Maverick County El Indio Landfill
Maverick County, Texas
TCEQ Permit No. MSW-2316

Permit Modification Application

Volume 2 of 2
Unmarked Version

Prepared for:
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

Prepared by:
SCS ENGINEERS

SCS Project No. 16220088.00 | October 2024

1901 Central Drive, Suite 550
Bedford, Texas 76021
817.571.2288

MSW LANDFILL PERMIT APPLICATION
TABLE OF CONTENTS

VOLUME 2 OF 2

PART III
SITE DEVELOPMENT PLAN NARRATIVE

FOR

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW 2316

Prepared for:

Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

PERMIT ISSUED: SEPTEMBER 11, 2007

REVISIONS 1, 2, 3, & 4 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 1 – July 2010, October 2010, January 2011
Revision 2 – July 2014
Revision 3 – January 2024
Revision 4 – October 2024

SCS Project Nos. 16209033.00, 16214011.00, 16220088.00 & 16223092.00

TABLE OF CONTENTS

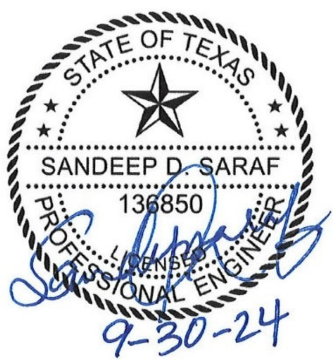
SECTION **PAGE**

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

SCS Engineers
TBPE Reg. # F-3407

ATTACHMENTS TO PART III

Attachment	***Description***
1	Site Layout Plan
2	Fill Cross-Sections
3	Existing Contour Map
4	Geology Report
5	Groundwater Characterization Report
6	Ground and Surface Water Protection Plan and Drainage Plan
7	Final Contour Map
8	Cost Estimate for Closure and Post-Closure
9	Applicant's Statement
10	Soil and Liner Quality Control Plan (SLQCP)
11	Groundwater Sampling and Analysis Plan (GWSAP)
12	Final Closure Plan
13	Post-Closure Care Plan
14	Landfill Gas Management Plan
15	Leachate and Contaminated Water Plan



2.1 PROPOSED LANDFILL METHOD §330.63(d)(4)(B)

The basic design of the proposed Maverick County Landfill will consist of area fill both above and below ground. The site will be continuously developed using 14 disposal cells. The proposed below-ground waste disposal will extend approximately 45 feet below ground to a finished base grade (top of liner) elevation of approximately 691 feet m.s.l. The bottom liner system of each cell will slope to drain at a minimum 2 percent toward a perforated LCS pipe located in the center of each cell. The LCS pipe will be sloped at a minimum slope of 1% towards the leachate collection sump.

The proposed above-ground waste disposal generally includes a 3 horizontal to 1 vertical fill slope from the landfill perimeter to a top elevation of approximately 833 feet m.s.l. with a 5% cap slope.

An eight-foot high chain-link security fence with a locking gate at the entrance to the facility has been installed on the FM 1021 perimeter of the site.

Development of the proposed landfill will be an ongoing process throughout the projected 73 year site life. The landfill will be developed in one phase as shown on Attachment 1 of Part III. The 14 individual cells outlined represent discrete construction limits for extending the landfill floor excavation and lining system.

Throughout the development of the site where excavation is proposed, the general excavation sequence will be as follows.

1. Construct temporary erosion controls including diversion berms, ditches and filter fences.

2. Strip and stockpile topsoil in designated areas. Construct appropriate erosion controls to maintain natural drainage patterns to the extent possible.

3. Excavate to the elevations shown in Part III, and stockpile soil in designated areas to construct screening berms and push wall berms when appropriate. Maintain stockpiles in compliance with the Erosion Control Plan.

4. Construct a compacted clay liner in accordance with the Soil Liner Quality Control Plan (SLQCP) provided in Part III, Attachment 10. In general, the constructed lined area will not exceed that area which will be covered by one lift of waste within 6 months.

Construction Sequence for Phase 1, Cell 1

1. Construct an all-weather road along the western and southern edges of the excavation. Construct the all-weather road of a surface such as asphalt, crushed rock, gravel, or other suitable materials. These roads will be maintained in a passable condition in all weather conditions.

2. Prior to excavation of Cell 1, appropriate upgradient drainage controls will be placed as necessary to prevent stormwater run-on into the Cell 1 excavation. Also, as Cell 1 is excavated, construct an access ramp along the north face of the excavation.

3. Place a containment berm approximately six feet in height at the bottom of the excavation to control stormwater run-on from non-SLER'd areas of the Cell. This area will be pumped out after each significant storm event. Diversion ditches along the east and south sides of the excavation will take stormwater to the detention basin west of Cell 1.

4. Construct the liner over the bottom and side slopes of Cell 1, in accordance with the guidelines found in the SLQCP. The limits of the liner will typically extend 10 feet beyond the edge of fill at the toe of excavation.

5. Install the prepared subgrade and compacted clay liner over the bottom of Cell 1. Install the textured HDPE flexible membrane liner and geocomposite drainage mat over the exterior side slopes and interior side slopes as appropriate. Extend the compacted clay liner and geocomposite drainage mat over the interior berms and terminate them as shown in the details. Follow the guidelines for installation, testing, and certification for the liner provided in the SLQCP (Attachment 10).

6. Install the leachate collection system headers, laterals and gravel drainage material at Sump 1. Construct the side slope risers and leachate access structures. Follow with protective cover over the leachate collection system. Refer to the detailed drawings for the leachate collection system and compacted clay liner termination details.

7. Connect power/air sources for pump operation. Test equipment for proper level controls and monitoring of liquid levels so as to assure that no more than 30 cm of head can build up over the liner at the sump. Refer to the Leachate and Contaminated Water Plan for a discussion of management of liquids collected in the leachate collection system or within the working area berm.

Filling Sequence for Cell 1

1. Establish the location of the initial working face (approximately ½ to 1 acre). Begin filling the area with waste, proceeding upgradient. Continue filling the area with waste and constructing berms as necessary until the entire lined area has been covered with one lift of waste including intermediate cover. Maintain a small working face geometry for optimum waste compaction and run-off control. Place waste in four to fifteen foot lifts, as determined by the on-site operator, with no less than six inches of on-site soils placed over all exposed waste areas daily. The working face should not exceed a 5H:1V slope at any time during the filling operation.

2. Excavation for Cell 2, may begin as soon as interim grades for Cell 1 grades are nearing completion. Time construction of the liner materials so as to reduce the amount of time that the liner is exposed, yet allow adequate time to assure that it is ready when the initial excavated area reaches practicable capacity. Construct additional stormwater berms and ditches to reduce run-on to the lined area.

Construction Sequence for Cell 2

1. Continue landfilling until Cell 1 has reached interim grades as shown in Part III, Attachment 1. Cell 2, will be the next area to be constructed.

2. Cell 2 will be constructed in the same manner as Cell 1.

3. Begin Cell 2 at the north and west boundary of the fill area and move to the south and east. Cell 2 will be developed and filled to complete approximate intermediate grades.

4. Following the completion of Cell 2, develop Cells 3 through 14, in numerical order, in a similar filling and construction sequence as Cells 1 and 2.

2.2 ALL-WEATHER OPERATIONS §330.63(d)(4)(a)

Access to the proposed facility will be provided by Farm to Market (F.M.) Road 1021. FM 1021 and FM 2366 state maintained roadways within one mile of the site, and are all-weather asphalt roadways. The landfill access will incorporate an asphalt driveway and an all weather drive within the site.

Internal roadways to disposal areas will be surfaced with all-weather material (such as on-site soils and crushed stone) and properly maintained to provide continuous access to waste disposal areas during both dry and wet weather conditions.

Roads will be graded for proper drainage to minimize rutting and soft spots. Roadside ditches and culverts will be installed and maintained as necessary. Equipment, such as a motor grader, will be available to provide periodic maintenance as required.

Refer to Part III, Attachment 1, Site Layout Plan for layouts of existing and proposed roadways for the proposed landfill development.

To help minimize the tracking of mud from the site onto public roads, the site entrance road will be constructed with an all-weather surface from FM 1021 and hose bib with a washdown area will be provided. During periods of inclement weather, the site operator will inspect the main access road on a daily basis and, as needed, will clear mud tracked onto the pavement.

As a routine procedure, a stockpile of cover material sufficient to cover the working face or active area will be maintained near the working area. This will provide periodic cover on a contingency basis for such conditions as inclement weather, unanticipated down-time of cover hauling equipment, and fire/hot load control at the working face.

During dry weather, the operator will perform dust control by sprinkling water on the roads and ramps, as necessary.

2.3 ACCESS CONTROL §330.63(b)(1)

Site access control consists of an 8-foot chain link fence with 2-strand barbed wire top rail, in concrete footings along the FM 1021 side of the landfill and a 5-foot 5-strand barbed-wire fence on steel poles with concrete footings around the remaining perimeter of the site. A gate with control features will be located at the facility entrances, including the primary entrance (i.e., the existing main entrance) and secondary entrance/exit gates. Site personnel will inspect regularly the fencing, report any failure, and see that any damage is quickly repaired. All security features, including the entry gates, and the locks will be kept in proper working order, maintained, and quickly replaced if inoperable and/or irreparable. Maintenance will be performed on site security mechanisms (i.e. fences, locking gates) as necessary to maintain access control, as described in Part IV – Site Operating Plan, Section 4.1. The fences, gates, and other means of access control will be maintained and operated to prevent the entry of livestock, to protect the public from exposure to potential health and safety hazards, and to discourage unauthorized entry or uncontrolled disposal of solid waste or hazardous materials.

Scale house personnel at the primary entrance will control site access whenever the entry gates are open. When the site is closed, the entry gates will be closed to prevent unauthorized and uncontrolled waste disposal and locked when no personnel are present on site. Lighting will be provided at the scale house and primary entrance gate. The perimeter fencing will prevent vehicular and pedestrian access to the site at points other than the entry gates. Under normal operations, the primary entrance constructed for the facility will be the only public entrance for the proposed landfill. Generally, the proposed secondary entrance will be for landfill personnel or Maverick County designated personnel. However, in the event that primary entrance is inaccessible due to weather or traffic, approved waste haulers and/or the general public may be directed to through the secondary entrance. The locations of the primary and secondary entrances are shown on Part III, Attachment 1B. The primary entrance layout is shown in Part III, Attachment 1B1.

The gate attendant will direct drivers to the proper disposal area. There, the drivers will be directed to a specific unloading area. Operations over the life of the facility may include alteration to the location and quantity of entrance and administrative facilities (i.e. building, trailers, citizen service areas, fuel tanks, scales, equipment maintenance facilities, etc.) and other facility appurtenances even though they will remain in the same general location. In all cases, any alteration in the location of these facilities will be designed to increase the level of service provided by the facility without interfering with site operations.

2.4 SITE LIFE §330.63(d)(4)(D)

The disposal rate for the proposed Maverick County Landfill is expected to range from approximately 150 tons/day to 400 tons/day. The region currently has a collection rate of 6 lbs/person/day.

The total calculated waste capacity from top of protective cover to bottom of final cover for the proposed facility is approximately 15,320,345 cubic yards, which includes the volume of daily and intermediate cover. This volume is based on a recalculation by utilizing currently approved landfill unit configuration depicting permitted top of protective cover contours and permitted top of waste contours. The total waste volume considering the reduction in volume (20%) for daily and intermediate cover is approximately 12,256,676 cubic yards, as calculated in Table 2, which represents an estimated site life of approximately 73 years.

Table 1 and Table 2 located on the following pages provide the Estimated Rate of Waste Deposition and Operating Life of Site.

TABLE 1
ESTIMATED RATE OF WASTE DEPOSITION

Operating Year	Date	Daily Tonnage*	Yearly Tonnage	Yearly Volume (cy)***	Cumulative Volume**
**1	2011	97.5	30,406	60,812	60,812
2	2012	156.0	48,657	97,314	158,126
3	2013	178.6	55,711	111,422	269,548
4	2014	165.1	51,523	103,046	372,594
5	2015	160.8	50,174	100,348	472,942
6	2016	165.9	51,773	103,546	576,488
7	2017	148.5	46,335	92,670	669,158
8	2018	156.9	48,954	97,908	767,066
9	2019	180.4	56,295	112,590	879,656
10	2020	177.4	55,359	110,718	990,374
11	2021	187.3	58,431	116,862	1,107,236
12	2022	189.5	61,933	123,866	1,231,102
13	2023	191.8	62,676	125,352	1,356,454
14	2024	194.1	63,428	126,857	1,483,311
15	2025	196.4	64,189	128,379	1,611,690
16	2026	198.8	64,960	129,919	1,741,609
17	2027	201.2	65,739	131,478	1,873,088
18	2028	203.6	66,528	133,056	2,006,144
19	2029	206.0	67,326	134,653	2,140,797
20	2030	208.5	68,134	136,269	2,277,066
21	2031	211.0	68,952	137,904	2,414,970
22	2032	213.5	69,779	139,559	2,554,528
23	2033	216.1	70,617	141,234	2,695,762
24	2034	218.7	71,464	142,928	2,838,690
25	2035	221.3	72,322	144,643	2,983,334

Operating Year	Date	Daily Tonnage*	Yearly Tonnage	Yearly Volume (cy)***	Cumulative Volume**
26	2036	224.0	73,190	146,379	3,129,713
27	2037	226.7	74,068	148,136	3,277,849
28	2038	229.4	74,957	149,913	3,427,762
29	2039	232.1	75,856	151,712	3,579,474
30	2040	234.9	76,766	153,533	3,733,007
31	2041	237.7	77,688	155,375	3,888,382
32	2042	240.6	78,620	157,240	4,045,622
33	2043	243.5	79,563	159,127	4,204,749
34	2044	246.4	80,518	161,036	4,365,785
35	2045	249.4	81,484	162,969	4,528,754
36	2046	252.3	82,462	164,924	4,693,678
37	2047	255.4	83,452	166,903	4,860,581
38	2048	258.4	84,453	168,906	5,029,487
39	2049	261.5	85,467	170,933	5,200,420
40	2050	264.7	86,492	172,984	5,373,404
41	2051	267.9	87,530	175,060	5,548,464
42	2052	271.1	88,580	177,161	5,725,625
43	2053	274.3	89,643	179,287	5,904,912
44	2054	277.6	90,719	181,438	6,086,350
45	2055	280.9	91,808	183,615	6,269,965
46	2056	284.3	92,909	185,819	6,455,784
47	2057	287.7	94,024	188,049	6,643,833
48	2058	291.2	95,153	190,305	6,834,138
49	2059	294.7	96,294	192,589	7,026,727
50	2060	298.2	97,450	194,900	7,221,627
51	2061	301.8	98,619	197,239	7,418,865
52	2062	305.4	99,803	199,606	7,618,471
53	2063	309.1	101,000	202,001	7,820,472
54	2064	312.8	102,212	204,425	8,024,896
55	2065	316.5	103,439	206,878	8,231,774
56	2066	320.3	104,680	209,360	8,441,135
57	2067	324.2	105,936	211,873	8,653,008
58	2068	328.1	107,208	214,415	8,867,423
59	2069	332.0	108,494	216,988	9,084,411
60	2070	336.0	109,796	219,592	9,304,003
61	2071	340.0	111,114	222,227	9,526,230
62	2072	344.1	112,447	224,894	9,751,124
63	2073	348.2	113,796	227,593	9,978,717
64	2074	352.4	115,162	230,324	10,209,041
65	2075	356.6	116,544	233,088	10,442,128

Operating Year	Date	Daily Tonnage*	Yearly Tonnage	Yearly Volume (cy)***	Cumulative Volume**
66	2076	360.9	117,942	235,885	10,678,013
67	2077	365.3	119,358	238,715	10,916,728
68	2078	369.6	120,790	241,580	11,158,308
69	2079	374.1	122,239	244,479	11,402,787
70	2080	378.6	123,706	247,413	11,650,200
71	2081	383.1	125,191	250,382	11,900,581
72	2082	387.7	126,693	253,386	12,153,968
73	2083	392.4	128,213	256,427	12,410,394

Notes for Table 1:
*Daily tonnage for years 2011-2022 is based on actual tonnage received at the landfill. Following 2022, the daily/yearly waste collection rates account for 1.2% anticipated annual growth rate. Anticipated annual growth rate based on previous ten years of growth from U.S. Census data.
*** Yearly volume of waste in CY is based on an estimate in-place density of 1,000 lb/cy.
**** Total available solid waste volume calculated as 12,256,676 CY (See Table 2). Approximate site life is 73 years.

TABLE 2
MAVERICK COUNDY EL INDIO MSWF
SITE LIFE AND SOIL BALANCE

ITEM	TOTAL
SITE AIRSPACE	
WASTE AREA (ACRES)[1]	108.61
WASTE AREA (FT^2)	4,731,260
GROSS VOLUME (CY)	16,546,969
3' FINAL COVER MATERIAL (CY)	525,624
4' LINER MATERIAL (CY)	700,832
NET LANDFILL VOLUME (CY)	15,320,345
SITE LIFE	
DAILY AND INTERMEDIATE COVER (@20%)(CY)	3,064,069
NET SOLID WASTE VOLUME (CY)	12,256,676
SITE LIFE (YRS)	73
SOIL BALANCE	
EXCAVATION (CY)	4,241,761
LINER SYSTEM (CY)[3]	700,832
DAILY AND INTERMEDIATE COVER (CY)	3,064,069
FINAL COVER SYSTEM (CY)	525,624
SOIL BALANCE (CY)	75,764

Notes for Table 2:

1) Area within waste placement as shown on plans.
2) Geocomposite drainage layer in liner system assumed negligible for volume calculations.
3) Includes clay and protective cover soil.

outfall channel. The pond discharge structures are designed to convey the 25 and 100 year, 24 hour events.

The entire perimeter drainage system has been designed to assure that the landfill is not impacted by the 100 year, 24 hour storm event and is maintained below the landfill anchor trench crest elevation.

4.5 DRAINAGE IMPACT §330.63(c)(1)(C)

The proposed surface water management system consists of several drainage basins. The facility has been designed so that the natural drainage patterns are not significantly altered.

4.6 FLOODPLAIN CONSIDERATIONS §330.63(c)(2)

The location restriction criteria in 30 TAC §330.547 states that disposal units located in a 100 year flood plain shall demonstrate that the unit will not restrict the flow of the 100 year flood plain, reduce temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment.

No portion of the permitted boundary fall within the 100 year flood plain. The facility will not restrict the flow of the 100 year flood plain.

There are no levees within or that otherwise effect the landfill permitted area. There are no levee improvement districts or approved or proposed plans for reclamation projects within the permit area.

The perimeter drainage facilities have been designed to convey the 100 year, 24 hour peak flowrate at an elevation below the adjacent liner anchor trench crest elevation.

4.7 FINAL COVER EROSION PROTECTION §330.305

The above-ground waste disposal will generally include a 1(V):3(H) fill slope from the perimeter berm/access road to a grade break for a 5% crown slope to a peak elevation of approximately 833 feet m.s.l. The final grades are shown on **Part III, Attachment 7**, Final Contour Map.

The final cover (from top to bottom) will consist of a 6” vegetated soil layer, a 12” soil layer, a 200-mil geocomposite (double-sided), a 40-mil LLDPE geomembrane, an 18” soil layer (with permeability no greater than 1 x 10^{-5} cm/sec), at least 6” of intermediate cover and, finally at least 6” of daily cover above the waste.

The final cover has been designed to minimize soil loss from erosion. The TCEQ recommends that the soil loss on the final cover not exceed 3.0 tons/year/acre. These limits are from the TCEQ “Use of the Universal Soil Loss Equations in Finals Cover/Combination Design, October 1993”. Based on the configuration of the final cover system, the maximum calculated soil loss is 2.34 tons/year/acre for the 1(V):3(H) slope for the closure/post closure period. The soil loss calculations are included in Part III, Attachment 6, Universal Soil Loss Equation.

During the active life and post-closure care period of the site, the final cover will be inspected for erosion gulleys and ponding of water. If erosion gulleys or ponding does occur, these areas will be repaired by replacing and regarding the final cover soil as required.

5.0 PROTECTION OF ENDANGERED SPECIES §330.63(b)(5)

The proposed site has been designed to protect endangered species. The United States Department of the Interior-Fish and Wildlife Service was contacted to assess the effects of the proposed construction of a municipal solid waste facility on species federally listed or proposed for listing as threatened or endangered.

Based on correspondence from the U.S. Fish and Wildlife Service and Texas Parks and Wildlife, the U.S. Fish and Wildlife Service concluded the following:

> “The Service confirms that according to the information provided in your letter and data within our files, it is unlikely that impacts to endangered species may occur.”

The site development plan has incorporated an appropriate buffer around the perimeter of the site and has developed this permit application in conformance with EPA and the TCEQ guidelines for the siting, design, and construction of a municipal solid waste disposal facility. Therefore, the site will be protective of endangered species.

For additional information regarding the U.S. Fish and Wildlife Service review, see Part I, **Appendix I-C3**.

6.0 LANDFILL MARKERS §330.143

6.1 SITE MARKERS §330.143(b)

Landfill markers will consist of durable posts, steel or wooden, extending at least 6 feet above ground level to clearly identify significant landfill features such as site boundaries,

MAVERICK COUNTY – EL INDIO MSW LANDFILL
MAVERICK COUNTY, TEXAS
PERMIT APPLICATION
SITE DEVELOPMENT PLAN PART III
ATTACHMENT 1

SITE LAYOUT PLAN

Prepared for:
Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

PERMIT ISSUED: SEPTEMBER 11, 2007

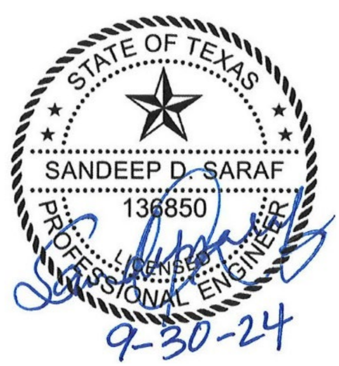
REVISIONS 2, 3 and 4, PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

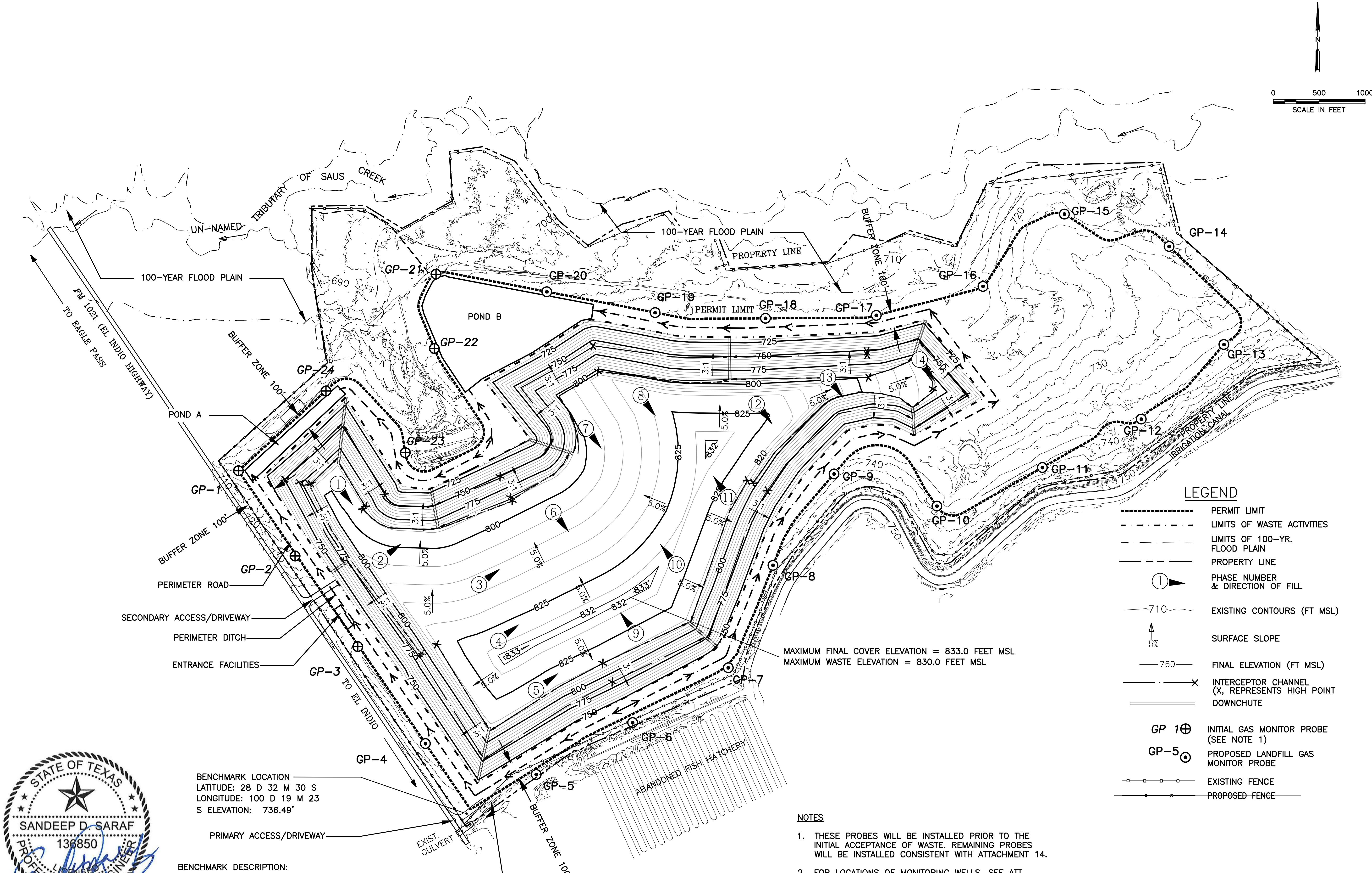
Revision 1 – January 2004, May 2004
Revision 2 – June 2009, June 2010,
Revision 3 – July 2014, October 2014
Revision 4 – October 2024
SCS Project Nos. 16208046, 16209033.00, 16223092.00

TABLE OF CONTENTS

Drawings



SCS Engineers
TBPE Reg. # F-3407



BENCHMARK LOCATION
LATITUDE: 28 D 32 M 30 S
LONGITUDE: 100 D 19 M 23
S ELEVATION: 736.49'

BENCHMARK DESCRIPTION:
SET BRASS CAP IN CONCRETE 25' WEST OF A WOODEN POST BEING THE SOUTHWEST CORNER AND 25' NORTH OF THE SOUTH FENCE LINE.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- PROPERTY LINE
- PHASE NUMBER & DIRECTION OF FILL
- 710 EXISTING CONTOURS (FT MSL)
- 5% SURFACE SLOPE
- 760 FINAL ELEVATION (FT MSL)
- INTERCEPTOR CHANNEL (X, REPRESENTS HIGH POINT)
- DOWNCHUTE
- GP 1 INITIAL GAS MONITOR PROBE (SEE NOTE 1)
- GP-5 PROPOSED LANDFILL GAS MONITOR PROBE
- EXISTING FENCE
- PROPOSED FENCE

NOTES

1. THESE PROBES WILL BE INSTALLED PRIOR TO THE INITIAL ACCEPTANCE OF WASTE. REMAINING PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.
2. FOR LOCATIONS OF MONITORING WELLS, SEE ATT 4-24 IN ATTACHMENT 4.
3. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	4/09	REMOVE 20' WIDE TERRACES; REVISE FINAL GRADES; AND ADD INTERCEPTOR CHANNELS	RK
2	4/09	DECREASE SPACING OF GAS PROBES TO 600'	RK
3	6/09	ADD FENCE LOCATIONS	RK
4	9/24	REVISED LIMIT OF WASTE, FINAL COVER GRADING, AND FINAL DRAINAGE CONDITIONS	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: SITE LAYOUT

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

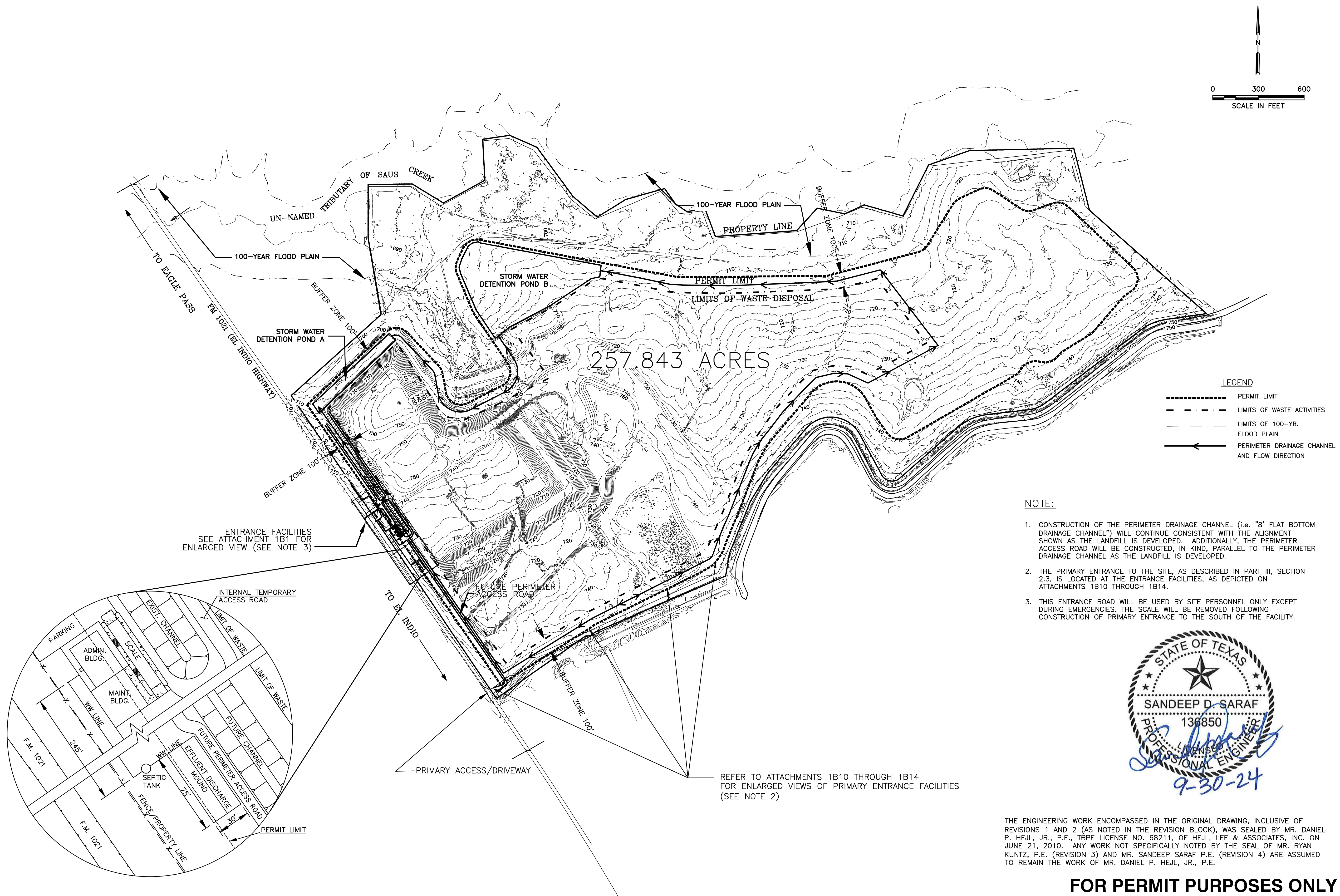
CADD FILE: CC 6-09 SITE LAYOUT (9.10.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT **1A**

9/30/2024 3:15 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\CC 6-09 SITE LAYOUT (9.10.2021)



NOTE:

1. CONSTRUCTION OF THE PERIMETER DRAINAGE CHANNEL (i.e. "8' FLAT BOTTOM DRAINAGE CHANNEL") WILL CONTINUE CONSISTENT WITH THE ALIGNMENT SHOWN AS THE LANDFILL IS DEVELOPED. ADDITIONALLY, THE PERIMETER ACCESS ROAD WILL BE CONSTRUCTED, IN KIND, PARALLEL TO THE PERIMETER DRAINAGE CHANNEL AS THE LANDFILL IS DEVELOPED.
2. THE PRIMARY ENTRANCE TO THE SITE, AS DESCRIBED IN PART III, SECTION 2.3, IS LOCATED AT THE ENTRANCE FACILITIES, AS DEPICTED ON ATTACHMENTS 1B10 THROUGH 1B14.
3. THIS ENTRANCE ROAD WILL BE USED BY SITE PERSONNEL ONLY EXCEPT DURING EMERGENCIES. THE SCALE WILL BE REMOVED FOLLOWING CONSTRUCTION OF PRIMARY ENTRANCE TO THE SOUTH OF THE FACILITY.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

THE ENGINEERING WORK ENCOMPASSED IN THE ORIGINAL DRAWING, INCLUSIVE OF REVISIONS 1 AND 2 (AS NOTED IN THE REVISION BLOCK), WAS SEALED BY MR. DANIEL P. HEJL, JR., P.E., TBPE LICENSE NO. 68211, OF HEJL, LEE & ASSOCIATES, INC. ON JUNE 21, 2010. ANY WORK NOT SPECIFICALLY NOTED BY THE SEAL OF MR. RYAN KUNTZ, P.E. (REVISION 3) AND MR. SANDEEP SARAF P.E. (REVISION 4) ARE ASSUMED TO REMAIN THE WORK OF MR. DANIEL P. HEJL, JR., P.E.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	6/2010	MODIFIED BUILDING & ENTRANCE LAYOUT	
2	6/2010	ADDED SEPTIC TANK, EFFLUENT MOUND, AND NOTE 1.	
3	7/2014	ADD SECONDARY ENTRANCE	RRK
4	10/2014	ADD NOTE 2 AND FUTURE PERIMETER ROAD	RRK
5	9/2024	REVISED LIMITS OF WASTE AND ADD CALLOUT FOR PRIMARY ENTRANCE FACILITIES	SDS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: **ENTRANCE FACILITIES**

PROJECT: **MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION**

CLIENT: **MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

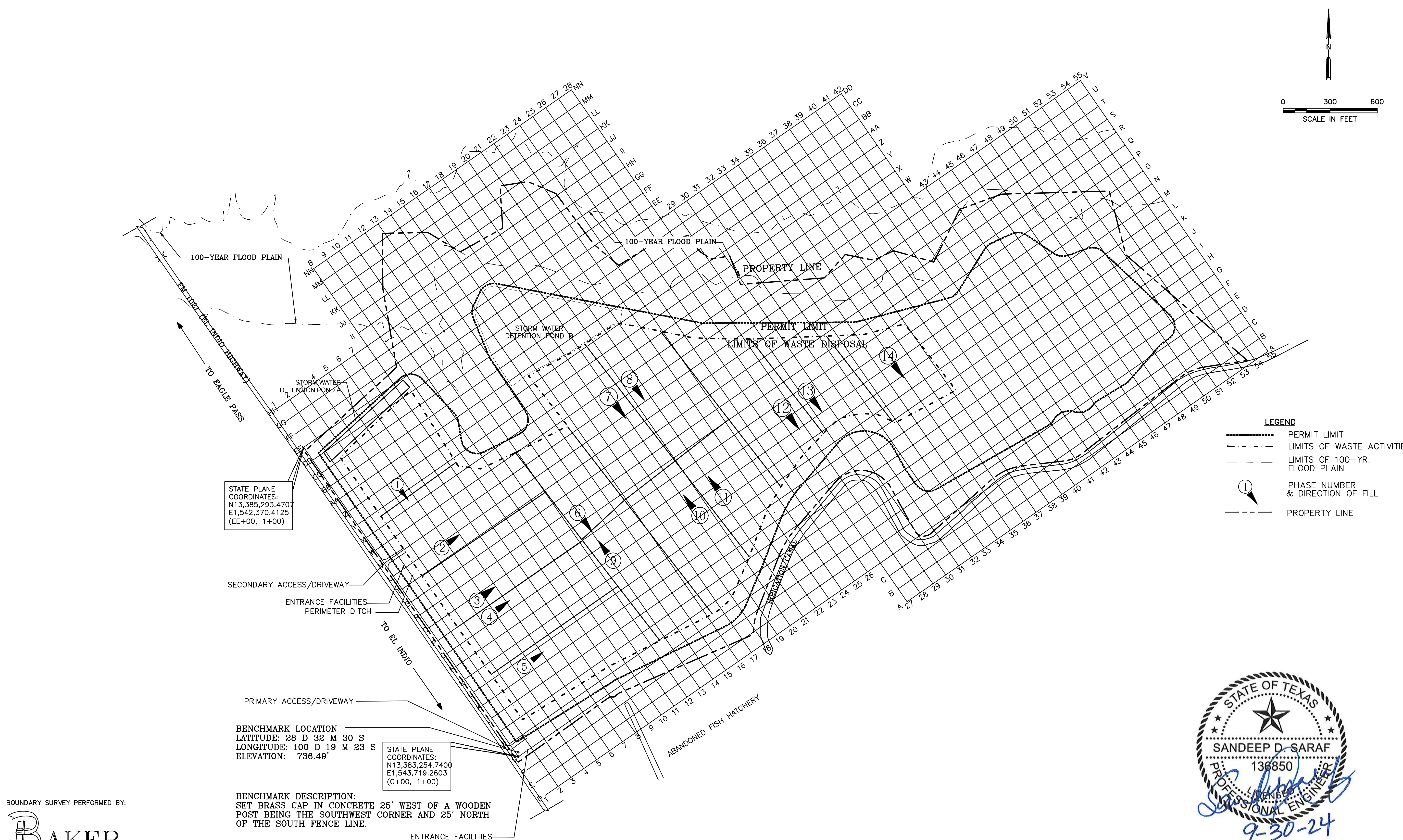
PROJ. NO. 16223092.00	DWN. BY: DNA	Q/A RVW BY: AGA
DSN. BY: SS	CHK. BY: AGA	APP. BY: SDS

CADD FILE: III-1B (093022 - UPDATED)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. **1B**



BENCHMARK LOCATION
LATITUDE: 28 D 32 M 30 S
LONGITUDE: 100 D 19 M 23 S
ELEVATION: 736.49'

BENCHMARK DESCRIPTION:
SET BRASS CAP IN CONCRETE 25' WEST OF A WOODEN POST BEING THE SOUTHWEST CORNER AND 25' NORTH OF THE SOUTH FENCE LINE.

BOUNDARY SURVEY PERFORMED BY:

BAKER SURVEYING, INC.
PH. (210) 653-7270
FAX. 653-2942
11003 WYE DRIVE
SAN ANTONIO, TEXAS 78217
SURVEYED: JANUARY 1997
JOB NO. 96-204

PLAT SHOWING:
SURVEY OF A 257.843 ACRE TRACT OF LAND SITUATED IN MAVERICK COUNTY, TEXAS OUT OF THE ANASTACIO CARR SURVEY NO. 39, ABSTRACT 75 AND THE P. L. BUQUOR SURVEY NO. 40, ABSTRACT 1159 BEING THAT SAME TRACT CALLED 257.838 ACRES AND CONVEYED TO MAVERICK COUNTY, A POLITICAL SUBDIVISION AND RECORDED IN VOLUME 432, PAGE 294 OF THE OFFICIAL RECORDS OF MAVERICK COUNTY, TEXAS.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED LIMITS OF WASTE	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: SITE COORDINATE GRID SYSTEM

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | CHK. BY: AGA | DSN. BY: SS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: 1C - SITE COORDINATE GRID SYSTEM(82422)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 1C

NOTE: ALL ELEVATIONS INDICATE TOP OF LINER SYSTEM. TOP OF SUMP IS INDICATED AT SUMP LOCATIONS.

LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- PHASE NUMBER & DIRECTION OF FILL
- PROPOSED LINER ELEVATION
- GRADED SLOPE 3H:1V
- PROPOSED LINER SLOPE
- PROPOSED LINER ELEVATION – POINT

NOTE:

1. ALL ELEVATIONS/CONTOURS PROVIDED IN THIS APPLICATION INDICATE FEET ABOVE MEAN SEA LEVEL.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED LINER GRADES BASED ON NEW LIMITS OF WASTE BOUNDARY.	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: TOP OF LINER GRADES

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

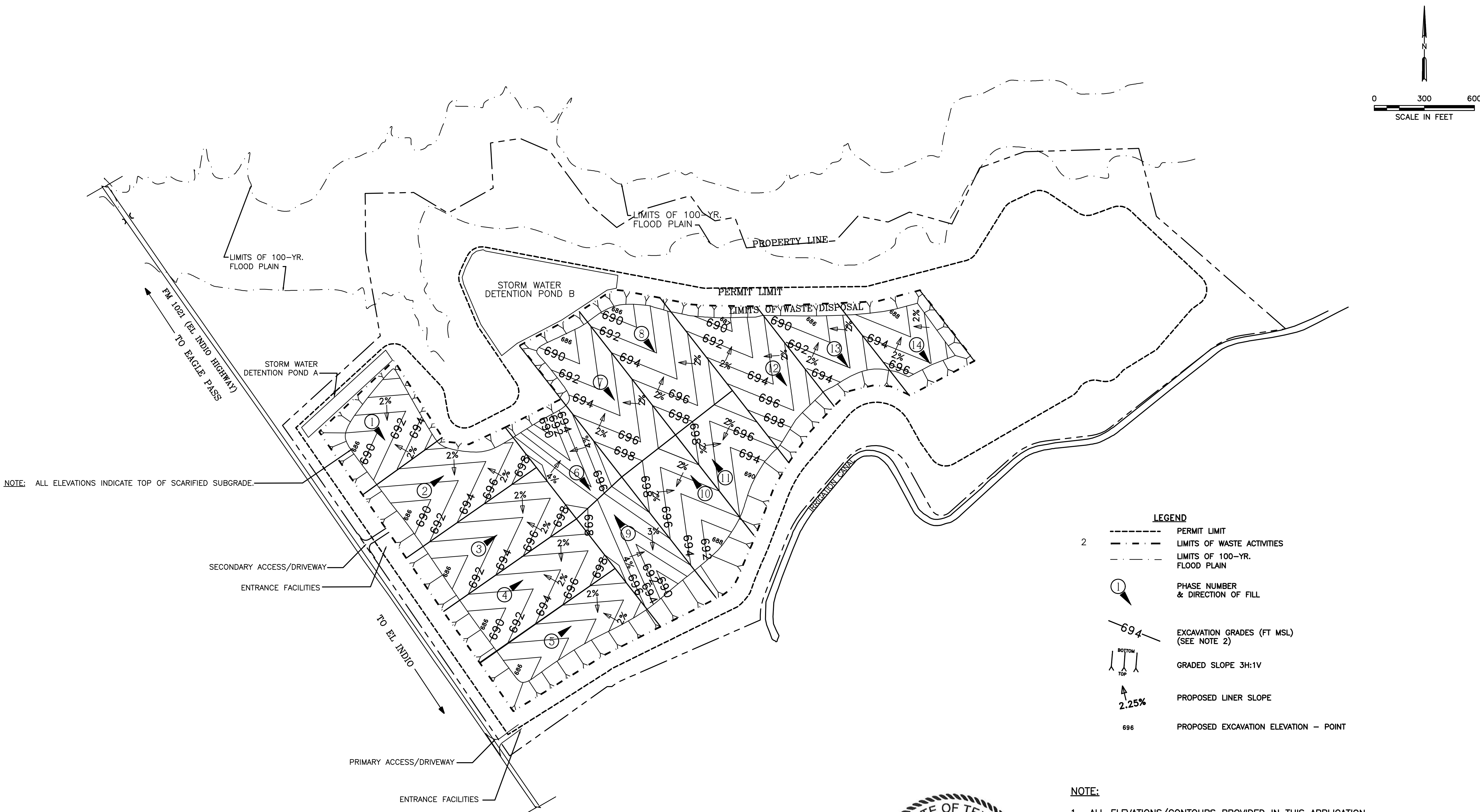
CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

CADD FILE: III-1D
DATE: 09/2024
SCALE: AS SHOWN
ATTACHMENT **1D**

7/30/2024 4:54 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\III-1D



NOTE:

1. ALL ELEVATIONS/CONTOURS PROVIDED IN THIS APPLICATION INDICATE FEET ABOVE MEAN SEA LEVEL.
2. THIS DRAWING DEPICTS EXCAVATION GRADE ELEVATIONS FOR CELLS CONSTRUCTED WITH THE STANDARD LINER (SEE ATT. 10A FOR STANDARD LINER DETAILS). FOR CELLS CONSTRUCTED WITH THE ALTERNATE LINER SYSTEM, USING A GCL, THE CELLS WILL BE EXCAVATED TO A DEPTH 2 FEET HIGHER THAN SHOWN ON THIS DRAWING (SEE ATTACHMENT 10A–GCL FOR ALTERNATE LINER DETAILS). WHETHER THE CELLS ARE CONSTRUCTED WITH THE STANDARD LINER OR ALTERNATE LINER, THE TOP OF THE LINER ELEVATIONS WILL COINCIDE WITH THE ELEVATIONS SHOWN ON ATTACHMENT 1D.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/10	DESIGNATE NOTATIONS, ADD NOTE 2; REVISE CALL-OUT IN LEGEND; ADD "STANDARD" TO DRAWING TITLE	RK
		REVISE CELL 12 AND CELL 16 EXCAVATION GRADES	
2	9/24	REVISED EXCAVATION GRADES BASED ON NEW LIMITS OF WASTE BOUNDARY.	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
EXCAVATION GRADES BOTTOM OF STANDARD LINER SYSTEM

PROJECT TITLE
MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

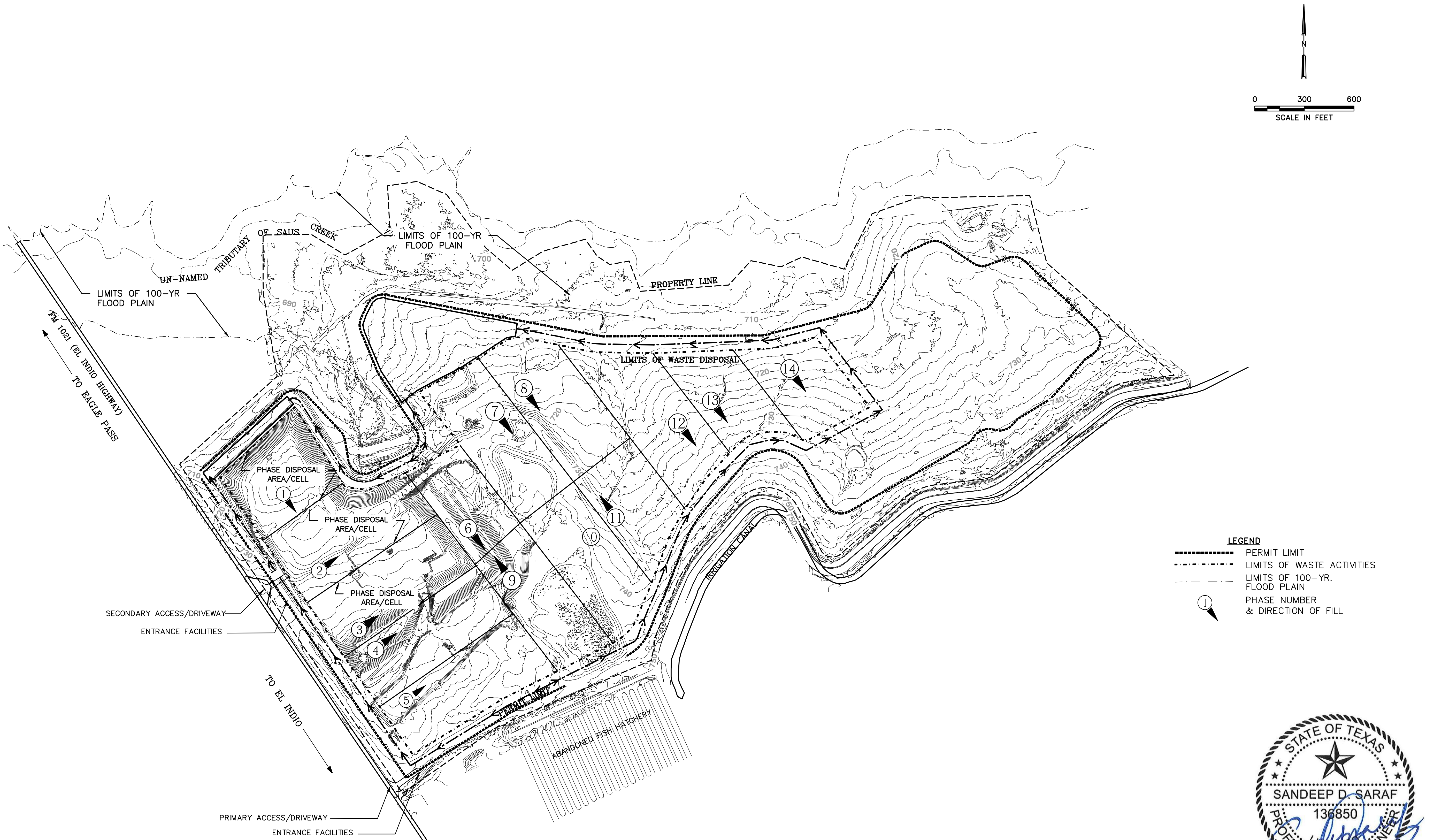
PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

CADD FILE: III-1D1

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
1D1



7/30/2024 5:10 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\1E - Development Phasing Plan_1

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED LIMIT OF WASTE AND FINAL DRAINAGE CONDITIONS	SS
2			
3			
4			
5			

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: DEVELOPMENT PHASING PLAN

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

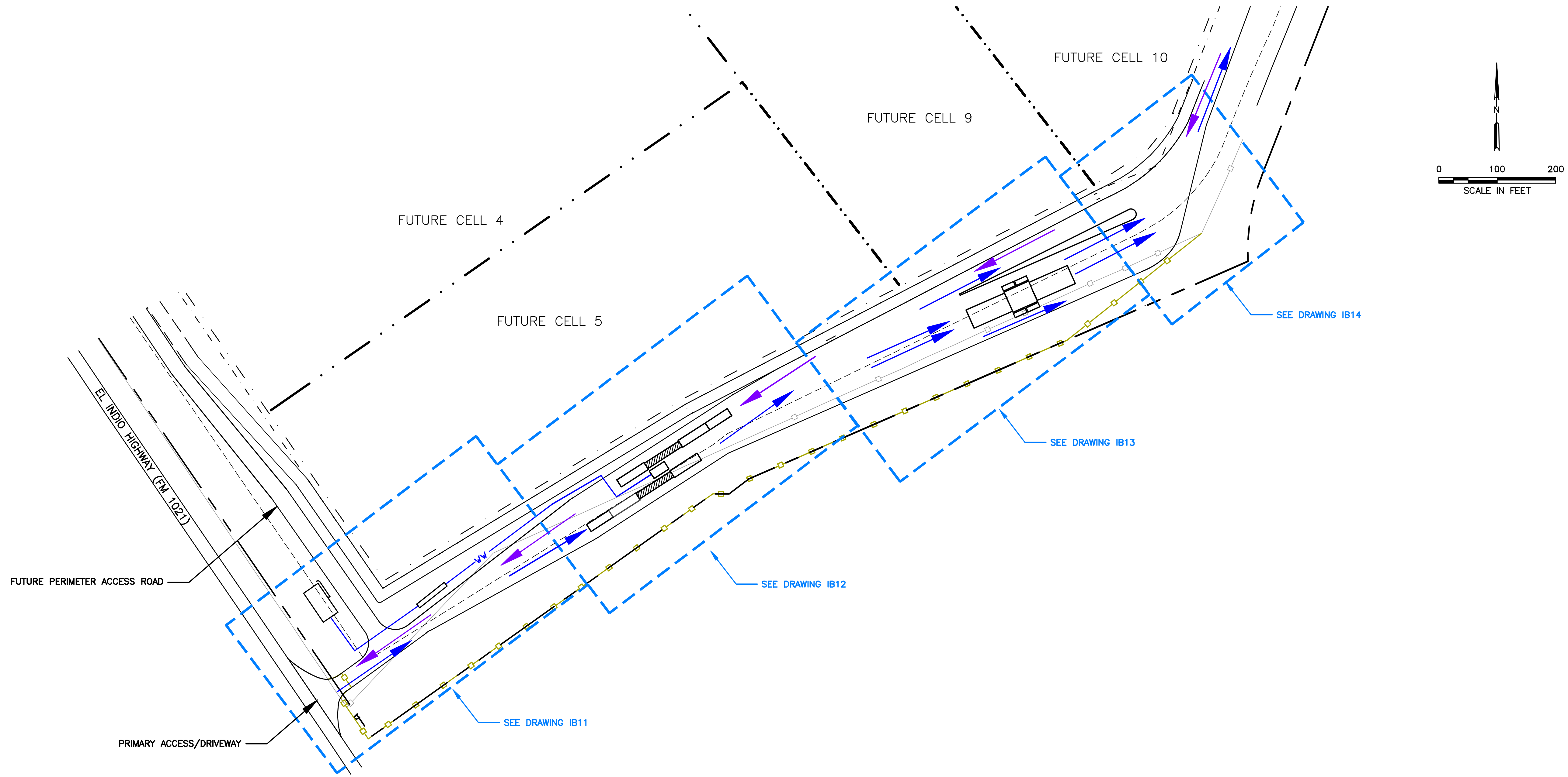
CADD FILE: 1E - DEVELOPMENT PHASING PLAN_1

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 1E

FOR PERMIT PURPOSES ONLY



LEGEND

- PERMIT BOUNDARY
- PERMIT BOUNDARY
- LIMITS OF WASTE
- CELL/UNIT LIMITS
- EXISTING FENCE
- PROPOSED FENCE
- PROPOSED SEPTIC LINE
- PROPOSED DRIVING LANES
- PROPOSED PAVEMENT
- INCOMING TRAFFIC FLOW
- OUTGOING TRAFFIC FLOW

NOTES:

1. RESIDENTIAL CUSTOMERS USING THE CITIZEN'S COLLECTION STATION WILL ENTER VIA MAVERICK COUNTY MSWF (MSW PERMIT NO 2316) APPROVED ENTRANCES.
2. SOUTH EXISTING FENCE TO BE RELOCATED AS SHOWN ALONG THE PROPERTY BOUNDARY.
3. THE PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: NEW PRIMARY ENTRANCE FACILITY

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY
16179 FM 1021
EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

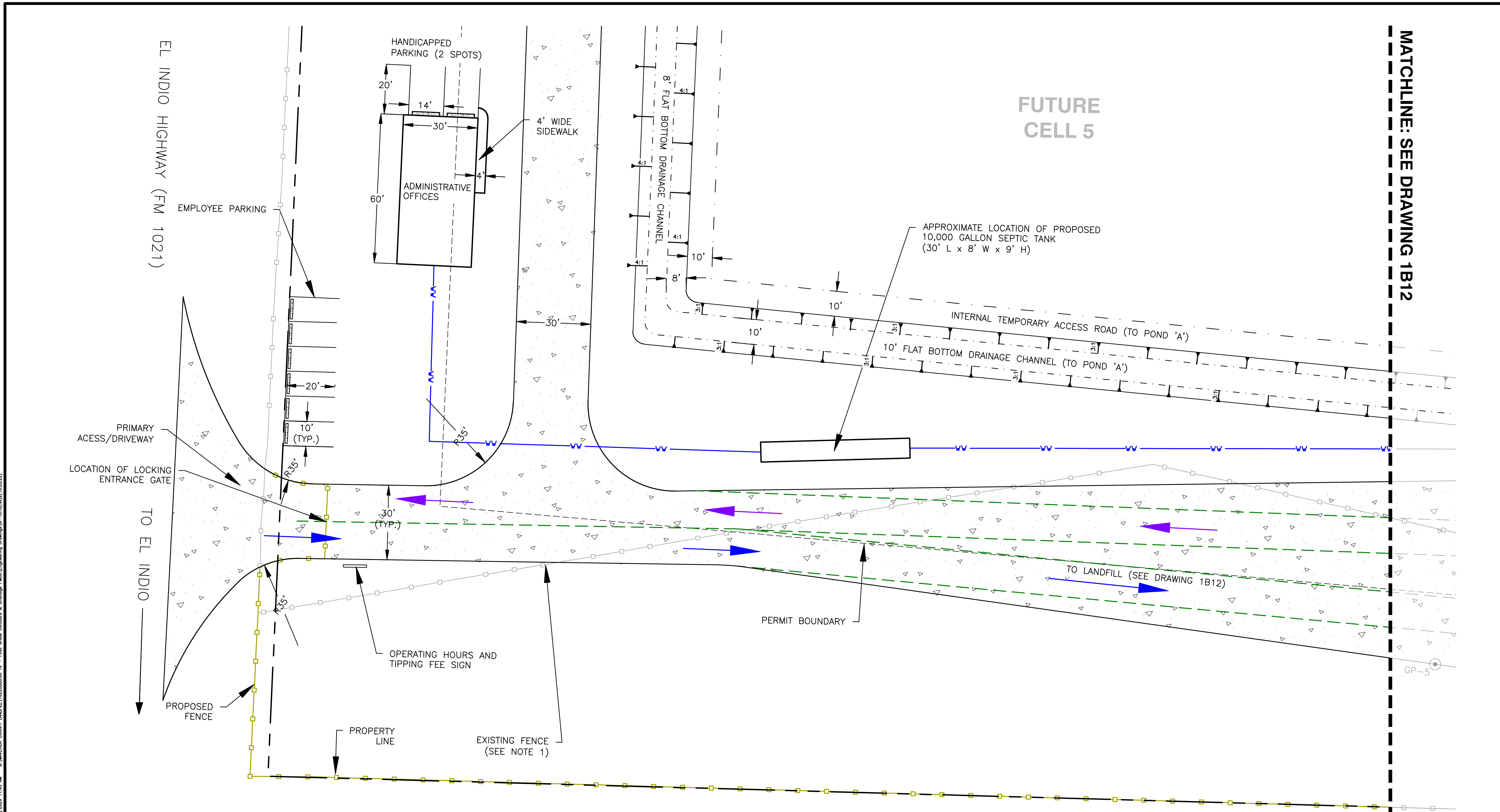
PROJ. NO. 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: III-1B10(REV)2(10.28.22)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. **1B10**



LEGEND

- PERMIT BOUNDARY
- PERMIT BOUNDARY
- LIMITS OF WASTE
- CELL/UNIT LIMITS
- EXISTING FENCE
- PROPOSED FENCE
- PROPOSED SEPTIC LINE
- PROPOSED DRIVING LANES
- PROPOSED PAVEMENT
- INCOMING TRAFFIC FLOW
- OUTGOING TRAFFIC FLOW

NOTES:

1. EXISTING SOUTH FENCE TO BE RELOCATED AS SHOWN ALONG THE PROPERTY BOUNDARY.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: NEW PRIMARY ENTRANCE FACILITY

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

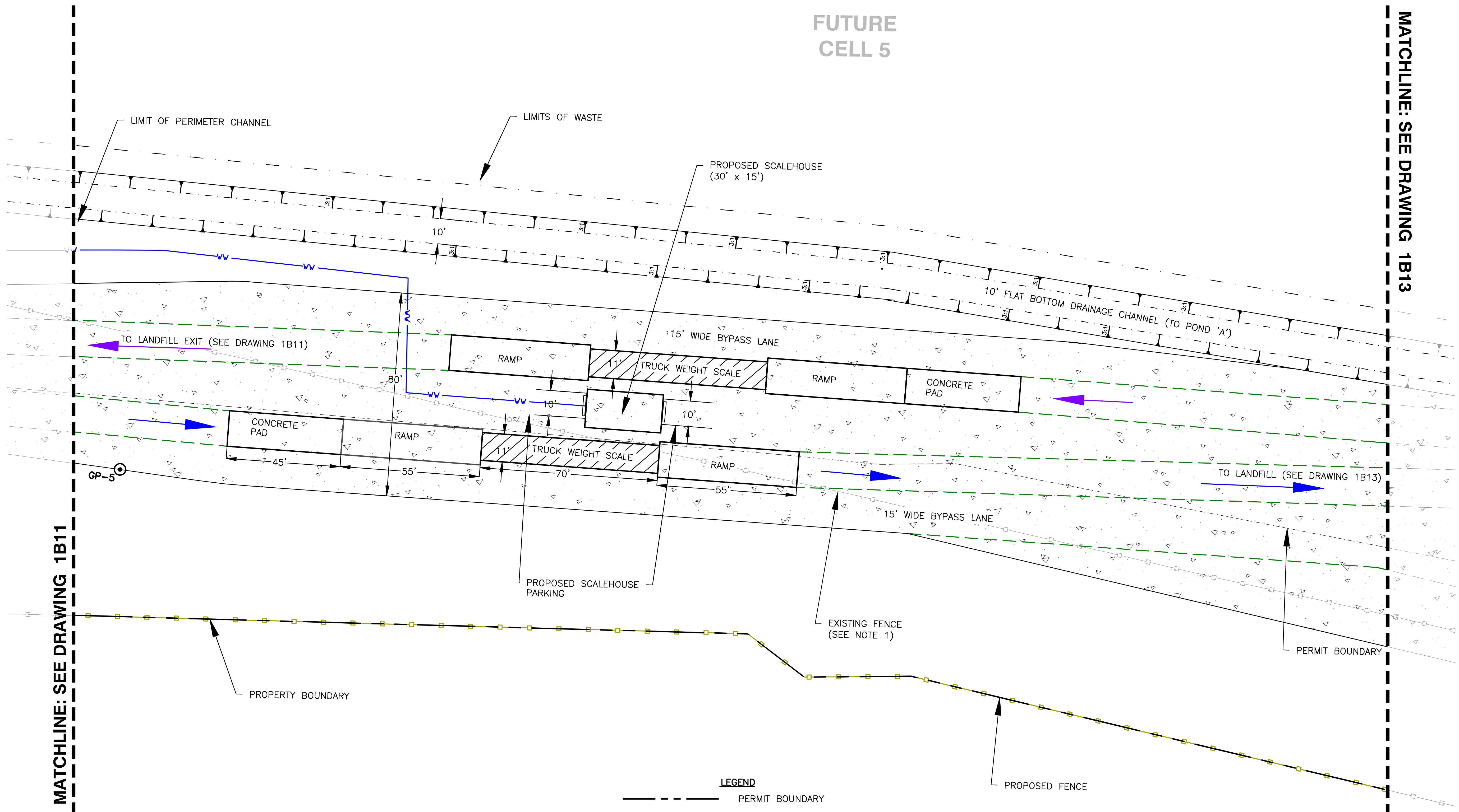
PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: SS | CHK. BY: AGA | APP. BY: SDS

CADD FILE: III-1B10(REV)2(10.28.22)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 1B11



LEGEND

- PERMIT BOUNDARY
- PERMIT BOUNDARY
- LIMITS OF WASTE
- CELL/UNIT LIMITS
- EXISTING FENCE
- PROPOSED FENCE
- PROPOSED SEPTIC LINE
- PROPOSED DRIVING LANES
- PROPOSED PAVEMENT
- INCOMING TRAFFIC FLOW
- OUTGOING TRAFFIC FLOW
- GP-5 PROPOSED GAS MONITORING PROBE (SEE NOTE 2)

NOTES:

1. SOUTH EXISTING FENCE TO BE RELOCATED AS SHOWN ALONG THE PROPERTY BOUNDARY.
2. THE PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.

0 20 40
SCALE IN FEET

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: NEW PRIMARY ENTRANCE FACILITY

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

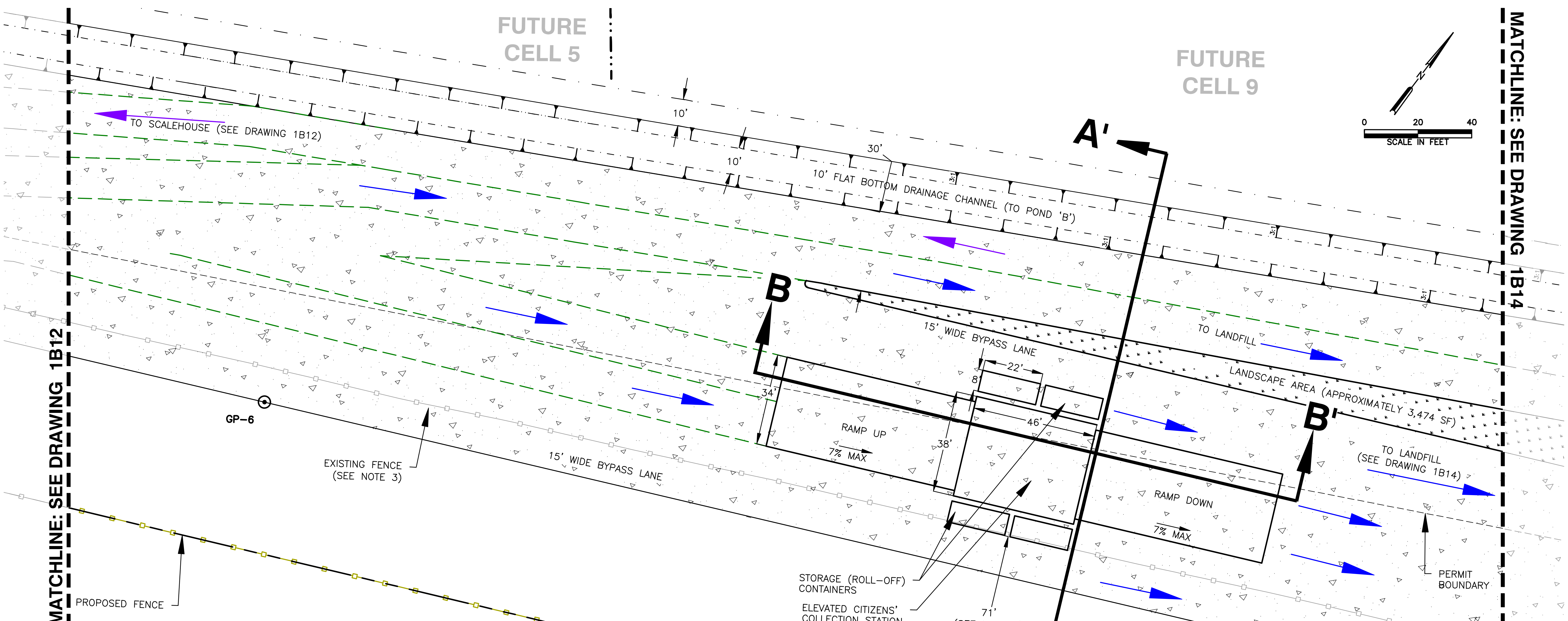
PROJ. NO. 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

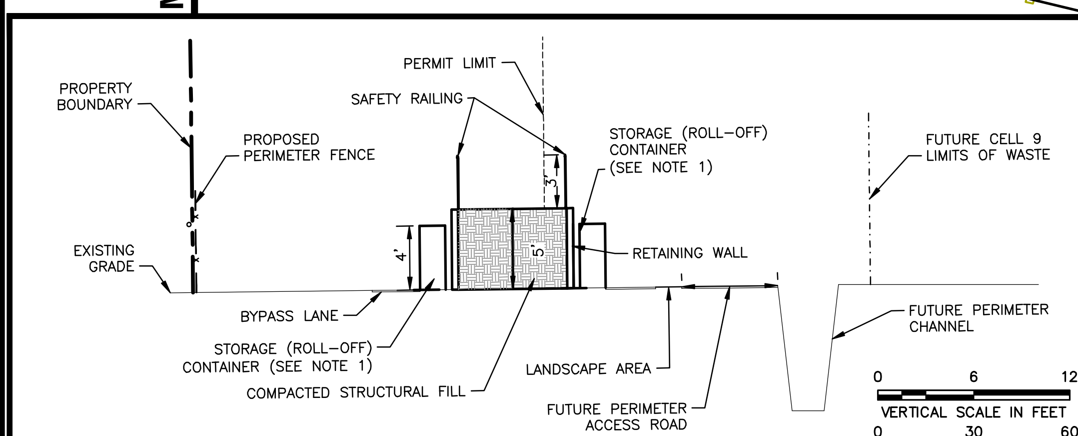
CADD FILE: IB-1B10(REV)2(10.28.22)

DATE: 09/2024

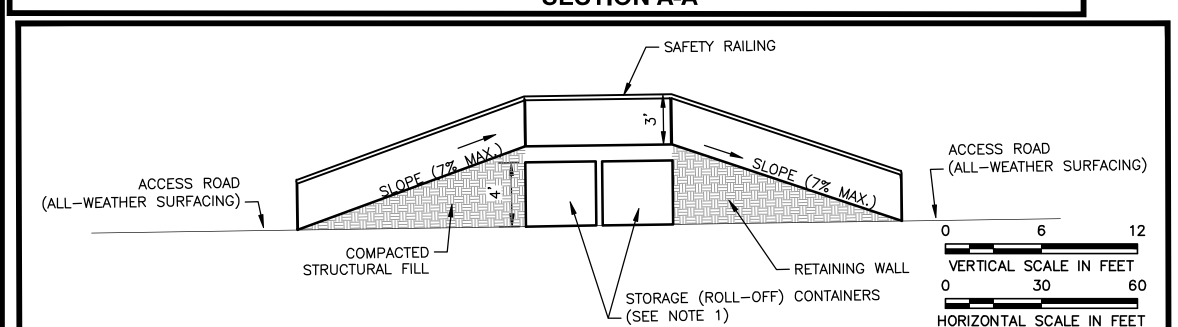
SCALE: AS SHOWN

ATTACHMENT NO. 1B12





SECTION A-A'



SECTION B-B'

LEGEND

- PROPERTY BOUNDARY
- PERMIT BOUNDARY
- LIMITS OF WASTE
- CELL/UNIT LIMITS
- EXISTING FENCE
- PROPOSED FENCE
- PROPOSED DRIVING LANES
- PROPOSED PAVEMENT
- PROPOSED GRASS
- INCOMING TRAFFIC FLOW
- OUTGOING TRAFFIC FLOW
- GP-6 PROPOSED GAS MONITORING PROBE (SEE NOTE 4)

NOTES:

1. STORAGE CONTAINERS TO BE PLACED A MINIMUM DISTANCE OF 50-FEET FROM PROPERTY LINE.
2. RESIDENTIAL CUSTOMERS USING THE CITIZEN'S COLLECTION STATION WILL ENTER VIA MAVERICK COUNTY MSWF (MSW PERMIT NO 2316) APPROVED ENTRANCES.
3. SOUTH EXISTING FENCE TO BE RELOCATED AS SHOWN ALONG THE PROPERTY BOUNDARY.
4. THE PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: NEW PRIMARY ENTRANCE FACILITY

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

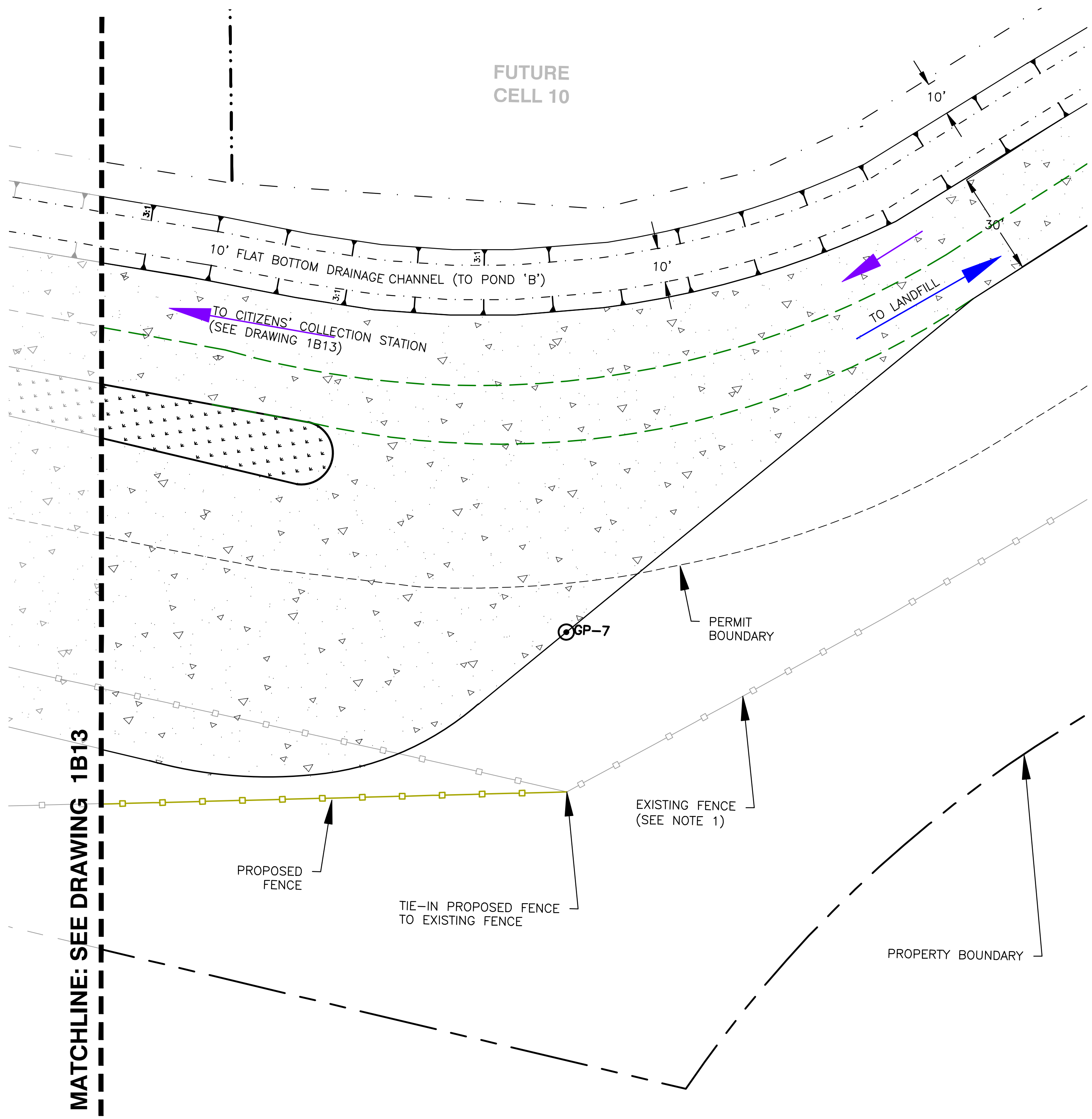
PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: SS | CHK. BY: AGA | APP. BY: SDS

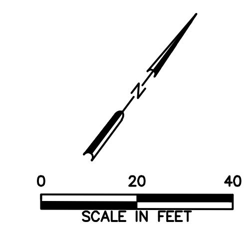
CADD FILE: III-1B10(REV)2(10.28.22)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 1B13





LEGEND

- PROPERTY BOUNDARY
- PERMIT BOUNDARY
- LIMITS OF WASTE
- CELL/UNIT LIMITS
- EXISTING FENCE
- PROPOSED FENCE
- PROPOSED DRIVING LANES
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE AREA
- INCOMING TRAFFIC FLOW
- OUTGOING TRAFFIC FLOW
- GP-7 PROPOSED GAS MONITORING PROBE (SEE NOTE 2)

NOTES:

1. SOUTH EXISTING FENCE TO BE RELOCATED AS SHOWN ALONG THE PROPERTY BOUNDARY.
2. THE PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: NEW PRIMARY ENTRANCE FACILITY

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: SS | CHK. BY: AGA | APP. BY: SDS

CADD FILE: III-1B10(REV)2(10.28.22)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. **1B14**

MAVERICK COUNTY – EL INDIO MSW LANDFILL
MAVERICK COUNTY, TEXAS
PERMIT APPLICATION
SITE DEVELOPMENT PLAN PART III
ATTACHMENT 2

FILL CROSS-SECTIONS

Prepared for:
Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24

PERMIT ISSUED: SEPTEMBER 11, 2007

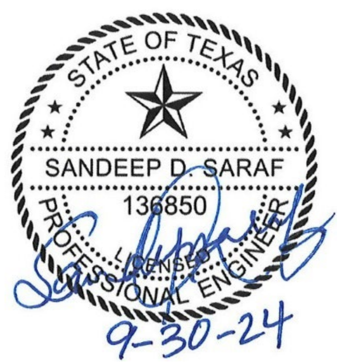
REVISIONS 2, 3, & 4 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

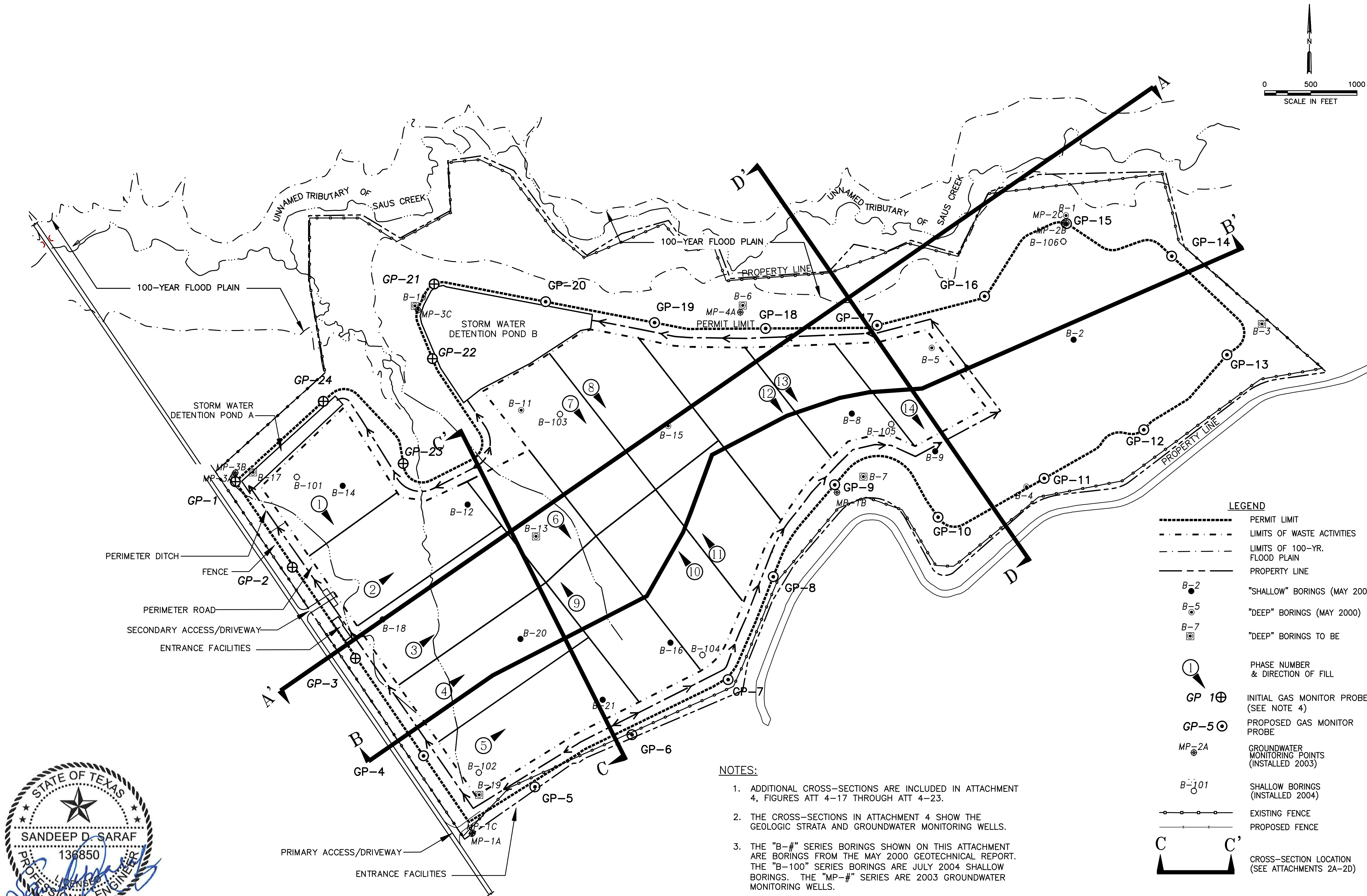
Revision 1 – January 2004, July 2004, August 2004
Revision 2 – April 2009
Revision 3 – July 2010
Revision 4 – October 2024
SCS Project No. 16208046.00, 16223092.00

TABLE OF CONTENTS

Drawings



SCS Engineers
TBPE Reg. # F-3407



NOTES:

1. ADDITIONAL CROSS-SECTIONS ARE INCLUDED IN ATTACHMENT 4, FIGURES ATT 4-17 THROUGH ATT 4-23.
2. THE CROSS-SECTIONS IN ATTACHMENT 4 SHOW THE GEOLOGIC STRATA AND GROUNDWATER MONITORING WELLS.
3. THE "B-#" SERIES BORINGS SHOWN ON THIS ATTACHMENT ARE BORINGS FROM THE MAY 2000 GEOTECHNICAL REPORT. THE "B-100" SERIES BORINGS ARE JULY 2004 SHALLOW BORINGS. THE "MP-#" SERIES ARE 2003 GROUNDWATER MONITORING WELLS.
4. THESE PROBES WILL BE INSTALLED PRIOR TO THE INITIAL ACCEPTANCE OF WASTE. REMAINING PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.

LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- PROPERTY LINE
- B-2 "SHALLOW" BORINGS (MAY 2000)
- B-5 "DEEP" BORINGS (MAY 2000)
- B-7 "DEEP" BORINGS TO BE
- 1 PHASE NUMBER & DIRECTION OF FILL
- GP 1 INITIAL GAS MONITOR PROBE (SEE NOTE 4)
- GP-5 PROPOSED GAS MONITOR PROBE
- MP-2A GROUNDWATER MONITORING POINTS (INSTALLED 2003)
- B-101 SHALLOW BORINGS (INSTALLED 2004)
- EXISTING FENCE
- PROPOSED FENCE
- C C' CROSS-SECTION LOCATION (SEE ATTACHMENTS 2A-2D)

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

REV	DATE	DESCRIPTION	BY
1	4/09	REVISED ALIGNMENT OF CROSS SECTION B-B'	RK
2	4/09	DECREASE SPACING OF GAS PROBES TO 600'	SS
3	9/24	REVISED LIMIT OF WASTE, LOCATION OF B-B' TO INCLUDE NEW FINAL COVER PEAK, AND LOCATION OF EXISTING FENCE.	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CROSS-SECTION LOCATIONS AND SOIL BORING LOCATIONS

PROJECT TITLE
MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DRN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: CC 6-09 LOCATIONS (9.10.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
2

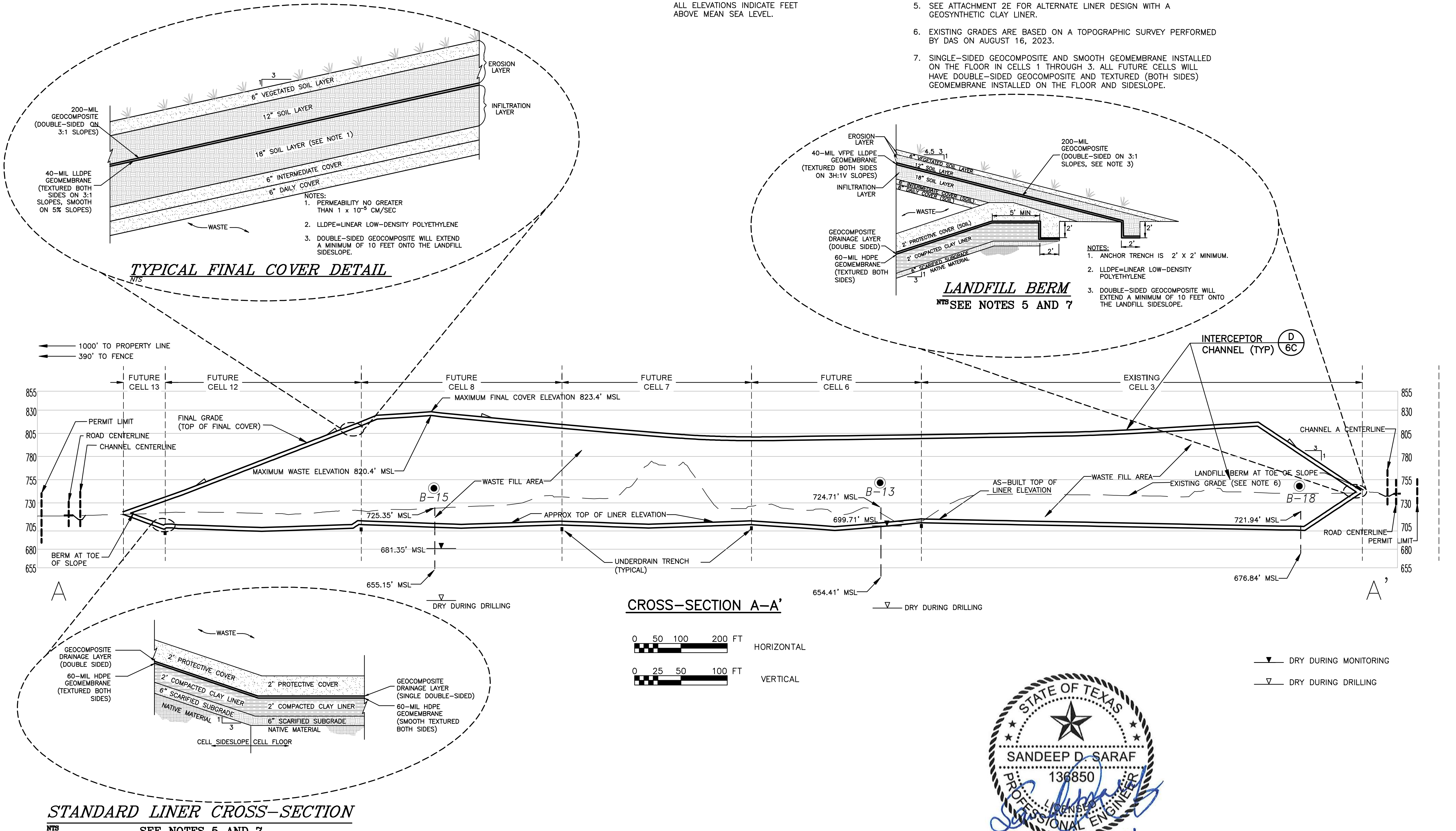
LEGEND:

- WATER LEVEL DURING DRILLING
- WATER LEVEL AT END OF MONITORING PERIOD
- B–5 BORING LOCATION AND BORING NUMBER

ALL ELEVATIONS INDICATE FEET ABOVE MEAN SEA LEVEL.

NOTES:

1. ADDITIONAL CROSS–SECTIONS ARE INCLUDED IN ATTACHMENT 4, FIGURES ATT 4–17 THROUGH ATT 4–23.
2. THE CROSS–SECTIONS IN ATTACHMENT 4 SHOW THE GEOLOGIC STRATA AND GROUNDWATER MONITORING WELLS.
3. THE BORINGS SHOWN ON THIS ATTACHMENT ARE BORINGS FROM THE MAY 2000 GEOTECHNICAL REPORT.
4. DETAILED BORING LOGS FOR THE BORINGS SHOWN ON THIS CROSS–SECTION ARE INCLUDED IN APPENDIX 2D OF THIS ATTACHMENT.
5. SEE ATTACHMENT 2E FOR ALTERNATE LINER DESIGN WITH A GEOSYNTHETIC CLAY LINER.
6. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.
7. SINGLE–SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE–SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.



CROSS–SECTION A–A'

0 50 100 200 FT HORIZONTAL

0 25 50 100 FT VERTICAL

- DRY DURING MONITORING
- DRY DURING DRILLING

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/10	ADDED NOTE 5 REFERENCE & NOTE; REVISED DETAIL TITLE	RK
2	10/10	REVISE PROJECT TITLE	RK
3	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS-SECTION A-A'

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO.: 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

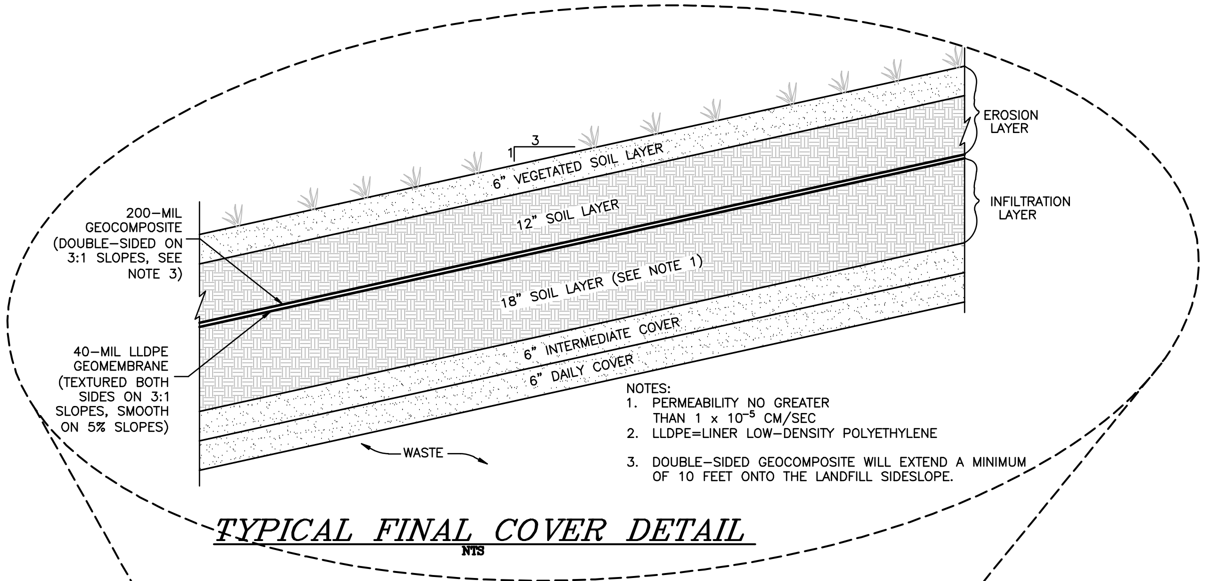
CADD FILE: CC 6–09 2A SECTIONS (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT **2A**

9/30/2024 3:41 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\CC 6-09 2A SECTIONS (09.13.2021)



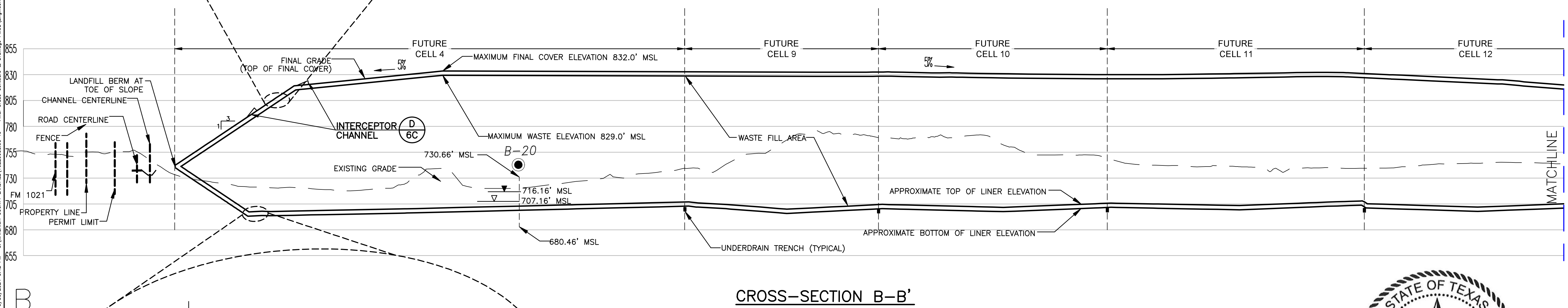
TYPICAL FINAL COVER DETAIL
NTS

LEGEND:

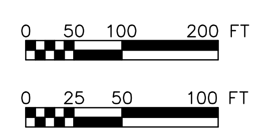
- ▽ WATER LEVEL DURING DRILLING
- ▼ WATER LEVEL AT END OF MONITORING PERIOD
- B-5 ⦿ BORING LOCATION AND BORING NUMBER
- ALL ELEVATIONS INDICATE FEET ABOVE MEAN SEA LEVEL.

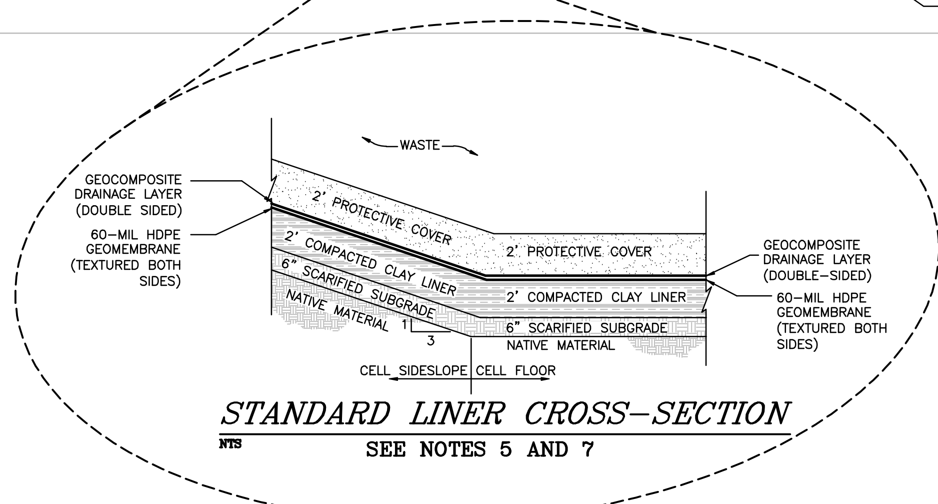
NOTES:

1. ADDITIONAL CROSS-SECTIONS ARE INCLUDED IN ATTACHMENT 4, FIGURES ATT 4-17 THROUGH ATT 4-23.
2. THE CROSS-SECTIONS IN ATTACHMENT 4 SHOW THE GEOLOGIC STRATA AND GROUNDWATER MONITORING WELLS.
3. THE BORINGS SHOWN ON THIS ATTACHMENT ARE BORINGS FROM THE MAY 2000 GEOTECHNICAL REPORT.
4. DETAILED BORING LOGS FOR THE BORINGS SHOWN ON THIS CROSS-SECTION ARE INCLUDED IN APPENDIX 2D OF THIS ATTACHMENT.
5. SEE ATTACHMENT 2E FOR ALTERNATE LINER DESIGN WITH A GEOSYNTHETIC CLAY LINER.
6. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.
7. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.



CROSS-SECTION B-B'





STANDARD LINER CROSS-SECTION
NTS
SEE NOTES 5 AND 7

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/10	ADDED NOTE 5 REFERENCE & NOTE; REVISED DETAIL TITLE	RK
2	10/10	REVISE PROJECT TITLE	RK
3	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS-SECTION B-B'

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

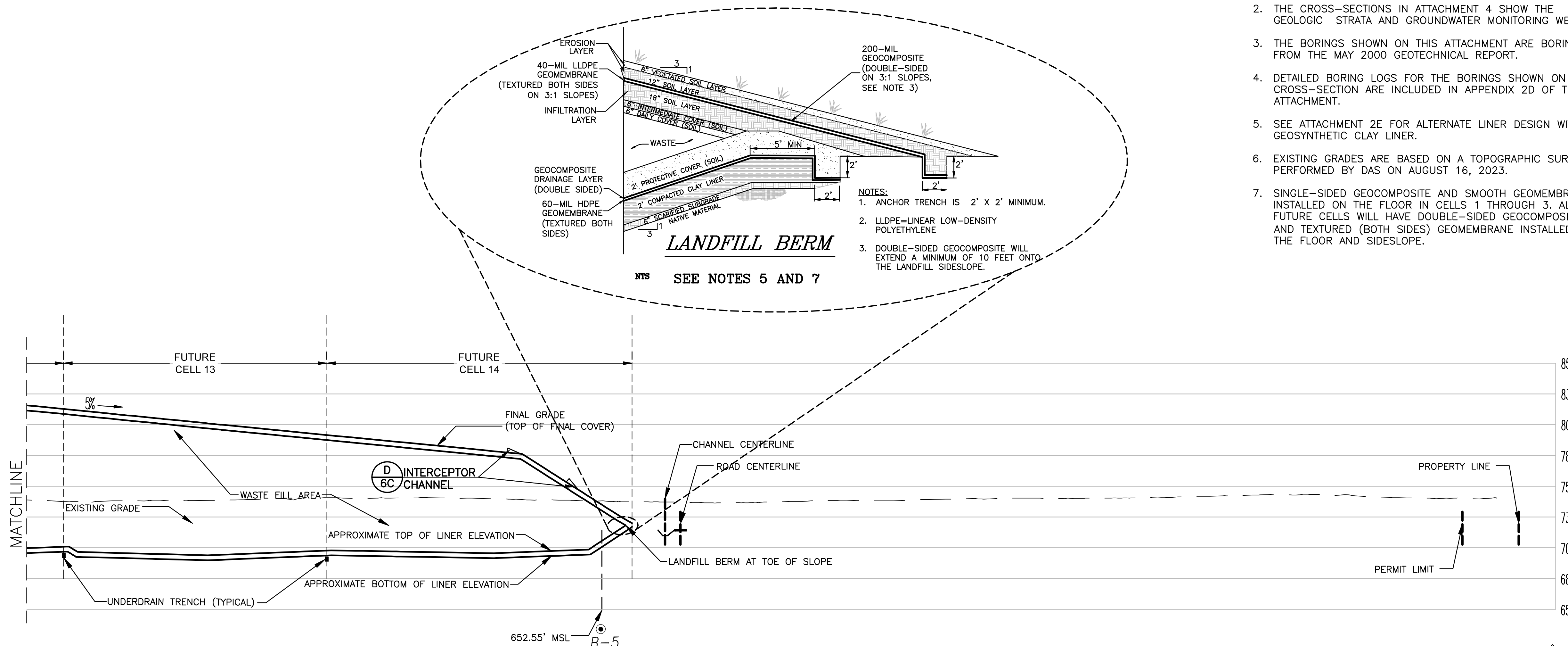
CADD FILE: CC 6-09 2A SECTIONS (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT **2B1**

9/30/2024 3:42 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\CC 6-09 2A SECTIONS (09.13.2021)



CROSS-SECTION B-B'

0 50 100 200 FT HORIZONTAL

0 25 50 100 FT VERTICAL

NOTES:

1. ADDITIONAL CROSS-SECTIONS ARE INCLUDED IN ATTACHMENT 4, FIGURES ATT 4-17 THROUGH ATT 4-23.
2. THE CROSS-SECTIONS IN ATTACHMENT 4 SHOW THE GEOLOGIC STRATA AND GROUNDWATER MONITORING WELLS.
3. THE BORINGS SHOWN ON THIS ATTACHMENT ARE BORINGS FROM THE MAY 2000 GEOTECHNICAL REPORT.
4. DETAILED BORING LOGS FOR THE BORINGS SHOWN ON THIS CROSS-SECTION ARE INCLUDED IN APPENDIX 2D OF THIS ATTACHMENT.
5. SEE ATTACHMENT 2E FOR ALTERNATE LINER DESIGN WITH A GEOSYNTHETIC CLAY LINER.
6. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.
7. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	4/09	REVISED SECTION TO NEW FINAL FILL GRADES	RK
2	7/10	ADDED NOTE 5 REFERENCE & NOTE	RK
3	10/10	REVISE PROJECT TITLE	RK
4	9/24	GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V;	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
CROSS-SECTION B-B'

PROJECT TITLE
MAVERICK COUNTY
EL INDIO MSW LANDFILL
PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

CADD FILE: CC 6-09 2A SECTIONS (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
2B2

9/30/2024 3:42 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\CC 6-09 2A SECTIONS (09.13.2021)

NOTES:

1. ADDITIONAL CROSS-SECTIONS ARE INCLUDED IN ATTACHMENT 4, FIGURES ATT 4-17 THROUGH ATT 4-23.
2. THE CROSS-SECTIONS IN ATTACHMENT 4 SHOW THE GEOLOGIC STRATA AND GROUNDWATER MONITORING WELLS.
3. THE BORINGS SHOWN ON THIS ATTACHMENT ARE BORINGS FROM THE MAY 2000 GEOTECHNICAL REPORT.
4. DETAILED BORING LOGS FOR THE BORINGS SHOWN ON THIS CROSS-SECTION ARE INCLUDED IN APPENDIX 2D OF THIS ATTACHMENT.
5. BORINGS B-12 AND B-21 ARE LOCATED APPROXIMATELY 200' FROM THE LOCATION OF THIS CROSS-SECTION. THEIR BORING INFORMATION IS INCLUDED TO SUPPLEMENT THAT PROVIDED BY BORING B-20 WHICH IS LOCATED ALONG THIS CROSS-SECTION.
6. SEE ATTACHMENT 2E FOR ALTERNATE LINER DESIGN WITH A GEOSYNTHETIC CLAY LINER.
7. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.
8. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.

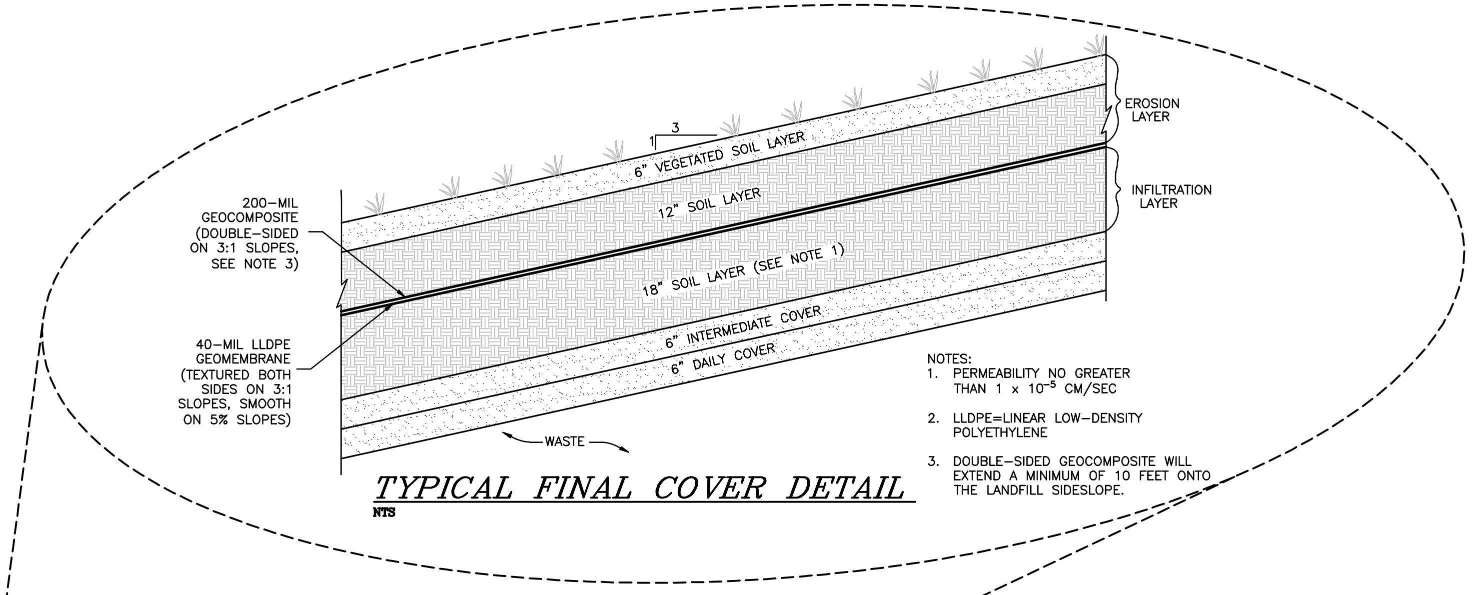
LEGEND:

WATER LEVEL DURING DRILLING

WATER LEVEL AT END OF MONITORING PERIOD

B-5 BORING LOCATION AND BORING NUMBER

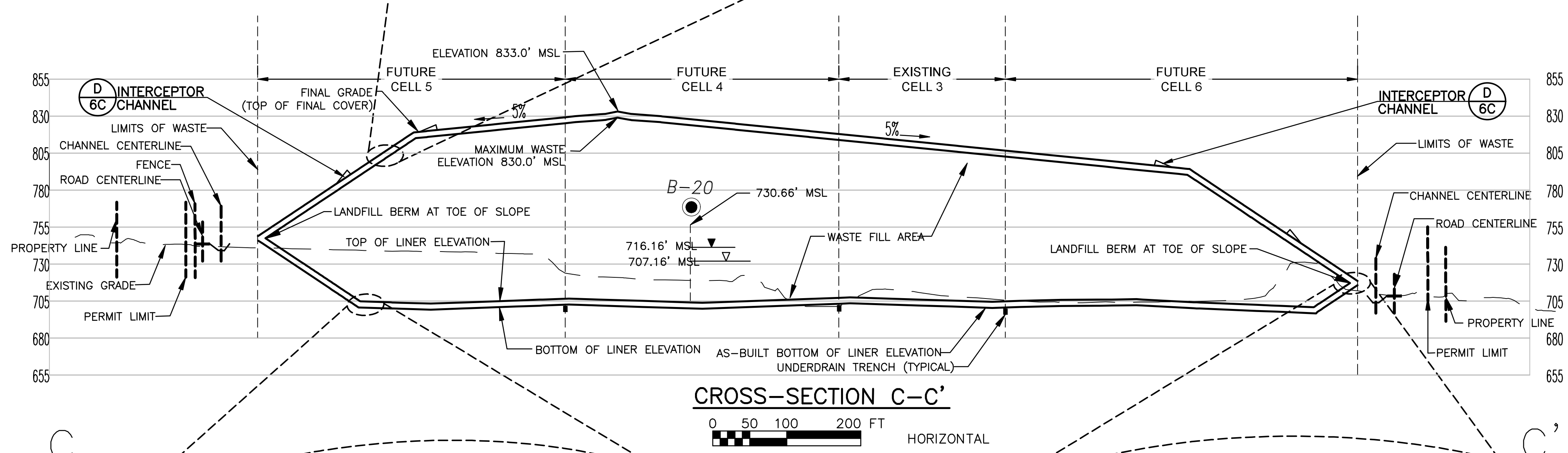
ALL ELEVATIONS INDICATE FEET ABOVE MEAN SEA LEVEL.



TYPICAL FINAL COVER DETAIL

NTS

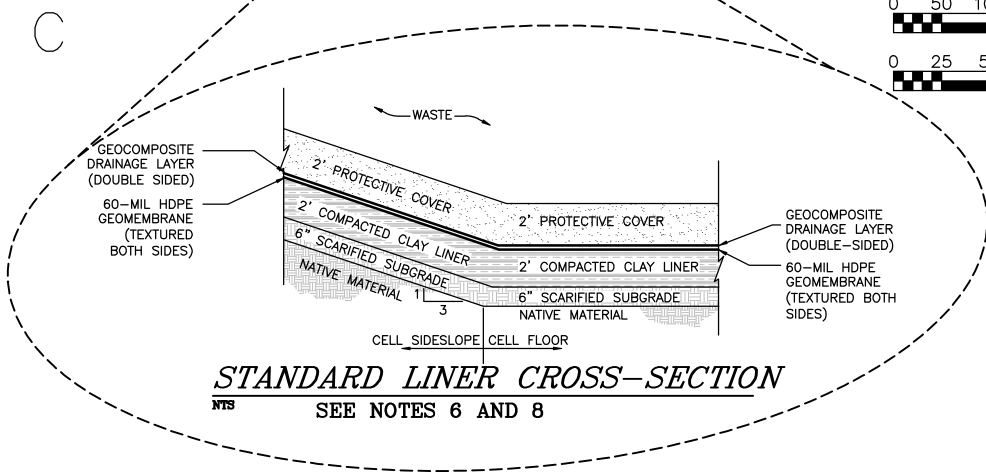
NOTES:
1. PERMEABILITY NO GREATER THAN 1 x 10^{-5} CM/SEC
2. LLDPE=LINEAR LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.



CROSS-SECTION C-C'

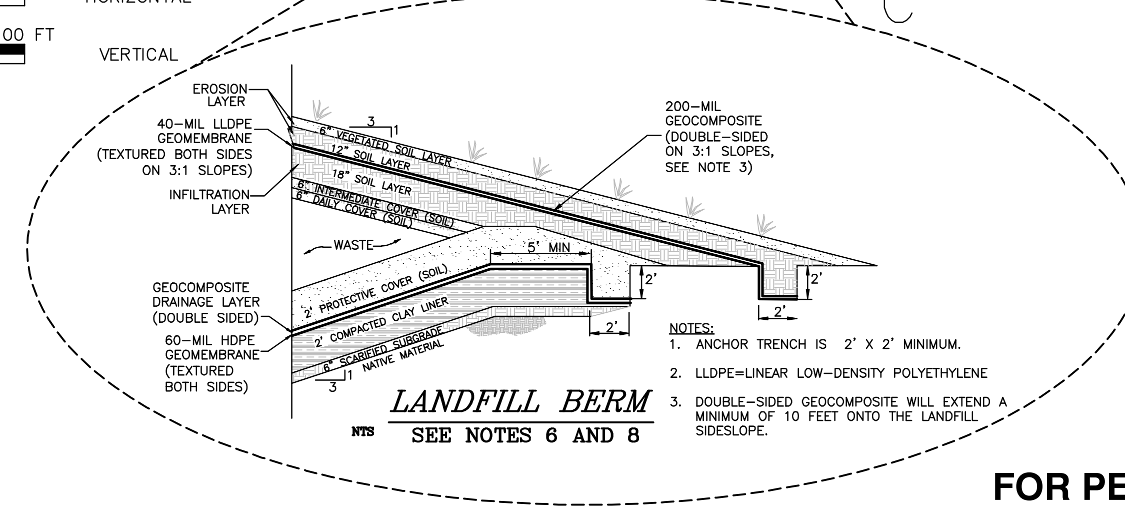
0 50 100 200 FT HORIZONTAL

0 25 50 100 FT VERTICAL



STANDARD LINER CROSS-SECTION

NTS SEE NOTES 6 AND 8



LANDFILL BERM

NTS SEE NOTES 6 AND 8

NOTES:
1. ANCHOR TRENCH IS 2' X 2' MINIMUM.
2. LLDPE=LINEAR LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/10	ADDED NOTE 6 REFERENCE & NOTE; REVISED DETAIL TITLE	RK
2	10/10	REVISE PROJECT TITLE	RK
3	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS-SECTION C-C'

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

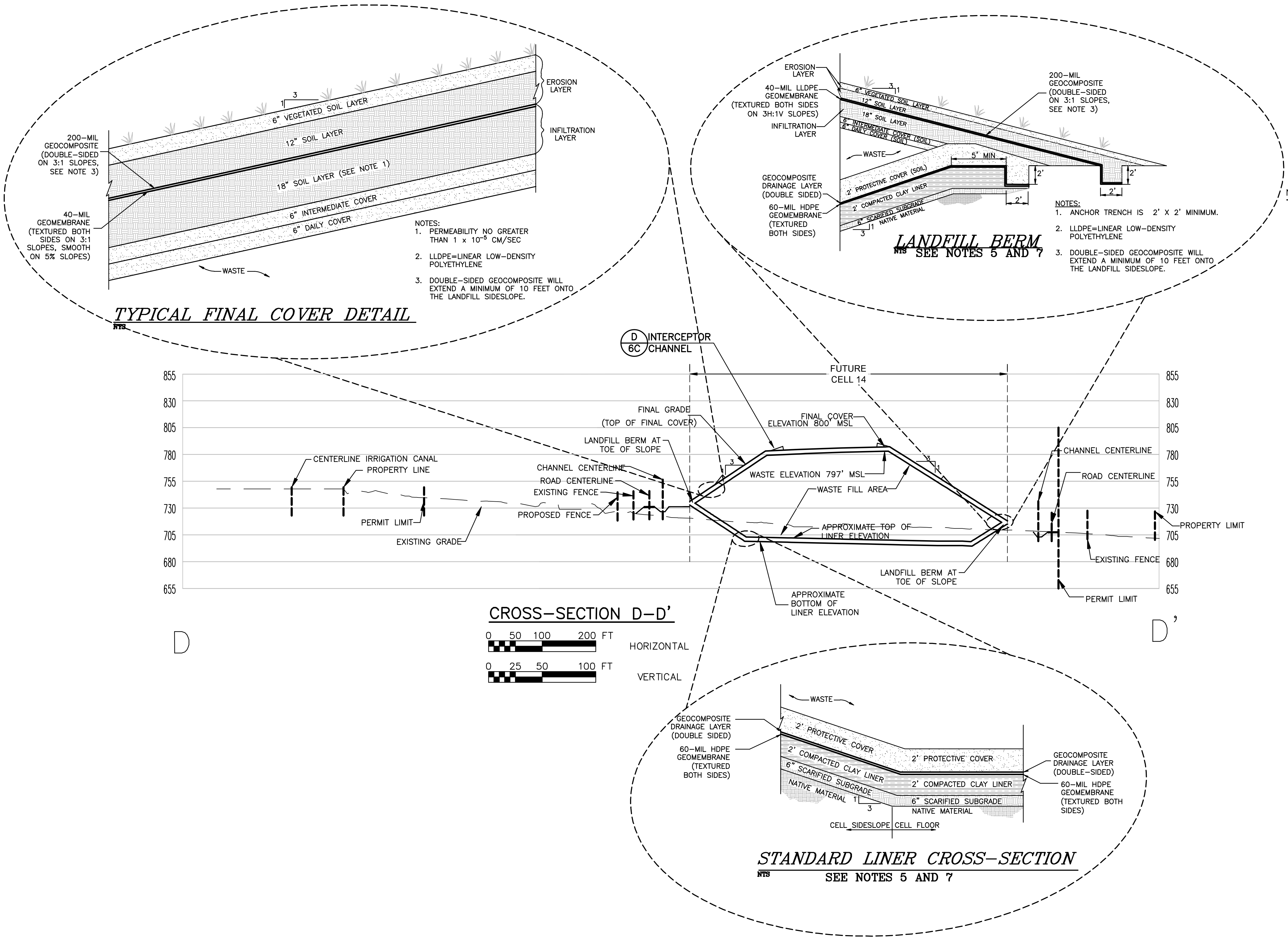
CADD FILE: CC 6-09 2A SECTIONS (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT 2C

9/30/2024 3:43 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\CC 6-09 2A SECTIONS (09.13.2021)



NOTES:

1. ADDITIONAL CROSS-SECTIONS ARE INCLUDED IN ATTACHMENT 4, FIGURES ATT 4-17 THROUGH ATT 4-23.
2. THE CROSS-SECTIONS IN ATTACHMENT 4 SHOW THE GEOLOGIC STRATA AND GROUNDWATER MONITORING WELLS.
3. THE BORINGS SHOWN ON THIS ATTACHMENT ARE BORINGS FROM THE MAY 2000 GEOTECHNICAL REPORT.
4. DETAILED BORING LOGS FOR THE BORINGS SHOWN ON THIS CROSS-SECTION ARE INCLUDED IN APPENDIX 2D OF THIS ATTACHMENT.
5. SEE ATTACHMENT 2E FOR ALTERNATE LINER DESIGN WITH A GEOSYNTHETIC CLAY LINER.
6. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.
7. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.

