CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION

TCEQ PART I APPLICATION FORM, CORE DATA FORM, AND MAILING LABELS

Prepared for
City of Del Rio

October 2020
Revision 1 January 2021
Revision 2 May 2021
Revision 3 September 2021

Revision 4 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

This document is intended for permitting purposes only.

CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION

TCEQ PART I APPLICATION FORM, CORE DATA FORM, AND MAILING LABELS

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PART I FORM

CORE DATA FORM

MAILING LABELS

PART I FORM

11. Permits and Construction Approvals

Permit or Approval	Received	Pending	Not Applicable
Hazardous Waste Management Program under the Texas Solid Waste Disposal Act	☐	☐	☒
Underground Injection Control Program under the Texas Injection Well Act	☐	☐	☒
National Pollutant Discharge Elimination System Program under the Clean Water Act and Waste Discharge Program under Texas Water Code, Chapter 26	☒	☐	☐
Prevention of Significant Deterioration Program under the Federal Clean Air Act (FCAA). Nonattainment Program under the FCAA	☐	☐	☒
National Emission Standards for Hazardous Air Pollutants Preconstruction Approval under the FCAA	☐	☐	☒
Ocean Dumping Permits under the Marine Protection Research and Sanctuaries Act	☐	☐	☒
Dredge or Fill Permits under the CWA	☐	☐	☒
Licenses under the Texas Radiation Control Act	☐	☐	☒
Other (describe) TCEQ Air Quality Premit/Registration	☒	☐	☐
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐
Other (describe)	☐	☐	☐

12. General Facility Information

Facility Name: City of Del Rio Landfill

Contact Name: **John A. Sheedy IV** Title: **Interim City Manager**

MSW Authorization No. (if available): **207B**

Regulated Entity Reference No. (if issued)*: RN**102143294**

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

City: **Del Rio** County: **Val Verde** State: **Texas** Zip Code: **78840**

(Area Code) Telephone Number: **(830) 774-8525**

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

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

Benchmark Elevation (above mean sea level): **1051.10** ft.

Provide a description of the location of the facility 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.**

Contact Name: **John A. Sheedy IV** Title: **Interim City Manager**

Mailing Address: **114 W. Martin St**

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

(Area Code) Telephone Number: **(830) 774-8525**

Email Address: **john.sheedy@cityofdelrio.com**

TX Secretary of State (SOS) Filing Number:

*If the Site Operator (Permittee/Registrant) does not have this number, complete a TCEQ Core Data Form (TCEQ-10400) and submit it with this application. List the Site Operator (Permittee/Registrant) as the Customer.

Signature Page

I, John A. Sheedy IV, Interim City Manager
(Site Operator (Permittee/Registrant)'s Authorized Signatory) (Title)

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.

Signature: ________ Date: 10/21/2021

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, ____________, hereby designate ____________
(Print or Type Operator Name) (Print or Type Representative Name)

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.

____
Printed or Typed Name of Operator or Principal Executive Officer

____
Signature

SUBSCRIBED AND SWORN to before me by the said John A. Sheedy IV
On this 21st day of October, 2021
My commission expires on the 5th day of February, 2022

____
Notary Public in and for
Val Verde County, Texas
(Note: Application Must Bear Signature & Seal of Notary Public)

MARIA CASTRO ACOSTA
Notary ID #10096157
My Commission Expires
February 5, 2022

CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PARTS I/II
GENERAL APPLICATION REQUIREMENTS

Prepared for
City of Del Rio

October 2020
Revision 1 January 2021
Revision 2 May 2021
Revision 3 September 2021
Revision 4 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER

Twobista Metaferia
10/21/2021

Parts I/II

GENERAL APPLICATION REQUIREMENTS

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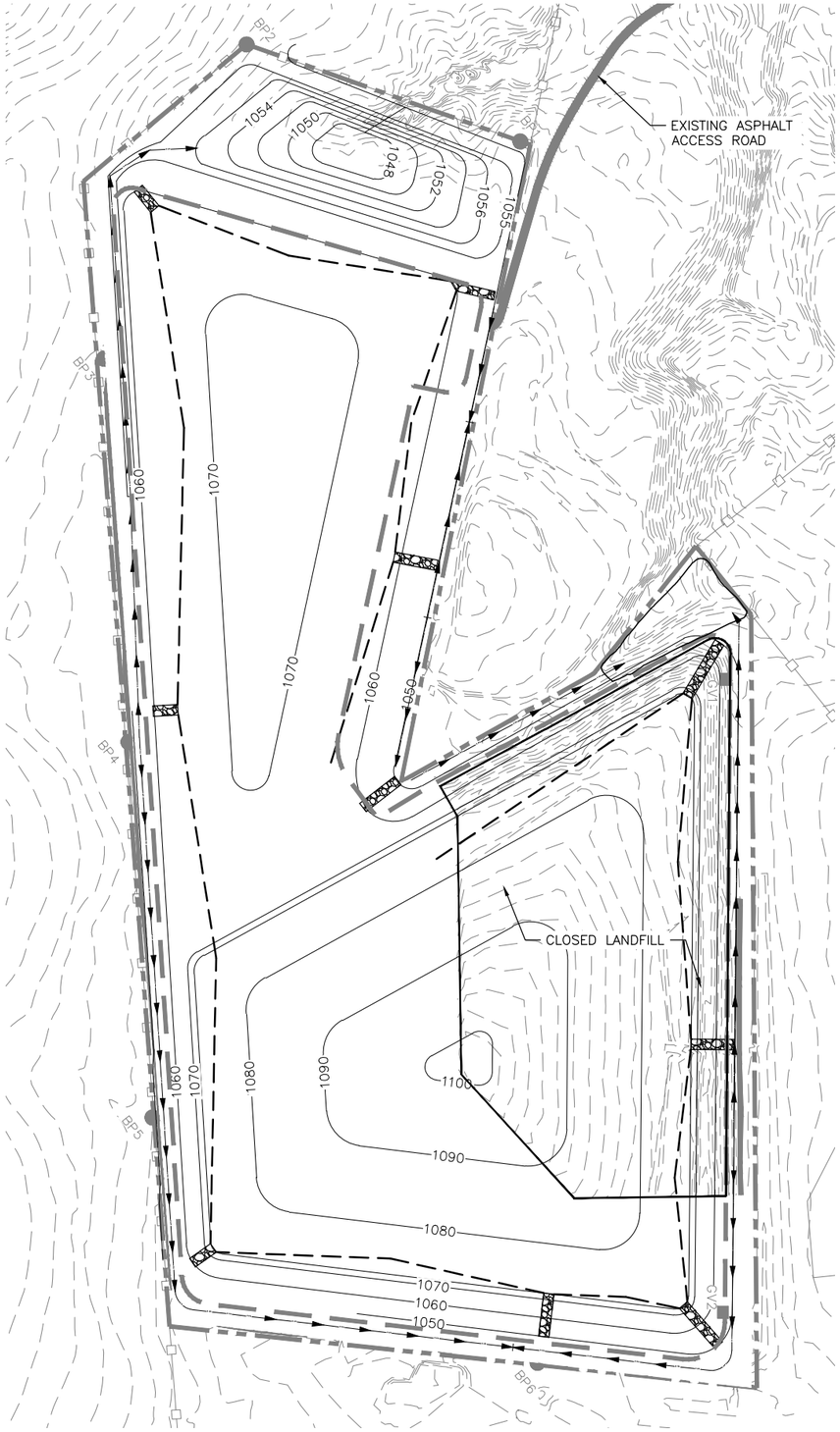
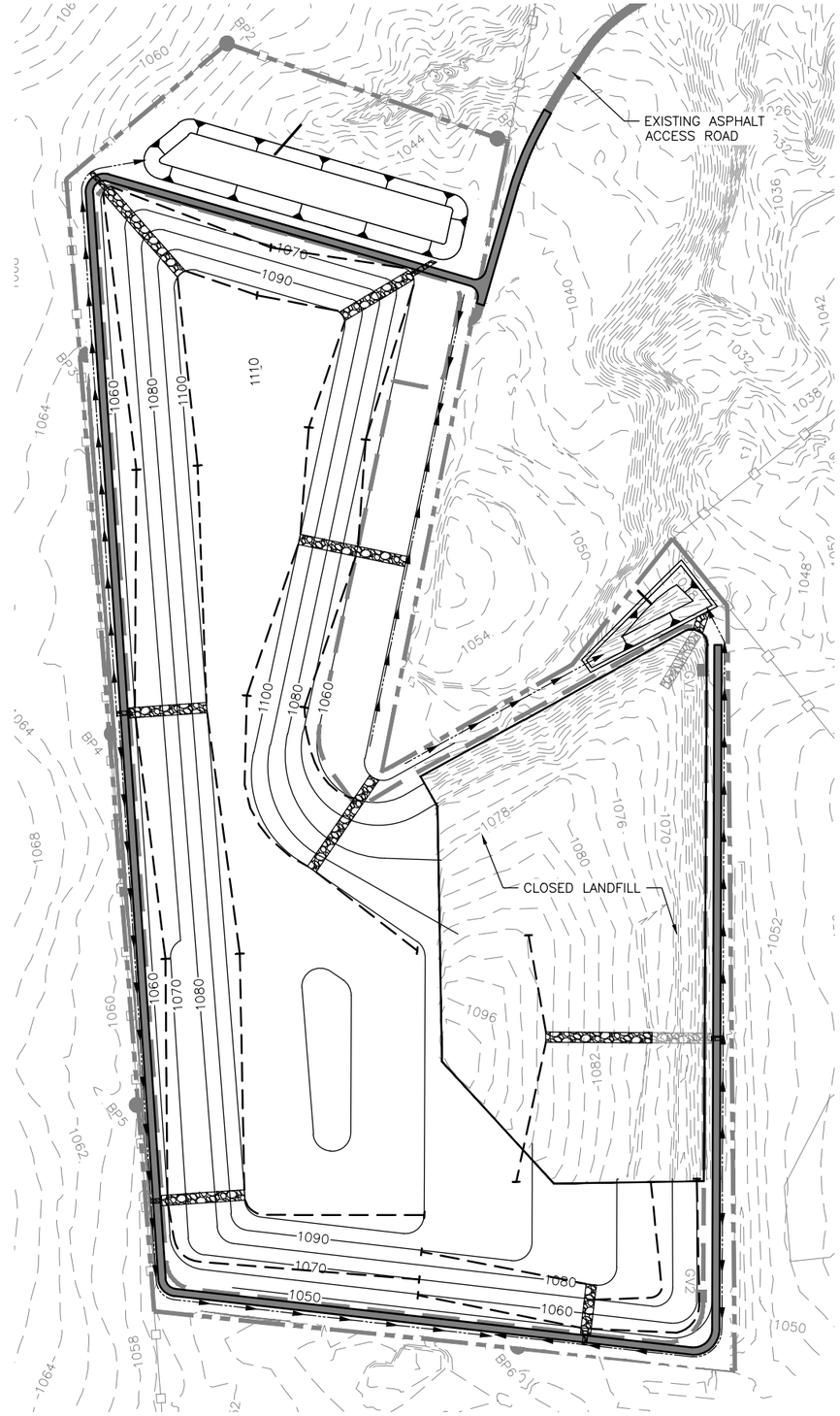
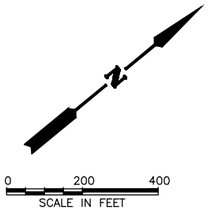


PERMITTED LANDFILL COMPLETION PLAN



PROPOSED LANDFILL COMPLETION PLAN
(TCEQ PERMIT NO. MSW–207B)



LEGEND

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

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDIA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON–GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F–1741

CITY OF Del Rio TEXAS

Charbista Metaferia 10/21/2021

STATE OF TEXAS — TEMOBISTA METAFERIA — 123183 — LICENSED — PROFESSIONAL ENGINEER

NO.	REVISION	BY	DATE
3.	3RD NOD	TM	10/2021
2.	2ND NOD	TM	09/2021
1.	1ST NOD	TM	05/2021

VERIFY SCALE 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

EXISTING AND PROPOSED LANDFILL COMPLETION PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
I/II–2.1

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
C:\pwworking\cpy\pw_cpy\jtorres\d0774896\DELR1900546 Figure I&II-2.1.dwg LAYOUT: Layout1 USER:

CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION

APPENDIX I/IIA
FACILITY LAYOUT MAPS

Prepared for
City of Del Rio

October 2020
Revision 1 May 2021
Revision 2 September 2021
Revision 3 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
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STATE OF TEXAS
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PROFESSIONAL ENGINEER

Twobista Metaferia
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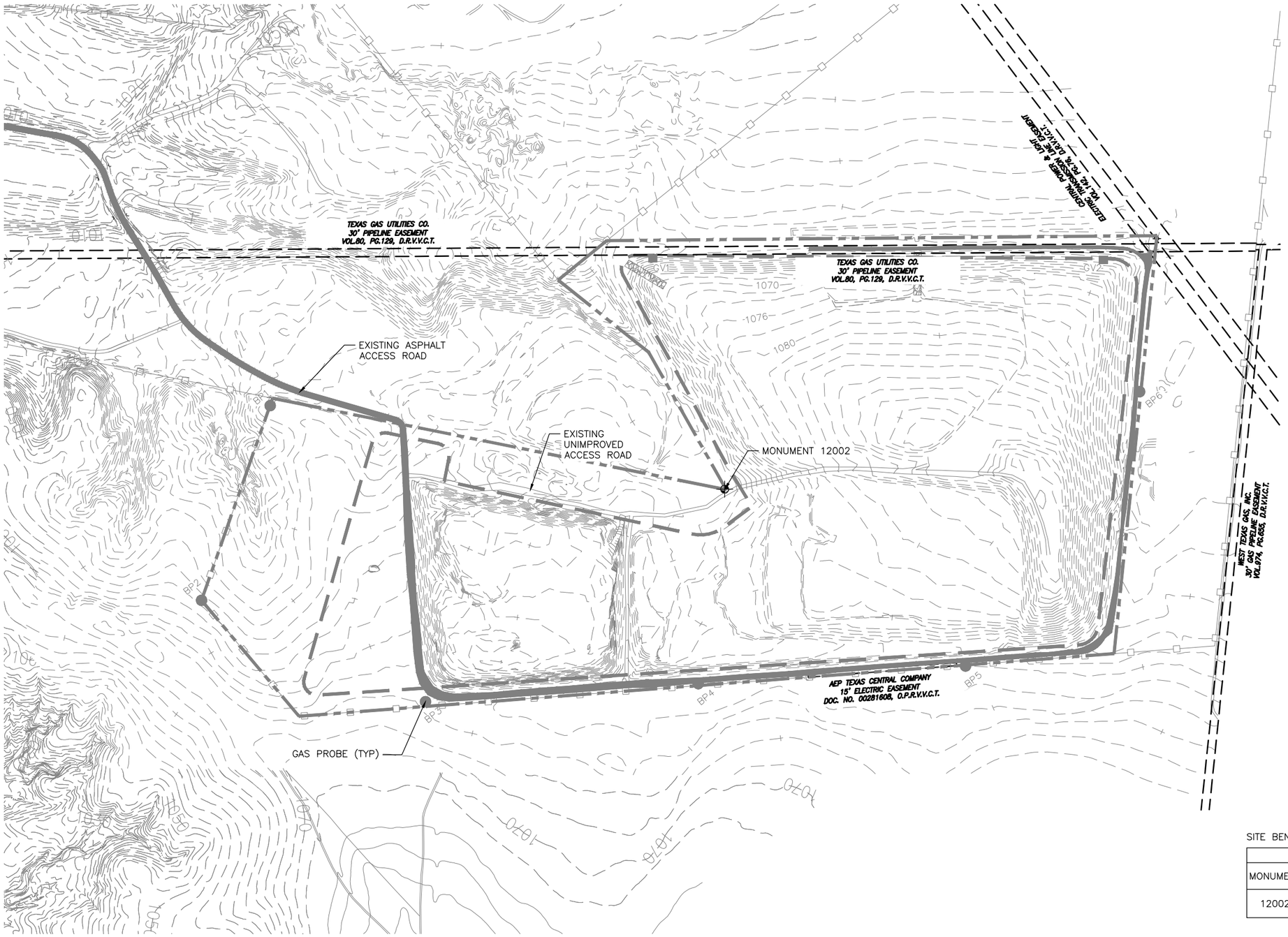

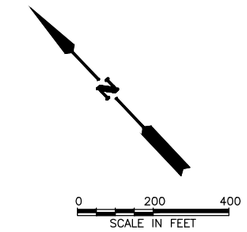

LEGEND

- PERMIT BOUNDARY
- 1084 — EXISTING CONTOURS
- LIMITS OF WASTE
- GV2 — GAS VENT
- EXISTING SITE FENCE

NOTES:

1. THE FACILITY BUILDINGS ARE NOT LOCATED WITHIN THE PERMIT BOUNDARY.
2. THE CENTRAL POWER AND LIGHT ELECTRIC TRANSMISSION EASEMENT LINE SHOWN ON THE PLAN IS THE CONSTRUCTION CENTER LINE AND THE 100 FEET RIGHT-OF-WAY THAT THE UTILITY COMPANY IS PROTECTING (50 FEET FROM THE CONSTRUCTION CENTER LINE ON EACH SIDE).

SITE BENCHMARK INFORMATION IS LISTED BELOW

SITE BENCHMARK INFORMATION			
MONUMENT	NORTHING	EASTING	ELEVATION (FT-MSL)
12002	13681568.26	1378001.94	1051.10

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
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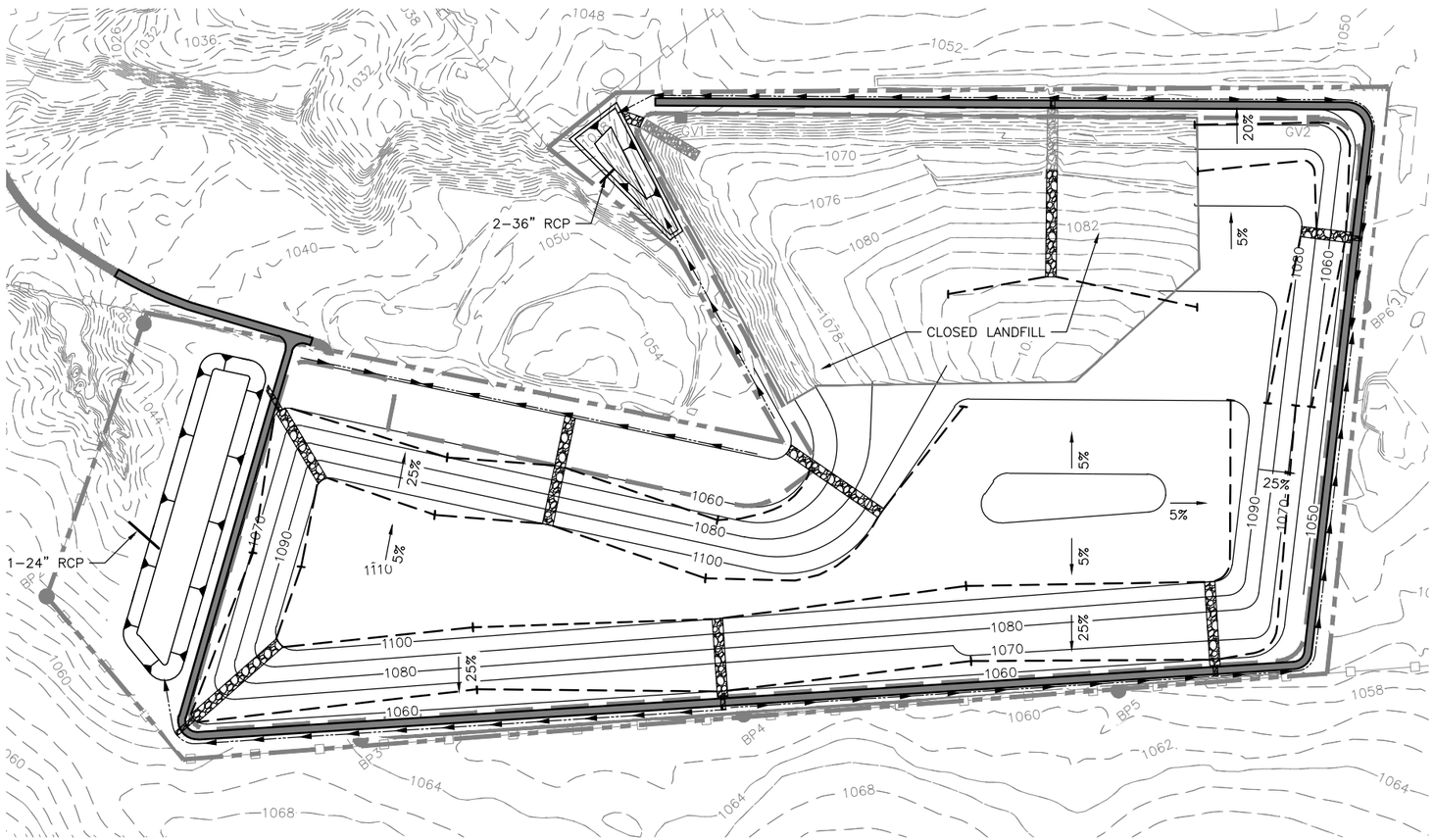
CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

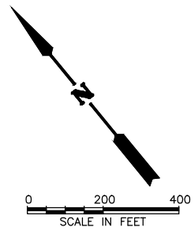
GENERAL SITE PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE
A.1

REFERENCES: DELR1900546 Border Base Permit.dwg _Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
C:\pwworking\cpy\pw_cpy\tmetaferia\d0774896\DELR1900546 Figure 1&II-A.1.dwg LAYOUT: Layout1 USER:





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2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.
3. REFER TO APPENDIX IIIC–LEACHATEAND CONTAMINATED WATER MANAGEMENT PLAN FOR CONTAMINATED WATER RUN–ON/RUN–OFF BERM DESIGN INFORMATION.
4. THE SECTOR DEVELOPMENT SHOWN ON THIS DRAWING SHOWS THE GENERAL SEQUENCE OF FILLING OPERATIONS. THE LOCATION OF THE ALL–WEATHER ACCESS ROAD FROM THE LANDFILL HAUL ROAD TO THE ACTIVE AREA WILL BE DETERMINED DURING SITE OPERATIONS.
5. INTERMEDIATE COVERS CONSIST OF A 12–INCH THICK SOIL LAYER. REFER TO PART IV – SITE OPERATING PLAN FOR ADDITIONAL SOIL COVER REQUIREMENTS.
6. LANDFILL HAUL ROAD WILL BE SURFACED WITH CRUSHED STONE TO PROVIDE–WEATHER ACCESS.
7. REFER TO APPENDIX IIIF–SURFACE WATER DRAINAGE PLAN FOR THE EROSION SEDIMENTATION CONTROL PLAN. DRAINAGE STRUCTURES ARE SHOWN AS THE SITE DEVELOPS. ADDITIONALLY BMPS WILL BE SUED TO CONTROL EROSION AS NEEDED.
8. REFER TO APPENDIX IV FOR LANDFILL GAS MANAGEMENT PLAN.
9. TEMPORARY CHUTES AND SWALES WILL BE PLACED OVER THE INTERMEDIATE COVER AREA TO MINIMIZE EROSION AND HELP ESTABLISH VEGETATION FOR INTERMEDIATE COVER AREAS THAT WILL NOT RECEIVE WASTE OF FINAL COVER WITHIN 180 DAYS AFTER PLACEMENT (REFER TO APPENDIX IIIF–G FOR MORE INFORMATION). MULCH, HYDROSEEDING OR SIMILAR METHODS WILL BE SUED TO ESTABLISH VEGETATION OVER THE INTERMEDIATE COVER AREAS. SWALE AND LETDOWN SPACING WILL MEET THE REQUIREMENTS OF THE EROSION CONTROL PLAN INCLUDED IN APPENDIX IIIF–G.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

10/21/2021

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
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NO.	REVISION	BY	DATE
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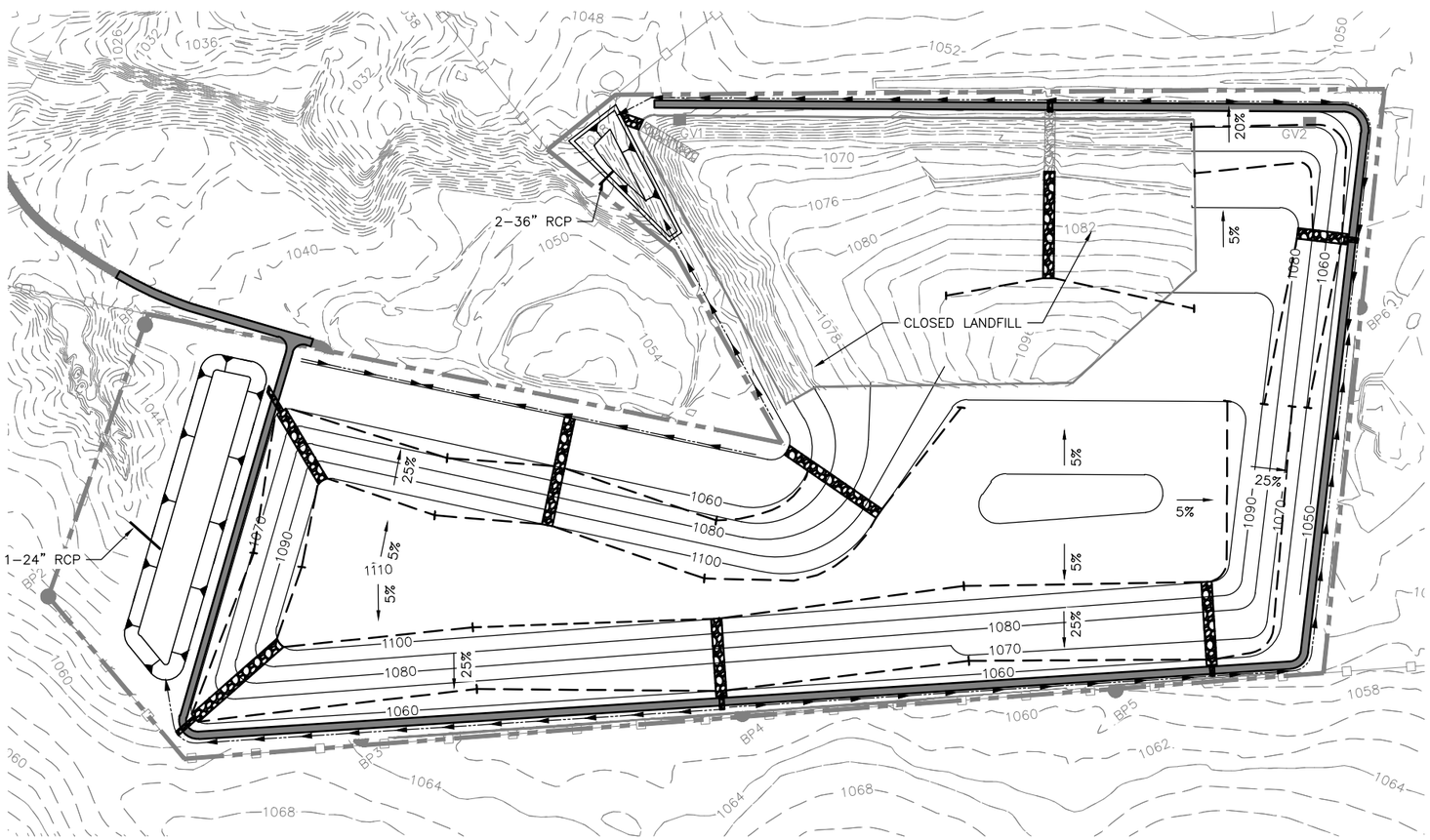
CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

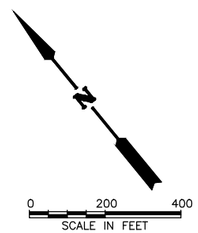
SECTOR DEVELOPMENT PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No.DELR1900546

FIGURE
A.4

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546 Figure I&II-A.4.dwg LAYOUT: Layout1 USER: C:\pwworking\cpy\pw_cpy\jtorres\d0774898\DELR1900546 DELR1900546_LF AREA COMPOSITE





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2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.
3. REFER TO APPENDIX IIIF–SURFACE WATER DRAINAGE PLAN FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1113 FT–MSL MAXIMUM TOP OF WASTE ELEVATION IS 1109 FT–MSL.
5. TYPICAL SIDESLOPES ARE 4H:1V, TYPICAL TOPSLOPE IS 5%.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F–1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

LANDFILL COMPLETION PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
A.5

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
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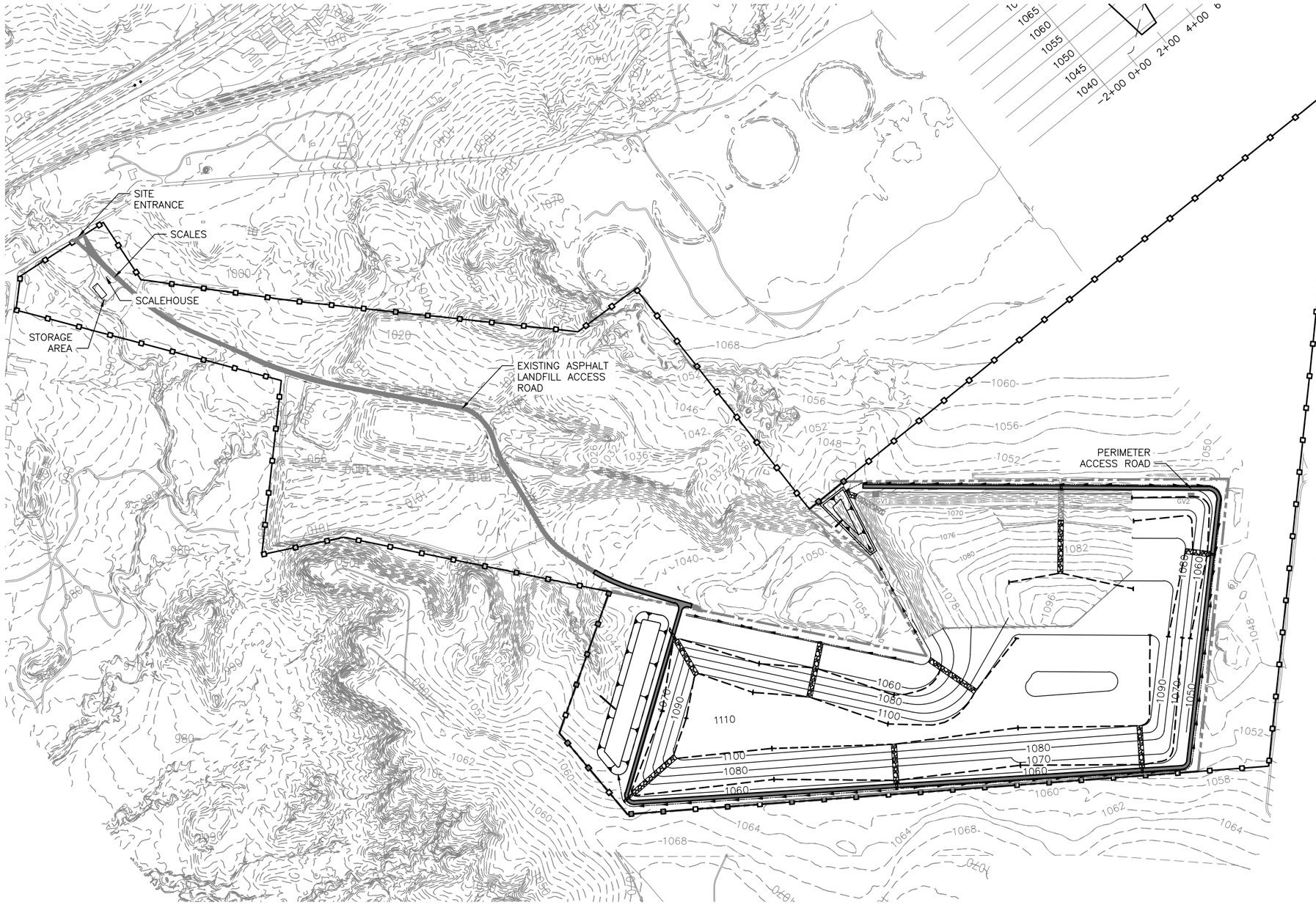

N

0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDIA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON–GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.
3. ACCESS TO THE SITE WILL BE CONTROLLED BY PERIMETER FENCING (MINIMUM 4–FEET HIGH, 3 STRAND BARBED WIRE FENCES), A GATED ENTRANCE, AND NATURAL BARRIERS (E.G DENSE FOLIAGE AND VEGETATION). THE ACCESS CONTROL PLAN IS PROVIDED TO PREVENT ENTRY OF LIVESTOCK, TO PREVENT THE PUBLIC EXPOSURE TO POTENTIAL HEALTH AND SAFETY HAZARDS, AND TO DISCOURAGE UNAUTHORIZED ENTRY OR UNCONTROLLED DISPOSAL OF SOLID WASTE OR HAZARDOUS MATERIAL. NO TRESPASSING SIGNS WILL BE ADDED TO DISCOURAGE UNAUTHORIZED ENTRY OR UNCONTROLLED DISPOSAL OF SOLID WASTE OR HAZARDOUS MATERIAL.
4. ALL THE LFG MONITORING PROBES ARE LOCATED WITHIN THE PERIMETER FENCE.
5. THERE ARE NO NATURAL WINDBREAKS ON SITE.

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CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
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PROFESSIONAL ENGINEER
10/21/2021

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

ACCESS CONTROL PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
A.7

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION

APPENDIX I/IIC
LOCATION RESTRICTION DEMONSTRATIONS

Prepared for

City of Del Rio

October 2020
Revision 1 May 2021
Revision 2 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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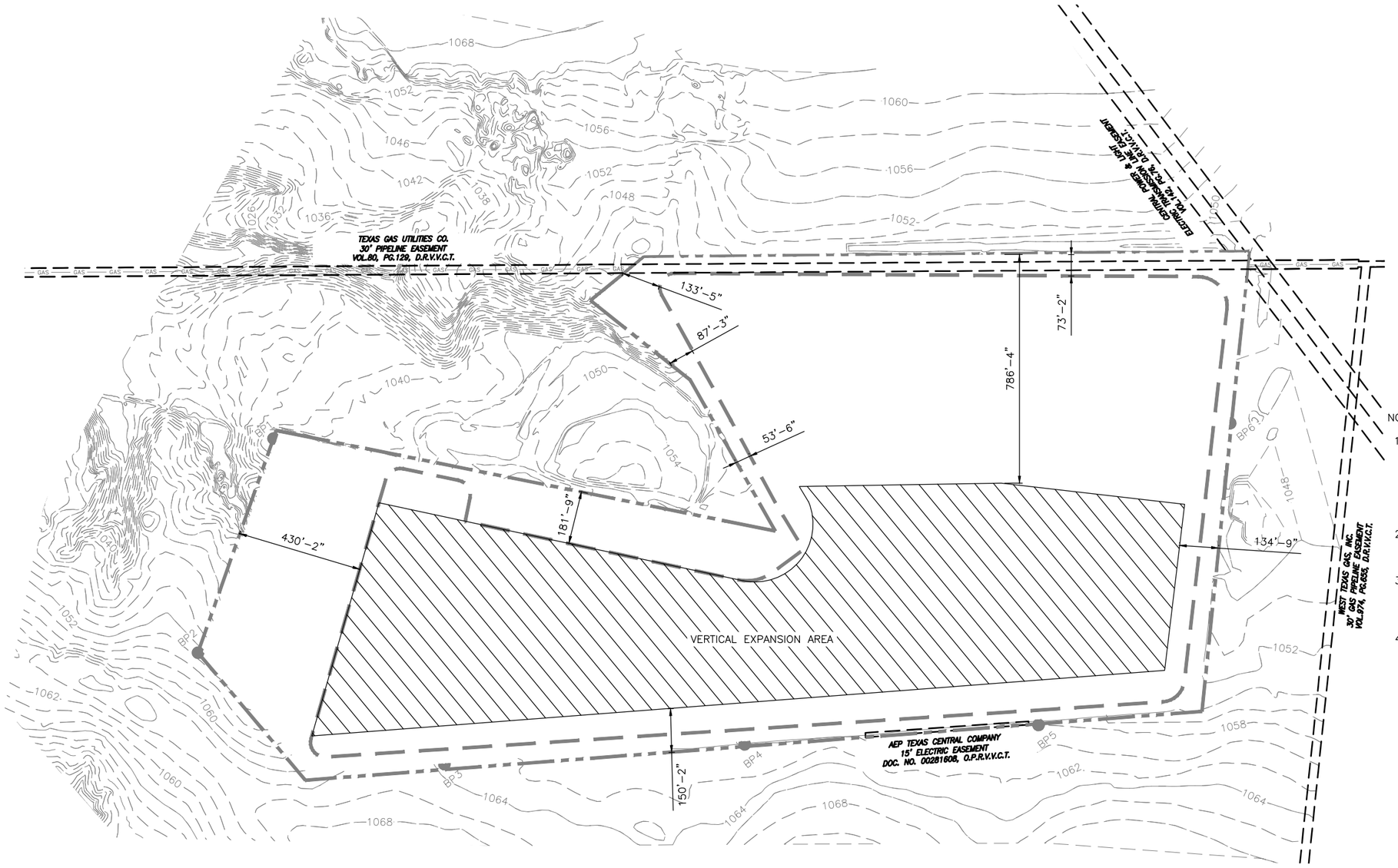

0 200 400
SCALE IN FEET

LEGEND

	PERMIT BOUNDARY
1084	EXISTING CONTOURS
	LIMITS OF WASTE
BP1	GAS PROBE

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS WERE DEVELOPED BY COOPER AERIAL SURVEYS CO. FROM AERIAL PHOTOGRAPHY FLOWN 11-20-2017. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATION SYSTEM NORTH CENTRAL ZONE NAD 1983. ELEVATIONS ARE BASED ON THE NAVD 1988.
2. THE PERMIT BOUNDARY WAS REPRODUCED FROM A LEGAL DESCRIPTION PREPARED BY WEAVER CONSULTANT GROUP.
3. WIDTH OF THE BUFFER ZONE BETWEEN THE LIMITS OF WASTE AND THE PERMIT BOUNDARY VARIES. HOWEVER, THE BUFFER ZONE IS A MINIMUM OF 50 FEET FOR EXISTING FILL AREAS.
4. THE CENTRAL POWER AND LIGHT ELECTRIC TRANSMISSION EASEMENT LINE SHOWN ON THE PLAN IS THE CONSTRUCTION CENTER LINE AND THE 100 FEET RIGHT-OF-WAY THAT THE UTILITY COMPANY IS PROTECTING (50 FEET FROM THE CONSTRUCTION CENTER LINE ON EACH SIDE).

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CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

BUFFER ZONE PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE
C.1

REFERENCES: DELR1900546 Border Base Permit.dwg _Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

Prepared for
City of Del Rio

October 2020
Revision 1, May 2021
Revision 2, September 2021
Revision 3, October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
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Dallas, TX 75235
214-638-0500

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Part III

Site Development Plan

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
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PROFESSIONAL ENGINEER

Tewobista Metaferia
10/21/2021

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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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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIA
LANDFILL UNIT DESIGN INFORMATION

Prepared for

City of Del Rio

October 2020

Revision 1, May 2021
Revision 2 September 2021
Revision 3 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
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Dallas, TX 75235
214-638-0500

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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIA-A
LINER, OVERLINER AND FINAL COVER SYSTEM DETAILS

Prepared for

City of Del Rio

October 2020
Revision 1 May 2021
Revision 2 September 2021
Revision 3 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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DRAWING A.7 - Final Cover Details II (Currently Approved Plan – No change for this Amendment)

DRAWING A.8 – Overliner Details

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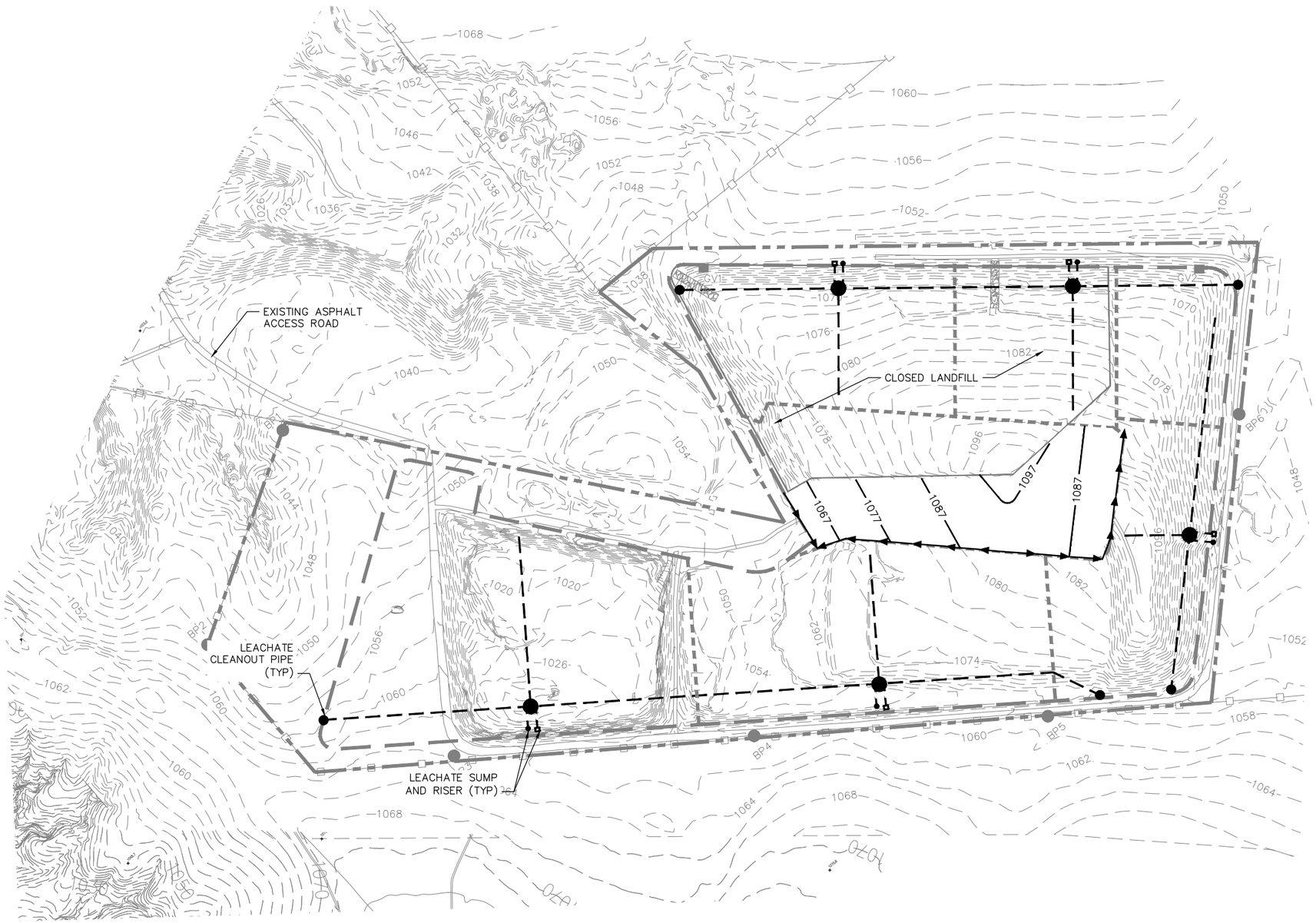

0 200 400
SCALE IN FEET

LEGEND

	PERMIT BOUNDARY
	LIMIT OF WASTE
	CELL BOUNDARY
	CLOSED CELL BOUNDARY
1050	EXISTING CONTOURS
1086	OVERLINER CONTOURS
	OVERLINER LEACHATE PIPES
	PERMITTED LEACHATE PIPES
BP1	GAS PROBE
	PERMITTED LEACHATE SUMP
GV2	GAS VENT

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1,2,3,4 & D TOP UPDATED AUGUST 2018 AND CELLS 6 AND 6 UPDATED JANUARY 2020 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON-GOING LANDFILL ACTIVITIES.

