Appendix F

Unstable Areas Demonstration

LOCATION RESTRICTIONS DEMONSTRATION
UNSTABLE AREAS
40 CFR PART 257.64
WESTON DISPOSAL SITE NO. 3 LANDFILL
WISCONSIN PUBLIC SERVICE CORPPORATION

Wisconsin Public Service Corporation (WPSC) owns and operates the Weston Disposal Site No. 3 Landfill, located in the E 1/2 of the NW 1/4 and W 1/2 of the NE 1/4, Section 23, Township 26 North, Range 7 East, Town of Knowlton, Marathon County, Wisconsin. The WPSC Weston Disposal Site No. 3 Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 3067, FID No. 737025120. The construction of Cells 1 and 2 commenced in May 2015. The landfill was placed into operation in 2016.

In addition to the state regulations, the landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.* Weston Disposal Site No. 3 Landfill, Cells 1 and 2, is defined as a CCR unit and existing CCR landfill in accordance with 40 CFR 257.53 since construction commenced prior to October 19, 2015. Future landfill cells are permitted by the WDNR in the conditionally approved Plan of Operation and defined as lateral expansions under 40 CFR 257.53 when constructed. This document fulfills the requirements for the Location Restrictions Demonstration for Landfill No. 3 as an existing CCR landfill in accordance with 40 CFR 257 Subpart D.

Location restrictions related to unstable areas are outlined in 40 CFR 257.64 – Unstable Areas:

> *§ 257.64 Unstable areas.*
>
> *(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. (b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable: (1) On- site or local soil conditions that may result in significant differential settling; (2) On-site or local geologic or geomorphologic features; and (3) On-site or local human-made features or events (both surface and subsurface).*

The rule defines an *"Unstable Area"* as *"a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit.*

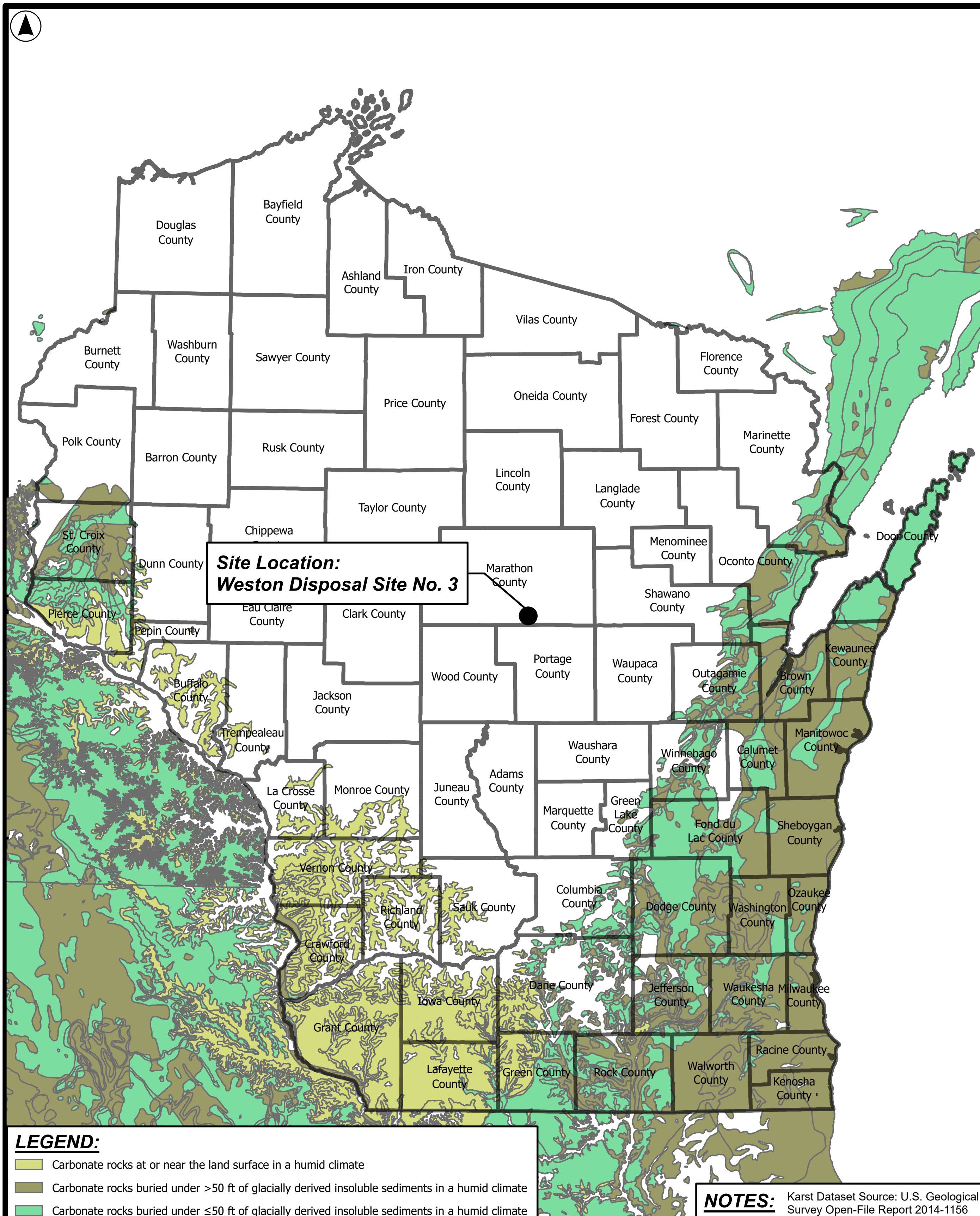
Based on review of the site's location, soil conditions, human-made features or events (both surface and subsurface), geology, and hydrogeology the existing Weston Disposal Site No. 3 Landfill is not located in an unstable area that could result in significant differential settlement or mass movement damaging the facility.

This report was completed under the direction of John, M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR Part 257 Subpart D.

John Mathew Trast, P.E.
Licensed Professional Engineer No. 31792
Senior Consultant
GEI Consultants, Inc.

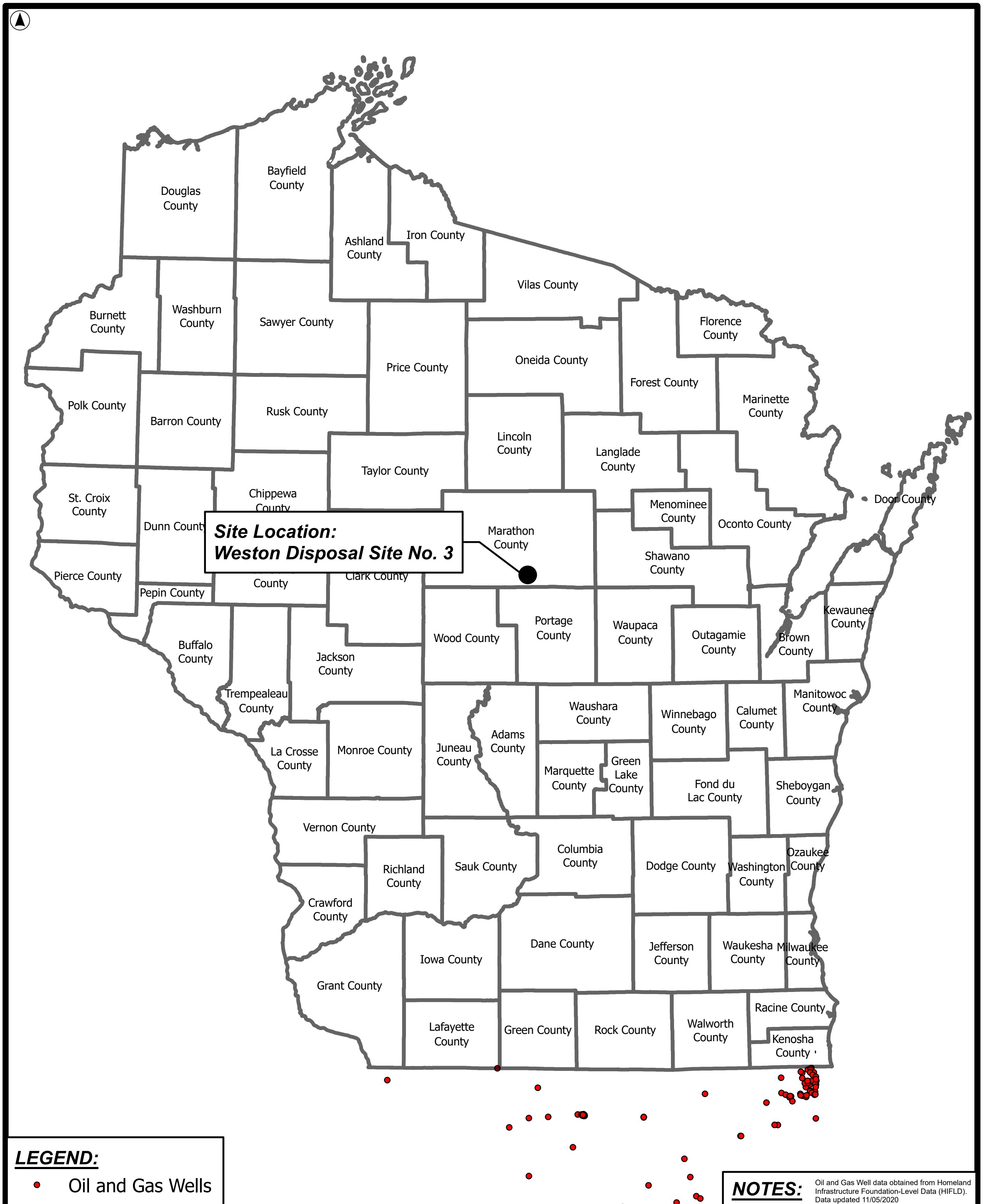
WISCONSIN
JOHN M.
TRAST
31792
GREEN BAY,
WISCONSIN
PROFESSIONAL ENGINEER

10/12/2018



Plan of Operation Modification Weston Disposal Site No. 3 Town of Knowlton, WI	GEI Consultants	USGS NATIONAL SCALE KARST PONTENTIAL
WEC Energy Group Milwaukee, WI	Project 2203724	December 2022 Fig. 1

Path: C:\Users\jhansen\OneDrive - GEI Consultants, Inc\Documents\GIS_Work\MISCELLANEOUS\2022\2203724 - Caledonia Ash Landfill\2203724 - Caledonia Ash Landfill.aprx



Plan of Operation Modification Weston Disposal Site No. 3 Town of Knowlton, WI	GEI Consultants	OIL AND GAS WELL MAP
WEC Energy Group Milwaukee, WI	Project 2203724	December 2022 Fig. 4

Path: C:\Users\jhansen\OneDrive - GEI Consultants, Inc\Documents\GIS_Work\MISCELLANEOUS\2022\2203724 - Caledonia Ash Landfill\2203724 - Caledonia Ash Landfill.aprx

Appendix G

Floodplains Demonstration

National Flood Hazard Layer FIRMette

FEMA

89°38'39"W 44°43'42"N

89°38'1"W 44°43'16"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

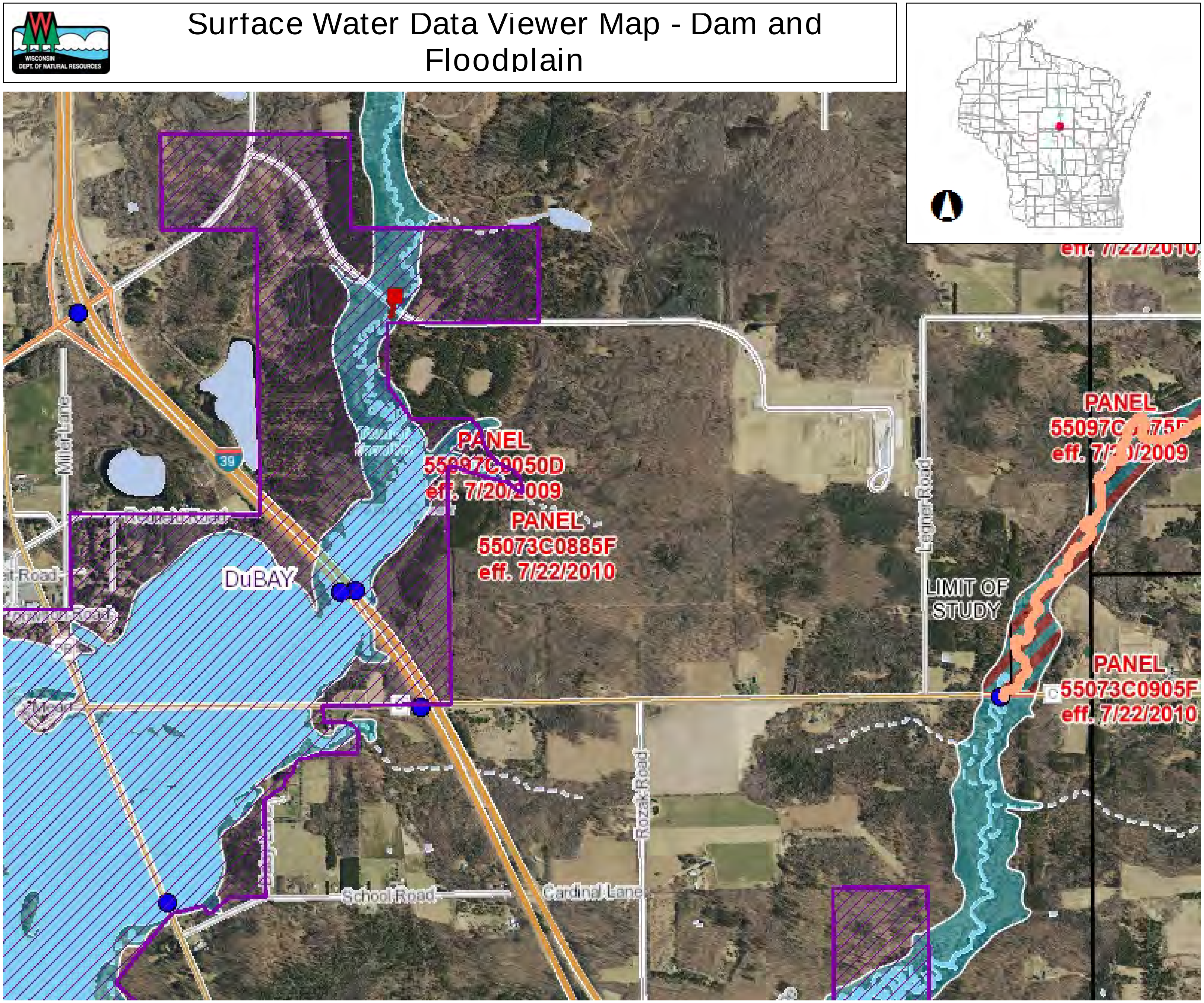
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/13/2022 at 3:38 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Surface Water Data Viewer Map - Dam and Floodplain



Legend

Dams
- Dams with FERC License
- Dams

Record Flood Levels

Analysis Lines
- Other
- Flood Insurance Study
- Letter of Map Revision
- Case By Case Analysis
- Bridge

Analysis Points
- Other
- Flood Insurance Study
- Letter of Map Revision
- Case By Case Analysis
- Bridge

Analysis Catchments

Floodplain Storage

Cross Sections

Floodplains
- Flood Fringe
- Floodway

FERC Project Area Boundaries

DOT Bridges

Statewide Paper FIRM Index

FIRM Panels

Flood Hazard Boundaries
- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway

Notes

0.8 0 0.38 0.8 Miles

NAD_1983_HARN_Wisconsin_TM

1: 23,760

Appendix H

Liner Design Calculations

AECOM

Calculation Cover Sheet

Project Weston Disposal Site No. 3 Expansion | Division Environment

Subject HELP Analysis of Proposed Liner and Cover | File No. ____________

Job No. 60186058 | Calc. No. ____________

Originator Karl M. Krueger | Date 7/12/2012

Reviewed Mark J. Vannieuwenhoven Date 7/12/12 No. of Sheets 53

RECORD OF ISSUES							
NO.	DESCRIPTION	BY	DATE	CHKD.	DATE	APPRD	DATE
1	Permitted Base Liner	KMK	6/29/12	MJV	6/29/12		
2	Proposed 2' Clay/Geomembrane	KMK	7/12/12	MJV	7/12/12		
3	Proposed 2'SBL/GCL/Geomembrane	KMK	7/12/12	MJV	7/12/12		
4	Permitted Cover	KMK	7/12/12	MJV	7/12/12		
5	Proposed Cover (clay/geomembrane)	KMK	7/12/12	MJV	7/12/12		
6	Proposed Cover (SBL/GCL/geomembrane)	KMK	7/12/12	MJV	7/12/12		
7	Proposed Cover (fly ash/geomembrane)	KMK	7/12/12	MJV	7/12/12		

PRELIMINARY CALC. □ SUPERCEDED CALC. □ FINAL CALC. X

BRIEF SUMMARY OF CALCULATIONS INCLUDING SCOPE AND RESULTS

The Hydrologic Evaluation of Landfill Performance (HELP) Model, version 3.07, was utilized to predict the percolation rate through the permitted components of the existing landfill final cover systems. According to the model predictions, the following rates of percolation can be expected through the various permitted and proposed alternative base liner or final cover cross-sections:

Liner Location	**Description**	**Percolation Rate Through Liner**
Base	Permitted 5-foot-thick clay liner	1.29 in/yr
Base	Two foot compacted clay liner and 60-mil geomembrane composite liner	0.0011 in/yr
Base	Two foot soil barrier layer, GCL, and 60-mil geomembrane composite liner	0.00025 in/yr
Cover	Permitted 2-foot compacted clay and 6 inches of topsoil	0.92 in/yr
Cover	Two foot compacted clay and 40-mil geomembrane composite cover	0.00 in/yr
Cover	Two foot soil barrier, GCL, and 40-mil geomembrane composite cover	0.00 in/yr
Cover	Two foot compacted fly ash and Geomembrane composite cover	0.00001 in/yr

AECOM

Calculation Cover Sheet

Project Weston Disposal Site No. 3 Expansion

Division Environment

Subject HELP Analysis of Proposed Liner and Cover

File No. ______

Job No. 60186058

Calc. No. ______

Originator Karl M. Krueger

Date 7/12/2012

Reviewed Mark J. Vannieuwenhoven Date 7/12/12 No. of Sheets 53

The HELP Model was also used to estimate the leachate generation rate for both the open and closed phase of the project. The following leachate generation rates can be expected within the proposed landfill:

- Open Phase – 10.96 inches per year, with a peak generation rate of 0.242 inches per day.
- Closed Phase – 0.0000 inches per year (Note: a minimum of 1 inch per year shall be used for all closed areas of landfills that will have a composite cap – NR 512.12).

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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EVAPOTRANSPIRATION DATA:     G:\04DEPT03\USERS\VANN\HELP30~1\GB_OPEN.D11
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OUTPUT DATA FILE:            G:\04DEPT03\USERS\VANN\HELP30~1\CLAY_LNR.OUT
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TIME: 10:53   DATE: 6/29/2012

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TITLE: LEGNER OPEN PHASE, PERMITTED CLAY LINER

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 30

```
THICKNESS                  =    120.00   INCHES
POROSITY                   =      0.5410 VOL/VOL
FIELD CAPACITY             =      0.1870 VOL/VOL
WILTING POINT              =      0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2361 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.499999987000E-04 CM/SEC
```

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER   1

```
   THICKNESS                     =     12.00   INCHES
   POROSITY                      =      0.4170 VOL/VOL
   FIELD CAPACITY                =      0.0450 VOL/VOL
   WILTING POINT                 =      0.0180 VOL/VOL
   INITIAL SOIL WATER CONTENT    =      0.0450 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =  0.999999978000E-02 CM/SEC
   SLOPE                         =      2.00   PERCENT
   DRAINAGE LENGTH               =    120.0    FEET


                         LAYER  3
                         --------

               TYPE 3 - BARRIER SOIL LINER
               MATERIAL TEXTURE NUMBER  16
   THICKNESS                     =     60.00   INCHES
   POROSITY                      =      0.4270 VOL/VOL
   FIELD CAPACITY                =      0.4180 VOL/VOL
   WILTING POINT                 =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT    =      0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
          A SLOPE LENGTH OF  550. FEET.

SCS RUNOFF CURVE NUMBER              =     96.80
FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =      4.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      1.763  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      2.164  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.188  INCHES
INITIAL SNOW WATER                   =      0.416  INCHES
INITIAL WATER IN LAYER MATERIALS     =     54.495  INCHES
TOTAL INITIAL WATER                  =     54.911  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          GREEN BAY             WISCONSIN

     STATION LATITUDE                         =  44.29 DEGREES
     MAXIMUM LEAF AREA INDEX                  =   0.00
     START OF GROWING SEASON (JULIAN DATE)    =    130
     END OF GROWING SEASON (JULIAN DATE)      =    275
     EVAPORATIVE ZONE DEPTH                   =   4.0  INCHES
     AVERAGE ANNUAL WIND SPEED                =  10.10 MPH
```

AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 74.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.19	1.05	1.90	2.70	3.13	3.17
3.25	3.16	3.17	2.10	1.76	1.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.00	17.80	28.60	43.70	55.10	64.70
69.50	67.50	58.90	48.40	34.20	20.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN
AND STATION LATITUDE = 44.29 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.00	1.03	2.01	2.68	3.18	3.26
	3.75	3.13	3.03	2.00	1.96	1.35
STD. DEVIATIONS	0.48	0.64	0.83	1.24	1.56	1.63
	1.89	1.38	1.32	0.96	0.87	0.66
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

EVAPOTRANSPIRATION

TOTALS	0.452	0.428	0.431	1.291	2.568	2.609
	2.703	2.148	2.051	1.335	0.789	0.404
STD. DEVIATIONS	0.078	0.090	0.149	0.753	1.342	1.372
	1.185	1.017	0.806	0.600	0.329	0.115

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	0.8333	0.7307	0.7362	0.5739	0.4791	0.6889
	0.9184	0.9541	0.9519	0.9472	0.9479	0.9129
STD. DEVIATIONS	0.7036	0.4657	0.3507	0.2222	0.2665	0.5061
	0.4889	0.4229	0.4102	0.5912	0.8440	0.7656

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.1083	0.0981	0.1078	0.1041	0.1067	0.1036
	0.1084	0.1108	0.1077	0.1112	0.1083	0.1113
STD. DEVIATIONS	0.0156	0.0158	0.0139	0.0093	0.0108	0.0171
	0.0173	0.0040	0.0024	0.0042	0.0082	0.0065

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	2.8901	2.7209	2.5131	2.0255	1.6364	2.4294
	3.1354	3.2578	3.3532	3.2997	3.6556	3.3056
STD. DEVIATIONS	2.6411	1.6810	1.1927	0.7843	0.9101	1.7815
	1.6672	1.4420	1.4220	2.3676	4.8179	3.6956

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.37 (4.313)	102972.2	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	17.210 (4.1643)	62470.57	60.667
LATERAL DRAINAGE COLLECTED FROM LAYER 2	9.67465 (4.32733)	35118.984	34.10530
PERCOLATION/LEAKAGE THROUGH LAYER 3	1.28643 (0.10825)	4669.746	4.53496
AVERAGE HEAD ON TOP OF LAYER 3	2.852 (1.429)		

CHANGE IN WATER STORAGE	0.196	(3.6845)	712.92	0.692

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	3.53	12813.899
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.24026	872.15161
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.006307	22.89374
AVERAGE HEAD ON TOP OF LAYER 3	51.247	
MAXIMUM HEAD ON TOP OF LAYER 3	60.665	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	85.9 FEET	
SNOW WATER	5.30	19227.0059
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5410	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	35.2946	0.2941
2	1.4807	0.1234
3	25.6200	0.4270
SNOW WATER	0.372	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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TEMPERATURE DATA FILE:      G:\04DEPT03\USERS\VANN\HELP30~1\GB.D7
SOLAR RADIATION DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\GB.D13
EVAPOTRANSPIRATION DATA:    G:\04DEPT03\USERS\VANN\HELP30~1\GB_OPEN.D11
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OUTPUT DATA FILE:           G:\04DEPT03\USERS\VANN\HELP30~1\2FTCLAY.OUT


TIME:  12:33     DATE:   7/12/2012


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

     TITLE:  LEGNER OPEN PHASE, 2' CLAY AND 60-MIL GEOMEMBRANE

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  30
           THICKNESS                  =    120.00   INCHES
           POROSITY                   =      0.5410 VOL/VOL
           FIELD CAPACITY             =      0.1870 VOL/VOL
           WILTING POINT              =      0.0470 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2361 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.499999987000E-04 CM/SEC


                                   LAYER  2
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                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   1
  THICKNESS                  =     12.00   INCHES
  POROSITY                   =      0.4170 VOL/VOL
  FIELD CAPACITY             =      0.0450 VOL/VOL
  WILTING POINT              =      0.0180 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0477 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
  SLOPE                      =      2.00   PERCENT
  DRAINAGE LENGTH            =    120.0    FEET


                        LAYER  3
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.06   INCHES
  POROSITY                   =      0.0000 VOL/VOL
  FIELD CAPACITY             =      0.0000 VOL/VOL
  WILTING POINT              =      0.0000 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      1.00   HOLES/ACRE
  FML INSTALLATION DEFECTS   =      1.00   HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD


                        LAYER  4
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
  THICKNESS                  =     24.00   INCHES
  POROSITY                   =      0.4270 VOL/VOL
  FIELD CAPACITY             =      0.4180 VOL/VOL
  WILTING POINT              =      0.3670 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.4270 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE
         GROUND CONDITIONS, A SURFACE SLOPE OF  5.% AND
         A SLOPE LENGTH OF  550. FEET.

