overburden pressure generated by these layers to estimate Δp. The unit weight of waste was based on the average waste thickness using the Unit Weight Profile for Waste/Daily Cover within an MSW Landfill chart from Ref 5.

At Evaluation Point 1:

Top of Final Cover Elevation (ft-msl)	=	1063		Waste Thickness	=	37.5 ft
Top of Protective Cover Elevation (ft-msl)	=	1022.0		Protective Cover Thickness	=	2.0 ft
Top of Waste Elevation (ft-msl)	=	1059.5		Liner Thickness	=	2.0 ft
Top of Liner Elevation (ft-msl)	=	1020.0		Final Cover Thickness	=	3.5 ft
γ_{waste}	=	47	pcf	p_{waste}	=	1764.9 psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0 psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0 psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0 psf
				Δp	=	2650.9 psf

At Evaluation Point 2:

Top of Final Cover Elevation (ft-msl)	=	1104		Waste Thickness	=	74.5 ft
Top of Protective Cover Elevation (ft-msl)	=	1026.0		Protective Cover Thickness	=	2.0 ft
Top of Waste Elevation (ft-msl)	=	1100.5		Liner Thickness	=	2.0 ft
Top of Liner Elevation (ft-msl)	=	1024		Final Cover Thickness	=	3.5 ft
γ_{waste}	=	52	pcf	p_{waste}	=	3901.9 psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0 psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0 psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0 psf
				Δp	=	4787.9 psf

At Evaluation Point 3:

Top of Final Cover Elevation (ft-msl)	=	1070		Waste Thickness	=	44.5 ft
Top of Protective Cover Elevation (ft-msl)	=	1022.0		Protective Cover Thickness	=	2.0 ft
Top of Waste Elevation (ft-msl)	=	1066.5		Liner Thickness	=	2.0 ft
Top of Liner Elevation (ft-msl)	=	1020		Final Cover Thickness	=	3.5 ft
γ_{waste}	=	48	pcf	p_{waste}	=	2139.1 psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0 psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0 psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0 psf
				Δp	=	3025.1 psf

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

At Evaluation Point 4:

Top of Final Cover Elevation (ft-msl)	=	1098		Waste Thickness	=	66.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1028.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1094.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1026		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	51	pcf	p_{waste}	=	3406.6	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	4292.6	psf

At Evaluation Point 5:

Top of Final Cover Elevation (ft-msl)	=	1082		Waste Thickness	=	56.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1022.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1078.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1020		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	50	pcf	p_{waste}	=	2813.2	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	3699.2	psf

At Evaluation Point 6:

Top of Final Cover Elevation (ft-msl)	=	1072		Waste Thickness	=	39.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1029.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1068.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1027		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	47	pcf	p_{waste}	=	1870.4	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	2756.4	psf

At Evaluation Point 7:

Top of Final Cover Elevation (ft-msl)	=	1099		Waste Thickness	=	78.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1017.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1095.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1015		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	53	pcf	p_{waste}	=	4156.5	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	5042.5	psf

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

At Evaluation Point 8:

Top of Final Cover Elevation (ft-msl)	=	1089		Waste Thickness	=	62.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1023.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1085.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1021		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	51	pcf	p_{waste}	=	3165.8	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	4051.8	psf

At Evaluation Point 9:

Top of Final Cover Elevation (ft-msl)	=	1095		Waste Thickness	=	75.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1016.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1091.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1014		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	53	pcf	p_{waste}	=	3965.1	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	4851.1	psf

At Evaluation Point 10:

Top of Final Cover Elevation (ft-msl)	=	1090.0		Waste Thickness	=	62.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1024.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1086.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1022		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	51	pcf	p_{waste}	=	3165.8	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	4051.8	psf

At Evaluation Point 11:

Top of Final Cover Elevation (ft-msl)	=	1085		Waste Thickness	=	68.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1013.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1081.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1011		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	52	pcf	p_{waste}	=	3528.7	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	4414.7	psf

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

At Evaluation Point 12:

Top of Final Cover Elevation (ft-msl)	=	1084		Waste Thickness	=	57.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1023.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1080.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1021		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	50	pcf	p_{waste}	=	2871.3	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	3757.3	psf

At Evaluation Point 13:

Top of Final Cover Elevation (ft-msl)	=	1093		Waste Thickness	=	68.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1021.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1089.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1019		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	52	pcf	p_{waste}	=	3528.7	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	4414.7	psf

At Evaluation Point 14:

Top of Final Cover Elevation (ft-msl)	=	1082		Waste Thickness	=	54.5	ft
Top of Protective Cover Elevation (ft-msl)	=	1024.0		Protective Cover Thickness	=	2.0	ft
Top of Waste Elevation (ft-msl)	=	1078.5		Liner Thickness	=	2.0	ft
Top of Liner Elevation (ft-msl)	=	1022		Final Cover Thickness	=	3.5	ft
γ_{waste}	=	50	pcf	p_{waste}	=	2698.0	psf
γ_{pc}	=	120	pcf	p_{pc}	=	240.0	psf
γ_{liner}	=	120	pcf	p_{liner}	=	240.0	psf
γ_{fc}	=	116	pcf	p_{fc}	=	406.0	psf
				Δp	=	3584.0	psf

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Evaluation Point 1:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d[1] (pcf)	γ_w (pcf)	γ'_m[1] (pcf)	w[1] (%)	e_o[1]	C_c[1]	C_r[1]	p_c[1] (psf)	p_o (psf)	Δp (psf)	S[2] (ft)	H_f (ft)
Stratum III	1018.0	1008.0	10.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	555.5	2650.95	0.497	9.5
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2222.0	2650.95	0.445	19.6
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4444.0	2650.95	0.265	19.7
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6666.0	2650.947	0.190	19.8
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8888.0	2650.95	0.260	19.7
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11110.0	2650.95	0.399	19.6
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	14998.5	2650.95	1.512	48.5
																3.569

Evaluation Point 2:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d[1] (pcf)	γ_w (pcf)	γ'_m[1] (pcf)	w[1] (%)	e_o[1]	C_c[1]	C_r[1]	p_c[1] (psf)	p_o (psf)	Δp (psf)	S[2] (ft)	H_f (ft)
Stratum III	1022.0	1008.0	14.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	777.7	4787.92	0.781	13.2
Stratum III	1018.0	998.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2666.4	4787.92	0.583	19.4
Stratum III	998.0	978.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4888.4	4787.92	0.387	19.6
Stratum III	978.0	958.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	7110.4	4787.919	0.433	19.6
Stratum III	958.0	938.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	9332.4	4787.92	0.537	19.5
Stratum III	938.0	918.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11554.4	4787.92	0.637	19.4
Stratum III	918.0	868.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15442.9	4787.92	1.986	48.0
																5.344