LEGEND:

- WATER LEVEL DURING DRILLING
- WATER LEVEL AT END OF MONITORING PERIOD
- B-5 BORING LOCATION AND BORING NUMBER
- ALL ELEVATIONS INDICATE FEET ABOVE MEAN SEA LEVEL.

STATE OF TEXAS SANDEEP D. SARAF 136850 LICENSED PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/10	ADDED NOTE 5 REFERENCE & NOTE; REVISED DETAIL TITLE	RK
2	10/10	REVISE PROJECT TITLE	RK
3	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: CROSS-SECTION D-D'

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

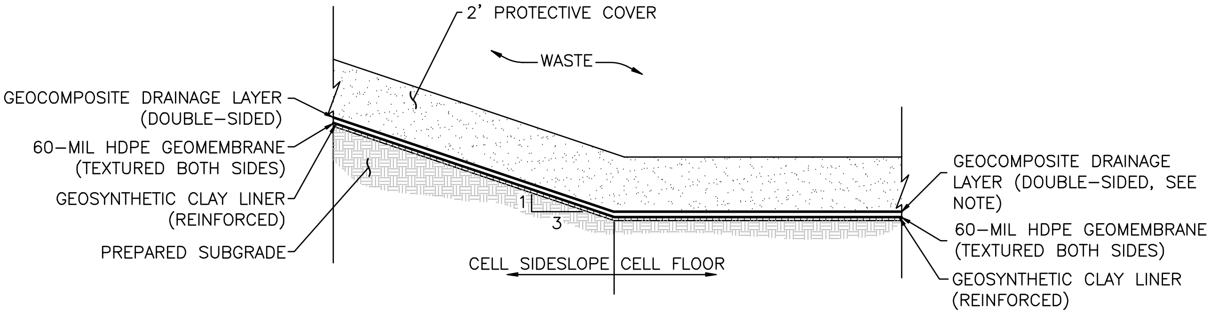
CADD FILE: CC 6-09 2A SECTIONS (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT 2D

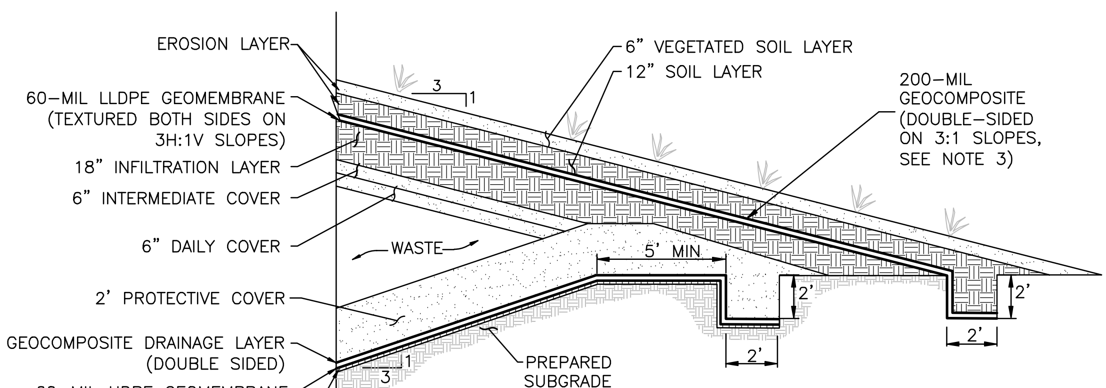
9/30/2024 3:44 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\CC 6-09 2A SECTIONS (09.13.2021)



ALTERNATE LINER CROSS-SECTION

NTS

NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.



LANDFILL BERM WITH GCL ALTERNATE

NTS

NOTES:

1. ANCHOR TRENCH IS 2' X 2' MINIMUM.
2. LLDPE=LINEAR LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.

FOR PERMIT PURPOSES ONLY

7/31/2024 10:09 AM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\2E

REV	DATE	DESCRIPTION	BY
2	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

DRAWING TITLE: **ALTERNATE LINER DESIGN**

PROJECT TITLE: **MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION**

CLIENT: **MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: RRK | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: 2E

DATE: 09/2024

SCALE: AS SHOWN

DRAWING NO. **2E**

MAVERICK COUNTY – EL INDIO MSW LANDFILL
MAVERICK COUNTY, TEXAS
PERMIT APPLICATION
SITE DEVELOPMENT PLAN PART III
ATTACHMENT 3

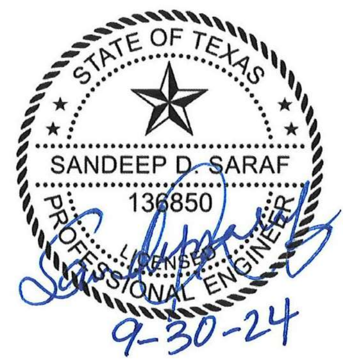
EXISTING CONTOUR MAP

Prepared for:

Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

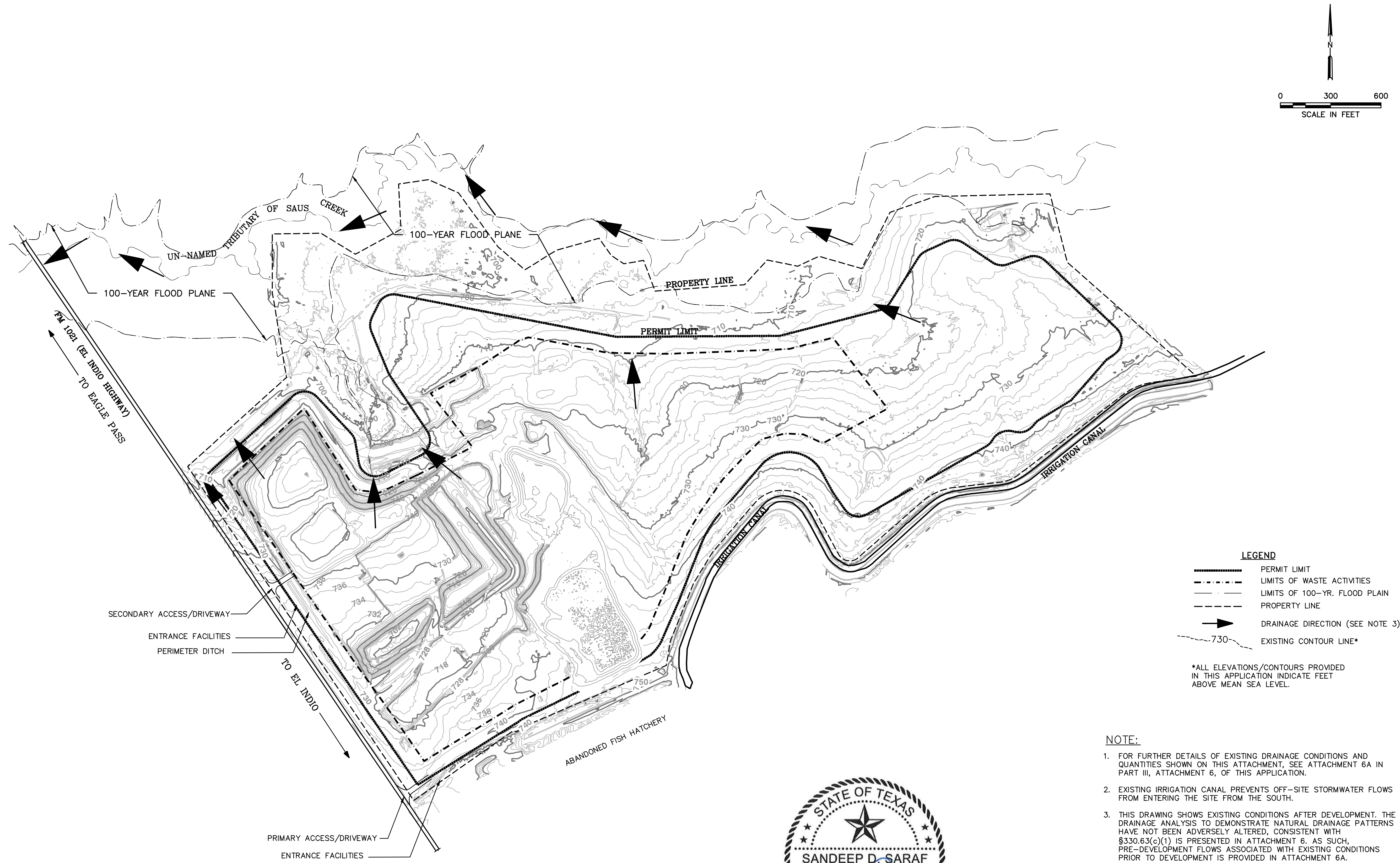


PERMIT ISSUED: SEPTEMBER 11, 2007

REVISIONS 2 & 3 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 1 – July 2004
Revision 2 – October 2010
Revision 3 – September 2024
SCS Project No. 16212041.00 & 16223092.00



NOTE:

1. FOR FURTHER DETAILS OF EXISTING DRAINAGE CONDITIONS AND QUANTITIES SHOWN ON THIS ATTACHMENT, SEE ATTACHMENT 6A IN PART III, ATTACHMENT 6, OF THIS APPLICATION.
2. EXISTING IRRIGATION CANAL PREVENTS OFF-SITE STORMWATER FLOWS FROM ENTERING THE SITE FROM THE SOUTH.
3. THIS DRAWING SHOWS EXISTING CONDITIONS AFTER DEVELOPMENT. THE DRAINAGE ANALYSIS TO DEMONSTRATE NATURAL DRAINAGE PATTERNS HAVE NOT BEEN ADVERSELY ALTERED, CONSISTENT WITH §330.63(c)(1) IS PRESENTED IN ATTACHMENT 6. AS SUCH, PRE-DEVELOPMENT FLOWS ASSOCIATED WITH EXISTING CONDITIONS PRIOR TO DEVELOPMENT IS PROVIDED IN ATTACHMENT 6A.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

THE ENGINEERING WORK ENCOMPASSED IN THE ORIGINAL DRAWING, INCLUSIVE OF REVISIONS 1 AND 2 (AS NOTED IN THE REVISION BLOCK), WAS SEALED BY MR. DANIEL P. HEJL, JR., P.E., TBPE LICENSE NO. 68211, OF HEJL, LEE & ASSOCIATES, INC. ON JULY 23, 2004. ANY WORK NOT SPECIFICALLY NOTED BY THE SEAL OF MR. RYAN KUNTZ, P.E. (REVISION 3) AND MR. SANDEEP SARAF, P.E. (REVISION 4) ARE ASSUMED TO REMAIN THE WORK OF MR. DANIEL P. HEJL, JR., P.E.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/20/04	III-3-REV JULY 2004.DWG	SH
2	5/26/04	III-1A.DWG	SH
3	10/2014	ADD SECONDARY ENTRANCE GATE	RRK
4	9/2024	REVISED LIMIT OF WASTE AND FINAL DRAINAGE CONDITIONS	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING
EXISTING CONTOUR MAP

PROJECT
MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: SS | CHK. BY: AGA | APP. BY: SDS

CADD FILE: III-3 - (10-28-2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 3

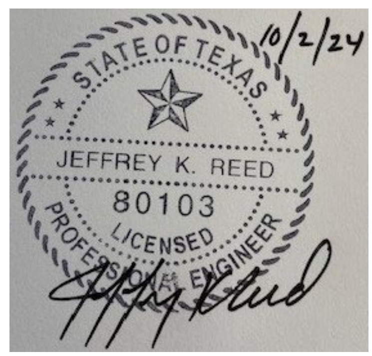
7/31/2024 10:15 AM G:\MAVERICK COUNTY LANDFILL\16220068.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\III-3 - (10-28-2021)

PART III
SITE DEVELOPMENT PLAN
ATTACHMENT 4

APPENDIX E - GEOTECHNICAL REPORT

FOR

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316



Prepared for:
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

PERMIT ISSUED: SEPTEMBER 11, 2007

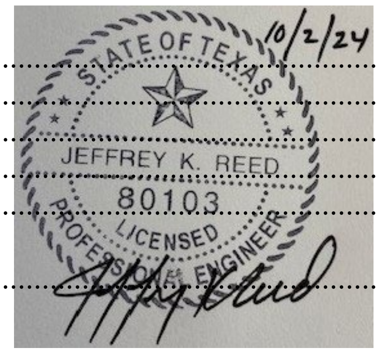
REVISIONS 1, 2, and 3 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 1 – April 2009
Revision 2 – July 2010, October 2010, and January 2011
Revision 3 – October 2024
SCS Project No. 16208046.00, 16209033.00, 16223092.00

TABLE OF CONTENTS

SECTION **PAGE**



LIST OF APPENDICES

4.0 SLOPE STABILITY ANALYSES

Several slope stability analyses were performed to assess the stability of the proposed landfill. In particular, stability of the proposed excavated landfill side slopes, stability of the interior waste slopes, the overall stability of the final filled landfill, and the stability of the final cover system were evaluated.

4.1 Stability Analysis of Excavated Slopes

A stability analysis was performed to consider the potential for formation of failure surfaces in the soils in which the landfill is founded. The stratigraphy and strength data for the in-situ soils were developed from borings and laboratory testing described above.

With the exception of the side slopes, which will be cut to a slope of 3H:1V, the excavated grades of the landfill will range on the floor from 2 to 5 percent. Therefore, the critical sections will occur along the perimeter of the cells. The maximum excavation depth is limited to 52 feet, therefore, the maximum 3H:1V slope height will not exceed approximately 55 feet.

XSTABL Version 5.205, an integrated slope stability analysis program for personal computers, was used for the analysis. The slope geometry for the critical section of the landfill was input into the program along with the unit weight and strength parameters. Potential failure surfaces were analyzed and the minimum factor of safety was computed. The calculations are presented in ***Appendix E-2***.

As indicated in Appendix E-2, two slopes were analyzed. Assuming a 45-foot high cut slope in native clay, the analysis predicts a factor of safety exceeding 1.7. The XSTABL analysis also indicates that the ground water level within the native tan clay would need to be in excess of 20 feet above the toe of the cut slope to reduce the factor of safety to 1.5.

4.2 Stability Analysis During Filling

Analyses were performed to assess the stability of interior waste slopes. These analyses consider the liner system as follows (from top to bottom):

- 24-inch thick layer of protective cover soil;
- geocomposite drainage layer*;
- 60-mil smooth (floor only)** or textured (floor and/or sideslope) high density polyethylene (HDPE) geomembrane; and
- 2-foot thick compacted clay liner, or Geosynthetic Clay Liner (GCL)**.

* In Cells 1, 2, and 3, smooth geomembrane and a single-sided geocomposite were used on the cell floor, whereas textured geomembrane and double-sided geocomposite were used on the side slopes. In future cells, textured geomembrane and double-sided geocomposite will be used on cell floors and sideslopes.
** Cell 3 was constructed with a GCL/HDPE geomembrane liner system. In compliance with the current permit, 24-in thick compacted clay liner may be replaced with a reinforced GCL in the future cells.

Strength parameters and interface shear strengths are shown in ***Appendix E-3***.

A review of the floor grades and final cover contours was performed to determine the worst case conditions. A worst case condition was considered as a combination of greatest waste height, steepest floor slope directed down slope, or away from the interim waste slope, and interim waste slope angle. The slope of the floor liner system is 2 percent toward a center leachate collection trench for each phase, with the exception to Phases 6 and 9, that consist of floor slopes ranging from 3 to 5%, as shown on Attachment 1D1 and Attachment 10B. Specifically, the floor slopes within these phases are as follows: 4% in Phase 6 and 3% and 4% in Phase 9towards the center leachate collection trench. The maximum height of waste over the liner system is less than 140 feet, but is highest over Phases 6 through 11. Based on combination of the above criteria to determine worst case interim waste fill scenarios, the most critical cross section (Section A-A’) was determined as shown on Attachment 10B in this section where the maximum waste height can be achieved with floor slopes ranging from 2 to 4%. Several worst-case scenario analyses were performed to determine appropriate filling conditions for representative floor grade and waste cross sections. In addition, the interior waste slope was assumed to be graded to either 3H:1V or 4H:1V.

The results of the most critical analyses (interim conditions) are presented on Table 1, with the input parameters, and corresponding model output are provided in Appendix E-3. The analyses demonstrate that smooth geomembrane on the floor is acceptable for phases with floor slopes of 2% or flatter. It is recommended that portions of phases with floor slopes steeper than 2% utilize textured geomembrane on the floor. Smooth geomembrane is acceptable for floor slopes greater than 2% provided waste filling in the cell is conducted in lifts spreading across the entire cell floor starting from the low end (i.e. leachate sump) and progressing to the high end.

The interface friction angle used below for the single-sided geocomposite versus smooth HDPE geomembrane (8°) is a conservative assumption compared to the value reported for this interface in the literature (i.e., 11° according to GRI Report #30).

Table 1
Results of Interim Waste Slope Stability Analyses

Scenario	File name	Failure Mode	Liner System	Lowest Interface Peak Shear Strength	Factor of Safety
Scenario 1 Slope Section: 3:1 waste slope, 140' max. waste height. 2% base slope	MSLB825-rev	Block	Double-sided GC/FML-Tex	18°	1.70
Scenario 2 Slope Section: 3:1 waste slope, 140' max. waste height. 4% base slope.	MSLB837-rev	Block	Double-sided GC/FML-Tex	18°	1.65
Scenario 3 Cross Section A-A Slope Section: 3:1 waste slope with two 50' wide benches at 50' vert. height. 140' max waste height. (Base slope varied per grading plan)	MSLB767	Block	Single-sided GC/FML-Smooth	8°	1.51
Scenario 4 Cross Section A-A Slope Section: 4:1 Waste slope with no benches. 140' max. waste height. (Base slope varied per grading plan)	MSLB789	Block	Single-sided GC/FML-Smooth	8°	1.53

Notes:
1. Double-sided GC/60-mil HDPE (textured) interface = 18°
2. Single-sided GC/60-mil HDPE (smooth) interface= 8° (assumed worst case, conservative assumption compared to literature)
3. Soil Liner (unsat)/60-mil HDPE (smooth) interface= 18°
4. Soil Liner (sat)/60-mil HDPE (smooth) interface= 11°
5. GCL (reinf)/60-mil HDPE (smooth) interface = 13°
6. Soil Liner internal shear strength = 20°, 200 psf

4.3 Stability of Final Filled Configuration

The stability of the final filled configuration was analyzed as presented in Appendix E-5.

STABL Version 5M (2016 version) was used for this analysis. Cross sections selected for analyses, input parameters and assumptions, results, and PCSTABL5M output files are presented in Appendix E-5. The results of the analyses are also presented in Table 2 below.

Table 2. Calculated FSs for Final Conditions

Cross Section	Output	Analyzed Stability	Calculated Factor of	Target

	File Name	Mode	Safety	Factor of Safety
Cross Section 1	Mavco_section1_wb	Block	1.61	1.50
Cross Section 2	Mavco_section2_wb	Block	1.87	1.50
Cross Section 3	Mavco_section3_wb	Block	1.75	1.50
Cross Section 3	Mavco_section3_circular	Circular	2.31	1.50

Adequate FSs were calculated for the analyzed cross sections.

4.4 Stability of the Final Cover Liner System

A stability analysis of the final cover liner system was performed to estimate the potential for sliding to occur following closure of the landfill cells. Conservatively, an infinite slope analysis method for c-φ soils with seepage was used to investigate the soil cover/geomembrane interface shear strength parameters. A worst-case section, consisting of a 33% (3 Horizontal: 1 Vertical (3H:1V))slope was analyzed.

Veneer stability of the final cover system sideslope was evaluated using a veneer stability model developed by Koerner and Soong (1998). Static forces were considered in the veneer stability analysis, using basic equations as shown on the calculation spreadsheets in Appendix E-4.

The veneer slope stability analysis was performed based on the following assumptions:

- Maximum final cover slope was assumed to be at a 3H:1V slope, or 18.44 degrees.
- Length of the slope was assumed to be 340 feet (104 m, longest 3H:1V slope of the Landfill).
- Using interface friction angle values reported in GRI #30, 21 degrees interface friction angle with 5.8 kPa adhesion (for textured LLDPE) was used in the analyses.
- The average cover soil internal friction angle was assumed to be 20 degrees and zero cohesion (to be conservative).
- It is assumed that the head on the geomembrane liner is minimal due to the double-sided geocomposite drainage layer on the geomembrane.

Veneer stability of the final cover system top deck was evaluated the same method (Koerner and Soong (1998) but this time also taking the seepage forces into account in the analysis since a geocomposite drainage layer is not proposed for the top deck. Conservatively, it is assumed that the soil layers above the geomembrane will be saturated. The top deck veneer slope stability analysis was performed based on the following assumptions:

- Maximum final cover slope was assumed to be at a 5% slope, or 2.86 degrees.
- The average cover soil internal friction angle was assumed to be 20 degrees and zero cohesion (to be conservative).
- Using interface friction angle values reported in GRI #30, 11 degrees interface friction angle (for smooth LLDPE) was used in the analyses.
- The seepage force analysis assumed percolation from a 24-hour, 25-year storm event (7.9 inches) to be 8.4 mm per hour.

The results of the veneer slope stability analysis of the final cover system are presented in Appendix E-4. As shown in Appendix E-4, the target safety factor of 1.5 was exceeded with a minimum estimated safety factor of 3.37 for the 3H: 1V side slopes. The method presented is a conservative evaluation of veneer stability, as the analysis disregards tensile strength of the geosynthetic components (e.g., geomembrane and geotextile/geonet composite) and cohesion of the cover soils. Saturation of the cover soil is not anticipated since the drainage layer will have sufficient capacity to transmit flow so that the final cover remains unsaturated.

Since the final cover slopes vary from approximately 5 to 33 percent an analysis was performed to determine whether a smooth geomembrane could be used along the flatter portions of the cover. Using a conservative estimate of the minimum expected interface shear strength, the results indicate that smooth geomembrane can be used on crown slopes of 5 percent and less.

The results of the final cover stability analyses are included in ***Appendix E-4***.

5.0 SUMMARY

Raba-Kistner Consultants, Inc. has provided engineering services in support of a Subtitle D permit application for the proposed Maverick County — El Indio Landfill near El Indio, Texas. This report presents the geotechnical summary and engineering evaluations and analyses performed to demonstrate that the soils within the proposed landfill are suitable for the intended purpose.

A conservative settlement analysis resulted in a computed maximum differential settlement of less than 3 inches for leachate collection headers. This corresponds to a post-settlement reduction on the slope of the pipe of 0.02 percent compared to the minimum design grade for the leachate lines of 1.0 percent.

Analyses were performed to assess the stability of the excavated landfill side slopes, the interior waste slopes, the final filled landfill, and the final cover system configurations. These analyses indicated minimum factors of safety of 1.5 in all cases for slopes not exceeding 3H:1V (33%) based on the conditions provided in Table 1 and Table 2.

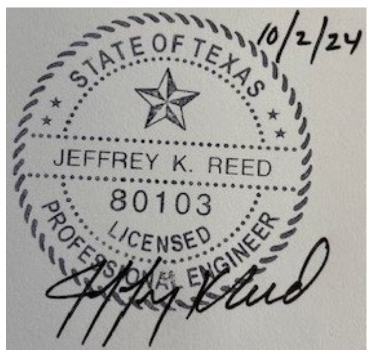
6.0 References

1. Turner, A.K, and Schuster, R.L., "Landslides: Investigation and Mitigation," Transportation Research Board Special Report 247, Transportation Research Board, National Research Council, 1996.

2. Barfield, BJ; Warner, R.C, "Applied Hydrology and Sedimentology for Disturbed Areas," Stillwater, OK, Oklahoma Technical Press, 1981.

APPENDIX E-3

Waste Slope Stability



SCS Engineers	WASTE SLOPE STABILITY-GM/CCL		
	Proj. No. 16208046.00	Made By: JMH	Date: 3/19/2010
	Project: Maverick County-El Indio Landfill Maverick County, TX	Checked By: JKR	Sheet 1 of 2

OBJECTIVE: Estimate the factor of safety against sliding for interior waste slopes.

GIVEN: Based on a review of the designed grades, the following worst-case conditions were identified:

Floor Grade	2.0% - 4%	1.15 degrees
Maximum Interior Waste Slopes	33.0%	18.3 degrees
Maximum Waste Height		140 feet

Liner System Evaluated (from top to bottom):
24" Protective Cover consisting of on-site soils
Geocomposite Drainage Layer
60-mil HDPE Geomembrane
24-in. thick Compacted Clay Liner

Based on a review of available data, the following parameters were assigned to the referenced materials.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	Φ (deg)	C (psf)	moist	saturated	
Waste	32	200	65	75	Bray et al. (2009)
Protective Cover	20	200	100	115	Est. for clay
Protective Cover/Geocomposite Interface	26	0	---	---	*
Geocomposite SS/Smooth Geomembrane Interface	11	0	---	---	*
Geocomposite DS/Textured Geomembrane Interface	26	0	---	---	*
Smooth Geomembrane/Clay Interface	11	300	---	---	*
Textured Geomembrane/Clay Interface	18	0	---	---	*
Compacted Clay Liner	20	200	100	116	Estimate for compacted clay

Notes:

* GRI Report #30, "Direct Shear Database of Geosynthetic-to Geosynthetic and Geosynthetic-to-Soil Interfaces" by G. R. Koerner and D. Narejo (2005). Peak friction angles are reported in this table.

** Based on shear strength parameters, the critical interface will be the SS geocomposite (geonet side) and smooth geomembrane.

SCS Engineers	WASTE SLOPE STABILITY-GM/CCL		
	Proj. No. 16208046.00	Made By: JMH	Date: 3/19/2010
	Project: Maverick County-El Indio Landfill Maverick County, TX	Checked By: JKR	Sheet 2 of 2

METHOD: PCStabl5M3, Purdue University, 1985
Analyze the critical condition for block and circular failure surfaces.

RESULTS: See Table 1, Appendix E-3

CONCLUSIONS:

Using the estimated strength parameters and worst-case slopes, the analyses indicate that the temporary waste slopes will remain stable under configurations presented in Table 1.

SCS Engineers	WASTE SLOPE STABILITY-GM/GCL		
	Proj. No. 16208046.00	Made By: JMH	Date: 3/19/2010
	Project: Maverick County-El Indio Landfill Maverick County, TX	Checked By: JKR	Sheet 1 of 2

OBJECTIVE: Estimate the factor of safety against sliding for interior waste slopes.

GIVEN: Based on a review of the designed grades, the following worst-case conditions were identified:

Floor Grade	2.0% - 4%	1.15 degrees
Maximum Interior Waste Slopes	33.0%	18.3 degrees
Maximum Waste Height		140 feet

Liner System Evaluated (from top to bottom):
24” Protective Cover consisting of on-site soils
Geocomposite Drainage Layer
60-mil HDPE Geomembrane
Geosynthetic Clay Liner (GCL) reinforced on floor and on sideslopes

Based on a review of available data, the following parameters were assigned to the referenced materials.

Material	**Strength Parameters**		**Unit Weight (pcf)**		**Reference**
	Φ (deg)	**C (psf)**	**moist**	**saturated**	
Waste	32	200	65	75	Bray et al. (2009)
Protective Cover	20	200	100	115	Est. for clay
Protective Cover/Geocomposite Interface	26	0	---	---	*
Geocomposite/Smooth Geomembrane Interface	11	0	---	---	*
Geocomposite/Textured Geomembrane Interface	26	0	---	---	*
Smooth Geomembrane/ reinforced GCL Interface	13.9		---	---	**
Textured Geomembrane/reinforced GCL Interface	21.3		---	---	*
GCL/Subgrade Interface	20		---	---	*
GCL Internal (Reinforced)	25		---	---	*

Notes:

* GRI Report #30.** Interface friction angle testing performed by TRI Environmental during Cell 3 construction (attached in Appendix E-5).

** Based on shear strength parameters, the critical interface will be the SS geocomposite (geonet side) and smooth geomembrane.

SCS Engineers	WASTE SLOPE STABILITY-GCL		
	Proj. No. 16208046.00	Made By: JMH	Date: 3/19/2010
	Project: Maverick County-El Indio Landfill Maverick County, TX	Checked By: JKR	Sheet 2 of 2

METHOD: PCStabl5M3, Purdue University, 1985
Analyze the critical condition for block and circular failure surfaces.

RESULTS: See Table 1, Appendix E-3

CONCLUSIONS:

Using the estimated strength parameters and worst-case slopes, the analyses indicates that the temporary waste slopes will remain stable under configurations presented in Table 1.

Table 1. Waste Interim Slope Stability Analysis

Scenario	File name	Failure Mode	Liner System	Lowest Interface Peak Shear Strength	Factor of Safety
Scenario 1 Slope Section: 3:1 waste slope, 140' max. waste height. 2% base slope	MSLB825-rev	Block	Double-sided GC/FML-Tex	18°	1.70
Scenario 2 Slope Section: 3:1 waste slope, 140' max. waste height. 4% base slope.	MSLB837-rev	Block	Double-sided GC/FML-Tex	18°	1.65
Scenario 3 Site-specific Slope Section: 3:1 waste slope with two 50' wide benches at 50' vert. height. 140' max waste height. (Base slope varied per grading plan)	MSLB767	Block	Single-sided GC/FML-Smooth	8°	1.51
Scenario 4 Site-specific Slope Section: 4:1 Waste slope with no benches. 140' max. waste height. (Base slope varied per grading plan)	MSLB789	Block	Single-sided GC/FML-Smooth	8°	1.53

Notes:
1. Double-sided GC/60-mil HDPE (textured) interface = 18°
2. Single-sided GC/60-mil HDPE (smooth) interface= 8º (assumed worst case, conservative)
3. Soil Liner (unsat)/60-mil HDPE (smooth) interface= 11°
4. Soil Liner (sat)/60-mil HDPE (smooth) interface= 11°
5. GCL (reinf)/60-mil HDPE (smooth) interface = 13.9°
6. Soil Liner internal shear strength = 20º, 200 psf
7. Revised stability runs for Scenarios 1 and 2 are attached. Cells 4 to 14 will be constructed with textured geomembrane on the cell floors. Therefore Scenarios 3 and 4 do not apply to Cells 4 to 14. In addition, the revised friction angle is higher than the one previously used. Therefore, Scenarios 3 and 4 are not revised.

SCENARIO 1

Slope Section:

3:1 Waste Slope, 140’ (max.) Waste Height. 2% Base Slope

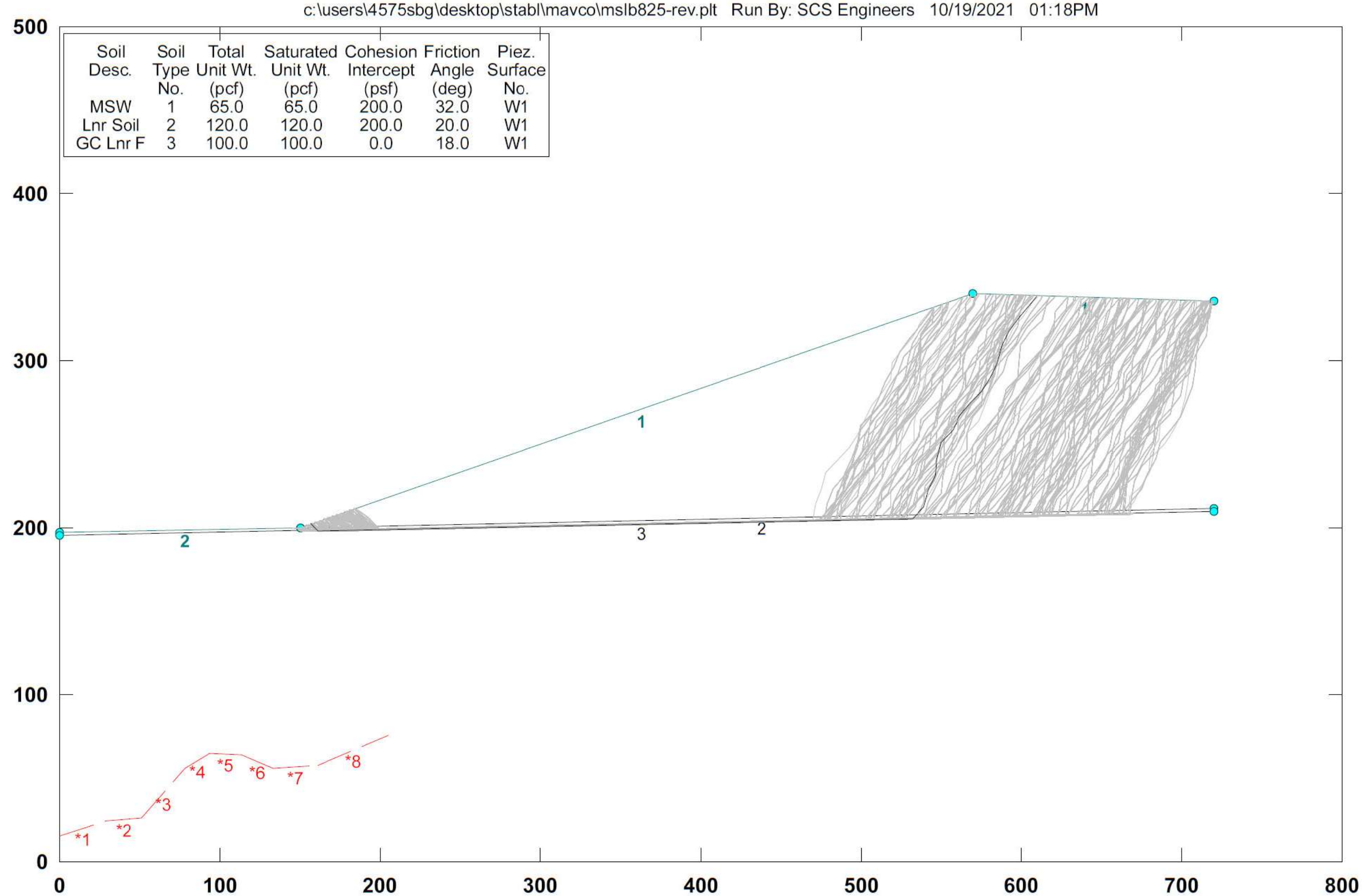
Block-Type Failure Surface

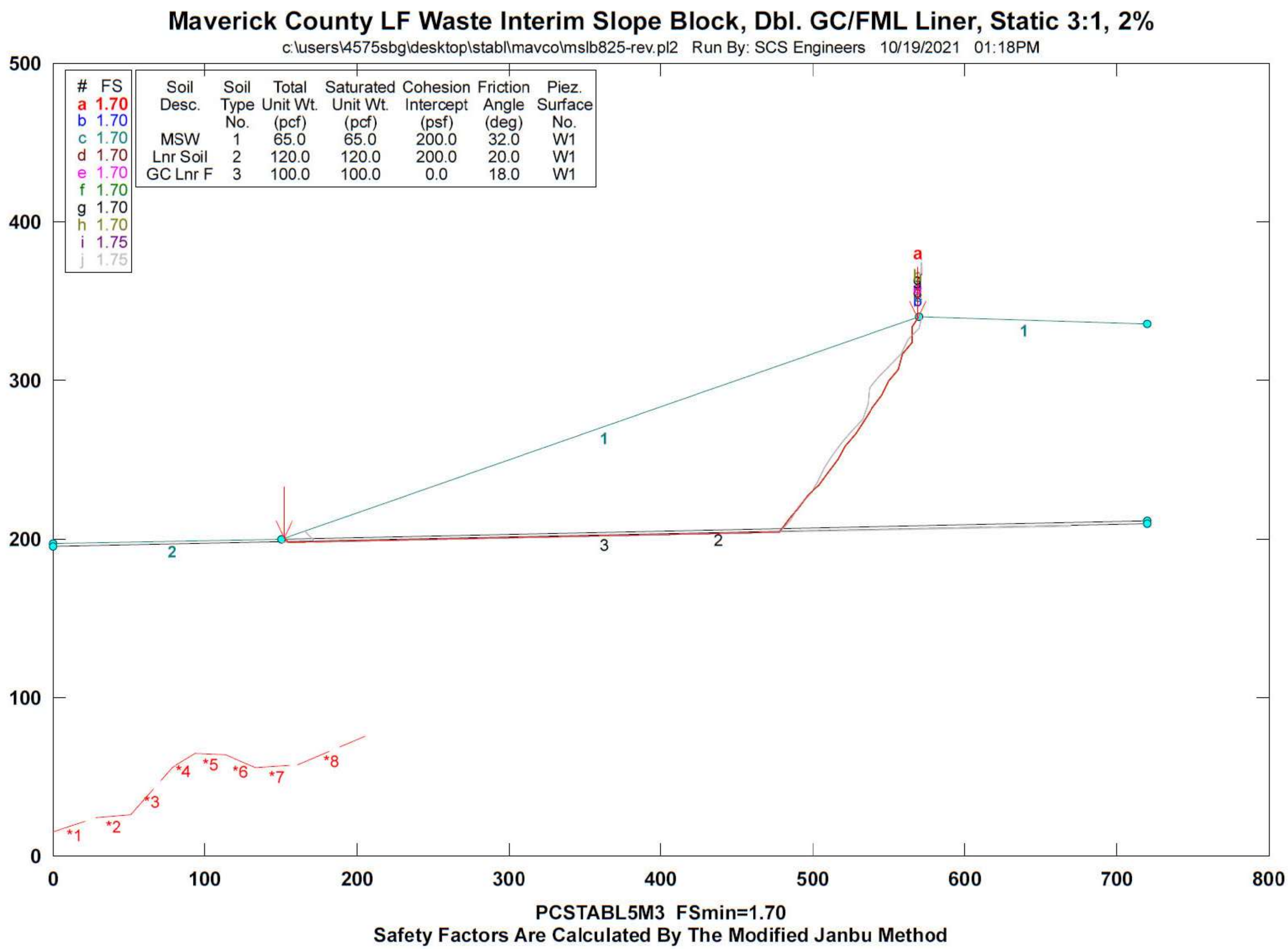
Interface Friction Angle= 18°

Maverick County LF Waste Interim Slope Block, Dbl. GC/FML Liner, Static 3:1, 2%

c:\users\4575sbg\desktop\stabl\mavco\mslb825-rev.plt   Run By: SCS Engineers   10/19/2021   01:18PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
MSW	1	65.0	65.0	200.0	32.0	W1
Lnr Soil	2	120.0	120.0	200.0	20.0	W1
GC Lnr F	3	100.0	100.0	0.0	18.0	W1





Maverick County LF Waste Interim Slope Block, Dbl. GC/FML Liner, Static 3:1, 2%
c:\users\4575sbg\desktop\stabl\mavco\mslb825-rev.pl2 Run By: SCS Engineers 10/19/2021 01:18PM
FS
a 1.70
b 1.70
c 1.70
d 1.70
e 1.70
f 1.70
g 1.70
h 1.70
i 1.75
j 1.75
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
MSW 1 65.0 65.0 200.0 32.0 W1
Lnr Soil 2 120.0 120.0 200.0 20.0 W1
GC Lnr F 3 100.0 100.0 0.0 18.0 W1
PCSTABL5M3 FSmin=1.70
Safety Factors Are Calculated By The Modified Janbu Method

```
                   ** PCSTABL5M3 **
               by Purdue University 1985
             rev. for SCS Engineers HVA 2008
              --Slope Stability Analysis--
           Simplified Janbu, Simplified Bishop
              or Spencer`s Method of Slices
 Run Date:                 10/19/2021
 Time of Run:              01:18PM
 Run By:                   SCS Engineers
 Input Data Filename:      C:mslb825-rev.in
 Output Filename:          C:mslb825-rev.OUT
 Unit:                     ENGLISH
 Plotted Output Filename:  C:mslb825-rev.PLT
 PROBLEM DESCRIPTION   Maverick County LF Waste Interim Slope
                       Block, Dbl. GC/FML Liner, Static 3:1, 2%
 BOUNDARY COORDINATES
     3 Top   Boundaries
     5 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1          0.00     197.00     150.00     200.00        2
     2        150.00     200.00     570.00     340.00        1
     3        570.00     340.00     720.00     335.50        1
     4        150.00     200.00     720.00     211.40        2
     5          0.00     195.00     720.00     209.40        3
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1    65.0     65.0     200.0     32.0    0.00       0.0      1
   2   120.0    120.0     200.0     20.0    0.00       0.0      1
   3   100.0    100.0       0.0     18.0    0.00       0.0      1
Searching Routine Will Be Limited To An Area Defined By  8 Boundaries
 Of Which The First  8 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left     Y-Left    X-Right    Y-Right
    No.        (ft)       (ft)       (ft)       (ft)
     1          0.00      15.00      29.00      24.00
     2         29.00      24.00      51.00      26.00
     3         51.00      26.00      78.00      56.00
     4         78.00      56.00      94.00      65.00
     5         94.00      65.00     113.00      64.00
     6        113.00      64.00     133.00      56.00
     7        133.00      56.00     161.00      58.00
     8        161.00      58.00     205.00      76.00
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Sliding Block Surfaces, Has Been
 Specified.
1000 Trial Surfaces Have Been Generated.
 2 Boxes Specified For Generation Of Central Block Base
 Length Of Line Segments For Active And Passive Portions Of
 Sliding Block Is  10.0
 Box        X-Left     Y-Left    X-Right    Y-Right      Height
 No.         (ft)       (ft)       (ft)       (ft)        (ft)
  1         150.00     197.90     200.00     198.90       0.10
  2         470.00     204.30     670.00     208.30       0.10
 Following Are Displayed The Ten Most Critical Of The Trial
       Failure Surfaces Examined.  They Are Ordered - Most Critical
       First.
       * * Safety Factors Are Calculated By The Modified Janbu Method * *
       Failure Surface Specified By 20 Coordinate Points
         Point      X-Surf      Y-Surf
          No.        (ft)        (ft)
```

1	152.07	200.69
2	155.01	197.99
3	477.46	204.45
4	484.04	211.98
5	490.09	219.94
6	496.86	227.30
7	503.92	234.38
8	510.11	242.23
9	516.52	249.91
10	521.35	258.67
11	527.99	266.14
12	533.78	274.30
13	538.90	282.89
14	545.37	290.51
15	549.52	299.61
16	556.16	307.09
17	558.58	316.79
18	565.51	324.00
19	565.54	334.00
20	568.83	339.61

*** 1.697 ***

Individual data on the 23 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.7	19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.1	423.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.1	39.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	322.4	1172450.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.1	630.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.8	12108.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	4.7	31003.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	6.1	37918.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	6.8	39965.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	7.1	39446.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	6.2	32514.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	6.4	31217.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	4.8	21578.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	6.6	26988.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	5.8	21345.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	5.1	16705.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	6.5	18497.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	4.2	10096.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	6.6	13351.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	2.4	3745.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	6.9	7635.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	21.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	3.3	481.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.07	200.69
2	155.01	197.99
3	477.46	204.45
4	484.04	211.98
5	490.09	219.94
6	496.86	227.30
7	503.92	234.38
8	510.11	242.23
9	516.52	249.91
10	521.35	258.67
11	527.99	266.14

```
   12        533.78      274.30
   13        538.90      282.89
   14        545.37      290.51
   15        549.52      299.61
   16        556.16      307.09
   17        558.58      316.79
   18        565.51      324.00
   19        565.54      334.00
   20        568.83      339.61
      ***     1.697   ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        152.07      200.69
    2        155.01      197.99
    3        477.46      204.45
    4        484.04      211.98
    5        490.09      219.94
    6        496.86      227.30
    7        503.92      234.38
    8        510.11      242.23
    9        516.52      249.91
   10        521.35      258.67
   11        527.99      266.14
   12        533.78      274.30
   13        538.90      282.89
   14        545.37      290.51
   15        549.52      299.61
   16        556.16      307.09
   17        558.58      316.79
   18        565.51      324.00
   19        565.54      334.00
   20        568.83      339.61
      ***     1.697   ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        152.07      200.69
    2        155.01      197.99
    3        477.46      204.45
    4        484.04      211.98
    5        490.09      219.94
    6        496.86      227.30
    7        503.92      234.38
    8        510.11      242.23
    9        516.52      249.91
   10        521.35      258.67
   11        527.99      266.14
   12        533.78      274.30
   13        538.90      282.89
   14        545.37      290.51
   15        549.52      299.61
   16        556.16      307.09
   17        558.58      316.79
   18        565.51      324.00
   19        565.54      334.00
   20        568.83      339.61
      ***     1.697   ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        152.07      200.69
    2        155.01      197.99
```

3	477.46	204.45
4	484.04	211.98
5	490.09	219.94
6	496.86	227.30
7	503.92	234.38
8	510.11	242.23
9	516.52	249.91
10	521.35	258.67
11	527.99	266.14
12	533.78	274.30
13	538.90	282.89
14	545.37	290.51
15	549.52	299.61
16	556.16	307.09
17	558.58	316.79
18	565.51	324.00
19	565.54	334.00
20	568.83	339.61

*** 1.697 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.07	200.69
2	155.01	197.99
3	477.46	204.45
4	484.04	211.98
5	490.09	219.94
6	496.86	227.30
7	503.92	234.38
8	510.11	242.23
9	516.52	249.91
10	521.35	258.67
11	527.99	266.14
12	533.78	274.30
13	538.90	282.89
14	545.37	290.51
15	549.52	299.61
16	556.16	307.09
17	558.58	316.79
18	565.51	324.00
19	565.54	334.00
20	568.83	339.61

*** 1.697 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.07	200.69
2	155.01	197.99
3	477.46	204.45
4	484.04	211.98
5	490.09	219.94
6	496.86	227.30
7	503.92	234.38
8	510.11	242.23
9	516.52	249.91
10	521.35	258.67
11	527.99	266.14
12	533.78	274.30
13	538.90	282.89
14	545.37	290.51
15	549.52	299.61
16	556.16	307.09
17	558.58	316.79

18	565.51	324.00
19	565.54	334.00
20	568.83	339.61

*** 1.697 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.07	200.69
2	155.01	197.99
3	477.46	204.45
4	484.04	211.98
5	490.09	219.94
6	496.86	227.30
7	503.92	234.38
8	510.11	242.23
9	516.52	249.91
10	521.35	258.67
11	527.99	266.14
12	533.78	274.30
13	538.90	282.89
14	545.37	290.51
15	549.52	299.61
16	556.16	307.09
17	558.58	316.79
18	565.51	324.00
19	565.54	334.00
20	568.83	339.61

*** 1.697 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.35	205.12
2	172.40	198.31
3	478.24	204.48
4	484.96	211.89
5	490.63	220.12
6	497.43	227.46
7	502.87	235.85
8	507.21	244.86
9	512.96	253.04
10	519.09	260.94
11	525.62	268.51
12	532.68	275.60
13	536.01	285.02
14	536.97	294.98
15	543.62	302.45
16	550.53	309.68
17	557.56	316.79
18	562.50	325.48
19	569.43	332.69
20	571.77	339.95

*** 1.749 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.35	205.12
2	172.40	198.31
3	478.24	204.48
4	484.96	211.89
5	490.63	220.12
6	497.43	227.46
7	502.87	235.85
8	507.21	244.86

9	512.96	253.04
10	519.09	260.94
11	525.62	268.51
12	532.68	275.60
13	536.01	285.02
14	536.97	294.98
15	543.62	302.45
16	550.53	309.68
17	557.56	316.79
18	562.50	325.48
19	569.43	332.69
20	571.77	339.95
***	1.749	***

SCENARIO 2

Slope Section:

3:1 Waste Slope, 140’ (max.) Waste Height. 4% Base Slope

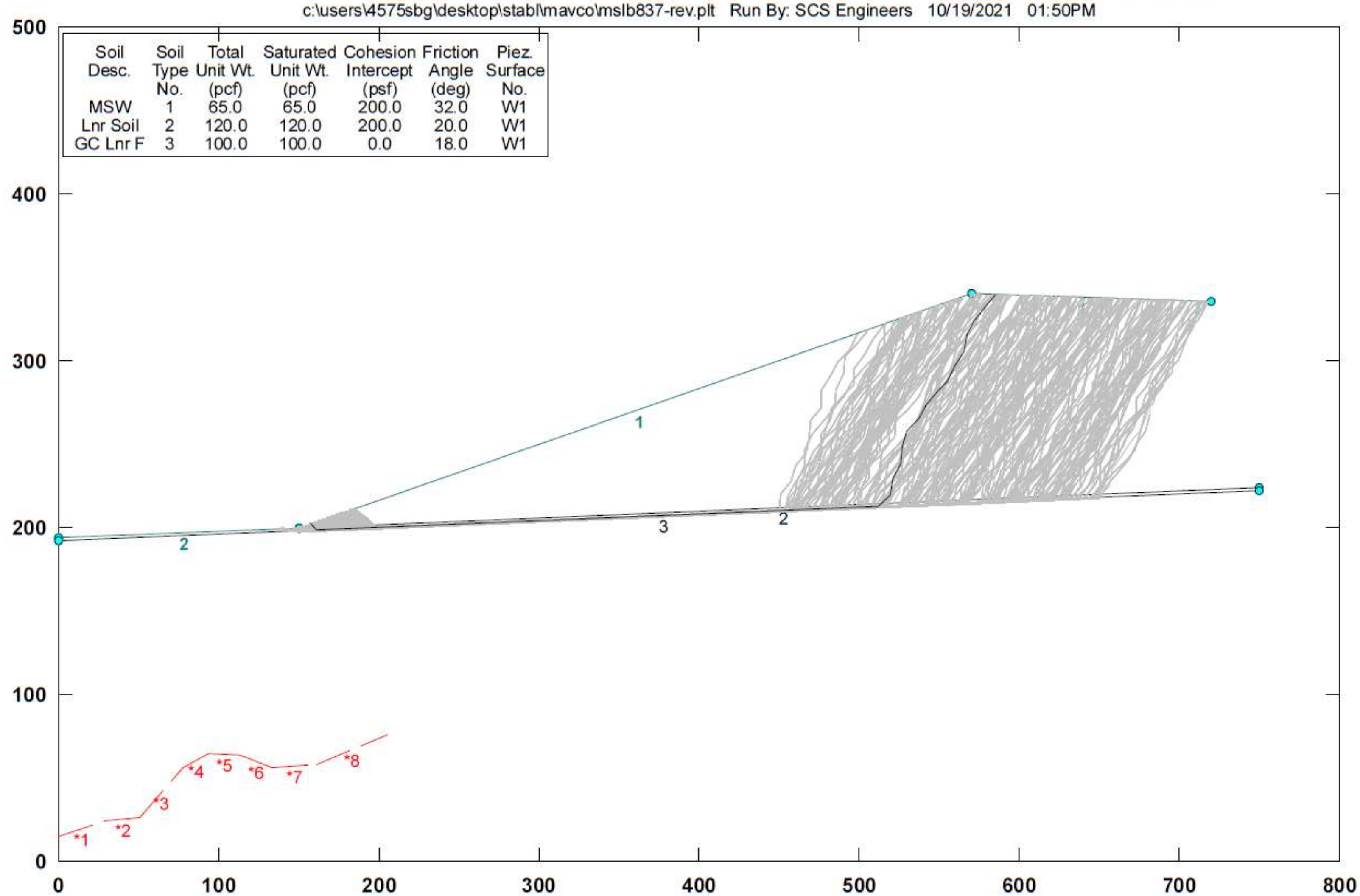
Block-Type Failure Surface

Interface Friction Angle= 18°

Maverick County LF Waste Interim Slope Block, Dbl. GC/FML Liner, Static 3:1, 4%

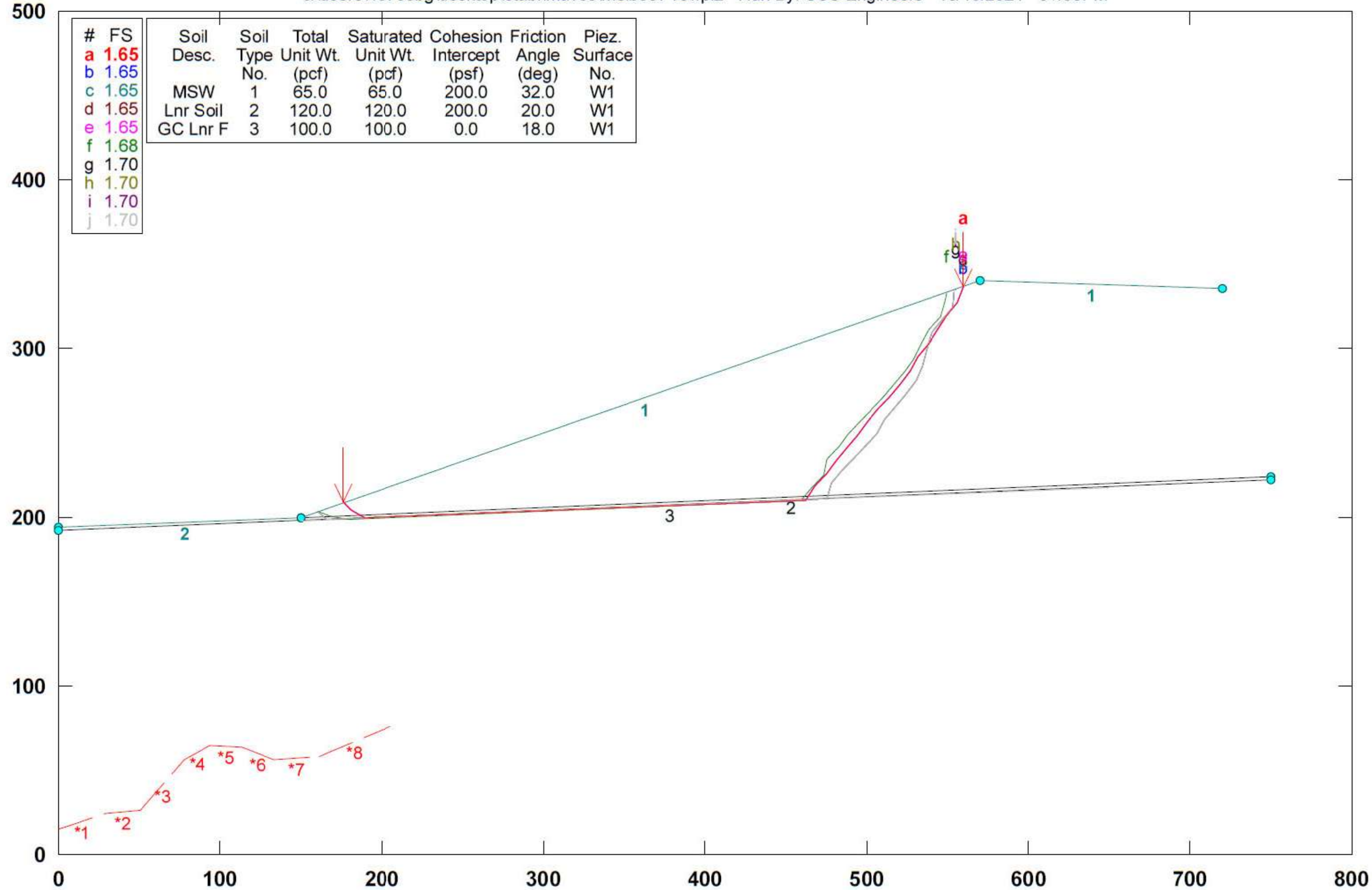
c:\users\4575sbg\desktop\stabl\mavco\mslb837-rev.plt Run By: SCS Engineers 10/19/2021 01:50PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
MSW	1	65.0	65.0	200.0	32.0	W1
Lnr Soil	2	120.0	120.0	200.0	20.0	W1
GC Lnr F	3	100.0	100.0	0.0	18.0	W1



Maverick County LF Waste Interim Slope Block, Dbl. GC/FML Liner, Static 3:1, 4%

c:\users\4575sbg\desktop\stabl\mavco\mslb837-rev.pl2 Run By: SCS Engineers 10/19/2021 01:50PM



PCSTABL5M3 FSmin=1.65

Safety Factors Are Calculated By The Modified Janbu Method

```
      ** PCSTABL5M3 **
               by Purdue University 1985
            rev. for SCS Engineers HVA 2008
             --Slope Stability Analysis--
          Simplified Janbu, Simplified Bishop
             or Spencer`s Method of Slices

  Run Date:                 10/19/2021
  Time of Run:              01:50PM
  Run By:                   SCS Engineers
  Input Data Filename:      C:mslb837-rev.in
  Output Filename:          C:mslb837-rev.OUT
  Unit:                     ENGLISH
  Plotted Output Filename:  C:mslb837-rev.PLT
  PROBLEM DESCRIPTION   Maverick County LF Waste Interim Slope
                        Block, Dbl. GC/FML Liner, Static 3:1, 4%

  BOUNDARY COORDINATES
      3 Top   Boundaries
      5 Total Boundaries

  Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
     No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
      1          0.00     194.00     150.00     200.00        2
      2        150.00     200.00     570.00     340.00        1
      3        570.00     340.00     720.00     335.50        1
      4        150.00     200.00     750.00     224.00        2
      5          0.00     192.00     750.00     222.00        3

ISOTROPIC SOIL PARAMETERS
   3 Type(s) of Soil
  Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
  Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
   No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
    1    65.0     65.0     200.0     32.0    0.00       0.0      1
    2   120.0    120.0     200.0     20.0    0.00       0.0      1
    3   100.0    100.0       0.0     18.0    0.00       0.0      1
 Searching Routine Will Be Limited To An Area Defined By  8 Boundaries
  Of Which The First  8 Boundaries Will Deflect Surfaces Upward
  Boundary     X-Left     Y-Left    X-Right    Y-Right
     No.        (ft)       (ft)       (ft)       (ft)
      1          0.00      15.00      29.00      24.00
      2         29.00      24.00      51.00      26.00
      3         51.00      26.00      78.00      56.00
      4         78.00      56.00      94.00      65.00
      5         94.00      65.00     113.00      64.00
      6        113.00      64.00     133.00      56.00
      7        133.00      56.00     161.00      58.00
      8        161.00      58.00     205.00      76.00

 A Critical Failure Surface Searching Method, Using A Random
  Technique For Generating Sliding Block Surfaces, Has Been
  Specified.

 1000 Trial Surfaces Have Been Generated.

  2 Boxes Specified For Generation Of Central Block Base
  Length Of Line Segments For Active And Passive Portions Of
```

Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	150.00	197.90	200.00	199.80	0.10
2	450.00	209.90	650.00	217.90	0.10

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	176.39	208.80
2	180.81	204.44
3	189.47	199.44
4	462.10	210.38
5	468.05	218.42
6	475.11	225.50
7	480.82	233.70
8	487.58	241.08
9	494.16	248.61
10	500.21	256.57
11	506.97	263.93
12	514.04	271.01
13	520.23	278.86
14	526.63	286.54
15	531.47	295.30
16	538.11	302.77
17	543.90	310.93
18	549.02	319.52
19	555.49	327.14
20	559.64	336.24
21	560.02	336.67

*** 1.650 ***

Individual data on the 24 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.4	839.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5.2	2767.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.2	2714.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.2	226.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	272.6	982500.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.1	493.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.5	9283.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	4.3	25357.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	7.1	39133.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	5.7	29607.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	6.8	32496.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	6.6	29412.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	6.1	24836.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	6.8	25338.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	7.1	24183.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

16	6.2	19114.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	6.4	17380.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	4.8	11130.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	6.6	12624.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	5.8	8834.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	5.1	5635.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	6.5	4519.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	4.2	1122.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	176.39	208.80
2	180.81	204.44
3	189.47	199.44
4	462.10	210.38
5	468.05	218.42
6	475.11	225.50
7	480.82	233.70
8	487.58	241.08
9	494.16	248.61
10	500.21	256.57
11	506.97	263.93
12	514.04	271.01
13	520.23	278.86
14	526.63	286.54
15	531.47	295.30
16	538.11	302.77
17	543.90	310.93
18	549.02	319.52
19	555.49	327.14
20	559.64	336.24
21	560.02	336.67

*** 1.650 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	176.39	208.80
2	180.81	204.44
3	189.47	199.44
4	462.10	210.38
5	468.05	218.42
6	475.11	225.50
7	480.82	233.70
8	487.58	241.08
9	494.16	248.61
10	500.21	256.57
11	506.97	263.93
12	514.04	271.01
13	520.23	278.86
14	526.63	286.54
15	531.47	295.30
16	538.11	302.77
17	543.90	310.93
18	549.02	319.52
19	555.49	327.14

20	559.64	336.24
21	560.02	336.67

*** 1.650 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	176.39	208.80
2	180.81	204.44
3	189.47	199.44
4	462.10	210.38
5	468.05	218.42
6	475.11	225.50
7	480.82	233.70
8	487.58	241.08
9	494.16	248.61
10	500.21	256.57
11	506.97	263.93
12	514.04	271.01
13	520.23	278.86
14	526.63	286.54
15	531.47	295.30
16	538.11	302.77
17	543.90	310.93
18	549.02	319.52
19	555.49	327.14
20	559.64	336.24
21	560.02	336.67

*** 1.650 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	176.39	208.80
2	180.81	204.44
3	189.47	199.44
4	462.10	210.38
5	468.05	218.42
6	475.11	225.50
7	480.82	233.70
8	487.58	241.08
9	494.16	248.61
10	500.21	256.57
11	506.97	263.93
12	514.04	271.01
13	520.23	278.86
14	526.63	286.54
15	531.47	295.30
16	538.11	302.77
17	543.90	310.93
18	549.02	319.52
19	555.49	327.14
20	559.64	336.24
21	560.02	336.67

*** 1.650 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.57	203.52
2	168.76	200.60
3	178.63	199.00
4	459.36	210.26
5	466.20	217.55
6	473.24	224.66
7	475.78	234.33
8	482.36	241.86
9	488.75	249.55
10	495.75	256.69
11	502.75	263.83
12	509.83	270.90
13	516.63	278.22
14	523.49	285.50
15	529.01	293.84
16	533.46	302.80
17	538.48	311.44
18	545.53	318.54
19	548.75	328.01
20	549.14	333.05
***	1.683	***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.14	203.38
2	165.96	198.49
3	475.09	210.85
4	478.33	220.31
5	484.93	227.83
6	491.95	234.95
7	498.98	242.06
8	505.79	249.39
9	510.91	257.97
10	517.92	265.10
11	524.42	272.71
12	530.16	280.89
13	534.14	290.07
14	537.09	299.62
15	540.07	309.17
16	546.73	316.63
17	552.68	324.67
18	554.30	334.53
19	554.61	334.87
***	1.704	***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.14	203.38
2	165.96	198.49
3	475.09	210.85
4	478.33	220.31
5	484.93	227.83
6	491.95	234.95
7	498.98	242.06
8	505.79	249.39
9	510.91	257.97
10	517.92	265.10
11	524.42	272.71
12	530.16	280.89
13	534.14	290.07
14	537.09	299.62
15	540.07	309.17
16	546.73	316.63
17	552.68	324.67
18	554.30	334.53
19	554.61	334.87

*** 1.704 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.14	203.38
2	165.96	198.49
3	475.09	210.85
4	478.33	220.31
5	484.93	227.83
6	491.95	234.95
7	498.98	242.06
8	505.79	249.39
9	510.91	257.97
10	517.92	265.10
11	524.42	272.71
12	530.16	280.89
13	534.14	290.07
14	537.09	299.62
15	540.07	309.17
16	546.73	316.63
17	552.68	324.67
18	554.30	334.53
19	554.61	334.87

*** 1.704 ***

Failure Surface Specified By 19 Coordinate Points

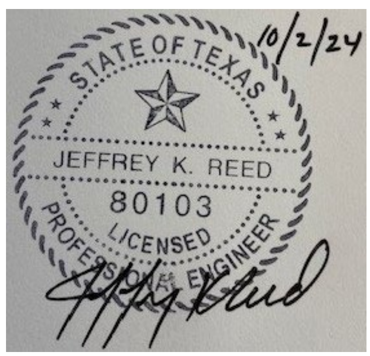
Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.14	203.38
2	165.96	198.49
3	475.09	210.85
4	478.33	220.31
5	484.93	227.83
6	491.95	234.95

7	498.98	242.06
8	505.79	249.39
9	510.91	257.97
10	517.92	265.10
11	524.42	272.71
12	530.16	280.89
13	534.14	290.07
14	537.09	299.62
15	540.07	309.17
16	546.73	316.63
17	552.68	324.67
18	554.30	334.53
19	554.61	334.87
***	1.704	***

APPENDIX E-4

Final Cover Stability

(Veneer Stability Analysis)



FINAL COVER SYSTEM

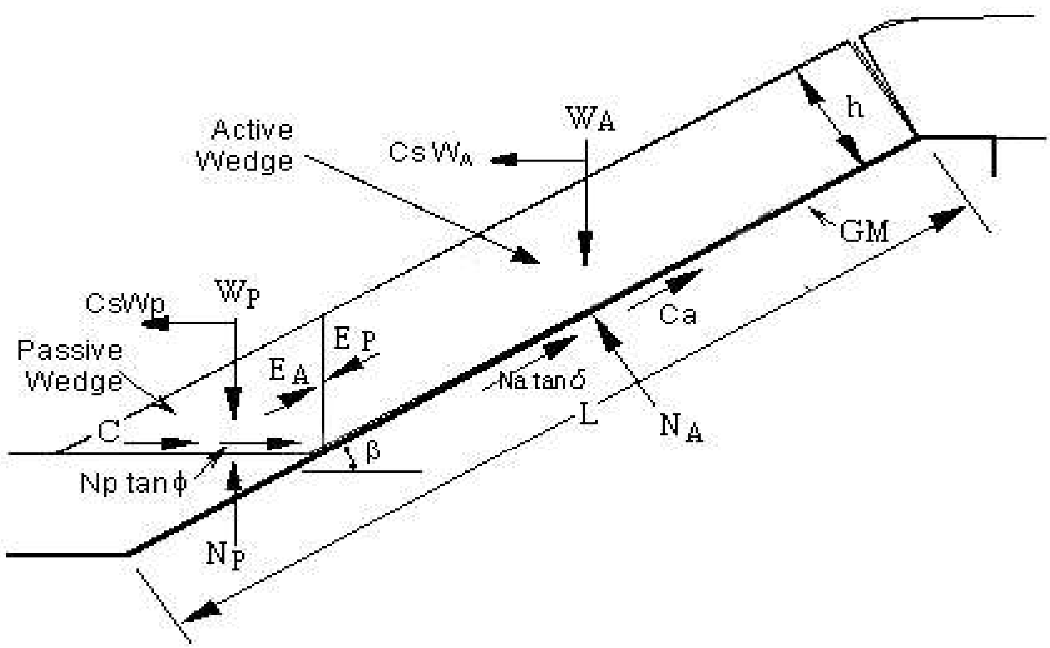
VENEER STABILITY – SIDE SLOPES (3H:1V)

COVER STABILITY CALCULATION (STATIC)

Project: Final Cover System, 33.33% slope, 340' slope length	Calc'd by:	BG	Date:	10/1/2021
Location: Maverick County Landfill	Chk'd by:	JR	Date:	10/1/2021

Prepared by: SCS ENGINEERS
Date: October 2021

Consideration: To determine the minimum factor of safety (FS) corresponding to a minimum interface friction angle equal to 21 degrees and 5.8 kPa adhesion between critical soil/geosynthetic interface on a geosynthetic lined slope using an analysis as described by Koerner and Soong (1998) referenced below.



Ref.: R.M. Koerner, and T-Y.Soong, 1998. "Analysis and Design of Veneer Cover Soils". Proceeding of 6th International Conference on Geosynthetics, Vol. 1, pp. 1-23, Atlanta, Georgia, USA.

Parameters:

L	=	length of slope meausured along the geomembrane
β	=	soil slope angle beneath the geomembrane
FS	=	factor of safety against instability
W_A	=	total weight of the active wedge
W_P	=	total weight of the passive wedge
N_A	=	effective force normal to the failure plane of the active wedge
h	=	thickness of the cover soil
γ	=	unit weight of the cover soil
ϕ	=	cover soil friction angle
δ	=	interface friction angle between cover soil and geomembrane
C_a	=	adhesive force between cover soil of the active wedge and the geomembrane
c_a	=	adhesion between cover soil of the active wedge and the geomembrane
C	=	cohesive force along the failure plane of the passive wedge
c	=	cohesion of the cover soil

COVER STABILITY CALCULATION (STATIC)

Calculate Factor of Safety (FS):

$$FS = \frac{-b + (b^2 - 4ac)^{1/2}}{2a}$$, where

$$a = (C_S W_A + N_A \sin\beta)(\cos\beta) + C_S W_P(\cos\beta)$$

$$b = -[(C_S W_A + N_A \sin\beta)\sin\beta(\tan\phi) + (N_A \tan\delta + C_a)(\cos^2\beta) + (C + W_P \tan\phi)\cos\beta]$$

$$c = (N_A \tan\delta + C_a)\cos\beta \sin\beta \tan\phi$$, where

$$W_A = \gamma h^2 [(L/h) - (1/\sin\beta) - (\tan\beta/2)]$$

$$N_A = W_A(\cos\beta)$$

$$W_P = \gamma h^2 / \sin 2\beta$$

$$C_a = c_a(L-(h/\sin\beta))$$

$$C = (ch)/(\sin\beta)$$

γ =	18.00	kN/m^3						
h =	462.28	mm	=	0.46	m	=	18	inches
L =	104.00	m				=	341	feet
β =	18.44	°	=	0.32	rad			
C_s =	0.000	g						
ϕ =	20.00	°	=	0.35	rad			
δ =	21.00	°	=	0.37	rad			
c =	0.00	kN/m^2						
c_a =	5.80	kN/m^2				=	121.1	psf

W_A =	852.59	kN
N_A =	808.81	kN
W_P =	6.41	kN
C_a =	594.72	kN
C =	0.00	kN
a =	242.70	
b =	-846.30	
c =	98.86	
FS =	**3.37**	

Summary:

At the interface friction angle of 21 degrees and 5.8 kPa adhesion for all soil-geosynthetic & geosynthetic-geosynthetic interfaces and under static condition, the factor of safety is calculated as 3.36, indicating the final cover system is stable under the static slope conditions analyzed (a slope of 18.44 degrees or 3:1 slope, with longest slope length = 341').

FINAL COVER SYSTEM

VENEER STABILITY – TOP DECK (5%)

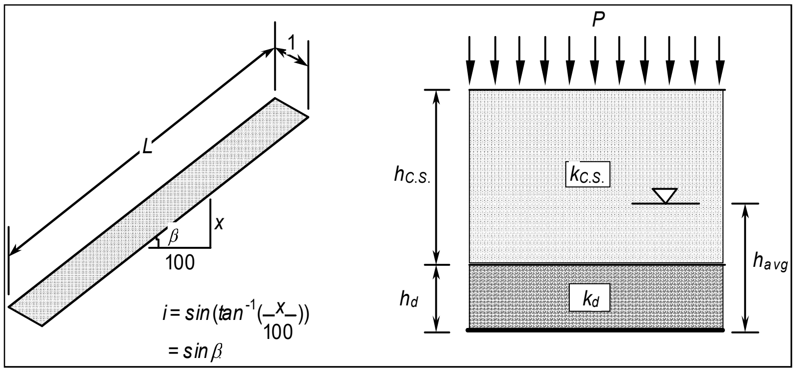
COVER STABILITY CALCULATION (SEEPAGE FORCES)

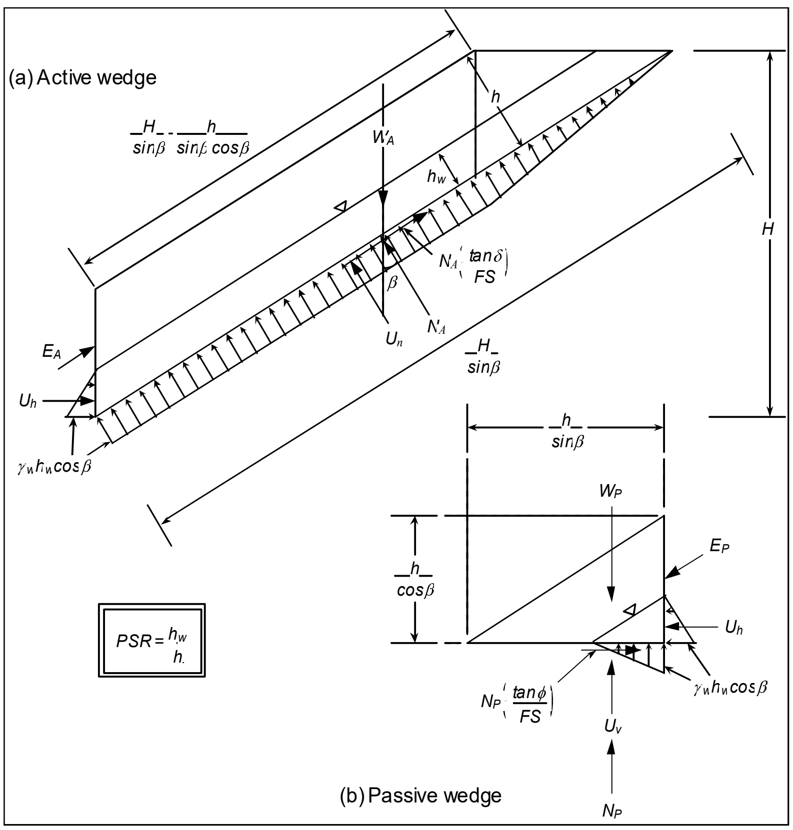
Veneer (Final Cover) System Stability - Top Deck at 5%

Project: Maverick County Landfill	Calc'd by: BG		Date: 10/1/2021
Location: Maverick County, TX	Chk'd by: JKR		Date: 10/1/2021

Prepared by: SCS ENGINEERS
Date: October, 2021

Consideration: To evaluate the stability of the cover system with seepage forces applied using the method described by Koerner and Soong (1998) referenced below.





Ref.: R.M. Koerner, and T-Y.Soong, 1998. "Analysis and Design of Veneer Cover Soils". Proceeding of 6th International Conference on Geosynthetics, Vol. 1, pp. 1-23, Atlanta, Georgia, USA.

COVER STABILITY CALCULATION (SEEPAGE FORCES)

Parameters:

DLC	=	drainage layer capacity
$FLUX_{allow}$	=	allowable flow rate of the drainage layer per unit width of slope
k_d	=	permeability of drainage soil or geosynthetic
h_d	=	thickness of the drainage soil or geosynthetic
i	=	sin β = slope gradient
$FLUX_{req'd}$	=	actual flow rate per unit width of slope
PERC	=	the rate of percolation
P	=	probable maximum (hourly) precipitation (25-year storm event)
RC	=	runoff coefficient
L	=	length of drainage slope
k_{cs}	=	permeability of cover soil
β	=	slope angle
w	=	1.0 m = unit width of drainage slope
PSR	=	parallel submergence ratio
h_{avg}	=	average head buildup above the geomembrane
h_{cs}	=	thickness of cover soil
FS	=	factor of safety against instability
W_A	=	total weight of the active wedge
W_P	=	total weight of the passive wedge
U_h	=	resultant of the pore pressures acting on the interwedge surfaces
U_n	=	resultant of the pore pressures acting perpendicular to the slope
U_v	=	resultant of the vertical pore pressures acting on the passive wedge
N_A	=	effective force normal to the failure plane of the active wedge
h	=	thickness of the cover soil
H	=	vertical height of the slope measured from the toe
h_w	=	(PSR)(h) = height of the free water surface measured from the geomembrane
γ_{dry}	=	dry unit weight of the cover soil
$\gamma_{sat'd}$	=	saturated unit weight of the cover soil
γ_w	=	unit weight of water
ϕ	=	cover soil friction angle
δ	=	interface friction angle between cover soil and geomembrane

COVER STABILITY CALCULATION (SEEPAGE FORCES)

Calculate Drainage Layer Capacity (DLC):

$PERC = P(1\text{-}RC)$, for $P(1\text{-}RC) \leq k_{cs}$
$PERC = k_{cs}$, for $P(1\text{-}RC) > k_{cs}$

k_{CS} =	1.00E-05	cm/s	=	3.60E-01	mm/hr
P =	8.40	mm/hr			
RC =	0.40				

P(1-RC) = 5.04 mm/hr

PERC = 0.36 mm/hr

$$FLUX_{req'd} = \frac{PERC}{1000} \times L(\cos\beta) \times w$$

L =	213.40	m			
β =	2.86	°	=	0.05	rad

$L(\cos\beta)$ = 213.13 m

$FLUX_{req'd}$ = 0.08 m^3/hr

$$FLUX_{allow} = k_d \times i \times h_d$$

k_d =	1.00E-05	cm/s	=	1.00E-07	m/s
h_d =	1500.00	mm	=	1.50	m
i =	0.05				

$FLUX_{allow}$ = 0.00 m^3/hr

$$DLC = \frac{FLUX_{allow}}{FLUX_{req'd}}$$

DLC = 0.00

Notes:
1) If only one soil layer above geomembrane, treat it as a drainage layer.
2) DLC needs to be greater than one to avoid saturation of the drainage layer.

(Final cover soil layers are saturated.)

COVER STABILITY CALCULATION (SEEPAGE FORCES)

Calculate Parallel Submergence Ratio (PSR):

$$h_{avg} = \frac{FLUX_{req'd}/3600}{k_d \times i}, \text{ for DLC} \geq 1.0$$

$$h_{avg} = \frac{[FLUX_{req'd}/(3600 \times i)] - [h_d \times (k_d - k_{cs})]}{k_{cs}}, \text{ for DLC} < 1.0$$

h_{avg} for DLC $\geq$ 1.0 = 4271.60 m
h_{avg} for DLC < 1.0 = 4271.60 m

h_{avg} = 4271.595 m

$$PSR = \frac{h_{avg}}{h_{cs} + h_d}$$

if PSR $\geq$ 1, set PSR = 1

h_{CS} = 457.20 mm = 0.46 m

PSR = 2182.503

PSR = 1.000

Calculate Factor of Safety (FS):

$$W_A = \frac{\gamma_{dry}(h - h_w)[2H\cos\beta - (h + h_w)] + \gamma_{sat'd}(h_w)(2H\cos\beta - h_w)}{\sin 2\beta}$$

γ_{dry} = 18.00 kN/m^3
$\gamma_{sat'd}$ = 18.86 kN/m^3

$h = h_d + h_{cs}$ = 1957.20 mm = 1.96 m
h_w = 1957.20 mm = 1.96 m
$H = L \times \sin\beta$ = 10.65 m

W_A = 7152.32 kN

$$U_h = \frac{\gamma_w (h_w)^2}{2}$$

γ_w = 9.81 kN/m^3

U_h = 18.79 kN

$$U_n = \frac{\gamma_w(h_w)(\cos\beta)(2H\cos\beta - h_w)}{\sin 2\beta}$$

U_n = 3715.63 kN

COVER STABILITY CALCULATION (SEEPAGE FORCES)

$N_A = W_A(\cos\beta) + U_h(\sin\beta) - U_n$

$N_A =$ 3426.84 kN

$W_P = \dfrac{\gamma_{dry}(h^2 - h_w^2) + \gamma_{sat'd}(h_w)^2}{\sin 2\beta}$

$W_P =$ 724.87 kN

$U_V = U_h(\cot\beta)$

$U_V =$ 376.10 kN

$FS = \dfrac{-b + (b^2 - 4ac)^{1/2}}{2a}$

$a = W_A(\sin\beta)(\cos\beta) - U_h(\cos^2\beta) + U_h$

a = 356.47

$b = -W_A(\sin^2\beta)(\tan\phi) + U_h(\sin\beta)(\cos\beta)(\tan\phi) - N_A(\cos\beta)(\tan\delta) - (W_P - U_V)(\tan\phi)$

$\phi =$ 20.00 ° = 0.35 rad
$\delta =$ 11.00 ° = 0.19 rad

b = -798.36

$c = N_A(\sin\beta)(\tan\delta)(\tan\phi)$

c = 12.10

FS = 2.22

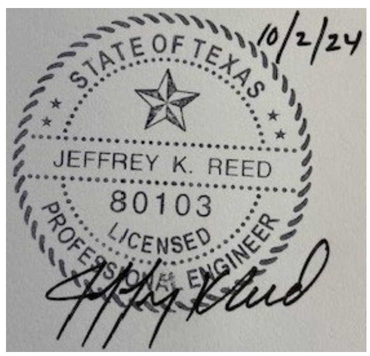
Summary:

DLC	**0.00**
PSR	**1.000**
FS	**2.22**

At the interface friction angle of 11 degrees for all soil-geosynthetics, geosynthetics-geosynthetics interfaces, the factor of safety is calculated as 2.22 indicating that there is adequate shear strength available to prevent the cover system from sliding.
Therefore the cover system is stable under the slope conditions analyzed.
It is assumed that the soil layer above the interface will be saturated.
Slope length = 700 feet (213.4 m) at 5% topslope
Final cover soil hydraulic conductivity = 1 x 10^{-5} cm/sec.

APPENDIX E-5

Stability of Final Filled Configuration



SCS Engineers	WASTE SLOPE STABILITY- FINAL CONFIGURATION		
	Proj. No. 16220088.00	Prepared By: BG	Date: 9/1/2021
	Project: Maverick County-El Indio Landfill Maverick County, TX	Checked By: JKR	Sheet 2 of 60

OBJECTIVE:

To evaluate the global stability of the landfill for the final filled configuration as part of the permit modification application dated September 2021. Final conditions stability analyses include both circular and block failure modes, which provide factors of safety against failure of the constructed landfill, landfilled municipal solid waste (MSW), the critical interface of the liner system, and the underlying foundation soils.

METHOD:

Slope stability analyses were performed using the computer program PCSTABL5M (FHWA, 2016 Version). This program uses two-dimensional limit equilibrium methods to calculate a factor of safety (FS) against shear failure for slope sections analyzed. The PCSTABL5M program uses an automatic search routine to generate multiple shear failure surfaces for both circular failures and block or wedge-type failure modes until the surface with the lowest FS-value (i.e., critical failure surface) is found. The analytical methods used for the circular and sliding block failure modes in the slope stability analysis are the Modified Bishop and Modified Janbu methods, respectively.

Sliding block failure mode was used to analyze stability of the critical interfaces in the bottom liner system, whereas circular failure search mode was used to evaluate stability under final conditions.

TARGET FACTOR OF SAFETY:

A minimum acceptable FS of 1.5 was assumed for global static slope stability analyses under final conditions. The recommended minimum FS for the conditions analyzed are consistent with the recommendations from the Corps of Engineers "Design and Construction of Levees" manual (EM 1110-2-1913) and EPA's "Technical Guidance Manual for Design of Solid Waste Disposal Facilities."

CROSS SECTIONS ANALYZED:

Slope stability analyses were performed for selected cross-sections of the landfill. The locations of these cross sections were selected based on review of the liner and final cover grading plans. For the existing landfill cells (Cells 1, 2, and 3) as-built liner system grades were used along with the proposed final cover grading plan. For the future cells of the landfill currently permitted base grades with minor modifications at the crest of the landfill sideslopes (if needed) were used along with the proposed final cover grading plan. A critical slope section is considered to have a maximum waste height, a maximum exterior slope angle, and a shallow perimeter berm. All slope sections are buttressed by the excavation and the landfill perimeter, including a perimeter berm of various heights.

Three cross sections were analyzed for this permit modification application. Cross sections 1 and 2, which are primarily located within the footprints of existing Cells 2 and 3, respectively, were analyzed to demonstrate that the existing liner systems have adequate FS in waste block mode. Cross section 1 represents a critical cross section within Cells 1 and 2 with compacted clay/geomembrane liner system. Cross section 2 was analyzed to estimate the FS of the existing GCL/geomembrane liner system in waste block mode. Cross section 3 represents a critical cross section for the future cell with highest waste slope and low perimeter berm height. This section was selected for the analysis as it was the section with the lowest calculated FS among other future areas sections analyzed within the footprints of Cells 6, 9, and 11/12. Future cells will be constructed with textured geomembrane on the cell floors and side slopes and with compacted clay liner or GCL. Among Cross section 1, 2, and 3, the one with the highest waste slope is Cross section 3. Therefore, Cross section 3 was also analyzed in circular failure mode.

Drawings E5.1 and E5.2 at the end of this attachment (prior to the output files) present plan views of the landfill showing where the various sections were cut. Profiles of the sections, which can also be seen on the model outputs, are presented in drawings E5.3 to E5.5.

MATERIAL PROPERTIES:

Liner System Evaluated:

24-in. Protective Cover consisting of on-site soils
Geocomposite Drainage Layer *
60-mil HDPE Geomembrane*, ***
24-in. thick Compacted Clay Liner or GCL**

* In Cells 1, 2, and 3, smooth geomembrane and a single-sided geocomposite were used on the cell floor, whereas textured geomembrane and double-sided geocomposite were used on the side slopes. In future cells, textured geomembrane and double-sided geocomposite will be used on cell floors and sideslopes.
** Cell 3 was constructed with a GCL/HDPE geomembrane liner system. In compliance with the current permit, 24-in thick compacted clay liner may be replaced with a reinforced GCL in the future cells.
*** Future cells will be constructed with textured geomembrane on the cell floors and side slopes. Textured geomembrane will be used with compacted clay liner or GCL.

Based on a review of available data, the following parameters were assigned to the referenced materials.

Table E.5.1. Summary of Geotechnical Strength Properties –Final Conditions

Material	γ (pcf)	c (pcf)	ϕ (°)
Foundation Soils (drained)[1]	120	0	25
Municipal Solid Waste [2]	65	200	32
Soil Liner/Final Cover Soils	120	200	20

[1] Average PI for Native Upper Clay (from Section 2.0) = 21. Using PI versus effective friction angle graph (Ladd et al. (1977) from EPRI (1990)), a friction angle of 30 degrees is estimated. Conservatively, 25 degrees is used for the foundation soil.
[2] Zekkos et al. (2006) and Bray et al. (2009).

ADDITIONAL SLOPE STABILITY ANALYSES ASSUMPTIONS:

The slope stability analyses were performed based on the following assumptions:

- The analyses assume that either a block-type failure surface occurs along the weakest interface of geosynthetic/geosynthetic or soil/geosynthetic components of the liner system or, if a failure occurs within the waste mass or the foundation soil layer that a circular failure surface occurs.

- The representative interface friction angles for the interfaces of the existing/proposed liner systems are summarized in Table E-5-2, which are based on GRI Report #30, "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces" by G. R. Koerner and D. Narejo (2005) and available site specific interface friction testing performed during Cell 3 construction.

  Consistent with the recommendations of Stark and Choi (2004), residual shear strengths are assigned to the sideslopes and peak shear strength are assigned to the base of the liner system to satisfy a FS greater than 1.5. Based on Table E-5-2, interface friction angles used in the block-type stability analyses for the cell floor and side slope liner systems are selected and summarized below for different conditions:

  - Cross Section 1: Cells 1 and 2 have compacted clay/geomembrane liner system with textured geomembrane on the sideslope and smooth geomembrane on the cell floor, respectively. Interface friction angles of 11 degrees (peak, smooth HDPE geomembrane/saturated compacted clay liner or smooth geomembrane/SS geocomposite interface) and 15 degrees (residual, textured HDPE geomembrane /DS geocomposite interface) were used in the block-type stability analyses for the cell floor and side slope liner systems, respectively.

  - Cross Section 2: Cell 3 has GCL/geomembrane liner system with textured geomembrane on the sideslope and smooth geomembrane on the cell floor, respectively. Interface friction angles of 11 degrees (peak, smooth HDPE geomembrane/SS geocomposite interface) and 11 degrees (residual, GCL/

textured HDPE geomembrane) were used in the block-type stability analyses for the cell floor and side slope liner systems, respectively.

- Cross Section 3: Future cells will be constructed with textured geomembrane on the cell floors and side slopes. Textured geomembrane will be used with compacted clay liner or GCL. Interface friction angles of 18 degrees (peak, textured HDPE geomembrane/ clay or DS geocomposite/ protective cover) and 11 degrees (residual, GCL/textured HDPE geomembrane) were used in the block-type stability analyses for the cell floor and side slope liner systems, respectively.

To be conservative, no adhesion value was used in the analysis; however, adhesion is typically considered to determine the effective shear strength of the critical interface.

Table E.5.2. Summary of Liner Interface Properties

Interface	Peak Friction Angle ϕ_{peak} (°)	Residual Friction Angle $\phi_{residual}$ (°)
Textured HDPE GM /Compacted Clay (Saturated)	18	16
Textured HDPE GM /DS Geocomposite	26	15
DS Geocomposite/ Protective Cover	18	18
Smooth HDPE GM /Compacted Clay (Saturated)	11	11
Smooth HDPE GM /SS Geocomposite	11	9
SS Geocomposite/ Protective Cover	30	21
GCL Internal Strength	25	15
NW geotextile /Compacted Clay	20	20
Textured HDPE GM /GCL [1]	21.3	11.5
Smooth HDPE GM /GCL [1]	13.9	8.7

[1] Friction angles reported above, which are used for the cross section within the Cell 3 footprint, are from GCL/Geomembrane interface friction testing performed by TRI Environmental during Cell 3 constructing in September 2019. Test results are attached to this submittal. Interface friction angles reported for textured Interface friction angles reported in GRI #30 for these interfaces are slightly higher than the reported test results. Therefore, the values used in the analyses are considered conservative.

[2] HDPE: High Density Polyethylene; GM: geomembrane; SS: single-sided, DS: double-sided; GCL: Geosynthetic Clay Liner.

[3] Interface friction angle for each interface considered is based on 2005 GRI Report #30, "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces" by G. R. Koerner and D. Narejo (2005).

RESULTS:

The estimated FSs for the analyses performed for this permit modification application are summarized in Table E.5.3. The associated STABL output files are presented in the end of this submittal.

Table E.5.3. Calculated FSs for Final Conditions

Cross Section	**Output File Name**	**Analyzed Stability Mode**	**Calculated Factor of Safety**	**Target Factor of Safety**
Cross Section 1	Mavco_section1_wb	Block	1.61	1.50
Cross Section 2	Mavco_section2_wb	Block	1.87	1.50
Cross Section 3	Mavco_section3_wb	Block	1.75	1.50
Cross Section 3	Mavco_section3_circular	Circular	2.31	1.50

CONCLUSIONS:

Stability of the landfill final configuration as proposed in this permit modification application was analyzed in this submittal. Final conditions stability analyses included both circular and block failure modes. Adequate FSs were calculated for the analyzed cross sections.

Interface friction angles used in the block-type failure mode are considered typical and conservative for the existing interfaces. Should there be a different interface present due to selection of materials not considered before, the global slope stability analyses should be reevaluated during construction in order to validate the requirements of the FS values.

REFERENCES:

Bray, J. D., Zekkos, D., Kavazanjian E., "Shear Strength of Municipal Solid Waste", Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 6, June 2009.

EPA, "Solid Waste Disposal Facility Criteria, Technical Manual", EPA530-R-93-017, 1993.

Electric Power Research Institute (EPRI), "Manual on Estimating Soil Properties for Foundation Design", EPRI EL-6800, Project 1493-6, August 1990.

FHWA, "PC STABL6 Users Guide, Slope Stability Analysis Program", 1995.

Koerner, G. R. and Narejo, D., "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to Soil Interfaces", GRI Report #30, June 14, 2005.

Stark, T. D. and Choi, H., "Peak versus Residual Interface Strengths for Landfill Liner and Cover Design", Geosynthetics International, Vol. 11, No. 6, 2004.

U.S. Army Corps of Engineers "Design and Construction of Levees", Manual No. 1110-2-1913, 30 April 2000.

Zekkos, D., Bray, J. D., Kavazanjian, E. Matasovic, N., "Unit Weight of Municipal Solid Waste", Vol. 132, No. 10, October 2006.

Figures

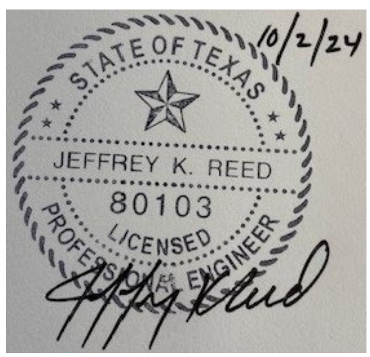
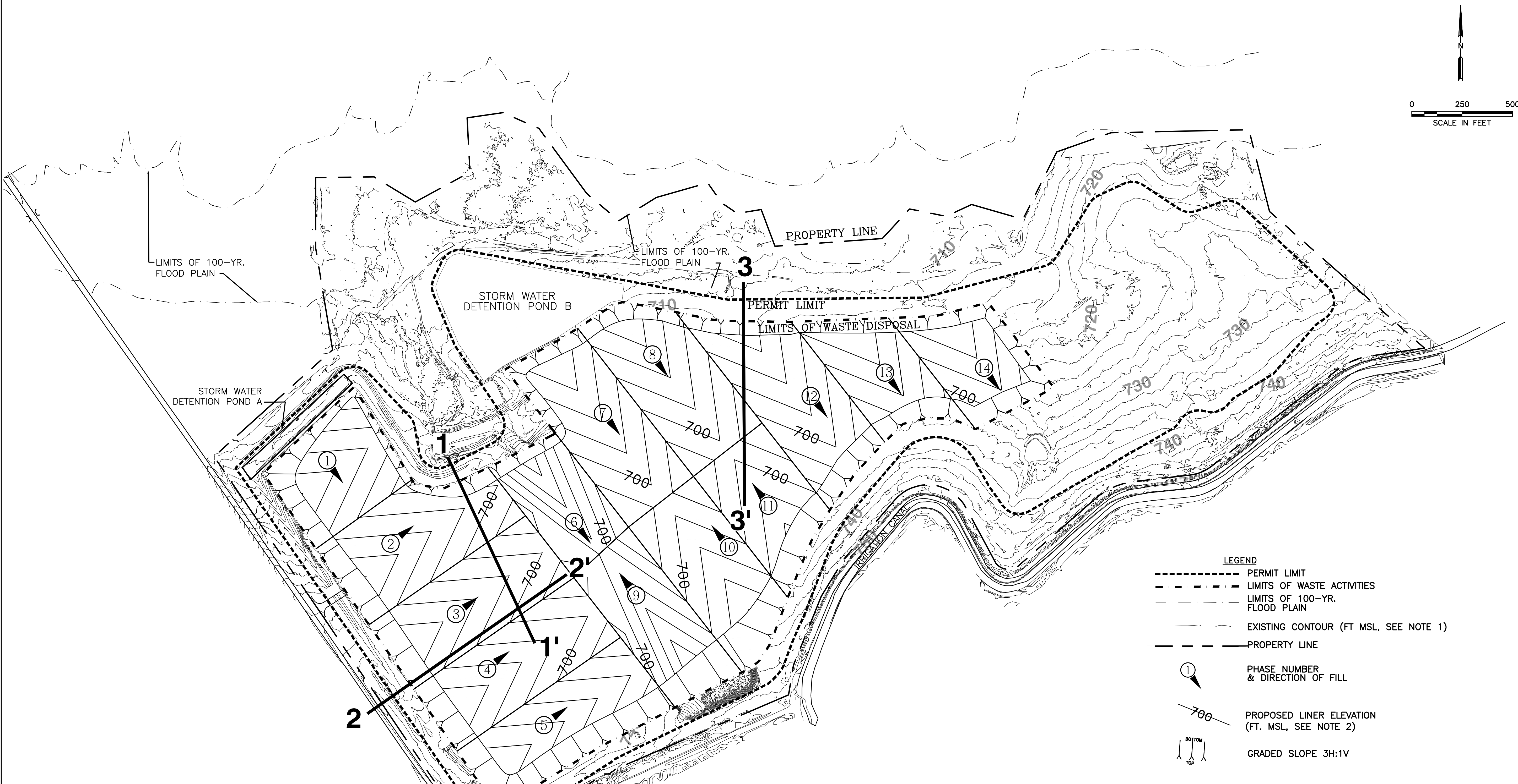
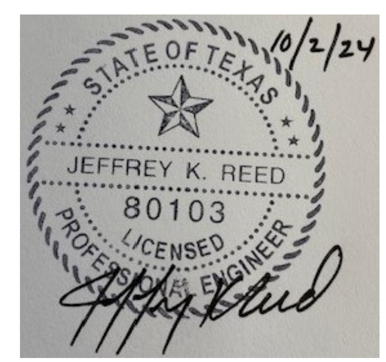

STATE OF TEXAS
JEFFREY K. REED
80103
LICENSED
PROFESSIONAL ENGINEER
10/2/24

Figure E5.1



LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- EXISTING CONTOUR (FT MSL, SEE NOTE 1)
- PROPERTY LINE
- PHASE NUMBER & DIRECTION OF FILL
- 700 PROPOSED LINER ELEVATION (FT. MSL, SEE NOTE 2)
- BOTTOM / TOP GRADED SLOPE 3H:1V
- **1-1'** STABILITY-SECTION LOCATIONS



NOTE:

1. EXISTING CONTOURS ARE REPRESENTATIVE OF AN AERIAL SURVEY FLOWN ON 8/16/2023 BY DALLAS AERIAL SURVEY, INC.
2. CONTOURS SHOWN REPRESENT TOP OF PROTECTIVE SOIL LAYER ELEVATIONS.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: STABILITY SECTIONS LOCATION MAP 1

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

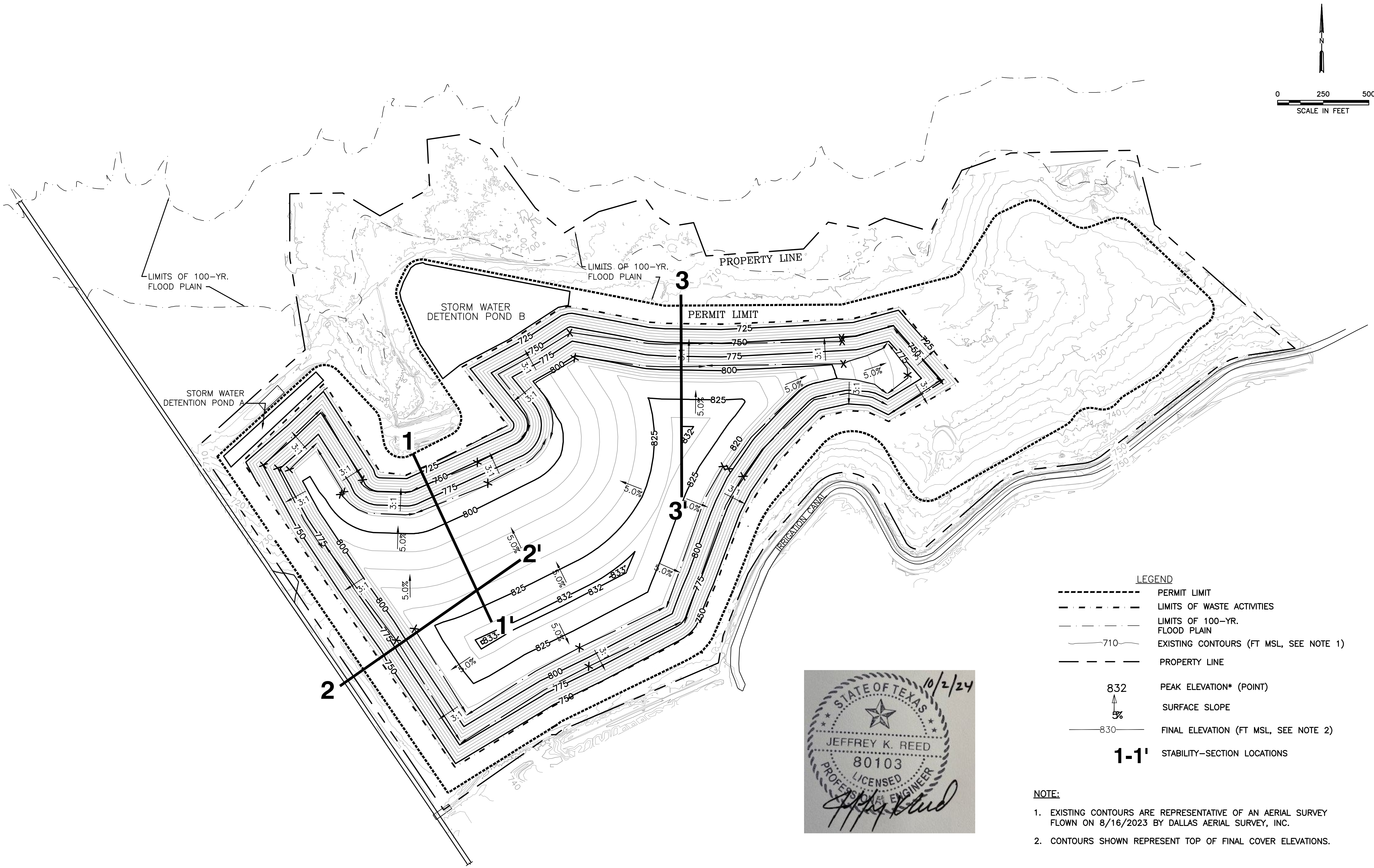
CADD FILE: SECTIONS LINER SYSTEM(11-21-21)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT **E5.1**

Figures E5.2 Through E5.5



LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- 710 EXISTING CONTOURS (FT MSL, SEE NOTE 1)
- PROPERTY LINE
- 832 PEAK ELEVATION* (POINT)
- 5% SURFACE SLOPE
- 830 FINAL ELEVATION (FT MSL, SEE NOTE 2)
- **1-1'** STABILITY-SECTION LOCATIONS

STATE OF TEXAS
JEFFREY K. REED
80103
LICENSED
PROFESSIONAL ENGINEER
10/2/24

NOTE:

1. EXISTING CONTOURS ARE REPRESENTATIVE OF AN AERIAL SURVEY FLOWN ON 8/16/2023 BY DALLAS AERIAL SURVEY, INC.
2. CONTOURS SHOWN REPRESENT TOP OF FINAL COVER ELEVATIONS.

FOR PERMIT PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: STABILITY SECTIONS LOCATION MAP 2

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: SECTIONS FINAL COVER(11-21-21)

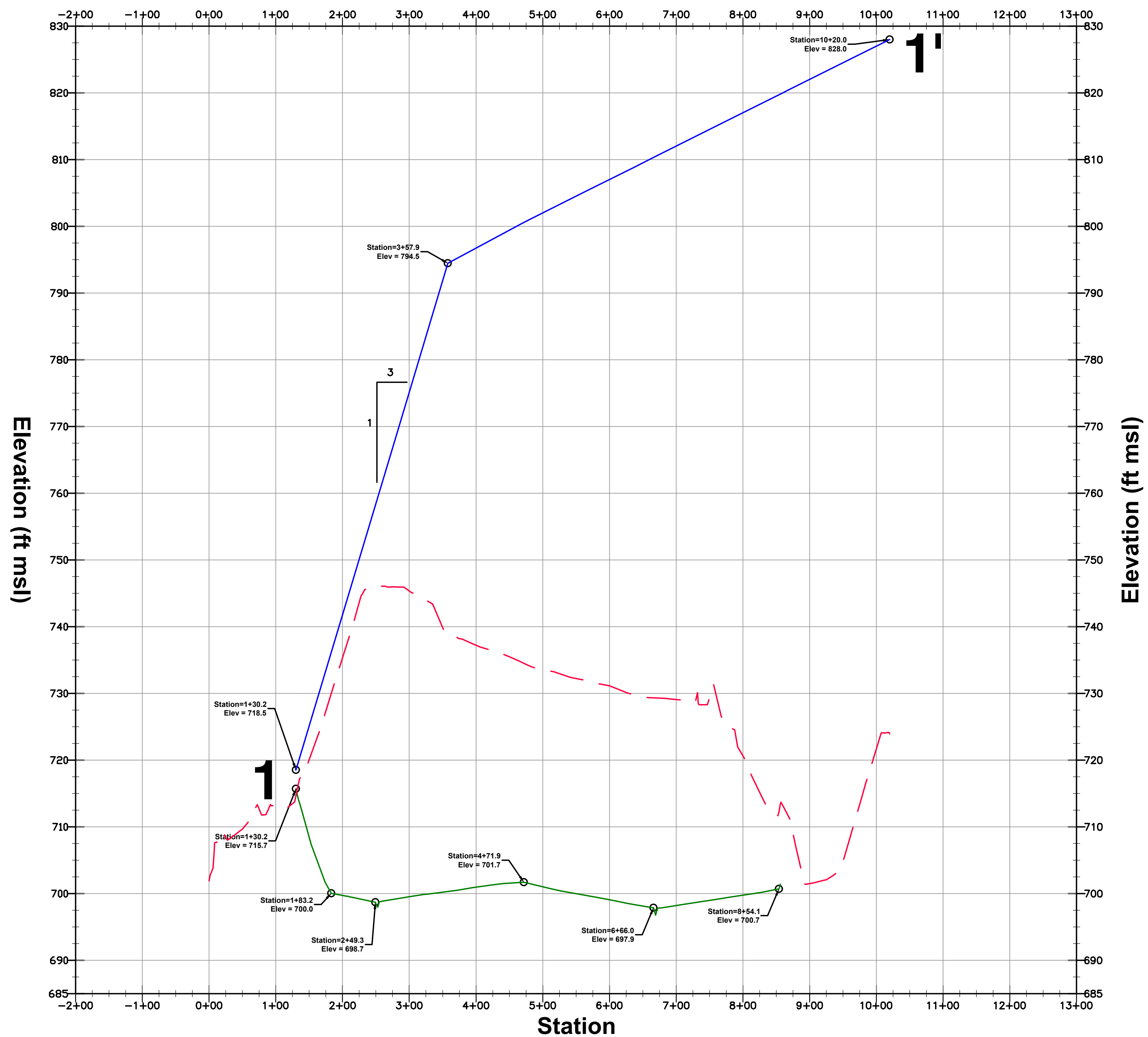
DATE: 09/2024

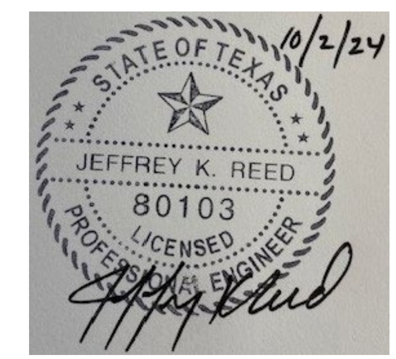
SCALE: AS SHOWN

ATTACHMENT

E5.2

9/30/2024 4:11 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Stability Package\Sections FINAL COVER(11-21-21)





0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

LEGEND

- EXISTING TOPOGRAPHY (SEE NOTE 1)
- EXISTING TOP OF PROTECTIVE COVER
- PROPOSED FINAL COVER

NOTE:

1. CONTOURS ARE REPRESENTATIVE OF AN AERIAL SURVEY FLOWN ON 8/16/2023 BY DALLAS AERIAL SURVEY, INC.

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: STABILITY CROSS SECTION 1

PROJECT: MAVERICK COUNTY EL INDIO MSW LANDFILL TIER III PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS 78860

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: BGD | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

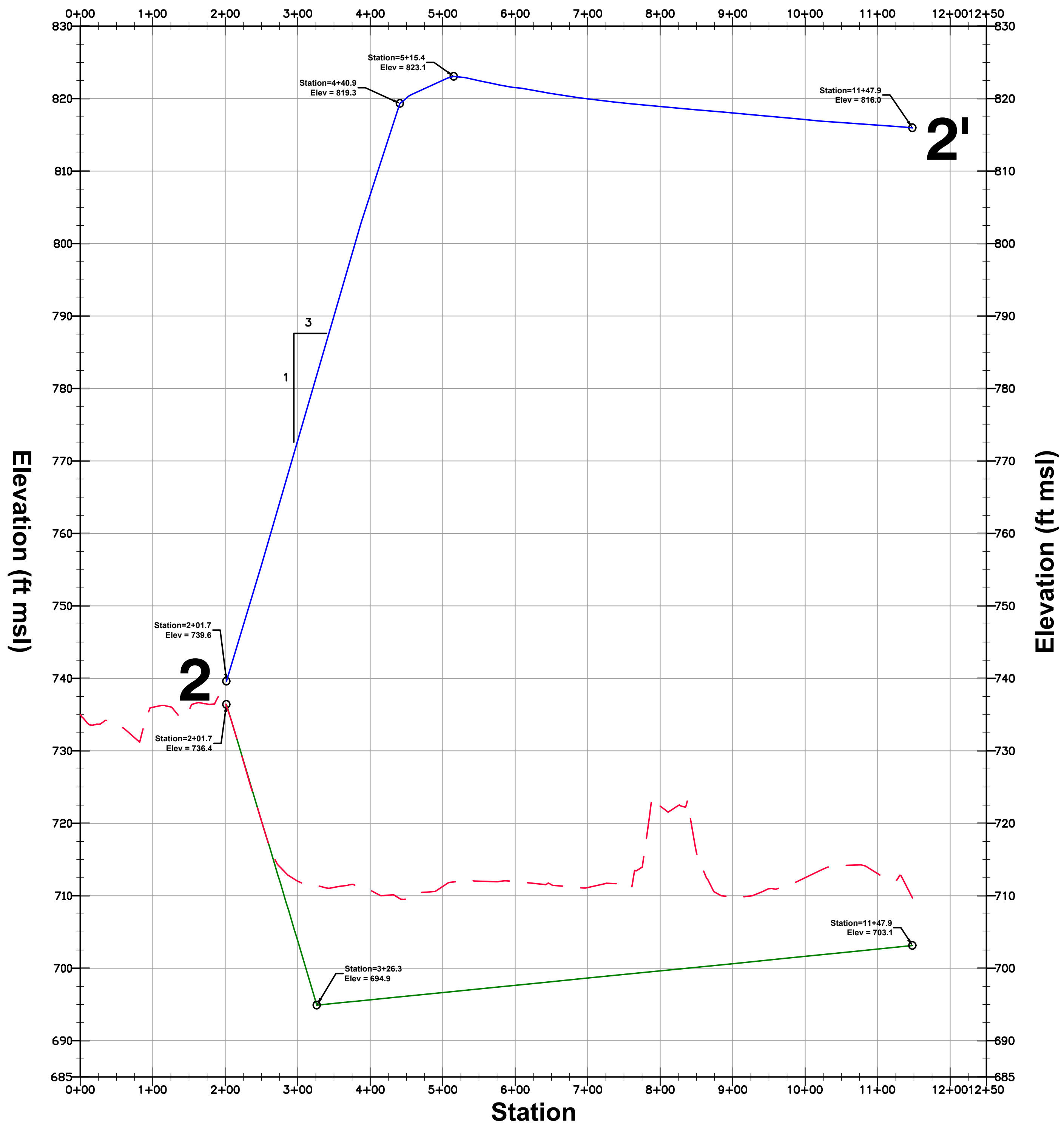
CADD FILE: SECTIONS – CROSS SECTIONS

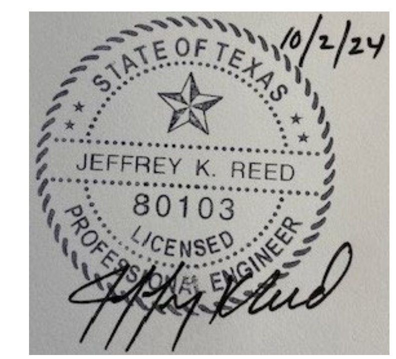
DATE: 09/2024

SCALE: AS SHOWN

DRAWING NO.