SCS RUNOFF CURVE NUMBER             =     96.80
FRACTION OF AREA ALLOWING RUNOFF    =      0.0    PERCENT
```

AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	4.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.763	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.164	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.188	INCHES
INITIAL SNOW WATER	=	0.416	INCHES
INITIAL WATER IN LAYER MATERIALS	=	39.156	INCHES
TOTAL INITIAL WATER	=	39.572	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
GREEN BAY WISCONSIN

STATION LATITUDE	=	44.29 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	130
END OF GROWING SEASON (JULIAN DATE)	=	275
EVAPORATIVE ZONE DEPTH	=	4.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.19	1.05	1.90	2.70	3.13	3.17
3.25	3.16	3.17	2.10	1.76	1.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.00	17.80	28.60	43.70	55.10	64.70
69.50	67.50	58.90	48.40	34.20	20.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN
AND STATION LATITUDE = 44.29 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.00	1.03	2.01	2.68	3.18	3.26
	3.75	3.13	3.03	2.00	1.96	1.35
STD. DEVIATIONS	0.48	0.64	0.83	1.24	1.56	1.63
	1.89	1.38	1.32	0.96	0.87	0.66
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.452	0.428	0.431	1.291	2.568	2.609
	2.703	2.148	2.051	1.335	0.789	0.404
STD. DEVIATIONS	0.078	0.090	0.149	0.753	1.342	1.372
	1.185	1.017	0.806	0.600	0.329	0.115
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.9416	0.8296	0.8438	0.6781	0.5866	0.7928
	1.0259	1.0627	1.0586	1.0572	1.0577	1.0227
STD. DEVIATIONS	0.7088	0.4740	0.3582	0.2286	0.2712	0.5117
	0.4963	0.4294	0.4149	0.5907	0.8603	0.7638
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	3.2728	3.0883	2.8797	2.3930	2.0034	2.7944
	3.5012	3.6278	3.7276	3.6839	4.0801	3.6940
STD. DEVIATIONS	2.7286	1.6994	1.2151	0.8068	0.9261	1.7973
	1.6894	1.4624	1.4318	2.4145	5.1107	3.7702

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.37 (4.313)	102972.2	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	17.210 (4.1643)	62470.57	60.667
LATERAL DRAINAGE COLLECTED FROM LAYER 2	10.95729 (4.39439)	39774.953	38.62688
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00110 (0.00046)	4.003	0.00389
AVERAGE HEAD ON TOP OF LAYER 3	3.229 (1.468)		
CHANGE IN WATER STORAGE	0.199 (3.6924)	722.69	0.702

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	3.53	12813.899
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.24177	877.62384
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000044	0.15871
AVERAGE HEAD ON TOP OF LAYER 3	51.711	
MAXIMUM HEAD ON TOP OF LAYER 3	61.232	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	86.1 FEET	
SNOW WATER	5.30	19227.0059
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5410	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	35.2946	0.2941
2	1.6206	0.1351
3	0.0000	0.0000
4	10.2480	0.4270
SNOW WATER	0.372	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    G:\04DEPT03\USERS\VANN\HELP30~1\GB.D4
TEMPERATURE DATA FILE:      G:\04DEPT03\USERS\VANN\HELP30~1\GB.D7
SOLAR RADIATION DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\GB.D13
EVAPOTRANSPIRATION DATA:    G:\04DEPT03\USERS\VANN\HELP30~1\GB_OPEN.D11
SOIL AND DESIGN DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\2FTSBL~1.D10
OUTPUT DATA FILE:           G:\04DEPT03\USERS\VANN\HELP30~1\2FTSBL.OUT


TIME:  12:32     DATE:   7/12/2012


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

     TITLE:  LEGNER OPEN PHASE, 2' SBL, GCL AND 60-MIL HDPE

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  30
           THICKNESS                  =    120.00   INCHES
           POROSITY                   =      0.5410 VOL/VOL
           FIELD CAPACITY             =      0.1870 VOL/VOL
           WILTING POINT              =      0.0470 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2361 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.499999987000E-04 CM/SEC


                                   LAYER  2
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                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   1
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4170 VOL/VOL
FIELD CAPACITY              =      0.0450 VOL/VOL
WILTING POINT               =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0477 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    120.0    FEET


                        LAYER  3
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      1.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  4
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                   =      0.24   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000003000E-08 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  23
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4610 VOL/VOL
FIELD CAPACITY              =      0.3600 VOL/VOL
WILTING POINT               =      0.2030 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3599 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.900000032000E-05 CM/SEC
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GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 550. FEET.

SCS RUNOFF CURVE NUMBER	=	96.80	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	4.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.763	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.164	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.188	INCHES
INITIAL SNOW WATER	=	0.416	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.721	INCHES
TOTAL INITIAL WATER	=	38.137	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM GREEN BAY WISCONSIN

STATION LATITUDE	=	44.29	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	275	
EVAPORATIVE ZONE DEPTH	=	4.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.19	1.05	1.90	2.70	3.13	3.17
3.25	3.16	3.17	2.10	1.76	1.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING

COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.00	17.80	28.60	43.70	55.10	64.70
69.50	67.50	58.90	48.40	34.20	20.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN
AND STATION LATITUDE = 44.29 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.00	1.03	2.01	2.68	3.18	3.26
	3.75	3.13	3.03	2.00	1.96	1.35
STD. DEVIATIONS	0.48	0.64	0.83	1.24	1.56	1.63
	1.89	1.38	1.32	0.96	0.87	0.66
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.452	0.428	0.431	1.291	2.568	2.609
	2.703	2.148	2.051	1.335	0.789	0.404
STD. DEVIATIONS	0.078	0.090	0.149	0.753	1.342	1.372
	1.185	1.017	0.806	0.600	0.329	0.115
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.9416	0.8297	0.8439	0.6781	0.5866	0.7929
	1.0260	1.0628	1.0586	1.0572	1.0578	1.0228
STD. DEVIATIONS	0.7088	0.4741	0.3582	0.2287	0.2712	0.5117
	0.4963	0.4294	0.4149	0.5907	0.8603	0.7638

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	3.2731	3.0885	2.8799	2.3932	2.0035	2.7946
	3.5014	3.6280	3.7278	3.6842	4.0803	3.6942
STD. DEVIATIONS	2.7288	1.6995	1.2152	0.8068	0.9262	1.7974
	1.6895	1.4625	1.4319	2.4146	5.1107	3.7703

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.37 (4.313)	102972.2	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	17.210 (4.1643)	62470.57	60.667
LATERAL DRAINAGE COLLECTED FROM LAYER 2	10.95806 (4.39460)	39777.770	38.62962
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00032 (0.00028)	1.176	0.00114
AVERAGE HEAD ON TOP OF LAYER 3	3.229 (1.468)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00025 (0.00088)	0.900	0.00087
CHANGE IN WATER STORAGE	0.199 (3.6926)	722.98	0.702

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	3.53	12813.899
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.24177	877.62952
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000052	0.18898
AVERAGE HEAD ON TOP OF LAYER 3	51.711	
MAXIMUM HEAD ON TOP OF LAYER 3	61.233	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	86.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.003305	11.99581
SNOW WATER	5.30	19227.0059
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5410	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	35.2946	0.2941
2	1.6207	0.1351
3	0.0000	0.0000
4	0.1770	0.7500
5	8.6397	0.3600
SNOW WATER	0.372	

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Leachate Generation Calculations

PURPOSE

Calculate the quantity of leachate generated by the Weston Disposal Site No. 3 Expansion during open and closed conditions. For landfills with a composite liner system, NR 512.12(3), Wis. Adm. Code, requires a minimum generation rate of 6 inches per year for all unclosed areas within the proposed limits of filling, and 1 inch per year for all closed areas. In some situations, such as open conditions, the HELP analysis estimated greater daily flow rates than required by s. NR 512.12(3). The larger of the leachate generation rates was used to determine the leachate volumes for each condition analyzed.

DATA AND ASSUMPTIONS

- Assume 10.96 in/yr of leachate inflow for open conditions, HELP Model OPEN.OUT showed a generation rate of 10.96 in/yr. **(IR_1)**
- Assume 1.0 in/yr of leachate inflow for closed conditions based on NR 512.12(3). **(IR_3)**
- Maximum open area = 25 ac **($Area_1$) preliminary estimate based on landfill size**
- Total Area = 63.47 ac **($Area_3$)**

VARIABLES

$IR_1 := 10.96 \cdot \frac{in}{yr}$ $IR_2 := 1.0 \cdot \frac{in}{yr}$

$A_1 := 25 \cdot acre$ $A_2 := 63.47 \cdot acre$

CALCULATIONS

The average annual volume of leachate that is collected from the landfill under active filling conditions has been calculated by HELP Model v. 3.07 as 10.96 in/yr. This correlates to:

$$Inflow_{open} := IR_1 \cdot \frac{ft}{12 \cdot in} \cdot \frac{43560 \cdot ft^2}{acre} \cdot \frac{7.48 \cdot gal}{ft^3} \cdot \frac{yr}{365 \cdot day}$$

$$Inflow_{open} = 815 \cdot \frac{gal}{day \cdot acre}$$

The average annual volume of leachate that is collected from the landfill under closed conditions will be 1.0 in/yr based on the requirements of NR 512.12(3). This correlates to:

$$Inflow_{close} := IR_2 \cdot \frac{ft}{12 \cdot in} \cdot \frac{43560 \cdot ft^2}{acre} \cdot \frac{7.48 \cdot gal}{ft^3} \cdot \frac{yr}{365 \cdot day}$$

$$Inflow_{close} = 74 \cdot \frac{gal}{day \cdot acre}$$

Determine the leachate generation rates for the various conditions of landfill development and operations listed below:

CASE 1 - Worst Case Scenario, 25 acres open, remainder of landfill in closed phase.

$$Volume := Inflow_{open} \cdot (A_1) + Inflow_{close} \cdot (A_2 - A_1)$$

4 Day Capacity

$$Volume = 23245 \cdot \frac{gal}{day} \qquad S := 4 \cdot day \cdot Volume \qquad S = 92979 \cdot gal$$

RESULTS AND CONCLUSIONS

The maximum amount of leachate that is collected from the Weston Disposal Site No. 3 Expansion is estimated to be approximately 23,250 gallons per day. This volume is generated when the final phases are open and the remainder of the landfill is closed. Phases are expected to be closed as final waste grades are reached, limiting the extent of open area as the site nears capacity. The maximum open area at the site is expected to be about 25 acres, but could be greater or less depending on final phasing and design. The resulting 4-day leachate volume for 93,000 gallons. Approximately 100,000 gallons of storage should be provided on site to allow for leachate collection without hauling operations over a 4 day period.

Purpose

The purpose of this calculation is to demonstrate the liquid leakage rates of the base liner system at the Weston Disposal Site No. 3 Ash Landfill (WDS3), comprised of a GCL overlying a soil barrier layer, is not greater than the liquid leakage rate of a liner with 2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec, as outlined in NR 504.12(3)(a)5 of the Wisconsin Administrative Code. The code sites that the liquid flow rate comparison shall be made using the following equation, which is derived from Darcy's Law for gravity flow through porous media:

$q = k(h/t + 1)$

Where:

q = flow rate per unit area (cubic centimeters/second/squared centimeter)
k = hydraulic conductivity of the liner (centimeters/second)
h = hydraulic head above the liner (centimeters)
t = thickness of the liner (centimeters)

Data and Assumptions

The following data and assumptions were utilized to calculate the liquid leakage rates of the two base liner systems:

- The 60-mil geomembrane layer in the WDS3 base liner was ignored for this calculation.
- The hydraulic conductivities of the GCL and soil barrier layer are taken from the WDS3 Cell 1 and Cell 2 Liner Construction Documentation Report, submitted in March 2016. The GCL hydraulic conductivity was assumed to be 5 x 10^{-9} cm/sec based on the max certified value from the Manufacturer's Quality Control data, and the soil barrier layer was tested to be an average of 2.0 x 10^{-9} cm/sec, which was based on undisturbed (Shelby tube) test results.
- Only the GCL hydraulic conductivity of 5 x 10^{-9} cm/sec was used in GCL and soil barrier layer base liner option in the Darcy's Law equation.
- The GCL thickness was assumed to be 0.1 feet, or 3 centimeters.
- The hydraulic head above the liner was assumed to be 1 foot, or 30 centimeters.

Results

GCL and Soil Barrier Layer

q = 5 x 10^{-9} cm/sec ((30 cm//3 cm) + 1) = 5.5 x 10^{-8} (cm^3/second)/cm^2

Compacted Soil

q = 1 x 10^{-7} cm/sec ((30 cm/60.96 cm) + 1) = 1.5 x 10^{-7} (cm^3/second)/cm^2

The liquid leakage rate of the GCL and soil barrier layer base liner system at the WDS3 Ash Landfill is calculated to be 5.5 x 10^{-8} (cm^3/second)/cm^2, which is not greater than the liquid leakage rate of a 2-foot compacted soil calculated to be 1.5 x 10^{-7} (cm^3/second)/cm^2. These results satisfy the demonstration required in NR 504.12(3)(a)5 of the Wisconsin Administrative Code.

Percolation Rates using HELP Model

The Hydrologic Evaluation of Landfill Performance (HELP) Model, version 4.01, was also utilized to predict the percolation rate of a GCL and soil barrier layer compared to a liner composed of 2 feet of compacted soil. The HELP model layers included a 20-foot layer of coal ash, a 1-foot vertical percolation layer of coarse drainage sand, and either a GCL and 2 feet of soil barrier layer or 2 feet of compacted soil Please note that the hydraulic conductivities of the GCL and soil barrier layer in the HELP Model are not identical to the hydraulic conductivities utilized in the Darcy's Law equations above.

A summary of the HELP Model percolation rates between the two base liner systems is provided below:

Liner Location	Description	Percolation Rate through Liner
Base	GCL and 2 feet of soil barrier layer	0.083 in/year
Base	2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec	1.24 in/year

Based on the HELP Model, the percolation rate of a GCL and 2 feet of soil barrier layer is 93.3% lower than a base liner of 2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec.

References

WDS3 Cell 1 and Cell 2 Liner Construction Documentation Report, dated March 2016.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title:	Base Liner (2 feet of compacted soil)	**Simulated On:**	9/29/2023 12:25

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	240	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1956	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	12	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.045	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec
Slope	=	2	%
Drainage Length	=	100	ft

Layer 3
Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	96.6	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	20	inches
Initial Water in Evaporative Zone	=	3.865	inches
Upper Limit of Evaporative Storage	=	10.82	inches
Lower Limit of Evaporative Storage	=	0.94	inches
Initial Snow Water	=	0.674077	inches
Initial Water in Layer Materials	=	57.72	inches
Total Initial Water	=	58.394	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	44.77	Degrees
Maximum Leaf Area Index	=	2.5	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	275	days
Average Wind Speed	=	10.1	mph
Average 1st Quarter Relative Humidity	=	73	%
Average 2nd Quarter Relative Humidity	=	68	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	76	%

Note: Evapotranspiration data was obtained for Mosinee, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.129031	0.950823	1.714978	3.03031	3.902035	4.481818
3.368111	3.862539	3.659746	2.952984	2.169278	1.2857

Note: Precipitation was simulated based on HELP V4 weather simulation for: Lat/Long: 44.77/-89.68

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
19.6	26.4	33	50.6	66.2	75.2
81.3	78.7	67.5	50.4	36.4	25

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.77/-89.68
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.77/-89.68

Average Annual Totals Summary

Title: Base Liner (2 feet of compacted soil)
Simulated on: 9/29/2023 12:26

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	32.51	[4.24]	118,001.7	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	25.829	[3.207]	93,760.2	79.46
Subprofile1				
Lateral drainage collected from Layer 2	5.0171	[2.005]	18,212.2	15.43
Percolation/leakage through Layer 3	1.237153	[0.258533]	4,490.9	3.81
Average Head on Top of Layer 3	1.2120	[0.4847]	---	---
Water storage				
Change in water storage	0.4238	[2.8171]	1,538.4	1.30

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Base Liner (2 feet of compacted soil)
Simulated on: 9/29/2023 12:26

	Peak Values for Years 1 - 40*	
	(inches)	(cubic feet)
Precipitation	2.77	10,039.8
Runoff	0.000	0.0000
Subprofile1		
Drainage collected from Layer 2	0.0471	170.9
Percolation/leakage through Layer 3	0.003990	14.5
Average head on Layer 3	4.1536	---
Maximum head on Layer 3	5.7693	---
Location of maximum head in Layer 2	30.52 (feet from drain)	
Other Parameters		
Snow water	3.9938	14,497.5
Maximum vegetation soil water	0.5410 (vol/vol)	
Minimum vegetation soil water	0.0470 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Base Liner (2 feet of compacted soil)
Simulated on: 9/29/2023 12:26
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	64.1996	0.2675
2	0.8985	0.0749
3	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Base Liner (2' Soil Barrier Layer and GCL) **Simulated On:** 9/29/2023 12:34

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	240	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1956	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	12	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.0453	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec
Slope	=	2	%
Drainage Length	=	100	ft

Layer 3
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	1.2	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer

C (Moderate)

Material Texture Number 29

Thickness	=	24	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.4189	vol/vol
Effective Sat. Hyd. Conductivity	=	6.80E-07	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	96.6	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	20	inches
Initial Water in Evaporative Zone	=	3.865	inches
Upper Limit of Evaporative Storage	=	10.82	inches
Lower Limit of Evaporative Storage	=	0.94	inches
Initial Snow Water	=	0.674077	inches
Initial Water in Layer Materials	=	58.43	inches
Total Initial Water	=	59.104	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	44.77	Degrees
Maximum Leaf Area Index	=	2.5	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	275	days
Average Wind Speed	=	10.1	mph
Average 1st Quarter Relative Humidity	=	73	%
Average 2nd Quarter Relative Humidity	=	68	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	76	%

Note: Evapotranspiration data was obtained for Mosinee, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.129031	0.950823	1.714978	3.03031	3.902035	4.481818
3.368111	3.862539	3.659746	2.952984	2.169278	1.2857

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.77/-89.68

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
19.6	26.4	33	50.6	66.2	75.2
81.3	78.7	67.5	50.4	36.4	25

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.77/-89.68
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.77/-89.68

Average Annual Totals Summary

Title: Base Liner (2' Soil Barrier Layer and GCL)

Simulated on: 9/29/2023 12:35

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	32.51	[4.24]	118,001.7	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	25.829	[3.207]	93,760.2	79.46
Subprofile1				
Lateral drainage collected from Layer 2	6.1682	[2.1969]	22,390.5	18.97
Percolation/leakage through Layer 3	0.083477	[0.016691]	303.0	0.26
Average Head on Top of Layer 3	1.4901	[0.5311]	---	---
Subprofile2				
Percolation/leakage through Layer 4	0.096926	[0.025626]	351.8	0.30
Water storage				
Change in water storage	0.4130	[2.8193]	1,499.1	1.27

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Base Liner (2' Soil Barrier Layer and GCL)
Simulated on: 9/29/2023 12:36

	Peak Values for Years 1 - 40*	
	(inches)	(cubic feet)
Precipitation	2.77	10,039.8
Runoff	0.000	0.0000
Subprofile1		
Drainage collected from Layer 2	0.0505	183.5
Percolation/leakage through Layer 3	0.000481	1.7469
Average head on Layer 3	4.4590	---
Maximum head on Layer 3	6.1100	---
Location of maximum head in Layer 2	31.46 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 4	0.000898	3.2596
Other Parameters		
Snow water	3.9938	14,497.5
Maximum vegetation soil water	0.5410 (vol/vol)	
Minimum vegetation soil water	0.0470 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Base Liner (2' Soil Barrier Layer and GCL)
Simulated on: 9/29/2023 12:36
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	64.1996	0.2675
2	1.0077	0.0840
3	0.9000	0.7500
4	9.5164	0.3965
Snow water	0.0000	---

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: R. Wienkes	Date: 12/4/2013	By: D. Engstrom	Date: 1/14/2014	196089.0003.0000

LEACHATE SUMP CAPACITY CALCULATIONS

Purpose:

To verify the proposed leachate sumps and corresponding pumps can adequately handle the anticipated leachate flow to the sumps at the proposed Weston Disposal Site No. 3 Expansion.

Methodology:

An in-house TRC spreadsheet was used to analyze the volume of the proposed leachate sumps and confirm the adequacy of the size of the sump with respect to the corresponding pump. The approximate worst-case volume of leachate drainage to any sump was determined for active and closed conditions. The functional sump volume (overall sump volume minus the area occupied by the gravel drainage material and the inaccessible area below the pump inlet) was determined in order to calculate the time it takes to reach capacity. The sump dewater time, which was determined using a pump typical for this application, was compared to sump fill-time to ensure it will not overflow. For consistency, the proposed sump size will be used at all 17 sump locations in the proposed Expansion.

Assumptions:

The following assumptions input parameters were used in the analysis of the leachate sump capacity:

- The leachate generation rate going to an individual sump during active conditions is approximately 6 inches per year, as determined by NR 512.12(3).
- The leachate generation rate going to a sump during closed conditions is approximately 1 inch per year, as determined by NR 512.12(3).
- For consistency, the largest landfill drainage area was used to size each of the 17 sumps of the Expansion. The largest contributing area occurs in Cell 2 (4.4 acres) and was used to calculate the volume of leachate draining to each sump.
- The leachate sump will be filled with aggregate material with a porosity of 30 percent, which is typical of poorly graded gravel (UFC, 2005).
- Refer to Details on Plan Sheet 25 for the typical dimensions of a leachate collection sump. The base of the sump will be at a uniform grade.
- Due to the pump wheels, pump inlet location, sedimentation, etc., approximately 6 inches of inaccessible (dead) space will be located at the bottom of the sump.

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: R. Wienkes	Date: 12/4/2013	By: D. Engstrom	Date: 1/14/2014	196089.0003.0000

- A submersible pump operating at 40 gallons per minute (gpm) was assumed for normal operating conditions.
- During the worst case pumping scenario when all pumps are operating, which is not likely to occur regularly, the flowrate from the sumps could be as low as 10 gpm (refer to Appendix E-3).

Results:

The sumps are adequately sized to handle the estimated worst-case leachate volume during active and closed conditions at the landfill. The sump will reach full volume approximately every 55 hours during active conditions and every 334 hours during closed conditions. The pump will be able to dewater the sump in approximately 2 hours during active and closed conditions under normal operation. During active conditions when all pumps are operating, it is anticipated it could take up to 9 hours to dewater the sumps. In conclusion, the sumps are sufficiently sized because the dewatering time is much less than the sump fill-time.

References:

Department of Defense: Unified Facilities Criteria (UFC). 2005. UFC 3-220-10N: Soil mechanics.

Leachate Generation Calculations

TRC
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PROJECT/LOCATION: WPS - Weston Disposal Site No. 3		
PREPARED BY: R. Wienkes	DATE: 12/4/2013	PROJECT / PROPOSAL NO.