Evaluation Point 3:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d[1] (pcf)	γ_w (pcf)	γ'_m[1] (pcf)	w[1] (%)	e_o[1]	C_c[1]	C_r[1]	p_c[1] (psf)	p_o (psf)	Δp (psf)	S[2] (ft)	H_f (ft)
Stratum III	1018.0	1008.0	10.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	555.5	3025.10	0.528	9.5
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2222.0	3025.10	0.487	19.5
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4444.0	3025.10	0.294	19.7
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6666.0	3025.104	0.212	19.8
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8888.0	3025.10	0.308	19.7
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11110.0	3025.10	0.440	19.6
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	14998.5	3025.10	1.592	48.4
																3.861

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Evaluation Point 4:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1024.0	1008.0	16.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	888.8	4292.58	0.800	15.2
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2888.6	4292.58	0.516	19.5
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	5110.6	4292.58	0.346	19.7
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	7332.6	4292.579	0.380	19.6
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	9554.6	4292.58	0.494	19.5
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11776.6	4292.58	0.600	19.4
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15665.1	4292.58	1.915	48.1

5.051

Evaluation Point 5:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1018.0	1008.0	10.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	555.5	406.00	0.156	9.8
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2222.0	406.00	0.095	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4444.0	406.00	0.050	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6666.0	406	0.034	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8888.0	406.00	0.025	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11110.0	406.00	0.130	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	14998.5	406.00	0.999	49.0

1.488

Evaluation Point 6:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1025.0	1008.0	17.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	944.4	406.00	0.172	16.8
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2999.7	406.00	0.072	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	5221.7	406.00	0.042	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	7443.7	406	0.030	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	9665.7	406.00	0.023	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11887.7	406.00	0.191	19.8
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15776.2	406.00	1.113	48.9

1.644

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Evaluation Point 7:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1013.0	1008.0	5.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	277.8	406.00	0.128	4.9
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	1666.5	406.00	0.124	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	3888.5	406.00	0.056	19.9
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6110.5	406	0.036	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8332.5	406.00	0.027	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	10554.5	406.00	0.085	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	14443.0	406.00	0.913	49.1
															1.369	

Evaluation Point 8:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1019.0	1008.0	11.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	611.1	406.00	0.159	10.8
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2333.1	406.00	0.091	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4555.1	406.00	0.048	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6777.1	406	0.033	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8999.1	406.00	0.025	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11221.1	406.00	0.139	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15109.6	406.00	1.015	49.0
															1.511	

Evaluation Point 9:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1012.0	1008.0	4.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	222.2	406.00	0.118	3.9
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	1555.4	406.00	0.132	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	3777.4	406.00	0.058	19.9
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	5999.4	406	0.037	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8221.4	406.00	0.027	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	10443.4	406.00	0.075	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	14331.9	406.00	0.896	49.1
															1.343	

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Evaluation Point 10:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1020.0	1008.0	12.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	666.6	240.00	0.105	11.9
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2444.2	240.00	0.053	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4666.2	240.00	0.028	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6888.2	240	0.019	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	9110.2	240.00	0.015	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11332.2	240.00	0.126	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15220.7	240.00	0.992	49.0
															1.338	

Evaluation Point 11:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1009.0	1008.0	1.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	55.6	240.00	0.047	1.0
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	1222.1	240.00	0.102	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	3444.1	240.00	0.038	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	5666.1	240	0.024	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	7888.1	240.00	0.017	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	10110.1	240.00	0.022	20.0
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	13998.6	240.00	0.799	49.2
															1.049	

Evaluation Point 12:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	γ'^1_m (pcf)	w^1 (%)	e_o^1	C_c^1	C_r^1	p_c^1 (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1019.0	1008.0	11.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	611.1	240.00	0.103	10.9
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2333.1	240.00	0.056	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4555.1	240.00	0.029	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6777.1	240	0.020	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8999.1	240.00	0.015	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11221.1	240.00	0.117	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15109.6	240.00	0.975	49.0
															1.315	

Foundation Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Evaluation Point 13:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	$\gamma'_m{}^1$ (pcf)	w^1 (%)	$e_o{}^1$	$C_c{}^1$	$C_r{}^1$	$p_c{}^1$ (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1017.0	1008.0	9.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	500.0	240.00	0.100	8.9
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2110.9	240.00	0.061	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4332.9	240.00	0.031	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6554.9	240	0.020	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	8776.9	240.00	0.015	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	10998.9	240.00	0.099	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	14887.4	240.00	0.941	49.1
															1.267	

Evaluation Point 14:

Unit	Top of Elevation (ft-msl)	Bottom Elevation (ft-msl)	H_o (ft)	G_s (ft)	γ_d^1 (pcf)	γ_w (pcf)	$\gamma'_m{}^1$ (pcf)	w^1 (%)	$e_o{}^1$	$C_c{}^1$	$C_r{}^1$	$p_c{}^1$ (psf)	p_o (psf)	Δp (psf)	S^2 (ft)	H_f (ft)
Stratum III	1020.0	1008.0	12.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	666.6	240.00	0.105	11.9
Stratum III	1008.0	988.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	2444.2	240.00	0.053	19.9
Stratum III	988.0	968.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	4666.2	240.00	0.028	20.0
Stratum III	968.0	948.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	6888.2	240	0.019	20.0
Stratum III	948.0	928.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	9110.2	240.00	0.015	20.0
Stratum III	928.0	908.0	20.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	11332.2	240.00	0.126	19.9
Stratum III	908.0	858.0	50.0	2.65	92.7	62.4	111.1	16.3	0.7310	0.301	0.113	10250.0	15220.7	240.00	0.992	49.0
															1.338	

Summary of LCS and Liner Slopes After Settlement

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Slope from Evaluation Point 2 to Evaluation Point 1:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 2 (ft-msl)	Elevation Point 1 (ft-msl)	Slope (%)	Elevation Point 2 (ft-msl)	Elevation Point 1 (ft-msl)	Length	Elevation Point 2 (ft-msl)	Elevation Point 1 (ft-msl)	Slope (%)
223.5	1024.0	1020.0	1.79%	5.344	3.569	223.5	1018.7	1016.43	1.0%

Slope from Evaluation Point 4 to Evaluation Point 3:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 4 (ft-msl)	Elevation Point 3 (ft-msl)	Slope (%)	Elevation Point 4 (ft-msl)	Elevation Point 3 (ft-msl)	Length	Elevation Point 4 (ft-msl)	Elevation Point 3 (ft-msl)	Slope (%)
443.2	1026.0	1020.0	1.35%	5.051	3.861	443.2	1020.9	1016.14	1.1%