2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774-0796. DATED: 10-25-94.

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CITY OF Del Rio TEXAS

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT
OVERLINER PLAN

Date: MAY 2021
Designed: T. METAERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
A.1a

REFERENCES: DELR1900546_ECBASE.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE_LF AREA COMPOSITE.dwg DELR1900546_ECBASE_OVERLINER
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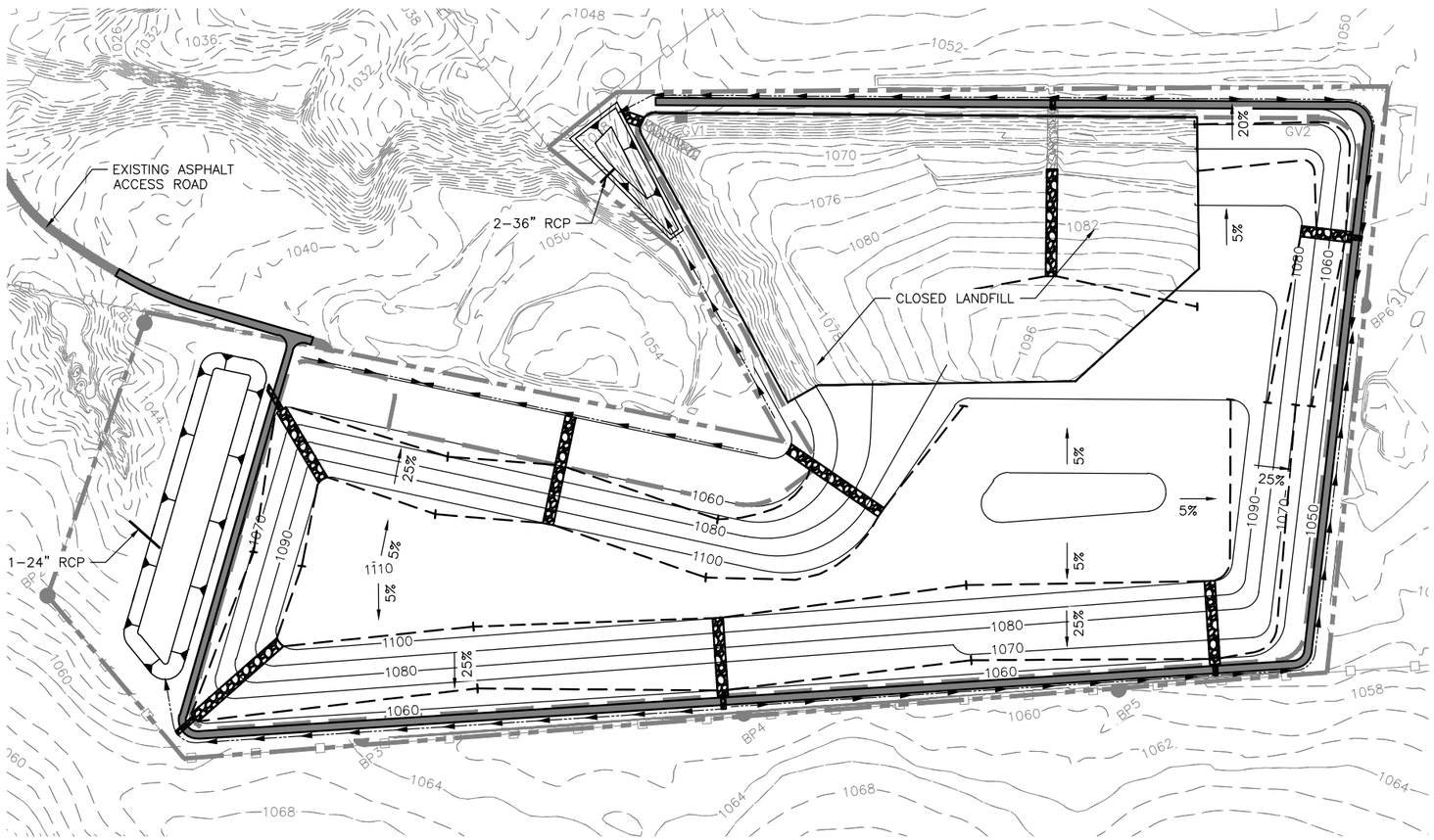

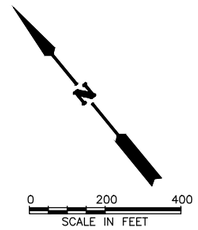

LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT

NOTES:

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2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.
3. REFER TO APPENDIX IIIH–SURFACE WATER DRAINAGE PLAN FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1113 FT–MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1110.5 FT–MSL.
5. TYPICAL SIDESLOPES FOR THE PROPOSED VERTICAL EXPANSION AREA ARE 4H:1V. TYPICAL TOPSLOPE IS 5%.

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CITY OF Del Rio TEXAS

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT
COMPLETION PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No.DELR1900546

FIGURE
A.2

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIA-B
LANDFILL UNIT CROSS SECTIONS

Prepared for

City of Del Rio

October 2020

Revision 1 May 2021
Revision 2 September 2021
Revision 3 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
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Twobista Metaferia
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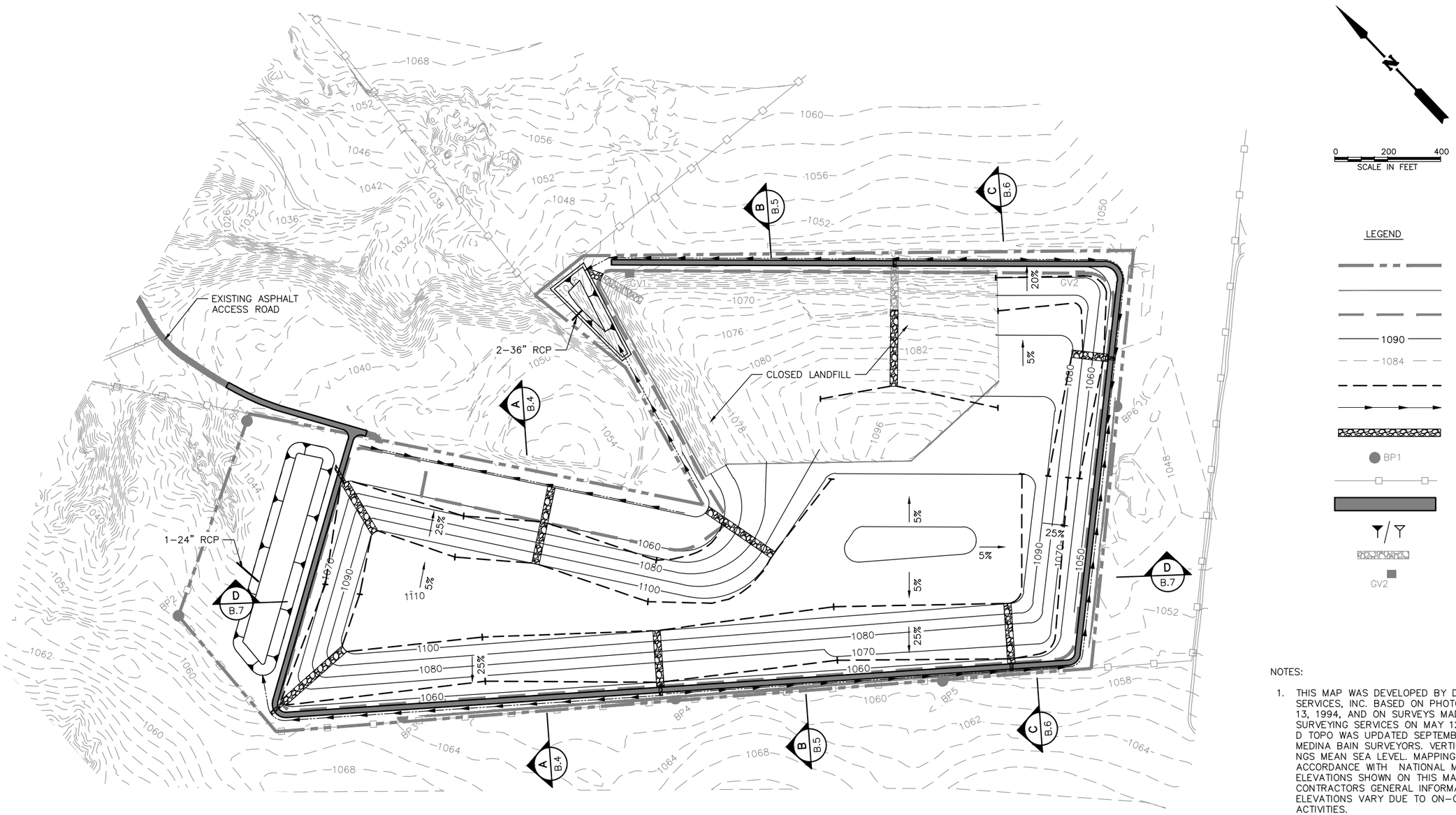
DRAWING B.6 - Typical Cross Section C

DRAWING B.7 - Typical Cross Section D



LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON–GOING LANDFILL ACTIVITIES.

2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.

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CITY OF Del Rio TEXAS

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CITY OF DEL RIO
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MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

LANDFILL COMPLETION PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA
Drawn: T. BENSON
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE
B.3

REFERENCES: DELR1900546 Border Base Permit.dwg __Std ENVIRO SEALS.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1700632_ECBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE.dwg DELR1900546_PCBASE
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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIE
CLOSURE PLAN

Prepared for
City of Del Rio

October 2020
Revision 1 May 2021
Revision 2 September 2021
Revision 3 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
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LICENSED
PROFESSIONAL ENGINEER

Twobista Metaferia
10/21/2021

This document is intended for permitting purposes only.

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CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIG
CLOSURE AND POST-CLOSURE CARE COST ESTIMATE

Prepared for

City of Del Rio

October 2020
Revision 1 May 2021
Revision 2 September 2021

Revision 3 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

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Appendix IIIG-A TCEQ Forms

TABLE IIIG-1
CLOSURE COST ESTIMATES
ACTIVE LANDFILL (37.3 acres)

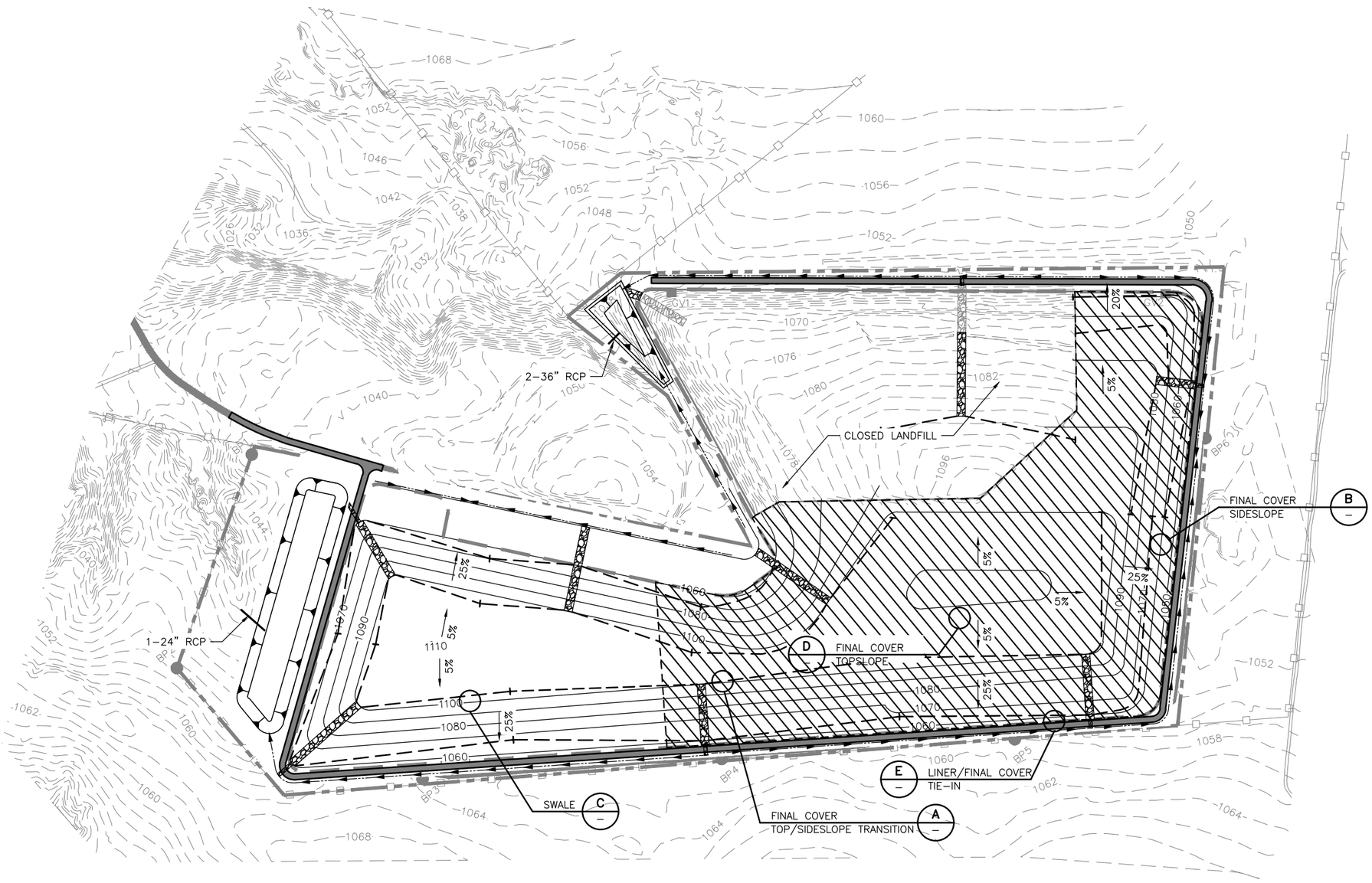
Client: City of Del Rio
Project: Major Permit Amendment
Description: Closure Cost Estimates

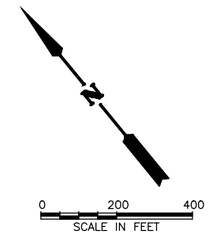
Date: 10/16/2020
Job No: DELR1900546
By: T. Metaferia
Checked By: B. Hindman

Description	Quantity	Unit	Inflation Factor[1]	Unit Cost 2005	Unit Cost 2020	Total Cost
ENGINEERING						
Topographic Survey	1	LS	1.282	$17,020.00	$21,819.64	$21,819.64
Boundary Survey for Affidavit	1	LS	1.282	$4,000.00	$5,128.00	$5,128.00
Site Evaluation	1	LS	1.282	$2,900.00	$3,717.80	$3,717.80
Final Cover Plans and Specifications	1	LS	1.282		$50,000.00	$50,000.00
Final Cover Construction - Contract Administration	1	LS	1.282		$14,000.00	$14,000.00
Final Cover Construction - Observation and Quality Assurance	1	LS	1.282	$78,200.00	$100,252.40	$100,252.40
Affidavit to the Public	1	LS	1.282	$1,300.00	$1,666.60	$1,666.60
TPDES, Other Permits	1	LS	1.282	$6,000.00	$7,692.00	$7,692.00
Engineering Total						**$204,276.45**
Legal Fees	25%					$51,069.11
CONSTRUCTION						
Infiltration Layer (Top Slope)	120,355	CY	1.282	$5.70	$7.31	$879,792.61
Erosion/vegetation layer (soil and topsoil)	60,177	CY	1.282	$4.00	$5.13	$308,709.72
Revegetation	37.3	Acre	1.282	$1,965.00	$2,519.13	$93,963.55
Site grading and drainage	37.3	Acre	1.282	$1,140.00	$1,461.48	$54,513.20
Subtotal						**$1,336,979.09**
Mobilization, bonds, insurance	10%					$133,697.91
TCEQ Administration	5%					$66,849.00
Construction Total						**$1,537,526.00**
Subtotal Closure Cost (Engineering + Legal + Construction)						**$1,792,871.56**
Contingency	10%					$179,287.16
Contract Performance Bond	2%					$35,857.43
Third Party Administration and Project Management	2.5%					$44,821.79
Subtotal						**$259,966.38**
TOTAL CLOSURE COST						**$2,052,837.94**

Note:

1. Inflation factor is to bring the 2005 dollars to 2018. The inflation factors used are 2.9, 2.7, 2.2, 1.2, 1.0, 2.1, 1.8, 1.5, 1.5, 1.0, 1.3, 1.8, 2.3 and 1.8 for years 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 respectively. The inflation factors are obtained from the TCEQ website.





LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT
- AREA REQUIRING FINAL COVER SEE NOTE 6)

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.
3. REFER TO APPENDIX IIIH–SURFACE WATER DRAINAGE PLAN FOR DRAINAGE DESIGN INFORMATION.
4. MAXIMUM FINAL COVER ELEVATION IS 1113 FT–MSL. MAXIMUM TOP OF WASTE ELEVATION IS 1110.5 FT–MSL.
5. TYPICAL SIDESLOPES ARE 4H:1V. TYPICAL TOPSLOPE IS 5%.
6. THE LARGEST AREA REQUIRING FINAL COVER IS 37.3 ACRES.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

Smobista Metafera 10/21/2021

STATE OF TEXAS TEMOBISTA METAFERA 123183 LICENSED PROFESSIONAL ENGINEER

NO.	REVISION	BY	DATE
3.	3RD NOD	TM	10/2021
2.	2ND NOD	TM	09/2021
1.	1ST NOD	TM	05/2021

VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE
0 1"

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

COMPLETION PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA
Drawn: T. BENSON
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE

IIIE–1

REFERENCES: DELR1900546 Border Base Permit.dwg _Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE.dwg DELR1900546 C:\pwworking\cpy\pw_cpy\jlorrea\d0780520\DELR1900546 Figure IIIE–1.dwg LAYOUT: Layout1 USER:

APPENDIX IIIG-A
TCEQ FORMS

- TCEQ Form 20721
- TCEQ Form 20723

Texas Commission on Environmental Quality

Closure Cost Estimate Form for Municipal Solid Waste Type I Landfills

This form is for use by applicants or site operators to provide cost estimates for closure 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 close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover. If you need assistance in completing this form, please contact the MSW Permits Section in the Waste Permits Division at (512) 239-2335.

Facility Name: **City of Del Rio Landfill**

MSW Permit No.: **207B**

Site Operator/Permittee Name and Mailing Address: **City of Del Rio**

114 W Martin St

Del Rio, TX 78840

Total Closure Cost Estimate (2020 Dollar Amount): **$1,763,221.67**

I. 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 Closure Cost Estimate has been completed in substantial conformance with the facility Closure 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 Manager**

Date: 10/21/2021

Company Name: **CP&Y, Inc.** Firm Registration Number: **F-1741**

Professional Engineer's Seal

Professional Engineer's Signature

D. Closure Cost Estimates Worksheet

If any item listed in this worksheet is not applicable to the subject facility, enter "NA" (Not Applicable) in the affected field.

Table 1. Closure Cost Estimates Worksheet.

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
1. Engineering Costs						
1.1	Topographic Survey	Lump Sum	1	21819.64	21,819.64	4
1.2	Boundary Survey	Lump Sum	1	5,128.00	5,128.00	4
1.3	Site Evaluation	Lump Sum	1	3717.80	3,717.80	4
1.4	Development of Plans	Lump Sum	1	50000.00	50,000.00	2
1.5	Contract Administration (bidding and award)	Lump Sum	1	14,000.0 0NA	14,000.00	2
1.6	Closure Inspection and Testing	Lump Sum	1	100,252. 40	100,252.40	4
1.7	TPDES and other Permits	Lump Sum	1	7,692.00	7,692.00	NA
1.8	Additional Engineering Cost Items (describe in attachments)	Lump Sum	1	1,666.60	1,666.60	4
1.9 Engineering Costs Subtotal						
1.9.1	Engineering Costs Subtotal				204,276.45	
2. Construction Costs						
2.1 Mobilization						
2.1.1	Mobilization of Personnel and Equipment	Lump Sum	1	10% of Const Cost	133,697.91	4
2.2 Final Cover System						
2.2.1 Side Slope Cover (the top slope quantities are included in this section to be conservative)						
2.2.1a	Infiltration Layer – Compacted Clay	Cubic Yards	120,355	7.31	879,792.61	4
2.2.1b	Infiltration Layer – Geosynthetic Clay Liner	Square Feet	NA	NA	NA	NA

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.2.1c	Flexible Membrane Cover – HDPE	Square Feet	NA	NA	NA	NA
2.2.1d	Flexible Membrane Cover – LLDPE	Square Feet	NA	NA	NA	NA
2.2.1e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA
2.2.1f	Drainage Layer – Drainage Geocomposite Material	Square Feet	NA	NA	NA	NA
2.2.1g	Erosion Layer	Cubic Yards	60,177	5.13	308,709.72	4
2.2.1h	Vegetation	Acres	37.3	2,519.13	93,963.55	4
2.2.2 Top Slope Cover						
2.2.2a	Infiltration Layer – Compacted Clay	Cubic Yards	NA	NA	NA	NA
2.2.2b	Infiltration Layer – Geosynthetic Clay Liner	Square Feet	NA	NA	NA	NA
2.2.2c	Flexible Membrane Cover – HDPE	Square Feet	NA	NA	NA	NA
2.2.2d	Flexible Membrane Cover – LLDPE	Square Feet	NA	NA	NA	NA
2.2.2e	Drainage Layer – Aggregate	Cubic Yards	NA	NA	NA	NA
2.2.2f	Drainage Layer – Drainage Geocomposite Material	Square Feet	NA	NA	NA	NA
2.2.2g	Erosion Layer	Cubic Yards	NA	NA	NA	NA
2.2.2h	Vegetation	Acres	NA	NA	NA	NA
2.2.3 Cells for Class 1 Nonhazardous Industrial Waste						
2.2.3a	Dike Construction	NA	NA	NA	NA	NA
2.3 Site Grading						
2.3.1	Site Grading	Acres	37.3	1,461.48	54,513.20	4
2.4 Site Fencing and Security						
2.4.1	Site Fencing and Security	NA	NA	NA	NA	NA
2.5 Landfill Gas Monitoring and Control System						
2.5.1	Gas Control Wells	NA	NA	NA	NA	NA

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
2.5.2	Gas Header Piping	NA	NA	NA	NA	NA
2.5.3	Gas Lateral Piping	NA	NA	NA	NA	NA
2.5.4	Flare Station	Lump Sum	NA	NA	NA	NA
2.5.5	Condensate Sumps	NA	NA	NA	NA	NA
2.5.6	Completion of LFG Monitoring System	NA	NA	NA	NA	NA
2.6 Groundwater Monitoring System						
2.6.1	Groundwater Monitoring Well Installation	Each	NA	NA	NA	NA
2.6.2	Piezometer and Monitor Well Plugging and Abandonment	Each	NA	NA	NA	NA
2.7 Leachate Management						
2.7.1	Completion of Leachate Management System	NA	NA	NA	NA	NA
2.8 Stormwater Management						
2.8.1	Stormwater Drainage Management System	NA	NA	NA	NA	NA
2.9 Other Cost Items						
2.9.1	Additional Construction Cost Items (describe in attachments)	Lump Sum			66,849.00	4
2.10 Construction Costs Subtotal						
2.10.1	Construction Costs Subtotal				1,470,677.00	
3. Storage and Processing Unit Closure Costs						
3.1	Waste Disposal	☐ Tons ☐ Cubic Yards	NA	NA	NA	NA
3.2	Material Removal and Disinfection	NA	NA	NA	NA	NA
3.3	Demolition and Disposal Units	NA	NA	NA	NA	NA
3.4	Additional Storage and Processing Unit Closure Cost Items (describe in attachments)	NA	NA	NA	NA	NA

Item No.	Item Description	Units[1]	Quantity	Unit Cost	Cost	Source of Unit Cost Estimate[2]
3.5 Storage and Processing Unit Closure Costs Subtotal						
3.5.1	Storage and Processing Unit Closure Costs Subtotal				NA	
4. Sum of Engineering, Construction, and Storage and Processing Unit Closure Costs						
4.1	Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals (Includes Legal Fees which are 25% of total Engineering Cost)				255,345.56	
5. Contingency						
5.1	Contingency (10% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)				179,287.16	
6. Contract Performance Bond						
6.1	Contract Performance Bond (2% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)				35,857.43	
7. Third Party Administration and Project Management Costs						
7.1	Third Party Administration and Project Management Costs (2.5% of Sum of Engineering, Construction, and Storage and Processing Unit Closure Cost Subtotals)				44,821.79	
8. Total Closure Costs						
8.1	Total Closure Costs (sum of amounts in Sections 4, 5, 6, and 7)				2,052,837.94	

[1] For items marked "specify," the responsible professional engineer will enter appropriate unit of measurement

[2] Sources of Unit Costs for Cost Estimates table may include:
(1) Published Cost Estimator Manuals (e.g., RS Means);
(2) Third Party Quotes (e.g., Environmental Field Services Contractors);
(3) Verifiable Data based on Actual Operations; or
(4) Other sources of cost acceptable to the executive director of the TCEQ.

CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIH
SURFACE WATER DRAINAGE PLAN

Prepared for

City of Del Rio

October 2020
Revision 1 May 2020
Revision 2 October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500

STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER

Twobista Metaferia
10/21/2021

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APPENDICES

APPENDIX IIIH-A – Permitted Condition Hydrologic Calculations

APPENDIX IIIH-B – Post-Development Condition Hydrologic Calculations

APPENDIX IIIH-C – Not Used

APPENDIX IIIH-D – Final Cover Erosion Control Structure Design

APPENDIX IIIH-E – Erosion Layer Evaluation

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 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 weather data to determine the peak flow rates for the permit boundary area. 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 Effect of Site Development on Drainage from the Site

The purpose of this section is to evaluate the peak flow rates, runoff volumes, and peak flow velocities of the existing permitted- and post-development hydrologic conditions. Due to the construction and content of the permitted drainage condition, runoff volumes and velocities were calculated as supplemental data, based on the existing condition analyses. A summary of peak flow rates, runoff volumes, and peak flow velocities entering and exiting the permit boundary is provided in Figure IIIH.1 Site Drainage Patterns,

Runon/Runoff. As shown on Figure IIIH.1 the flow rates at the discharge points for the proposed conditions are less than that of the permitted condition. Although the volume increased slightly at discharge points 1 and 3 the overall volume exiting the permit boundary is the same for the existing and post-development condition. The post development velocity is lower at all the discharge points than the permitted condition.

4.2.1 Comparison of Existing 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 1998 utilized different weather data than what is currently required by TCEQ. The comparison between existing and post-development conditions is only meaningful if both conditions are based on consistent weather data. Therefore, to develop a direct comparison between the existing permitted and post-development conditions, new hydrologic models were developed for the existing permitted condition utilizing the required weather data. 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 existing 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.

Table 4-1 – Summary of 25-Year Hydrologic Analysis

	Discharge Point 1		Discharge Point 2		Discharge Point 3		Discharge Point 4	
	Exist	Prop	Exist	Prop	Exist	Prop	Exist	Prop
Q – Flow Rate (cfs)	74.4	52.1	350.8	337.5	212.8	117.6	96.2	79.7
V – Velocity (fps)	23.6	4.0	4.7	4.6	6.5	8.3	11.6	6.0
Vol – Runoff Volume (ac-ft)	34.7	36.6	62.6	60.1	16.7	19.1	6.7	4.6

4.2.2 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 four separate locations along the permit boundary (DC1, DC2, DC3, and DC4 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.

4.2.3 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. Although the volume increased slightly at discharge points 1 and 3, the total runoff volume for exiting the permit boundary decreased. Since all the discharge points from the site ultimately discharge into the Rio Grande the increase in runoff volume at DC1 and DC3 does not adversely alter the existing condition.

4.2.4 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 at DC3. The increase in velocity is due to the cross-sectional area decreasing from an open channel with a bottom width of 60 feet to two (2) 36-inch culverts at Pond 2. The area directly downstream of Pond 2 is a channel that discharges into the Calaversas Creek and is owned by the City. So no adverse condition is created by the slight increase in velocity in this area.. Velocity calculations are provided in Appendices IIIH-A and IIIH-B for the permitted conditions and post-development, respectively.

4.2.5 Summary

From the hydrologic evaluations of the updated 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 is not significantly altered, 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).

DRAWINGS

- IIIH.1 – SITE DRAINAGE PATTERN RUNON/RUNOFF
- IIIH.2 – DRAINAGE STRUCTURE PLAN
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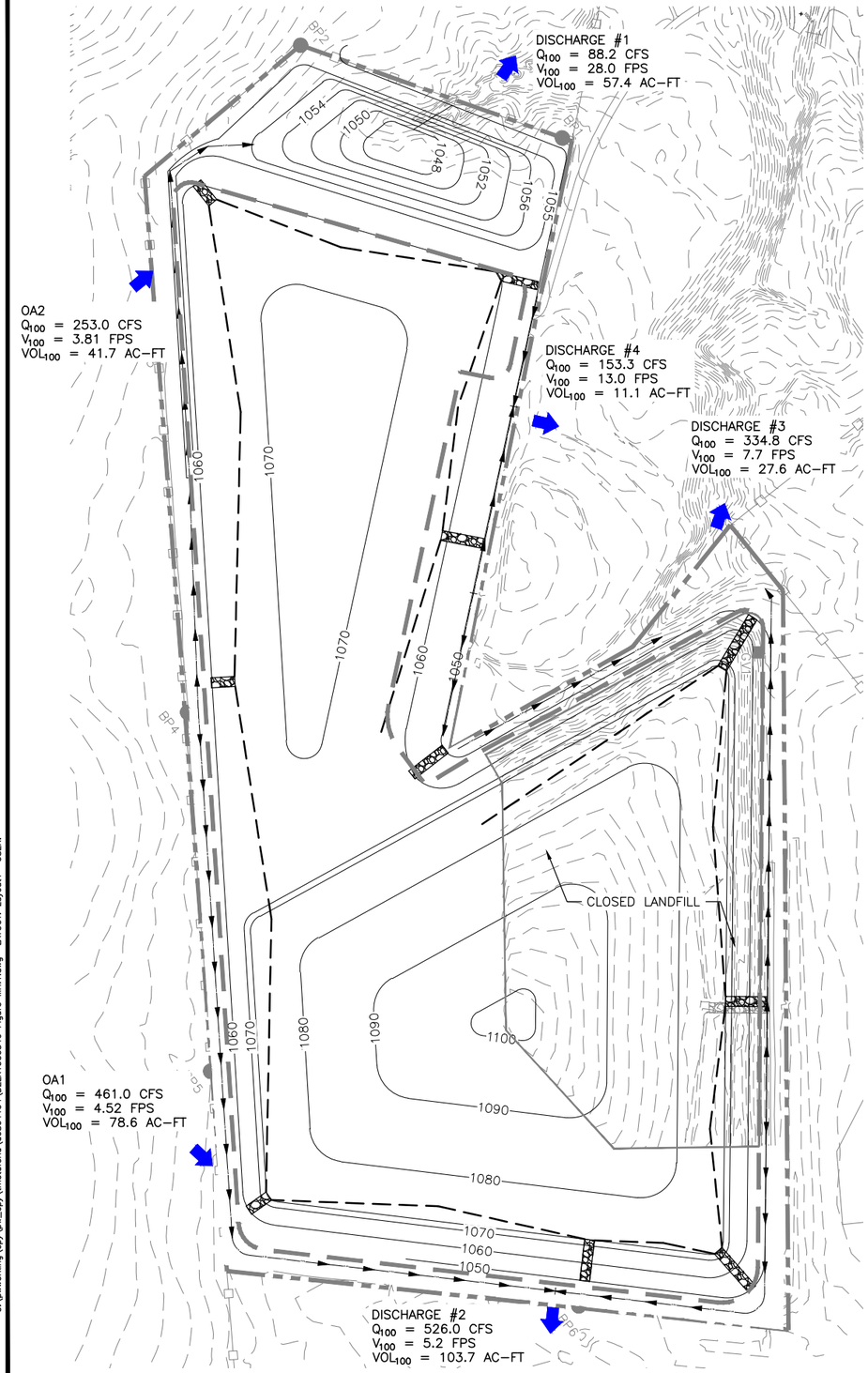
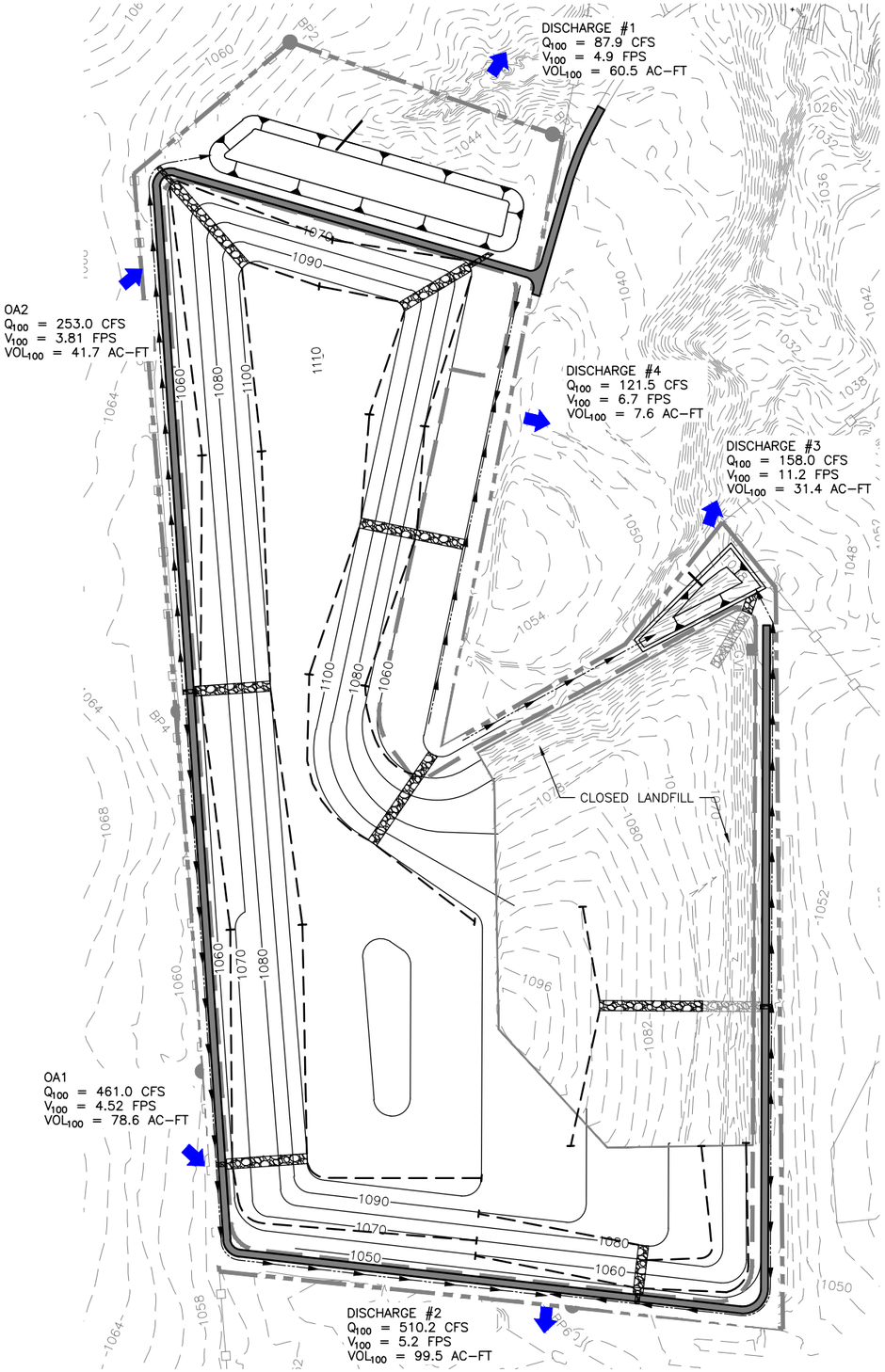
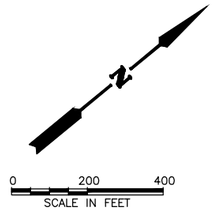
- IIIH.9 – Pond 1 Cross Sections A and B
- IIIH.10 – Pond 2 Outlet Structure
- IIIH.11 – Pond 2 Cross Sections C and D



PERMITTED LANDFILL COMPLETION PLAN



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



LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 — FINAL COVER CONTOURS
- 1084 — EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 — GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE

NOTES:

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2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774-0796. DATED: 10-25-94.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

NO.	REVISION	BY	DATE
2.	3RD NOD	TM	10/2021
1.	1ST NOD	TM	05/2021

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

SITE DRAINAGE PATTERNS RUNON/RUNOFF

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
IIIH.1

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546 Figure IIIH.1.dwg LAYOUT: Layout1 USER:
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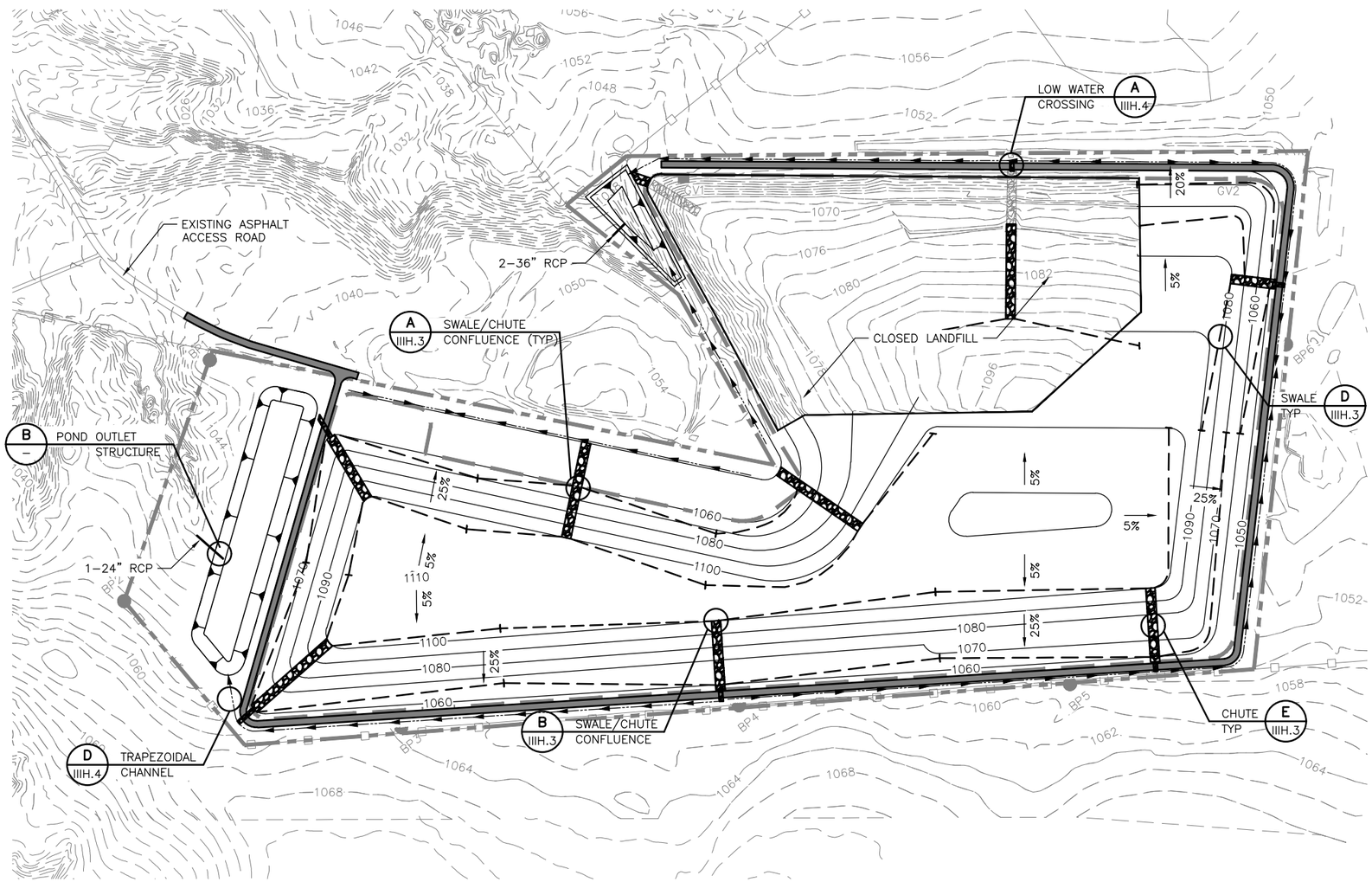

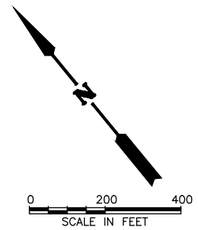

LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1-5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774-0796. DATED: 10-25-94.