CHECKED BY: D. Engstrom	DATE: 1/14/2014	196089.0003.0000

LEACHATE GENERATION RATE
FOR SUMP VOLUME ANALYSIS

Leachate Generation Rate = (Cell Area) x (Leachate Generation Rate) x (Conversion Factor)

Conversion Factor = (43560 sf/ac) x (7.481 gal/cf) / (12 in/ft) / (365 days/yr)

CELL/SUBCELL	CELL SIZE (acres)	ESTIMATED LEACHATE GENERATION OPEN CONDITIONS (gallons/day)(1)	ESTIMATED LEACHATE GENERATION CLOSED CONDITIONS (gallons/day)(1)
CELL 1 (sump A)	2.9	1,300	200
CELL 1 (sump B)	3.7	1,600	300
CELL 2 (sump A)	4.4	2,000	300
CELL 2 (sump B)	4.1	1,800	300
CELL 3	4.2	1,900	300
CELL 4A	3.0	1,400	200
CELL 4B	3.9	1,700	300
CELL 5A	3.0	1,400	200
CELL 5B	3.9	1,700	300
CELL 6A	3.0	1,400	200
CELL 6B	3.9	1,700	300
CELL 7A	3.0	1,400	200
CELL 7B	3.9	1,700	300
CELL 8 (sump A)	3.1	1,400	200
CELL 8 (sump B)	1.7	800	100
CELL 9 (sump A)	2.5	1,100	200
CELL 9 (sump B)	3.4	1,500	300

Notes:
(1) Leachate generation rates obtained from NR 512.12.

Leachate Sump Capacity Calculations

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PROJECT / PROPOSAL NAME: WPS- Weston Disposal Site No. 3 Expansion - Plan of Operation		
PREPARED BY: R. Wienkes	DATE: 12/4/2013	PROJECT / PROPOSAL NO.
CHECKED BY: D. Engstrom	DATE: 1/14/2014	196089.0003.0000

LEACHATE SUMP CAPACITY CALCULATIONS

ANTICIPATED LEACHATE GENERATION:

Open Conditions:	2000 gallons/day =	1.4 gallons/min	
Closed Conditions:	320 gallons/day =	0.2 gallons/min	NR 512.12(3)

SUMP CALCULATIONS:

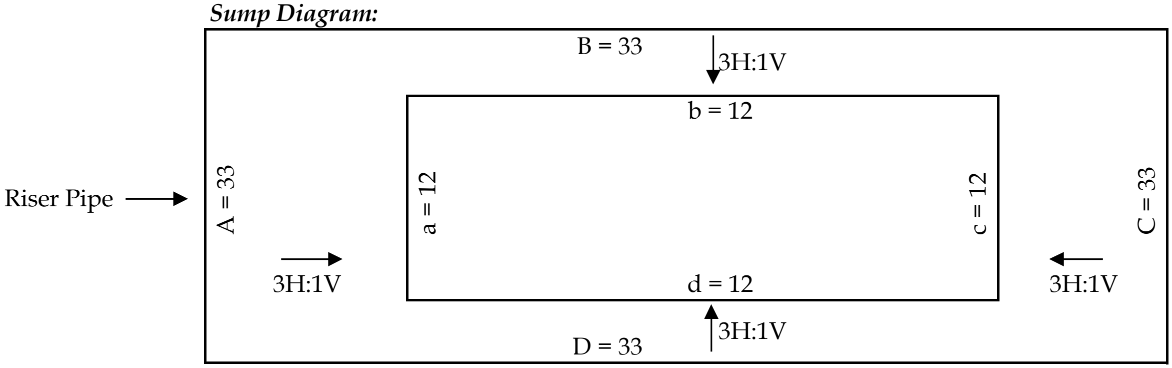
Total Depth of Sump:	3.5	feet	
Porosity of Stone in Sump:	30	percent	Unified Facilities Criteria (UFC), 2005

Dimensions of Top of Sump		
A	33	feet
B	33	feet
C	33	feet
D	33	feet

Dimensions of Bottom on Sump		
a	12	feet
b	12	feet
c	12	feet
d	12	feet

Sump Side Slopes (i.e., 6:1 = 6)	
Aa	3
Bb	3
Cc	3
Dd	3

Sump Diagram:



Volume of Sump:	**2157.8 ft^3**	**16,142.1 gallons**
Maximum Volume of Liquid in Sump:	**647.3 ft^3**	**4,842.6 gallons**

Note: Sump assumed to be uniformly shaped.

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PROJECT / PROPOSAL NAME: WPS- Weston Disposal Site No. 3 Expansion - Plan of Operation		
PREPARED BY: R. Wienkes	DATE: 12/4/2013	PROJECT / PROPOSAL NO.
CHECKED BY: D. Engstrom	DATE: 1/14/2014	196089.0003.0000

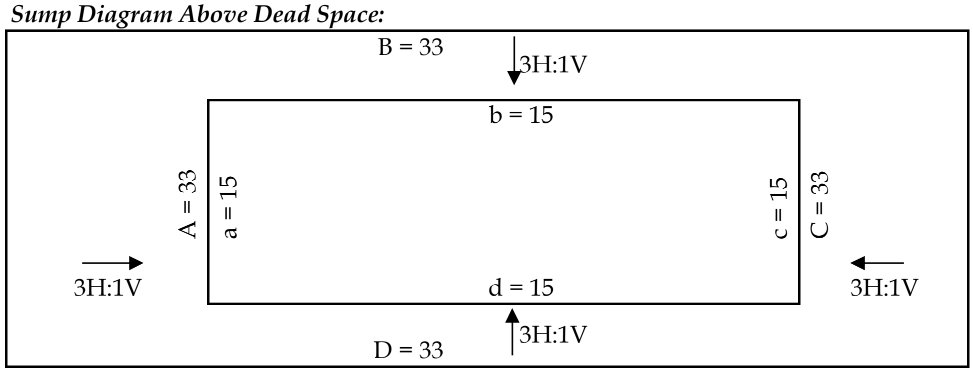
Depth in Sump that the Pump(s) Can Actually Pump (i.e., Dead Space Calculations)

Depth of Dead Space: 0.50 feet (due to wheels, pump inlet, sedimentation, etc.)

Depth above Dead Space: 3.00 feet

Sump Diagram Above Dead Space:

Riser Pipe ===>



Volume of Sump Above Dead Space:	**1971.0 ft^3**	**14,745.1**	**gallons**
Maximum Volume of Liquid in Sump Above Dead Space:	**591.3 ft^3**	**4,423.5**	**gallons**

Note: Sump assumed to be uniformly shaped.

PUMP CALCULATIONS:

Sump Dewatering Times

For Active Conditions:

Sump will be filled to capacity every: 53 hours

For Closed Conditions:

Sump will be filled to capacity every: 332 hours

Proposed Pump Run-Times

Model: Grundfos 40S Submersible

Pump Rate: 40 gallons/minute under normal operating conditions

Pump Rate: 10 gallons/minute under worst case

For Active Conditions under Normal Operation:

Pump will be able to pump water down in:	**2 hours**	**OK**	**2 < 53**
Sump will need to be pumped out every:	55 hours		

For Closed Conditions under Normal Operation:

Pump will be able to pump water down in:	**2 hours**	**OK**	**2 < 332**
Sump will need to be pumped out every:	334 hours		

For Active Conditions under Worst Case Pumping Scenario:

Pump will be able to pump water down in:	**9 hours**	**OK**	**9 < 53**
Sump will need to be pumped out every:	62 hours		

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

GEOSYNTHETIC INTERFACE SLOPE STABILITY

Purpose:

The purpose of this analysis is to evaluate the stability of the liner and cover system against slippage along the interfaces between materials including the geomembrane, geosynthetic layers and adjacent soils, in accordance with NR 516.04(5)(c).

Methodology:

The infinite slope interface stability was evaluated for the other proposed slopes using the procedures outlined in *Influence of Water Flow on the Stability of Geosynthetic-Soil Layered Systems on Slopes* (Giroud, Bachus, and Bonaparte, 1995) for conditions with and without water at the interface. The system is modeled similar to a block sliding on an inclined plane. The weight of the soil and water (if present) provide the driving forces where the strength of the interface resists the downslope movement. The stability is analyzed for the critical conditions for the proposed landfill geometry. Because a total of six cover options are presented, a simplified calculation is performed for each geometry where the critical interface values above and below the geomembrane are evaluated. The geomembrane is used as the reference point because excess pore pressures are anticipated above the geomembrane, but not below the geomembrane. A graphical solution showing the minimum interface strength values needed is provided for the conditions analyzed.

Assumptions and Inputs:

Liner Design and Slope Geometry

The liner systems consist of the following (top to bottom), as shown in Detail 1 of Sheet 21,

- drainage sand over a 60-mil high density polyethylene (HDPE) geomembrane (textured on the perimeter berms),
- 60-mil HDPE geomembrane (textured on the perimeter berm slopes) over geosynthetic clay liner (GCL), and
- GCL over 2-foot-thick compacted clay liner.

The critical slope geometry of the base and sideslope is as follows (refer to Plan Sheet 5 of the POO) (refer to Figure 2)

- 3H:1V sideslope with a maximum height of 20 feet, and
- Maximum base slope of 3.48 percent (conservatively, a 10 percent slope was analyzed based on the possible waving of geosynthetic interface testing on slopes less than 10 percent per NR 516.04(5)(c)).

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

Final Cover Design and Slope Geometry Configurations

Three final cover configurations are proposed each using a geocomposite drainage layer. In addition, a 1-foot-thick select granular fill drainage layer is being considered for each final cover configuration for a total of 6 final cover configurations. The final cover systems consist of the following (top to bottom), as shown in Detail 1 of Sheet 27.

- Option 1:
  - 6-inch-thick topsoil layer
  - 2.5-foot-thick general fill layer
  - Geocomposite drainage layer or 1-foot-thick select granular fill drainage layer
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on 4H:1V slopes; smooth on 5% slopes)
  - GCL
  - 2-foot-thick compacted fine-grained soil layer
- Option 2:
  - 6-inch-thick topsoil layer
  - 2.5-foot-thick general fill layer
  - Geocomposite drainage layer or 1-foot-thick select granular fill drainage layer
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on 4H:1V slopes; smooth on 5 percent slopes)
  - 2-foot-thick compacted select clay fill layer
- Option 3:
  - 6-inch-thick topsoil layer
  - 2.5-foot-thick general fill layer
  - Geocomposite drainage layer or 1-foot-thick select granular fill drainage layer
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on 4H:1V slopes; smooth on 5 percent slopes)
  - 2-foot thick compacted fly ash layer

Interface Strength Parameters

Interface shear strength test results were not available for the specific materials in the liner and cover systems. Due to the preliminary nature of the design, reference interface strength values were used for comparable materials from a TRC database of interface test results. Interface shear tests will be performed on the materials specified for construction prior to shipment to the site. The table below presents the assumed interface strength values considered for the analysis.

Interface Friction Test Results

LINER COVER OPTION	INTERFACE DESCRIPTION	HEAD ON INTERFACE	PEAK STRENGTH FRICTION ANGLE (degrees)	PEAK STRENGTH ADHESION (psf)	HIGH DISP. STRENGTH FRICTION ANGLE (degrees)	HIGH DISP. STRENGTH ADHESION (psf)
Liner System	***Select granular fill drainage layer over textured 60-mil HDPE geomembrane (select granular fill drainage layer over smooth 60-mil HDPE geomembrane – base grades)***	***Yes***	***30*** ***(21)***	***10*** ***(10)***	***19*** ***(18)***	***40*** ***(10)***
	Textured 60-mil HDPE geomembrane over GCL ***(smooth 60-mil HDPE geomembrane over GCL – base grades)***	No	37 ***(11)***	2 ***(5)***	26 ***(6)***	5 ***(2)***
	GCL over clay liner	***No***	***24***	***4***	***21***	***4***
Cover Option 1	General fill over geocomposite drainage layer [1]	Yes	30	55	8	112
	Geocomposite drainage layer over textured 40-mil LLDPE geomembrane ***(geocomposite drainage layer over smooth 40-mil LLDPE geomembrane – 5% slopes)*** [1]	Yes	37 ***(11)***	2 ***(5)***	26 ***(6)***	5 ***(2)***
	Select granular fill drainage layer over textured 40-mil LLDPE geomembrane (select granular fill drainage layer over smooth 40-mil LLDPE geomembrane – 5% slopes) [1]	Yes	***30*** (21)	***10*** (10)	***19*** (18)	***40*** (10)
	Textured 40-mil LLDPE geomembrane over GCL ***(smooth 40-mil LLDPE geomembrane over GCL – 5% slopes)***	No	37 ***(11)***	2 ***(5)***	26 ***(6)***	5 ***(2)***
	GCL over compacted fine-grained soil	***No***	***24***	***4***	***21***	***22***
Cover Option 2	Textured 40-mil LLDPE geomembrane over compacted select clay (smooth 40-mil LLDPE geomembrane over compacted select clay – 5% slopes)	No	23 (12)	40 (54)	21 (7)	18 (98)
Cover Option 3	Textured 40-mil LLDPE geomembrane over fly ash (smooth 40-mil LLDPE geomembrane over fly ash – 5% slopes)	No	30 (20)	20 (50)	19 (18)	40 (10)

Notes:

[1] These interfaces are the same for each cover option; therefore, the values are not repeated in this table.

[2] Critical interfaces used in the simplified analysis are bold and italicized.

708 Heartland Trail, Suite 3000, Madison, WI 53717 (608) 826-3600 FAX: (608) 826-3941

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

The strengths of the interfaces are provided in terms of peak and high displacement strengths. High displacement strengths are representative of an interface where some movement has occurred during installation of the geosynthetics, placement of soil or waste, or another factor such as seismic activity. The analyses were performed considering both the peak and high displacement strength values.

Slope Stability Analysis

The analysis assumes the following:

- Slope failures slide as a block.
- The soil above the geosynthetic being evaluated is free draining and has a uniform thickness.
- No geosynthetics tensile reinforcement is included in the slope.
- Water is assumed on the interfaces located above the geomembrane.
- The interfaces below the geomembrane do not include head on the interface.

Head on the interface

The water thickness for the liner system (above the geomembrane) was assumed to be 0.5 feet at the perimeter berm slopes and 1.0 feet for the base slopes. For the final cover configurations the water thickness was assumed to be 1.0 feet on the 4H:1V slopes and the 5 percent slopes for the geocomposite drainage layer and select granular fill drainage blanket conditions based on the “Water Balance Analysis” provided in this Appendix.

Results:

Several conditions were analyzed to capture the most critical interface conditions. The results of each analysis are presented for the strength inputs in the table below. In addition, a graphical solution for the required interface strength values above and below the geomembrane are provided for the liner and final cover geometries analyzed at a factor of safety of 1.3. The values in the graphs must be exceeded by the interface strength test results. The results of the interface testing should be compared to the graphical solutions presented in the calculations by a qualified professional engineer who understands the assumptions inherent to the calculations. A minimum factor of safety of 1.4 was calculated for the GCL interface over the clay liner in the liner perimeter berm. Lower factor of safety values were calculated using the high displacement strength; however, all cases indicate that the factor of safety is greater than 1.0 for the high displacement condition which is considered acceptable because mechanisms to activate the high displacement condition are not anticipated at the site (e.g. seismic conditions and cover soil placement techniques).

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

CONDITION EVALUATED	INTERFACE DESCRIPTION[(1)]	FACTOR OF SAFETY PEAK	FACTOR OF SAFETY HIGH DISP.
Liner perimeter berm – 3H:1V slope 0.5 feet of water on upper interface	Select granular fill drainage layer over textured 60-mil HDPE geomembrane	1.6	1.8
	GCL over clay liner	1.4	1.3
Liner base – Up to a 10 percent slope 1.0 foot of water on upper interface	Select granular fill drainage layer over smooth 60-mil HDPE geomembrane	2.8	2.5
	Smooth 60-mil HDPE geomembrane over GCL	2.3	1.2
Final cover – 4H:1V slope 1.0 foot of water on upper interface	Select granular fill drainage layer over textured 40-mil LLDPE geomembrane	2.0	1.6
	GCL over compacted fine-grained soil	1.8	1.7
Final cover – 5 percent slope 1.0 feet of water on upper interface	Geocomposite drainage layer over smooth 40-mil LLDPE geomembrane	3.5	1.8
	Smooth 40-mil LLDPE geomembrane over GCL	4.1	2.2

Notes:

(1) The worst-case strength parameters corresponding to all final cover options (Options 1-3) were used to analyze worst-case factors of safety for the interface above and below the geosynthetic.

References:

Giroud, J.P., R.C. Bachus, and R. Bonaparte. 1995. Influence of Water Flow on the Stability of Geosynthetics-Soil Layered Systems on Slopes. *Geosynthetics International*. Vol. 2 No. 6, pp. 1149-1180.

Giroud, J.P., N.D. Williams, T. Pelte, and J.F. Beech. 1995. Stability of Geosynthetics-Soil Layered Systems on Slopes. *Geosynthetics International*. Vol. 2 No. 6 pp. 1115-1148.

Koerner, R.M. and T.Y. Soong. 1998. Analysis and Design of Veneer Cover Soils. 1998 Sixth International Conference on Geosynthetics. pp. 1-24.

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	J. Hotstream	12/12/2013	R. Wienkes	1/30/14	196089.0003.0000

GLOBAL SLOPE STABILITY

Purpose:

This calculation checks the global stability of the interphase construction and final configuration of the proposed Expansion at the Wisconsin Public Service Corporation's Weston Disposal Site No. 3. Coal combustion residuals (CCRs) will be placed at this disposal site.

Methodology:

The critical conditions for the interphase and final configurations are based on the planned geometry of the landfill components. The conditions evaluated were modeled in the slope stability software Slope/W©, version 7.22, by GeoSlope International. The slopes were analyzed using the Spencer Method which satisfies both moment and force equilibrium. The slopes were modeled using both long term (drained) and short term (undrained) strength conditions. Both circular and block shaped trial slip surfaces were analyzed along the proposed slopes. In addition, the most critical slip surface found in each analysis was optimized. The optimizing process divides the critical slip surface into segments and reorients the segments allowing the software to identify the most critical slip surface for the subsurface geometry input into the model.

Assumptions:

- The minimum required factor of safety is 1.3 (WAC NR 514.07(1)(b)).
- Based on the probabilistic hazard curves (Frankel, 2002), the ground motion is less than 0.1 g based on 10 percent exceedence in a 250 year time frame. Therefore, a seismic analysis is not required for the stability evaluation (Richardson, 1995).

Design Sections:

One design section was used to evaluate the final cover and the filling configurations. Figure 1 shows the section line used for the final cover configuration. Note that the section is offset to provide the highest cover conditions at the critical section location. Figure 2 provides the base grade geometry used for this section. This location was selected based on geologic cross section E-E' presented in the Feasibility Report (included as Figure 3 in this calculation) was evaluated. Geologic cross section E-E' was selected based on the thickness of the soil below the southern toe of the proposed expansion, the interpreted bedrock surface orientation, and the high groundwater levels observed in 2013. The filling configuration was based on the same section and was developed to estimate the maximum height of CCR placement without buttressing the toe of the CCR slope.

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	J. Hotstream	12/12/2013	R. Wienkes	1/30/14	196089.0003.0000

Soil Parameters:

The soil parameters used in the global stability analyses are based on field testing results and published data. Generally, the soil conditions observed at the site are loose alluvial soils overlying medium dense to dense residual soil. Due to the shallow nature and the similar materials encountered (primarily silty sands, silty gravels, and silts) the soil is modeled as one unit in the slope stability analysis. Bedrock was encountered at depths ranging from 5 feet to 23 feet below the ground surface. The select aggregate fill was not included in the stability models because it is a higher strength material in the liner system. In addition to soil strengths, the critical interface strength between the geomembrane and clay liner was included as a layer in the global stability model. The following table summarized the soil parameters used in the analyses.

MATERIAL	TOTAL UNIT WEIGHT, (pcf)	UNDRAINED SHEAR STRENGTH, s_u (psf)	UNDRAINED FRICTION ANGLE, ϕ' (deg.)	APPARENT COHESION, c' (psf)	DRAINED FRICTION ANGLE, ϕ' (deg.)
CCRs	106(1)	275(2)	32(2)	275(2)	32(2)
Compacted Liner(3)	130	1,500	-	0	30
General Fill Cover(3)	115	600	-	0	26
Compacted General Fill(3)	125	1,000	-	0	30
Structural Fill(4)	115	-	-	0	30
Select Granular Fill(5)	135	-	-	0	36
Overburden Soil(5)	120	-	-	0	35
Granitic Bedrock(6)	135	-	-	0	40
Critical Geosynthetic Interface(7)	115	5	11	5	11

Notes:

(1) The total unit weight of the CCR is based on the Field and Laboratory Test Program Observations and Results Weston Power Plant 4 – Fly Ash Material – Test Pad (CQM Inc., 2009).

(2) The waste properties are based on published results of Class F fly ash compacted to approximately 90% of the standard proctor maximum dry density (Kim and Prezzi, 2008). Undrained conditions are not anticipated for the waste mass based on published results (Kim and Prezzi, 2008), so drained strength conditions were applied for both analyses.

(3) Assumed values for clay (Table 5.5, Figure 12.56, Holtz, 2011).

(4) Assumed structural fill below landfill would be similar to recompacted overburden soils.

(5) Assumed values based on correlations (Table 12.3 Holtz 2011, Figure 7, NAVFAC, 1986).

(6) Strength of the granitic bedrock is assumed to be similar to a dense gravel based on the descriptions of highly fractured granite in the field logs.

(7) The critical geosynthetics interface is incorporated to model potential slip along an interface in the composite liner system. The value used is based on conservative values for materials similar to those planned for use (TRC, 2013).

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	J. Hotstream	12/12/2013	R. Wienkes	1/30/14	196089.0003.0000

Results:

Results of the global stability analyses are summarized in the table below with the outputs for the analyses attached to this packet. The attached output includes detailed output for the most critical condition and a summary plate showing the critical slip surface for the other conditions.

CROSS SECTION	STRENGTH CONDITION	CIRCULAR SLIP SURFACE FACTOR OF SAFETY	BLOCK SLIP SURFACE FACTOR OF SAFETY
Interphase Construction	Undrained	2.20	1.62
	Drained	2.23	1.36
Perimeter Berm	Undrained	2.61	2.66
	Drained	2.18	1.51
Final Configuration	Undrained	2.57	2.13
	Drained	2.81	2.64
Final Configuration with Sedimentation Basin	Undrained	2.30	2.21
	Drained	2.50	2.54

All of the conditions modeled meet the factor of safety requirement in WAC NR 514.07(1)(b). The most critical slip surfaces are within the waste and critical geosynthetic interface. The lowest factor of safety occurs for the drained condition during waste placement.

References:

CQM, Inc. 2009. Field and Laboratory Test Program Observations and Results, Weston Power Plant 4 – Fly Ash Material – Test Pad. Letter to Andrew Gilbert. April 27, 2009.

Holtz, Robert D., W. D. Kovacs, and T. C. Sheahan. 2011. An introduction to geotechnical engineering. Second edition. New Jersey: Pearson. 853 p.

Frankel, A.D., et al. 2002. Documentation for the 2002 update of the national seismic hazard maps. U.S. Geological Survey. 33 p.

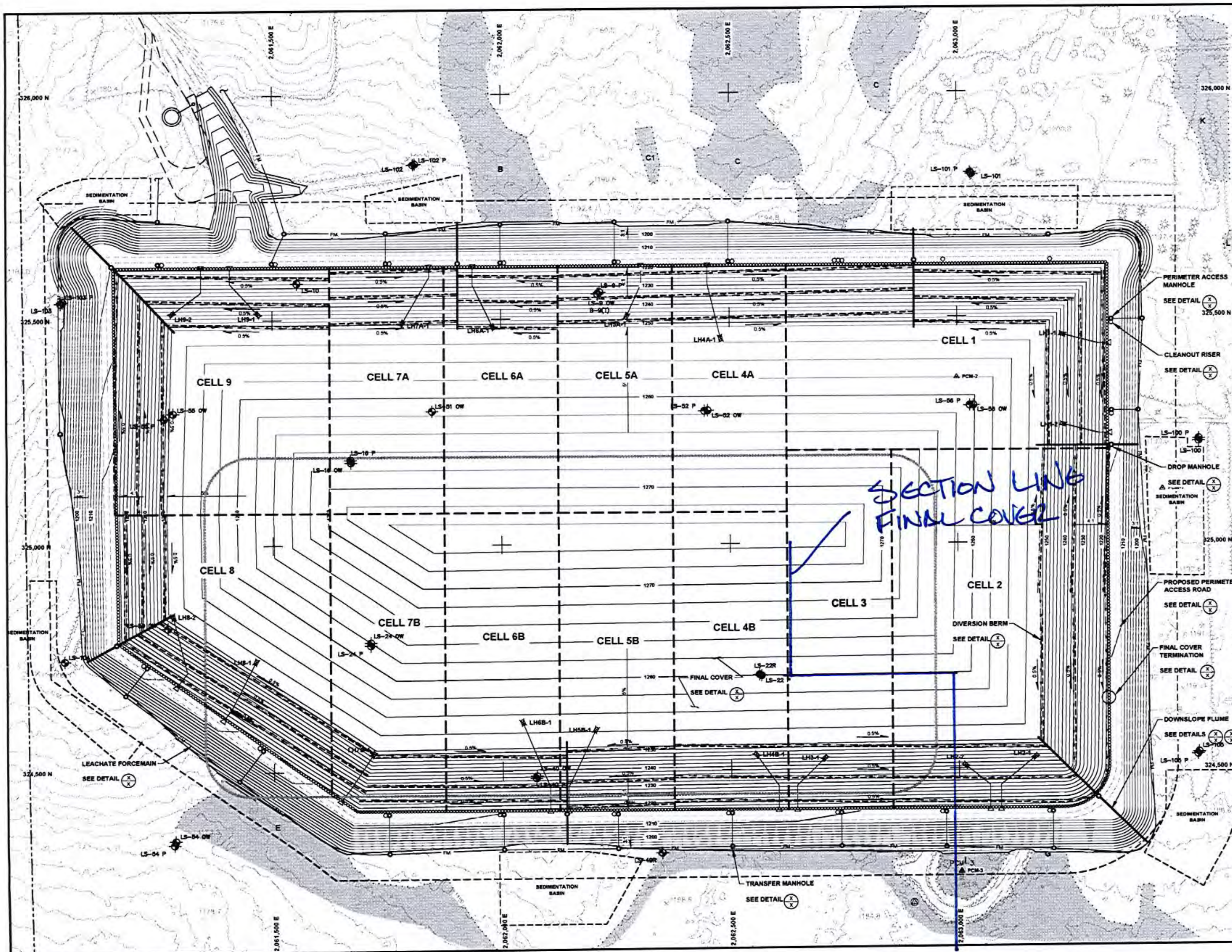
Kim, B. and Prezzi, M. 2008. “Evaluation of the mechanical properties of class-F fly ash.” Waste Management. 28, p 649-659.

Naval Facilities Engineering Command (NAVFAC). 1986. Soil Mechanics Design Manual 7.01.

Richardson, G.N. and E. Kavazanjian, Jr. 1995. RCRA Subtitle D (258) seismic design guidance for municipal solid waste landfill facilities. U.S. Environmental Protection Agency. 143 p.

TRC Environmental Corporation. 2013. Interface strength of geosynthetics. Database.

Figures



NOTES

1. REFER TO PLAN SHEET 2 FOR STANDARD LEGEND AND BASE MAP NOTES.
2. CONTOURS REPRESENT FINAL GRADES (TOP OF FINAL COVER) WITHIN THE LIMITS OF WASTE AND FINISHED GRADE (TOP OF TOPSOIL, TOP OF ROAD SURFACE, ETC.) BEYOND.

CONSTRUCTION ACTIVITIES

CONSTRUCTION QUANTITIES

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.

NOT FOR CONSTRUCTION

NO.	BY	DATE	REVISION	APP'D
3				
2				
1				

PROJECT: WISCONSIN PUBLIC SERVICE CORPORATION
WESTON DISPOSAL SITE NO. 3 EXPANSION
PLAN OF OPERATION

SHEET TITLE: FINAL GRADES

DRAWN BY: LSTORMER	SCALE: 1"=100'	PROJ. NO.	196069.0003
CHECKED BY: —		FILE NO.	196069.0003.SHT16-FC.dwg
APPROVED BY: —	DATE PRINTED	SHEET 16 OF 28	
DATE: DECEMBER 2013			

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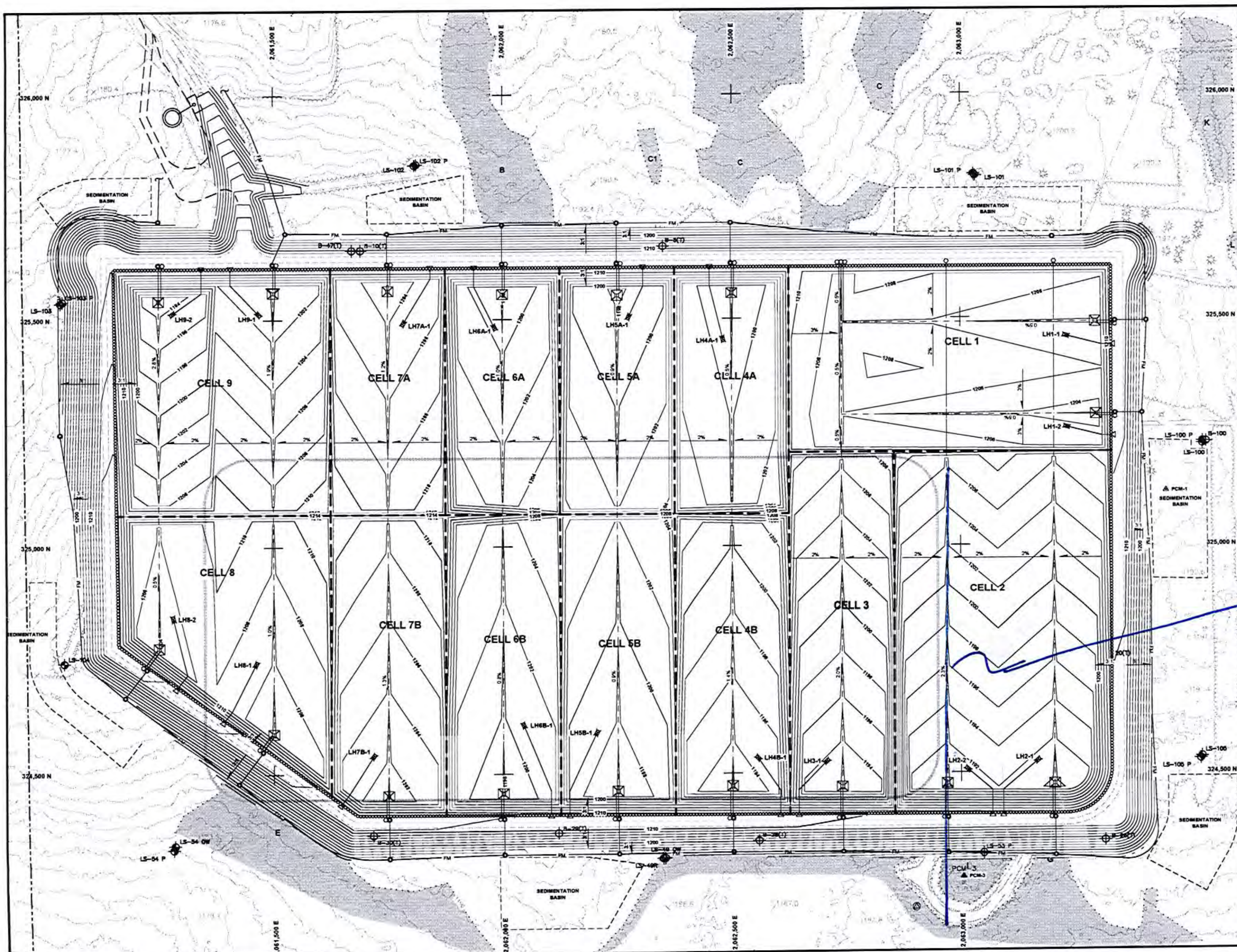
Phone: 608.826.3600

File Location: J:\WPT\Weston Disposal Site\196069\0003 File Name: 196069.0003.SHT16-FC Layout Name: SHEET 16
Plot Information: NONE STORMER, LARRY — ANSI A (8.50 X 11.00 INCHES) December 12, 2013 K:\AUTOCAD_CONFIG\PLOTTERS\PLOT STYLES\FMT COLOR.CTB

FIGURE 1



NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.

NOT FOR CONSTRUCTION

NO.	BY	DATE	REVISION	APP'D
3				
2				
1				

PROJECT: WISCONSIN PUBLIC SERVICE CORPORATION
WESTON DISPOSAL SITE NO. 3 EXPANSION
PLAN OF OPERATION

SHEET TITLE: BASE GRADES/LEACHATE COLLECTION SYSTEM

DRAWN BY: LSTORMER	SCALE: 1"=100'	PROJ. NO. 196089.0003	
CHECKED BY: —		FILE NO. 196089.0003.SHT05-BG.dwg	
APPROVED BY: —	DATE PRINTED:	SHEET 5 OF 28	
DATE: DECEMBER 2013			

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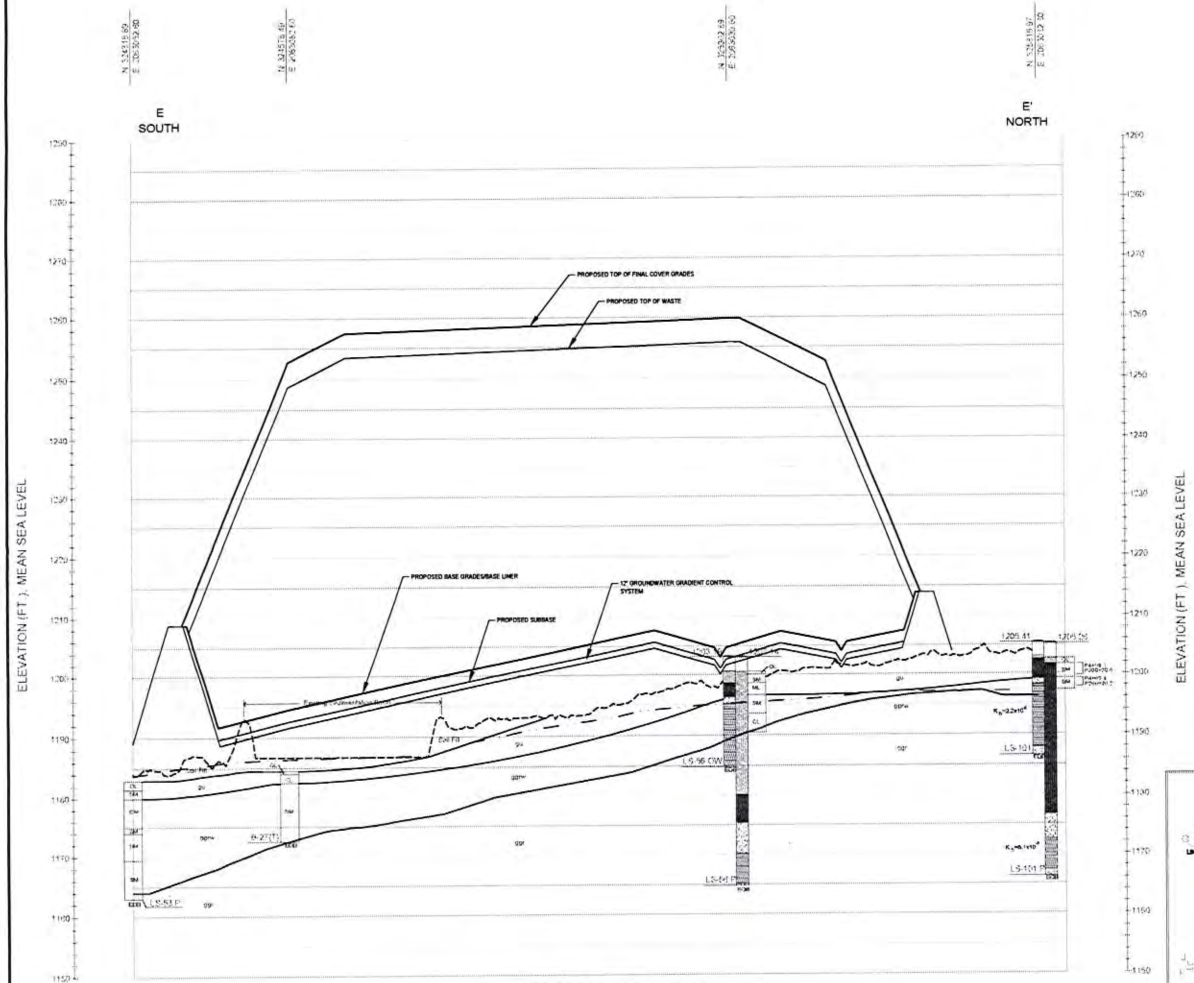
FIGURE 2



GEOLOGIC CROSS-SECTION E-E'

SCALE: 1"=100' HORIZ. & 1"=10' VERT.
10X VERTICAL EXAGGERATION

LEGEND

- EXISTING GROUND SURFACE
- LITHOSTRATIGRAPHIC UNIT (DASHED WHERE APPROXIMATE)
- COMPETENT BEDROCK SURFACE (DASHED WHERE APPROXIMATE)
- HIGH TABLE SURFACE - SHOWING FLOW DIRECTION
- HIGH WATER TABLE (H) 4-23-08

- TOP OF PVC ELEVATION
- ANNULAR SPACE SEAL
- SOIL CLASSIFICATION (USCS)
- SAMPLE INTERVAL WITH LABORATORY (VERTICAL) HYDRAULIC CONDUCTIVITY (CENTIMETERS/SECOND) (K_v), % PASSING No. 4 SIEVE (P4), AND % PASSING No. 200 (P200)
- LITHOSTRATIGRAPHIC CONTACT (DASHED WHERE APPROXIMATE)
- BENTONITE SEAL
- SAND FILTER PACK
- WELL SCREEN
- FIELD (HORIZONTAL) HYDRAULIC CONDUCTIVITY (K_h) (CENTIMETERS/SECOND)
- SOIL BORING/MONITORING WELL DESIGNATION — * - ORIGINAL BORING; ** - REPLACEMENT BORING
- NATURAL CAVE IN OR SAND FILL
- EOB: END OF BORING

STRATIGRAPHIC UNIT

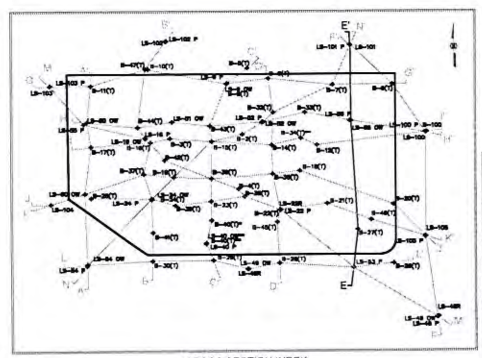
PLEISTOCENE	gu - MARATHON FORMATION, UNDIFFERENTIATED (Attig and Muldoon, 1989) BROWN TO DARK BROWN SAND TO SILTY SAND DERIVED FROM TILL, RESIDUUM, OR HILLSLOPE SEDIMENT ggrw - WEATHERED BEDROCK. YELLOWISH BROWN TO DARK BROWN SILTY SAND DERIVED FROM LOWER PROTEROZOIC BEDROCK (ggr)
LOWER PROTEROZOIC	ggr - GNEISSIC GRANITE (LaBerge and Myers, 1983) LIGHT GREY TO PINK QUARTZ DIORITE AND RED TO PINK GRANITE, WITH TRACE BLACK AMPHIBOLITE

UNIFIED SOIL CLASSIFICATION

GW	WELL GRADED GRAVELS & GRAVEL WITH SAND
GP	POORLY GRADED GRAVELS & GRAVEL WITH SAND
GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
GC	CLAYEY GRAVELS, CLAYEY GRAVEL WITH SAND
SW	WELL GRADED SANDS & SAND WITH GRAVEL
SP	POORLY GRADED SANDS & SANDS WITH GRAVEL
SP-SM	POORLY GRADED SAND WITH SILT, SAND WITH SILT & GRAVEL
SM	SILTY SANDS, SILTY SAND WITH GRAVEL
SC	CLAYEY SANDS, CLAYEY SANDS WITH GRAVEL
CH	HIGH PLASTICITY CLAY
CL-ML	SILTY CLAY TO CLAYEY SILT
CL	LOW PLASTICITY CLAY, GRAVELLY-SANDY CLAYS
ML	SILT, GRAVELLY-SANDY SILT
OL	ORGANIC CLAY, SANDY-GRAVELLY ORGANIC SOIL
OH	ORGANIC, HIGH PLASTICITY, SILTY CLAY
PT	PEAT, MUCK, ORGANIC SOILS

NOTES

1) SOIL FILL - DISTURBED SOIL OR SOIL THAT HAS BEEN PLACED FOR CONSTRUCTION OF ROADS AND BERMS ASSOCIATED WITH THE EXISTING LANDFILL
2) FILL - COAL COMBUSTION RESIDUALS
3) HIGH WATER TABLE BASED ON SURFACE PRESENTED ON HIGH WATER TABLE MAP FR-6 (REV. 1)