Slope from Evaluation Point 6 to Evaluation Point 5:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 6 (ft-msl)	Elevation Point 5 (ft-msl)	Slope (%)	Elevation Point 6 (ft-msl)	Elevation Point 5 (ft-msl)	Length	Elevation Point 6 (ft-msl)	Elevation Point 5 (ft-msl)	Slope (%)
553.5	1027.0	1020.0	1.26%	1.644	1.488	553.5	1025.4	1018.51	1.2%

Slope from Evaluation Point 8 to Evaluation Point 7:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 8 (ft-msl)	Elevation Point 7 (ft-msl)	Slope (%)	Elevation Point 8 (ft-msl)	Elevation Point 7 (ft-msl)	Length	Elevation Point 8 (ft-msl)	Elevation Point 7 (ft-msl)	Slope (%)
544.8	1021.0	1015.0	1.10%	1.511	1.369	544.8	1019.5	1013.63	1.1%

Slope from Evaluation Point 10 to Evaluation Point 9:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 10 (ft-msl)	Elevation Point 9 (ft-msl)	Slope (%)	Elevation Point 10 (ft-msl)	Elevation Point 9 (ft-msl)	Length	Elevation Point 10 (ft-msl)	Elevation Point 9 (ft-msl)	Slope (%)
757.5	1022.0	1014.0	1.06%	1.338	1.343	757.5	1020.7	1012.66	1.1%

Slope from Evaluation Point 12 to Evaluation Point 11:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 12 (ft-msl)	Elevation Point 11 (ft-msl)	Slope (%)	Elevation Point 12 (ft-msl)	Elevation Point 11 (ft-msl)	Length	Elevation Point 12 (ft-msl)	Elevation Point 11 (ft-msl)	Slope (%)
752.2	1021.0	1011.0	1.33%	1.315	1.267	752.2	1019.7	1009.73	1.3%

Slope from Evaluation Point 14 to Evaluation Point 13:

Prior to Settlement				Estimated Settlement		After Settlement			
Length	Elevation Point 14 (ft-msl)	Elevation Point 13 (ft-msl)	Slope (%)	Elevation Point 14 (ft-msl)	Elevation Point 13 (ft-msl)	Length	Elevation Point 14 (ft-msl)	Elevation Point 13 (ft-msl)	Slope (%)
291.7	1022.0	1019.0	1.03%	1.338	1.267	291.7	1020.7	1017.73	1.0%

Conclusions:

The above calculations verify that the slopes and lengths used to design the leachate collection system in Appendix IIIC are valid. As noted in Appendix IIIC-A, the slope between the sector ridgeline and leachate collection line used in the HELP Model analysis was chosen to be 1.0 %, which approximates the lowest post-settlement slope. Slopes of the primary collection lines remain positive post-settlement, with flattening of the primary collection lines occurring during landfill filling (as the height of the fill over the lines increases) and post-filling and closure of the landfill. Slopes of the primary collection lines remain positive over the filling and closure of the landfill.

Leachate Collection System and Liner Strain

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Step 1 -Determine the strain percentage in the Subtitle D liner system based on the total settlement between he evaluation points.

Strain Equation

$$\text{Strain} = \frac{L_f - L_o}{L_o} * 100$$

Where: L_f = Final distance between evaluation points after total settlement (ft)
L_o = Initial distance between evaluation points before settlement (ft)

Note: A negative strain value indicates the component is in compression. A positive strain value indicates the components is in tension.

Calculated Strain between Evaluation Points

Evaluation Point		Initial Evaluation (ft-msl)		Post-Settlement Elevation (ft-msl)		Plan View Distance (ft)	L_o (ft)	L_f (ft)	Strain (%)
A	B	A	B	A	B				
2	1	1024	1020	5.34	3.57	223.5	223.54	223.51	0.0129%
4	3	1026	1020	5.05	3.86	443.2	443.24	443.20	0.0088%
6	5	1027	1020	1.64	1.49	553.5	553.54	553.50	0.0080%
8	7	1021	1015	1.51	1.37	544.8	544.83	544.80	0.0061%
10	9	1022	1014	1.34	1.34	757.5	757.54	757.50	0.0056%
12	11	1021	1019	1.31	1.27	752.2	752.20	752.20	0.0004%
14	13	1022	1019	1.34	1.27	291.7	291.72	291.70	0.0053%

Conclusions:

The allowable tensile strain for a drainage geocomposite is more than 20% for the geotextile and 200% for the geonet. Reference: Koerner, Rovert M., *Designing with Geosynthetics* , Third Edition. Prentice-Hall, New Jersey, 1994. (pages 112 and 400)

The allowable tensile strain for compacted clay liner is 0.5%
Reference: Quian, Xuede, R.M. Koerner, D. H. Gray, *Geotechnical Aspects of Landfill Design and Construction* , Prentice-Hall, Inc., New Jersey, 2002. (page 469)

The calculated strains show in the above table are negative, which represent compressive strain.

Strain is acceptable

Heave Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Foundation Settlement and Heave Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Estimate the potential heave of the excavation bottom that may occur due to the excavation of overburden soils. Using standard consolidation theory.

Note: Approximate evaluation location for the heave analysis is shown on Sheet IIIL-B-1-2, Point 10.

Where:

C_{ss} = Swell index, ft
γ = Unit weight of soil, pcf
e_o = Initial void ratio
P_o = Present overburden pressure, psf
ΔP = Change in overburden pressure, psf
D = Depth of excavation, ft
H_i = Depth of shale layer, ft

Material properties of the soil material to be excavted at the site based on laboratory test results.

Stratum II		Stratum III	
$\gamma_{II(Dry)}$	95.8	$\gamma_{III(IDry)}$	95.5
Natural Moisture Content	16.2%	Natural Moisture Content	16.3%
$\gamma_{II(in-situ)}$	111.3	$\gamma_{III(in-situ)}$	111.1

C_{ss}	0.1127
e_o	0.731
H_i	150

The change in loading is due to excavation of overburden soils.

The maximum depth of excavation is approximately = 30 ft
Number of Soil layers = 2

$$\Delta P = D_{II} * \gamma_{II(in-situ)} + D_I * \gamma_{I(in-situ)}$$

D_{II} = 10 ft
D_I = 20 ft
ΔP = 3335 psf

Using the standard consolidation theory:

$$S = C_{SS} * H_i * \log\frac{P_o - \Delta P}{P_o}$$

$$P_o = \frac{H_i}{2} * \gamma_{(moist,in-situ)} + \Delta P$$

P_o = 11683 psf
Projected Heave S = -2.47 ft

References:

Terzaghi, Karl and Peck, Ralph, *Soil Mechanics in Engineering Principle* , Third Edition, John Wiley and Sons, Inc, New York, 1996.
Das, Braja M., *Principles of Geotehcnical Engineering* , Fourth Edition, PWS, Boston, 1998.
Day, Robert W., *Geotechnical Engineer's Portable Handbood* , McGraw-Jill, New York, 2000.