E5.3





0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

LEGEND

EXISTING TOPOGRAPHY (SEE NOTE 1)
EXISTING TOP OF PROTECTIVE COVER
PROPOSED FINAL COVER

NOTE:

1. CONTOURS ARE REPRESENTATIVE OF AN AERIAL SURVEY FLOWN ON 8/16/2023 BY DALLAS AERIAL SURVEY, INC.

REV	DATE	DESCRIPTION	BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING
STABILITY CROSS SECTION 2

PROJECT
MAVERICK COUNTY
EL INDIO MSW LANDFILL
TIER III PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
SOLID WASTE AUTHORITY
16179 FM 1021
EL INDIO, TEXAS 78860

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

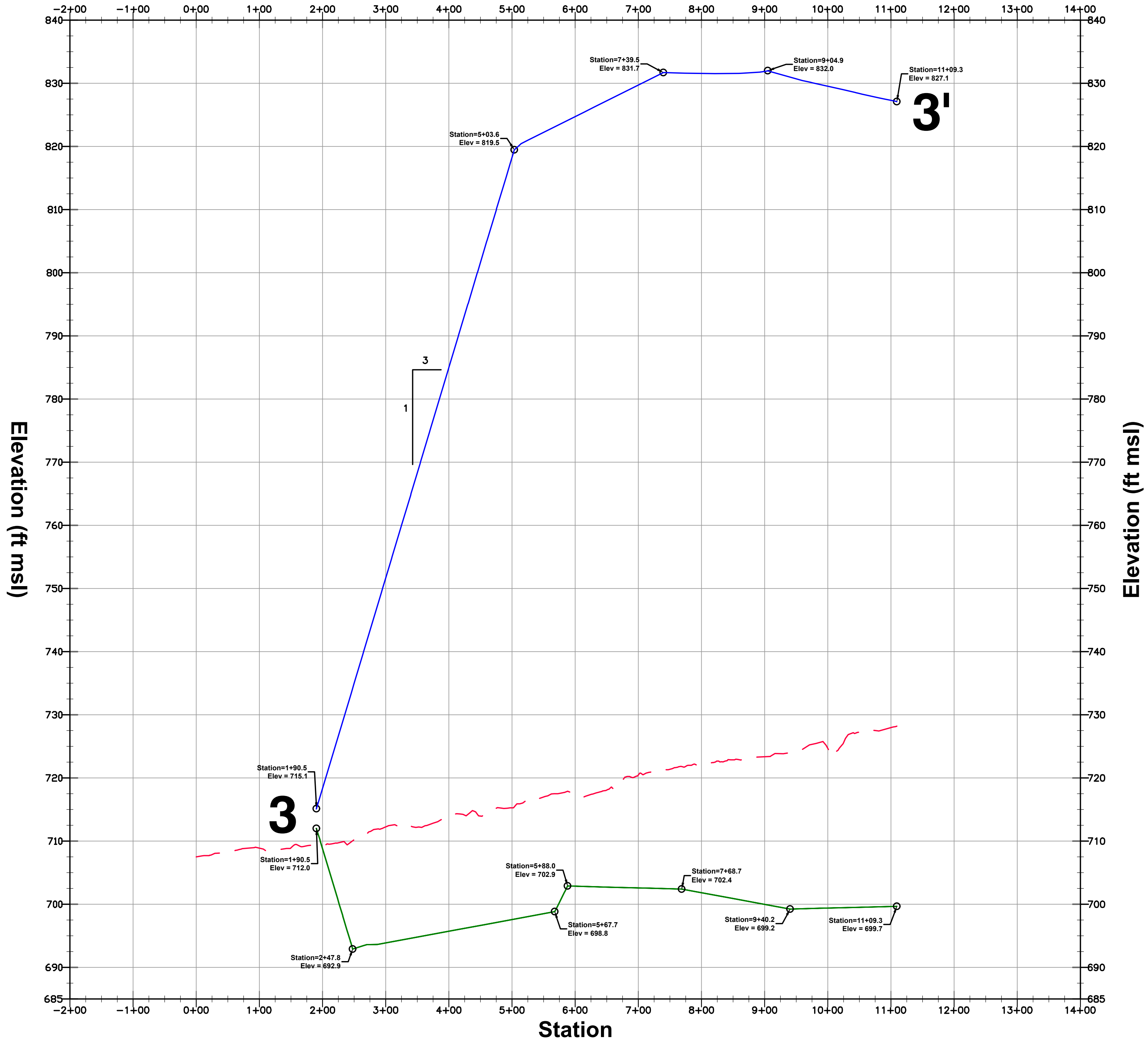
PROJ. NO. 16223092.00
DSN. BY: BGD
DWN. BY: DNA
CHK. BY: SDS
Q/A RVW BY: AGA
APP. BY: SDS

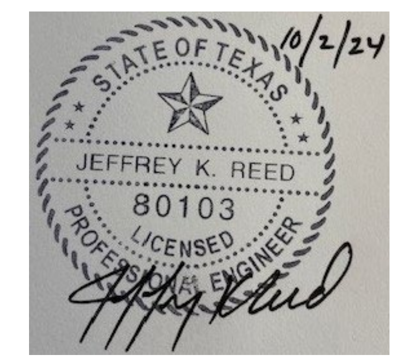
CADD FILE: SECTIONS – CROSS SECTIONS

DATE: 09/2024

SCALE: AS SHOWN

DRAWING NO.
E5.4





0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

LEGEND

- EXISTING TOPOGRAPHY (SEE NOTE 1)
- PROPOSED TOP OF PROTECTIVE COVER
- PROPOSED FINAL COVER

NOTE:

1. CONTOURS ARE REPRESENTATIVE OF AN AERIAL SURVEY FLOWN ON 8/16/2023 BY DALLAS AERIAL SURVEY, INC.

REV | DATE | DESCRIPTION | BY

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: STABILITY CROSS SECTION 3

PROJECT: MAVERICK COUNTY EL INDIO MSW LANDFILL TIER III PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS 78860

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: BGD | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: SECTIONS – CROSS SECTIONS

DATE: 09/2024

SCALE: AS SHOWN

DRAWING NO. E5.5

9/30/2024 4:15 PM: \MAVERICK COUNTY LANDFILL\16220088.00 T9 – Final Grade Contours & Drainage PMOD\Stability Package\Sections – Cross Sections nlomoah-asare, doreen

GEOMEMBRANE/GCL INTERFACE TEST RESULTS FOR

CELL 3 LINER SYSTEM

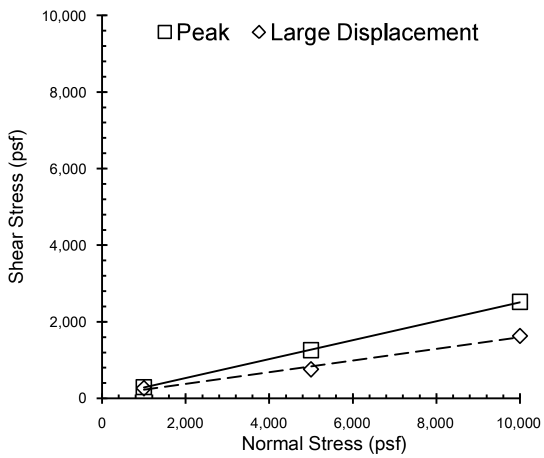
(September, 2019)

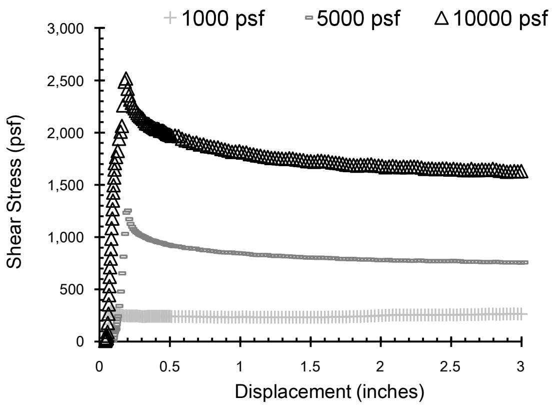
TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
Austin, TX - USA | Anaheim, CA - USA | Anderson, SC - USA | Gold Coast - Australia | Suzhou - China

Interface Shear Strength of Geosynthetic Clay Liner by Direct Shear (ASTM D6243)

Client:	SCS Engineers	TRI Log #:	G191291-1
Project:	Maverick County	Richard S. Lacey, P.E. 9/13/2019	
		Analysis & Quality Review/Date	

GSE Bentoliner NWL-35 GCL vs. GSE 60mil Smooth HDPE





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	13.9	8.7
Y-intercept or Adhesion	psf	36	71
Minimum Secant Angle	Degrees	14.1	8.6

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	GSE Bentoliner NWL-35 GCL (non-woven/fuzzy side against HDPE) R# 135080691	
Lower Box	GSE 60mil Smooth HDPE R# 107176281	
Conditioning	Wet: Loading applied and interface flooded for 24 hours prior to shear.	
Shearing Rate	inches/minute	0.04

Test Notes
Shearing occurred at the interface at all stresses.

Specimen No.		-	1	2	3
Normal Stress		psf	1,000	5,000	10,000
Box Edge Dimension		in	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	18	56	103
Peak	Shear Stress	psf	293	1,256	2,518
	Secant Angle	deg.	16.3	14.1	14.1
Large Displacement	Shear Stress	psf	266	757	1,630
	Secant Angle	deg.	14.9	8.6	9.3

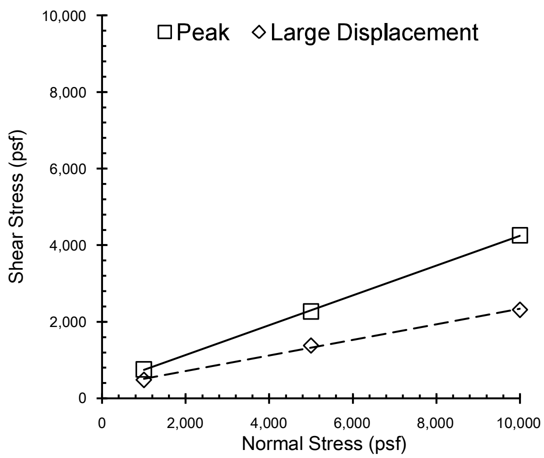
1160 North Gilbert Street, Anaheim, CA 92801, www.precisionlabs.net
Precision Geosynthetic Laboratories International dba TRI Environmental, Inc.

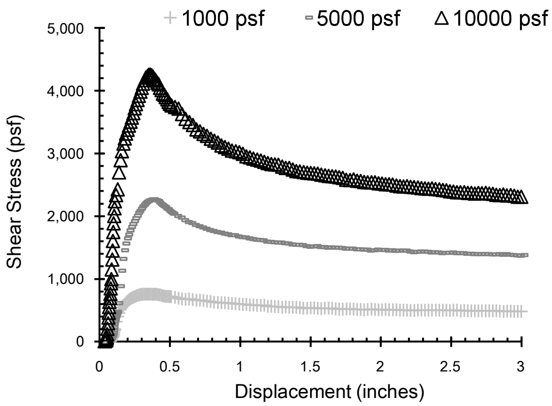
Interface Shear Strength of Geosynthetic Clay Liner by Direct Shear (ASTM D6243)

Client: SCS Engineers
Project: Maverick County

TRI Log #: G191291-2
Richard S. Lacey, P.E. 9/13/2019
Analysis & Quality Review/Date

GSE Bentoliner NWL-35 GCL vs. GSE 60mil DS Textured HDPE





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	21.3	11.5
Y-intercept or Adhesion	psf	354	310
Minimum Secant Angle	Degrees	23.1	13.0

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	GSE Bentoliner NWL-35 GCL (non-woven/fuzzy side against HDPE) R# 135080691	
Lower Box	GSE 60mil DS Textured HDPE R# 102194858	
Conditioning	Wet: Loading applied and interface flooded for 24 hours prior to shear.	
Shearing Rate	inches/minute	0.04

Test Notes
Shearing occurred at the interface at all stresses.

Specimen No.		-	1	2	3
Normal Stress		psf	1,000	5,000	10,000
Box Edge Dimension		in	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	18	56	103
Peak	Shear Stress	psf	759	2,271	4,257
	Secant Angle	deg.	37.2	24.4	23.1
Large Displacement	Shear Stress	psf	482	1,379	2,312
	Secant Angle	deg.	25.8	15.4	13.0
Pre-test Asperity Height , Avg. of 5 Meas.		mils	20	20	20

PCSTABL5M SLOPE STABILITY ANALYSES RESULTS

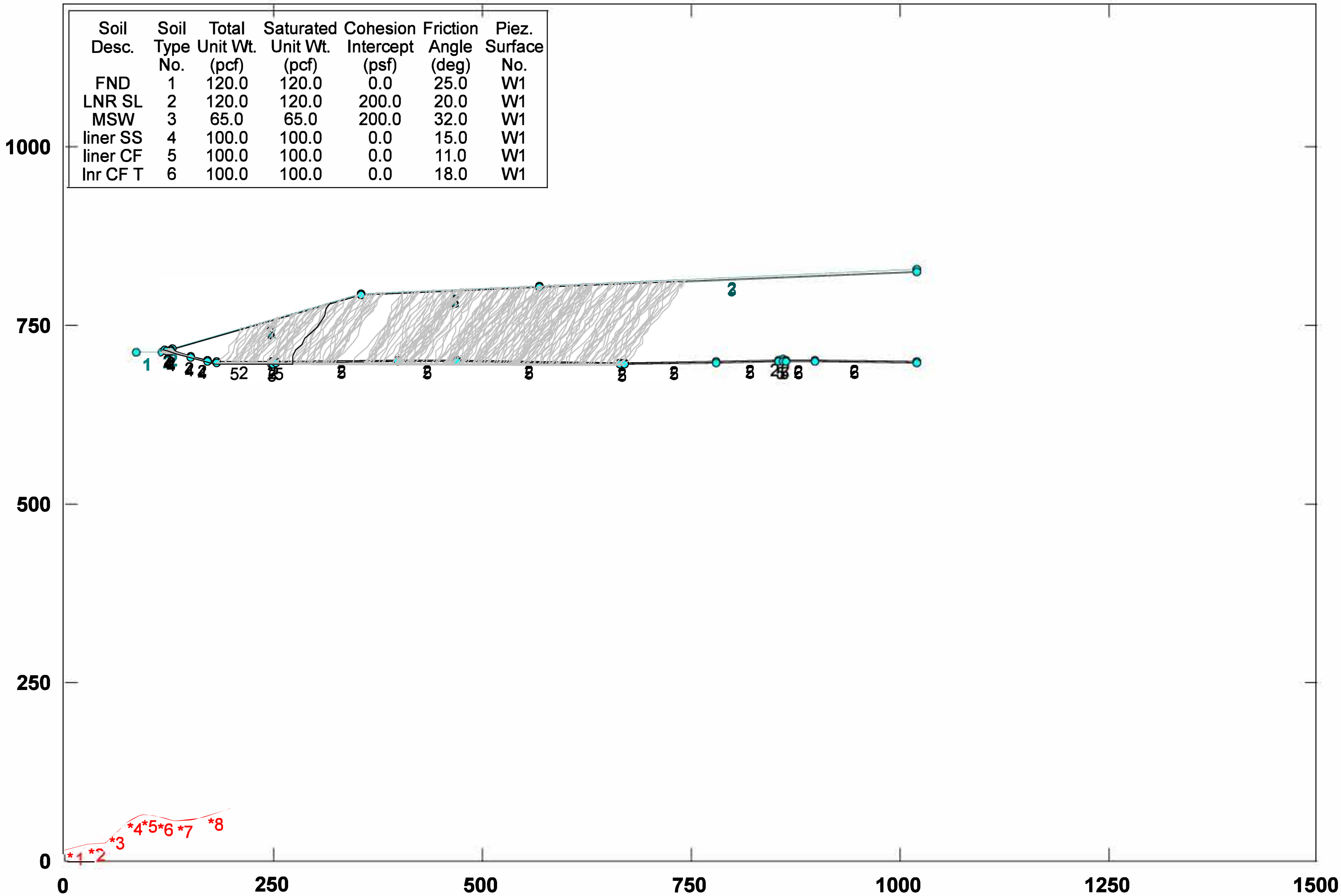
GRAPHICAL PRINTOUTS

Cross Section 1

Waste Block Mode

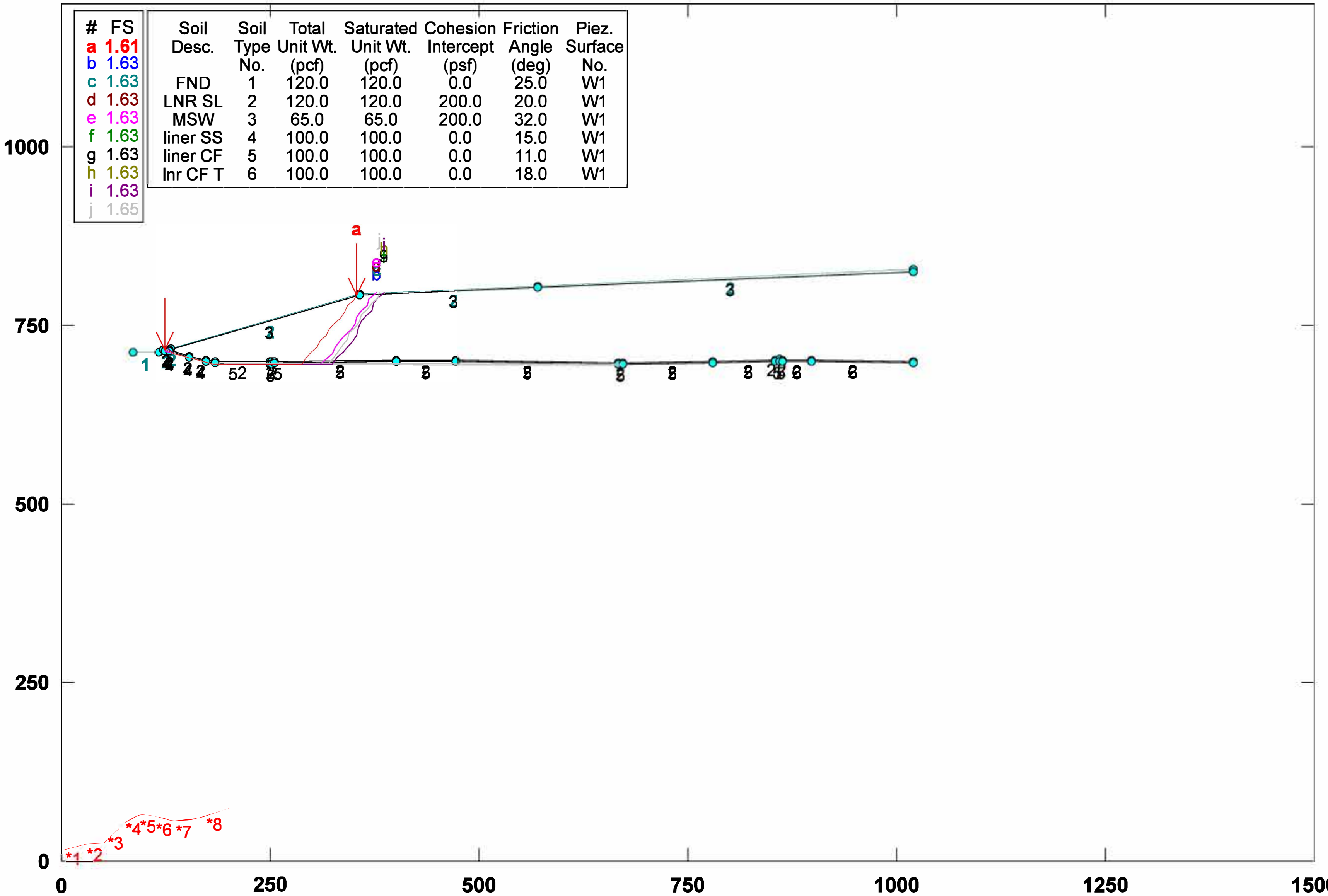
Maverick County Landfill Section 1, Cell 2North, Waste Block Mode

c:\users\4575sbg\desktop\stabl\mavco\mavco_section1_wb.plt Run By: SCS Engineers 10/22/2021 10:57AM



Maverick County Landfill Section 1, Cell 2North, Waste Block Mode

c:\users\4575sbg\desktop\stabl\mavco\mavco_section1_wb.pl2 Run By: SCS Engineers 10/22/2021 10:57AM



PCSTABL5M3 FSmin=1.61

Safety Factors Are Calculated By The Modified Janbu Method

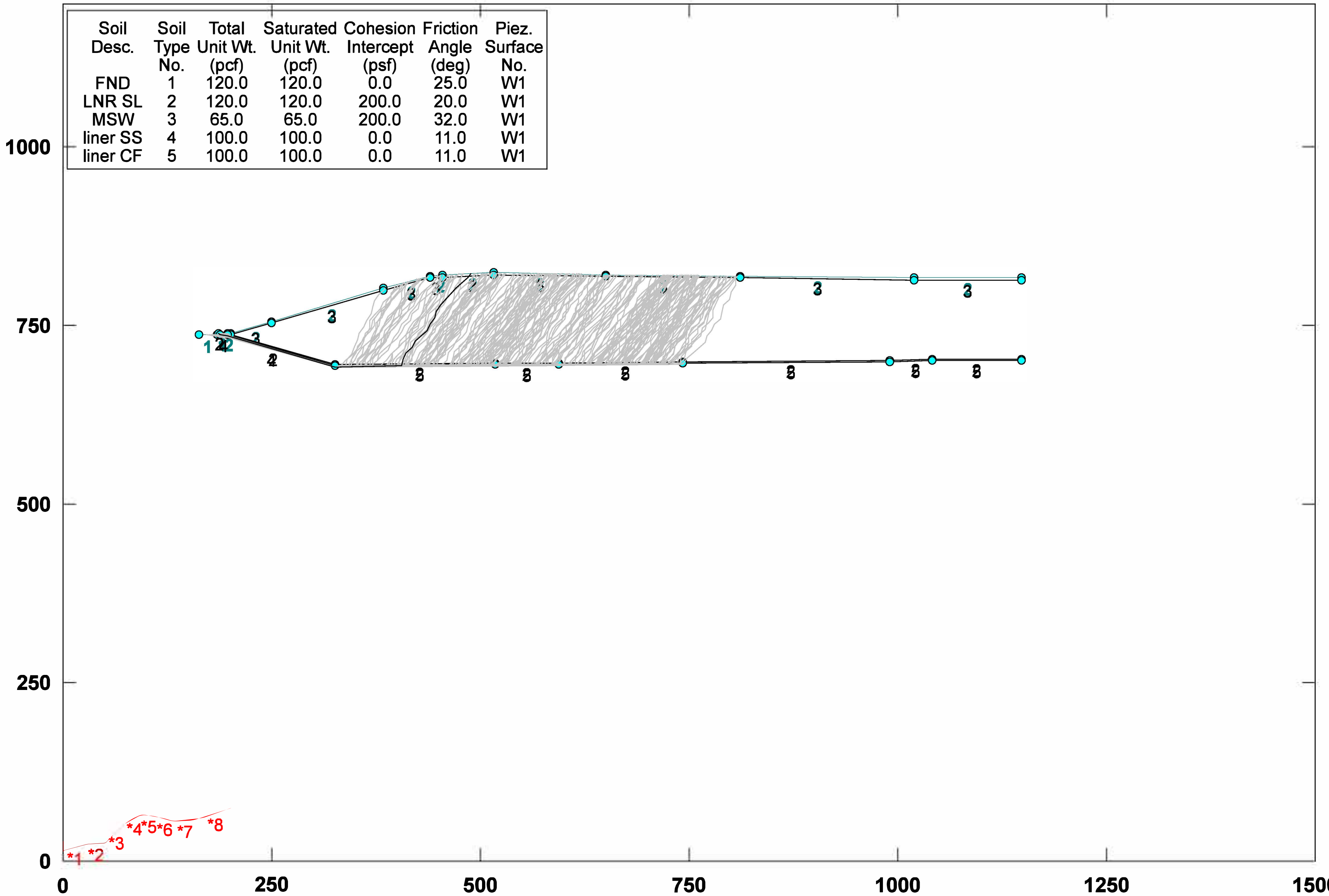
Cross Section 2

Waste Block Mode

Maverick County Landfill Section 2, Cell 3, Waste Block Mode

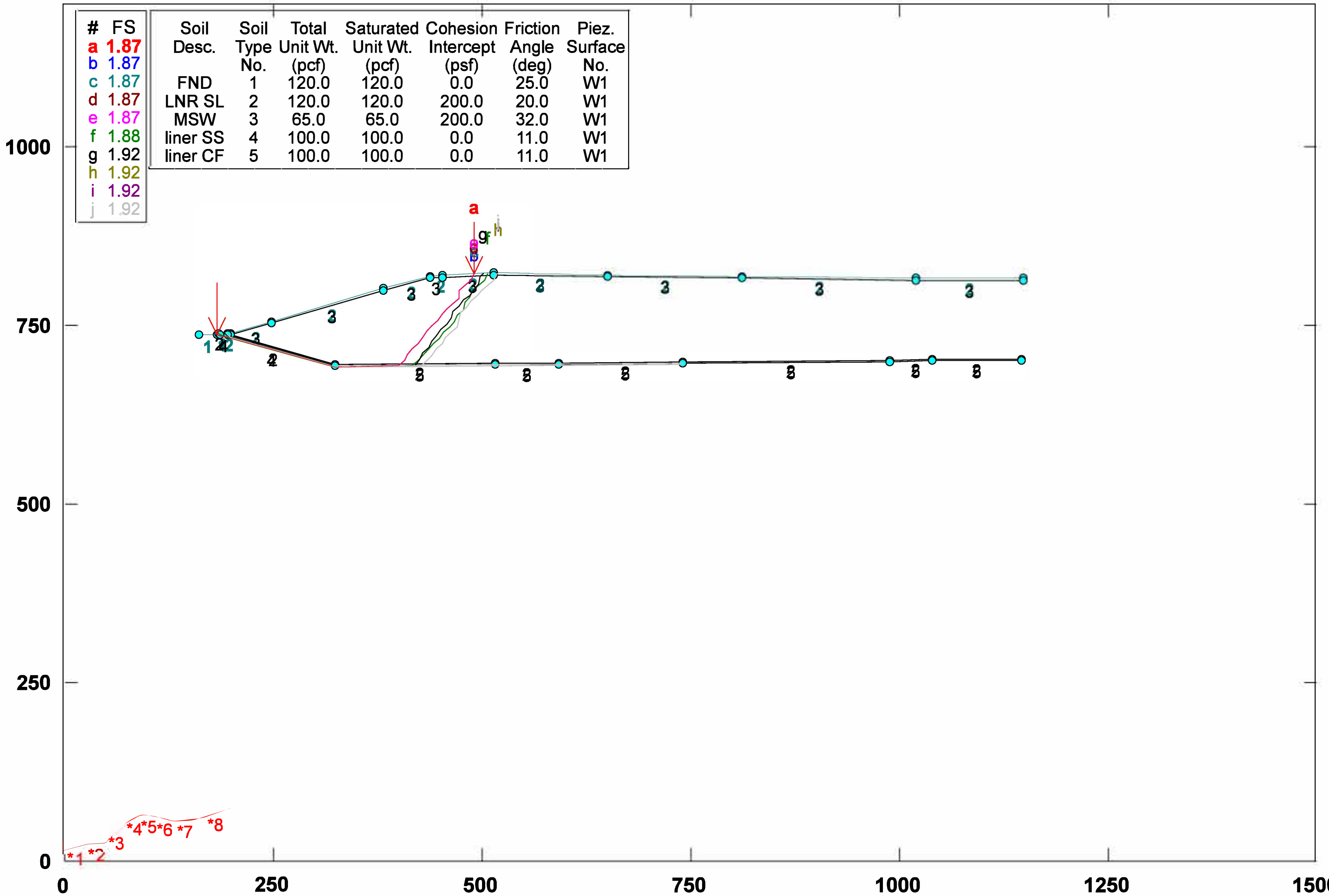
c:\users\4575sbg\desktop\stabl\mavco\mavco_section2_wb.plt Run By: SCS Engineers 10/22/2021 10:58AM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
FND	1	120.0	120.0	0.0	25.0	W1
LNR SL	2	120.0	120.0	200.0	20.0	W1
MSW	3	65.0	65.0	200.0	32.0	W1
liner SS	4	100.0	100.0	0.0	11.0	W1
liner CF	5	100.0	100.0	0.0	11.0	W1



Maverick County Landfill Section 2, Cell 3, Waste Block Mode

c:\users\4575sbg\desktop\stabl\mavco\mavco_section2_wb.pl2 Run By: SCS Engineers 10/22/2021 10:58AM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
FND	1	120.0	120.0	0.0	25.0	W1
LNR SL	2	120.0	120.0	200.0	20.0	W1
MSW	3	65.0	65.0	200.0	32.0	W1
liner SS	4	100.0	100.0	0.0	11.0	W1
liner CF	5	100.0	100.0	0.0	11.0	W1

PCSTABL5M3 FSmin=1.87

Safety Factors Are Calculated By The Modified Janbu Method

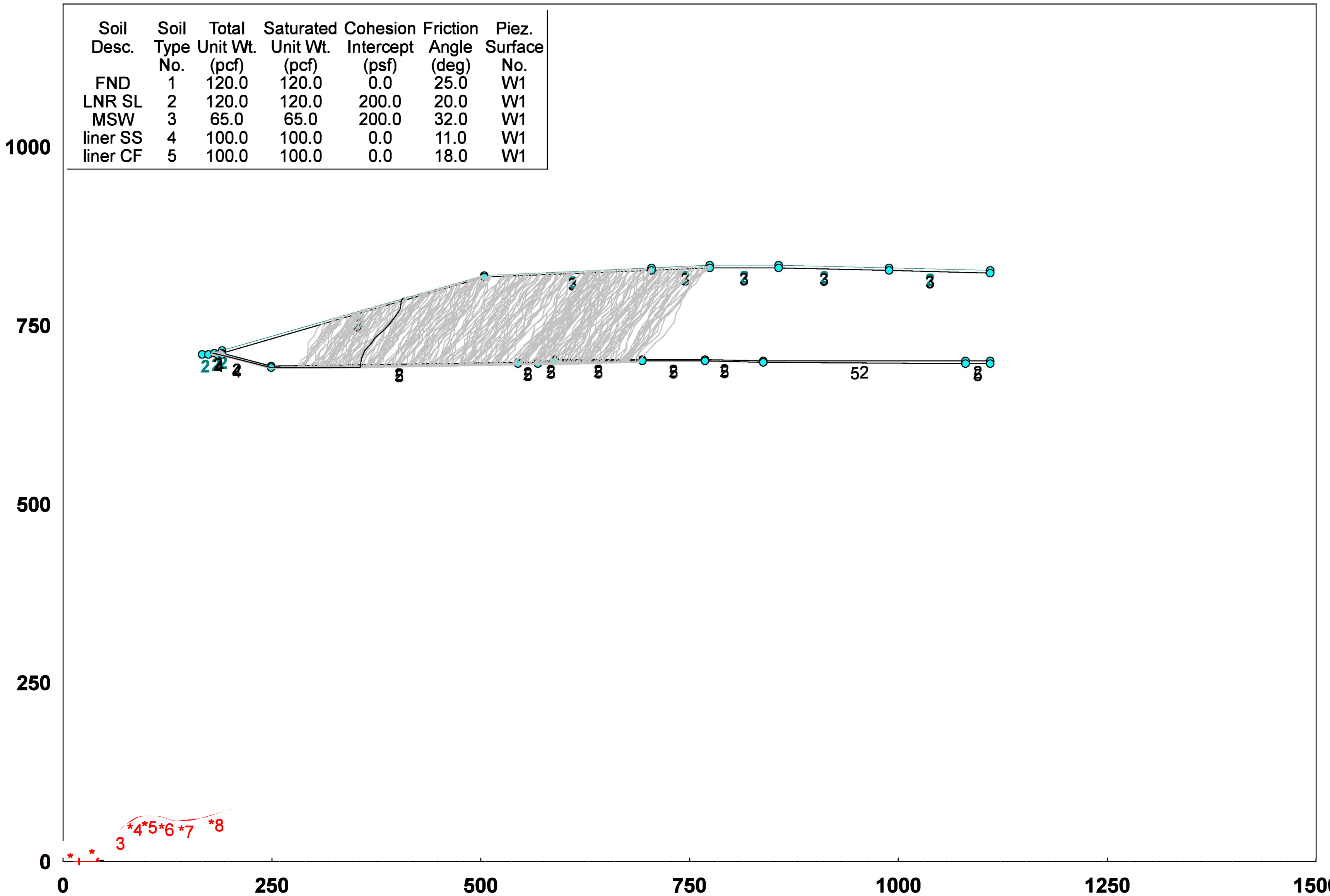
Cross Section 3

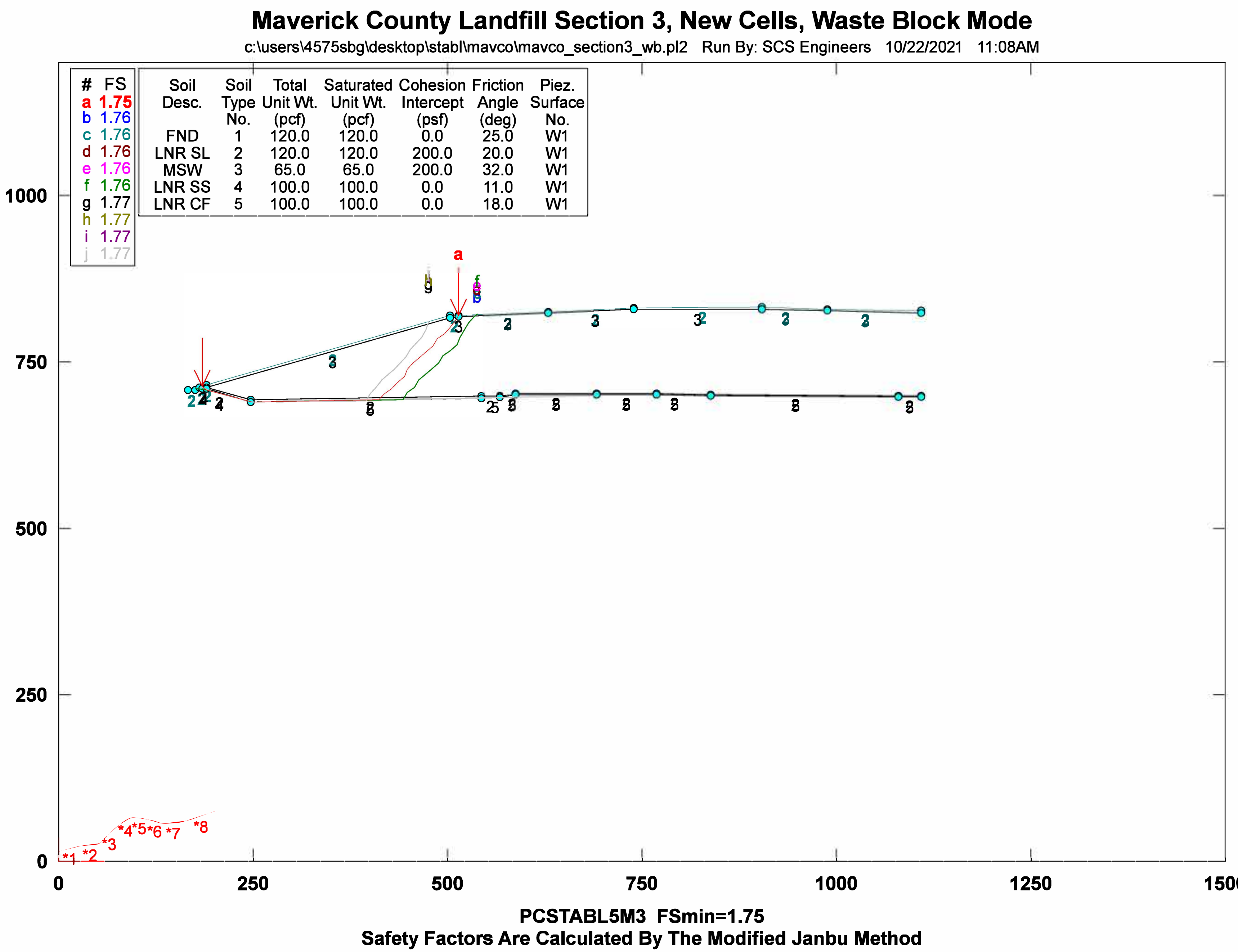
Waste Block Mode

Maverick County Landfill Section 3, New Cells, Waste Block Mode

c:\users\4575sbg\desktop\stabl\mavco\mavco_section3_wb.plt Run By: SCS Engineers 9/16/2021 10:50AM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
FND	1	120.0	120.0	0.0	25.0	W1
LNR SL	2	120.0	120.0	200.0	20.0	W1
MSW	3	65.0	65.0	200.0	32.0	W1
liner SS	4	100.0	100.0	0.0	11.0	W1
liner CF	5	100.0	100.0	0.0	18.0	W1





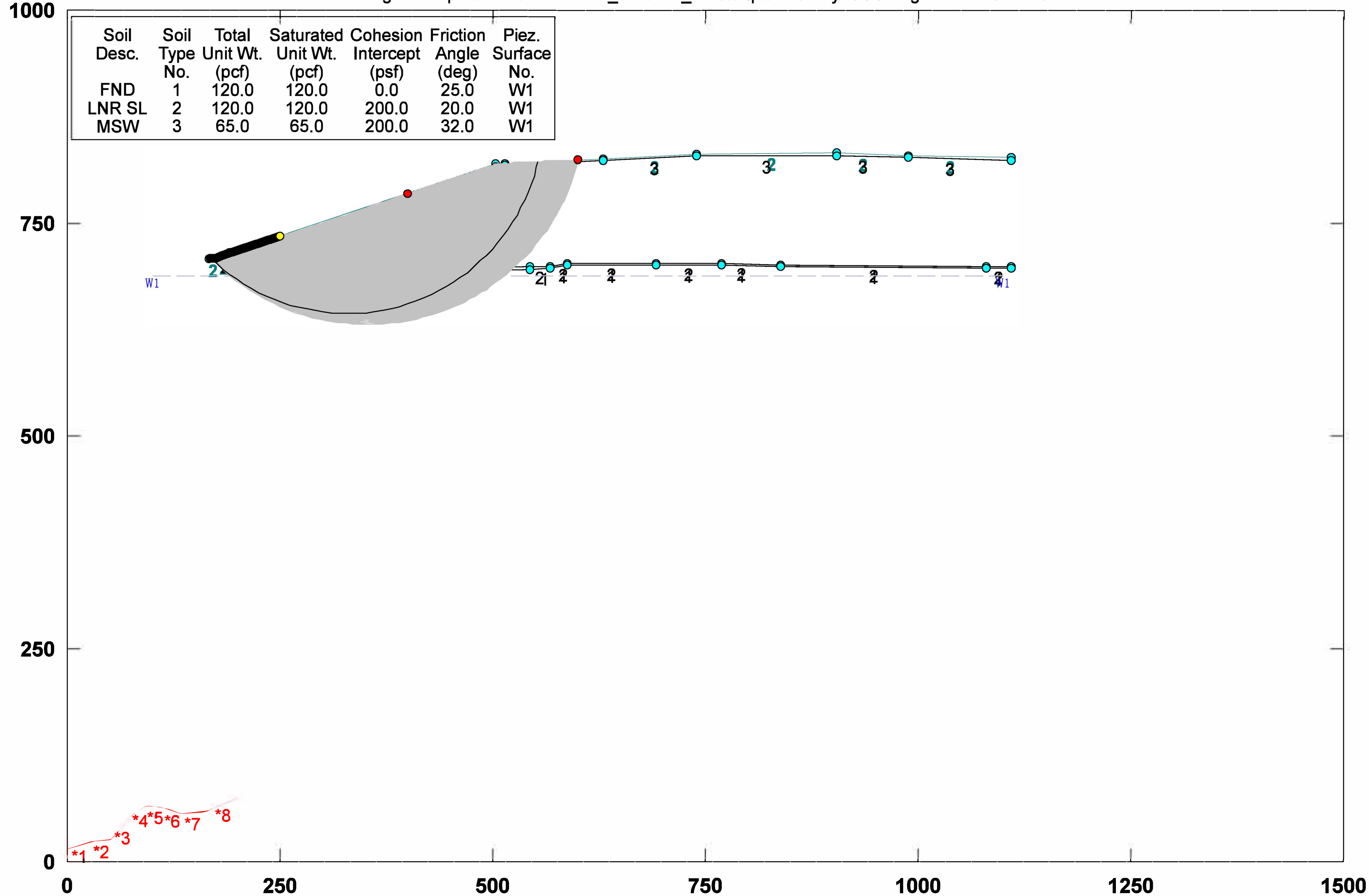
Maverick County Landfill Section 3, New Cells, Waste Block Mode
c:\users\4575sbg\desktop\stabl\mavco\mavco_section3_wb.pl2 Run By: SCS Engineers 10/22/2021 11:08AM
FS
a 1.75
b 1.76
c 1.76
d 1.76
e 1.76
f 1.76
g 1.77
h 1.77
i 1.77
j 1.77
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
FND 1 120.0 120.0 0.0 25.0 W1
LNR SL 2 120.0 120.0 200.0 20.0 W1
MSW 3 65.0 65.0 200.0 32.0 W1
LNR SS 4 100.0 100.0 0.0 11.0 W1
LNR CF 5 100.0 100.0 0.0 18.0 W1
1000
750
500
250
0
0
250
500
750
1000
1250
1500
PCSTABL5M3 FSmin=1.75
Safety Factors Are Calculated By The Modified Janbu Method

Cross Section 3

Circular Mode

Maverick County Landfill Section 3, New Cells, Circular Mode

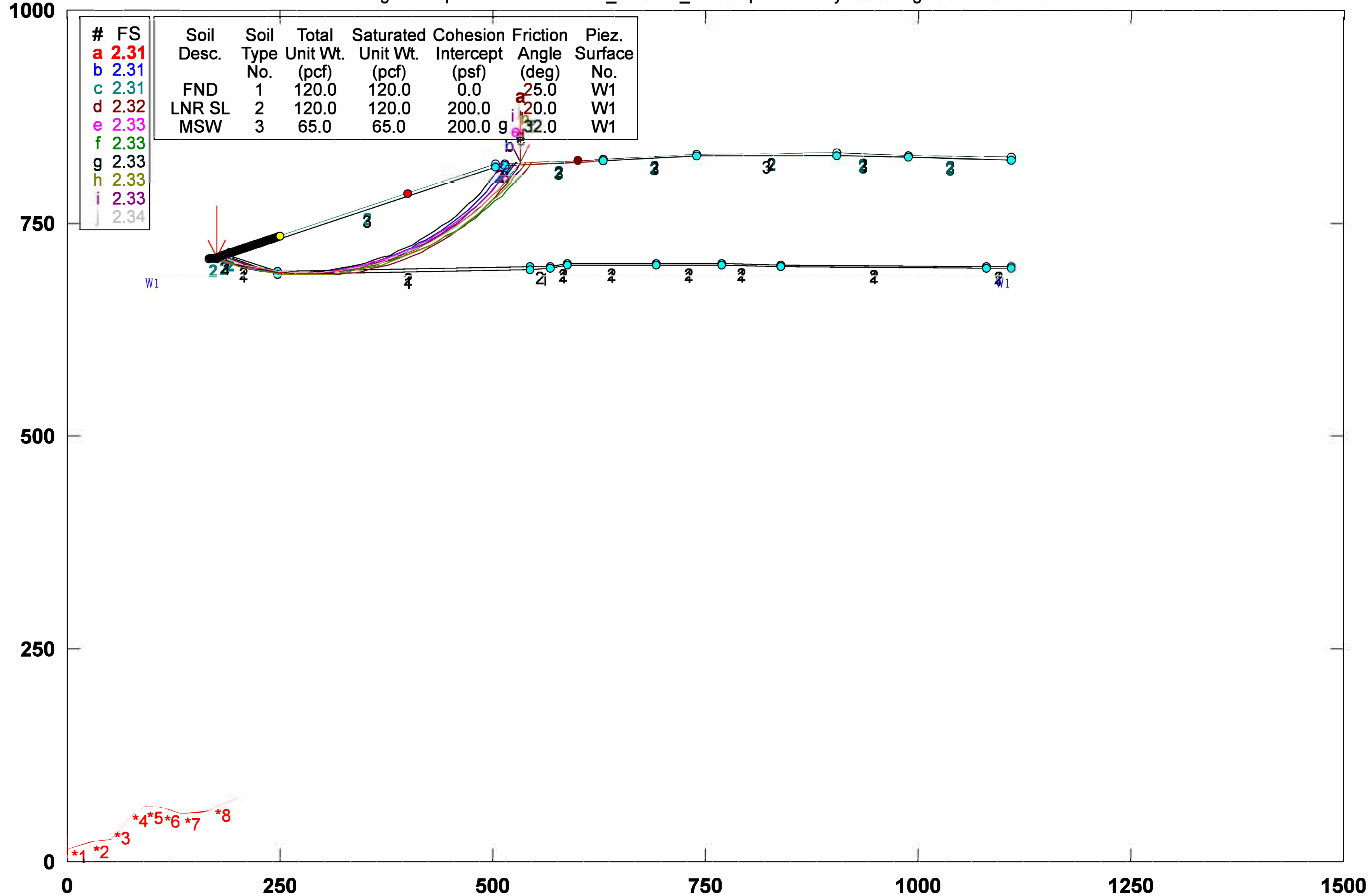
c:\users\4575sbg\desktop\stabl\mavco\mavco_section3_circular.plt Run By: SCS Engineers 10/22/2021 11:16AM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
FND	1	120.0	120.0	0.0	25.0	W1
LNR SL	2	120.0	120.0	200.0	20.0	W1
MSW	3	65.0	65.0	200.0	32.0	W1

Maverick County Landfill Section 3, New Cells, Circular Mode

c:\users\4575sbg\desktop\stabl\mavco\mavco_section3_circular.pl2 Run By: SCS Engineers 10/22/2021 11:16AM



#	FS
a	2.31
b	2.31
c	2.31
d	2.32
e	2.33
f	2.33
g	2.33
h	2.33
i	2.33
j	2.34

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
FND	1	120.0	120.0	0.0	25.0	W1
LNR SL	2	120.0	120.0	200.0	20.0	W1
MSW	3	65.0	65.0	200.0	32.0	W1

PCSTABL5M3 FSmin=2.31

Safety Factors Are Calculated By The Modified Bishop Method

PCSTABL5M SLOPE STABILITY ANALYSES RESULTS

OUTPUT FILES PRINTOUTS

Cross Section 1

Waste Block Mode

** PCSTABL5M3 **
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 10/22/2021
Time of Run: 10:57AM
Run By: SCS Engineers
Input Data Filename: C:mavco_section1_wb.in
Output Filename: C:mavco_section1_wb.OUT
Unit: ENGLISH
Plotted Output Filename: C:mavco_section1_wb.PLT
PROBLEM DESCRIPTION Maverick County Landfill
Section 1, Cell 2North, Waste Block Mode

BOUNDARY COORDINATES
6 Top Boundaries
43 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	85.30	711.70	117.40	712.40	1
2	117.40	712.40	121.30	715.60	2
3	121.30	715.60	130.30	718.50	2
4	130.30	718.50	357.90	794.50	2
5	357.90	794.50	570.50	805.50	2
6	570.50	805.50	1020.00	828.00	2
7	121.30	715.60	130.20	715.60	2
8	130.20	715.60	357.60	791.50	3
9	357.60	791.50	570.50	802.50	3
10	570.50	802.50	1020.00	825.00	3
11	130.20	715.60	153.00	707.40	2
12	153.00	707.40	173.90	701.70	2
13	173.90	701.70	183.20	700.10	2
14	183.20	700.10	249.30	698.70	2
15	249.30	698.70	252.10	698.70	2
16	252.10	698.70	255.10	698.80	2
17	255.10	698.80	400.00	701.00	2
18	400.00	701.00	471.90	701.70	2
19	471.90	701.70	666.10	697.90	2
20	666.10	697.90	672.10	697.80	2
21	672.10	697.80	780.30	699.50	2
22	780.30	699.50	854.10	700.70	2
23	854.10	700.70	859.00	702.40	2
24	859.00	702.40	863.70	700.80	2
25	863.70	700.80	898.60	702.00	2
26	898.60	702.00	1020.00	700.00	2
27	124.20	713.60	130.20	713.60	4
28	130.20	713.60	153.00	705.40	4
29	153.00	705.40	173.90	699.70	4
30	173.90	699.70	183.20	698.10	4
31	183.20	698.10	249.30	696.70	5
32	249.30	696.70	252.10	696.70	5
33	252.10	696.70	255.10	696.80	5
34	255.10	696.80	400.00	699.00	5
35	400.00	699.00	471.90	699.70	5
36	471.90	699.70	666.10	695.90	5
37	666.10	695.90	672.10	695.80	5
38	672.10	695.80	780.30	697.50	5
39	780.30	697.50	854.10	698.70	5
40	854.10	698.70	859.00	700.40	5
41	859.00	700.40	863.70	698.80	5
42	863.70	698.80	898.60	700.00	6
43	898.60	700.00	1020.00	698.00	6

ISOTROPIC SOIL PARAMETERS
6 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	65.0	65.0	200.0	32.0	0.00	0.0	1
4	100.0	100.0	0.0	15.0	0.00	0.0	1
5	100.0	100.0	0.0	11.0	0.00	0.0	1
6	100.0	100.0	0.0	18.0	0.00	0.0	1

Searching Routine Will Be Limited To An Area Defined By 8 Boundaries
Of Which The First 8 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	15.00	29.00	24.00
2	29.00	24.00	51.00	26.00
3	51.00	26.00	78.00	56.00
4	78.00	56.00	94.00	65.00
5	94.00	65.00	113.00	64.00
6	113.00	64.00	133.00	56.00
7	133.00	56.00	161.00	58.00
8	161.00	58.00	205.00	76.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
3 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	134.00	711.00	137.00	710.00	1.00
2	182.00	696.00	183.00	696.00	1.00
3	184.00	697.00	670.00	695.00	1.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.41	716.60
2	126.46	715.70
3	135.20	710.85
4	182.76	695.86
5	286.96	696.09
6	292.47	704.44
7	299.50	711.55
8	306.09	719.08
9	310.18	728.20
10	317.24	735.28
11	321.19	744.47
12	326.05	753.20
13	333.07	760.33
14	338.26	768.88
15	343.04	777.66
16	349.73	785.09
17	353.19	792.93

*** 1.612 ***

Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	191.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.2	34.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.6	1405.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.1	58.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	4.9	3651.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	17.8	22540.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	20.9	43565.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	8.9	24368.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.4	1300.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	66.1	241379.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	2.8	12229.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	3.0	13294.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	31.9	153453.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.8	4053.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	1.3	6604.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	3.4	15962.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	7.0	31208.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	6.6	27074.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	4.1	15087.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	7.1	23163.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	3.9	11322.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	4.9	11595.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	7.0	14014.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	5.2	8405.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	4.8	5567.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	6.7	5104.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	2.0	922.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1.5	260.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.08	716.17
2	124.75	714.51
3	134.19	711.21
4	182.73	696.43
5	309.98	696.26
6	317.03	703.35
7	323.89	710.62
8	327.02	720.12
9	332.89	728.21
10	339.67	735.56
11	346.30	743.06
12	351.71	751.46
13	353.14	761.36
14	358.70	769.67
15	365.29	777.19
16	368.62	786.62
17	375.55	793.83
18	376.38	795.46

*** 1.626 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	123.08	716.17
2	124.75	714.51
3	134.19	711.21

```
       4        182.73      696.43
       5        309.98      696.26
       6        317.03      703.35
       7        323.89      710.62
       8        327.02      720.12
       9        332.89      728.21
      10        339.67      735.56
      11        346.30      743.06
      12        351.71      751.46
      13        353.14      761.36
      14        358.70      769.67
      15        365.29      777.19
      16        368.62      786.62
      17        375.55      793.83
      18        376.38      795.46
         ***      1.626   ***

   Failure Surface Specified By 18 Coordinate Points
     Point      X-Surf      Y-Surf
      No.        (ft)        (ft)
       1        123.08      716.17
       2        124.75      714.51
       3        134.19      711.21
       4        182.73      696.43
       5        309.98      696.26
       6        317.03      703.35
       7        323.89      710.62
       8        327.02      720.12
       9        332.89      728.21
      10        339.67      735.56
      11        346.30      743.06
      12        351.71      751.46
      13        353.14      761.36
      14        358.70      769.67
      15        365.29      777.19
      16        368.62      786.62
      17        375.55      793.83
      18        376.38      795.46
         ***      1.626   ***

   Failure Surface Specified By 18 Coordinate Points
     Point      X-Surf      Y-Surf
      No.        (ft)        (ft)
       1        123.08      716.17
       2        124.75      714.51
       3        134.19      711.21
       4        182.73      696.43
       5        309.98      696.26
       6        317.03      703.35
       7        323.89      710.62
       8        327.02      720.12
       9        332.89      728.21
      10        339.67      735.56
      11        346.30      743.06
      12        351.71      751.46
      13        353.14      761.36
      14        358.70      769.67
      15        365.29      777.19
      16        368.62      786.62
      17        375.55      793.83
      18        376.38      795.46
         ***      1.626   ***
```

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.18	717.49
2	127.27	717.41
3	134.38	710.38
4	182.33	696.26
5	324.22	696.02
6	329.34	704.60
7	336.36	711.73
8	342.85	719.34
9	348.59	727.52
10	352.57	736.70
11	355.52	746.25
12	358.50	755.80
13	365.16	763.26
14	371.11	771.30
15	372.73	781.16
16	379.49	788.54
17	385.46	795.93
***	1.634	***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.18	717.49
2	127.27	717.41
3	134.38	710.38
4	182.33	696.26
5	324.22	696.02
6	329.34	704.60
7	336.36	711.73
8	342.85	719.34
9	348.59	727.52
10	352.57	736.70
11	355.52	746.25
12	358.50	755.80
13	365.16	763.26
14	371.11	771.30
15	372.73	781.16
16	379.49	788.54
17	385.46	795.93
***	1.634	***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.18	717.49
2	127.27	717.41
3	134.38	710.38
4	182.33	696.26
5	324.22	696.02
6	329.34	704.60
7	336.36	711.73
8	342.85	719.34
9	348.59	727.52
10	352.57	736.70
11	355.52	746.25
12	358.50	755.80
13	365.16	763.26
14	371.11	771.30
15	372.73	781.16
16	379.49	788.54

17	385.46	795.93
***	1.634	***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.18	717.49
2	127.27	717.41
3	134.38	710.38
4	182.33	696.26
5	324.22	696.02
6	329.34	704.60
7	336.36	711.73
8	342.85	719.34
9	348.59	727.52
10	352.57	736.70
11	355.52	746.25
12	358.50	755.80
13	365.16	763.26
14	371.11	771.30
15	372.73	781.16
16	379.49	788.54
17	385.46	795.93
***	1.634	***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.88	716.75
2	126.03	715.63
3	134.88	710.99
4	182.83	696.22
5	320.78	696.90
6	325.87	705.51
7	331.43	713.82
8	336.37	722.51
9	343.14	729.87
10	344.67	739.76
11	351.62	746.95
12	357.36	755.13
13	359.66	764.87
14	366.72	771.94
15	371.07	780.95
16	378.14	788.02
17	381.57	795.72
***	1.654	***

.667 ***

Cross Section 2

Waste Block Mode

** PCSTABL5M3 **
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 10/22/2021
Time of Run: 11:33AM
Run By: SCS Engineers
Input Data Filename: C:mavco_section2_wb.in
Output Filename: C:mavco_section2_wb.OUT
Unit: ENGLISH
Plotted Output Filename: C:mavco_section2_wb.PLT
PROBLEM DESCRIPTION Maverick County Landfill
Section 2, Cell 3, Waste Block Mode

BOUNDARY COORDINATES
13 Top Boundaries
38 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	163.80	736.50	184.30	737.00	1
2	184.30	737.00	186.60	738.10	1
3	186.60	738.10	196.60	738.10	1
4	196.60	738.10	201.70	739.60	2
5	201.70	739.60	249.80	755.60	2
6	249.80	755.60	384.20	801.80	2
7	384.20	801.80	440.50	819.30	2
8	440.50	819.30	454.30	820.40	2
9	454.30	820.40	515.40	823.10	2
10	515.40	823.10	649.50	820.70	2
11	649.50	820.70	812.10	818.80	2
12	812.10	818.80	1019.40	816.90	2
13	1019.40	816.90	1147.90	816.00	2
14	196.60	738.10	201.40	736.50	2
15	201.40	736.50	249.80	752.60	3
16	249.80	752.60	384.20	798.80	3
17	384.20	798.80	440.50	816.30	3
18	440.50	816.30	454.30	817.40	3
19	454.30	817.40	515.40	820.10	3
20	515.40	820.10	649.50	817.70	3
21	649.50	817.70	812.10	815.80	3
22	812.10	815.80	1019.40	813.90	3
23	1019.40	813.90	1147.90	813.00	3
24	201.40	736.50	326.30	694.90	2
25	326.30	694.90	518.30	696.90	2
26	518.30	696.90	593.20	697.60	2
27	593.20	697.60	742.10	699.10	2
28	742.10	699.10	991.00	701.60	2
29	991.00	701.60	1041.00	702.10	2
30	1041.00	702.10	1147.90	703.20	2
31	188.60	736.10	196.60	736.10	4
32	196.60	736.10	326.30	692.90	4
33	326.30	692.90	518.30	694.90	5
34	518.30	694.90	593.20	695.60	5
35	593.20	695.60	742.10	697.10	5
36	742.10	697.10	991.00	699.60	5
37	991.00	699.60	1041.00	700.10	5
38	1041.00	700.10	1147.90	701.20	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	65.0	65.0	200.0	32.0	0.00	0.0	1
4	100.0	100.0	0.0	11.0	0.00	0.0	1
5	100.0	100.0	0.0	11.0	0.00	0.0	1

Searching Routine Will Be Limited To An Area Defined By 8 Boundaries Of Which The First 8 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	15.00	29.00	24.00
2	29.00	24.00	51.00	26.00
3	51.00	26.00	78.00	56.00
4	78.00	56.00	94.00	65.00
5	94.00	65.00	113.00	64.00
6	113.00	64.00	133.00	56.00
7	133.00	56.00	161.00	58.00
8	161.00	58.00	205.00	76.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

3 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	196.60	735.00	202.60	733.00	1.00
2	326.00	692.00	326.10	692.00	1.00
3	330.00	692.50	742.00	696.00	1.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.29	737.47
2	187.81	735.35
3	197.75	734.25
4	326.00	692.40
5	402.40	692.76
6	408.56	700.63
7	412.54	709.81
8	418.58	717.78
9	425.45	725.04
10	430.30	733.79
11	435.60	742.27
12	442.26	749.73
13	449.07	757.05
14	454.41	765.51
15	460.37	773.53
16	467.14	780.89
17	474.07	788.11
18	474.79	798.08
19	481.77	805.23
20	488.83	812.32
21	491.84	821.86

22	491.95	822.06
***	1.872	***

Individual data on the 34 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.3	135.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.2	325.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.8	262.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	8.0	2940.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.2	510.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	3.6	2220.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.3	225.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	48.1	85658.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	76.2	339567.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.3	1804.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	57.9	391029.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	18.2	137936.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.7	5700.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	1.6	11954.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	3.8	28281.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	4.0	27787.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	6.0	39344.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	6.9	42303.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	4.9	27919.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	5.3	28030.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	4.9	24237.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1.8	8348.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	6.8	30495.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	5.2	20923.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.1	396.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	6.0	20758.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	6.8	20317.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	6.9	17625.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.7	1437.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	7.0	10147.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	7.1	7126.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2.1	1213.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.9	171.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.1	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.29	737.47
2	187.81	735.35
3	197.75	734.25
4	326.00	692.40
5	402.40	692.76
6	408.56	700.63
7	412.54	709.81
8	418.58	717.78
9	425.45	725.04
10	430.30	733.79
11	435.60	742.27
12	442.26	749.73
13	449.07	757.05
14	454.41	765.51
15	460.37	773.53
16	467.14	780.89

17	474.07	788.11
18	474.79	798.08
19	481.77	805.23
20	488.83	812.32
21	491.84	821.86
22	491.95	822.06
***	1.872	***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.29	737.47
2	187.81	735.35
3	197.75	734.25
4	326.00	692.40
5	402.40	692.76
6	408.56	700.63
7	412.54	709.81
8	418.58	717.78
9	425.45	725.04
10	430.30	733.79
11	435.60	742.27
12	442.26	749.73
13	449.07	757.05
14	454.41	765.51
15	460.37	773.53
16	467.14	780.89
17	474.07	788.11
18	474.79	798.08
19	481.77	805.23
20	488.83	812.32
21	491.84	821.86
22	491.95	822.06
***	1.872	***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.29	737.47
2	187.81	735.35
3	197.75	734.25
4	326.00	692.40
5	402.40	692.76
6	408.56	700.63
7	412.54	709.81
8	418.58	717.78
9	425.45	725.04
10	430.30	733.79
11	435.60	742.27
12	442.26	749.73
13	449.07	757.05
14	454.41	765.51
15	460.37	773.53
16	467.14	780.89
17	474.07	788.11
18	474.79	798.08
19	481.77	805.23
20	488.83	812.32
21	491.84	821.86
22	491.95	822.06
***	1.872	***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.29	737.47
2	187.81	735.35
3	197.75	734.25
4	326.00	692.40
5	402.40	692.76
6	408.56	700.63
7	412.54	709.81
8	418.58	717.78
9	425.45	725.04
10	430.30	733.79
11	435.60	742.27
12	442.26	749.73
13	449.07	757.05
14	454.41	765.51
15	460.37	773.53
16	467.14	780.89
17	474.07	788.11
18	474.79	798.08
19	481.77	805.23
20	488.83	812.32
21	491.84	821.86
22	491.95	822.06

*** 1.872 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	187.40	738.10
2	188.46	737.03
3	198.03	734.12
4	326.07	692.01
5	418.29	693.50
6	424.85	701.05
7	431.30	708.69
8	437.72	716.36
9	444.09	724.07
10	450.82	731.46
11	455.87	740.10
12	462.86	747.24
13	469.68	754.56
14	472.51	764.15
15	479.26	771.53
16	481.01	781.37
17	487.28	789.16
18	491.07	798.42
19	498.11	805.52
20	504.34	813.34
21	509.34	822.00
22	509.66	822.85

*** 1.878 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	194.15	738.10
2	197.95	734.89
3	326.08	691.80
4	422.11	693.33
5	427.27	701.89
6	431.10	711.13

7	438.16	718.21
8	441.97	727.46
9	447.60	735.73
10	453.60	743.72
11	460.62	750.85
12	464.52	760.06
13	466.77	769.80
14	473.75	776.96
15	479.64	785.04
16	486.70	792.12
17	492.97	799.91
18	498.08	808.51
19	500.40	818.24
20	503.24	822.56

*** 1.919 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	194.89	738.10
2	200.95	733.68
3	326.08	692.03
4	428.95	693.38
5	435.94	700.54
6	441.56	708.81
7	447.13	717.11
8	453.93	724.44
9	458.46	733.36
10	465.25	740.70
11	471.96	748.11
12	474.13	757.87
13	476.71	767.54
14	483.58	774.81
15	488.78	783.35
16	495.81	790.46
17	501.83	798.45
18	508.78	805.63
19	515.73	812.82
20	519.72	821.99
21	520.68	823.01

*** 1.921 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	194.89	738.10
2	200.95	733.68
3	326.08	692.03
4	428.95	693.38
5	435.94	700.54
6	441.56	708.81
7	447.13	717.11
8	453.93	724.44
9	458.46	733.36
10	465.25	740.70
11	471.96	748.11
12	474.13	757.87
13	476.71	767.54
14	483.58	774.81
15	488.78	783.35
16	495.81	790.46
17	501.83	798.45
18	508.78	805.63

19	515.73	812.82
20	519.72	821.99
21	520.68	823.01
***	1.921	***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	194.89	738.10
2	200.95	733.68
3	326.08	692.03
4	428.95	693.38
5	435.94	700.54
6	441.56	708.81
7	447.13	717.11
8	453.93	724.44
9	458.46	733.36
10	465.25	740.70
11	471.96	748.11
12	474.13	757.87
13	476.71	767.54
14	483.58	774.81
15	488.78	783.35
16	495.81	790.46
17	501.83	798.45
18	508.78	805.63
19	515.73	812.82
20	519.72	821.99
21	520.68	823.01
***	1.921	***

Cross Section 3
Waste Block Mode

** PCSTABL5M3 **
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 10/22/2021
Time of Run: 11:37AM
Run By: SCS Engineers
Input Data Filename: C:mavco_section3_wb.in
Output Filename: C:mavco_section3_wb.OUT
Unit: ENGLISH
Plotted Output Filename: C:mavco_section3_wb.PLT
PROBLEM DESCRIPTION Maverick County Landfill
Section 3, New Cells, Waste Block Mode

BOUNDARY COORDINATES
10 Top Boundaries
37 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	167.00	709.10	175.00	709.10	2
2	175.00	709.10	181.90	712.20	2
3	181.90	712.20	190.50	715.10	2
4	190.50	715.10	503.60	819.50	2
5	503.60	819.50	514.30	820.40	2
6	514.30	820.40	630.20	826.20	2
7	630.20	826.20	739.50	831.70	2
8	739.50	831.70	905.10	832.00	2
9	905.10	832.00	988.40	830.00	2
10	988.40	830.00	1109.30	827.10	2
11	181.30	712.00	190.50	712.00	2
12	190.50	712.00	503.60	816.50	3
13	503.60	816.50	514.30	817.40	3
14	514.30	817.40	630.20	823.20	3
15	630.20	823.20	739.50	828.70	3
16	739.50	828.70	905.10	829.00	3
17	905.10	829.00	988.40	827.00	3
18	988.40	827.00	1109.30	824.10	3
19	190.50	712.00	247.80	692.90	2
20	247.80	692.90	544.40	698.40	2
21	544.40	698.40	567.70	698.80	2
22	567.70	698.80	588.10	702.90	2
23	588.10	702.90	692.70	702.60	2
24	692.70	702.60	768.70	702.40	2
25	768.70	702.40	838.70	701.10	2
26	838.70	701.10	1080.70	699.60	2
27	1080.70	699.60	1109.30	699.70	2
28	185.50	710.00	190.50	710.00	4
29	190.50	710.00	247.80	690.90	4
30	247.80	690.90	544.40	696.40	5
31	544.40	696.40	567.70	696.80	5
32	567.70	696.80	588.10	700.90	5
33	588.10	700.90	692.70	700.60	5
34	692.70	700.60	768.70	700.40	5
35	768.70	700.40	838.70	699.10	5
36	838.70	699.10	1080.70	697.60	5
37	1080.70	697.60	1109.30	697.70	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	65.0	65.0	200.0	32.0	0.00	0.0	1
4	100.0	100.0	0.0	11.0	0.00	0.0	1
5	100.0	100.0	0.0	18.0	0.00	0.0	1

Searching Routine Will Be Limited To An Area Defined By 8 Boundaries Of Which The First 8 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	15.00	29.00	24.00
2	29.00	24.00	51.00	26.00
3	51.00	26.00	78.00	56.00
4	78.00	56.00	94.00	65.00
5	94.00	65.00	113.00	64.00
6	113.00	64.00	133.00	56.00
7	133.00	56.00	161.00	58.00
8	161.00	58.00	205.00	76.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

3 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 12.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	190.50	708.50	196.50	707.50	1.00
2	248.60	690.00	249.00	690.00	1.00
3	280.00	690.50	690.00	699.00	1.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.46	713.40
2	191.26	708.46
3	248.72	689.74
4	411.90	692.82
5	419.53	702.09
6	427.91	710.68
7	436.39	719.16
8	444.10	728.36
9	448.00	739.71
10	455.91	748.73
11	464.34	757.27
12	472.78	765.80
13	480.94	774.60
14	487.09	784.90
15	495.51	793.46
16	503.30	802.58
17	510.20	812.40
18	513.63	820.34

*** 1.746 ***

Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)

1	1.6	193.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.3	945.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.0	660.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.8	563.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	56.5	111766.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.9	2935.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	163.2	799090.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.9	6104.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1.7	10633.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	5.0	30690.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	8.4	48498.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	8.5	45949.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	7.7	38676.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	3.9	17429.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	7.9	31174.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	8.4	29884.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	8.4	26783.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	8.2	22785.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	6.2	14300.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	8.4	15730.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	7.8	11458.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.3	372.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	6.6	6263.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	2.1	1067.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1.3	242.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	177.84	710.37
2	178.91	709.48
3	190.89	708.93
4	248.63	690.23
5	442.63	694.02
6	449.10	704.13
7	457.43	712.77
8	463.87	722.89
9	472.13	731.60
10	480.34	740.34
11	488.33	749.30
12	494.94	759.32
13	503.42	767.80
14	511.71	776.48
15	515.81	787.76
16	520.97	798.59
17	527.03	808.95
18	535.27	817.67
19	538.59	821.62

*** 1.759 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	177.84	710.37
2	178.91	709.48
3	190.89	708.93
4	248.63	690.23
5	442.63	694.02
6	449.10	704.13
7	457.43	712.77
8	463.87	722.89
9	472.13	731.60

10	480.34	740.34
11	488.33	749.30
12	494.94	759.32
13	503.42	767.80
14	511.71	776.48
15	515.81	787.76
16	520.97	798.59
17	527.03	808.95
18	535.27	817.67
19	538.59	821.62
***	1.759	***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	177.84	710.37
2	178.91	709.48
3	190.89	708.93
4	248.63	690.23
5	442.63	694.02
6	449.10	704.13
7	457.43	712.77
8	463.87	722.89
9	472.13	731.60
10	480.34	740.34
11	488.33	749.30
12	494.94	759.32
13	503.42	767.80
14	511.71	776.48
15	515.81	787.76
16	520.97	798.59
17	527.03	808.95
18	535.27	817.67
19	538.59	821.62
***	1.759	***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	177.84	710.37
2	178.91	709.48
3	190.89	708.93
4	248.63	690.23
5	442.63	694.02
6	449.10	704.13
7	457.43	712.77
8	463.87	722.89
9	472.13	731.60
10	480.34	740.34
11	488.33	749.30
12	494.94	759.32
13	503.42	767.80
14	511.71	776.48
15	515.81	787.76
16	520.97	798.59
17	527.03	808.95
18	535.27	817.67
19	538.59	821.62
***	1.759	***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	177.84	710.37
2	178.91	709.48
3	190.89	708.93
4	248.63	690.23
5	442.63	694.02
6	449.10	704.13
7	457.43	712.77
8	463.87	722.89
9	472.13	731.60
10	480.34	740.34
11	488.33	749.30
12	494.94	759.32
13	503.42	767.80
14	511.71	776.48
15	515.81	787.76
16	520.97	798.59
17	527.03	808.95
18	535.27	817.67
19	538.59	821.62
***	1.759	***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.70	712.81
2	184.57	712.36
3	195.44	707.28
4	248.86	689.90
5	394.59	692.75
6	400.99	702.90
7	407.61	712.90
8	415.25	722.16
9	423.68	730.71
10	431.40	739.89
11	439.47	748.77
12	446.48	758.51
13	452.74	768.75
14	459.92	778.37
15	467.56	787.61
16	471.88	798.81
17	476.11	810.04
18	476.33	810.41
***	1.765	***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.70	712.81
2	184.57	712.36
3	195.44	707.28
4	248.86	689.90
5	394.59	692.75
6	400.99	702.90
7	407.61	712.90
8	415.25	722.16
9	423.68	730.71
10	431.40	739.89
11	439.47	748.77
12	446.48	758.51
13	452.74	768.75
14	459.92	778.37
15	467.56	787.61
16	471.88	798.81

17	476.11	810.04
18	476.33	810.41
***	1.765	***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.70	712.81
2	184.57	712.36
3	195.44	707.28
4	248.86	689.90
5	394.59	692.75
6	400.99	702.90
7	407.61	712.90
8	415.25	722.16
9	423.68	730.71
10	431.40	739.89
11	439.47	748.77
12	446.48	758.51
13	452.74	768.75
14	459.92	778.37
15	467.56	787.61
16	471.88	798.81
17	476.11	810.04
18	476.33	810.41
***	1.765	***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.70	712.81
2	184.57	712.36
3	195.44	707.28
4	248.86	689.90
5	394.59	692.75
6	400.99	702.90
7	407.61	712.90
8	415.25	722.16
9	423.68	730.71
10	431.40	739.89
11	439.47	748.77
12	446.48	758.51
13	452.74	768.75
14	459.92	778.37
15	467.56	787.61
16	471.88	798.81
17	476.11	810.04
18	476.33	810.41
***	1.765	***

Cross Section 3
Circular Mode

```
                         ** PCSTABL5M3 **
                    by Purdue University 1985
                 rev. for SCS Engineers HVA 2008
                  --Slope Stability Analysis--
               Simplified Janbu, Simplified Bishop
                  or Spencer`s Method of Slices
    Run Date:                 10/22/2021
    Time of Run:              11:40AM
    Run By:                   SCS Engineers
    Input Data Filename:      C:mavco_section3_circular.in
    Output Filename:          C:mavco_section3_circular.OUT
    Unit:                     ENGLISH
    Plotted Output Filename:  C:mavco_section3_circular.PLT
    PROBLEM DESCRIPTION   Maverick County Landfill
                          Section 3, New Cells, Circular Mode
```

BOUNDARY COORDINATES
10 Top Boundaries
37 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	167.00	709.10	175.00	709.10	2
2	175.00	709.10	181.90	712.20	2
3	181.90	712.20	190.50	715.10	2
4	190.50	715.10	503.60	819.50	2
5	503.60	819.50	514.30	820.40	2
6	514.30	820.40	630.20	826.20	2
7	630.20	826.20	739.50	831.70	2
8	739.50	831.70	905.10	832.00	2
9	905.10	832.00	988.40	830.00	2
10	988.40	830.00	1109.30	827.10	2
11	181.30	712.00	190.50	712.00	2
12	190.50	712.00	503.60	816.50	3
13	503.60	816.50	514.30	817.40	3
14	514.30	817.40	630.20	823.20	3
15	630.20	823.20	739.50	828.70	3
16	739.50	828.70	905.10	829.00	3
17	905.10	829.00	988.40	827.00	3
18	988.40	827.00	1109.30	824.10	3
19	190.50	712.00	247.80	692.90	2
20	247.80	692.90	544.40	698.40	2
21	544.40	698.40	567.70	698.80	2
22	567.70	698.80	588.10	702.90	2
23	588.10	702.90	692.70	702.60	2
24	692.70	702.60	768.70	702.40	2
25	768.70	702.40	838.70	701.10	2
26	838.70	701.10	1080.70	699.60	2
27	1080.70	699.60	1109.30	699.70	2
28	185.50	710.00	190.50	710.00	1
29	190.50	710.00	247.80	690.90	1
30	247.80	690.90	544.40	696.40	1
31	544.40	696.40	567.70	696.80	1
32	567.70	696.80	588.10	700.90	1
33	588.10	700.90	692.70	700.60	1
34	692.70	700.60	768.70	700.40	1
35	768.70	700.40	838.70	699.10	1
36	838.70	699.10	1080.70	697.60	1
37	1080.70	697.60	1109.30	697.70	1

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil   Total   Saturated   Cohesion Friction   Pore   Pressure   Piez.

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	65.0	65.0	200.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	100.00	689.00
2	1100.00	689.00

Searching Routine Will Be Limited To An Area Defined By 8 Boundaries
Of Which The First 8 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	15.00	29.00	24.00
2	29.00	24.00	51.00	26.00
3	51.00	26.00	78.00	56.00
4	78.00	56.00	94.00	65.00
5	94.00	65.00	113.00	64.00
6	113.00	64.00	133.00	56.00
7	133.00	56.00	161.00	58.00
8	161.00	58.00	205.00	76.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 168.00 ft.
and X = 250.00 ft.
Each Surface Terminates Between X = 400.00 ft.
and X = 600.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	175.46	709.30
2	184.94	706.14
3	194.53	703.29
4	204.20	700.74
5	213.94	698.50
6	223.75	696.58
7	233.62	694.97
8	243.54	693.67
9	253.49	692.70
10	263.47	692.04
11	273.47	691.71
12	283.47	691.69
13	293.46	691.99
14	303.44	692.61
15	313.40	693.56
16	323.32	694.82
17	333.19	696.39
18	343.01	698.28
19	352.77	700.49

20	362.44	703.01
21	372.04	705.83
22	381.53	708.96
23	390.93	712.39
24	400.21	716.12
25	409.36	720.15
26	418.38	724.46
27	427.26	729.07
28	435.98	733.95
29	444.55	739.11
30	452.94	744.55
31	461.16	750.24
32	469.19	756.20
33	477.03	762.41
34	484.66	768.87
35	492.09	775.57
36	499.29	782.51
37	506.27	789.67
38	513.02	797.05
39	519.52	804.65
40	525.78	812.44
41	531.79	820.44
42	532.40	821.31

Circle Center At X = 279.0 ; Y = 1004.1 and Radius, 312.5

*** 2.307 ***

Individual data on the 52 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	5.8	1604.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.6	346.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.0	2213.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.6	486.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	5.0	5415.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	4.0	5443.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	9.7	15471.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	9.7	18706.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	9.8	21604.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	9.9	24144.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	3.2	8404.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	6.7	17905.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2.7	7601.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	4.6	13038.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	2.6	7808.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	10.0	31533.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	10.0	34442.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	10.0	36941.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	10.0	39018.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	10.0	40666.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	10.0	41879.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	5.2	22099.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	4.8	20624.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	9.9	43656.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	9.8	44397.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	9.8	44870.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	9.7	45074.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	9.6	45013.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	9.5	44691.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	9.4	44115.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	9.3	43293.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	9.2	42233.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

33	9.0	40947.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	8.9	39446.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	8.7	37744.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	8.6	35856.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	8.4	33798.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	8.2	31587.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	8.0	29240.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	7.8	26778.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	7.6	24220.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	7.4	21587.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	7.2	18901.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	4.3	10252.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2.7	5874.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	6.7	12798.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	1.3	2092.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	5.2	7289.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	6.3	6027.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	4.3	2331.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	1.7	388.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.6	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.49	709.10
2	179.95	705.87
3	189.51	702.95
4	199.17	700.35
5	208.91	698.08
6	218.72	696.13
7	228.58	694.51
8	238.50	693.22
9	248.46	692.26
10	258.44	691.64
11	268.43	691.34
12	278.43	691.38
13	288.42	691.75
14	298.40	692.46
15	308.35	693.50
16	318.25	694.86
17	328.11	696.56
18	337.90	698.58
19	347.62	700.93
20	357.26	703.60
21	366.80	706.60
22	376.24	709.90
23	385.56	713.52
24	394.75	717.45
25	403.81	721.68
26	412.73	726.22
27	421.49	731.04
28	430.08	736.16
29	438.49	741.56
30	446.73	747.24
31	454.77	753.18
32	462.60	759.39
33	470.23	765.86
34	477.63	772.58
35	484.81	779.55
36	491.75	786.75
37	498.45	794.17
38	504.90	801.82
39	511.09	809.67

40	517.01	817.73
41	519.00	820.64

Circle Center At X = 272.3 ; Y = 991.5 and Radius, 300.1
*** 2.309 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	168.83	709.10
2	178.33	705.97
3	187.92	703.14
4	197.59	700.60
5	207.34	698.37
6	217.15	696.44
7	227.02	694.82
8	236.93	693.50
9	246.88	692.48
10	256.85	691.78
11	266.85	691.39
12	276.85	691.31
13	286.84	691.53
14	296.83	692.07
15	306.79	692.91
16	316.73	694.07
17	326.62	695.53
18	336.46	697.29
19	346.24	699.36
20	355.96	701.74
21	365.60	704.41
22	375.14	707.38
23	384.60	710.64
24	393.94	714.20
25	403.18	718.04
26	412.28	722.17
27	421.26	726.58
28	430.10	731.26
29	438.78	736.22
30	447.31	741.44
31	455.67	746.92
32	463.86	752.66
33	471.87	758.65
34	479.68	764.89
35	487.31	771.36
36	494.72	778.07
37	501.93	785.01
38	508.91	792.16
39	515.67	799.53
40	522.20	807.10
41	528.50	814.88
42	533.42	821.36

Circle Center At X = 274.5 ; Y = 1014.0 and Radius, 322.7
*** 2.311 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	182.08	712.26
2	191.33	708.46
3	200.71	705.00
4	210.21	701.86
5	219.81	699.07
6	229.50	696.61
7	239.28	694.50

8	249.12	692.74
9	259.02	691.33
10	268.97	690.27
11	278.94	689.56
12	288.93	689.20
13	298.93	689.20
14	308.93	689.55
15	318.90	690.25
16	328.85	691.31
17	338.75	692.72
18	348.59	694.47
19	358.37	696.58
20	368.06	699.03
21	377.67	701.82
22	387.16	704.94
23	396.55	708.41
24	405.80	712.20
25	414.91	716.31
26	423.88	720.75
27	432.67	725.50
28	441.30	730.56
29	449.74	735.92
30	457.99	741.58
31	466.03	747.52
32	473.86	753.74
33	481.46	760.24
34	488.82	767.01
35	495.95	774.02
36	502.82	781.29
37	509.43	788.80
38	515.77	796.53
39	521.83	804.48
40	527.60	812.65
41	533.09	821.01
42	533.29	821.35

Circle Center At X = 294.0 ; Y = 971.8 and Radius, 282.6

*** 2.320 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.14	709.10
2	181.65	706.01
3	191.26	703.22
4	200.94	700.75
5	210.71	698.58
6	220.53	696.73
7	230.42	695.19
8	240.34	693.97
9	250.30	693.07
10	260.28	692.48
11	270.28	692.22
12	280.28	692.27
13	290.27	692.65
14	300.25	693.34
15	310.20	694.36
16	320.11	695.69
17	329.97	697.33
18	339.78	699.30
19	349.51	701.57
20	359.17	704.15
21	368.75	707.05
22	378.22	710.24

23	387.59	713.74
24	396.84	717.54
25	405.97	721.63
26	414.96	726.01
27	423.80	730.67
28	432.49	735.62
29	441.02	740.84
30	449.38	746.33
31	457.56	752.08
32	465.55	758.09
33	473.34	764.36
34	480.93	770.87
35	488.31	777.62
36	495.47	784.61
37	502.40	791.82
38	509.09	799.24
39	515.55	806.88
40	521.76	814.72
41	526.41	821.01

Circle Center At X = 273.5 ; Y = 1004.9 and Radius, 312.7

*** 2.328 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	174.63	709.10
2	184.16	706.08
3	193.78	703.34
4	203.47	700.89
5	213.24	698.73
6	223.06	696.87
7	232.94	695.29
8	242.85	694.01
9	252.81	693.03
10	262.78	692.34
11	272.77	691.95
12	282.77	691.86
13	292.77	692.07
14	302.76	692.57
15	312.73	693.37
16	322.67	694.47
17	332.57	695.86
18	342.43	697.55
19	352.23	699.53
20	361.97	701.80
21	371.63	704.36
22	381.22	707.20
23	390.72	710.33
24	400.12	713.75
25	409.41	717.44
26	418.59	721.40
27	427.65	725.64
28	436.58	730.14
29	445.37	734.91
30	454.01	739.94
31	462.50	745.22
32	470.83	750.76
33	478.99	756.54
34	486.98	762.56
35	494.78	768.81
36	502.39	775.30
37	509.81	782.00
38	517.02	788.93

39	524.02	796.07
40	530.81	803.41
41	537.38	810.95
42	543.72	818.69
43	546.27	822.00

Circle Center At X = 280.9 ; Y = 1027.7 and Radius, 335.8

*** 2.329 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.97	709.10
2	182.45	705.90
3	192.02	703.03
4	201.70	700.49
5	211.45	698.29
6	221.27	696.42
7	231.16	694.89
8	241.09	693.70
9	251.05	692.85
10	261.04	692.34
11	271.04	692.18
12	281.03	692.36
13	291.02	692.89
14	300.98	693.76
15	310.91	694.96
16	320.79	696.51
17	330.61	698.40
18	340.36	700.62
19	350.03	703.18
20	359.60	706.07
21	369.07	709.28
22	378.42	712.82
23	387.65	716.68
24	396.74	720.85
25	405.68	725.33
26	414.46	730.12
27	423.07	735.20
28	431.50	740.58
29	439.74	746.24
30	447.78	752.19
31	455.61	758.40
32	463.23	764.89
33	470.62	771.63
34	477.77	778.61
35	484.68	785.85
36	491.33	793.31
37	497.73	801.00
38	503.85	808.90
39	509.71	817.01
40	511.84	820.19

Circle Center At X = 270.8 ; Y = 983.2 and Radius, 291.0

*** 2.330 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.97	709.10
2	182.40	705.76
3	191.92	702.72
4	201.54	699.98
5	211.24	697.56
6	221.01	695.44

7	230.85	693.63
8	240.74	692.14
9	250.67	690.97
10	260.63	690.11
11	270.62	689.57
12	280.62	689.35
13	290.62	689.45
14	300.61	689.87
15	310.58	690.60
16	320.52	691.66
17	330.43	693.02
18	340.29	694.71
19	350.09	696.71
20	359.82	699.01
21	369.47	701.63
22	379.03	704.55
23	388.50	707.78
24	397.85	711.31
25	407.09	715.13
26	416.21	719.25
27	425.19	723.65
28	434.02	728.34
29	442.70	733.30
30	451.21	738.55
31	459.56	744.06
32	467.73	749.83
33	475.70	755.86
34	483.48	762.14
35	491.06	768.67
36	498.43	775.43
37	505.57	782.43
38	512.49	789.65
39	519.18	797.08
40	525.62	804.73
41	531.82	812.58
42	537.77	820.62
43	538.45	821.61

Circle Center At X = 282.5 ; Y = 1003.1 and Radius, 313.8

*** 2.331 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	180.42	711.54
2	189.80	708.05
3	199.28	704.89
4	208.88	702.07
5	218.56	699.58
6	228.33	697.44
7	238.17	695.63
8	248.06	694.18
9	258.00	693.07
10	267.97	692.31
11	277.96	691.90
12	287.96	691.84
13	297.96	692.13
14	307.94	692.77
15	317.89	693.76
16	327.80	695.10
17	337.66	696.78
18	347.45	698.81
19	357.16	701.18
20	366.79	703.89

21	376.31	706.93
22	385.73	710.31
23	395.02	714.01
24	404.17	718.04
25	413.18	722.38
26	422.03	727.04
27	430.71	732.00
28	439.21	737.27
29	447.52	742.83
30	455.63	748.68
31	463.53	754.81
32	471.22	761.21
33	478.67	767.87
34	485.88	774.80
35	492.85	781.97
36	499.57	789.38
37	506.02	797.02
38	512.19	804.89
39	518.09	812.96
40	523.44	820.86

Circle Center At X = 284.7 ; Y = 977.2 and Radius, 285.4

*** 2.331 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	178.77	710.79
2	188.20	707.48
3	197.74	704.48
4	207.38	701.79
5	217.09	699.43
6	226.88	697.39
7	236.73	695.68
8	246.64	694.29
9	256.58	693.23
10	266.55	692.50
11	276.55	692.11
12	286.55	692.04
13	296.54	692.30
14	306.53	692.90
15	316.48	693.82
16	326.40	695.08
17	336.28	696.66
18	346.09	698.57
19	355.84	700.80
20	365.51	703.35
21	375.09	706.23
22	384.57	709.41
23	393.93	712.92
24	403.18	716.72
25	412.30	720.84
26	421.27	725.25
27	430.09	729.95
28	438.76	734.95
29	447.25	740.23
30	455.56	745.79
31	463.68	751.62
32	471.61	757.72
33	479.33	764.07
34	486.84	770.68
35	494.12	777.53
36	501.17	784.62
37	507.98	791.94

38	514.55	799.49
39	520.87	807.24
40	526.92	815.20
41	531.21	821.25

Circle Center At X = 283.6 ; Y = 994.0 and Radius, 302.0

*** 2.338 ***

PART III

ATTACHMENT 6

GROUNDWATER AND SURFACE WATER PROTECTION PLAN AND DRAINAGE PLAN

FOR

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/2/2024

Prepared for:
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

PERMIT ISSUED: SEPTEMBER 11, 2007

PERMIT MODIFICATION (REVISION 1, 2,3 and 4) PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 1 – April 2009
Revision 2 – June 2009
Revision 3 – August 2009
Revision 4 – October 2024

SCS Project No. 16208046.00 & 16223092.00

TABLE OF CONTENTS

SECTION **PAGE**

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/2/2024

Attachments

6A Existing Drainage Conditions
6A1 Calculations for Existing Drainage Conditions
6B Final Drainage Conditions
6B1 Calculations for Final Drainage Conditions
6C Drainage Structures: Details
6D1 Drainage Structures: Interceptor Channel and Downchute Calculations
6D1A Intermediate Cover – Interceptor Channel and Downchute Drainage Sub-Basins
6D1B Final Cover – Interceptor Channel Drainage Sub-Basins
6D1C Final Cover – Downchute Drainage Sub-Basins
6D2 Drainage Structures: Perimeter Channel Calculations
6D3 Drainage Structures: Culvert at Main Entrance Calculations
6E1 Detention Ponds: Detention Pond A Design
6E2 Detention Ponds: Detention Pond B Design

6F Temporary Erosion & Sedimentation Control Measures

Appendices

1. Reference Material: City of Austin Drainage Criteria Manual
2. Erosion and Sedimentation Control Plan
2A. Soil Loss Analysis
2B. Overland Flow Velocity Analysis
3A. Reference Material: Soil Survey Map and Description, USLE/RUSLE References
4. Reference Material: Hydrology and Hydraulic Calculation References, MACCAFERRI Reno Mattress Information

2.2 Drainage Patterns

Attachment 6A shows the existing drainage patterns at the site. Site and aerial topography was provided by Baker Surveying, Inc. of San Antonio, Texas.

The site is bordered on the north and west (low side) by a tributary of Saus Creek, on the south and east (high side) by an existing irrigation canal operated by the Maverick County Irrigation District No. 1 and on the southwest by FM 1021. Stormwater runoff currently leaves the site at three points as labeled discharge points (referred to as Point of Demonstration [POD]) I, II, and III on Attachment 6A.

No areas within the proposed permit limit are within the 100-year floodplain as shown on FEMA Firm Map No. 480470-0012A and 480470-0013A, dated 12-20-77.

Based upon field observations, the southern boundary of the landfill property is bounded by a gravel roadway, which provides access to the existing irrigation canal for operation and maintenance. The roadway is bounded on the south side by a bar ditch which intercepts flow and conveys it to an existing culvert pipe under FM 1021. Therefore, the drainage flow is diverted from the south in an east to west flow direction to the pipe under FM 1021, which is then conveyed to lower elevation areas away from the landfill site and on the opposite side of FM 1021 from the landfill site.

The run-on and run-off calculations have been updated to include run-on from FM 1021 along the west side of the landfill property. Upon site observation, there is an intermittent bar ditch located within the western side of the FM 1021 rights-of-way. However, since the bar ditch is not well defined, the landfill run-on calculations will include provisions for installing an interceptor swale/channel on the landfill property, adjacent to the fence fronting FM 1021. This will assure that any run-on from FM 1021 will be conveyed through the proposed bar ditch to the existing tributary of Saus Creek and away from the site property.

2.3 Drainage Area Map

The drainage contributing area for the permitted site is approximately 189 acres, which is comprised of the drainage area south of the permit limit to the southern property boundary defined by the irrigation canal or topographic ridgeline on the southwest corner of the property. This contributing area encompasses the permitted area plus area from off-site or the south up-gradient portion of the property outside of the permit limit. The only off-site contributing area is the area adjacent to the southwest corner of the subject tract and a portion of the roadway along FM 1021. Although, the time of concentration for peak runoff from the various drainage areas to the PODs is considered in this drainage analysis, the drainage areas north of the permit limit are excluded since these areas do not contribute runoff to the perimeter drainage system (channels and ponds) associated with the final drainage condition (post-development condition).

2.4 Storm Runoff Determination

For determining the anticipated peak flow at a given location, the Rational Method was utilized. The Rational Method estimates the peak rate of runoff at any location in a drainage area as a function of the size of the drainage area (herein referred to as basins or sub-basins), runoff coefficient, and mean rainfall intensity for a duration equal to the time-of-concentration (the time required for water to flow from the most remote point of the drainage area to the location being analyzed). The Rational Method is expressed as the following:

$$\mathbf{Q = CIA}$$

Where, Q = maximum rate of runoff, cfs.

C = runoff coefficient representing a ratio of runoff to rainfall.

I = average rainfall intensity for a duration equal to the time-of-concentration, inches per hour.

A = basin or sub-basin area contributing to the discharge location, acres.

Runoff coefficients, C, for composite analysis and Manning's n-values for channel flow calculation were gathered from information provided in the Drainage Design Criteria Manual of the City of Austin and reference material provided in Appendix 4. C values for pasture/range land with an average slope between 2 to 7% slope category were used for pre-development conditions. These C values are 0.42 and 0.49 for 25 and 100 year storm frequencies, respectively. For developed conditions, a weighted average of C values of 0.77 for sideslope areas and 0.44 for topslope areas were used to represent a grass cover condition of the landfill for the 25 and 100 year storm frequency, respectively. C-values of 0.86 and 0.95 were used for asphalt pavement along FM 1021 for the above referenced storm events, respectively. Weighted averages were used for C-values for pre-development Sub-basin 5 and post-development Sub-basin C, which include asphalt pavement associated with FM 1021.

Pre-development and post-development storm runoff calculations were performed for each basin and sub-basin within the contributing area. The peak discharge for 25 and 100 year storm frequency events were determined and presented for each sub-basin and accumulated drainage areas. The location, and quantities of surface drainage entering, exiting, and internal to the site for the 25 year, 24-hour storm event were presented in the drainage calculation.

Time of concentration for the storm runoff was determined using the United State Department of Agriculture, Hydrology National Engineering Handbook. The time of concentration to any point in a storm drainage system is a combination of the sheet flow, the shallow concentrated flow and the channel flow. The minimum time of concentration for any drainage basin is ten minutes, per 30 TAC §330.305(f)(1). The time of concentration for sheet flow is determined by the following formula:

$$\boldsymbol{T_c = \frac{0.007(nL)^{0.8}}{{P_2}^{0.5}S^{0.4}}} \qquad \textbf{(Eq. 3-3)}$$

Where, T_c = Time of Concentration (min.)

L = Sheet flow Length (ft)

n = Manning's roughness coefficient

P_2 = 2-year, 24-hour rainfall, (in)

S = Slope of the ground (ft/ft)

The sheet flow usually extends for approximately 300 feet, unless the terrain is noticeably flat without any obvious concentration. The time of concentration for shallow concentrated and open channel flows can be determined using the following formula:

$$\boldsymbol{T_c = \frac{L}{60 * V_S}}$$

Where, Tc = Time of Concentration (min.)
L = Length of the reach (ft)
V = Average velocity (ft/sec)

The average velocity for shallow concentrated flow (associated with short-grass pasture surface flow) can be determined using the following formula:

$$\boldsymbol{V = 6.962(S)^{0.5}}$$

Where, V = Average velocity (ft/sec)
S = slope of the ground (ft/ft)

The average velocity for channel flow can be determined using the following formula:

$$\boldsymbol{V = \frac{1.49\, R^{2/3} S^{1/2}}{n}}$$

Where, V = Average velocity (ft/sec)
R = hydraulic radius (ft)

$$r = \frac{a}{P_w}$$

a = cross-sectional flow area (ft^2)
P_w = wetted perimeter (ft)
S = slope of the ground (ft/ft)
n = Manning's n value for open channel flow (grass - 0.027)

When the storm runoff becomes channelized, Manning's Equation was utilized to estimate flow velocity in order to determine the time of concentration. Manning's roughness coefficients (n-values) of 0.15 was used for short grass prairie sheet flow. Manning's n-values for open channel flow of 0.013, 0.0225, 0.027, and 0.033 were used for concrete-lined, windy and sluggish, grass-lined, or gabion-lined channels, respectively.

Rainfall intensity, used in the Rational Method for evaluating storm runoff, was calculated using the constants from "Rainfall Frequency Atlas of the United States" as presented in the Hydraulic Manual published by the Texas Department of Highway and Transportation (n.k.a. Texas Department of Transportation, TxDOT). The constants for Maverick County for various rainfall events are shown below. The following equation represents mathematically the intensity-duration-frequency curves:

$$\mathbf{i = a / (t + b)^{c}}$$

Where, $\quad$ i = average rainfall intensity (in/hr)

t = time of concentration (min.)

a, b, c are constants for different storm frequencies

Constants used in this drainage calculation are as follows:

Storm frequency	a	b	c
25 – year	168.7	15	0.879
100 – year	238	16.8	0.884

2.5 Existing Storm Runoff

Pre-development drainage areas were divided into five basins with three points of concentration identified (PODs), comprised of approximately 189 acres, as previously described in Section 2.3. The existing drainage peak flow for a 25 and 100-year storm frequency is summarized on Attachment 6A (Existing Drainage Conditions). The total peak flow exiting the property boundary for the existing drainage conditions (POD I+II+III) is based on the time of concentration for the drainage flow path for Drainage Basin 3. This serves as a conservative analysis since the chosen flow path disregards the flow in the Unamed Tributary of Saus Creek from POD III to the combined flow at POD I+II+III. The total estimated runoff exiting the subject landfill site is approximately 408.60 and 624.90 cfs, for 25 and 100-year storm frequency, respectively.

The rainfall time of concentration nomograph, and other data sheets used in performing the drainage calculations are included in Appendix 4 of this attachment.

3.0 DEVELOPED CONDITIONS

3.1 Final Grading

The developed condition final grading plan is shown in Attachment 6B. Sideslopes of the final landfill will be 3H:1V around the perimeter. Sheet flow down sideslopes will be collected by interceptor channels that were designed to reduce the erosion on the landfill sideslopes by minimizing the length of sheet flow and diverting it to downchutes as shown on Attachment 6B. The landfill cap or topslope is designed with a 5% slope. The ridge of the cap will be located along the center of cap in a generally northeast and southwest direction.

3.2 Drainage Area Map

The drainage area for the developed condition is divided into 11 drainage basins, namely A thru I, 4AR and 4BR, as presented in Attachment 6B (Final Drainage Conditions). The total drainage area is approximately 189 acres, as previously described. Runoff from off-site, such as the south portion of the property outside of the permit limit, that contributes to drainage flow to the proposed perimeter channels or from the proposed landfill has been included in the drainage analysis. In a similar case, as the existing drainage conditions, the total peak flow exiting the property boundary for final drainage conditions (post-development at POD I+II+III) is based on the time of concentration and combined peak flow from POD II+III plus the discharge from Pond A (representative of peak flow at POD I). Related to POD I, the longest flow path is represented by the time of concentration from Drainage Basin A to discharge from Pond A. Related to the combined flow from POD II+III, the longest flow path is represented by the time of concentration from Drainage Basin E to the combined flow at POD I+II+II over the entire area represented by PODs II and III, but disregards the flow in the Unamed Tributary of Saus Creek. The peak flow for a 25 and 100-year storm frequency from the final drainage condition is summarized on Attachment 6B, which approximately 408.40 and 552.61 cfs, for 25 and 100-year storm frequency, respectively.

3.3 Drainage Controls

This section describes the drainage controls, such as interceptor channels, downchutes, perimeter channels, culverts, and detention ponds that will be constructed at the landfill. Stormwater runoff from the landfill topslopes and sideslopes will flow into interceptor channels, a.k.a. “sideslope swales”, designed to collect the surface runoff and convey it into gabion-lined downchutes, thereby minimizing the erosion potential of the landfill cover. Stormwater collected in the downchutes will be discharged to the perimeter channels that will route the stormwater to the proposed detention ponds for flow regulation and control of off-site sedimentation.

Interceptor channels and downchutes will be installed on intermediate cover and at landfill completion following placement of final cover. When installed on intermediate cover, these structures will be utilized on topslopes and external embankment sideslopes, as defined in Attachment 6, Appendix 2 (Erosion and Sediment Control Plan), Section 1.0. The interceptor channels will be installed on intermediate cover provided the landfill slopes have been constructed to an elevation less than or equal to 80 vertical feet (on a 3H:1V slope) above the landfill berm and the contributing flow length to the interceptor channel is greater than 220 feet. An example of this approach is shown on Attachment 6D1A. Alternatively, as discussed in Appendix 2, Section 5.1.1, at the discretion of the Landfill Manager, silt fences or hay bales may be installed on a temporary basis in lieu of interceptor channels and downchutes on intermediate cover slopes, provided the contributing flow length to the structures is less than or equal to 220 feet.

Interceptor channels and downchutes installed for landfill completion (i.e., final cover phase) will be installed at the locations depicted on Attachment 7. Interceptor channels installed on final cover will be installed at a maximum spacing of 125 horizontal feet on a 3H:1V sideslope.

Erosion and sedimentation controls that will be implemented at the landfill are described in Appendix 2, Section 5.1, including the use of interceptor channels and downchutes along with other best management practices for the landfill cover phases. The installation schedule or frequency for interceptor channels and downchutes, silt fences, or hay bales is based on the potential soil loss or overland flow velocity on the intermediate or final cover, as described in Appendix 2, Section 6.0 and Section 7.0, respectively.

3.3.1 Permissible Non-Erosive Velocities

The peak flow velocities calculated for each of the stormwater conveyance structures, described in the following subsections, were compared to the respective permissible non-erosive velocity for that drainage feature (i.e., vegetated landfill slopes, interceptor channels, downchutes, perimeter drainage channels, etc.). Landfill cover or drainage features experiencing erosive velocities (i.e., in excess of the defined non-erosive velocity) will be armored using concrete, rip rap, or gabions.

In accordance with published literature, as provided with calculations in Appendix 4 (see page 4-14), and TCEQ guidance, permissible non-erosive velocities are defined as velocities less than or equal to the following:

- 5 feet per second (fps) for vegetated perimeter channels, interceptor channels, and final cover slopes; and

- 3 fps for intermediate cover slopes with vegetation in fair condition (i.e., 60 percent vegetation coverage).

These velocities are considered appropriate for the surface slopes and percent vegetation coverage, described herein, and the predominantly sandy clay loam or silty clay loam present at the landfill property.

3.3.2 Interceptor Channel Capacity by Manning's Equation

The interceptor channels will be grass-lined, constructed with the cross-section depicted on Attachment 6C, and a minimum 1.0% channel slope. The flow carrying capacity of the interceptor channels can be determined using the following Manning's Equation**:**

$$Q = \frac{1.49}{n} AR^{2/3} So^{1/2}$$

Where: Q = discharge (cfs, evaluated using the Rational Method)

n = Manning's roughness coefficient (0.027 for grass-lined interceptor channels)

A = Cross sectional flow area (ft^2)

R = Hydraulic radius (ft; A/P; P = wetted perimeter, ft)

S_0 = Channel slope (%)

Hydraflow Express Extension for Autodesk Civil 3D was used for evaluating the hydraulic properties (i.e., peak flow depth and velocity) of the interceptor channels. Manning's Equation was used in this computer model to perform these calculations. Output summary sheets for these calculations are presented Attachment 6D1. This analysis was performed for the largest contributing sub-basins areas for interceptor channels installed on both intermediate and final cover as shown on Attachments 6D1A and 6D1B, respectively.

3.3.3 Downchute Capacity

Downchutes convey stormwater collected from interceptor channels down the 3H:1V landfill slopes. All downchutes installed on final cover will be Reno mattress or rock gabion-lined (Manning's "n" of 0.035) trapezoidal channels with 4H:1V sideslopes and 4-foot bottom width. However, downchutes installed on intermediate cover will be lined with either Reno mattress, gabions, turf reinforcement, or flexible membrane liner (thickness > 40-mil). Manning's n-values for channels lined with gabions (or reno mattress), turf reinforcement mats, and flexible membrane liner are 0.035, 0.025, and 0.009, respectively. Turf reinforcement mats are geosynthetic mats that underlie vegetation and allow vegetation to grow up through the mat for reinforcement. Based on product data provided in Appendix 4 (Page 4-15 through 4-17), Manning's n-values values range from 0.028 to 0.035 for turf reinforcement mats or downchutes lined with gabion or rip rap.

For purposes of sizing the intermediate cover downchutes, it was assumed that all downchutes on intermediate cover would be lined with Reno mattresses or gabions, since these lining materials have a greater Manning's n-value, which results in a greater flow depth and required channel depth. Additionally, calculations were performed for downchutes lined with turf reinforcement to verify that the estimated peak velocity is below the manufacturer's maximum allowable velocity. Calculations assuming downchutes lined with turf reinforcement mat were performed utilizing a Manning's n-value of 0.028 (lowest value for a stand of grass 6 to 12 inches high). Calculations for downchutes lined with flexible membrane liner (n=0.009) were not performed, since flexible membrane liner does not have a velocity constraint. Therefore, since sizing calculations for downchutes installed on intermediate cover were performed assuming gabion-lined channels (n=0.035), the calculations were performed for the most conservative case.

An isometric view of a downchute is provided on Attachment 6C. Downchutes installed on intermediate cover will be constructed with the same geometric cross-section, shown on Attachment 6C, Detail A, for all installed lining material options. As described below, downchutes installed on intermediate cover were designed based on the greatest contributing drainage area. Therefore, downchutes installed on intermediate cover may be lined with any of the proposed lining materials: Reno mattress, gabions, turf reinforcement, or flexible membrane liner (thickness

> 40-mil), for all slopes, velocities, and flow rates that may be experienced during the design storm event. These different lining options will allow the landfill owner flexibility when constructing downchutes on intermediate cover.

Hydraflow Express Extension for Autodesk Civil 3D was also used for evaluating the hydraulic properties of the downchutes based on the largest contributing sub-basins for both downchutes installed on intermediate and final cover, as depicted on Attachments 6D1A and 6D1C, respectively. As described above this computer program uses Manning's Equation to determine the peak flow depth and velocity. Output summary sheet for these calculations are also provided in Attachment 6D1.

Downchutes discharge the collected stormwater into perimeter drainage channels or detention ponds. Riprap, gabions, or dissipation blocks will be installed at the confluence of downchutes and detention ponds to reduce erosive velocities.

3.3.4 <u>Perimeter Channel Capacity</u>

Perimeter channels collect stormwater runoff from landfill slopes, buffer areas and downchutes. These perimeter channels convey the collected runoff to the sedimentation/detention ponds prior to discharging off-site. Channels range from six to eight feet wide trapezoidal design with 4H:1V sideslopes. Perimeter ditches will be concrete-lined or grass-lined to provide channel protection and maintain favorable flow velocity. The channels have been designed to convey the anticipated flow associated with a 100-year storm event. Refer to Attachment 6C for the typical ditch section, and Attachment 6B for the perimeter channel layout and flow direction.

While perimeter channels may be concrete-lined or grass-lined, post-development time-of-concentration calculations shown in Attachment 6B1 utilize concrete-lined channels. This is considered a conservative analysis as the manning's n value for concrete of 0.013 produces lower time-of-concentration, and therefore a higher flow rate.

The Hydraflow Express Extension for Autodesk Civil 3D computer program (2020 version), developed by Autodesk, Inc, was used to assist in determining the hydraulic data for each segment of the proposed perimeter drainage channels. Flow depths and velocities for the 25-year and 100-year frequency storm were determined for each segment of the concrete-lined or grass-lined perimeter channels and are presented in the attached spreadsheets located in Attachment 6D2.

3.3.5 Culverts

Temporary and permanent culverts will be installed to provide access crossing the perimeter ditches. The culvert for the main entrance to the landfill will be a two barrel 5'x3' concrete box culvert that will convey approximately 240 cfs flow. Pre-cast concrete boxes or cast-in-place boxes will be installed with wing walls, guard rails and other associated structures. See Attachment 6D3 for calculations relating to the culvert at the main entrance.

3.3.6 Detention Ponds

Two detention ponds namely Ponds "A" and "B" are to be located on the site. Pond "A" is located in the northwest portion of the site and serves to regulate the runoff for the south and west phases of development, while Pond "B" serves the middle phase and northeast portion of the site, respectively. The purpose of the detention pond(s) is to attenuate developed peak discharges at points so as not to alter natural drainage patterns. Storage of runoff in the pond regulates peak discharge from the drainage basin and provides silt storage/control features.

Pursuant to the drainage calculations regarding the detention requirements for proposed detention pond B , it was determined that this pond is not required to regulate the peak discharge. The calculations show that the required detention time for pond B is minimal. However, Pond B will be constructed with minimum berms to serve as a silt and sedimentation control measure.

Attachment 6E1 presents details and layout for Detention Pond A.
Attachment 6E2 presents details and layout for Detention Pond B.

Pond A has been designed to be drained by a two-barrel of 3’x3’ box culvert. A concrete riprap overflow spillway is designed to discharge the 100-year storm event. The ponds are sized to convey the 25-year frequency storm without overtopping the spillways.

3.4 Sequence of Development for Drainage Structures

The following procedures describe the sequence of installing drainage structures, the perimeter drainage system, and temporary and permanent erosion controls:

1. During ongoing landfill development, the perimeter drainage system (e.g., perimeter channels and detention ponds) will be constructed and maintained. Construction of the perimeter drainage system will be sequenced to coincide with the construction of the individual disposal cells, with the perimeter drainage system constructed or expanded concurrent with the respective cell construction. As an example, prior to beginning landfill operations for Cell 1, Pond “A” will be constructed. The perimeter channels adjacent to the cell being developed will be constructed at the same time as the adjacent cell. The construction plans for the perimeter drainage system will be maintained at the landfill as a part of the site operating record.

2. To control off-site sedimentation and reduce erosive velocities, vegetation or other approved structural controls (as described in Appendix 2, Section 5.1.1) will be installed. The need for structural controls will be evaluated during site inspections described in the Site Operating Plan (SOP), Section 7.0.

3. Following placement of intermediate or final cover, appropriate structural controls will be installed, including interceptor channels and downchutes or other approved BMPs as described in Appendix 2, Section 5.1.1; and establishing required level of vegetation for the type of cover. Interceptor channels and downchutes will be installed on intermediate cover at the frequency/spacing specified in Appendix 2, Section 5.4.

4. Prior to placement of final cover, temporary structural controls will be removed followed by the installation of the permanent interceptor channels and downchutes. Temporary BMPs will be removed in such a manner to minimize disturbance of the vegetative layer in place at the time of removal. Interceptor channels and downchutes will be installed on final cover following placement of final cover, as described in Appendix 2, Section 5.5.

5. At the discretion of the Landfill Manager, temporary detention basins may be constructed with each successive cell constructed. These basins will be constructed adjacent to each cell, as needed to collect runoff from adjacent upland areas and control stormwater from entering the waste disposal cell. Uncontaminated water collected in these temporary detention basins may be used as a source of water, including dust control on the landfill haul roads. Detailed design of these temporary detention basins will be completed with the respective cell construction plans since the required volume will vary depending on surrounding grades, but in all cases will be constructed with 3H:1V excavation sideslopes and sized to store runoff from contributing drainage areas associated with a 25-year, 24-hour storm event. Maintenance and inspection of these basins will be performed consistent with inspections for intermediate cover drainage features, as described in the SOP, Section 7.0.

3.5 Maintenance of Drainage Structures

The landfill owner/operator will be responsible for maintaining drainage appurtenances. Refer to Section 7.0 of the Site Operating Plan for planned drainage structure inspection and maintenance program.

4.0 COMPARISON OF EXISTING AND FINAL DRAINAGE PATTERNS

Final drainage patterns will not be significantly altered from existing condition (assumed here to be pre-development conditions) due to the construction of the landfill. Once the landfill is completed, stormwater runoff from the site will be discharged at generally the same locations as pre-development condition. All stormwater will continue to be directed to the existing tributary of Saus Creek.

Pursuant to the drainage calculations presented in Attachments 6A, 6A1, 6B, 6B1, and stormwater detention design information presented in Attachment 6E, the post-landfill development drainage condition (final drainage condition) will not significantly alter pre-development drainage patterns in the vicinity of the landfill. The existing and proposed drainage conditions based on the 25-year, 24-hour storm event are summarized in the following table (see also Section 4.1 below).

Discharge Point	Existing Q25	Existing Q100	Proposed Q25	Proposed Q100
I	212.55 cfs	333.90 cfs	≤174.44cfs	≤234.68cfs
II	94.60 cfs	148.69 cfs	≤197.84cfs	≤268.11cfs
III	111.97 cfs	175.97 cfs	≤73.98 cfs	≤99.19 cfs
I+II+III	408.60 cfs	624.90 cfs	≤408.40cfs	≤552.61cfs

5.0 TPDES CERTIFICATION

Consistent with the Texas Pollutant Discharge Elimination System (TPDES) General Permit, TXR050000, a Notice of Intent (NOI) for stormwater discharge associated with an industrial activity will be filed with the TCEQ prior to beginning landfill operations. Additionally, in accordance with the TPDES General Permit, a stormwater pollution prevention plan (SWPPP) will be prepared and implemented at the landfill prior to submitting the NOI.. The NOI and SPWPPP will be maintained at the landfill in the Site Operating Record.

6.0 EROSION CONTROL PLAN

An erosion control plan is included as Appendix 2 of this Attachment. Estimates of soil loss over the development and 30 year post-closure period are also included in this appendix.