4) THIS ORIGINAL PLAN SHEET WAS DEVELOPED BY AECOM, INC. FOR THE AUGUST 2012 FEASIBILITY REPORT FOR THE WESTON DISPOSAL SITE NO. 3 EXPANSION. TRC HAS MODIFIED THE HIGH WATER TABLE CONTOUR SURFACE AND THE SUBBASE/BASE/FINAL GRADES IN RESPONSE TO PART B, ITEM 1 OF THE INCOMPLETENESS RESPONSE ISSUED BY THE WDNR ON OCTOBER 5, 2012



CROSS-SECTION INDEX
NOT TO SCALE

NO.	BY	DATE	REVISION	APP'D
3				
2				
1				

PROJECT: WISCONSIN PUBLIC SERVICE CORPORATION
WPS - WESTON DISPOSAL SITE NO. 3
PROPOSED EXPANSION

SHEET TITLE: GEOLOGIC CROSS SECTION E-E'

DRAWN BY: DPR	SCALE: AS SHOWN	PROJ. NO.	196089.0004.0000
CHECKED BY: TDH		FILE NO.	196089.0004 GEOXS.dwg
APPROVED BY: CDM	DATE PRINTED:	FR-14 (REV. 1)	
DATE: JUNE 2013			

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Suite 3000
Madison, WI 53717
Phone: 608.826.3600

File Location: J:\WPS\Weston Disposal Site\196089\0001\0000 File Name: 196089.0004.GEOXS Layout Name: FR-14 (REV. 1)
Plot Information: NONE STORMER, LARRY — ANSI A (8.50 X 11.00 INCHES) June 4, 2013 0.3869 K:\AUTOCAD_CONFIG\PLOTTERS\PLOT STYLES\RMT COLOR.CTB

FIGURE 3

Calculations

TRC
Results you can rely on
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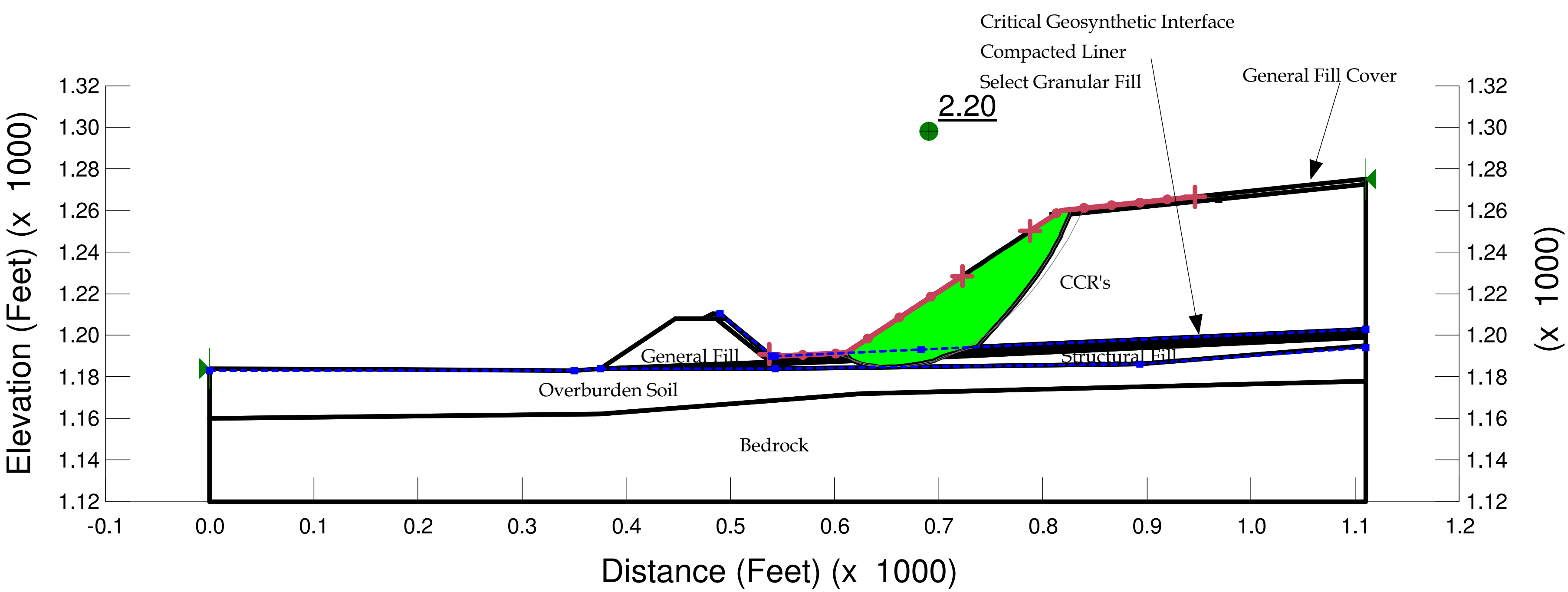
TEL: (608) 826-3600
FAX: (608) 826-3941

PROJECT NAME:	PREPARED BY:	CHECKED BY:	PROJECT/PROPOSAL NO.:	GLOBAL STABILITY ANALYSIS
WPS Corp. Weston Site No. 3 Plan of Operation	D. Engstrom	J. Hotstream	196089.0003	INTERPHASE CONSTRUCTION SHORT TERM (UNDRAINED)
	DATE: 1/24/2014	DATE: 1/30/2014		

Method: Spencer
Slip Surface Option: Entry and Exit
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 1500 psf Phi: 0 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 600 psf Phi: 0 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 1000 psf Phi: 0 °
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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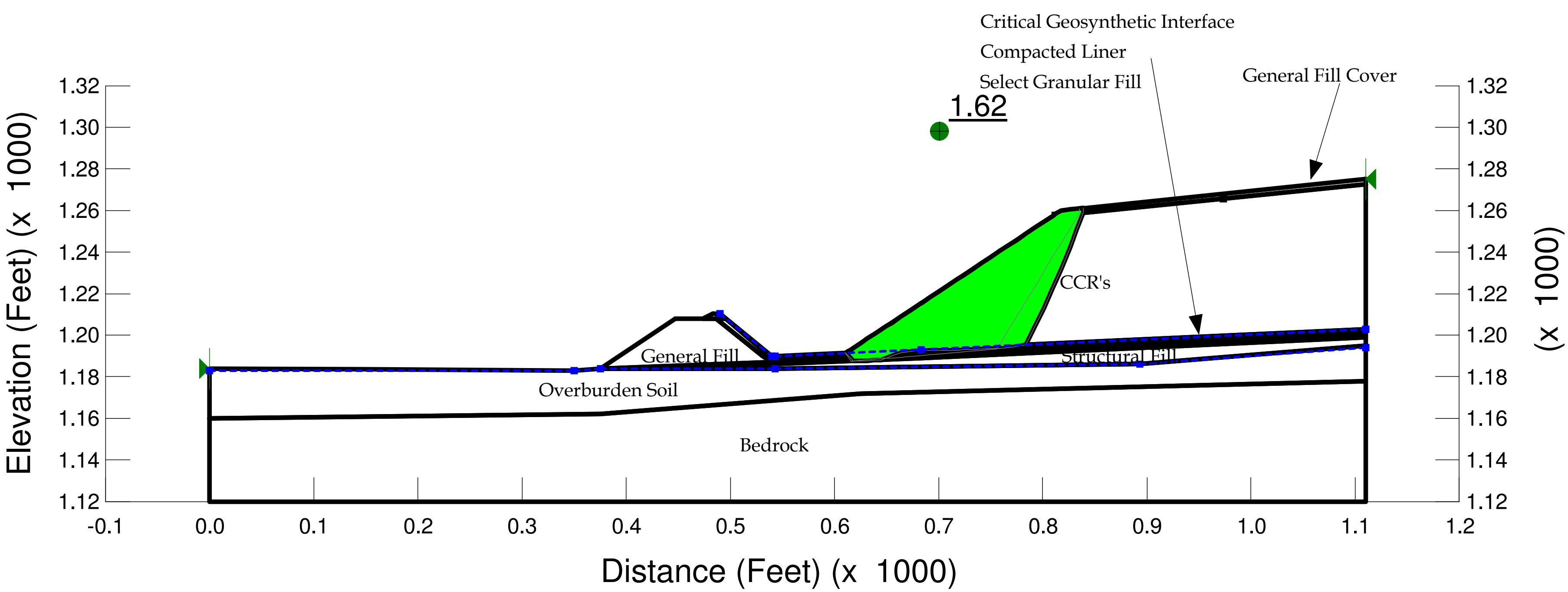
TRC Results you can rely on 708 Heartland Trail, Suite 3000 Madison, WI 53717 TEL: (608) 826-3600 FAX: (608) 826-3941	PROJECT NAME: WPS Corp. Weston Site No. 3 Plan of Operation	PREPARED BY: D. Engstrom DATE: 1/24/2014	CHECKED BY: J. Hotstream DATE: 1/30/2014	PROJECT/PROPOSAL NO.: 196089.0003	**GLOBAL STABILITY ANALYSIS** **INTERPHASE CONSTRUCTION** **SHORT TERM (UNDRAINED)**

Method: Spencer
Slip Surface Option: Fully-Specified
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 1500 psf Phi: 0 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 600 psf Phi: 0 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 1000 psf Phi: 0 °
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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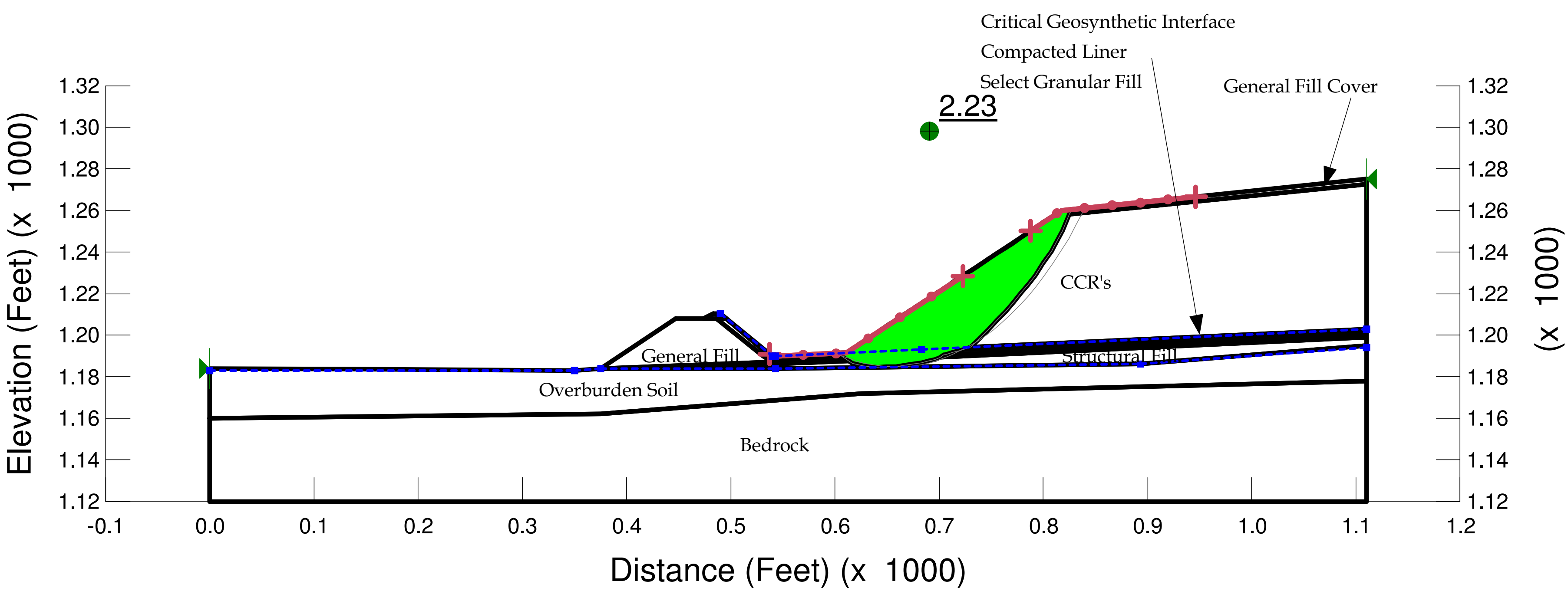
TRC Results you can rely on **708 Heartland Trail, Suite 3000** **Madison, WI 53717** **TEL: (608) 826-3600** **FAX: (608) 826-3941**	PROJECT NAME: WPS Corp. Weston Site No. 3 Plan of Operation	PREPARED BY: D. Engstrom DATE: 1/24/2014	CHECKED BY: J. Hotstream DATE: 1/30/2014	PROJECT/PROPOSAL NO.: 196089.0003	**GLOBAL STABILITY ANALYSIS** **INTERPHASE CONSTRUCTION** **LONG TERM (DRAINED)**

Method: Spencer
Slip Surface Option: Entry and Exit
Tension Crack Option: (none)
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 0 psf Phi: 30 °
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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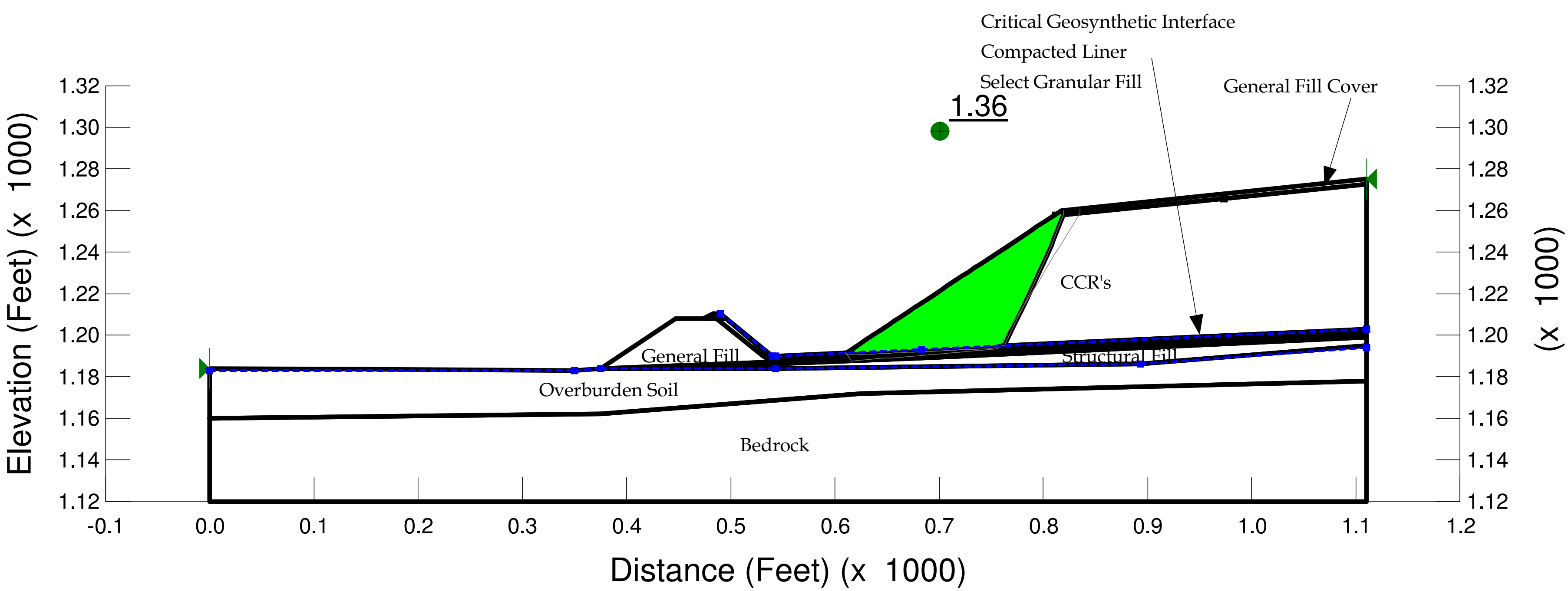
708 Heartland Trail, Suite 3000 Madison, WI 53717 TEL: (608) 826-3600 FAX: (608) 826-3941	PROJECT NAME: WPS Corp. Weston Site No. 3 Plan of Operation	PREPARED BY: D. Engstrom DATE: 1/24/2014	CHECKED BY: J. Hotstream DATE: 1/30/2014	PROJECT/PROPOSAL NO.: 196089.0003	**GLOBAL STABILITY ANALYSIS** **INTERPHASE CONSTRUCTION** **LONG TERM (DRAINED)**

Method: Spencer
Slip Surface Option: Fully-Specified
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 0 psf Phi: 30 °
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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Specified

File Information

Created By: Hotstream, Jonathan
Revision Number: 27
Last Edited By: Hotstream, Jonathan
Date: 1/31/2014
Time: 12:10:10 AM
File Name: Im_drained_rev_CCRFailJH.gsz
Directory: \\ntapa-madison\msn-vol3\DATA\PROJECTS_Vision\WPSC - Weston\196089\0003 - POO\Appendices\G_ Geotechnical\Global Stability\
Last Solved Date: 1/31/2014
Last Solved Time: 12:11:30 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Specified

Kind: SLOPE/W
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Fully-Specified
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Tension Crack
  - Tension Crack Option: Tension Crack Line
  - Percentage Wet: 1

Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

CCR

Model: Mohr-Coulomb

Unit Weight: 106 pcf

Cohesion: 275 psf

Phi: 32 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Compacted Liner

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Cohesion: 0 psf

Phi: 30 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

General Fill Cover

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion: 0 psf

Phi: 26 °

Phi-B: 0 °

Select Granular Fill

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion: 0 psf

Phi: 36 °
Phi-B: 0 °

Compacted General Fill

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Overburden Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2

Bedrock

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Cohesion: 0 psf
Phi: 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2

Critical Geosynthetic Interface

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 5 psf
Phi: 11 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Structural Fill

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2

Slip Surface Limits

Left Coordinate: (0, 1184) ft
Right Coordinate: (1110, 1275) ft

Fully Specified Slip Surfaces

Fully Specified Slip Surface 1

	X (ft)	Y (ft)
	551.104	1232.5
	615.8353	1187.5
	755.5525	1193.2799
	868.9925	1286.5

Fully Specified Slip Surface 2

	X (ft)	Y (ft)
	551	1207
	599	1180.5
	705	1172.9897
	950	1291

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	490	1210.4257
	540	1190
	543	1190
	683	1193
	1110	1203

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	1183

	350	1183
	375	1184
	543	1184
	893	1186
	1110	1194

Tension Crack Line

	X (ft)	Y (ft)
	812	1257.6226
	973	1265.6604

Regions

	Material	Points	Area (ft^2)
Region 1	CCR	28,24,42,40	25747.75
Region 2	General Fill Cover	27,28,40,41	684.375
Region 3	Critical Geosynthetic Interface	24,20,19,18,17,34,33,22,23,42	637.75027
Region 4	Compacted General Fill	5,25,6,16,21,7,8,9,4	2268
Region 5	Compacted General Fill	26,25,6,16,21,33	23.893145
Region 6	Compacted General Fill	21,33,34	11.71698
Region 7	Compacted General Fill	9,10,4	87
Region 8	Select Granular Fill	9,10,11,12,15,14,13	568.5
Region 9	Compacted Liner	21,34,17,18,19,20,15,14,13,9,8,7	1299.2766
Region 10	Bedrock	29,35,36,32,31,30	53800
Region 11	Structural Fill	4,37,38,39,12,11,10	3167.5
Region 12	Overburden Soil	4,3,2,1,29,30,31,32,39,38,37	18800.5

Points

	X (ft)	Y (ft)
Point 1	0	1184
Point 2	150	1183.5
Point 3	350	1183
Point 4	375	1184
Point 5	447	1208
Point 6	477	1208

Point 7	531	1190
Point 8	534	1189
Point 9	540	1187
Point 10	543	1186
Point 11	683	1189
Point 12	1110	1199
Point 13	543	1187
Point 14	683	1190
Point 15	1110	1200
Point 16	483	1208
Point 17	540	1189
Point 18	543	1189
Point 19	683	1192
Point 20	1110	1202
Point 21	486	1208
Point 22	540	1190
Point 23	543	1190
Point 24	1110	1203
Point 25	473.3	1208
Point 26	483	1210.4257
Point 27	1110	1275
Point 28	1110	1272.5
Point 29	0	1160
Point 30	375	1162
Point 31	625	1172
Point 32	1110	1178
Point 33	490	1210.4257
Point 34	495.6607	1208
Point 35	0	1120
Point 36	1110	1120
Point 37	543	1184
Point 38	893	1186
Point 39	1110	1195
Point 40	810	1257.5
Point 41	817.5	1260
Point 42	611	1191.5

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	Optimized	1.36	(707.598, 1275.61)	109.2546	(819.071, 1260.08)	(608.75, 1191.45)
2	1	2.50	(707.598, 1275.61)	113.929	(835.265, 1260.91)	(610.11, 1191.48)

Slices of Slip Surface: Optimized

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	Optimized	608.81715	1191.431	-1.2928659	5.4000916	1.0496715	5
2	Optimized	609.9422	1191.1085	20.335462	51.272591	6.0135687	5
3	Optimized	611.5471	1190.6485	51.18913	138.06051	16.886086	5
4	Optimized	616.4677	1190.5835	61.84769	307.38679	47.727967	5
5	Optimized	625.2147	1190.7665	62.131154	605.33241	105.58763	5
6	Optimized	633.05245	1190.932	62.286205	871.96357	157.38534	5
7	Optimized	639.98095	1191.08	62.313621	1107.5588	203.17508	5
8	Optimized	646.9095	1191.228	62.342481	1343.1541	248.96455	5
9	Optimized	653.83805	1191.376	62.369897	1578.7637	294.7571	5
10	Optimized	660.454	1191.5185	62.312984	1803.1875	338.39173	5
11	Optimized	666.75745	1191.6555	62.170239	2017.1465	380.0089	5
12	Optimized	673.0991	1191.793	62.080041	2232.7816	421.94164	5
13	Optimized	679.4789	1191.9305	62.039297	2449.666	464.10762	5
14	Optimized	682.8344	1192.003	62.003734	2562.1328	485.97586	5
15	Optimized	688.02845	1192.122	62.164932	2737.7025	520.07181	5
16	Optimized	697.46965	1192.342	62.236081	3055.0528	581.74464	5
17	Optimized	705.20035	1192.524	62.15827	3316.3431	632.54945	5
18	Optimized	711.8363	1192.6785	62.210999	3540.3654	676.08472	5
19	Optimized	718.47225	1192.833	62.263728	3764.237	719.5907	5
20	Optimized	724.9037	1192.9845	62.209225	3980.0482	761.55076	5
21	Optimized	731.13075	1193.133	62.047075	4189.7188	802.3381	5
22	Optimized	737.35785	1193.281	61.884926	4399.5499	843.15666	5
23	Optimized	743.5849	1193.4295	61.724381	4609.2205	883.94369	5
24	Optimized	750.18285	1193.8325	46.23238	4656.0958	896.06667	5

25	Optimized	757.1518	1194.4895	15.410317	4827.9565	935.46421	5
26	Optimized	761.45245	1194.895	-3.6096336	4933.9547	959.06364	5
27	Optimized	766.5707	1199.4045	-277.52055	2736.2709	1709.8118	275
28	Optimized	775.2086	1208.3085	-820.52953	2344.4618	1464.9824	275
29	Optimized	783.223	1216.6415	-1328.8121	1958.5306	1223.8258	275
30	Optimized	790.58015	1224.365	-1799.9057	1619.7182	1012.1123	275
31	Optimized	797.6517	1232.0035	-2266.2744	1236.9376	772.92437	275
32	Optimized	804.43765	1239.557	-2727.664	906.35221	566.35172	275
33	Optimized	808.9153	1244.747	-3044.9868	602.56943	376.52717	275
34	Optimized	813.75	1251.0445	-3430.9371	338.05168	211.23813	275
35	Optimized	818.2855	1256.9525	-3792.9362	63.591587	39.736434	275

Slices of Slip Surface: 1

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1	610.1392	1191.4595	-1.3196402	6.0762434	1.1811021	5
2	1	610.58435	1191.15	18.586358	54.823732	7.0438319	5
3	1	611.28205	1190.665	49.787145	143.79573	18.273418	5
4	1	612.9596	1189.499	124.79936	497.81469	215.3605	0
5	1	615.0528	1188.044	0	1123.6649	816.39035	0
6	1	615.7929	1187.5295	-194.28185	1176.4797	679.24087	0
7	1	617.3588	1187.563	-195.81784	762.04211	439.96522	0
8	1	622.46445	1187.774	0	938.70982	682.01261	0
9	1	629.6288	1188.0705	0	1168.9176	849.26832	0
10	1	636.79315	1188.367	0	1399.0695	1016.4835	0
11	1	643.9575	1188.6635	0	1629.3191	1183.7696	0
12	1	651.12185	1188.96	0	1859.5687	1351.0557	0
13	1	658.2862	1189.256	0	2089.8183	1518.3418	0
14	1	665.45055	1189.5525	0	2319.9284	1685.5266	0
15	1	672.52455	1189.8455	182.8572	2497.4222	1336.3147	0
16	1	679.5082	1190.1345	174.17288	2719.6093	1469.6084	0
17	1	686.62765	1190.429	165.75188	2946.1034	1605.2367	0
18	1	693.8829	1190.729	157.62679	3177.1865	1743.3436	0
19	1	701.13815	1191.029	149.5017	3408.1319	1881.371	0
20	1	708.3934	1191.329	141.37661	3639.0773	2019.3985	0

21	1	715.64865	1191.629	133.25289	3870.1605	2157.5046	0
22	1	722.9039	1191.929	125.1278	4101.1059	2295.532	0
23	1	730.1591	1192.229	117.00133	4332.189	2433.6398	0
24	1	737.41435	1192.5295	108.87486	4563.1344	2571.668	0
25	1	744.6696	1192.83	100.74839	4794.0799	2709.6962	0
26	1	751.92485	1193.13	92.62192	5025.163	2847.8039	0
27	1	755.81505	1193.4955	75.480159	3606.428	2038.5937	0
28	1	756.7039	1194.226	31.200059	3784.6046	729.58794	5
29	1	761.16295	1197.8905	-190.93646	3316.3922	2072.3119	275
30	1	768.74605	1204.122	-568.69373	3028.8238	1892.6192	275
31	1	776.24675	1210.2855	-942.34996	2744.4306	1714.9106	275
32	1	783.74745	1216.449	-1315.9753	2459.9344	1537.1376	275
33	1	791.2482	1222.613	-1689.6727	2175.5412	1359.429	275
34	1	798.74895	1228.777	-2063.3701	1891.045	1181.656	275
35	1	806.24965	1234.941	-2436.9646	1606.6517	1003.9474	275
36	1	813.75	1241.1045	-2810.6225	1329.5963	830.82396	275
37	1	821.93445	1247.83	-3218.3147	930.54455	581.46877	275
38	1	830.8169	1255.129	-3660.855	397.68113	248.49875	275

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	D. Engstrom	11/27/2013	R. Wienkes	12/24/2013	196089.0003.0000

PIPE STRENGTH CALCULATIONS

Purpose:

To verify that the proposed piping for the Weston Disposal Site No. 3 Expansion will withstand the potential worst-case loading conditions for long-term performance.

Methodology:

The pipe strength analysis consists of calculating the pipes' abilities to withstand crushing, buckling and excessive ring deflection under high fills and after closure. The loading and the structural stability for each condition was calculated and compared with the allowable parameters to determine if the application is appropriate.

Assumptions:

Pipe strength calculations were originally presented in the August 2012 Feasibility Report (FR) (AECOM, 2012) and then revised in the June 2013 FR Incompleteness Response Letter (TRC, 2013). The assumptions utilized in the previous submittals have been incorporated into the attached calculations. For detailed information about the methodology and assumptions used, refer to Attachment 4 of the FR Incompleteness Response Letter and Appendix I of the FR.

The results from the previous submittals indicate that SDR 11 HDPE and SCH 80 PVC piping are appropriate for the 8-inch leachate collection piping; therefore, calculations for the following piping applications have been included with this Plan of Operation Submittal:

1. Proposed 6-inch SCH 80 PVC or SDR 11 HDPE gradient control piping
2. Proposed 8-inch SCH 80 PVC or SDR 17 HDPE cleanout riser
3. Proposed 18-inch SCH 80 PVC or SDR 17 HDPE sideslope riser
4. Proposed 3-inch SCH 120 PVC or SDR 11 HDPE leachate headwell piping

Results:

The results in the following table verify that proposed materials are acceptable for the various piping applications of the Expansion.

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	D. Engstrom	11/27/2013	R. Wienkes	12/24/2013	196089.0003.0000

PIPE DESCRIPTION	CRUSHING FACTOR OF SAFETY (min. of 2)	DEFLECTION ESTIMATED DEFLECTION (%) (max. of 7%)	BUCKLING FACTOR OF SAFETY (min. of 2)
1. 6-inch perforated gradient control pipe			
SCH 80 PVC	7.7	6.1	7.1
SDR 11 HDPE	4.2	6.1	10.7
2. 8-inch cleanout riser pipe			
SCH 80 PVC	21.8	2.0	20.2
SDR 17 HDPE	8.6	2.0	11.7
3. 18-inch sideslope riser pipe			
SCH 80 PVC	19.6	2.0	17.0
SDR 17 HDPE	8.6	2.0	11.8
4. 3-inch leachate headwell pipe			
SCH 120 PVC	34.7	2.2	39.7
SDR 11 HDPE	11.6	2.2	21.1

The results indicate that HDPE 17 is adequate for the 8-inch diameter cleanout riser pipe; however, to maintain consistency with the other leachate collection piping and prevent uneven fusing or welding, WPS will likely elect to use HDPE SDR 11 pipe for that application as well. The results also indicate that the gradient control piping has the potential to deflect up to 6.1%; however, the maximum deflection (7%) is a recommendation for maintaining cleaning and jetting ability within the pipe. The gradient control piping will only transfer groundwater is not anticipated to require cleaning; therefore, SDR 11 HDPE and SCH 80 PVC piping remain adequate options for this application.

References:

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Harrison, S., Watkins, R.K. 1996. HDPE Leachate Collection Pipe Design by Fundamentals of Mechanics. Presented at the Nineteenth International Madison Waste Conference, Department of Engineering Professional Development, University of Wisconsin Madison. September 25-26, 1996.

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	D. Engstrom	11/27/2013	R. Wienkes	12/24/2013	196089.0003.0000

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ISCO. 2012. HDPE Typical Physical Properties. http:// www.isco-pipe.com/media. Accessed on November 16, 2012.

LamsonVylon. 2010. Plastic Pipe Design Manual. Prime Conduit, Inc., 23240 Chagrin Boulevard Suite 405, Cleveland, OH 44122. http://www.primeconduit.com/. Accessed on November 12, 2012.

The Plastic Pipe Institute (PPI). 2009. Handbook of Polyethylene Pipe: Second Edition.

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Uni-bell PVC Pipe Association. 2013. Uni-bell Handbook of PVC Pipe Design and Construction. 4th edition. Dallas: Uni-bell PVC Pipe Association.

Watkins, Reynold K. 1987. Structural performance of perforated and slotted high-density polyethylene pipes under high soil cover. Department of Civil Engineering, Utah State University.

Calculations

- Wall Crushing, Excessive Deflection: Long-term (Watkins' Method)
- Buckling

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PROJECT / PROPOSAL NAME / LOCATION:			
WPS Pipe Strength Verification			
PREPARED BY:	D. Engstrom	DATE: 11/27/2013	PROJECT / PROPOSAL NO.
CHECKED BY:	R. Wienkes	DATE: 12/20/2013	196089.0003

PIPE STRENGTH CALCULATIONS
CLOSURE LOADING CALCULATION

Calculate Dead Loads:

Equation:

$$W_L = \gamma_L H_L$$

Where:

W_L = The vertical pressure due to the soil layer

γ_L = The unit weight of the soil layer

H_L = The height of the soil layer

Inputs:

Pipe Inputs:

Pipe #	Description
1	Proposed 6-inch (SCH 80 PVC or SDR 11 HDPE) Gradient Control Pipe
2	Proposed 8-inch (SCH 80 PVC or SDR 17 HDPE) Cleanout Riser Pipe
3	Proposed 18-inch (SCH 80 PVC or SDR 17 HDPE) Sideslope Riser Pipe
4	Proposed 3-inch (SCH 120 PVC or SDR 11 HDPE) Leachate Headwell Pipe

Soil Inputs:

Soil Layer #	Soil Type	Unit Weight (pcf)
1	Bedding	125
2	Sand	125
3	Liner Clay	125
4	Waste	128
5	Cover System	125

Results:

Soil Outputs:

Pipe #	Bedding ht. (ft)	Sand ht. (ft)	Liner Clay ht. (ft)	Waste ht. (ft)[1]	Cover System ht. (ft)	Total Closure Load (psi) [2]
1	3.5	2	2	160	5	**153**
2	2	0	0	47	5	**48**
3	2	0	0	47	5	**48**
4	2	0	0	55	5	**55**

Notes:

(1) Waste height takes into consideration the possibility for a vertical expansion after closure of the proposed expansion.

(2) Total Closure load used to determine pipe's ability to withstand wall crushing excessive deflection and buckling in long term loading scenarios.

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PROJECT / PROPOSAL NAME / LOCATION: WPS Pipe Strength Verification		
PREPARED BY: D. Engstrom	DATE: 11/27/2013	PROJECT / PROPOSAL NO.
CHECKED BY: R. Wienkes	DATE: 12/20/2013	196089.0003

WATKIN'S METHOD
PVC PIPE DESIGN BY RING COMPRESSION AND DEFLECTION
PVC PIPE

Equations (Harrison and Watkins, 1996):

$$C_{ring} = \frac{P_{max} \cdot OD}{2 \cdot t_{min}}$$

$$D_{sidewall} = \frac{F_{max}}{E'_{bedding}}$$

$$\%\ Deflection = \frac{D_{sidewall}}{OD} \cdot 100$$

Variables (units):

C_{ring}= Ring Compression Force (psi)
P_{max}= Maximum Pipe Loading(psi) = F_{max}/OD
OD = Outside Diameter (in)
t_{min}= Minimum Wall Thickness (in) = OD/SDR
SDR = Standard Dimension Ratio
$D_{sidewall}$= Sidewall Deflection (in)
F_{max}= Maximum Load (lb/in) = $P_{max} \cdot OD$
$E'_{bedding}$= Bedding Constrained Modulus (psi)

	PIPE 1	PIPE 2	PIPE 3	PIPE 4	
Inputs:	**6" SCH 80**	**8" SCH 80**	**18" SCH 80**	**3" SCH 120**	
STANDARD DIMENSION RATIO, SDR	15.3	17.3	19.2	9.4	(1)
OUTSIDE DIAMETER, OD (inches)	6.625	8.625	18.000	3.500	(1)
WALL THICKNESS, t_{min} (inches)	0.432	0.500	0.937	0.371	(1)
MAXIMUM PIPE LOADING, P_{max} (psi)	153	48	48	55	(3)
BEDDING CONSTRAINED MODULUS, $E'_{bedding}$ (psi)	2,500	2,400	2,400	2,500	(2)
ALLOWABLE DEFLECTION (%)	7.5%	7.5%	7.5%	7.5%	(4)
PIPE COMPRESSIVE STRENGTH (psi)	**9,000**	**9,000**	**9,000**	**9,000**	(1)
Calculated Values:					
RING COMPRESSIVE FORCE, C_{ring} (psi)	1,174	413	460	259	
FS AGAINST RING COMPRESSION (Min. of 2)	**7.7**	**21.8**	**19.6**	**34.7**	
MAXIMUM LOAD, F_{max} (lb/in)	1,014	413	861	193	
DEFLECTION:SIDEFILL COMP. (in)	0.406	0.172	0.359	0.077	
% DEFLECTION (Max. of 7%)	**6.1%**	**2.0%**	**2.0%**	**2.2%**	

References:
[1] Harvel, 2013
[2] Uni-Bell, 2013. Soil modulus based on the compaction conditions and the stress level from overburden soils.
[3] From closure loading calculations.
[4] LamsonVylon, 2010

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CHECKED BY: R. Wienkes	DATE: 12/20/2013	

WATKIN'S METHOD

HDPE PIPE DESIGN BY RING COMPRESSION AND DEFLECTION

HDPE PIPE

Equations (Harrison and Watkins, 1996):

$$C_{ring} = \frac{P_{max} \cdot OD}{2 \cdot t_{min}}$$

$$D_{sidewall} = \frac{F_{max}}{E'_{bedding}}$$

$$\%\,Deflection = \frac{D_{sidewall}}{OD} \cdot 100$$

Variables (units):

C_{ring}= Ring Compression Force (psi)
P_{max}= Maximum Pipe Loading(psi) = F_{max}/OD
OD = Outside Diameter (in)
t_{min}= Minimum Wall Thickness (in) = OD/SDR
SDR = Standard Dimension Ratio
$D_{sidewall}$= Sidewall Deflection (in)
F_{max}= Maximum Load (lb/in) = P_{max} ·OD
$E'_{bedding}$= Bedding Constrained Modulus (psi)

Inputs:	PIPE 1 6" SDR 11	PIPE 2 8" SDR 17	PIPE 3 18" SDR 17	PIPE 4 3" SDR 11	
STANDARD DIMENSION RATIO, SDR	11.0	17.0	17.0	11.0	(1)
OUTSIDE DIAMETER, OD (inches)	6.625	8.625	18.000	3.500	(1)
WALL THICKNESS, t_{min} (inches)	0.602	0.507	1.059	0.318	(1)
MAXIMUM PIPE LOADING, P_{max} (psi)	153	48	48	55	(3)
BEDDING CONSTRAINED MODULUS, $E'_{bedding}$ (psi)	2,500	2,400	2,400	2,500	(2)
ALLOWABLE DEFLECTION (%)	7.5%	7.5%	7.5%	7.5%	(4)
PIPE COMPRESSIVE STRENGTH (psi)	**3,500**	**3,500**	**3,500**	**3,500**	(5)

Calculated Values:

	PIPE 1	PIPE 2	PIPE 3	PIPE 4
RING COMPRESSIVE FORCE, C_{ring} (psi)	842	407	407	303
FS AGAINST RING COMPRESSION (Min. of 2)	**4.2**	**8.6**	**8.6**	**11.6**
MAXIMUM LOAD, F_{max} (lb/in)	1,014	413	861	193
DEFLECTION:SIDEFILL COMP. (in)	0.406	0.172	0.359	0.077
% DEFLECTION (Max. of 7%)	**6.1%**	**2.0%**	**2.0%**	**2.2%**

References:
(1) Chevron, 2011
(2) Uni-Bell, 2013. Soil modulus based on the compaction conditions and the stress level from overburden soils.
(3) From closure loading calculations.
(4) LamsonVylon, 2010
(5) Pipe compressive strength obtained from Harrison and Watkins, 1996/AECOM, 2012. Maximum allowable stress of 1,000 psi, which includes a factor of safety, (PPI, 2009) was presented in the FR Incompleteness Response Letter (TRC, 2013).

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CHECKED BY: R. Wienkes	DATE: 12/20/2013	

PVC PIPE DESIGN BY BUCKLING PRESSURE

Equations (Lamson Vylon, 2010):

$$P_B = 1.15\sqrt{P_{cr} \cdot E'_{soil}}$$

$$P_{cr} = \frac{.447 \cdot PS}{(1-\nu^2)}$$

$$PS = \frac{6.7 \cdot E'_{pipe} \cdot I}{r^3}$$

Variables (units):

P_B= Confined Buckling Pressure (psi)
P_{cr}= Unconfined Pressure (psi)
$E'_{bedding}$= Soil Modulus (psi)
ν = Poisson's Ratio
PS = Pipe stiffness (psi)
E'_{pipe} =Flexual Modulus (psi)
I= Moment of Intertia (in^3) = $(t_{ave})^3/12$
r=Mean Pipe Radii (in) = $(OD-t_{ave})/2$
t_{ave}= Average Wall Thickness
OD= Outside Diameter

Inputs:

	PIPE 1 6" SCH 80	PIPE 2 8" SCH 80	PIPE 3 18" SCH 80	PIPE 4 3" SCH 120	
STANDARD DIMENSION RATIO, SDR	15.3	17.3	19.2	9.4	(1)(3)
OUTSIDE DIAMETER, OD (inches)	6.625	8.625	18.000	3.500	(1)(3)
INSIDE DIAMETER, ID (inches)	5.709	7.565	16.014	2.758	(1)(3)
MAXIMUM LOAD (psi)	153	44	44	55	(4)
SOIL MODULUS, $E'_{bedding}$ (psi)	2,500	2,400	2,400	2,500	(5)
PIPE FLEXURAL MODULUS, E'_{pipe} (psi)	360,000	360,000	360,000	360,000	(1)(6)
PIPE POISSON'S RATIO, ν	0.41	0.41	0.41	0.41	(1)(3)

Calculated Values:

	PIPE 1	PIPE 2	PIPE 3	PIPE 4
AVERAGE WALL THICKNESS, t_{ave} (inches)	0.458	0.530	0.993	0.371
MOMENT OF INERTIA, I ($inch^3$)	0.008	0.012	0.082	0.004
MEAN RADII, r (inches)	3.084	4.048	8.504	1.565
PIPE STIFFNESS, PS (psi)	658.7	451.3	320.1	2,680.3
UNCONFINED BUCKLING PRESSURE, P_{cr} (psi)	354	242	172	1,440
CONFINED BUCKLING PRESSURE, P_B (psi)	1,082	877	739	2,182
FOS AGAINST BUCKLING (Min. of 2)	**7.1**	**20.2**	**17.0**	**39.7**

References:

(1) Harvel, 2013

(2) Chevron, 2011

(3) Uni-Bell, 2013. Soil modulus based on the compaction conditions and the stress level from overburden soils.

(4) From closure loading calculations.

(5) Lamson Vylon, 2010

(6) ISCO, 2012

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PREPARED BY: D. Engstrom	DATE: 11/27/2013	PROJECT / PROPOSAL NO.
CHECKED BY: R. Wienkes	DATE: 12/20/2013	196089.0003

HDPE PIPE DESIGN BY BUCKLING PRESSURE

Equations (Lamson Vylon, 2010):

$$P_B = 1.15\sqrt{P_{cr} \cdot E'_{soil}}$$

$$P_{cr} = \frac{.447 \cdot PS}{(1-\nu^2)}$$

$$PS = \frac{6.7 \cdot E'_{pipe} \cdot I}{r^3}$$

Variables (units):

P_B= Confined Buckling Pressure (psi)

P_{cr}= Unconfined Pressure (psi)

$E'_{bedding}$= Soil Modulus (psi)

ν = Poisson's Ratio

PS = Pipe stiffness (psi)

E'_{pipe} =Flexual Modulus (psi)

I= Moment of Intertia (in^3) = $(t_{ave})^3/12$

r=Mean Pipe Radii (in) = $(OD-t_{ave})/2$

t_{ave}= Average Wall Thickness

OD= Outside Diameter

	PIPE 1 6" SDR 11	PIPE 2 8" SDR 17	PIPE 3 18" SDR 17	PIPE 4 3" SDR 11	
STANDARD DIMENSION RATIO, SDR	15.3	17.0	17.0	11.0	(1)(3)
OUTSIDE DIAMETER, OD (inches)	6.625	8.625	18.000	3.500	(1)(3)