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TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
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PROFESSIONAL ENGINEER
10/21/2021

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

DRAINAGE STRUCTURE PLAN

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
IIIH.2

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ELR1900546_ECBASE_LF AREA COMPOSITE
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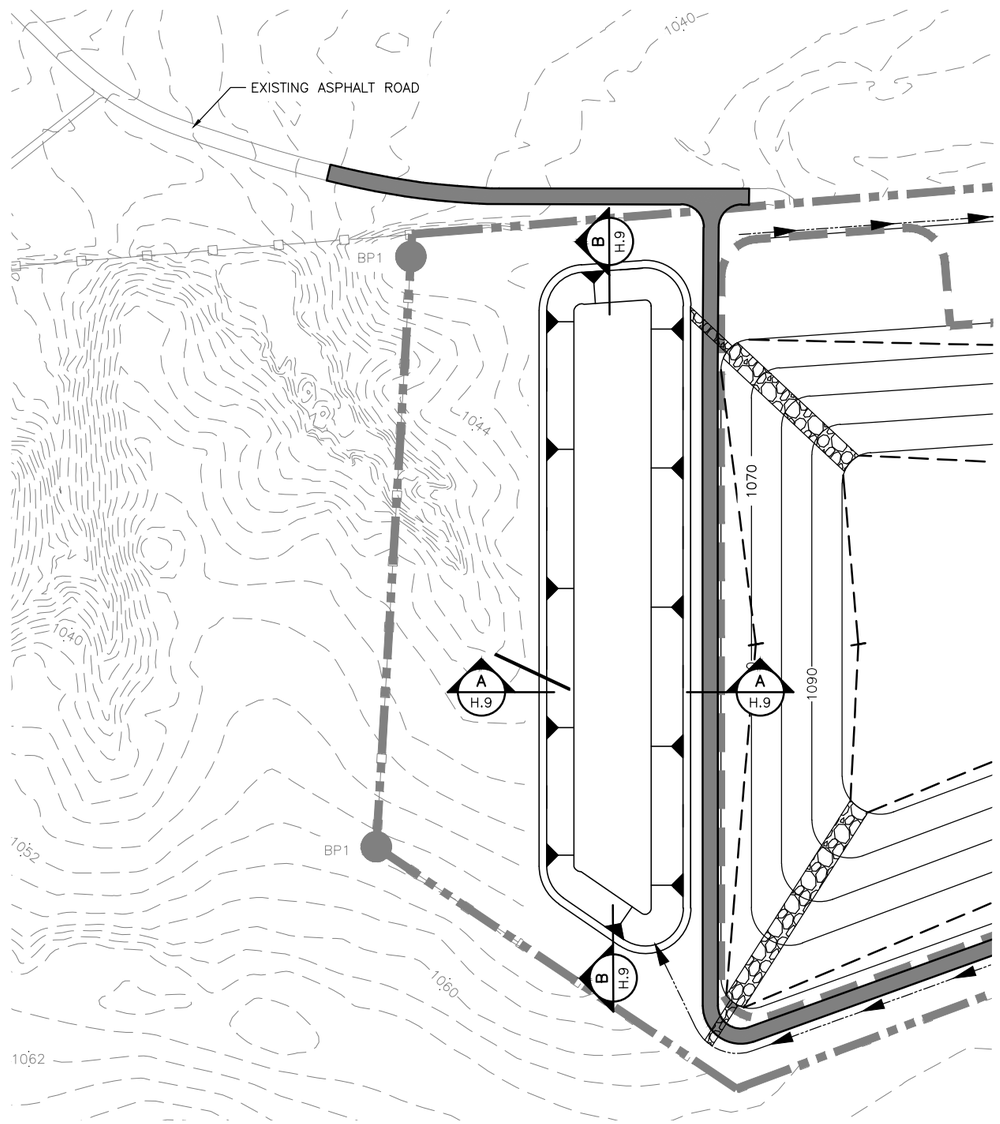
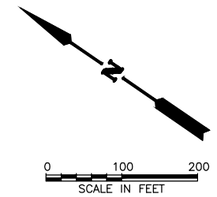


POND 1 OUTLET PLAN



LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 — FINAL COVER CONTOURS
- 1084 — EXISTING CONTOURS
- SWALES
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- CHUTES
- BP1 — GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDIA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.

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10/21/2021

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

POND 1 OUTLET STRUCTURE

Date: OCTOBER 2021
Designed: T. METAFERIA
Drawn: T. METAFERIA
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE
IIIH.8

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE.dwg DELR1900546 Figure IIIH-18.dwg LAYOUT: Layout1 USER:
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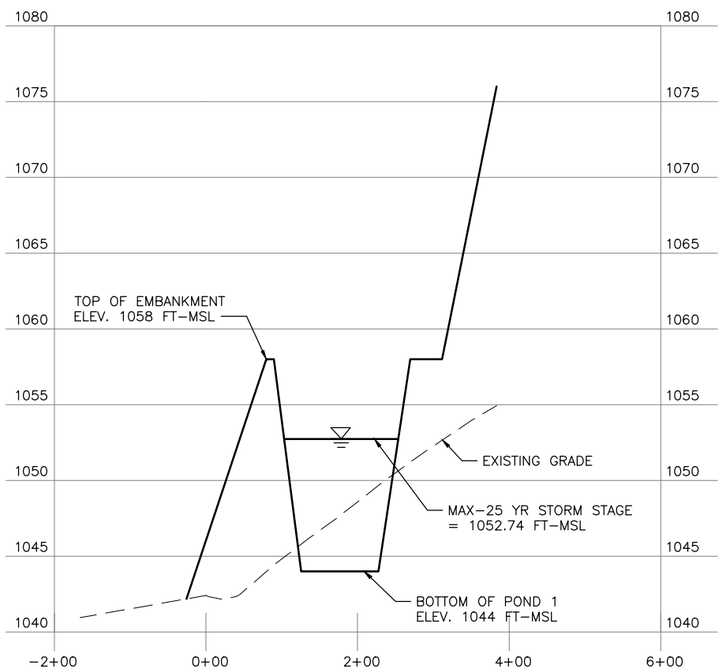

A
H.8
SECTION

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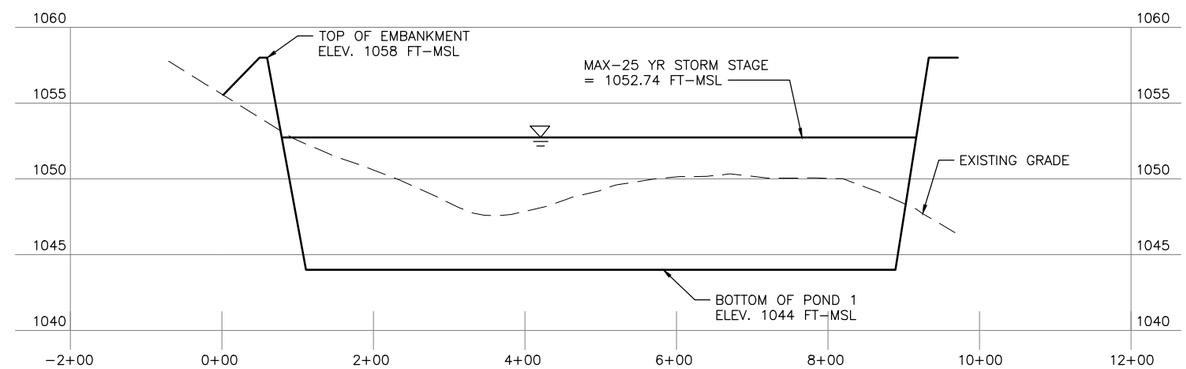
0 5 10
SCALE IN FEET (VERTICAL)



B
H.8
SECTION

0 100 200
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

POND 1
CROSS SECTIONS A AND B

Date: OCTOBER 2021
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Drawn: T. METAFERIA
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE
IIIH.9

REFERENCES: DELR1900546_PCBASE.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS
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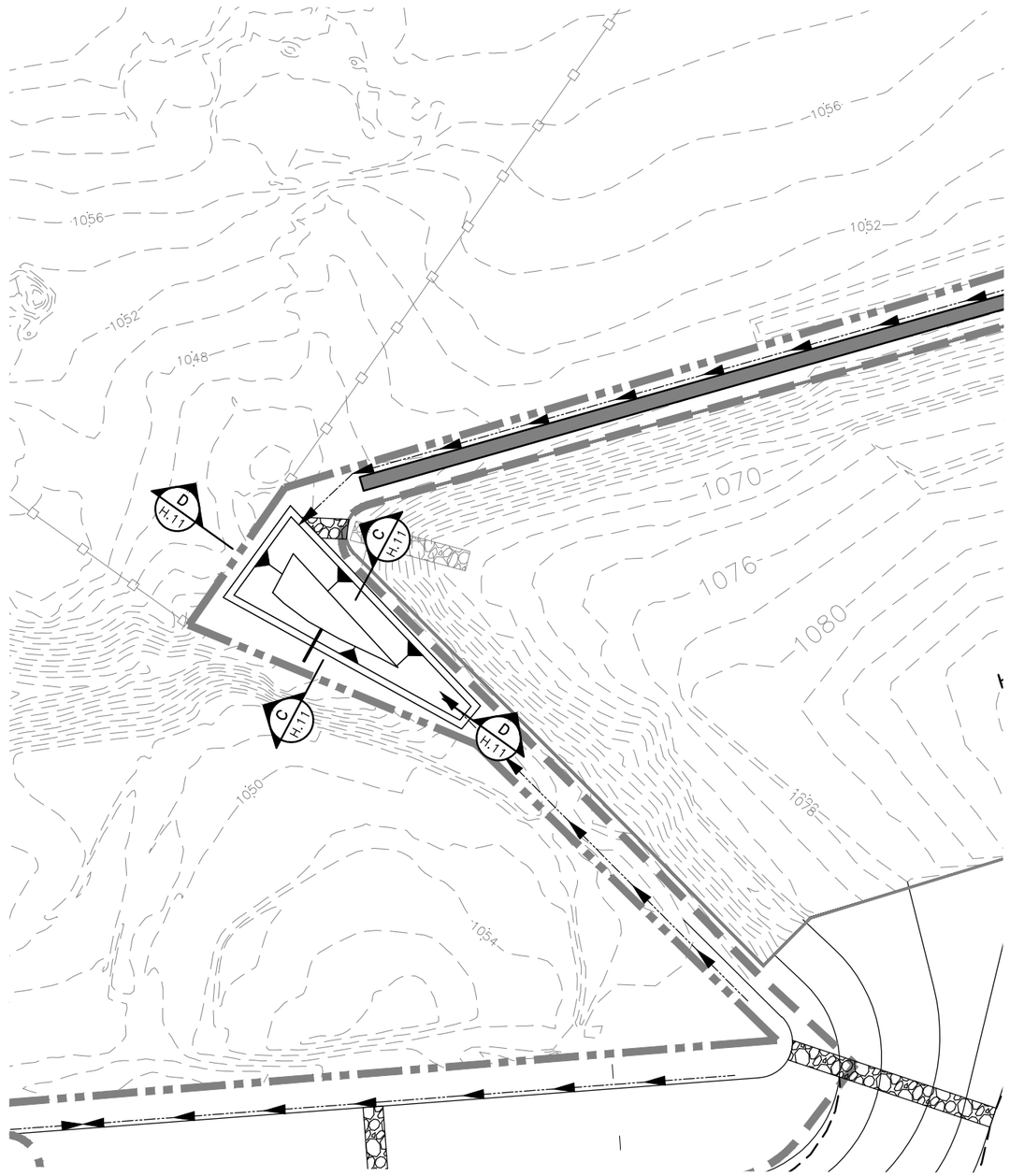
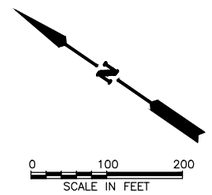


POND 2 OUTLET PLAN



LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 — FINAL COVER CONTOURS
- 1084 — EXISTING CONTOURS
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2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.

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CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

POND OUTLET 2 STRUCTURE

Date: OCTOBER 2021
Designed: T. METAFERIA
Drawn: T. METAFERIA
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE

IIIH.10

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE.dwg DELR1900546_PCBASE
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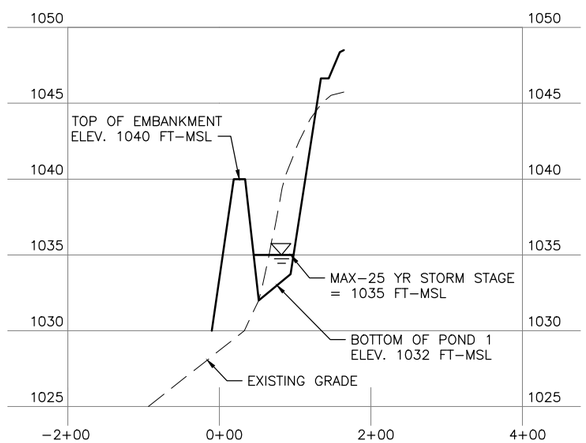

C H.10 SECTION

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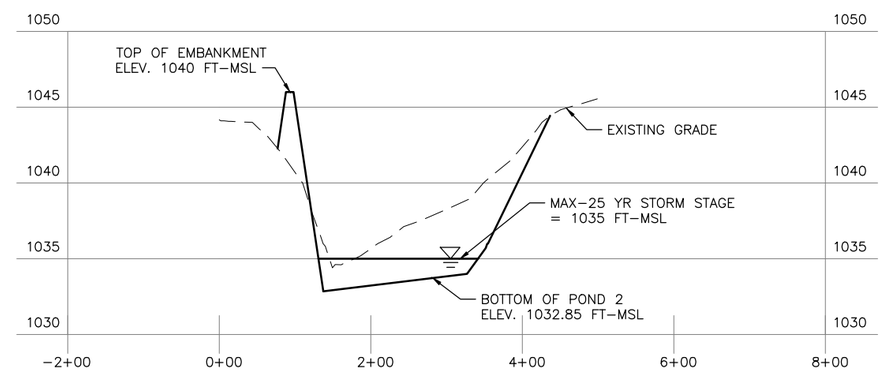
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)



D H.10 SECTION

0 100 200
SCALE IN FEET (HORIZONTAL)
0 5 10
SCALE IN FEET (VERTICAL)

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CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

10/21/2021

STATE OF TEXAS
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123183
LICENSED
PROFESSIONAL ENGINEER

NO.	REVISION	BY	DATE
1	NEW DRAWING	TM	10/2021

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CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT
POND 2
CROSS SECTIONS C AND D

Date: OCTOBER 2021
Designed: T. METAFERIA
Drawn: T. METAFERIA
Reviewed: B. HINDMAN
CP&Y Proj. No. DELR1900546

FIGURE
IIIH.11

REFERENCES: DELR1900546_PCBASE.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS
Nov 03, 2021 - 6:02am C:\pwworking\cpy\pw_cpy\tmetaferia\d0804194\DELR1900546 Figure IIIH-21.dwg LAYOUT: Layout1 USER:

APPENDIX IIIH-A
PERMITTED CONDITION HYDROLOGIC CALCULATIONS

Figures IIIH-A-1 and IIIH-A-105

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PAGES IIIH-A-1 THROUGH IIIH-A-36 ARE LEFT BLANK ON PURPOSE

VOLUME CALCULATIONS

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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 Discharging into Pond

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD9	0.0140	6.07	8.99	4.5
LD10	0.0062	6.07	3.98	2.0
CH1	0.0091	6.19	5.85	3.0
OA2	0.0791	5.95	50.60	25.1
			Total Volume at Pond =	34.7

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD6	0.0022	6.07	1.42	0.7
LD7	0.0092	6.07	5.88	3.0
LD8	0.0117	6.07	7.46	3.8
OA1	0.1492	5.95	95.50	47.4
CH2	0.0157	6.19	10.06	5.2
CH3	0.0078	6.19	4.98	2.6
			Total Volume at Discharge Point #2 =	62.6

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD3	0.0103	6.07	6.59	3.3
CH4	0.0097	6.19	6.19	3.2
LD4	0.0084	6.07	5.37	2.7
LD5	0.0130	6.07	8.30	4.2
CH5	0.0100	6.19	6.40	3.3
			Total Volume at Discharge Point #3 =	16.7

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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)
LD1	0.0058	6.07	3.69	1.9
CH6	0.0031	6.19	1.96	1.0
LD2	0.0100	6.07	6.38	3.2
CH7	0.0019	6.19	1.22	0.6
			Total Volume at Discharge Point #4 =	6.7

Total Volume Exiting Permit Boundary = 120.7 acre-ft

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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 Discharging into Pond

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD9	0.0140	10.02	8.99	7.5
LD10	0.0062	10.02	3.98	3.3
CH1	0.0091	10.15	5.85	4.9
OA2	0.0791	9.88	50.60	41.7
			Total Volume at Pond =	57.4

2. Volume at Discharge Point #2

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD6	0.0022	10.02	1.42	1.2
LD7	0.0092	10.02	5.88	4.9
LD8	0.0117	10.02	7.46	6.2
OA1	0.1492	9.88	95.50	78.6
CH2	0.0157	10.15	10.06	8.5
CH3	0.0078	10.15	4.98	4.2
			Total Volume at Discharge Point #2 =	103.7

3. Volume at Discharge Point #3

Area No.	Area (sq mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
LD3	0.0103	10.02	6.59	5.5
CH4	0.0097	10.15	6.19	5.2
LD4	0.0084	10.02	5.37	4.5
LD5	0.0130	10.02	8.30	6.9
CH5	0.0100	10.15	6.40	5.4
			Total Volume at Discharge Point #3 =	27.6

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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)
LD1	0.0058	10.02	3.69	3.1
CH6	0.0031	10.15	1.96	1.7
LD2	0.0100	10.02	6.38	5.3
CH7	0.0019	10.15	1.22	1.0
			Total Volume at Discharge Point #4 =	11.1

Total Volume Exiting Permit Boundary = 199.8 acre-ft

APPENDIX IIIH-B
POST-DEVELOPMENT CONDITION HYDROLOGIC CALCULATIONS

Figures IIIH-B-1 and IIIH-B-119

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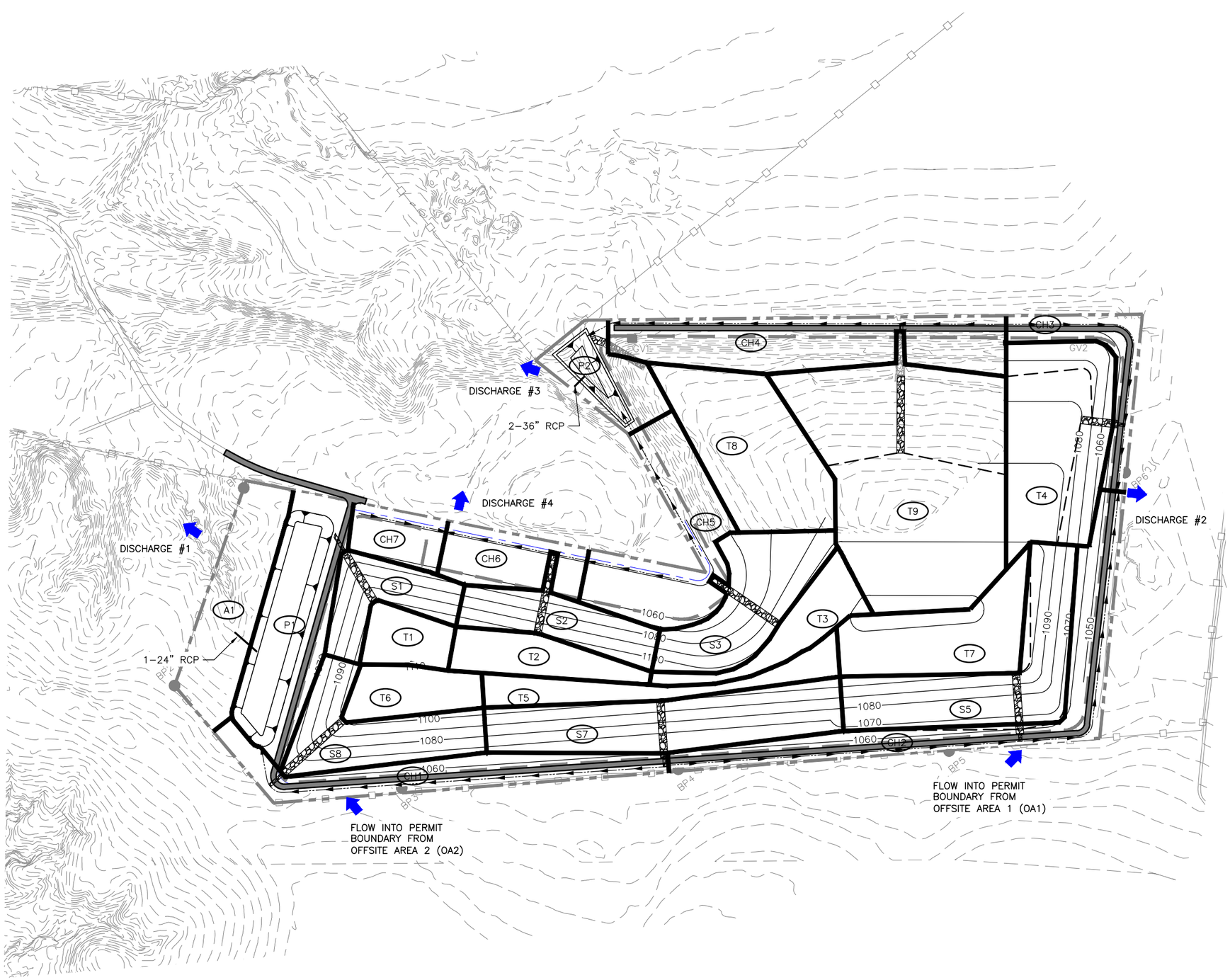
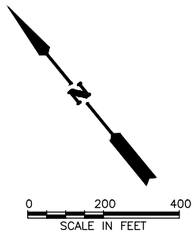
Velocity Calculations	IIIH-B-114





LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- 1090 — FINAL COVER CONTOURS
- 1084 — EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 — GAS PROBE
- T7 — DRAINAGE AREA DESIGNATION
- DRAINAGE BOUNDARY
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE

POST DEVELOPMENT DRAINAGE AREAS

DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)	DRAINAGE AREA	AREA (ACRES)
T1	1.52	S1	2.48	CH1	4.24
T2	2.23	S2	2.84	CH2	6.04
T3	2.22	S3	4.26	CH3	2.23
T4	6.55	S4	–	CH4	6.17
T5	2.54	S5	5.70	CH5	4.84
T6	2.00	S6	–	CH6	2.37
T7	4.27	S7	5.83	CH7	1.52
T8	6.05	S8	3.78	P1	5.54
T9	13.91	A1	4.14	P2	2.36

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

NO.	REVISION	BY	DATE

VERIFY SCALE 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

POST DEVELOPMENT DRAINAGE

Date: OCTOBER 2020
Designed: T. METAFERIA
Drawn: J.TORRES
Reviewed: B. HINDMAN
CP&Y Proj. No: DELR1900546

FIGURE
IIIH–B–16

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
C:\pwworking\cpy\pw_cpy\tmetaferia\d0804194\DELR1900546 Figure IIIH–B–16.dwg LAYOUT: Layout1 USER:

HEC-1 OUTPUT – POST-DEVELOPMENT 100-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   26SEP21  TIME  17:51:57  *                                                    *           (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      S8
           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/S8
           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      S7
           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/S7
           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     0A2
 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  0.0066
 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  A1/DC1
 81          KO       0       0       0       7      21
 82          BA   0.006
 83          LS       0      30
 84          UK     345    0.03     0.3     100
 85          RD     245    0.04    0.03            TRAP      50       3     YES
             *

 86          KK      T7
 87          KO       0       0       0       7      21
 88          BA  0.0067
 89          LS       0      85
 90          UK   244.1    0.05     0.3     100
 91          RD   437.6   0.005    0.03            TRAP       0       2      NO
             *

 92          KK      S5
 93          KO       0       0       0       7      21
 94          BA  0.0089
 95          LS       0      86
 96          UK   175.6    0.25     0.3     100
 97          RD   643.6   0.005    0.03            TRAP       0       2      NO
```

```
                 *

   98            KK    C/S5
   99            KO       0       0       7      21
  100            HC       2
                 *

  101            KK     0A1
  102            KO       0       0       7      21
  103            BA  0.1492
  104            LS       0      84
  105            US    0.56    0.64
                 *

  106            KK   C/CH2
  107            KO       0       0       7      21
  108            HC       2
                 *
1                                          HEC-1 INPUT                                                    PAGE  4

 LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  109            KK     CH2
  110            KO       0       0       7      21
  111            BA  0.0094
  112            LS       0      86
  113            UK      47    0.25     0.3     100
  114            RD     865    0.01    0.03            TRAP      10       3     YES
                 *

  115            KK      T4
  116            KO       0       0       7      21
  117            BA  0.0102
  118            LS       0      86
  119            UK   175.6    0.25     0.3     100
  120            RD   696.8   0.005    0.03            TRAP       0       2      NO
                 *

  121            KK     CH3
  122            KO       0       0       7      21
  123            BA  0.0035
  124            LS       0      86
  125            UK   155.7    0.25     0.3     100
  126            RD    1456    0.01    0.03            TRAP      10       3     YES
                 *

  127            KK  C/DC#2
  128            KO       0       0       7      21
  129            HC       2
                 *

  130            KK      T9
  131            KO       0       0       7      21
  132            BA  0.0217
  133            LS       0      85
  134            UK   919.3    0.05     0.3     100
  135            RD     232   0.005    0.03            TRAP       0       2      NO
                 *

  136            KK     CH4
  137            KO       0       0       7      21
  138            BA  0.0096
  139            LS       0      86
  140            UK   155.8    0.25     0.3     100
  141            RD    1064    0.01    0.03            TRAP      10       3     YES
                 *

  142            KK      T8
  143            KO       0       0       7      21
  144            BA  0.0095
  145            LS       0      85
  146            UK   359.7    0.05     0.3     100
  147            RD   720.5   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


  148            KK      T3
  149            KO       0       0       7      21
  150            BA  0.0035
  151            LS       0      85
  152            UK      49    0.05     0.3     100
  153            RD     535   0.005    0.03            TRAP       0       2      NO
                 *

  154            KK      S3
  155            KO       0       0       7      21
```

```
          156          BA  0.0067
          157          LS       0      86
          158          UK     160    0.25     0.3     100
          159          RD     304   0.005    0.03            TRAP       0       2      NO
                       *

          160          KK    C/S3
          161          KO       0       0       0       7      21
          162          HC       2
                       *

          163          KK     CH5
          164          KO       0       0       0       7      21
          165          BA  0.0076
          166          LS       0      86
          167          UK     200    0.25     0.3     100
          168          RD    1996    0.01    0.03            TRAP       2       2     YES
                       *

          169          KK      P2
          170          KO       0       0       0       7      21
          171          BA  0.0037
          172          LS       0     100
          173          UD       0
                       *

          174          KK    C/P2
          175          KO       0       0       0       7      21
          176          HC       3
                       *

          177          KK    R/P2
          178          KO       0       0       0       7      21
          179          RS       1    ELEV    1034
          180          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          181          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          182          SS    1040      10     2.6     1.5
          183          SL    1033   14.12     0.6     0.5
                       *
1                                                HEC-1 INPUT                                                PAGE  6

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          184          KK      T2
          185          KO       0       0       0       7      21
          186          BA  0.0035
          187          LS       0      85
          188          UK      49    0.05     0.3     100
          189          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          190          KK      S2
          191          KO       0       0       0       7      21
          192          BA  0.0044
          193          LS       0      86
          194          UK     160    0.25     0.3     100
          195          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          196          KK    C/S2
          197          KO       0       0       0       7      21
          198          HC       2
                       *

          199          KK     CH6
          200          KO       0       0       0       7      21
          201          BA  0.0037
          202          LS       0      86
          203          UK     200    0.05     0.3     100
          204          RD     537    0.01    0.03            TRAP       2       2     YES
                       *

          205          KK     CH7
          206          KO      00       0       7      21
          207          BA  0.0024
          208          LS       0      86
          209          UK     210    0.05     0.3     100
          210          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

          211          KK   C/DC4
          212          KO       0       0       0       7      21
          213          HC       2
          214          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         .          S8
            .           .
            .           .
 18       C/S8...........
            .
            .
 21         .          T5
            .           .
            .           .
 27         .           .          S7
            .           .           .
            .           .           .
 33         .        C/S7...........
            .           .
            .           .
 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
            V
            V
 80     A1/DC1 ***
            .
            .
 86         .          T7
            .           .
            .           .
 92         .           .          S5
            .           .           .
            .           .           .
 98         .        C/S5...........
            .           .
            .           .
101         .           .         OA1
            .           .           .
            .           .           .
106         .       C/CH2...........
            .           V
            .           V
109         .         CH2 ***
            .           .
            .           .
115         .           .          T4
            .           .           V
            .           .           V
121         .           .         CH3 ***
            .           .           .
            .           .           .
127         .      C/DC#2...........
            .           .
            .           .
130         .           .          T9
            .           .           V
            .           .           V
136         .           .         CH4 ***
            .           .           .
            .           .           .
142         .           .           .          T8
            .           .           .           .
            .           .           .           .
148         .           .           .           .          T3
            .           .           .           .           .
            .           .           .           .           .
154         .           .           .           .           .          S3
```

```
                .          .          .          .          .          .
                .          .          .          .          .          .
  160           .          .          .          .       C/S3...........
                .          .          .          .          V
                .          .          .          .          V
  163           .          .          .          .        CH5 ***
                .          .          .          .          .
                .          .          .          .          .
  169           .          .          .          .          .          P2
                .          .          .          .          .          .
                .          .          .          .          .          .
  174           .          .          .       C/P2........................
                .          .          .          V
                .          .          .          V
  177           .          .          .       R/P2
                .          .          .          .
                .          .          .          .
  184           .          .          .          .         T2
                .          .          .          .          .
                .          .          .          .          .
  190           .          .          .          .          .          S2
                .          .          .          .          .          .
                .          .          .          .          .          .
  196           .          .          .          .       C/S2...........
                .          .          .          .          V
                .          .          .          .          V
  199           .          .          .          .        CH6 ***
                .          .          .          .          .
                .          .          .          .          .
  205           .          .          .          .          .         CH7
                .          .          .          .          .          .
                .          .          .          .          .          .
  211           .          .          .          .      C/DC4...........
```

(***) 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   30OCT21  TIME  17:51:57  *                                          *           (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     *        S8  *
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          *           *
          **************

  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       S8

     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


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            *            *
   18 KK    *      C/S8  *
            *            *
            **************

   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/S8

  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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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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
                   1.43    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
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                    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    *        S7  *
            *            *
            **************

   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
                          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       S7

    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/S7  *
            *            *
            **************

  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/S7

  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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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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
                  1.43    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
                                                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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  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
                    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     69.66    723.03     10.14       .62
                    MAIN          1.95      1.42       4.84   1539.50    298.57    731.43      9.78     10.59

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5246E+02  EXCESS= .3572E+01 OUTFLOW= .5621E+02 BASIN STORAGE= .9416E-01 PERCENT ERROR=   -.5


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                    MAIN          1.95      1.42       5.00              291.88    730.00      9.78

       ***             ***             ***             ***             ***

                          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)
+   291.88     12.17                97.26       28.24       19.68        19.68
                         (INCHES)    8.389       9.744       9.781        9.781
                          (AC-FT)   48.23       56.02       56.24        56.24

                         CUMULATIVE AREA =    .10780 SQ MI   ACRES=           68.9920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   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
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                                        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


               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


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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)
+    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
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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

  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)
+   401.99     12.08                111.57       32.61       22.73        22.73
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                    (INCHES)     8.448       9.877       9.920        9.920
                     (AC-FT)     55.33       64.69       64.97        64.97

                    CUMULATIVE AREA =    .12280 SQ MI   ACRES=          78.5920


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
  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

  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)
+    86.91     14.00                63.78       40.64       36.21        36.21
```

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                    (INCHES)     4.829      12.308      15.803       15.803
                     (AC-FT)     31.63       80.61      103.50       103.50

 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
    32.848     14.00                27.66        9.91        6.87         6.85

  PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1057.49     14.00              1055.84     1048.53     1047.15      1047.15

                    CUMULATIVE AREA =    .12280 SQ MI   ACRES=           78.5920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  80 KK     *    A1/DC1  *
            *            *
            **************

  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         .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

  83 LS          SCS LOSS RATE
                      STRTL        4.67  INITIAL ABSTRACTION
                     CRVNBR       30.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  84 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        345.  OVERLAND FLOW LENGTH
                           S       .0300  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                      DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  85 RD            MAIN CHANNEL
                           L        245.  CHANNEL LENGTH
                           S       .0400  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                          WD       50.00  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         .86      1.67       5.00     69.00      2.70    758.49      1.70       .20
                   MAIN          1.01      1.55        .62    122.50     87.93    840.68     15.14      6.63


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1035E+03  EXCESS= .5477E+00 OUTFLOW= .1040E+03 BASIN STORAGE= .8352E-03 PERCENT ERROR=    .0


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL
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```
                  MAIN          1.01      1.55       5.00               87.92    840.00     15.15

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   A1/DC1

    TOTAL RAINFALL =   11.90, TOTAL LOSS =   10.19, TOTAL EXCESS =    1.71

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    87.92     14.00                64.56       40.92       36.40        36.40
                        (INCHES)     4.660      11.814      15.146       15.146
                         (AC-FT)     32.01       81.16      104.05       104.05

                        CUMULATIVE AREA =    .12880 SQ MI   ACRES=           82.4320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   86 KK    *        T7  *
            *            *
            **************

   87 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

   88 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

   89 LS          SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   90 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
   91 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
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                                        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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  92 KK     *        S5  *
            *            *
            **************

  93 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

  94 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

  95 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  96 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
  97 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
```

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                  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       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)
+    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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   98 KK    *      C/S5  *
            *            *
            **************

   99 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


  100 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)
+   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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  101 KK    *       OA1  *
            *            *
            **************

  102 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

  103 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

  104 LS          SCS LOSS RATE
                        STRTL         .38  INITIAL ABSTRACTION
                       CRVNBR       84.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  105 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  106 KK    *     C/CH2  *
            *            *
            **************

  107 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


  108 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 109 KK   *       CH2  *
          *            *
          **************

 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


             SUBBASIN RUNOFF DATA

 111 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

 112 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 113 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
 114 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
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```
  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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 115 KK     *        T4  *
            *            *
            **************

 116 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

 117 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

 118 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 119 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
 120 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  121 KK    *       CH3  *
            *            *
            **************

  122 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

  123 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

  124 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  125 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
  126 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  127 KK    *    C/DC#2  *
            *            *
            **************

  128 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


  129 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   C/DC#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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  130 KK    *        T9  *
            *            *
            **************

  131 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

  132 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

  133 LS          SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  134 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
  135 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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             *            *
  136 KK     *       CH4  *
             *            *
             **************

  137 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

  138 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .01  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
                 1.43    2.76    5.19    6.83    7.90    9.54   10.80   11.90     .00     .00     .00     .00

                                                STORM AREA =     .01

 139 LS         SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 140 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
 141 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 142 KK     *        T8  *
            *            *
            **************

 143 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

 144 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

 145 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 146 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
 147 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 148 KK      *        T3  *
             *            *
             **************

 149 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


             SUBBASIN RUNOFF DATA

 150 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

 151 LS        SCS LOSS RATE
                    STRTL         .35  INITIAL ABSTRACTION
                   CRVNBR       85.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 152 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
 153 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 154 KK      *        S3  *
             *            *
             **************

 155 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


            SUBBASIN RUNOFF DATA

 156 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

 157 LS          SCS LOSS RATE
                    STRTL        .33  INITIAL ABSTRACTION
                   CRVNBR      86.00  CURVE NUMBER
                    RTIMP        .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 158 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
 159 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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            *            *
 160 KK     *      C/S3  *
            *            *
            **************
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  161 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


  162 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  163 KK    *       CH5  *
            *            *
            **************

  164 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

  165 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

  166 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  167 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
  168 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
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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     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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  169 KK    *        P2  *
            *            *
            **************

  170 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

  171 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

  172 LS          SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  173 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
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  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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  174 KK    *      C/P2  *
            *            *
            **************

  175 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


  176 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  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)
+   226.48     12.08                28.47        8.22        5.72         5.72
                       (INCHES)     8.539       9.864       9.883        9.883
                        (AC-FT)     14.12       16.31       16.34        16.34

                       CUMULATIVE AREA =    .03100 SQ MI   ACRES=           19.8400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  177 KK    *      R/P2  *
            *            *
            **************

  178 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

  179 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

  180 SA              AREA          .0        .2        .2        .2        .3        .3        .4        .5

  181 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

  183 SL          LOW-LEVEL OUTLET
                       ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                       CAREA       14.12  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
```

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                    EXPL         .50  EXPONENT OF HEAD

 182 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     72.99     78.84     85.72     93.91    103.82    116.08    131.63    151.98    179.77
        ELEVATION   1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

          OUTFLOW    184.39    187.79    192.49    198.66    206.50    216.19    227.94    241.93    258.35    277.38
        ELEVATION   1040.19   1040.30   1040.43   1040.58   1040.76   1040.96   1041.19   1041.43   1041.70   1042.00


                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
          OUTFLOW     67.95     72.99     74.43     78.84     85.72     93.91     96.09    103.82    116.08    117.68
        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      1.79      1.83      1.89      1.96      2.04      2.13
          OUTFLOW    131.63    135.89    151.93    179.77    184.39    187.79    192.49    198.66    206.50    216.19
        ELEVATION   1036.75   1037.00   1038.00   1040.00   1040.19   1040.30   1040.43   1040.58   1040.76   1040.96

          STORAGE      2.23      2.35      2.48      2.62
          OUTFLOW    227.94    241.93    258.35    277.38
        ELEVATION   1041.19   1041.43   1041.70   1042.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       68. TO       73.
                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)
+   157.96     12.25                73.48       69.33       68.91       68.91
                        (INCHES)    22.039      83.174     119.119     119.119
                         (AC-FT)     36.44      137.51      196.94      196.94

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
     1.119     12.25                 .00         .00         .00         -.22

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1038.43     12.25              1034.25     1034.06     1034.04     1034.04

                        CUMULATIVE AREA =    .03100 SQ MI   ACRES=           19.8400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
 184 KK     *        T2  *
            *            *
            **************

 185 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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 186 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

 187 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 188 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
 189 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


 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 190 KK     *        S2  *
            *            *
            **************

 191 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

  192 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

  193 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  194 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
  195 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        .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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  196 KK      *      C/S2  *
              *            *
              **************

  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           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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            *            *
  199 KK    *       CH6  *
            *            *
            **************

  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


               SUBBASIN RUNOFF DATA

  201 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

  202 LS          SCS LOSS RATE
                     STRTL         .33  INITIAL ABSTRACTION
                    CRVNBR       86.00  CURVE NUMBER
                     RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  203 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
  204 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)
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                  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= .4190E+01  EXCESS= .2002E+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 =   11.90, 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)
+   101.22     12.08                10.79        3.11        2.16         2.16
                        (INCHES)    8.652       9.977       9.979        9.979
                         (AC-FT)     5.35        6.17        6.17         6.17

                        CUMULATIVE AREA =    .01160 SQ MI   ACRES=            7.4240


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  205 KK    *       CH7  *
            *            *
            **************

  206 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

  207 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

  208 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  209 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
  210 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
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                                        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

      ***            ***            ***            ***            ***

                        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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  211 KK    *     C/DC4  *
            *            *
            **************

  212 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


  213 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION    C/DC4

  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
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
+                            S8      58.27   12.08          5.          2.          1.        .01

          2 COMBINED AT
+                          C/S8      84.68   12.08          8.          2.          2.        .01
```

	HYDROGRAPH AT								
+	T5	34.09	12.08	4.	1.	1.	.00		
	HYDROGRAPH AT								
+	S7	88.10	12.08	8.	2.	1.	.01		
	2 COMBINED AT								
+	C/S7	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	291.88	12.17	97.	28.	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								
+	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	401.99	12.08	112.	33.	23.	.12		
	ROUTED TO								
+	R/P1	86.91	14.00	64.	41.	36.	.12		
+								1057.49	14.00
	HYDROGRAPH AT								
+	A1/DC1	87.92	14.00	65.	41.	36.	.13		
	HYDROGRAPH AT								
+	T7	52.29	12.08	6.	2.	1.	.01		
	HYDROGRAPH AT								
+	S5	89.07	12.08	8.	2.	2.	.01		
	2 COMBINED AT								
+	C/S5	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/DC#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

         3 COMBINED AT
+                        C/P2     226.48   12.08         28.          8.          6.        .03

         ROUTED TO
+                        R/P2     157.96   12.25         73.         69.         69.        .03
+                                                                                        1038.43       12.25

         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
+                        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/DC4     121.45   12.08         13.          4.          3.        .01
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

                S8  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

                S7  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         4.84    298.57    731.43      9.78     5.00    291.88    730.00       9.78

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5246E+02 EXCESS= .3572E+01 OUTFLOW= .5621E+02 BASIN STORAGE= .9416E-01 PERCENT ERROR=   -.5

                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

            A1/DC1  MANE          .62     87.93    840.68     15.14     5.00     87.92    840.00      15.15

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1035E+03 EXCESS= .5477E+00 OUTFLOW= .1040E+03 BASIN STORAGE= .8352E-03 PERCENT ERROR=    .0

                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
```

```
                S5  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

                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 ***
```

HEC-1 OUTPUT – POST-DEVELOPMENT 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   26SEP21  TIME  18:06:35  *                                                    *           (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      S8
           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/S8
           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      S7
           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/S7
           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     0A2
 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  0.0066
 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  A1/DC1
 81          KO       0       0       0       7      21
 82          BA   0.006
 83          LS       0      30
 84          UK     345    0.03     0.3     100
 85          RD     245    0.04    0.03            TRAP      50       3     YES
             *

 86          KK      T7
 87          KO       0       0       0       7      21
 88          BA  0.0067
 89          LS       0      85
 90          UK   244.1    0.05     0.3     100
 91          RD   437.6   0.005    0.03            TRAP       0       2      NO
             *

 92          KK      S5
 93          KO       0       0       0       7      21
 94          BA  0.0089
 95          LS       0      86
 96          UK   175.6    0.25     0.3     100
 97          RD   643.6   0.005    0.03            TRAP       0       2      NO
```

```
                 *

   98            KK    C/S5
   99            KO       0       0       7      21
  100            HC       2
                 *

  101            KK     0A1
  102            KO       0       0       7      21
  103            BA  0.1492
  104            LS       0      84
  105            US    0.56    0.64
                 *

  106            KK   C/CH2
  107            KO       0       0       7      21
  108            HC       2
                 *
1                                          HEC-1 INPUT                                                    PAGE  4

 LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  109            KK     CH2
  110            KO       0       0       7      21
  111            BA  0.0094
  112            LS       0      86
  113            UK      47    0.25     0.3     100
  114            RD     865    0.01    0.03            TRAP      10       3     YES
                 *

  115            KK      T4
  116            KO       0       0       7      21
  117            BA  0.0102
  118            LS       0      86
  119            UK   175.6    0.25     0.3     100
  120            RD   696.8   0.005    0.03            TRAP       0       2      NO
                 *

  121            KK     CH3
  122            KO       0       0       7      21
  123            BA  0.0035
  124            LS       0      86
  125            UK   155.7    0.25     0.3     100
  126            RD    1456    0.01    0.03            TRAP      10       3     YES
                 *

  127            KK  C/DC#2
  128            KO       0       0       7      21
  129            HC       2
                 *

  130            KK      T9
  131            KO       0       0       7      21
  132            BA  0.0217
  133            LS       0      85
  134            UK   919.3    0.05     0.3     100
  135            RD     232   0.005    0.03            TRAP       0       2      NO
                 *

  136            KK     CH4
  137            KO       0       0       7      21
  138            BA  0.0096
  139            LS       0      86
  140            UK   155.8    0.25     0.3     100
  141            RD    1064    0.01    0.03            TRAP      10       3     YES
                 *

  142            KK      T8
  143            KO       0       0       7      21
  144            BA  0.0095
  145            LS       0      85
  146            UK   359.7    0.05     0.3     100
  147            RD   720.5   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


  148            KK      T3
  149            KO       0       0       7      21
  150            BA  0.0035
  151            LS       0      85
  152            UK      49    0.05     0.3     100
  153            RD     535   0.005    0.03            TRAP       0       2      NO
                 *

  154            KK      S3
  155            KO       0       0       7      21
```

```
          156          BA  0.0067
          157          LS       0      86
          158          UK     160    0.25     0.3     100
          159          RD     304   0.005    0.03            TRAP       0       2      NO
                       *

          160          KK    C/S3
          161          KO       0       0       0       7      21
          162          HC       2
                       *

          163          KK     CH5
          164          KO       0       0       0       7      21
          165          BA  0.0076
          166          LS       0      86
          167          UK     200    0.25     0.3     100
          168          RD    1996    0.01    0.03            TRAP       2       2     YES
                       *

          169          KK      P2
          170          KO       0       0       0       7      21
          171          BA  0.0037
          172          LS       0     100
          173          UD       0
                       *

          174          KK    C/P2
          175          KO       0       0       0       7      21
          176          HC       3
                       *

          177          KK    R/P2
          178          KO       0       0       0       7      21
          179          RS       1    ELEV    1034
          180          SA       0   0.167   0.215   0.245   0.283   0.319   0.429   0.492
          181          SE    1034  1034.2    1035    1036    1037    1038    1040    1042
          182          SS    1040      10     2.6     1.5
          183          SL    1033   14.12     0.6     0.5
                       *
1                                                HEC-1 INPUT                                                PAGE  6

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          184          KK      T2
          185          KO       0       0       0       7      21
          186          BA  0.0035
          187          LS       0      85
          188          UK      49    0.05     0.3     100
          189          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          190          KK      S2
          191          KO       0       0       0       7      21
          192          BA  0.0044
          193          LS       0      86
          194          UK     160    0.25     0.3     100
          195          RD     434   0.005    0.03            TRAP       0       2      NO
                       *

          196          KK    C/S2
          197          KO       0       0       0       7      21
          198          HC       2
                       *

          199          KK     CH6
          200          KO       0       0       0       7      21
          201          BA  0.0037
          202          LS       0      86
          203          UK     200    0.05     0.3     100
          204          RD     537    0.01    0.03            TRAP       2       2     YES
                       *

          205          KK     CH7
          206          KO      00       0       7      21
          207          BA  0.0024
          208          LS       0      86
          209          UK     210    0.05     0.3     100
          210          RD     317    0.01    0.03            TRAP       2       2      NO
                       *

          211          KK   C/DC4
          212          KO       0       0       0       7      21
          213          HC       2
          214          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         .         S8
            .          .
            .          .
 18      C/S8...........
            .
            .
 21         .         T5
            .          .
            .          .
 27         .          .         S7
            .          .          .
            .          .          .
 33         .       C/S7...........
            .          .
            .          .
 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
            V
            V
 80    A1/DC1 ***
            .
            .
 86         .         T7
            .          .
            .          .
 92         .          .         S5
            .          .          .
            .          .          .
 98         .       C/S5...........
            .          .
            .          .
101         .          .        OA1
            .          .          .
            .          .          .
106         .      C/CH2...........
            .          V
            .          V
109         .        CH2 ***
            .          .
            .          .
115         .          .         T4
            .          .          V
            .          .          V
121         .          .        CH3 ***
            .          .          .
            .          .          .
127         .     C/DC#2...........
            .          .
            .          .
130         .          .         T9
            .          .          V
            .          .          V
136         .          .        CH4 ***
            .          .          .
            .          .          .
142         .          .          .         T8
            .          .          .          .
            .          .          .          .
148         .          .          .          .         T3
            .          .          .          .          .
            .          .          .          .          .
154         .          .          .          .          .         S3
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```
                .          .          .          .          .          .
                .          .          .          .          .          .
  160           .          .          .          .       C/S3...........
                .          .          .          .          V
                .          .          .          .          V
  163           .          .          .          .        CH5 ***
                .          .          .          .          .
                .          .          .          .          .
  169           .          .          .          .          .          P2
                .          .          .          .          .          .
                .          .          .          .          .          .
  174           .          .          .       C/P2......................
                .          .          .          V
                .          .          .          V
  177           .          .          .       R/P2
                .          .          .          .
                .          .          .          .
  184           .          .          .          .         T2
                .          .          .          .          .
                .          .          .          .          .
  190           .          .          .          .          .          S2
                .          .          .          .          .          .
                .          .          .          .          .          .
  196           .          .          .          .       C/S2...........
                .          .          .          .          V
                .          .          .          .          V
  199           .          .          .          .        CH6 ***
                .          .          .          .          .
                .          .          .          .          .
  205           .          .          .          .          .         CH7
                .          .          .          .          .          .
                .          .          .          .          .          .
  211           .          .          .          .      C/DC4...........
```

(***) 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   30OCT21  TIME  18:06:35  *                                          *           (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
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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

  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     *        S8  *
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          *           *
          **************

  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       S8

    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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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              **************
              *            *
   18 KK      *      C/S8  *
              *            *
              **************

   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/S8

  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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
   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
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                    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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   27 KK    *        S7  *
            *            *
            **************

   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

                  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       S7

    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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  33 KK     *      C/S7  *
            *            *
            **************

  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/S7

  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
                                                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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  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
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                    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
                   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     47.37    724.97      6.18       .54
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```
                  MAIN          1.95      1.42       5.00   1539.50    206.55    730.00      5.90      9.29

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3175E+02  EXCESS= .2177E+01 OUTFLOW= .3390E+02 BASIN STORAGE= .1731E-02 PERCENT ERROR=    .1

                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL

                  MAIN          1.95      1.42       5.00              206.55    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)
+   206.55     12.17                 59.74       17.09       11.86       11.86
                        (INCHES)     5.152       5.897       5.897       5.897
                         (AC-FT)     29.62       33.90       33.91       33.91

                        CUMULATIVE AREA =    .10780 SQ MI   ACRES=           68.9920


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   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
                   1.02    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
```

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                                                                                  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
```

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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        .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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   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
                                                   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)
+   267.80     12.17                69.01       19.93       13.85       13.85
                      (INCHES)     5.225       6.036       6.044       6.044
                       (AC-FT)     34.22       39.53       39.58       39.58
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                    CUMULATIVE AREA =    .12280 SQ MI   ACRES=          78.5920


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  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

  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)
+    51.76     14.00                47.75       32.88       30.82       30.82
                         (INCHES)    3.615       9.956      13.451      13.451
                          (AC-FT)   23.68       65.21       88.10       88.10
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```
 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
    18.505     14.00                14.24        4.11        2.85         2.82

  PEAK STAGE    TIME                         MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1052.74     14.00              1051.04     1046.12     1045.47      1045.47

                       CUMULATIVE AREA =    .12280 SQ MI   ACRES=           78.5920


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  80 KK     *    A1/DC1  *
            *            *
            **************

  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         .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

  83 LS          SCS LOSS RATE
                       STRTL        4.67  INITIAL ABSTRACTION
                      CRVNBR       30.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  84 UK            OVERLAND-FLOW ELEMENT NO. 1
                           L        345.  OVERLAND FLOW LENGTH
                           S       .0300  SLOPE
                           N        .300  ROUGHNESS COEFFICIENT
                          PA       100.0  PERCENT OF SUBBASIN
                       DXMIN           5  MINIMUM NUMBER OF DX INTERVALS
                 MUSKINGUM-CUNGE
  85 RD            MAIN CHANNEL
                           L        245.  CHANNEL LENGTH
                           S       .0400  SLOPE
                           N        .030  CHANNEL ROUGHNESS COEFFICIENT
                          CA         .01  CONTRIBUTING AREA
                       SHAPE        TRAP  CHANNEL SHAPE
                          WD       50.00  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         .86      1.67       4.46     21.56       .33    832.09       .38       .08
                  MAIN          1.01      1.55        .71    122.50     52.07    840.46     12.84      5.79


CONTINUITY SUMMARY (AC-FT) - INFLOW= .8810E+02  EXCESS= .1223E+00 OUTFLOW= .8819E+02 BASIN STORAGE= .8108E-03 PERCENT ERROR=    .0


                                          INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL


                  MAIN          1.01      1.55       5.00               52.07    840.00     12.84
```

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     ***            ***            ***            ***            ***

                        HYDROGRAPH AT STATION   A1/DC1

    TOTAL RAINFALL =    7.85, TOTAL LOSS =    7.47, TOTAL EXCESS =     .38

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     34.58-HR
+   (CFS)       (HR)
                          (CFS)
+    52.07     14.00                47.92       32.94       30.87       30.87
                       (INCHES)     3.459       9.510      12.842      12.842
                        (AC-FT)     23.76       65.33       88.22       88.22

                       CUMULATIVE AREA =    .12880 SQ MI   ACRES=          82.4320


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  86 KK     *        T7  *
            *            *
            **************

  87 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

  88 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

  89 LS          SCS LOSS RATE
                       STRTL         .35  INITIAL ABSTRACTION
                      CRVNBR       85.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
  90 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
  91 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       1.60     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
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                                        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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   92 KK    *        S5  *
            *            *
            **************

   93 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

   94 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

   95 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
   96 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
   97 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       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)
+    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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   98 KK    *      C/S5  *
            *            *
            **************

   99 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


  100 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)
+    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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  101 KK    *       OA1  *
            *            *
            **************

  102 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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103 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

104 LS          SCS LOSS RATE
                      STRTL         .38  INITIAL ABSTRACTION
                     CRVNBR       84.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

105 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
                                                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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  106 KK    *     C/CH2  *
            *            *
            **************

  107 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


  108 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 109 KK    *       CH2  *
           *            *
           **************

 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


              SUBBASIN RUNOFF DATA

 111 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

 112 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 113 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
 114 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
 115 KK    *        T4  *
           *            *
           **************

 116 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

 117 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

 118 LS          SCS LOSS RATE
                      STRTL         .33  INITIAL ABSTRACTION
                     CRVNBR       86.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 119 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
 120 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
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```
  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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 121 KK     *       CH3  *
            *            *
            **************

 122 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

 123 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

 124 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 125 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
 126 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

      ***            ***            ***            ***            ***
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                        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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  127 KK    *    C/DC#2  *
            *            *
            **************

  128 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


  129 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION   C/DC#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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  130 KK    *        T9  *
            *            *
            **************

  131 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

  132 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

 133 LS          SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 134 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
 135 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       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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 136 KK     *       CH4  *
            *            *
            **************

 137 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

 138 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .01  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 =     .01

 139 LS           SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 140 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
 141 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 142 KK      *        T8  *
             *            *
             **************

 143 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

 144 BA           SUBBASIN CHARACTERISTICS
                        TAREA         .01  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 =     .01

 145 LS         SCS LOSS RATE
                      STRTL         .35  INITIAL ABSTRACTION
                     CRVNBR       85.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

                KINEMATIC WAVE
 146 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
 147 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 148 KK     *        T3  *
            *            *
            **************

 149 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

 150 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

 151 LS           SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 152 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
 153 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                **************
                *            *
 154 KK         *        S3  *
                *            *
                **************

 155 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

 156 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

   6 PH                              DEPTHS FOR   O-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

 157 LS        SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

               KINEMATIC WAVE
 158 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
 159 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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            *            *
 160 KK     *      C/S3  *
            *            *
            **************

 161 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


  162 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


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            *            *
  163 KK    *       CH5  *
            *            *
            **************

  164 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

  165 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

  166 LS          SCS LOSS RATE
                    STRTL         .33  INITIAL ABSTRACTION
                   CRVNBR       86.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  167 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
  168 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  169 KK    *        P2  *
            *            *
            **************

  170 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

  171 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

  172 LS          SCS LOSS RATE
                        STRTL         .00  INITIAL ABSTRACTION
                       CRVNBR      100.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

  173 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  174 KK    *      C/P2  *
            *            *
            **************

  175 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


  176 HC          HYDROGRAPH COMBINATION
                       ICOMP           3  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)
+   145.49    12.08                 17.71        5.07        3.52         3.52
                       (INCHES)     5.311       6.078       6.093        6.093
                        (AC-FT)      8.78       10.05       10.07        10.07

                       CUMULATIVE AREA =    .03100 SQ MI   ACRES=           19.8400


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  177 KK    *      R/P2  *
            *            *
            **************

  178 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

  179 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

  180 SA              AREA          .0        .2        .2        .2        .3        .3        .4        .5

  181 SE          ELEVATION     1034.00   1034.20   1035.00   1036.00   1037.00   1038.00   1040.00   1042.00

  183 SL          LOW-LEVEL OUTLET
                       ELEVL     1033.00  ELEVATION AT CENTER OF OUTLET
                       CAREA       14.12  CROSS-SECTIONAL AREA
                        COQL         .60  COEFFICIENT
                        EXPL         .50  EXPONENT OF HEAD

  182 SS          SPILLWAY
                        CREL     1040.00  SPILLWAY CREST ELEVATION
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                    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     72.99     78.84     85.72     93.91    103.82    116.08    131.63    151.98    179.77
        ELEVATION    1034.00   1034.15   1034.35   1034.59   1034.91   1035.33   1035.92   1036.75   1038.00   1040.00

          OUTFLOW     184.39    187.79    192.49    198.66    206.50    216.19    227.94    241.93    258.35    277.38
        ELEVATION    1040.19   1040.30   1040.43   1040.58   1040.76   1040.96   1041.19   1041.43   1041.70   1042.00


                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .01       .01       .04       .08       .14       .16       .24       .37       .39
          OUTFLOW      67.95     72.99     74.43     78.84     85.72     93.91     96.09    103.82    116.08    117.68
        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      1.79      1.83      1.89      1.96      2.04      2.13
          OUTFLOW     131.63    135.89    151.93    179.77    184.39    187.79    192.49    198.66    206.50    216.19
        ELEVATION    1036.75   1037.00   1038.00   1040.00   1040.19   1040.30   1040.43   1040.58   1040.76   1040.96

          STORAGE       2.23      2.35      2.48      2.62
          OUTFLOW     227.94    241.93    258.35    277.38
        ELEVATION    1041.19   1041.43   1041.70   1042.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       68. TO       73.
                 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)
+   117.56     12.25                69.98       68.45       68.30       68.30
                        (INCHES)   20.987      82.122     118.067      118.067
                         (AC-FT)    34.70      135.77      195.20       195.20

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     34.58-HR
+  (AC-FT)      (HR)
      .392     12.25                  .00         .00         .00         -.23

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     34.58-HR
+   (FEET)      (HR)
   1035.99     12.25               1034.08     1034.02     1034.01      1034.01

                        CUMULATIVE AREA =    .03100 SQ MI   ACRES=           19.8400


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  184 KK    *        T2  *
            *            *
            **************

  185 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

  186 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .00  SUBBASIN AREA

                  PRECIPITATION DATA
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  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

 187 LS           SCS LOSS RATE
                        STRTL         .35  INITIAL ABSTRACTION
                       CRVNBR       85.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
 188 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
 189 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

       ***             ***             ***             ***             ***

                           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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


             **************
             *            *
 190 KK      *        S2  *
             *            *
             **************

 191 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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 192 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

 193 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 194 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
 195 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
                   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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 196 KK     *      C/S2  *
            *            *
            **************

 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           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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 199 KK     *       CH6  *
            *            *
            **************

 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


              SUBBASIN RUNOFF DATA

 201 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

 202 LS          SCS LOSS RATE
                       STRTL         .33  INITIAL ABSTRACTION
                      CRVNBR       86.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

                 KINEMATIC WAVE
 203 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
 204 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
```

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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 =    .01160 SQ MI   ACRES=            7.4240


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  205 KK    *       CH7  *
            *            *
            **************

  206 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

  207 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

  208 LS          SCS LOSS RATE
                        STRTL         .33  INITIAL ABSTRACTION
                       CRVNBR       86.00  CURVE NUMBER
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

                  KINEMATIC WAVE
  209 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
  210 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


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  211 KK    *     C/DC4  *
            *            *
            **************

  212 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


  213 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

       ***            ***            ***            ***            ***

                         HYDROGRAPH AT STATION    C/DC4

  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
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
+                            S8      37.16   12.08          3.          1.          1.       .01

          2 COMBINED AT
+                          C/S8      53.99   12.08          5.          1.          1.       .01

          HYDROGRAPH AT
+                            T5      22.38   12.08          2.          1.          0.       .00
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	HYDROGRAPH AT								
+		S7	59.78	12.08	5.	1.	1.	.01	
	2 COMBINED AT								
+		C/S7	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	206.55	12.17	60.	17.	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	
	HYDROGRAPH AT								
+		P1	60.46	12.08	6.	2.	1.	.01	
	3 COMBINED AT								
+		C/P1	267.80	12.17	69.	20.	14.	.12	
	ROUTED TO								
+		R/P1	51.76	14.00	48.	33.	31.	.12	
+									1052.74 14.00
	HYDROGRAPH AT								
+		A1/DC1	52.07	14.00	48.	33.	31.	.13	
	HYDROGRAPH AT								
+		T7	32.26	12.08	4.	1.	1.	.01	
	HYDROGRAPH AT								
+		S5	55.58	12.08	5.	1.	1.	.01	
	2 COMBINED AT								
+		C/S5	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/DC#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	
	3 COMBINED AT								
+		C/P2	145.49	12.08	18.	5.	4.	.03	

```
          ROUTED TO
+                          R/P2     117.56   12.25          70.         68.         68.        .03
+                                                                                                          1035.99       12.25

          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/DC4      79.70   12.08           8.          2.          2.        .01
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

                 S8  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

                 S7  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    206.55    730.00      5.90      5.00    206.55    730.00       5.90

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3175E+02 EXCESS= .2177E+01 OUTFLOW= .3390E+02 BASIN STORAGE= .1731E-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

             A1/DC1  MANE       .71     52.07    840.46     12.84      5.00     52.07    840.00      12.84

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8810E+02 EXCESS= .1223E+00 OUTFLOW= .8819E+02 BASIN STORAGE= .8108E-03 PERCENT ERROR=    .0

                 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

                 S5  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
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              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: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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 Discharging into Pond

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T6	0.0031	6.07	2.00	1.0
S8	0.0059	6.07	3.78	1.9
T5	0.0040	6.07	2.54	1.3
S7	0.0091	6.19	5.83	3.0
CH1	0.0066	6.19	4.24	2.2
OA2	0.0791	5.95	50.62	25.1
T1	0.0024	6.07	1.52	0.8
S1	0.0039	6.19	2.48	1.3
			Volume at Discharging into Pond =	36.6

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
S5	0.0089	6.19	5.70	2.9
OA1	0.1492	5.95	95.49	47.3
CH2	0.0094	6.19	6.04	3.1
T4	0.0102	6.19	6.55	3.4
CH3	0.0035	6.19	2.23	1.2
			Total Volume at Discharge Point #2 =	60.1

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
CH4	0.0096	6.19	6.17	3.2
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
CH5	0.0076	6.19	4.84	2.5
			Total Volume at Discharge Point #3 =	19.1

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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)
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 Discharging into Discharge #4				4.6

Total Volume Exiting Permit Boundary = 120.3 acre-ft

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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 Discharging into Pond

Area No.	Area (sq. mi)	Total Excess Rainfall (in)	Area (acre)	Volume (acre-ft)
T6	0.0031	10.02	2.00	1.7
S8	0.0059	10.02	3.78	3.2
T5	0.0040	10.02	2.54	2.1
S7	0.0091	10.15	5.83	4.9
CH1	0.0066	10.15	4.24	3.6
OA2	0.0791	9.88	50.62	41.7
T1	0.0024	10.02	1.52	1.3
S1	0.0039	10.15	2.48	2.1
			Volume at Discharging into Pond =	60.5

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
S5	0.0089	10.15	5.70	4.8
OA1	0.1492	9.88	95.49	78.6
CH2	0.0094	10.15	6.04	5.1
T4	0.0102	10.15	6.55	5.5
CH3	0.0035	10.15	2.23	1.9
			Total Volume at Discharge Point #2 =	99.5

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
CH4	0.0096	10.15	6.17	5.2
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
CH5	0.0076	10.15	4.84	4.1
			Total Volume at Discharge Point #3 =	31.4

Volume Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Volume Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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)
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 Discharging into Discharge #4				7.6

Total Volume Exiting Permit Boundary = 199.0 acre-ft

VELOCITY CALCULATIONS

Velocity Calculations

Client: City of Del Rio
Project: Major Permit Amendment
Description: Velocity Calculations

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
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} = 461.0 cfs
Q_{25} = 305.0 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	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} = 253.0 cfs
Q_{25} = 168.0 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	253	0.018	0.03	50.00	50.00	100.00	0.53	3.81
25	168	0.018	0.03	50.00	50.00	100.00	0.42	3.33

2. Flow Velocity exiting the landfill permit boundary

Discharge #1

Q_{100} = 87.9 cfs
Q_{25} = 52.1 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	88	0.400	0.03	3.00	3.000	50.00	0.35	4.88
25	52	0.400	0.03	3.00	3.000	50.00	0.26	3.97

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: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
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} = 158.0 cfs
Q_{25} = 117.6 cfs

Low Water Outlet

Storm Year	Flow Rate (cfs)	Bottom Slope (ft/ft)	Length of 2-36" RCP (ft)	Flow Velocity (fps)
100	158	0.038	52.00	11.17
25	118	0.038	52.00	8.32

Discharge #4

Q_{100} = 119.7 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	120	0.015	0.03	3.00	3.00	0.00	2.44	6.69
25	80	0.015	0.03	3.00	3.00	0.00	2.06	5.97

APPENDIX IIIH-D
FINAL COVER EROSION CONTROL STRUCTURE DESIGN

Figures IIIH-D-1 and IIIH-D-11

TABLE OF CONTENTS

Drainage Swale Design IIIH-D-1

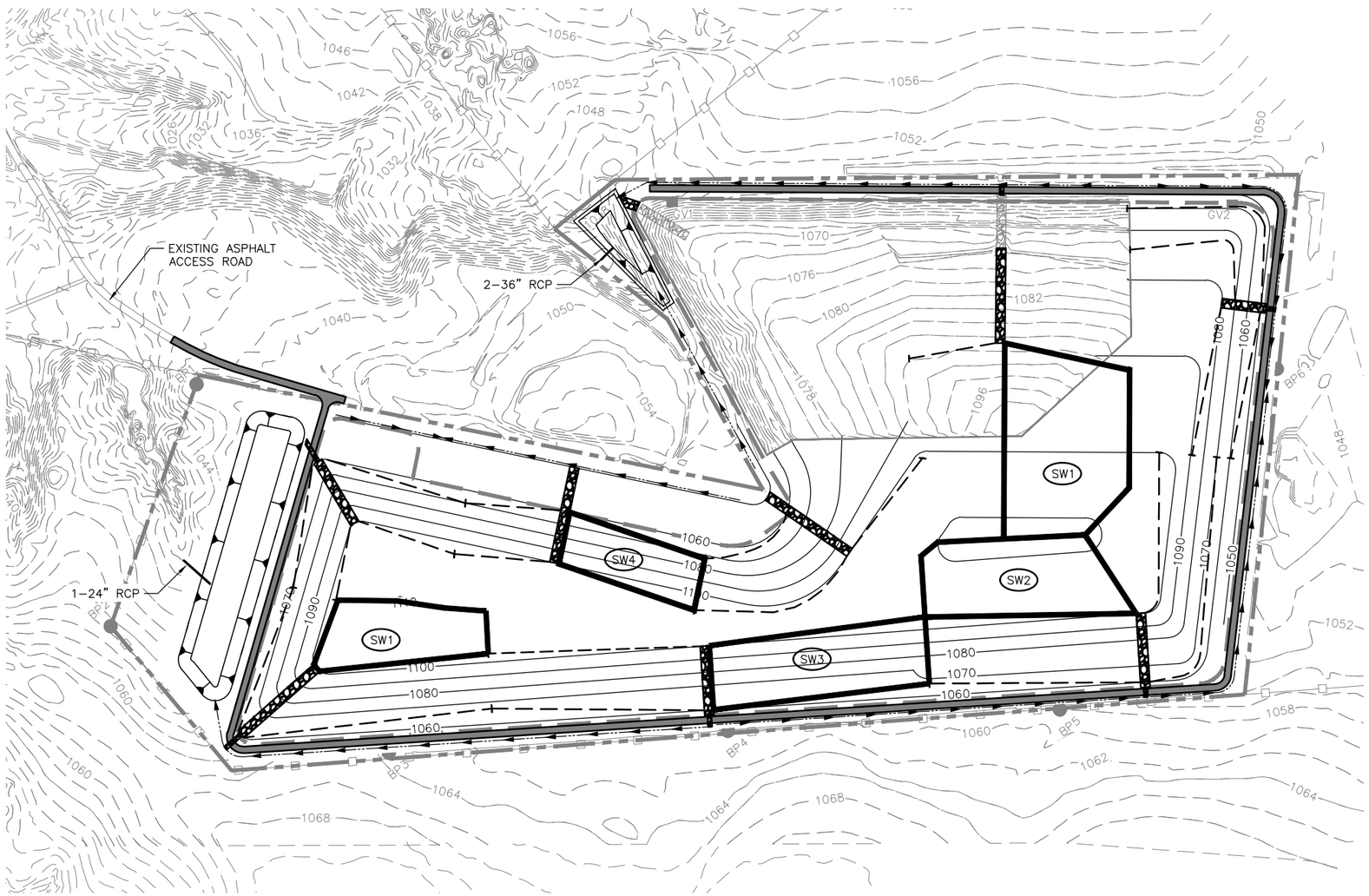
Drainage Letdown/Chute Design IIIH-D-7

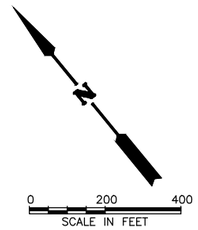
1 DRAINAGE SWALE DESIGN

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 1.43 feet (Drainage Area SW3).
- Maximum flow velocity is 2.70 fps (Drainage Area SW3).
- 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.





LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT
- DRAINAGE BOUNDARY

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON–GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.

DRAINAGE AREA	AREA (ACRES)
SW1	4.55
SW2	3.05
SW3	3.02
SW4	1.58
SW5	2.00

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F–1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

NO.	REVISION	BY	DATE
1.	3RD NOD – COMPLETE REPLACEMENT	TM	10/2021

VERIFY SCALE 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

TYPICAL SWALE DRAINAGE AREAS

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
IIIH–D–2

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
Nov 02, 2021 – 1:22pm C:\pwworking\cpy\pw_cpy\tmetaferia\d0804194\DELR1900546 Figure IIIH–D–2_R.dwg LAYOUT: Layout1 USER:

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Swale Analysis

Date: 10/16/2020
Job No: DELR1900546
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	4.55	25.0
SW2	3.05	16.8
SW3	3.02	16.6
SW4	1.58	8.7
SW5	2.00	11.0

Final Cover Erosion Control Structure Design

Client: City of Del Rio
Project: Major Permit Amendment
Description: Swale Analysis

Date: 10/16/2020
Job No: DELR1900546
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	25.0	0.005	0.03	2	20	0	1.01	2.21	0.55	0.08	1.09	11.31	22.31
SW2	16.8	0.005	0.03	2	20	0	0.87	2.00	0.53	0.06	0.94	8.40	19.22
SW3	16.6	0.005	0.03	2	4	0	1.43	2.70	0.56	0.11	1.55	6.16	8.59
SW4	8.7	0.005	0.03	2	4	0	1.12	2.29	0.54	0.08	1.21	3.79	6.74
SW5	11.0	0.005	0.03	2	20	0	0.75	1.80	0.52	0.05	0.80	6.11	16.39

Note: Calculations were performed using Bentely FlowMaster.

Maximum flow depth is 1.25 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: 10/21/2021
Job No: DELR1900546
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 IILF-C-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 =	8.7	cfs (from page IIIF-C-3)
S =	0.005	ft/ft
b =	0	ft
z_r =	2	(H) : 1 (V)
z_l =	4	(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:

$d =$ 1.12 ft

$R =$ 0.530 ft

$A_f =$ 3.790 sf

Solve for Q:

$Q =$ 8.70

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.

$Q = VA$ $V = Q/A$

$V =$ 2.29 ft/s

$T = b + d(z_l + z_r)$

$T =$ 6.74 ft

$$F_r = \frac{V}{(g\,A / T)^{0.5}}$$

$F_r =$ 0.54

$$\text{Velocity Head} = \frac{V^2}{2\,g}$$

Velocity Head = 0.08 ft

Energy Head = Water Elevation (normal depth) + Velocity Head

Specific Energy = 1.21 ft

2 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-67 to IIIH-B-110.
- Chute layouts and drainage areas are shown on Sheet IIIH-D-11.

Client: City of Del Rio
Project: Major Permit Amendment
Description: Drainage Letdown/Chute Design

Date: 10/16/2020
Job No: DELR1900546
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	66.87	0.05	0.04	4	4	13	1.56	5.90	1.34	0.54	1.26	11.33	18.72
TOP SLOPE (25%) AREAS													
LD1	37.88	0.25	0.04	4	4	13	0.93	0.32	8.22	1.05	1.37	4.61	4.61
LD2	52.73	0.25	0.04	4	4	13	1.05	0.39	9.24	1.33	1.72	5.70	16.13
LD3	67.88	0.25	0.04	4	4	13	1.16	0.45	10.11	1.59	2.04	6.72	16.63
LD4	40.84	0.20	0.04	4	4	13	1.07	0.36	7.86	0.96	1.32	5.20	15.88
LD5	66.87	0.20	0.04	4	4	13	1.20	0.48	9.35	1.36	1.84	7.15	16.84
LD6	66.21	0.20	0.04	4	4	13	1.20	0.48	9.31	1.35	1.83	7.11	16.81
LD7	87.84	0.25	0.04	4	4	13	1.28	0.53	11.04	1.90	2.42	7.95	17.21
LD8	82.16	0.25	0.04	4	4	13	1.24	0.51	10.80	1.81	2.32	7.61	17.05
LD9	53.99	0.25	0.04	4	4	13	1.06	0.40	9.33	1.35	1.75	5.79	16.17
LOW WATER CROSSING (2%) AREAS													
LD1	37.88	0.02	0.04	8	8	6	0.84	3.52	0.84	0.19	1.04	10.75	19.50
LD5	66.87	0.02	0.04	8	8	13	0.86	3.93	0.86	0.24	1.13	17.03	26.25
LD6	66.21	0.02	0.04	8	8	13	0.89	3.91	0.86	0.24	1.12	16.92	26.18
LD7	87.84	0.02	0.04	8	8	20	0.83	3.98	0.86	0.25	1.07	22.04	33.25
LD8	82.16	0.02	0.04	8	8	20	0.80	3.90	0.86	0.24	1.03	21.05	32.76
LD9	53.99	0.02	0.04	8	8	10	0.85	3.76	0.85	0.22	1.07	14.37	23.66

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: 10/21/2021
Job No: DELR1900546
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 =	53.99	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: 10/21/2021
Job No: DELR1900546
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 =	0.4	ft
R =	0.360	ft
A_f =	5.790	sf

Solve for Q:

Q = 53.99

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 = 9.33 ft/s

T = b + 2(z x d)

T = 16.17 ft

$$F_r = \frac{V}{(g\,A / T)^{0.5}}$$

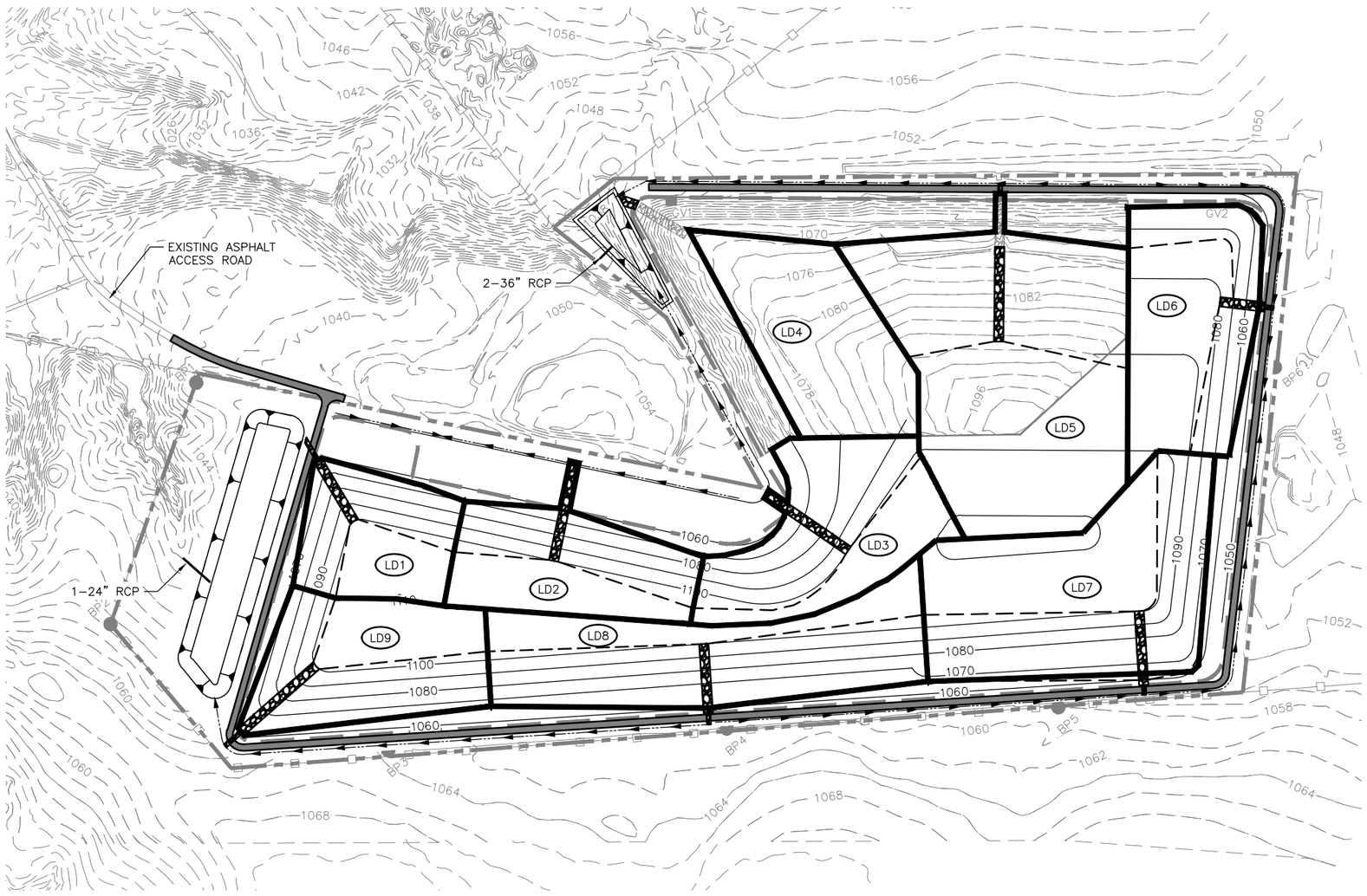
F_r = 2.75

$$\text{Velocity Head} = \frac{V^2}{2\,g}$$

Velocity Head = 1.35 ft

Energy Head = Water Elevation (normal depth) + Velocity Head

Specific Energy = 1.75 ft



0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT
- DRAINAGE BOUNDARY

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON–GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.
3. FLOW RATES ARE OBTAINED FROM THE 25–YR STORM EVENT HEC–1 MODEL OUTPUT IN APPENDIX IIIH–B.

DRAINAGE AREA	AREA (ACRES)	FLOW RATES (NOTE 3)
LD1	4.00	37.88
LD2	5.07	52.73
LD3	6.48	67.88
LD4	6.05	40.84
LD5	13.91	66.87
LD6	6.55	66.21
LD7	9.97	87.84
LD8	8.37	82.16
LD9	5.97	53.99

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F–1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

NO.	REVISION	BY	DATE
1.	3RD NOD – COMPLETE REPLACEMENT	TM	10/2021

VERIFY SCALE 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

LETDOWN DRAINAGE AREAS

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
IIIH–D–11

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
Nov 01, 2021 – 4:06pm C:\pwworking\cpy\pw_cpy\tmetaferia\d0804194\DELR1900546 Figure IIIH–D–8.dwg LAYOUT: Layout1 USER:

APPENDIX IIIH-E
EROSION LAYER EVALUATION

Figures IIIH-E-1 and IIIH-E-23

1 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 Postclosure Care Plan.

2 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 6.1 inches (see IIIH-D-10). Therefore, the minimum erosion layer thickness is 6.1 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 6.03 inches and 6.71 inches, respectively, 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.

3 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 DAILY COVER AND NON-EXTERNAL SIDE SLOPES EROSION AND SEDIMENTATION 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.