Part III

Attachment 6

Attachment 6A

EXISTING DRAINAGE CONDITIONS

LEGEND

- PERMIT LIMIT
- LIMITS OF 100-YR. FLOOD PLAIN
- (1) EXISTING DRAINAGE SUB-BASIN
- [II] EXISTING DISCHARGE POINT, POINT OF DEMONSTRATION (POD)
- FLOW DIRECTION
- DRAINAGEWAY (STREAM OR DITCH)
- 750 EXISTING CONTOUR
- DRAINAGE AREA BOUNDARY AREA
- LIMITS OF WASTE ACTIVITIES
- PROPERTY BOUNDARY
- ASSUMED FLOW PATH

SUB-BASIN	AREA (AC)	TC (MIN.)	C_{25}	I_{25} (IN/HR)	Q_{25} (CFS)	C_{100}	I_{100} (IN/HR)	Q_{100} (CFS)
1	2.2	10.0	0.42	9.9	9.0	0.49	13.0	13.8
2	89.7	35.5	0.42	5.3	201.0	0.49	7.2	315.7
3	43.0	36.5	0.42	5.2	94.6	0.49	7.1	148.7
4	50.8	36.4	0.42	5.2	112.0	0.49	7.1	176.0
5	3.0	31.7	0.46	5.7	7.8	0.53	7.7	12.1

POD	Q_{25}	Q_{100}
I	$Q25 \leq 212.55$ cfs	$Q100 \leq 333.90$ cfs
II	$Q25 \leq 94.60$ cfs	$Q100 \leq 148.69$ cfs
III	$Q25 \leq 111.97$ cfs	$Q100 \leq 175.97$ cfs
I II III	$Q25 \leq 408.60$ cfs	$Q100 \leq 624.90$ cfs

NOTES:

1. 1997 CONTOURS ARE REPRESENTATIVE OF AN AERIAL SURVEY FLOWN IN 1997 BY BAKER SURVEYING, INC.
2. THIS DRAINAGE AREA IS EXCLUDED FROM THE CALCULATIONS AS IT DOES NOT CONTRIBUTE STORMWATER FLOWS TO THE DEVELOPED LANDFILL CONDITIONS DRAINAGE FEATURES, AND AS SUCH, FLOWS FROM THIS DRAINAGE AREA REMAIN UNCHANGED FROM EXISTING TO DEVELOPED CONDITIONS.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED PRE-DEVELOPMENT DRAINAGE CALCS	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: EXISTING DRAINAGE CONDITIONS

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

DSN. BY: SS · DWN. BY: DNA · CHK. BY: AGA · Q/A RVW BY: AGA · APP. BY: SDS

CADD FILE: 6-09 PRE-DEVELOPMENT DRAINAGE (9.21.22)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. **6A**

Part III

Attachment 6

Attachment 6A1

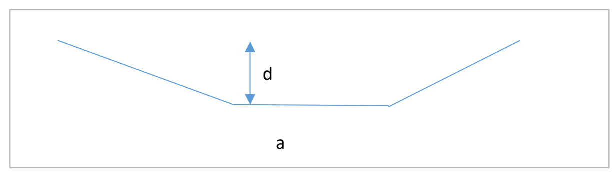
CALCULATIONS FOR EXISTING DRAINAGE CONDITIONS

TIME OF CONCENTRATION CALCULATIONS
- EXISTING DRAINAGE CONDITIONS -

2-yr, 24-hr Rainfall Depth = 3.68 inches

Discharge Study Point	Contributing Drainage Areas (Sub-Basins)	Drainage Areas		Curve Number (CN)	Sheet Flow				Shallow Concentrated Flow				Open Channel Flow								Time of Concentration (Tc)			
					Surface Description	Length	Slope	Manning Roughness Coefficient	Surface Description	Length	Slope	Avg. Velocity	Surface Description	Length	Slope	Manning n	Cross-sectional Area	Wetted Perimeter	Hydraulic Radius	Avg. Velocity	Sheet Flow T_c	Shallow Concentrated Flow T_c	Channel Flow T_c	Total T_c
		(acres)	(sq. miles)			(feet)	(ft/ft)			(feet)	(ft/ft)	(ft/s)		(feet)	(ft/ft)		(ft2)	(ft)	(ft)	(ft/s)	(min)	(min)	(min)	(min)
POD-I	1	2.2	0.0034	80.0	Grass	82	0.024	0.15	-	-	-	-	Grass	381	0.050	0.0225	3.0	13.6	0.2	5.4	7	-	1	10.0
	2	89.7	0.1401	80.0	Grass	300	0.030	0.15	Grass	556	0.027	1.1	Grass	2322	0.014	0.0225	17.7	40.6	0.4	4.5	19	8	9	35.5
	5	3.0	0.0047	80.0	Grass	300	0.025	0.15	Grass	446	0.009	0.6	-	-	-	-	-	-	-	-	20	12	-	31.7
	1+2+5	94.8	0.1482	80.0	Grass	300	0.030	0.15	Grass	556	0.027	1.1	Grass	2322	0.014	0.0225	17.7	40.6	0.4	4.5	19	8	9	35.5
POD-II	3	43.0	0.0671	80.0	Grass	300	0.018	0.15	Grass	203	0.063	1.7	Grass	2789	0.014	0.0225	16.2	44.0	0.4	4.1	23	2	11	36.5
POD-III	4	50.8	0.0794	80.0	Grass	300	0.028	0.15	Grass	1167	0.026	1.1	-	-	-	-	-	-	-	-	19	17	-	36.4
POD I +II+III	1+2+3+4+5	188.6	0.2947	80.0	Grass	300	0.018	0.15	Grass	203	0.063	1.7	Grass	3171	0.016	0.0225	16.2	44.0	0.4	4.3	23	2	12	37.4

Channel Section:



Total Area = 0.2947 sq. miles
Total Area = 188.6 acres

Sub-Basin Channel	a (ft)	d (ft)	left slope (%)	right slope (%)	Area (ft^2)	Wetted P (ft)	2-year, 24 hour		
1	5.28	0.5	79.6	78.4	3.0	13.6	Q2yr :	9.8	cfs
2	12.19	1.1	19.5	36.5	17.7	40.6	Q2 yr:	67.5	cfs
3	22.82	0.5	10.7	9.3	16.2	44.0	Q2 yr:	26.0	cfs

Note: Time of concentration calculated for each Drainage Area using the methodology presented in Attachment 6, Section 2.4, and flow path presented on Attachment 6A, related to Existing Drainage Conditions

Methodology: Reference: United States Department of Agriculture. Hydrology National Engineering Handbook, Part 630 (May 2010). Chapter 15, Time of Concentration.

Sheet Flow T_c

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5}S^{0.4}} \quad \text{(ep. 15-8)}$$

where:
T_t = travel time, h
n = Manning's roughness coefficient (0.15, short-grass prairie)
l = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in (3.68 inches)
S = slope of land surface, ft/ft

Shallow Concentrated Flow T_c

$$V = 6.962\,(s)^{0.5}$$

where:
V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

(Table 15-3 for Short-grass pasture flow type)

Channel Flow T_c

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \quad \text{(eq. 15-10)}$$

where:
V = Average velocity, ft/s
r = hydraulic radius, ft
$= \frac{a}{P_w}$
a = cross-sectional flow area, ft2
P_w = Wetted perimeter, ft
s = slope of the hydraulic grade line, ft/ft
n = Manning's n value for open channel flow (0.027, grass)

MAVERICK COUNTY EL INDIO MSW LANDFILL
RATIONAL METHOD CALCULATIONS
- EXISTING DRAINAGE CONDITIONS -

Method: Determine peak discharge rate associated with the 25 - year, 24 - hour and 100 - year, 24 - hour storm event for the contributing sub-basins using Rational Method.

Solution: **Rational Method Calculations for Existing Drainage Conditions Areas**

25-year, 24-hour

Sub-Basin Area [1]	Runoff Coef. C [2]	Rainfall Int. I, (in/hr) [3]	Area (acres)	Peak Discharge (cfs)	t_c = min
1	0.42	9.9	2.2	9.0	10.0
2	0.42	5.3	89.7	201.0	35.5
3	0.42	5.2	43.0	94.6	36.5
4	0.42	5.2	50.8	112.0	36.4
5	0.46	5.7	3.0	7.8	31.7
I	0.42	5.3	94.8	212.5	35.5
I + II + III	0.42	5.2	188.6	408.6	37.4

$$I = \frac{b}{(t_c + d)^e}$$

Where, I =	Rainfall intensity, in/hr
b=	168
d=	15.0
e=	0.879

Sub-Basin Area	Flow Rate (cfs)	Area (acres)
I	212.55	89.7
II	94.60	43.0
III	111.97	50.8
I + II + III	408.60	188.6

100-year, 24-hour

Sub-Basin Area [1]	Runoff Coef. C [2]	Rainfall Int. I, (in/hr) [3]	Area (acres)	Peak Discharge (cfs)	t_c = min
1	0.49	13.0	2.2	13.8	10.0
2	0.49	7.2	89.7	315.7	35.5
3	0.49	7.1	43.0	148.7	36.5
4	0.49	7.1	50.8	176.0	36.4
5	0.53	7.7	3.0	12.1	31.7
I	0.49	7.2	94.8	333.9	35.5
I + II + III	0.49	7.0	183.4	624.9	37.4

$$I = \frac{b}{(t_c + d)^e}$$

Where, I =	Rainfall intensity, in/hr
b=	238
d=	16.8
e=	0.884

Sub-Basin Area	Flow Rate (cfs)	Area (acres)
I	333.90	89.68
II	148.69	42.96
III	175.97	50.80
I + II + III	624.90	188.60

Notes:

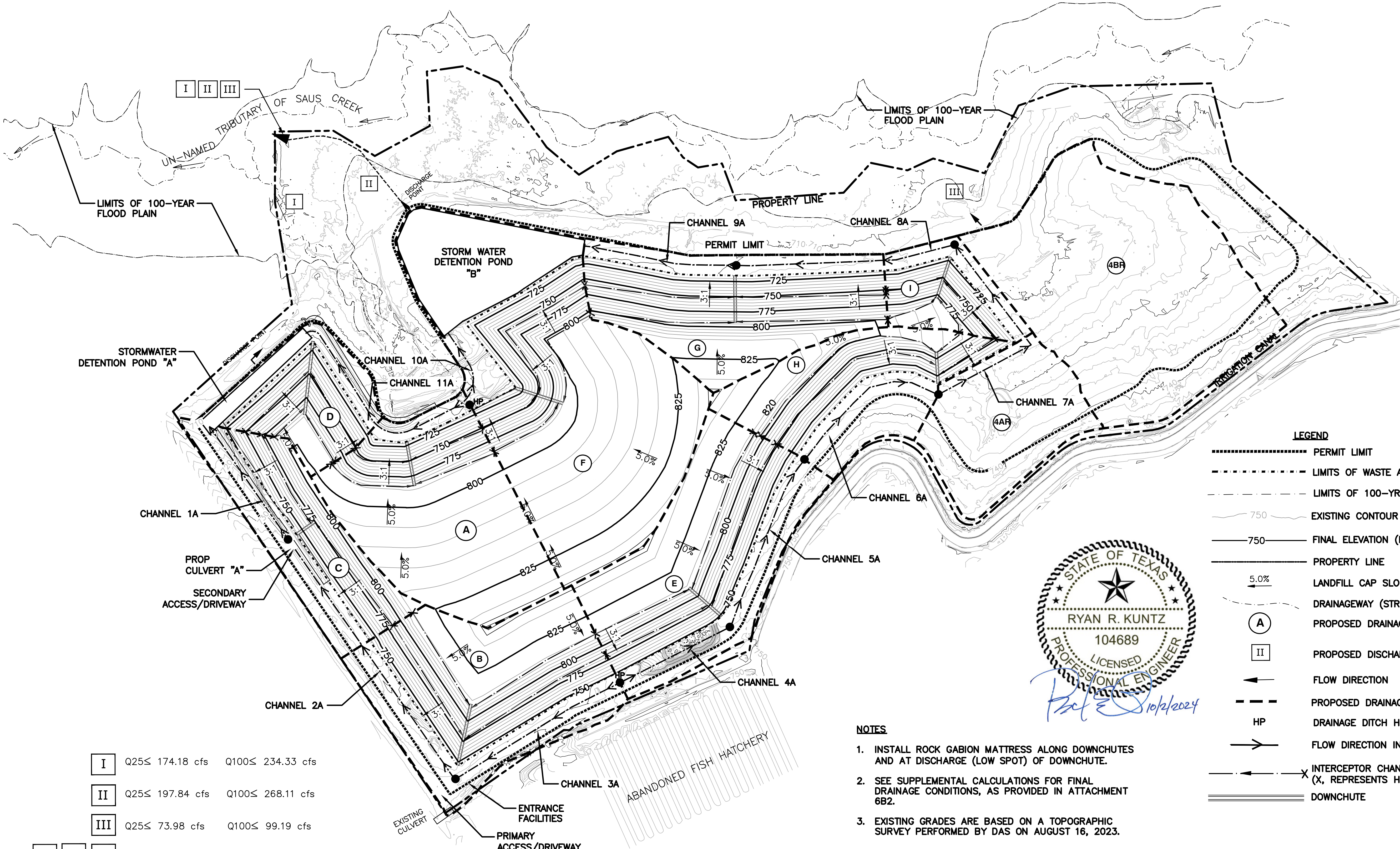
1. The sub-basin areas and time of concentrations used in these calculations are depicted on SCS Method Input Parameters, provided in Attachment 6A1.
2. Runoff Coefficients, C, and Manning's "n" are referenced from the City of Austin's Drainage Criteria Manual, as described in Attachment 6, Section 2.4. Weighted averages were used for C-values based on land-use type.
3. Rainfall Intensity (I) calculated for t_c = 10 min, using equation for rainfall intensity shown above. Coefficient b, d, and e are for a 25-year, 24-hour and 100-year, 24-hour storm events for Maverick Co., Texas (see Appendix 4, page 4-5).

Part III

Attachment 6

Attachment 6B

FINAL DRAINAGE CONDITIONS



I	Q25≤ 174.18 cfs	Q100≤ 234.33 cfs
II	Q25≤ 197.84 cfs	Q100≤ 268.11 cfs
III	Q25≤ 73.98 cfs	Q100≤ 99.19 cfs
I II III	Q25≤ 408.40 cfs	Q100≤ 552.61 cfs

NOTES

1. INSTALL ROCK GABION MATTRESS ALONG DOWNCHUTES AND AT DISCHARGE (LOW SPOT) OF DOWNCHUTE.
2. SEE SUPPLEMENTAL CALCULATIONS FOR FINAL DRAINAGE CONDITIONS, AS PROVIDED IN ATTACHMENT 6B2.
3. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.

LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- 750 EXISTING CONTOUR (FT MSL, SEE NOTE 3)
- 750 FINAL ELEVATION (FT MSL)
- PROPERTY LINE
- 5.0% LANDFILL CAP SLOPE
- DRAINAGEWAY (STREAM OR DITCH)
- (A) PROPOSED DRAINAGE BASIN (SEE NOTE 2)
- II PROPOSED DISCHARGE POINT
- FLOW DIRECTION
- PROPOSED DRAINAGE BASIN BOUNDARY
- HP DRAINAGE DITCH HIGH POINT
- FLOW DIRECTION IN PERIMETER CHANNEL
- X INTERCEPTOR CHANNEL (X, REPRESENTS HIGH POINT)
- DOWNCHUTE

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/2/2024

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	4/09	GRADES AND ADD INTERCEPTOR CHANNELS	RK
2		REMOVE 20' WIDE TERRACES; REVISE FINAL	
3	9/24	REVISED LIMIT OF WASTE, FINAL COVER	SS
4		GRADING, AND FINAL DRAINAGE CONDITIONS	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: **FINAL DRAINAGE CONDITIONS**

PROJECT: **MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION**

CLIENT: **MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: DRAINAGE DESIGN CHECK (BGC)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. **6B**

9/30/2024 4:33 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\DRAINAGE DESIGN CHECK (BGC)

Part III

Attachment 6

Attachment 6B1

CALCULATIONS FOR FINAL DRAINAGE CONDITIONS

MAVERICK COUNTY EL INDIO MSW LANDFILL
TIME OF CONCENTRATION CALCULATIONS
- FINAL DRAINAGE CONDITIONS -

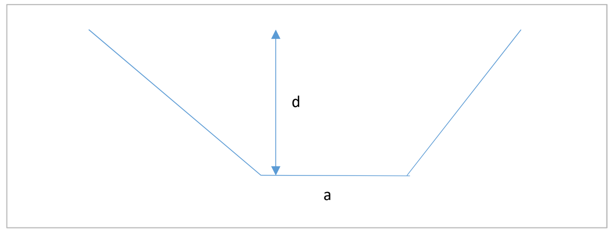
2-yr, 24-hr Rainfall Depth = 3.68 imches

Discharge Study Point	Contributing Drainage Areas (Sub-Basins)	Area (sq. mi.)	Curve Number (CN)	Sheet Flow: Surface Description	Sheet Flow: Length (feet)	Sheet Flow: Slope (ft/ft)	Sheet Flow: Manning Roughness Coefficient	Shallow Concentrated Flow: Surface Description	Shallow Concentrated Flow: Length (feet)	Shallow Concentrated Flow: Slope (ft/ft)	Shallow Concentrated Flow: Avg. Velocity (ft/s)	Open Channel Flow: Surface Description	Open Channel Flow: Length (feet)	Open Channel Flow: Slope (ft/ft)	Open Channel Flow: Manning n	Open Channel Flow: Cross-sectional Area (ft2)	Open Channel Flow: Wetted Perimeter (ft)	Open Channel Flow: Hydraulic Radius (ft)	Open Channel Flow: Avg. Velocity (ft/s)	Time of Concentration (Tc): Sheet Flow T_c (min)	Time of Concentration (Tc): Shallow Concentrated Flow T_c (min)	Time of Concentration (Tc): Channel Flow T_c (min)	Time of Concentration (Tc): Total T_c (min)
POD-I	A	0.0291	85.0	Grass	300	0.050	0.15	Grass	445	0.010	0.7	Grass	421	0.01	0.027	5.1	16.3	0.3125	2.5	15	11	2.8	
												Gabion	228	0.333	0.033	1.9	26.0	0.1	4.6	-	-	0.8	30.7
												Concrete	204	0.005	0.013	4.8	22.1	0.2	2.9	-	-	1.2	
	B	0.0334	85.0	Grass	270	0.050	0.15	-	-	-	-	Grass	710	0.010	0.027	3.9	14.3	0.28	2.3	14	-	5.1	
												Gabion	305	0.333	0.033	1.9	26.0	0.1	4.6	-	-	1.1	23.0
												Concrete	749	0.005	0.013	13.6	33.6	0.4	4.4	-	-	2.8	
	C	0.0219	85.0	Grass	175	0.237	0.15	-	-	-	-	Grass	645	0.01	0.027	3.3	13.0	0.3	2.2	5	-	4.9	
												Gabion	110	0.333	0.033	1.9	26.0	0.1	4.6	-	-	0.4	14.1
												Concrete	661	0.005	0.013	6.2	25.6	0.2	3.2	-	-	3.5	
	D	0.0107	85.0	Grass	136	0.050	0.15	-	-	-	-	Grass	269	0.01	0.027	3.3	13.0	0.3	2.2	8	-	2.0	11.5
												Gabion	377	0.333	0.033	1.9	26.0	0.1	4.6			1.4	
	Pond A	0.0018	80.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	A+B+C+D+Pond A	0.0970	85.0	Grass	300	0.050	0.15	Grass	445	0.010	0.7	Grass	421	0.010	0.027	5.1	16.3	0.3	2.5	15	11	2.8	
												Gabion	228	0.333	0.033	1.9	26.0	0.1	4.6	-	-	0.8	33.7
												Concrete	742	0.005	0.013	4.8	22.1	0.2	2.9	-	-	4.2	
POD-II	E	0.0311	85.0	Grass	250	0.050	0.15	-	-	-	-	Grass	847	0.01	0.027	3.3	13.0	0.3	2.2	13	-	6.4	
												Gabion	270	0.333	0.033	1.9	26.0	0.1	4.6	-	-	1.0	25.1
												Concrete	890	0.005	0.013	5.9	23.3	0.3	3.2	-	-	4.6	
	F	0.0433	85.0	Grass	300	0.050	0.15	Grass	455	0.010	0.7	Grass	409	0.01	0.027	3.3	13.0	0.3	2.2	15	11	3.1	
												Gabion	247	0.333	0.033	1.9	26.0	0.1	1.0	-	-	4.2	34.1
												Concrete	407	0.005	0.013	6.5	23.9	0.3	10.9	-	-	0.6	
	G	0.0224	85.0	Grass	300	0.061	0.15	Grass	42	0.010	0.7	Grass	120	0.01	0.027	3.3	13.0	0.3	2.2	14	1	0.9	
												Gabion	246	0.333	0.033	1.9	26.0	0.1	4.6	-	-	0.9	20.1
												Concrete	761	0.005	0.013	9.9	29.7	0.3	3.9	-	-	3.2	
	H	0.0187	85.0	Grass	287	0.050	0.15	-	-	-	-	Grass	1097	0.01	0.027	3.3	13.0	0.3	2.2	15	-	8.3	
												Gabion	167	0.333	0.033	1.9	26.0	0.1	4.6	-	-	0.6	26.2
												Concrete	526	0.005	0.013	6.5	23.9	0.3	3.4	-	-	2.6	
	I	0.0086	85.0	Grass	300	0.050	0.15	-	-	-	-	Grass	82	0.01	0.027	3.3	13.0	0.3	2.2	15	-	0.6	
												Gabion	218	0.333	0.033	1.9	26.0	0.1	4.6	-	-	0.8	17.2
												Concrete	342	0.005	0.013	7.1	24.5	0.3	11.4	-	-	0.5	
	4AR	0.0172	80.0	Grass	300	0.036	0.15	Grass	422	0.036	0.7	-	-	-	-	-	-	-	-	17	10	-	27.4
	Pond B	0.0117	80.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E+F+G+H+I+4AR +Pond B	0.1357	85.0	Grass	250	0.050	0.15	-	-	-	-	Grass	847	0.01	0.027	3.3	13.0	0.3	2.2	13.2	-	6.4	
												Gabion	270	0.333	0.033	1.9	26.0	0.1	4.6	-	-	1.0	54.20
												Concrete	7334	0.005	0.013	14.4	48.0	0.3	3.6	-	-	33.7	
POD-III	4BR	0.0448	80.0	Grass	300	0.046	0.15	Grass	494	0.028	1.2	Grass	847	0.011	0.027	47.6	143.6	0.3	2.7	15.8	7.0	5.2	28.0
POD-II+III	E+F+G+H+I+ 4AR+4BR+Pond B	0.1977	85.0	Grass	250	0.050	0.15	-	-	-	-	Grass	847	0.01	0.027	3.3	13.0	0.3	2.2	13.2	-	6.4	
												Gabion	270	0.333	0.033	1.9	26.0	0.1	4.6	-	-	1.0	54.20
												Concrete	7334	0.005	0.013	14.4	48.0	0.3	3.6	-	-	33.7	

Total Area = 0.2947 sq. miles
Total Area = 188.6 acres

MAVERICK COUNTY EL INDIO MSW LANDFILL
TIME OF CONCENTRATION CALCULATIONS
- FINAL DRAINAGE CONDITIONS -

Channel Section:



Sub-Basin Channels	a (ft)	d (ft)	left slope (%)	right slope (%)	Area (ft2)	Wetted P (ft)	2-year, 24 hour		
A-Swale	0	1.25	33	28.6	5.1	16.3	Q2yr :	25.1	cfs
A-Downchute	4	0.4	25	25	1.9	26.0	Q2yr :	25.1	cfs
Channel 10A	8	0.5	33	33	4.8	22.1	Q2yr :	25.1	cfs
B-Swale	0	1.1	33	28.6	3.9	14.3	Q2yr:	18.5	cfs
B-Downchute	4	0.4	25	25	1.9	26.0	Q2yr:	18.5	cfs
Channel 2A	8	1.1	25	25	13.6	33.6	Q2yr:	32	cfs
C-Swale	0	1	33	28.6	3.3	13.0	Q2yr :	10.9	cfs
C-Downchute	4	0.4	25	25	1.9	26.0	Q2yr :	10.9	cfs
Channel 1A	8	0.6	25	25	6.2	25.6	Q2yr :	29.1	cfs
D-Swale	0	1	33	28.6	3.3	13.0	Q2yr :	12.6	cfs
D-Downchute	4	0.4	25	25	1.9	26.0	Q2yr :	12.6	cfs
E-Swale	0	1	33	28.6	3.3	13.0	Q2 yr:	19.4	cfs
E-Downchute	4	0.4	25	25	1.9	26.0	Q2 yr:	19.4	cfs
Channel 5A	8	0.6	33	33	5.9	23.3	Q2 yr:	29.8	cfs

Sub-Basin Channels	a (ft)	d (ft)	left slope (%)	right slope (%)	Area (ft2)	Wetted P (ft)	2-year, 24 hour		
F-Swale	0	1	33	28.6	3.3	13.0	Q2 yr:	28.9	cfs
F-Downchute	4	0.4	25	25	1.9	26.0	Q2 yr:	28.9	cfs
Chanel 9A	8	0.7	33	33	6.5	23.9	Q2 yr:	28.9	cfs
G-Swale	0	1	33	28.6	3.3	13.0	Q2 yr:	17.7	cfs
G-Downchute	4	0.4	25	25	1.9	26.0	Q2 yr:	17.7	cfs
Channel 8A	10	0.8	33	33	9.9	29.7	Q2 yr:	55.5	cfs
H-Swale	0	1	33	28.6	3.3	13.0	Q2 yr:	25.4	cfs
H-Downchute	4	0.4	25	25	1.9	26.0	Q2 yr:	25.4	cfs
Channel 6A	8	0.7	33	33	6.5	23.9	Q2 yr:	38.9	cfs
I-Swale	0	1	33	28.6	3.3	13.0	Q2 yr:	12.6	cfs
I-Downchute	4	0.4	25	25	1.9	26.0	Q2 yr:	12.6	cfs
Channel 7A	8	0.7	33	33	7.1	24.5	Q2 yr:	41.5	cfs
4BR	33.9	0.9	6.1	4.4	47.6	143.6	Q2 yr:	74.4	cfs

Methodology:

Reference: United States Department of Agriculture. Hydrology National Engineering Handbook, Part 630 (May 2010). Chapter 15, Time of Concentration.

Sheet Flow T_c

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5} S^{0.4}} \quad \text{(ep. 15-8)}$$

where:

T_t = travel time, h
n = Manning's roughness coefficient (0.15, short-grass prairie)
l = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in (3.68 inches)
S = slope of land surface, ft/ft

Shallow Concentrated Flow T_c

$$V = 6.962\,(s)^{0.5}$$

where:

V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

(Table 15-3 for Short-grass pasture flow type)

Channel Flow T_c

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \quad \text{(eq. 15-10)}$$

where:

V = Average velocity, ft/s
r = hydraulic radius, ft
$= \frac{a}{P_w}$
a = cross-sectional flow area, ft2
P_w = Wetted perimeter, ft
s = slope of the hydraulic grade line, ft/ft
n = Manning's n value for open channel flow (0.027, grass)

MAVERICK COUNTY EL INDIO MSW LANDFILL
RATIONAL METHOD CALCULATIONS
- FINAL DRAINAGE CONDITIONS -

Method: 1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the contributing sub-basins using Rational Method.

2. Use a Manning's "n" associated with grass-lined channels and runoff coefficient "C" for grass slopes.

Solution: **Rational Method Calculations for Developed Drainage Conditions Areas**

25-year, 24-hour

Sub-Basin Area [1]	Runoff Coef. C [2]	Rainfall Int. I, (in/hr) [3]	Area (acres)	Peak Discharge (cfs)	t_c = min
A	0.48	5.8	18.6	52.3	30.7
B	0.52	6.8	21.4	76.2	23.0
C	0.58	8.7	14.0	70.5	14.1
D	0.52	9.4	6.9	33.4	11.5
E	0.52	6.5	19.9	67.6	25.1
F	0.49	5.5	27.7	73.4	34.1
G	0.60	7.3	14.3	63.0	20.1
H	0.55	6.4	12.0	42.1	26.2
I	0.57	7.9	5.5	24.9	17.2
4AR	0.42	6.2	11.0	28.7	27.4
4BR	0.42	6.1	28.7	74.0	28.0
I	0.51	5.5	62.1	174.2	33.7
II	0.50	4.0	97.9	197.8	54.2
II+III	0.48	4.0	126.5	243.0	54.2

$$I = \frac{b}{\left(t_c + d\right)^e}$$

Where, I = Rainfall intensity, in/hr
b= 168
d= 15.0
e= 0.879

Sub-Basin Area	Flow Rate (cfs)	Area (acres)
I[4]	174.18	60.93
II	197.84	90.42
III	73.98	28.67
I + II + III	408.40	188.63

100-year, 24-hour

Sub-Basin Area [1]	Runoff Coef. C [2]	Rainfall Int. I, (in/hr) [3]	Area (acres)	Peak Discharge (cfs)	t_c = min
A	0.48	7.8	18.6	70.2	30.7
B	0.52	9.1	21.4	101.8	23.0
C	0.58	11.5	14.0	93.2	14.1
D	0.52	12.4	6.9	44.0	11.5
E	0.52	8.7	19.9	90.4	25.1
F	0.49	7.4	27.7	98.8	34.1
G	0.60	9.8	14.3	83.9	20.1
H	0.55	8.5	12.0	56.3	26.2
I	0.57	10.5	5.5	33.1	17.2
4AR	0.42	8.3	11.0	38.5	27.4
4BR	0.42	8.2	28.7	99.2	28.0
I	0.51	7.4	62.1	234.3	33.7
II	0.50	5.5	97.9	268.1	54.2
II+III	0.48	5.5	126.5	329.3	54.2

$$I = \frac{b}{\left(t_c + d\right)^e}$$

Where, I = Rainfall intensity, in/hr
b= 238
d= 16.8
e= 0.884

Sub-Basin Area	Flow Rate (cfs)	Area (acres)
I[4]	234.33	60.93
II	268.11	90.42
III	99.19	28.67
I + II + III	552.61	188.63

Notes: 1. The sub-basin areas used in these calculations are depicted on Attachment 6B, provided at the end of this appendix.
2. Runoff Coefficients, C, and Manning's "n" are referenced from the City of Austin's Drainage Criteria Manual, as described in Attachment 6, Section 2.4. However, a runoff coeficient of 0.44 was used for topslope areas, and a runoff coefficient of 0.77 was used for sideslope areas (see Attachment 6, Appendix 4, page 4-6). Weighted averages where used based on topslope and sideslope areas, and land use.

3. Rainfall Intensity (I) calculated for t_c = 10 min, using equation for rainfall intensity shown above. Coefficient b, d, and e are for a 25-year, 24-hour and 100-year, 24-hour storm events for Maverick Co., Texas (see Appendix 4, page 4-5).
4. Rational Method flow calculations into Pond A less than previous analysis, as shown in Attachment 6E1. As such, Pond A is adequately sized for 24-hr, 100-yr storm.

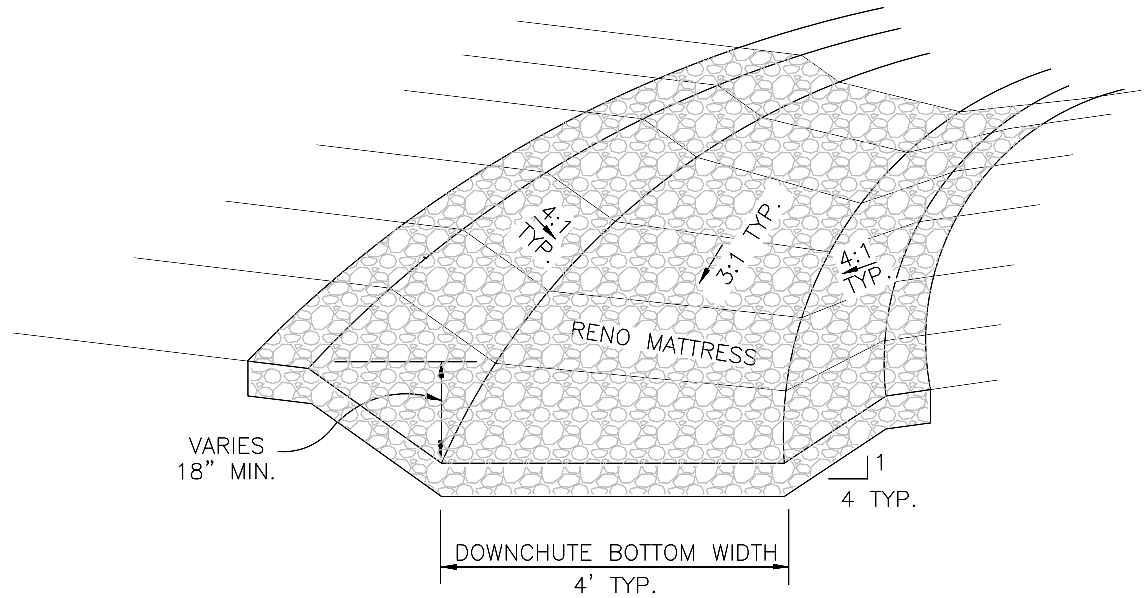
Part III

Attachment 6

Attachment 6C

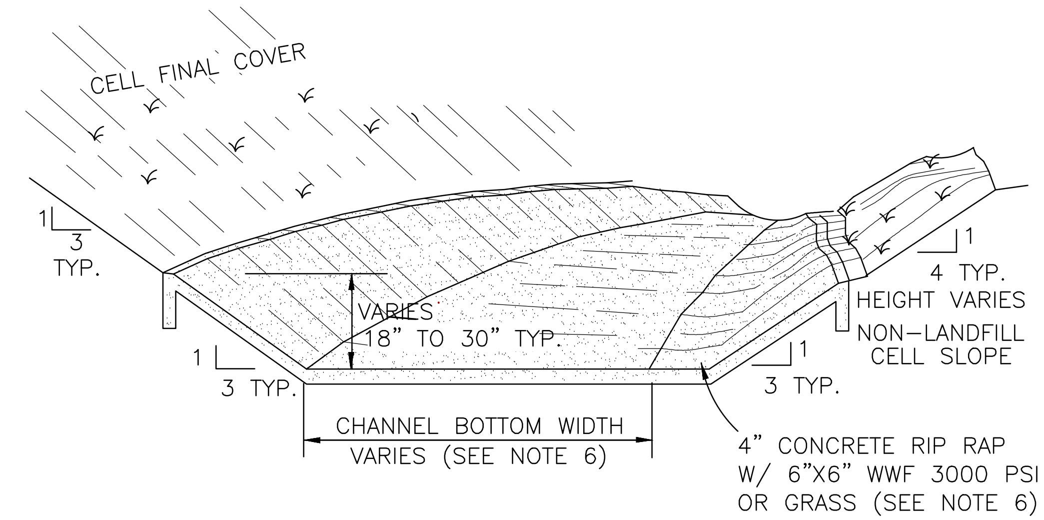
DRAINAGE STRUCTURES:

DETAILS



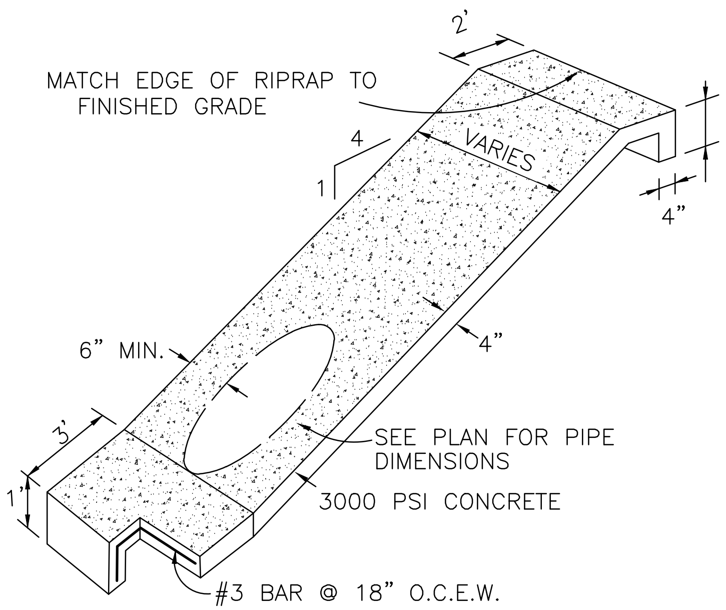
TYPICAL DOWNCHUTE DETAIL (SEE NOTE 5) A 6C

NOT TO SCALE
n = 0.035
RENO MATTRESS LINED



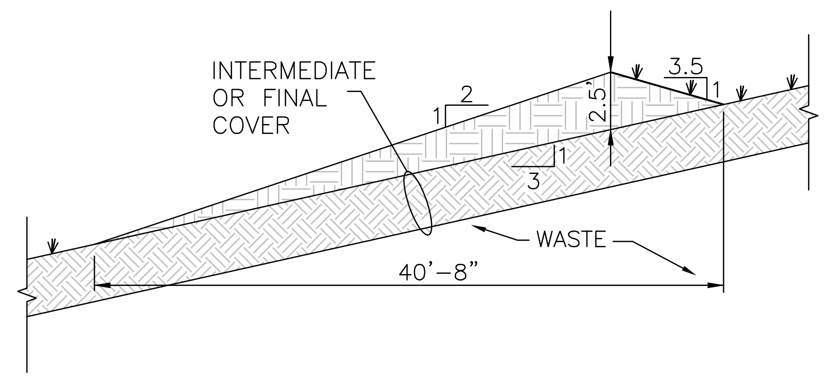
TYPICAL PERIMETER CHANNEL DETAIL B 6C

NOT TO SCALE
S = 0.5%



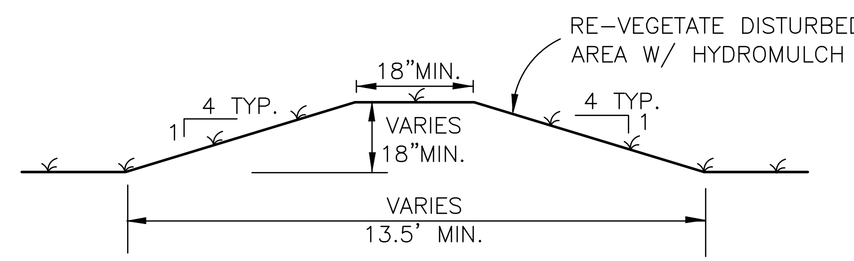
CULVERT SAFETY END TREATMENT C 6C

N.T.S.



TYPICAL INTERCEPTOR CHANNEL (SEE NOTE 5) D 6C

NOT TO SCALE
n = 0.027
S = 1%
GRASS LINED



STORM WATER DIVERSION BERM DETAIL E 6C

NOT TO SCALE

GENERAL NOTES

1. EXCEPT AS NOTED ON CONSTRUCTION DRAWINGS OR DESIGNATED ON-SITE BY THE ENGINEER OR DESIGNATED REPRESENTATIVE, ALL TREES, BRUSH, STUMPS, OBSTRUCTIONS AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE DRAINAGE CHANNEL.
2. THE DRAINAGE CHANNEL SHALL BE EXCAVATED OR SHAPED TO LINE, GRADE, AND CROSS-SECTION, AS REQUIRED TO MEET THE CRITERIA SPECIFIED HEREIN AND BE FREE OF BANK PROJECTIONS OR OTHER IRREGULARITIES WILL IMPEDE NORMAL FLOW.
3. FILL SHALL BE COMPACTED AS NEEDED TO PREVENT UNEQUAL SETTLEMENT THAT WOULD CAUSE DAMAGE TO THE COMPLETED DRAINAGE CHANNEL.
4. ALL EARTH REMOVED AND NOT NEEDED IN CONSTRUCTION SHALL BE SPREAD OR DISPOSED OF SO THAT IT WILL NOT INTERFERE WITH THE FUNCTIONING OF THE DRAINAGE CHANNEL OR RESULT IN EROSION AND SILTATION PROBLEMS.
5. THE DESIGN FOR INTERCEPTOR CHANNELS AND DOWNCHUTES ARE REPRESENTATIVE OF THESE STRUCTURES INSTALLED ON EITHER INTERMEDIATE OR FINAL COVER.
6. PERIMETER CHANNEL MAY BE CONCRETE OR GRASS-LINED. CHANNEL WIDTH AND GEOMETRY TO BE INSTALLED CONSISTENT WITH ATTACHMENT 6D2, PEREIMETER CHANNEL CALCULATIONS

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	04/09	REMOVED AND REPLACED TYPICAL INTERCEPTOR SECTION; ADDED NOTE 5; CHANGE LANDFILL SLOPE	RK
2	9/24	REVISED CHANNEL PROPERTIES AND LANDFILL SIDESLOPE	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
DRAINAGE STRUCTURE DETAILS

PROJECT TITLE
MAVERICK COUNTY
EL INDIO MSW LANDFILL
PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: 6C DRAINDETAIL

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT

6C

8/1/2024 9:19 AM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\6c DRAINDETAIL

Part III

Attachment 6

Attachment 6D1

DRAINAGE STRUCTURES:

INTERCEPTOR CHANNEL AND DOWNCHUTE CALCULATIONS

INTERMEDIATE COVER
INTERCEPTOR CHANNEL FLOW ANALYSIS

Prepd By: RRK Date: September 2024

Required: Calculate the flow velocity and flow depth for sizing interceptor channels installed on the intermediate cover.

Method: 1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the greatest interceptor channel contributing sub-basin using the Rational Method.
2. Use a Manning's "n" associated with grass-lined channels and runoff coefficient "C" for grass slopes.
3. Using the specified interceptor channel geometry, determine flow velocity and flow depth using HYDROCALC program.

Solution: **Rational Method Calculation for Greatest Interceptor Channel Contributing Area**

Drainage Area [1]	Runoff Coef. C^3	Rainfall Int. I, (in/hr)[2]	Area (acres)	Peak Discharge (cfs)
IIC-1	0.44	9.89	12.0	52.2

Interceptor Channel Configuration

Bottom Width	0
Left Sideslopes (xH:1V)	3
Right Sideslopes (xH:1V)	3.5
Bottom Slope (ft/ft)	0.01
Manning's "n"	0.027
Flow Depth	1.80
Peak Velocity (fps)	4.96
Peak Discharge Rate (cfs)	52.2

$$I = \frac{b}{(t_c + d)^e}$$

Where, I = Intensity, in/hr
b= 168
d= 15.0
e= 0.879
t_c (min) = 10

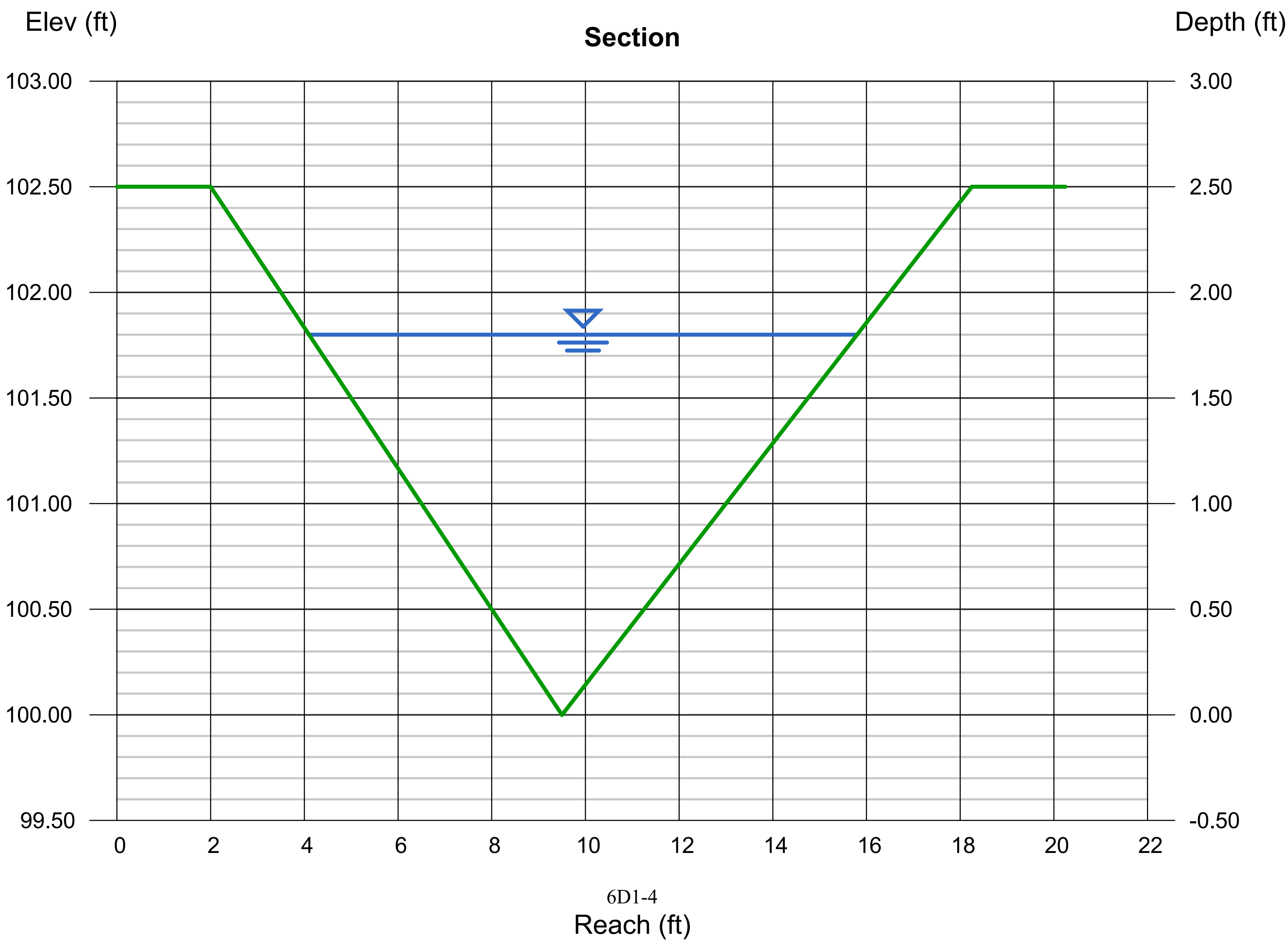
Conclusion: From above calculation, the calculated velocity of 4.96 fps is less than the permissible velocity of 5 fps for grass-lined channels (see Attachment 6, Section 3.3.1). Therefore, interceptor channels constructed on intermediate cover will be installed with a minimum 0.5-foot freeboard or a total minimum depth of 2.5 feet. Interceptor channels will be installed with a minimum 1 percent channel slope. Specifications for the installation of interceptor channels on intermediate cover are described in Attachment 6, Appendix 2, Section 5.1.1. The design detail for an interceptor channel is depicted on Attachment 6C.

Notes: 1. This calculation is representative of the largest contributing sub-basin for an interceptor channel on intermediate cover, as depicted on Attachment 6D1A.
2. Rainfall Intensity (I) calculated for tc = 10 min, using equation for rainfall intensity shown above. Coefficient b, d, and e are for a 25-year, 24-hour storm event for Maverick Co., Texas (see Appendix 4, page 4-5).
3. Runoff Coefficients, C, and Manning's "n" are referenced from the City of Austin's Drainage Criteria Manual, as described in Attachment 6, Section 2.4.
4. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).

Channel Report

Intermediate Interceptor Channel - 1

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.50	Depth (ft)	= 1.80
Total Depth (ft)	= 2.50	Q (cfs)	= 52.20
		Area (sqft)	= 10.53
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.96
Slope (%)	= 1.00	Wetted Perim (ft)	= 12.24
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.75
		Top Width (ft)	= 11.70
Calculations		EGL (ft)	= 2.18
Compute by:	Known Q		
Known Q (cfs)	= 52.20		



FINAL COVER
INTERCEPTOR CHANNEL FLOW ANALYSIS

FINAL COVER - INTERCEPTOR CHANNEL FLOW ANALYSIS

Prepd By: RRK
Date: September 2024

Required: Calculate the flow velocity and flow depth for sizing interceptor channels installed on the final cover. The largest sub-basins contributing to interceptor channels were selected for this analysis.

Method:
1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the contributing sub-basins using Rational Method.
2. Use a Manning's "n" associated with grass-lined channels and runoff coefficient "C" for grass slopes.
3. Using the specified channel geometry, determine flow velocity and flow depth using HYDROCALC program.
4. Compare the flow velocity to the permissible velocity of 5 fps for grass-lined channels (see Attachment 6, Section 3.3.1).

Solution: **Rational Method Calculations for Final Cover Interceptor Channel Contributing Areas**

Sub-Basin Area [1]	Runoff Coef. C [2]	Rainfall Int. I, (in/hr) [3]	Area (acres)	Peak Discharge (cfs)
IC-1	0.44	9.89	9.2	39.9
IC-2	0.44	9.89	12.0	52.2
IC-3	0.77	9.89	2.3	17.8
IC-4	0.77	9.89	3.0	23.0
IC-5	0.77	9.89	2.4	18.4

$$I = \frac{b}{(t_c + d)^e}$$

Where, I = Rainfall intensity, in/hr
b= 168
d= 15.0
e= 0.879
t_c = 10 min

Interceptor Channel Calculations Summary [4]

Sub-Basin Area	Flow Rate (cfs)	Bottom Slope (ft/ft)	Manning's n^2	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
IC-1	39.9	0.01	0.027	3.0	3.5	0.0	1.63	4.62
IC-2	52.2	0.01	0.027	3.0	3.5	0.0	1.80	4.96
IC-3	17.8	0.01	0.027	3.0	3.5	0.0	1.21	3.74
IC-4	23.0	0.01	0.027	3.0	3.5	0.0	1.33	4.00
IC-5	18.4	0.01	0.027	3.0	3.5	0.0	1.22	3.80

Conclusions: From the above interceptor channel calculations summary, the calculated worst-case velocities of 4.6 fps is less than the permissible velocity of 5 fps. Therefore, interceptor channels installed on final cover sideslopes will be constructed with a minimum 0.5-foot freeboard over the maximum depth of flow or a total minimum depth of 2.5 feet. Interceptor channels will be installed on final cover with a minimum 1 percent channel slope. Specifications for the installation of interceptor channels on final cover are described in Attachment 6, Appendix 2, Section 5.1.1. The design detail for interceptor channels installed on final cover are depicted on Attachment 6C.

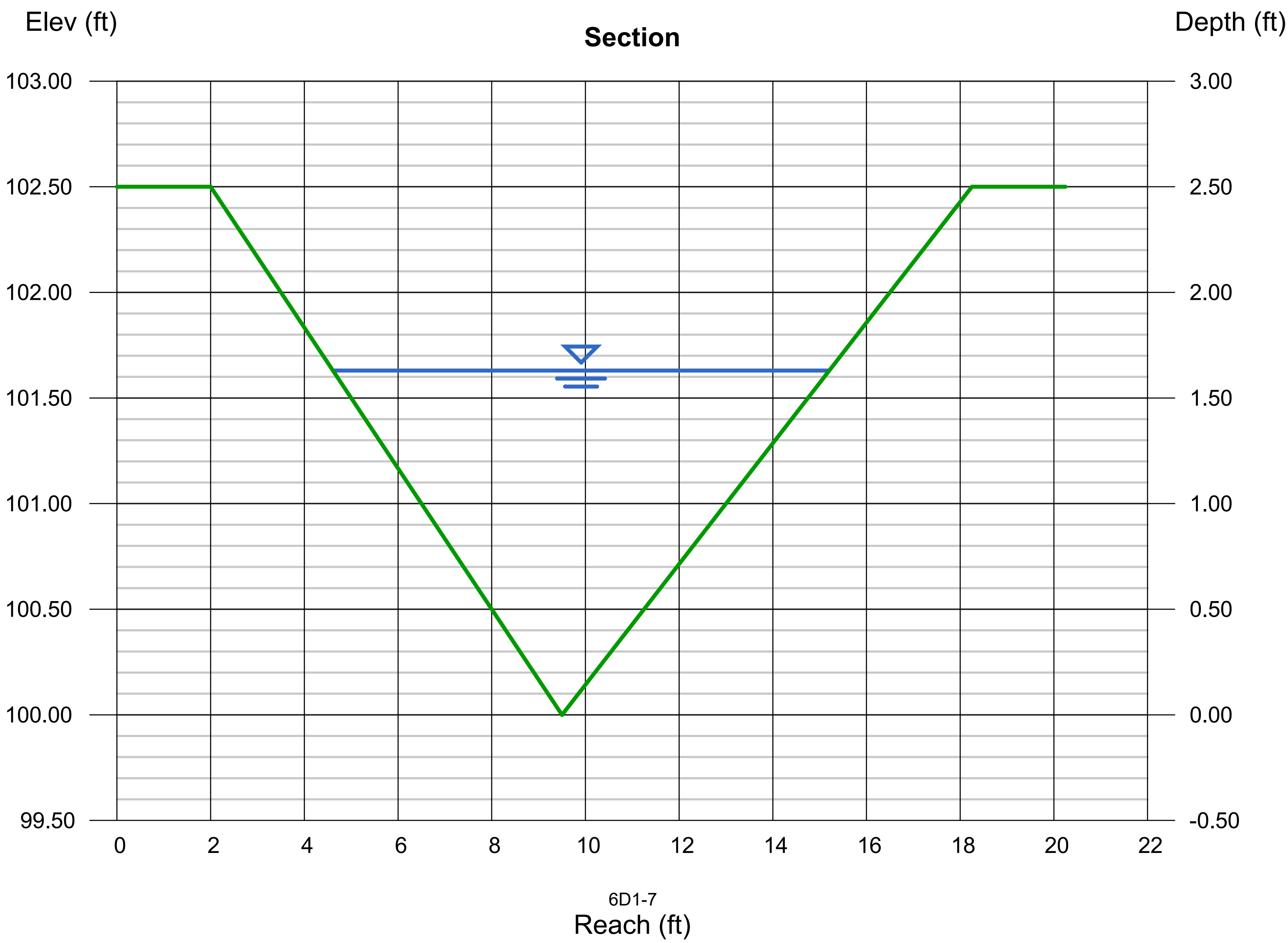
Notes:
1. The sub-basin areas used in these calculations are depicted on Attachment 6D1B, provided at the end of this appendix.
2. Runoff Coefficients, C, and Manning's "n" are referenced from the City of Austin's Drainage Criteria Manual, as described in Attachment 6, Section 2.4. However, a runoff coeficient of 0.44 was used for topslope areas, and a runoff coefficient of 0.77 was used for sideslope areas (see Attachment 6, Appendix 4, page 4-6).

3. Rainfall Intensity (I) calculated for t_c = 10 min, using equation for rainfall intensity shown above. Coefficient b, d, and e are for a 25-year, 24-hour storm event for Maverick Co., Texas (see Appendix 4, page 4-5).
4. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).

Channel Report

Interceptor Channel - 1

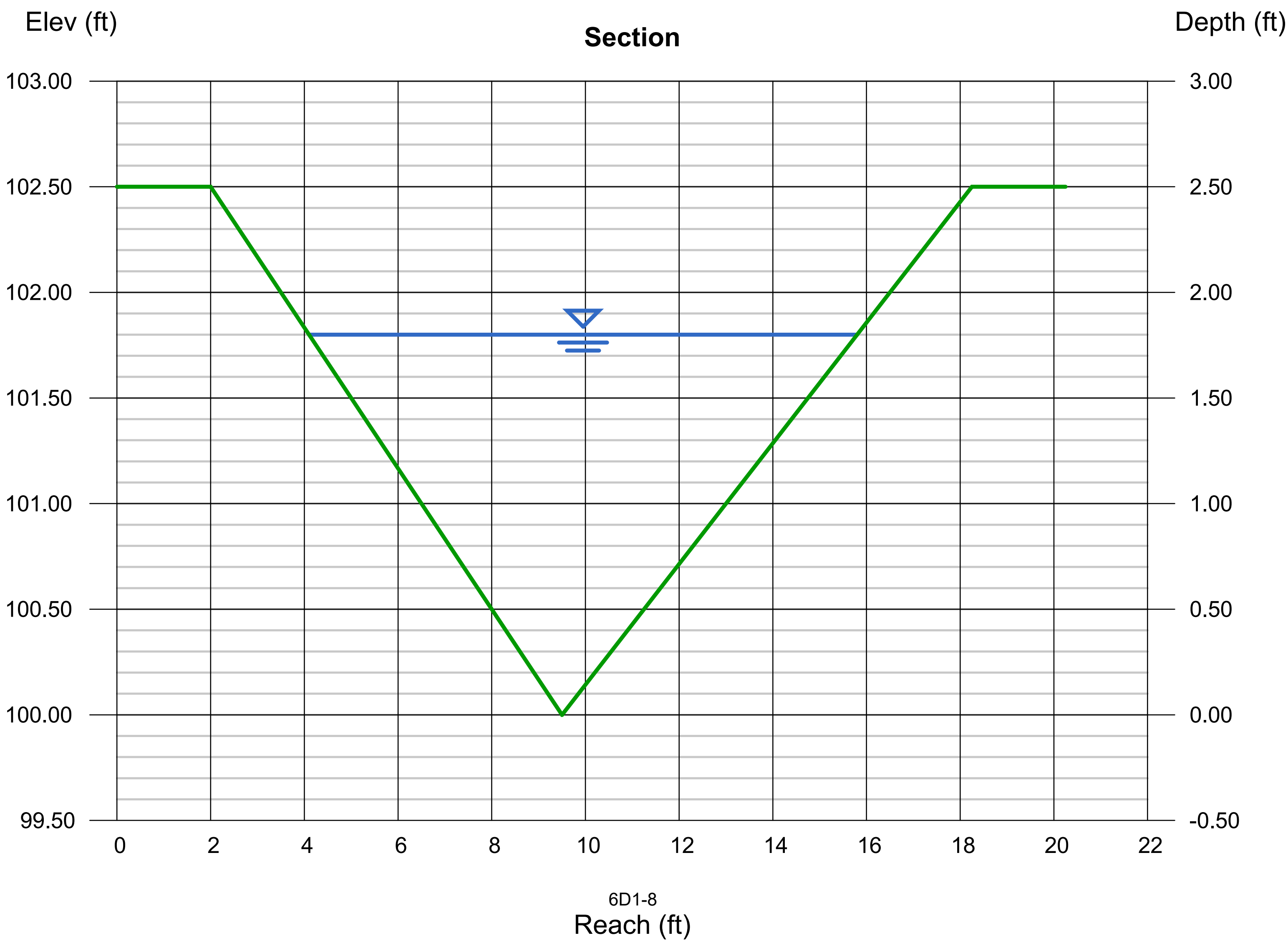
Triangular			**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.50		Depth (ft)	= 1.63
Total Depth (ft)	= 2.50		Q (cfs)	= 39.90
			Area (sqft)	= 8.63
Invert Elev (ft)	= 100.00		Velocity (ft/s)	= 4.62
Slope (%)	= 1.00		Wetted Perim (ft)	= 11.09
N-Value	= 0.027		Crit Depth, Yc (ft)	= 1.57
			Top Width (ft)	= 10.59
Calculations			EGL (ft)	= 1.96
Compute by:	Known Q			
Known Q (cfs)	= 39.90			



Channel Report

Interceptor Channel - 2

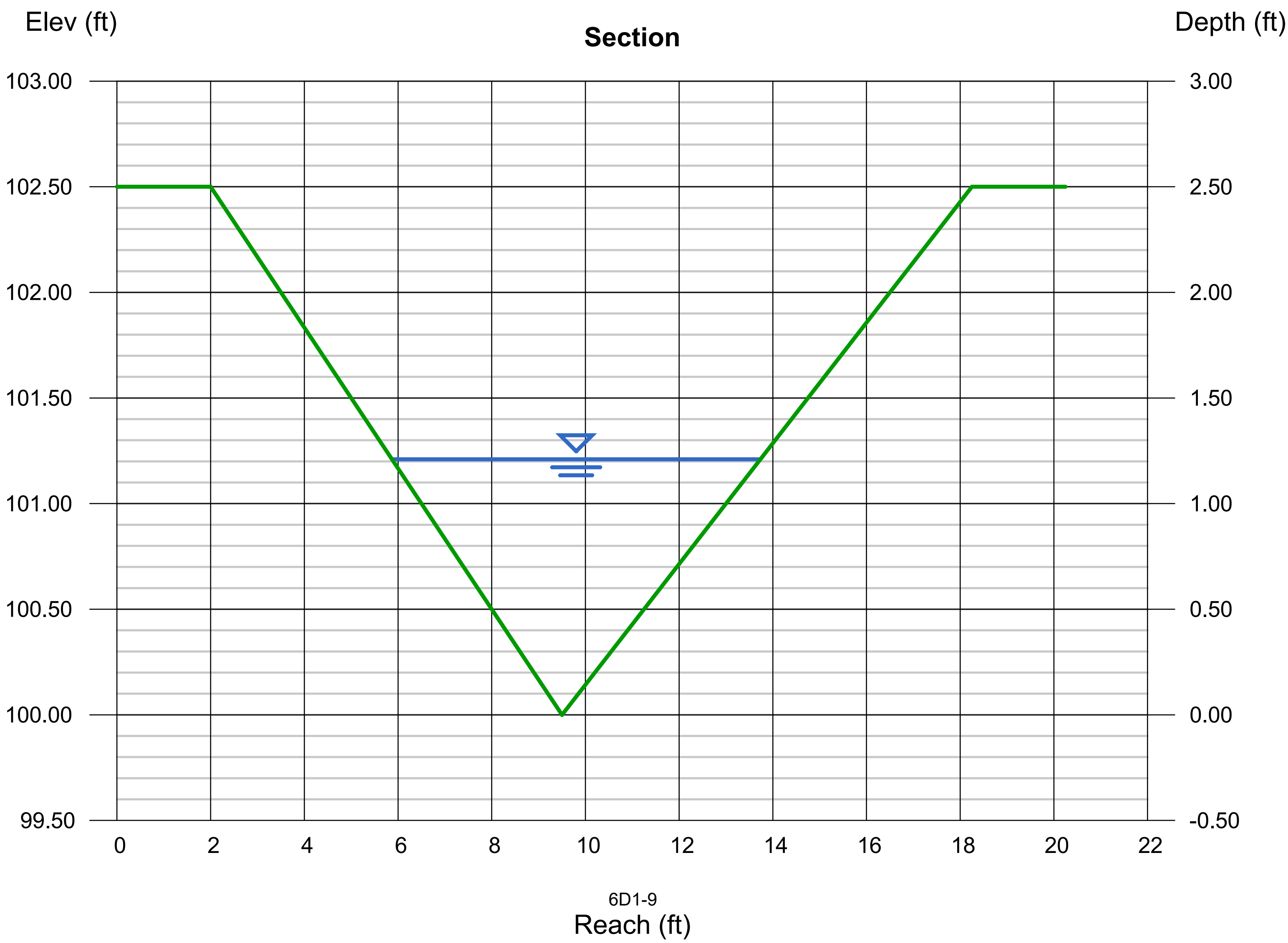
Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.50	Depth (ft)	= 1.80
Total Depth (ft)	= 2.50	Q (cfs)	= 52.20
		Area (sqft)	= 10.53
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.96
Slope (%)	= 1.00	Wetted Perim (ft)	= 12.24
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.75
		Top Width (ft)	= 11.70
Calculations		EGL (ft)	= 2.18
Compute by:	Known Q		
Known Q (cfs)	= 52.20		



Channel Report

Interceptor Channel - 3

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.50	Depth (ft)	= 1.21
Total Depth (ft)	= 2.50	Q (cfs)	= 17.80
		Area (sqft)	= 4.76
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.74
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.23
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.14
		Top Width (ft)	= 7.86
Calculations		EGL (ft)	= 1.43
Compute by:	Known Q		
Known Q (cfs)	= 17.80		



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Oct 20 2022

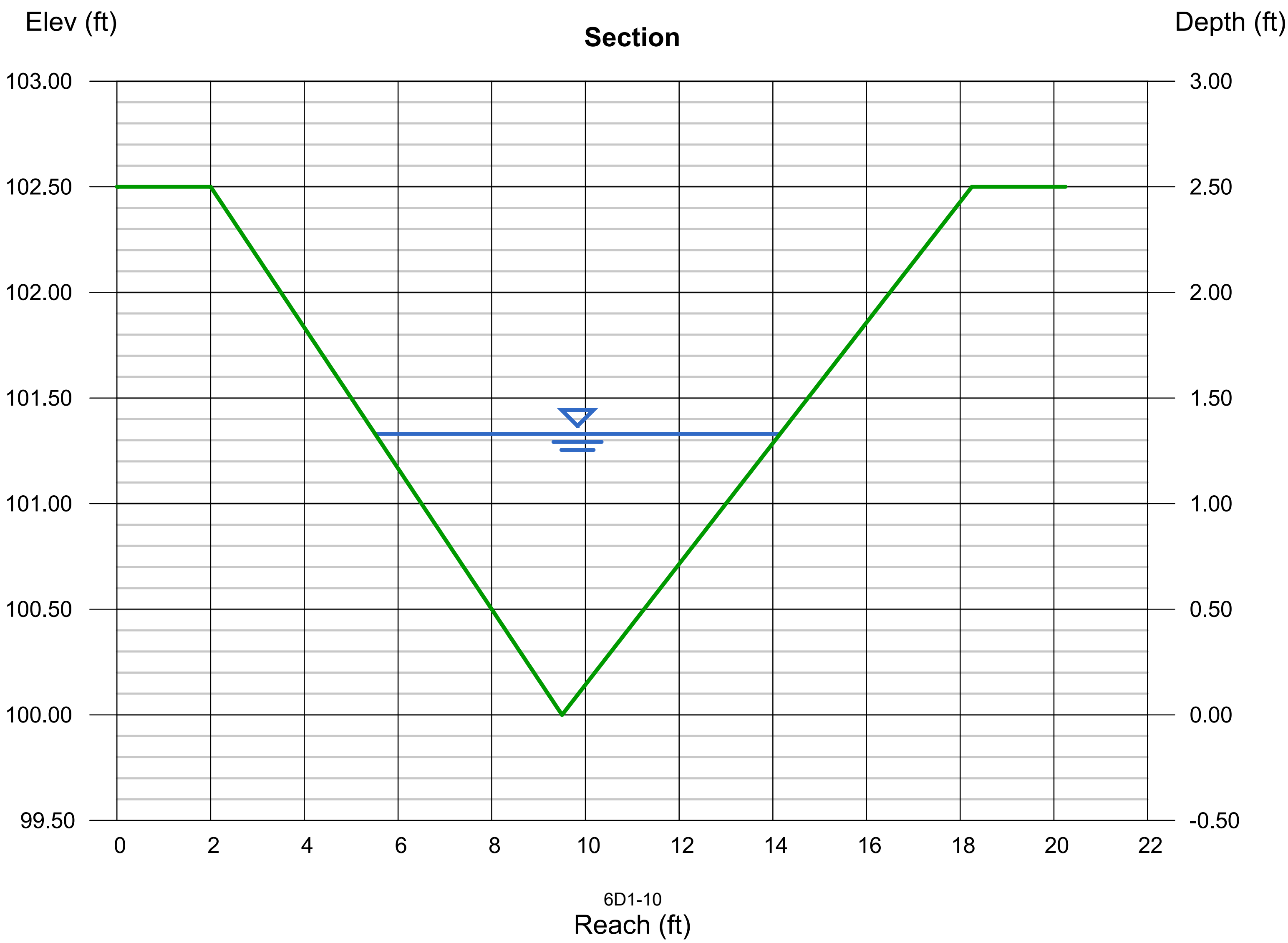
Interceptor Channel - 4

Triangular
Side Slopes (z:1) = 3.00, 3.50
Total Depth (ft) = 2.50

Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.027

Calculations
Compute by: Known Q
Known Q (cfs) = 23.00

Highlighted
Depth (ft) = 1.33
Q (cfs) = 23.00
Area (sqft) = 5.75
Velocity (ft/s) = 4.00
Wetted Perim (ft) = 9.05
Crit Depth, Yc (ft) = 1.26
Top Width (ft) = 8.64
EGL (ft) = 1.58

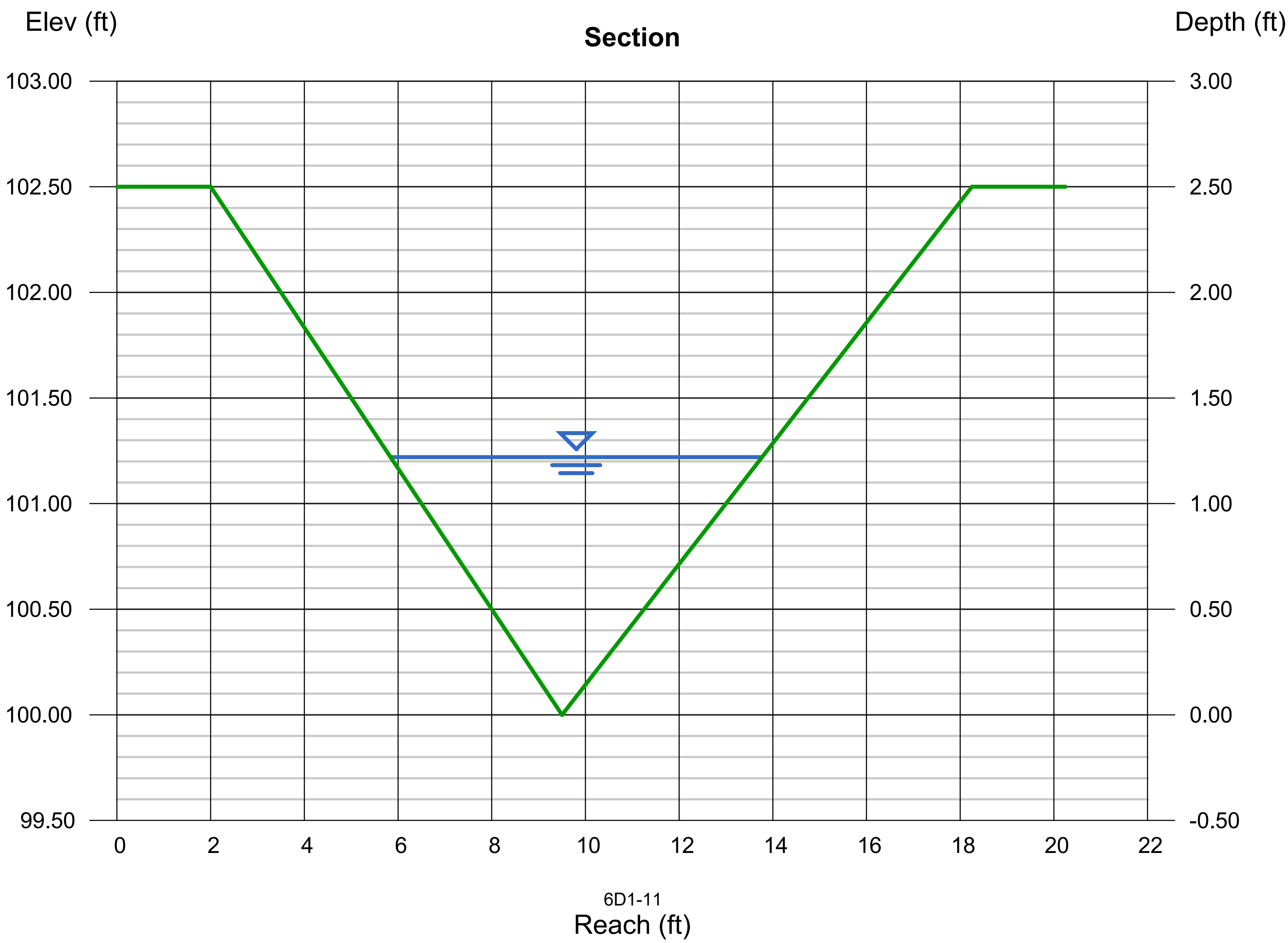


6D1-10

Channel Report

Interceptor Channel - 5

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.50	Depth (ft)	= 1.22
Total Depth (ft)	= 2.50	Q (cfs)	= 18.40
		Area (sqft)	= 4.84
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.80
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.30
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.15
		Top Width (ft)	= 7.93
Calculations		EGL (ft)	= 1.44
Compute by:	Known Q		
Known Q (cfs)	= 18.40		



INTERMEDIATE COVER
DOWNCHUTE FLOW ANALYSIS

Required: Calculate the flow velocity and flow depth for sizing downchutes installed on the intermediate cover.

Method:
1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the greatest downchute contributing drainage sub-basin using the Rational Method.
2. Use a Manning's "n" associated with gabion-lined channels and runoff coefficient "C" for grass slopes.
3. Using the specified downchute geometry, determine flow velocity and flow depth using HYDROCALC program.

Solution: **Rational Method Calculations for Greatest Downchute Contributing Area**

Drainage Area [1]	Runoff Coef. C[3]	Rainfall Int. I, (in/hr)[2]	Area (acres)	Peak Discharge (cfs)
ID-1	**0.44**	**9.89**	**19.0**	**82.6**

Downchute Configuration [4]

Bottom Width	4
Left Sideslopes (xH:1V)	4
Right Sideslopes (xH:1V)	4
Bottom Slope (ft/ft)	0.333
Manning's "n"	0.035
Flow Depth	0.75
Peak Velocity (fps)	15.73
Peak Discharge Rate (cfs)	82.6

Conclusion: From above calculations, the downchute design provided on Attachment 6C is adequate for downchutes installed on intermediate cover. Therefore, downchutes on intermediate cover will be constructed with a minimum 4-foot wide base, 4H:1V sideslopes, and minimum total depth of 1.5 feet. Specifications for the installation of downchutes on intermediate cover are described in Attachment 6, Appendix 2, Section 5.1.1.

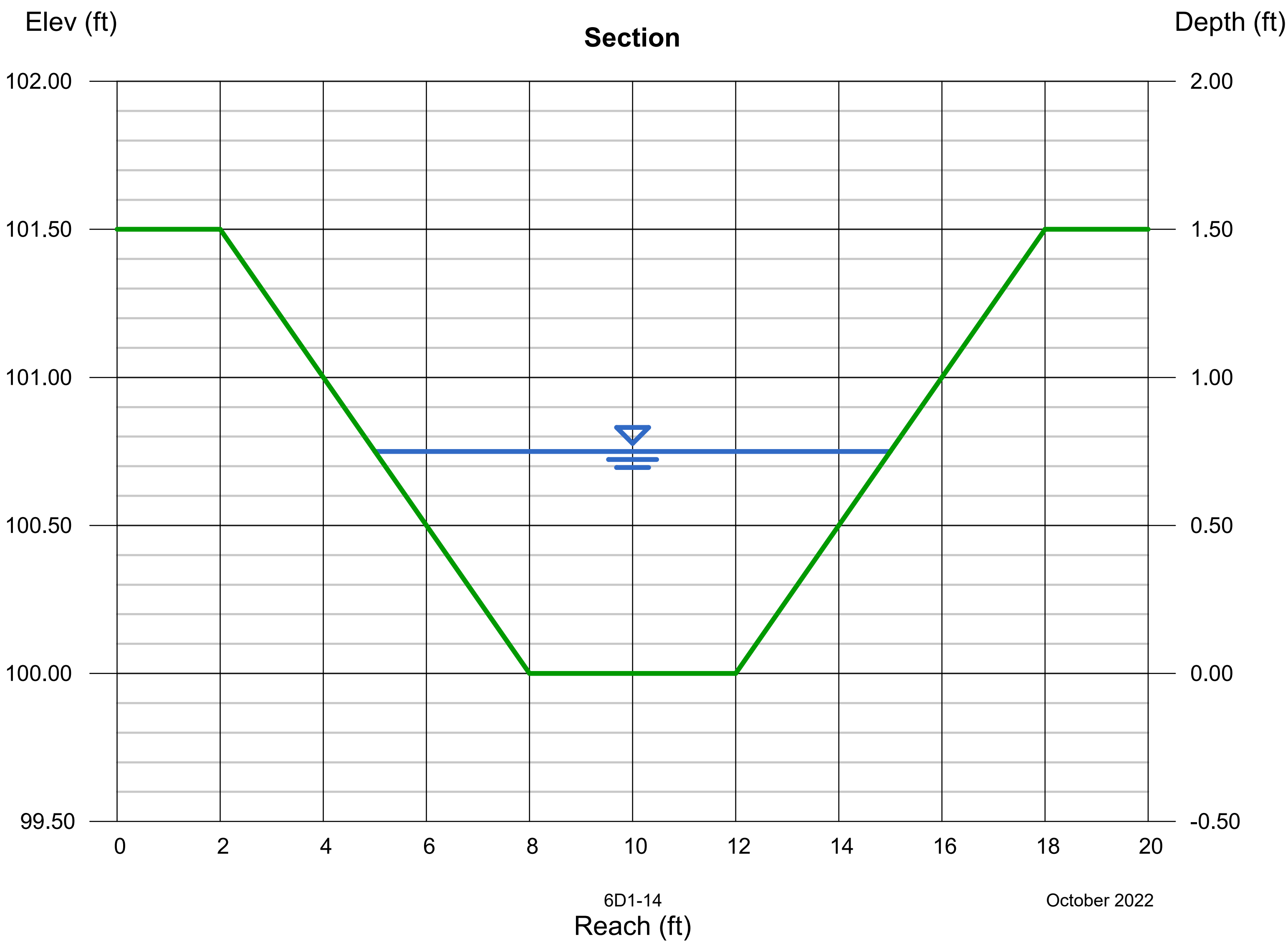
Notes:
1. This calculation is representative of the largest contributing sub-basin for a downchute on intermediate cover, as depicted on Attachment 6D1A.
2. Rainfall Intensity (I) calculated for t_c = 10 min using the same equation on page 6D1-3.
3. Manning's "n" is for riprap or gabion lined channels. A runoff coeficient of 0.44 since a majority of the sub-basin is comprised of landfill topslopes (see Appendix 4, page 4-6).
4. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Sep 23 2022

Intermediate Downchute - 1

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.75
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 82.60
Total Depth (ft)	= 1.50	Area (sqft)	= 5.25
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 15.73
Slope (%)	= 33.33	Wetted Perim (ft)	= 10.18
N-Value	= 0.035	Crit Depth, Yc (ft)	= 1.50
		Top Width (ft)	= 10.00
Calculations		EGL (ft)	= 4.60
Compute by:	Known Q		
Known Q (cfs)	= 82.60		



MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - DOWNCHUTE FLOW ANALYSIS

Required: Calculate the flow velocity and flow depth for sizing downchutes installed on the intermediate cover.

Method:
1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the greatest downchute contributing drainage sub-basin using the Rational Method.
2. Use a Manning's "n" associated with gabion-lined channels and runoff coefficient "C" for grass slopes.
3. Using the specified downchute geometry, determine flow velocity and flow depth using HYDROCALC program.

Solution: **Rational Method Calculations for Greatest Downchute Contributing Area**

Drainage Area [1]	Runoff Coef. C[3]	Rainfall Int. I, (in/hr)[2]	Area (acres)	Peak Discharge (cfs)
ID-1	0.44	9.89	19.0	82.6

Downchute Configuration [4]

Bottom Width	4
Left Sideslopes (xH:1V)	4
Right Sideslopes (xH:1V)	4
Bottom Slope (ft/ft)	0.333
Manning's "n"	0.028
Flow Depth	0.67
Peak Velocity (fps)	18.46
Peak Discharge Rate (cfs)	82.6

Conclusion:

From above calculations, the downchute design provided on Attachment 6C is adequate for downchutes installed on intermediate cover. Additionally, the peak velocity is less than the manudacturer's maximum allowable velocity for TRM, as provided in Appendix 4, page 4-17. Therefore, downchutes on intermediate cover will be constructed with a minimum 4-foot wide base, 4H:1V sideslopes, and minimum total depth of 1.5 feet. Specifications for the installation of downchutes on intermediate cover are described in Attachment 6, Appendix 2, Section 5.1.1.

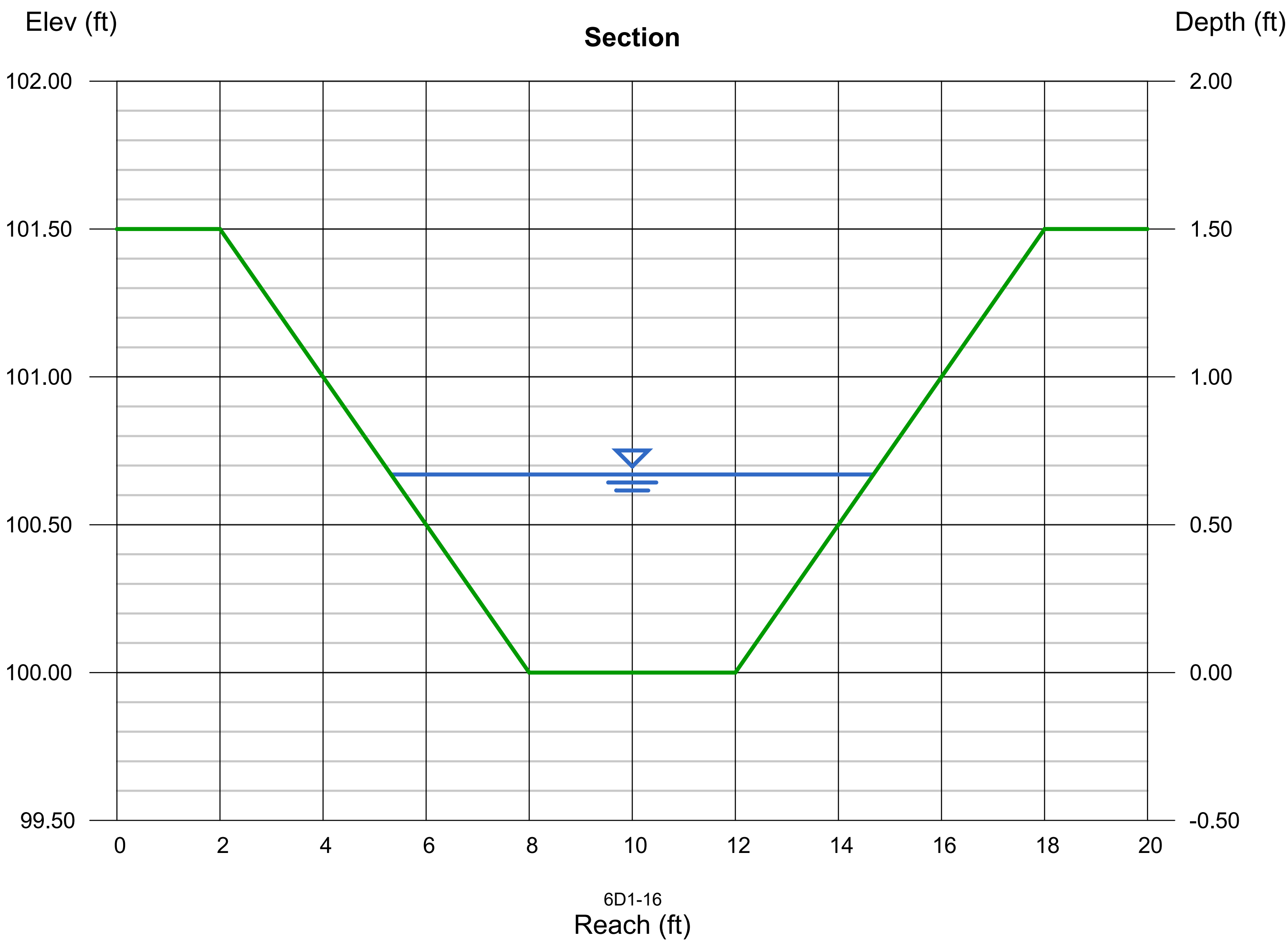
Notes:
1. This calculation is representative of the largest contributing sub-basin for a downchute on intermediate cover, as depicted on Attachment 6D1A.
2. Rainfall Intensity (I) calculated for t_c = 10 min using the same equation on page 6D1-3.
3. Manning's "n" is for TRM-lined channels (see Appendix 4, Page 4-17). A runoff coeficient of 0.44 since a majority of the sub-basin is comprised of landfill topslopes (see Appendix 4, page 4-6).

4. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).

Channel Report

Intermediate Downchute - 1 (TRM)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.67
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 82.60
Total Depth (ft)	= 1.50	Area (sqft)	= 4.48
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 18.46
Slope (%)	= 33.33	Wetted Perim (ft)	= 9.52
N-Value	= 0.028	Crit Depth, Yc (ft)	= 1.50
		Top Width (ft)	= 9.36
Calculations		EGL (ft)	= 5.97
Compute by:	Known Q		
Known Q (cfs)	= 82.60		



FINAL COVER
DOWNCHUTE FLOW ANALYSIS

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER - DOWNCHUTE FLOW ANALYSIS

Required: Calculate the flow velocity and flow depth for sizing downchutes installed on the final cover.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the greatest downchute contributing drainage sub-basin using the Rational Method.
2. Use a Manning's "n" associated with gabion-lined channels and runoff coefficient "C" for grass slopes.
3. Using the specified downchute geometry, determine flow velocity and flow depth using HYDROCALC program.

Solution: **Rational Method Calculations for Greatest Downchute Contributing Area**

Drainage Area [1]	Runoff Coef. C[3]	Rainfall Int. I, (in/hr)[2]	Area (acres)	Peak Discharge (cfs)
D-1	**0.44**	**9.89**	**23.3**	**101.3**

Downchute Configuration [4]

Bottom Width	4
Left Sideslopes (xH:1V)	4
Right Sideslopes (xH:1V)	4
Bottom Slope (ft/ft)	0.333
Manning's "n"	0.035
Flow Depth	0.83
Peak Velocity (fps)	16.66
Peak Discharge Rate (cfs)	101.3

Conclusion: From above calculations, the downchute design provided on Attachment 6C is adequate for downchutes installed on final cover. Therefore, downchutes on final cover will be constructed with a minimum 4-foot wide base, 4H:1V sideslopes, and minimum total depth of 1.5 feet. Specifications for the installation of downchutes on intermediate cover are described in Attachment 6, Appendix 2, Section 5.1.1.

Notes:

1. This calculation is representative of the largest contributing sub-basin for a downchute on final cover, as depicted on Attachment 6D1C.
2. Rainfall Intensity (I) calculated for t_c = 10 min using the same equation on page 6D1-3.
3. Manning's "n" is for riprap or gabion lined channels. A runoff coeficient of 0.44 since a majority of the sub-basin is comprised of landfill topslopes (see Appendix 4, page 4-6).

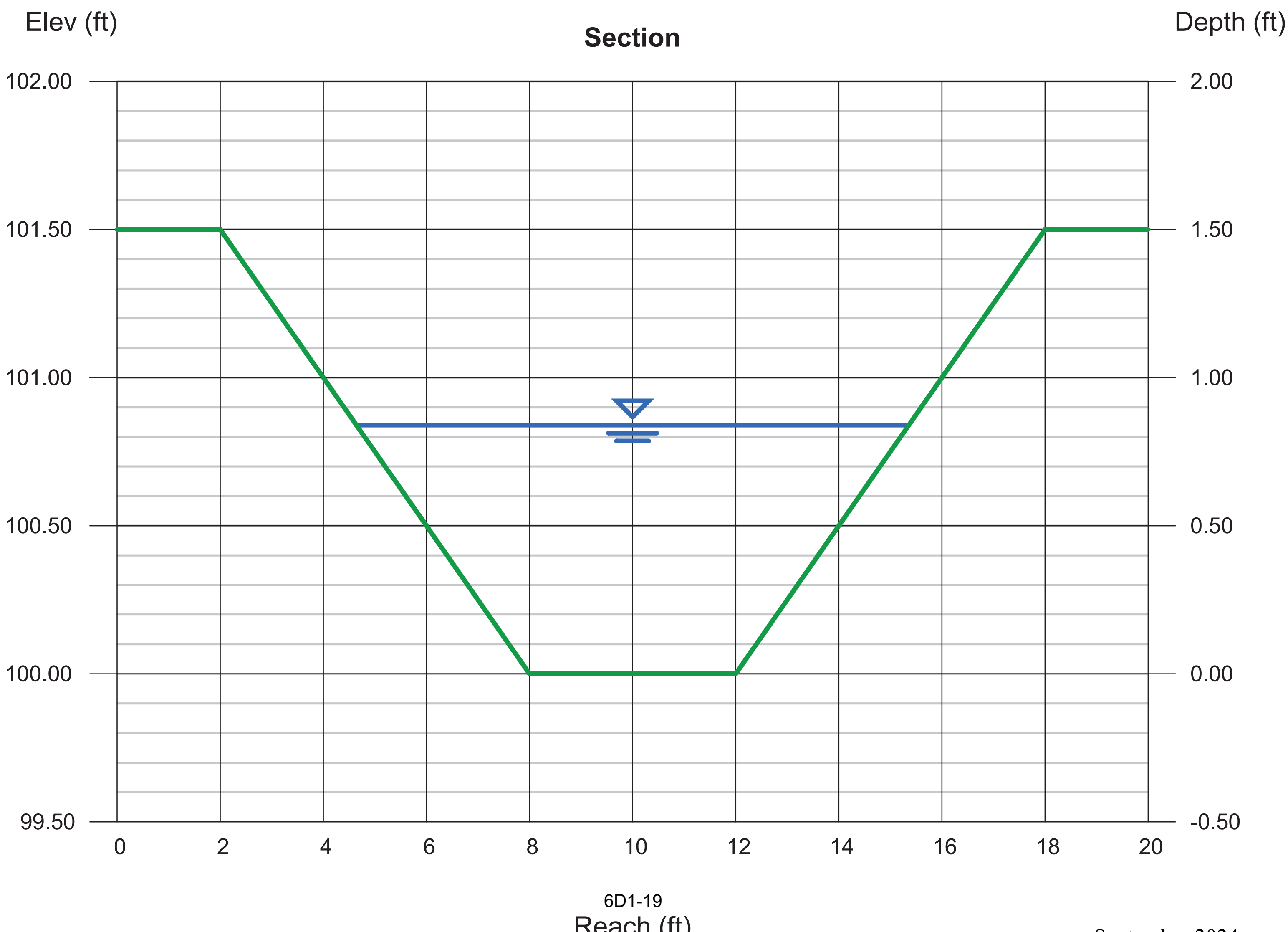
4. Calculations were performed using the HYDROCALC program developed by Dodson and Associates (Version 1.3, 1986).

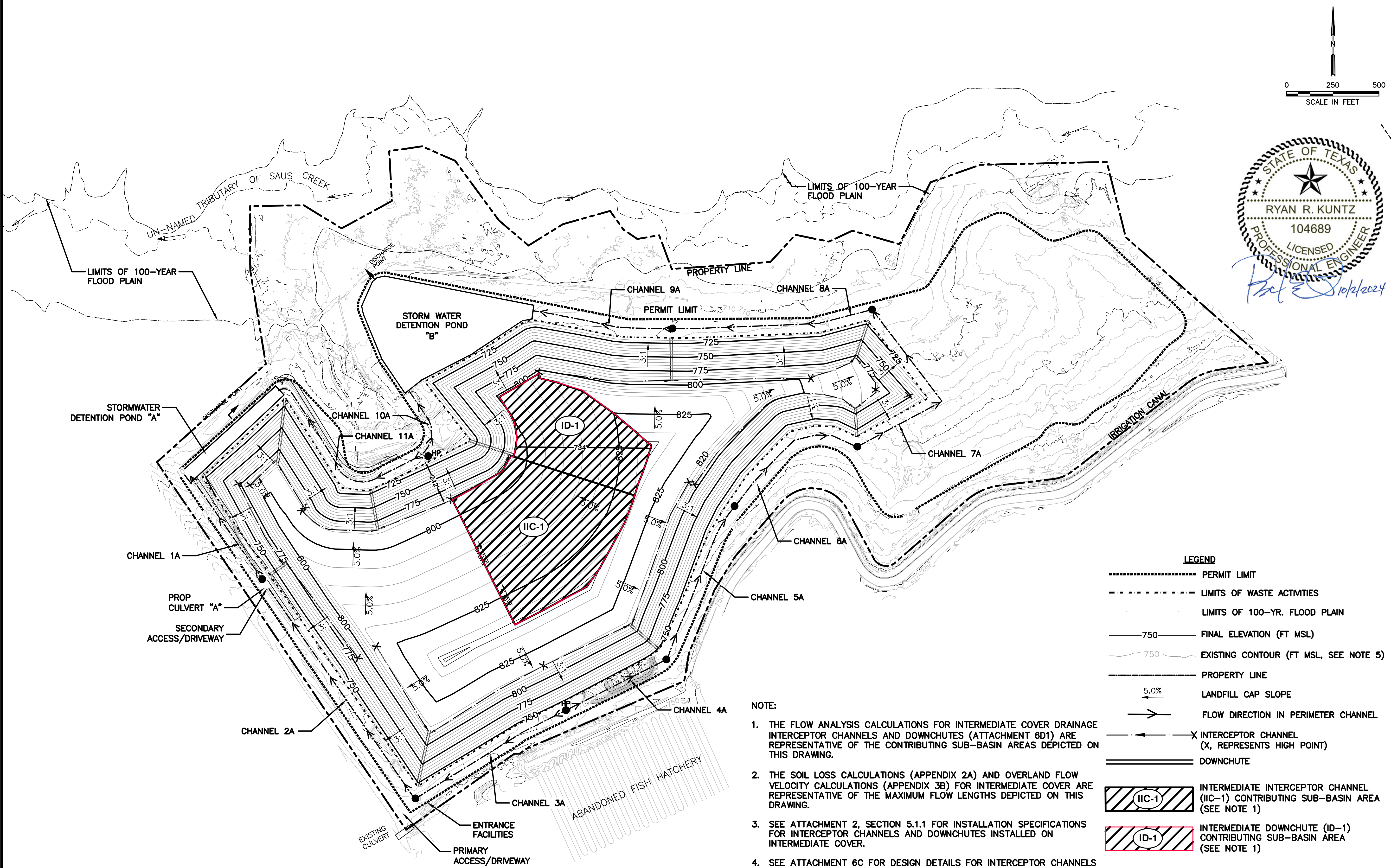
Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Sep 23 2022

Downchute - 1

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.84
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 101.30
Total Depth (ft)	= 1.50	Area (sqft)	= 6.18
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 16.39
Slope (%)	= 33.33	Wetted Perim (ft)	= 10.93
N-Value	= 0.035	Crit Depth, Yc (ft)	= 1.50
		Top Width (ft)	= 10.72
Calculations		EGL (ft)	= 5.01
Compute by:	Known Q		
Known Q (cfs)	= 101.30		





NOTE:

1. THE FLOW ANALYSIS CALCULATIONS FOR INTERMEDIATE COVER DRAINAGE INTERCEPTOR CHANNELS AND DOWNCHUTES (ATTACHMENT 6D1) ARE REPRESENTATIVE OF THE CONTRIBUTING SUB-BASIN AREAS DEPICTED ON THIS DRAWING.
2. THE SOIL LOSS CALCULATIONS (APPENDIX 2A) AND OVERLAND FLOW VELOCITY CALCULATIONS (APPENDIX 3B) FOR INTERMEDIATE COVER ARE REPRESENTATIVE OF THE MAXIMUM FLOW LENGTHS DEPICTED ON THIS DRAWING.
3. SEE ATTACHMENT 2, SECTION 5.1.1 FOR INSTALLATION SPECIFICATIONS FOR INTERCEPTOR CHANNELS AND DOWNCHUTES INSTALLED ON INTERMEDIATE COVER.
4. SEE ATTACHMENT 6C FOR DESIGN DETAILS FOR INTERCEPTOR CHANNELS AND DOWNCHUTES INSTALLED ON INTERMEDIATE COVER.
5. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.

LEGEND

	PERMIT LIMIT
	LIMITS OF WASTE ACTIVITIES
	LIMITS OF 100-YR. FLOOD PLAIN
750	FINAL ELEVATION (FT MSL)
750	EXISTING CONTOUR (FT MSL, SEE NOTE 5)
	PROPERTY LINE
5.0%	LANDFILL CAP SLOPE
	FLOW DIRECTION IN PERIMETER CHANNEL
X	INTERCEPTOR CHANNEL (X, REPRESENTS HIGH POINT)
	DOWNCHUTE
IIC-1	INTERMEDIATE INTERCEPTOR CHANNEL (IIC-1) CONTRIBUTING SUB-BASIN AREA (SEE NOTE 1)
ID-1	INTERMEDIATE DOWNCHUTE (ID-1) CONTRIBUTING SUB-BASIN AREA (SEE NOTE 1)

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED PROFESSIONAL ENGINEER
10/2/2024

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED LIMIT OF WASTE, FINAL COVER GRADING, AND FINAL DRAINAGE CONDITIONS	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: INTERMEDIATE COVER SUB-BASINS

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

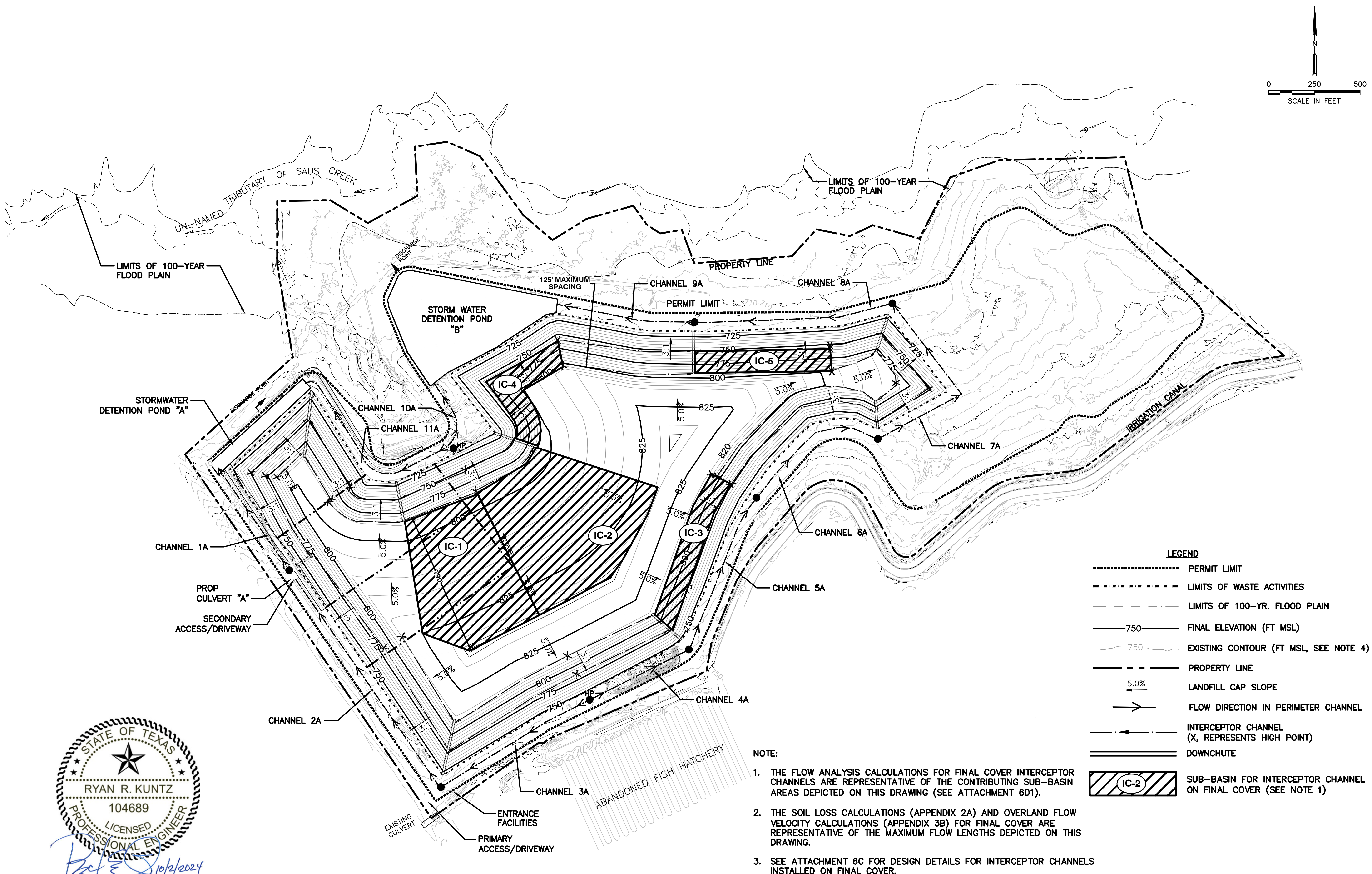
PROJ. NO. 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: DRAINAGE DESIGN CHECK (BGC)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 6D1A



LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- 750 — FINAL ELEVATION (FT MSL)
- 750 — EXISTING CONTOUR (FT MSL, SEE NOTE 4)
- PROPERTY LINE
- 5.0% — LANDFILL CAP SLOPE
- FLOW DIRECTION IN PERIMETER CHANNEL
- INTERCEPTOR CHANNEL (X, REPRESENTS HIGH POINT)
- DOWNCHUTE
- IC-2 — SUB-BASIN FOR INTERCEPTOR CHANNEL ON FINAL COVER (SEE NOTE 1)

NOTE:

1. THE FLOW ANALYSIS CALCULATIONS FOR FINAL COVER INTERCEPTOR CHANNELS ARE REPRESENTATIVE OF THE CONTRIBUTING SUB-BASIN AREAS DEPICTED ON THIS DRAWING (SEE ATTACHMENT 6D1).
2. THE SOIL LOSS CALCULATIONS (APPENDIX 2A) AND OVERLAND FLOW VELOCITY CALCULATIONS (APPENDIX 3B) FOR FINAL COVER ARE REPRESENTATIVE OF THE MAXIMUM FLOW LENGTHS DEPICTED ON THIS DRAWING.
3. SEE ATTACHMENT 6C FOR DESIGN DETAILS FOR INTERCEPTOR CHANNELS INSTALLED ON FINAL COVER.
4. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED LIMIT OF WASTE, FINAL COVER GRADING, AND FINAL DRAINAGE CONDITIONS	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: FINAL COVER - INTERCEPTOR CHANNEL SUB-BASINS

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

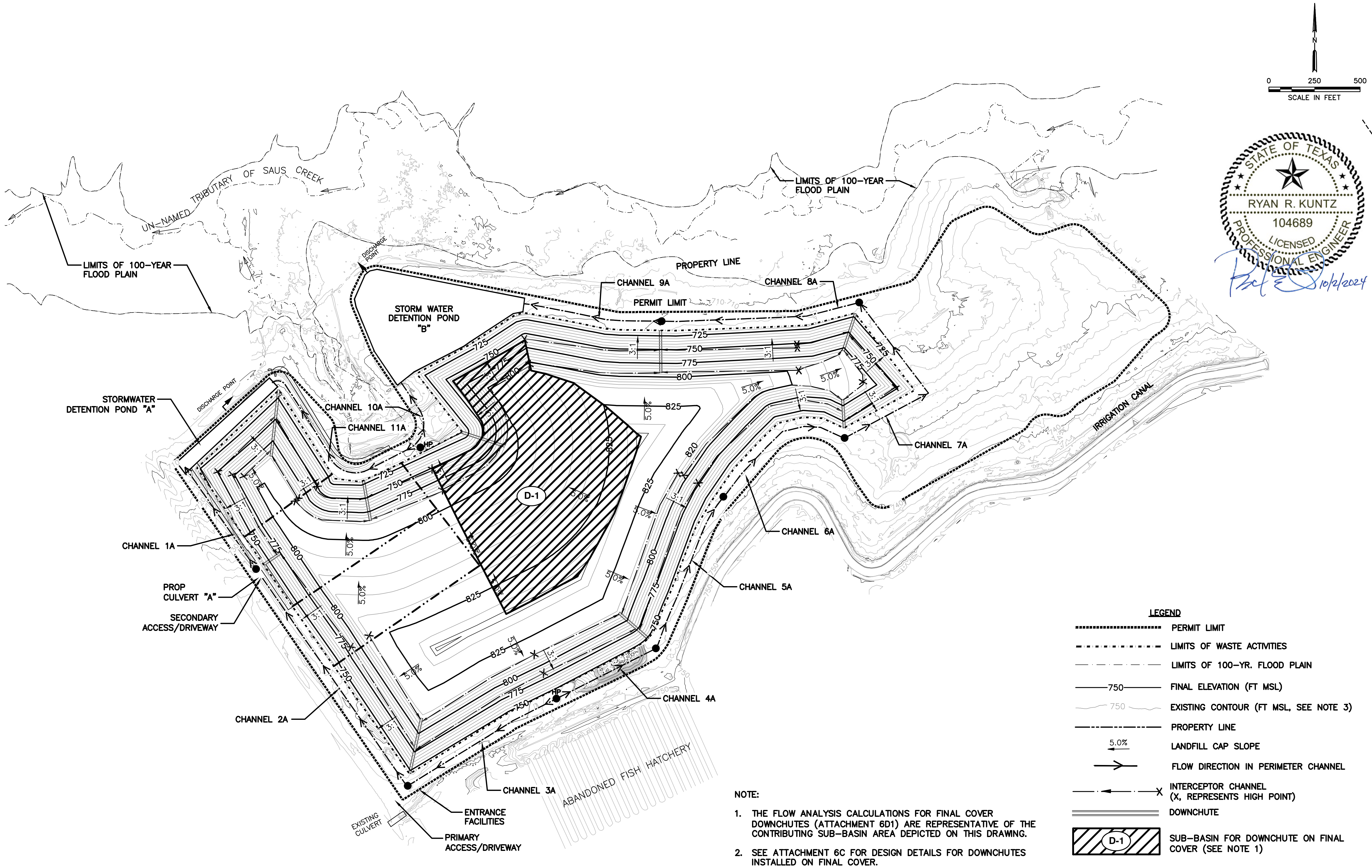
CADD FILE: DRAINAGE DESIGN CHECK (BGC)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. **6D1B**

9/30/2024 5:03 PM G:\MAVERICK COUNTY LANDFILL\16223092.00 T9 - Final Grade Contours & Drainage PMOD\DRAINAGE DESIGN CHECK (BGC)



NOTE:

1. THE FLOW ANALYSIS CALCULATIONS FOR FINAL COVER DOWNCHUTES (ATTACHMENT 6D1) ARE REPRESENTATIVE OF THE CONTRIBUTING SUB-BASIN AREA DEPICTED ON THIS DRAWING.
2. SEE ATTACHMENT 6C FOR DESIGN DETAILS FOR DOWNCHUTES INSTALLED ON FINAL COVER.
3. EXISTING GRADES ARE BASED ON A TOPOGRAPHIC SURVEY PERFORMED BY DAS ON AUGUST 16, 2023.

LEGEND

- PERMIT LIMIT
- LIMITS OF WASTE ACTIVITIES
- LIMITS OF 100-YR. FLOOD PLAIN
- 750 FINAL ELEVATION (FT MSL)
- 750 EXISTING CONTOUR (FT MSL, SEE NOTE 3)
- PROPERTY LINE
- 5.0% LANDFILL CAP SLOPE
- FLOW DIRECTION IN PERIMETER CHANNEL
- INTERCEPTOR CHANNEL (X, REPRESENTS HIGH POINT)
- DOWNCHUTE
- D-1 SUB-BASIN FOR DOWNCHUTE ON FINAL COVER (SEE NOTE 1)

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	9/24	REVISED LIMIT OF WASTE, FINAL COVER GRADING, AND FINAL DRAINAGE CONDITIONS	

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING: FINAL COVER - DOWNCHUTE SUB-BASINS

PROJECT: MAVERICK COUNTY MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY SOLID WASTE AUTHORITY 16179 FM 1021 EL INDIO, TEXAS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO.: 16223092.00 | DSN. BY: SS | DWN. BY: DNA | CHK. BY: AGA | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: DRAINAGE DESIGN CHECK (BGC)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT NO. 6D1C

9/30/2024 5:03 PM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\DRAINAGE DESIGN CHECK (BGC)

Part III

Attachment 6

Attachment 6D2

DRAINAGE STRUCTURES PERIMETER CHANNEL CALCULATIONS

Channel Name	Receiving Basin	Channel Length (ft)	Bottom Slope (ft/ft)	Bottom Width (ft)	Sideslope (XH:1V)	25-yr, 24-hr storm [2]			100-yr, 24-hr storm [2]			Design Depth (ft)	Mannings Coefficient [1]	Lining Material
						flow (cfs)	flow velocity (fps)	Flow Depth (ft)	flow (cfs)	flow velocity (fps)	Flow Depth (ft)			
1A	POND-A	728	0.0050	8	4	62.7	6.09	0.9	84.1	6.65	1.04	2.0	0.013	Concrete
2A	POND-A	1,401	0.0050	8	4	46.8	5.58	0.8	62.5	6.07	0.89	2.0	0.013	Concrete
3A	POND-A	972	0.0050	6	3	9.8	3.92	0.4	16.8	4.20	0.50	1.5	0.013	Concrete
4A	POND-B	577	0.0050	6	3	9.2	3.43	0.4	11.8	3.77	0.41	1.5	0.013	Concrete
5A	POND-B	890	0.0050	8	3	44.7	5.51	0.7	60.0	6.01	0.87	2.0	0.013	Concrete
6A	POND-B	816	0.0050	8	3	46.8	5.58	0.8	63.1	6.13	0.89	2.0	0.013	Concrete
7A	POND-B	1,147	0.0050	8	3	87.6	6.75	1.1	118.1	7.35	1.24	2.5	0.013	Concrete
8A	POND-B	1,091	0.0050	8	3	92.0	6.83	1.1	124.4	7.44	1.27	2.5	0.013	Concrete
9A	POND-B	775	0.0050	10	3	109.8	7.01	1.1	148.9	7.69	1.28	2.5	0.013	Concrete
10A	POND-B	653	0.0050	8	3	69.9	6.32	0.9	80.6	6.63	1.01	2.5	0.013	Concrete

Notes:

1.) Mannings coefficient is for concrete channels, as referenced from City of Austin's Drainage Criteria Manual, as described in Attachment 6, Appendix 1.

2.) Stormwater flows were calculated using rational method and storm intensity coefficients for 25-yr, 24-hr or 100-yr, 24-hr storms, as shown in Attachment 6B1.

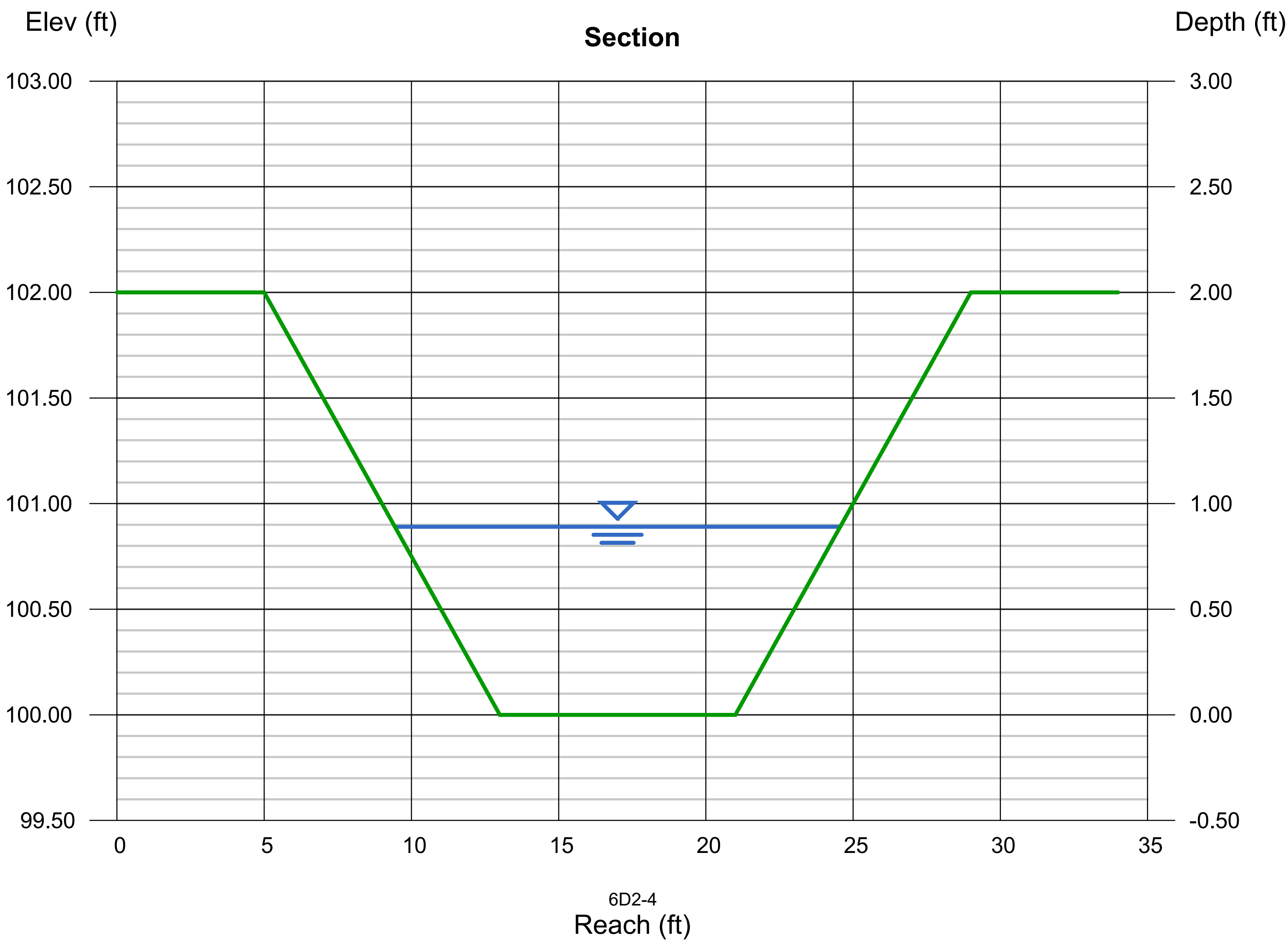
Channel Name	Receiving Basin	Channel Length (ft)	Bottom Slope (ft/ft)	Bottom Width (ft)	Sideslope (XH:1V)	25-yr, 24-hr storm [2]			100-yr, 24-hr storm [2]			Design Depth (ft)	Mannings Coefficient [1]	Lining Material
						flow (cfs)	flow velocity (fps)	Flow Depth (ft)	flow (cfs)	flow velocity (fps)	Flow Depth (ft)			
1A	POND-A	728	0.0050	8	4	62.7	6.09	0.9	84.1	6.65	1.04	2.0	0.013	Concrete
2A	POND-A	1,401	0.0050	8	4	46.8	5.58	0.8	62.5	6.07	0.89	2.0	0.013	Concrete
3A	POND-A	972	0.0050	10	3	9.8	2.02	0.4	16.8	2.42	0.59	1.5	0.027	Grass
4A	POND-B	577	0.0050	10	3	9.2	1.95	0.4	11.8	2.15	0.48	1.5	0.027	Grass
5A	POND-B	890	0.0050	10	3	44.7	3.36	1.0	60.0	3.68	1.20	2.0	0.027	Grass
6A	POND-B	816	0.0050	10	3	46.8	3.39	1.1	63.1	3.75	1.23	2.0	0.027	Grass
7A	POND-B	1,147	0.0050	10	3	87.6	4.14	1.5	118.1	4.49	1.73	2.5	0.027	Grass
8A	POND-B	1,091	0.0050	10	3	92.0	4.19	1.5	124.4	4.56	1.78	2.5	0.027	Grass
9A	POND-B	775	0.0050	10	3	109.8	4.42	1.7	148.9	4.82	1.95	2.5	0.027	Grass
10A	POND-B	653	0.0050	10	3	69.9	3.87	1.3	80.6	4.02	1.41	2.5	0.027	Grass

Notes:
1.) Mannings coefficient is for concrete or grass channels, as referenced from City of Austin's Drainage Criteria Manual, as described in Attachment 6, Appendix 1.
2.) Stormwater flows were calculated using rational method and storm intensity coefficients for 25-yr, 24-hr or 100-yr, 24-hr storms, as shown in Attachment 6B1.