INSIDE DIAMETER, ID (inches)	5.421	7.611	15.882	2.826	(1)(3)
MAXIMUM LOAD (psi)	153	44	44	55	(4)
SOIL MODULUS, $E'_{bedding}$ (psi)	2,500	2,400	2,400	2,500	(5)
PIPE FLEXURAL MODULUS, E'_{pipe} (psi)	135,000	135,000	135,000	135,000	(1)(6)
PIPE POISSON'S RATIO, ν	0.45	0.45	0.45	0.45	(1)(3)

Calculated Values:

	PIPE 1	PIPE 2	PIPE 3	PIPE 4
AVERAGE WALL THICKNESS, t_{ave} (inches)	0.784	0.507	1.059	0.337
MOMENT OF INERTIA, I ($inch^3$)	0.040	0.011	0.099	0.003
MEAN RADII, r (inches)	2.921	4.059	8.471	1.582
PIPE STIFFNESS, PS (psi)	1,458.2	146.9	147.3	729.3
UNCONFINED BUCKLING PRESSURE, P_{cr} (psi)	817	82	83	409
CONFINED BUCKLING PRESSURE, P_B (psi)	1,644	511	512	1,163
FS AGAINST BUCKLING (Min. of 2)	**10.7**	**11.7**	**11.8**	**21.1**

References:

(1) Harvel, 2013

(2) Chevron, 2011

(3) Uni-Bell, 2013. Soil modulus based on the compaction conditions and the stress level from overburden soils.

(4) From closure loading calculations.

(5) Lamson Vylon, 2010

(6) ISCO, 2012

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT NO.
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: D. Engstrom	Date: 11/22/2013	By: R. Wienkes	Date: 12/24/2013	196089.0003.0000

PIPING AND PERMEABILITY CALCULATIONS FOR LEACHATE AND GRADIENT CONTROL SYSTEMS

Purpose:

The purpose of the piping and permeability calculations is to demonstrate proper filter design at the Weston Disposal Site No. 3. This includes determining the appropriate grain size distributions of the drainage materials. The calculation then verifies that the cover and leachate collection systems are stable self-filtering structures as required by s. NR 504.06(5)(f). In addition, the geotextile for the gradient control system (GCS) and the geocomposite for the cover are analyzed to ensure the surrounding soil is retained.

Methodology:

The filter calculations have been performed using relationships provided in the Naval Facilities Engineering Command (NAVFAC) Design Manual 7.01, Figure 4, pg. 7.1-273 (U.S. Navy, 1986). Sufficient aggregate drainage layer and perforation design can be achieved by satisfying the following criteria:

- The pore space in the soil filter that is in contact with the material being retained is small enough to limit particles from being washed into or through it. Likewise, the perforation size of the collection system pipe will limit pipe bedding material from entering the pipe.

This criteria can be demonstrated through the relationships provided by the NAVFAC Design Manual, comparing the particle sizes of the given materials to one another and to the pipe perforation size. To avoid movement of particles:

$$\frac{D15_F}{D85_B} < 5 \quad (if\ C_u \geq 1.5)$$

$$\frac{D50_F}{D50_B} < 25$$

$$\frac{D15_F}{D15_B} < 20 \quad (if\ C_u \leq 4)$$

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT NO.
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: D. Engstrom	Date: 11/22/2013	By: R. Wienkes	Date: 12/24/2013	196089.0003.0000

To avoid loss of filter (pipe bedding) material into collection pipe perforations:

$$\frac{D85_F}{Hole\ Diameter} > 1.2$$

Where:

D_n = Particle size at which n percent of the given material is finer
F = Filter material
B = Base material (material to be retained)
C_u = Uniformity coefficient = D_{60}/D_{10}

As required by NR 504.06(5)(tm) the leachate collection drainage layer shall have a minimum saturated hydraulic conductivity of 1 x 10^{-2} cm/sec and shall contain no more than 5% material by weight which passes the number 200 sieve. The pipe bedding material must meet the criteria set forth in NR 504.06(5) (e), which specifies that material must have a uniformity coefficient less than 4, the maximum particle size must not be greater than 1.5 inches, and no more than 5% of the material shall pass the number 4 sieve.

The geotextile and geocomposite drainage layer used in the design of the GCS and final cover must be able to adequately retain the existing soil surrounding the aggregate bedded pipe. This is analyzed by comparing the maximum allowable geotextile opening size (O_{95}) to the Apparent Opening Size (AOS) specified by the manufacturer and determined from test procedure ASTM D4751. As described in the MIRAFI Geotextile Filter Design, Application, and Product Selection Guide, O_{95} is determined through the flow chart in Figure 1 using the following soil characteristics:

- Particle sizes at which 10, 20, 30, 50, 60, and 85 percent of the given material is finer (D10, D20, D30, D50, D60, and D85, respectively)
- Plasticity Index (if applicable)
- Dispersivity (if applicable)
- Relative density of the soil

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Assumptions:

Waste Material Properties

For this calculation, it was assumed that the waste at the waste/drainage layer interface will consist of a bottom ash material with physical properties similar to what was submitted in the FR (AECOM, 2012).

Granular Drainage Material Properties

A grain size distribution for a granular drainage layer material for the leachate collection system having a hydraulic conductivity greater than 1×10^{-2} cm/sec has been included with the example grain size distribution reports. Upon construction, the gradation and permeability of the material will be tested to verify that the material meets the requirements set forth in these calculations and the requirements of NR 504.06(5)(tm).

Aggregate Drainage Material Properties

A grain-size distribution for the leachate collection trench aggregate has been included with the example grain size distribution reports. The same material used for the leachate collection trench is expected to be used for the sump aggregate. Laboratory testing will be performed prior to and during the placement of the material to verify the gradation used in these calculations was appropriate and that the requirements specified in NR 504.06(5)(e) are met.

Leachate Collection Pipe Properties

The 8-inch diameter pipe with 3/8-inch-diameter perforation is used in leachate collection trench and a 6-inch pipe with 3/8 inch diameter perforations for the gradient control piping. The 18-inch-diameter sideslope riser pipe will also have 3/8-inch-diameter circular perforations.

Existing and Rooting Zone Soils

Grain-size distributions for the existing soil surrounding the GCS aggregate bedding and proposed rooting zone soils are determined from laboratory testing described in AECOM's Weston Disposal Site No. 3 Feasibility Report. This material is assumed to be non-plastic and have medium relative density ($35\% < I_d < 65\%$).

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WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: D. Engstrom	Date: 11/22/2013	By: R. Wienkes	Date: 12/24/2013	196089.0003.0000

Results:

Piping and permeability analyses are completed for the following scenarios:

- the drainage blanket/waste interface
- the final cover drainage material/rooting zone interface
- and the perforated pipe/sump aggregate

and the following specifications were developed for the drainage materials:

RESULTS		
MATERIAL	**SPECIFICATIONS**	**BASIS FOR CONSTRAINTS**
Granular Drainage Layer Material for Leachate Collection System	D15 <1.19 mm; D50 < 4.5 mm; k > 1×10^{-2} cm/sec; Percent finer #200 <5%	Gradation of the Bottom Ash Material; NR 504.06(5)(tm)
Leachate Collection Trench/Sump Material	D85 > 11.5 mm; C_u < 4; Maximum particle size < 1.5 inches; Percent finer #4 sieve < 5%	Perforation Size (3/8 inch) of Leachate Collection Piping; NR 504.06(5)(e)
GCS Trench Bedding	D85 > 11.5 mm	Perforation Size (3/8 inch) of GWGCS Collection Piping
Final Cover Drainage Layer Material	D15 <3.51 mm; D50 < 17.68 mm; k > 1×10^{-3} cm/sec	Gradation of the Rooting Zone (e.g. surrounding native soil)
Geotextile/Geocomposite	AOS < 2.64 mm	Gradation of Surrounding Native Soil

Laboratory testing will be performed prior to and during the placement of the drainage materials to verify the requirements specified in NR 504.06 are met. At that time, the compatibility of the granular drainage blanket and the leachate pipe bedding material will be verified to ensure a self-filtering design. If the materials do not meet the piping criteria for particle migration, a fine aggregate will be installed between the granular drainage material and the leachate pipe bedding material to prevent the granular drainage material from washing into the leachate pipe bedding aggregate.

A complete listing of the specifications and testing requirements for the drainage materials and the geosynthetics is found in the CQA Plan in Appendix C.

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WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: D. Engstrom	Date: 11/22/2013	By: R. Wienkes	Date: 12/24/2013	196089.0003.0000

References:

AECOM. 2012. Weston Disposal Site No. 3 Expansion, Feasibility Report. Green Bay, WI. 1808 p.

Mirafi. 2013. Geotextile filter design, application, and product selection guide. TenCate Nicolon. Pendgrass, Georgia. 12 p.

U.S. Navy. 1982 Soil Mechanics. Naval Facilities Engineering Command (NAVFAC) design manual DM-7.1. Washington D.C.

Figures

COMPUTATION SHEET

SHEET 1 OF 1

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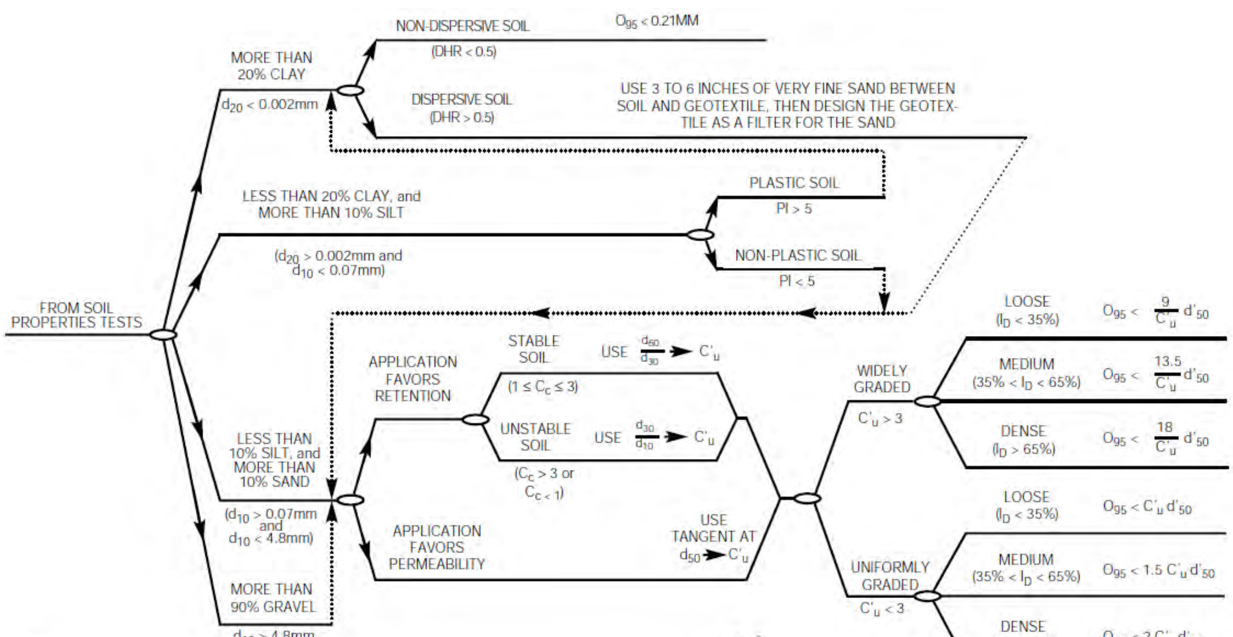
PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT NO.
WPS - Weston Disposal Site No. 3 Expansion – Plan of Operation	By: D. Engstrom	Date: 11/25/2013	By: R. Wienkes	Date: 12/26/2013	196089.0003.0000

FIGURE 1
SOIL RETENTION CRITERIA FOR STEADY STATE FLOW



NOTES:

d_x = particle diameter of which size *x* percent is smaller

$C'_u = \sqrt{\dfrac{d'_{100}}{d'_0}}$ where: d'_{100} and d'_0 are the extremeties of a straight line drawn through the particle-size distribution, as directed above and d'_{50} is the midpoint of this line

$$C_c = \frac{(d_{30})^2}{d_{60} \times d_{10}}$$

I_D = relative density of the soil
PI = plasticity index of the soil
DHR = double-hydrometer ratio of the soil
O_{95} = geotextile opening size

Calculations

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PROJECT: WPS Piping and Permeability Calculation		
PREPARED BY: D. Engstrom	DATE: 11/22/2013	PROJECT / PROPOSAL NO. 196089.0003
CHECKED BY: R. Wienkes	DATE: 12/20/2013	

Piping and Permeability Calculation

Waste (Bottom Ash) / Drainage Layer Material

Input

Base **Waste**[1]

$D15_B$	0.03	mm =	0.0012	inches
$D50_B$	0.18	mm =	0.01	inches
$D85_B$	0.30	mm =	0.01	inches
$D60_B$	0.25	mm =	0.01	inches
$D10_B$	0.02	mm =	0.0008	inches

Filter **Drainage Layer**

Maximum

$D15_F$	1.19	mm	=	0.047	inches
$D50_F$	4.49	mm	=	0.177	inches

Results

Head Loss (Permeability Criteria)

	Actual[2]	Required	Results
k_B	tbd	1×10^{-2} cm/sec	tbd

Particle Migration (Piping Criteria)

	Actual		Required	Results
$D15_F/D85_B$	4.0	<	5.0	OK
$D50_F/D50_B$	24.9	<	25.0	OK
$D15_F/D15_B$	39.7	<	40.0	OK

Notes:

(1) Waste gradation based on laboratory testing on the bottom ash collected from Weston Power Plant.

(2) Permeability will be verified prior to installation of the drainage material.

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PROJECT: WPS Piping and Permeability Calculation		
PREPARED BY: D. Engstrom	DATE: 11/22/2013	PROJECT / PROPOSAL NO.
CHECKED BY: R. Wienkes	DATE: 12/20/2013	196089.0003

Piping and Permeability Calculation

Drainage Material / Collection Pipe

Input

Filter		**Pipe Bedding Material**					**Collection Pipe**		
Minimum							Leachate Collection/GWGCS Pipe		
Leachate/ GWGCS	$D85_F$	11.50	mm	=	0.45	inches	Hole Dia.	0.38	inches
Sump	$D85_F$	11.50	mm	=	0.45	inches	Sideslope Riser Pipe		
							Hole Dia.	0.38	inches

Results

Perforation Size Results (Piping Criteria)

		Actual		Required	Results
Leachate/ GWGCS	$D85_F /_{HOLE}$	1.21	>	1.2	OK
Sump	$D85_F /_{HOLE}$	1.21	>	1.2	OK

Notes:

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PROJECT: WPS Piping and Permeability Calculation		
PREPARED BY: D. Engstrom	DATE: 1/16/2014	PROJECT / PROPOSAL NO.
CHECKED BY: R. Wienkes	DATE: 1/19/2014	196089.0003

Piping and Permeability Calculation

Rooting Zone Material / Cover Drainage Layer Material

Input

Base — Rooting Zone[1]

$D15_B$	0.09	mm =	0.0035	inches
$D50_B$	0.71	mm =	0.03	inches
$D85_B$	2.10	mm =	0.08	inches
$D60_B$	1.00	mm =	0.04	inches
$D10_B$	0.08	mm =	0.0030	inches

Filter — Cover Drainage Layer

Maximum

$D15_F$	3.51	mm =	0.138	inches
$D50_F$	17.68	mm =	0.696	inches

Results

Head Loss (Permeability Criteria)

	Actual	Required	Results
k_B	tbd	1×10^{-3} cm/sec	tbd

Particle Migration (Piping Criteria)

	Actual		Required	Results
$D15_F/D85_B$	1.7	<	5.0	OK
$D50_F/D50_B$	24.9	<	25.0	OK
$D15_F/D15_B$	39.0	<	40.0	OK

Notes:

[1] Rooting zone soil is above the final cover drainage layer soil. Diameter input was determined from Appendix D in AECOM's Weston Disposal Site No. 3 Feasibility Report.

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PROJECT: WPS Piping and Permeability Calculation		
PREPARED BY: D. Engstrom	DATE: 11/25/2013	PROJECT / PROPOSAL NO. 196089.0003
CHECKED BY: R. Wienkes	DATE: 12/20/2013	

Geotextile Filterability Calculation

Existing Soil / Geotextile and Rooting Zone / Geocomposite

Input

Base — **Existing Ground / Rooting Zone** [(1)]

$D50_B$	0.71	mm			
$D85_B$	2.10	mm			
$D60_B$	1.00	mm			
$D30_B$	0.28	mm			
$D10_B$ <	0.075	mm	=	#200	Sieve

Filter — **6 oz. Geotextile** [(2)] **and Geocomposite**

AOS = 0.21 mm

Results

Particle Migration (Piping Criteria) [(4)]

$$C_c = \frac{(D30_B)^2}{D10_B * D60_B} = 1.05$$ Stable

$$C'_u = \frac{D60_B}{D30_B} = 3.57$$ Widely Graded

$$O_{95,\ max} < \frac{13.5 * D50_B}{C'_u} = \mathbf{2.68\ mm}$$

AOS		O_{95} [(3)]	Results
0.21	<	2.68	OK

Notes:

(1) Existing ground is the soil surrounding the geotextile filter around the gradient control pipe aggregate (also used in cover rooting zone). Diameter input was determined from Appendix D in AECOM's Weston Disposal Site No. 3 Feasibility Report.

(2) Geotextile Apparent Opening Size (AOS) is defined in the Construction Quality Assurance Plan.

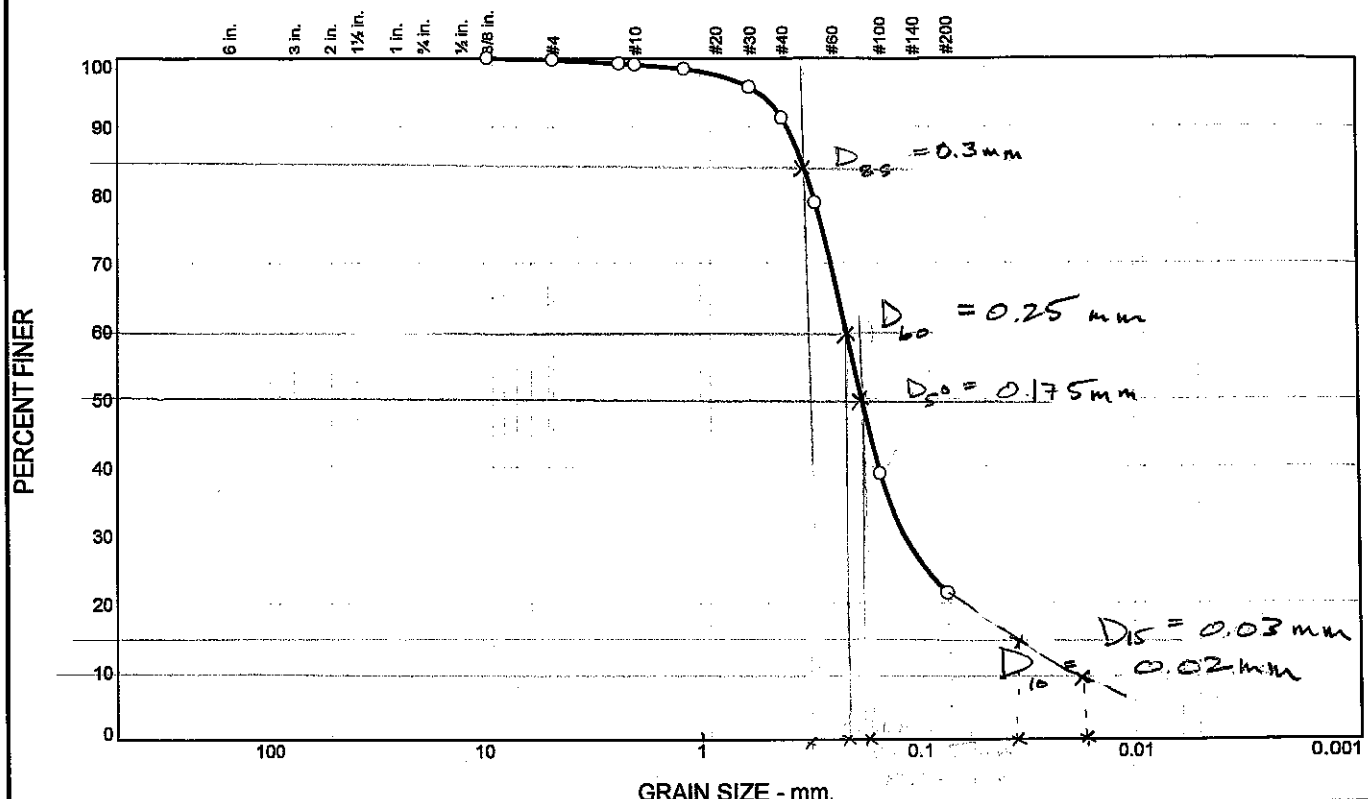
(3) Maximum O_{95} value is for non-plastic soil with 10% or greater fines where the application favors retention. I_D is between 35% and 65% for medium compacted soil.

(4) Refer to Figure 1 for equations used in particle migration evaluation.

Example Grain Size Distributions

WESTON Bottom Ash

Particle Size Distribution Report



% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
0.0	0.0	0.2	0.7	8.0	69.7	21.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.8		
#8	99.2		
#10	99.1		
#16	98.4		
#30	95.7		
#40	91.1		
#50	78.8		
#100	39.0		
#200	21.4		

* (no specification provided)

Material Description

BOTTOM ASH NORTH BASIN

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4054 D_{85}= 0.3462 D_{60}= 0.2168
D_{50}= 0.1843 D_{30}= 0.1171 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

RECEIVED SATURATED

Source of Sample: WESTON
Sample Number: W1&2-BA NORTH BASIN

Date: 07/16/09

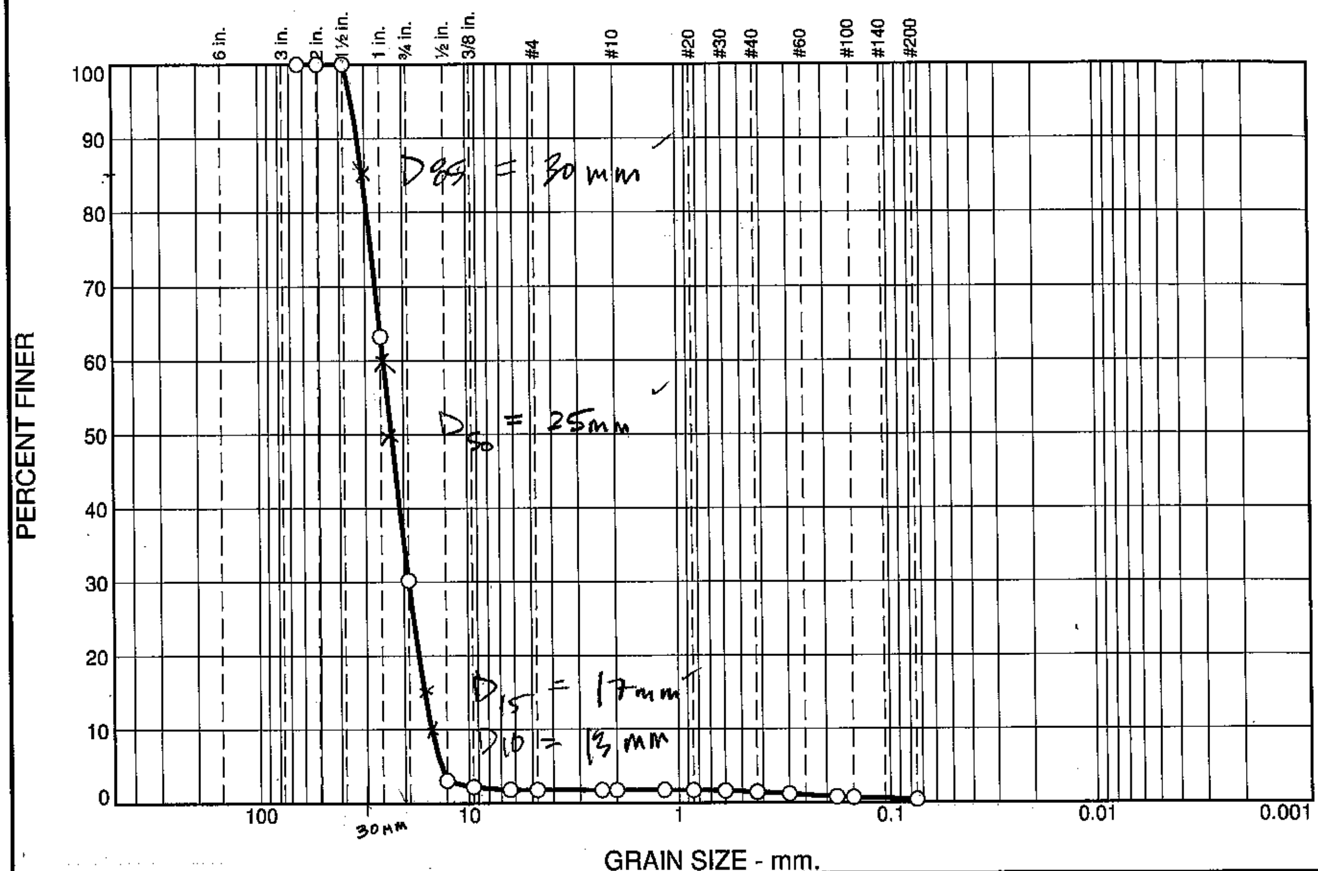
STS | AECOM

Client: WISCONSIN PUBLIC SERVICE
Project: WINNEBAGO COUNTY GAS VENTING
Project No: 60097365 (10535-003) **Figure**

Tested By: MARK MUSIAL

Aggregate (Sample)

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	69.8	28.4				1.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5	100.0		
2.0	100.0		
1.5	100.0		
1.0	63.2		
.75	30.2		
.5	3.1		
.375	2.2		
.25	1.8		
#4	1.8		
#8	1.8		
#10	1.8		
#16	1.8		
#20	1.7		
#30	1.7		
#40	1.5		
#50	1.2		
#80	0.8		
#100	0.7		
#200	0.5		

* (no specification provided)

Material Description

Poorly graded gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 32.4878 D_{85}= 30.7986 D_{60}= 24.7250
D_{50}= 22.7422 D_{30}= 19.0071 D_{15}= 16.0570
D_{10}= 14.9144 C_u= 1.66 C_c= 0.98

Classification

USCS= GP AASHTO=

Remarks

Source of Sample: Select Aggregate Fill
Sample Number: Sample #1

Date: 06-20-13

TRC Environmental Corp. Madison, Wisconsin	Client: Project: Project No: Figure

Existing Ground

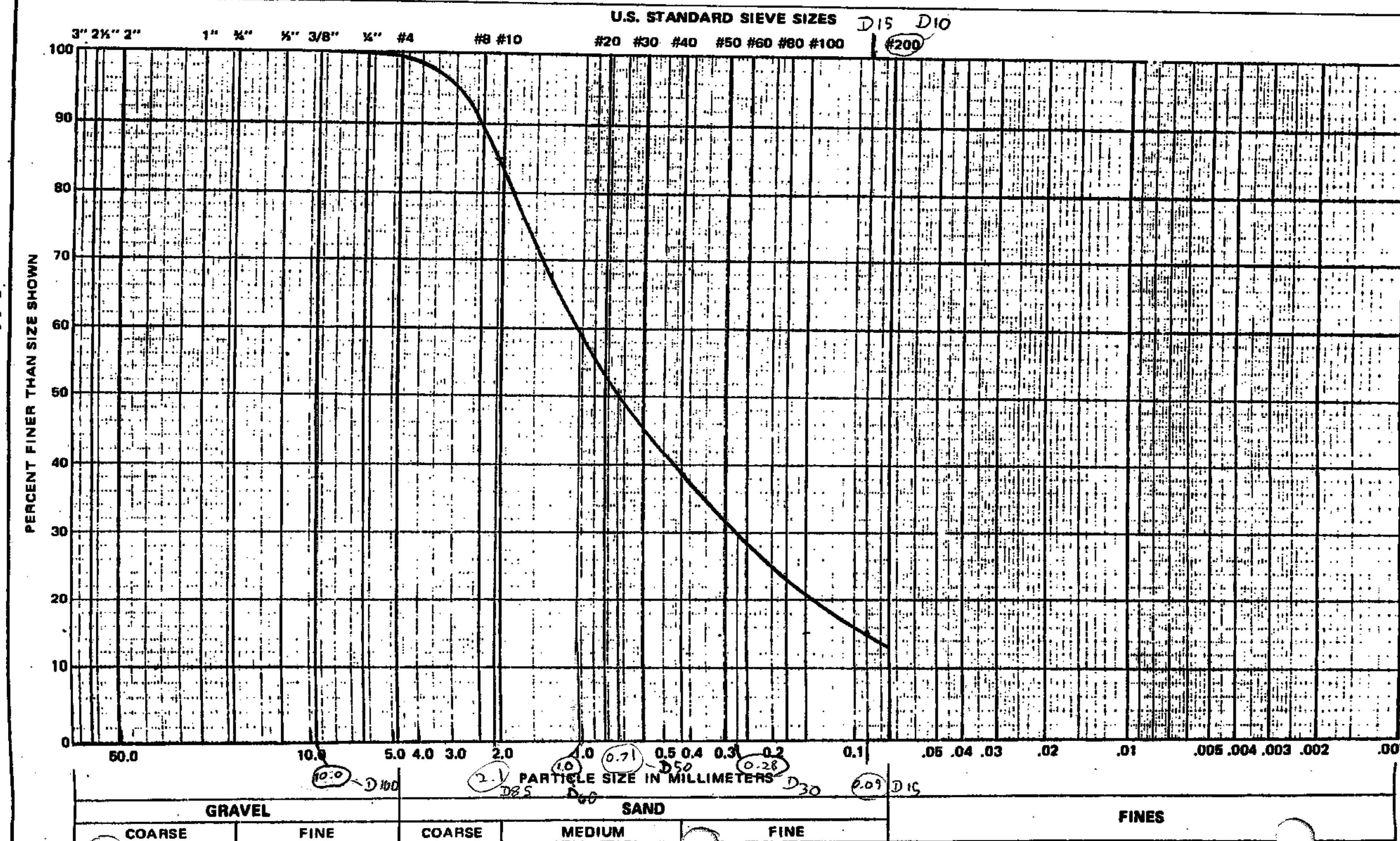
TWIN CITY TESTING AND ENGINEERING LABORATORY, INC.

Sample No. B-8, S-2
Classification (ASTM:D2487) SM
Description SILTY SAND

Project: PROPOSED LANDFILL
KNOWLTON, WISCONSIN

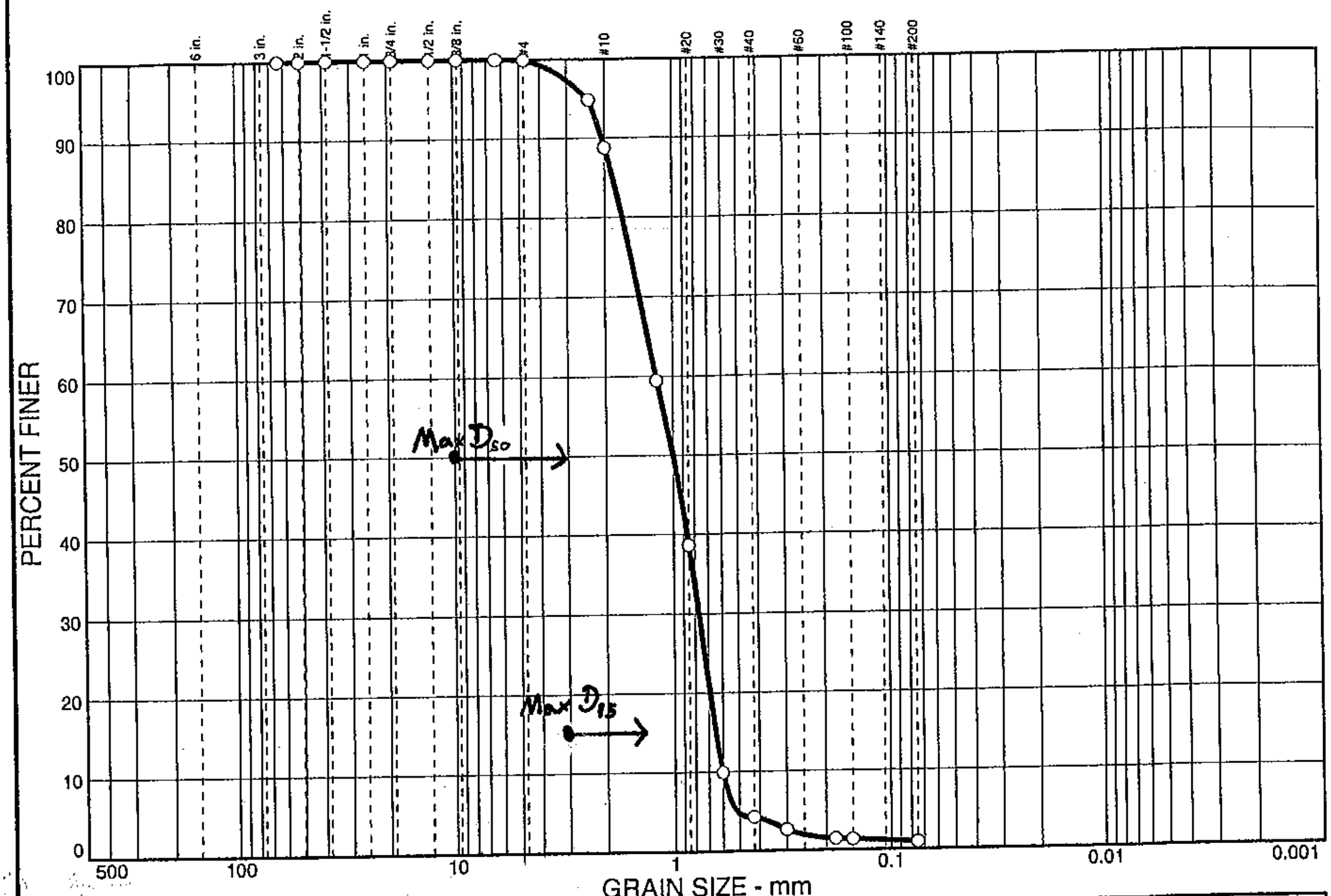
Reported To: Donohue & Associates, Inc

GRAIN SIZE DISTRIBUTION CURVE



Example Cover Drainage Material

GRAIN SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.1	99.0	0.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5 in.	100.0		
2.0 in.	100.0		
1.5 in.	100.0		
1.0 in.	100.0		
.75 in.	100.0		
.5 in.	100.0		
.375 in.	100.0		
.25 in.	100.0		
#4	99.9		
#8	94.8		
#10	88.7		
#16	59.4		
#20	38.6		
#30	9.9		
#40	4.2		
#50	2.6		
#80	1.4		
#100	1.3		
#200	0.9		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.84 D_{60}= 1.19 D_{50}= 1.00
D_{30}= 0.771 D_{15}= 0.649 D_{10}= 0.601
C_u= 1.98 C_c= 0.83

Classification

USCS= SP AASHTO=

Remarks

Sample No.: **Source of Sample:** Select Granular Fill **Date:**
Location: COVER HYDRAULIC CONDUCTIVITY > 1 X 10^{-3} cm/sec **Elev./Depth:**

Client:
Project:
Project No: **Figure:**

Appendix I

Final Cover Design Calculations

Calculation Cover Sheet

Project Weston Disposal Site No. 3 Expansion | Division Environment

Subject HELP Analysis of Proposed Liner and Cover | File No. ____________

Job No. 60186058 | Calc. No. ____________

Originator Karl M. Krueger | Date 7/12/2012

Reviewed Mark J. Vannieuwenhoven Date 7/12/12 No. of Sheets 53

RECORD OF ISSUES							
NO.	DESCRIPTION	BY	DATE	CHKD.	DATE	APPRD	DATE
1	Permitted Base Liner	KMK	6/29/12	MJV	6/29/12		
2	Proposed 2' Clay/Geomembrane	KMK	7/12/12	MJV	7/12/12		
3	Proposed 2'SBL/GCL/Geomembrane	KMK	7/12/12	MJV	7/12/12		
4	Permitted Cover	KMK	7/12/12	MJV	7/12/12		
5	Proposed Cover (clay/geomembrane)	KMK	7/12/12	MJV	7/12/12		
6	Proposed Cover (SBL/GCL/geomembrane)	KMK	7/12/12	MJV	7/12/12		
7	Proposed Cover (fly ash/geomembrane)	KMK	7/12/12	MJV	7/12/12		

PRELIMINARY CALC. □ SUPERCEDED CALC. □ FINAL CALC. X

BRIEF SUMMARY OF CALCULATIONS INCLUDING SCOPE AND RESULTS

The Hydrologic Evaluation of Landfill Performance (HELP) Model, version 3.07, was utilized to predict the percolation rate through the permitted components of the existing landfill final cover systems. According to the model predictions, the following rates of percolation can be expected through the various permitted and proposed alternative base liner or final cover cross-sections:

Liner Location	Description	Percolation Rate Through Liner
Base	Permitted 5-foot-thick clay liner	1.29 in/yr
Base	Two foot compacted clay liner and 60-mil geomembrane composite liner	0.0011 in/yr
Base	Two foot soil barrier layer, GCL, and 60-mil geomembrane composite liner	0.00025 in/yr
Cover	Permitted 2-foot compacted clay and 6 inches of topsoil	0.92 in/yr
Cover	Two foot compacted clay and 40-mil geomembrane composite cover	0.00 in/yr
Cover	Two foot soil barrier, GCL, and 40-mil geomembrane composite cover	0.00 in/yr
Cover	Two foot compacted fly ash and Geomembrane composite cover	0.00001 in/yr

Calculation Cover Sheet

Project Weston Disposal Site No. 3 Expansion | Division Environment

Subject HELP Analysis of Proposed Liner and Cover | File No. ______

Job No. 60186058 | Calc. No. ______

Originator Karl M. Krueger | Date 7/12/2012

Reviewed Mark J. Vannieuwenhoven Date 7/12/12 | No. of Sheets 53

The HELP Model was also used to estimate the leachate generation rate for both the open and closed phase of the project. The following leachate generation rates can be expected within the proposed landfill:

- Open Phase – 10.96 inches per year, with a peak generation rate of 0.242 inches per day.
- Closed Phase – 0.0000 inches per year (Note: a minimum of 1 inch per year shall be used for all closed areas of landfills that will have a composite cap – NR 512.12).

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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EVAPOTRANSPIRATION DATA:    G:\04DEPT03\USERS\VANN\HELP30~1\GB_CLOSE.D11
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OUTPUT DATA FILE:           G:\04DEPT03\USERS\VANN\HELP30~1\PERMCAP.OUT


TIME:  13:12     DATE:   7/12/2012


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     TITLE:  PERMITTED FINAL COVER (2' CLAY AND 6" TOPSOIL)

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   8
           THICKNESS                 =      6.00   INCHES
           POROSITY                  =      0.4630 VOL/VOL
           FIELD CAPACITY            =      0.2320 VOL/VOL
           WILTING POINT             =      0.1160 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.4524 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.369999994000E-03 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 30

THICKNESS	=	720.00 INCHES
POROSITY	=	0.5410 VOL/VOL
FIELD CAPACITY	=	0.1870 VOL/VOL
WILTING POINT	=	0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1876 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 420. FEET.

SCS RUNOFF CURVE NUMBER	=	79.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	6.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.715	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	2.778	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.696	INCHES
INITIAL SNOW WATER	=	0.416	INCHES
INITIAL WATER IN LAYER MATERIALS	=	148.013	INCHES
TOTAL INITIAL WATER	=	148.429	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
GREEN BAY WISCONSIN

STATION LATITUDE	=	44.29 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	130
END OF GROWING SEASON (JULIAN DATE)	=	275
EVAPORATIVE ZONE DEPTH	=	6.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.19	1.05	1.90	2.70	3.13	3.17
3.25	3.16	3.17	2.10	1.76	1.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.00	17.80	28.60	43.70	55.10	64.70
69.50	67.50	58.90	48.40	34.20	20.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN
AND STATION LATITUDE = 44.29 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.00	1.03	2.01	2.68	3.18	3.26
	3.75	3.13	3.03	2.00	1.96	1.35
STD. DEVIATIONS	0.48	0.64	0.83	1.24	1.56	1.63

	1.89	1.38	1.32	0.96	0.87	0.66

RUNOFF

TOTALS	0.059	0.349	2.291	2.054	0.310	0.073
	0.238	0.095	0.216	0.289	0.539	0.235
STD. DEVIATIONS	0.119	0.384	1.207	1.330	0.530	0.220
	0.531	0.361	0.516	0.582	0.833	0.356

EVAPOTRANSPIRATION

TOTALS	0.453	0.428	0.426	1.480	3.373	3.597
	3.457	2.736	2.252	1.362	0.740	0.395
STD. DEVIATIONS	0.078	0.090	0.123	0.840	1.130	1.461
	1.452	1.162	0.792	0.338	0.210	0.100

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.0985	0.0545	0.0749	0.1032	0.1055	0.0498
	0.0314	0.0276	0.0579	0.0994	0.1092	0.1080
STD. DEVIATIONS	0.0254	0.0309	0.0327	0.0129	0.0200	0.0282
	0.0296	0.0276	0.0421	0.0386	0.0260	0.0215

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0491	0.0410	0.0257	0.0208	0.0311	0.0345
	0.0274	0.0249	0.0167	0.0153	0.0293	0.0464
STD. DEVIATIONS	0.0328	0.0311	0.0237	0.0174	0.0247	0.0355
	0.0280	0.0222	0.0167	0.0154	0.0247	0.0318

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.3816	0.0898	0.1952	1.3748	1.9579	0.8896
	0.6279	0.5154	1.4681	2.6794	3.3742	1.5559
STD. DEVIATIONS	0.1735	0.0843	0.1262	0.9098	1.1410	0.9197
	0.7272	0.6091	1.4234	1.7249	1.8384	1.0535

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES		CU. FEET	PERCENT
PRECIPITATION	28.37	(4.313)	102972.2	100.00

RUNOFF	6.750	(2.3911)	24501.21	23.794
EVAPOTRANSPIRATION	20.699	(3.0717)	75138.91	72.970
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.91982	(0.13089)	3338.948	3.24257
AVERAGE HEAD ON TOP OF LAYER 2	1.259	(0.437)		
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.36212	(0.22793)	1314.505	1.27656
CHANGE IN WATER STORAGE	0.556	(1.0005)	2017.58	1.959

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	3.53	12813.899
RUNOFF	2.218	8049.5776
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.004252	15.43442
AVERAGE HEAD ON TOP OF LAYER 2	6.000	
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.006132	22.25838
SNOW WATER	4.87	17664.7324

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4630
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1160

****

****

FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	2.6828	0.4471
2	10.2480	0.4270
3	157.3583	0.2186
SNOW WATER	0.372	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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SOLAR RADIATION DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\GB.D13
EVAPOTRANSPIRATION DATA:    G:\04DEPT03\USERS\VANN\HELP30~1\GB_CLOSE.D11
SOIL AND DESIGN DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\CLAYCAP.D10
OUTPUT DATA FILE:           G:\04DEPT03\USERS\VANN\HELP30~1\CLAYCAP.OUT


TIME:  13: 9     DATE:   7/12/2012


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

     TITLE:  FINAL COVER (2' COMPACTED CLAY AND 40-MIL LLDPE)

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   8
           THICKNESS                    =      6.00   INCHES
           POROSITY                     =      0.4630 VOL/VOL
           FIELD CAPACITY               =      0.2320 VOL/VOL
           WILTING POINT                =      0.1160 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.3511 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.369999994000E-03 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