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

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 =	188	Length =	595
Case 3.	Typical Side Slope	Case 4.	Longest Side Slope
Slope =	20%	Slope =	20%
Length =	160	Length =	210

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	188	0.75
2. Longest Top Slope	5	595	1.5
3. Typical Side Slope	25	160	7.5
4. Longest Side Slope	25	210	8.5

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

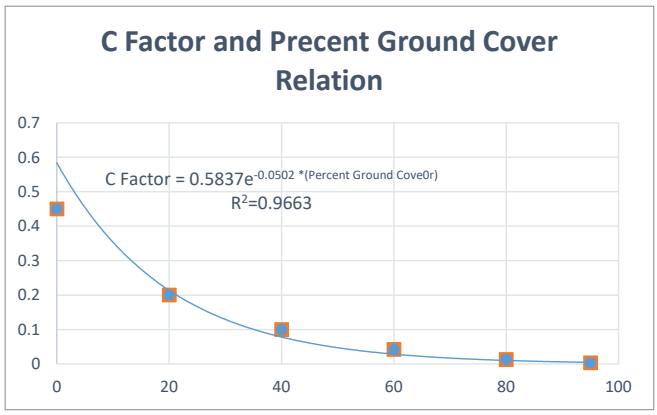
Purpose - **Determine expected soil loss and minimum thickness for the erosion layer.**

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	0.75	0.0064	1	0.21
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	7.5	0.0064	1	2.09
4. Longest Side Slope 25% slope 163 ft length	150	0.29	8.5	0.0064	1	2.37

Note: Erosion layer will be maintained to provide 90% ground coverage

Erosion layer thickness calculations:

T_{el} = 6 in + (AYF(2000lb/ton)(12in/ft))/(w(43,560sf/ac))

Where:

T_{el} = Erosion layer thickness
A = Soil loss (ton/ac/yr)
Y = Postclosure Period (yr)
F = Factor of Safety
w = Specific weight of soil (pcf)

Y =	30	yr
F =	2	
w =	110	pcf

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Erosion Layer Evaluation

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
Checked By: B. Hindman

Purpose - **Determine expected soil loss and minimum thickness for the erosion layer.**

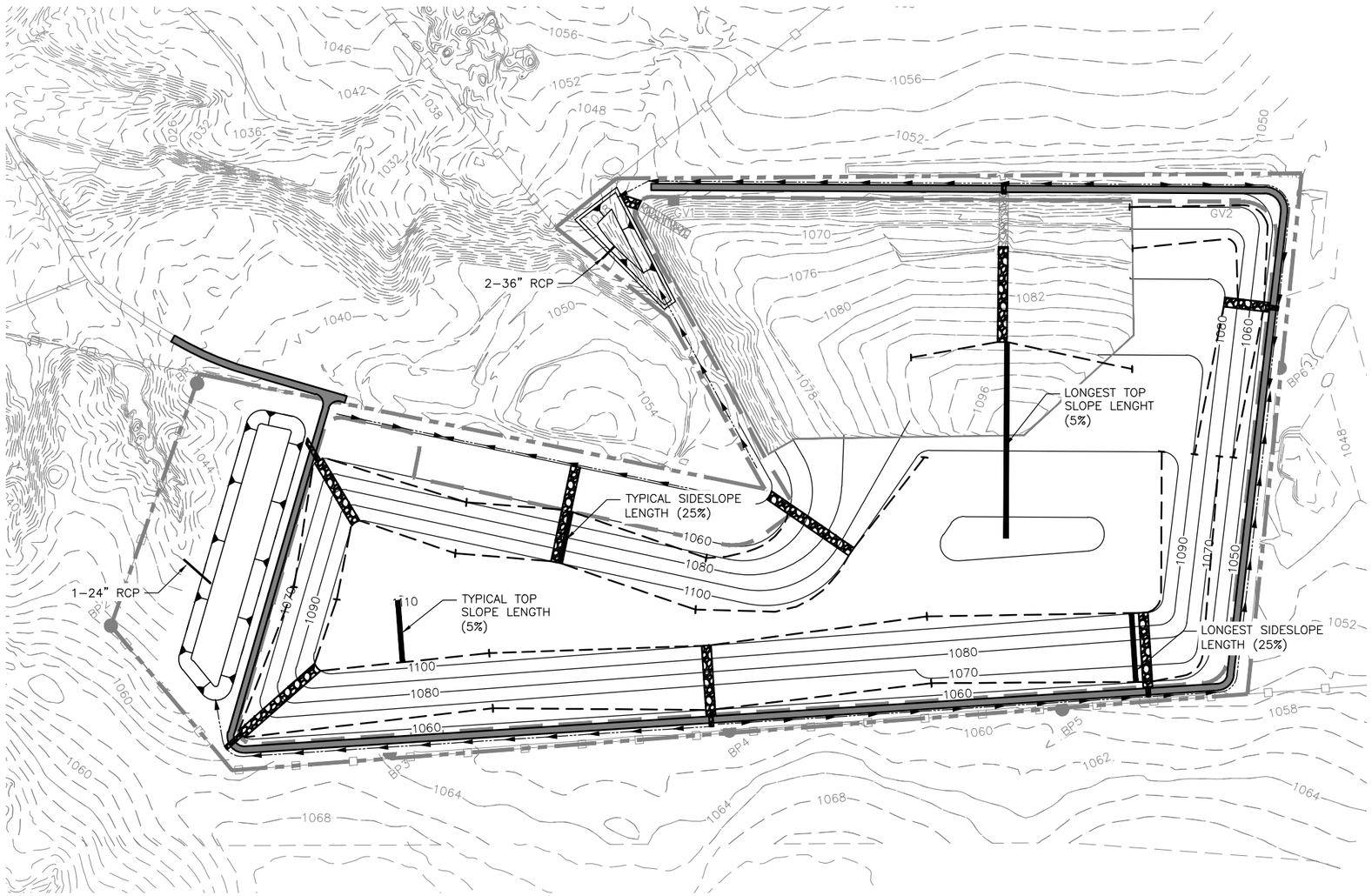
1. Typical Top Slope Thickness:		
T_{el} Required Thickness =	6.06	in
Total Estimated Soil Loss =	0.06	in
Specified Thickness =	12.00	in
2. Longest Top Slope Thickness:		
T_{el} Required Thickness =	6.13	in
Total Estimated Soil Loss =	0.13	in
Specified Thickness =	12.00	in
3. Typical Side Slope Thickness:		
T_{el} Required Thickness =	6.13	in
Total Estimated Soil Loss =	0.13	in
Specified Thickness =	12.00	in
4. Longest Side Slope Thickness:		
T_{el} Required Thickness =	6.71	in
Total Estimated Soil Loss =	0.71	in
Specified Thickness =	12.00	in

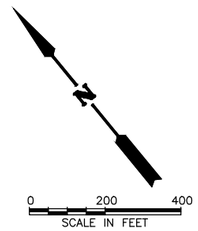
Conculsion:

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 0.71 inches

Soil Loss Estimate Summary Table

Case	Slope (%)	Length (ft)	L_s	Percent Ground Cover	C Factor	A (tons/ac/yr)
Top Slope	5	250	0.85	70	0.017	0.67
Top Slope	5	250	0.85	80	0.013	0.51
Top Slope	5	250	0.85	90	0.0064	0.25
Top Slope	5	414	1.09	70	0.017	0.86
Top Slope	5	414	1.09	80	0.013	0.66
Top Slope	5	414	1.09	90	0.0064	0.32
Side Slope	20	120	4.45	70	0.017	3.51
Side Slope	20	120	4.45	80	0.013	2.68
Side Slope	20	120	4.45	90	0.0064	1.32
Side Slope	20	163	5.2	70	0.017	4.10
Side Slope	20	163	5.2	80	0.013	3.14
Side Slope	20	163	5.2	90	0.0064	1.54





LEGEND

- PERMIT BOUNDARY
- CLOSED CELL BOUNDARY
- LIMIT OF WASTE
- 1090 FINAL COVER CONTOURS
- 1084 EXISTING CONTOURS
- SWALES
- PERIMETER CHANNEL
- CHUTES
- BP1 GAS PROBE
- EXISTING SITE FENCE
- PROPOSED ACCESS ROAD
- CUT/FILL MARKERS
- EXISTING CHUTE
- GV2 GAS VENT
- FLOW LENGTH

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1–5 & D TOPO WAS UPDATED SEPTEMBER, 2018 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON–GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774–0796. DATED: 10–25–94.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F–1741

CITY OF Del Rio TEXAS

10/21/2021

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER

NO.	REVISION	BY	DATE
1.	3RD NOD – NEW DRAWING	TM	10/2021

VERIFY SCALE 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

LONGEST AND TYPICAL FLOW LENGTHS

Date: OCTOBER 2020
Designed: T. METAFERIA, P.E.
Drawn: J.TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
IIIH–E–9

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_PCBASE.dwg DELR1900546_ECBASE.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
C:\pwworking\cpy\pw_cpy\tmetaferia\d0804194\DELR1900546 Figure IIIH–E–9.dwg LAYOUT: Layout1 USER:

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Sheet Flow Velocity

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
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 =	188	ft

Case 2: Longest top slope

slope =	0.05	ft/ft
Length =	595	ft

Case 3: Typical side slope

slope =	0.25	ft/ft
Length =	160	ft

Case 4: Longest side slope

slope =	0.25	ft/ft
Length =	210	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 =	188	ft
$P_{2,24}$ =	4.34	in
S =	0.05	ft/ft
t_c =	0.23	hr
	14.07	min

Case 2:

n =	0.24	
L =	595	ft
$P_{2,24}$ =	4.34	in
S =	0.05	ft/ft
t_c =	0.59	hr
	35.38	min

Case 3:

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

Case 4:

n =	0.24	
L =	210	ft
$P_{2,24}$ =	4.34	in
S =	0.25	ft/ft
t_c =	0.13	hr
	8.08	min

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Sheet Flow Velocity

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
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:

$Q = CiA$

Q = Flow rate (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr)
A = draiange area (ac)

$i = b/(t_c + d)^e$

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 =	14.07	min
i =	6.93	in/hr
Length =	188	ft
A =	0.0043	ac
Q =	0.021	cfs

Case 2:

C =	0.7	
t_c =	35.38	min
i =	4.36	in/hr
Length =	595	ft
A =	0.0137	ac
Q =	0.042	cfs

Case 3:

C =	0.7	
t_c =	6.50	min
i =	8.91	in/hr
Length =	160	ft
A =	0.0037	ac
Q =	0.023	cfs

Case 4:

C =	0.7	
t_c =	8.08	min
i =	8.40	in/hr
Length =	210	ft
A =	0.0048	ac
Q =	0.028	cfs

Erosion Layer Evaluation

Client: City of Del Rio
Project: Major Permit Amendment
Description: Sheet Flow Velocity

Date: 10/16/2020
Job No: DELR1900546
By: K. Dieckow
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 =	0.021	cfs
n =	0.24	
S =	0.05	ft/ft
y =	0.081	ft/ft

Case 2:

Q =	0.042	cfs
n =	0.24	
S =	0.05	ft/ft
y =	0.122	ft/ft

Case 2:

Q =	0.023	cfs
n =	0.24	
S =	0.25	ft/ft
y =	0.053	ft/ft

Case 2:

Q =	0.028	cfs
n =	0.24	
S =	0.25	ft/ft
y =	0.060	ft/ft

Determining Sheet Flow Velocity.

V = Q/A (assume unit flow widith for the flow area, A)

Case 1:

Q =	0.021	cfs
A =	0.081	sf
V =	0.259	ft/s

Case 2:

Q =	0.042	cfs
A =	0.122	sf
V =	0.342	ft/s

Case 3:

Q =	0.023	cfs
A =	0.053	sf
V =	0.436	ft/s

Case 4:

Q =	0.028	cfs
A =	0.060	sf
V =	0.474	ft/s

EPA

Solid Waste Disposal Facility Criteria

Technical Manual

Printed on Recycled Paper

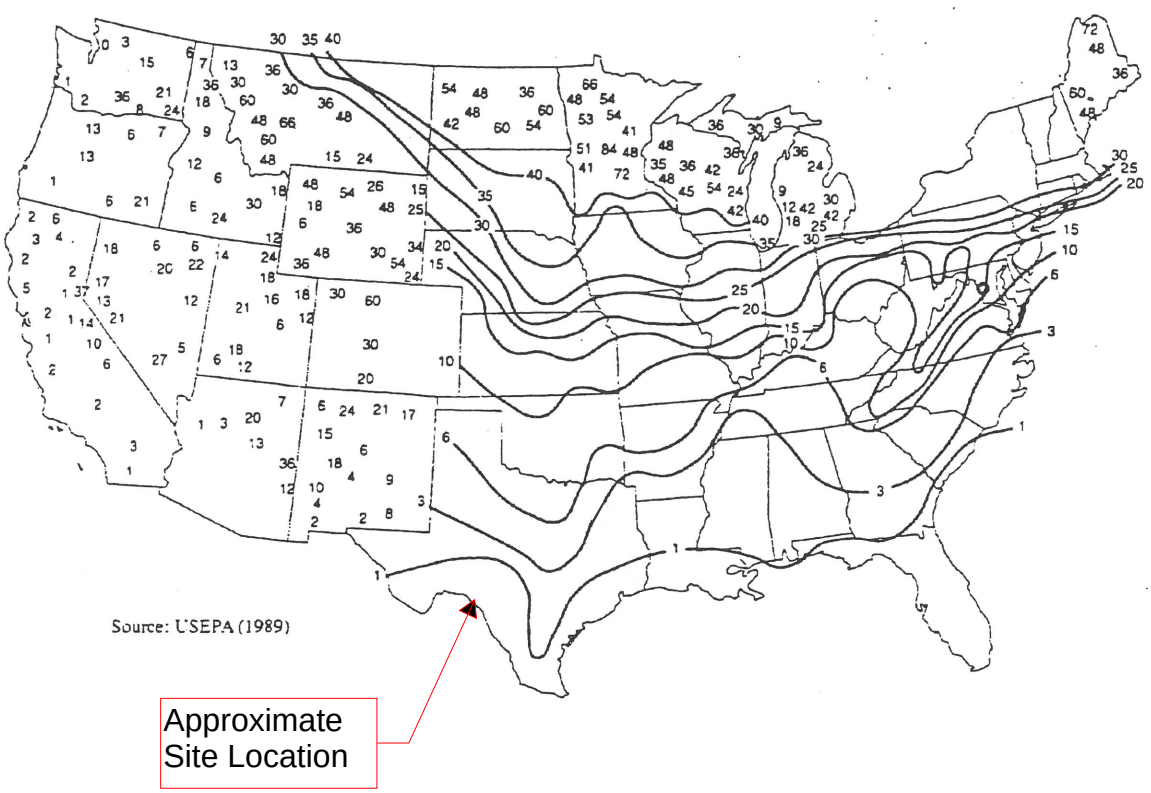


Figure 6-4
Regional Depth of Frost Penetration in Inches

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

USE OF THE UNIVERSAL SOIL LOSS EQUATION IN FINAL COVER/CONFIGURATION DESIGN

PROCEDURAL HANDBOOK

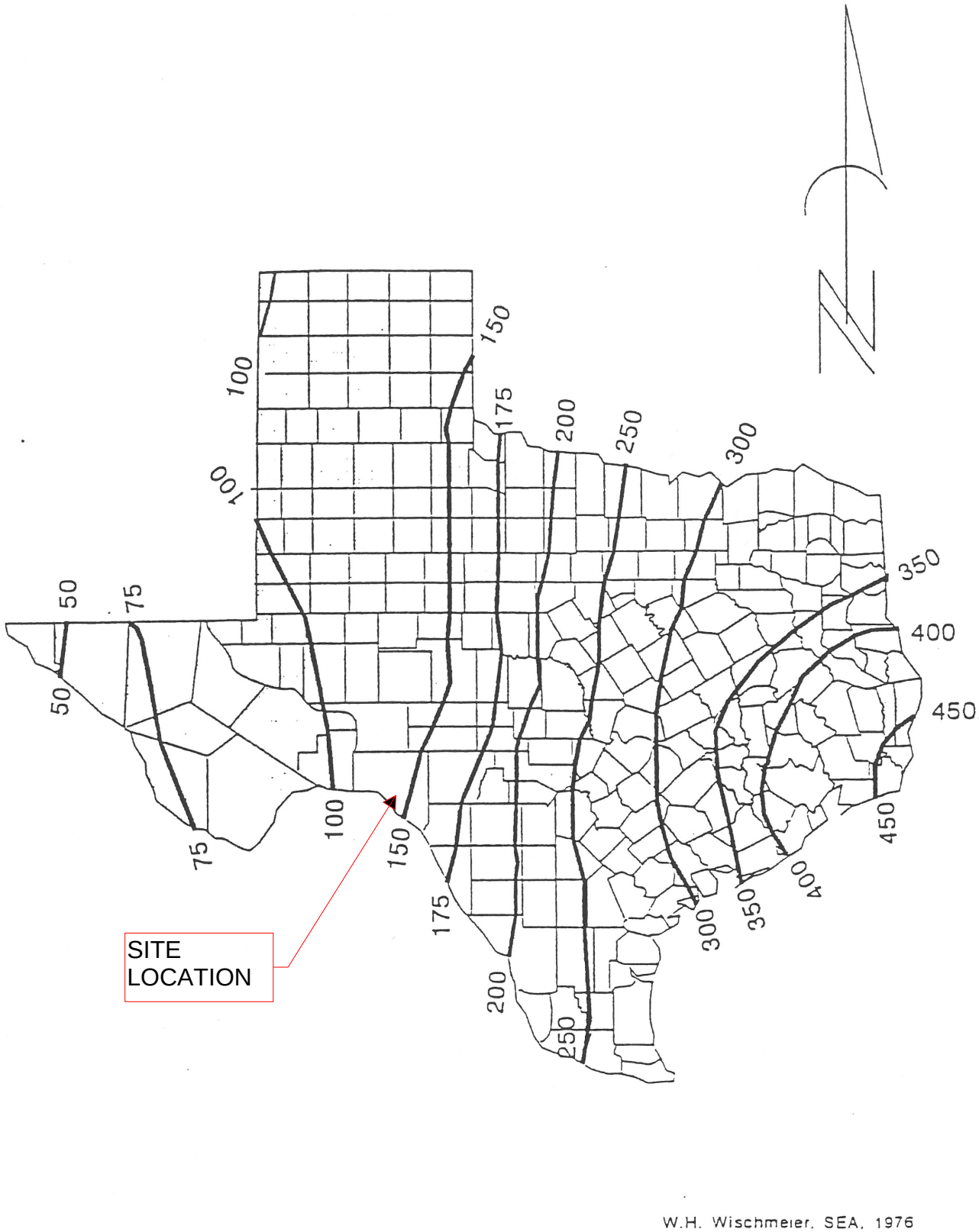
PERMITS SECTION
MUNICIPAL SOLID WASTE DIVISION

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.



W.H. Wischmeier, SEA, 1976

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).

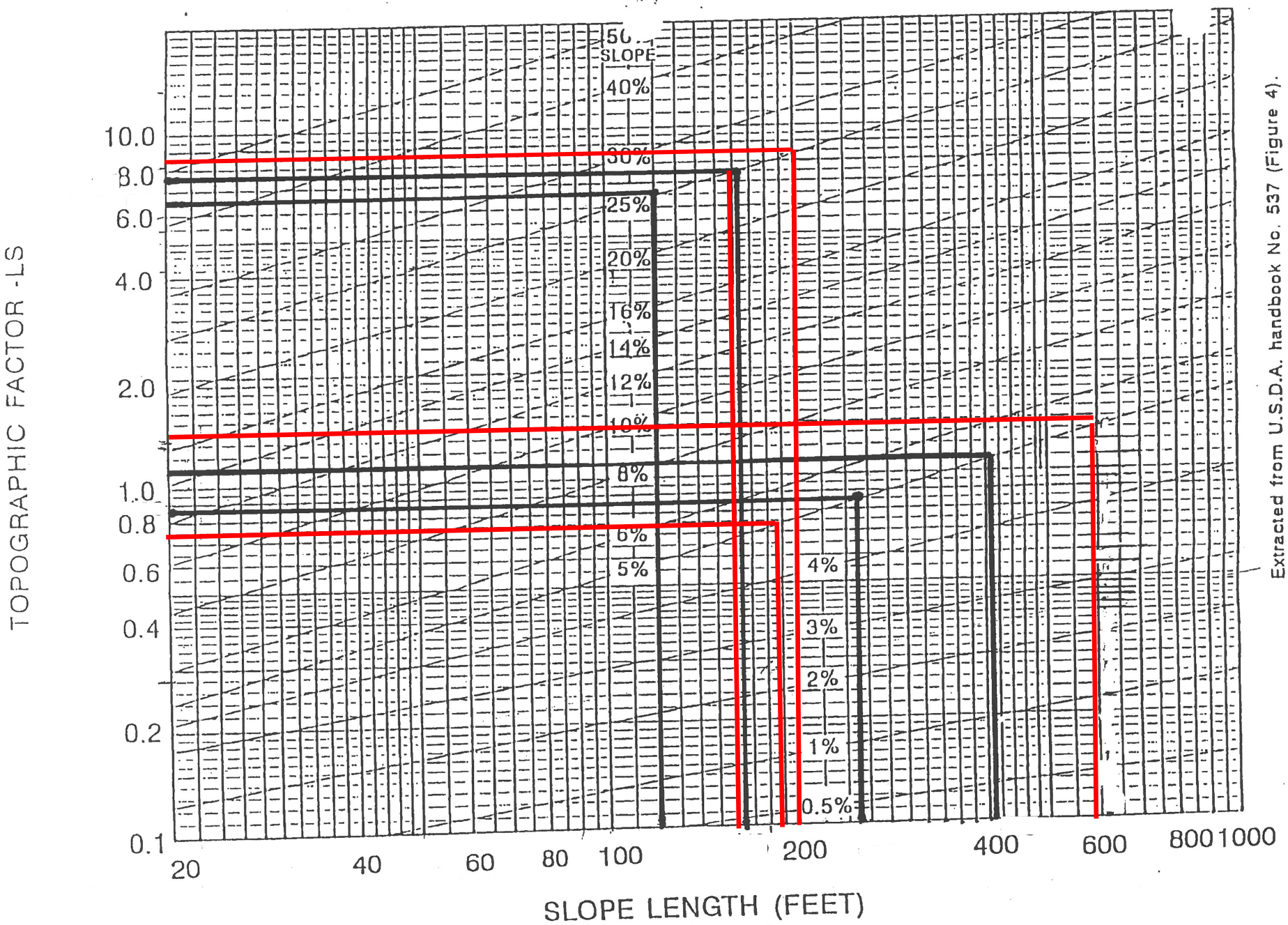


FIGURE 2.- Slope effect chart (topographic factor, LS). LS = $(\lambda/72.6)^m$ 65.41 $\sin^2$ ()=4.56 sin ()+ 0.065) whereλ= slope lenght in feet ;()=angle of slope; and m = 0.2 for gradients <1 percent, 0.3 for 1 to 3 slopes; 0.4 for 3.5 to 4.5 percent slopes, and 0.5 for slopes of 5 percent or steeper.

Texas Department of Transportation

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)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Slender Grama (Dilley)	1.0
	Little Bluestem (OK Select)	0.8	Sand Lovegrass (Mason)	0.2
	Purple Prairie Clover (Cuero)	0.6	Sand Dropseed (Borden County)	0.2
	Engelmann Daisy (Eldorado)	0.75	Partridge Pea (Comanche)	0.6
	Illinois Bundleflower	1.3	Little Bluestem (OK Select)	0.8
	Awnless Bushsunflower (Plateau)	0.2	Englemann Daisy (Eldorado)	0.75
			Purple Prairie Clover	0.3
19 (Atlanta) Feb. 1–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.5	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
20 (Beaumont) Jan. 15–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.7	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.1	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
21 (Pharr) Jan. 15–May 15	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (South Texas)	1.0	Slender Grama (Dilley)	2.0
	Texas Grama (Atascosa)	1.0	Hairy Grama (Chaparral)	0.6
	Slender Grama (Dilley)	1.0	Shortspike Windmillgrass (Welder)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Pink Pappusgrass (Maverick)	0.6
	Pink Pappusgrass (Maverick)	0.6	Plains Bristlegrass (Catarina Blend)	0.2
	Halls Panicum (Oso)	0.2	Hooded Windmillgrass (Mariah)	0.3
	Plains Bristlegrass (Catarina Blend)	0.2	Multi-flowered False Rhoades Grass	0.1
	False Rhodes Grass (Kinney)	0.1	(Hidalgo)	0.2
	Hooded Windmillgrass (Mariah)	0.2	Arizona Cottontop (La Salle)	
	Arizona Cottontop (La Salle)	0.2		
22 (Laredo) Jan. 15–May 1	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (South Texas)	1.0	Slender Grama (Dilley)	2.0
	Texas Grama (Atascosa)	1.0	Hairy Grama (Chaparral)	0.6
	Slender Grama (Dilley)	1.0	Shortspike Windmillgrass (Welder)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Pink Pappusgrass (Maverick)	0.6
	Pink Pappusgrass (Maverick)	0.6	Plains Bristlegrass (Catarina Blend)	0.2
	Halls Panicum (Oso)	0.2	Hooded Windmillgrass (Mariah)	0.3
	Plains Bristlegrass (Catarina Blend)	0.2	Multi-flowered False Rhoades Grass	0.1
	False Rhodes Grass (Kinney)	0.1	(Hidalgo)	0.2
	Hooded Windmillgrass (Mariah)	0.2	Arizona Cottontop (La Salle)	
	Arizona Cottontop (La Salle)	0.2		
23 (Brownwood) Feb. 1–May 15	Green Sprangletop (Van Horn)	0.6	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
	Little Bluestem (OK Select)	0.8	Sand Dropseed (Borden County)	0.2
	Blue Grama (Hachita)	0.4	Partridge Pea (Comanche)	0.6
	Western Wheatgrass (Barton)	1.2	Little Bluestem (OK Select)	0.8
	Galleta Grass (Viva)	0.6	Englemann Daisy (Eldorado)	0.75
	Engelmann Daisy (Eldorado)	0.75	Purple Prairie Clover (Cuero)	0.3
	Awnless Bushsunflower (Plateau)	0.2		

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)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Bermudagrass	1.8	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Sideoats Grama (Haskell)	4.5	Sand Dropseed (Borden Co.)	0.4
10 (Tyler)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
11 (Lufkin)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
12 (Houston)	Green Sprangletop	0.3	Green Sprangletop	0.3
Jan. 15–May 15	Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
13 (Yoakum)	Green Sprangletop	0.3	Green Sprangletop	0.3
Jan. 15–May 15	Sideoats Grama (South Texas)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
14 (Austin)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Bermudagrass	2.4	Bermudagrass	4.8
	Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
15 (San Antonio)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 1	Sideoats Grama (South Texas)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
16 (Corpus Christi)	Green Sprangletop	0.3	Green Sprangletop	0.3
Jan. 1–May 1	Sideoats Grama (South Texas)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
17 (Bryan)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
18 (Dallas)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Sideoats Grama (El Reno)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed (Borden Co.)	0.4
19 (Atlanta)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
20 (Beaumont)	Green Sprangletop	0.3	Green Sprangletop	0.3
Jan. 15–May 15	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
21 (Pharr)	Green Sprangletop	0.3	Green Sprangletop	0.3
Jan. 15–May 15	Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed (Borden Co.)	0.4
22 (Laredo)	Green Sprangletop	0.3	Green Sprangletop	0.3
Jan. 15–May 1	Sideoats Grama (South Texas)	4.5	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	1.8	Sand Dropseed	0.4
23 (Brownwood)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Bermudagrass	1.2	Bermudagrass	3.6
	Blue Grama (Hachita)	0.9	Sand Dropseed (Borden Co.)	0.4
24 (El Paso)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
	Blue Grama (Hachita)	1.2	Sand Dropseed (Borden Co.)	0.4
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	1.8
25 (Childress)	Green Sprangletop	0.3	Green Sprangletop	0.3
Feb. 1–May 15	Sideoats Grama (El Reno)	3.6	Sand Dropseed (Borden Co.)	0.4
	Blue Grama (Hachita)	1.2	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	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 4.5 Western Wheatgrass 5.6 Wheat (Red, Winter) 34
Odessa (6), San Angelo (7), El Paso (24)	September 1–November 30	Western Wheatgrass 8.4 Wheat (Red, Winter) 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1–November 30	Tall Fescue 4.5 Oats 24 Wheat 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 4.5 Western Wheatgrass 5.6 Cereal Rye 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-207B

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIK
WASTE CONTAINMENT POINT OF COMPLIANCE

Prepared for

City of Del Rio

October 2020
Revision 1 May 2021
Revision 2 October 2021

Prepared by

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STATE OF TEXAS
TEWOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER

Twobista Metaferia
10/21/2021

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TABLES

Table 3-1 – Typical Chemical Constituent Concentrations in Leachate
Table 3-2 – Chemical Constituent MCLs and Del Rio LF Leachate Quality
Table 6-1 – Landfill Conditions Modeled in HELP
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FIGURES

Figure 7.1 Site Plan Point of Compliance

APPENDIX

APPENDIX IIIK-A – Leachate Generation Model
APPENDIX IIIK-B – Rainfall Recharge Model
APPENDIX IIIK-C – MULTIMED Model
APPENDIX IIIK-D – Leachate Sampling Analysis

1 INTRODUCTION

The development of the Del Rio Landfill is a vertical expansion over a portion of the pre-Subtitle D area as well as the Subtitle D area of the landfill. The purpose of this appendix is to demonstrate that the containment system design for the pre-Subtitle D area with an overliner and the approved existing alternative liner for the Subtitle D area meets the point of compliance (POC) requirement set forth in Title 30 TAC §330.331(a), which is:

> *"a design that ensures that the concentration values listed in Table 1 of this paragraph will not be exceeded in the uppermost aquifer at the point of compliance."*

This is achieved by demonstrating that the predicted concentrations of selected leachate chemical constituents do not exceed maximum contaminant levels listed in Table 1 in §330.331(a)(1) in the uppermost aquifer at the POC.

2 CONTAINMENT SYSTEM AND DEMONSTRATION OVERVIEW

The following subsections describe the overliner and approved existing containment system (liner) at the City of Del Rio Landfill. The details of the liner system below are illustrated in Appendix IIIA-A figures.

2.1 Pre-Subtitle D Area Liner

The pre-Subtitle D area is located in the middle of the of the landfill as shown in the Figure 7.1 and is 12.3 acres. Consistent with MSW regulations at that time, the pre-Subtitle D liner is constructed with a 36-inch-thick compacted clay liner with a coefficient of permeability less than 1.0×10^{-7} cm/s and 24 inches of protective cover.

2.2 Subtitle D Alternative Liner

Cells 1 – 6 are Subtitle D areas. In December 1994, the site was approved for an alternative liner. The alternative liner consists of 24 inches of compacted clay, overlain by a geocomposite leachate collection layer and 24 inches of protected cover. The TCEQ approval for the alternative liner is included in Appendix IIID-A. Cells 1 through 5 have been constructed with the alternative liner. The details of the alternative liner are shown in Appendix IIIA-A. Cell 6 will be constructed with the previously approved alternative liner.

2.3 Overliner

The overliner will be constructed over the portion of the pre-Subtitle D area. The overliner system will comprised of a reinforced geosynthetic clay liner (GCL) and a 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on both sides. This will be overlain by a geocomposite leachate collection layer and 24 inches of protective cover. The overliner plan is included in Appendix IIIA-A.

2.4 POC Overview

The POC demonstration will show that the approved existing Subtitle D alternative liner area and the pre-Subtitle D liner with overliner will serve as a containment system and reduce the leachate infiltration into the groundwater. Once the Subtitle D final cover is in place, leachate generation rates will decrease even further. If the containment design systems described above reduce and/or eliminate leachate generation

into the ground, then current groundwater conditions at the site will be unaffected and will remain below the constituent parameters listed in Table 1 of §330.331(a)(1).

3 LEACHATE QUALITY

The site currently has a groundwater monitoring waiver and does not have any historical data on the groundwater chemical constituent levels at the site. Refer to Section 4.2 for discussion on the site's hydrogeology and groundwater characteristics. Although the site does not have any historical data on the chemical constituents in the groundwater a leachate quality analysis was conducted for this permit amendment application and are shown in Table 3-2.

The POC demonstration was conducted by showing that the containment system with highest leachate percolation will not allow the concentrations of the 24 EPA constituents shown in Table 3-1 to be exceeded at the relevant point of compliance. This is done by modeling a Dilution Attenuation Factor (DAF), defined as the initial input leachate concentration, Co, divided by the concentration at the POC, Cp:

$$DAF = \frac{\text{Co, Initial Constituent Concentration of Leachate within the Landfill}}{\text{Cp, Constituent Concentration at the POC}}$$

Two data inputs for the leachate concentrations were used to calculate the DAF. The first input of leachate concentrations are based on recommended input concentrations from USEPA's "Draft Background Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics: July 1988", and the Toxicity Characteristic Leaching Procedure (TCLP) in 40 CFR 261.62. The greater of the two values for each constituent were used as the recommended input concentration. Table 3-1 lists these data. As noted in the above equation, the DAF represents the factor by which the constituent concentration is expected to decrease between the landfill and the POC. As shown in Table 3-1, the required DAFs range from less than 100 to 260. When the constituent's concentration in leachate is divided by the model predicted DAF, the resulting concentration must be less than the allowable maximum contaminant levels (MCLs) in groundwater for the chemical parameters listed in Table 1 included in Title 30 TAC §330.331(a)(1).

The highest listed DAF is 260, which indicates that if a trichloroethylene concentration of 1.3 mg/l exists within the landfill, then the concentration would have to be reduced by a factor of 260 prior to the constituent reaching the POC to meet the 0.005 mg/l MCL for this constituent.

$$DAF = \frac{1.3 \text{ mg/l}}{0.005 \text{ mg/l}} = 260$$

A DAF of 260 has been the historical standard used in POC demonstrations approved by the TCEQ and is the standard discussed in the original TCEQ guidance document for POC demonstrations (Texas Water Commission Alternate Liner Design Handbook, August 1993).

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]	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 (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	

4 SITE GEOLOGY

Multiple site investigations have been conducted at the 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 Table 2-2 of Appendix IIIJ. The subsurface investigations reveal that the subsurface materials at the site can be divided into three strata. The properties of these strata are described in the following sections.

4.1.1 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.

4.1.2 Stratum II

Stratum II consists of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cementitious 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.

4.1.3 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.

5 HYDROGEOLOGY AND GROUNDWATER CHARACTERISTICS

5.1 Regional Aquifers

The Supplemental Geotechnical Information dated November 1994, recharge to the Edwards aquifer occurs north of the City of Del Rio where precipitation enters the Edwards aquifer through fracture networks, faults and/or karst features. Water that does not reach the subsurface runs off, evaporates and is lost to evapotranspiration.

The uppermost transmissive unit of the Edwards aquifer is the Salmon Peak formation, which represents the first perennial aquifer. Upper 80 feet characterized as granular with abundant caprinids (extinct bivalves) and other shell fragments, cross-bedded. The lower portion is described as consisting of low permeability mudstone with abundant masses of chert. Regionally, the hydraulic relationship between the Edwards and the Trinity aquifers is variable and complex. Throughout much of the Edwards Plateau, the Edwards Aquifer is hydraulically connected to the underlying Trinity Aquifer and is mapped as the Edwards-Trinity (Plateau) Aquifer by the Texas Water Development Board.

Regional groundwater flow is towards the south-southwest. Locally, groundwater flow is controlled by dissolution channels formed preferentially along bedding planes, joints, and fractures. Flow may also be influenced by localized pumping.

5.2 Site Hydrogeology

5.2.1 1986 and 1994 Groundwater Investigation

The uppermost (perennial) aquifer was evaluated during the 1986 Raba-Kistner geotechnical investigation by for the site. During this investigation a deep test boring was drilled to a total depth of 162 feet to evaluate the Salmon Peak limestone, the recognized upper transmissive unit of the Edwards Aquifer.

When deep boring B-3 was drilled during the 1986 Raba-Kistner investigation the portion of the unit that was drilled was not saturated, suggesting the upper porous and permeable part of the Salmon Peak is absent and only the lower, less permeable portion remains at this location. Deep boring B-3 penetrated the top of the Salmon Peak at a depth of 135 feet below grade (910 ft-msl). No groundwater was encountered or otherwise noted to be present in the formation at the time of drilling.

In March 1994, four piezometers were installed to monitor the groundwater activities around the site. All the piezometers were dry on drilling and remained dry over the observation period. In the Supplemental Geotechnical Information dated November 1994 prepared by Trinity Engineering Testing Corporation (included in Appendix IIIJ-C), calculations were made to estimate the top elevations of the Salmon Peak and the thickness of the Del Rio Clay at five locations within the landfill site. The calculated average thickness of the Del Rio Clay based on the five locations is 130.8 ft (refer to Table 3-1 in Appendix IIIJ). Based on the soil characterization of the Del Rio clay and the dry climate in the region the geotechnical report concluded that there is no groundwater at the site in the weathered-unweathered Del Rio Clay transition.

5.2.2 Groundwater Waiver

An Alternative Liner Demonstration permit modification was submitted for the site in 1994. A groundwater monitoring waiver was requested as part of alternative liner permit modification. As mentioned above the two site investigations (1986 and 1994) concluded that there was no shallow

groundwater system in the Del Rio Clay. The alternative liner and the groundwater waiver request were granted to the City in December 1994.

The City is currently requesting to extend the groundwater waiver as part of this Major Permit Amendment Application. Refer to Appendix IIIN for the No Migration Demonstration.

6 POINT OF COMPLIANCE DEMONSTRATION

This section describes the point of compliance (POC) demonstration using (1) the Hydrologic Evaluation of Landfill Performance (HELP) model to estimate leachate percolation through the liner in the pre-Subtitle D and Subtitle D areas and (2) Multimedia Exposure Assessment (Multimed) to perform pollutant fate and transport simulations between the landfill and the point of compliance. The following subsections discuss the POC demonstration methods using the HELP and Multimed models.

6.1 HELP Model Demonstration

6.1.1 HELP Model

The HELP Model, Version 4.0, is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of the landfill. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, run-off, infiltration, percolation, soil moisture storage, evapotranspiration, and lateral drainage. The HELP Model was used to estimate the rate of percolation through the various areas of the landfill. The percolation rate was determined for various landfill configurations as discussed in Section 6.1.2.

6.1.2 HELP Model Input

HELP Model simulations were performed to obtain percolation rates for each of the areas and conditions listed below. Table 6-1 summarizes the landfill configurations modeled using HELP.

Table 6-1 – Landfill Conditions Modeled in HELP

Area	Interim Condition 23-Year Timeframe	Closed Condition 30-Year Timeframe
Subtitle D Area	50 feet of waste with intermediate cover	80 feet of waste with final cover
Pre-Subtitle D with Overliner Area	60 feet of waste with intermediate cover	60 feet of waste with final cover

Additional HELP Model input information is provided in Appendix IIIK-A. The HELP Model results summary and output files are also provided in Appendix IIIK-A.

6.2 Multimed Model Demonstration

The MULTIMED Model Version 2.00 was used to assess contaminant fate and transport between the landfill base and the POC. MULTIMED was developed by the Athens Environmental Research Laboratory for the EPA. 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.

7 MODEL INPUT PARAMETERS

Appendices IIIK-A through IIIK-C present detailed information about the HELP and MULTIMED models and liner leakage calculations. Conservative assumptions were made in determining the recharge rate, percolation rate, and the dilution attenuation factor (DAF). The results of the leachate generation model utilizing the HELP Model are included in Appendix IIIK-A. The HELP model input parameters for determining the recharge rate through the Del Rio Clay and percolation is detailed in Appendix IIIK-B.

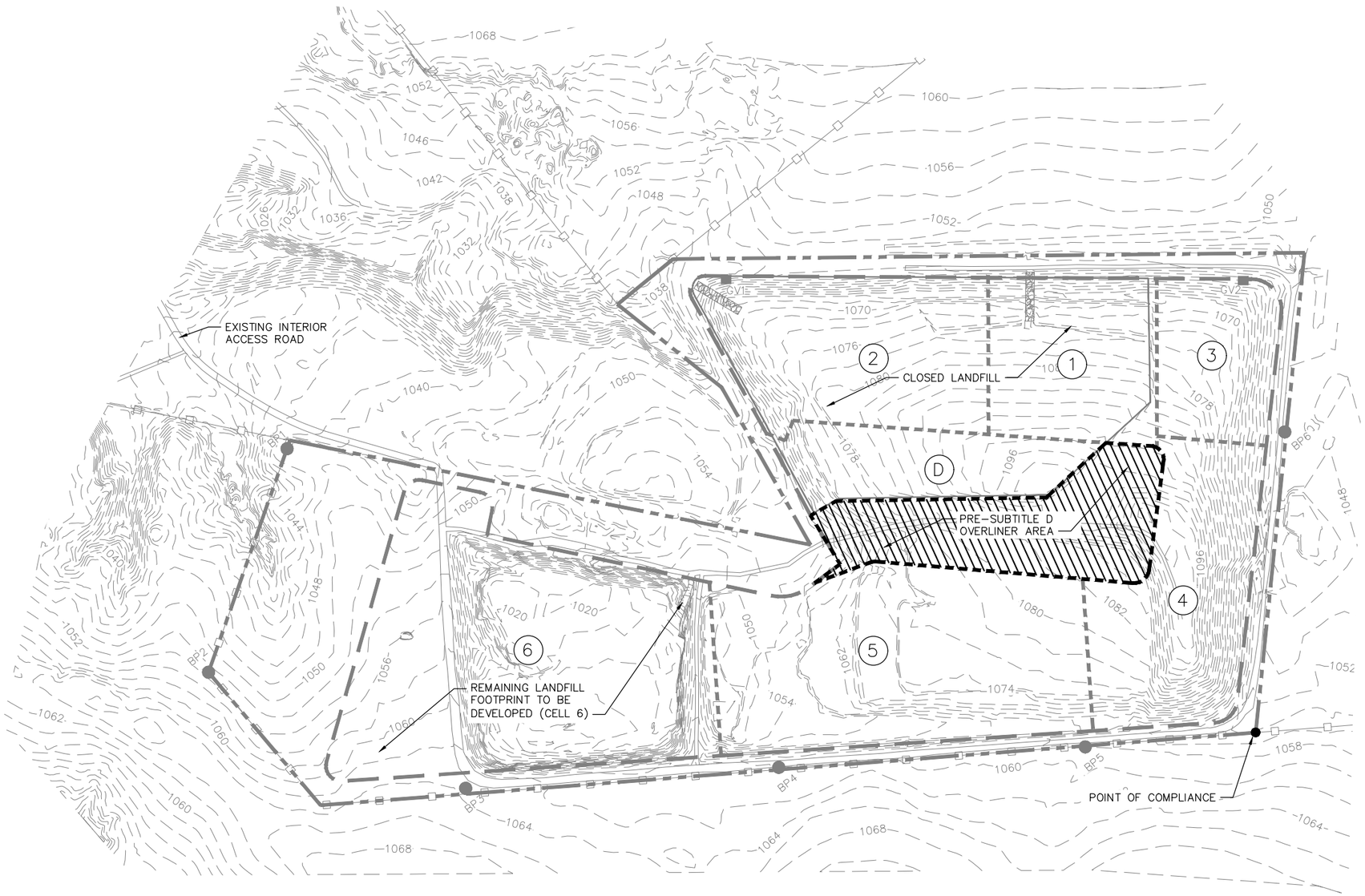
The MULTIMED model input parameters are detailed in Appendix IIIK-C. By assuming the leachate does not undergo adsorption, biodegradation, and decay, a single MULTIMED simulation accounts for all 24 constituents identified by the EPA as requiring landfill design protection criteria because the constituent concentration at the POC is independent of chemical-specific properties. The model result is expressed in terms of the DAF. Refer to Section 2.4 for DAF calculations. The POC for this demonstration is shown on Figure 7.1. The POC as defined by §330.3(108) is a vertical surface located no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down through the uppermost aquifer underlying the regulated units, and located on land owned by the owner of the facility. Based on the bedrock contours on the top of the Edwards hydrologic unit shown on Figure 4.1 in Appendix IIIN, the Edwards (Salmon Peak) elevation contour (940 ft-msl) was selected to represent the uppermost aquifer underlying the landfill. For this demonstration, the POC is located 80 feet (in the vertical direction) from the bottom of the lowest waste grade elevation which is 1020 ft-msl. The groundwater flow direction at the site is south-southwest. Therefore, the POC was selected to be down gradient of the existing limit of waste at the permit boundary.

8 RESULTS AND CONCLUSIONS

The results from the HELP model showed that the approved alternative liner containment design has the highest leachate percolation compared to the overliner. The highest percolation rate from the HELP model was used as an input in MULTIMED model in conjunction with the recharge rate to evaluate the performance of the approved alternate liner system design by estimating constituent concentrations at the POC. The constituent concentrations at the base of the landfill liner and at the POC were used to calculate the DAF. The approved alternate liner must provide a DAF of 260 at the point of compliance.

The results of the alternate liner design demonstration are provided below:

- POC distance = 100 ft was used in the model as shown in Figure 7.1.
- Allowable clay liner Permeability = 5.08×10^{-5} m/yr



0 200 400
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CELL BOUNDARY
- CLOSED CELL BOUNDARY
- EXISTING SITE FENCE
- 1050 EXISTING CONTOURS
- (1) CELL DESIGNATION
- BP1 GAS PROBE
- EXISTING CHUTE

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1,2,3,4 & D TOP UPDATED AUGUST 2018 AND CELLS 6 AND 6 UPDATED JANUARY 2020 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON-GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774-0796. DATED: 10-25-94.
3. CELLS 1, 2 AND A SECTION OF THE PRE-SUBTITLE D WERE APPROVED FOR CLOSURE 2013 BY TCEQ.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

NO.	REVISION	BY	DATE
1.	1ST NOD - NEW DRAWING	TM	05/2021
2.	2ND NOD	TM	10/2021

VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE
0 1"

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

SITE PLAN
POINT OF COMPLIANCE

Date: MAY 2021
Designed: T. METAERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
7.1

REFERENCES: DELR1900546_ECBASE.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_ECBASE_LF AREA COMPOSITE
Oct 21, 2021 - 10:19am C:\pwworking\cpy\pw_cpy\tmetaferia\d0854221\DELR1900546 Figure 7.1.dwg LAYOUT: Layout1 USER:

Table 8-1 – MULTIMED Results

Hydraulic Conductivity m/yr	DAF
56.7	260
100	408
300	1106
500	1805
700	2505

The hydraulic conductivity for the site ranges from 50 m/year to 700 m/year. Table 8-1 shows the calculated DAF using different hydraulic conductivity within the range set for the site. As shown in Table 8-1, 260 DAF is attainted using a hydraulic conductivity of 56.7 m/year. A hydraulic conductivity of less than 56.7 m/year results in a DAF less than 260, but it should be noted that the leachate quality at Del Rio Landfill, as shown in Table 3-2, is at or lower than the MCL values set in 330.331(a)(1). Therefore the DAF needed for the site leachate to attain the values set in 330.331a)(1) is 1. The predicted concentrations of the selected leachate chemical constituents do not exceed maximum contaminant levels in the perched groundwater zone at the point of compliance for either the approved alternate liner or the pre-Subtitle D overliner areas.