Channel Report

Channel 1A 25-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 0.89
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 62.70
Total Depth (ft)	= 2.00	Area (sqft)	= 10.29
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.09
Slope (%)	= 0.50	Wetted Perim (ft)	= 15.34
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.04
		Top Width (ft)	= 15.12
Calculations		EGL (ft)	= 1.47
Compute by:	Known Q		
Known Q (cfs)	= 62.70		

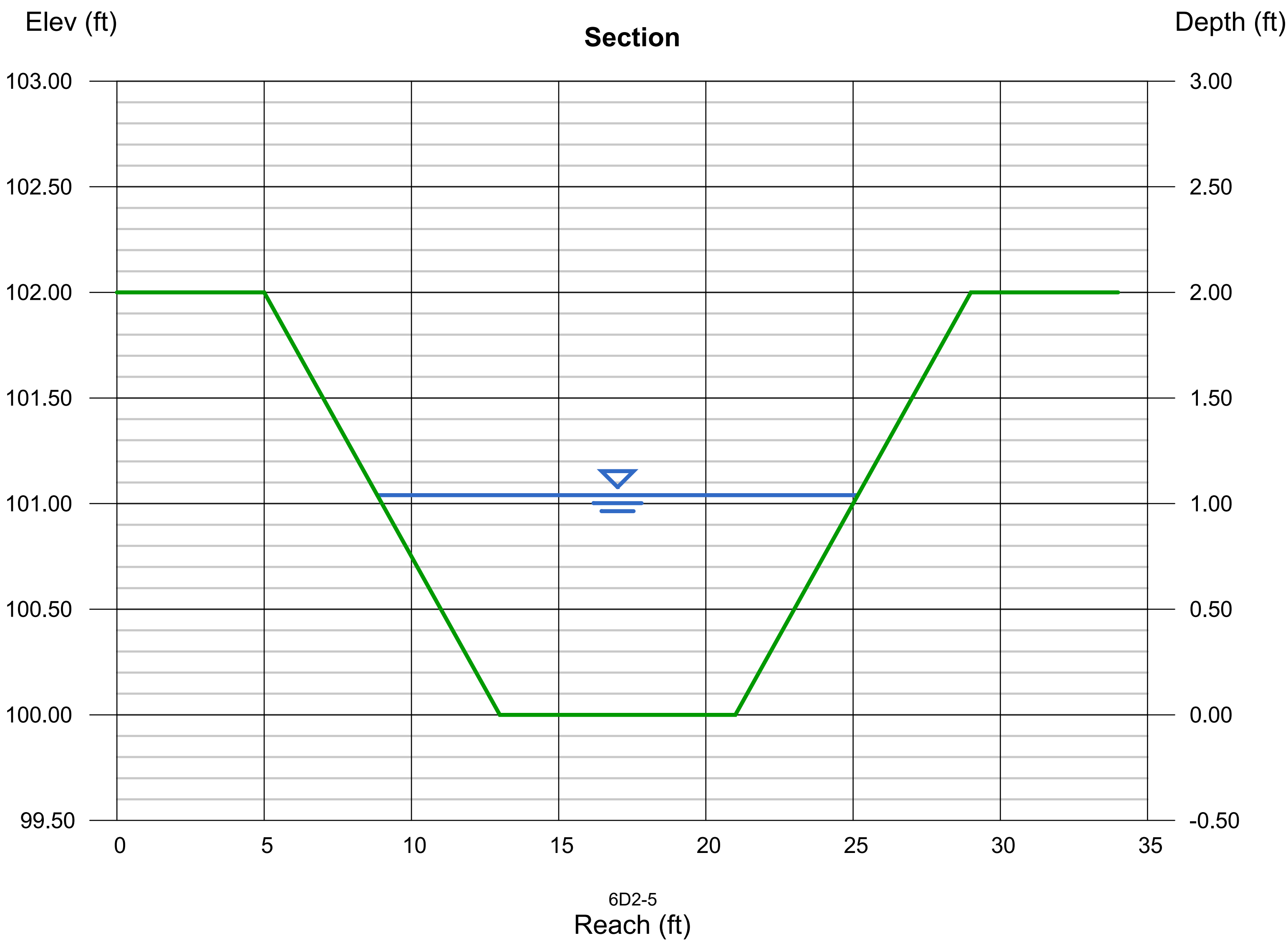


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Sunday, Oct 30 2022

Channel 1A 100-yr-24-Hour Storm

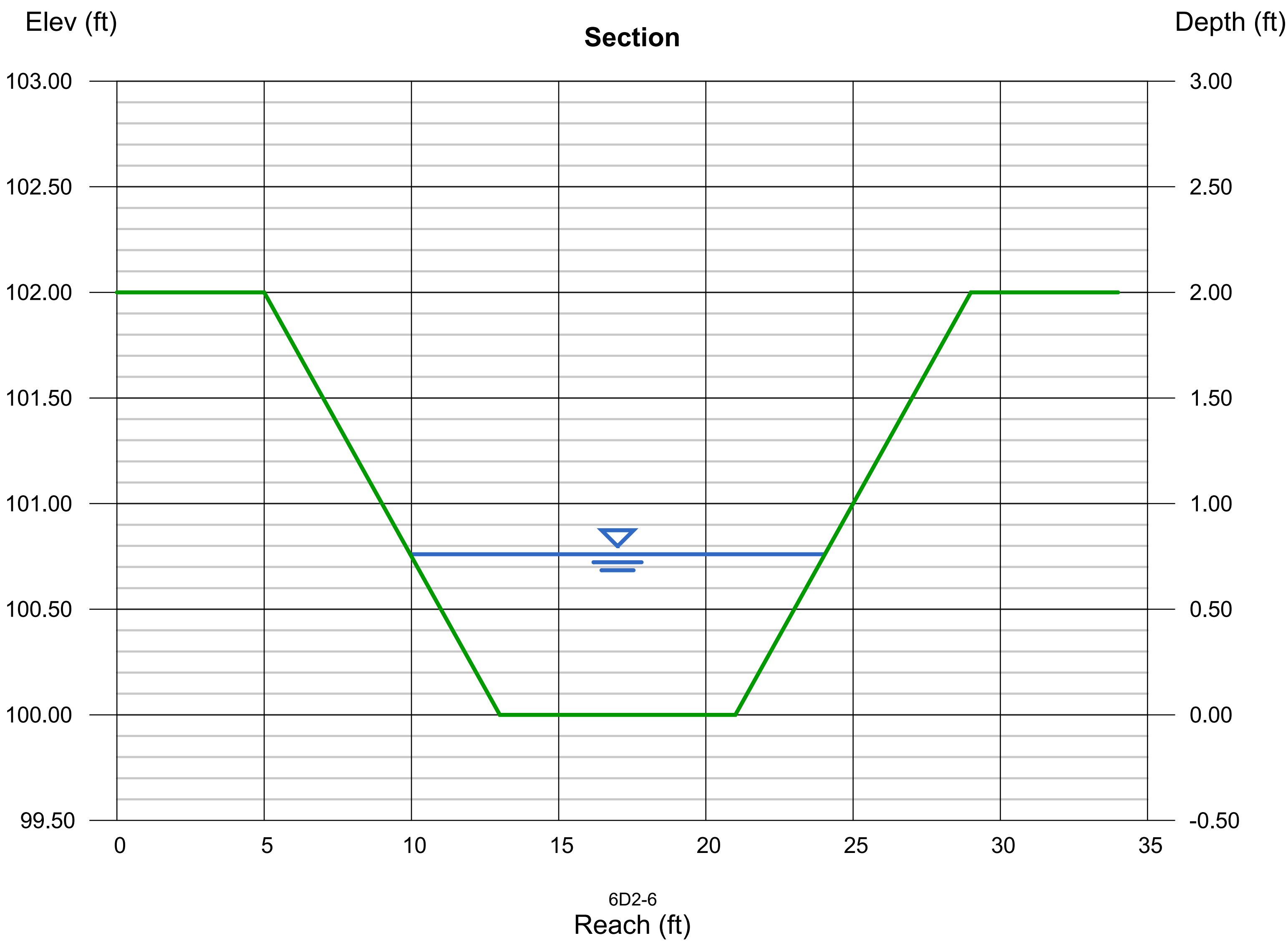
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 1.04
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 84.10
Total Depth (ft)	= 2.00	Area (sqft)	= 12.65
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.65
Slope (%)	= 0.50	Wetted Perim (ft)	= 16.58
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.23
		Top Width (ft)	= 16.32
Calculations		EGL (ft)	= 1.73
Compute by:	Known Q		
Known Q (cfs)	= 84.10		



Channel Report

Channel 2A 25-yr-24-Hour Storm

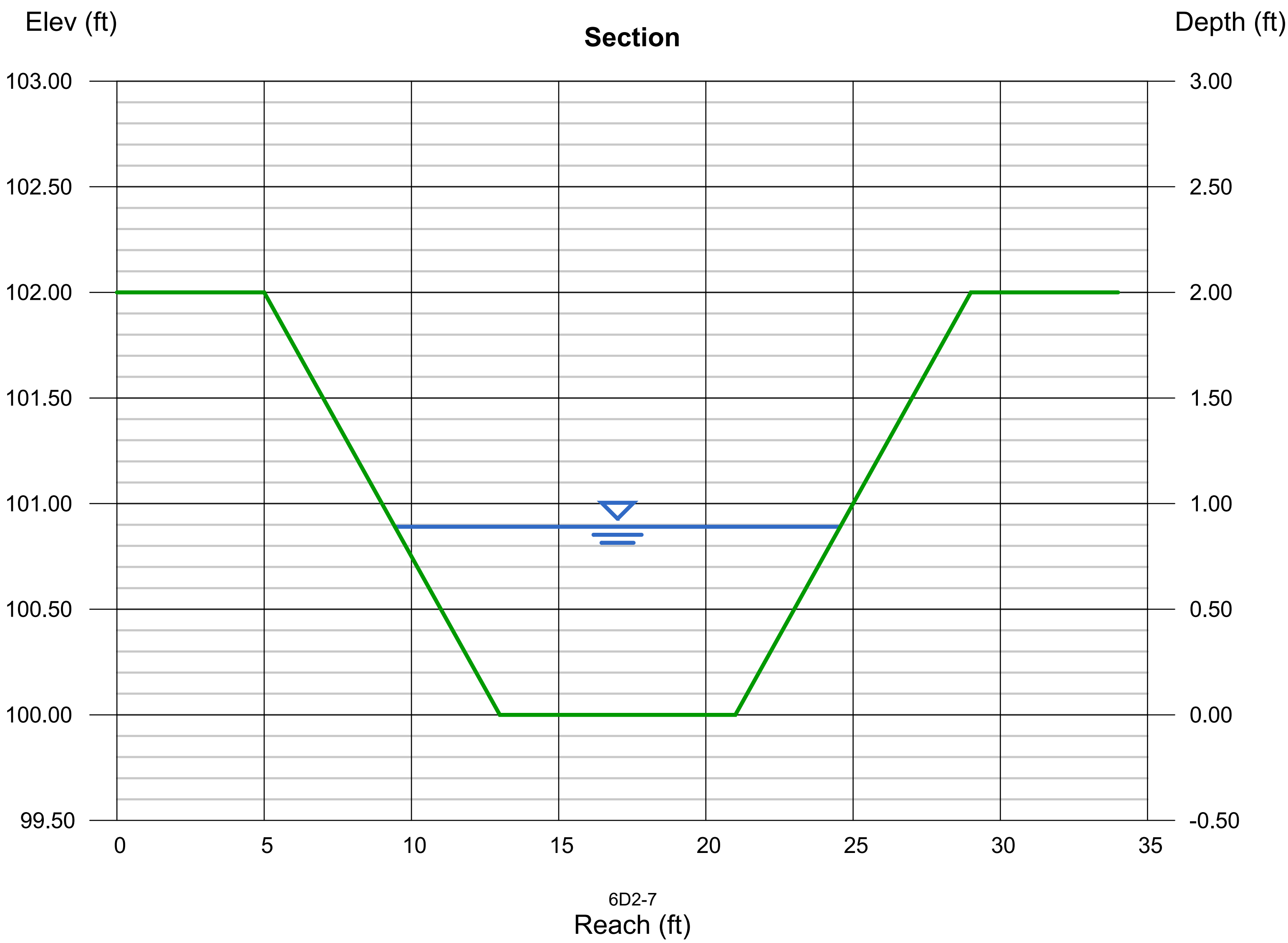
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 0.76
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 46.80
Total Depth (ft)	= 2.00	Area (sqft)	= 8.39
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 5.58
Slope (%)	= 0.50	Wetted Perim (ft)	= 14.27
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.88
		Top Width (ft)	= 14.08
Calculations		EGL (ft)	= 1.24
Compute by:	Known Q		
Known Q (cfs)	= 46.80		



Channel Report

Channel 2A 100-yr-24-Hour Storm

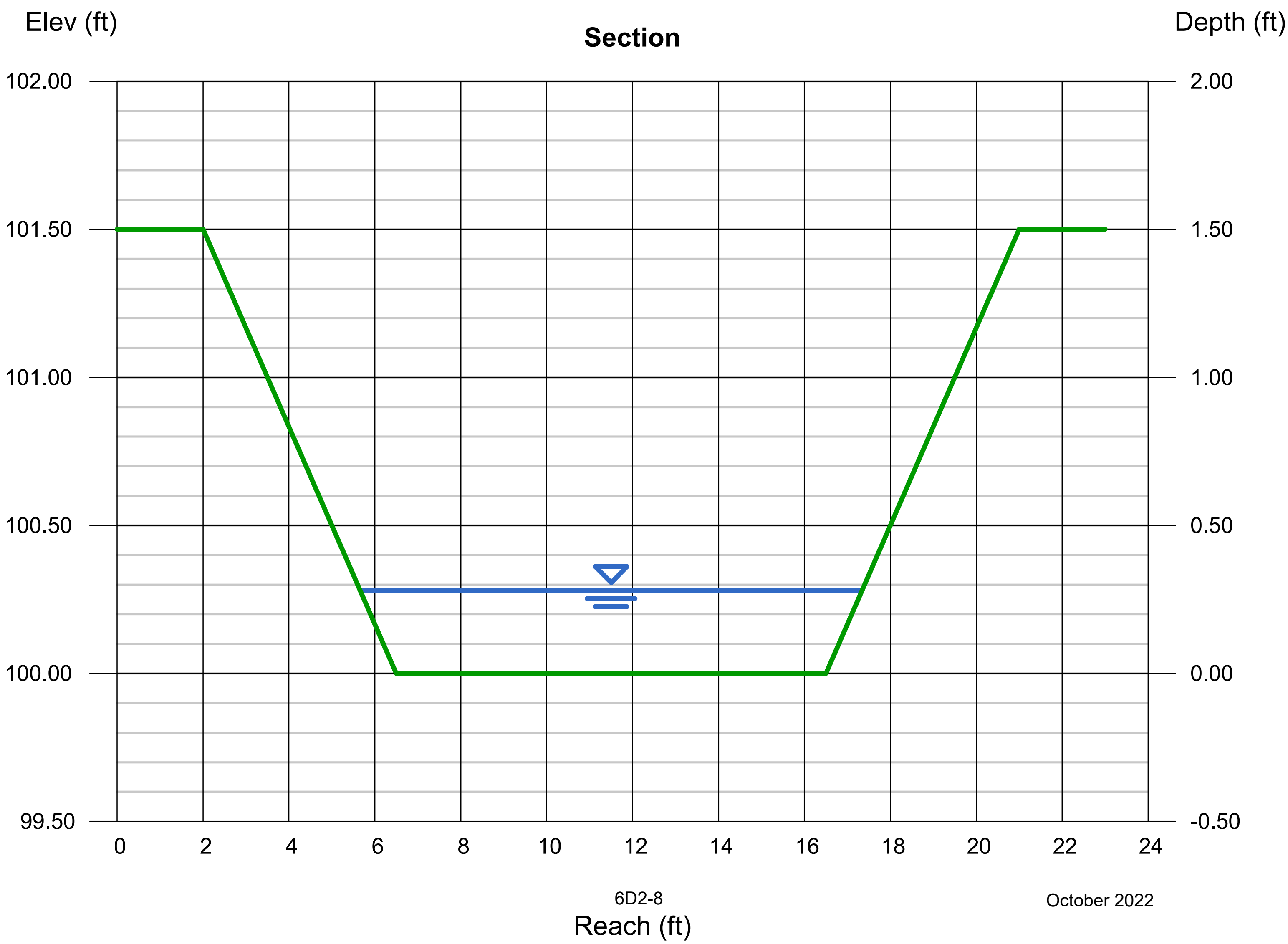
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 0.89
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 62.50
Total Depth (ft)	= 2.00	Area (sqft)	= 10.29
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.07
Slope (%)	= 0.50	Wetted Perim (ft)	= 15.34
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.04
		Top Width (ft)	= 15.12
Calculations		EGL (ft)	= 1.46
Compute by:	Known Q		
Known Q (cfs)	= 62.50		



Channel Report

Channel 3A 25-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.28
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 9.800
Total Depth (ft)	= 1.50	Area (sqft)	= 3.04
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.23
Slope (%)	= 0.50	Wetted Perim (ft)	= 11.77
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.31
		Top Width (ft)	= 11.68
Calculations		EGL (ft)	= 0.44
Compute by:	Known Q		
Known Q (cfs)	= 9.80		



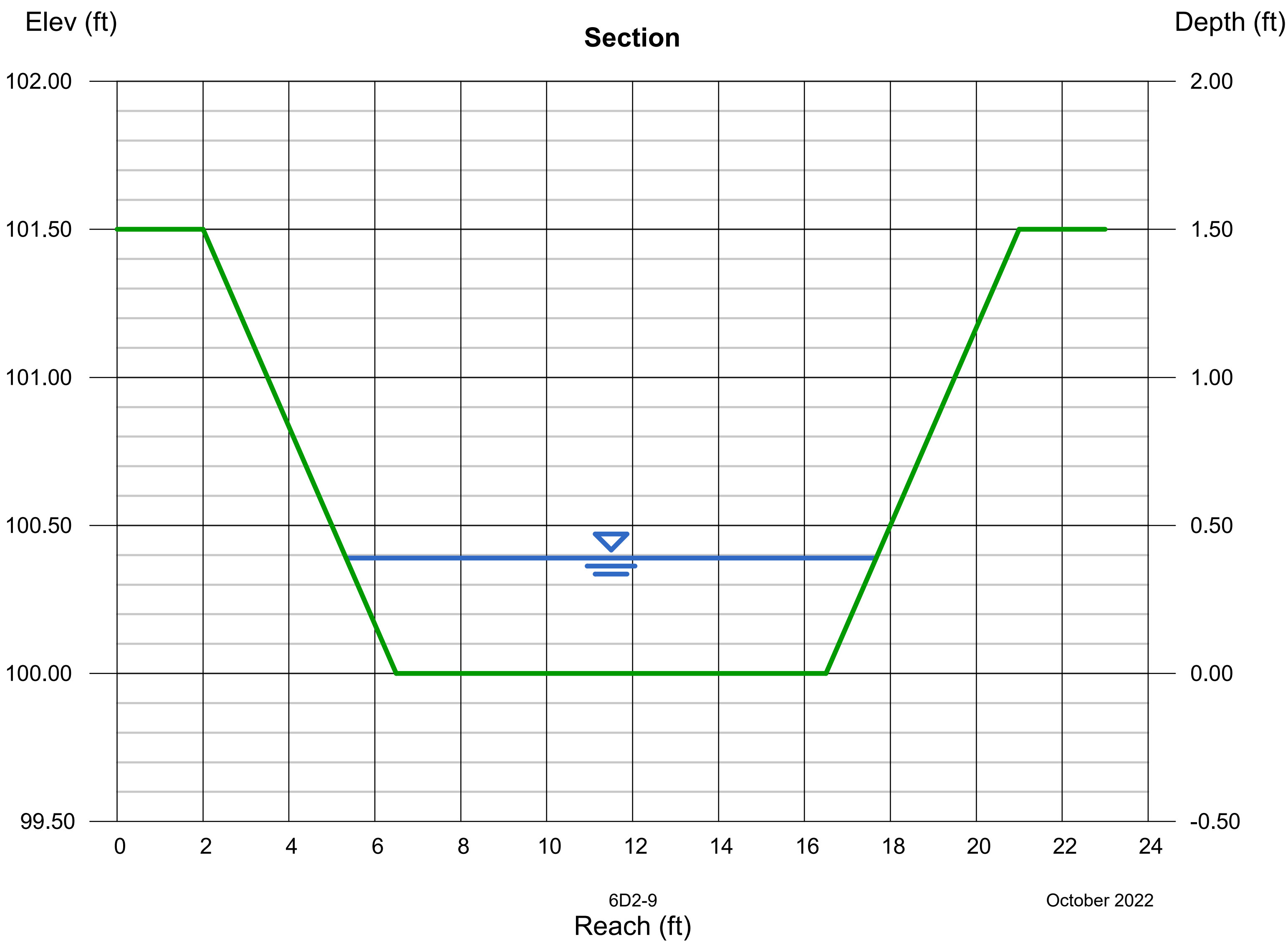
Channel Report

Channel 3A 100-yr-24-Hour Storm

Trapezoidal	
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 16.80

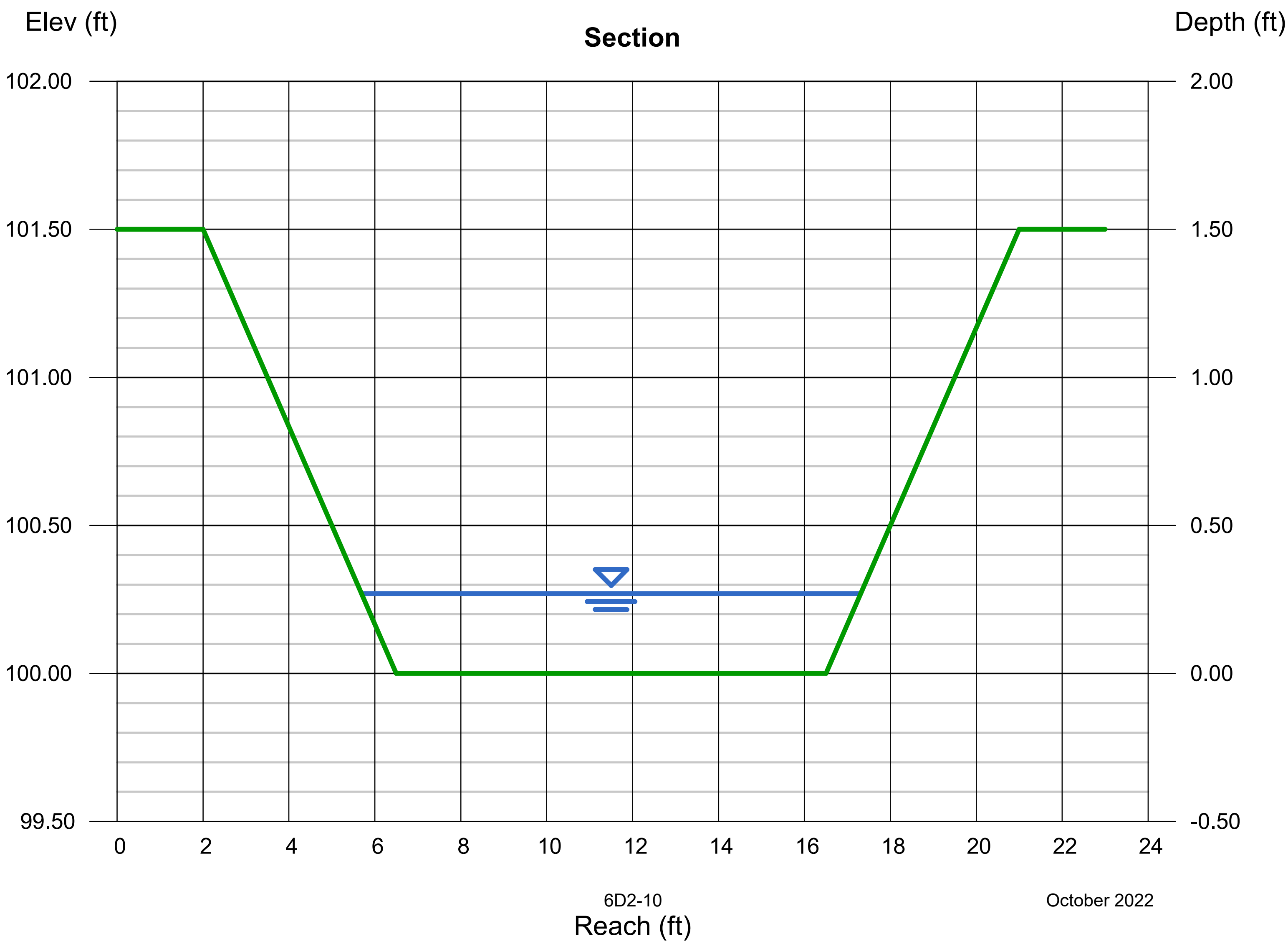
Highlighted	
Depth (ft)	= 0.39
Q (cfs)	= 16.80
Area (sqft)	= 4.36
Velocity (ft/s)	= 3.86
Wetted Perim (ft)	= 12.47
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 12.34
EGL (ft)	= 0.62



Channel Report

Channel 4A 25-yr-24-Hour Storm

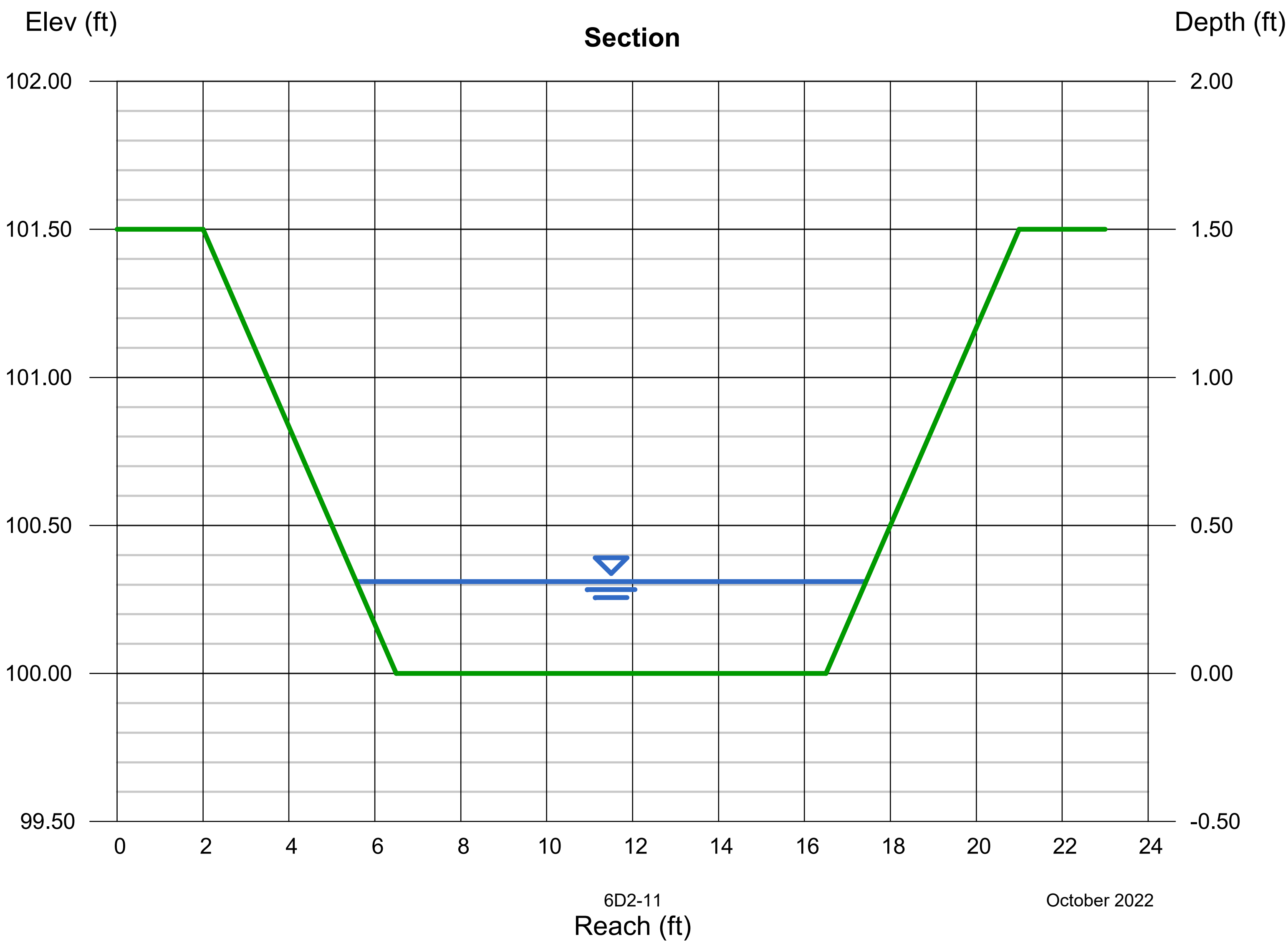
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.27
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 9.200
Total Depth (ft)	= 1.50	Area (sqft)	= 2.92
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.15
Slope (%)	= 0.50	Wetted Perim (ft)	= 11.71
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.29
		Top Width (ft)	= 11.62
Calculations		EGL (ft)	= 0.42
Compute by:	Known Q		
Known Q (cfs)	= 9.20		



Channel Report

Channel 4A 100-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.31
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 11.80
Total Depth (ft)	= 1.50	Area (sqft)	= 3.39
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.48
Slope (%)	= 0.50	Wetted Perim (ft)	= 11.96
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.34
		Top Width (ft)	= 11.86
Calculations		EGL (ft)	= 0.50
Compute by:	Known Q		
Known Q (cfs)	= 11.80		



Channel Report

Channel 5A 25-yr-24-Hour Storm

Trapezoidal

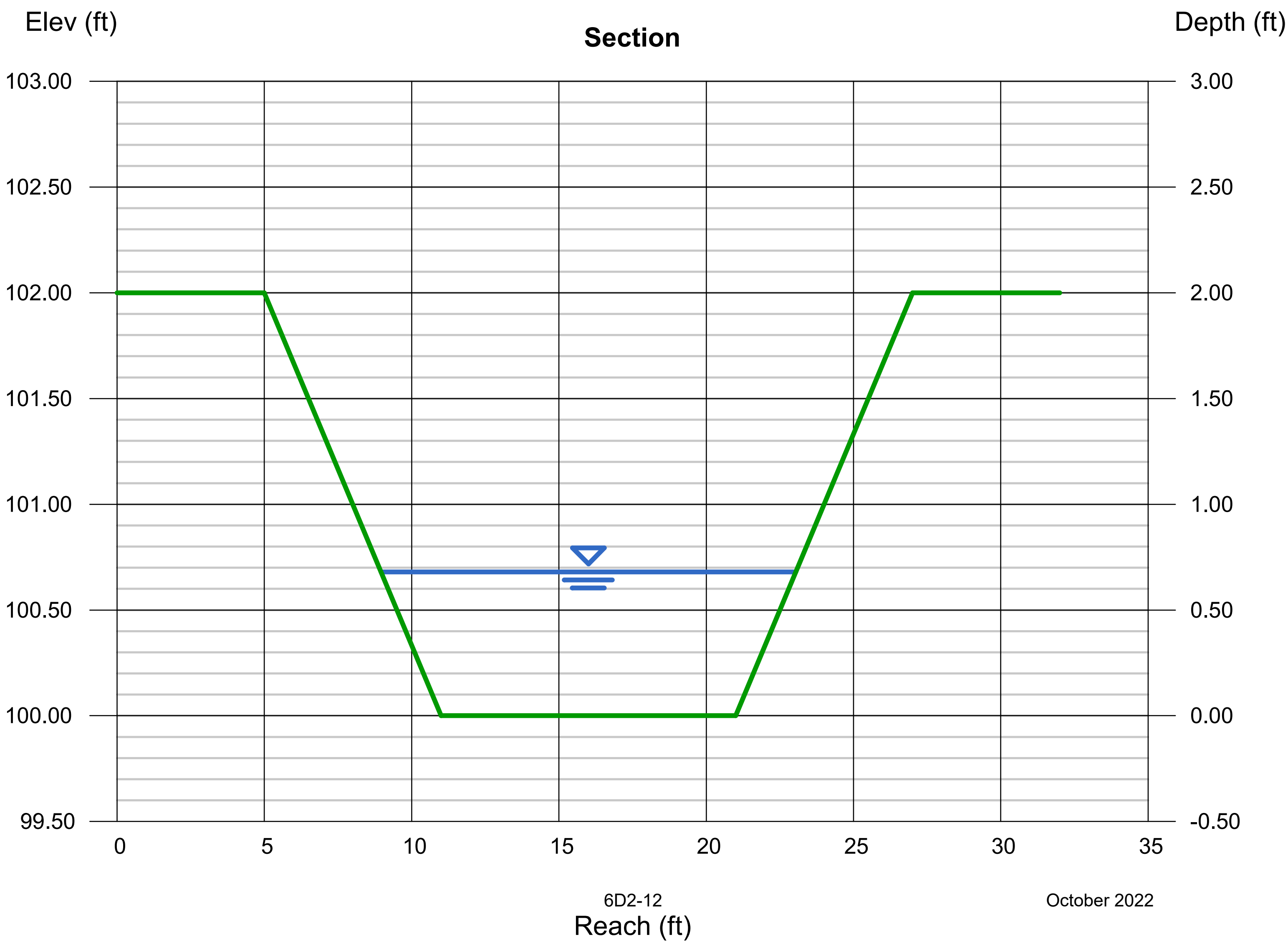
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 44.70

Highlighted

Depth (ft)	= 0.68
Q (cfs)	= 44.70
Area (sqft)	= 8.19
Velocity (ft/s)	= 5.46
Wetted Perim (ft)	= 14.30
Crit Depth, Yc (ft)	= 0.79
Top Width (ft)	= 14.08
EGL (ft)	= 1.14

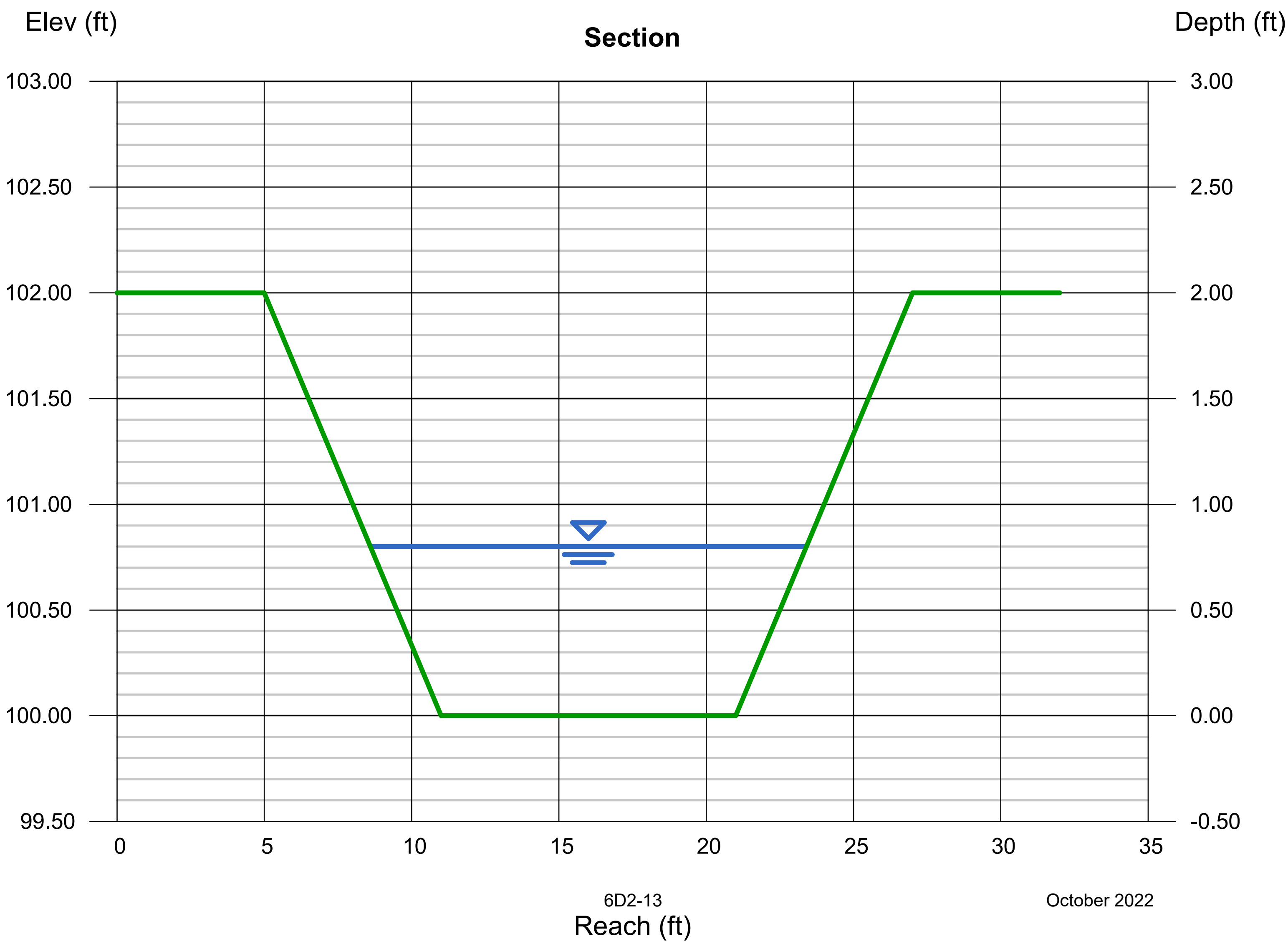


Channel Report

Channel 5A 100-yr-24-Hour Storm

Trapezoidal	
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 60.00

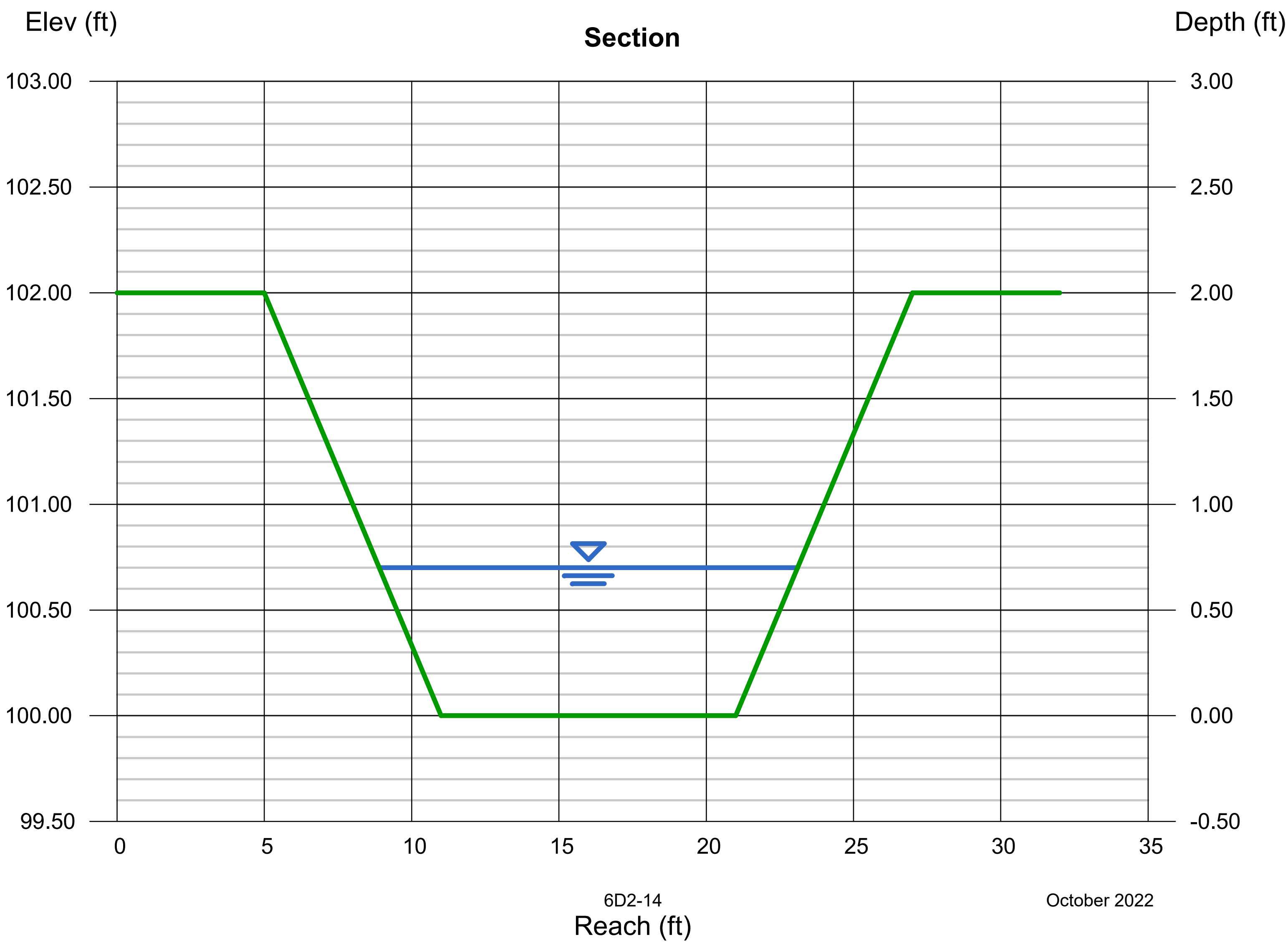
Highlighted	
Depth (ft)	= 0.80
Q (cfs)	= 60.00
Area (sqft)	= 9.92
Velocity (ft/s)	= 6.05
Wetted Perim (ft)	= 15.06
Crit Depth, Yc (ft)	= 0.95
Top Width (ft)	= 14.80
EGL (ft)	= 1.37



Channel Report

Channel 6A 25-yr-24-Hour Storm

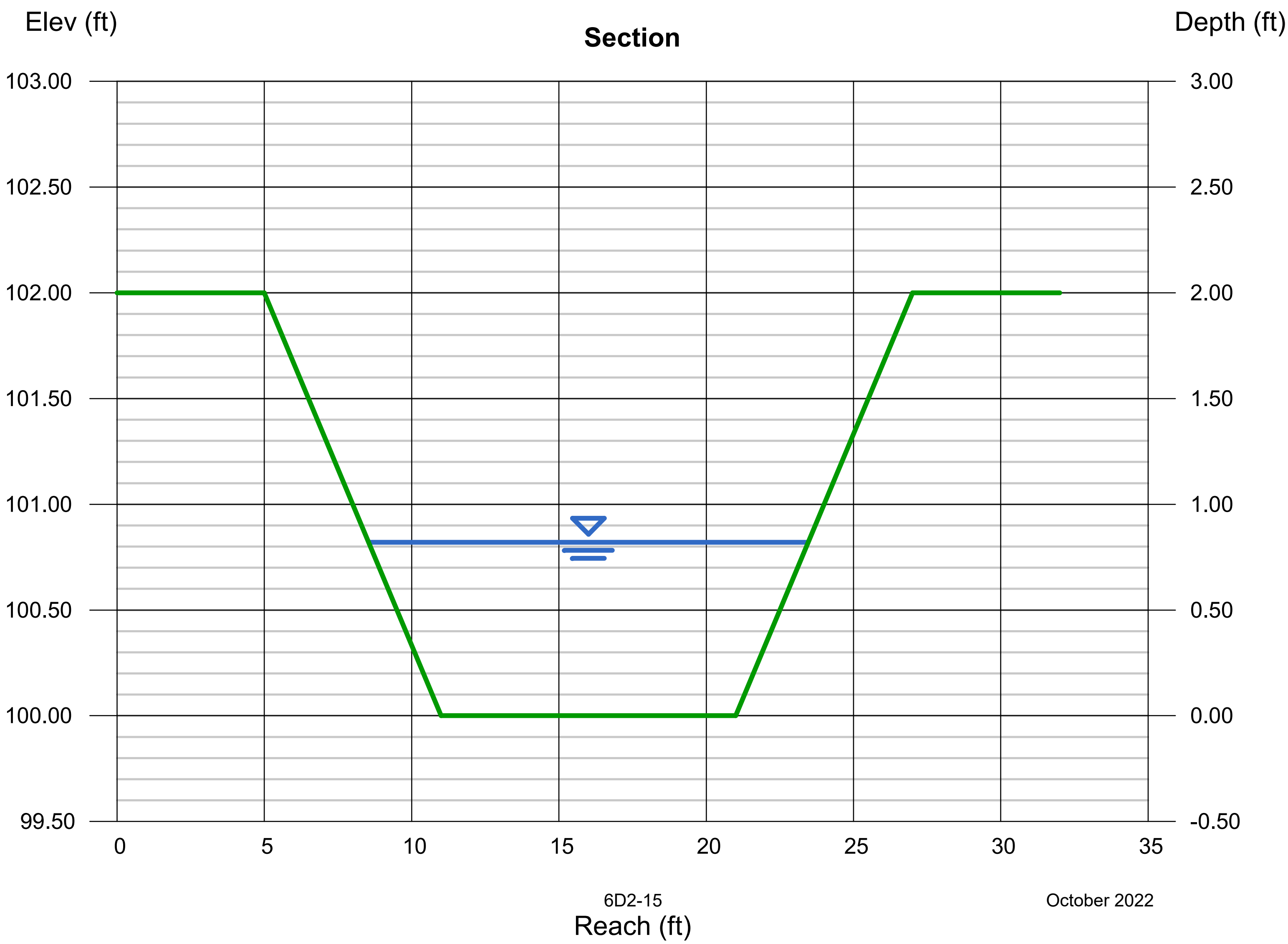
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.70
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 46.80
Total Depth (ft)	= 2.00	Area (sqft)	= 8.47
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 5.53
Slope (%)	= 0.50	Wetted Perim (ft)	= 14.43
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.81
		Top Width (ft)	= 14.20
Calculations		EGL (ft)	= 1.17
Compute by:	Known Q		
Known Q (cfs)	= 46.80		



Channel Report

Channel 6A 100-yr-24-Hour Storm

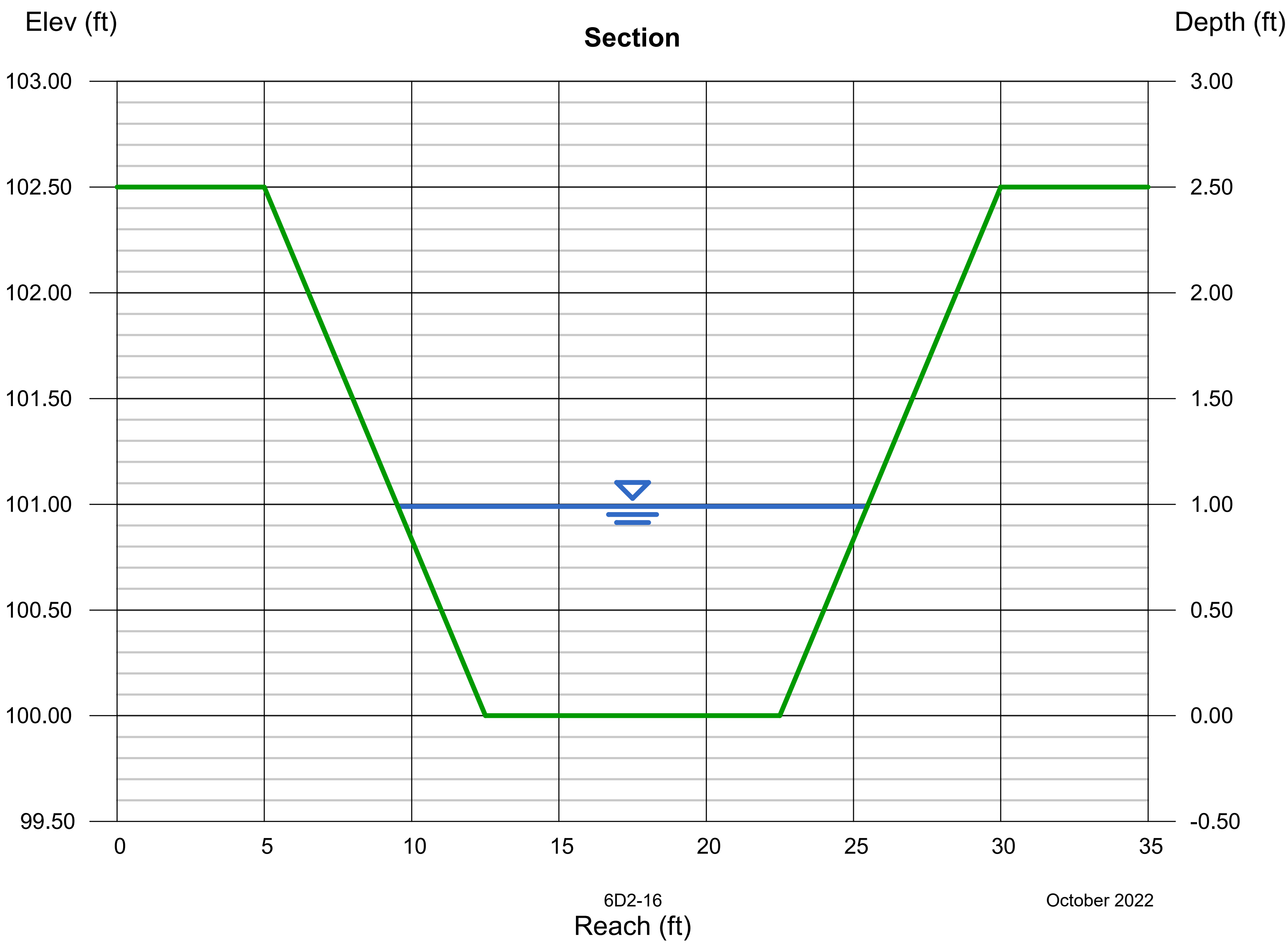
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.82
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 63.10
Total Depth (ft)	= 2.00	Area (sqft)	= 10.22
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.18
Slope (%)	= 0.50	Wetted Perim (ft)	= 15.19
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.97
		Top Width (ft)	= 14.92
Calculations		EGL (ft)	= 1.41
Compute by:	Known Q		
Known Q (cfs)	= 63.10		



Channel Report

Channel 7A 25-yr-24-Hour Storm

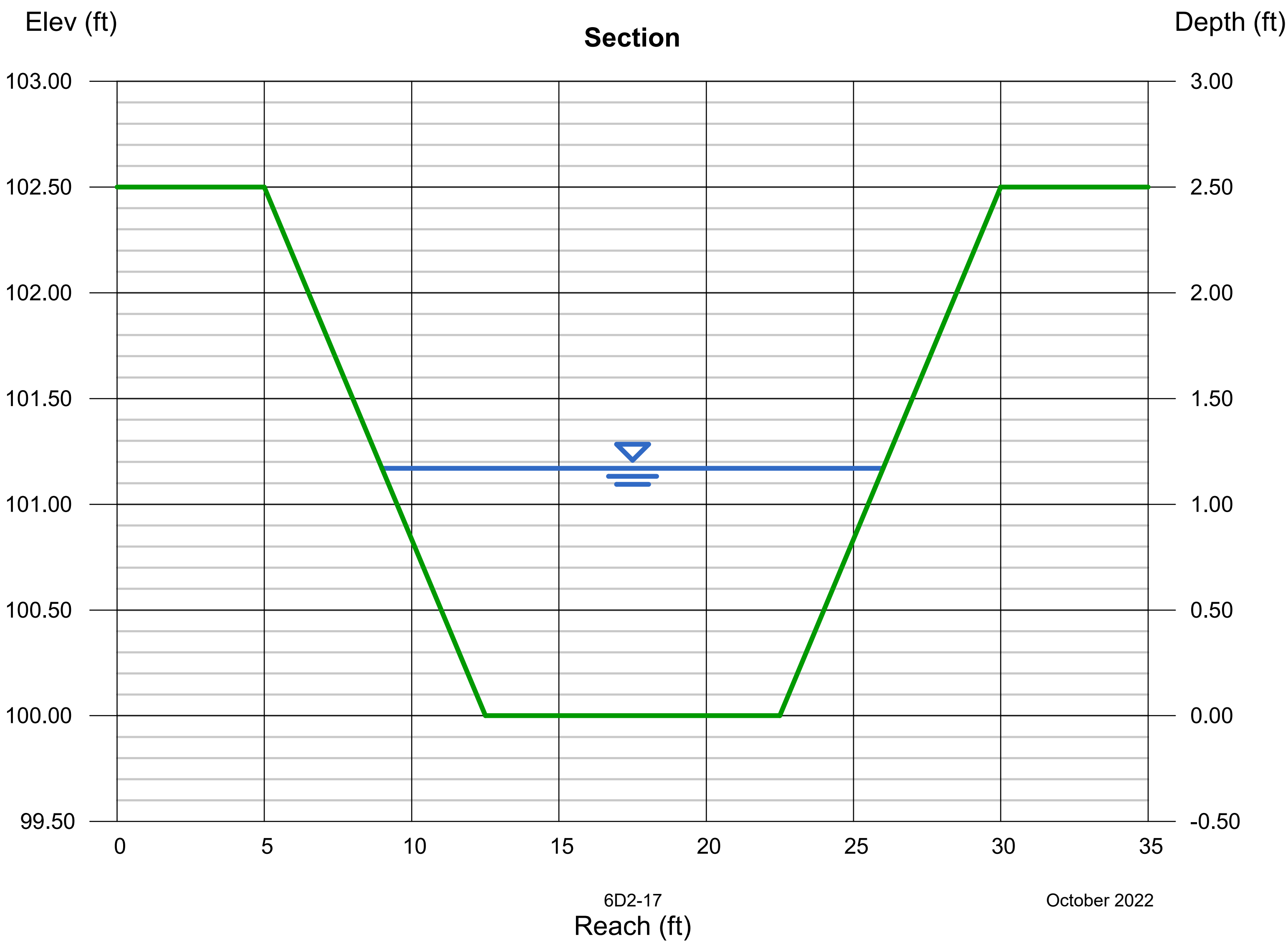
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.99
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 87.60
Total Depth (ft)	= 2.50	Area (sqft)	= 12.84
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.82
Slope (%)	= 0.50	Wetted Perim (ft)	= 16.26
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.18
		Top Width (ft)	= 15.94
Calculations		EGL (ft)	= 1.71
Compute by:	Known Q		
Known Q (cfs)	= 87.60		



Channel Report

Channel 7A 100-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.17
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 118.10
Total Depth (ft)	= 2.50	Area (sqft)	= 15.81
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 7.47
Slope (%)	= 0.50	Wetted Perim (ft)	= 17.40
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.41
		Top Width (ft)	= 17.02
Calculations		EGL (ft)	= 2.04
Compute by:	Known Q		
Known Q (cfs)	= 118.10		

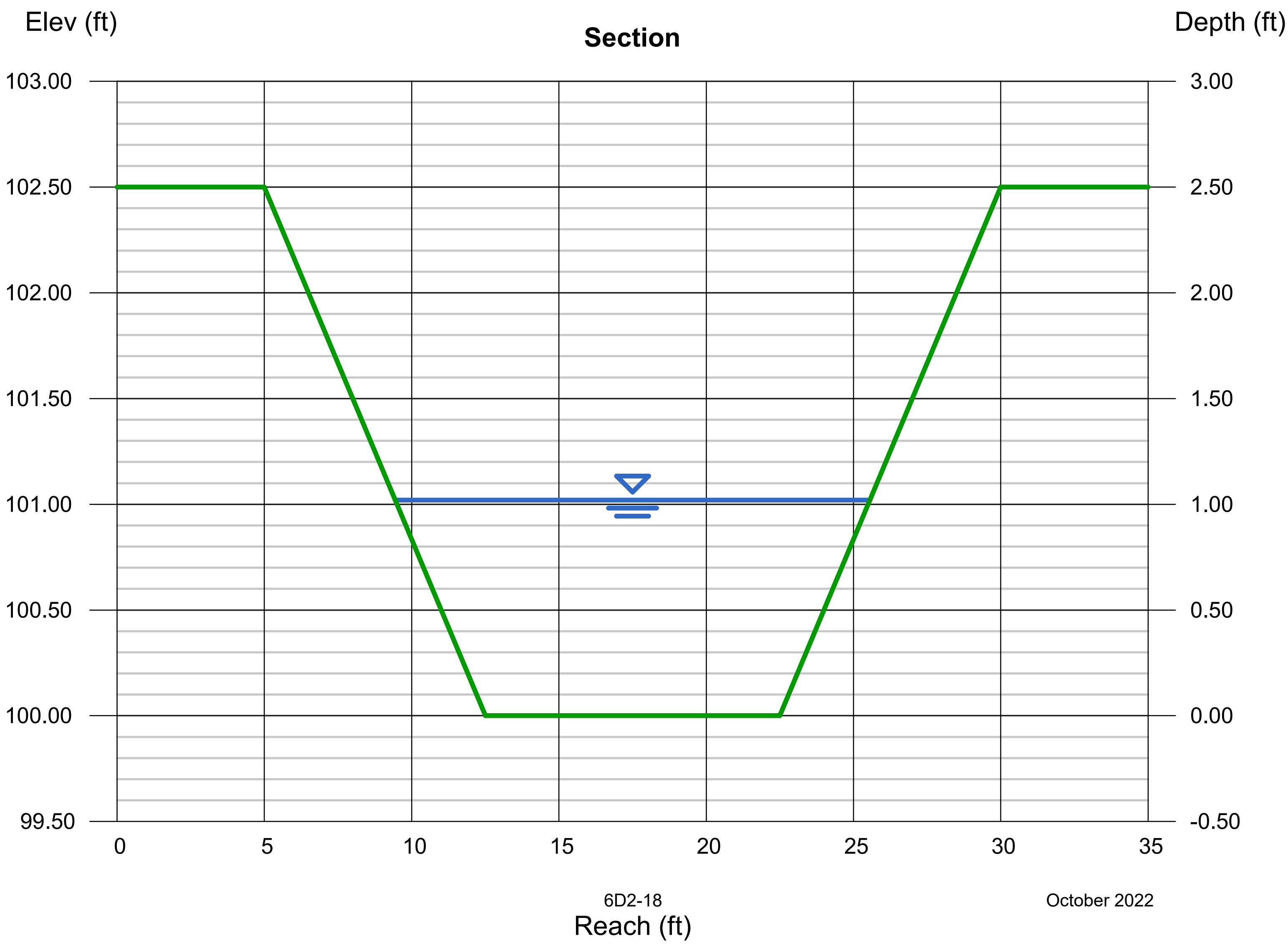


Channel Report

Channel 8A 25-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.02
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 92.00
Total Depth (ft)	= 2.50	Area (sqft)	= 13.32
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.91
Slope (%)	= 0.50	Wetted Perim (ft)	= 16.45
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.22
		Top Width (ft)	= 16.12
		EGL (ft)	= 1.76

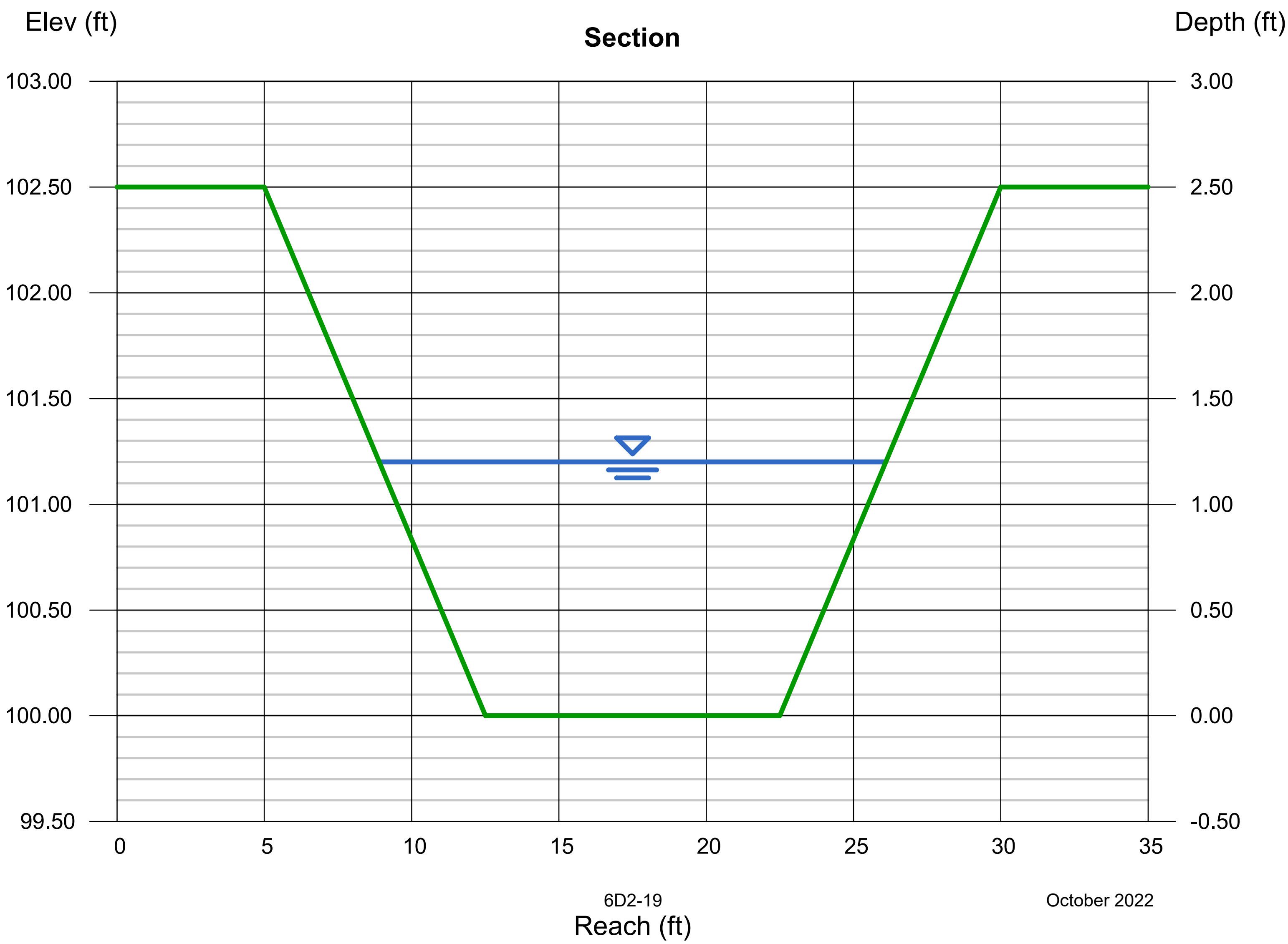
Calculations
Compute by: Known Q
Known Q (cfs) = 92.00



Channel Report

Channel 8A 100-yr-24-Hour Storm

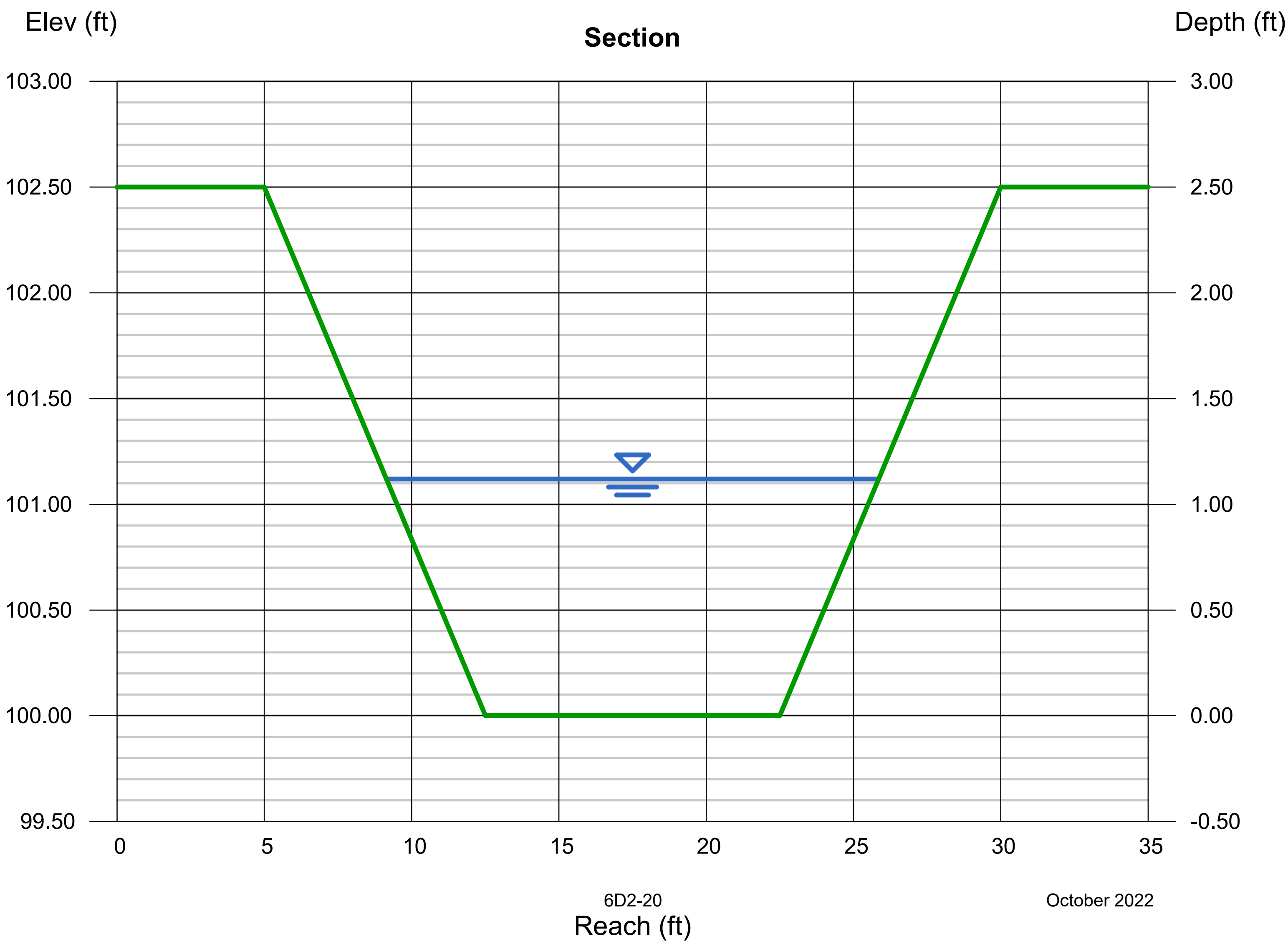
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.20
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 124.40
Total Depth (ft)	= 2.50	Area (sqft)	= 16.32
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 7.62
Slope (%)	= 0.50	Wetted Perim (ft)	= 17.59
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.45
		Top Width (ft)	= 17.20
Calculations		EGL (ft)	= 2.10
Compute by:	Known Q		
Known Q (cfs)	= 124.40		



Channel Report

Channel 9A 25-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.12
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 109.80
Total Depth (ft)	= 2.50	Area (sqft)	= 14.96
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 7.34
Slope (%)	= 0.50	Wetted Perim (ft)	= 17.08
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.35
		Top Width (ft)	= 16.72
Calculations		EGL (ft)	= 1.96
Compute by:	Known Q		
Known Q (cfs)	= 109.80		

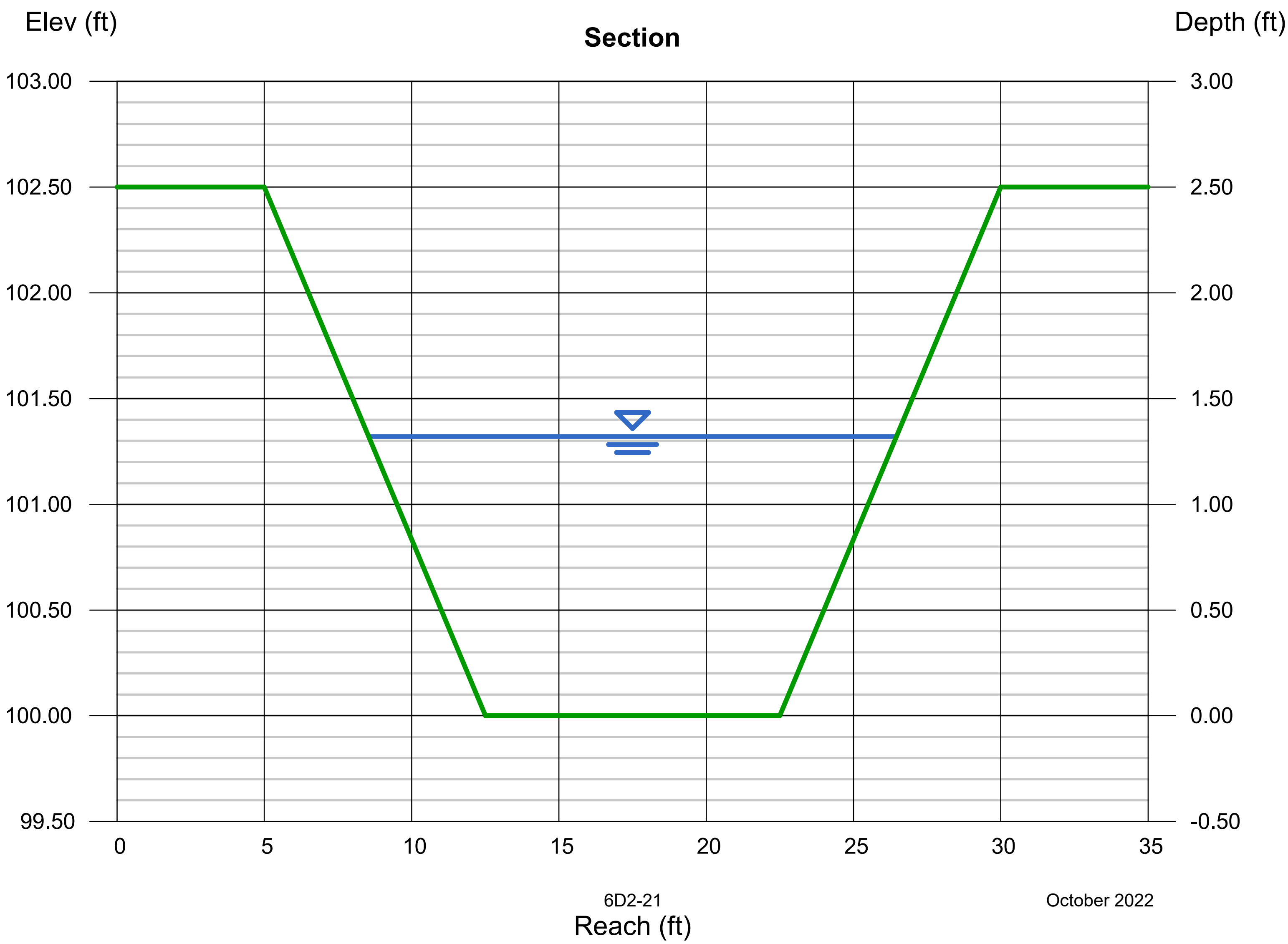


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 22 2022

Channel 9A 100-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.32
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 148.90
Total Depth (ft)	= 2.50	Area (sqft)	= 18.43
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 8.08
Slope (%)	= 0.50	Wetted Perim (ft)	= 18.35
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.61
		Top Width (ft)	= 17.92
Calculations		EGL (ft)	= 2.34
Compute by:	Known Q		
Known Q (cfs)	= 148.90		

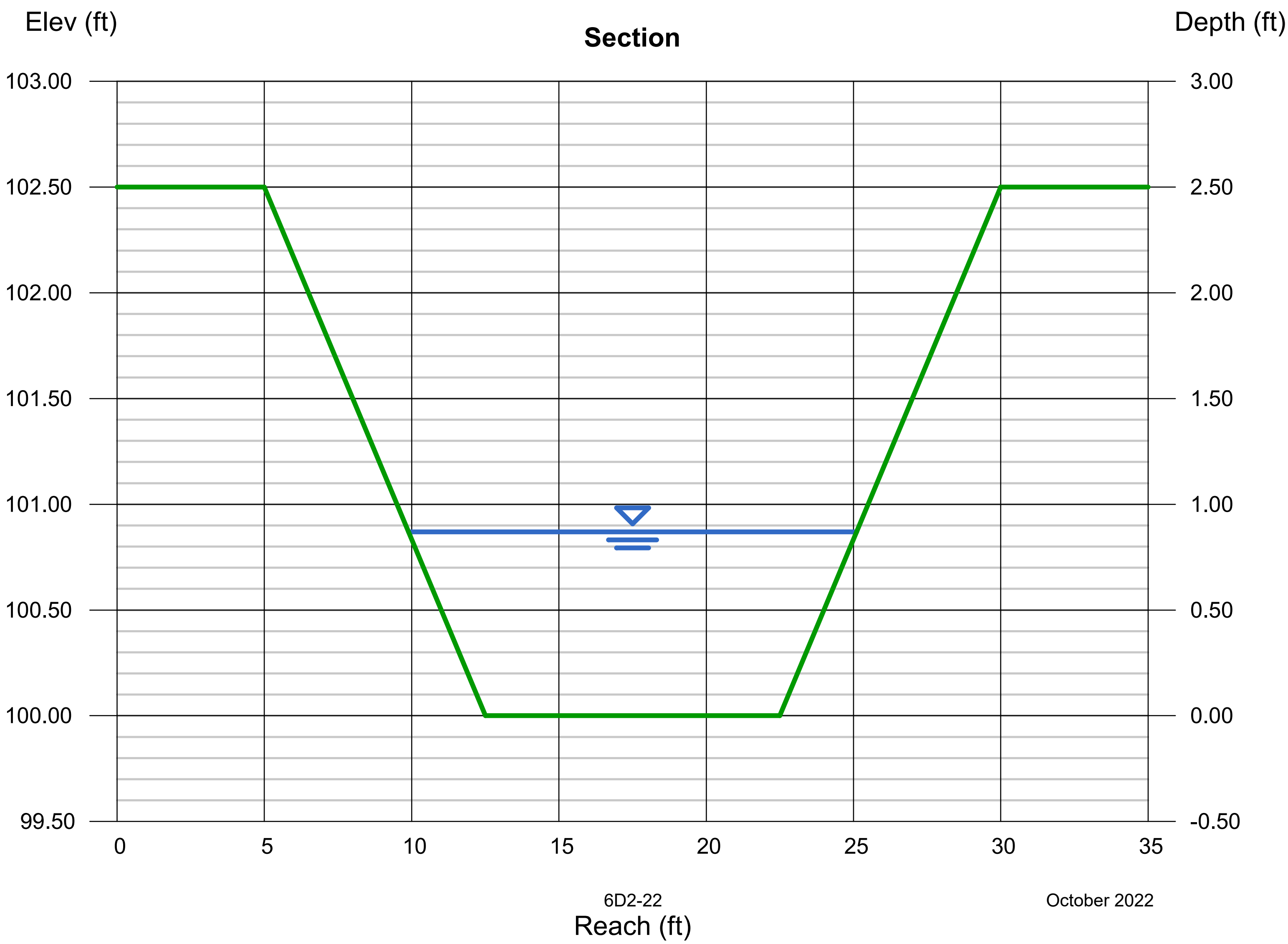


Channel Report

Channel 10A 25-yr-24-Hour Storm

Trapezoidal	
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.013
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 69.90

Highlighted	
Depth (ft)	= 0.87
Q (cfs)	= 69.90
Area (sqft)	= 10.97
Velocity (ft/s)	= 6.37
Wetted Perim (ft)	= 15.50
Crit Depth, Yc (ft)	= 1.04
Top Width (ft)	= 15.22
EGL (ft)	= 1.50

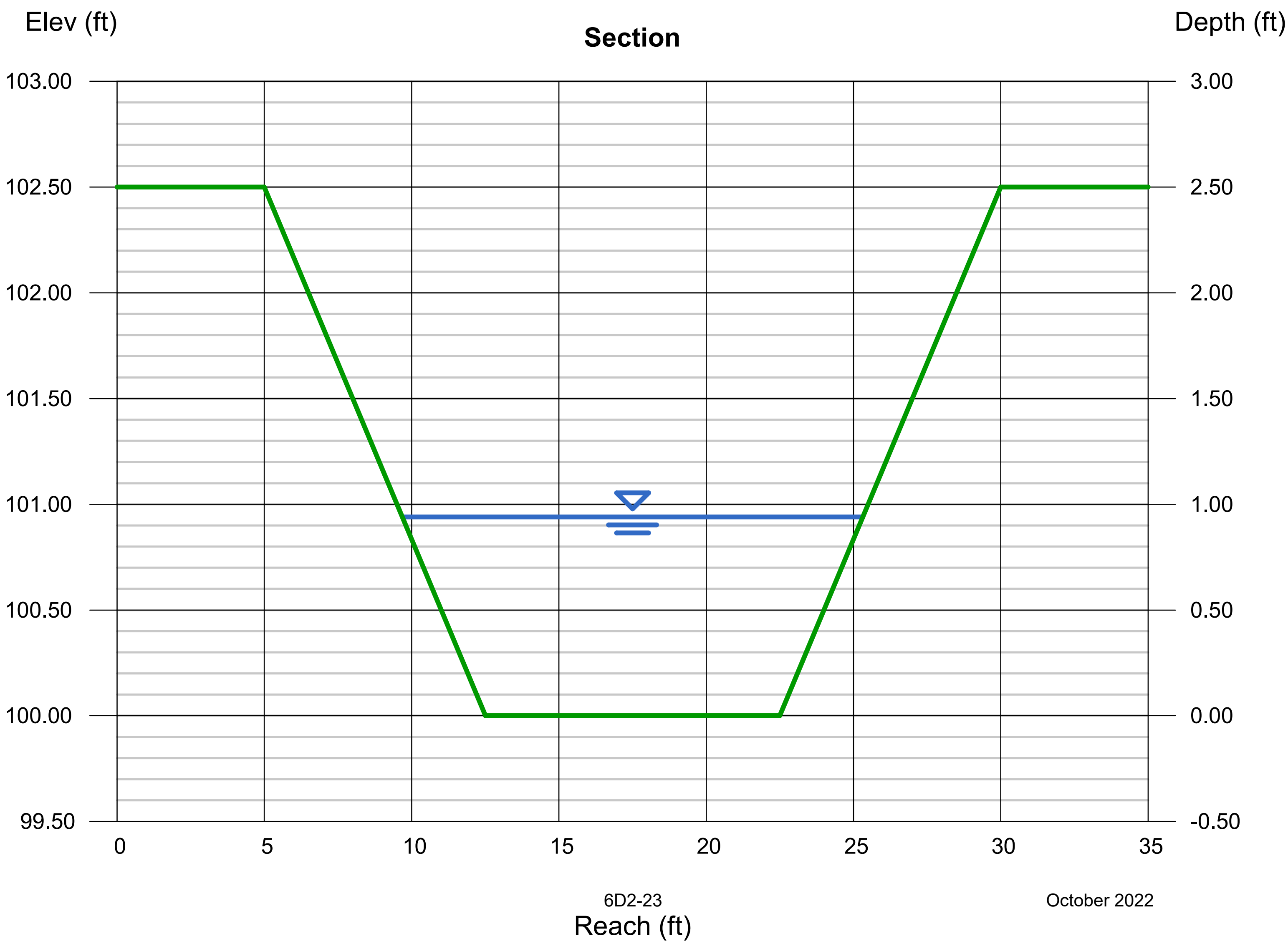


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 22 2022

Channel 10A 100-yr-24-Hour Storm

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.94
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 80.60
Total Depth (ft)	= 2.50	Area (sqft)	= 12.05
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.69
Slope (%)	= 0.50	Wetted Perim (ft)	= 15.95
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.13
		Top Width (ft)	= 15.64
Calculations		EGL (ft)	= 1.64
Compute by:	Known Q		
Known Q (cfs)	= 80.60		

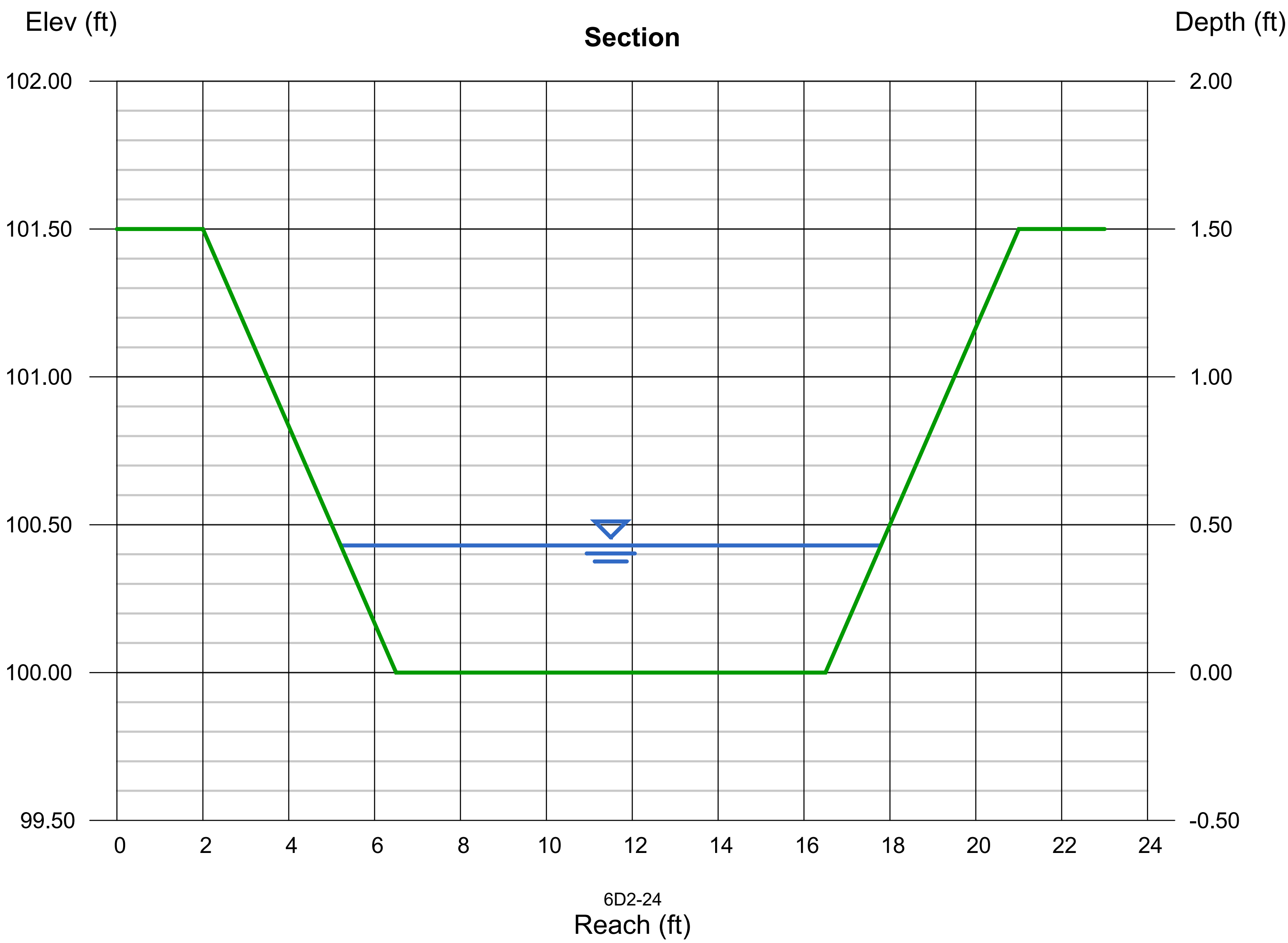


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Sunday, Oct 30 2022

Channel 3A 25-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.43
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 9.800
Total Depth (ft)	= 1.50	Area (sqft)	= 4.85
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 2.02
Slope (%)	= 0.50	Wetted Perim (ft)	= 12.72
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.31
		Top Width (ft)	= 12.58
Calculations		EGL (ft)	= 0.49
Compute by:	Known Q		
Known Q (cfs)	= 9.80		

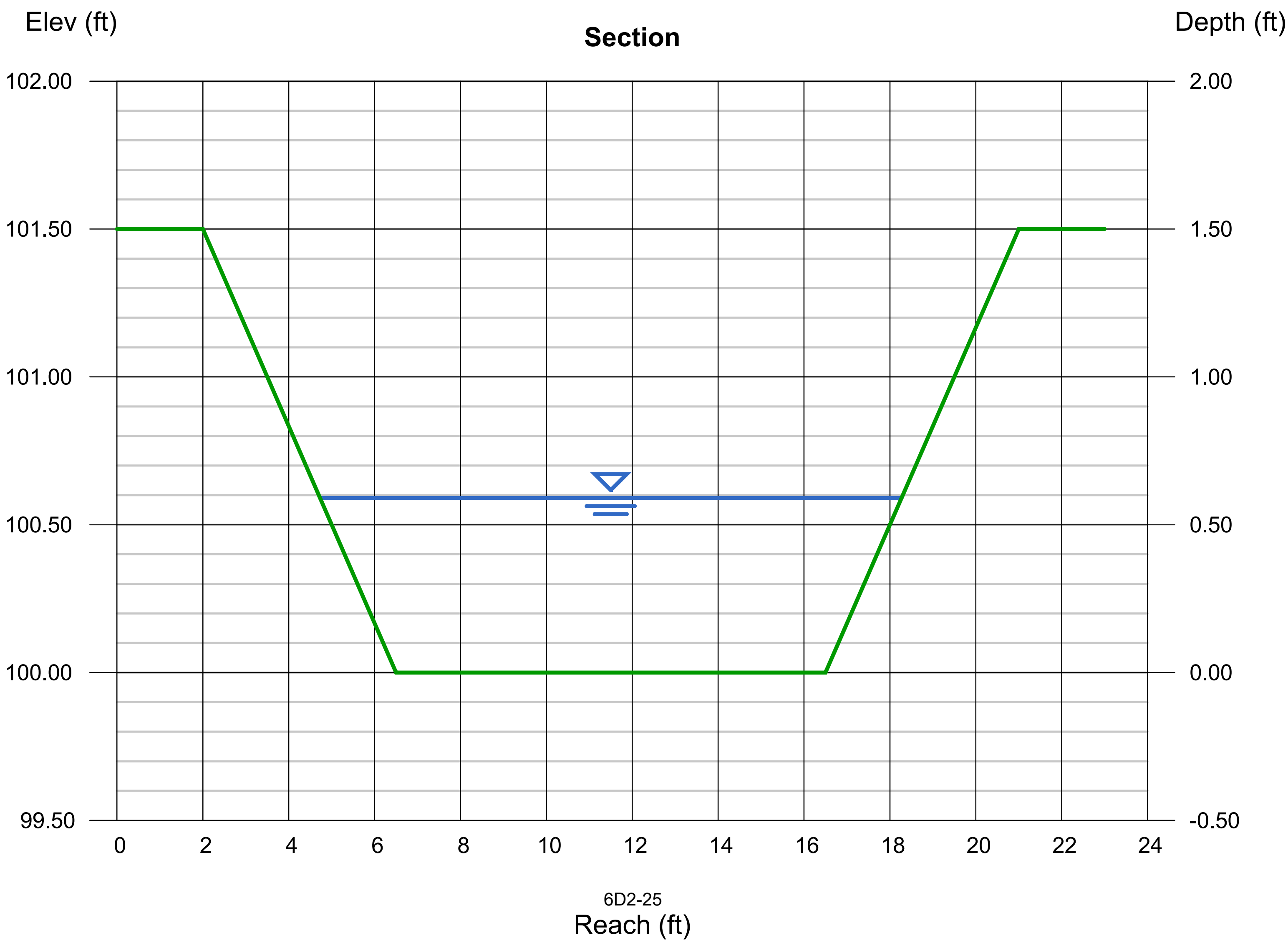


6D2-24

Channel Report

Channel 3A 100-yr-24-Hour Storm - Grass

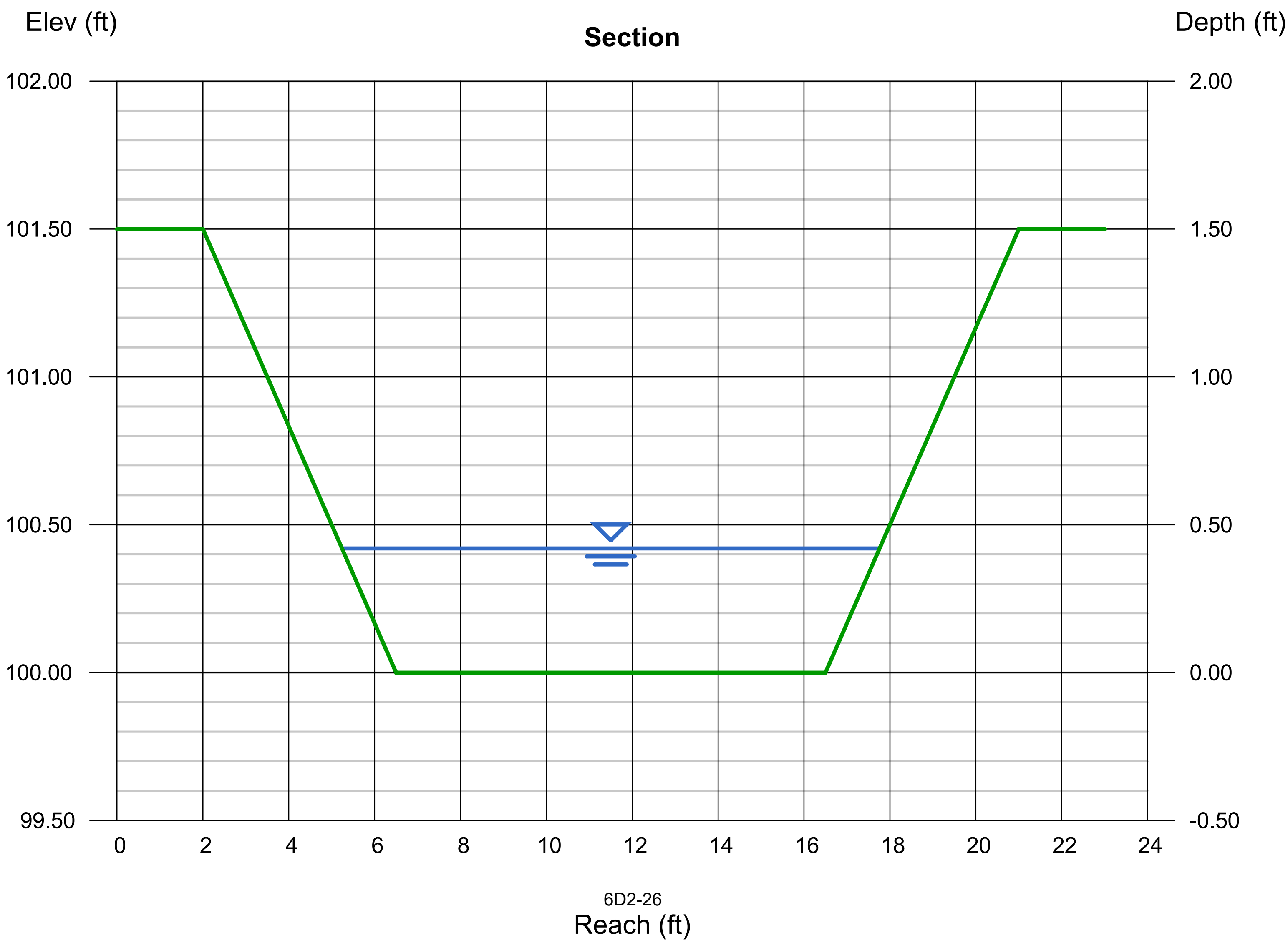
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.59
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 16.80
Total Depth (ft)	= 1.50	Area (sqft)	= 6.94
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 2.42
Slope (%)	= 0.50	Wetted Perim (ft)	= 13.73
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.43
		Top Width (ft)	= 13.54
Calculations		EGL (ft)	= 0.68
Compute by:	Known Q		
Known Q (cfs)	= 16.80		



Channel Report

Channel 4A 25-yr-24-Hour Storm - Grass

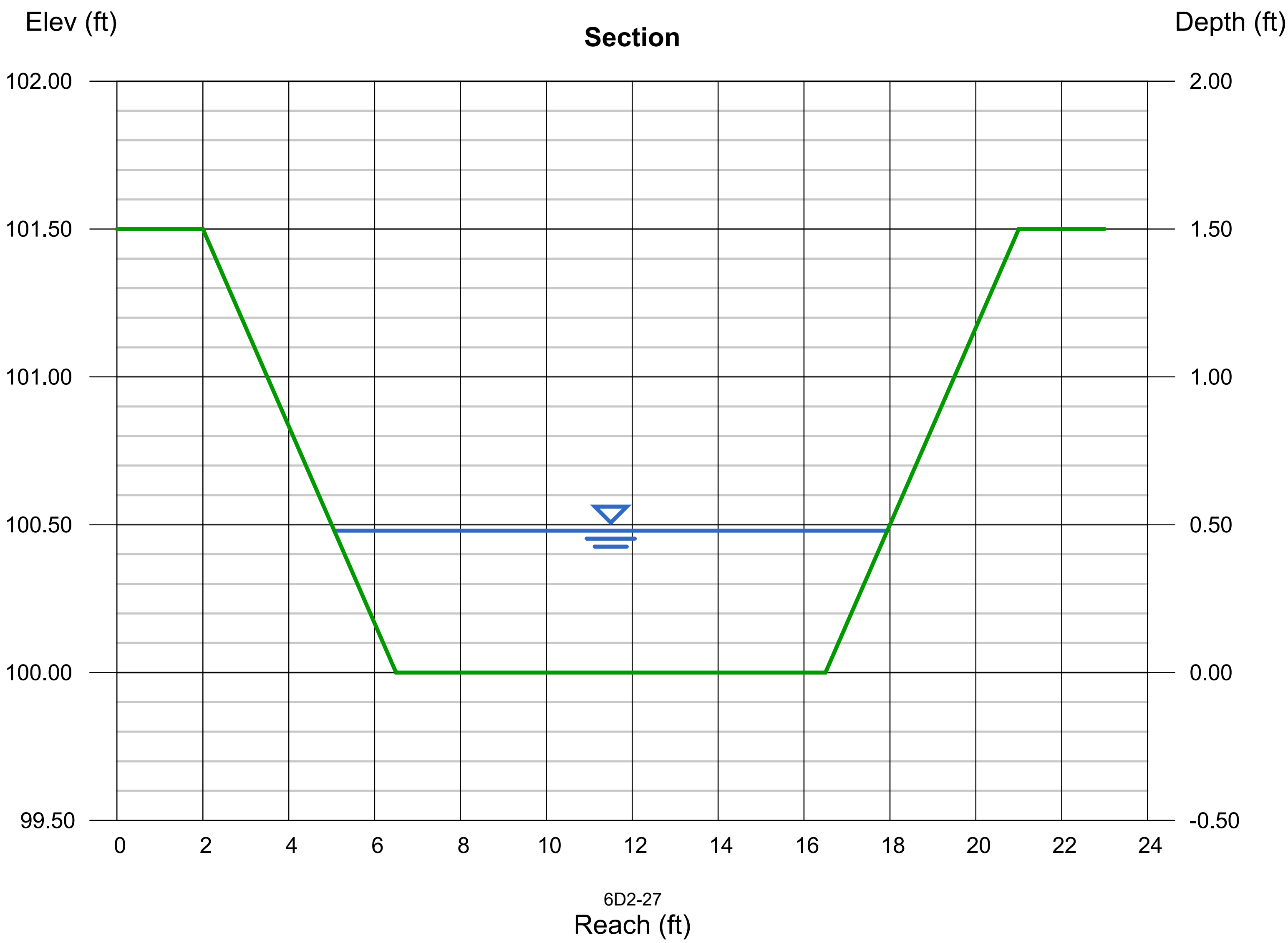
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.42
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 9.200
Total Depth (ft)	= 1.50	Area (sqft)	= 4.73
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 1.95
Slope (%)	= 0.50	Wetted Perim (ft)	= 12.66
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.29
		Top Width (ft)	= 12.52
Calculations		EGL (ft)	= 0.48
Compute by:	Known Q		
Known Q (cfs)	= 9.20		



Channel Report

Channel 4A 100-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.48
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 11.80
Total Depth (ft)	= 1.50	Area (sqft)	= 5.49
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 2.15
Slope (%)	= 0.50	Wetted Perim (ft)	= 13.04
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.34
		Top Width (ft)	= 12.88
Calculations		EGL (ft)	= 0.55
Compute by:	Known Q		
Known Q (cfs)	= 11.80		

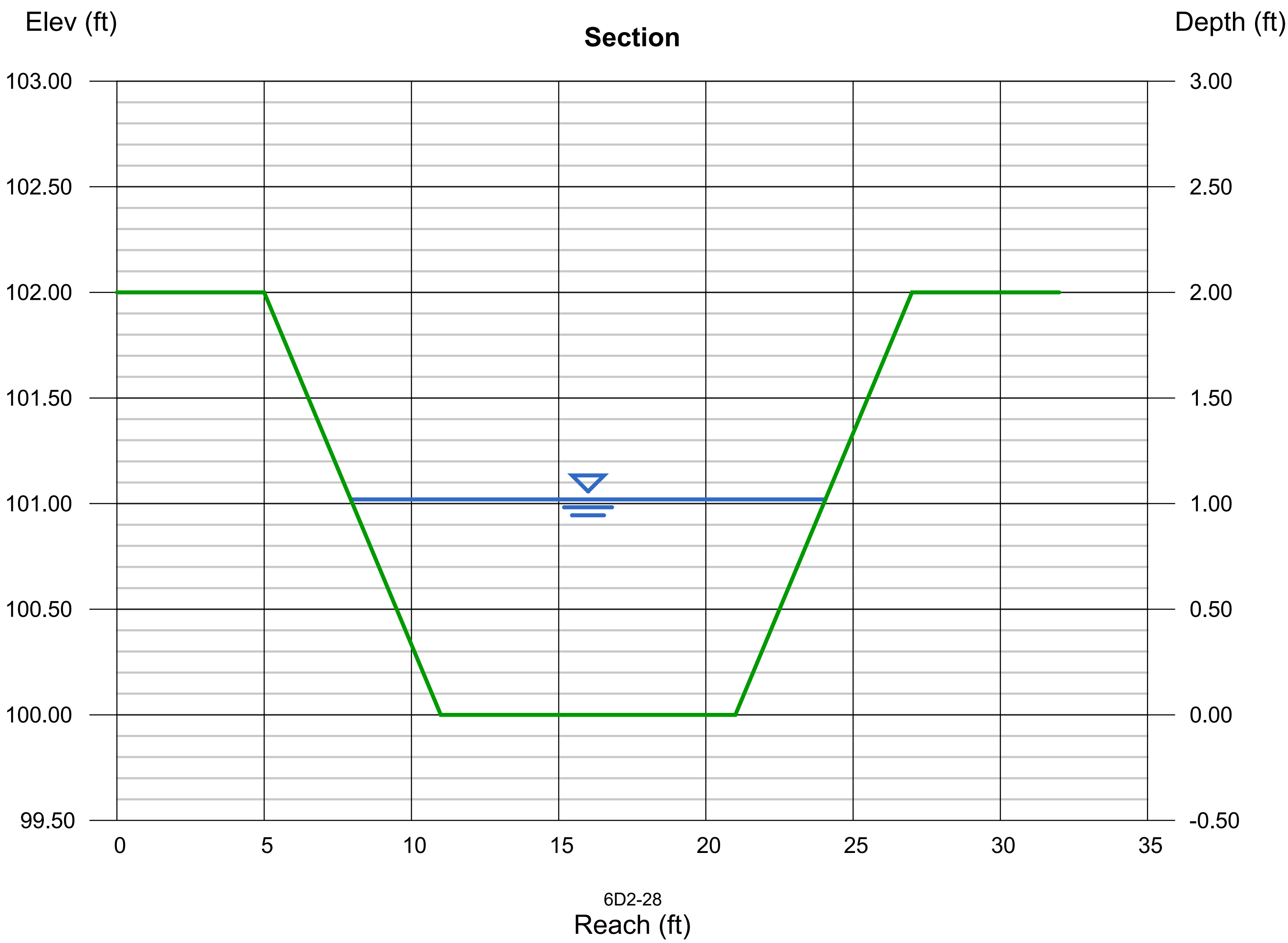


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Sunday, Oct 30 2022

Channel 5A 25-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.02
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 44.70
Total Depth (ft)	= 2.00	Area (sqft)	= 13.32
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.36
Slope (%)	= 0.50	Wetted Perim (ft)	= 16.45
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.79
		Top Width (ft)	= 16.12
Calculations		EGL (ft)	= 1.20
Compute by:	Known Q		
Known Q (cfs)	= 44.70		



Channel Report

Channel 5A 100-yr-24-Hour Storm - Grass

Trapezoidal

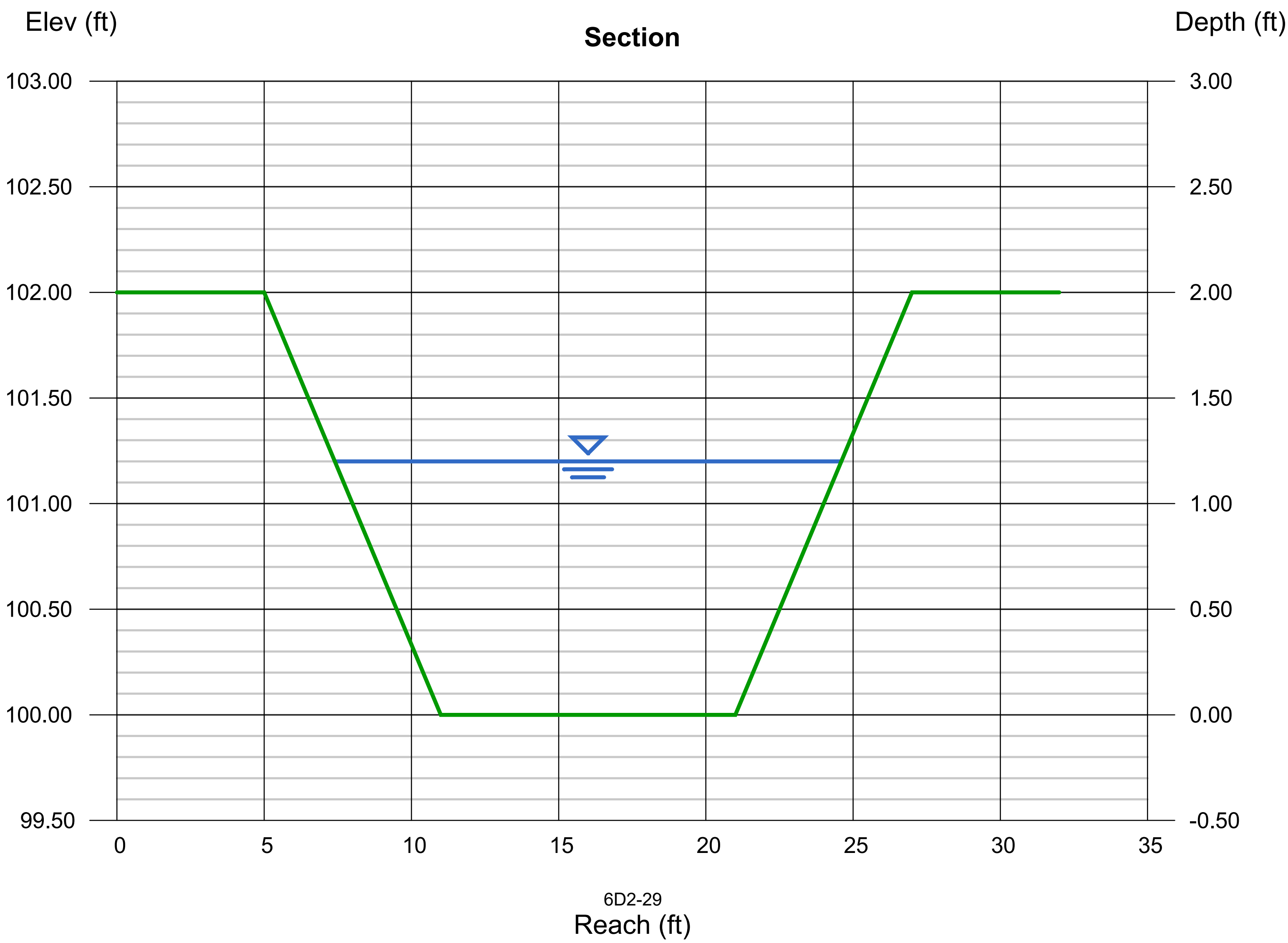
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 60.00

Highlighted

Depth (ft)	= 1.20
Q (cfs)	= 60.00
Area (sqft)	= 16.32
Velocity (ft/s)	= 3.68
Wetted Perim (ft)	= 17.59
Crit Depth, Yc (ft)	= 0.95
Top Width (ft)	= 17.20
EGL (ft)	= 1.41



Channel Report

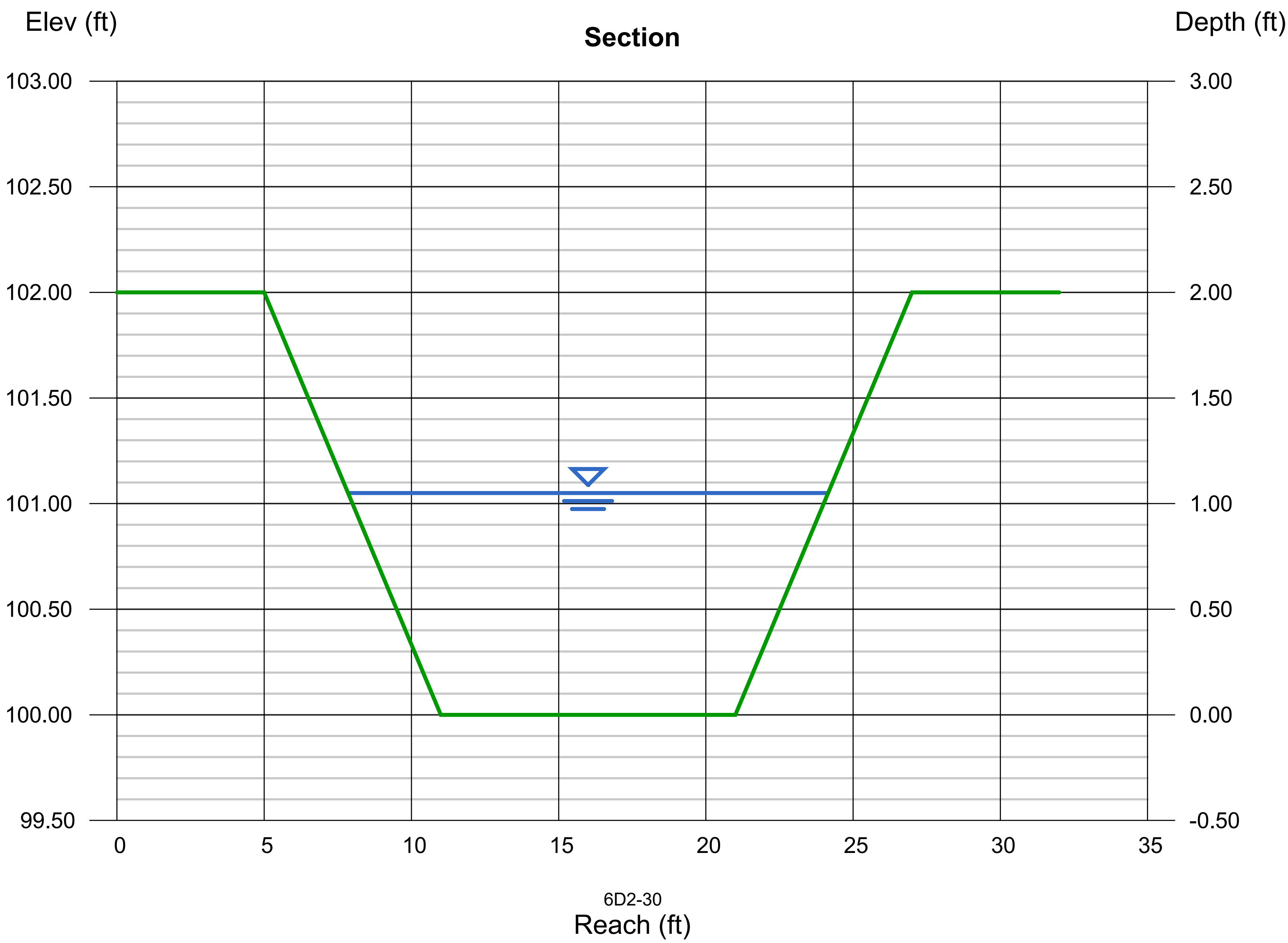
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. | Sunday, Oct 30 2022

Channel 6A 25-yr-24-Hour Storm - Grass

Trapezoidal
Bottom Width (ft) = 10.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.027

Calculations
Compute by: Known Q
Known Q (cfs) = 46.80

Highlighted
Depth (ft) = 1.05
Q (cfs) = 46.80
Area (sqft) = 13.81
Velocity (ft/s) = 3.39
Wetted Perim (ft) = 16.64
Crit Depth, Yc (ft) = 0.81
Top Width (ft) = 16.30
EGL (ft) = 1.23