FINAL COVER SYSTEM SETTLEMENT ANALYSIS

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose -

Estimate primary settlement of waste below the final cover system.
Estimate secondary settlement of waste below the final cover system.
Estimate total settlement of waste below the final cover system.
Verify that strain induced on the final cover due to settlement is within acceptable limits.

References:

1. Sowers, George F., Settlement of Solid Waste, Proceedings of the Eighth International Conference on Soil Mechanics and Foundations Engineering, 1973.
2. Quian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall, Inc., New Jersey, 2002.
3. Koerner, Robert M., Designing with Geosynthetics, Third Edition. Prentice-Hall, New Jersey, 1994.
4. Acar, Yalcin B. & Daniel, David E., Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics, Volume 2, American Society of Civil Engineers, 1995.
5. Zornberg, Jorge G., et al., Retention of Free Liquids in Landfills Undergoing Vertical Expansion, Journal of Geotechnical and Geoenvironmental Engineering, July 1999.
6. Fassett, Jeffrey B., et al., Geotechnical Properties of Municipal Solid Wastes and Their Use in Landfill Design, Waste Tech, 1994.

Step 1 - Select critical location for settlement.

Evaluation point locations are shown on Sheet IIIL-B-18

Permit Page - IIIL-1999

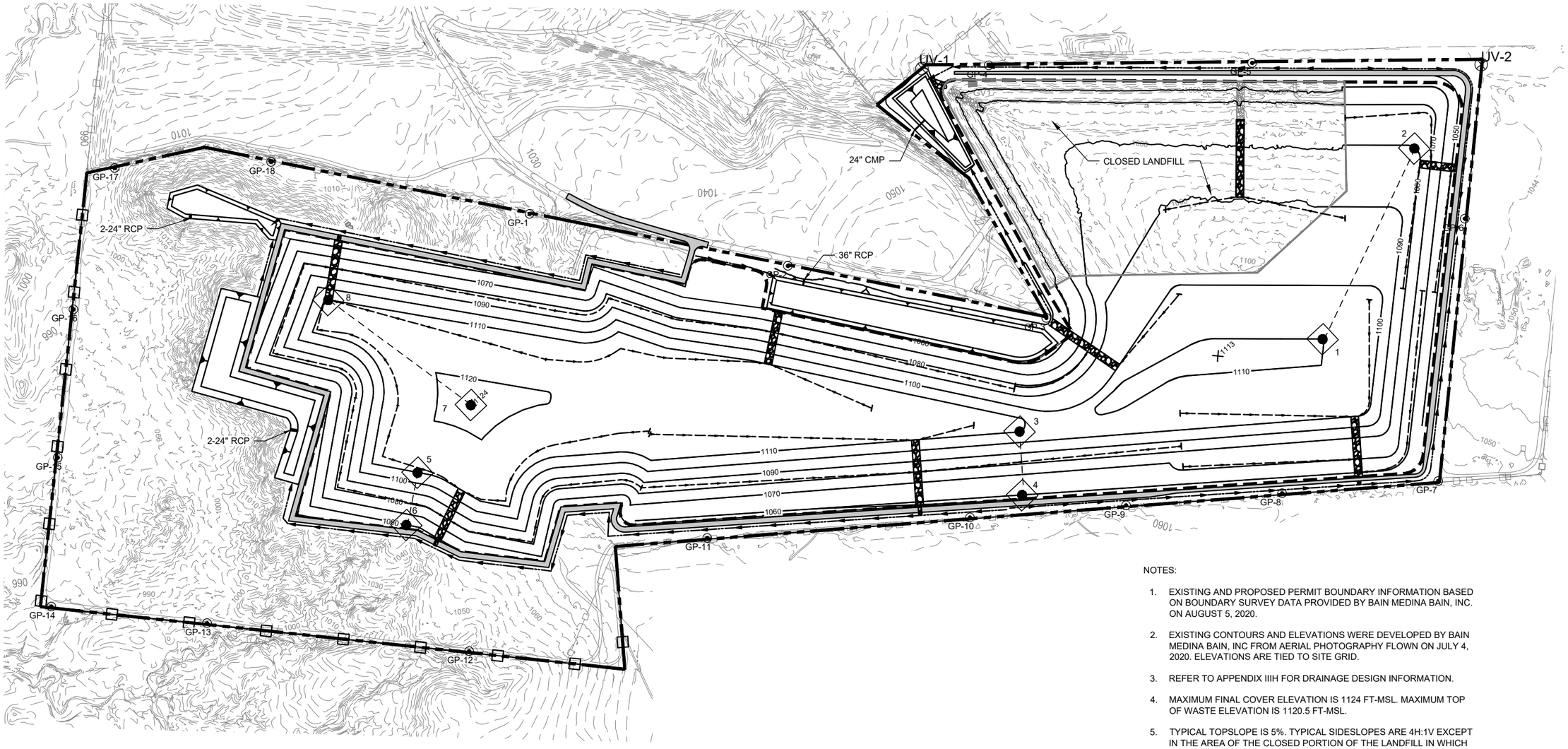
LEGEND

- SETTLEMENT EVALUATION POINT
- CHUTES
- PROPOSED GAS PROBE (GP-5)
- PROPOSED GAS VENTS (UV-1)
- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- FINAL COVER CONTOURS (1090)
- EXISTING CONTOURS (1084)
- PERIMETER CHANNEL
- SWALES
- EXISTING SITE FENCE
- PROPOSED SITE FENCE
- EXISTING CHUTE

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. REFER TO APPENDIX IIIH FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1124 FT-MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1120.5 FT-MSL.
5. TYPICAL TOPSLOPE IS 5%. TYPICAL SIDESLOPES ARE 4H:1V EXCEPT IN THE AREA OF THE CLOSED PORTION OF THE LANDFILL IN WHICH THE SIDESLOPES ARE 5H:1V.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV company
TEXAS REGISTERED ENGINEERING FIRM
TBPE F-1741

CITY OF DEL RIO
TEXAS

STATE OF TEXAS
TEWOBSTA METAFERIA
123183
LICENSED PROFESSIONAL ENGINEER
03/07/2025

NO.	REVISION	BY	DATE
1.	2nd TECHNICAL NOD	STV	03/ 2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