APPENDIX IIIK-C

MULTIMED MODEL

10/21/2021

4 AQUIFER-SPECIFIC DATA

Variable Name	Unit	Value	Comments
Particle diameter	cm	0.025	From Ref. 1, Table 6-10, p. 105, value from medium silt range.
Aquifer porosity	unitless	0.10	Obtained from the TETCO Geotechnical Report
Bulk density	g/cc	2.40	Obtained from the TETCO Geotechnical Report
Aquifer thickness	m	135	Obtained from the TETCO Geotechnical Report
Mixing zone depth	m		Derived by MULTIMED.
Hydraulic conductivity	m/yr	65	Obtained from the TETCO Geotechnical Report (50 to 700 m/yr)
Hydraulic gradient	unitless	0.0004	Obtained from the TETCO Geotechnical Report
Groundwater seepage velocity	m/yr		Derived by MULTIMED.
Retardation coefficient	unitless		Derived by MULTIMED.
Longitudinal dispersity	m		Derived by MULTIMED.
Transversal dispersity	m		Derived by MULTIMED.
Vertical dispersity	m		Derived by MULTIMED.
Organic carbon content	%	0	Conservative assumption.
Receptor well distance	m	30	Refer to Figure 7.1 for POC location

<u>References</u>

1. Sharp-Hansen, S., C. Travers, P. Hummel, and T. Allison, 1990. A Subtitle D Landfill Application Manual for The Multimedia Exposure Model (MULTIMED), U.S. Environmental Protection Agency, 470 p.

MULTIMED MODEL OUTPUT

```
1

                    U. S.   E N V I R O N M E N T A L   P R O T E C T I O N   A G E N C Y

                              E X P O S U R E   A S S E S S M E N T

                                M U L T I M E D I A   M O D E L

                            MULTIMED - (Version 2.00 Beta - October 1996)
1
 Run options
 --- -------



 DEFAULT


 DEL RIO LF VERTICAL EXPAN
 Chemical simulated is DEFAULT CHEMICAL


 Option Chosen                        Saturated and unsaturated zone models
 Run was                              DETERMIN
 Infiltration input by user
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points                240
 NMAT    - Number of different porous materials          1
 KPROP   - Van Genuchten or Brooks and Corey             1
 IMSHGN  - Spatial discretization option                 1
 NVFLAYR - Number of layers in flow model                1
```

```
 OPTIONS CHOSEN
 ------- ------
 Van Genuchten functional coefficients
 User defined coordinate system
1


 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS     MATERIAL PROPERTY
 ---------    ---------------     -----------------
     1                 24.00              1


                                                   DATA FOR MATERIAL  1
                                                   ---- --- --------
                                              VADOSE ZONE MATERIAL VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                    MEAN     STD DEV      MIN         MAX
           ------------------------------------------------------------------------------------------------------------------------
-
           Saturated hydraulic conductivity          cm/hr       CONSTANT        0.360E-03 -999.       0.100E-10  0.100E+05
           Unsaturated zone porosity                 --          CONSTANT        0.306     -999.       0.100E-08  0.990
           Air entry pressure head                   m           CONSTANT        0.000     -999.       0.000      -999.
           Depth of the unsaturated zone             m           CONSTANT         24.0     -999.       0.100E-08  -999.


                                                   DATA FOR MATERIAL  1
                                                   ---- --- --------
                                              VADOSE ZONE FUNCTION VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                    MEAN     STD DEV      MIN         MAX
```

```
          ------------------------------------------------------------------------------------------------------------------------
-
          Residual water content                    --          CONSTANT        0.700E-01 -999.       0.100E-08   1.00
          Brook and Corey exponent,EN               --          CONSTANT        0.000     -999.       0.000       10.0
          ALFA coefficient                         1/cm         CONSTANT        0.500E-02 -999.       0.000       1.00
          Van Genuchten exponent, ENN               --          CONSTANT         1.09     -999.        1.00       5.00
1

 UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

 Currently Not Used in Multimed  Version 2.0              1
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      1
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying continuous source
 Computer generated times for computing concentrations
1


                                                    DATA FOR MATERIAL  1
                                                    ---- --- --------
                                                    VADOSE TRANSPORT VARIABLES
```

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.00	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.88	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00

Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.508E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	135.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	50.0	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.400E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09

Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	28.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.4208E-02

```
1

                    U. S.   E N V I R O N M E N T A L   P R O T E C T I O N   A G E N C Y

                              E X P O S U R E   A S S E S S M E N T

                                M U L T I M E D I A   M O D E L

                            MULTIMED - (Version 2.00 Beta - October 1996)
1
 Run options
 --- -------



 DEFAULT


 DEL RIO LF VERTICAL EXPAN
 Chemical simulated is DEFAULT CHEMICAL


 Option Chosen                        Saturated and unsaturated zone models
 Run was                              DETERMIN
 Infiltration input by user
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points                240
 NMAT    - Number of different porous materials          1
 KPROP   - Van Genuchten or Brooks and Corey             1
 IMSHGN  - Spatial discretization option                 1
 NVFLAYR - Number of layers in flow model                1
```

```
 OPTIONS CHOSEN
 ------- ------
 Van Genuchten functional coefficients
 User defined coordinate system
1


 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS     MATERIAL PROPERTY
 ---------    ---------------     -----------------
     1                 24.00              1


                                                 DATA FOR MATERIAL  1
                                                 ---- --- --------
                                             VADOSE ZONE MATERIAL VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                   MEAN     STD DEV      MIN         MAX
           ------------------------------------------------------------------------------------------------------------------------
-
           Saturated hydraulic conductivity          cm/hr       CONSTANT        0.360E-03 -999.       0.100E-10  0.100E+05
           Unsaturated zone porosity                 --          CONSTANT        0.306     -999.       0.100E-08  0.990
           Air entry pressure head                   m           CONSTANT        0.000     -999.       0.000      -999.
           Depth of the unsaturated zone             m           CONSTANT         24.0     -999.       0.100E-08  -999.


                                                 DATA FOR MATERIAL  1
                                                 ---- --- --------
                                             VADOSE ZONE FUNCTION VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                   MEAN     STD DEV      MIN         MAX
```

```
          ------------------------------------------------------------------------------------------------------------------------
-
          Residual water content                    --          CONSTANT        0.700E-01 -999.       0.100E-08   1.00
          Brook and Corey exponent,EN               --          CONSTANT        0.000     -999.       0.000       10.0
          ALFA coefficient                         1/cm         CONSTANT        0.500E-02 -999.       0.000       1.00
          Van Genuchten exponent, ENN               --          CONSTANT         1.09     -999.        1.00       5.00
1

 UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

 Currently Not Used in Multimed  Version 2.0              1
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      1
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying continuous source
 Computer generated times for computing concentrations
1


                                                    DATA FOR MATERIAL  1
                                                    ---- --- --------
                                                    VADOSE TRANSPORT VARIABLES
```

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.00	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.88	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00

Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.508E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	135.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	56.7	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.400E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09

Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	28.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3844E-02

```
1

                    U. S.   E N V I R O N M E N T A L   P R O T E C T I O N   A G E N C Y

                                E X P O S U R E   A S S E S S M E N T

                                  M U L T I M E D I A   M O D E L

                              MULTIMED - (Version 2.00 Beta - October 1996)
1
 Run options
 --- -------



 DEFAULT


 DEL RIO LF VERTICAL EXPAN
 Chemical simulated is DEFAULT CHEMICAL


 Option Chosen                        Saturated and unsaturated zone models
 Run was                              DETERMIN
 Infiltration input by user
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points                240
 NMAT    - Number of different porous materials          1
 KPROP   - Van Genuchten or Brooks and Corey             1
 IMSHGN  - Spatial discretization option                 1
 NVFLAYR - Number of layers in flow model                1


 OPTIONS CHOSEN
```

```
 ------- ------
 Van Genuchten functional coefficients
 User defined coordinate system
1


 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS     MATERIAL PROPERTY
 ---------    ---------------     -----------------
     1                 24.00             1


                                                DATA FOR MATERIAL  1
                                                ---- --- --------
                                            VADOSE ZONE MATERIAL VARIABLES


           ---------------------------------------------------------------------------------------------------------------
-
                      VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                   MEAN     STD DEV      MIN         MAX
           ---------------------------------------------------------------------------------------------------------------
-
           Saturated hydraulic conductivity          cm/hr       CONSTANT        0.360E-03 -999.       0.100E-10  0.100E+05
           Unsaturated zone porosity                 --          CONSTANT        0.306     -999.       0.100E-08  0.990
           Air entry pressure head                   m           CONSTANT        0.000     -999.       0.000      -999.
           Depth of the unsaturated zone             m           CONSTANT         24.0     -999.       0.100E-08  -999.


                                                DATA FOR MATERIAL  1
                                                ---- --- --------
                                            VADOSE ZONE FUNCTION VARIABLES


           ---------------------------------------------------------------------------------------------------------------
-
                      VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                   MEAN     STD DEV      MIN         MAX
           ---------------------------------------------------------------------------------------------------------------
-
```

```
          Residual water content                    --          CONSTANT        0.700E-01 -999.       0.100E-08   1.00
          Brook and Corey exponent,EN               --          CONSTANT        0.000     -999.       0.000       10.0
          ALFA coefficient                         1/cm         CONSTANT        0.500E-02 -999.       0.000       1.00
          Van Genuchten exponent, ENN               --          CONSTANT         1.09     -999.        1.00       5.00
1

 UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

 Currently Not Used in Multimed  Version 2.0              1
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      1
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --             0.0
 WTFUN  - Weighting factor                --             1.2
 Used only for Numerical Model            --             0.0
 Used only for Numerical Model            --             0.0
 Used only for Numerical Model            --             0.0
 Used only for Numerical Model            --             0.0
 Used only for Numerical Model            --             0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying continuous source
 Computer generated times for computing concentrations
1


                                                        DATA FOR MATERIAL  1
                                                        ---- --- --------
                                                        VADOSE TRANSPORT VARIABLES
```

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.00	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.88	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00
Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.508E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	135.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	100.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.400E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.

Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	28.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.2446E-02

```
1

                    U. S.   E N V I R O N M E N T A L   P R O T E C T I O N   A G E N C Y

                                E X P O S U R E   A S S E S S M E N T

                                  M U L T I M E D I A   M O D E L

                              MULTIMED - (Version 2.00 Beta - October 1996)
1
 Run options
 --- -------



 DEFAULT


 DEL RIO LF VERTICAL EXPAN
 Chemical simulated is DEFAULT CHEMICAL


 Option Chosen                        Saturated and unsaturated zone models
 Run was                              DETERMIN
 Infiltration input by user
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points                240
 NMAT    - Number of different porous materials          1
 KPROP   - Van Genuchten or Brooks and Corey             1
 IMSHGN  - Spatial discretization option                 1
 NVFLAYR - Number of layers in flow model                1
```

```
 OPTIONS CHOSEN
 ------- ------
 Van Genuchten functional coefficients
 User defined coordinate system
1


 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS     MATERIAL PROPERTY
 ---------    ---------------     -----------------
     1                 24.00              1


                                                   DATA FOR MATERIAL  1
                                                   ---- --- --------
                                              VADOSE ZONE MATERIAL VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                    MEAN     STD DEV      MIN         MAX
           ------------------------------------------------------------------------------------------------------------------------
-
           Saturated hydraulic conductivity          cm/hr       CONSTANT        0.360E-03 -999.       0.100E-10  0.100E+05
           Unsaturated zone porosity                 --          CONSTANT        0.306     -999.       0.100E-08  0.990
           Air entry pressure head                   m           CONSTANT        0.000     -999.       0.000      -999.
           Depth of the unsaturated zone             m           CONSTANT         24.0     -999.       0.100E-08  -999.


                                                   DATA FOR MATERIAL  1
                                                   ---- --- --------
                                              VADOSE ZONE FUNCTION VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                    MEAN     STD DEV      MIN         MAX
```

```
          ------------------------------------------------------------------------------------------------------------------------
-
          Residual water content                    --          CONSTANT        0.700E-01 -999.       0.100E-08   1.00
          Brook and Corey exponent,EN               --          CONSTANT        0.000     -999.       0.000       10.0
          ALFA coefficient                         1/cm         CONSTANT        0.500E-02 -999.       0.000       1.00
          Van Genuchten exponent, ENN               --          CONSTANT         1.09     -999.        1.00       5.00
1

 UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

 Currently Not Used in Multimed  Version 2.0              1
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      1
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying continuous source
 Computer generated times for computing concentrations
1


                                                    DATA FOR MATERIAL  1
                                                    ---- --- --------
                                                    VADOSE TRANSPORT VARIABLES
```

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.00	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.88	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00

Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.508E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	135.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	300.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.400E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09

Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	28.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.9040E-03

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

```
1
 Run options
 --- -------



 DEFAULT


 DEL RIO LF VERTICAL EXPAN
 Chemical simulated is DEFAULT CHEMICAL


 Option Chosen                        Saturated and unsaturated zone models
 Run was                              DETERMIN
 Infiltration input by user
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points                240
 NMAT    - Number of different porous materials          1
 KPROP   - Van Genuchten or Brooks and Corey             1
 IMSHGN  - Spatial discretization option                 1
 NVFLAYR - Number of layers in flow model                1
```

```
 OPTIONS CHOSEN
 ------- ------
 Van Genuchten functional coefficients
 User defined coordinate system
1


 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS     MATERIAL PROPERTY
 ---------    ---------------     -----------------
     1                 24.00              1


                                                DATA FOR MATERIAL  1
                                                ---- --- --------
                                            VADOSE ZONE MATERIAL VARIABLES


           ---------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                   MEAN     STD DEV      MIN         MAX
           ---------------------------------------------------------------------------------------------------------------
-
           Saturated hydraulic conductivity          cm/hr       CONSTANT        0.360E-03 -999.       0.100E-10  0.100E+05
           Unsaturated zone porosity                 --          CONSTANT        0.306     -999.       0.100E-08  0.990
           Air entry pressure head                   m           CONSTANT        0.000     -999.       0.000      -999.
           Depth of the unsaturated zone             m           CONSTANT         24.0     -999.       0.100E-08  -999.


                                                DATA FOR MATERIAL  1
                                                ---- --- --------
                                            VADOSE ZONE FUNCTION VARIABLES


           ---------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                   MEAN     STD DEV      MIN         MAX
```

```
          ------------------------------------------------------------------------------------------------------------------------
-
          Residual water content                    --          CONSTANT        0.700E-01 -999.       0.100E-08   1.00
          Brook and Corey exponent,EN               --          CONSTANT        0.000     -999.       0.000       10.0
          ALFA coefficient                         1/cm         CONSTANT        0.500E-02 -999.       0.000       1.00
          Van Genuchten exponent, ENN               --          CONSTANT         1.09     -999.        1.00       5.00
1

 UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

 Currently Not Used in Multimed  Version 2.0              1
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      1
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying continuous source
 Computer generated times for computing concentrations
1


                                                    DATA FOR MATERIAL  1
                                                    ---- --- --------
                                                    VADOSE TRANSPORT VARIABLES
```

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.00	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.88	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00

Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.508E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	135.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	500.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.400E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09

Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	28.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.5538E-03

U. S. E N V I R O N M E N T A L P R O T E C T I O N A G E N C Y

E X P O S U R E A S S E S S M E N T

M U L T I M E D I A M O D E L

MULTIMED - (Version 2.00 Beta - October 1996)

```
1
 Run options
 --- -------



 DEFAULT


 DEL RIO LF VERTICAL EXPAN
 Chemical simulated is DEFAULT CHEMICAL


 Option Chosen                        Saturated and unsaturated zone models
 Run was                              DETERMIN
 Infiltration input by user
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points                240
 NMAT    - Number of different porous materials          1
 KPROP   - Van Genuchten or Brooks and Corey             1
 IMSHGN  - Spatial discretization option                 1
 NVFLAYR - Number of layers in flow model                1
```

```
 OPTIONS CHOSEN
 ------- ------
 Van Genuchten functional coefficients
 User defined coordinate system
1


 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS     MATERIAL PROPERTY
 ---------    ---------------     -----------------
     1                 24.00              1


                                                 DATA FOR MATERIAL  1
                                                 ---- --- --------
                                             VADOSE ZONE MATERIAL VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                    MEAN     STD DEV      MIN         MAX
           ------------------------------------------------------------------------------------------------------------------------
-
           Saturated hydraulic conductivity          cm/hr       CONSTANT        0.360E-03 -999.       0.100E-10  0.100E+05
           Unsaturated zone porosity                 --          CONSTANT        0.306     -999.       0.100E-08  0.990
           Air entry pressure head                   m           CONSTANT        0.000     -999.       0.000      -999.
           Depth of the unsaturated zone             m           CONSTANT         24.0     -999.       0.100E-08  -999.


                                                 DATA FOR MATERIAL  1
                                                 ---- --- --------
                                             VADOSE ZONE FUNCTION VARIABLES


           ------------------------------------------------------------------------------------------------------------------------
-
                       VARIABLE NAME                UNITS      DISTRIBUTION          PARAMETERS              LIMITS
                                                                                    MEAN     STD DEV      MIN         MAX
```

```
          ------------------------------------------------------------------------------------------------------------------------
-
          Residual water content                    --          CONSTANT        0.700E-01 -999.       0.100E-08   1.00
          Brook and Corey exponent,EN               --          CONSTANT        0.000     -999.       0.000       10.0
          ALFA coefficient                         1/cm         CONSTANT        0.500E-02 -999.       0.000       1.00
          Van Genuchten exponent, ENN               --          CONSTANT         1.09     -999.        1.00       5.00
1

 UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

 Currently Not Used in Multimed  Version 2.0              1
 NTSTPS - Number of time values concentration calc       20
 DUMMY  - Not presently used                              1
 ISOL   - Type of scheme used in unsaturated zone         1
 N      - Stehfest terms or number of increments         18
 NTEL   - Points in Lagrangian interpolation              3
 NGPTS  - Number of Gauss points                        104
 NIT    - Convolution integral segments                   2
 IBOUND - Type of boundary condition                      1
 ITSGEN - Time values generated or input                  1
 TMAX   - Max simulation time             --            0.0
 WTFUN  - Weighting factor                --            1.2
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0
 Used only for Numerical Model            --            0.0


 OPTIONS CHOSEN
 ------- ------
 Analytical unsaturated zone model
 Stehfest numerical inversion algorithm
 Nondecaying continuous source
 Computer generated times for computing concentrations
1


                                                  DATA FOR MATERIAL  1
                                                  ---- --- --------
                                                  VADOSE TRANSPORT VARIABLES
```

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Longitudinal dispersivity of material	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	1.00	-999.	0.000	100.
Bulk density of soil for material	g/cc	CONSTANT	1.88	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000
Parameter not used by the Analytical Model		CONSTANT	0.000	0.000	0.000	0.000

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Solid phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Dissolved phase decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Overall chemical decay coefficient	1/yr	CONSTANT	0.000	-999.	0.000	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000	-999.	0.000	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.000	-999.	0.000	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000	-999.	0.000	10.0
Reference temperature for air diffusion	C	CONSTANT	0.000	-999.	0.000	100.
Molecular weight	g/M	CONSTANT	0.000	-999.	0.000	-999.
Mole fraction of solute	--	CONSTANT	0.000	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000	-999.	0.000	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.000	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000	0.000	0.000	1.00

Soil/Air Boundary Layer Thickness	cm	CONSTANT	-999.	-999.	0.000	-999.
Not currently used		CONSTANT	-999.	-999.	0.000	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.508E-05	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.320E+06	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.282E-01	-999.	0.000	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000	-999.	0.000	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000	-999.
Length scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.250E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	2.40	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	135.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	700.	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.400E-03	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09

Longitudinal dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	28.0	-999.	0.000	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.300E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.0	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000	-999.	0.000	360.
Well vertical distance	m	CONSTANT	0.000	-999.	0.000	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3992E-03

APPENDIX IIIK-D

LEACHATE SAMPLING ANALYSIS

POLLUTION CONTROL SERVICES

Report of Sample Analysis

Client Information	Sample Information	Laboratory Information
Rene Maldonado **Del Rio, City of (Landfill)** **1897 Railway Ave** **Del Rio, TX 78840**	**Project Name:** Landfill Leachate Quarterly **Sample ID:** Leachate **Matrix:** Non-Potable Water **Date/Time Taken:** 9/1/2021 1049	**PCS Sample #:** 648011 **Page 1 of 2** **Date/Time Received:** 9/1/2021 10:56 **Report Date:** 9/21/2021 Approved by: Chuck Wallgren, President

Test Description	Result	Units	RL	Analysis Date/Time	Method	Analyst
Nitrate-N_IC	<0.2	mg/L	0.2	9/2/2021 12:17	EPA 300.0	JAS
Fluoride_IC	2.44	mg/L	0.20	9/2/2021 12:17	EPA 300.0	JAS
Arsenic/ICP (Total)	<0.010	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Barium/ICP (Total)	0.047	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Cadmium/ICP (Total)	<0.005	mg/L	0.005	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Lead/ICP (Total)	<0.005	mg/L	0.005	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Hexavalent Chrome	<0.003	mg/L	0.003	9/1/2021 16:30	SM 3500-Cr D	DJL
Silver/ICP (Total)	<0.010	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL

Quality Assurance Summary

Test Description	Precision	Limit	LCL	MS	MSD	UCL	LCS	LCS Limit
Nitrate-N_IC	<1	20	70	101	101	130	103	85 - 115
Fluoride_IC	<1	10	93	99	98	109	102	85 - 115
Arsenic/ICP (Total)	1	20	75	98	99	125	105	85 - 115
Barium/ICP (Total)	<1	20	75	87	87	125	105	85 - 115
Cadmium/ICP (Total)	<1	20	75	94	94	125	105	85 - 115
Lead/ICP (Total)	<1	20	75	84	84	125	105	85 - 115
Hexavalent Chrome	<1	20	75	92	92	125	102	85 - 115
Silver/ICP (Total)	<1	20	75	82	82	125	100	85 - 115

***Quality Statement:** All supporting quality data adhered to data quality objectives and test results meet the requirements of NELAC unless otherwise noted as flagged exceptions or in a case narrative attachment. Reports with full quality data deliverables are abailable on request.*

These analytical results relate only to the sample tested.
All data is reported on an 'As Is' basis unless designated as 'Dry Wt'.
RL = Reporting Limits

Web Site: www.pcslab.net
eMail: chuck@pcslab.net
Toll Free 800-880-4616
1532 Universal City Blvd, Suite 100
Universal City, TX 78148-3318
210-340-0343
FAX # 210-658-7903

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POLLUTION CONTROL SERVICES

Report of Sample Analysis

Client Information	Sample Information	Laboratory Information
Rene Maldonado **Del Rio, City of (Landfill)** **1897 Railway Ave** **Del Rio, TX 78840**	**Project Name:** Landfill Leachate Quarterly **Sample ID: Leachate** **Matrix: Non-Potable Water** **Date/Time Taken: 9/1/2021 1049**	**PCS Sample #: 648011** **Page 2 of 2** **Date/Time Received: 9/1/2021 10:56** **Report Date: 9/21/2021**

Test Description	Flag	Result	Units	RL	Analysis Date/Time	Method	Analyst
Selenium/ICP (Total)		<0.010	mg/L	0.010	9/7/2021 13:34	EPA 200.7 / 6010 B	DJL
Mercury/CVAA (Total)	R	<0.002	mg/L	0.002	9/13/2021 12:40	EPA 245.1	EMV
VOC 8260			See Attached			Pace Analytical - TN	
Pesticides 8081			See Attached			Pace Analytical - TN	
Benzene			See Attached			Pace Analytical - TN	
Herbicides 8151			See Attached			Pace Analytical - TN	

Quality Assurance Summary

Test Description	Precision	Limit	LCL	MS	MSD	UCL	LCS	LCS Limit
Selenium/ICP (Total)	1	20	75	97	98	125	110	85 - 115
Mercury/CVAA (Total)	<1	20	75	*40	*40	125	103	85 - 115
VOC 8260	See Attached Report for Quality Assurance Information							
Pesticides 8081	See Attached Report for Quality Assurance Information							
Benzene	See Attached Report for Quality Assurance Information							
Herbicides 8151	See Attached Report for Quality Assurance Information							

***Quality Statement:** All supporting quality data adhered to data quality objectives and test results meet the requirements of NELAC unless otherwise noted as flagged exceptions or in a case narrative attachment. Reports with full quality data deliverables are abailable on request.*

*Approved for release per QA Plan, Exception to Limits - QAM Section 13-4
R Spike recovery outside control limits due to matrix effect - LCS within limits

These analytical results relate only to the sample tested.
All data is reported on an 'As Is' basis unless designated as 'Dry Wt'.
RL = Reporting Limits

Web Site: www.pcslab.net Toll Free 800-880-4616 1532 Universal City Blvd, Suite 100 210-340-0343 FAX # 210-658-7903
eMail: chuck@pcslab.net Universal City, TX 78148-3318

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POLLUTION CONTROL SERVICES

1532 Universal City Blvd, Suite 100
Universal City, TX 78148-3318
Facsimilie 210.658.7903
210.340.0343

1057

CHAIN OF CUSTODY & SUBCONTRACT TRACKING SHEET

TO: Pace Analytical - TN
12065 Lebanon Rd

Mount Juliet, TN 37122

Relinquished by: Greg Felux
Date/Time: Sep 02, 2021 09:32
Received by:
Date/Time:

L1399307

PCS#	Date	Time	Analysis Requested	Pres	T. A. T.
648011	09/01/21	1049	VOC 8260, Herbicides 8151, Pesticides 8081	TCE	Std

Project: 648011

Sample Receipt Checklist

COC Seal Present/Intact: Y N
COC Signed/Accurate: Y N
Bottles arrive intact: Y N
Correct bottles used: Y N
Sufficient volume sent: Y N
RAD Screen <0.5 mR/hr: Y N

If Applicable
VOA Zero Headspace: Y N
Pres.Correct/Check: Y N

Unless otherwise requested, send results and invoice to:

5300 4290 9119

Chuck Wallgren
Pollution Control Services
1532 Universal City Blvd, Suite 100
Universal City, TX 78148-3318

Authorized by: Date: 09/02/2021

2.6 10-2.6
AGA

9/3/21 930

ANALYTICAL REPORT

September 15, 2021

Cp
Tc
Ss
Cn
Sr
Qc
Gl
Al
Sc

Pollution Control Services - TX

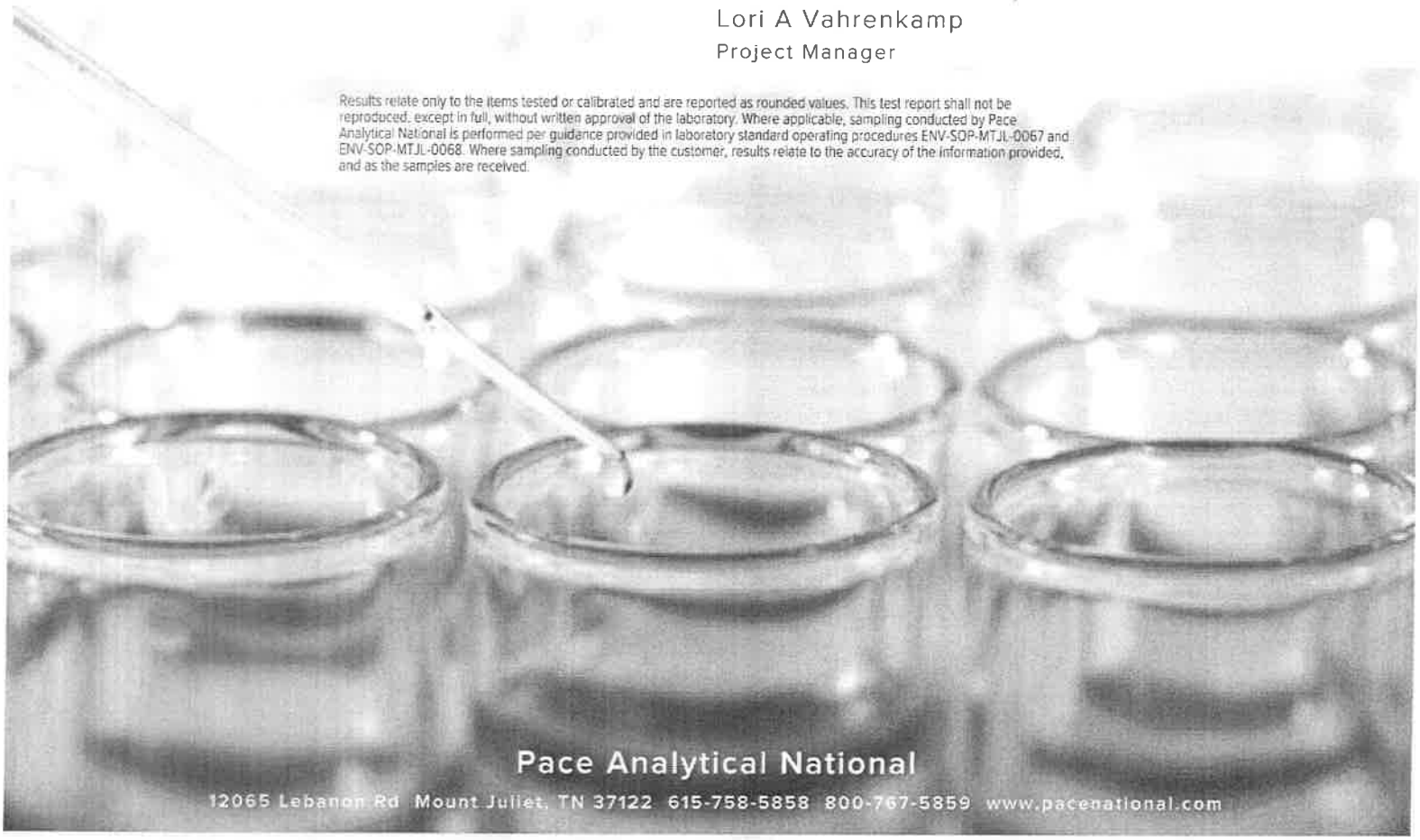
Sample Delivery Group:	L1399307
Samples Received:	09/03/2021
Project Number:	648011
Description:	

Report To: Chuck Wallgren
1532 Universal City Blvd
Universal City, TX 78148

Entire Report Reviewed By:

Lori A Vahrenkamp
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.



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SAMPLE SUMMARY

648011 L1399307-01 GW			Collected by	Collected date/time 09/01/21 10:49	Received date/time 09/03/21 09:30	
Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1735547	1	09/05/21 20:55	09/05/21 20:55	BMB	Mt. Juliet, TN
Chlorinated Acid Herbicides (GC) by Method 8151	WG1734817	1	09/06/21 07:52	09/08/21 04:08	AO	Mt. Juliet, TN
Pesticides (GC) by Method 8081	WG1735510	1	09/07/21 22:58	09/08/21 20:28	MTJ	Mt. Juliet, TN

IIIK-D-6

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

Lori A Vahrenkamp
Project Manager

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Acetone	<0.0500	J4	0.0500	1	09/05/2021 20:55	WG1735547
Acrolein	<0.0500		0.0500	1	09/05/2021 20:55	WG1735547
Acrylonitrile	<0.0100		0.0100	1	09/05/2021 20:55	WG1735547
Benzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromodichloromethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromoform	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Bromomethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
n-Butylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
sec-Butylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
tert-Butylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Carbon tetrachloride	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Chlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Chlorodibromomethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Chloroethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
2-Chloroethyl vinyl ether	<0.0500		0.0500	1	09/05/2021 20:55	WG1735547
Chloroform	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
Chloromethane	<0.00250		0.00250	1	09/05/2021 20:55	WG1735547
2-Chlorotoluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
4-Chlorotoluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dibromo-3-Chloropropane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
1,2-Dibromoethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Dibromomethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,3-Dichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,4-Dichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Dichlorodifluoromethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
1,1-Dichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1-Dichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
cis-1,2-Dichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
trans-1,2-Dichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2-Dichloropropane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1-Dichloropropene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,3-Dichloropropane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
cis-1,3-Dichloropropene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
trans-1,3-Dichloropropene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
2,2-Dichloropropane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Di-isopropyl ether	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Ethylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Hexachloro-1,3-butadiene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Isopropylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
p-Isopropyltoluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
2-Butanone (MEK)	<0.0100		0.0100	1	09/05/2021 20:55	WG1735547
Methylene Chloride	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
4-Methyl-2-pentanone (MIBK)	<0.0100		0.0100	1	09/05/2021 20:55	WG1735547
Methyl tert-butyl ether	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Naphthalene	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
n-Propylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Styrene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1,1,2-Tetrachloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1,2,2-Tetrachloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Tetrachloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Toluene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2,3-Trichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,2,4-Trichlorobenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
1,1,1-Trichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,1,2-Trichloroethane	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Trichloroethene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Trichlorofluoromethane	<0.00500		0.00500	1	09/05/2021 20:55	WG1735547
1,2,3-Trichloropropane	<0.00250		0.00250	1	09/05/2021 20:55	WG1735547
1,2,4-Trimethylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
1,3,5-Trimethylbenzene	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Vinyl chloride	<0.00100		0.00100	1	09/05/2021 20:55	WG1735547
Xylenes, Total	<0.00300		0.00300	1	09/05/2021 20:55	WG1735547
(S) Toluene-d8	*103*		*80.0-120*		*09/05/2021 20:55*	WG1735547
(S) 4-Bromofluorobenzene	*105*		*77.0-126*		*09/05/2021 20:55*	WG1735547
(S) 1,2-Dichloroethane-d4	*87.8*		*70.0-130*		*09/05/2021 20:55*	WG1735547

Chlorinated Acid Herbicides (GC) by Method 8151

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
2,4-D	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dalapon	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
2,4-DB	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dicamba	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dichloroprop	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
Dinoseb	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
MCPA	<0.100	J4	0.100	1	09/08/2021 04:08	WG1734817
MCPP	<0.100	J4	0.100	1	09/08/2021 04:08	WG1734817
2,4,5-T	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
2,4,5-TP (Silvex)	<0.00200		0.00200	1	09/08/2021 04:08	WG1734817
(S) 2,4-Dichlorophenyl Acetic Acid	*59.5*		*14.0-158*		*09/08/2021 04:08*	WG1734817

Pesticides (GC) by Method 8081

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Aldrin	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Alpha BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Beta BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Delta BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Gamma BHC	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Chlordane	<0.00500		0.00500	1	09/08/2021 20:28	WG1735510
4,4-DDD	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
4,4-DDE	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
4,4-DDT	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Dieldrin	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endosulfan I	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endosulfan II	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endosulfan sulfate	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endrin	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endrin aldehyde	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Endrin ketone	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Hexachlorobenzene	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Heptachlor	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Heptachlor epoxide	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Methoxychlor	<0.0000500		0.0000500	1	09/08/2021 20:28	WG1735510
Toxaphene	<0.000500		0.000500	1	09/08/2021 20:28	WG1735510
(S) Decachlorobiphenyl	*89.3*		*10.0-128*		*09/08/2021 20:28*	WG1735510
(S) Tetrachloro-m-xylene	*95.8*		*10.0-127*		*09/08/2021 20:28*	WG1735510

QUALITY CONTROL SUMMARY

L1399307-01

Method Blank (MB)

(MB) R3701364-2 09/05/21 14:09

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Acetone	<0.0113		0.0113	0.0500
Acrolein	<0.00254		0.00254	0.0500
Acrylonitrile	<0.000671		0.000671	0.0100
Benzene	<0.0000941		0.0000941	0.00100
Bromobenzene	<0.000118		0.000118	0.00100
Bromodichloromethane	<0.000136		0.000136	0.00100
Bromoform	<0.000129		0.000129	0.00100
Bromomethane	<0.000605		0.000605	0.00500
n-Butylbenzene	<0.000157		0.000157	0.00100
sec-Butylbenzene	<0.000125		0.000125	0.00100
tert-Butylbenzene	<0.000127		0.000127	0.00100
Carbon tetrachloride	<0.000128		0.000128	0.00100
Chlorobenzene	<0.000116		0.000116	0.00100
Chlorodibromomethane	<0.000140		0.000140	0.00100
Chloroethane	<0.000192		0.000192	0.00500
2-Chloroethyl vinyl ether	<0.000575		0.000575	0.0500
Chloroform	<0.000111		0.000111	0.00500
Chloromethane	<0.000960		0.000960	0.00250
2-Chlorotoluene	<0.000106		0.000106	0.00100
4-Chlorotoluene	<0.000114		0.000114	0.00100
1,2-Dibromo-3-Chloropropane	<0.000276		0.000276	0.00500
1,2-Dibromoethane	<0.000126		0.000126	0.00100
Dibromomethane	<0.000122		0.000122	0.00100
1,2-Dichlorobenzene	<0.000107		0.000107	0.00100
1,3-Dichlorobenzene	<0.000110		0.000110	0.00100
1,4-Dichlorobenzene	<0.000120		0.000120	0.00100
Dichlorodifluoromethane	<0.000374		0.000374	0.00500
1,1-Dichloroethane	<0.000100		0.000100	0.00100
1,2-Dichloroethane	<0.0000819		0.0000819	0.00100
1,1-Dichloroethene	<0.000188		0.000188	0.00100
cis-1,2-Dichloroethene	<0.000126		0.000126	0.00100
trans-1,2-Dichloroethene	<0.000149		0.000149	0.00100
1,2-Dichloropropane	<0.000149		0.000149	0.00100
1,1-Dichloropropene	<0.000142		0.000142	0.00100
1,3-Dichloropropane	<0.000110		0.000110	0.00100
cis-1,3-Dichloropropene	<0.000111		0.000111	0.00100
trans-1,3-Dichloropropene	<0.000118		0.000118	0.00100
2,2-Dichloropropane	<0.000161		0.000161	0.00100
Di-isopropyl ether	<0.000105		0.000105	0.00100
Ethylbenzene	<0.000137		0.000137	0.00100

QUALITY CONTROL SUMMARY

L1399307-01

Method Blank (MD)

(MB) R3701364-2 09/05/21 14:09

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Hexachloro-1,3-butadiene	<0.000337		0.000337	0.00100
Isopropylbenzene	<0.000105		0.000105	0.00100
p-Isopropyltoluene	<0.000120		0.000120	0.00100
2-Butanone (MEK)	<0.00119		0.00119	0.0100
Methylene Chloride	<0.000430		0.000430	0.00500
4-Methyl-2-pentanone (MIBK)	<0.000478		0.000478	0.0100
Methyl tert-butyl ether	<0.000101		0.000101	0.00100
Naphthalene	<0.00100		0.00100	0.00500
n-Propylbenzene	<0.0000993		0.0000993	0.00100
Styrene	<0.000118		0.000118	0.00100
1,1,1,2-Tetrachloroethane	<0.000147		0.000147	0.00100
1,1,2,2-Tetrachloroethane	<0.000133		0.000133	0.00100
Tetrachloroethene	<0.000300		0.000300	0.00100
Toluene	<0.000278		0.000278	0.00100
1,2,3-Trichlorobenzene	<0.000230		0.000230	0.00100
1,2,4-Trichlorobenzene	<0.000481		0.000481	0.00100
1,1,1-Trichloroethane	<0.000149		0.000149	0.00100
1,1,2-Trichloroethane	<0.000158		0.000158	0.00100
Trichloroethene	<0.000190		0.000190	0.00100
Trichlorofluoromethane	<0.000160		0.000160	0.00500
1,2,3-Trichloropropane	<0.000237		0.000237	0.00250
1,2,4-Trimethylbenzene	<0.000322		0.000322	0.00100
1,3,5-Trimethylbenzene	<0.000104		0.000104	0.00100
Vinyl chloride	<0.000234		0.000234	0.00100
Xylenes, Total	<0.000174		0.000174	0.00300
(S) Toluene-d8	*102*			*80.0-120*
(S) 4-Bromofluorobenzene	*102*			*77.0-126*
(S) 1,2-Dichloroethane-d4	*90.4*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3701364-1 09/05/21 13:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acetone	0.0250	0.0460	184	19.0-160	J4
Acrolein	0.0250	0.0293	117	10.0-160	
Acrylonitrile	0.0250	0.0312	125	55.0-149	
Benzene	0.00500	0.00471	94.2	70.0-123	
Bromobenzene	0.00500	0.00513	103	73.0-121	

QUALITY CONTROL SUMMARY

L1399307-01

Laboratory Control Sample (LCS)

(LCS) R3701364-1 09/05/21 13:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec %	Rec. Limits %	LCS Qualifier
Bromodichloromethane	0.00500	0.00434	86.8	75.0-120	
Bromoform	0.00500	0.00512	102	68.0-132	
Bromomethane	0.00500	0.00461	92.2	10.0-160	
n-Butylbenzene	0.00500	0.00465	93.0	73.0-125	
sec-Butylbenzene	0.00500	0.00485	97.0	75.0-125	
tert-Butylbenzene	0.00500	0.00540	108	76.0-124	
Carbon tetrachloride	0.00500	0.00435	87.0	68.0-126	
Chlorobenzene	0.00500	0.00530	106	80.0-121	
Chlorodibromomethane	0.00500	0.00492	98.4	77.0-125	
Chloroethane	0.00500	0.00439	87.8	47.0-150	
2-Chloroethyl vinyl ether	0.0250	0.0277	111	51.0-160	
Chloroform	0.00500	0.00439	87.8	73.0-120	
Chloromethane	0.00500	0.00442	88.4	41.0-142	
2-Chlorotoluene	0.00500	0.00518	104	76.0-123	
4-Chlorotoluene	0.00500	0.00512	102	75.0-122	
1,2-Dibromo-3-Chloropropane	0.00500	0.00614	123	58.0-134	
1,2-Dibromoethane	0.00500	0.00494	98.8	80.0-122	
Dibromomethane	0.00500	0.00534	107	80.0-120	
1,2-Dichlorobenzene	0.00500	0.00537	107	79.0-121	
1,3-Dichlorobenzene	0.00500	0.00556	111	79.0-120	
1,4-Dichlorobenzene	0.00500	0.00502	100	79.0-120	
Dichlorodifluoromethane	0.00500	0.00421	84.2	51.0-149	
1,1-Dichloroethane	0.00500	0.00456	91.2	70.0-126	
1,2-Dichloroethane	0.00500	0.00504	101	70.0-128	
1,1-Dichloroethene	0.00500	0.00473	94.6	71.0-124	
cis-1,2-Dichloroethene	0.00500	0.00446	89.2	73.0-120	
trans-1,2-Dichloroethene	0.00500	0.00455	91.0	73.0-120	
1,2-Dichloropropane	0.00500	0.00480	96.0	77.0-125	
1,1-Dichloropropene	0.00500	0.00452	90.4	74.0-126	
1,3-Dichloropropane	0.00500	0.00535	107	80.0-120	
cis-1,3-Dichloropropene	0.00500	0.00475	95.0	80.0-123	
trans-1,3-Dichloropropene	0.00500	0.00511	102	78.0-124	
2,2-Dichloropropane	0.00500	0.00366	73.2	58.0-130	
Di-isopropyl ether	0.00500	0.00460	92.0	58.0-138	
Ethylbenzene	0.00500	0.00469	93.8	79.0-123	
Hexachloro-1,3-butadiene	0.00500	0.00419	83.8	54.0-138	
Isopropylbenzene	0.00500	0.00508	102	76.0-127	
p-Isopropyltoluene	0.00500	0.00466	93.2	76.0-125	
2-Butanone (MEK)	0.0250	0.0327	131	44.0-160	
Methylene Chloride	0.00500	0.00481	96.2	67.0-120	