```
                    LAYER  2
                    --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   6
THICKNESS                 =     24.00   INCHES
POROSITY                  =      0.4530 VOL/VOL
FIELD CAPACITY            =      0.1900 VOL/VOL
WILTING POINT             =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT =     0.2109 VOL/VOL
EFFECTIVE SAT. HYD. COND.  = 0.720000011000E-03 CM/SEC


                    LAYER  3
                    --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  34
THICKNESS                 =      0.25   INCHES
POROSITY                  =      0.8500 VOL/VOL
FIELD CAPACITY            =      0.0100 VOL/VOL
WILTING POINT             =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT =     0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  33.0000000000     CM/SEC
SLOPE                     =      5.00   PERCENT
DRAINAGE LENGTH           =    420.0    FEET


                    LAYER  4
                    --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  36
THICKNESS                 =      0.04   INCHES
POROSITY                  =      0.0000 VOL/VOL
FIELD CAPACITY            =      0.0000 VOL/VOL
WILTING POINT             =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.  = 0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY       =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS  =      1.00   HOLES/ACRE
FML PLACEMENT QUALITY     =  3 - GOOD


                    LAYER  5
                    --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                 =     24.00   INCHES
POROSITY                  =      0.4270 VOL/VOL
FIELD CAPACITY            =      0.4180 VOL/VOL
WILTING POINT             =      0.3670 VOL/VOL
```

```
          INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC
```

```
                                  LAYER  6
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  30
          THICKNESS                   =    720.00   INCHES
          POROSITY                    =      0.5410 VOL/VOL
          FIELD CAPACITY              =      0.1870 VOL/VOL
          WILTING POINT               =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.1870 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.499999987000E-04 CM/SEC
```

```
                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ----------------------------------------

        NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                 SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A
                 FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
                 AND A SLOPE LENGTH OF  420. FEET.

       SCS RUNOFF CURVE NUMBER              =     79.30
       FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
       EVAPORATIVE ZONE DEPTH               =     18.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE    =      4.887  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE   =      8.214  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.716  INCHES
       INITIAL SNOW WATER                   =      0.416  INCHES
       INITIAL WATER IN LAYER MATERIALS     =    152.058  INCHES
       TOTAL INITIAL WATER                  =    152.473  INCHES
       TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

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                     EVAPOTRANSPIRATION AND WEATHER DATA
                     -----------------------------------

        NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                 GREEN BAY             WISCONSIN

            STATION LATITUDE                         =  44.29 DEGREES
            MAXIMUM LEAF AREA INDEX                  =   3.50
            START OF GROWING SEASON (JULIAN DATE)    =    130
            END OF GROWING SEASON (JULIAN DATE)      =    275
            EVAPORATIVE ZONE DEPTH                   =  18.0  INCHES
            AVERAGE ANNUAL WIND SPEED                =  10.10 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  73.00 %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  68.00 %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  74.00 %
```

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.19	1.05	1.90	2.70	3.13	3.17
3.25	3.16	3.17	2.10	1.76	1.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.00	17.80	28.60	43.70	55.10	64.70
69.50	67.50	58.90	48.40	34.20	20.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN
AND STATION LATITUDE = 44.29 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.00	1.03	2.01	2.68	3.18	3.26
	3.75	3.13	3.03	2.00	1.96	1.35
STD. DEVIATIONS	0.48	0.64	0.83	1.24	1.56	1.63
	1.89	1.38	1.32	0.96	0.87	0.66
RUNOFF						
TOTALS	0.016	0.118	1.361	1.415	0.085	0.007
	0.048	0.018	0.008	0.020	0.058	0.041
STD. DEVIATIONS	0.054	0.179	0.918	1.134	0.230	0.021
	0.115	0.046	0.026	0.116	0.193	0.136

EVAPOTRANSPIRATION

TOTALS	0.453	0.428	0.439	1.439	3.363	4.106
	3.560	2.703	2.140	1.204	0.642	0.389
STD. DEVIATIONS	0.078	0.090	0.119	0.792	1.040	1.409
	1.597	1.152	0.753	0.258	0.187	0.095

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0816	0.0101	0.0000	1.1656	1.3148	0.2903
	0.1890	0.0704	0.1183	0.3061	0.4216	0.3339
STD. DEVIATIONS	0.0848	0.0209	0.0000	0.8630	0.8156	0.1997
	0.2436	0.1133	0.3185	0.5703	0.6180	0.3757

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0001	0.0000	0.0000	0.0017	0.0019	0.0004
	0.0003	0.0001	0.0002	0.0004	0.0006	0.0005
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0013	0.0012	0.0003
	0.0004	0.0002	0.0005	0.0008	0.0009	0.0005

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.37 (4.313)	102972.2	100.00
RUNOFF	3.195 (1.5720)	11597.08	11.262

EVAPOTRANSPIRATION	20.865	(3.0937)	75739.80	73.554
LATERAL DRAINAGE COLLECTED FROM LAYER 3	4.30167	(1.50664)	15615.052	15.16434
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000	(0.00000)	0.010	0.00001
AVERAGE HEAD ON TOP OF LAYER 4	0.001	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000	(0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.006	(1.2700)	20.26	0.020

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             PEAK DAILY VALUES FOR YEARS    1 THROUGH   40
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                               3.53        12813.899

      RUNOFF                                      2.036        7392.3901

      DRAINAGE COLLECTED FROM LAYER  3            0.71618      2599.72266

      PERCOLATION/LEAKAGE THROUGH LAYER  5        0.000000        0.00019

      AVERAGE HEAD ON TOP OF LAYER  4             0.032

      MAXIMUM HEAD ON TOP OF LAYER  4             0.065

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)                 0.0 FEET

      PERCOLATION/LEAKAGE THROUGH LAYER  6        0.000000        0.00000

      SNOW WATER                                  4.87        17664.7324


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                   0.4079

      MINIMUM VEG. SOIL WATER (VOL/VOL)                   0.0953


       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	2.0659	0.3443
2	5.3684	0.2237
3	0.0028	0.0110
4	0.0000	0.0000
5	10.2480	0.4270
6	134.6398	0.1870
SNOW WATER	0.372	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**               FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    G:\04DEPT03\USERS\VANN\HELP30~1\GB.D4
TEMPERATURE DATA FILE:      G:\04DEPT03\USERS\VANN\HELP30~1\GB.D7
SOLAR RADIATION DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\GB.D13
EVAPOTRANSPIRATION DATA:    G:\04DEPT03\USERS\VANN\HELP30~1\GB_CLOSE.D11
SOIL AND DESIGN DATA FILE:  G:\04DEPT03\USERS\VANN\HELP30~1\SBLCAP.D10
OUTPUT DATA FILE:           G:\04DEPT03\USERS\VANN\HELP30~1\SBLCAP.OUT


TIME:  13: 7     DATE:   7/12/2012


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

     TITLE:  FINAL COVER (2' SBL, GCL, AND 40-MIL GEOMEMBRANE)

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


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   8
           THICKNESS                   =      6.00   INCHES
           POROSITY                    =      0.4630 VOL/VOL
           FIELD CAPACITY              =      0.2320 VOL/VOL
           WILTING POINT               =      0.1160 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.3511 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.369999994000E-03 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1900 VOL/VOL
WILTING POINT	=	0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2109 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.720000011000E-03 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 34

THICKNESS	=	0.25 INCHES
POROSITY	=	0.8500 VOL/VOL
FIELD CAPACITY	=	0.0100 VOL/VOL
WILTING POINT	=	0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	33.0000000000 CM/SEC
SLOPE	=	5.00 PERCENT
DRAINAGE LENGTH	=	420.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.24 INCHES
POROSITY	=	0.7500 VOL/VOL
FIELD CAPACITY	=	0.7470 VOL/VOL
WILTING POINT	=	0.4000 VOL/VOL

```
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000003000E-08 CM/SEC


                        LAYER  6
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  23
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4610 VOL/VOL
FIELD CAPACITY              =      0.3600 VOL/VOL
WILTING POINT               =      0.2030 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3600 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.900000032000E-05 CM/SEC


                        LAYER  7
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  30
THICKNESS                   =    720.00   INCHES
POROSITY                    =      0.5410 VOL/VOL
FIELD CAPACITY              =      0.1870 VOL/VOL
WILTING POINT               =      0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1870 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999987000E-04 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A
           FAIR STAND OF GRASS, A SURFACE SLOPE OF  5.%
           AND A SLOPE LENGTH OF  420. FEET.