FINAL COVER SETTLEMENT EVALUATION POINTS

DESIGN:	T. METAFERIA
DRAWN:	T. METAFERIA
REVIEW:	B. HINDMAN
CP&Y:	DELR200302
CLIENT:	CITY OF DEL RIO

FIGURE
IIIL-B-18

PRINTED BY: MetafeT
FILE PATH: C:\pwworking\stvipw_stv1\metaferiald0842279\DELR2000302 Figure IIIL-B-5 FC Settlement Evaluation

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 8/7/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Purpose - **Determine the post-settlement slope of the final cover system and verify that the strain induced on the final cover due to settlement is within acceptable limits.**

Step 1 - Estimate primary settlement of waste below the final cover system:

MSW will undergo primary consolidation due to its own weight, final cover, equipment, etc. Primary consolidation occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. In addition, by the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Primary settlement is calculated using the following equation:

$$S_P = \frac{H_o C_c}{1 + e_o} \log\left(\frac{\sigma_o' + \Delta\sigma}{\sigma_o'}\right)$$

Where:
- S_P = Primary settlement, ft
- H_o = Waste thickness below the final cover before settlement, ft
- C_c = Compression index
- e_o = Void ratio of the waste layer below final cover before settlement (i.e., before final cover placement)
- σ'_o = Overburden pressure acting at mid-height of refuse below the final cover, psf
- $\Delta\sigma$ = Change in loading/increase in overburden pressure, psf

For this site, assume: $C_c = 0.35 e_o$ (Ref. 1, p. 210)

The compression index is a function of the void ratio. The compression index can range from $C_c = 0.15e_0$ to $C_c = 0.55e_0$ for fills that are low and high in organic content, respectively. An average compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced.

The average void ratio of waste below the final cover is estimated by determining the void ratio at the midpoint of the waste column below the final cover system. The void ratio is calculated for each settlement evaluation point using the following equation.

$$e_o = 1.86 - 0.00102\sigma_o'$$ (Ref. 5, pg 590)

Where:
- e_o = Void ratio of the waste layer below final cover before settlement (i.e., before final cover placement)
- σ'_o = Overburden pressure, kPa

$$\sigma_o' = 0.5\gamma_{msw} H_o$$

$$\Delta\sigma = \gamma_{cov} T_c$$

- γ_{msw} = Unit weight of waste below the final cover system, pcf
- γ_{cov} = Unit weight of cover, pcf
- T_c = Thickness of final cover system, ft

Parameters:
- γ_{cov} = 116 pcf
- T_c = 3.0 ft
- γ_{msw} = varies (see note below)

Note: γ_{msw} is selected based on the midpoint of the waste thicknesses below the final cover system using the Unit Weight Profile for Waste/Daily Cover within an MSW Landfill chart from Ref. 4.

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 8/7/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

The settlement points analyzed are shown on Sheet IIIL-B-17. An example calculation of the estimated primary settlement is shown below for Evaluation Points 1 and 2.

At Evaluation Point 1:

Top of Final Cover Elevation (ft-msl) = 1110
Bottom of Waste Elevation (ft-msl) = 1045

H_o = 62 ft
γ_{msw} = 51 pcf

$$\sigma_o' = 0.5\gamma_{msw}H_o$$

σ'_o = 1568.01 psf
σ'_o = 75.1 kPa

$$e_o = 1.86 - 0.00102\sigma_o'$$

e_o = 1.78

$$C_c = 0.35e_o$$

C_c = 0.62

$$\Delta\sigma = \gamma_{cov}T_c$$

$\Delta\sigma$ = 348 psf

$$S_P = \frac{H_oC_c}{1+e_o}\log\left(\frac{\sigma_o' + \Delta\sigma}{\sigma_o'}\right)$$

S_P = 1.21 ft

At Evaluation Point 2:

Top of Final Cover Elevation (ft-msl) = 1080.0
Bottom of Waste Elevation (ft-msl) = 1027.0

H_o = 50 ft
γ_{msw} = 49 pcf

$$\sigma_o' = 0.5\gamma_{msw}H_o$$

σ'_o = 1221.48 psf
σ'_o = 58.5 kPa

$$e_o = 1.86 - 0.00102\sigma_o'$$

e_o = 1.80

$$C_c = 0.35e_o$$

C_c = 0.63

$$\Delta\sigma = \gamma_{cov}T_c$$

$\Delta\sigma$ = 348 psf

$$S_P = \frac{H_oC_c}{1+e_o}\log\left(\frac{\sigma_o' + \Delta\sigma}{\sigma_o'}\right)$$

S_P = 1.22 ft

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 8/7/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Step 2 - Estimate secondary settlement of waste below the final cover system.

Secondary consolidation continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physio-chemical reaction, and bio-chemical decay. The settlement-log time relationship is similar to secondary compression of soils and can be expressed by:

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log\left(\frac{t_1}{t_2}\right)$$ (Ref. 2, pg. 451)

Where:
- S_c = Secondary settlement, ft
- α = Secondary compression index
- e'_o = Void ratio of the waste layer below the final cover after primary settlement has occurred due to the final cover
- H'_o = Waste thickness below the final cover system after settlement, ft
- t_1 = Starting time of secondary settlement, years
- t_2 = Time at which settlement is determined, years

For this site, assume: $\alpha = 0.06 e'_o$ (Ref. 1, pg. 210)

As reported by Sowers (Ref. 1), the secondary compression index is used to estimate waste decomposition. The secondary compression index ranges from $\alpha = 0.03e'_o$ to $\alpha = 0.09e'_o$ for conditions that are unfavorable and favorable to decay, respectively. An average secondary compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced.

The void ratio of the waste below the final cover at closure is a function of the overburden pressure caused by placement of the final cover system. The void ratio is calculated for each settlement evaluation point using the following equation.

$$e'_o = 1.86 - 0.00102\sigma''_o$$ (Ref. 5, pg. 590)

$$\sigma''_o = 0.5\gamma'_{msw} H'_o$$

Where:
- σ''_o = overburden pressure, kPa
- γ'_{msw} = unit weight of waste below the final cover after primary settlement has occurred, pcf

For this site, the void ratio after primary settlement for the waste/cover soils below the final cover system varies between 1.5 to 1.9. Therefore, the secondary compression index will range between 0.09 to 0.11. Most literature sources report the secondary compression index in terms of the "modified secondary compression index" (Refs. 2, 6). The modified secondary compression index, C'_α, is defined by the following:

$$C'_\alpha = \frac{\alpha}{1 + e'_o}$$

The secondary compression index calculated for this site translates to a modified secondary compression index of 0.03 to 0.04 (for a void ratio of 1.5 to 1.9). These values are consistent with reported values for the modified secondary compression index which vary from 0.03 to 0.1 (Refs. 2, 6).