QUALITY CONTROL SUMMARY

L1399307-01

Laboratory Control Sample (LCS)

(LCS) R3701364-1 09/05/21 13:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Methyl-2-pentanone (MIBK)	0.0250	0.0274	110	68.0-142	
Methyl tert-butyl ether	0.00500	0.00484	96.8	68.0-125	
Naphthalene	0.00500	0.00643	129	54.0-135	
n-Propylbenzene	0.00500	0.00496	99.2	77.0-124	
Styrene	0.00500	0.00530	106	73.0-130	
1,1,1,2-Tetrachloroethane	0.00500	0.00465	93.0	75.0-125	
1,1,2,2-Tetrachloroethane	0.00500	0.00504	101	65.0-130	
Tetrachloroethene	0.00500	0.00494	98.8	72.0-132	
Toluene	0.00500	0.00501	100	79.0-120	
1,2,3-Trichlorobenzene	0.00500	0.00498	99.6	50.0-138	
1,2,4-Trichlorobenzene	0.00500	0.00466	93.2	57.0-137	
1,1,1-Trichloroethane	0.00500	0.00417	83.4	73.0-124	
1,1,2-Trichloroethane	0.00500	0.00517	103	80.0-120	
Trichloroethene	0.00500	0.00512	102	78.0-124	
Trichlorofluoromethane	0.00500	0.00420	84.0	59.0-147	
1,2,3-Trichloropropane	0.00500	0.00525	105	73.0-130	
1,2,4-Trimethylbenzene	0.00500	0.00492	98.4	76.0-121	
1,3,5-Trimethylbenzene	0.00500	0.00468	93.6	76.0-122	
Vinyl chloride	0.00500	0.00440	88.0	67.0-131	
Xylenes, Total	0.0150	0.0161	107	79.0-123	
(S) Toluene-d8			*103*	*80.0-120*	
(S) 4-Bromofluorobenzene			*106*	*77.0-126*	
(S) 1,2-Dichloroethane-d4			*89.8*	*70.0-130*	

QUALITY CONTROL SUMMARY

L1399307-01

Method Blank (MB)

(MB) R3702851-1 09/07/21 16:48

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
2,4-D	<0.000547		0.000547	0.00200
Dalapon	<0.000344		0.000344	0.00200
2,4-DB	<0.000302		0.000302	0.00200
Dicamba	<0.000245		0.000245	0.00200
Dichloroprop	<0.00104		0.00104	0.00200
Dinoseb	<0.000250		0.000250	0.00200
MCPA	<0.0131		0.0131	0.100
MCPP	<0.0660		0.0660	0.100
2,4,5-T	<0.000258		0.000258	0.00200
2,4,5-TP (Silvex)	<0.000335		0.000335	0.00200
(S) 2,4-Dichlorophenyl Acetic Acid	*67.0*			*14.0-158*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3702851-2 09/07/21 17:18 • (LCSD) R3702851-3 09/07/21 17:33

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
2,4-D	0.00500	0.00424	0.00406	84.8	81.2	50.0-120			4.34	20
Dalapon	0.00500	0.00382	0.00362	76.4	72.4	32.0-120			5.38	20
2,4-DB	0.00500	0.00485	0.00473	97.0	94.6	53.0-140			2.51	20
Dicamba	0.00500	0.00427	0.00411	85.4	82.2	51.0-120			3.82	20
Dichloroprop	0.00500	0.00436	0.00423	87.2	84.6	55.0-127			3.03	20
Dinoseb	0.00500	0.00421	0.00399	84.2	79.8	36.0-134			5.37	20
MCPA	0.0500	0.637	0.647	1270	1290	10.0-160	E J4	E J4	1.56	40
MCPP	0.0500	0.561	0.479	1120	958	10.0-160	E J4	E J4	15.8	23
2,4,5-T	0.00500	0.00435	0.00414	87.0	82.8	54.0-120			4.95	20
2,4,5-TP (Silvex)	0.00500	0.00380	0.00431	76.0	86.2	50.0-125			12.6	20
(S) 2,4-Dichlorophenyl Acetic Acid				*86.4*	*80.2*	*14.0-158*				

QUALITY CONTROL SUMMARY

L1399307-01

Method Blank (MB)

(MB) R3702502-1 09/08/21 19:35

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Aldrin	<0.0000198		0.0000198	0.0000500
Alpha BHC	<0.0000172		0.0000172	0.0000500
Beta BHC	<0.0000208		0.0000208	0.0000500
Delta BHC	<0.0000150		0.0000150	0.0000500
Gamma BHC	<0.0000209		0.0000209	0.0000500
4,4-DDD	<0.0000177		0.0000177	0.0000500
4,4-DDE	<0.0000154		0.0000154	0.0000500
4,4-DDT	<0.0000198		0.0000198	0.0000500
Dieldrin	<0.0000162		0.0000162	0.0000500
Endosulfan I	<0.0000160		0.0000160	0.0000500
Endosulfan II	<0.0000164		0.0000164	0.0000500
Endosulfan sulfate	<0.0000217		0.0000217	0.0000500
Endrin	<0.0000161		0.0000161	0.0000500
Endrin aldehyde	<0.0000237		0.0000237	0.0000500
Endrin ketone	<0.0000219		0.0000219	0.0000500
Heptachlor	<0.0000148		0.0000148	0.0000500
Heptachlor epoxide	<0.0000183		0.0000183	0.0000500
Hexachlorobenzene	<0.0000176		0.0000176	0.0000500
Methoxychlor	<0.0000193		0.0000193	0.0000500
Chlordane	<0.0000198		0.0000198	0.00500
Toxaphene	<0.000168		0.000168	0.000500
(S) Decachlorobiphenyl	*87.3*			*10.0-128*
(S) Tetrachloro-m-xylene	*107*			*10.0-127*

Laboratory Control Sample (LCS)

(LCS) R3702502-2 09/08/21 19:44

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aldrin	0.00100	0.00108	108	22.0-124	
Alpha BHC	0.00100	0.00119	119	54.0-130	
Beta BHC	0.00100	0.00119	119	53.0-136	
Delta BHC	0.00100	0.00119	119	54.0-133	
Gamma BHC	0.00100	0.00114	114	55.0-129	
4,4-DDD	0.00100	0.00103	103	56.0-140	
4,4-DDE	0.00100	0.00108	108	52.0-128	
4,4-DDT	0.00100	0.00111	111	50.0-141	
Dieldrin	0.00100	0.00121	121	59.0-133	
Endosulfan I	0.00100	0.00120	120	57.0-131	

QUALITY CONTROL SUMMARY

L1399307-01

Laboratory Control Sample (LCS)

(LCS) R3702502-2 09/08/21 19:44

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Endosulfan II	0.00100	0.00123	123	58.0-133	
Endosulfan sulfate	0.00100	0.00124	124	58.0-133	
Endrin	0.00100	0.000964	96.4	57.0-134	
Endrin aldehyde	0.00100	0.00109	109	53.0-129	
Endrin ketone	0.00100	0.00127	127	60.0-145	
Heptachlor	0.00100	0.00113	113	27.0-132	
Heptachlor epoxide	0.00100	0.00121	121	57.0-130	
Hexachlorobenzene	0.00100	0.00112	112	30.0-114	
Methoxychlor	0.00100	0.00128	128	54.0-155	
(S) Decachlorobiphenyl			*52.4*	*10.0-128*	
(S) Tetrachloro-m-xylene			*105*	*10.0-127*	

L1399309-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1399309-01 09/10/21 14:25 • (MS) R3703262-1 09/10/21 14:35 • (MSD) R3703262-2 09/10/21 14:44

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Aldrin	0.00100	<0.000500	0.000638	0.000696	63.8	69.6	10	10.0-141	P	P	8.70	40
Alpha BHC	0.00100	<0.000500	0.000714	0.000769	71.4	76.9	10	10.0-145	P		7.42	40
Beta BHC	0.00100	<0.000500	0.000844	0.000851	84.4	85.1	10	14.0-146	P	P	0.826	35
Delta BHC	0.00100	<0.000500	0.000949	0.000986	94.9	98.6	10	17.0-143			3.82	38
Gamma BHC	0.00100	<0.000500	<0.000500	<0.000500	45.3	46.0	10	14.0-141			1.53	40
4,4-DDD	0.00100	<0.000500	0.000550	0.000564	55.0	56.4	10	10.0-160			2.51	38
4,4-DDE	0.00100	<0.000500	<0.000500	<0.000500	0.000	0.000	10	10.0-159	J6	J6	0.000	35
4,4-DDT	0.00100	<0.000500	0.000951	0.000761	95.1	76.1	10	10.0-160		P	22.2	38
Dieldrin	0.00100	<0.000500	0.000635	0.000683	63.5	68.3	10	10.0-158			7.28	38
Endosulfan I	0.00100	<0.000500	0.00116	0.00129	116	129	10	10.0-153	P		10.6	36
Endosulfan II	0.00100	<0.000500	0.000524	0.000533	52.4	53.3	10	10.0-159	P	P	1.70	39
Endosulfan sulfate	0.00100	<0.000500	0.000521	0.000608	52.1	60.8	10	23.0-147	P	P	15.4	35
Endrin	0.00100	<0.000500	0.000736	0.000793	73.6	79.3	10	10.0-160	P		7.46	39
Endrin aldehyde	0.00100	<0.000500	<0.000500	<0.000500	0.000	0.000	10	10.0-148	J6	J6	0.000	38
Endrin ketone	0.00100	<0.000500	0.000522	0.000556	52.2	55.6	10	10.0-160	P		6.31	40
Heptachlor	0.00100	<0.000500	0.000883	0.000928	88.3	92.8	10	16.0-136			4.97	40
Heptachlor epoxide	0.00100	<0.000500	0.000821	0.000914	82.1	91.4	10	10.0-160	P		10.7	36
Hexachlorobenzene	0.00100	<0.000500	0.000785	0.000818	78.5	81.8	10	10.0-130	P	P	4.12	40
Methoxychlor	0.00100	<0.000500	0.000945	0.000593	94.5	59.3	10	10.0-160	P	J3 P	45.8	34
(S) Decachlorobiphenyl					*89.3*	*90.1*		*10.0-128*				
(S) Tetrachloro-m-xylene					*98.2*	*118*		*10.0-127*				

QUALITY CONTROL SUMMARY

L1399307-01

L1399309-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1399309-01 09/10/21 14:25 • (MS) R3703262-1 09/10/21 14:35 • (MSD) R3703262-2 09/10/21 14:44

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %

Sample Narrative:

OS: IS/SURR failed on lower dilution.

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
P	RPD between the primary and confirmatory analysis exceeded 40%.

ACCREDITATIONS & LOCATIONS

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1 6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.

Cp Tc 3 Ss 4 Cn 5 Sr 6 Qc 7 Gl 8 Al 9 Sc

POLLUTION CONTROL SERVICES

Chain of Custody Number: 648011

MULTIPLE SAMPLE ANALYSIS REQUEST AND CHAIN OF CUSTODY FORM

Stamp 1st sample and COC as same number

CUSTOMER INFORMATION

Name: Del Rio, City of (Landfill)

REPORT INFORMATION

Attention:

Phone:

Fax: (000) 000-0000

SAMPLE INFORMATION

Project Information:

Landfill Leachate Quality Testing

Report "Soils" ☐ As Is ☐ Dry Wt.

Collected By:

Requested Analysis

Client / Field Sample ID	Collected Date	Collected Time	Field Chlorine Residual mg/L	Composite or Grab	Matrix (DW-Drinking Water; NPW-Non-potable water; WW-Wastewater; LW-Liquid Waste)	Container Type	Container Number	Preservative	Metals(with Hex Cr)	NO3, F	VOC 8260	8081	8151				Instructions/Comments: PCS Sample Number
Leachate	Start: 9-1-21 End: 9-1-21	Start: 10:45 End: 10:49		☐C ☒G	☐ DW ☒ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☒P ☒G ☐O	8	☐ H_2SO_4 ☒ HNO_3 ☐ H_3PO_4 ☐ NaOH ☒ ICE ☐	★	★	★	★	★				648011 ☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:
	Start: End:	Start: End:		☐C ☐G	☐ DW ☐ NPW ☐ WW ☐ Soil ☐ Sludge ☐ LW ☐ Other	☐P ☐G ☐O		☐ H_2SO_4 ☐ HNO_3 ☐ H_3PO_4 ☐ NaOH ☐ ICE ☐									☐S ☐B ☐N ☐HEM Other:

Required Turnaround: ☐ Routine (6-10 days) | ***EXPEDITE:*** (See Surcharge Schedule) ☐ < 8 Hrs. ☐ < 16 Hrs. ☐ < 24 Hrs. ☐ 5 days ☐ Other: _____ ***Rush Charges Authorized by:***

Sample Archive/Disposal: ☐ Laboratory Standard ☐ Hold for client pick up | **Container Type:** P = Plastic, G = Glass, O = Other | Carrier ID:

Relinquished By:	[signature]	Date: 9-1-21	Time: 10:56 AM	Received By:	[signature]	Date: 9-1-21	Time: 2:47 pm
Relinquished By:	[signature]	Date: 9-1-21	Time: 10:56 AM	Received By:	[signature]	Date: 9/1/21	Time: 1056

Rev. Multiple Sample COC 20180628

1532 Universal City Blvd., Ste. 100, Universal City, Texas 78148
P (210) 340-0343 or (800) 880-4616 - F (210) 658-7903

Login at www.pcslab.net

Pollution Control Services
Sample Log-In Checklist

PCS Sample No(s) 648011 **COC No.** 648011

Client/Company Name: Rel Rio **Checklist Completed by:** [illegible]

Sample Delivery to Lab Via:
Client Drop Off ✓ Commercial Carrier: Bus ____ UPS ____ Lone Star ____ FedEx ____ USPS ____
PCS Field Services: Collection/Pick Up____ Other:____

Sample Kit/Coolers
Sample Kit/Cooler? Yes____ No ✓ Sample Kit/Cooler: Intact? Yes ✓ No___
Custody Seals on Sample Kit/Cooler: Not Present ✓ If Present, Intact ___ Broken ___
Sample Containers Intact; Unbroken and Not Leaking? Yes ✓ No ___
Custody Seals on Sample Bottles: Not Present ✓ If Present, Intact ___ Broken ___
COC Present with Shipment or Delivery or Completed at Drop Off? Yes ✓ No ___
Has COC sample date/time and other pertinent information been provided by client/sampler? Yes: ✓ No: ___
Has COC been properly Signed when Received/Relinquished? Yes ✓ No ___
Does COC agree with Sample Bottle Information, Bottle Types, Preservation, etc.? Yes ✓ No ___
All Samples Received before Hold Time Expiration? Yes ✓ No ___
Sufficient Sample Volumes for Analysis Requested? Yes ✓ No ___
Zero Headspace in VOA Vial if Present? Yes ___ No ✓

Sample Preservation:
* ***Cooling:*** **Not Required** _____ or **Required** ✓
If cooling required, record temperature of submitted samples Observed/Corrected 4 / 2 °C
Is Ice Present in Sample Kit/Cooler? ____ Yes ____ No Samples received same day as collected? ✓ Yes ____ No
Lab Thermometer Make and Serial Number: Vaughan 1807009583 Other: ____

Acid Preserved Sample - If present, is pH <2? **Yes** ____ **No** ____** ____H_2SO_4 ____HNO_3 ____H_3PO_4
Base Preserved Sample - If present, is pH >12? Yes ____ No ____ ____NaOH
Other Preservation:____ If Present, Meets Requirements? Yes____ No____
Sample Preservations Checked by:____ Date ____ Time ____
pH paper used to check sample preservation (PCS log #): ____ (HEM pH checked at analysis).
Samples Preserved/Adjusted by Lab:

Lab #	Parameters Preserved	Preservative Used	Log #

Adjusted by Tech/Analyst:____ Date :____Time:____

Client Notification/ Documentation for "No" Responses Above/ Discrepancies/ RevisionComments
Person Notified: ____ Contacted by:____
Notified Date: ____Time: ____
Method of Contact: At Drop Off:____ Phone ___ Left Voice Mail ____ E-Mail ____ Fax ____
Unable to Contact____ Authorized Laboratory to Proceed :____(Lab Director)
Regarding / Comments:____

Actions taken to correct problems/discrepancies:____

Receiving qualifier needed (*requires client notification above*) Temp. ___ Holding Time ___ Initails: ____
Receiving qualifier entered into LIMS at login Initial/Date: ____
Revision Comments: ____

** Samples submitted for Metals Analysis (except Hex Cr) or Drinking Water for Coliform Bacteria Only are not required to be iced. Samples collected prior day to receipt at the laboratory must meet method specific thermal cooling requirements, "or will be flagged accordingly". Samples delivered the same day as collected may not meet thermal criteria, but shall be considered acceptable if evidence that the chilling process has begun, such as arrival on ice (EPA 815-F-08-006, June 2008). ** Water samples for metals analysis that are not acid preserved prior to shipment may be acceptably preserved by the laboratory on receipt – however, the sample digestion procedure must be delayed for at least 24 hours after preservation by the laboratory.*

CITY OF DEL RIO LANDFILL

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

MAJOR PERMIT AMENDMENT APPLICATION
PART III — SITE DEVELOPMENT PLAN

APPENDIX IIIN
NO MIGRATION DEMONSTRATION

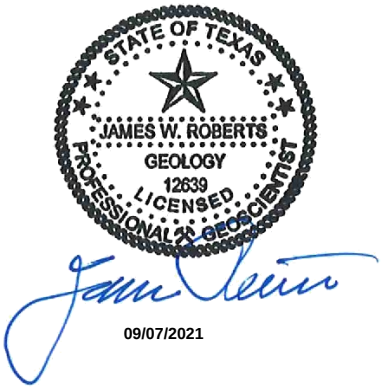
Prepared for

City of Del Rio

October 2021

Prepared by

CP&Y Inc
TPBE Registration No. F-1741
1820 Regal Row, Suite 200
Dallas, TX 75235
214-638-0500



This document is intended for permitting purposes only.

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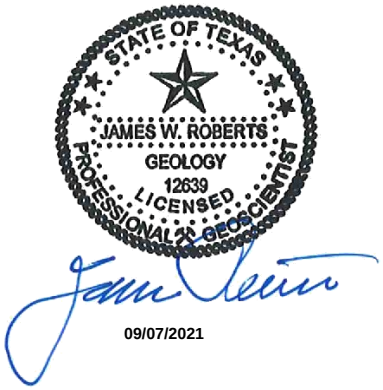

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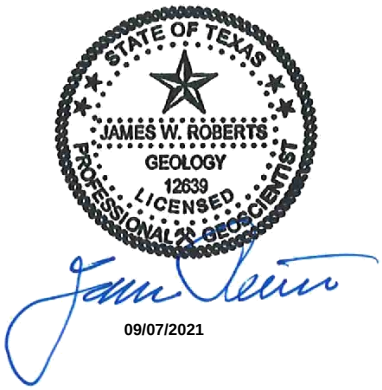


1 INTRODUCTION

The Del Rio Landfill expansion includes a vertical expansion over a portion of the pre-Subtitle D area as well as the Subtitle D area of the landfill. The purpose of this appendix is to comply with §330.401(d) by demonstrating that there is no potential for migration of hazardous constituents from the solid waste management unit to the uppermost aquifer as defined in §330.3 of this title during the active life and the closure and post-closure care period of the unit. This is achieved by demonstrating that the time that leachate reaches the uppermost aquifer will exceed the site life of the landfill including the post-closure period. The uppermost aquifer as defined by Title 30 TAC §330.3 is the geologic formation nearest the natural ground surface that is an aquifer; includes lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

2 CONTAINMENT SYSTEM

The following subsections describe the proposed and approved existing containment system (liner) at the City of Del Rio Landfill. The details of the liner system below are illustrated in Appendix IIIA-A figures.

2.1 Pre-Subtitle D Area Liner

The pre-Subtitle D area is located in the middle of the of the landfill as shown in the Figure 2.1 and is 12.3 acres. Consistent with MSW regulations at that time, the pre-Subtitle D liner was constructed with a 36-inch-thick compacted clay liner with a coefficient of permeability less than 1.0×10^{-7} cm/s and 24 inches of protective cover.

2.2 Subtitle D Alternative Liner

Cells 1 – 6 are Subtitle D areas. In December 1994, the site was approved for an alternative liner. The alternative liner consists of 24 inches of compacted clay, overlain by a geocomposite leachate collection layer and 24 inches of protected cover. The TCEQ approval for the alternative liner is included in Appendix IIID-A. Cells 1 through 5 have been constructed with the alternative liner.

2.3 Overliner

The overliner will be constructed over the portion of the pre-Subtitle D area. The overliner system will be comprised of a reinforced geosynthetic clay liner (GCL) and a 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on both sides). This will be overlain by a geocomposite leachate collection layer and 24 inches of protective cover. The overliner plan is included in Appendix IIIA-A.

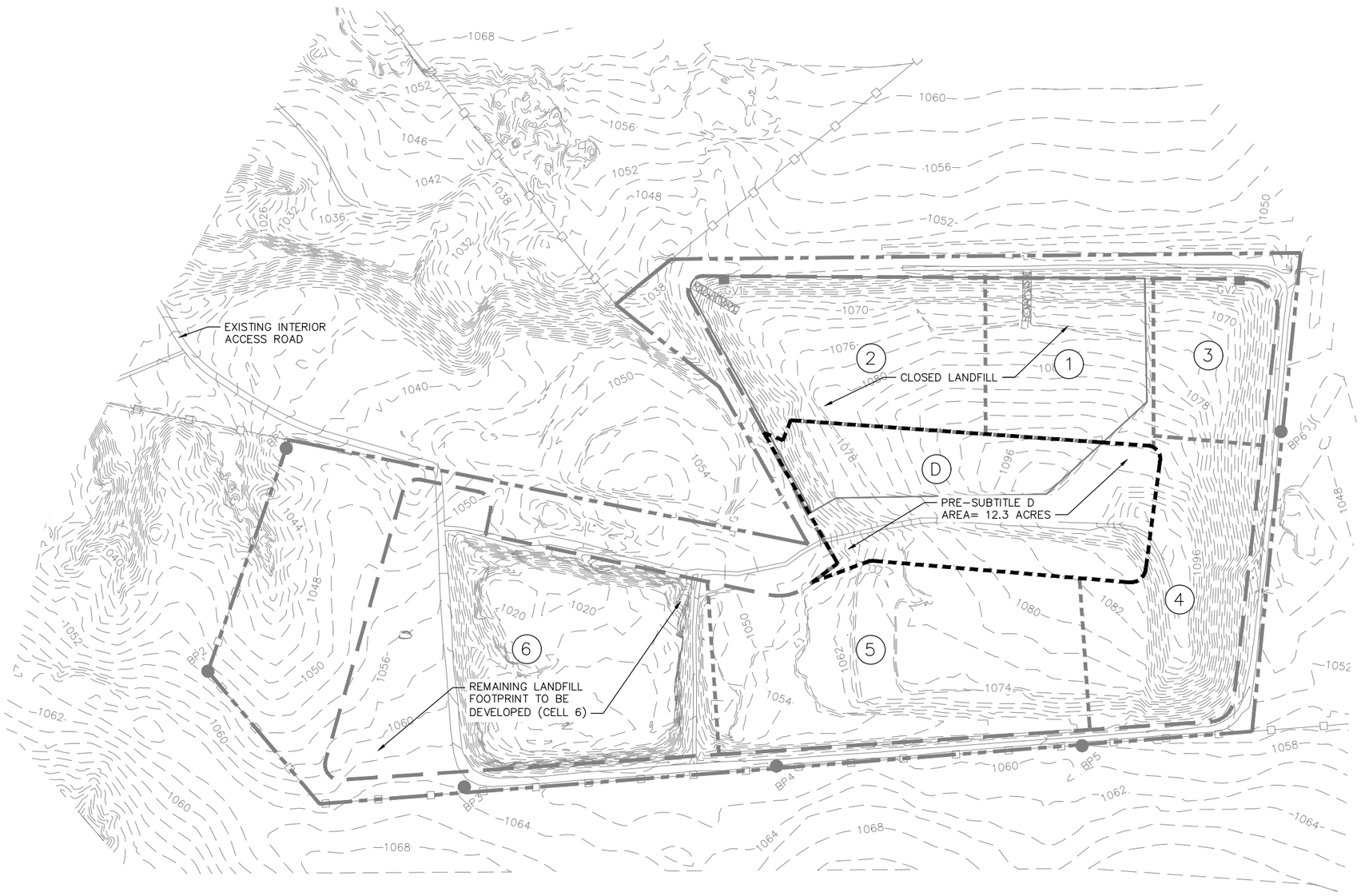
3 SITE GEOLOGY

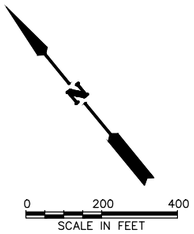
Multiple site investigations have been conducted across the Del Rio Landfill facility since 1986 to characterize subsurface conditions at the site, with the most recent work being performed within the extension area located at the west end of the current landfill permit boundary.

3.1 Landfill Stratigraphy

Based on observations made from boreholes drilled across the landfill since 1986, landfill stratigraphy has been subdivided into three “soil zones” or “stratums” identified from shallowest to deepest as Stratum 1, Stratum 2, and Stratum 3. The relationship of each of these intervals (site specific stratigraphy) to the geology of southeastern Val Verde County is shown in Table 3-1.

- **Stratum I – Uvalde Gravel:** Consists of 1.5 - 4.5 feet of silty clay, sand & gravel. The layer is a "topsoil" zone with residual soils sometimes consisting of erosional remnants of Buda limestone. This layer looks to be equivalent to the Uvalde Gravel which is described as consisting of caliche-cemented gravels with occasional boulders. Gravels and cobbles are comprised of a mix of chert, quartz, limestone, and igneous rock fragments.
- **Stratum II – Uvalde Gravel/Del Rio Clay:** Consists of 2.0 feet to 11.0 feet of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cemented material, primarily calcium carbonate intermixed with the soil or as thin hard interbedded layers. This stratum or zone is not present everywhere across the landfill. Gravels can include remnants of Buda limestone as well as fragments of chert, quartz, and igneous rock fragments. In some areas the lower part of this zone includes uppermost portions of the Del Rio Clay.
- **Stratum III – Del Rio Clay:** This zone underlies Stratum I and Stratum II and consists mostly of clay and weathered shale, grading into un-weathered shale, containing some limestones/siltstone seams, caliche, and gypsum. One deep boring drilled in 1986 by Raba-Kistner Consultants and identified as deep boring B-3 penetrated a total of 135 feet of Del Rio Clay at the east end of the landfill.
- **Salmon Peak Limestone:** Deep boring B-3, drilled by Raba-Kistner in November 1986, penetrated 27 feet of the Salmon Peak limestone. No groundwater was encountered at the time the boring was drilled but moisture was noted, indicating the top of the saturated layer was below the total depth of the borehole. The location of the deep Raba-Kistner borehole is shown on Figure 3.2.





LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- CELL BOUNDARY
- CLOSED CELL BOUNDARY
- EXISTING SITE FENCE
- 1050 EXISTING CONTOURS
- (1) CELL DESIGNATION
- BP1 GAS PROBE
- EXISTING CHUTE

NOTES:

1. THIS MAP WAS DEVELOPED BY DALLAS AERIAL SERVICES, INC. BASED ON PHOTOGRAPHS TAKEN APRIL 13, 1994, AND ON SURVEYS MADE BY TIERRA SURVEYING SERVICES ON MAY 12, 2003. CELLS 1,2,3,4 & D TOP UPDATED AUGUST 2018 AND CELLS 6 AND 6 UPDATED JANUARY 2020 BY BAIN MEDINA BAIN SURVEYORS. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP STANDARDS. THE ELEVATIONS SHOWN ON THIS MAP ARE FOR THE CONTRACTORS GENERAL INFORMATION, ACTUAL ELEVATIONS VARY DUE TO ON-GOING LANDFILL ACTIVITIES.
2. PERMIT BOUNDARY INFORMATION BASED ON BOUNDARY SURVEY DATA PROVIDED BY TIERRA SURVEYING SERVICES, 400 AVENUE 2, DEL RIO, TEXAS (830) 774-0796. DATED: 10-25-94.
3. CELLS 1, 2 AND A SECTION OF THE PRE-SUBTITLE D WERE APPROVED FOR CLOSURE 2013 BY TCEQ.

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TBPE REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

STATE OF TEXAS
TEMOBISTA METAFERIA
123183
LICENSED
PROFESSIONAL ENGINEER
10/21/2021

NO.	REVISION	BY	DATE
1.	3RD NOD - NEW DRAWING	TM	10/2021

VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE
0 1"

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

SITE PLAN

Date: MAY 2021
Designed: T. METAERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
2.1

REFERENCES: DELR1900546_EOBASE.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS.dwg DELR1900546_EOBASE_LF AREA COMPOSITE C:\pwworking\cpy\pw_cpy\tmetaferia\d0870496\DELR1900546 Figure 2.1.dwg LAYOUT: Layout1 USER:

Table 3-1 Stratigraphic Chart

ERA	SYSTEM	GROUP	FORMATION Maverick Basin & Rio Grande Embayment	HYDROLOGIC UNIT	LANDFILL LITHOLOGY	COMMENTS
Cenozoic	Quaternary		Alluvium		Not Present	
	Tertiary		Uvalde Gravel		Stratum I	Stratum I consists of 1.5 - 4.5 feet of silty clay, sand & gravel. The layer is a "topsoil" zone with residual soils sometimes consisting of erosional remnants of Buda LS.
					Stratum II	Stratum II predominantly consists of 2.0 feet to 11.0 feet of caliche and clay soils with some gravel content. Clay is the predominant constituent. The caliche is a cementitious material, primarily calcium carbonate, and is intermixed with the soil or as thin hard interbedded layers. Not present everywhere across the landfill. This interval can include remnants of Buda LS and includes upper portions of the Del Rio Clay. The Buda is not present across most of the landfill but is present along and near the southern boundary.
Mesozoic	Cretaceous	Washita Group	Buda Limestone	Confining Bed		
			Del Rio Clay	Confining Bed	Stratum III	Stratum III consists mostly of clay and weathered shale, grading into un-weathered shale, containing some limestones/siltstone seams, caliche, and gypsum. This layer can consist of upper, middle and deeper portions of the Del Rio Clay across the landfill.
			Georgetown	Edwards Hydrologic Unit	Not recognized or otherwise noted in landfill	Penetrated 27 feet of Salmon Peak. Deep boring B-3 drilled 11/6/1986 by Raba-Kistner Consultants, Inc. Total depth 162 feet (Elevation 883 msl).
			Salmon Peak Fm		Salmon Peak	
		Fredricksburg Group	McKnight Fm		Not Penetrated in the Landfill	
			West Nueces Fm			
		Trinity Group	Glen Rose Fm	Trinity		

Source:

1. Source: Condon, S.M., and Dyman, T.S., 2006, Chapter 2: 2003 Geologic Assessment of Undiscovered Conventional Oil and Gas Resources in the Upper Cretaceous Navarro and Taylor Groups, Western Gulf Province, Texas, in Symposium and Geologic Assessment of Undiscovered Oil and Gas, Navarro and Taylor Groups, Western Gulf Province, Texas ISBN: 1411309987.
2. Geologic and hydrogeologic units of Val Verde County, Texas: adapted from Overview of Groundwater Conditions in Val Verde County, Texas, prepared by the Texas Water Development Board with cooperation of the Texas Commission on Environmental Quality and Texas Parks and Wildlife Department, December 2018.

Figure 3.1 illustrates a cross section prepared by Raba-Kistner and presented in the 1994 TETCO geotechnical report also shows local geology underlying the landfill. The precise location of the cross section transect has not been shown in geotechnical reports.

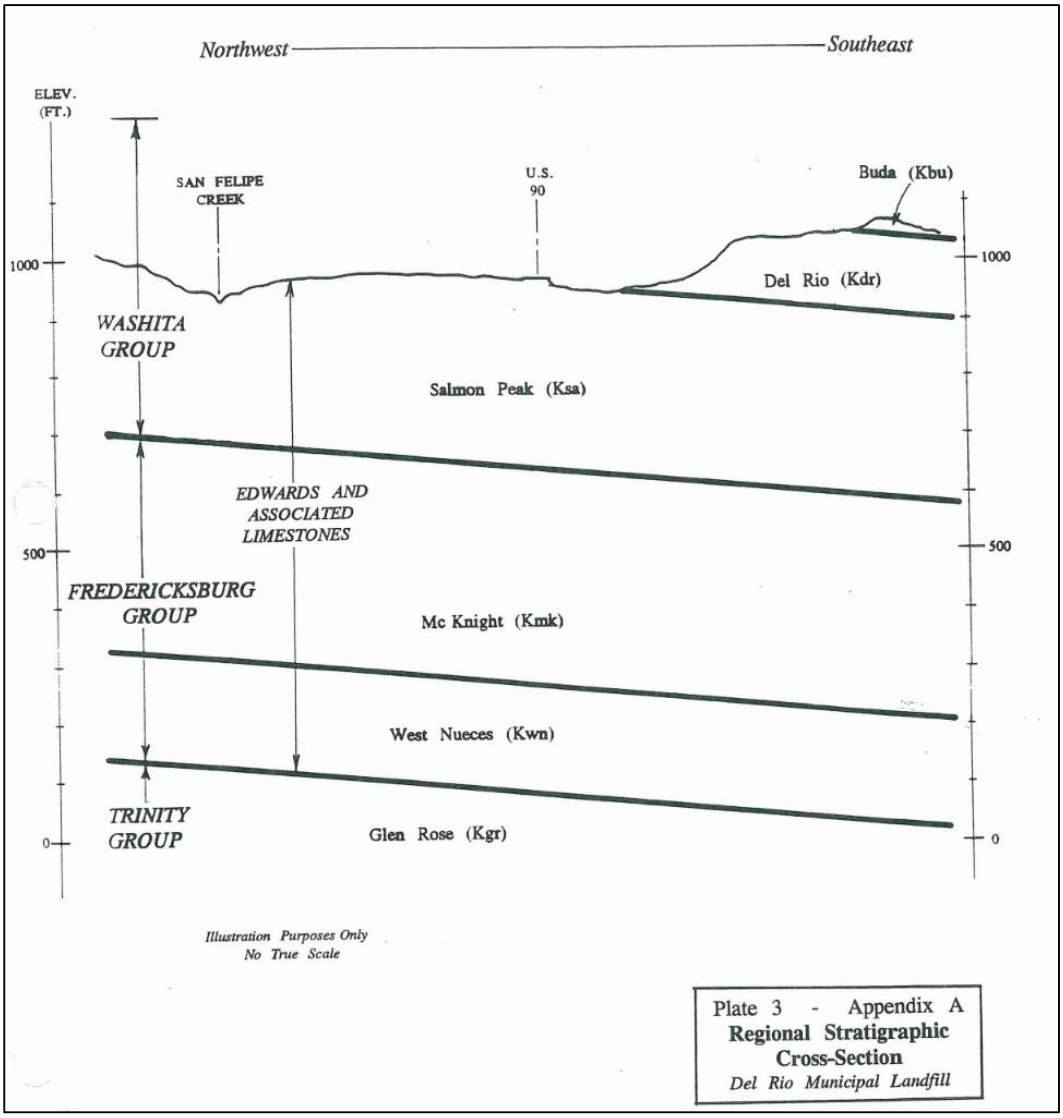


Figure 3.1: Landfill Cross Section (1994 TETCO)

4 HYDROGEOLOGY AND GROUNDWATER CHARACTERISTICS

4.1 Regional Aquifers

Figure 4.1 is a topographic map developed to show the location of wells located within 1.0 mile of the landfill, the transect of Geologic Cross Section A – A', the up-dip limits of the Buda Limestone and elevation contours on the top of the Edwards Limestone (undifferentiated). Elevation contours show the direction of dip and direction of groundwater flow in the Edwards is to the south.

Three borings (B-3, B-13, and B-16) drilled by Arias at the northwest end of the landfill in 2020 encountered the Buda limestone. The trace of the Buda is shown to aid in visualizing the geologic relationships referenced in the literature and geotechnical reports, as well as to show the source of Buda rock fragments noted in the Uvalde Gravel.

Figure 4.2 shows Cross Section A – A' as a north to south cross section prepared to illustrate how geology of the landfill ties into the local geology of southeastern Val Verde County, Texas. The cross section transect is roughly parallel to geologic dip of the Edwards Limestone (undifferentiated) and includes wells located within 1.0 mile of the landfill. Comments made on driller's logs are shown adjacent to wells. Cross Section A – A' shows the south-dipping Del Rio Clay (Del Rio confining unit) ranges from 58 feet in total thickness about 1.0 mile north of the land fill to 135 feet below the landfill. Underlying the Del Rio is the Edwards Hydrologic Unit (Edwards Aquifer), which is the first perennial aquifer underlying the landfill.

The Edwards Aquifer, shown as the Edwards Hydrologic Unit on Cross Section A – A' (Figure 4.2), is the first perennial aquifer underlying the landfill and is the principal source of fresh groundwater to wells in the Del Rio area. The Del Rio Clay, or Del Rio Confining Unit overlies the Edwards and acts as a barrier to precipitation and the vertical movement of water. Recharge to the Edwards aquifer occurs where the Edwards is exposed at the surface and precipitation enters the aquifer through dissolution channels, fracture networks, faulting and/or karst features.

In 1986 Raba-Kistner Consultants reported the uppermost transmissive unit of the Edwards Hydrologic unit as the Salmon Peak formation. Lithology descriptions provided by Raba-Kistner indicated the upper part of the Salmon Peak is granular with abundant fossil fragments and cross-bedded. The lower portion is described as consisting of low permeability mudstone with abundant masses of chert.

Elevation contours over the Edwards aquifer shown on Figure 4.1, indicate the formation dips about 61 feet/mile (0.011 ft/ft) to the south. This is consistent with the estimated gradient of 55 feet/mile discussed on pages 1 and 2 of the Supplemental Geotechnical Information report prepared by TETCO in November 1994 (see pages IIIJ-C-78 and IIIJ-C-79 of Appendix J). In the supplemental report, TETCO provided estimated elevations at the top of the Salmon Peak limestone (Edwards Hydrologic Unit) that were computed at the locations of the landfill sumps, identified as A, B, C, D, and E in the following Table 4.1. The locations A, B, C, and D and associated elevations on the top of the Salmon Peak limestone are also shown on Figure 4.1.

Table 4-1 – Del Rio Clay Thickness and Salmon Peak Aquifer Elevations

Point No.	Ground Elev (ft-msl)	Bottom of Waste Elev (ft-msl)	Top Salmon Peak Elev (ft-msl)	Total Thickness (ft)	Thickness Below Bottom of Waste (ft)
A	1,048	1,021	931	117	90
B	1,049	1,021	924	125	97
C	1,051	1,021	913	138	108
D	1,058	1,021	917	141	104
E	1,060	1,021	927	133	94
Averages				**130.8**	**98.6**

Underlying the Edwards Hydrologic Unit is the Trinity Aquifer system. Regionally, hydraulic communication between the Edwards and the Trinity aquifers is variable and complex. Consequently, the Edwards and Trinity Aquifers are recognized by the Texas Water Development Board as a single hydrologic unit referred to as the Edwards-Trinity (Plateau) Aquifer. None of the wells located within 1.0 mile of the landfill were drilled deep enough to have penetrated the Edwards-Trinity.

4.2 Site Hydrogeology

4.2.1 1986 and 1994 Groundwater Investigation

In accordance with rule §330.63(e)(4)(B) if no aquifers exist within 50 feet of the elevation of the deepest excavation, at least one test hole shall be drilled to the top of the first perennial aquifer beneath the site, if sufficient data does not exist to accurately locate it. The §330.63(e)(4)(B) allows the executive director to accept data equivalent to a deep boring on the site to determine information for aquifers more than 50 feet below the site. The uppermost (perennial) aquifer was penetrated in deep boring B-3 drilled in November 1986 as part of the Raba-Kistner geotechnical investigation for the site. Deep boring B-3, shown on Figure 4.2, was drilled to a total depth of 162 feet which penetrated the upper 27 feet of the Salmon Peak limestone, the recognized upper transmissive unit of the Edwards Hydrologic Unit. The top of the Salmon Peak was penetrated in deep boring B-3 at 135 feet below grade (subsurface elevation 910 feet) but did not encounter groundwater at the time the hole was drilled. The reason groundwater was not encountered at the time is because the boring was simply not drilled deep enough to have penetrated the saturated portion of the aquifer. The estimated top of the saturated part of the Salmon Peak is shown on Cross Section A – A' (Figure 4.2) as a black dashed line shown just below the top of the Edwards Hydrologic Unit. Placement and gradient of the dashed line on Cross Section A – A' is shown based on the reported depths of the "first perforation" on the following two driller's logs which are both shown on Figures 4.1 and 4.2 above:

- Domestic Water Well No. YR-70-42-101 drilled in 1965, total depth 134 ft. The first perforation noted on the driller's log of this well is at a depth of 80 feet (elevation of 945 feet below the surface).

- Domestic Water Well No. YR-70-42-103 (owner J. Leach), drilled in 1969, total depth 200 ft. The first perforation noted on the driller's log of this well is at a depth of 100 feet (elevation 975 feet below the surface).