SCS RUNOFF CURVE NUMBER            =     79.30
FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     18.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      4.887  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      8.214  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      1.716  INCHES
INITIAL SNOW WATER                 =      0.416  INCHES
INITIAL WATER IN LAYER MATERIALS   =    150.630  INCHES
TOTAL INITIAL WATER                =    151.045  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
GREEN BAY WISCONSIN

STATION LATITUDE	=	44.29 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	130
END OF GROWING SEASON (JULIAN DATE)	=	275
EVAPORATIVE ZONE DEPTH	=	18.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.19	1.05	1.90	2.70	3.13	3.17
3.25	3.16	3.17	2.10	1.76	1.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.00	17.80	28.60	43.70	55.10	64.70
69.50	67.50	58.90	48.40	34.20	20.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR GREEN BAY WISCONSIN
AND STATION LATITUDE = 44.29 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						

TOTALS	1.00	1.03	2.01	2.68	3.18	3.26
	3.75	3.13	3.03	2.00	1.96	1.35
STD. DEVIATIONS	0.48	0.64	0.83	1.24	1.56	1.63
	1.89	1.38	1.32	0.96	0.87	0.66

RUNOFF

TOTALS	0.016	0.118	1.361	1.415	0.085	0.007
	0.048	0.018	0.008	0.020	0.058	0.041
STD. DEVIATIONS	0.054	0.179	0.918	1.134	0.230	0.021
	0.115	0.046	0.026	0.116	0.193	0.136

EVAPOTRANSPIRATION

TOTALS	0.453	0.428	0.439	1.439	3.363	4.106
	3.560	2.703	2.140	1.204	0.642	0.389
STD. DEVIATIONS	0.078	0.090	0.119	0.792	1.040	1.409
	1.597	1.152	0.753	0.258	0.187	0.095

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0816	0.0101	0.0000	1.1656	1.3148	0.2903
	0.1890	0.0704	0.1183	0.3061	0.4216	0.3339
STD. DEVIATIONS	0.0848	0.0209	0.0000	0.8630	0.8156	0.1997
	0.2436	0.1133	0.3185	0.5703	0.6180	0.3757

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0001	0.0000	0.0000	0.0017	0.0019	0.0004
	0.0003	0.0001	0.0002	0.0004	0.0006	0.0005
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0013	0.0012	0.0003
	0.0004	0.0002	0.0005	0.0008	0.0009	0.0005

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.37 (4.313)	102972.2	100.00
RUNOFF	3.195 (1.5720)	11597.08	11.262
EVAPOTRANSPIRATION	20.865 (3.0937)	75739.80	73.554
LATERAL DRAINAGE COLLECTED FROM LAYER 3	4.30167 (1.50664)	15615.052	15.16434
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 4	0.001 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.000	0.00000
CHANGE IN WATER STORAGE	0.006 (1.2700)	20.26	0.020

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	3.53	12813.899
RUNOFF	2.036	7392.3901
DRAINAGE COLLECTED FROM LAYER 3	0.71618	2599.72266
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00006
AVERAGE HEAD ON TOP OF LAYER 4	0.032	
MAXIMUM HEAD ON TOP OF LAYER 4	0.065	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00000
SNOW WATER	4.87	17664.7324
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4079	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0953	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	2.0659	0.3443
2	5.3684	0.2237
3	0.0028	0.0110
4	0.0000	0.0000
5	0.1800	0.7500
6	8.6400	0.3600
7	134.6398	0.1870
SNOW WATER	0.372	

****
****

708 Heartland Trail, Suite 3000, Madison, WI 53717 (608) 826-3600 FAX: (608) 826-3941

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

GEOSYNTHETIC INTERFACE SLOPE STABILITY

Purpose:

The purpose of this analysis is to evaluate the stability of the liner and cover system against slippage along the interfaces between materials including the geomembrane, geosynthetic layers and adjacent soils, in accordance with NR 516.04(5)(c).

Methodology:

The infinite slope interface stability was evaluated for the other proposed slopes using the procedures outlined in *Influence of Water Flow on the Stability of Geosynthetic-Soil Layered Systems on Slopes* (Giroud, Bachus, and Bonaparte, 1995) for conditions with and without water at the interface. The system is modeled similar to a block sliding on an inclined plane. The weight of the soil and water (if present) provide the driving forces where the strength of the interface resists the downslope movement. The stability is analyzed for the critical conditions for the proposed landfill geometry. Because a total of six cover options are presented, a simplified calculation is performed for each geometry where the critical interface values above and below the geomembrane are evaluated. The geomembrane is used as the reference point because excess pore pressures are anticipated above the geomembrane, but not below the geomembrane. A graphical solution showing the minimum interface strength values needed is provided for the conditions analyzed.

Assumptions and Inputs:

Liner Design and Slope Geometry

The liner systems consist of the following (top to bottom), as shown in Detail 1 of Sheet 21,

- drainage sand over a 60-mil high density polyethylene (HDPE) geomembrane (textured on the perimeter berms),
- 60-mil HDPE geomembrane (textured on the perimeter berm slopes) over geosynthetic clay liner (GCL), and
- GCL over 2-foot-thick compacted clay liner.

The critical slope geometry of the base and sideslope is as follows (refer to Plan Sheet 5 of the POO) (refer to Figure 2)

- 3H:1V sideslope with a maximum height of 20 feet, and
- Maximum base slope of 3.48 percent (conservatively, a 10 percent slope was analyzed based on the possible waving of geosynthetic interface testing on slopes less than 10 percent per NR 516.04(5)(c)).

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

Final Cover Design and Slope Geometry Configurations

Three final cover configurations are proposed each using a geocomposite drainage layer. In addition, a 1-foot-thick select granular fill drainage layer is being considered for each final cover configuration for a total of 6 final cover configurations. The final cover systems consist of the following (top to bottom), as shown in Detail 1 of Sheet 27.

- Option 1:
  - 6-inch-thick topsoil layer
  - 2.5-foot-thick general fill layer
  - Geocomposite drainage layer or 1-foot-thick select granular fill drainage layer
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on 4H:1V slopes; smooth on 5% slopes)
  - GCL
  - 2-foot-thick compacted fine-grained soil layer
- Option 2:
  - 6-inch-thick topsoil layer
  - 2.5-foot-thick general fill layer
  - Geocomposite drainage layer or 1-foot-thick select granular fill drainage layer
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on 4H:1V slopes; smooth on 5 percent slopes)
  - 2-foot-thick compacted select clay fill layer
- Option 3:
  - 6-inch-thick topsoil layer
  - 2.5-foot-thick general fill layer
  - Geocomposite drainage layer or 1-foot-thick select granular fill drainage layer
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane (textured on 4H:1V slopes; smooth on 5 percent slopes)
  - 2-foot thick compacted fly ash layer

Interface Strength Parameters

Interface shear strength test results were not available for the specific materials in the liner and cover systems. Due to the preliminary nature of the design, reference interface strength values were used for comparable materials from a TRC database of interface test results. Interface

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

shear tests will be performed on the materials specified for construction prior to shipment to the site. The table below presents the assumed interface strength values considered for the analysis.

Interface Friction Test Results

LINER COVER OPTION	INTERFACE DESCRIPTION	HEAD ON INTERFACE	PEAK STRENGTH FRICTION ANGLE (degrees)	PEAK STRENGTH ADHESION (psf)	HIGH DISP. STRENGTH FRICTION ANGLE (degrees)	HIGH DISP. STRENGTH ADHESION (psf)
Liner System	***Select granular fill drainage layer over textured 60-mil HDPE geomembrane (select granular fill drainage layer over smooth 60-mil HDPE geomembrane – base grades)***	***Yes***	***30 (21)***	***10 (10)***	***19 (18)***	***40 (10)***
	Textured 60-mil HDPE geomembrane over GCL ***(smooth 60-mil HDPE geomembrane over GCL – base grades)***	No	37 ***(11)***	2 ***(5)***	26 ***(6)***	5 ***(2)***
	GCL over clay liner	***No***	***24***	***4***	***21***	***4***
Cover Option 1	General fill over geocomposite drainage layer (1)	Yes	30	55	8	112
	Geocomposite drainage layer over textured 40-mil LLDPE geomembrane ***(geocomposite drainage layer over smooth 40-mil LLDPE geomembrane – 5% slopes) (1)***	Yes	37 ***(11)***	2 ***(5)***	26 ***(6)***	5 ***(2)***
	Select granular fill drainage layer over textured 40-mil LLDPE geomembrane (select granular fill drainage layer over smooth 40-mil LLDPE geomembrane – 5% slopes) (1)	Yes	***30*** (21)	***10*** (10)	***19*** (18)	***40*** (10)
	Textured 40-mil LLDPE geomembrane over GCL ***(smooth 40-mil LLDPE geomembrane over GCL – 5% slopes)***	No	37 ***(11)***	2 ***(5)***	26 ***(6)***	5 ***(2)***
	GCL over compacted fine-grained soil	***No***	***24***	***4***	***21***	***22***
Cover Option 2	Textured 40-mil LLDPE geomembrane over compacted select clay (smooth 40-mil LLDPE geomembrane over compacted select clay – 5% slopes)	No	23 (12)	40 (54)	21 (7)	18 (98)
Cover Option 3	Textured 40-mil LLDPE geomembrane over fly ash (smooth 40-mil LLDPE geomembrane over fly ash – 5% slopes)	No	30 (20)	20 (50)	19 (18)	40 (10)

Notes:

(1) These interfaces are the same for each cover option; therefore, the values are not repeated in this table.

(2) Critical interfaces used in the simplified analysis are bold and italicized.

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
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The strengths of the interfaces are provided in terms of peak and high displacement strengths. High displacement strengths are representative of an interface where some movement has occurred during installation of the geosynthetics, placement of soil or waste, or another factor such as seismic activity. The analyses were performed considering both the peak and high displacement strength values.

Slope Stability Analysis

The analysis assumes the following:

- Slope failures slide as a block.
- The soil above the geosynthetic being evaluated is free draining and has a uniform thickness.
- No geosynthetics tensile reinforcement is included in the slope.
- Water is assumed on the interfaces located above the geomembrane.
- The interfaces below the geomembrane do not include head on the interface.

Head on the interface

The water thickness for the liner system (above the geomembrane) was assumed to be 0.5 feet at the perimeter berm slopes and 1.0 feet for the base slopes. For the final cover configurations the water thickness was assumed to be 1.0 feet on the 4H:1V slopes and the 5 percent slopes for the geocomposite drainage layer and select granular fill drainage blanket conditions based on the "Water Balance Analysis" provided in this Appendix.

Results:

Several conditions were analyzed to capture the most critical interface conditions. The results of each analysis are presented for the strength inputs in the table below. In addition, a graphical solution for the required interface strength values above and below the geomembrane are provided for the liner and final cover geometries analyzed at a factor of safety of 1.3. The values in the graphs must be exceeded by the interface strength test results. The results of the interface testing should be compared to the graphical solutions presented in the calculations by a qualified professional engineer who understands the assumptions inherent to the calculations. A minimum factor of safety of 1.4 was calculated for the GCL interface over the clay liner in the liner perimeter berm. Lower factor of safety values were calculated using the high displacement strength; however, all cases indicate that the factor of safety is greater than 1.0 for the high displacement condition which is considered acceptable because mechanisms to activate the high displacement condition are not anticipated at the site (e.g. seismic conditions and cover soil placement techniques).

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	By: J. Hotstream	Date: 12/20/2013	By: N. Bower	Date: 1/13/2014	196089.0003.0000

CONDITION EVALUATED	INTERFACE DESCRIPTION[1]	FACTOR OF SAFETY	
		PEAK	HIGH DISP.
Liner perimeter berm – 3H:1V slope 0.5 feet of water on upper interface	Select granular fill drainage layer over textured 60-mil HDPE geomembrane	1.6	1.8
	GCL over clay liner	1.4	1.3
Liner base – Up to a 10 percent slope 1.0 foot of water on upper interface	Select granular fill drainage layer over smooth 60-mil HDPE geomembrane	2.8	2.5
	Smooth 60-mil HDPE geomembrane over GCL	2.3	1.2
Final cover – 4H:1V slope 1.0 foot of water on upper interface	Select granular fill drainage layer over textured 40-mil LLDPE geomembrane	2.0	1.6
	GCL over compacted fine-grained soil	1.8	1.7
Final cover – 5 percent slope 1.0 feet of water on upper interface	Geocomposite drainage layer over smooth 40-mil LLDPE geomembrane	3.5	1.8
	Smooth 40-mil LLDPE geomembrane over GCL	4.1	2.2

Notes:

(1) The worst-case strength parameters corresponding to all final cover options (Options 1-3) were used to analyze worst-case factors of safety for the interface above and below the geosynthetic.

References:

Giroud, J.P., R.C. Bachus, and R. Bonaparte. 1995. Influence of Water Flow on the Stability of Geosynthetics-Soil Layered Systems on Slopes. *Geosynthetics International*. Vol. 2 No. 6, pp. 1149-1180.

Giroud, J.P., N.D. Williams, T. Pelte, and J.F. Beech. 1995. Stability of Geosynthetics-Soil Layered Systems on Slopes. *Geosynthetics International*. Vol. 2 No. 6 pp. 1115-1148.

Koerner, R.M. and T.Y. Soong. 1998. Analysis and Design of Veneer Cover Soils. 1998 Sixth International Conference on Geosynthetics. pp. 1-24.

Leachate Generation Calculations

PURPOSE

Calculate the quantity of leachate generated by the Weston Disposal Site No. 3 Expansion during open and closed conditions. For landfills with a composite liner system, NR 512.12(3), Wis. Adm. Code, requires a minimum generation rate of 6 inches per year for all unclosed areas within the proposed limits of filling, and 1 inch per year for all closed areas. In some situations, such as open conditions, the HELP analysis estimated greater daily flow rates than required by s. NR 512.12(3). The larger of the leachate generation rates was used to determine the leachate volumes for each condition analyzed.

DATA AND ASSUMPTIONS

- Assume 10.96 in/yr of leachate inflow for open conditions, HELP Model OPEN.OUT showed a generation rate of 10.96 in/yr. **(IR_1)**
- Assume 1.0 in/yr of leachate inflow for closed conditions based on NR 512.12(3). **(IR_3)**
- Maximum open area = 25 ac **($Area_1$) preliminary estimate based on landfill size**
- Total Area = 63.47 ac **($Area_3$)**

VARIABLES

$IR_1 := 10.96 \cdot \frac{in}{yr}$ $\quad$ $IR_2 := 1.0 \cdot \frac{in}{yr}$

$A_1 := 25 \cdot acre$ $\quad$ $A_2 := 63.47 \cdot acre$

CALCULATIONS

The average annual volume of leachate that is collected from the landfill under active filling conditions has been calculated by HELP Model v. 3.07 as 10.96 in/yr. This correlates to:

$$Inflow_{open} := IR_1 \cdot \frac{ft}{12 \cdot in} \cdot \frac{43560 \cdot ft^2}{acre} \cdot \frac{7.48 \cdot gal}{ft^3} \cdot \frac{yr}{365 \cdot day}$$

$$Inflow_{open} = 815 \cdot \frac{gal}{day \cdot acre}$$

The average annual volume of leachate that is collected from the landfill under closed conditions will be 1.0 in/yr based on the requirements of NR 512.12(3). This correlates to:

$$Inflow_{close} := IR_2 \cdot \frac{ft}{12 \cdot in} \cdot \frac{43560 \cdot ft^2}{acre} \cdot \frac{7.48 \cdot gal}{ft^3} \cdot \frac{yr}{365 \cdot day}$$

$$Inflow_{close} = 74 \cdot \frac{gal}{day \cdot acre}$$

Determine the leachate generation rates for the various conditions of landfill development and operations listed below:

CASE 1 - Worst Case Scenario, 25 acres open, remainder of landfill in closed phase.

$$\text{Volume} := \text{Inflow}_{open} \cdot (A_1) + \text{Inflow}_{close} \cdot (A_2 - A_1)$$

4 Day Capacity

$$\text{Volume} = 23245 \cdot \frac{\text{gal}}{\text{day}}$$

$$S := 4 \cdot \text{day} \cdot \text{Volume} \qquad S = 92979 \cdot \text{gal}$$

RESULTS AND CONCLUSIONS

The maximum amount of leachate that is collected from the Weston Disposal Site No. 3 Expansion is estimated to be approximately 23,250 gallons per day. This volume is generated when the final phases are open and the remainder of the landfill is closed. Phases are expected to be closed as final waste grades are reached, limiting the extent of open area as the site nears capacity. The maximum open area at the site is expected to be about 25 acres, but could be greater or less depending on final phasing and design. The resulting 4-day leachate volume for 93,000 gallons. Approximately 100,000 gallons of storage should be provided on site to allow for leachate collection without hauling operations over a 4 day period.

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PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
WPS – Weston Disposal Site No. 3 Expansion	J. Hotstream	12/12/2013	R. Wienkes	1/30/14	196089.0003.0000

GLOBAL SLOPE STABILITY

Purpose:

This calculation checks the global stability of the interphase construction and final configuration of the proposed Expansion at the Wisconsin Public Service Corporation's Weston Disposal Site No. 3. Coal combustion residuals (CCRs) will be placed at this disposal site.

Methodology:

The critical conditions for the interphase and final configurations are based on the planned geometry of the landfill components. The conditions evaluated were modeled in the slope stability software Slope/W©, version 7.22, by GeoSlope International. The slopes were analyzed using the Spencer Method which satisfies both moment and force equilibrium. The slopes were modeled using both long term (drained) and short term (undrained) strength conditions. Both circular and block shaped trial slip surfaces were analyzed along the proposed slopes. In addition, the most critical slip surface found in each analysis was optimized. The optimizing process divides the critical slip surface into segments and reorients the segments allowing the software to identify the most critical slip surface for the subsurface geometry input into the model.

Assumptions:

- The minimum required factor of safety is 1.3 (WAC NR 514.07(1)(b)).
- Based on the probabilistic hazard curves (Frankel, 2002), the ground motion is less than 0.1 g based on 10 percent exceedence in a 250 year time frame. Therefore, a seismic analysis is not required for the stability evaluation (Richardson, 1995).

Design Sections:

One design section was used to evaluate the final cover and the filling configurations. Figure 1 shows the section line used for the final cover configuration. Note that the section is offset to provide the highest cover conditions at the critical section location. Figure 2 provides the base grade geometry used for this section. This location was selected based on geologic cross section E-E′ presented in the Feasibility Report (included as Figure 3 in this calculation) was evaluated. Geologic cross section E-E′ was selected based on the thickness of the soil below the southern toe of the proposed expansion, the interpreted bedrock surface orientation, and the high groundwater levels observed in 2013. The filling configuration was based on the same section and was developed to estimate the maximum height of CCR placement without buttressing the toe of the CCR slope.

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	J. Hotstream	12/12/2013	R. Wienkes	1/30/14	196089.0003.0000

Soil Parameters:

The soil parameters used in the global stability analyses are based on field testing results and published data. Generally, the soil conditions observed at the site are loose alluvial soils overlying medium dense to dense residual soil. Due to the shallow nature and the similar materials encountered (primarily silty sands, silty gravels, and silts) the soil is modeled as one unit in the slope stability analysis. Bedrock was encountered at depths ranging from 5 feet to 23 feet below the ground surface. The select aggregate fill was not included in the stability models because it is a higher strength material in the liner system. In addition to soil strengths, the critical interface strength between the geomembrane and clay liner was included as a layer in the global stability model. The following table summarized the soil parameters used in the analyses.

MATERIAL	TOTAL UNIT WEIGHT, (pcf)	UNDRAINED SHEAR STRENGTH, s_u (psf)	UNDRAINED FRICTION ANGLE, ϕ' (deg.)	APPARENT COHESION, c' (psf)	DRAINED FRICTION ANGLE, ϕ' (deg.)
CCRs	106(1)	275(2)	32(2)	275(2)	32(2)
Compacted Liner(3)	130	1,500	-	0	30
General Fill Cover(3)	115	600	-	0	26
Compacted General Fill(3)	125	1,000	-	0	30
Structural Fill(4)	115	-	-	0	30
Select Granular Fill(5)	135	-	-	0	36
Overburden Soil(5)	120	-	-	0	35
Granitic Bedrock(6)	135	-	-	0	40
Critical Geosynthetic Interface(7)	115	5	11	5	11

Notes:

(1) The total unit weight of the CCR is based on the Field and Laboratory Test Program Observations and Results Weston Power Plant 4 – Fly Ash Material – Test Pad (CQM Inc., 2009).

(2) The waste properties are based on published results of Class F fly ash compacted to approximately 90% of the standard proctor maximum dry density (Kim and Prezzi, 2008). Undrained conditions are not anticipated for the waste mass based on published results (Kim and Prezzi, 2008), so drained strength conditions were applied for both analyses.

(3) Assumed values for clay (Table 5.5, Figure 12.56, Holtz, 2011).

(4) Assumed structural fill below landfill would be similar to recompacted overburden soils.

(5) Assumed values based on correlations (Table 12.3 Holtz 2011, Figure 7, NAVFAC, 1986).

(6) Strength of the granitic bedrock is assumed to be similar to a dense gravel based on the descriptions of highly fractured granite in the field logs.

(7) The critical geosynthetics interface is incorporated to model potential slip along an interface in the composite liner system. The value used is based on conservative values for materials similar to those planned for use (TRC, 2013).

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PROJECT/PROPOSAL NAME	PREPARED By:	Date:	CHECKED By:	Date:	PROJECT/PROPOSAL NO.
WPS – Weston Disposal Site No. 3 Expansion	J. Hotstream	12/12/2013	R. Wienkes	1/30/14	196089.0003.0000

Results:

Results of the global stability analyses are summarized in the table below with the outputs for the analyses attached to this packet. The attached output includes detailed output for the most critical condition and a summary plate showing the critical slip surface for the other conditions.

CROSS SECTION	STRENGTH CONDITION	CIRCULAR SLIP SURFACE FACTOR OF SAFETY	BLOCK SLIP SURFACE FACTOR OF SAFETY
Interphase Construction	Undrained	2.20	1.62
	Drained	2.23	1.36
Perimeter Berm	Undrained	2.61	2.66
	Drained	2.18	1.51
Final Configuration	Undrained	2.57	2.13
	Drained	2.81	2.64
Final Configuration with Sedimentation Basin	Undrained	2.30	2.21
	Drained	2.50	2.54

All of the conditions modeled meet the factor of safety requirement in WAC NR 514.07(1)(b). The most critical slip surfaces are within the waste and critical geosynthetic interface. The lowest factor of safety occurs for the drained condition during waste placement.

References:

CQM, Inc. 2009. Field and Laboratory Test Program Observations and Results, Weston Power Plant 4 – Fly Ash Material – Test Pad. Letter to Andrew Gilbert. April 27, 2009.

Holtz, Robert D., W. D. Kovacs, and T. C. Sheahan. 2011. An introduction to geotechnical engineering. Second edition. New Jersey: Pearson. 853 p.

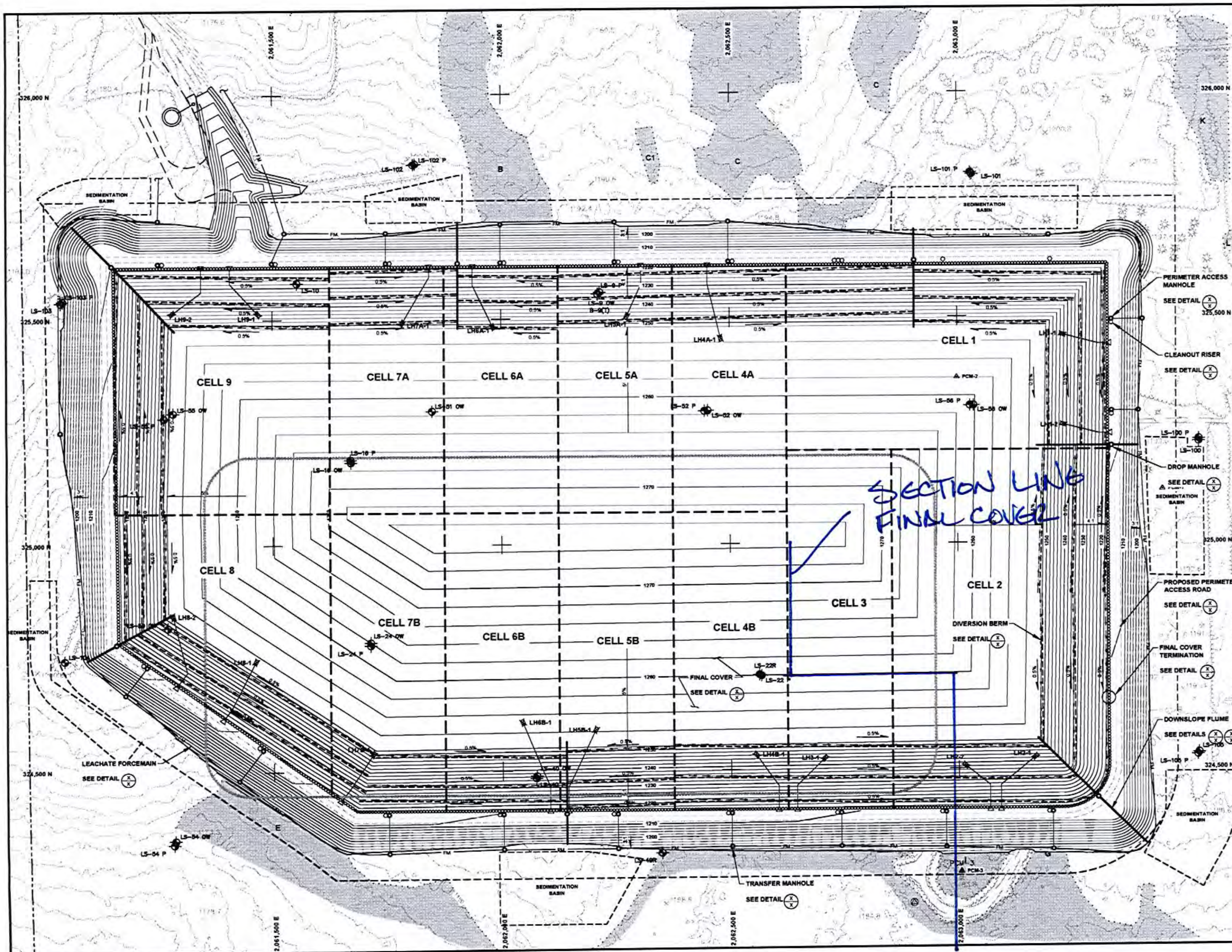
Frankel, A.D., et al. 2002. Documentation for the 2002 update of the national seismic hazard maps. U.S. Geological Survey. 33 p.

Kim, B. and Prezzi, M. 2008. "Evaluation of the mechanical properties of class-F fly ash." Waste Management. 28, p 649-659.

Naval Facilities Engineering Command (NAVFAC). 1986. Soil Mechanics Design Manual 7.01.

Richardson, G.N. and E. Kavazanjian, Jr. 1995. RCRA Subtitle D (258) seismic design guidance for municipal solid waste landfill facilities. U.S. Environmental Protection Agency. 143 p.

TRC Environmental Corporation. 2013. Interface strength of geosynthetics. Database.



NOTES

1. REFER TO PLAN SHEET 2 FOR STANDARD LEGEND AND BASE MAP NOTES.
2. CONTOURS REPRESENT FINAL GRADES (TOP OF FINAL COVER) WITHIN THE LIMITS OF WASTE AND FINISHED GRADE (TOP OF TOPSOIL, TOP OF ROAD SURFACE, ETC.) BEYOND.

CONSTRUCTION ACTIVITIES

CONSTRUCTION QUANTITIES

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.