Time frame used for this analysis:

t_1 = 0.083 years
t_2 = 30 years (postclosure period)

An example calculation of the estimated secondary settlement using the above secondary settlement period is shown for Evaluation Points 1 and 2. The estimated secondary settlement for all evaluation points is shown on Sheet IIIL-B-2-8.

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 8/7/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

At Evaluation Point 1:

$$H'_o = H_o - S_p$$
H'$_o$ = 60.8 ft

$$\sigma''_o = 0.5\gamma'_{msw}H'_o$$
γ'_{msw} = 74 pcf
σ''_o = 2,249 psf
σ''_o = 108 kPa

$$e'_o = 1.86 - 0.00102\sigma''_o$$
e'$_o$ = 1.75

$$\alpha = 0.06e'_o$$
= 0.11

$$S_c = \frac{H'_o\alpha}{1+e'_o}\log\left(\frac{t_1}{t_2}\right)$$
S_c = 5.9 ft

At Evaluation Point 2:

$$H'_o = H_o - S_p$$
H'$_o$ = 48.8 ft

$$\sigma''_o = 0.5\gamma'_{msw}H'_o$$
γ'_{msw} = 70 pcf
σ''_o = 1,707 psf
σ''_o = 82 kPa

$$e'_o = 1.86 - 0.00102\sigma''_o$$
e'$_o$ = 1.78

$$\alpha = 0.06e'_o$$
= 0.11

$$S_c = \frac{H'_o\alpha}{1+e'_o}\log\left(\frac{t_1}{t_2}\right)$$
S_c = 4.8 ft

Step 3 - Estimate total settlement of waste below the final cover system.

Total settlement is the combination of primary and secondary settlement. An example calculation of the estimated total settlement is shown below for Evaluation Points 1 and 2. The estimated total settlement for all evaluation points is shown on page IIIL-B-2-8.

At Evaluation Point 1:

Thickness of waste column	= 62	ft
Primary Settlement, S_p	= 1.2	ft
Secondary Settlement, S_c	= 5.9	ft
Total Settlement	= 7.1	ft

At Evaluation Point 2:

Thickness of waste column	= 50	ft
Primary Settlement, S_p	= 1.2	ft
Secondary Settlement, S_c	= 4.8	ft
Total Settlement	= 6.0	ft

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 8/7/2024
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Step 4 - Verify that strain induced on the geocomposite due to settlement is within acceptable limits.

Determine the post-settlement slope of the final cover system and verify the strain induced on the geocomposite due to settlement is within acceptable limits.

Note that negative values indicate the components are in compression.

$$Strain = \frac{L_f - L_o}{L_o} x100$$

L_f = Final distance between evaluation points after total settlement, ft
L_o = Initial distance between evaluation points before total settlement, ft

An example calculation of the estimated strain is shown below for Evaluation Points FC1 and 2. The estimated strain for all evaluation points is shown on page HIE-B-3-11.

At Evaluation Point 1 to Elevation Point 2:

Initial Distance:

Evaluation Point 1 Elevation	=	1110	ft-msl
Evaluation Point 2 Elevation	=	1080	ft-msl
Plan View Distance	=	972.88	ft
L_o	=	973.34	ft

Total Settlement:

Total Settlement Point 1	=	7.1	ft
Total Settlement Point 2	=	6.0	ft

Final Distance (after settlement):

Evaluation Point 1 Elevation	=	1102.85	ft-msl
Evaluation Point 2 Elevation	=	1073.99	ft-msl
Plan View Distance	=	972.88	ft
L_f	=	973.31	ft

Strain = -0.004 %

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Final Cover Evaluation - Settlement Summary Table

Evaluation Point [1]	Initial Top of Final Cover Elevation (ft-msl)	Initial Top of Waste Elevation (ft-msl)	Bottom of Waste Elevation (ft-msl)	H_o (ft)	γ_{msw} (pcf)	σ'_o (psf)	$\Delta\sigma$ (psf)	e_o	C_c	S_p (ft)	H'_o (ft)	γ'_{msw} (pcf)	σ''_o (psf)	e'_o	α	S_c (ft)	Total Settlement (ft)	Post-Settlement Top of Final Cover Elevation (ft-msl)
1	1110.0	1107.0	1045.0	62.0	51	1568.0	348.0	1.78	0.62	1.2	60.8	51	1537.4	1.8	0.11	6.0	7.2	1102.8
2	1080.0	1077.0	1027.0	50.0	49	1221.5	348.0	1.80	0.63	1.2	48.8	49	1191.6	1.8	0.11	4.8	6.0	1074.0
3	1110.0	1107.0	1027.0	80.0	53	2126.6	348.0	1.76	0.61	1.2	78.8	53	2095.3	1.8	0.11	7.7	8.9	1101.1
4	1060.0	1057.0	1056.0	1.0	42	20.9	348.0	1.86	0.65	0.3	0.7	42	15.0	1.9	0.11	0.1	0.4	1059.6
5	1110.0	1107.0	1019.0	88.0	54	2389.7	348.0	1.74	0.61	1.2	86.8	54	2358.3	1.7	0.10	8.5	9.6	1100.4
6	1060.0	1057.0	1054.0	3.0	42	63.2	348.0	1.86	0.65	0.6	2.4	42	51.5	1.9	0.11	0.2	0.8	1059.2
7	1124.0	1121.0	1022.0	99.0	56	2766.6	348.0	1.72	0.60	1.1	97.9	56	2735.0	1.7	0.10	9.5	10.6	1113.4
8	1110.0	1107.0	1023.0	84.0	54	2257.0	348.0	1.75	0.61	1.2	82.8	54	2225.7	1.8	0.11	8.1	9.3	1100.7

[1] Refer to Sheet IIIL-B-18 for Evaluation Point locations (1 thru 8).

Final Cover Settlement Analysis

Client: City of Del Rio
Project: Major Permit Amendment
Description: Final Cover Settlement Analysis

Date: 3/7/2025
Job No: DELR2000302
By: T. Metaferia
Checked By: B. Hindman

Final Cover Evaluation - Strain Summary

Evaluation Point [1]		Initial Top of Final Cover Elevation (ft-msl)		Post-Settlement Top of Final Cover Elevation (ft-msl)		Plan View Distance (ft)	L_o (ft)	L_f (ft)	Initial Slope (ft/ft)	Post-Settlement Slope (ft/ft)	Strain (%)
A	B	A	B	A	B						
2	1	1080.0	1110.0	1074.0	1102.8	788.5	789.1	789.0	-0.038	-0.037	-0.005
4	3	1060.0	1110.0	1059.6	1101.1	285.0	289.4	288.0	-0.173	-0.144	-0.467
6	5	1060.0	1110.0	1059.2	1100.4	282.0	286.4	285.0	-0.175	-0.144	-0.492
8	7	1110.0	1124.0	1100.7	1113.4	661.7	661.8	661.8	-0.021	-0.019	-0.004

[1] Refer to Sheet IIIL-B-18 for Evaluation Point locations. The "A" and "B" points represent the upgradient and downgradient endpoints, respectively.