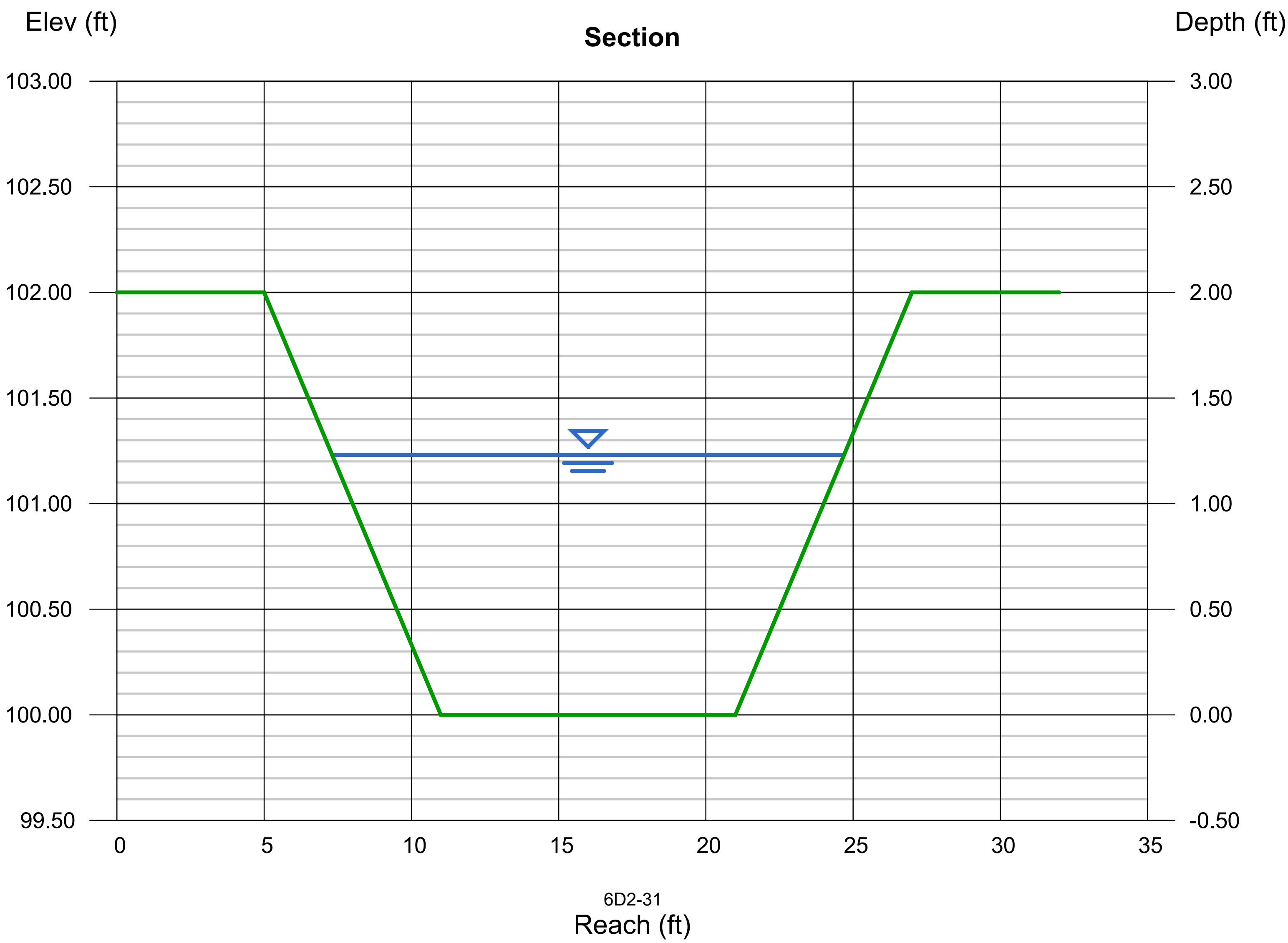


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. | Sunday, Oct 30 2022

Channel 6A 100-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.23
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 63.10
Total Depth (ft)	= 2.00	Area (sqft)	= 16.84
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.75
Slope (%)	= 0.50	Wetted Perim (ft)	= 17.78
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.97
		Top Width (ft)	= 17.38
Calculations		EGL (ft)	= 1.45
Compute by:	Known Q		
Known Q (cfs)	= 63.10		

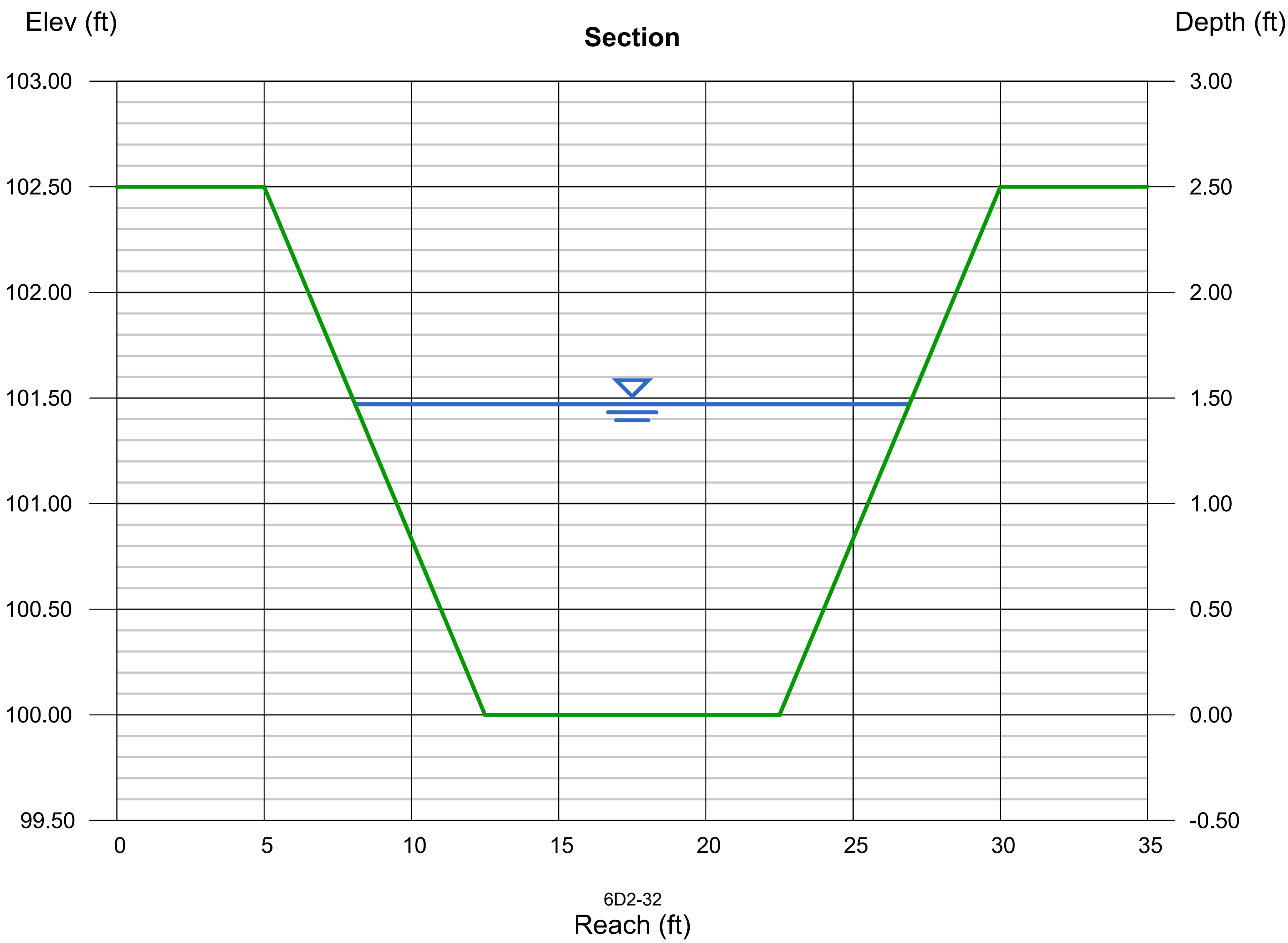


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Sunday, Oct 30 2022

Channel 7A 25-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.47
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 87.60
Total Depth (ft)	= 2.50	Area (sqft)	= 21.18
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.14
Slope (%)	= 0.50	Wetted Perim (ft)	= 19.30
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.18
		Top Width (ft)	= 18.82
Calculations		EGL (ft)	= 1.74
Compute by:	Known Q		
Known Q (cfs)	= 87.60		



Channel Report

Channel 7A 100-yr-24-Hour Storm - Grass

Trapezoidal

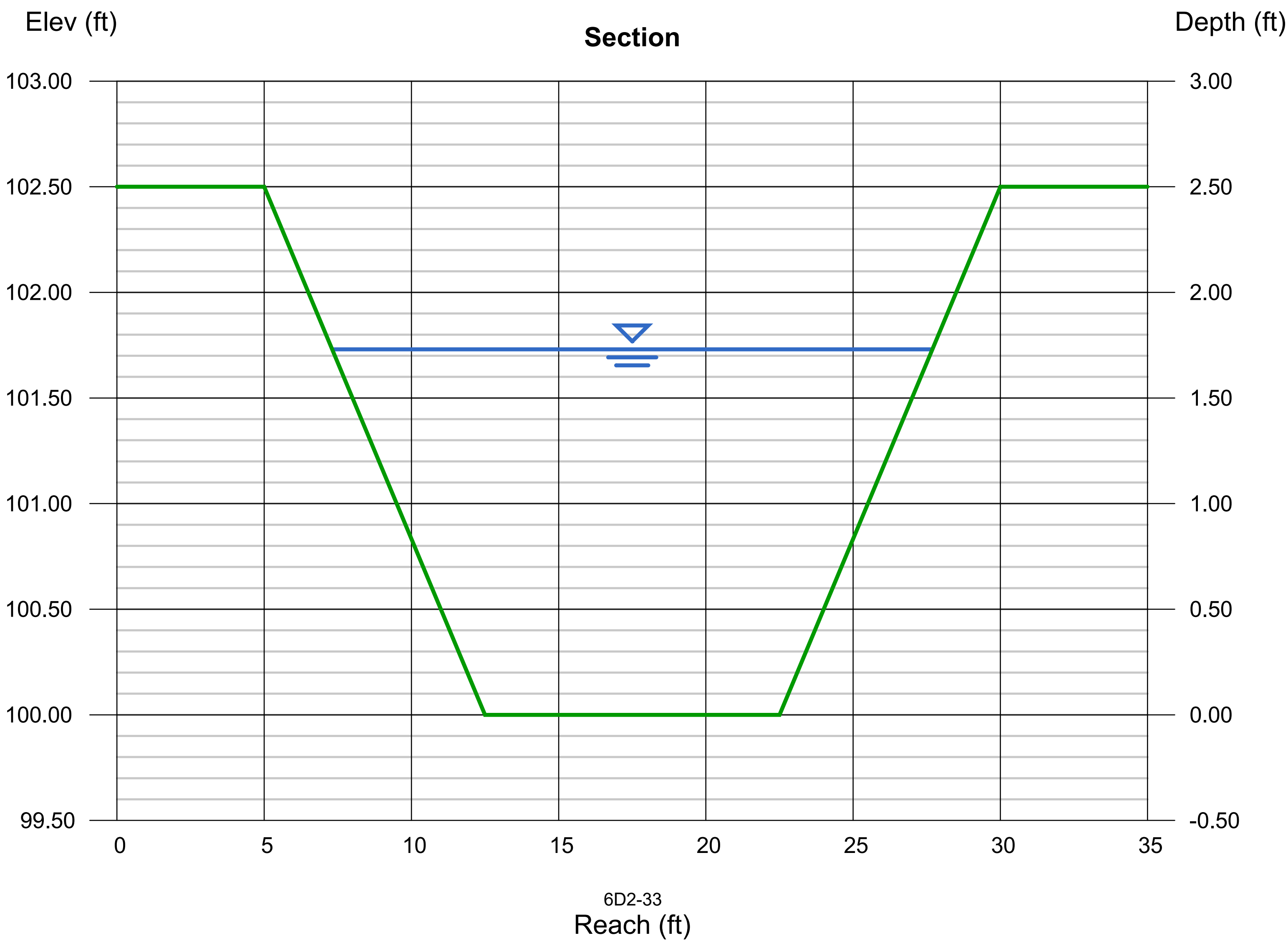
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 118.10

Highlighted

Depth (ft)	= 1.73
Q (cfs)	= 118.10
Area (sqft)	= 26.28
Velocity (ft/s)	= 4.49
Wetted Perim (ft)	= 20.94
Crit Depth, Yc (ft)	= 1.41
Top Width (ft)	= 20.38
EGL (ft)	= 2.04



Channel Report

Channel 8A 25-yr-24-Hour Storm - Grass

Trapezoidal

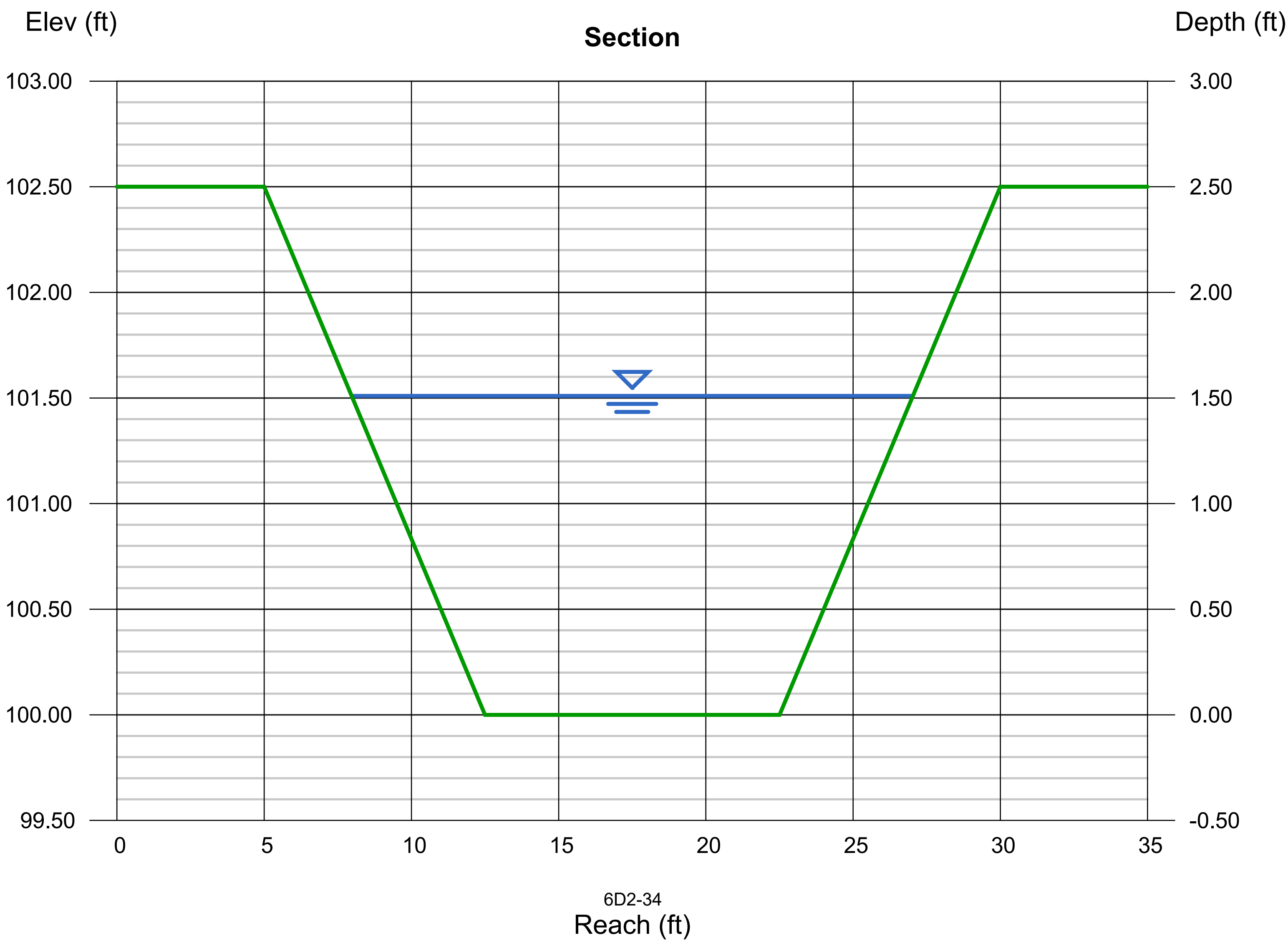
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 92.00

Highlighted

Depth (ft)	= 1.51
Q (cfs)	= 92.00
Area (sqft)	= 21.94
Velocity (ft/s)	= 4.19
Wetted Perim (ft)	= 19.55
Crit Depth, Yc (ft)	= 1.22
Top Width (ft)	= 19.06
EGL (ft)	= 1.78

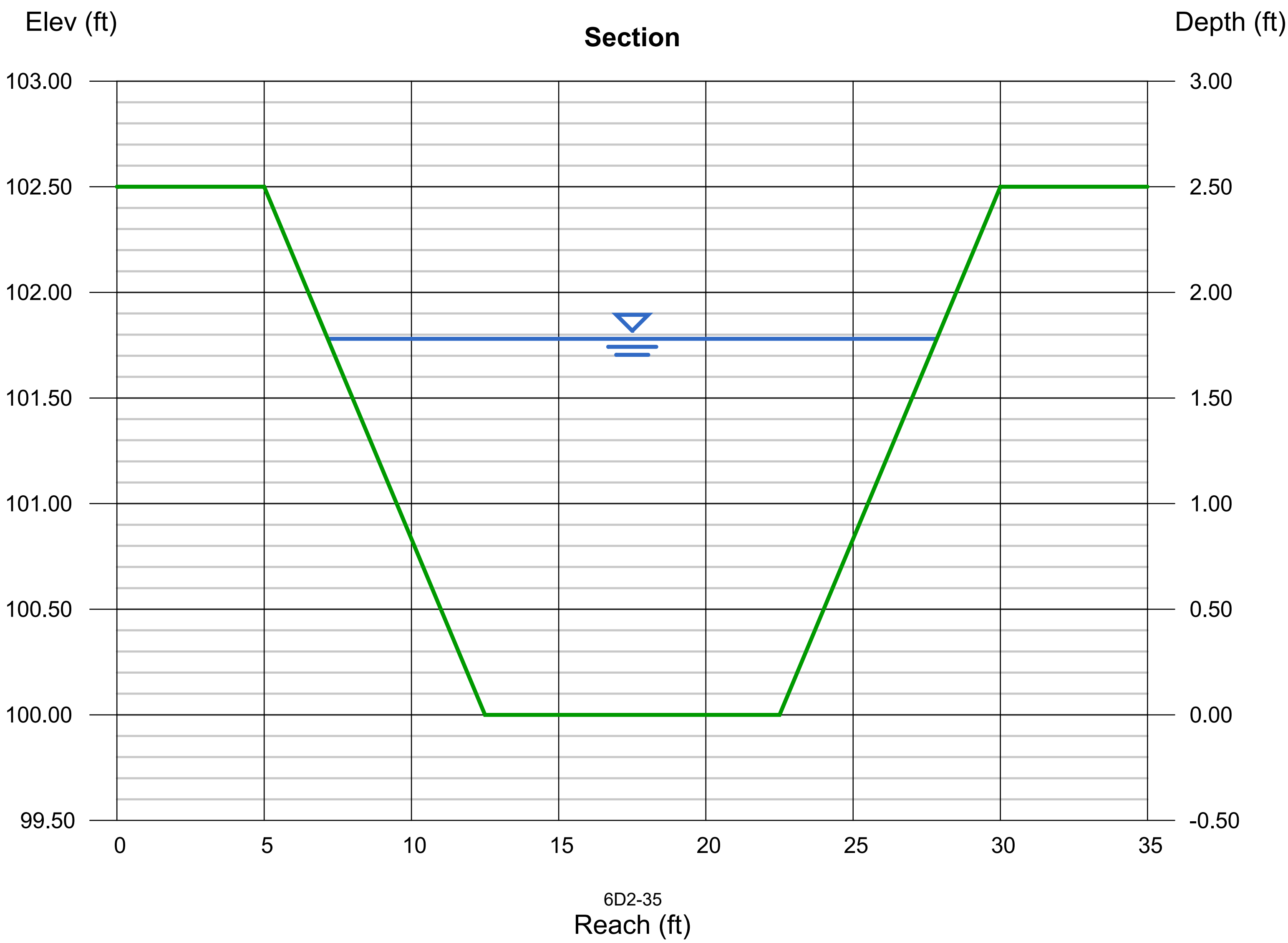


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Sunday, Oct 30 2022

Channel 8A 100-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.78
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 124.40
Total Depth (ft)	= 2.50	Area (sqft)	= 27.31
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.56
Slope (%)	= 0.50	Wetted Perim (ft)	= 21.26
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.45
		Top Width (ft)	= 20.68
Calculations		EGL (ft)	= 2.10
Compute by:	Known Q		
Known Q (cfs)	= 124.40		



Channel Report

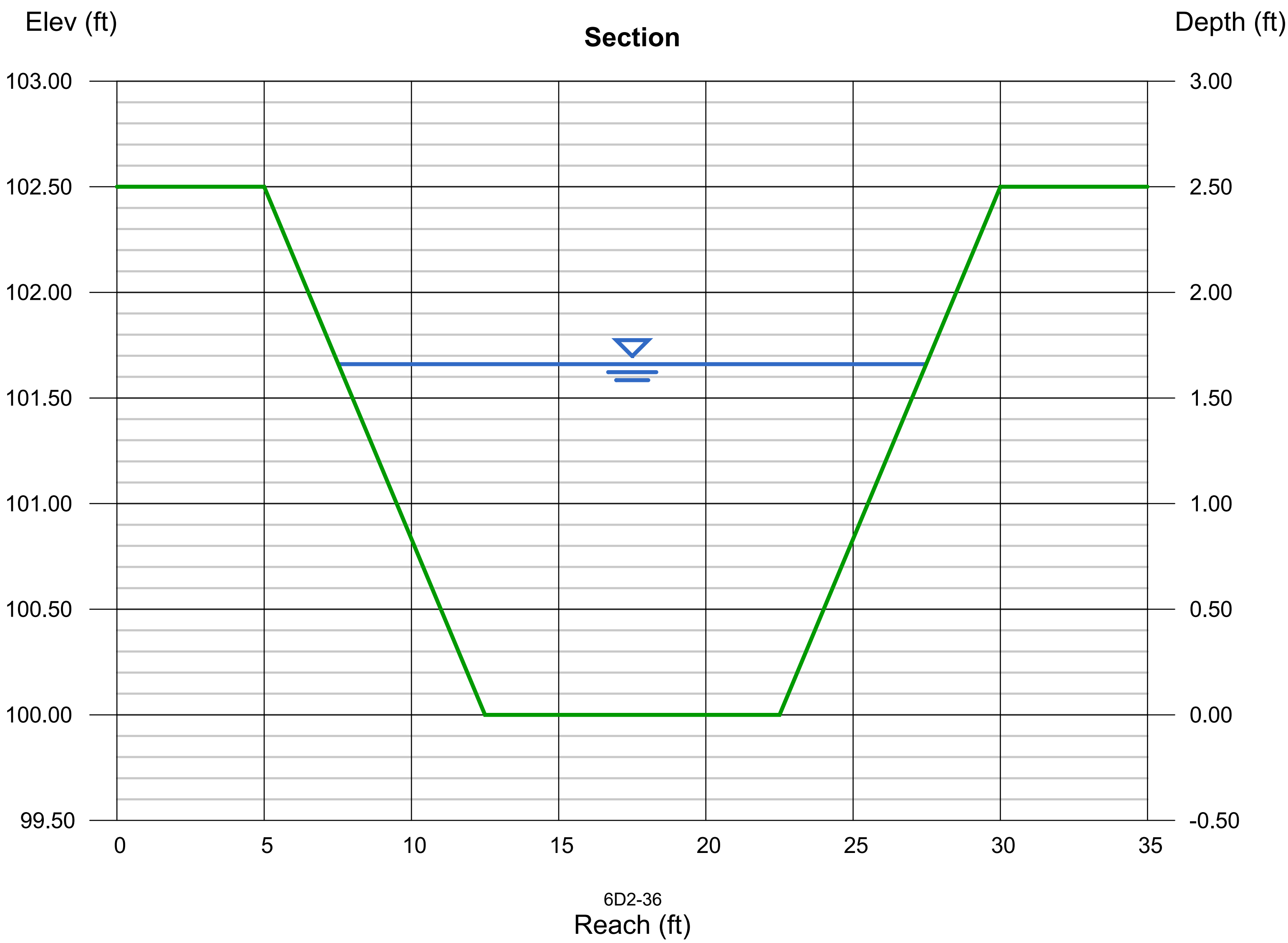
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Sunday, Oct 30 2022

Channel 9A 25-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.66
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 109.80
Total Depth (ft)	= 2.50	Area (sqft)	= 24.87
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.42
Slope (%)	= 0.50	Wetted Perim (ft)	= 20.50
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.35
		Top Width (ft)	= 19.96
		EGL (ft)	= 1.96

Calculations

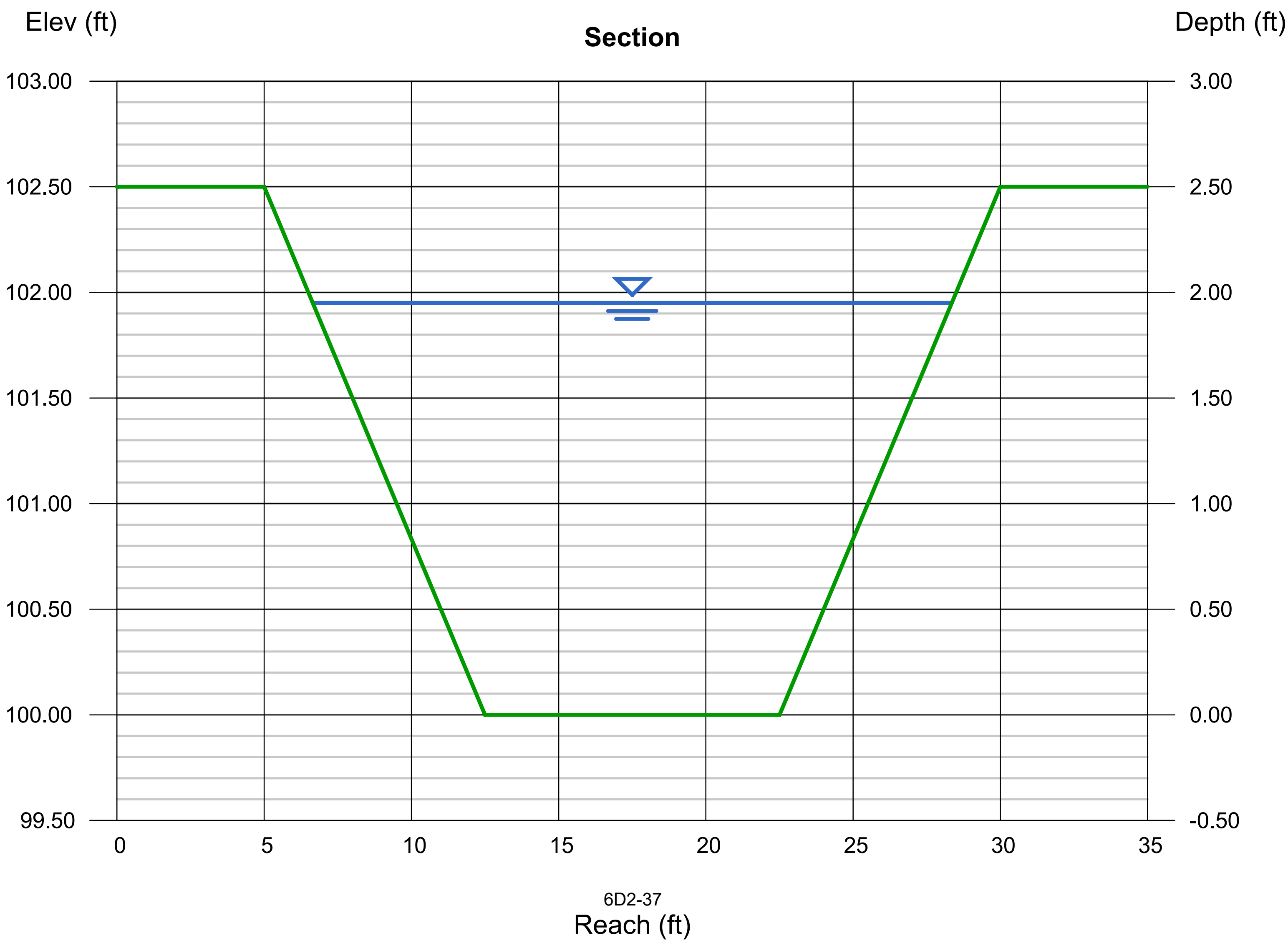
Compute by:	Known Q
Known Q (cfs)	= 109.80



Channel Report

Channel 9A 100-yr-24-Hour Storm - Grass

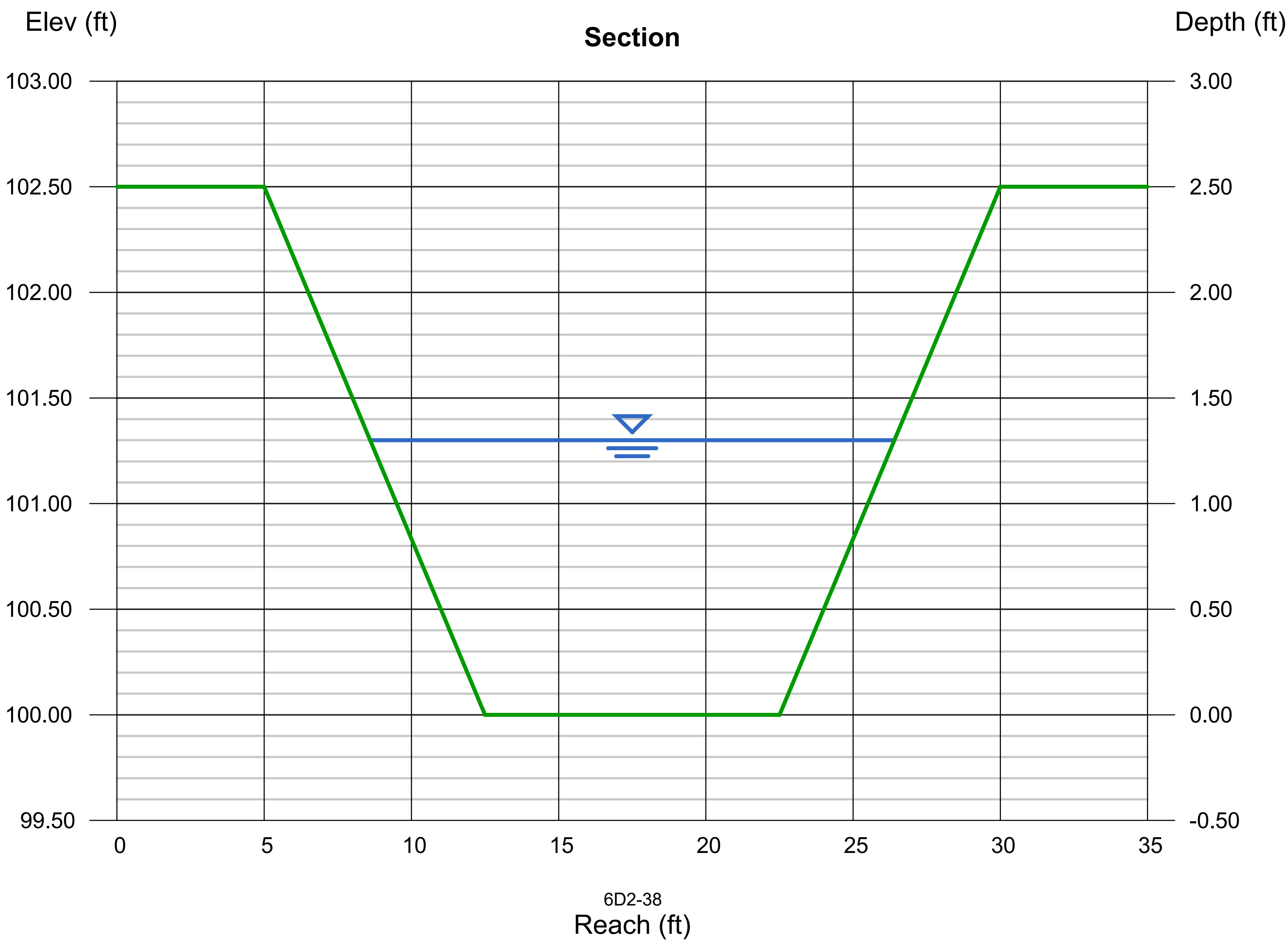
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.95
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 148.90
Total Depth (ft)	= 2.50	Area (sqft)	= 30.91
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.82
Slope (%)	= 0.50	Wetted Perim (ft)	= 22.33
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.61
		Top Width (ft)	= 21.70
Calculations		EGL (ft)	= 2.31
Compute by:	Known Q		
Known Q (cfs)	= 148.90		



Channel Report

Channel 10A 25-yr-24-Hour Storm - Grass

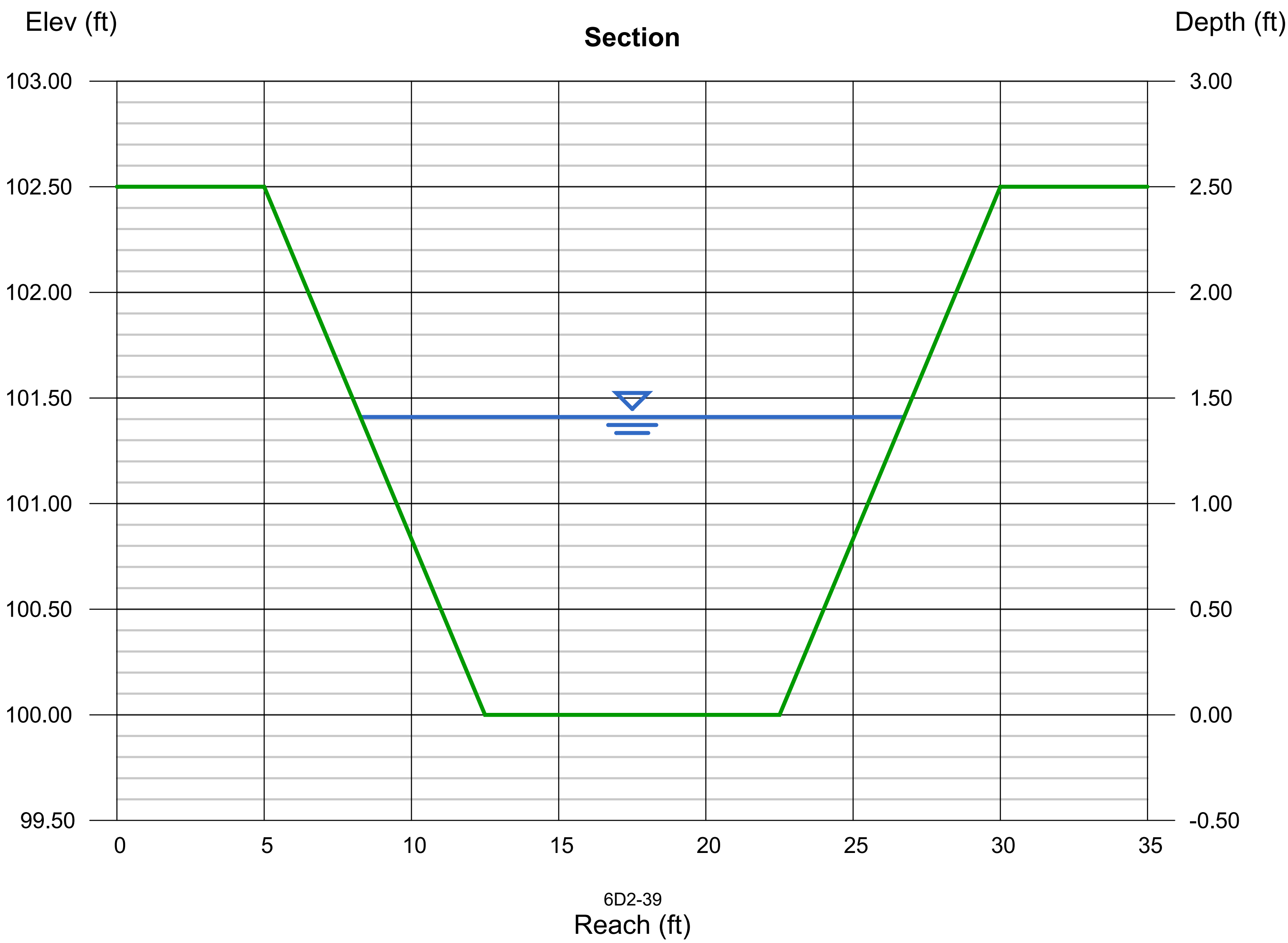
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.30
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 69.90
Total Depth (ft)	= 2.50	Area (sqft)	= 18.07
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.87
Slope (%)	= 0.50	Wetted Perim (ft)	= 18.22
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.04
		Top Width (ft)	= 17.80
Calculations		EGL (ft)	= 1.53
Compute by:	Known Q		
Known Q (cfs)	= 69.90		



Channel Report

Channel 10A 100-yr-24-Hour Storm - Grass

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.41
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 80.60
Total Depth (ft)	= 2.50	Area (sqft)	= 20.06
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.02
Slope (%)	= 0.50	Wetted Perim (ft)	= 18.92
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.13
		Top Width (ft)	= 18.46
Calculations		EGL (ft)	= 1.66
Compute by:	Known Q		
Known Q (cfs)	= 80.60		



Part III
Attachment 6
Appendix 2

EROSION AND SEDIMENTATION CONTROL PLAN

TABLE OF CONTENTS

STATE OF TEXAS
RYAN R. KUNTZ
104689
LICENSED
PROFESSIONAL ENGINEER
10/2/2024

- Where flow velocities are greater than the permissible non-erodible velocities (see Attachment 6, Section 3.3.1);

- Where the erosion potential is greater than 50 tons/acre/year for intermediate cover or 3 tons/acre/year for final cover;

- Where non-structural controls are not effective; or

- Areas identified during cover inspections (see Site Operating Plan [SOP], Section 7.0).

Erosion will be controlled by vegetation on landfill slopes and in drainage structures (interceptor channels and detention ponds) with flow velocities less than or equal to 5 fps. Downchutes installed on final cover will be lined with Reno mattresses or gabions; and perimeter drainage channels will be lined with concrete or grass. Downchutes installed on intermediate cover will be lined with Reno mattresses, riprap, gabions, turf reinforcement, or flexible membrane liner (thickness $\geq$ 40-mil).

For perimeter channels, downchutes, or ponds with exit velocities greater than 5 feet per second, Reno mattresses, gabions, riprap, or dissipation blocks will be installed at the confluence of these structures or downstream of the outlet structures where other armoring is not already in-place. These structures will dissipate the water velocity and energy prior to the confluence with other drainage features or discharging onto adjacent properties.

If erosion is observed within hydraulic structures, based on inspection of on-site structural controls, maintenance of the structural controls will be performed, as described in the SOP, Section 7.0.

erosion. The Landfill Manager will install rock berms using the design criteria shown on Attachment 6F.

5. **Silt Fences and/or Hay Bales:** Silt fences or hay bales can be used to trap sediment suspended in runoff. The maximum drainage area to the fence should not exceed the manufacturer's specification, but in no case should the drainage area be greater than 0.5 acre per 100 feet of fence. Silt fences or hay bales are recommended for temporary or short term control, at which point they should be replaced and more permanent controls installed (i.e., interceptor channels and downchutes). These controls will be installed, as needed, on top dome surfaces, on external embankment slopes, at the toe of soil stockpiles, near property lines, and natural drainage features. Survey control will be used to install silt fences or hay bales at a specified elevation required for erosion control on the landfill slopes. At the discretion of the Landfill Manager, silt fences and hay bales may be installed on intermediate cover in lieu of interceptor channels and downchutes provided the following criteria are met:

    a. They are installed on top domes surfaces (i.e., 5 percent topslopes near the grade break with a 3H:1V sideslope).

    b. The contributing flow length is less than or equal to 220 feet (i.e., 0.5 acre per 100 feet).

    However, in the event the contributing flow length is greater than 220 feet, silt fences and hay bales will be replaced with interceptor channels and downchutes. Attachment 6F includes installation guidelines for silt fences and hay bales. When installing and anchoring silt fences and hay bales, landfill personnel will make sure that the anchoring posts are adequately secured in the intermediate cover. Landfill personnel will routinely inspect silt fence and hay bale anchoring posts and sediment accumulation behind silt fences and hay bales during inspections of landfill cover and BMPs, as described in the SOP, Section 7.0. As a result of these inspections, accumulated sediment will be

5.3 SOIL STOCKPILES AND DAILY COVER EROSION CONTROL PRACTICES

Soil stockpiles and areas with daily cover are typically not vegetated, as these areas remain active for long periods of time. However, it is appropriate to install structural controls/BMPs to reduce erosion and off-site sedimentation from these areas. At a minimum, BMPs will be installed down-gradient of daily cover areas and at the toe of slope of soil stockpiles that have the potential to drain to the perimeter drainage system or landfill property boundary. The site is anticipated to have excess soil stockpiled for operations at the landfill for extended periods; therefore, it will be necessary to vegetate the portion of the soil stockpile that will not be used for more than 180 days to help minimize soil erosion. Any of the BMPs described in Section 5.1.1 may also be installed to reduce erosion and off-site sedimentation.

Additionally, on areas with daily cover that have been inactive for less than 180 days (i.e., not requiring intermediate cover), the Landfill Manager may elect to install silt fences or hay bales on a temporary basis to control erosion and sediment prior to installing the intermediate cover, as described in Section 5.4.

5.4 INTERMEDIATE COVER EROSION CONTROL PRACTICES

Vegetation (i.e., minimum 60 percent vegetative coverage) will be established on intermediate cover within 180 days following application of the intermediate cover. Vegetation will provide a minimum 60 percent ground coverage. When vegetation is being established, landfill personnel will perform cover inspection, as described in the SOP, Section 7.0, and will continue to place seed, mulch, and/or fertilizer until vegetation is established.

A soil loss demonstration for intermediate cover is included in Appendix 2A. This demonstration is discussed in Section 6.1 of this appendix. As discussed in Section 6.1, the soil loss analysis was performed for two scenarios, including (1) intermediate cover with installed silt fences and/or hay bales; and (2) intermediate cover with installed interceptor channels and downchutes. Although, the sideslope length evaluated for both scenarios is 242 horizontal feet (representative of 81 vertical feet on a 3H:1V slope), the topslope length was varied based on the maximum allowable or achievable topslope length contributing to either a silt fence/hay bale or interceptor channel, respectively. Based on the results of the soil loss analysis discussed in Section 6.1 of this appendix, the maximum erosion potential on intermediate cover is less than the permissible soil loss of 50 tons/acre/year for both intermediate cover scenarios.

Additionally, an overland flow velocity demonstration for intermediate cover is included in Appendix 2B. This demonstration was performed for the same flow lengths on the topslope and sideslope, as performed for the soil loss demonstration. This demonstration is described further in Section 7.0 of this appendix. Based on the results of this demonstration, the peak velocity on intermediate cover topslopes and sideslopes will be less than the permissible non-erodible velocity of 3 fps.

Based on the above described demonstrations, silt fences and/or hay bales or interceptor channels and downchutes will be installed on intermediate cover when the external slopes have been constructed to an elevation less than or equal to 81 vertical feet above the landfill berm (i.e., 242 horizontal feet on a 3H:1V sideslope). However, it should be noted, that silt fences may only be installed when the contributing topslope length is less than or equal to 220 feet, as described in Section 5.1.1 of this appendix. If the contributing topslope length is greater than 220 feet, interceptor channels and downchutes will be installed on intermediate cover topslopes. Additionally, interceptor channels and downchutes to be installed on the intermediate are only required on the western aerial fill portion of the landfill, as shown on Attachment 6D1A.

Interceptor channels and downchutes, silt fences, or hay bales will be installed on intermediate cover within 180 days following application of intermediate cover and construction of external embankment sideslopes to an elevation requiring installation of structural controls, as described above. Other structural controls will be installed, as needed, as a result of inspections of the landfill cover and structural controls. These controls will also be evaluated for effectiveness during the inspections.

5.5 FINAL COVER EROSION CONTROL PRACTICES

Final cover will be installed consistent with Attachment 12 - Final Closure Plan. Areas that receive final cover will be vegetated immediately following completion of final cover placement. Vegetation will provide at least 85 percent ground coverage. Vegetation will be established on the final cover consistent with the requirements specified in Section 5.1.1 of this appendix. Following vegetation establishment and certification of closure, landfill personnel will perform final cover inspections and maintenance, as described in the SOP, Section 7.0.

A soil loss demonstration for final cover is included in Appendix 2A as discussed in Section 6.2 of this appendix; and an overland flow velocity demonstration for final cover is included in Appendix 2B, as described in Section 7.0 of this appendix. For the final cover, a typical maximum flow length of 790 feet on the 5 percent topslope and 125 feet on the 3H:1V sideslope (based on the maximum spacing between interceptor channels) was evaluated in the soil loss and overland flow velocity analyses. Based on the results of these analyses, the maximum soil loss on final cover is estimated to be less than 3 tons/acre/year (see Section 6.2 of this appendix); and peak overland flow velocities on the final cover topslopes and sideslopes will be less than the permissible non-erodible velocity of 5 fps.

Therefore, consistent with the drainage design, interceptor channels will be installed on final cover with a maximum spacing of 125 horizontal feet or 42 vertical feet on a 3H:1V sideslope. Interceptor channels and downchutes will be installed on final cover during placement of final cover at the locations shown on Attachment 7.

6.0 SOIL LOSS CALCULATION

TCEQ Solid Waste regulations require an estimation of soil loss to demonstrate erosional stability of the landfill during all phases of operation including the closure and post-closure care period. The USLE was used to calculate the soil loss resulting from runoff contacting the intermediate and final cover. Consistent with TCEQ guidelines ("Guidance for Addressing Erosional Stability During All Phases of Landfill Operation", TCEQ, February 14, 2007), soil loss calculations are only required for top dome surfaces and external embankment sideslopes for both intermediate and final cover phases of landfill operation. The USLE is an empirical equation which estimates soil losses as a result of rainfall and runoff. The USLE was developed by statistical analysis of many plot-years of rainfall, runoff, and sediment loss data from many small plots located around the country. The USLE is supported by the National Resource Conservation Service (NRCS).

The Universal Soil Loss Equation is:

$$A=RKLSCP$$

Where
A = average annual soil loss (tons/acre/year)
R = rainfall and runoff erosivity index for a given location
K = soil erodibility factor
L = slope length factor
S = slope steepness factor
C = cover and management factor
P = erosion control practice factor

Soil loss calculations for intermediate and final cover, with in-place interceptor channels and downchutes, were performed using the standard USLE. However, soil loss calculations for intermediate cover, with in-place silt fences and/or hay bales, were performed using the Revised USLE (RUSLE). The RUSLE was used to estimate soil loss associated with a segmented composite slope, such as the 5 percent topslope and 33.3 percent sideslope since the USLE does not have this capacity. Input parameters for the RUSLE are further described in the intermediate cover soil loss calculations provided in Appendix 2A.

Soil loss calculations for both intermediate and final cover are presented in Appendix 2A.

The soil loss calculations for both intermediate cover scenarios are based on the assumption that vegetation will be established following application of intermediate cover, and that the established vegetation will provide at least 60 percent ground coverage. Additionally, it was conservatively assumed that structural controls, such as interceptor channels, silt fences, or hay bales will be installed on intermediate cover when the external slopes have been constructed to an elevation less than or equal to 81 vertical feet above the landfill berm (i.e., 242 horizontal feet on a 3H:1V sideslope), as described in Section 5.4. Based on the results of the soil loss calculation, the maximum erosion potential on intermediate cover was estimated as follows:

- 35.2 tons/acre/year for both the 220-foot topslope and 242-foot sideslope segments combined (i.e., 462-foot total composite slope) when silt fences and/or hay bales are installed; and

- 2.2 tons/acre/year and 16.2 tons/acre/year for the topslope and sideslope, respectively, when interceptor channels and downchutes are installed.

Therefore, the soil loss potential is less than the permissible soil loss of 50 tons/acre/year for both intermediate cover scenarios.

6.2 FINAL COVER SOIL LOSS

The purpose of calculating the soil loss from final cover is to evaluate the frequency (i.e., spacing between interceptor channels) at which the interceptor channels must be installed to maintain soil loss at less than or equal to 3 tons/acre/year (maximum permissible soil loss recommended by the TCEQ for final cover slopes). Soil loss on the final cover was calculated for the maximum slopes and flow lengths shown in Table 6.2.1 as provided below. These slopes and flow lengths are also depicted on Attachment 6D1B.

For the final cover sideslopes, a typical maximum flow length (on the 3H:1V slope) of 125 feet was used for calculation of the soil loss between interceptor channels. The analysis for the topslope is based on the greatest flow length of 790 feet on the 5 percent topslope. Soil loss calculations for final cover were based on the assumption that vegetation would be established following application of final cover, and that the vegetation would provide at least 85 percent ground coverage.

Based on the results, the maximum erosion potential of the final cover was estimated to be 0.48 tons/acre/year and 2.24 tons/acre/year on the topslope and sideslope, respectively.

7.0 OVERLAND FLOW VELOCITY

As described in Attachment 6, Section 2.4, the time of concentration for sheet flow and/or shallow concentrated flow was calculated using equations referenced from the City of Austin's Drainage Criteria Manual. However, a separate analysis was performed to evaluate overland flow velocities on intermediate and final cover topslopes and sideslopes. Overland flow is defined as the combination of sheet flow and shallow concentrated flow. Calculated overland flow velocities were compared to the permissible non-erosive, as defined in Attachment 6, Section 3.3.1.

For this analysis, it was conservatively assumed that sheet flow occurs at lengths less than 100 feet consistent with Technical Release 55 (TR-55), developed by the Natural Resources Conservation Service, whereas shallow concentrated flow begins at lengths greater than 100 feet. The time-of-concentration for sheet flow on the landfill slopes was analyzed using Kinematic Wave procedures, which are referenced from TR-55. Sheet flow velocity is defined as the ratio of the sheet flow length to the sheet flow time of concentration.

The shallow concentrated flow velocity was analyzed by calculating the shallow concentrated flow depth, which was derived from Manning's Equation (see Appendix 4, page 4-2). Based on this derivation, it has been demonstrated that the shallow concentrated flow velocity can be calculated from the ratio of the peak flow rate and flow depth. The peak flow rate was calculated using the Rational Method.

These methods were performed to demonstrate that the overland flow velocity on intermediate and final cover slopes will be below 3 fps and 5 fps, respectively. The greatest potential slopes and flow lengths for both intermediate and final cover topslopes and sideslopes, as shown in Table 6.2.1, were evaluated. The flow lengths provided in Table 6.2.1 were selected to maintain velocities less than permissible non-erosive velocities or maintain soil loss less than the permissible soil loss limits (see Section 6.0 of this appendix). Interceptor channels will be installed to maintain these maximum flow lengths on both intermediate and final cover.

Sample calculations for overland flow velocity on intermediate and final topslope and sideslope areas are presented in Appendix 2B. As presented in the calculations, flow velocities will be maintained less than the maximum permissible non-erosive velocities for the respective vegetated cover.

TABLE 6.2.1
SLOPES AND FLOW LENGTHS

Cover Phase	Structural Controls	Topslope		Sideslope	
		Slope	Flow Length	Slope	Flow Length
Intermediate Cover	Silt Fences/Hay Bales	5 percent	220 feet	33.3 percent	242 feet
Intermediate Cover	Interceptor Channels & Downchutes	5 percent	790 feet	33.3 percent	242 feet
Final Cover	Interceptor Channels & Downchutes	5 percent	790 feet	33.3 percent	125 feet

Notes:
[1] Flow lengths are the maximum distances between structural controls for both intermediate and final cover.
[2] The maximum flow length up-gradient of a silt fence and/or hay bale is 220 feet, as specified in Section 5.1.1 of this appendix.

APPENDIX 2A
SOIL LOSS ANALYSIS

INTERMEDIATE COVER
SOIL LOSS ANALYSIS

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - SOIL LOSS ANALYSIS
SILT FENCES AND/OR HAY BALES

Required: Evaluate the expected soil loss from the intermediate cover consistent with 30 TAC §330.305(d)(2). This soil loss estimate represents the scenario when silt fences and/or hay bales are installed at the grade break between the topslope and sideslope. This evaluation includes the combined soil loss from an uninterrupted topslope and sideslope with intermediate cover, using the Revised Universal Soil Loss Equation (RUSLE) for segmented slopes.

Method: The expected soil loss is calculated using the RUSLE, since the slope and length factors differ for the topslope and sideslope segments of the composite landfill slope. The annual soil loss is calculated for each segment and the total annual soil loss is calculated over the total composite slope. This total annual soil loss is compared to the permissible soil loss of 50 tons/acre/year for intermediate cover; as referenced from the TCEQ's "Guidance for Addressing Erosional Stability During all Phases of Landfill Operation", as prepared February 14, 2007.

References:
1. Soil Conservation Service National Engineering Handbook, Section 3 - Sedimentation, Chapter 3 - Erosion.
2. TNRCC, *Use of the USLE in Final Cover/Configuration Design, 1993.*
3. United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Maverick County, Texas.*
4. Haan, Barfield, and Hayes; *Design Hydrology and Sedimentology for Small Catchments;* Academic Press, 1994.
5. TCEQ, *Guidance for Addressing Erosional Stability During all Phases of Landfill Operation", February 14, 2007.*

Note: All reference material referred to in these calculations is provided in Appendix 3A.

Solution:

1. **Revised Soil Loss Equation for Segmented Slopes (see reference Page 3A-11):**

$$A_i = RK_iC_iP_iS_i\left[\frac{\lambda_i^{m+1} - \lambda_{i-1}^{m+1}}{(\lambda_i - \lambda_{i-1})72.6^m}\right]$$

Where:	A_i =	Soil loss from the ith segment (tons/ac/yr)
	R =	Rainfall factor
	K_i =	Soil erodibility factor for the ith segment.
	C_i =	Plant cover for ith segment.
	P_i =	Erosion control practice factor for the ith segment
	S_i =	Slope steepness factor
	m =	exponent related to the rill/interrill ratio
	λ_i =	Slope length at start of segment, i.
	λ_{i-1} =	Slope length at end of segment, i.

Note: λ and m variables above are used to calculate a slope length factor for each segment. R, K, C, and P are constant for both the topslope and sideslope segments.

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - SOIL LOSS ANALYSIS
SILT FENCES AND/OR HAY BALES

Rainfall Factor:

The rainfall factor, R, represents the average intensity for the maximum intensity, 30 minute storms over a 22 year period of record compiled by the SCS. Using Figure 1, Average Annual Values of the R Factor **(see page 3A-6)**, the R factor for Maverick Co., Texas is:

R = 180 (applicable for topslope and sideslope segments)

Soil Erodibility Factor

The soil erodibility, K, factor represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assuming soils at the characteristic of a sandy clay loam to sandy loam with an organic matter content of 4%, from Table 1 - Approximate Values of Factor K **(see page 3A-7)**, the K factor for the area is:

K = 0.2 (applicable for topslope and sideslope segments)

Plant Cover and Management Factor:

The plant cover or cropping management factor, C, represents the percentage of soil loss that would occur if the surface were partially protected by some combination of cover and management practices. Use of Table 2, Factor C for Permanent Pasture, Range, and Idle Land **(see page 3A-8)** for **60% vegetation cover** with no appreciable canopy yields the desired C value.

C = 0.042 (applicable for topslope and sideslope segments)

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration, and runoff velocity. It was conservatively assumed that silt fences and/or hay bales on intermeidate cover would not reduce soil loss, therefore, the P value is:

P = 1.00 (applicable for topslope and sideslope segments)

Slope Length and Slope Steepness Factors

The impact on erosion, due to both the slope steepness factor and slope length factor are calculated below. The slope length on the 5 percent topslope up-gradient of a silt fence or hay bale may not exceed 220 feet. The slope length on a 33.3 percent sideslope with intermediate cover is depicted on Attachment 6D1A.

1. Topslope, Segment i_1:

slope =	5	%
m =	0.4	
length, λ =	220	ft
θ =	0.05	radians

2. Sideslope, Segment i_2

slope =	33.3	%
m =	0.667	
length, λ =	242	ft
θ =	0.32	radians

The slope length exponent, m, is based on a moderate rill/interrill ratio (see reference page 3A-12)

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - SOIL LOSS ANALYSIS
SILT FENCES AND/OR HAY BALES

Slope Steepness Factor Calculations (see reference Page 3A-10):

$S_i =$ 10.8sinθ +0.03 for sinθ < 0.09
$S_i =$ 16.8sinθ -0.50 for sinθ ≥ 0.09

$S_{i1} =$ 0.57 (topslope)

$S_{i2} =$ 4.81 (sideslope)

Length Factor Calculations (see reference Page 3A-11):

$$L = \left[\frac{\lambda_i^{m+1} - \lambda_{i-1}^{m+1}}{(\lambda_i - \lambda_{i-1})72.6^m} \right]$$

Segment	λ_i	λ_{i-1}	m_i	L_i
Topslope, i_1	0	220	0.4	1.56
Sideslope, i_2	220	462	0.667	4.66

2. **Revised Universal Soil Loss Calculations:**

Slope Segment	R	K_i	C_i	P_i	S_i	L_i	A_i (tons/ac/yr)
Topslope, Segment i_1 5% slope 220 ft length	180	0.2	0.042	1.00	0.57	1.56	1.34
Sideslope, Segment i_2 22.2% slope 242 ft length	180	0.2	0.042	1.00	4.81	4.66	33.84

$A_{(i1+i2)}$	=	1.34	+	33.84	=	35.18

Conclusion:

The above soil loss calculations were conservatively performed assuming no reduction in soil loss from the topslope when silt fences or hay bales are installed at the grade break of the landfill. These structures will actually reduce the soil loss to an amount less than shown in this calculation when installed and maintained properly. The total soil loss of 35.18 tons/acre/year is for erosion over the topslope and sideslope combined. As shown, this soil loss is less than the permissible soil loss of 50 tons/acre/year. The County will install silt fences or hay bales on intermediate cover, as specified in Attachment 6, Appendix 2, Section 5.1.1 to reduce erosion from intermediate cover. The inspection and maintenance of intermediate cover and the respective BMPs are described in the Site Operating Plan, Section 7.0.

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - SOIL LOSS ANALYSIS
INTERCEPTOR CHANNELS AND DOWNCHUTES

Required: Determine expected soil loss for the landfill topslope and sideslope final cover consistent with 30 TAC §330.305(d)(2). The soil loss estimate represents the scenario when interceptor channels and downchutes are installed on intermediate cover.

Method: Expected soil loss is calculated using the Universal Soil Loss Equation. The annual soil loss calculated for intermediate cover conditions is compared to the permissible soil loss of 50 tons/acre/year; as referenced from the TCEQ's "Guidance for Addressing Erosional Stability During all Phases of Landfill Operation", as prepared February 14, 2007.

References:

1. SCS National Engineering Handbook, Section 3 - Sedimentation, Chapter 3 - Erosion.
2. TNRCC, *Use of the USLE in Final Cover/Configuration Design, 1993.*
3. United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Maverick County, Texas.*
4. United States Environmental Protection Agency, *Solid Waste Disposal Facility Criteria Technical Manual, 1993.*
5. TCEQ, *Guidance for Addressing Erosional Stability During all Phases of Landfill Operation, February 14, 2007.*

Note: All reference material referred to in these calculations is provided in Appendix 3A.

Solution:

1. **Soil loss equation:** A = RKLSCP

Where:

A =	Soil Loss (tons/ac/yr)
R =	Rainfall/Runoff Factor
K =	Soil Erodibility Factor
L =	Slope Length Factor
S =	Slope Steepness Factor
C =	Cover and Management Factor
P =	Erosion Control Practice Factor

Rainfall Factor:

The rainfall factor, R, represents the average intensity for 30-minute storms over a 22-year period of records compiled by the SCS. Using Figure 1 - Average Annual Values of the R Factor (**see page 3A-6**), the R factor for Maverick County, Texas is:

R = 180

Soil Erodibility Factor

The soil erodibility, K, factor represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assuming soils at the landfill are characteristic of a sandy clay loam to sandy loam with an organic matter content of 4%, from Table 1 - Approximate Values of Factor K **(see page 3A-7)**, the K factor for the area is:

K = 0.2 (average K value)

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - SOIL LOSS ANALYSIS
INTERCEPTOR CHANNELS AND DOWNCHUTES

Slope Length and Slope Steepness Factors

The slope length factor, L, and slope steepness factor, S, represents the erosion of the soil due to both slope length and degree of slope. The slope lengths on a 5 percent topslope and 33.3 percent sideslope are depicted on Attachment 6D1A. These lengths represent the longest flow paths above and below an interceptor channel installed near the landfill grade break of the west hill.

Topslope Conditions			Sideslope Conditions		
slope =	5	%	slope =	33.3	%
length, λ =	790	ft	length, λ =	242	ft
m =	0.4		m =	0.667	
θ =	0.05	radians	θ =	0.32	radians

The slope length exponent, m, is based on a moderate rill/interrill erosion ratio (see reference Page 3A-12).

Slope Length Factor Calculations (see reference Page 3A-10):
Using the following equation, L is determined.

$$L = \left(\frac{\lambda}{72.6} \right)^m$$

Topslope, L = 2.60 Sideslope, L = 2.23

Slope Steepness Factor Calculations (see reference Page 3A-10):

S =	10.8sinθ +0.03	for	sinθ < 0.09
S =	16.8sinθ -0.50	for	sinθ ≥ 0.09

Topslope, S = 0.57 Sideslope, S = 4.81

Plant Cover and Management Factor:

The cover and cropping management factor, C, represents the percentage of soil loss that would occur if the surface were partially protected by some combination of cover and management practices. Using of Table 2 - Factor C for Permanent Pasture, Range, and Idle Land **(see page 3A-8)** for **<u>60% vegetation cover</u>** with no appreciable canopy yields the desired C value.

C = 0.042

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration, and runoff velocity. It was conservatively assumed that interceptor would not further reduce the soil loss. Therefore, the P factor is:

P = 1.00

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER - SOIL LOSS ANALYSIS
INTERCEPTOR CHANNELS AND DOWNCHUTES

2. Universal Soil Loss Calculations:

Slope Condition	R	K	L	S	C	P	A (tons/ac/yr)
5% slope 790 ft length	180	0.20	2.60	0.57	0.042	1.00	2.2
33.3% slope 242 ft length	180	0.20	2.23	4.81	0.042	1.00	16.2

Conclusions:

The above soil loss calculations represent the scenario when interceptor channels and downchutes will be installed on intermediate cover. Interceptor channels will be installed when the topslope length exceeds 220 feet and will be installed on the sideslope near the grade break between the topslope and sideslope. As shown, the soil loss for both the topslope and sideslope is less than the permissible soil loss of 50 tons/acre/year. The County will install interceptor channels and downchutes on intermediate cover, as specified in Appendix 2, Section 5.1.1 to reduce erosion from intermediate cover. The inspection and maintenance of intermediate cover and the respective BMPs are described in Site Operating Plan, Section 7.0.

FINAL COVER
SOIL LOSS ANALYSIS

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER - SOIL LOSS ANALYSIS

Required: Determine expected soil loss for the landfill topslope and sideslope final cover consistent with 30 TAC §330.305(d)(2).

Method: Expected soil loss is calculated using the Universal Soil Loss Equation. The annual soil loss calculated for final cover conditions is compared to the permissible soil loss of 3 tons/acre/year; as referenced from the TCEQ's "Guidance for Addressing Erosional Stability During all Phases of Landfill Operation", as prepared February 14, 2007.

References:
1. SCS National Engineering Handbook, Section 3 - Sedimentation, Chapter 3 - Erosion.
2. TNRCC, *Use of the USLE in Final Cover/Configuration Design, 1993.*
3. United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Maverick County, Texas.*
4. United States Environmental Protection Agency, *Solid Waste Disposal Facility Criteria Technical Manual, 1993.*
5. TCEQ, *Guidance for Addressing Erosional Stability During all Phases of Landfill Operation, February 14, 2007.*

Note: All reference material referred to in these calculations is provided in Appendix 3A.

Solution:

1. **Soil loss equation:** A = RKLSCP

Where:
A = Soil Loss (tons/ac/yr)
R = Rainfall/Runoff Factor
K = Soil Erodibility Factor
L = Slope Length Factor
S = Slope Steepness Factor
C = Cover and Management Factor
P = Erosion Control Practice Factor

Rainfall Factor:

The rainfall factor, R, represents the average intensity for 30-minute storms over a 22-year period of records compiled by the SCS. Using Figure 1 - Average Annual Values of the R Factor (**see page 3A-6**), the R factor for Maverick County, Texas is:

R = 180

Soil Erodibility Factor

The soil erodibility, K, factor represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. Assuming soils at the landfill are characteristic of a sandy clay loam to sandy loam with an organic matter content of 4%, from Table 1 - Approximate Values of Factor K **(see page 3A-7)**, the K factor for the area is:

K = 0.2 (average K value)

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER - SOIL LOSS ANALYSIS

Slope Length and Slope Steepness Factors

The slope length factor, L, and slope steepness factor, S, represents the erosion of the soil due to both slope length and degree of slope. For topslope conditions the length represents the longest flow path on a 5 percent topslope, while for sideslope conditions, the length represents the maximum flow path between interceptor channels on the sideslopes.

Topslope Conditions			Sideslope Conditions		
slope =	5	%	slope =	33.3	%
length, λ =	790	ft	length, λ =	125	ft
m =	0.4		m =	0.667	
θ =	0.05	radians	θ =	0.32	radians

The slope length exponent, m, is based on a moderate rill/interrill erosion ratio (see reference Page 3A-12).

Slope Length Factor Calculations (see reference Page 3A-10):
Using the following equation, L is determined.

$$L = \left(\frac{\lambda}{72.6}\right)^m$$

Topslope, L = 2.60 Sideslope, L = 1.44

Slope Steepness Factor Calculations (see reference Page 3A-10):

S =	$10.8\sin\theta + 0.03$	for	$\sin\theta < 0.09$
S =	$16.8\sin\theta - 0.50$	for	$\sin\theta \geq 0.09$

Topslope, S = 0.57 Sideslope, S = 4.81

Plant Cover and Management Factor:

The cover and cropping management factor, C, represents the percentage of soil loss that would occur if the surface were partially protected by some combination of cover and management practices. Using of Table 2 - Factor C for Permanent Pasture, Range, and Idle Land **(see page 3A-8)** for **85% vegetation cover** with no appreciable canopy yields the desired C value.

C = 0.009

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration, and runoff velocity. It was conservatively assumed that interceptor would not further reduce the soil loss. Therefore, the P factor is:

P = 1.00

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER - SOIL LOSS ANALYSIS

2. Universal Soil Loss Calculations:

Slope Condition	R	K	L	S	C	P	A (tons/ac/yr)
5% slope 790 ft length	180	0.20	2.60	0.57	0.009	1.00	0.48
33.3% slope 125 ft length	180	0.20	1.44	4.81	0.009	1.00	2.24

Conclusions:

Based on the soil loss calculations for final cover, the estimated soil loss on the topslope and sideslope is below the permissible soil loss of 3 tons/acre/year for final cover, consistent with TCEQ's guidance document for addressing erosional stability during all phases of landfill operation.

APPENDIX 2B
OVERLAND FLOW VELOCITY ANALYSIS

INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

Required:

Calculate the peak velocity on intermediate sideslopes and topslopes. Compare calculated peak velocities to permissible non-erodible flow velocity for intermediate cover.

Method:

1. Determine the time of concentration (t_C) and velocity using the Manning's Kinematic Solution for sheet flow on intermediate cover.
2. Determine the shallow concentrated flow velocity on intermediate cover using a derivation of Manning's Equation.
3. Compare peak velocity to permissible non-erodible velocity.

References:

1. Texas Department of Transportation, *Bridge Division Hydraulic Manual* , November 2004.
2. Natural Resouces Conservation Service, *Urban Hydrology for Small Watersheds* , *Technical Release 55* , Junes 1986.

Solution:

Calculate the expected peak overland flow velocity on the intermediate cover, using the above method, for both Case 1 - 270-foot Intermediate Sideslope and Case 2 - 790-foot Intermediate Topslope.

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

Case 1: 270-foot Intermediate Sideslope:

1. Determine the time of concentration (t_C) and velocity using the Manning's Kinematic Solution for sheet flow for intermediate sideslopes.

Sheet Flow Velocity:

Sheet Flow Length = 100 ft
Slope = 0.333 ft/ft

Sheet Flow Time of Concentration Equation:

$$t_c = \frac{0.007(nL)^{0.8}}{(P_{25,24})^{0.5}S^{0.4}}$$

Where:
t_c = sheet flow time of concentration (hr)
n = Manning's roughness coefficient
L = slope length
$P_{25,24}$ = 25-year, 24-hour rainfall depth (in)
S = slope (ft/ft)

Sheet Flow Velocity Equation:

$$V = \frac{L}{60t_c}$$

Where:
V = sheet flow velocity (fps)
t_c = sheet flow time of concentration (min)
L = sheet flow length (ft)

Calculate t_c:

n = 0.09 (See Appendix 4, page 4-9, 60 percent of a surface roughness for short grass, consistent with a minimum of 60 percent vegetation on intermediate cover)
L = 100
$P_{25,24}$ = 7.86
S = 0.333

t_c =	0.022	hr
	1.35	min

Calculate the sheet flow velocity:

L = 100
t_c = 1.35

V =	1.24	fps

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

2. Determine the shallow concentrated flow velocity on the sideslopes using a derivation of Manning's Equation.

Shallow Concentrated Flow Velocity:

Shallow Concentrated Flow Length = 170 ft
Slope = 0.333 ft/ft

Rational Method Equation:

$$Q = CiA$$

Where:
- Q = flow rate (cfs)
- C = runoff coefficient
- i = rainfall intensity (in/hr)
- A = drainage area (ac)

Intensity Equation:

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

Where:
- i = rainfall intensity (in/hr)
- b = Constant for Maverick County = 168
- d = Constant for Maverick County = 15.0
- e = Constant for Maverick County = 0.879
- t_c = time of concentration (min) (noted below)

Time of Concentration Equation:

$$t_c = \frac{L}{V} = 1.19 \text{ min}$$

Calculate peak flow rate:

C =	0.77		
t_c =	1.19	min	(see note below)
i =	14.48	in/hr	
A =	0.0039	ac	(A = L/43560, see Appendix 4, page 4-3)

$$\boxed{Q = 0.044 \text{ cfs}}$$

Note: (t_c is solved through trial and error by manually adjusting the value for the time of concentration until the ratio of length to velocity and t_c to reach the peak flow rate, as calculated using the Rational Method, are equal)

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

Calculate approximate depth of flow derived from Manning's Equation (see attached derivation, Appendix 4, page 4-2):

$$d = \left(\frac{Qn}{1.49 S^{0.5}} \right)^{0.6}$$

Q =	0.044	cfs
n =	0.025	(Manning's n for channel flow, conservative)
S =	0.333	ft/ft

d =	0.018	ft	=	0.22	in

Calculate shallow concentrated flow velocity:

$$V = \frac{Q}{d}$$ **(see Appendix 4, page 4-3)**

V =	2.38	fps

3. Compare peak velocity to permissible non-erodible velocity.

Case 1 Conclusion:

The peak velocity on the sideslope is associated with the shallow concentrated flow component of overland flow. The calculated sideslope shallow concentrated flow velocity is less than the permissible non-erodible velocity of 3.0 ft/s on intermediate cover, as discussed in Attachment 6, Section 3.3.1. Therefore, the expected peak velocity is acceptable on the intermediate sideslopes provided interceptor channels, silt fences, or hay bales are installed as specified in Attachment 6, Appendix 2, Section 5.1.1.

Case 2: 790-foot Intermediate Topslope:

1. Determine the time of concentration (t_C) and velocity using the Manning's Kinematic Solution for sheet flow for intermediate topslopes.

Sheet Flow Velocity:

Sheet Flow Length =	100	ft
Slope =	0.05	ft/ft

Sheet Flow Time of Concentration Equation:

$$t_c = \frac{0.007(nL)^{0.8}}{(P_{25,24})^{0.5} S^{0.4}}$$ **(as described above)**

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

Sheet Flow Velocity Equation:

$$V = \frac{L}{60t_c}$$ **(as described above)**

Calculate t_c:

n =	0.09	**(as described above)**
L =	100	
$P_{25,24}$ =	7.86	
S =	0.05	

t_c =	0.048	hr
	2.88	min

Calculate the sheet flow velocity:

L =	100
t_c =	2.88

V =	0.58	fps

2. Determine the shallow concentrated flow velocity on the topslopes using a derivation of Manning's Equation.

<u>Shallow Concentrated Flow Velocity:</u>

Shallow Concentrated Flow Length =	690	ft
Slope =	0.05	ft/ft

Rational Method Equation:

Q = CiA **(as described above)**

Where:	Q =	flow rate (cfs)
	C =	runoff coefficient
	i =	rainfall intensity (in/hr)
	A =	drainage area (ac)

Intensity Equation:

$$i = b / (t_c + d)^e$$ **(as described above)**

Time of Concentration Equation:

$$t_c = \frac{L}{V} = 5.26 \text{ min}$$

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
INTERMEDIATE COVER
OVERLAND FLOW VELOCITY

Calculate peak flow rate:

C =	0.77		
t_c =	5.26	min	(see note below)
i =	11.89	in/hr	
A =	0.0158	ac	(A = L/43560)

Q =	0.145	cfs

Note: (t_c is solved through trial and error by manually adjusting the value for the time of concentration until the ratio of length to velocity and t_c to reach the peak flow rate, as calculated using the Rational Method, are equal)

Calculate approximate depth of flow derived from Manning's Equation (see attached derivation):

$$d = \left(\frac{Qn}{1.49 S^{0.5}} \right)^{0.6}$$

Q =	0.145	cfs
n =	0.025	(Manning's n for channel flow, conservative)
S =	0.05	ft/ft

d =	0.066	ft	=	0.80	in

Calculate shallow concentrated flow velocity:

$$V = \frac{Q}{d}$$

V =	2.18	fps

3. Compare peak velocity to permissible non-erodible velocity.

Case 2 Conclusion:

The peak velocity on the topslope is associated with the shallow concentrated flow component of overland flow. The calculated topslope shallow concentrated flow velocity is less than the permissible non-erodible velocity of 3.0 ft/s on intermediate cover, as discussed in Attachment 6, Section 3.3.1. Therefore, the expected peak velocity is acceptable on the intermediate topslopes.

FINAL COVER
OVERLAND FLOW VELOCITY

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER
OVERLAND FLOW VELOCITY

Required:

Calculate the peak velocity on final cover sideslopes and topslopes. Compare calculated peak velocities to permissible non-erodible flow velocity for final cover.

Method:

1. Determine the time of concentration (t_C) and sheet flow velocity on final cover using the Manning's Kinematic Solution.
2. Determine the shallow concentrated flow velocity on final cover using a derivation of Manning's Equation.
3. Compare peak velocity to permissible non-erodible velocity.

References:

1. Texas Department of Transportation, *Bridge Division Hydraulic Manual* , November 2004.
2. Natural Resouces Conservation Service, *Urban Hydrology for Small Watersheds* , *Technical Release 55* , Junes 1986.

Solution:

Calculate the expected peak overland flow velocity on the final cover, using the above methods, for both Case 1 - 125-foot Final Cover Sideslope and Case 2 - 750-foot Final Cover Topslope.

Note: The sideslope length is the greatest spacing between interceptor channels on final cover, and the topslope length is the greatest flow length on the final cover topslope.

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER
OVERLAND FLOW VELOCITY

Case 1: 125-foot Final Cover Sideslope:

1. Determine the time of concentration (t_C) and sheet flow velocity on final cover sideslopes using the Manning's Kinematic Solution.

Sheet Flow Velocity:

Sheet Flow Length = 100 ft
Slope = 0.333 ft/ft

Sheet Flow Time of Concentration Equation:

$$t_c = \frac{0.007(nL)^{0.8}}{(P_{25,24})^{0.5} S^{0.4}}$$

Where:
t_c = sheet flow time of concentration (hr)
n = Manning's roughness coefficient
L = slope length
$P_{25,24}$ = 25-year, 24-hour rainfall depth (in)
S = slope (ft/ft)

Sheet Flow Velocity Equation:

$$V = \frac{L}{60t_c}$$

Where:
V = sheet flow velocity (fps)
t_c = sheet flow time of concentration (min)
L = sheet flow length (ft)

Calculate t_c:

n = 0.15 (**See Appendix 4, page 4-9**, surface roughness for short grass)
L = 100
$P_{25,24}$ = 7.86
S = 0.333

t_c =	0.034	hr
	2.03	min

Calculate the sheet flow velocity:

L = 100
t_c = 2.03

V =	0.82	fps

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER
OVERLAND FLOW VELOCITY

2. Determine the shallow concentrated flow velocity on the sideslopes using a derivation of Manning's Equation.

Shallow Concentrated Flow Velocity:

Shallow Concentrated Flow Length = 25 ft
Slope = 0.333 ft/ft

Rational Method Equation:

$$Q = CiA$$

Where:
- Q = flow rate (cfs)
- C = runoff coefficient
- i = rainfall intensity (in/hr)
- A = drainage area (ac)

Intensity Equation:

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

Where:

i =	rainfall intensity (in/hr)		
b =	Constant for Maverick County	=	168
d =	Constant for Maverick County	=	15.0
e =	Constant for Maverick County	=	0.879
t_c =	time of concentration (min) (noted below)		

Time of Concentration Equation:

$$t_c = \frac{L}{V} = 0.37 \text{ min}$$

Calculate peak flow rate:

C =	0.77		
t_c =	0.37	min	(see note below)
i =	15.16	in/hr	
A =	0.0006	ac	(A = L/43560, see Appendix 4, page 4-3)

$$\boxed{Q = 0.007 \text{ cfs}}$$

Note: (t_c is solved through trial and error by manually adjusting the value for the time of concentration until the ratio of length to velocity and t_c to reach the peak flow rate, as calculated using the Rational Method, are equal)

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER
OVERLAND FLOW VELOCITY

Calculate approximate depth of flow derived from Manning's Equation (see attached derivation, Appendix 4, page 4-2):

$$d = \left(\frac{Qn}{1.49 S^{0.5}} \right)^{0.6}$$

Q =	0.007	cfs
n =	0.025	(Manning's n for channel flow, conservative)
S =	0.333	ft/ft

d =	0.006	ft	=	0.07	in

Calculate shallow concentrated flow velocity:

$$V = \frac{Q}{d}$$ **(see Appendix 4, page 4-3)**

V =	1.13	fps

3. Compare peak velocity to permissible non-erodible velocity.

Case 1 Conclusion:

The peak velocity on the sideslope is associated with the shallow concentrated flow component of overland flow. The calculated sideslope shallow concentrated flow velocity is less than the permissible non-erodible velocity of 5.0 ft/s for final cover slopes, as discussed in Attachment 6, Section 3.3.1.

Case 2: 750-foot Final Cover Topslope:

1. Determine the time of concentration (t_C) and sheet flow velocity on final cover topslopes using the Manning's Kinematic Solution.

Sheet Flow Velocity:

Sheet Flow Length =	100	ft
Slope =	0.05	ft/ft

Sheet Flow Time of Concentration Equation:

$$t_c = \frac{0.007(nL)^{0.8}}{(P_{25,24})^{0.5} S^{0.4}}$$ **(as described above)**

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER
OVERLAND FLOW VELOCITY

Sheet Flow Velocity Equation:

$$V = \frac{L}{60t_c}$$ **(as described above)**

Calculate t_c:

n =	0.15	**(as described above)**
L =	100	
$P_{25,24}$ =	7.86	
S =	0.05	

t_c =	0.072	hr
	4.33	min

Calculate the sheet flow velocity:

L =	100
t_c =	4.33

V =	0.38	fps

2. Determine the shallow concentrated flow velocity on the topslopes using a derivation of Manning's Equation.

<u>Shallow Concentrated Flow Velocity:</u>

Shallow Concentrated Flow Length =	650	ft
Slope =	0.05	ft/ft

Rational Method Equation:

$Q = CiA$ **(as described above)**

Where:	Q =	flow rate (cfs)
	C =	runoff coefficient
	i =	rainfall intensity (in/hr)
	A =	drainage area (ac)

Intensity Equation:

$i = b / (t_c + d)^e$ **(as described above)**

Time of Concentration Equation:

$$t_c = \frac{L}{V} = 5.06 \text{ min}$$

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316
FINAL COVER
OVERLAND FLOW VELOCITY

Calculate peak flow rate:

C =	0.77		
t_c =	5.06	min	(see note below)
i =	12.00	in/hr	
A =	0.0149	ac	(A = L/43560)

Q =	0.138	cfs

Note: (t_c is solved through trial and error by manually adjusting the value for the time of concentration until the ratio of length to velocity and t_c to reach the peak flow rate, as calculated using the Rational Method, are equal)

Calculate approximate depth of flow derived from Manning's Equation (see attached derivation):

$$d = \left(\frac{Qn}{1.49 S^{0.5}} \right)^{0.6}$$

Q =	0.138	cfs
n =	0.025	(Manning's n for channel flow, conservative)
S =	0.05	ft/ft

d =	0.064	ft	=	0.77	in

Calculate shallow concentrated flow velocity:

$$V = \frac{Q}{d}$$

V =	2.14	fps

3. Compare peak velocity to permissible non-erodible velocity.

Case 2 Conclusion:
The peak velocity on the final cover topslope is associated with the shallow concentrated flow component of overland flow. The calculated topslope shallow concentrated flow velocity is less than the permissible non-erodible velocity of 5.0 ft/s on final cover, as discussed in Attachment 6, Section 3.3.1.

Part III

Attachment 6

Appendix 3A

REFERENCE MATERIAL:
SOIL SURVEY MAP AND DESCRIPTION
AND
USLE/RUSLE REFERENCES

Table 8.6 Slope Length Exponent m in Eq. (8.43) (after McCool *et al.*, 1993)[a]

Percentage slope	Rill/interrill ratio		
	Low[b]	Moderate[c]	High[d]
0.2	0.02	0.04	0.07
0.5	0.04	0.08	0.16
1.0	0.08	0.15	0.26
2.0	0.14	0.24	0.39
3.0	0.18	0.31	0.47
4.0	0.22	0.36	0.53
$\boxed{5.0}$	0.25	$\boxed{0.40}$	0.57
6.0	0.28	0.43	0.60
8.0	0.32	0.48	0.65
10.0	0.35	0.52	0.68
12.0	0.37	0.55	0.71
14.0	0.40	0.57	0.72
16.0	0.41	0.59	0.74
20.0	0.44	0.61	0.76
22.2			M=0.625
25.0	0.47	0.64	0.78
30.0	0.49	0.66	0.79
33.3			M=0.667
40.0	0.52	0.68	0.81
50.0	0.54	0.70	0.82
60.0	0.55	0.71	0.83

[a] Values in table are not applicable to thawing soils. See text for explanation.
[b] β = 1/2 value from Eq. (8.45) in Eq. (8.44).
[c] β = 1 × value from Eq. (8.45) in Eq. (8.44).
[d] β = 2 × value from Eq. (8.45) in Eq. (8.44).

would be $A_i(\lambda_i - \lambda_{i-1})$, and the average erosion per unit area over the entire slope length would be

$$A = R\sum_{i=1}^{n} K_i C_i P_i S_i \frac{\left[\lambda_i^{m+1} - \lambda_{i-1}^{m+1}\right]}{\lambda_e 72.6^m}, \qquad (8.47)$$

where λ_e is the total slope length. Equation (8.47) can also be used to evaluate the effects of variation in K, C, and P over the slope length.

An alternate method for evaluating irregular slopes is the use of a slope length adjustment factor (SAF). If the slope is divided into n increments of equal length ΔX, then

$$A = R\sum_{i=1}^{n} K_i C_i P_i S_i \frac{\left[(i\,\Delta X)^{m+1} - ([i-1]\,\Delta X)^{m+1}\right]}{n\,\Delta X\, 72.6^m}. \qquad (8.48)$$

Dividing by n times the soil loss from a uniform slope of equal length and assuming constant values of K_i C_i P_i along the slope, a slope adjustment factor can be developed for each segment, or

$$\mathrm{SAF}_i = \frac{A_i}{A} = \frac{i^{m+1} - (i-1)^{m+1}}{n^m}, \qquad (8.49)$$

where n is the number of segments and SAF is the slope adjustment factor. The sum of the SAF_i for a given slope is equal to the number of segments n; thus the average erosion over the slope is

$$A = \frac{R}{n}\sum_{i=1}^{n} K_i C_i P_i S_i L_i (\mathrm{SAF})_i. \qquad (8.50a)$$

where L_i is the slope length factor calculated from Eq. (8.43) using the m value corresponding to the segment steepness. In the development of a SAF relationship, R, K, C, and P remain constant over all segments; thus Eq. (8.50a) can be solved for an equivalent LS factor

$$LS = \frac{1}{n}\sum_{i=1}^{n} S_i L_i (\mathrm{SAF})_i. \qquad (8.50b)$$

Factors calculated from Eq. (8.50b) are given in Table 8.7. An example of its use is given in Example Problem 8.5.

Example Problem 8.5. Estimating *LS* factors

A soil that is very susceptible to rilling has a slope length of 210 ft and an average slope of 15%. Estimate the *LS* factor if:

(1) the slope is uniform
(2) the slope is convex with slopes of 10, 15, and 20% on segments 1, 2, and 3
(3) the slope is concave with slopes of 20, 15, and 10% on segments 1, 2, and 3.

Assume that the soil is not freezing and thawing.

Solution:

1. Uniform slope. The slope angle is

$$\theta = \tan^{-1} 0.15 = 8.53°.$$

From Eq. (8.45) for soils moderately susceptible to rilling,

$$\beta = \frac{11.16 \sin 8.53}{3.0(\sin 8.53)^{0.8} + 0.56} = 1.37.$$

Part III

Attachment 6

Appendix 4

REFERENCE MATERIAL:

HYDROLOGY AND HYDRAULIC CALCULATION REFERENCES

AND

MACCAFERRI RENO MATTRESS INFORMATION

Rainfall Intensity-Duration-Frequency Coefficients for Texas

Based on United States Geological Survey (USGS) Scientific Investigations Report 2004–5041
"Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas"

1. Select English or SI Units

English

2. Select or Enter a County

Maverick

3. Enter a Time of Conc.
Select Units

10 min

Coefficient	50% (2-year)	20% (5-year)	10% (10-year)	4% (25-year)	2% (50-year)	1% (100-year)
e	0.861	0.8691	0.8774	0.8792	0.8834	0.8844
b (in.)	66.16	100.56	130.75	167.74	203.36	237.57
d (min)	9.66	12.19	13.70	15.03	16.00	16.78
Intensity (in./hr)	5.09	6.80	8.13	9.89	11.44	12.97

(Spreadsheet Release Date: August 31, 2015; data table reshuffle by Asquith July 14, 2016)

LANDLOK® TURF REINFORCEMENT MAT PROPERTY TABLE[1] ENGLISH & METRIC UNITS

PROPERTY	TEST METHOD	VALUE	LANDLOK® 450	LANDLOK® 1051	LANDLOK® 300
MASS PER UNIT AREA	ASTM D-6566	MARV	10.0 oz/yd² 340 g/m²	14 oz/yd² 475 g/m²	8.3 oz/yd² 281 g/m²
THICKNESS	ASTM D-6525	MARV	0.4 in 10.1 mm	0.4 in 10.1 mm	0.3 in 7.6 mm
LIGHT PENETRATION	ASTM D-6567	TYPICAL	20%	5%	50%
COLOR	VISUAL	–	GREEN, TAN	TAN	GREEN, TAN
TENSILE STRENGTH	ASTM D-6818	MARV	400 x 300 lb/ft 5.8 x 4.3 kN/m	300 x 225 lb/ft 4.3 x 3.2 kN/m	2400 x 2000 lb/ft 35.0 x 29.2 kN/m
TENSILE ELONGATION	ASTM D-6818	MAXIMUM	50%	85%	50%
RESILIENCY	ASTM D-6524	MARV	90%	80%	75%
FLEXIBILITY	ASTM D-6575	TYPICAL	0.026 in-lbs 30000 mg-cm	0.022 in-lbs 25000 mg-cm	0.195 in-lbs 225000 mg-cm
FUNCTIONAL LONGEVITY	OBSERVED	TYPICAL	PERMANENT	PERMANENT	PERMANENT
UV RESISTANCE	ASTM D-4355	MINIMUM	80% @ 1000 HOURS	80% @ 1000 HOURS	90% @ 3000 HOURS
SEEDLING EMERGENCE[3]	ECTC DRAFT METHOD #4	TYPICAL	409%	220%	296%
ROLL WIDTH	MEASURED	TYPICAL	6.5 ft 2.0 m	6.5 ft 2.0 m	8.5 ft 2.6 m
ROLL LENGTH	MEASURED	TYPICAL	138.5 ft 42.2 m	138.5 ft 42.2 m	106 ft 32.3 m
ROLL WEIGHT	CALCULATED	TYPICAL	63 lb 28.6 kg	87 lb 39.5 kg	52 lb 23.5 kg
ROLL AREA	MEASURED	TYPICAL	100 yd² 84 m²	100 yd² 84 m²	100 yd² 84 m²

NOTES: 1. The listed property values are effective 08/2006 and are subject to change without notice. 2. MARV indicates Minimum Average Roll Value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the reported value. 3. Calculated as percent increase in average plant biomass with tall fescue grass seed in sand 14 days after seeding versus traditional monofilament TRMs and HPTRMs.

Use n=0.028 for calculations

LANDLOK® TURF REINFORCEMENT MAT PERFORMANCE VALUES ENGLISH & METRIC UNITS

MATERIAL	FUNCTIONAL LONGEVITY	SHORT-TERM MAXIMUM SHEAR STRESS AND VELOCITY						MANNING'S "n"		
		VEGETATED		PARTIALLY		UNVEGETATED		0-6	6-12	12-24
LANDLOK® 450	PERMANENT	10 lb/ft² 479 N/m²	18 ft/sec 5.5 m/sec	8 lb/ft² 383 N/m²	15 ft/sec 4.6 m/sec	5 lb/ft² 239 N/m²	12 ft/sec 3.7 m/sec	0.035	0.025	0.021
LANDLOK 1051	PERMANENT	10 lb/ft² 479 N/m²	18 ft/sec 5.5 m/sec	n/a	n/a	5 lb/ft² 239 N/m²	12 ft/sec 3.7 m/sec	0.036	0.026	0.020
LANDLOK 300	PERMANENT	12 lb/ft² 576 N/m²	20 ft/sec 6.1 m/sec	–	–	–	–	0.030	0.028	0.018

NOTES: 4. Maximum permissible shear stress has been obtained through fully vegetated (70% to 100% density) testing programs featuring specific soil types, vegetation classes, flow conditions and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information. 5. Maximum permissible shear stress has been obtained through partially vegetated (30% to 70% density) testing programs featuring specific soil types, vegetation classes, flow conditions and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information. 6. Maximum permissible shear stress has been obtained through unvegetated (0% to 30% density) testing programs featuring specific soil types, vegetation classes, flow conditions and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information. 7. Maximum permissible shear stress achieved after only 14 weeks of vegetative establishment versus the industry standard of two full growing seasons.

NOAA Atlas 14, Volume 11, Version 2
Location name: El Indio, Texas, USA*
Latitude: 28.5445°, Longitude: -100.3252°
Elevation: 733.69 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.444 (0.336-0.587)	0.548 (0.417-0.710)	0.712 (0.542-0.933)	0.853 (0.640-1.14)	1.05 (0.766-1.45)	1.21 (0.858-1.71)	1.38 (0.948-1.99)	1.55 (1.04-2.30)	1.79 (1.16-2.75)	1.97 (1.25-3.11)
10-min	0.703 (0.532-0.928)	0.869 (0.660-1.13)	1.13 (0.861-1.48)	1.36 (1.02-1.81)	1.68 (1.22-2.31)	1.93 (1.37-2.73)	2.19 (1.51-3.18)	2.47 (1.66-3.67)	2.83 (1.83-4.35)	3.10 (1.96-4.90)
15-min	0.900 (0.681-1.19)	1.11 (0.842-1.44)	1.44 (1.09-1.88)	1.72 (1.29-2.29)	2.11 (1.54-2.90)	2.42 (1.72-3.42)	2.74 (1.89-3.98)	3.08 (2.07-4.59)	3.55 (2.30-5.46)	3.91 (2.47-6.18)
30-min	1.29 (0.978-1.71)	1.58 (1.20-2.06)	2.04 (1.56-2.68)	2.43 (1.83-3.24)	2.98 (2.16-4.09)	3.40 (2.41-4.80)	3.85 (2.65-5.58)	4.33 (2.91-6.44)	5.00 (3.25-7.70)	5.53 (3.50-8.74)
60-min	1.66 (1.25-2.19)	2.04 (1.55-2.65)	2.66 (2.02-3.48)	3.18 (2.39-4.24)	3.92 (2.85-5.38)	4.51 (3.19-6.36)	5.13 (3.54-7.43)	5.81 (3.91-8.65)	6.78 (4.41-10.5)	7.57 (4.79-12.0)
2-hr	1.90 (1.45-2.50)	2.42 (1.83-3.08)	3.21 (2.45-4.17)	3.92 (2.96-5.19)	4.96 (3.64-6.79)	5.83 (4.16-8.20)	6.79 (4.70-9.77)	7.85 (5.29-11.6)	9.38 (6.11-14.3)	10.6 (6.76-16.7)
3-hr	2.02 (1.54-2.64)	2.63 (1.97-3.29)	3.51 (2.69-4.54)	4.34 (3.29-5.73)	5.59 (4.12-7.64)	6.66 (4.77-9.35)	7.86 (5.46-11.3)	9.20 (6.21-13.5)	11.1 (7.27-16.9)	12.7 (8.11-19.8)
6-hr	2.24 (1.72-2.92)	2.97 (2.22-3.65)	4.00 (3.07-5.13)	5.00 (3.80-6.56)	6.53 (4.85-8.89)	7.89 (5.69-11.0)	9.44 (6.59-13.4)	11.2 (7.56-16.2)	13.7 (8.95-20.6)	15.7 (10.1-24.3)
12-hr	2.52 (1.94-3.25)	3.32 (2.48-4.03)	4.41 (3.40-5.62)	5.50 (4.21-7.18)	7.21 (5.39-9.76)	8.75 (6.35-12.1)	10.5 (7.37-14.8)	12.5 (8.49-18.0)	15.3 (10.1-22.9)	17.7 (11.4-27.0)
24-hr	2.82 (2.19-3.62)	$\boxed{3.68 (2.76-4.44)}$	4.84 (3.76-6.14)	6.02 (4.63-7.80)	$\boxed{7.86 (5.91-10.6)}$	9.54 (6.96-13.2)	11.5 (8.07-16.0)	13.6 (9.27-19.4)	16.6 (11.0-24.6)	19.2 (12.3-29.0)
2-day	3.14 (2.46-4.02)	4.08 (3.10-4.94)	5.39 (4.21-6.79)	6.67 (5.16-8.59)	8.65 (6.54-11.6)	10.4 (7.65-14.3)	12.4 (8.80-17.3)	14.6 (10.0-20.7)	17.6 (11.7-25.8)	20.1 (13.0-30.2)
3-day	3.37 (2.65-4.30)	4.36 (3.35-5.29)	5.76 (4.52-7.25)	7.11 (5.52-9.12)	9.16 (6.94-12.2)	11.0 (8.06-14.9)	13.0 (9.21-17.9)	15.1 (10.4-21.3)	18.2 (12.1-26.5)	20.6 (13.4-30.7)
4-day	3.57 (2.80-4.53)	4.58 (3.54-5.58)	6.06 (4.77-7.61)	7.44 (5.80-9.53)	9.53 (7.22-12.6)	11.3 (8.33-15.3)	13.3 (9.48-18.4)	15.5 (10.7-21.7)	18.5 (12.3-26.8)	20.9 (13.6-31.1)
7-day	4.01 (3.17-5.08)	5.09 (4.00-6.25)	6.72 (5.33-8.42)	8.18 (6.40-10.4)	10.3 (7.81-13.5)	12.1 (8.88-16.2)	14.0 (9.98-19.1)	16.1 (11.1-22.5)	19.1 (12.7-27.5)	21.5 (14.0-31.6)
10-day	4.37 (3.47-5.51)	5.50 (4.36-6.78)	7.25 (5.77-9.06)	8.77 (6.88-11.1)	10.9 (8.29-14.3)	12.7 (9.33-16.9)	14.5 (10.4-19.8)	16.6 (11.6-23.1)	19.6 (13.1-28.1)	22.0 (14.3-32.2)
20-day	5.34 (4.26-6.69)	6.61 (5.31-8.17)	8.65 (6.94-10.8)	10.4 (8.19-13.1)	12.8 (9.72-16.5)	14.7 (10.8-19.4)	16.6 (11.9-22.4)	18.7 (13.1-25.9)	21.7 (14.6-30.9)	24.1 (15.8-35.0)
30-day	6.11 (4.89-7.63)	7.51 (6.06-9.27)	9.76 (7.87-12.1)	11.7 (9.23-14.7)	14.3 (10.9-18.4)	16.3 (12.1-21.4)	18.4 (13.2-24.7)	20.6 (14.4-28.3)	23.7 (16.0-33.4)	26.1 (17.1-37.6)
45-day	7.21 (5.79-8.97)	8.78 (7.13-10.8)	11.3 (9.18-14.0)	13.5 (10.7-16.9)	16.4 (12.6-21.1)	18.7 (13.9-24.5)	21.0 (15.1-28.0)	23.3 (16.4-31.8)	26.5 (17.9-37.2)	28.9 (19.0-41.4)
60-day	8.18 (6.58-10.1)	9.91 (8.07-12.2)	12.7 (10.3-15.8)	15.1 (12.0-18.9)	18.3 (14.1-23.4)	20.8 (15.5-27.2)	23.3 (16.9-31.0)	25.8 (18.1-35.1)	29.0 (19.7-40.6)	31.5 (20.7-44.9)

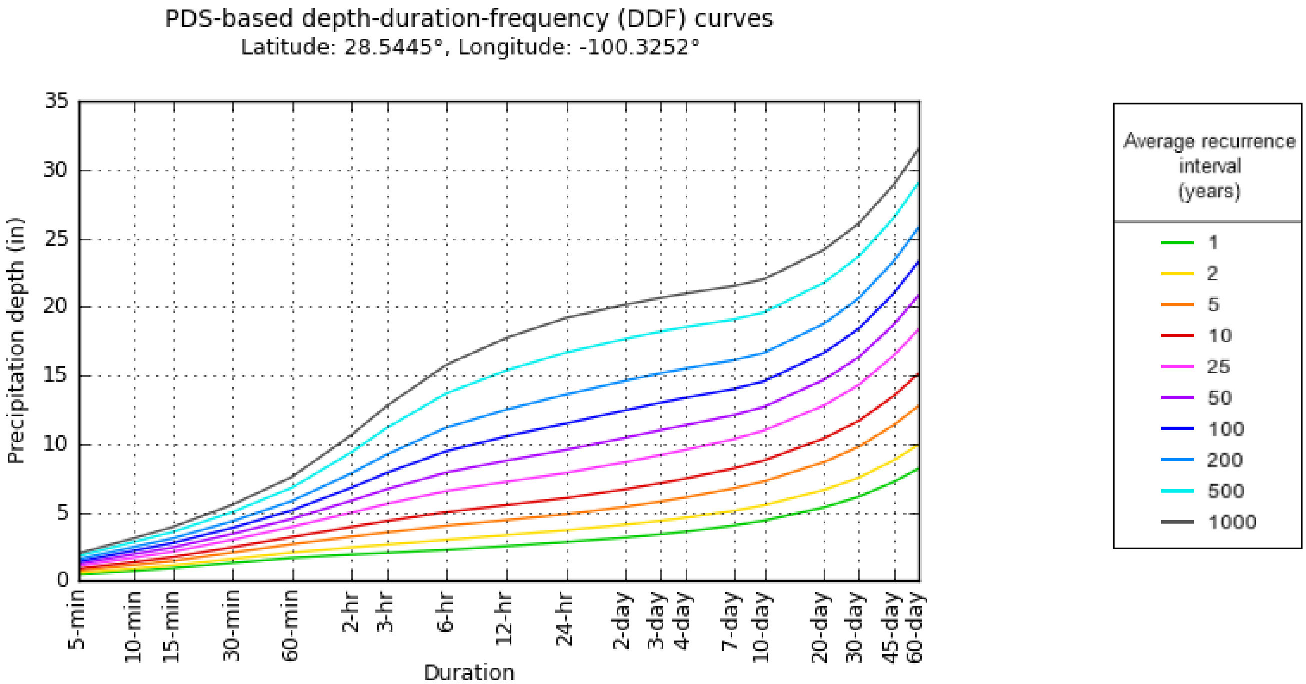
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

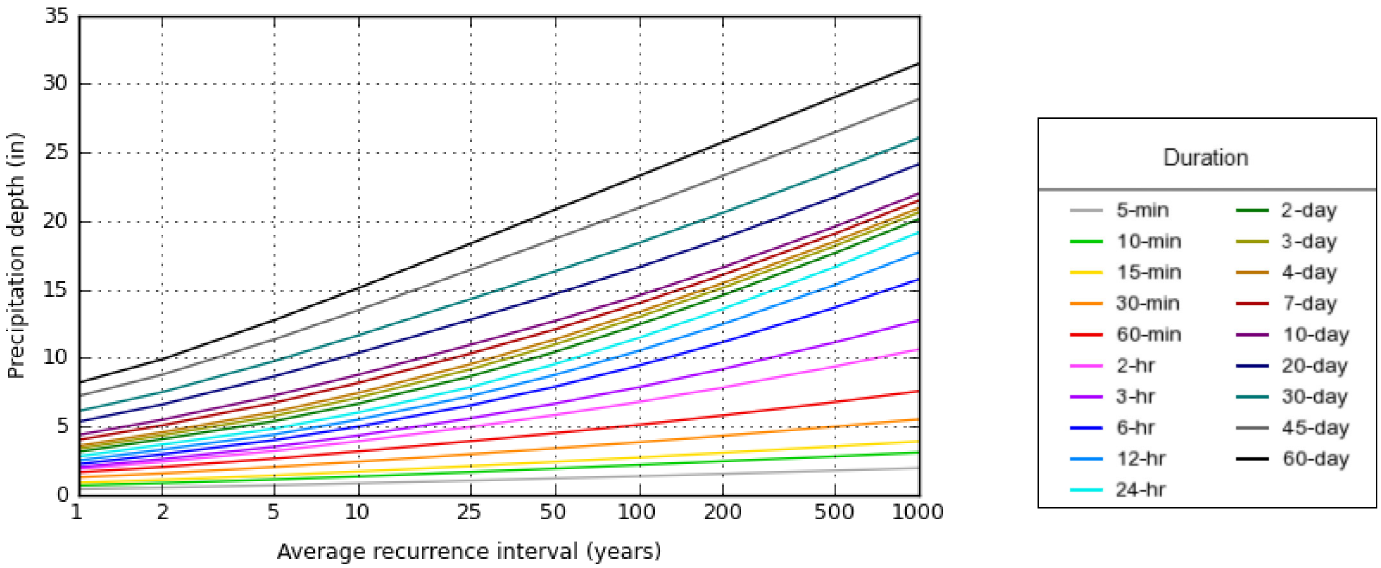
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical





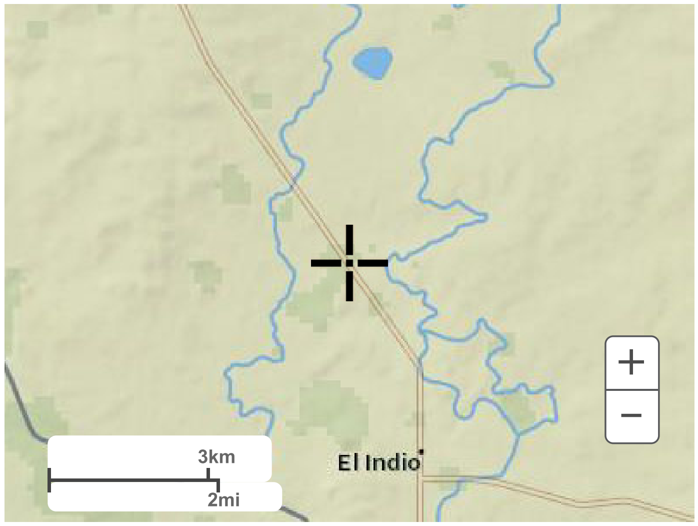
NOAA Atlas 14, Volume 11, Version 2

Created (GMT): Tue Jun 1 21:23:52 2021

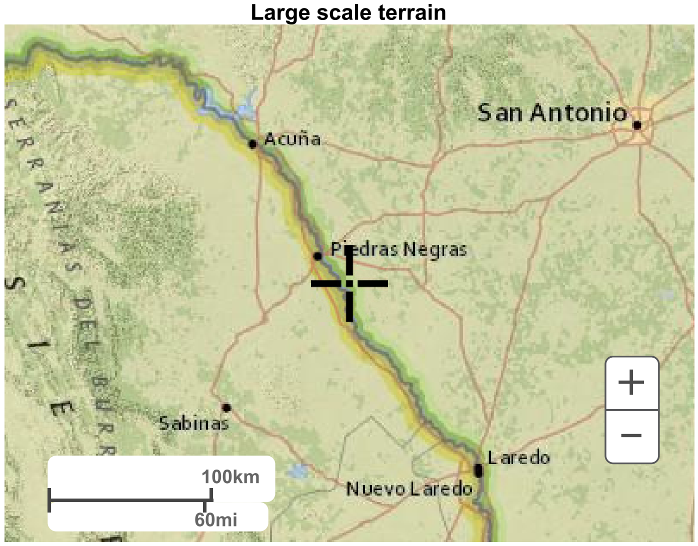
Back to Top

Maps & aerials

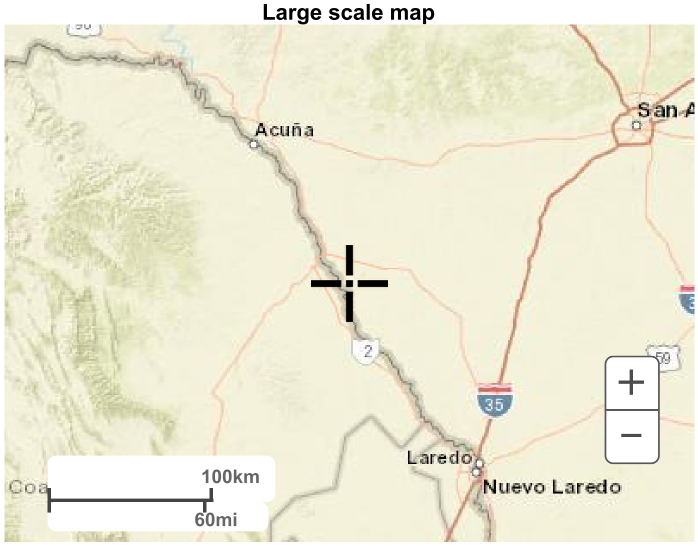
Small scale terrain



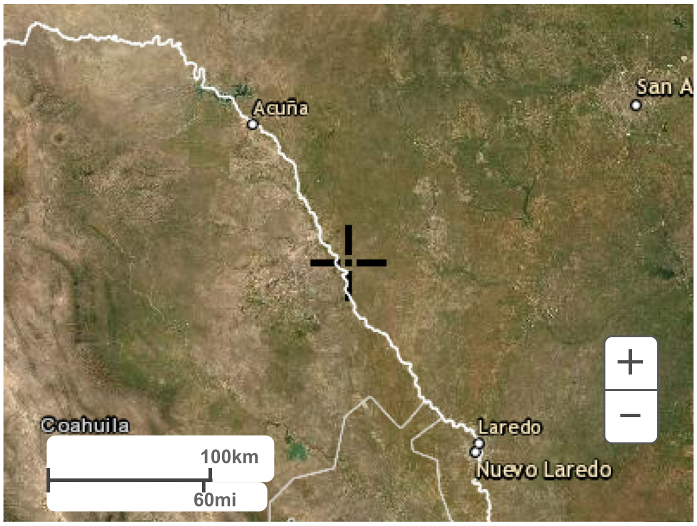
Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

An Irish engineer named Manning found that the equation

$$v = KR^{2/3}S^{1/2}$$

fit experimental data quite nicely. This equation is known as Manning's equation and differs from Chezy's equation only in the exponent on R. So that the factor related to the channel roughness would increase as roughness increased, Manning's equation is generally written as

$$v = (1/n)R^{2/3}S^{1/2}$$

in the metric system with v in meters per second and R in meters. The coefficient n is known as Manning's n. In the English system of units, Manning's equation is

$$v = \frac{1.49}{n}R^{2/3}S^{1/2}, \tag{4.23}$$

where v is in fps, R is in feet, and S is in feet per foot. Tables of Manning's n are widely available. Table 4.1 is such a table taken from several sources, drawing heavily on Schwab *et al.* (1966, 1971). Manning's n is influenced by many factors, including the physical roughness of the channel surface, the irregularity of the channel cross section, channel alignment and bends, vegetation, silting and scouring, and obstruction within the channel. Chow (1959) displays some photographs of typical channels and the associated values for Manning's n.

Figure 4.9 contains some useful relationships for calculating the hydraulic properties of A, P, R, and top width, T, for three common channels. For natural channels, these properties are best determined from measurements based on the actual cross sections of the channel.

Table 4.1 Typical Values for Manning's n

Type and description of conduits	n Values[a]		
	Min.	Design	Max.
Channels, lined			
Asphaltic concrete, machine placed		0.014	
Asphalt, exposed prefabricated		0.015	
Concrete	0.012	0.015	0.018
Concrete, rubble	0.016		0.029
Metal, smooth (flumes)	0.011		0.015
Metal, corrugated	0.021	0.024	0.026
Plastic	0.012		0.014
Shotcrete	0.016		0.017
Wood, planed (flumes)	0.009	0.012	0.016
Wood, unplaned (flumes)	0.011	0.013	0.015
Channels, earth			
Earth bottom, rubble sides	0.028	0.032	0.035
Drainage ditches, large, no vegetation			
(a) < 2.5 hydraulic radius	0.040		0.045
(b) 2.5–4.0 hydraulic radius	0.035		0.040
(c) 4.0–5.0 hydraulic radius	0.030		0.035
(d) > 5.0 hydraulic radius	0.025		0.030
Small drainage ditches	0.035	0.040	0.040
Stony bed, weeds on bank	0.025	0.035	0.040
Straight and uniform	0.017	0.0225	0.025
Winding, sluggish	0.0225	0.025	0.030
Channels, vegetated			
(See subsequent discussion)			

Type and description of conduits	n Values[a]		
	Min.	Design	Max.
Natural Streams			
(a) Clean, straight bank, full stage, no rifts or deep pools	0.025	0.027	0.033
(b) Same as (a) but some weeds and stones	0.030		0.040
(c) Winding, some pools and shoals, clean	0.035		0.050
(d) Same as (c), lower stages, more ineffective slopes and sections	0.040		0.055
(e) Same as (c), some weeds and stones	0.033		0.045
(f) Same as (d), stony sections	0.045		0.060
(g) Sluggish river reaches, rather weedy or with very deep pools	0.050		0.080
(h) Very weedy reaches	0.075		0.150
Pipe			
Asbestos cement		0.009	
Cast iron, coated	0.011	0.013	0.014
Cast iron, uncoated	0.012		0.015
Clay or concrete drain tile (4–12 in.)	0.010	0.0108	0.020
Concrete	0.010	0.014	0.017
Metal, corrugated	0.021	0.025	0.0255
Steel, riveted and spiral	0.013	0.016	0.017
Vitrified sewer pipe	0.010	0.014	0.017
Wood stave	0.010	0.013	
Wrought iron, black	0.012		0.015
Wrought iron, galvanized	0.013	0.016	0.017

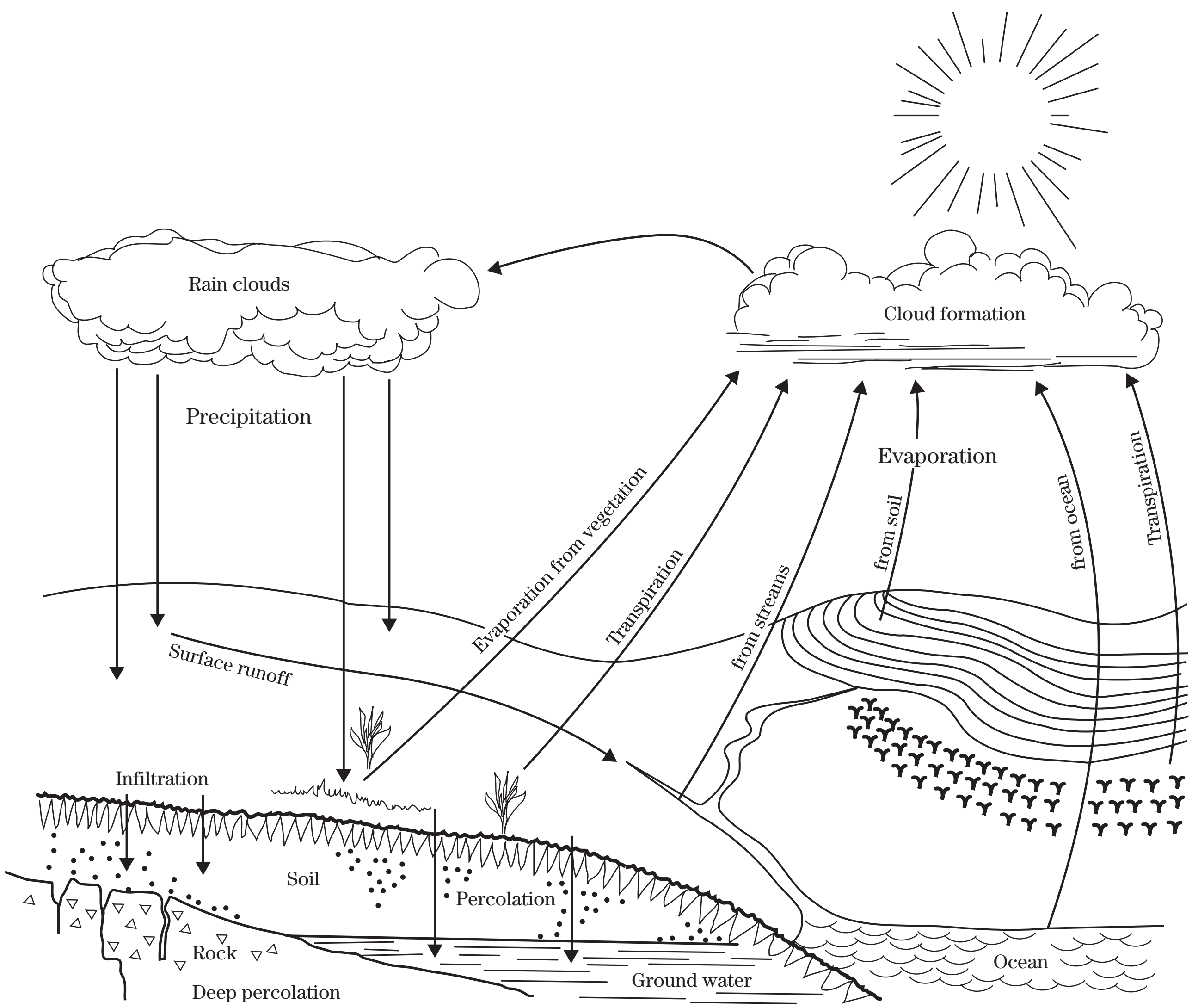
[a]Selected from numerous sources.