Also shown on Cross Section A – A' (Figure 4.2) is a blue dashed line that is shown parallel to the top of the saturated layer line (black dashed line) to indicate the location of the static water level (SWL) in the aquifer. The level shown is based on a 1970 reported static water level in a domestic well located north of the landfill and identified as Domestic Water Well YR-70-42-101 which is also shown on Figures 4.1 and 4.2. While the static water level has undoubtedly changed since 1970, the line is shown to indicate the relative position of the static water level to the top of the saturated layer. The gradient of the SWL is shown to be the same as the gradient of the top of the saturated layer which is roughly parallel to the top of the Edwards Hydrologic Unit. The location of the SWL will fluctuate up and down in response to changes in groundwater storage in the aquifer.

In the November 1994 Supplemental Geotechnical Information prepared by Trinity Engineering Testing Corporation (report included in Appendix IIIJ-C), calculations were made to estimate the top elevations of the Salmon Peak and the thickness of the Del Rio Clay at five locations within the landfill site. The calculated average thickness of the Del Rio Clay based on the five locations is 130.8 ft (refer to Table 4-1). Based on the soil characterization of the Del Rio clay and the dry climate in the region, the geotechnical report concluded that there is no groundwater at the site in the weathered-unweathered Del Rio Clay transition.

4.2.2 Groundwater Investigation 2020

Arias Geoprofessionals , Inc. (Arias) installed seventeen (17) boring logs of which ten (10) were converted to piezometers in November 2020 on a 75-ac tract of land located adjacent to the landfill. The location of the piezometers is shown in Figure 4.3. During installation, water was encountered at three of the 10 piezometer locations as follows:

- B-1
- B-15
- B-13

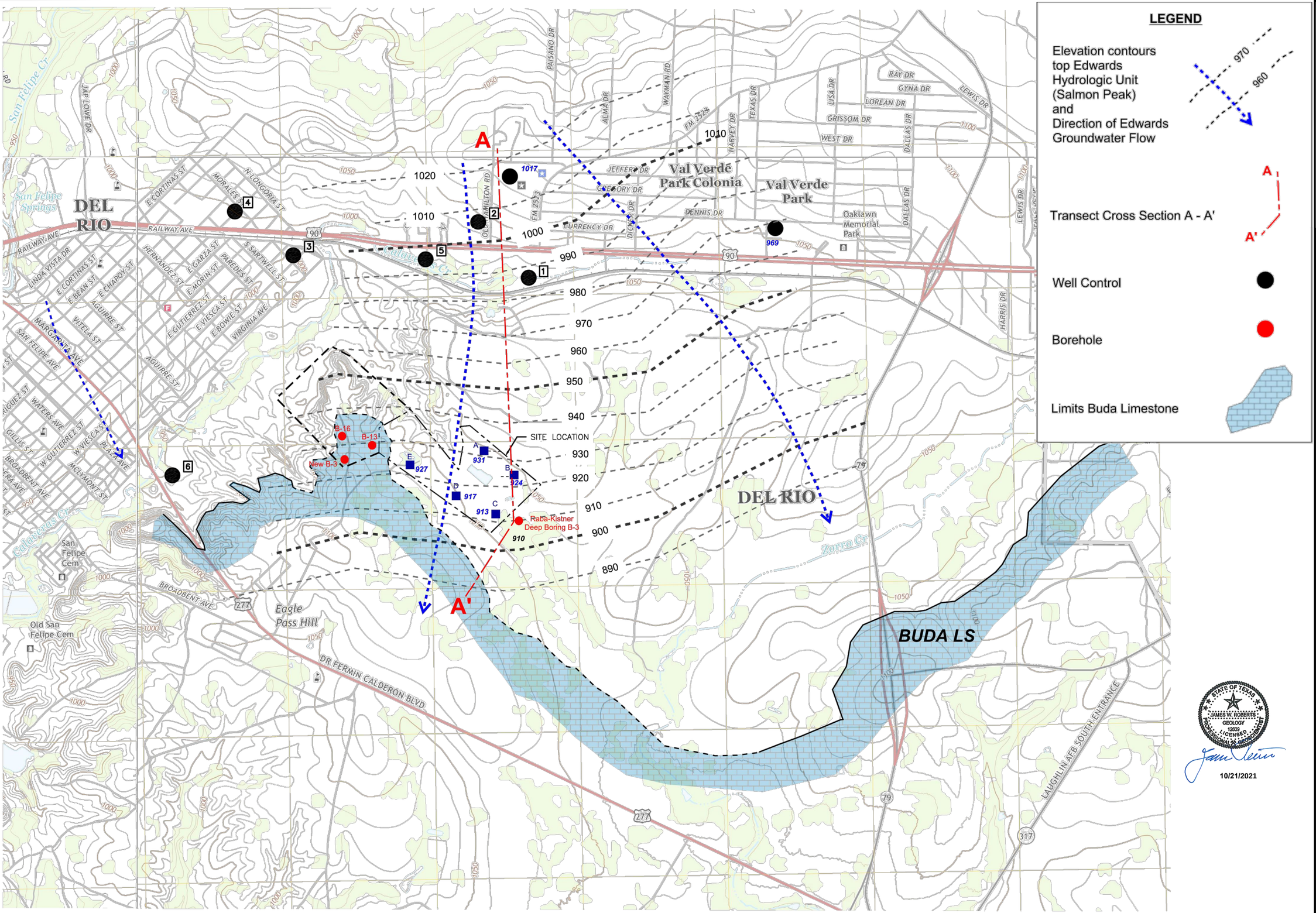
No water has been observed in the other seven (7) piezometers over the past eleven (11) months. Based on the analysis of the boring logs prepared by Arias, and taking the local topography into account, shallow groundwater encountered during the boring and sampling operations in borings B-1, B-15 and B-13 occurs in three distinct, vertically separated perched groundwater systems within the Del Rio Clay. As shown in Cross Section B-B' shown on Figure 4.4, approximately 110 feet of the upper Del Rio Clay can be subdivided into three general layers based on local lithology:

- Layer 1 – Fat clays with gravel and limestone fragments
- Layer 2 – Clay-shale, weathered, hard
- Layer 3 – Clay-shale, hard, with facies transition to marl

Two of the shallow groundwater systems occur in middle Layer 2 and were encountered in borings B-15 and B-13. The third perched groundwater system was encountered in lower Layer 3 in Boring B-1. Note that in all three cases these groundwater systems "daylight" to the southwest in the drainage of Calaveras Creek. The fact that all three groundwater zones daylight in the drainage of the creek clearly demonstrates these are perched systems.

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. Consequently, the perched groundwater systems encountered at the site are not in communication with the underlying Salmon Peak Formation which is the upper hydrologic unit of the Edwards Aquifer.



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CP&Y, INC.
TEXAS ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

NO.	REVISION	BY	DATE
1.	3RD NOD – NEW DRAWING	TM	10/2021

VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE
0 1"

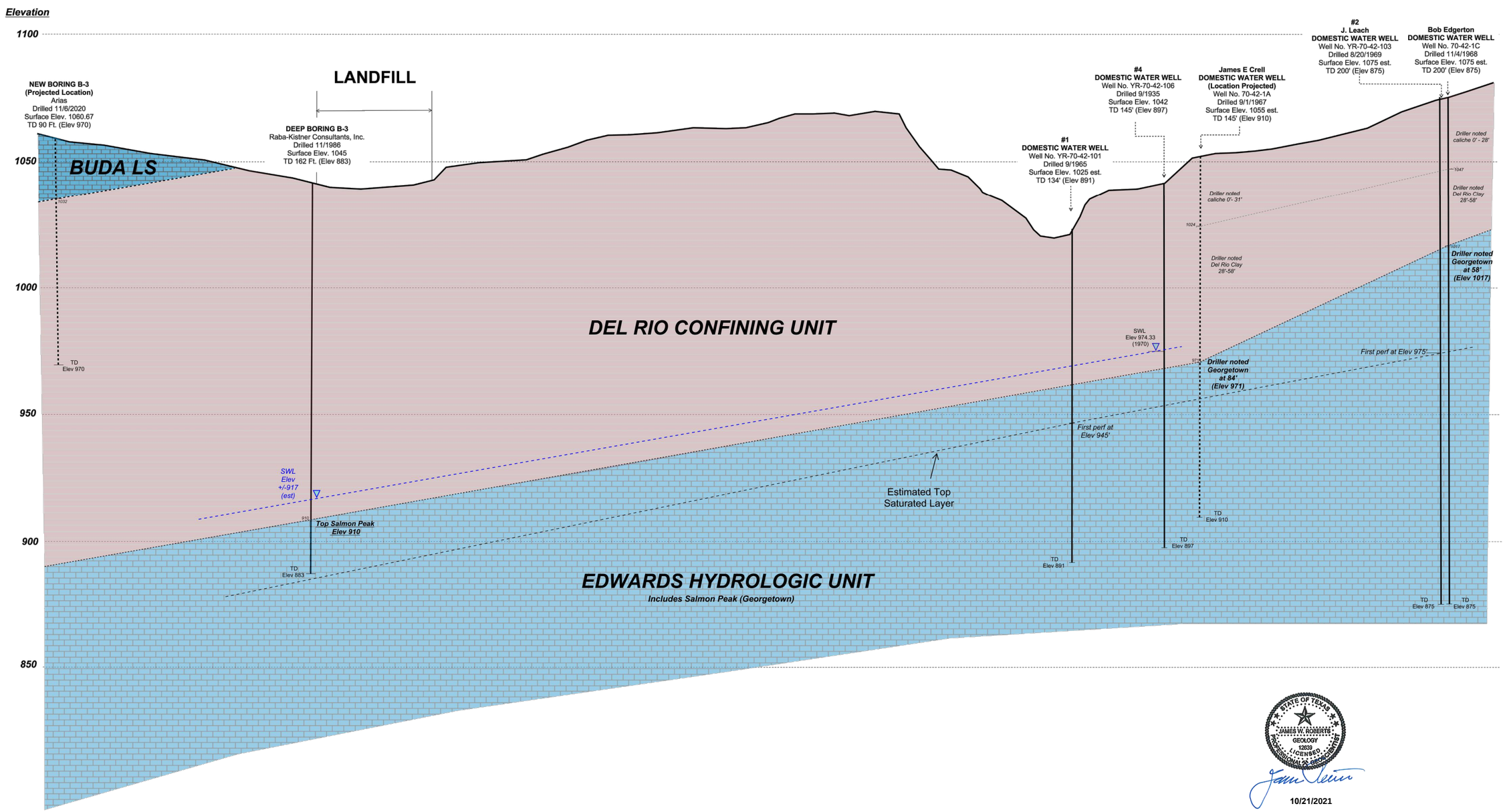
CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

TOP OF EDWARDS ELEVATION & LIMITS OF BUDA LIMESTONE

Date: OCTOBER 2021
Designed: T. METAERIA
Drawn: J. TORRES
Reviewed: J. ROBERTS, P.G.
CP&Y Proj. No. DELR1900546

FIGURE
4.1

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS C:\pwworking\cpy\pw_cpy\metaeria\d0870498\DELR1900546 Figure 4.1.dwg LAYOUT: Layout1 USER:



STATE OF TEXAS
JAMES W. ROBERTS
GEOLOGY
12639
LICENSED
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10/21/2021

FOR PERMITTING PURPOSES ONLY

CP&Y, INC.
TBPGE REGISTERED
ENGINEERING FIRM
F-1741

CITY OF Del Rio TEXAS

NO.	REVISION	BY	DATE
1.	3RD NOD – NEW DRAWING	TM	10/2021

VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE
0 1"

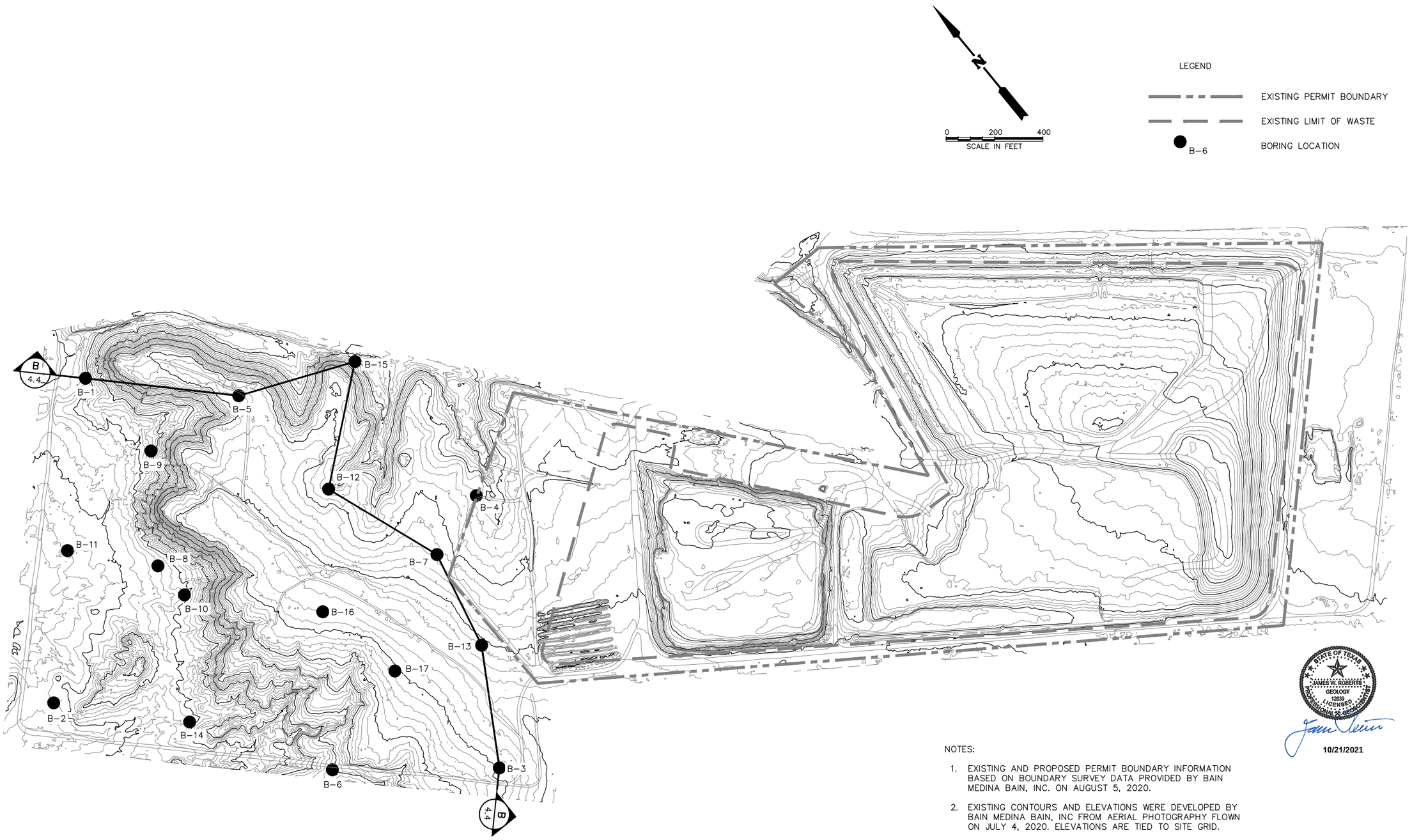
CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

CROSS SECTION A–A'

Date: OCTOBER 2021
Designed: T. METAFERIA
Drawn: J. TORRES
Reviewed: J. ROBERTS, P.G.
CP&Y Proj. No. DELR1900546

FIGURE
4.2

REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS
C:\pwworking\cpy\pw_cpy\jtorres\d0870496\DELR1900546 Figure 4.2.dwg LAYOUT: Layout1 USER:



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.

STATE OF TEXAS
JAMES W. ROBERTS
GEOLOGY
12835
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PROFESSIONAL GEOSCIENTIST

10/21/2021

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CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

NO.	REVISION	BY	DATE
1.	3RD NOD - NEW DRAWING	TM	10/2021

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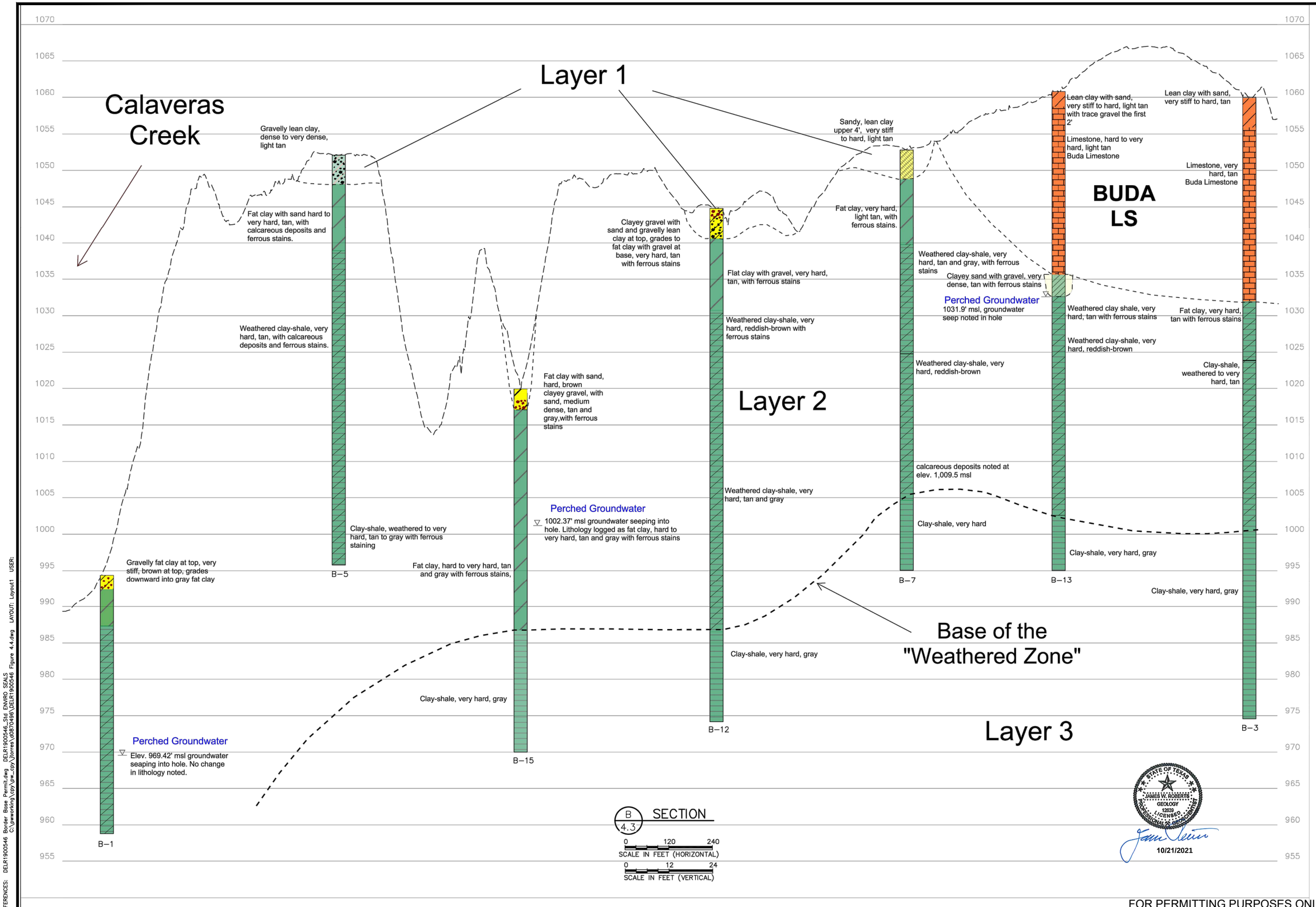
CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

ARIAS BORING AND PIEZOMETER LOCATION

Date: OCTOBER 2021
Designed: T. METAFERIA
Drawn: J. TORRES
Reviewed: B. HINDMAN, P.E.
CP&Y Proj. No. DELR1900546

FIGURE
4.3

REFERENCES: DELR2000302 Figure Border.dwg DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS
C:\pwworking\cpy\pw_cpy\jtorres\d0870496\DELR1900546 Figure 4.3.dwg LAYOUT: Layout1 USER:



B 4.3 SECTION

0 120 240
SCALE IN FEET (HORIZONTAL)

0 12 24
SCALE IN FEET (VERTICAL)

STATE OF TEXAS
JAMES W. ROBERTS
GEOLOGY
12033
LICENSED
PROFESSIONAL GEOSCIENTIST

10/21/2021

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REFERENCES: DELR1900546 Border Base Permit.dwg DELR1900546_Std ENVIRO SEALS
C:\pwworking\cpy\pw_cpy\jtorres\d0870496\DELR1900546 Figure 4.4.dwg LAYOUT: Layout1 USER:

CP&Y, INC.
TEXAS REGISTERED ENGINEERING FIRM F-1741

CITY OF Del Rio TEXAS

NO.	REVISION	BY	DATE
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0 1"

CITY OF DEL RIO
VAL VERDE COUNTY, TEXAS
MUNICIPAL SOLID WASTE LANDFILL NO. 207B
MAJOR PERMIT AMENDMENT

CROSS SECTION B–B'

Date: OCTOBER 2021
Designed: T. METAFERIA
Drawn: J. TORRES
Reviewed: J. ROBERTS, P.G.
CP&Y Proj. No. DELR1900546

FIGURE
4.4

5 GROUNDWATER MONITORING WAIVER

5.1 1994 Groundwater Waiver

A groundwater monitoring waiver was requested as part of alternative liner permit modification submitted to TCEQ in 1994. As mentioned above, the two site investigations (1986 and 1994) concluded that there was no shallow groundwater system in the Del Rio Clay. The alternative liner and the groundwater waiver requests were granted to the City in December 1994. The approval letter is included in Appendix IIID-A.

5.2 2020 Waiver Request

The City is currently requesting to extend the groundwater waiver as part of this Major Permit Amendment Application. As previously discussed with the TCEQ staff, the City has installed piezometers on the 75-ac tract of land located adjacent to the landfill to provide recent site-specific groundwater data for the site. The goal is to use the data obtained from the new piezometers along with previous data as part of the groundwater monitoring waiver request.

6 NO MIGRATION DEMONSTRATION

This section describes the no migration demonstration using:

1. the Hydrologic Evaluation of Landfill Performance (HELP) model to estimate leachate percolation through the liner in the pre-Subtitle D and Subtitle D areas,

2. Multimedia Exposure Assessment (MULTIMED) to perform pollutant fate and transport simulations between the landfill and uppermost aquifer which for this section will be referred to as the point of compliance, and

3. Darcy's equation to calculate the time travel for potential migration from the landfill to the uppermost aquifer.

The following subsections discuss the no migration demonstration methods using the HELP and MULTIMED models.

6.1 HELP Model Demonstration

6.1.1 HELP Model

The HELP Model, Version 4.0, is a quasi-two-dimensional hydrologic model that was used to model water movement across, into, through, and out of the landfill. The model uses climate, soil, and landfill design data to perform a solution technique that accounts for the effects of surface storage, run-off, infiltration, percolation, soil moisture storage, evapotranspiration, and lateral drainage. The HELP Model was used to estimate the rate of percolation through the various areas of the landfill, as discussed in Section 6.1.2.

6.1.2 HELP Model Input

HELP Model simulations were performed to estimate percolation rates for each of the areas and conditions listed in Table 6-1. The HELP output models are in Appendix IIIK-A.

Table 6-1 – Landfill Conditions Modeled in HELP

Area	Active Condition 1-Year Timeframe	Interim Condition 23-Year Timeframe	Closed Condition 30-Year Timeframe
Subtitle D Area	50 feet of waste with intermediate cover	50 feet of waste with intermediate cover	80 feet of waste with final cover
Pre-Subtitle D with Overliner	60 feet of waste with intermediate cover	60 feet of waste with intermediate cover	60 feet of waste with final cover

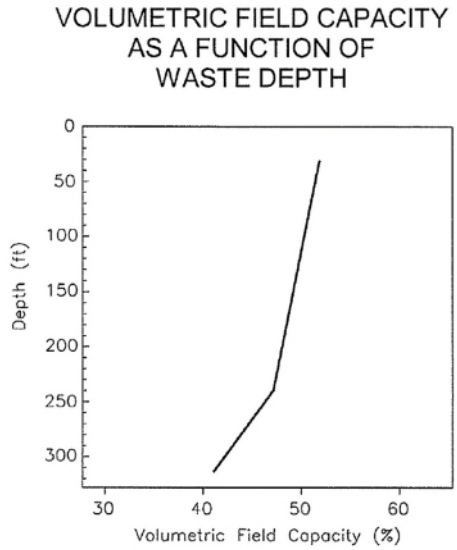
The active stage of the landfill was modeled for one year with intermediate or daily cover. A waste height of 50 feet is used for the active and interim conditions based on a bottom of waste grade elevation of 1020 ft-msl and an average top of waste grade elevation of 1070 ft-msl for the Subtitle-D area. A waste height of 60 feet was used for the pre-Subtitle-D area based on an assumed bottom of waste elevation at 1040 ft-msl and an average top of waste at 1100 ft-msl. The interim stages with intermediate cover were modeled for 23 years based on the projected site life. The site life calculations are included in Appendix IIIB. The closed landfill condition was modeled for 30 years based on TCEQ's post-closure period.

The evaporative zone depth was selected to be 10 inches for the active and interim cases and 12 inches for the closed case. The leaf area index was selected to be 0 for the active case, 2 for the interim cases and 4.5 for the closed case based on the selected ground area. The Soil Conservation Service (SCS) runoff curve numbers were calculated by HELP based on soil data and expected ground cover, surface slope, and slope length. The active case models a curve number of 53.3 and percent runoff area of zero, which is representative given that this condition assumes complete infiltration (minus evapotranspiration). The interim cases utilize the default curve number assigned by the HELP model which is 87.9 and corresponds to "fair" ground cover. The percent runoff area used varies between 70 to 90. This is representative of the intermediate cover, which will be 12 inches of compacted soil with 60 percent or more vegetation coverage. The final case models a curve number of 82 and percent runoff area of 100, which corresponds to "good" ground cover. This is representative of the final cover, which will have a minimum 90 percent vegetation coverage.

6.1.2.1 MOISTURE CONTENT AND FIELD CAPACITY

The initial moisture content was set at field capacity for all profile layers except the compacted clay barrier layer and the waste layer. HELP automatically sets the initial moisture content for a compacted clay barrier layer at porosity that is fully saturated. The initial moisture content for the waste layer was selected to be 25 percent for the 10-foot-thick and 25-foot-thick waste column cases. A moisture content of 25 percent is typical for recently placed waste. For the remaining cases, the initial moisture content for the waste layer was selected to be 38 percent to account for the fact that the waste will be in place for a longer period of time and the moisture content could increase.

Default values for the field capacity of each profile layer, other than the waste layer, were used. The field capacity values for the waste layer were obtained from "Retention of Free Liquids in Landfills Undergoing Vertical Expansion" (Zornberg, Jorge G., et al., 1999) and varied based on average waste column thickness. The relationship used is shown in the following graph.



Zornberg, Jorge G., et al., 1999

6.1.2.2 CLIMATE DATA INPUT

Precipitation data was synthetically simulated based on HELP V4 model program simulation using the latitude and longitude for Del Rio, Texas. The average annual precipitation over the modeled 30-year period was 18.19 inches. Temperature and solar radiation data were also synthetically generated by the HELP model using program defaults for Del Rio, Texas.

6.1.2.3 LANDFILL PROFILE

The profile presented below includes a clay liner with a standard Subtitle D final cover system. For additional information on the Liner Quality Control Plan refer to Appendix IIID.

- **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 waste column was split into two layers. The top 50-foot layer was modeled with a hydraulic conductivity of $1x10^{-3}$ cm/s. A lower hydraulic conductivity of $1x10^{-4}$ cm/s was used for the bottom layer because the additional overburden pressure will cause additional consolidation to this layer that will likely lower the hydraulic conductivity. 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 $1x10^{-5}$ 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 point of compliance (POC). 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 MULTIMED model input parameters are detailed in Appendix IIIK-C. By assuming the leachate does not undergo adsorption, biodegradation, and decay, a single MULTIMED simulation accounts for all 24 constituents identified by the EPA as required by the landfill design protection criteria.

The POC as defined by §330.3(108) is a vertical surface located no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down through the uppermost aquifer underlying the regulated units, and located on land owned by the owner of the facility. Based on the bedrock contours on the top of the Edwards hydrologic unit shown on Figure 4.1, the Edwards (Salmon Peak) elevation contour (940 ft-msl) was selected to represent the uppermost aquifer underlying the landfill. For this demonstration, the POC is located 80 feet (in the vertical direction) from the bottom of the lowest waste grade elevation which is 1020 ft-msl. The POC is located 100 feet in the horizontal direction, downgradient from the limits of waste.

6.3 Travel Time to Salmon Peak

Darcy's flow equation modified to reflect linear ground water velocity was used to calculate travel times for fluid flow from the base of the landfill to the top of the Salmon Peak Formation. Darcy's Equation is as follows:

$$v = \left(\frac{k}{n_e}\right) i$$

Where v= linear velocity
k = hydraulic conductivity
i = hydraulic gradient
n_e = effective porosity

For plastic clay-shale formations, such as the Del Rio Clay, fracture flow is not reasonable in the unweathered section where fractures are absent or at least widely spaced, tight, self-healing, and discontinuous. In these areas, the use of matrix flow porosity is more reasonable and better models the condition.

The conceptual model shown in Figure 6.1 illustrates the Del Rio Landfill and underlying stratigraphy used for calculating travel times. The thickness of the unweathered section of the Del Rio Clay has been taken as about 80 feet calculated from elevations of the top of the unweathered clay-shale (bottom of the landfill) and the top of the Salmon Peak. The unweathered Del Rio Clay, described as Layer 3 in Section 4.2.2, is expected to be more massive and less permeable with depth due to increased overburden which tends to consolidate the clay-shales. In addition, the frequency, occurrence and likelihood of fractures will diminish with depth, and fractures will be tightly closed by the overburden stresses. The unweathered Del Rio Clay was subdivided into three (3) parts in order to assign different hydraulic conductivities to take into consideration the variable permeability that can occur depending on depth. To simplify calculations the 80 feet of unweathered Del Rio Clay was divided into three (3) equal depths. The hydraulic gradient has been calculated as 0.76 assuming a piezometric head about 20 feet above the Del Rio/Salmon Peak contact. The 20-foot piezometric head is believed to be conservative and is based on review of upgradient water wells which exhibit piezometric heads and extrapolation downgradient below the landfill. Therefore, in the travel time model the following hydraulic conductivities were assigned to the three layers as follows:

$k = 2 \times 10^{-7}$ cm/sec top layer
$k = 2 \times 10^{-8}$ cm/sec middle layer
$k = 2 \times 10^{-9}$ cm/sec bottom layer

The first value was selected to be representative of field values from the deep piezometer slug tests. The middle value is one order of magnitude less permeable and is close to the value of the most permeable lab value obtained from all tests including those of the weathered clay-shale. The bottom value is again one order of magnitude less permeable and approximates the values from lab tests in the gray clay-shale from the upper levels. The deeper levels are more impermeable for the reasons previously stated, and that the hydraulic conductivity of the unweathered clay-shale will approach laboratory values at the lower levels.

and that the hydraulic conductivity of the unweathered clay-shale will approach laboratory values at the lower levels.

A calculated matrix porosity of 0.31 from the 1994 Geotechnical Report (Appendix IIIJ) was used for the clay-shales, based on previous laboratory unit weights, an effective porosity of 0.02 was used, based on a published range of 0.005 to 0.05 for shales. Calculated travel times are shown in the table below using both porosity values.

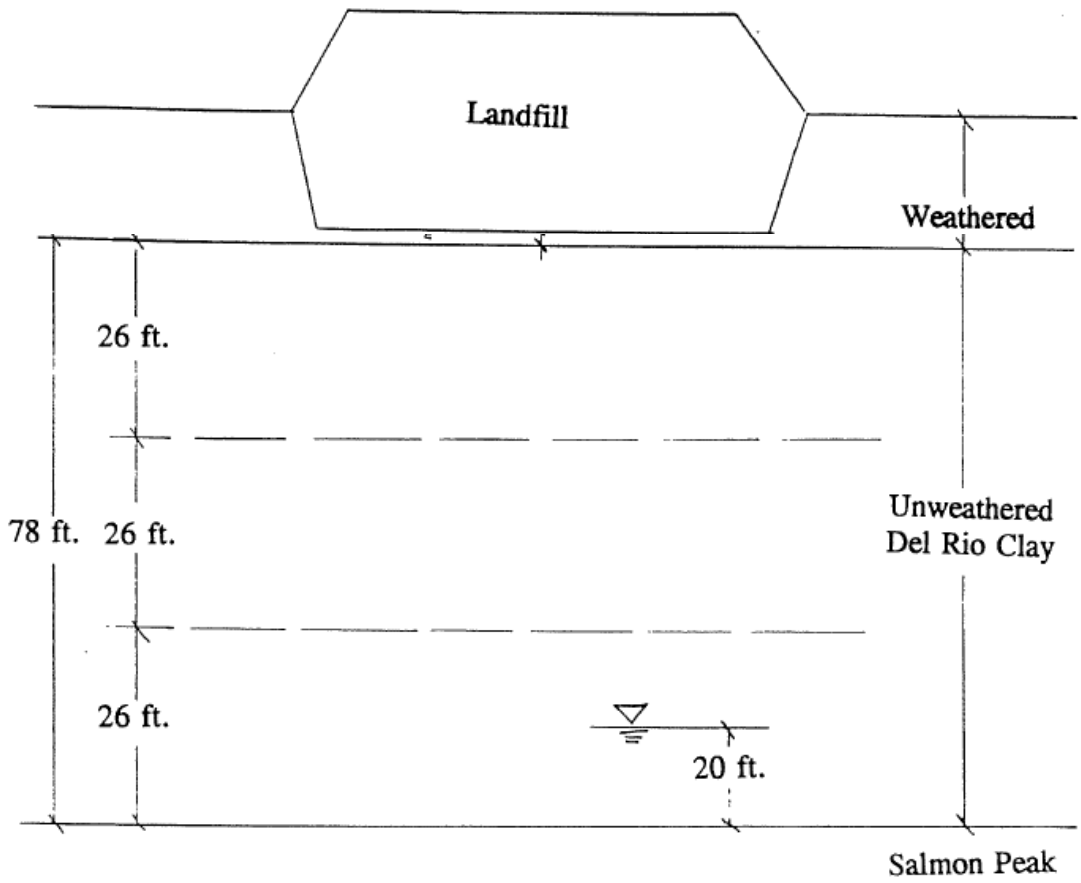


Figure 6.1 – Conceptual Model Used for Travel Time Calculations

Table 6-2 – Calculated Travel Times

Layer	k (cm/sec)	k (ft/yr)	Calculated Travel Times (yrs)	
			n = 0.31	n = 0.02
Top	$2x10^{-7}$	0.2069	51.3	3.3
Middle	$2x10^{-8}$	0.0207	512.6	33.1
Bottom	$2x10^{-9}$	0.0021	5128.8	330.7
Total			**5692.7**	**367.1**

The total travel time, according to these estimates, is more than 350 years even using the effective porosity of 0.02. Obviously, these calculations will have large variations depending on the selected hydraulic conductivities and porosity. It could be assumed fracture porosity flow in the upper levels and matrix porosity flow in the lower levels and still have large calculated travel times. These calculations show the long-expected travel times to the Salmon Peak and illustrate that ground water monitoring in the Salmon Peak would not be reasonable.

6.4 Travel Time to Calaveras Creek

The landfill site lies primarily within the Calaveras Creek drainage basin which has its head waters about 2.8 miles east of the landfill along U.S. 90. From the head water area flow is directed to the west for approximately 1.5 miles where the channel then makes an abrupt turn toward the southwest. From this point the channel flows southwesterly around the nortwestern and western extent of the landfill for a distance of about 2.5 miles where Calaveras then enters San Felipe Creek.A small drainage channel which begins in the landfill area and crosses the old landfill site directs surface water to the north and west towards Calaveras Creek. Calaveras Creek may be classified as an ephemeral stream consisting of a single, sinuous, shale and alluvial-bottomed channel which carries a mixed sediment load with particle and clast sizes that range from clay- to gravel-sized.

Calaveras Creek appears as a natural channel with dense vegetation occurring along the banks. The creek is generally about 15 to 30 feet wide and about 5 to 10 feet deep. The meandering creek channel is characterized by an alternating pool/riffle sequence (i.e. deep and shallow sections). During our field investigations of March 1994, the creek channel was walked from the landfill area downstream to Highway 277. The bed and bank consist of alternating alluvium and weathered shale materials. The alluvium can be generally described as brown silty clays with thin gravel and sand layers. The weathered shales, the Del Rio formation and-thin limestone or siltstone beds.

Based on previous site observations and results of the geotechnical studies, that Calaveras Creek in the landfill area is neither a losing or gaining stream. A "gaining stream", by definition, intersects the water table while a losing stream lies above the water table implying that surface water recharges the underlying aquifer. There was no obvious bank seepage recharge to the creek during our field inspections nor apparent base flow to support a "gaining stream" classification. In addition, the creek has a minimal vertical dissection located above the saturated zone. Ponded water in the creek channel is believed to be surface water related to ephemeral flow and the impervious nature of the channel soils.

A "losing stream" indicates that the surface water is recharging an aquifer. There is no evidence to support this classification because the stream only flows during precipitation events as the result of surface runoff and is incised into the Del Rio confining unit above the Edwards hydrologic unit. The only possible recharge would be localized bank recharge in the ponded areas and during high flows where the creek flow enters localized granular alluvium depositions. During subsequent low flows, the bank recharge may re-enter the creek, although in the March 1994 site observation following above-normal rainfall did not find evidence of seepage to the creek channel.

The most probable leachate flow and transport mechanism is discussed in the following paragraphs. For purposes of this discussion, it is first assumed that there is sufficient precipitation available to enter the waste layer and create leachate, and that some portion of this leachate which is not absorbed by the waste eventually drains to the bottom of the waste zone. The leachate then reaches the leachate collection medium where it then flows under gravity to the leachate collection sumps where it is subsequently removed. Some portion of the leachate will be absorbed, assuming a partially saturated initial liner condition, into the recompacted clay liner as it flows through the gravel collection system.

The first barrier which the leachate must breach is the recompacted clay liner. This clay liner provides not only a hydraulic barrier restricting flow, but also provides containment of leachate during the period of time required for the clay liner to reach full saturation (field capacity).

After the leachate has fully saturated the clay liner, leachate will be drawn into the unsaturated weathered clay-shale by soil suction gradients. Soil suction is defined as the state of the soil when it is under reduced pressure. It is measured in terms of the height of the water column (h) suspended in the soil. The Del Rio Clays at this site are desiccated with moisture contents below the plastic limit indicating their high affinity for moisture absorption. Thus, the leachate will be absorbed by the weathered clay-shales until their soil suction gradients have been reduced sufficiently to release moisture to lower levels. This process continues depending on the availability of leachate (moisture) and thus will be time dependent reflecting the leachate generation rate.

The absorptive potential of the Del Rio Clays is substantial. A conservative estimate of the flux rate of leachate through the compacted clay liner of 0.0002 inches per day (0.073 inches per year) was used in calculations to illustrate the absorptive potential. The clay liner is assumed to be fully saturated. This flux rate will be absorbed by the underlying Del Rio clays through its soil suction gradient until this suction gradient is satisfied. This moisture increase will be accompanied by swelling of the clay matrix. For each 1% increase in moisture, 0.225 inches of water are required per square foot per foot of thickness. The moisture contents from four laboratory permeability tests (TETCO 1994) on undisturbed samples of the Del Rio Clay increased from their initial to final moistures on an average of 6.8% and ranged from 5.4% to 8.2%.

It is assumed that the landfill site produces a large enough supply of leachate sufficient to saturate the clay liner and to overcome all absorptive affinity of the unsaturated weathered clay-shales. Leachate would then be released as free liquid and would eventually flow under gravity forces through a tortuous path of fractures, bedding planes and other secondary structures in contact with the unweathered Del Rio shales. Here the leachate would be further restricted in downward flow and would take the path of least resistance which would be to flow laterally. Portions of the leachate may be trapped in low areas of the weathered-unweathered transition or along discontinuous fracture planes. The remaining leachate would flow down-gradient following the path indicated by the contours of the weathered-unweathered transitional contact and eventually towards Calaveras Creek and to a minor extent towards Zorro Creek

to the south. The most probable discharge point, although unlikely based on the conservative assumptions, would be along Calaveras Creek exhibiting itself as seepage into the creek.

The existing water wells north and northeast of the landfill are topographically and hydraulically upgradient and would not be affected by leachate flow from the landfill. Additionally, there are no water wells immediately south and southwest of the landfill due to the poor quality of the Salmon Peak water in the downdip zone, nor are there any water wells west between the landfill and Calaveras Creek.

An estimate of the travel time for fluid flow from the landfill tract to Calaveras Creek has been made using the Darcy flow equation.

$$v = \left(\frac{k}{n_e}\right) i$$

Where v= linear velocity
k = hydraulic conductivity
i = hydraulic gradient
n_e = effective porosity

Substituting a (a) hydraulic gradient (i) of 0.0125 calculated from the slope of a hypothetical water table corresponding to the slope of the weathered-unweathered Del Rio transitional contact; (b.) a hydraulic conductivity of 1 X 10^{-5} cm/sec (10.346 ft/yr); and (c.) an effective porosity of 0.05 for the weathered clay-shale stratum results in a velocity of 2.587 ft. per year. Since Calaveras Creek is about 2500 feet to the nearest point of the landfill site, the estimated travel time is 966 years. This demonstrates that it is highly unlikely that flow could occur from the landfill to Calaveras Creek, particularly considering that this calculation did not consider the absorptive potential of the unsaturated zone along the 2500-foot route and considering the conservative assumption concerning the presence of a driving hydraulic head.

7 RESULTS AND CONCLUSIONS

Based on the methods described in the Section 6, the fate and transport was modeled using MULTIMED utilizing the leachate generated from the HELP models. As shown in Appendix IIIK, Table 8-1, 260 DAF is attainted using a hydraulic conductivity of 56.7 m/year. The DAF needed for the site's leachate to attain the values set in §330.331(a)(1) is 1, based on the Table 3-2 in Appendix IIIK. The predicted concentrations of the selected leachate chemical constituents do not exceed maximum contaminant levels in the perched groundwater zone at the point of compliance for either the approved alternate liner or the pre-Subtitle D overliner areas. Therefore, the site is in compliance with the §330.335 and §330.331.

The travel time calculations in Sections 6.3 and 6.4 demonstrate the time that leachate reaches the uppermost aquifer will exceed the site life of the landfill including the post-closure period. The site is in compliance with §330.401(d) in that there is no potential for migration of hazardous constituents from that solid waste management unit to the uppermost aquifer as defined in §330.3 of this title during the active life and the closure and post-closure care period of the unit.