Conclusions:

Compacted clay component of final cover has the smallest average allowable tensile strain value which is 0.5% (Reference 2, pg 469)
The maximum calculated strain (0.5%) represents compression versus tensile strain and is acceptable, therefore the system will be stable.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS
TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIN
NO MIGRATION DEMONSTRATION

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
13155 Noel Road, Suite 200
Dallas, TX 75240
214-638-0500

This document is intended for permitting purposes only.

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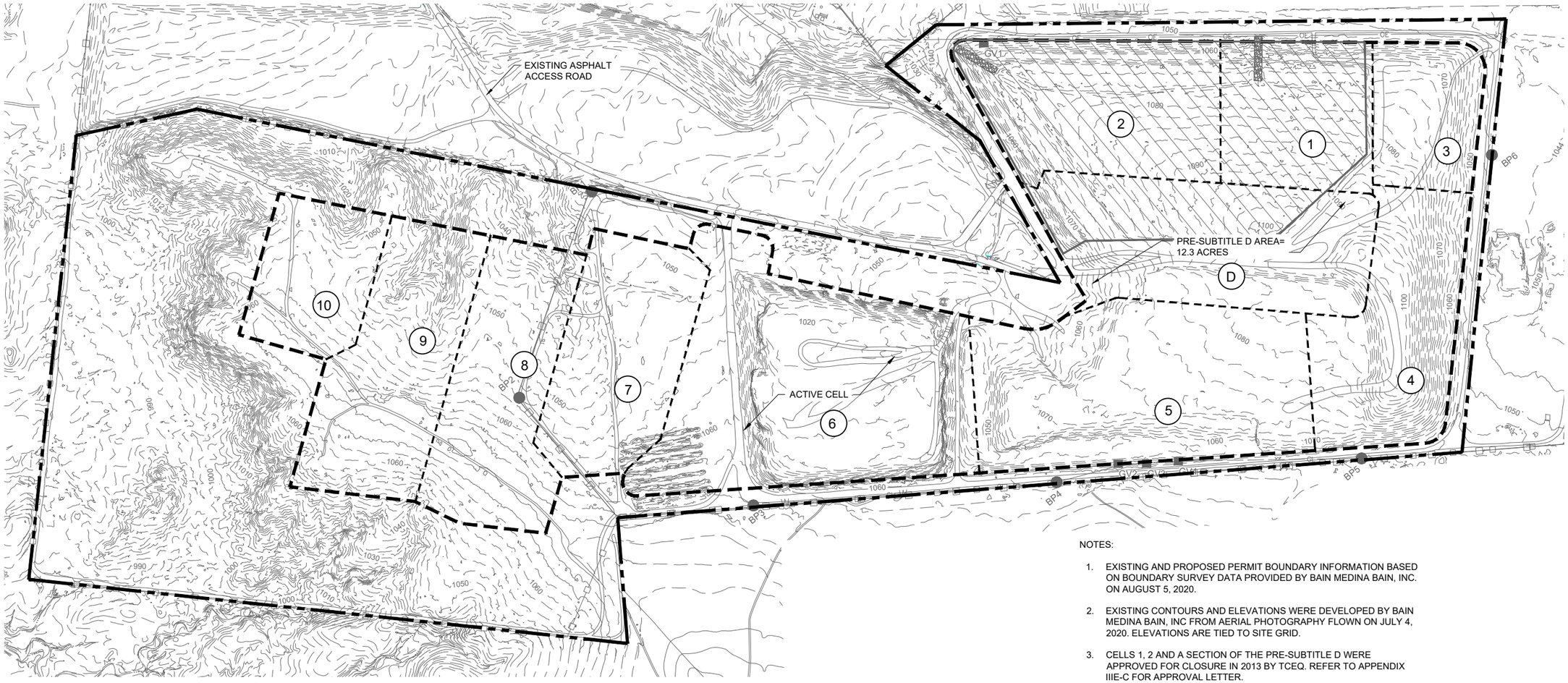
LEGEND

- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMITS OF WASTE
- 1084 — EXISTING GRADES
- BP1 — GAS PROBE
- GV1 — GAS VENT
- EXISTING SITE FENCE
- EXISTING CHUTE
- CLOSED CELLS (REFER TO NOTE 3)
- 1 — CELL DESIGNATION

N

0 200 400

SCALE IN FEET



NOTES:

1. EXISTING AND PROPOSED PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY BAIN MEDINA BAIN, INC. ON AUGUST 5, 2020.
2. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY BAIN MEDINA BAIN, INC FROM AERIAL PHOTOGRAPHY FLOWN ON JULY 4, 2020. ELEVATIONS ARE TIED TO SITE GRID.
3. CELLS 1, 2 AND A SECTION OF THE PRE-SUBTITLE D WERE APPROVED FOR CLOSURE IN 2013 BY TCEQ. REFER TO APPENDIX IIIE-C FOR APPROVAL LETTER.

FOR PERMITTING PURPOSES ONLY

CP&Y an STV Company
TEXAS REGISTERED ENGINEERING FIRM TBPE F-1741

CITY OF DEL RIO TEXAS

STATE OF TEXAS TEMOBISTA METAFERIA 123183 LICENSED PROFESSIONAL ENGINEER 03/07/2025

NO.	REVISION	BY	DATE
1.	2ND TECHNICAL NOD	STV	03/2025

VERIFY SCALE BAR LENGTH EQUALS ONE INCH ON ORIGINAL DRAWING. VERIFY LENGTH ON THIS SHEET AND ADJUST SCALE ACCORDINGLY.
0 1"

CITY OF DEL RIO LANDFILL NO. 207C
MAJOR PERMIT AMENDMENT

SITE PLAN

DESIGN: T. METAFERIA
DRAWN: T. METAFERIA
REVIEW: B. HINDMAN
CP&Y: DELR200302
CLIENT: CITY OF DEL RIO

FIGURE
2.1

PRINTED BY: MetafeT DATE: 11/13/2024
FILE PATH: C:\pwworkingstv\pw_stv\metaferiat\d0942281\DELR200302 Figure 2.1.dwg

- **Liner System** – The Subtitle D clay liner designed for developed and undeveloped cells consists of a 24-inch-thick compacted clay liner with a hydraulic conductivity of $1x10^{-7}$ cm/s. Default soil characteristics from the HELP model were selected for the compacted clay liner.