United States
Department of
Agriculture

**Natural
Resources
Conservation
Service**

Part 630 Hydrology
National Engineering Handbook

Chapter 15 Time of Concentration



Thick mulches in forests are associated with low retardance factors and reflect high degrees of retardance, as well as high infiltration rates. Hay meadows have relatively low retardance factors. Like thick mulches in forests, stem densities in meadows provide a high degree of retardance to overland flow in small watersheds. Conversely, bare surfaces with little retardance to overland flows are represented by high retardance factors.

The retardance factor is approximately the same as the curve number (CN) as defined in NEH630.09, Hydrologic Soil-Cover Complexes. In practical usage, CN is used as a surrogate for cn´, and the CN tables in NEH 630.09 may be used to approximate cn´ in equations 15–4a and 15–4b. A CN of less than 50, or greater than 95 should not be used in the solution of equations 15–4a and 15–4b (Mockus 1961).

Applications and limitations—The watershed lag equation was developed using data from 24 watersheds ranging in size from 1.3 acres to 9.2 square miles, with the majority of the watersheds being less than 2,000 acres in size (Mockus 1961). Folmar and Miller (2000) revisited the development of this equation using additional watershed data and found that a reasonable upper limit may be as much as 19 square miles.

(b) Velocity method

Another method for determining time of concentration normally used within the NRCS is called the velocity method. The velocity method assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path.

$$T_c = T_{t1} + T_{t2} + T_{t3} + \ldots T_{tn} \qquad \text{(eq. 15–7)}$$

where:
T_c = time of concentration, h
T_{tn} = travel time of a segment n, h
n = number of segments comprising the total hydraulic length

The segments used in the velocity method may be of three types: sheet flow, shallow concentrated flow, and open channel flow.

Sheet flow—Sheet flow is defined as flow over plane surfaces. Sheet flow usually occurs in the headwaters of a stream near the ridgeline that defines the watershed boundary. Typically, sheet flow occurs for no more than 100 feet before transitioning to shallow concentrated flow (Merkel 2001).

A simplified version of the Manning's kinematic solution may be used to compute travel time for sheet flow. This simplified form of the kinematic equation was developed by Welle and Woodward (1986) after studying the impact of various parameters on the estimates.

$$T_t = \frac{0.007\left(n\ell\right)^{0.8}}{\left(P_2\right)^{0.5} S^{0.4}} \qquad \text{(eq. 15–8)}$$

where:
T_t = travel time, h
n = Manning's roughness coefficient (table 15–1)
ℓ = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in
S = slope of land surface, ft/ft

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	*n* [1]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's *n* values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting *n*, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

This simplification is based on the following assumptions:

- shallow steady uniform flow
- constant rainfall excess intensity (that part of a rain available for runoff) both temporally and spatially
- 2-year, 24-hour rainfall assuming standard NRCS rainfall intensity-duration relations apply (Types I, II, and III)
- minor effect of infiltration on travel time

For sheet flow, the roughness coefficient includes the effects of roughness and the effects of raindrop impact including drag over the surface; obstacles such as litter, crop ridges, and rocks; and erosion and transport of sediment. These n values are only applicable for flow depths of approximately 0.1 foot or less, where sheet flow occurs. Table 15–1 gives roughness coefficient values for sheet flow for various surface conditions.

Kibler and Aron (1982) and others indicated the maximum sheet flow length is less than 100 feet. To support the sheet flow limit of 100 feet, Merkel (2001) reviewed a number of technical papers on sheet flow. McCuen and Spiess (1995) indicated that use of flow length as the limiting variable in the equation 15–8 could lead to less accurate designs, and proposed that the limitation should instead be based on:

$$\ell = \frac{100\sqrt{S}}{n} \qquad \text{(eq. 15–9)}$$

Table 15–2 Maximum sheet flow lengths using the McCuen-Spiess limitation criterion

Cover type	*n* values	Slope (ft/ft)	Length (ft)
Range	0.13	0.01	77
Grass	0.41	0.01	24
Woods	0.80	0.01	12.5
Range	0.13	0.05	172
Grass	0.41	0.05	55
Woods	0.80	0.05	28

where:
n = Manning's roughness coefficient
ℓ = limiting length of flow, ft
S = slope, ft/ft

Table 15–2 provides maximum sheet flow lengths based on the McCuen-Spiess limiting criteria for various cover type—n value—slope combinations.

Shallow concentrated flow—After approximately 100 feet, sheet flow usually becomes shallow concentrated flow collecting in swales, small rills, and gullies. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. It is assumed that shallow concentrated flow can be represented by one of seven flow types. The curves in figure 15–4 were used to develop the information in table 15–3.

To estimate shallow concentrated flow travel time, velocities are developed using figure 15–4, in which average velocity is a function of watercourse slope and type of channel (Kent 1964). For slopes less than 0.005 foot per foot, the equations in table 15–3 may be used.

After estimating average velocity using figure 15–4, use equation 15–1 to estimate travel time for the shallow concentrated flow segment.

Open channel flow— Shallow concentrated flow is assumed to occur after sheet flow ends at shallow depths of 0.1 to 0.5 feet. Beyond that channel flow is assumed to occur. Open channels are assumed to begin where surveyed cross-sectional information has been obtained, where channels are visible on aerial photographs, or where bluelines (indicating streams) appear on U.S. Geological Survey (USGS) quadrangle sheets.

Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for the bankfull elevation.

Manning's equation is:

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad \text{(eq. 15–10)}$$

Figure 15–4 Velocity versus slope for shallow concentrated flow

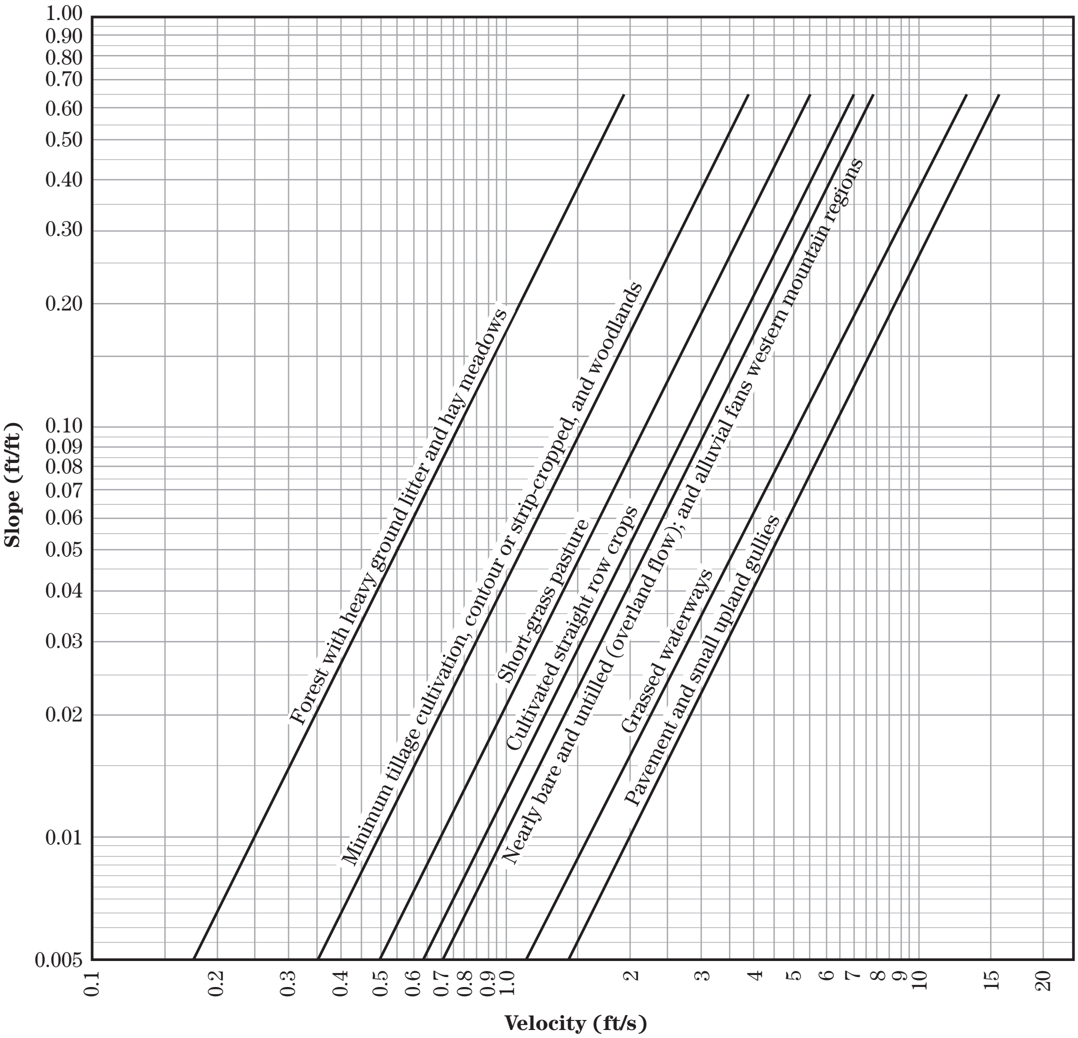


Table 15–3 Equations and assumptions developed from figure 15–4

Flow type	Depth (ft)	Manning's *n*	Velocity equation (ft/s)
Pavement and small upland gullies	0.2	0.025	$V = 20.328(s)^{0.5}$
Grassed waterways	0.4	0.050	$V=16.135(s)^{0.5}$
Nearly bare and untilled (overland flow); and alluvial fans in western mountain regions	0.2	0.051	$V=9.965(s)^{0.5}$
Cultivated straight row crops	0.2	0.058	$V=8.762(s)^{0.5}$
Short-grass pasture	0.2	0.073	$V=6.962(s)^{0.5}$
Minimum tillage cultivation, contour or strip-cropped, and woodlands	0.2	0.101	$V=5.032(s)^{0.5}$
Forest with heavy ground litter and hay meadows	0.2	0.202	$V=2.516(s)^{0.5}$

where:

V = average velocity, ft/s

r = hydraulic radius, ft

$= \frac{a}{P_w}$

a = cross-sectional flow area, ft^2

P_w = wetted perimeter, ft

s = slope of the hydraulic grade line (channel slope), ft/ft

n = Manning's *n* value for open channel flow

Manning's *n* values for open channel flow can be obtained from standard hydraulics textbooks, such as Chow (1959), and Linsley, Kohler, and Paulhus (1982). Publications dealing specifically with Manning's *n* values are Barnes (1967); Arcement and Schneider (1989); Phillips and Ingersoll (1998); and Cowen (1956). For guidance on calculating Manning's *n* values, see NEH630.14, Stage Discharge Relations.

Applications and limitations—The velocity method of computing time of concentration is hydraulically sound and provides the opportunity to incorporate changes in individual flow segments if needed. The velocity method is the best method for calculating time of concentration for an urbanizing watershed or if hydraulic changes to the watercourse are being considered.

Often, the average velocity and valley length of a reach are used to compute travel time through the reach using equation 15–1. If the stream is quite sinuous, the channel length and valley length may be significantly different and it is up to the modeler to determine which is the appropriate length to use for the depth of flow of the event under consideration.

The role of channel and valley storage is important in the development and translation of a flood wave and the estimation of lag. Both the hydraulics and storage may change from storm to storm and the velocity distribution may vary considerably both horizontally and vertically. As a result, actual lag for a watershed may have a large variation. In practice, calculations are typically based on the 2-year frequency discharge event since it is normally assumed that the time of concentration computed using these characteristics is representative of travel time conditions for a wide range of storm events. Welle and Woodward's simplification of Manning's kinematic equation was developed assuming the 2-year, 24-hour precipitation value.

630.1503 Other considerations

(a) Field observations

At the time field surveys to obtain channel data are made, there is a need to observe the channel system and note items that may affect channel efficiency. Observations such as the type of soil materials in the banks and bottoms of the channel; an estimate of Manning's roughness coefficients; the apparent stability or lack of stability of channel; indications of debris flows as evidenced by deposition of coarse sediments adjacent to channels, size of deposited materials, etc., may be significant.

(b) Multiple subarea watersheds

For multiple subarea watersheds, the time of concentration must be computed for each subarea individually, and consideration must be given to the travel time through downstream subareas from upstream subareas. Travel time and attenuation of hydrographs in valley reaches and reservoirs are accounted for using channel and reservoir routing procedures addressed in NEH630.17.

(c) Surface flow

Both of the standard methods for estimating time of concentration, as well as most other methods, assume that flow reaching the channel as surface flow or quick return flow adds directly to the peak of the subarea hydrograph. Locally derived procedures might be developed from data where a major portion of the contributing flow is other than surface flow. This is normally determined by making a site visit to the watershed.

(d) Travel time through bodies of water

The potential for detention is the factor that most strongly influences travel time through a body of water. It is best to divide the watershed such that any potential storage area is modeled as storage.

MAVERICK COUNTY – EL INDIO MSW LANDFILL
MAVERICK COUNTY, TEXAS
PERMIT APPLICATION
SITE DEVELOPMENT PLAN PART III
ATTACHMENT 7

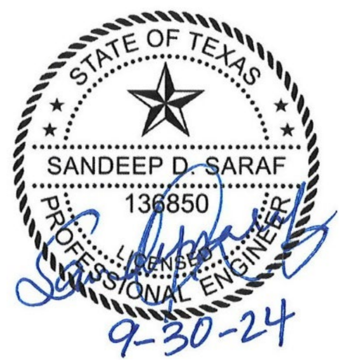
FINAL CONTOUR MAP

Prepared for:

Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

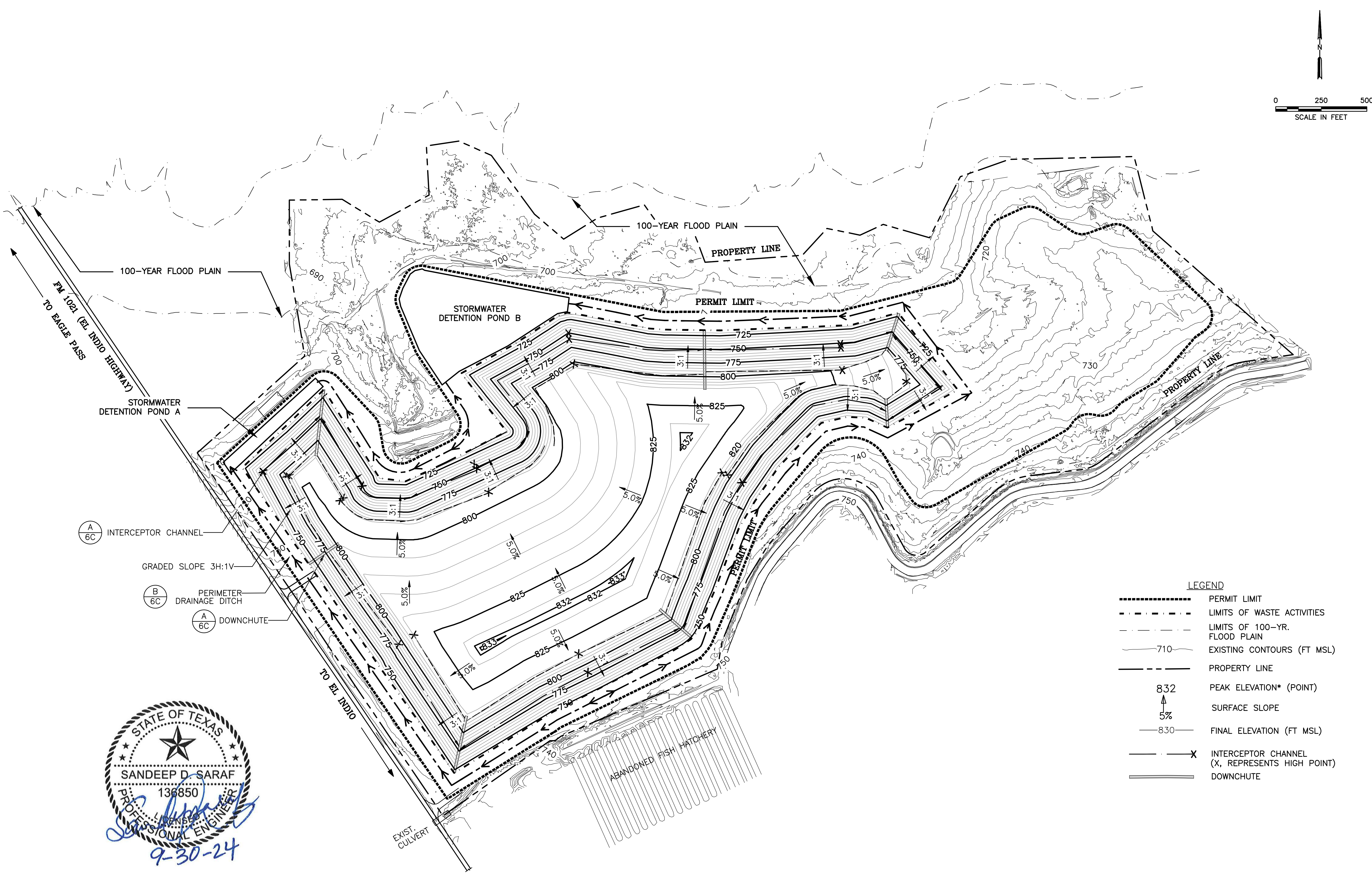


PERMIT ISSUED: SEPTEMBER 11, 2007

REVISIONS 1, 2, & 3 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revisions 1 & 2 – April 2009
Revision 3 – October 2024
SCS Project Nos. 16208046.00 & 16223092.00



STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	4/09	REMOVE 20' WIDE TERRACES; REVISE FINAL GRADES AND ADD INTERCEPTOR CHANNELS	RK
2	4/09	ADDED ALTERNATE ACESS/DRIVEWAY	RK
3	9/24	REVISED LIMIT OF WASTE, FINAL COVER GRADING, AND FINAL DRAINAGE CONDITIONS	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
FINAL CONTOUR MAP

PROJECT TITLE
MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: 6-09 FINAL CONTOUR MAP (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
7

MAVERICK COUNTY EL INDIO MSW LANDFILL

TCEQ PERMIT NO. MSW-2316

PART III, ATTACHMENT 8
CLOSURE AND POST-CLOSURE COST ESTIMATES

Prepared for:

Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

and

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

PERMIT ISSUED: SEPTEMBER 11, 2007

PERMIT MODIFICATION (REVISIONS 0, 1, 2, and 3) PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Registration No. F-3407
1901 CENTRAL DR., SUITE 550
BEDFORD, TEXAS 76021
817/571-2288

Revision 0 – January 2012
Revision 1 – January 2014
Revision 2 – November 2020
Revision 3 – October 2024

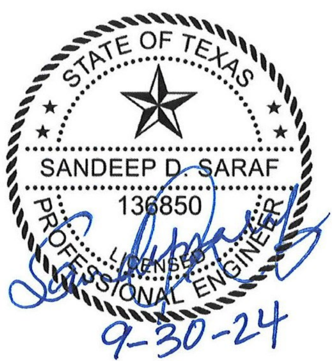
SCS Project Nos. 16211130.00, 16214011.00, and 16223092.00

TABLE OF CONTENTS

SECTION **PAGE**

List of Tables

Appendices



SCS Engineers
TBPE Reg. # F-3407

TABLE 8.1
MAVERICK COUNTY EL INDIO MSW LANDFILL
CLOSURE COST ESTIMATE

Description	Quantity	Unit	Unit Cost	Total Cost
1.0 ENGINEERING				
1.1 Topographic Survey	1	LS	$ 15,600	$ 15,600
1.2 Boundary Survey	1	LS	$ 10,850	$ 10,850
1.3 Site Evaluation	1	LS	$ 14,000	$ 14,000
1.4 Development Plans	1	LS	$ 47,700	$ 47,700
1.5 Contract Administration (Bidding and Award)	1	LS	$ 4,400	$ 4,400
1.6 Administration Costs	1	LS	$ 4,400	$ 4,400
1.7 Closure Inspection and Testing	1	LS	$ 53,800	$ 53,800
1.8 Groundwater Consultant	1	LS	$ 54,200	$ 54,200
1.9 TPDES and Other Permits	1	LS	$ 10,800	$ 10,800
ENGINEERING TOTAL				$ 215,800
2.0 CONSTRUCTION				
2.1 Final Cover System				
2.1.1 Infiltration Layer	60,017	CY	$ 3.58	$ 214,800
2.1.2 Erosion Layer	60,017	CY	$ 3.58	$ 214,800
2.1.3 Drainage Geocomposite (Double-sided)	640,188	SF	$ 0.90	$ 576,200
2.1.~~3~~4 Flexible Membrane Cover	1,080,300	SF	$ 0.65	$ 703,100
2.2 Landfill Gas Management System	0.0	AC	$ -	-
2.3 Revegetation	24.8	AC	$ 1,085	$ 26,900
2.4 Site Grading and Drainage	24.8	AC	$ 542	$ 13,500
2.5 Site Fencing and Security	1	LS	$ 10,800	$ 10,800
2.6 Leachate Collection System Completion	0	LS	$ -	-
2.7 Groundwater Characterization & Well Completion	0	WL	$ -	-
2.8 Building Demolition & Equipment Removal	1	LS	$ 10,800	$ 10,800
CONSTRUCTION TOTAL				$ 1,770,900
ENGINEERING & CONSTRUCTION SUBTOTAL				$ 1,986,700
CONTINGENCY	10.0%			$ 198,700
CONTRACT PERFORMANCE BOND	1.5%			$ 29,800
LEGAL FEES	LS			$ 100,000
TOTAL CLOSURE COST				**$ 2,315,200**

See Appendix 8A for Detailed Determination of Closure Costs

APPENDIX 8A

CLOSURE COST ESTIMATE CALCULATIONS

This includes pages 8A-1 through 8A-9 (9 pages)

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER

9-30-24

SCS Engineers
TBPE Reg. # F-3407

SECTION 2

CLOSURE COST ESTIMATE

Consistent with 30 TAC §330.503, "The owner or operator shall provide a detailed written cost estimate, in current dollars, showing the cost of 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 in accordance with the final closure plan. For any landfill this means the completion of the final closure requirements for active and inactive fill areas."

To comply with this rule, consistent with the Final Closure Plan (Attachment 12), Maverick County is providing a detailed closure cost estimate, in 2020 dollars, based on the cost of 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 in accordance with the final closure plan. As such, this plan addresses closure activities for the largest portion of the landfill that could potentially be open in the year to follow.

This detailed cost estimate has been developed consistent with the Final Closure Plan (Attachment 12). A summary of closure costs is presented on Table 8.1 - Closure Cost Estimate. Calculations and supporting data for the cost estimates are included in Appendix 8A - Closure Cost Estimate Calculations.

Consistent with 30 TAC 330.503(a), Maverick County will review the facility's permit conditions on an annual basis and verify that the current active area is less than or equal to the area(s) (i.e., the acreage) on which the closure cost estimates were based. Maverick County will increase the closure cost estimate and the amount of financial assurance provided if changes to the final closure plan or the landfill conditions increase the maximum cost of closure at any time during the active life of the landfill. Such proposed increases will be submitted to the TCEQ for review and approval. In addition, Maverick County will adjust the closure cost estimate, as required by the TCEQ to account for cost of living adjustments or other reasons as required by regulation or TCEQ directive.

Required: Estimate the cost to perform final closure activities on the largest portion of the landfill that could potentially be open in the year to follow (Refer to Table 8.1 for cost summary). Consistent with 30 TAC §330.503(a), this closure cost estimate is based on in 2020 dollars.

References:

1. Texas Natural Resource Conservation Commission, *Cost Estimate Handbook for Closure and Postclosure Care* , Version 1, August 1993.
2. 30 TAC 330, Subchapters K and L
3. Texas Water Commission, *Municipal Solid Waste Groundwater Protection Cost Study,* November 1992.
4. SCS information available from similar construction projects.

Solution: Assuming forced closure in the early phase of landfill operation (i.e., Cells 1, 2, and 3, only) that would require closure activities to begin under a forced closure scenario, including placement of final cover. Consistent with Attachment 12, the final cover includes an 18-inch vegetation/erosion layer, 200-mil double-sided drainage geocomposite (sideslopes only) above 40-mil geomembrane and 18-inch infiltration layer. As discussed in Attachment 8, as conditions at the site warrant a change in the closure cost estimate, notification to the TCEQ will be made.

Area requiring final cover placement =	24.8	ac (See Note 1)
=	1,080,300	sf
Area to be administratively closed =	257.8	ac

1.0 Engineering Costs

1.1 Topographic Survey						
30.0	acres (Cells 1, 2, 3, and surrounding area)			=	$ 15,600	(Lump Sum)
1.2 Boundary Survey						
257.8	acres (update to existing survey)			=	$ 10,850	(Lump Sum)
1.3 Site Evaluation						
257.8	ac @	$ 54	/ ac =	=	$ 14,000	
1.4 Development of Plans						
				=	$ 47,700	(Lump Sum)
			Subtotal =		$ 88,200	
1.5 Contract Administration						
		5%	of Subtotal	=	$ 4,400	
1.6 Administration of Costs: Certification and Affidavit						
		5%	of Subtotal	=	$ 4,400	
1.7 Closure Inspection and Testing						
24.8	acres @	$ 2,170	/ ac	=	$ 53,800	
1.8 Groundwater Consultant			Lump Sum	=	$ 54,200	

Closure prior to entire permitted footprint being filled and entire groundwater monitoring system being implemented will require an up-to-date hydrogeologic assessment of the site to confirm the adequacy of the groundwater monitoring program for the post-closure condition.

1.9 TPDES and Other Permits			
	Lump Sum	=	$ 10,800
	Engineering Total	**=**	**$ 215,800**

2.0 Construction Costs

2.1 Final Cover System

2.1.1 Infiltration Layer

1.5	ft thick				
1,080,300	sf				
60,017	cy for infiltration layer				
Soil available on-site for installation					
	$ 3.58	/ cy	=	$	214,800

2.1.2 Vegetation/Erosion Layer

1.5	ft thick				
1,080,300	sf				
60,017	cy for erosion layer				
Soil available on-site for installation					
	$ 3.58	/ cy	=	$	214,800

2.1.3 Drainage Geocomposite (double-sided)

640,188	sf			
$ 0.90	/ sf =	=	$	576,200

2.1.4 Flexible Membrane Cover

1,080,300	sf			
$ 0.65	/ sf =	=	$	703,100

2.2 Landfill Gas Management System (See Note 2)

0.0	ac @	$ -	/ ac =	$	-

2.3 Revegetation

24.8	ac @	$ 1,084.7	/ ac =	$	26,900

2.4 Site Grading and Drainage

24.8	ac @	$ 542.3	/ ac =	$	13,500

2.5 Site Fencing and Security

If the site were closed prior to entire permitted footprint being filled, site fencing and security for the entire landfill would already be in place. Nevertheless, to ensure adequacy of the fencing for access control, an allowance was included in this estimate.

Allowance = $ 10,800

2.6 Leachate Collection System Completion

The forced closure scenario assumes that the LCS has been installed. No expenses are projected for this item.

2.7 Groundwater Characterization & Well Completion

Based on recent characterization of the groundwater regime, assume no additional study required.

2.8 Building Demolition & Equipment Removal

In view of the quality of the onsite buildings, it is assumed that they will remain and used for other purposes; cost for this item is for relocation of the landfill equipment.

Lump Sum = $ 10,800

Construction Total = $ 1,556,100

Notes:

1. Assumes forced closure of Cells 1, 2, and 3.
2. Based on landfill gas emissions from landfills of similar size and characteristics, it is assumed that the estimated emissions from the landfill at this stage of development will be below regulatory thresholds that would warrant installation of a LFG control system.
3. Unit costs are based on SCS' review of bid tabulations from recent landfill construction projects.

MAVERICK COUNTY – EL INDIO MSW LANDFILL
MAVERICK COUNTY, TEXAS
PERMIT APPLICATION
SITE DEVELOPMENT PLAN PART III
ATTACHMENT 10
SOIL AND LINER QUALITY CONTROL PLAN

Prepared for:

Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

PERMIT ISSUED: SEPTEMBER 11, 2007

REVISIONS 1, 2, AND 3 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Permit Issued: September 11, 2007

Revision 1 – July 2010, October 2010, and January 2011
Revision 2 – July 2014, October 2014, December 2014
Revision 3 – October 2024
SCS Project No. 16214011.00 & 16223092.00

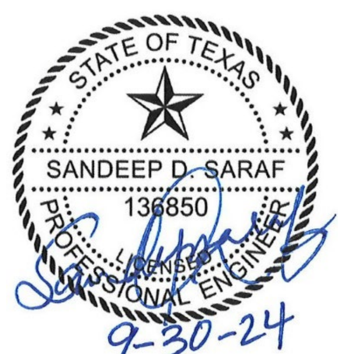
Table of Contents

Section **Page**

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

SCS Engineers
TBPE Reg. # F-3407

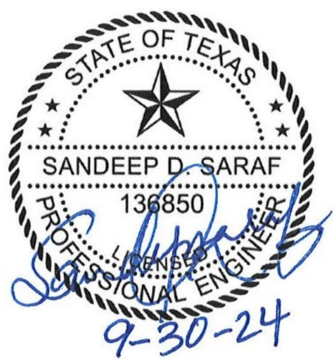
List of Tables



SCS Engineers
TBPE Reg. # F-3407

List of Figures

List of Appendices



SCS Engineers
TBPE Reg. # F-3407

1 INTRODUCTION

1.1 PURPOSE

The following Soil and Liner Quality Control Plan (SLQCP) has been prepared for the Maverick County El Indio Landfill, TCEQ Permit No. MSW-2316 (landfill) in accordance with 30 TAC §330.339 of the Texas Commission of Environmental Quality (TCEQ) regulations. This SLQCP is intended to provide Maverick County (Owner) and Maverick County Solid Waste Authority (Operator), Design Engineer, Construction Quality Assurance (CQA) Professional of Record, Contractor, and Geosynthetics Contractor the needed guidance regarding construction quality control and quality assurance during construction of municipal solid waste disposal units at the landfill. This SLQCP also will provide the CQA Professional of Record the needed guidance for preparing the soil liner, geomembrane liner, and geosynthetic clay liner (GCL) evaluation reports for each individual landfill cell.

Regarding the site geology, a review of the boring logs of the subsurface investigations conducted indicated that the subsurface stratigraphy beneath the site consists predominantly of calcareous silty clays of the marine origin overlying clay-shale. Additional information regarding site geology can be found in Attachment 4 (Geology Report) of the Site Development Plan.

This SLQCP addresses the testing methods and frequency requirements set forth in the 30 TAC §330.339. There are two liner options available for use at this landfill, the standard liner system (aka, composite liner system) and the alternate liner system. Details of the composite liner system are included on Attachments 10A within the Figures section of this attachment. The approved composite liner system is comprised of the following components (top to bottom):

- 2-foot-thick Protective Cover;
- Geocomposite Drainage Layer*;
- 60-mil High Density Polyethylene (HDPE) Geomembrane**;
- 2-foot-thick Compacted Clay Liner**; and
- 6” scarified subgrade.

* In Cells 1, 2, and 3, smooth geomembrane and a single-sided geocomposite were used on the cell floor, whereas textured geomembrane and double-sided geocomposite were used on the side slopes. In future cells, textured geomembrane and double-sided geocomposite will be used on cell floors and sideslopes.
** Cell 3 was constructed with a GCL/HDPE geomembrane liner system. In compliance with the current permit, 24-in thick compacted clay liner may be replaced with a reinforced GCL in the future cells.

Consistent with 30 TAC §330.335, the landfill has an approved alternate liner demonstration. The alternate liner design demonstration (ALDD) is provided in Attachment 10, Appendix 3 – Alternate Liner Design Demonstration. Details of the alternate liner system are included on Attachment 10A-GCL within the Figures section of this attachment. This ALDD was prepared in accordance with 30 TAC §330.335, which demonstrates through computerized modeling (i.e., MULTIMED) that when the GCL alternate liner is installed, the maximum contaminant levels detailed in §330.331, Table 1 will not be exceeded at the point-of-compliance. This GCL ALDD authorizes construction of future landfill cells using a GCL, a geomembrane liner, and a leachate collection system. This approved liner system is comprised of the following components (top to bottom), as shown on Attachment 10A-GCL:

- 2-foot-thick Protective Cover;
- Geocomposite Drainage Layer;
- 60-mil HDPE Geomembrane;
- Geosynthetic clay liner (GCL); and
- Prepared subgrade.

Additionally, Attachment 10A-GCL includes a detail, GCL/Clay Liner Tie-in, that depicts the tie-in of a GCL to compacted clay liner when adjacent cells are constructed with different liners. Consistent with this detail, the GCL will be overlapped a minimum of 3 feet over an adjacent compacted clay liner.

The design of the leachate collection system components are described in Attachment 15 – Leachate and Contaminated Water Plan. Additional guidance and technical requirements for the liners, leachate collection system, and related construction will also be presented in the construction plans and technical specifications prepared prior to construction of each phase of the landfill.

This SLQCP includes the CQA requirements for the following:

- Subgrade and General Fill
- Low Permeability Soil Liner
- Geosynthetic Clay Liner (see Appendix 3)
- Geosynthetics (i.e., geomembrane, drainage geocomposite, and geotextiles)
- Leachate Collection Piping
- Drainage Aggregates
- Protective Cover

This SLQCP, which will be followed during liner construction, outlines materials selection and evaluation, laboratory test requirements, field test requirements and treatment of problems during the installation of the components described above. This SLQCP also includes reporting requirements for soil liner, GCL, and geomembrane liner evaluation reports for the CQA of soil liner or GCL, and geomembrane liner components of the liner system.

1.2 DEFINITIONS

Whenever the terms listed below are used, the intent and meaning shall be interpreted as indicated.

1.2.1 ASTM

This means the American Society for Testing and Materials. When a specific test is indicated, the most current version of the test is intended.

1.2.2 Atterberg Limits

A series of six "limits of consistency" of fine-graded soils defined by Swedish soil scientist Albert Atterberg, two of which are frequently used to establish a soil's physical boundaries dealing with its plasticity characteristics. These soil boundaries or limits used most frequently in geotechnical engineering are based upon the following:

- Liquid Limit (LL): The percentage of moisture in a soil, subjected to a prescribed test, that defines the upper point which is the soil's consistency changes from the plastic to the liquid state.

- Plasticity Index (PI): The numerical difference between the LL and the PL of a fine-graded soil that denotes the soils plastic range. The larger the PI the greater a soil's plasticity range and the greater the plasticity characteristics.

1.2.3 Ballast Evaluation Report (BER)

If ballasting or dewatering are used during liner construction, filling, or operation of the landfill, a ballast evaluation report will be submitted to TCEQ to verify that the liner did not undergo uplift and to document that the ballast meets the applicable TCEQ requirements under §330.337. Groundwater controls and ballast placement requirements are discussed in Section 2.5 and Section 10.4, respectively, of this SLQCP.

1.2.4 Classification System

The soil classification system shall be in accordance with the standard test method for classification of soils for engineering purposes (ASTM D2487).

1.2.5 Coefficient of Permeability (a.k.a. Hydraulic Conductivity)

The rate of flow through soil under a unit hydraulic gradient through a unit cross-sectional area at standard temperature.

1.2.6 Compaction

The process of increasing the density or unit weight of soil by rolling, tamping, vibrating, or other mechanical means.

1.2.7 Constructed Soil Liner

Soil liners constructed from reworked soils.

1.2.8 Construction Quality Assurance (CQA)

A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design (EPA, 1993). CQA includes observations and evaluations of materials and workmanship necessary to assess and document that construction has been performed consistent with the contract documents. CQA refers to measures taken by the CQA geotechnical professional (GP) and/or CQA monitor to assess if the liner system construction has been in compliance with the permit drawings and this SLQCP.

1.2.9 Construction Quality Control (CQC)

These actions provide a means to measure the characteristics of an item or service to comply with the requirements of the contract documents. CQC actions will be performed by either the Contractor or CQA team. All quality control testing shall be performed prior to the construction of the liner. In no instance shall quality control field or laboratory testing be undertaken after completion of liner construction.

1.2.10 Contract Documents

These are the official set of documents provided by the owner. The documents include bidding requirements, contract forms, contract conditions, technical specifications, construction plans, addenda, and contract modifications.

1.2.11 Contractor

This is the person or persons, firm, partnership, corporation, or any combination, who as an independent contractor, has entered into a contract with the owner, and who is referred to throughout the contract documents by singular number.

1.2.12 Geotechnical Professional (GP)

The GP is an authorized representative of the owner and has overall responsibility for construction quality assurance, and confirming that the facility has been constructed in general accordance with the permit application, as approved by the TCEQ, and the construction plans and technical specifications, specifically as it relates to the liner system. The GP must be registered as a Professional Engineer in the State of Texas with experience in solid waste engineering and/or geotechnical engineering. Alternatively, a GP may be a geologist with experience in geotechnical testing and evaluating the engineering properties of soils for liner systems which involve in-situ or compacted soil.

The GP must show competency and experience in certifying similar installations and be presently employed by or practicing as a solid waste engineer, geotechnical engineer or as an engineering geologist in a geotechnical/environmental engineering organization. The credentials of the GP must meet or exceed the minimum requirements required by the TCEQ. The GP will be the professional of record, who signs the SLER or GCLER, and GLER for the respective liner system construction.

1.2.13 CQA Monitors

These are representatives of the GP who work under direct supervision of the GP. The CQA Monitor is responsible for quality assurance monitoring and performing on-site tests and observations. A qualified Lead CQA Monitor shall have a minimum of two years of directly related experience; or be a graduate engineer or geologist with one year of directly related experience. A junior CQA Monitor may work under the direct supervision of the Lead CQA Monitor or the GP and may have less than one year of directly related experience. The CQA Monitor is onsite full time during subgrade preparation, liner system construction, and leachate collection system construction and reports directly to the GP. Any references to monitoring, testing, or observations to be performed by the GP should be interpreted to mean the GP or CQA Monitors working under the GP's direction.

1.2.14 Density

Mass density of a soil is its weight per unit volume; usually reported in pounds per cubic foot.

1.2.15 Design Engineer

The individual(s) or firm(s) responsible for the design and preparation of the project construction plans and technical specifications. Also referred to as "designer" or "engineer."

1.2.16 Earthwork

This is a construction activity involving the use of soil materials as defined in the technical specifications.

1.2.17 Extrusion Weld

A bond between two HDPE materials which is achieved by extruding a bead of HDPE over the leading edge of the seam between the upper and lower sheet using a handheld apparatus. Extrusion welds shall be used for patch repairs, destructive repairs, and in some tie-ins.

1.2.18 Film Tear Bond

A failure in the geomembrane sheet material on either side of the seam and not within the seam itself.

1.2.19 Flexible Membrane Liner (FML)

This is a synthetic lining material, also referred to as geomembrane, membrane, liner, or sheet. FMLs for landfill application are typically fabricated of High Density Polyethylene (HDPE).

1.2.20 Fusion Weld

A bond between two HDPE materials which is achieved by fusing both HDPE surfaces in a homogeneous bond of the two surfaces using a power-driven apparatus capable of heating and compressing the overlapped portions of the geomembrane sheets.

1.2.21 Geomembrane Liner Evaluation Report (GLER)

Construction certification report for the geomembrane liner, prepared and sealed by the GP that is submitted to the TCEQ for approval. This report also includes submittal of the form TCEQ-10070 – Geomembrane/Geosynthetic Liner Evaluation Report or current TCEQ approved form and required attachments indicated on such form.

1.2.22 Geosynthetic Clay Liner

A factory manufactured hydraulic barrier consisting of a sodium bentonite layer between two geotextiles. In the case of the alternate liner for the Maverick County - El Indio Landfill, a reinforced GCL will be placed on the cell sideslopes and floor, with the geotextiles needle-punched together to provide internal reinforcement.

1.2.23 Geosynthetic Clay Liner Evaluation Report (GCLER)

Construction certification report for the GCL (prepared and sealed by the GP) that is submitted to the TCEQ for approval, and documents the GCL installation and testing consistent with Appendix 4 of this SLQCP. This report also includes submittal of the form TCEQ-10070 – Geomembrane/Geosynthetic Liner Evaluation Report or current TCEQ approved form and required attachments indicated on such form. Typically this report is submitted in conjunction with the GLER in an all-inclusive Liner Evaluation Report (LER).

1.2.24 Geosynthetics Contractor

The individual is also referred to as the "contractor," and is the person or firm responsible for geosynthetic construction. This definition applies to any person installing FML, geotextile, geocomposite, or other geosynthetic materials, even if not their primary function.

1.2.25 Independent Geosynthetics Laboratory (IGL)

A qualified geosynthetics testing laboratory not affiliated with either the manufacturer, owner, or contractor.

1.2.26 In-Situ Soils

Undisturbed soils; the term routinely used in describing an in-place soil liner.

1.2.27 Moisture Content

Ratio of quantity of water in the soil (by weight) to the weight of the soil solids (dry soil), expressed in percentage; also referred to as water content.

1.2.28 Moisture/Density Relationship

A test in which soil samples are compacted in a known volumetric container at various moisture contents at a constant level of compactive effort and their corresponding densities are determined. The test procedures and compactive efforts used are those normally prescribed in ASTM D698 and D1557, Standard and Modified Proctor, respectively. See also Optimum Moisture Content.

1.2.29 Nonconformance

This is a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformance include, but are not limited to, physical defects, test failures, and inadequate documentation.

1.2.30 Operator

The organization that will operate the disposal unit (Maverick County Solid Waste Authority).

1.2.31 Operator's Representative

This is the person that is an official representative of the operator responsible for planning, organizing, and controlling the construction activities.

1.2.32 Optimum Moisture Content (OMC)

Moisture content corresponding to the maximum dry density as determined in the Standard Proctor Test (ASTM D698) or Modified Proctor Test (ASTM D1557).

1.2.33 Panel

This is a unit area of the FML which will be seamed in the field.

1.2.34 Project Representative

The on-site or designated representative of the operator.

1.2.35 Quality Assurance Laboratory

The firm(s) responsible for conducting tests on borrow and clay liner samples taken from the site, as well as testing of conformance testing for geosynthetics. Multiple laboratories can be used.

1.2.36 Seasonal High Water Level

The highest measured or calculated water level in an aquifer during investigations for a permit application and/or any groundwater characterization studies at a facility (30 TAC §330.3(137)).

1.2.37 Secondary Structure

The macrostructure of geologic stratum. Structural features in a soil or rock deposit which can be seen with little or no magnification to include, but not limited to, pockets, lenses, layers, seams, or partings of varying soil types, slickensided fissures, laminated structure, and/or mineral concretions or staining.

1.2.38 Soil Liner Evaluation Report (SLER)

Construction certification report for the soil liner, prepared and sealed by the GP that is submitted to the TCEQ for approval. This report also includes submittal of the form TCEQ-00674 – Soil Liner Evaluation Report or current TCEQ approved form and required attachments indicated on such form.

1.2.39 Technical Specifications (Specifications)

These are the qualitative requirements for products, materials, and workmanship upon which construction contract is based.

1.2.40 TCEQ

Texas Commission on Environmental Quality at the discretion of the GP or CQA Monitor. Confirm that the FML is placed in a manner that provides good contact with the underlying soil liner materials, and that no bridging or stretching over surface features occurs.

- Observe that no more panels are deployed than can be seamed on that same day.
- Observe that there are no horizontal seams (i.e. seams parallel to the slope contours) on sideslopes or slopes steeper than 5H:1V.

The CQA Monitor must inform both the Contractor and the GP of any observed variances or unacceptable conditions from above. Note, however, that the CQA Monitor's failure to identify one or more of the above conditions does not relieve the Contractor of responsibility for installing and protecting the FML installation in accordance with the construction plans, technical specifications and this SLQCP.

4.3.3 Field Seaming

A seam numbering system must be agreed to by the GP and Contractor prior to the start of seaming operations. One procedure is to identify the seam by adjacent panels. For example, the seam located between Panels 306 and 401 would be Seam No. 306/401.

Trial seam testing will be performed for each of the following events:

- At the beginning of each seaming period per work day and for each seaming apparatus, including in the morning and immediately after each extended break throughout the day.
- After any major change in environmental condition, i.e., temperature, humidity, dust, etc.
- Any time the seaming apparatus is turned off for longer than 30 minutes.

Both the welder and the welding apparatus must be tested for extrusion welding. Each extrusion welder and welding apparatus must be tested at least once daily. Only the welding apparatus must be tested according to the above schedule for fusion welding, but the welding apparatus must be tested at least once daily.

Each trial seam shall be at least 3 feet in length, and 1 foot wide. A minimum of 4 adjoining 1-inch wide coupons will be die-cut from the test seam. Two field samples will be tested for shear, and two field samples tested for peel. The apparatus used for field testing must have a current certificate of calibration issued by the appropriate State or Federal agency.

If one of the test seams fails, the trial seam will be repeated and testing performed on the trial seam samples. If the second trial seam fails, two additional trial seams will be performed and tested. Trial seaming and retesting will continue until two consecutive passing test series (i.e., two

- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing.

- The panels are being welded in accordance with the construction plans and technical specifications. Seams should be oriented parallel to the line of maximum slope. In corners and odd-shaped geometric locations, the number of field seams should be minimized.

- There is no free moisture in the weld area.

- Observe that at the end of each day or installation segment, all unseamed panel edges are anchored with sandbags or other approved devices. Penetration anchors shall not be used to secure the FML.

4.4 SEAM TESTING

Seam testing methods and frequencies are presented in Table ATT10-2.

4.4.1 Nondestructive Testing

Continuous nondestructive testing will be required on all seams. Air pressure testing on dual-track fusion welds and vacuum box testing for extrusion welds are the acceptable methods of nondestructive testing. All factory seams (if applicable) also must be nondestructively tested.

4.4.1.1 Air Pressure Testing of Dual Track Fusion Welds

The ends of the air channel of each dual track fusion weld must be sealed and pressured to approximately 30 psi for HDPE. The air pump must then be shut off and the air pressure observed after 5 minutes. A loss of less than 4 psi is acceptable if it is determined that the air channel is not blocked between the sealed ends. A loss equal to or greater than 4 psi indicates the presence of a seam leak which must then be isolated and repaired. The CQA Monitor should observe and record all pressure gauge readings.

4.4.1.2 Vacuum Box Testing

A suction value of approximately 3 to 5 inches (7.62 to 12.7 cm) of gauge vacuum must be applied to all extrusion welded seams that can be tested in this manner. Examples of extrusion welded seams that do not easily lend themselves to vacuum testing would be around boots, appurtenances, etc. The seam must be observed for leaks for at least 10 seconds while subjected to this vacuum. The CQA Monitor should observe all vacuum box testing.

4.4.1.3 Alternative Test Methods

Alternative test methods will not be allowed, unless approved by the TCEQ prior to implementation.

retains all ownership and responsibility for the FML until all required documentation is complete, and the cover material is placed. After panels are placed, seamed, tested successfully, and any repairs are made, the completed installation will be inspected by the Owner's and Contractor's representatives. Any damage or defect found during this inspection will be repaired by the installer. The installation will not be accepted until it meets the requirements of both representatives. In addition, the FML will be accepted by the GP only when the following has been completed:

- The installation is finished.
- All seams have been inspected and verified to be acceptable.
- All required laboratory and field tests have been completed and reviewed.
- All required Contractor-supplied documentation has been received and reviewed.
- Surveyed as-built record drawings have been completed and verified by the GP. The as-built drawings show the true panel dimensions, the location of all seams, trenches, pipes, appurtenances, and repairs.
- Written Acceptance of the GLER by TCEQ.

5 DRAINAGE GEOCOMPOSITE

5.1 INTRODUCTION

This section describes CQA procedures for the installation of drainage geocomposite. All quality control testing will be conducted in accordance with this SLQCP and the project construction plans and technical specifications. The GP or CQA Monitor will be on-site and will observe all geocomposite installation.

The drainage geocomposite for the floor and sideslopes shall consist of a geonet with a filter geotextile heat-bonded to both sides (referred to as double-sided).

5.2 DELIVERY

Upon delivery, the CQA Monitor must observe the following:

- The drainage geocomposite is wrapped in rolls with protective covering.
- The rolls are not damaged during unloading.
- The drainage geocomposite is protected from mud, soil, dirt, dust, debris, cutting, or impact forces.
- Each roll is marked or tagged with proper identification.

Any damaged rolls shall be rejected and removed from the site or stored at a location, separate from accepted rolls, designated by the Owner. All rolls which do not have proper manufacturer's documentation shall also be stored at a separate location until all documentation has been received and approved.

5.3 QUALITY CONTROL TESTING

The drainage geocomposite manufacturer (or supplier), will conduct quality control testing at a frequency consistent with the manufacturer's specifications and certify that all materials delivered to the site comply with the material properties presented in Table ATT10-3 – Required Physical Properties of Geocomposite. The material certifications shall be reviewed by the GP and approved for the project prior to acceptance of any of the material.

The geocomposite manufacturer also shall certify that geocomposite transmissivity meets or exceeds the transmissivity requirements specified in Table ATT10-3. The manufacturer shall further certify that transmissivity results meet or exceed all requirements for the gradient and confining pressures listed in the technical specifications. If alternate gradient or confining pressures are used for the certification, geocomposite manufacturer shall certify that material meets or exceeds the technical specification requirements. However, even with manufacturer certification, the GP reserves the right to reject any materials not meeting the transmissivity requirements of the specifications, including gradient and confining pressure requirements.

5.4 INSTALLATION

5.4.1 Surface Preparation

Prior to geocomposite installation, the CQA Monitor must observe the following:

- All lines and grades have been verified by the contractor.
- All debris, soil, dust and other materials shall be removed from the FML surface being prepared prior to deployment of the overlying geocomposite.
- When placed over a FML, the FML installation, including all required documentation, has been completed.
- The supporting surface does not contain stones that could damage the geocomposite or the geomembrane.

5.4.2 Placement

During placement, the CQA Monitor must perform the following:

- Observe the geocomposite as it is deployed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the technical specifications.
- Verify that equipment used to deploy the geocomposite does not damage the geocomposite or underlying FML by handling, trafficking, leakage of hydrocarbons, or by other means. Only low ground pressure rubber-tired support equipment approved by the GP may be allowed on the geocomposite.
- Verify that people working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite or underlying FML.
- Verify that the geocomposite is anchored to prevent movement by the wind (the contractor is responsible for any damage resulting to or from windblown geocomposite).
- Verify that the geocomposite remains free of contaminants such as soil, grease, fuel, etc.
- Observe that the geocomposite is laid smooth and free of tension, stress, folds, wrinkles, or creases.

TABLES

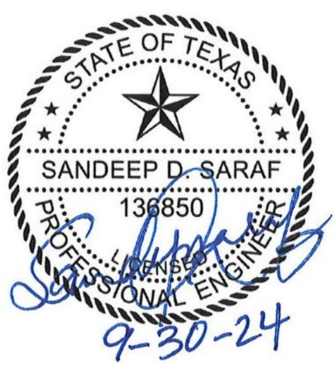
TABLE ATT10-3
REQUIRED PHYSICAL PROPERTIES OF GEOCOMPOSITE

TEST NAME	GEOCOMPOSITE COMPONENT	TEST METHOD	MINIMUM FREQUENCY OF TESTING	MINIMUM TEST STANDARDS
Carbon Black Content	Geonet	ASTM D1603 [2]	per manufacturer recommendation	2%-3%
Density	Geonet	ASTM D1505	per manufacturer recommendation	0.94 g/cc
Thickness	Geonet	ASTM D5199	per manufacturer recommendation	250 mil
Transmissivity [1, 3, 4]	Geocomposite DS = Double-Sided	ASTM D4716	per manufacturer recommendation	SS = $1x10^{-3}$ m^2/s DS = $5x10^{-4}$ m^2/s
Mass per Unit Area [3]	Non-Woven Geotextile	ASTM D5261	per manufacturer recommendation	8 oz/sy

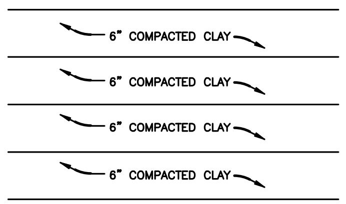
Notes:

1. Gradient of 0.05, normal load of 10,000 psf for SS and gradient of 0.3, normal load of 4,000 psf.
2. ASTM D4218 is also an appropriate test method per GRI GM13.
3. A non-woven geotextile and geocomposite performance demonstration is provided in Attachment 10, Appendix 2. The GP will review the properties of the selected geocomposite and may require additional testing to confirm the parameters of a cell-specific design.
4. Consistent with Attachment 10, Section 5, geocomposite installed on the floor and on the sideslopes shall be a double-sided (DS) geocomposite.

FIGURES

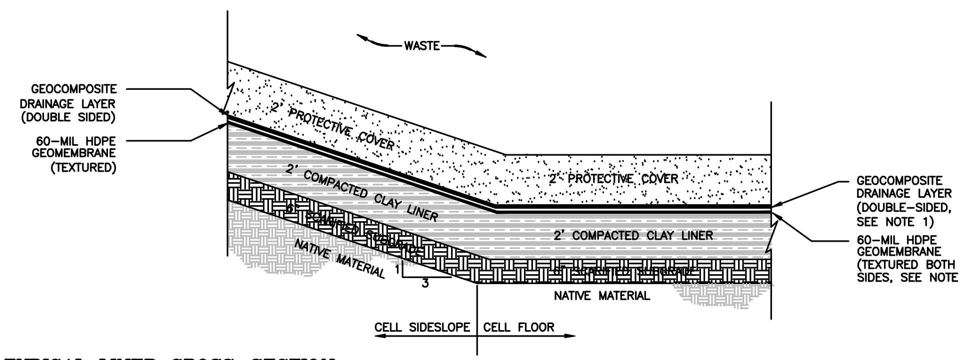


SCS Engineers
TBPE Reg. # F-3407

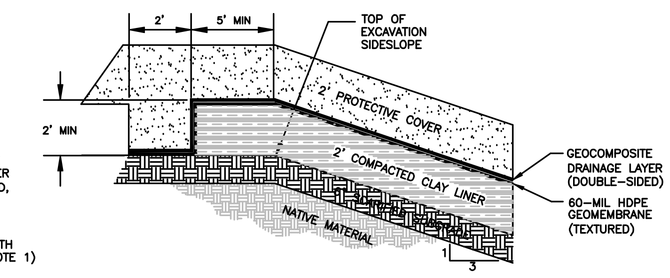


COMPACTED CLAY LINER SHALL BE CONSTRUCTED IN 8" LOOSE LIFTS, COMPACTED TO 6" THICKNESS. COMPACTION SHALL BE 95% STANDARD PROCTOR DENSITY, OR 90% +/- 2% OPTIMUM MOISTURE CONTENT.

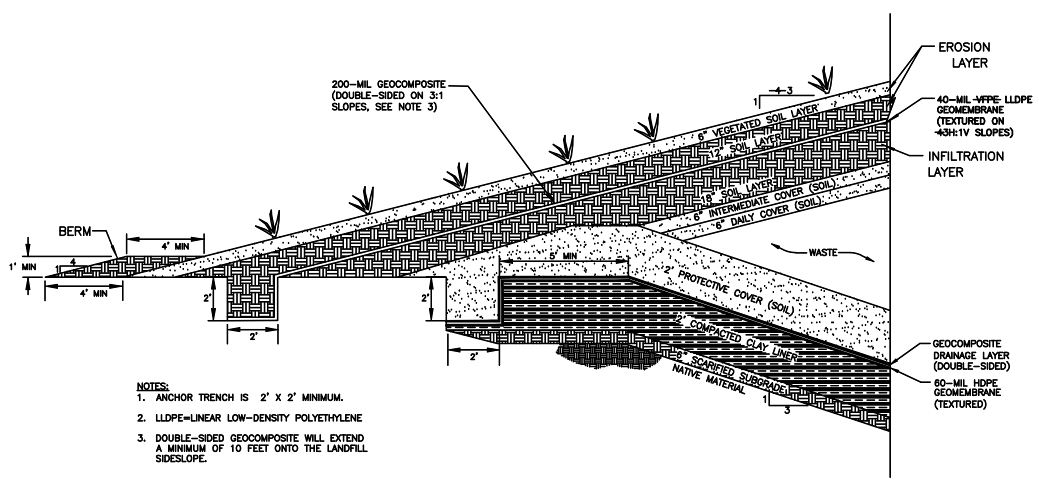
COMPACTION DETAILS FOR COMPACTED CLAY LINER
NTS



TYPICAL LINER CROSS-SECTION
NTS

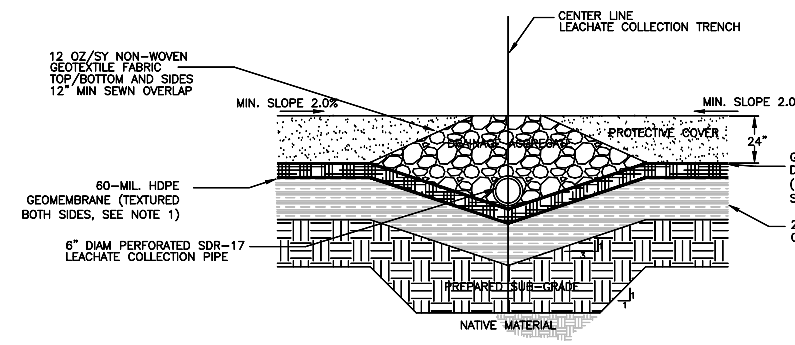


ANCHOR TRENCH & SIDESLOPE TERMINATION DETAIL
NTS

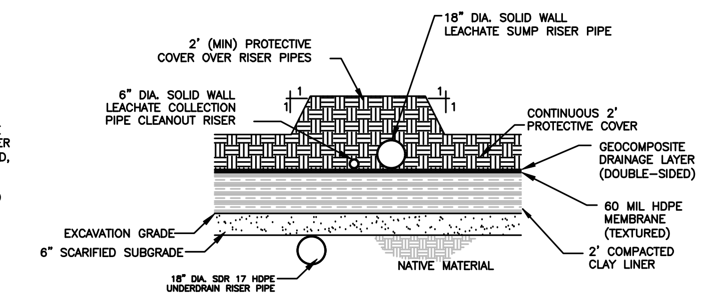


NOTES:
1. ANCHOR TRENCH IS 2' X 2' MINIMUM.
2. LLDPE=LINEAR LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.

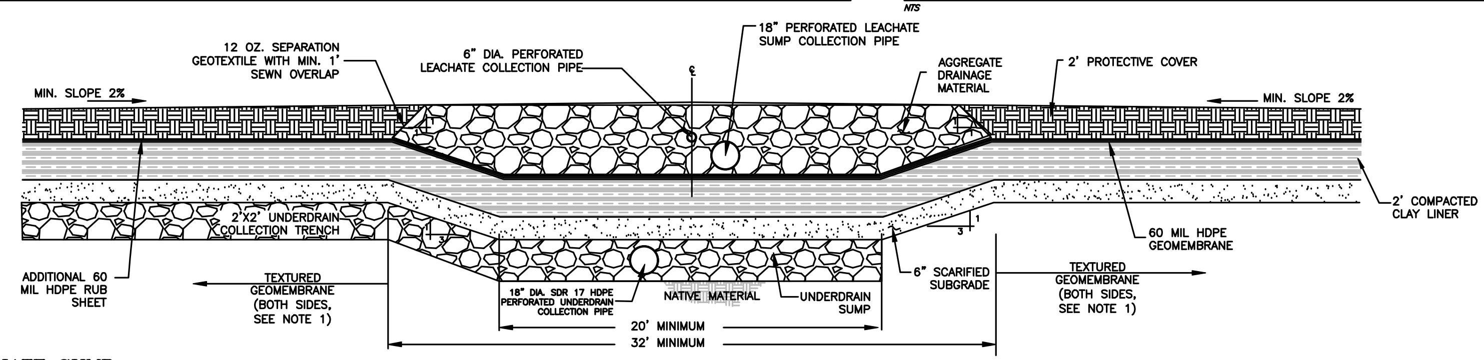
LINER AND FINAL COVER TIE-IN DETAIL
NTS



LEACHATE COLLECTION TRENCH DETAIL
NTS



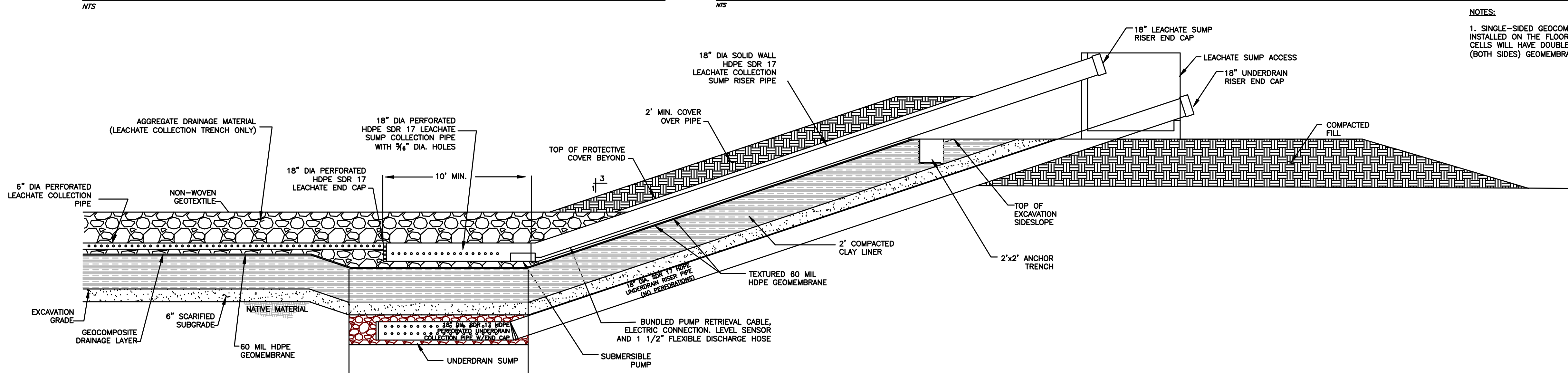
SIDESLOPE RISER
NTS



LEACHATE SUMP
NTS

NOTE: SEE DETAIL 1 ON ATT 10-5 FOR UNDERDRAIN SUMP DETAIL

NOTES:
1. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR.



LEACHATE SUMP SECTION
NTS

NOTE: SEE DETAIL 4 ON ATT 10-5 FOR UNDERDRAIN COLLECTION PIPE PERFORATION DETAILS.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: LINER & LEACHATE COLLECTION DETAILS

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24

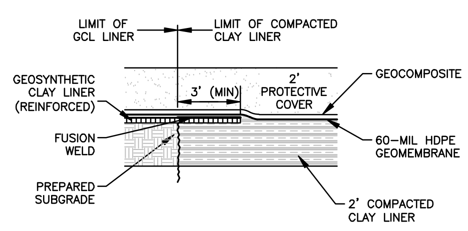
CADD FILE: 10A

DATE: 09/2024

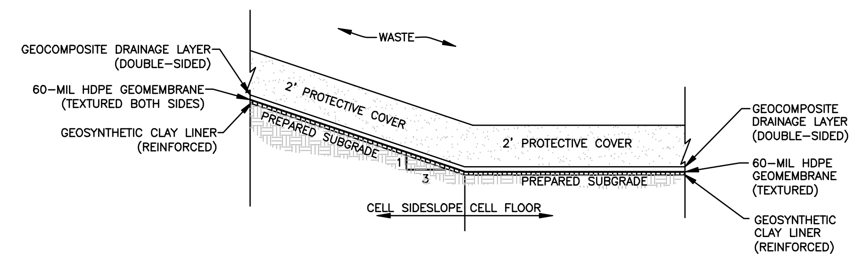
SCALE: AS SHOWN

ATTACHMENT 10A

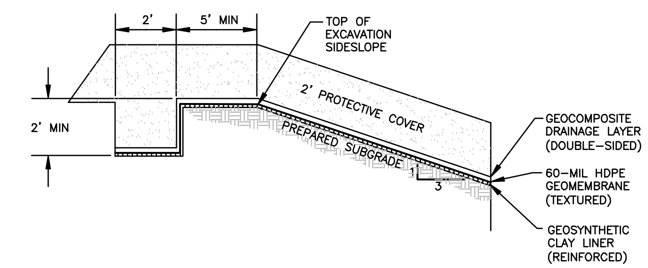
8/1/2024 10:35 AM G:\MAVERICK COUNTY LANDFILL\16220086.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\10A



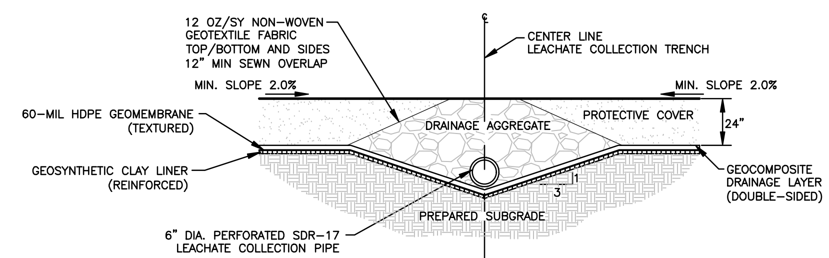
GCL/CLAY LINER TIE-IN
NTS



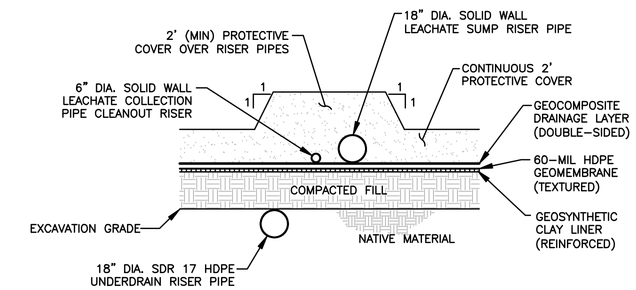
ALTERNATE LINER CROSS-SECTION NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3
NTS



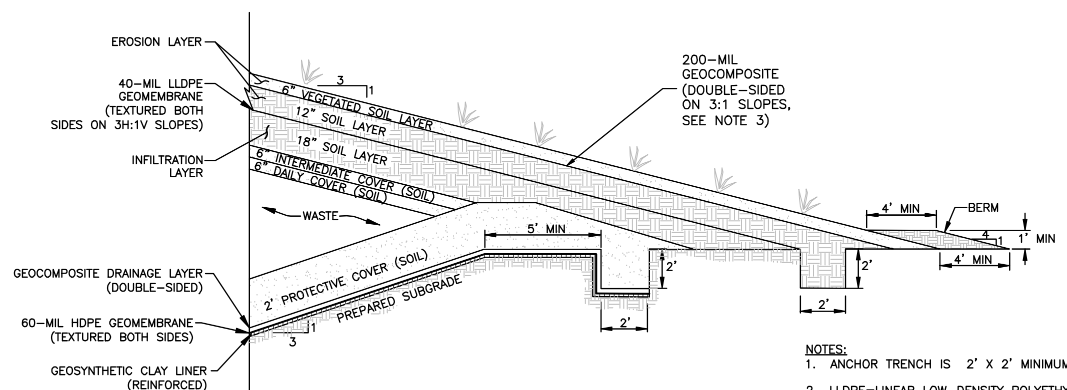
ANCHOR TRENCH & SIDESLOPE TERMINATION DETAIL
NTS



LEACHATE COLLECTION TRENCH DETAIL NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3
NTS

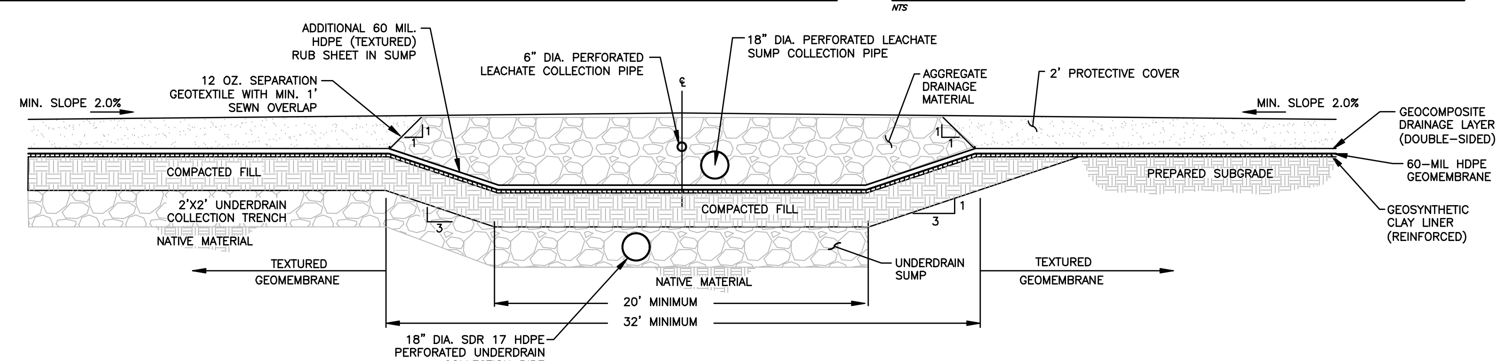


SIDESLOPE RISER
NTS



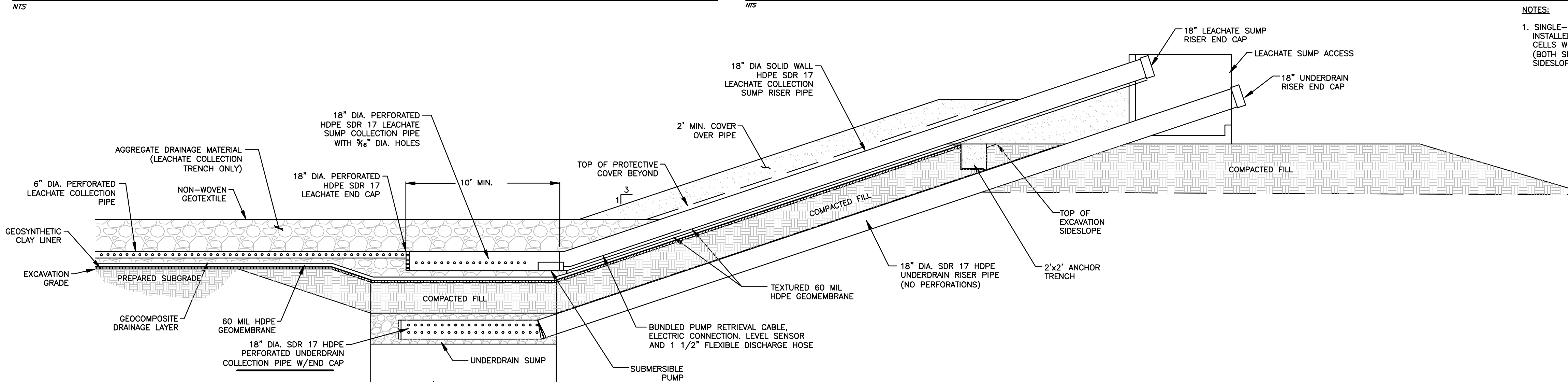
NOTES:
1. ANCHOR TRENCH IS 2' X 2' MINIMUM.
2. LLDPE=LINEAR LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.

ALTERNATE LINER AND FINAL COVER TIE-IN DETAIL
NTS



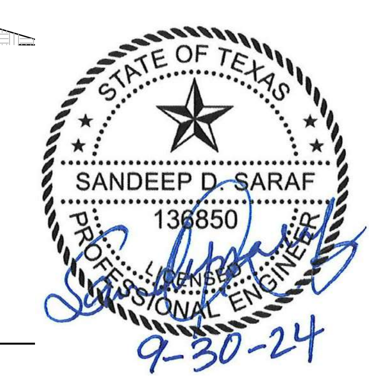
LEACHATE SUMP
NTS

NOTES:
1. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.



LEACHATE SUMP SECTION
NTS

NOTE: SEE DETAIL 4 ON ATT 10-5 FOR UNDERDRAIN COLLECTION PIPE PERFORATION DETAILS.



FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/10	REVISE PROJECT TITLE	RK
2	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
LINER & LEACHATE COLLECTION DETAILS WITH GCL ALTERNATE

PROJECT TITLE
MAVERICK COUNTY
EL INDIO MSW LANDFILL
PERMIT MODIFICATION

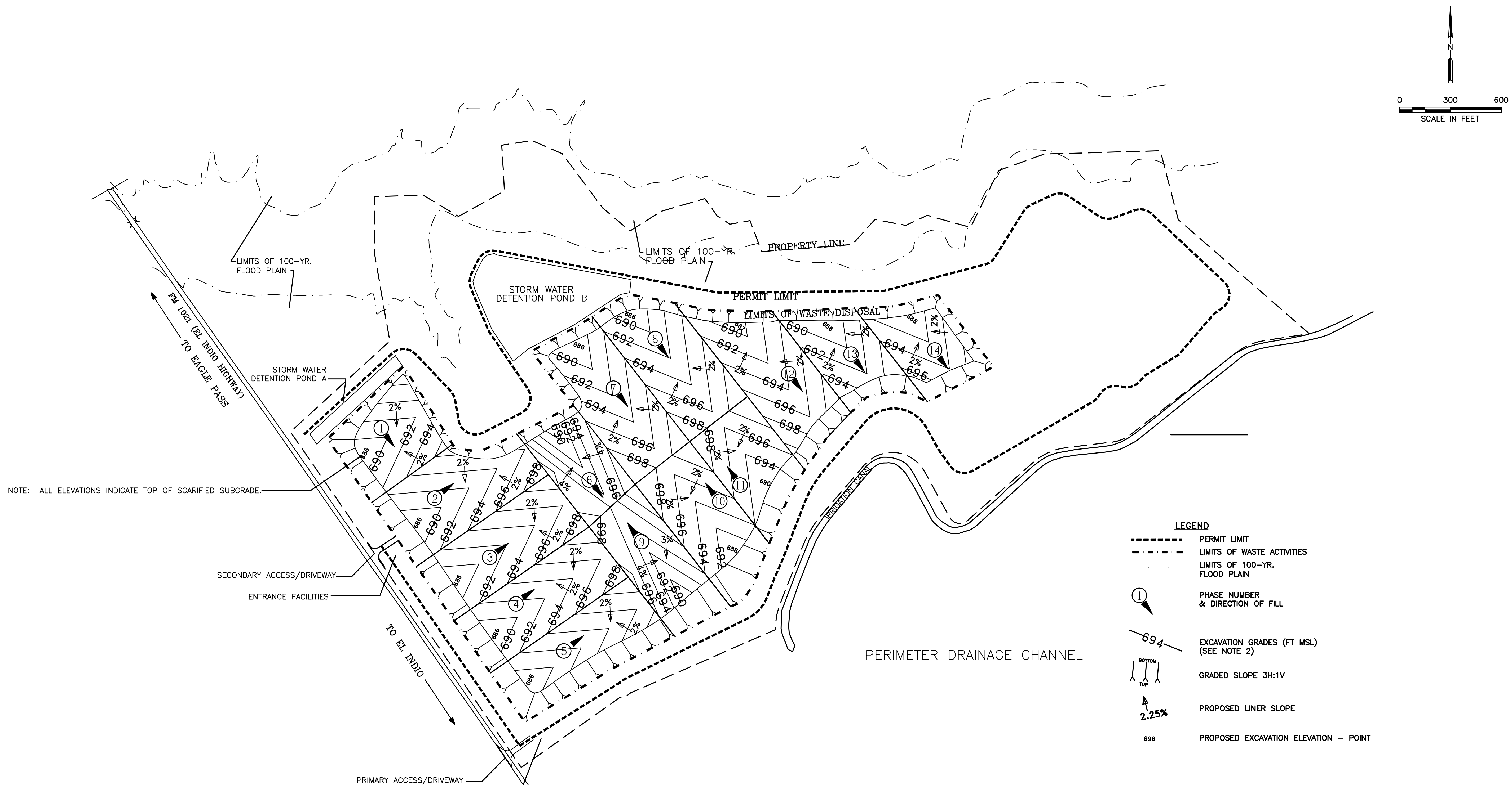
CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: 10A GCL-LINER DETAILS
DATE: 09/2024
SCALE: AS SHOWN
ATTACHMENT
10A-GCL

8/1/2024 10:44 AM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\10A GCL-LINER DETAILS



NOTE:

1. ALL ELEVATIONS/CONTOURS PROVIDED IN THIS APPLICATION INDICATE FEET ABOVE MEAN SEA LEVEL.
2. THIS DRAWING DEPICTS EXCAVATION GRADE ELEVATIONS FOR CELLS CONSTRUCTED WITH THE STANDARD LINER (SEE ATT. 10A FOR STANDARD LINER DETAILS). FOR CELLS CONSTRUCTED WITH THE ALTERNATE LINER SYSTEM, USING A GCL, THE CELLS WILL BE EXCAVATED TO A DEPTH 2 FEET HIGHER THAN SHOWN ON THIS DRAWING (SEE ATTACHMENT 10A–GCL FOR ALTERNATE LINER DETAILS). WHETHER THE CELLS ARE CONSTRUCTED WITH THE STANDARD LINER OR ALTERNATE LINER, THE TOP OF THE LINER ELEVATIONS WILL COINCIDE WITH THE ELEVATIONS SHOWN ON ATTACHMENT 1D.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/10	DESIGNATE NOTATIONS, ADD NOTE 2; REVISE CALL-OUT IN LEGEND; ADD "STANDARD" TO DRAWING TITLE REVISE CELL 12 AND CELL 16 EXCAVATION GRADES	RK
2	9/24	REVISED EXCAVATION GRADES BASED ON NEW LIMITS OF WASTE BOUNDARY.	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
EXCAVATION GRADES BOTTOM OF STANDARD LINER SYSTEM

PROJECT TITLE
MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00	DWN. BY: DNA	Q/A RVW BY: AGA
DSN. BY: AGA	CHK. BY: SDS	APP. BY: SDS

CADD FILE: 10B

DATE: 09/2024

SCALE: AS SHOWN

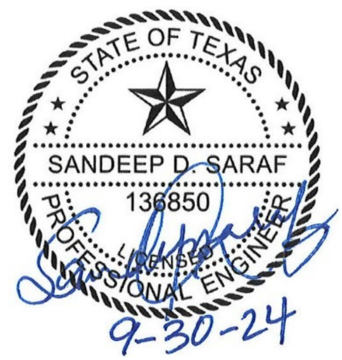
ATTACHMENT **10B**

MAVERICK COUNTY – EL INDIO MSW LANDFILL
MAVERICK COUNTY, TEXAS
PERMIT APPLICATION
SITE DEVELOPMENT PLAN PART III, ATTACHMENT 12

FINAL CLOSURE PLAN

Prepared for:
Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824



PERMIT ISSUED: SEPTEMBER 11, 2007

PERMIT MODIFICATION (REVISIONS 1, 2, 3, 4, and 5) PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Registration No. F-3407
1901 CENTRAL DR., SUITE 550
BEDFORD, TEXAS 76021
817/571-2288

Revision 1 – January 2012
Revision 2 – January 2014
Revision 3 – November 2020
Revision 4 – January 2024
Revision 5 – October 2024

SCS Project Nos. 16208046, 16209033.00, 16222088.00 & 16223092.00

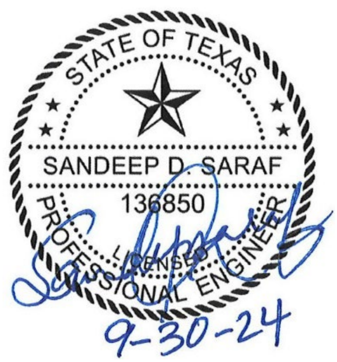
TABLE OF CONTENTS

PART III, ATTACHMENT 12
FINAL CLOSURE PLAN

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

APPENDICES TO PART III, ATTACHMENT 12

ATTACHMENTS TO PART III, ATTACHMENT 12



SCS Engineers
TBPE Reg. # F-3407

1.0 INTRODUCTION

This Final Closure Plan (FCP) consists of procedures to be followed for closure of any disposal area of the Maverick County Municipal Solid Waste Facility and for final closure of the entire facility. This final closure plan is provided to address the requirements for landfill units which receive waste on or after October 9, 1993 as required in 30 TAC 330.457.

The specific closure procedures outlined in this FCP must be acknowledged and utilized during closure operations. This FCP shall be maintained at the site office as part of the Operating Record.

This final closure plan (FCP) is organized as follows:

- Section 2.0 of this attachment provides schedule requirements for initiating and completing closure operations, including notifications to TCEQ and the public.
- Section 3.0 provides requirements for pre-closure activities necessary to evaluate the site before final cover installation and to provide information necessary for deed recordation.
- Section 4.0 provides a description of the final cover materials and design utilized for this facility.
- Section 5.0 provides installation information for the chosen materials.
- Section 6.0 provides information relating to certification of closure activities.
- Section 7.0 provides estimates of the maximum waste volume and maximum closure area for the site.
- Section 8.0 provides information regarding the required cost estimate for closure of the MSWF.
- Appendix A provides the Final Cover Quality Control Plan (FCQCP) including detailed information on installation and testing requirements.

2.0 SCHEDULE FOR CLOSURE OPERATIONS §330.457(f)

The schedules for specific closure related operations are described in detail in sections 2.1 through 2.7.

2.1 SUBMITTAL OF FINAL CLOSURE PLAN §330.457(d) & (e)(1)

This FCP is submitted to the Texas Commission on Environmental Quality (TCEQ) for review and approval in conjunction with the Site Development Plan.

2.2 PUBLIC NOTIFICATION OF INITIATION OF CLOSURE ACTIVITIES §330.461

No later than 90 days prior to the initiation of final site closure, the facility permittee shall notify the public of the planned closure. The public notice shall be placed in the local newspaper of largest circulation in the vicinity of the facility, and shall include the following information, at a minimum:

- Name of facility;
- Address;
- Physical location;
- Permit number; and,
- Last day of intended waste receipt.

The owner/operator will make available an adequate number of copies of approved closure plans for public access and review.

2.3 TCEQ NOTIFICATION OF INITIATION OF CLOSURE ACTIVITIES §330.457(f)(2)

No later than 45 days prior to the initiation of closure activities, the permittee of the MSWLF shall provide written notification to the TCEQ of the intent to close an area of the landfill, and/or the intent to close the entire facility and place this notice in the site's Operating Record. Upon notification to the executive director, the permittee shall post a site sign as described in section 2.4.

2.4 POSTING OF SIGNS §330.461(b)

No later than 45 days prior to initiation of final site closure activities at the facility, the permittee shall post a sign at the main entrance, and all public points of access, notifying all persons of the date of closing for the facility and the prohibition against further receipt of waste materials after the stated date. Also, once closure activities begin, suitable barriers shall be installed at all access points to adequately prevent unauthorized dumping of solid waste at the closed facility.

2.5 INITIATION OF CLOSURE ACTIVITIES §330.457(f)(3) and §330.457(f)(4)

Per 30TAC§330.457(f)(3), Closure activities at the unit shall begin no later than 30 days after the date on which the facility receives the known final receipt of waste. However, if the site has remaining capacity which will likely receive waste in the future, the initiation of construction activities may be postponed for a maximum of one year after the most recent receipt of waste. A request for an extension beyond the one-year deadline for the initiation for final closure may be submitted to the executive director for review and approval and shall include all applicable documentation necessary to demonstrate that the unit has the capacity to receive additional waste and threat the owner or operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed MSWLF. Per 30TAC§330.457(f)(4), within 180 days of last receipt of waste for a MSWLF unit, the owner shall complete the installation of the final cover system for that unit.

2.6 COMPLETION OF CLOSURE ACTIVITIES §330.457(f)(4)

The permittee shall complete final closure activities for the facility in accordance with the FCP within 180 days following the initiation of final closure activities. A request, including all necessary applicable documentation, for an extension of closure activities completion may be submitted to the TCEQ for approval if closure activities are estimated to take longer than 180 days. The necessary applicable documentation shall include documents necessary to demonstrate that the final closure will, of necessity, take longer than 180 days and all steps have been taken and will continue to be taken to prevent threats to human health and the environment from the unclosed MSWLF.

2.7 SUBMITTAL OF AN "AFFIDAVIT TO THE PUBLIC" §330.457(g)

Within 10 days after completion of final site closure activities for the facility or site, the owner shall place in the operating record and submit to the TCEQ a certified copy of an "Affidavit to the Public" in accordance with §330.19 and §330.457(g). The affidavit shall inform the public of the date of closing for the facility, and that the receipt of waste materials after the stated date is prohibited. The affidavit will be placed in the site's Operating Record.

In addition, the owner or operator of the closed facility or site shall record a certified notation on the deed to the facility or site property, or on some other instrument that is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and use of the land is restricted according to the provisions specified in 30 TAC 330.465 (relating to Post-Closure Land Use). The owner or operator shall submit a certified copy of the modified deed to the executive director and place a copy of the modified deed in the operating record within the timeframe specified in this paragraph.

In accordance with §330.461(d), the site may request permission from the TCEQ to remove notation from the deed if all wastes are removed from the site in accordance with §330.7(a). The post-closure land use will conform to §330.463. Post-closure land use is projected to be open land.

3.0 PRE-CLOSURE ACTIVITIES

Before initiation of closure activities begins, the following tasks shall be performed:

- Topographic survey of surface of area to be closed;
- Site evaluation; and,
- Boundary survey (if final site closure).

Once this information is obtained, a proper final cover system shall be constructed that will minimize stormwater infiltration into the waste and erosion of the final cover.

3.1 TOPOGRAPHIC SURVEY

A topographic survey shall be performed upon final waste placement. The survey will assist in evaluating the existing height and top slope areas to receive final cover so that permit compliance can be evaluated and the final cover system can be properly constructed.

3.2 SITE EVALUATION

An evaluation of the areas to receive final cover shall be performed upon final waste placement. The evaluation shall include a site inspection to delineate the area of waste disposal, and analyze drainage and erosion protection needs. An evaluation of the operation records shall also be performed to confirm no inappropriate waste disposal activities have taken place at the facility. The design of the final cover system shall address any problem areas detected during the site evaluation.

3.3 BOUNDARY SURVEY

A boundary survey of the entire facility shall be performed as part of the final site closure to provide a metes and bounds description for the filing of the affidavit of closure, and deed recording of any area of the site which has received waste.

4.0 FINAL COVER MATERIALS AND DESIGN §330.457

Per 30TAC§330.457(f)(4), within 180 days of the last receipt of wastes for a MSWLF unit, the owner or operator shall complete the installation of a final cover system for that unit that is designed and constructed to minimize infiltration and erosion. The final cover system shall be composed of no less than two feet of soil and consist of an infiltration layer overlain by an erosion layer as described below. Per 30TAC§330.457 a description of the final cover materials and design is provided in sections 4.1 through 4.5 and procedures for installation are provided in sections 5.1 through 5.4.

4.1 INFILTRATION LAYER 30TAC§330.457(a)(2)

The infiltration layer shall consist of a minimum 18-inch thick layer of constructed low permeability material (with a coefficient of permeability no greater than 1 x 10^{-5} cm/s). The final cover system for this facility includes an 18-inch thick layer of constructed low permeability material (with a coefficient of permeability no greater than 1 x 10^{-5} cm/s) overlain by the synthetic membrane (described in section 4.3) as the infiltration layer. See **Attachment 12A** for details of the final cover.

4.2 FLEXIBLE MEMBRANE COVER 30TAC§330.457(a(1)

The 18” thick low permeability layer (described in section 4.1) shall be overlain by a synthetic membrane that has a permeability less than or equal to the permeability of the bottom liner system. The final cover system for this facility includes a 60 mil LLDPE (linear low-density polyethylene) geomembrane as the flexible membrane cover, exceeding the 20 mil thickness required by 30TAC§330.457(a)(1) for flexible membrane liners. See **Attachment 12A** for details of the final cover.

DRAINAGE GEOCOMPOSITE

A double-sided geocomposite will be installed on top of the flexible membrane cover (described in Section 4.2) on the sideslope only. The drainage composite will be terminated on the topslope 10-feet from the crest of the topslope and sideslope. The erosion layer (described in Section 5.3) will be placed directly over the drainage geocomposite on sideslope and flexible membrane cover installed on topslopes. See **Attachment 12A** for details of the final cover.

4.4 EROSION PROTECTION LAYER 30TAC§330.457(a)(3)

The erosion protection layer shall consist of a minimum of six inches of earthen material that is capable of sustaining native plant growth and shall be seeded or sodded immediately following the application of the final cover in order to minimize erosion. The final cover system for this facility consists of a 12” native soil layer overlain by a 6” vegetated soil layer. See **Attachment 12A** for details of the final cover.

4.5 REVEGETATION

Revegetation includes the activities necessary to provide erosion protection over the surface of the completed final cover system. These areas shall be planted, seeded, sodded, or have hydromulch applied immediately following installation of the final cover to minimize erosion.

Plant Types: Mixes of native and non-native grasses may be used for revegetation purposes, provided they have an average root depth no more than six inches, and are suited to the climate in Maverick County. The maximum six-inch root depth is deep enough to prevent excessive drying of the roots during dry periods, and shallow enough to prevent penetration through the geomembrane. Thus the roots will not interfere with the final cover but will provide erosion protection. The types of grasses that are commonly found in the area and that are successful in establishing vegetation (based on observations of types of grasses growing successfully in the area) should be used. See **Part III, Attachment 7** for the final contour map.

4.6 SITE GRADING AND DRAINAGE

The final cover system shall be properly graded according to the permit drawings to promote positive drainage from the final cover, and to provide erosion/sedimentation control. See **Part III, Attachment 7** for the final contour map.

4.7 FINAL CONTOUR MAP §330.457(e)(5)

In accordance with §330.457(e)(5), a final contour map depicting the proposed final contours is included in **Part III, Attachment 7**. The maximum final cover elevation is 832 feet above m.s.l. The proposed facility includes waste disposal both above and below the existing grades. The sloped areas have maximum 3(H):1(V) sideslopes. The final cover system includes surface drainage features to collect, transport and control stormwater. These surface drainage features include diversion berms along terraces, downchutes along the slopes, perimeter drainage channels, and detention ponds. See **Part III, Attachment 6B** for the proposed drainage plan.

5.0 FINAL COVER INSTALLATION §330.457

After intermediate cover soil has been placed on the closure area and the topographic survey has been completed, final cover may be placed on the closure area. The final cover system will consist of the following (bottom to top):

- Daily Cover (6" soil)
- Intermediate Cover (6" soil)

- Infiltration layer (18” soil–permeability no greater than 1 x 10^{-5} cm/sec)
- Drainage Geocomposite (200 mil, double-sided on sideslope only)
- Flexible membrane cover (60 mil LLDPE, textured on both sides);
- Erosion protection layer (12” native soil);
- Vegetated topsoil (6” soil)

Sections 5.1 through 5.4 include limited information regarding the installation of the final cover materials. Refer to the final cover quality control plan (FCQCP) in **Appendix A** for more detailed information regarding quality control during construction of the final cover.

5.1 INFILTRATION LAYER 30TAC§330.457(a)(2)

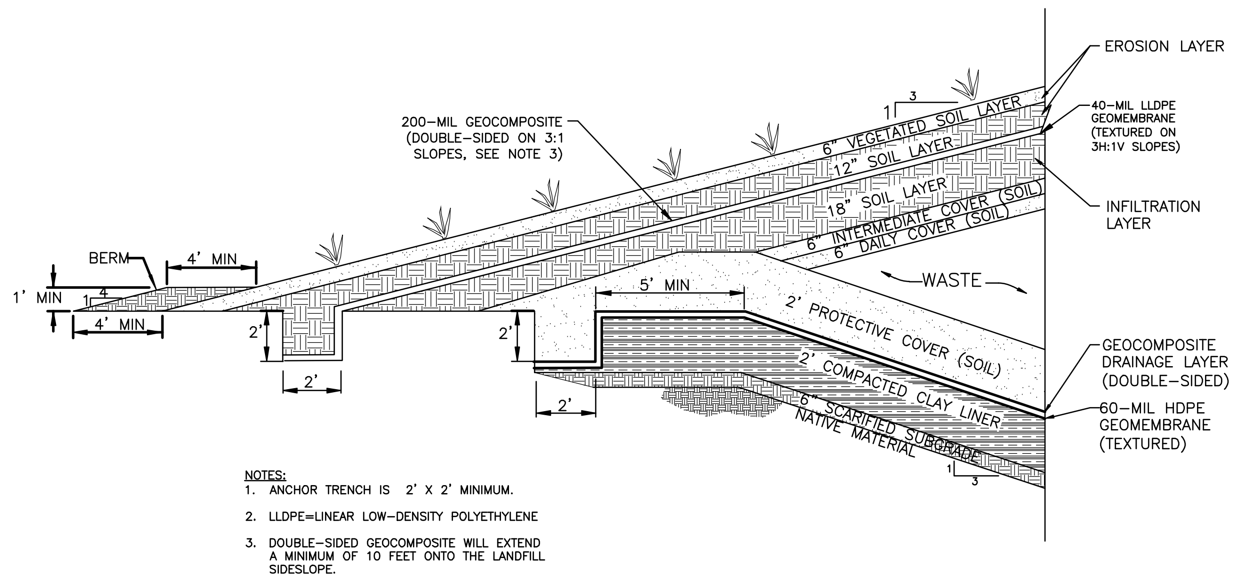
The infiltration layer shall be placed above the daily and intermediate cover. The infiltration layer shall consist of 18” soil with a permeability no greater than 1 x 10^{-5} cm/sec. Following placement of the infiltration layer, TCEQ requires the coefficient permeability of the infiltration layer to be tested at a frequency of no less than one test per surface acre of final cover per 30TAC§330.457(f). Permeability test results shall be submitted to the executive director in a format stipulated in technical guidelines furnished by the executive director.

5.2 FLEXIBLE MEMBRANE COVER

The flexible membrane cover shall be properly installed in accordance with the manufacturer’s quality assurance program. The top surface of the infiltration layer shall be smooth and free of materials which could damage the flexible membrane cover (i.e rocks, sticks and debris). Placement and installation of the flexible membrane cover shall be performed in a way to minimize wrinkling. The flexible membrane cover shall not be installed during adverse weather conditions such as in the presence of high wind or extreme heat. All persons walking on the geomembrane shall wear shoes that will not damage the material.

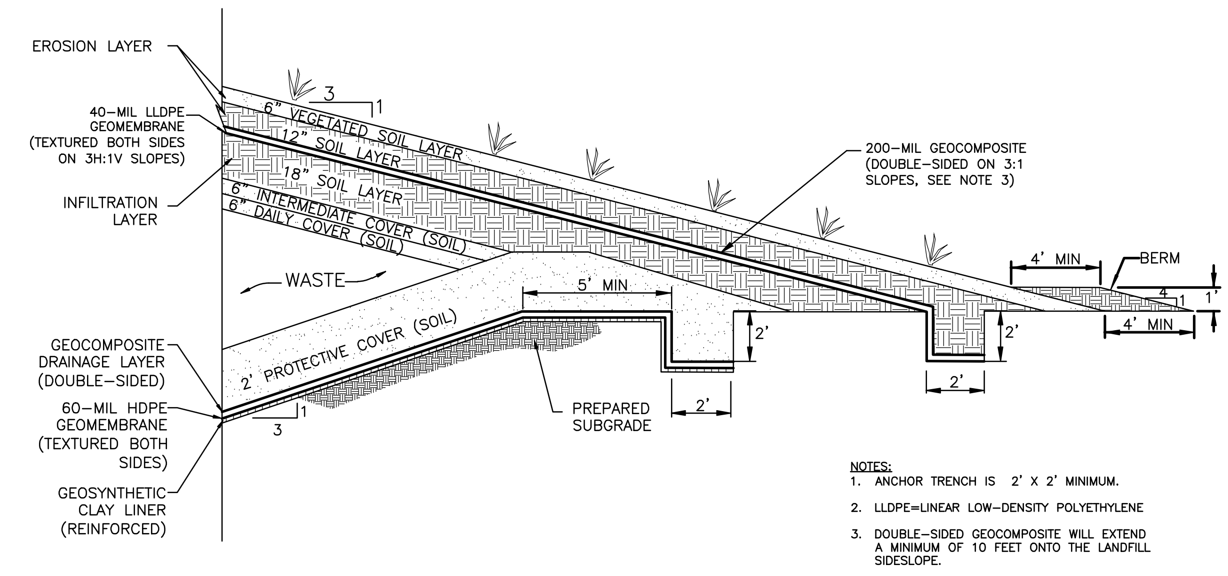
5.3 DRAINAGE GEOCOMPOSITE

The drainage goecomposite cover shall be properly installed in accordance with the manufacturer’s quality assurance program. Placement and installation of the geocomposite shall be performed in a way to minimize damage to the geocomposite or underlying geomembrane by handing, trafficking, leakage of hydrocarbons, or by other means. The geocomposite shall be placed free of tension, stress, folds, wrinkles, or creases.



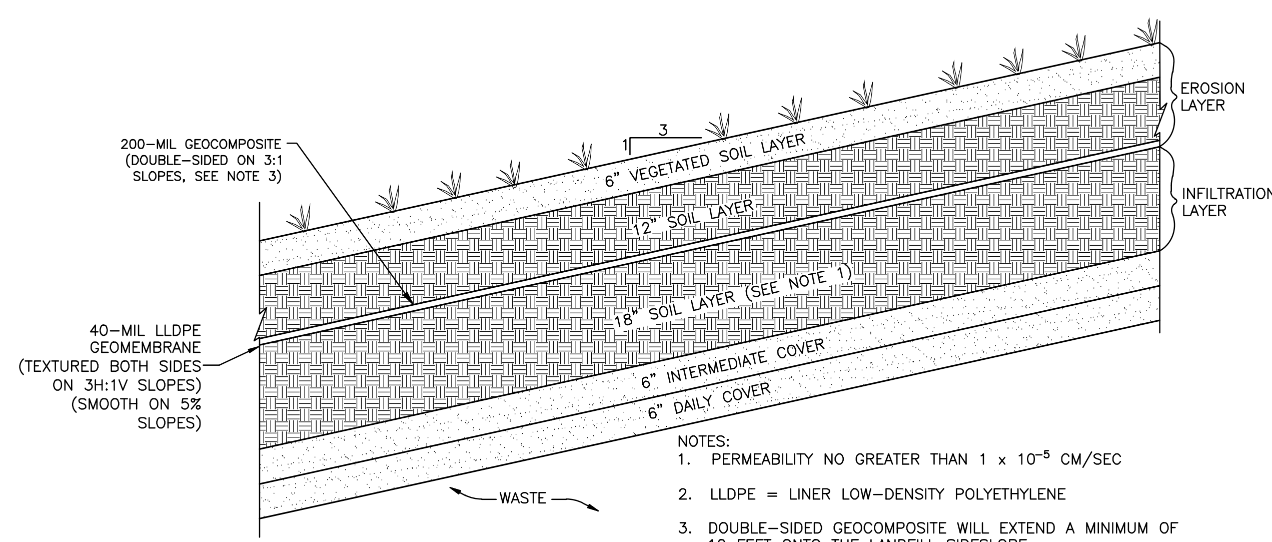
STANDARD LINER AND FINAL COVER TIE-IN DETAIL

NTS



ALTERNATE LINER AND FINAL COVER TIE-IN DETAIL

NTS



NOTES:
1. PERMEABILITY NO GREATER THAN 1×10^{-5} CM/SEC
2. LLDPE = LINER LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.

TYPICAL FINAL COVER DETAIL

NTS

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/10	REVISED FINAL COVER DETAIL TO BE CONSISTENT w/2009 PERMIT MODIFICATIONS. REVISED LINEAR DETAIL TO SHOW ALTERNATE LINER; REVISED DETAIL TITLE	RK
2	10/10	REVISE PROJECT TITLE	RK
3	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3:1	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
FINAL COVER DETAILS

PROJECT TITLE
MAVERICK COUNTY
EL INDIO MSW LANDFILL
PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DSN. BY: AGA | DWN. BY: DNA | CHK. BY: SDS | Q/A RVW BY: AGA | APP. BY: SDS

CADD FILE: 12A-FINAL COVER DETAILS

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
12A

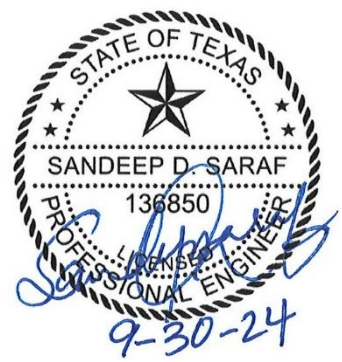
PART III

ATTACHMENT 14

LANDFILL GAS MANAGEMENT PLAN

FOR

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316



Prepared for:
Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

PERMIT ISSUED: SEPTEMBER 11, 2007

PERMIT MODIFICATION (REVISION 1) PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers, Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 1 – April 2009
Revision 2 – October 2024
SCS Project Nos. 16208065.00 & 16223092.00

TABLE OF CONTENTS

PART III, ATTACHMENT 14
LANDFILL GAS MANAGEMENT PLAN

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24

SCS Engineers
TBPE Reg. # F-3407

TABLE OF CONTENTS (CONTINUED)

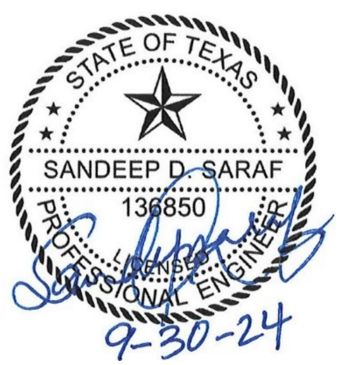
STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED PROFESSIONAL ENGINEER
9-30-24
SCS Engineers
TBPE Reg. # F-3407

APPENDICES TO PART III, ATTACHMENT 14

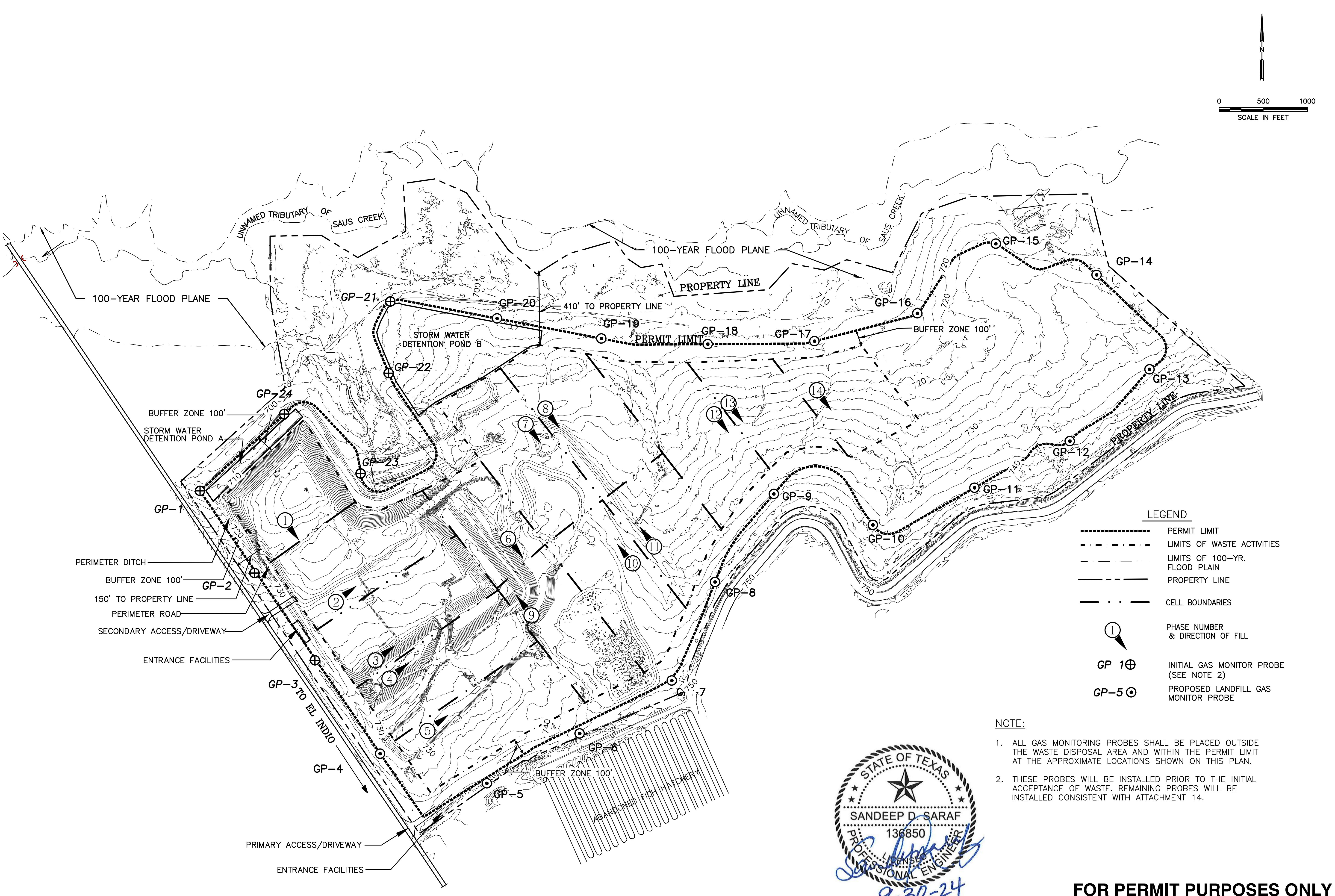
ATTACHMENTS TO PART III, ATTACHMENT 14

ATTACHMENTS TO
PART III
ATTACHMENT 14

Attachment	Title/Description
14A	**GAS MONITORING PROBE PLACEMENT**
14B	**TYPICAL GAS MONITORING PROBE**
14C	**ENTRANCE FACILITIES**



SCS Engineers
TBPE Reg. # F-3407



NOTE:

1. ALL GAS MONITORING PROBES SHALL BE PLACED OUTSIDE THE WASTE DISPOSAL AREA AND WITHIN THE PERMIT LIMIT AT THE APPROXIMATE LOCATIONS SHOWN ON THIS PLAN.
2. THESE PROBES WILL BE INSTALLED PRIOR TO THE INITIAL ACCEPTANCE OF WASTE. REMAINING PROBES WILL BE INSTALLED CONSISTENT WITH ATTACHMENT 14.

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	4/09	DECREASE SPACING OF GAS PROBES TO 600'	RK
2	4/09	ADD ALTERNATE ACCESS/DRIVEWAY	
3	9/24	REVISED LIMIT OF WASTE	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
GAS MONITORING PROBE PLACEMENT

PROJECT TITLE
MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

CADD FILE: CC 6-09 GMP (09.13.2021)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
14A

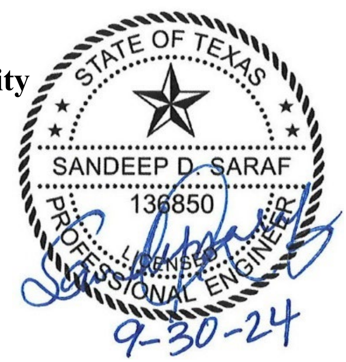
LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN

PART III, ATTACHMENT 15

FOR

MAVERICK COUNTY EL-INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW 2316

Prepared for:



Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

PERMIT ISSUED: SEPTEMBER 11, 2007

REVISIONS 1, 2, & 3 PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Reg. No. F-3407
1901 Central Drive, Suite 550
Bedford, Texas 76021
817/571-2288

Revision 1 – July and October 2010
Revision 2 – July 2014, October 2014, December 2014
Revision 3 – October 2024
SCS Project No. 16209033.00, 16214011.00 & 16223092.00

TABLE OF CONTENTS

SECTION **PAGE**

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24
SCS Engineers
TBPE Reg. # F-3407

APPENDICES TO PART III, ATTACHMENT 15

ATTACHMENTS TO PART III, ATTACHMENT 15

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER

9-30-24

SCS Engineers
TBPE Reg. # F-3407

1.0 INTRODUCTION

This document presents the Leachate and Contaminated Water Management Plan for cells constructed at the proposed Maverick County Landfill. Leachate, gas condensate and contaminated water are produced in the normal course of operations of a municipal solid waste disposal facility. Leachate is liquid that emerges from the refuse after it percolates or passes through the waste mass. Gas condensate is the liquid generated as a result of any gas recovery process at a municipal waste facility. Contaminated water is water which has come into contact with waste, leachate, or gas condensate. For environmental protection and efficient operations, it is necessary for the facility to have a plan for the management of leachate, gas condensate and contaminated water. This plan provides methods to minimize the volume of leachate, gas condensate and contaminated water generated and describes the proposed leachate collection system (LCS) for the disposal cells, the procedures for storage and disposal of leachate, gas condensate and contaminated water, and the leachate quality sampling plan. The TCEQ handbook titled *Leachate Collection System Handbook 30TAC§330.201* (October 1993) provided technical guidelines for use in drafting this attachment.

1.1 PROPOSED APPLICATION

This Application proposes to permit approximately 180 acres of an approximate 258-acre property owned by Maverick County, Texas. The design and installation of a LCS for the proposed lined areas is required. The proposed system will be installed in each new disposal cell as future cells are developed.

1.2 REGULATORY REQUIREMENTS

The Texas Commission on Environmental Quality (TCEQ) regulates on-site management of leachate, gas condensate and contaminated water as described in the Municipal Solid Waste Management Regulations (MSWMR). Leachate, gas condensate, contaminated surface water, and contaminated groundwater will not be discharged into waters of the state or nation, including wetlands, in violation of any requirements of 30 TAC §330.15(h), Section 21.251 of the Texas Water Code, V.T.C.S., the Clean Water Act, or the National Pollutant Discharge Elimination System (NPDES) requirements. Contaminated surface water and groundwater will not be placed in or on a landfill cell, with the exception of leachate may be recirculated into a cell constructed with a composite liner, as described in Section 4.6.2.

2.0 PROPOSED MSWF DESIGN

An area fill method will be utilized for the site. The property will be continuously developed in 14 cells. The cell designations and sequence of fill operations are shown in **Part III, Attachment 1E**.

The proposed below-ground waste disposal will extend approximately 50 feet below natural ground to a finished base grade (top of liner) elevation ranging from 692 feet m.s.l. to 714 feet m.s.l, as shown in Part III, Attachment 1D. These grades are applicable to either liner option, including (1) standard liner system with the compacted clay liner component, as shown on Attachment 15A; and (2) alternate liner system with the geosynthetic clay liner (GCL) component, as shown on Attachment 15A-GCL. The maximum excavation for the liner and sumps (leachate collection) is approximately 56 feet below existing ground, to approximately 686 feet m.s.l., as shown in Part III, Attachment 1D1. However, the elevations shown on Attachment 1D1 are associated with the standard liner system, which includes the 2-foot compacted clay liner. Therefore, in the event the alternate liner system is installed within a respective cell, then the excavation grades within that cell will be 2-foot higher than shown on Attachment 1D1.

The proposed above-ground fill will generally include a 1(V):3(H) fill slope from the perimeter to a peak elevation (top of final cover) of approximately 833 feet m.s.1. The maximum waste elevation is approximately 830 feet m.s.l. (approximately three feet below the top of the final cover system). The final grades are shown in **Part III, Attachment 7**.

3.0 LEACHATE MINIMIZATION PRACTICES

To minimize the quantity of leachate, gas condensate and contaminated water produced, the facility will take several precautions. These precautions extend to site construction, cover practices, surface water management, and waste acceptance.

The primary sources of liquids at a disposal facility which may ultimately need to be managed as leachate, gas condensate or contaminated water are rainfall and moisture present in incoming wastes. Rain falling directly on the facility is either:

- absorbed and retained in the waste;
- forms leachate;
- is extracted with the landfill gas;
- runs off into the perimeter drainage system as uncontaminated run-off; or
- collects in an excavated area separated from waste and is pumped into the perimeter drainage system as uncontaminated water. The run-off is managed carefully in both open and closed portions of the facility to limit the quantity which comes into contact with waste and thereby becomes contaminated.

Part III, Attachment 6 includes rainfall runoff design calculations.

Bulk liquids will not be accepted for disposal unless in accordance with Part IV, Section 4.20.5 of the Site Operating Plan.