- **Overliner System** – The overliner system consists of a GCL and 40-mil LLDPE geomembrane. The geomembrane liner was modeled for a good quality installation with four (4) construction defects per acre, and a production pinhole density of 1 hole/acre. Default soil characteristic from the HELP Model were selected for the LLDPE geomembrane hydraulic conductivity.

- **Leachate Collection System** – Developed Subtitle D Cells 1 through 5 were constructed with an LCS that includes a 200-mil thick single-sided geocomposite material (floor grades).

- **Waste Layers** – Various waste thicknesses were modeled to represent the various stages of landfill development in the Subtitle D and pre-subtitle D areas. A default wilting point was selected from HELP to represent municipal solid waste. The moisture content, field capacity, and porosity values were selected as discussed previously.

- **Intermediate Cover** – The intermediate cover consists of a 12-inch-thick layer of soil placed over the waste. Default soil characteristics were selected from HELP to represent the available onsite soils with a hydraulic conductivity of $6.4x10^{-5}$ cm/s.

- **Final Cover** – The final cover over the Subtitle D and pre-Subtitle D areas consists of a 12-inch erosion layer with the top 6 inches capable of sustaining growth of vegetation and an 18-inch infiltration layer. The infiltration layer consists of compacted soil with a hydraulic conductivity of $1x10^{-7}$ cm/s.

6.2 MULTIMED Model Demonstration

The MULTIMED Model Version 2.00 was used to assess contaminant fate and transport between the landfill and the uppermost aquifer. MULTIMED was developed by the Athens Environmental Research Laboratory for the Environmental Protection Agency. MULTIMED estimates the capacity of the hydrogeologic system modeled to dilute and attenuate contaminant concentrations. The model can be used to simulate the fate and transport processes in both the unsaturated and the saturated subsurface environments.

The unsaturated-zone flow module is used to simulate steady state one dimensional (vertical) flow in the unsaturated zone using a “semi analytical” method. The output from the unsaturated-zone flow is then used as an input in the unsaturated-zone transport module. The transport module then simulates a steady-state or transient, one-dimensional (vertical) transport in the unsaturated one and includes the effects of longitudinal dispersion, liner absorption, and first-order decay. Output from the unsaturated-zone transport module, contaminant concentrations at the water table (either steady state or time series), is used to join the unsaturated-zone transport module with the steady-state or transient, semi analytical saturated-zone transport module.

The saturated-zone transport module simulates one-dimensional (horizontal) uniform flow three-dimensional dispersion, linear adsorption, first order decay, and dilution resulting from direct infiltration into the ground-water plume. MULTIMED doesn’t simulate processes such as flow in fractures and chemical reactions between contaminants. The model transport modules assume piston flow, continuous, spatially distributed diffuse recharge through the entire unsaturated zone.

CITY OF DEL RIO LANDFILL

VAL VERDE COUNTY, TEXAS

TCEQ PERMIT NO. MSW-207C

MAJOR PERMIT AMENDMENT APPLICATION
PART IV – SITE OPERATING PLAN

Prepared for
City of Del Rio



September 2023
Revision 1 August 2024
Revision 2 March 2025

Prepared by
CP&Y an STV Company
TPBE Registration No. F-1741
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214-638-0500

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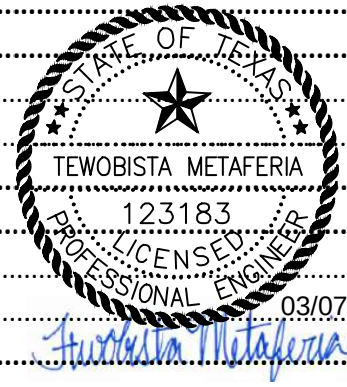
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Table 35-1 - Site Inspections are summarized here and any corrective actions taken shall be documented in the Site Operating Record.

ITEM INSPECTED	TASK	Frequency	Inspector	Referenced In this SOP
Fence/Gates	Inspect perimeter fence and gates for damage. Make repairs if necessary.	Weekly	Landfill Coordinator or Designee	Section 10.2
Windblown Waste	Police working face area, access roads, entrance areas, and perimeter fence for loose trash. Clean up as necessary.	Daily	Landfill Superintendent or Designee	Section 14
Waste Spilled on Route to the Site	Police the entrance areas and all roads at least 2 miles from the site entrances for loose trash. Clean up as necessary.	Daily	Landfill Superintendent or Designee	Section 17
Landfill Markers	Inspect all landfill markers for damage, color-coding, and general location. Correct or replace damaged markers within 15 days of discovery.	Monthly	Landfill Coordinator or Designee	Section 16.1
Site Access Road	Inspect site access road for damage from vehicle traffic, erosion, or excessive mud accumulation. Maintain as needed. Grading equipment will be used control or remove mud accumulations on roads as well as minimize depressions, ruts, and potholes.	Daily – more often during wet weather or extended dry weather periods.	Landfill Coordinator & Superintendent or Designee	Section 21
Daily Cover	Inspect for erosion, proper placement, thickness, and compaction. Correct problems as needed. Verify that vectors are not an issue.	Daily at the active face and all daily cover areas will be inspected.	Landfill Superintendent or Designee	Section 27.1
Intermediate Cover	Inspect for proper placement, thickness, erosion, compaction, settlement, and for presence of waste or other contamination. Correct problems as needed.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Superintendent or Designee	Section 27.3
Final Cover	Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout post-closure care period. Correct problems as needed.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Superintendent or Designee	Section 27.4
Leachate	Measure depth of leachate in sump, as required.	Weekly	Landfill Coordinator or Designee	Section 33
Leachate Odor	Inspect the caps and piping of the cleanout riser and sump riser of the leachate collection system to prevent potential odor escape.	Monthly	Landfill Coordinator or Designee	Table 19.1
Site Signs	Inspect all site signs for damage, general location, and accuracy of posted information.	Weekly	Landfill Coordinator or Designee	Section 13
Ponded Water	Inspect site for ponded water areas. Correct problems as needed.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Superintendent or Designee	Section 28 & 33
Odor	Inspect the perimeter of the site to assess the performance of site operations to control odor.	Daily	Landfill Coordinator & Superintendent or Designee	Section 19.2
Perimeter Channels/Ponds/Chutes/ Swales	Inspect perimeter channels, berms/dikes, chutes and swales for erosion, settlement, obstructions, silt and sediment build-up to verify that they are functioning as designed. Inspect for presence of sediment discharges along the site boundary in areas which have been disturbed by site activities.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Coordinator & Superintendent or Designee	Section 33