DAILY COVER 30 TAC §330.165(a)

As operations progress, a layer of soil at least 6” thick is placed over inactive areas that are not filled to final grade. Run-on diversion berms, placed upslope from the working face and daily cover areas will direct uncontaminated run-off into the surface drainage system. Daily cover shall be graded to prevent ponding and erosion. The area of active disposal shall be kept as small as practicable during operations to minimize the amount of rainfall/run-off which comes into contact with waste.

INTERMEDIATE COVER 30 TAC §330.165(c)

In addition to daily cover, all areas that have received waste but will be inactive for longer than 180 days shall receive intermediate cover. This intermediate cover shall be an additional six inches of well-compacted earthen material not previously mixed with garbage, rubbish, or other solid waste for a total of not less than 12 inches of cover. The intermediate cover shall be graded to prevent ponding of water. Run-off from areas with intermediate cover shall not be considered as having come into contact with the working face or leachate for the purpose of §330.55(b)(6) of this title (relating to Contaminated Water Treatment).

FINAL COVER 30 TAC §330.457(a)

Once final cover is installed on disposal areas, vegetation is established on the final cover to promote evapotranspiration, limit erosion, and reduce infiltration. Slopes will be maintained to prevent cover erosion and ponding of water.

The typical final cover system is composed of the following: (top to bottom) above waste, as shown in **Attachment 15A**.

1. 6" Vegetated Top Soil
2. 12" Erosion Layer (Soil)
3. Drainage Geocomposite (200-mil double-sided on sideslopes only)
4. Flexible Membrane Liner (40 mil LLDPE)
5. 18" Infiltration Layer (Soil, Maximum $1x10^{-5}$ cm/sec permeability)
6. 6" Intermediate Cover (Soil)
7. 6" Daily Cover (Soil)

STANDARD LINER SYSTEM 30 TAC §330.331 and §330.333

The standard liner system (referred to in the TCEQ regulations as a composite liner) consists of the following: (top to bottom) below waste, as shown in **Attachment 15A**.

1. 2' protective cover;
2. Geocomposite drainage layer*;
3. 60 mil. HDPE geomembrane**;
4. 2' compacted clay liner**;
5. 6" prepared subgrade; and,
6. Native material.

* In Cells 1, 2, and 3, smooth geomembrane and a single-sided geocomposite were used on the cell floor, whereas textured geomembrane and double-sided geocomposite were used on the side slopes. In future cells, textured geomembrane and double-sided geocomposite will be used on cell floors and sideslopes.
** Cell 3 was constructed with a GCL/HDPE geomembrane liner system. In compliance with the current permit, 24-in thick compacted clay liner may be replaced with a reinforced GCL in the future cells.

An evaluation of the maximum head on the liner and estimate of leachate production (prepared by Raba-Kistner, May 2004) using the Hydrologic Evaluation of Landfill Performance (HELP) model is provided in Appendix 1 of this attachment. A supplemental analysis was also performed using the HELP model to evaluate the maximum amount of leachate recirculation over a standard liner system. This supplemental analysis is included in Appendix 1A of this attachment. The procedures that will be used to recirculate leachate are described in Section 4.6.2 of this attachment.

ALTERNATE LINER SYSTEM 30 TAC §330.335

Attachment 10, Appendix 3 presents an Alternate Liner Design Demonstration, prepared in accordance with 30 TAC §330.335. This alternate liner is comprised of the following components (top to bottom), as shown on Attachment 15A-GCL:

1. 2' protective cover;
2. Geocomposite drainage layer;
3. 60 mil. HDPE geomembrane;
4. Geosynthetic clay liner; and
5. Prepared subgrade.

Attachment 10, Appendix 3 also includes HELP modeling to estimate the rate of percolation through the alternate liner for input into the MULTIMED model to demonstrate that the maximum contaminate levels for groundwater, detailed in §330.331, Table 1, will not be exceeded at the point-of-compliance. Leachate recirculation operations will not be performed over portions of the landfill that are lined with this alternative liner design.

4.0 LEACHATE MANAGEMENT SYSTEM 30 TAC §330.333

The purpose of the leachate collection system (LCS) is to control leachate head buildup within the waste during the active operations of the facility and to monitor leachate levels after the facility is closed. Liquid entering the facility drains to the bottom of the facility and collects over the geomembrane liner. The liner is overlain with a LCS extending over the bottom of each cell. The LCS is sloped to ensure leachate flows to the recovery sump. Details of the LCS are included in **Attachment 15B**. Leachate will be removed from the sumps and managed in accordance with Section 4.6-Recovered Leachate Handling System. The leachate recovery system would be composed of five main components, as discussed in the following sections. These are the:

- Drainage Layer;
- Collection Trenches;
- Recovery Sumps;
- Pump and Riser System; and,
- Recovered Leachate Handling.

Most of these components are constructed of HDPE (except for the sump and collection trench aggregate). These materials have been proven to be appropriate materials for use in Municipal Solid Waste Facility leachate collection systems based upon their resistance to deterioration caused by typical municipal landfill leachate. All drainage aggregate and granular drainage materials will have no more than 15% calcium carbonate to help prevent clogging. These materials will help ensure proper functioning of the leachate collection system throughout the active life and the post-closure period of the facility.

4.1 PROPOSED LEACHATE COLLECTION SYSTEM

The TCEQ Municipal Solid Waste Regulations recommend modeling the facility using the Hydrologic Evaluation of Landfill Performance (HELP Model) program. This program was developed by the US Army Corps of Engineers to assist designers in determining the effectiveness of landfill designs. The HELP model was used to estimate the amount of leachate that will be generated by the landfill during periods with and without leachate recirculation and confirm that the leachate collection system will maintain the leachate head on the liner below 12 inches. Output files from the HELP model are included in Appendix 1 (for the leachate generation analysis without recirculation) and Appendix 1A (for the leachate generation analysis with recirculation).

The Facility is comprised of one continuous development with approximately 180 acres inside the permit boundary. Waste disposal encompasses approximately 108.6 acres. There are 14 separate leachate collection systems and sumps for the facility. The leachate collection pipe will be installed on a one percent grade. The bottom cross slopes of the landfill will be graded at a minimum two percent and any liquid generated will drain to the collector and subsequently to the sump slope for that collector. See **Attachment 1** for the phase and cell configuration of the landfill, and **Attachment 15C** for the individual leachate collection systems.

Cell 1 will be developed first. Filling on the compacted clay liner or geosynthetic clay liner and leachate collection system will begin at the sump area and progress up-gradient to the liner termination berm. The sequence of development calls for this area to be filled to the maximum possible height utilizing 3:1 external slopes from the limits of fill, prior to moving into Cell 2. A portion of this area will be at final grade and final cover may be applied at this time. The remainder of the area will likely require intermediate cover of a minimum of 6 inches to minimize the generation of contaminated water and leachate. The next area will be developed similarly and will begin filling against the working face of the previously filled area. Cell 2 will be filled similar to Cell 1. After filling Cell 2, the fill sequence will continue to Cells 3 through 14 in numerical order. Refer to **Attachment 1E** for fill sequence. The facility will be developed in this fashion with new areas filling adjacent to previously deposited waste. Areas that remain open and do not receive waste for extended lengths of time (more than 180 days) will be covered with a minimum of 6 inches of intermediate cover above the 6” daily cover.

An estimate of the time required to fill Cell 1 was made prior to running the HELP Model. The initial waste deposition rate at the site is estimated to be 150 tons per day or 300 (in-place) cubic yards per day based on 1000 lbs/CY compaction. The estimated available volume for each cell and the estimated waste deposition rate were used to determine the estimated life of the cells. The estimated life and height of fill were used as input data for the HELP Model and in determining the leachate generation for the sump area.

The LCS will consist of a geosynthetic drainage layer, leachate collection trench, and a protective granular soil cover. The LCS overlies the compacted clay or geosynthetic clay liner and geomembrane liner system that drains to a collection sump. Each of the leachate collection trenches conveys leachate at a minimum 1.0% slope to cleanout risers at the leachate collection sump. The sump contains an 18-inch diameter SDR-17 riser pipe. The details are included for reference in **Attachments 15A, 15A-GCL (i.e. alternate liner design), and 15B.**

The minimum base grade slopes are 2% for the cell floor (top of liner) and 1.0% for the leachate collection trench.

4.2 LEACHATE DRAINAGE LAYER

The leachate drainage layer is placed above the liner to allow leachate to flow horizontally to the leachate collection trenches. The leachate drainage layer will consist of a geocomposite system. Manufacturers Data Sheets for the typical drainage geocomposites are included in ***Appendix 2***. Equivalent products may be used.

A geocomposite drainage layer is typically made of a polyethylene three-dimensional grid. It provides a planar liquid flow for conveying the accumulated leachate to the leachate collection trench. Although the geocomposite is much thinner than a granular drainage layer, it has a much higher hydraulic conductivity which allows for better overall leachate transmission. The geocomposite will be overlain by a geotextile to separate cover soil from the geocomposite and maintain an adequate hydraulic conductivity of the system.

The base of the drainage layer is sloped with a minimum of **2%** to promote liquid flow toward the leachate collection trenches, into the perforated leachate collection pipes, and ultimately to the sumps for extraction. The geocomposite provides sufficient flow capacity to effectively transmit leachate to collection pipes and sumps, thereby reducing head buildup. A leachate head of less than 12 inches will be maintained over the liner.

The drainage composite will be installed on the landfill floor and slopes with a two percent cross slope to promote flow toward the leachate collectors and ultimately to the sump area. The drainage composite will provide sufficient flow capacity to effectively transmit leachate to the collectors and sump area, thereby reducing head buildup. Leachate head buildup is estimated using the impingement rates from the Hydrologic Evaluation of Landfill Performance (HELP) computer model, along with estimated transmission rates of the drainage composite.

4.3 COLLECTION TRENCHES

Each cell contains one centrally located collection trench. The liner floor slopes at minimum 2% toward the collection trench. The trench detail is provided to this attachment. The trench slopes at a 1% grade towards the recovery sump. In the leachate collection trench, a geotextile cushion is placed above the 60-mil HDPE geomembrane. The geotextile acts as a cushion to protect the 60-mil HDPE geomembrane from damage during placement of the granular drainage material. The geotextile will wrap around and completely encase the granular material to provide control of sediment entering the collection trench. The granular material must be a gravel with a particle size consistent with the requirements of the SLQCP (see Section 8), and contain less than 15% calcium carbonate.

The leachate collection system designed for the site will use six-inch diameter perforated collection pipes, at a minimum grade of one percent. The collectors are HDPE SDR 17, or equal with 1/2-inch (maximum, but no less than 3/8-inch) perforations. The perforated collector will be embedded in granular material. The trench will be wrapped with a geotextile to prevent soil from entering the granular layer and potentially clogging the pipe. Refer to **Attachment 15A or Attachment 15A-GCL** for details. The perforated collectors will discharge into the sump area at the base grade low points of the cell area. Collection pipes will not penetrate the liner.

Cleanouts will be provided at the top of the sideslopes for periodic maintenance of the collectors. The cleanouts will be constructed of a minimum six-inch diameter non-perforated HDPE pipe joined to the perforated collectors in the sump. The six-inch pipe size has sufficient cross-sectional area for effective cleaning by pressurized jetting equipment. Correspondence from Renfro Equipment, assuring the ability to clean the collection system, has been included in ***Appendix 3.*** Maverick County intends to lease/rent/purchase the necessary equipment to perform the leachate line cleaning. Refer to **Attachment 15C** of the Site Development Plan for cleanout locations.

Pipe strength and deformation calculations were performed to demonstrate that the leachate collection piping will perform satisfactorily under expected maximum overburden pressures. Refer to ***Appendix 4*** for calculations of pipe strength and sump capacity.

4.4 LEACHATE RECOVERY SUMPS

Leachate entering the drainage layer and collection trenches is subsequently discharged into recovery sumps. The sumps are backfilled with the same granular material as the trenches. The base sump dimensions are 20 feet by 20 feet by two foot deep. The sumps are lined with an extra layer of geomembrane and also receive the protection of a geotextile between the granular material and the geomembrane. Leachate is stored in the sumps until it is removed by the leachate pumps. Each sump can hold approximately 3,085 gallons. Refer to ***Appendix 4*** for calculations of sump capacity. The sump design has been sized to accommodate the leachate generated by the largest cell (#12) at the peak of leachate generation, as determined by the HELP model runs in ***Appendix 1.*** The sump for each cell will be identical to the design proposed for cell #12.

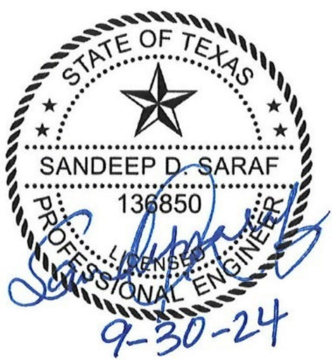
Attachment 15C and **15A** show a plan and section through the sump area and collection system details. Additionally, **Attachment 15A-GCL** depicts sections through the sump with the alternate liner, including the geosynthetic clay liner.

The maximum head on the liner has been estimated using the HELP Model. The maximum head is approximately 6.8 inches during periods without recirculation. See ***Appendix 1*** for additional information related to leachate generation without recirculation. See Appendix 1A for a summary of the leachate head on the liner during periods of leachate recirculation.

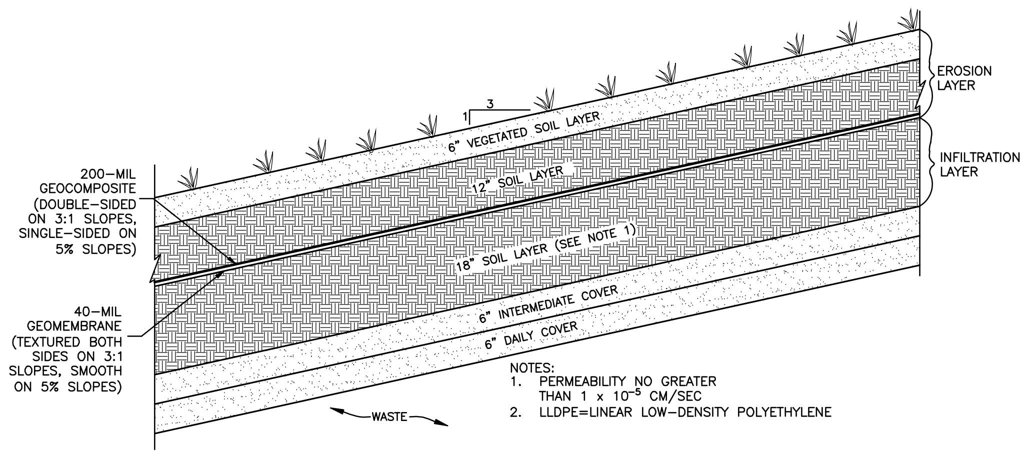
4.5 LEACHATE PUMP AND RISER SYSTEM

ATTACHMENTS TO
PART III
ATTACHMENT 15

Attachment	Title/Description
15A	LINER AND LEACHATE COLLECTION SYSTEM DETAILS
15A-GCL	LINER AND LEACHATE COLLECTION SYSTEM DETAILS WITH GCL ALTERNATE
15B	LINER AND LEACHATE COLLECTION SYSTEM DETAILS
15C	LEACHATE COLLECTION SYSTEM (PLAN VIEW)
15D	TYPICAL LEACHATE COLLECTION SYSTEM AND SUMP PLAN

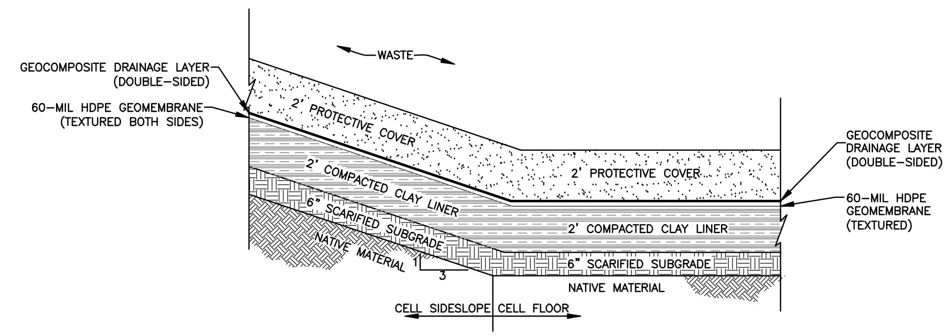


SCS Engineers
TBPE Reg. # F-3407



TYPICAL FINAL COVER DETAIL

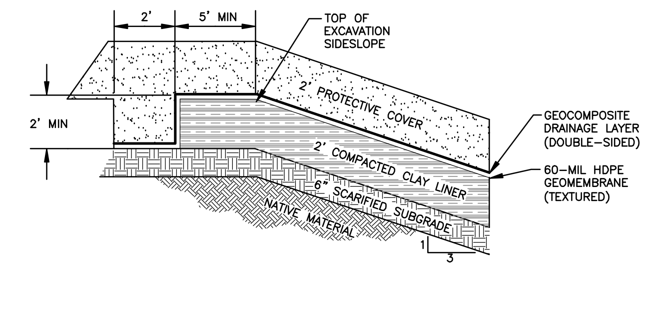
NTS



STANDARD LINER CROSS-SECTION

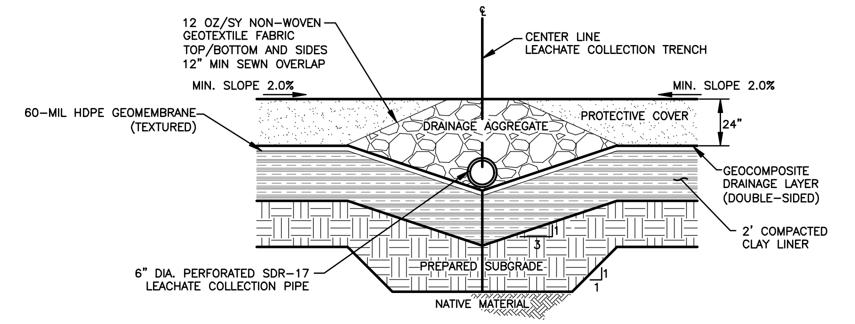
NTS

NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3



ANCHOR TRENCH & SIDESLOPE TERMINATION DETAIL

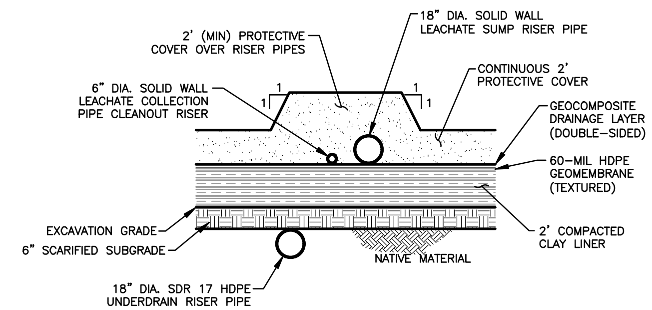
NTS



LEACHATE COLLECTION TRENCH DETAIL

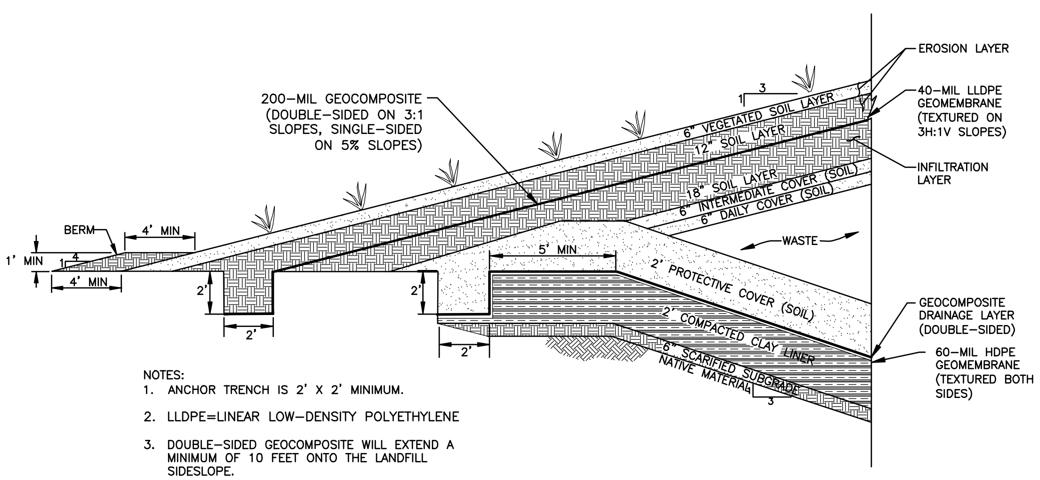
NTS

NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3



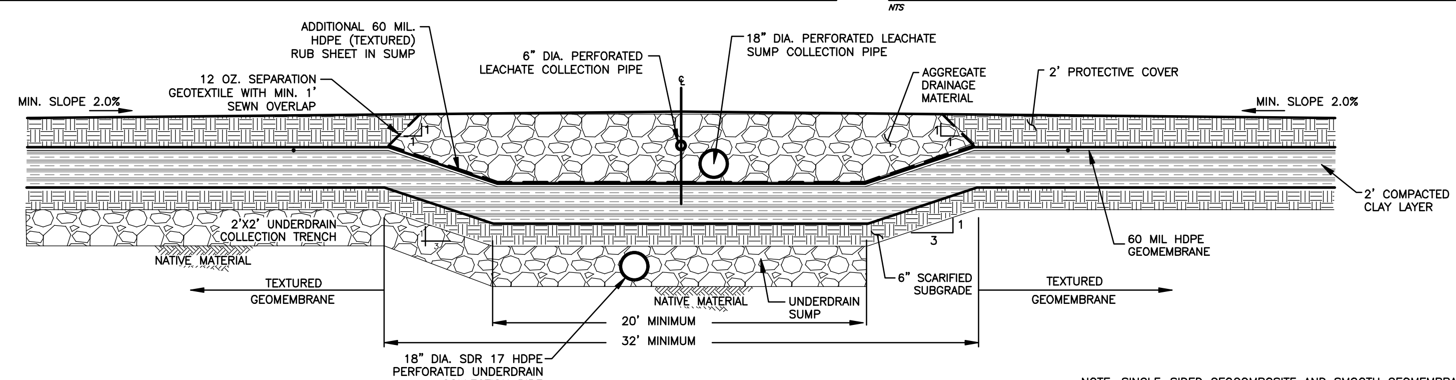
SIDESLOPE RISER

NTS



STANDARD LINER AND FINAL COVER TIE-IN DETAIL

NTS

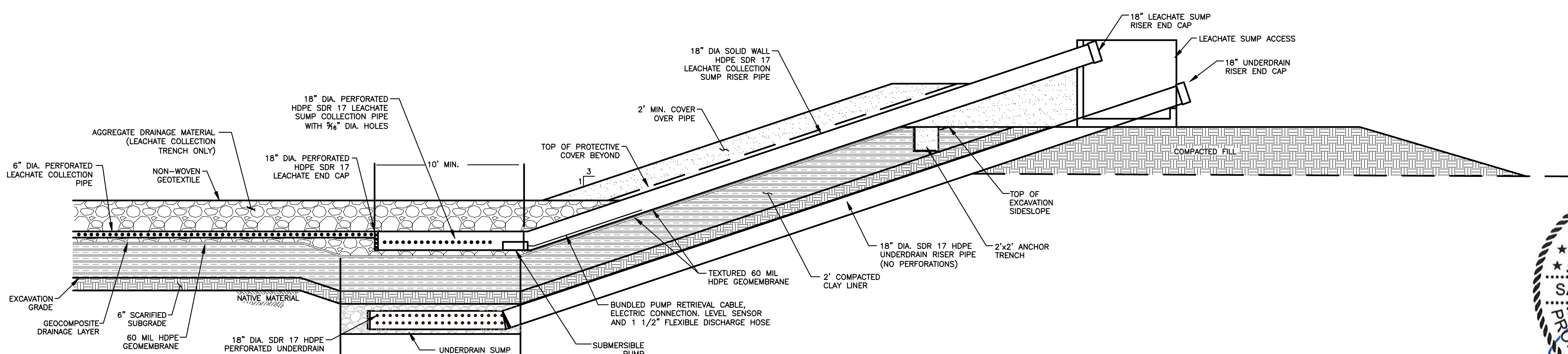


LEACHATE SUMP

NTS

NOTE: SEE DETAIL 1 ON ATT 10-5 FOR UNDERDRAIN SUMP DETAIL

NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3.



LEACHATE SUMP SECTION

NTS

NOTE: SEE DETAIL 4 ON ATT 10-5 FOR UNDERDRAIN COLLECTION PIPE PERFORATION DETAILS.

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	7/10	REV'D DETAIL TO BE CONSISTENT W/2009 PERMIT MOD.; REVISED DRAWING TITLE AND DETAIL TITLES	RK
2	10/10	REVISE PROJECT TITLE	RK
3	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3H:1V; UPDATED CELL FLOOR LINER DETAIL	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: STANDARD LINER & LEACHATE COLLECTION DETAILS

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

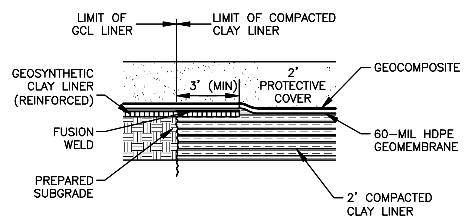
PROJ. NO. 16223092.00 | DWN. BY: DNA | Q/A RVW BY: AGA
DSN. BY: AGA | CHK. BY: SDS | APP. BY: SDS

CADD FILE: 15A-LINER DETAILS

DATE: 09/2024

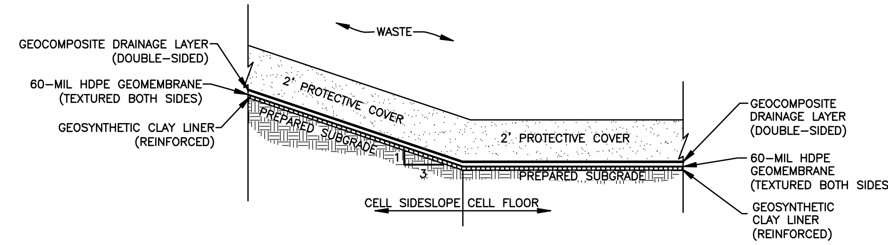
SCALE: AS SHOWN

ATTACHMENT **15A**



GCL/CLAY LINER TIE-IN

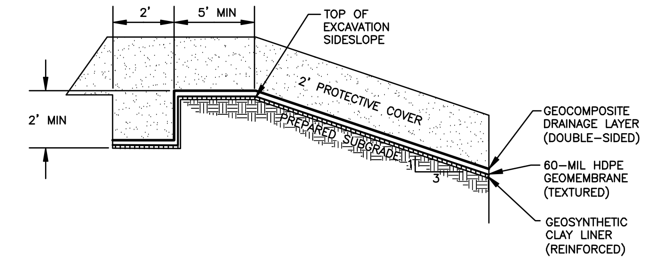
NTS



ALTERNATE LINER CROSS-SECTION

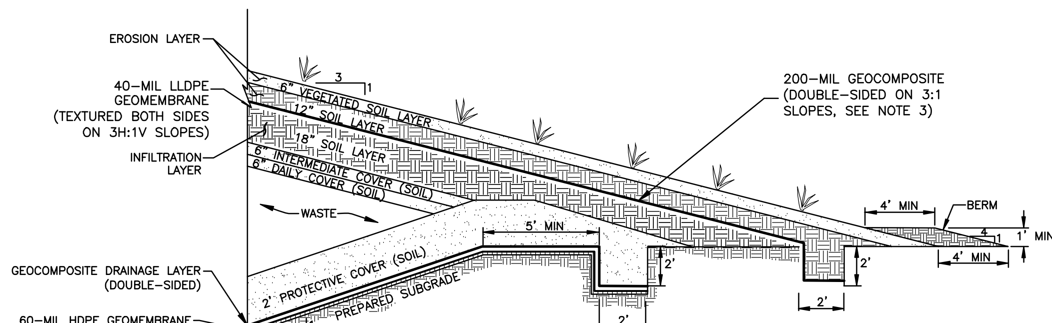
NTS

NOTE: SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3



ANCHOR TRENCH & SIDESLOPE TERMINATION DETAIL

NTS

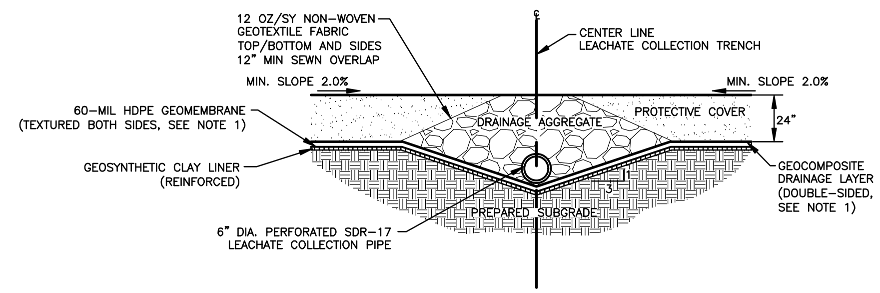


NOTES:

1. ANCHOR TRENCH IS 2' X 2' MINIMUM.
2. LLDPE=LINEAR LOW-DENSITY POLYETHYLENE
3. DOUBLE-SIDED GEOCOMPOSITE WILL EXTEND A MINIMUM OF 10 FEET ONTO THE LANDFILL SIDESLOPE.

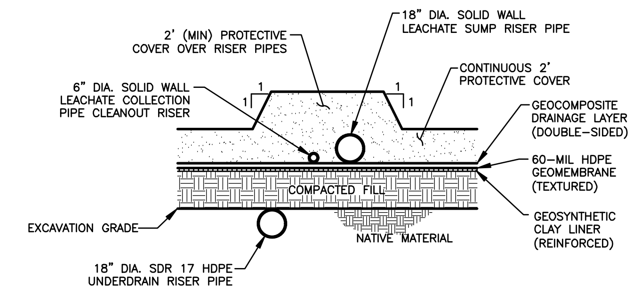
ALTERNATE LINER AND FINAL COVER TIE-IN DETAIL

NTS



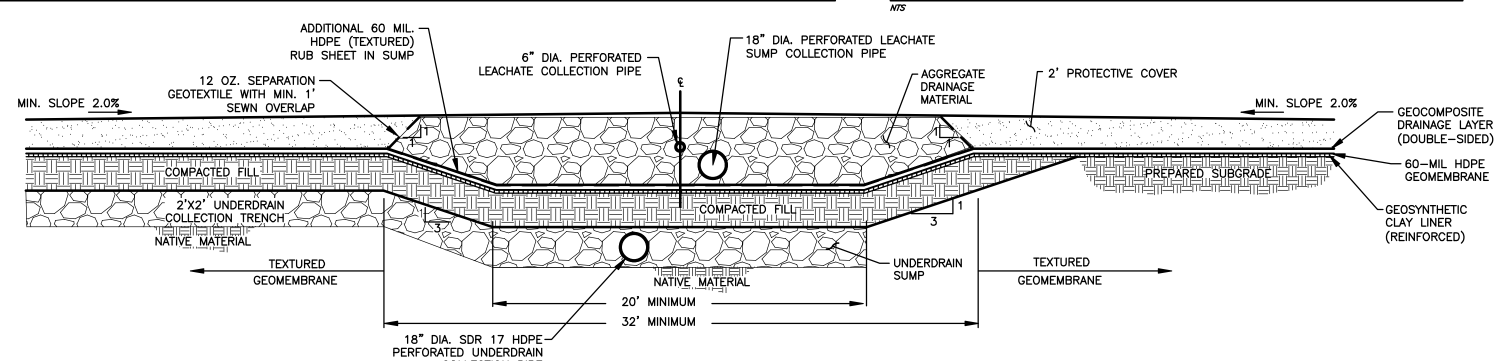
LEACHATE COLLECTION TRENCH DETAIL

NTS



SIDESLOPE RISER

NTS



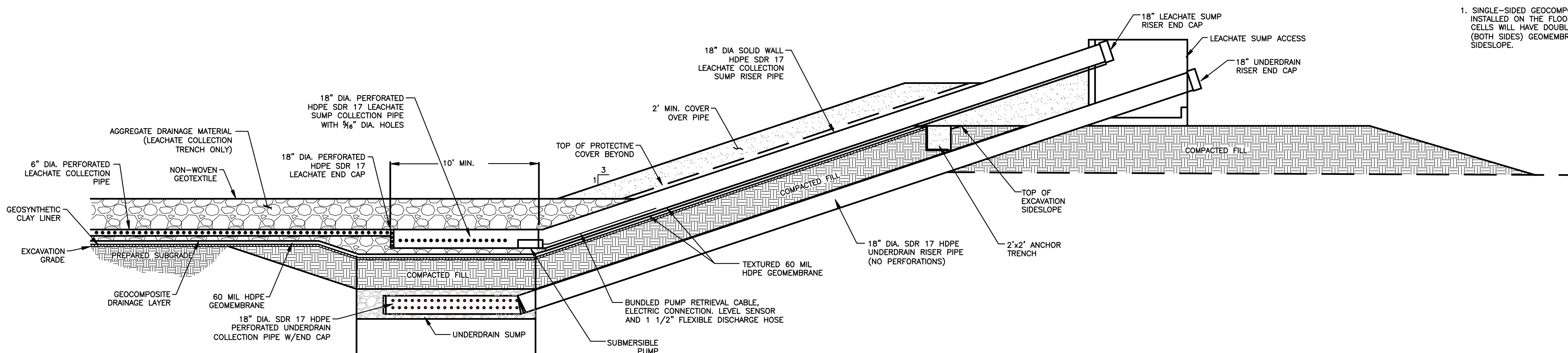
LEACHATE SUMP

NTS

NOTE: SEE DETAIL 1 ON ATT 10-5 FOR UNDERDRAIN SUMP DETAIL

NOTES:

1. SINGLE-SIDED GEOCOMPOSITE AND SMOOTH GEOMEMBRANE INSTALLED ON THE FLOOR IN CELLS 1 THROUGH 3. ALL FUTURE CELLS WILL HAVE DOUBLE-SIDED GEOCOMPOSITE AND TEXTURED (BOTH SIDES) GEOMEMBRANE INSTALLED ON THE FLOOR AND SIDESLOPE.



LEACHATE SUMP SECTION

NTS

NOTE: SEE DETAIL 4 ON ATT 10-5 FOR UNDERDRAIN COLLECTION PIPE PERFORATION DETAILS.

FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

REV	DATE	DESCRIPTION	BY
1	10/10	REVISE PROJECT TITLE	RK
2	9/24	ADDED GEOCOMPOSITE IN FINAL COVER; REPLACED VFPE WITH LLDPE GEOMEMBRANE; CHANGED SIDESLOPE TO 3:1	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE: LINER & LEACHATE COLLECTION DETAILS WITH GCL ALTERNATE

PROJECT TITLE: MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT: MAVERICK COUNTY 500 QUARRY STREET, SUITE 3 EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO.	DSN. BY:	DWN. BY:	CHK. BY:	Q/A RVW BY:	APP. BY:
16223092.00	AGA	DNA	SDS	AGA	SDS

CADD FILE: 15A GCL -LINER DETAILS

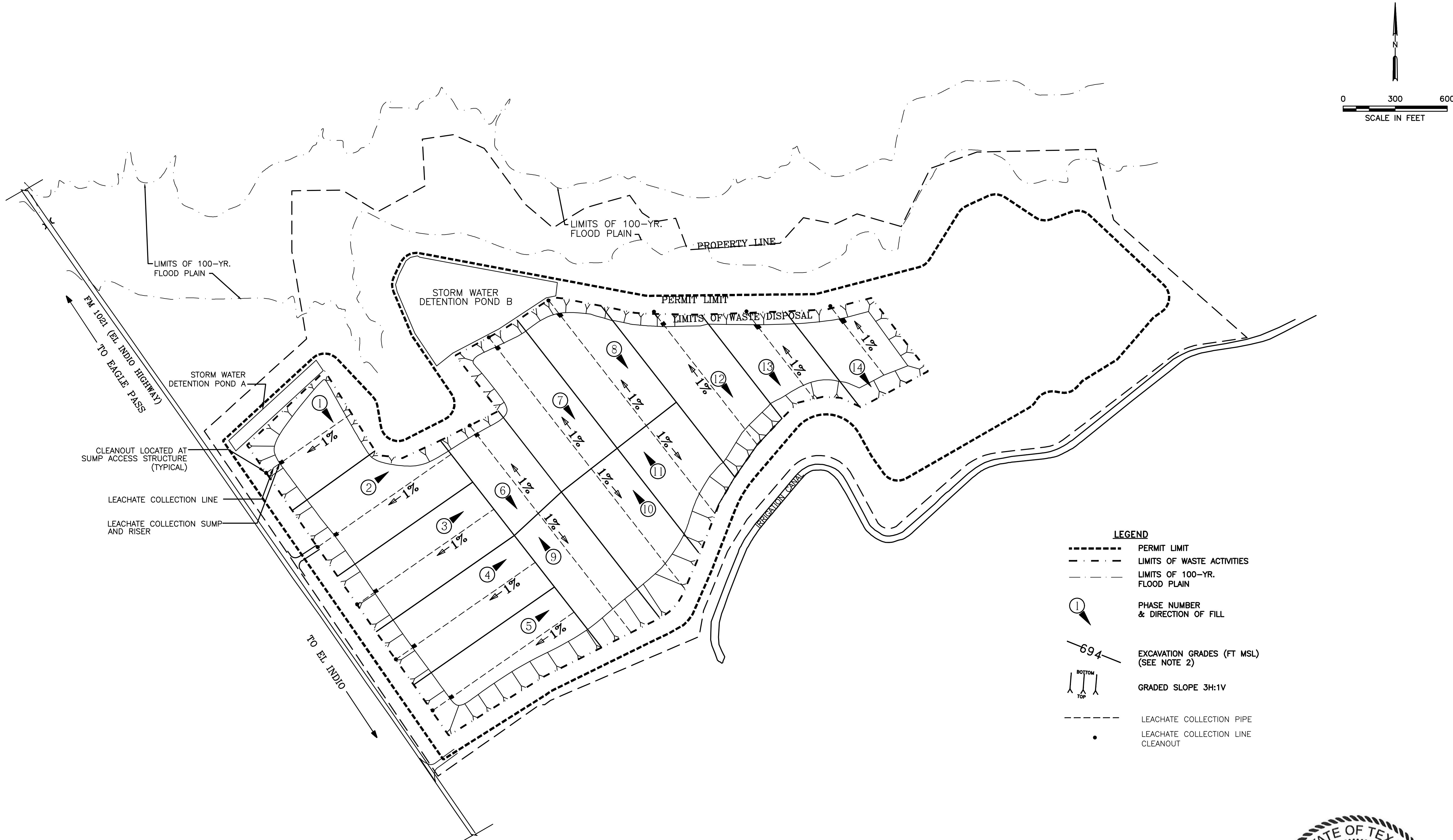
DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT

15A-GCL

8/1/2024 11:12 AM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\15A GCL -LINER DETAILS



STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	BY
1	10/10	SPLIT PHASE 16 INTO TWO CELLS	RK
2	9/24	REVISED EXCAVATION GRADES BASED ON NEW LIMITS OF WASTE BOUNDARY.	SS

TEXAS BOARD OF PROFESSIONAL ENGINEERS REG. NO. F-3407

DRAWING TITLE
LEACHATE COLLECTION SYSTEM

PROJECT TITLE
MAVERICK COUNTY EL INDIO MSW LANDFILL PERMIT MODIFICATION

CLIENT
MAVERICK COUNTY
500 QUARRY STREET, SUITE 3
EAGLE PASS, TEXAS 78852

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16223092.00
DWN. BY: DNA
Q/A RVW BY: AGA
DSN. BY: AGA
CHK. BY: SDS
APP. BY: SDS

CADD FILE: 15C(12-24-21)

DATE: 09/2024

SCALE: AS SHOWN

ATTACHMENT
15C

8/1/2024 11:45 AM G:\MAVERICK COUNTY LANDFILL\16220088.00 T9 - Final Grade Contours & Drainage PMOD\Engineering Drawings\15C(12-24-21)

MAVERICK COUNTY EL INDIO MSW LANDFILL
TCEQ PERMIT NO. MSW-2316

PART IV
SITE OPERATING PLAN

Prepared for:

Maverick County Solid Waste Authority
16179 FM 1021
El-Indio, Texas 78860

And

Maverick County
500 Quarry Street, Suite 3
Eagle Pass, Texas 78852
830/773-3824

PERMIT ISSUED: SEPTEMBER 11, 2007

PERMIT MODIFICATION (REVISION 0 - 6) PREPARED BY:

SCS ENGINEERS
Texas Board of Professional Engineers Registration No. F-3407
1901 CENTRAL DR., SUITE 550
BEDFORD, TEXAS 76021
817/571-2288

Revision 0 – April 2009
Revision 1 – June 2009
Revision 2 – August 2009
Revision 3 – March 2011
Revision 4 – November 2012
Revision 5 – July 2014, October 2014, December 2014
Revision 6 – October 2024

SCS Project No. 16208046.00, 16209033.00, 16211130.00, 16214011.00, 16223092.00

TABLE OF CONTENTS

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

TABLE OF CONTENTS (CONTINUED)

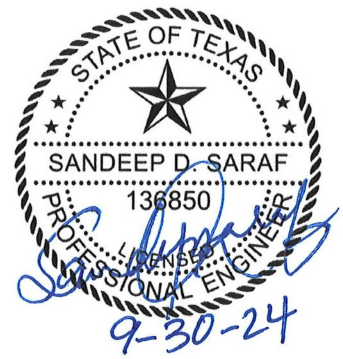
List of Tables

Appendices

STATE OF TEXAS
SANDEEP D. SARAF
136850
LICENSED
PROFESSIONAL ENGINEER
9-30-24

LIST OF ACRONYMS

ADC - Alternative Daily Cover
ADCOP - Alternative Daily Cover Operating Plan
CFR - Code of Federal Regulations
CCS – Citizens' Convenience Station
DOT - Department of Transportation
EPA - U.S. Environmental Protection Agency
FWS - U.S. Fish and Wildlife Service
GLER – geomembrane liner evaluation report
LCS - leachate collection system
LFG - landfill gas
MSW - Municipal Solid Waste
MSDS - Material Safety Data Sheets
msl - mean sea level
NRACM - nonregulated asbestos-containing material
OSHA - Occupational Health and Safety Administration
PCBs - polychlorinated biphenyls
RACM - regulated asbestos-containing material
RCRA - Resource Conservation and Recovery Act
SDP - site development plan
SLER - soils and liner evaluation report
SOP - site operating plan
TAC - Texas Administrative Code
TCEQ - Texas Commission on Environmental Quality
TNRCC – Texas Natural Resource Conservation Commission (predecessor to TCEQ)
TPDES – Texas Pollutant Discharge Elimination System
TxDOT - Texas Department of Transportation
WWTP - wastewater treatment plant



The Gate Attendant also will direct incoming vehicles to the proper location to unload refuse at the Landfill working face or at the Citizens' Collection Station (CCS) (residential customers only). When the gate attendant is not on duty, the Landfill Manager will direct incoming vehicles.

Gate Attendant Qualifications: The Gate Attendant will be required to have experience and education commensurate with job requirements, as described above, ability to read and write, and computer literacy skills. If the new employee does not have previous landfill experience, he/she will be required to complete a training program or on-the-job training specific to their job responsibilities, prior to working in an unsupervised position, as described in Section 2.2. Training requirements for Gate Attendants are described in Table 2.2.

Equipment Operators: Equipment Operators are responsible for the safe operation of the equipment they operate. As the personnel most closely involved with the actual landfill operation, these employees are responsible for being alert for potentially dangerous conditions or careless and improper actions on the part of non-employees and other persons while on the premises. Equipment operators are also responsible for maintenance, construction, litter abatement, and general site cleanup. The equipment operators will intervene, as necessary, to prevent accidents and report unsafe conditions immediately to the Landfill Manager.

In addition to the signs on the landfill that direct the waste hauling vehicles to the working face, the Equipment Operators will assure that incoming vehicles are directed to the proper location for unloading refuse at the working face. Equipment Operators will observe and inspect loads as they are dumped to prevent disposal of unauthorized waste (as defined in Section 5.1 of this SOP). Equipment Operators will be trained to recognize unauthorized waste, to implement procedures for managing unauthorized waste when/if detected (as defined in Section 5.2 and 5.4 of this SOP), to implement procedures for managing fires, and other specific training procedures as described in Section 2.2.

Equipment Operator Qualifications: Equipment Operators will be required to have 6 months (minimum) experience in equipment operation or on-the-job training by supervisor; and know the limitations and uses of landfill equipment. Additional training requirements for Equipment Operators are further described in Table 2.2.

Waste Screener: The Waste Screener (aka, Load Inspector) will be located at the working face of the landfill and located at the CCS when the CCS is in operation. A Waste Screener will direct incoming vehicles to the proper location to unload refuse at the working face. Important responsibilities of the Waste Screener include preventing unloading in undesignated areas and observing and inspecting loads as they are dumped to prevent disposal of unauthorized waste (as defined in Section 5.1 of this SOP). A Waste Screener will direct citizens to appropriate locations for unloading waste or recyclables at the CCS and observe that the respective materials are unloaded in the correct bin or container. Waste Screeners will be trained to recognize unauthorized waste, to implement procedures for managing unauthorized waste when/if detected (as defined in Section 5.2 and 5.4 of this SOP), to implement procedures for managing fires, and other specific training procedures as described in Section 2.2. At the discretion of the Landfill Manager, an Equipment Operator may also carry out the responsibilities of a Waste Screener. Waste Screeners may also perform litter abatement and general site cleanup.

Waste Screener Qualifications: Will be required to have the ability to read and write. Waste Screeners also will be required to have experience commensurate with job requirements, as described above. If the new employee does not have previous landfill experience, he/she will be required to complete a training program or on-the-job training specific to their job responsibilities, prior to working in an unsupervised position, as described in Section 2.2. Training requirements for Waste Screeners are described in Table 2.2.

General Laborers: Other site personnel or laborers may be employed from time to time in categories such as mechanics, maintenance, construction, litter abatement, and general site cleanup. General laborers will be required to have experience and education commensurate within their job requirements (i.e., mechanic, maintenance, construction, etc.).

General Laborer Qualifications: General laborers will be required to have 6 months (minimum) experience if employed for mechanic, maintenance, construction, or other skilled labor positions. If employed for general site cleanup, litter abatement, or other non-skilled labor, the employee is not required to have previous experience. All general laborers will complete on-the-job training specific to their job responsibilities, prior to working in an unsupervised position, as described in Section 2.2. Training requirements for General Laborers are described in Table 2.2.

TABLE 2.1
MINIMUM NUMBER OF PERSONNEL

Position	Personnel at Waste Acceptance Rate (W, tpd)	
	$W \leq 750$	$750 < W \leq 1,500$
Landfill Manager	1	1
Gate/Scale Attendant	1	1
Waste Screener[1]	2	2
Equipment Operator	2	3
General Laborer	1	2

Note: [1] Two Waste Screeners are only required on days when the CCS is in operation.

The number of landfill personnel, listed in Table 2.1, third column, is sufficient to operate the landfill at the maximum annual waste acceptance rate.

2.2 TRAINING

Landfill personnel will be trained in the contents of this SOP. Additionally, landfill personnel will complete a program or on-the-job training specific to their job responsibilities and title. Training will be designed to provide the landfill personnel with the knowledge to respond effectively to emergencies by familiarizing the landfill personnel with emergency procedures, emergency equipment, and emergency systems. The training program or on-the-job training will address the following topics, when applicable:

- Procedures for using, inspecting, repairing, and replacing landfill emergency and monitoring equipment.
- Emergency communication procedures and alarm systems.
- Response procedures for fire and explosions.
- Response procedures for surface water and groundwater contamination incidents.
- Procedures for shutdown of operations.
- Applicable rules, safety procedures, contingency plans, and permit requirements.
- Customer notification and load inspection procedures.
- Unauthorized waste detection and exclusion program, including but not limited to, identification of hazardous wastes, PCB wastes, and other unauthorized wastes, as described in Section 5.
- Waste handling procedures (acceptable and unauthorized wastes).
- Fire safety.
- Record keeping.

Personnel training will be directed by a person trained in waste management procedures, and will include instruction that educates landfill personnel in waste management procedures relevant to their position. Landfill personnel will complete training within six months after employment at the landfill. Employees will not work in unsupervised positions until they complete a training program or on-the-job training. In addition, landfill personnel will receive annual reviews of their initial training. Specific training requirements for landfill personnel are provided in Table 2.2.

Training and safety meetings will be scheduled at least once per month to discuss one or more of the topics listed above or other topics that relate to solid waste management. Training schedules will be conducted so landfill operations are not interrupted. The Landfill Manager will maintain the following documents and records related to personnel training:

- Job titles for each position at the landfill, and the name(s) of employees with that position.
- Written job descriptions for each position, including requisite skills, education, and other qualifications and responsibilities.

- Written descriptions of the type and amount of introductory training and continuing training that will be required for each position.

- Records that document the training and job experience listed above for the landfill personnel.

Documentation of training will be placed in the Site Operating Record. Selected management and other landfill personnel will receive training at TCEQ-sponsored or TCEQ-approved training courses, as deemed appropriate by the Landfill Manager. Training records on current landfill personnel will be kept until closure of the landfill. Training records on former employees will be kept for at least three years from the date the employee last worked at the landfill. Personnel training records may accompany personnel transferred within the County.

to the working face on a daily basis, and in the event of a fire at the working face, as described in Section 6. The scraper will have a minimum capacity of 11 cubic yards.

- **Track Loader:** The track loader will be on-site for general excavation and other earthwork.

- **Dump Truck:** The dump truck will be on-site for transporting cover soil from stockpile to working face on a daily basis, and in the event of a fire at the working face, as described in Section 6.

- **Water Truck:** The water truck will be on-site for dust control and supplemental watering.

In addition to the above list, miscellaneous pickup trucks, and other light utility vehicles as well as various pumps (1,500-gpm minimum), litter fences, instruments, and safety and training equipment will be onsite for operation of the landfill. In the event of equipment breakdown that would prevent proper site operation, temporary equipment will be rented as soon as possible for use, while the County owned equipment is being repaired or replaced.

As described in Section 4.2.2, the landfill will have a CCS to reduce traffic at the working face of the landfill. This CCS will be used for the acceptance and storage of waste, which will be disposed at the working face. Waste will be stored in separate containers or locations at the CCS, which will be properly identified for the types of waste to be received in each container or location. The type of container or storage mechanism will be based on the individual waste stream (see Section 4.2.2 for unloading waste at the CCS).

In accordance with §330.211(2), all containers used to store waste will be maintained to prevent spillage and leakage during storage and handling, and/or transport. Reusable containers will be used at the CCS. The containers will be inspected daily during days when the facility is in operation for spills or leaks, and promptly repaired or replaced, if necessary, as a result of these inspections. Additionally, these containers will be routinely cleaned to prevent nuisance odors and to prevent the harborage, feeding, and propagation of vectors.

SECTION 4

OPERATIONAL PROCEDURES

4.1 ACCESS CONTROL (§330.131)

Access to this site from El Indio and Eagle Pass will be via Farm to Market (F.M.) 1021, which is a two-lane asphalt roadway. The primary entrance road to the landfill will be 30 feet wide with a lockable security gate. The site has two entrances into the facility (primary and secondary), as shown on on Attachments 1B and 1B1. Approved waste haulers and/or the general public will be limited to accessing the site through the primary entrance during normal operations.

The site proposes to use its previously approved secondary entrance/exit gate for ingress and egress to F.M. 1021. The primary entrance will be comprised of a driveway and lockable gate (see Section 4.1.1) that provides access to the future all-weather perimeter access road, as shown on Attachments 1B10-14. Maverick County Solid Waste Authority has applied for a permit from Texas Department of Transportation (TxDOT) authorizing construction of a new driveway at the proposed primary entrance, which will be maintained in the Site Operating Record. Upon construction of the new primary entrance, Maverick County will use the currently approved primary entrance as their secondary entrance into the facility. Typically, the use of the secondary entrance gate will be limited to landfill personnel and other Maverick County designated personnel. However, when the primary entrance gate is inaccessible due to weather or traffic, the secondary entrance gate may be used by approved waste haulers and/or the general public. During these events, the secondary entrance gate will be monitored and controlled using the same normal operating procedures as the primary entrance. The gate attendant controls access and monitors all vehicles entering and exiting the site.

4.1.1 <u>Site Security</u>

Site security measures are designed to prevent unauthorized persons from entering the site, to protect the facility and its equipment from possible damage caused by trespassers, and to prevent disruption of facility operations caused by unauthorized site entry.

Unauthorized entry into the site will be prevented by controlling access to the landfill with the perimeter fence and gate at each entrance. A 6-foot chain link fence topped with three-strand barbed wire (i.e., 8-foot total fence height) will be maintained on the west side of the landfill property fronting F.M. 1021. The north, east, and south perimeter fence will be comprised of a predator-proof chain link or metal fence designed to prevent the entry of livestock, and discourage unauthorized entry to the landfill.

The perimeter fence and gates will be inspected monthly. Repairs and maintenance will be performed consistent with §330.131. If the perimeter fence or gates have been damaged (i.e., breached), the TCEQ region office and any local pollution agency with jurisdiction that has requested to be notified, will be notified within 24 hours of detection. The breach will be temporarily repaired within a 24-hour period (weather permitting), and will be permanently repaired within the timeframe approved by the TCEQ region office. Once permanent repairs have been completed, the TCEQ region office will be notified. If the breach can be permanently repaired within 8 hours of detection, then a notice to the TCEQ region office is not required. Documentation of perimeter fence and gate inspections and breaches will be maintained in the Site Operating Record. Refer to Table 4.2 of this SOP for the site inspection and maintenance schedule. "No Trespassing" signs will be posted at the property boundary.

The primary site entrance will be secured by a gate that is monitored by the gate attendant during site operating hours. Additionally, the secondary entrance will be secured by a gate that is monitored by landfill personnel (e.g. scalehouse/gate attendant or landfill manager) during site operating hours. Outside operating hours, the gates to the site will be locked. Entry to the active portion of the landfill will be restricted to designated personnel, approved waste haulers, and properly identified persons whose entry is authorized by landfill management. Visitors may be allowed on the active area only when accompanied by a site representative.

4.1.2 Traffic Control

Access to the landfill site will be provided via primary entrance gate located off of F.M. 1021, as described above. The primary entrance will have a gate that is attended during operating hours by the gate attendant. The gate attendant will restrict site access to authorized vehicles and direct commercial vehicles to the active working face of the landfill, and residential vehicles to the CCS or the landfill working face, as applicable, for the waste load size and type.

The landfill haul roads will be maintained in an all-weather condition and will be freely draining, and kept free of excessive ruts and potholes, as described in Section 4.12. Landfill haul roads will be passable by solid waste transportation vehicles in two directions to facilitate movement of traffic into and out of the site.

Within the site, signs will be placed along the landfill haul road and access road at a frequency adequate for direct waste haulers to appropriate waste disposal location (landfill working face or CCS). Private and commercial solid waste vehicles will not be allowed access to the CCS or any areas other than the working face of the landfill. Roads not being used for access to disposal areas will be blocked or otherwise marked for no entry. Landfill personnel will provide traffic directions, as necessary, to facilitate safe movement of vehicles.

The approach to the working face will be maintained such that two or more vehicles may safely unload side-by-side. A vehicle turn-around area large enough to enable vehicles to arrive and turn around safely will be provided adjacent to the landfill working face. The vehicles will back to a vacant area near the working face to unload. Similarly, roads to the CCS will be wide enough to enable two-way traffic and side-by-side unloading positions. Upon completion of the unloading operation, the transportation vehicles will leave the landfill working face area or CCS and depart the site. Loitering will not be permitted at the landfill working face or at the CCS.

4.2 UNLOADING WASTE (§330.133)

This landfill is authorized to receive municipal solid waste and those special solid wastes allowable under 30 TAC §330.171. The unloading of prohibited waste at the landfill working face and CCS will not be allowed. The categories of wastes that are prohibited at this site by state and federal regulations are discussed in Section 5 of this SOP. Prohibited waste are those waste prohibited from disposal at a landfill in accordance with 30 TAC §330.15(e). In addition to prohibited waste, the County has specified other waste that will not be disposed at the landfill. As such, unauthorized waste includes prohibited waste, as well as the site-specific waste not allowed at the landfill, as described in Section 5 of this SOP. Special wastes will not be handled at this landfill, except in accordance with TCEQ regulations and Section 4.20 of this SOP. Additionally, the County may establish an area on-site designated to receive brush.

The landfill will have a CCS to reduce traffic at the working face of the landfill. This CCS will be used for the acceptance and storage of waste, which will be disposed at the working face, and acceptance and storage of recyclables for transport to an authorized recycling or disposal facility. The CCS will only accept the waste streams authorized for disposal at the landfill described in Section 4.2.2. The unloading of waste in unauthorized areas are prohibited under 30 TAC §330.133(b).

As discussed in Section 2, trained personnel will monitor all incoming loads of waste. Trained personnel will be at the working face and CCS during operating hours to direct and observe each load that is brought in for disposal at each location. These personnel will be familiar with the rules and regulations governing the various types of waste that are excluded from this facility, including knowledge of 30 TAC §330.171. The personnel will also have a basic understanding of both Class 1 industrial and hazardous wastes, which are prohibited at this facility. The landfill personnel involved with unloading or inspection of waste will have authority and responsibility to (1) reject unauthorized loads, (2) have unauthorized material removed by the transporter, removed by onsite personnel, or otherwise properly managed by the facility, and (3) assess appropriate surcharges.

4.2.1 Waste Unloading at Landfill Working Face

Control will also be used to confine the working face to a minimum area consistent with the rate of incoming waste, while allowing for safe and efficient operation of the landfill. The maximum size of the working face will be 14,400 square feet (i.e., 120-ft by 120-ft). Only one working face will be active at any given time for disposal of waste in the landfill. However, as previously mentioned, a separate unloading area may be established for brush.

The unloading of waste in unauthorized areas will be prohibited. Solid waste dumping will be controlled to prevent disposal in locations other than those specified by landfill management. Any waste deposited in an unauthorized area will be removed immediately and disposed of properly.

Landfill personnel will report questionable waste materials or other issues of concern immediately to the Landfill Manager. A record of unauthorized material or waste removal will be maintained in the Site Operating Record, including the type of waste, generator/transporter, and date of receipt. Any unauthorized waste discovered at the landfill will be returned immediately to the transporter or generator of the waste or otherwise property managed by the landfill. Unauthorized waste that is not discovered by landfill employees until after it is unloaded will be returned to the vehicle that delivered the waste. (See Section 5.5 of this SOP, Managing Unauthorized Wastes, for further guidance.)

Signs with directional arrows and portable traffic barricades will restrict traffic to designated disposal locations. Waste hauling vehicles will be directed to the active disposal area. Signs will be placed along the access route to the designated disposal areas. In addition, rules for waste disposal and unauthorized waste will be prominently displayed on signs near the site's primary entrance.

4.2.2 Waste Unloading at CCS

The Gate Attendant will direct citizens with small or light vehicles to unload waste at the CCS into clearly identified storage containers (i.e., roll-offs). The CCS will only accept the waste streams authorized for disposal at the landfill. Roll-offs containing food waste will typically be removed from the CCS by the end of each day of operation, but will not be stored (i.e., maintained within containers) at the CCS longer than 48 hours following receipt of said waste. Solid waste containing food waste shall be stored in covered or containers that are leak-proof, durable, and designed for safe handling and easy cleaning.

The CCS location and layout plan are identified in Part III Attachment 1 (Site Layout Plan), Attachments 1B and 1B10-13, respectively. The CCS will be comprised of an elevated deck area with an all-weather surface for two-lane traffic, with collection containers situated behind a retaining wall for drop-off of the following waste:

- Brush, Wood Waste, and Yard Waste.
- Construction and Demolition Debris (C&D
- Municipal Solid Waste (MSW), and
- Scrap Metals

Each container or unloading area for waste will be clearly identified. Containers used at the CCS will be inspected and maintained in accordance with Table 4.2. A Waste Screener will direct citizens to appropriate locations for unloading materials at the CCS and observe that the respective materials are unloaded in the correct bin or container. Waste Screeners will be trained to recognize unauthorized waste, the procedures if unauthorized waste is detected, and fire protection procedures. Fire protection procedures for the CCS are described in Section 6.

The design of the CCS will comply with the requirements of §330.303 (related to Surface Water Drainage), and the applicable requirements of §330.207 (related to Contaminated Water Management).

4.3 HOURS OF OPERATION (§330.135)

The waste acceptance hours (i.e., site operating hours), when materials will be transported on or offsite, may be any time between the hours of 7 a.m. and 7 p.m., Monday through Sunday.

Operation of heavy equipment for compaction of solid waste, application of daily and intermediate cover, regrading, or construction activities may occur at the landfill any time between the hours of 5 a.m. and 9 p.m., Monday through Sunday. These additional hours for heavy equipment operation, before and after waste acceptance hours, are necessary to perform any necessary earthwork at the landfill that may otherwise interfere with waste disposal operation. Transportation of material or heavy equipment operation will not be conducted between 9 p.m. and 5 a.m.

Consistent with TCEQ rules, the County Judge may request alternate operating hours for special occasions, special purpose events, holidays or other special occurrences. The TCEQ may approve alternate operating hours up to five days in a calendar year period. Additionally, the TCEQ region office may allow additional temporary waste acceptance or operating hours to address disasters, other emergency situations, or other unforeseen circumstances that could result in the disruption of waste management services in the area. If the Landfill Manager determines the landfill needs to operate outside the approved operating hours, the Landfill Manager will seek approval from the TCEQ region office for the alternate operating hours prior to such occurrence. The Landfill Manager will record the dates and times of alternate or additional operating hours in the Site Operating Record.

The Landfill Manager, in consultation with the County Judge, may establish operating hours that are less than those noted above. These hours will be indicated on the sign at the primary entrance to the landfill.

4.4 SITE SIGNS (§330.137)

A site sign will be displayed at the primary entrance to the site. The site sign will be readable from the site entrance. This sign will measure at least 4 feet by 4 feet, and have lettering of at least 3 inches in height that state the name of the site, type of site, hours and days of operation, an emergency 24-hour contact phone number(s) that reaches an individual with the authority to obligate the facility at all times that the facility is closed, the local emergency fire department phone number, and the TCEQ permit number. Appendix IV-A includes a detail of the site sign. Also, signs prohibiting receipt of hazardous waste and other types of unauthorized waste, closed drums, and smoking will be posted at the primary entrance gate. In addition, a sign will be displayed at the primary entrance gate stating that all loads must be properly covered or secured. A sign will also be displayed at the secondary entrance to direct any waste haulers and/or the general public to the scalehouse at the primary entrance.

Within the site, signs will be placed along the landfill haul road and access road at a frequency adequate for waste transportation vehicles to be able to understand where the current waste disposal area is located and which roads are to be used. Roads not being used for access to the disposal area will be blocked or otherwise marked for no entry.

4.5 CONTROL OF WINDBLOWN WASTES AND LITTER (§330.139)

Windblown wastes will be controlled by the following methods:

- Waste transportation vehicles using this facility will be required to use adequate covers or other means of containment. The adequacy of covers or containment of incoming wastes will be checked at both of the landfill entrances. A sign will be prominently displayed at the landfill primary entrance stating that all loads will be properly covered and that a surcharge will be placed on all vehicles without adequate cover.

- Daily cover will be applied at the end of each day of operation to assist with the control of windblown waste.

- The facility will provide litter control fences, as necessary, at appropriate locations near the working face and elsewhere. The litter control fence will be of sufficient height and will be located as close as practical to the active area to control windblown waste and litter.

- As part of the overall site maintenance program, facility personnel will collect daily the windblown waste materials that may have accumulated throughout the entire site, including but not limited to, fences and gates, landfill haul roads and drainage channels throughout the site on days when the facility is in operation.

- Facility personnel will inspect public access roads within two miles in either direction from the landfill primary and secondary entrances for waste spilled en route to the landfill on a daily basis, as described in Section 4.8 of this SOP.

All collected litter will be taken daily to the working face of the landfill for disposal.

4.6 EASEMENTS AND BUFFER ZONES (§330.141)

4.6.1 Easements

In accordance with 30 TAC §330.141, solid waste unloading, storage, disposal, or facility operations will not occur within any easement or right-of-way that crosses the site. There are three known easements that traverse the site. All easements are listed in Part I/II General Information, Section 3.1.5. No solid waste unloading, storage, disposal, or processing operations shall occur within 25 feet of the center line of any utility line or pipeline easement, unless otherwise authorized by the TCEQ. All pipeline and utility easements will be clearly marked with posts that extend at least six feet above ground level, spaced at intervals no greater than 300 feet. All easement and right-of-way markers will be installed consistent with the requirements in Section 4.7 of this SOP.

4.6.2 Buffer Zones

The buffer zone for the landfill is located within and adjacent to the facility boundary on property that is owned or controlled by the County. No solid waste unloading, storage, disposal, or processing operations will occur within the buffer zone. However, perimeter drainage channels, detention ponds, and haul roads may be installed within the buffer zone. Buffer zones may vary around the perimeter of the landfill, but in no case are they less than 50 feet in width for unloading, storage, and processing consistent with §330.543(b)(1) for such operations as the CCS and 125 feet in width for landfill disposal operations consistent with §330.543(b)(2). Landfill haul roads will be constructed within the buffer zones to allow the safe passage of fire-fighting and other emergency equipment. The location and construction of the perimeter drainage channels and detention ponds will not interfere with the haul road to allow for safe passage of fire fighting and emergency vehicles. Buffer zones will be clearly marked as specified in Section 4.7 of this SOP.

4.7 LANDFILL MARKERS AND BENCHMARK (§330.143)

Landfill markers will be installed to clearly mark significant features as described in 30 TAC §330.143(b). The markers will be steel or wooden posts and will extend at least 6 feet above the ground surface. The markers will not be obscured by vegetation and will be placed in sufficient numbers to clearly show the required boundaries. The County will maintain visibility of all required landfill markers and the benchmark. Landfill markers will be inspected monthly and will be maintained and repaired as necessary. Markers will be replaced within 15 days of removal, destruction, or a determination that the markers do not meet regulatory requirements. Refer to Table 4.2 of this SOP for site inspection and maintenance schedule. Markers will be repainted as needed to retain visibility. Guidelines for type, placement, and color coding of markers are outlined below.

- Site Boundary - Site boundary markers will be painted black. The markers will be placed at each corner of the site and along each boundary line at intervals no greater than 300 feet. Fencing may be placed between these markers as required. In areas where the fence is located on the permit boundary, the fence posts may be painted black and used as site boundary markers.

- Buffer Zone - Buffer zone markers will be painted yellow. The markers identifying the buffer zone will be placed along each buffer zone boundary at all corners and between corners at intervals of no greater than 300 feet. Placement of the landfill grid markers may be made along a buffer zone boundary. The buffer zones will be a minimum of 125 feet wide, as described in Section 4.6.2.

- Easements and Rights-of-Way - Easement and right-of-way markers will be painted green. The markers will be placed along the centerline of an easement and along the boundary of a right-of-way, at each corner within the site, and at the intersection of the permit boundary. Where it is impractical to place a marker, the marker will be offset from the easement right-of-way and the offset distance will be clearly painted on the marker.

- Landfill Grid System - Grid markers will be painted white. The grid system will consist of lettered markers along two opposite sides of the site, and numbered markers along the other two sides. Markers will be spaced no greater than 100 feet apart measured along perpendicular lines. Where feasible, intermediate markers will be installed where markers cannot be seen from opposite boundaries. At a minimum, grid markers will delineate the area expected to receive waste within the next 3 years. The grid markers will be maintained during the active life of the site and throughout the post-closure period.

- SLER/GLER Area - SLER/GLER markers will be painted red. The markers will be placed so that all areas for which a SLER/GLER has been submitted and approved by the TCEQ are readily determinable. Such markers are to provide site workers immediate knowledge of the extent of approved disposal areas. These markers will be located and protected so that they are not destroyed during operations until operations extend into the next SLER/GLER area. The location of these markers will be tied into the landfill grid system and will be reported on each SLER/GLER submitted. SLER/GLER markers will not be placed inside the evaluated areas.

- 100-Year Floodplain – 100-Year floodplain protection markers will be painted blue. The markers will be installed for any area within the permit boundary that is within the 100-year floodplain. The area subject to flooding will be clearly marked by means of permanent post not more than 300 feet apart or closer if necessary to retain visual continuity.

The permanent benchmark is located approximately 25 feet west of a wooden post in the southwest corner of the landfill property and 25 feet north of the south fence line. The benchmark is a bronze survey marker, stamped with the elevation and survey date and set in concrete. This benchmark elevation was surveyed from a known United States Coast and Geodetic Survey benchmark or other reliable source.

4.8 CONTROL OF WASTE SPILLED EN ROUTE TO THE SITE (§330.145)

The Landfill Manager will take steps to assure that vehicles hauling waste to the site are enclosed or provided with a tarpaulin, net, or other means to properly secure the load. The steps taken by the County will include, as necessary, the posting of signs requiring the loads to be covered, refusing acceptance of uncovered loads, reporting offenders to the police, adding disposal surcharges, or other necessary means.

On a daily basis when the landfill is in operation, landfill personnel will inspect F.M. 1021 for spilled waste for a distance of two miles in either direction from the landfill’s primary entrance. In addition, on days when the secondary entrance is used by waste haulers, landfill personnel will inspect F.M. 1021 for spilled waste for a distance of two miles north of the primary entrance, two miles south of the secondary entrance, and the distance between both entrances. If spilled waste is found on these segments of F.M. 1021, such waste will be cleaned up by landfill personnel and delivered to the landfill, assuming such waste is suitable for disposal at the landfill. The Landfill Manager will consult with TxDOT officials and Maverick County concerning cleanup of F.M. 1021, consistent with 30 TAC §330.145. Cleanup of F.M. 1021 will include cleanup of the right-of-way as well.

4.9 DISPOSAL OF LARGE ITEMS (§330.147)

A large item/white goods storage area will be provided, as necessary, based on the quantity of these large item/white goods received for disposal. These items will be recycled as demand warrants but will not be stored in excess of 180 days. Large items that are not recycled will be disposed of at the working face. Care will be taken during disposal of large items such that: (1) large items are not placed directly on the liner protective cover, (2) large items are placed such that they do not interfere with continued waste filling, and (3) that other, smaller municipal solid waste is placed and compacted around them.

The County will maintain a program for the proper management of chlorinated fluorocarbon (CFC) refrigerant from refrigerators, freezers, air conditioning units, or other items in accordance with 40 CFR 82.156(f). CFCs will be evacuated from refrigerators, freezers, or air conditions by a third party vendor, or landfill personnel certified to perform this activity, prior to landfilling or recycling the units at an offsite facility. Items such as electrical equipment, which contains PCBs, will be excluded from waste fill. Procedures for detecting and excluding PCBs are provided in Section 5.

4.10 AIR QUALITY AND ODOR MANAGEMENT PLAN (§330.149)

4.10.1 Air Quality

Municipal solid waste landfills are subject to TCEQ regulations concerning burning and air pollution control. Measures to control air pollution may include, but are not limited to, the following items:

- Open burning of waste will not be permitted at this facility.
- The Landfill Manager will develop operations that are consistent with the State Implementation Plan (SIP) developed under the Federal Clean Air Act §110, as amended, and §330.15(d).
- Control of dust emissions (i.e. particulate matter control) from haul roads.
- Implementation of an Odor Management Plan.
- Investigate visible air emissions and implement controls as necessary.

4.10.2 Odor Management Plan

An Odor Management Plan will be implemented at the landfill and will include, but is not limited to, the following procedures:

- Incoming waste will be promptly landfilled.
- Identification of waste that require special attention and immediately cover and compact with daily cover or other waste.

- Identification of loads with significant odors by the Gate Attendant, and notification to the working face personnel.

- Freshly landfilled waste will be promptly covered with daily cover at the end of each operation day.

- Keeping the size of the working face to a minimum so waste can be covered quickly.

- Ponded water at the site will be controlled as detailed in Section 4.19 of this SOP.

- Damage or erosion of daily, intermediate, or final cover will be repaired within 5 days of detection (weather permitting) consistent with Section 4.18.5.

- Regular inspection of vapor-tight gaskets on leachate riser end caps. Damaged or deficient gaskets will be repaired following the inspection.

- Control of potential odors from leachate recirculation operations, as described in Section 4.23.

- Leachate will be disposed and handled as described in Attachment 15 – Leachate and Contaminated Water Plan.

- Control of landfill gas emissions as detailed in the Landfill Gas Management Plan.

- Clean-up spills of odorous materials immediately.

- Accidental fires will be controlled as outlined in Section 6 of this SOP.

4.11 DISEASE VECTOR CONTROL (§330.151)

The need for vector control (control of rodents, flies, mosquitoes, etc.) will be minimized through proper daily site operations, which include the application of daily and intermediate cover. The extent of the working face will also be minimized, as described in Section 4.2. Landfill personnel will make weekly checks for insects and rodents and will report problems to the Landfill Manager. If necessary, a licensed professional will apply pesticides or rodenticides to enhance vector control. Care will be taken to ensure that proper chemicals are used and that they are properly applied.

4.12 MAINTENANCE OF SITE ACCESS ROADS (§330.153)

The landfill haul roads (i.e., perimeter haul roads and other constructed interior haul roads) will be constructed of crushed stone, gravel, caliche, or asphalt paving. All-weather landfill haul roads will be maintained for access to the working face during wet-weather operation. In addition to the all-weather roads, some portions of the onsite roads will be maintained for use during dry weather only. The tracking of mud and trash onto public access roadways to the landfill will be minimized by removing mud and associated debris from the site's primary and secondary entrances at least once per day during periods of wet weather and on days when mud or debris is accumulated on the site entrances or public roadway.

Dust will be controlled on the landfill haul roads by periodic spraying from a water truck or other means during periods of significantly dry weather. Dust from on-site roads will not become a nuisance to surrounding areas. A water source and necessary equipment or other means of dust control approved by the TCEQ will be provided.

Grading equipment will be used, as necessary, to control or remove mud accumulations on landfill haul roads. All haul roads will be inspected for damage due to traffic or erosion following significant rainfall events but, in any instance, the minimum inspection frequency of the site roads will be monthly. Crushed stone, concrete rubble, masonry demolition debris, crushed glass, recycled asphalt materials, or caliche will be delivered to the site on an as-needed basis for use in maintaining passable haul roads during wet weather. All onsite haul roads will be maintained in a clean and safe condition. Site roads will be regraded on an as needed basis, as a result of monthly inspections, to minimize depressions, ruts and potholes. Refer to Table 4.2 of this SOP for the site inspection and maintenance schedule.

4.13 SALVAGING AND SCAVENGING (§330.155)

Salvaging will not be allowed to interfere with disposal of solid waste or to create public health nuisances. Salvaged materials will be considered as potential recycled materials. Salvaged items will be removed from the landfill property often enough and will not be stored in excess of 180 days to prevent the items from becoming a nuisance, to preclude the discharge of pollutants from the area, and to prevent an excessive accumulation of the material at the landfill. Special wastes received at the landfill will not be salvaged. Additionally, pesticide, fungicide, rodenticide, and herbicide containers will not be salvaged. Scavenging will be prohibited at all times.

4.14 ENDANGERED SPECIES PROTECTION (§330.157)

Landfill operations will not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of any endangered or threatened species. No endangered or threatened species are known to exist in the immediate vicinity of the landfill. Verification by the United States Department of the Interior Fish and Wildlife Service that no endangered species will be affected by landfill operations is provided in Part I/II, Appendix I-C3.

4.15 LANDFILL GAS MANAGEMENT (§330.159)

The monitoring of LFG at the landfill will be in accordance with Attachment 14 - Landfill Gas Management Plan. The reports and other submittals required by Attachment 14 will be included in the Site Operating Record, as described in Section 8.1 and submitted to the TCEQ consistent with TCEQ requirements.

4.16 TREATMENT OF ABANDONED OIL AND WATER WELLS (§330.161)

There are no known abandoned water wells or abandoned crude oil or natural gas wells on the landfill property. However, if such abandoned wells are encountered during the course of site development, the County will immediately provide written notification to the TCEQ of the location of these wells.

Within 30 days of finding any abandoned water wells, the County will provide written certification to the TCEQ that all such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations of the TCEQ or other applicable state agency.

For abandoned crude oil or natural gas wells, or other wells associated with mineral recovery, within 30 days of finding any such wells, the County will provide the TCEQ with written notification of the location of such wells. Within 30 days of plugging such wells, the County will provide the TCEQ with written certification that all such wells have been properly capped, plugged, and closed in accordance with all applicable rules and regulations of the Railroad Commission of Texas.

A copy of the well-plugging report to be submitted to the appropriate state agency will also be submitted to the TCEQ within 30 days after the well has been plugged. The County will also submit a permit modification (if applicable) identifying any proposed changes to the liner installation plan as a result of any well abandonment.

4.17 COMPACTION OF SOLID WASTE (§330.163)

Compaction of incoming waste provides more efficient use of available space and reduces the amount of settling after the fill is complete. The incoming waste will be spread in layers and compacted. Compaction of the waste will be accomplished by repeated passes of the landfill compaction equipment capable of providing a minimum 1,000 lbs/cy compaction. Adequate compaction will be accomplished to minimize future consolidation and settlement and provide for the proper application of intermediate and final cover.

Waste placement in landfill phases (i.e., cells) with floor slopes greater than 2% and smooth geomembrane on the floor will be conducted by the following: (1) spreading and compacting lifts across the entire cell floor; and (2) starting from the low end (i.e. leachate sump) and progressing to the high end.

4.18 SOIL MANAGEMENT, PLACEMENT, AND COMPACTION OF DAILY, INTERMEDIATE, AND FINAL COVER (§330.165)

4.18.1 Soil Management

Management of soil for use in and around the landfill will be an ongoing activity at the facility. In general, soil for use as daily cover, intermediate cover, final cover, and other uses will be available adjacent to the active area. The volume of the soil stockpile used for application of daily cover will depend on the size of the working face, but will be adequate to cover the working face with at least 6-inches, as described in Section 4.18.2. Soil used for fire control will be available within 1,100 feet of the working face, as described in Section 6.1. The soil stockpile(s) will consist of soil that has not previously come in contact with waste. Section 6.1 lists the minimum size of the soil stockpile that will be maintained for fire fighting purposes. This stockpile will be routinely replenished. If the volume of the soil stockpile is reduced to less than the minimum size, it will be replenished prior to the next day of waste acceptance.

4.18.2 Daily Cover

Daily cover of waste is necessary to control disease vectors, windblown waste, odors, fires, scavenging, and to promote runoff from the fill area. At the end of each working day, at least 6 inches of soil cover material that has not previously been mixed with garbage, rubbish, or other solid waste, or an approved alternative daily cover (ADC) material, will be placed over all solid waste received subsequent to the previous cover placement.

The use of ADC will be limited to a 24-hour period after which either waste or daily cover will be placed. The procedures that will be used for application of ADC are specified in the Alternative Daily Cover Operating Plan (ADCOP), as provided in Appendix IV-C. Prior to utilizing different ADCs materials other than previously authorized ADCs, the County will submit a request for temporary authorization consistent with §330.165(d)(1). Consistent with this ADCOP, a status report will be submitted on a two-month basis to the TCEQ during the temporary authorization period describing the effectiveness of the ADC.

If soil is used as daily cover, the minimum thickness will be 6 inches. To ensure that the daily cover soil will be adequate (i.e., minimize vectors, contaminated storm-water runoff, odors, etc.) the following procedures will be followed:

- The daily cover will be sloped to drain.

- The daily cover will be compacted by bulldozer to minimize infiltration of storm water, graded to drain, and will not have waste visibly protruding through it.

- The Landfill Manager will visually verify during placement that a minimum of 6 inches (compacted thickness) of daily cover soil has been placed. The Landfill Manager will document, on a daily basis, that he has visually verified the thickness and condition in the Cover Application Log (discussed further in Section 4.18.6 of this SOP).

- After each rainfall event, the Landfill Manager will inspect all daily cover areas for erosion, exposed waste or other damage, and repair, as described in Section 4.18.5. Runoff from areas that have intact daily cover is considered to not have come in contact with the working face or leachate.

Inactive areas with 6 inches of daily cover will be inspected weekly for erosion, ponded water, seeps, protruding waste, or other detrimental conditions that may cause contaminated runoff from the daily cover. Within a period of 180 days, an additional 6 inches of earthen material not previously mixed with garbage, rubbish or other solid waste will be placed over inactive areas with daily cover for a total of not less than 12 inches of cover. This 12-inch-thick layer of cover soil will be classified as "intermediate cover" as described in Section 4.18.3 of this SOP. Once the area becomes active again, the top 6 inches may be stripped off for use as daily cover in other areas, provided it can be removed without contamination by contact with solid waste.

4.18.3 Intermediate Cover

All areas that have received waste and will be inactive for longer than 180 days will be covered with 12 inches of well-compacted intermediate cover within 180 days after placement of daily cover or becoming inactive. The top six inches of the intermediate cover will be capable of sustaining native plant growth. Vegetation will be established on intermediate cover within 180 days following application of the intermediate cover and will provide a minimum 60 percent ground coverage, as described in Attachment 6, Appendix 2, Section 5.4. The intermediate cover will be graded and maintained to prevent ponding. Vegetation growth and erosion control features will be maintained as specified in Section 7 of this SOP.

The Landfill Manager will inspect intermediate cover at the site weekly for erosion, ponded water, seeps, protruding waste, or other detrimental conditions that may cause contaminated runoff. Erosion gullies or washed-out areas will be repaired within 5 days of detection, weather permitting, as described in Section 4.18.5.

4.18.4 Final Cover

Final cover will be placed as areas of the site are filled to the design top-of-waste grades. Final cover will be placed in accordance with Attachment 12 - Final Closure Plan. Areas that receive final cover will be vegetated immediately following completion of final cover placement, and will provide at least 85 percent ground coverage, as described in Attachment 6, Appendix 2, Section 5.5. Surface water will be managed throughout the operating life of the landfill to minimize erosion of the final cover. Erosion of final cover will be repaired within 5 days of detection, weather permitting, by restoring the cover material, grading, compacting, and seeding, as necessary. Monthly inspections and restorations will be implemented during the entire operational life. Refer to Table 4.2 of this SOP for a site inspection and maintenance schedule.

The final cover system, including the erosion control structures (interceptor channels and downchutes), will be maintained during and after construction. During the active life of the site, the Landfill Manager will inspect the final cover system monthly. Post-closure care inspection procedures are outlined in the Attachment 13 - Postclosure Care Plan. Final cover will be monitored throughout the entire closure and post-closure care period of the landfill.

4.18.5 Erosion of Cover

Intermediate and final cover will be inspected on a weekly and monthly basis, respectively, for erosion. Inactive areas with daily, intermediate, and final cover also will be inspected for erosion following significant rainfall events. A significant rainfall event is defined as precipitation greater than 0.5 inches. Erosion gullies or washed-out areas deep enough to impact the final or intermediate cover will be repaired within 5 days of detection (weather permitting) by restoring the cover material, grading, compacting, and/or seeding or sodding. An eroded area is considered to be deep enough to impact the final or intermediate cover if it exceeds four inches in depth as measured perpendicular to the slope. The TCEQ region office may approve more time for cover repairs if the extent of the damage indicates that more time will be needed or if repairs are delayed due to weather conditions.

The date of detection of erosion and date of completion of repairs, including justification of delays, will be documented in the Cover Application Log. Cover inspections will be conducted throughout the operational life of the landfill.

4.18.6 Cover Application Log

Throughout the landfill operation, a cover application log will be maintained and be readily available for inspection by the TCEQ and authorized agents or employees of local governments having jurisdiction. For daily and intermediate cover, the log will specify the area covered (by use of the grid system), how it was placed, and the date it was completed. For final cover, the log will specify the final cover area, the date of cover, and the thickness applied that date. Each entry will be certified by the signature of the Landfill Manager that the work was accomplished as stated in the log. Repairs will be documented in the appropriate cover log, including inspections for erosion, the findings, and the action taken.

4.19 PREVENTION OF PONDED WATER (§330.167)

The prevention of ponding water is necessary to control infiltration of water into the waste. Additionally, ponded water can be a source of odor and breeding grounds for vectors. This ponding water prevention plan to be implemented at the landfill includes, but is not limited to, the following procedures:

Preventative Actions:

- Inspections of the landfill cover will be performed consistent with Section 4.18 of this SOP for the respective cover (i.e., daily, weekly, or monthly) and following periods of wet weather to identify potential ponding locations.

- Routine site grading and maintenance to provide drainage and prevent the ponding of water over areas containing waste.

Corrective Actions:

- Should ponding occur, the water will be removed and the depressions filled within seven days of the occurrence.

- If the ponded water has come into contact with waste, leachate, or waste-contaminated soils, it will be treated as leachate and handled in accordance with the Attachment 15 - Leachate and Contaminated Water Plan.

4.20 DISPOSAL OF SPECIAL WASTES (§330.171)

Acceptance of special wastes, as defined in 30 TAC §330.3(148), will be performed in accordance with 30 TAC §330.171. The special wastes that will be accepted at the landfill are discussed in the following subsections.

4.20.1 Dead Animals and Slaughterhouse Waste

Dead animals or slaughterhouse wastes will be accepted at this landfill. Dead animals and slaughterhouse wastes will be buried and covered with a minimum of 3 feet of other solid waste or a minimum of 2 feet of soil immediately upon receipt

4.20.2 Non-Regulated asbestos-containing material (non-RACM)

Non-regulated asbestos-containing materials (non-RACM) may be accepted for disposal at this landfill provided the wastes are placed on the active working face and immediately covered with 12 inches of earthen material or 3 feet of solid waste. Under no circumstances may any material containing non-RACM be placed on any surface or roadway that is subject to vehicular traffic or disposed of by any other means by which the material could be crumbled into a friable state.

4.20.3 Empty Containers

Empty containers which have been used for pesticides, herbicides, fungicides, or rodenticides will be disposed at the site in accordance with the following:

- The containers are tripled rinsed prior to receipt at the landfill.
- The containers are rendered unusable prior to or upon receipt at the landfill.
- The containers are covered by the end of the same working day they are received.

Containers for which triple-rinsing is not feasible or practical (e.g., paper bags, cardboard containers) may be disposed at the landfill , provided that the waste is disposed as a municipal hazardous waste from conditionally exempt generators, as described in Section 4.20.4 or Class 2 industrial waste if classified as such in accordance with §335.506.

4.20.4 Municipal Hazardous Waste from Conditionally Exempt Generators

Municipal hazardous waste from a conditionally exempt small quantity generator (CESQG) may be accepted at the landfill without further approval from the TCEQ provided the amount of waste does not exceed 220 pounds per month per generator, and provided the landfill owner or operator authorizes acceptance of the waste.

4.20.5 Sludge, Grease Trap, Grit Trap, or Municipal Liquid Waste

Sludge, grease trap waste, grit trap waste, or liquid wastes from municipal sources will be accepted at a landfill for disposal only if the waste has been treated or processed and the treated/processed material has been tested, in accordance with Test Method 9095 (Paint Filter

Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication Number SW-846), as amended, and is certified to contain no free liquids.

4.20.6 Used Oil Filters

Used oil filters (to include filters that have been crushed and/or processed to remove free-flowing used oil) from **non-household generator**s will not be accepted at the landfill. However, used oil filters from internal combustion engines from **household generators** will be accepted at the landfill if the filter has been:

- Crushed to less than 20% of its original volume to remove all free-flowing used oil.
- Processed by a method other than crushing to remove all free-flowing used oil. A filter is considered to have been processed if:

  (i) the filter has been separated into component parts and the free-flowing used oil has been removed from the filter element by some means of compression in order to remove free-flowing used oil;
  (ii) the used filter element of a filter consisting of a replaceable filtration element in a reusable or permanent housing has been removed from the housing and pressed to remove free-flowing used oil; or
  (iii) the housing is punctured and the filter is drained for at least 24 hours.

4.20.7 Medical Waste

Medical waste that has been treated in accordance with the procedures specified in Subchapter Y (related to Medical Waste Management) may be accepted at the landfill.

4.20.8 Waste Generated Outside the Boundaries of Texas

Waste generated outside the boundaries of Texas, including waste generated at Maquiladora facilities, will be accepted at the landfill provided it is classified as MSW, one of the special wastes described in Section 4.20.1 through Section 4.20.8, or Class 2 or Class 3 industrial solid waste, as described in Section 4.21. As noted above, Class 1 industrial solid waste will not be accepted at the landfill. Waste generated outside the boundaries of Texas that has been classified as one of the above types of waste will be handle consistent with the requirements for that type of waste described in this SOP.

Prior to accepting waste generated outside the boundaries of Texas, the landfill operator will require that the generator submit a "Request for Authorization for Disposal of a Special Waste." This request will include the items listed in §330.171(b)(2), as described below in Section 4.20.10. Following receipt of the request, the County will submit said request to the TCEQ for approval. The waste generated outside the boundaries of Texas specified in the request will not be accepted until approval from the TCEQ has been obtained and will only be accepted for the time period specified in the approval.

4.20.9 Other Special Wastes

Special wastes, other than the special waste identified 30 TAC §330.171(c) & (d), requires prior written approval from the TCEQ. Approvals will be waste-specific and/or site-specific and will be granted only to appropriate facilities operating in compliance with TCEQ regulations. As specified in 30 TAC §330.171(b)(2), requests for approval to accept other special wastes will be submitted to the TCEQ and will include the following:

1. A complete description of the chemical and physical characteristics of each special waste and the quantity and rate at which each waste is produced and/or the expected frequency of disposal. An additional statement will be included as to whether the special waste is a Class I industrial waste or not.

2. An operational plan containing the procedures for handling each waste and listing required protective equipment for operating personnel and onsite emergency equipment.

3. A contingency plan outlining responsibility for containment and cleanup of any accidental spills occurring during the delivery and/or disposal operation.

Special waste classified as Class 1 industrial waste is prohibited from being disposed of at the landfill.

4.21 DISPOSAL OF INDUSTRIAL WASTE (§330.173)

As specified in Section 5.1, the County will not accept Class 1 industrial solid waste at the landfill. This facility will accept Class 2 and Class 3 industrial solid waste, as defined in §335.506 and §335.507, respectively, provided the acceptance of such waste does not interfere with landfill operation.

4.21.1 Petroleum Contaminated Soils

Soil contaminated by petroleum products, such as automotive gasoline, other fuels, used motor oil from an internal combustion engine, or crude oils (also referred to as petroleum contaminated soils), may be accepted for disposal without specific TCEQ approval. Prior to acceptance of petroleum contaminated soils, the soils must be certified as being under the limits specified in the Table 4.1.

To determine whether or not a soil meets the criteria listed in the table, one composite sample will be taken for every 50 cubic yards (CY) of contaminated soil. The composite sample should be comprised of four separate grab samples from within the 50 CY. The person taking the sample should strive to obtain the most representative sample possible. All samples must be analyzed for total petroleum hydrocarbon (TPH). If analytical data or process knowledge indicates the possible presence of other contaminants (e.g. benzene or lead), testing for additional parameters is required, as indicated in 30 TAC §335, Subchapter R and TCEQ Regulatory Guidance Document Number RG-22 and RG-29. When additional parameters are required (benzene or lead), it is only necessary to analyze the sample(s) which contain the highest level of

TPH from per 200 CY. For example, if there is 400 CY of contaminated soil, there should be eight samples tested for TPH and the two samples with the highest TPH level from those samples should be analyzed for the additional parameters of concern. Laboratory detection limits must be less than or equal to the maximum contaminant levels listed in Table 4.1.

TABLE 4.1
CONTAMINATED SOIL CONSTITUENTS OF CONCERN

CONSTITUENTS OF CONCERN	MAXIMUM CONTAMINANT LEVEL
Benzene	0.5 mg/1[1]
TPH	1,500 mg/kg
Lead[2]	1.5 mg/1[1]

Notes:
[1] An analysis of total contaminant level may be used as a screening tool prior to Toxicity Characteristic Leaching Procedure (TCLP). To determine the maximum total contaminant level at which a TCLP is not necessary multiply the table limit by a factor of 20. This formula is extrapolated from a 20:1 dilution factor when preparing TCLP samples for analysis (Title 40 Code of Federal Regulations, Part 261, Appendix II). If a contaminant total level exceeds 20 times the table limit (e.g. total lead>30 mg/kg, total benzene >10 mg/kg, etc.), then TCLP must be performed.

[2] If it is known through process knowledge, that the automotive gasoline and fuels did not contain lead, it is not necessary to test for lead.

4.22 VISUAL SCREENING OF DEPOSITED WASTE (§330.175)

Methods for visually screening the working face and deposited waste will include, but are not limited to, the following items consistent with 30 TAC §330.175:

- Orienting the working face away from the F.M. 1021.
- Developing the aerial fill portion of the landfill from the exterior to the interior, when appropriate (i.e., by constructing landfill sideslopes prior to filling operation
- Maintaining existing trees and other vegetation near the landfill permit boundary and adjacent to F.M. 1021.

4.23 LEACHATE AND CONTAMINATED WATER MANAGEMENT

Maverick County will not discharge contaminated water without specific written authorization by the TCEQ. The management of leachate and contaminated water will be performed in accordance with Attachment 15 – Leachate and Contaminated Water Plan. Reports and other submittals required by Attachment 15 will be maintained in the Site Operating Record, as described in Section 8.1 of this SOP.

Leachate collected from the leachate collection system may be recirculated back into the landfill by spraying on the working face, or injecting the leachate back into waste. However, recirculation will only take place over composite lined cells (referred herein as Standard Liner System, see Section 3.0) in accordance with §330.331(b).

Leachate that is recirculated into the landfill will be performed using the following procedures:

1. Leachate will be sprayed directly onto the waste at the working face via a dedicated water truck or injected into the waste mass using a dedicated pump.

2. Prior to performing leachate recirculation, containment berms and diversion berms will be constructed to prevent runoff of contaminated water and run-on of uncontaminated stormwater, respectively.

3. Leachate recirculation performed using a spray application will be performed as follows:

    a. The spray application will not be performed when standing water exists or during rain events.

    b. No odors are expected to be associated with this practice. Nevertheless, to provide assurance that odors and wind transmission are minimized, the following procedures will be implemented:

        i. The spray application of leachate will be performed at a minimum 100-foot setback from the limits-of-waste.
        ii. The leachate will be sprayed down towards the waste, such that the water stream is not being projected up into the air.
        iii. Spray applications will only be performed on days when the wind speed is less than or equal to 15 miles per hour.

    c. The rate of spraying will be low enough to prevent the occurrence of ponding and allow the infiltration of leachate prior subsequent applications.

4. Leachate recirculation performed by injection will be performed by installing either HDPE [SDR 17 or less] or polyvinyl chloride (PVC) [Sch 80 or less] below-grade horizontal pipes or vertical injection wells for introduction of the liquids into the landfill in areas of daily or intermediate cover only. As such, leachate recirculation will not occur in areas within in-place final cover.

    a. If below-grade horizontal pipes are installed, they will be installed in trenches at least 3 feet below the landfill surface and be comprised of solid and perforated sections of pipe. Using this technique, the perforated section will be maintained at least 50 feet from the landfill sideslope (i.e., to minimize seeps) when waste disposal in area of recirculation is above-grade.

    b. If vertical wells are installed, they will be installed with the bottom of the well at least 10 feet above the bottom liner of the landfill. The well will be comprised of perforated and solid components, with the solid piping extending from the landfill surface to at least 3 feet below grade and encased in soil backfill. The remainder of the well piping will be perforated and encased in gravel backfill.

5. Although, leachate recirculation is not expect to result in nuisance odors, if nuisance odors develop, the following procedures will be implemented to mitigate odors:

    a. Leachate recirculation will temporarily suspended until the nuisance odors dissipate.

    b. If nuisance odors are associated with spray applications, the area will be immediately covered with 6 inches of soil.

    c. If nuisance odors are associated with injection of leachate, all connections to horizontal or vertical injection points will be inspected to make sure that each connection is vapor-tight. If damaged or deficient connections are observed, then the connections will be repaired following the inspection.

    d. If nuisance odors are still occurring, then the procedures in Section 4.10.2, related to Odor Management Plan, should be reviewed and implemented as needed until odors are mitigated.

6. The Landfill Manager will maintain records of the volume of leachate recirculated into the landfill. The recirculation volume will be measured using either flow meters connected to pumps and/or water trucks, or by the volume discharged from water trucks based on the capacity of such storage units.

Leachate recirculation will be performed such that ponding and seeps will not occur. If either, ponding or seeps, are detected or if the leachate head on the liner exceeds 12 inches, the leachate recirculation in the respective cell will be discontinued until the condition is remediated. Additionally, preventative and corrective actions detailed in Section 4.19 will be followed related to cover inspections for seeps and ponding. If seeps are observed during inspections, the area will be packed with onsite soil (i.e., low permeable clay) to assist in mitigating the seep.

Leachate recirculation will be restricted to volumes less than 830,290 gallons/acre/year during below-grade waste disposal and 660,394 gallons/acre/year during above-grade waste disposal. Additionally, the maximum daily recirculation will be limited to less than or equal to 9,700 and 5,400 gallons/acre/day for below and above-grade disposal, respectively, provided total annual volumes are not exceeded and leachate recirculation at the landfill is limited to less than 100,000 gallons/day in accordance with §330.991(a)(7)(A). These allowable recirculation volumes pertain to areas draining to a common sump. The calculations and respective HELP modeling for leachate recirculation are provided in Attachment 15, Appendix 1A.

TABLE 4.2

SITE INSPECTION AND MAINTENANCE SCHEDULE

ITEM	TASK	SCHEDULE
Fence/Gate	Inspect perimeter fence and gate for damage, gaps, intrusions and the like. Make temporary repairs within 24-hours (weather permitting) and permanent repairs within the timeframe approved by the TCEQ region office.	Monthly
Windblown Waste	Police working fence area, wind fences, access roads, entrance areas (primary and secondary), and perimeter fence for loose trash. Clean up upon detection.	Daily
Waste Spilled en Route to the Site	Police entrance areas and FM-1021 at least 2 miles in either direction from the landfill entrances (primary and secondary) for loose trash. Clean up upon detection.	Daily
Landfill Markers	Inspect all landfill markers for damage, color coding, and general location. Correct or replace damaged markers within 15 days of discovery.	Monthly
Landfill Haul Road	Inspect landfill haul roads for damage from vehicle traffic, and erosion. Repair onsite roads, as needed, based on inspections. Inspect landfill entrances (primary and secondary) and onsite roads for excessive mud and/or waste accumulation. Maintain as needed with crushed rock or stone.	Monthly Daily (Wet Weather) Weekly (Otherwise)
Daily Cover	Inspect for proper placement, thickness, and compaction. Remedy deficiencies as needed.	Daily (active areas) Weekly (inactive areas)
Intermediate Cover	Inspect for proper placement, thickness, erosion, vegetation, compaction and for presence of waste or other contamination. Remedy deficiencies as needed within 5 days, weather permitting.	Weekly
Final Cover	Inspect for proper placement, thickness, vegetation, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout postclosure care period. Remedy deficiencies as needed within 5 days, weather permitting.	Monthly

TABLE 4.2 (Continued)

ITEM	TASK	SCHEDULE
Erosion Control	Inspect the intermediate and final cover for signs of erosion. Damaged areas will be repaired within 5 days (weather permitting) of detection by restoring cover material, grading, compaction, and/or seeding or sodding.	Weekly (Interim), Monthly (Final), and following wet weather
Disease Vector Control	Inspect landfill facility for insects and rodent populations and report them to the Landfill Manager.	Weekly
Ponding Water	Inspect landfill cover for potential ponding water locations. Grade and compact potential areas within seven days, weather permitting.	Daily (daily cover), Weekly (Interim), Monthly (Final) and following wet weather
Leachate Storage Tanks	Inspect leachate tanks, related piping, and connections for leaks or spills.	Weekly
Depth of Leachate on Liner	Measure leachate depth within sump using electric liquid indicator (see Attachment 15, Section 4.7).	Monthly (without recirculation) Weekly (with recirculation)
Leachate Pumps	Inspect leachate pumps and maintain, as necessary (see Attachment 15, Section 4.7).	Annually
Leachate Pipe Clean-out	Perform clean-out activities of leachate collection lines (see Attachment 15, Section 4.7).	Annually
CCS Containers	Inspect the containers for spills and leaks, and repair or replace containers, if necessary, as a result of these inspections.	Daily

- A public awareness program (see Section 5.3)

- Monitoring for unauthorized wastes at the landfill entrance and working face; and performing load inspections, including random inspections of incoming loads and compactor vehicles (see Section 5.4).

- Management of unauthorized waste and provisions for remediation of the incident (see Section 5.5).

- Recordkeeping requirements, including records of personnel training, inspections, and notifications involving receipt of regulated hazardous waste (see Section 5.6).

5.2 PERSONNEL TRAINING

The Landfill Manager, Waste Screeners, Equipment Operators, and Gate Attendant will maintain an understanding of this SOP and will be trained in the following areas:

1. Recognizing and identifying unauthorized wastes at the landfill entrance and working face and CCS. The Landfill Manager, Gate Attendant, Equipment Operators and Waste Screener are required to complete a course on Screening of Unauthorized Waste at Municipal Solid Waste Facilities. Records of all course attendance will be kept, including copies of certificates issued. Continuing education will also be a part of the personnel records.

2. All personnel will be trained on the types of wastes that are accepted at the landfill, and which wastes are considered unauthorized waste.

3. Identification of regulated hazardous, PCB, and other unauthorized waste, including signage or labeling and identification systems for regulated wastes (e.g. regulated asbestos-containing material, regulated hazardous, or wastes containing PCB).

4. Procedures to be implemented in the event of identification of regulated and unauthorized wastes.

5. How to perform a load inspections, including random inspections.

6. Waste handling procedures.

7. Health and safety.

The Landfill Manager will maintain an understanding of this SOP and will be trained in the above areas as well as customer notification and recordkeeping.

5.3 PUBLIC AWARENESS

In addition to training personnel in the detection and exclusion of unauthorized waste, the County will also maintain a public awareness program to educate the public and landfill customers about disposal of unauthorized wastes.

This education program will include the following action items:

1. Public Service Announcements will be used to inform the community of waste restrictions and consequences of disposal of unauthorized waste.

2. Maverick County will work with any and all civic organizations to promote proper waste classification and disposal alternatives.

3. Maverick County will provide information to the City of Eagle Pass, the Eagle Pass Independent School District and other community groups about the Type 1 Municipal Solid Waste Landfill and the wastes that can be accepted.

4. Signs will be posted at the landfill entrance specifying the types of unauthorized waste, especially regulated hazardous and PCB wastes. Customers will also be notified that their waste is subject to inspection and by entering the site, they automatically consent to inspection.

5.4 LOAD INSPECTION PROCEDURE

The Gate Attendant will be alert for signs of unauthorized waste, including unusual odors or visual signs of heat, fumes, large containers, unusual dust, liquids, or sludge when collection vehicles, landfill customers, etc. enter the facility. If any signs of unauthorized waste are detected by the Gate Attendant, the suspect load will be directed to the working face for an inspection. Additionally, incoming loads will be observed and visually inspected at the working face. All landfill personnel shall be on the lookout for trucks bringing in waste loads from potential sources of hazardous or PCB waste such as microelectronics manufacturers, electronic companies, metal plating industry, automotive and vehicle repair service companies, and dry cleaning establishments. Landfill personnel will immediately report any indication of unauthorized waste to the Landfill Manager. In turn, the Landfill Manager will direct appropriate landfill personnel to conduct a thorough evaluation of the load.

In the event an incoming load is suspected of containing unauthorized waste (based on visual evidence) or the incoming load has been randomly selected for inspection, the following procedures will be implemented:

1. The driver will be directed to a load inspection area located near the working face over an approved lined area, where the load will be discharged from the vehicle.

2. During the inspection, the Waste Screener will wear appropriate personal protective equipment consistent with the situation.

3. The Waste Screener will break up the waste pile and inspect the material for potential hazardous or unauthorized waste. Characteristics of unauthorized waste might be unusual odors, heat, fumes, large containers, unusual dust, liquids, or sludge.

4. Suspicious wastes will be flagged and samples may be taken for laboratory analysis.

5. Known unauthorized waste will be placed back into the vehicle and the driver will be instructed to depart the site. Should any regulated hazardous waste be detected or suspected, the entire load will be refused.

In addition to the above procedure, incoming loads will be inspected on a random basis. The Landfill Manager will be responsible for determining the random inspection schedule, but a minimum of one percent of incoming loads will be inspected per week or a minimum of 5 random inspections per week. The driver of the randomly selected load will be notified prior to unloading waste and the procedures for inspection of incoming loads, as described above, will be implemented.

5.5 MANAGING UNAUTHORIZED WASTE

Unknown wastes undergoing analysis must be properly segregated and protected against the elements, secured against unauthorized removal or accidental burial, and isolated from other waste and activities. An effort will be made to identify the entity that deposited the suspected unauthorized waste and to have this entity return to the site and assume full responsibility for proper disposal of the waste.

Known unauthorized wastes detected during an inspection will be returned immediately to the waste hauler/transporter. If the hauler is not available, the waste will be safely stored in a collection bin and will be removed from the site within 24 hours. All costs associated with the removal of unauthorized waste will be borne entirely by the transporter or generator, if identified. If not identified, Maverick County will assume all removal costs.

If regulated hazardous or PCB wastes are detected, the TCEQ Region office and any other local pollution agency with jurisdiction, that has requested to be notified, will be notified via telephone within 24 hours and the TCEQ Austin Office MSW Section will be notified in writing with a copy to the TCEQ Region Office within 14 days. As soon as is practical, the hauler will be required to remove the hazardous waste from the site. Prior to removal, the hauler must demonstrate that he has an EPA identification number, package the waste in accordance with TxDOT regulations, and properly manifest the waste designating a permitted facility to treat, store, or dispose of the hazardous waste.

5.6 RECORDKEEPING

The Landfill Manager will maintain and include in the Site Operating Record the following:

- Load inspection reports and resulting action. Load inspection reports, recorded on standardized forms, will be completed for each inspected load. The reports should include at a minimum, the date and time of inspection, the name and address of the hauling company and driver, the type of vehicle, the size and source of the load, contents of the load, indicators of unauthorized waste, and results of the inspection.

- Records of regulated hazardous or PCB waste notifications. The TCEQ will be notified whenever regulated hazardous or PCB waste is detected. Records of the notification will be kept in the Site Operating Record and will include the date and time of notification, the individual contacted, and the information reported.

- Personnel training records will be maintained in the Site Operating Record and will include evidence of successful completion of the training, type of training received, and the name of the instructor.

- A commercial transporter file shall be maintained. The file will contain basic information about the transporter (name, address, etc.) and copies of routes and inspections. The file will contain an agreement from every transporter delivering waste to the landfill that they have arranged their routes to eliminate unauthorized wastes from the loads they transport to the facility. The documentation will state that the transporter will remove any unauthorized Maverick County wastes disposed at the landfill immediately after its discharge or at the option of Maverick County, the transporter will pay any applicable surcharges to Maverick County to have Maverick County accomplish the required immediate removal. Maverick County does not accept ownership of any unauthorized waste.

- A copy of any actions taken or restrictions placed on a transporter.

- An incident file will be kept on any adverse consequences resulting from unauthorized waste. The file will document actions taken to mitigate the incident and operational changes made to prevent a recurrence. Also included will be actions taken against a transporter. The incident file will contain any necessary notifications to the TCEQ on the incident and subsequent action.

SECTION 6

FIRE PROTECTION PLAN (§330.129)

6.1 FIRE PREVENTION PROCEDURES

The following steps will be taken regularly by designated landfill personnel to prevent fires:

- Open burning is not authorized at any time at the landfill.
- Burning waste will be prevented from being unloaded in the active area of the landfill or at the CCS. The Gate Attendant, Waste Screeners, and Equipment Operators will be alert for signs of burning waste such as smoke, steam, or heat being released from incoming waste loads**.** Additionally, smoking will not be allowed in active areas of the landfill or at the CCS. Smoking will be confined to specific areas that are away from the active working area, re-fueling areas, CCS, and other specified fire-sensitive areas.
- Landfill equipment will not remain in the active area of the landfill overnight.
- Fuel spills will be contained and cleaned up immediately.
- Dead trees, brush, or vegetation adjacent to the landfill will be removed, and grass and weeds mowed so that forest, grass, or brush fires cannot spread to the landfill.
- A stockpile of earthen material adequately sized to cover the working face will be maintained within 1,100 feet of the working face or active disposal area for fire protection (i.e. in order to cover the working face within one hour). The stockpile will be sized to cover the working face with a six-inch layer of earthen material. As noted in Section 4.2, the maximum size of the working face will be approximately 14,400 square feet. Therefore, to cover this size of working face, the required soil stockpile will be approximately 270 cubic yards.

  The earthen volume will be transported to the working face by earth moving equipment with a combine capacity of 23 cubic yards (i.e., 12-cy dump truck and 11-cy scraper) and will be distributed across the working face by a onsite bulldozer while the soil is being transported. This equipment will be used to smother the fire within one hour of being detected.

  The following equation and calculation demonstrates the maximum distance from the working face that soil will be stockpiled to provide a 0.5-foot layer within one hour:

$$D = \frac{TS_E}{N_t FS}$$

- Assess extent of fire, possibilities for the fire to spread, and alternatives for extinguishing the fire.

- If it appears that the fire can be safely fought with available fire fighting devices until arrival of the Fire Department, attempt to contain or extinguish the fire.

- Upon arrival of Fire Department personnel, direct them to the fire and provide assistance as appropriate.

- All landfill employees will be trained in and be familiar with the use and limitations of firefighting equipment available onsite.

- Firefighting methods include smothering with soil, separating burning material from other waste, and spraying with water from the water truck or water pumped from nearby ponds or streams. If detected soon enough, a small fire may be fought with hand-held fire extinguishers. Under this circumstance, the fire area should be watered or otherwise controlled to ensure that the fire is out.

The site will follow the recommendations of the local fire department regarding the type, size, location, and number of fire extinguishers. At a minimum each piece of equipment will be equipped with a fire extinguisher. Each fire extinguisher will be fully charged and ready for use at all times, including after an incident in which the fire extinguisher was used, the extinguisher will be refilled or replaced. Each extinguisher will be inspected on an annual basis and recharged as necessary. A qualified service company will perform these inspections, and all extinguishers will display a current inspection tag. Inspection and recharging will be performed following each use. At a minimum, the administration building/scale house, maintenance shed, CCS, and all landfill equipment and vehicles will be equipped with fire extinguishers.

As discussed in Section 2.2 each employee will receive training in fire and explosion response procedures. This includes firefighting training to acquaint employees with the use and limitations of on-site firefighting equipment. Documentation of all employee training will be kept in the employee's file and site operating record, and be readily available to a TCEQ inspector. In the event of a significant fire at the landfill, the Fire Protection Plan will be reviewed to determine if modifications are necessary.

6.3 SPECIFIC FIRE-FIGHTING PROCEDURES

The following procedures will be followed in the event of a fire at the landfill working face or at the CCS (See also Section 6.2, above):

- If a fire occurs on a vehicle or piece of equipment, the equipment operator should bring the vehicle or equipment to a safe stop. If safety of personnel will allow, the vehicle must be parked away from fuel supplies, uncovered solid wastes, and other vehicles. The engine should be shut off and the brake engaged to prevent movement of the vehicle or piece of equipment.

- If a fire occurs at the working face, the burning area should be isolated and pushed away from the working face quickly, or fire breaks should be cut around the fire before it can spread. If this is not possible or is unsafe, efforts to cover the working face with soil should be initiated immediately to smother the fire. The faster that soil can be placed over the fire, the more effective this method will be in controlling and extinguishing the fire. The stockpiled soil within 1,015 feet of the working face will be used for firefighting purposes, as described in Section 6.1.

- In the event a fire occurs at the brush area, the steps described in Section 6.2 – General Rules for Fire will be implemented. Additionally, if it appears that a fire at one of these operations can be safely fought, landfill personnel will attempt to extinguish the fire by spraying with water from the water truck and take measures using site equipment to diminish heat and segregate materials to minimize the potential for the fire to spread until arrival of the local Fire Department. Site personnel and equipment will be utilized to assist the local Fire Department as needed and as appropriate. If the fire is small enough, it may be fought with a hand-held extinguisher.

- If a fire occurs that is not extinguished within 10 minutes of detection, the Landfill Manager will contact the TCEQ Region office via telephone within 4 hours and in writing within 14 days with a description of the fire and resulting response.

- The CCS may contain brush, wood waste, yard waste, municipal solid waste, as described in Section 4.2.2. In the event a fire occurs at one of these operations, the steps described in Section 6.2 – General Rules for Fires will be implemented. Additionally, if it appears that a fire at one of these operations can be safely fought, landfill personnel will attempt to extinguish the fire by use one of the following methods, depending on the waste stream involved:

    1. Extinguished by spraying with water from the water truck and taking measures using site equipment to diminish heat and segregate materials to minimize the potential for the fire to spread until arrival of the local Fire Department. Additionally, these materials may be extinguished by using dry fire extinguishing agents or devices, or smothering with soil.

    2. Site personnel and equipment will be utilized to assist the local Fire Department as needed and as appropriate. If the fire is small enough, it may be fought with a hand-held extinguisher.