NOT FOR CONSTRUCTION

NO	BY	DATE	REVISION	APP'D
3				
2				
1				

PROJECT: WISCONSIN PUBLIC SERVICE CORPORATION
WESTON DISPOSAL SITE NO. 3 EXPANSION
PLAN OF OPERATION

SHEET TITLE: FINAL GRADES

DRAWN BY: LSTORMER	SCALE: 1"=100'	PROJ NO.	196069.0003
CHECKED BY: —		FILE NO.	196069.0003.SHT16-FC.dwg
APPROVED BY: —	DATE PRINTED	SHEET 16 OF 28	
DATE: DECEMBER 2013			

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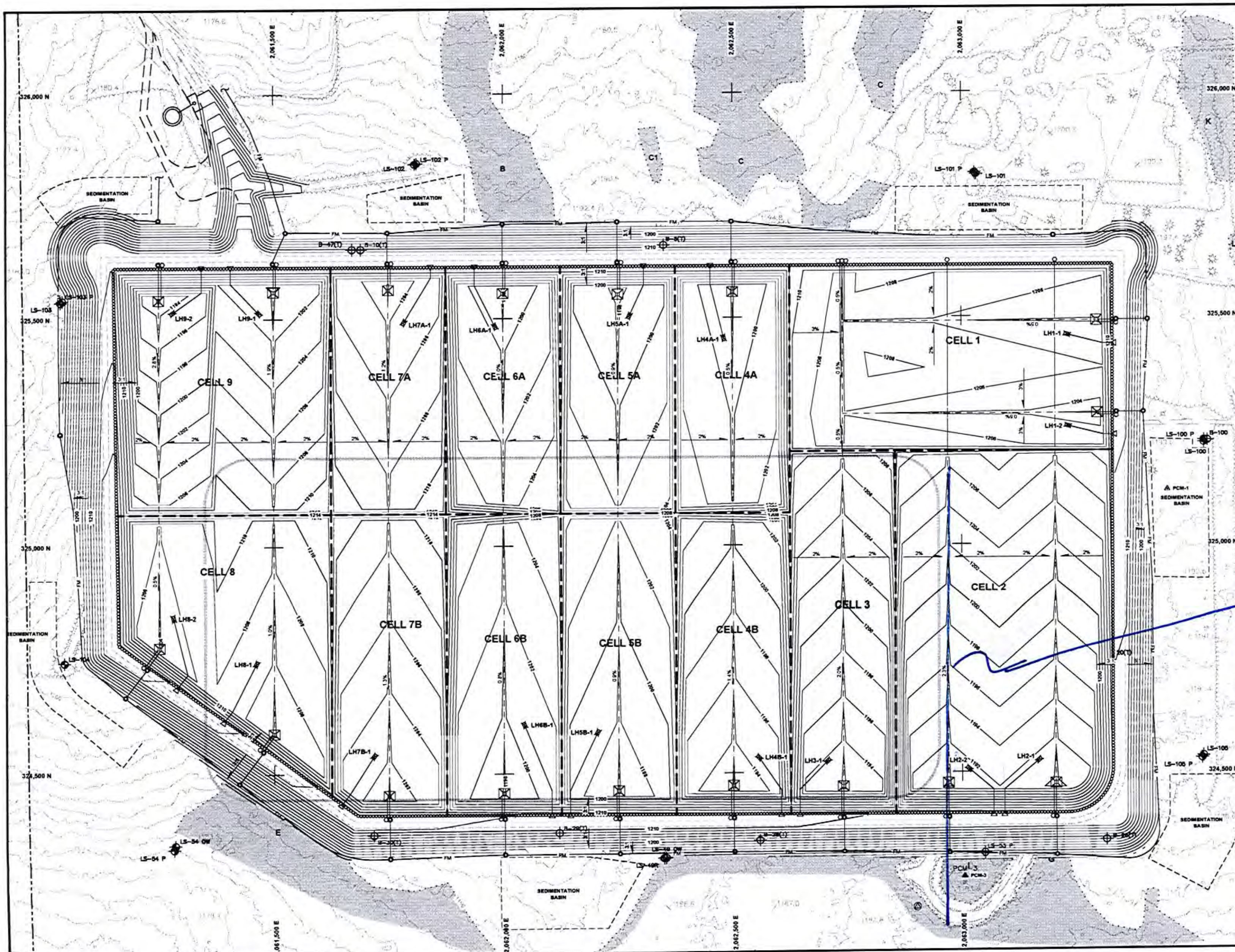
Madison, WI 53717
Phone: 608.826.3600

FIGURE 1



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WISCONSIN PUBLIC SERVICE CORPORATION
WESTON DISPOSAL SITE NO. 3 EXPANSION
PLAN OF OPERATION

BASE GRADES/LEACHATE COLLECTION SYSTEM

DRAWN BY: LSTORMER
SCALE: 1"=100'
DATE: DECEMBER 2013

SHEET 5 OF 28

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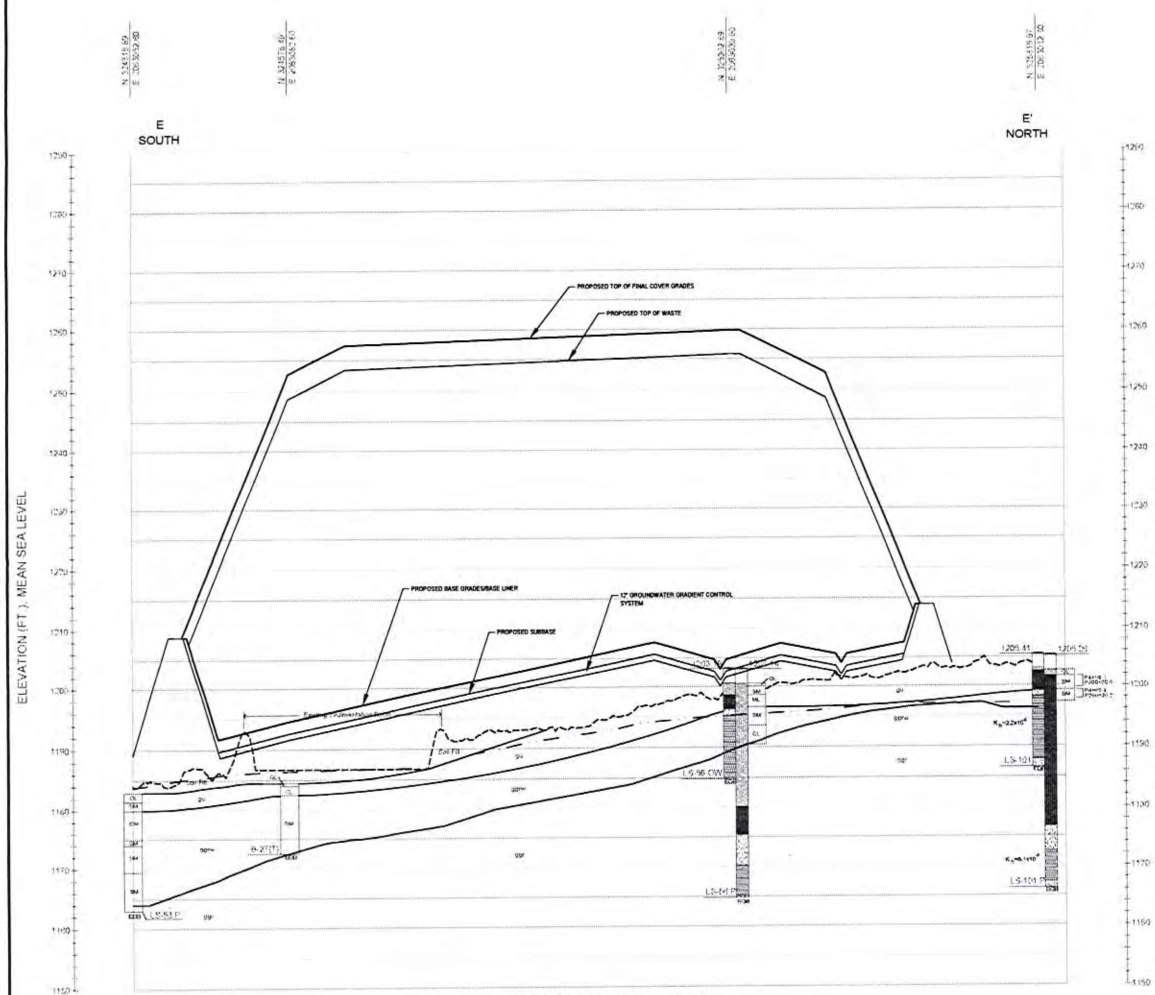
FIGURE 2



GEOLOGIC CROSS-SECTION E-E'

SCALE: 1"=100' HORIZ. & 1"=10' VERT.
10X VERTICAL EXAGGERATION

LEGEND

- EXISTING GROUND SURFACE
- LITHOSTRATIGRAPHIC UNIT (DASHED WHERE APPROXIMATE)
- COMPETENT BEDROCK SURFACE (DASHED WHERE APPROXIMATE)
- HIGH TABLE SURFACE - SHOWING FLOW DIRECTION
- HIGH WATER TABLE (H) 4-23-08

- TOP OF PVC ELEVATION
- ANNULAR SPACE SEAL
- SOIL CLASSIFICATION (USCS)
- SAMPLE INTERVAL WITH LABORATORY (VERTICAL) HYDRAULIC CONDUCTIVITY (CENTIMETERS/SECOND) (K_v), % PASSING No. 4 SIEVE (P4), AND % PASSING No. 200 (P200)
- LITHOSTRATIGRAPHIC CONTACT (DASHED WHERE APPROXIMATE)
- BENTONITE SEAL
- SAND FILTER PACK
- WELL SCREEN
- FIELD (HORIZONTAL) HYDRAULIC CONDUCTIVITY (K_h) (CENTIMETERS/SECOND)
- SOIL BORING/MONITORING WELL DESIGNATION — * - ORIGINAL BORING; ** - REPLACEMENT BORING
- NATURAL CAVE IN OR SAND FILL
- EOB: END OF BORING

STRATIGRAPHIC UNIT

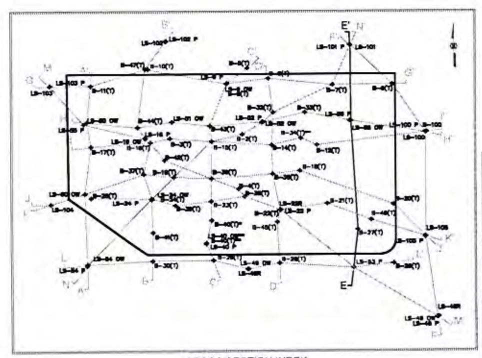
PLEISTOCENE	gu - MARATHON FORMATION, UNDIFFERENTIATED (Attig and Muldoon, 1989) BROWN TO DARK BROWN SAND TO SILTY SAND DERIVED FROM TILL, RESIDUUM, OR HILLSLOPE SEDIMENT ggrw - WEATHERED BEDROCK. YELLOWISH BROWN TO DARK BROWN SILTY SAND DERIVED FROM LOWER PROTEROZOIC BEDROCK (ggr)
LOWER PROTEROZOIC	ggr - GNEISSIC GRANITE (LaBerge and Myers, 1983) LIGHT GREY TO PINK QUARTZ DIORITE AND RED TO PINK GRANITE, WITH TRACE BLACK AMPHIBOLITE

UNIFIED SOIL CLASSIFICATION

GW	WELL GRADED GRAVELS & GRAVEL WITH SAND
GP	POORLY GRADED GRAVELS & GRAVEL WITH SAND
GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
GC	CLAYEY GRAVELS, CLAYEY GRAVEL WITH SAND
SW	WELL GRADED SANDS & SAND WITH GRAVEL
SP	POORLY GRADED SANDS & SANDS WITH GRAVEL
SP-SM	POORLY GRADED SAND WITH SILT, SAND WITH SILT & GRAVEL
SM	SILTY SANDS, SILTY SAND WITH GRAVEL
SC	CLAYEY SANDS, CLAYEY SANDS WITH GRAVEL
CH	HIGH PLASTICITY CLAY
CL-ML	SILTY CLAY TO CLAYEY SILT
CL	LOW PLASTICITY CLAY, GRAVELLY-SANDY CLAYS
ML	SILT, GRAVELLY-SANDY SILT
OL	ORGANIC CLAY, SANDY-GRAVELLY ORGANIC SOIL
OH	ORGANIC, HIGH PLASTICITY, SILTY CLAY
PT	PEAT, MUCK, ORGANIC SOILS

NOTES

1) SOIL FILL - DISTURBED SOIL OR SOIL THAT HAS BEEN PLACED FOR CONSTRUCTION OF ROADS AND BERMS ASSOCIATED WITH THE EXISTING LANDFILL
2) FILL - COAL COMBUSTION RESIDUALS
3) HIGH WATER TABLE BASED ON SURFACE PRESENTED ON HIGH WATER TABLE MAP FR-6 (REV. 1)
4) THIS ORIGINAL PLAN SHEET WAS DEVELOPED BY AECOM, INC. FOR THE AUGUST 2012 FEASIBILITY REPORT FOR THE WESTON DISPOSAL SITE NO. 3 EXPANSION. TRC HAS MODIFIED THE HIGH WATER TABLE CONTOUR SURFACE AND THE SUBBASE/BASE/FINAL GRADES IN RESPONSE TO PART B, ITEM 1 OF THE INCOMPLETENESS RESPONSE ISSUED BY THE WDNR ON OCTOBER 5, 2012



CROSS-SECTION INDEX
NOT TO SCALE

NO.	BY	DATE	REVISION	APP'D
3				
2				
1				

PROJECT: WISCONSIN PUBLIC SERVICE CORPORATION
WPS - WESTON DISPOSAL SITE NO. 3
PROPOSED EXPANSION

SHEET TITLE: GEOLOGIC CROSS SECTION E-E'

DRAWN BY: DPR	SCALE: AS SHOWN	PROJ. NO.	196089.0004.0000
CHECKED BY: TDH		FILE NO.	196089.0004 GEOXS.dwg
APPROVED BY: CDM	DATE PRINTED:	FR-14 (REV. 1)	
DATE: JUNE 2013			

TRC
708 Heartland Trail
Suite 3000
Madison, WI 53717
Phone: 608.826.3600

File Location: ... File Name: 196089.0004 GEOXS Layout Name: FR-14 (REV. 1)

FIGURE 3

708 Heartland Trail, Suite 3000
Madison, WI 53717
TEL: (608) 826-3600
FAX: (608) 826-3941

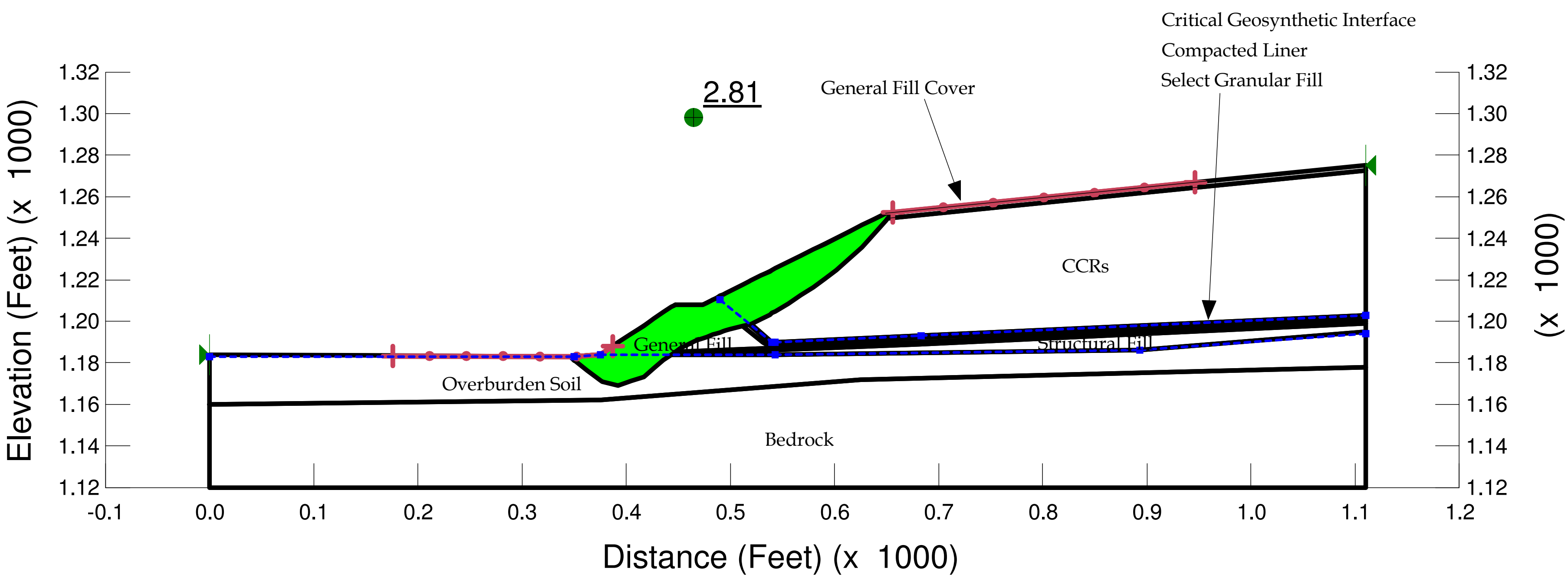
PROJECT NAME:	PREPARED BY:	CHECKED BY:	PROJECT/PROPOSAL NO.:
WPS Corp. Weston Site No. 3 Plan of Operation	D. Engstrom DATE: 1/24/2014	J. Hotstream DATE: 1/30/2014	196089.0003

GLOBAL STABILITY ANALYSIS

FINAL CONFIGURATION LONG TERM (DRAINED)

Method: Spencer
Slip Surface Option: Entry and Exit
Tension Crack Option: (none)
Percentage Wet: 1

Materials:
Name: CCRs Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 0 psf Phi: 30 °
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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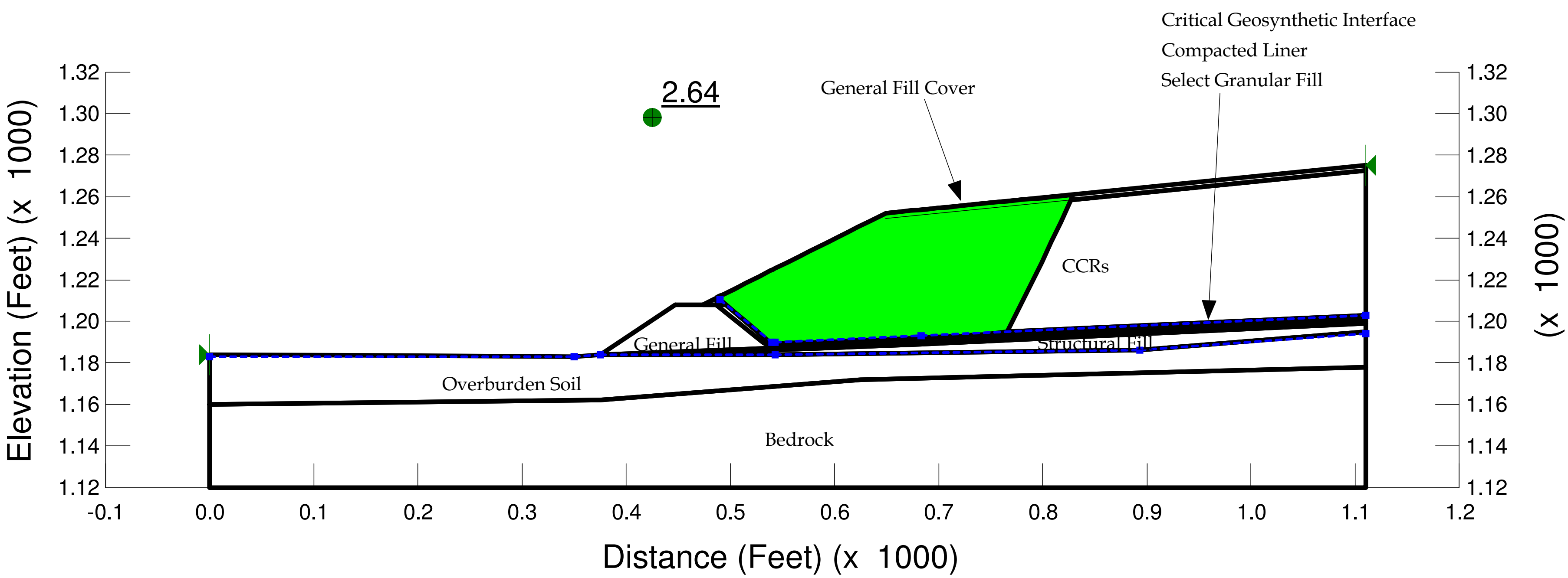
TRC Results you can rely on **708 Heartland Trail, Suite 3000** **Madison, WI 53717** **TEL: (608) 826-3600** **FAX: (608) 826-3941**	PROJECT NAME: WPS Corp. Weston Site No. 3 Plan of Operation	PREPARED BY: D. Engstrom DATE: 1/24/2014	CHECKED BY: J. Hotstream DATE: 1/30/2014	PROJECT/PROPOSAL NO.: 196089.0003	**GLOBAL STABILITY ANALYSIS** **FINAL CONFIGURATION** **LONG TERM (DRAINED)**

Method: Spencer
Slip Surface Option: Fully-Specified
Tension Crack Option: (none)
Percentage Wet: 1

Materials:
Name: CCRs Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 0 psf Phi: 30 °
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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708 Heartland Trail, Suite 3000
Madison, WI 53717
TEL: (608) 826-3600
FAX: (608) 826-3941

PROJECT NAME:
WPS Corp.
Weston Site No. 3
Plan of Operation

PREPARED BY:
D. Engstrom
DATE:
1/24/2014

CHECKED BY:
J. Hotstream
DATE:
1/30/2014

PROJECT/PROPOSAL NO.:
196089.0003

GLOBAL STABILITY ANALYSIS FINAL CONFIGURATION WITH SEDIMENTATION BASIN SHORT TERM (UNDRAINED)

Method: Spencer
Slip Surface Option: Entry and Exit
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 1500 psf Phi: 0 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 600 psf Phi: 0 °
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Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 1000 psf Phi: 0 ° Piezometric Line: 2
Name: Overburden Soil Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 2
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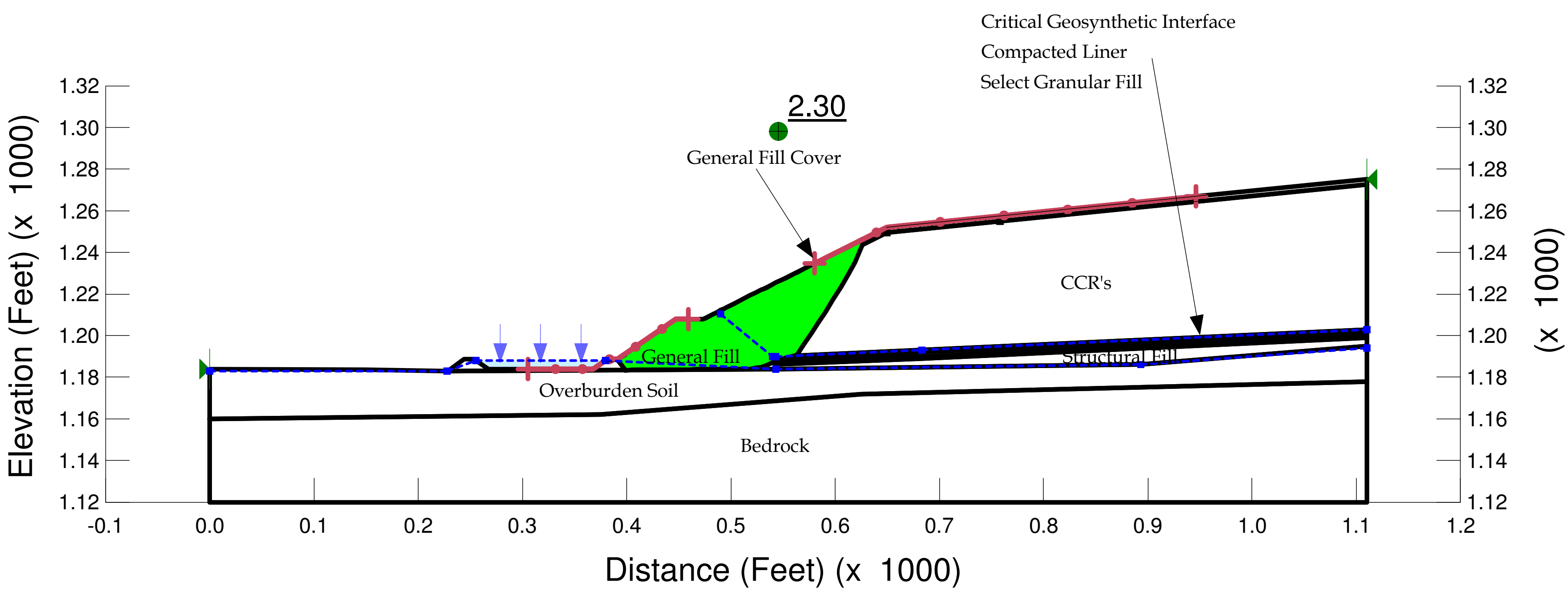

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TRC Results you can rely on 708 Heartland Trail, Suite 3000 Madison, WI 53717 TEL: (608) 826-3600 FAX: (608) 826-3941	PROJECT NAME: WPS Corp. Weston Site No. 3 Plan of Operation	PREPARED BY: D. Engstrom DATE: 1/24/2014	CHECKED BY: J. Hotstream DATE: 1/30/2014	PROJECT/PROPOSAL NO.: 196089.0003	**GLOBAL STABILITY ANALYSIS FINAL CONFIGURATION WITH SEDIMENTATION BASIN SHORT TERM (UNDRAINED)**

Method: Spencer
Slip Surface Option: Fully-Specified
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
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Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 1500 psf Phi: 0 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 600 psf Phi: 0 °
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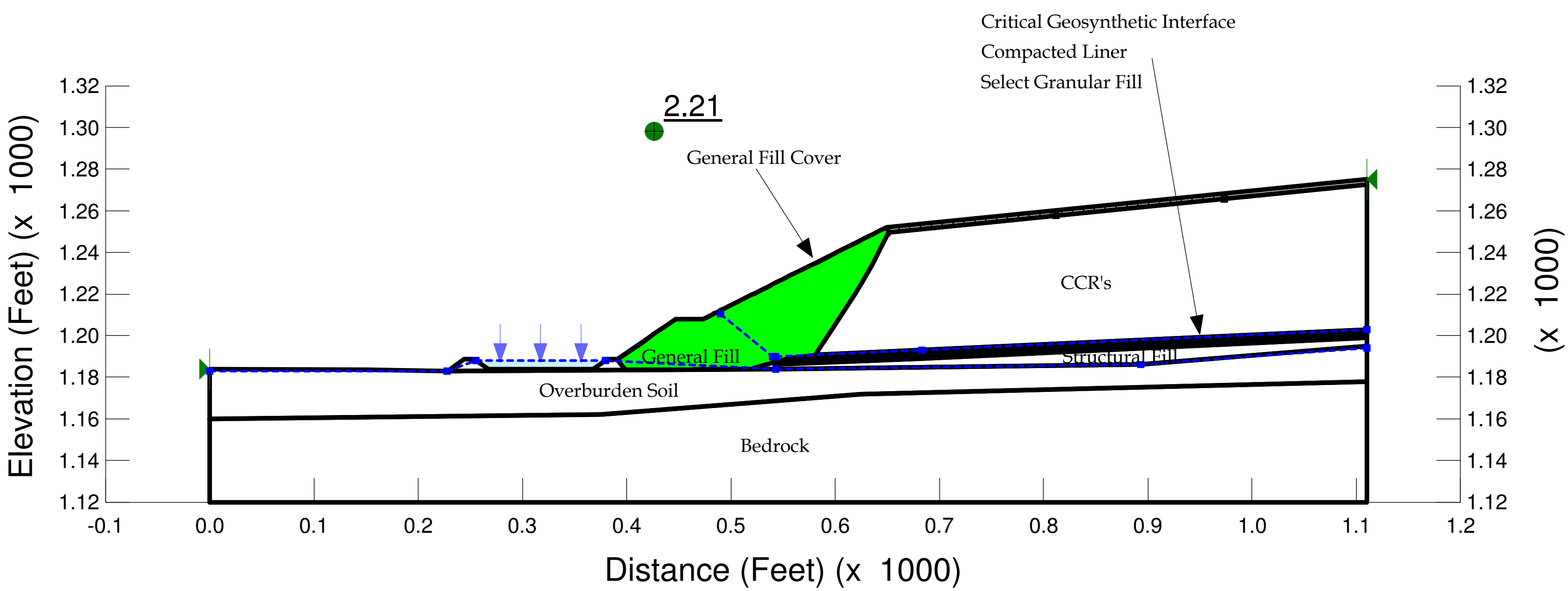
Name: Critical Geosynthetic Interface Unit Weight: 115 pcf Cohesion: 5 psf Phi: 11 ° Piezometric Line: 1
Name: Structural Fill Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2



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TRC
Results you can rely on
708 Heartland Trail, Suite 3000
Madison, WI 53717
TEL: (608) 826-3600
FAX: (608) 826-3941

PROJECT NAME:	PREPARED BY:	CHECKED BY:	PROJECT/PROPOSAL NO.:
WPS Corp. Weston Site No. 3 Plan of Operation	D. Engstrom DATE: 1/24/2014	J. Hotstream DATE: 1/30/2014	196089.0003

GLOBAL STABILITY ANALYSIS FINAL CONFIGURATION WITH SEDIMENTATION BASIN LONG TERM (DRAINED)

Method: Spencer
Slip Surface Option: Entry and Exit
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 °
Name: Select Granular Fill Unit Weight: 135 pcf Cohesion: 0 psf Phi: 36 °
Name: Compacted General Fill Unit Weight: 125 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 2
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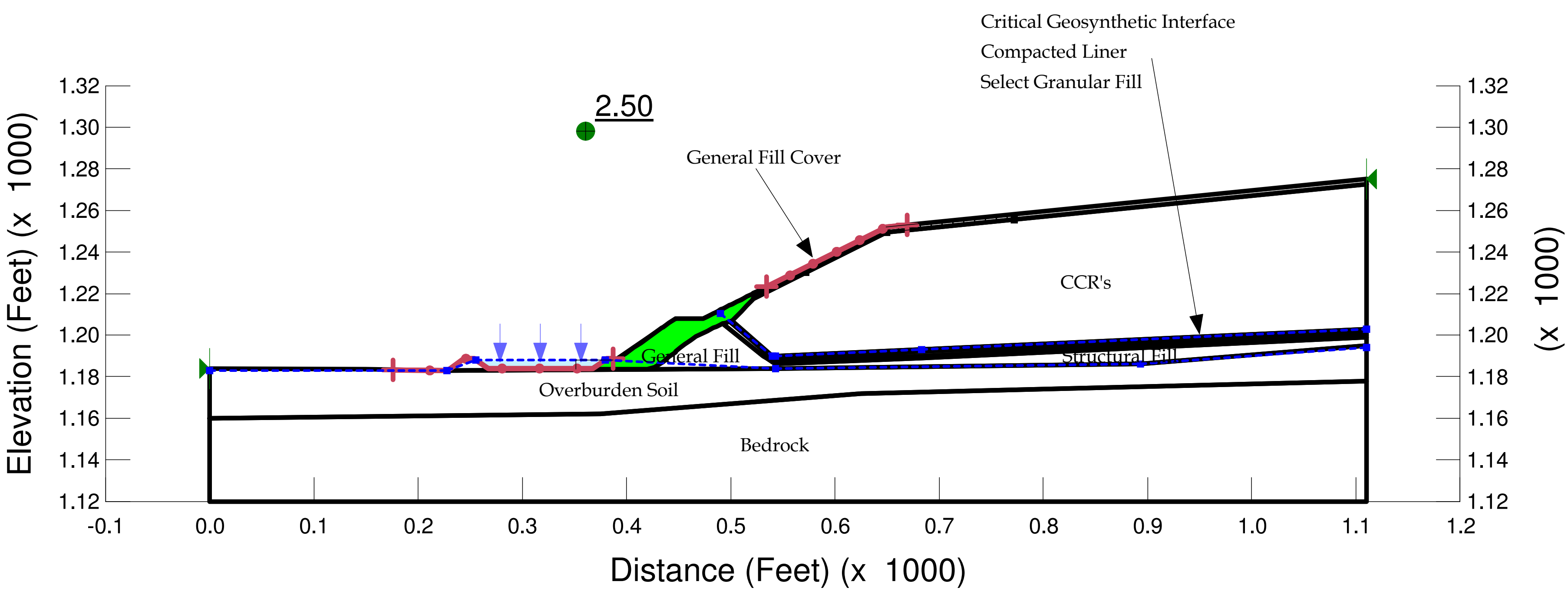

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TRC
Results you can rely on
708 Heartland Trail, Suite 3000
Madison, WI 53717
TEL: (608) 826-3600
FAX: (608) 826-3941

PROJECT NAME:
WPS Corp.
Weston Site No. 3
Plan of Operation

PREPARED BY:
D. Engstrom
DATE:
1/24/2014

CHECKED BY:
J. Hotstream
DATE:
1/30/2014

PROJECT/PROPOSAL NO.:
196089.0003

GLOBAL STABILITY ANALYSIS
FINAL CONFIGURATION
WITH SEDIMENTATION BASIN
LONG TERM (DRAINED)

Method: Spencer
Slip Surface Option: Fully-Specified
Tension Crack Option: Tension Crack Line
Percentage Wet: 1

Materials:
Name: CCR Unit Weight: 106 pcf Cohesion: 275 psf Phi: 32 ° Piezometric Line: 1
Name: Compacted Liner Unit Weight: 130 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: General Fill Cover Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 °
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Name: Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 ° Piezometric Line: 2
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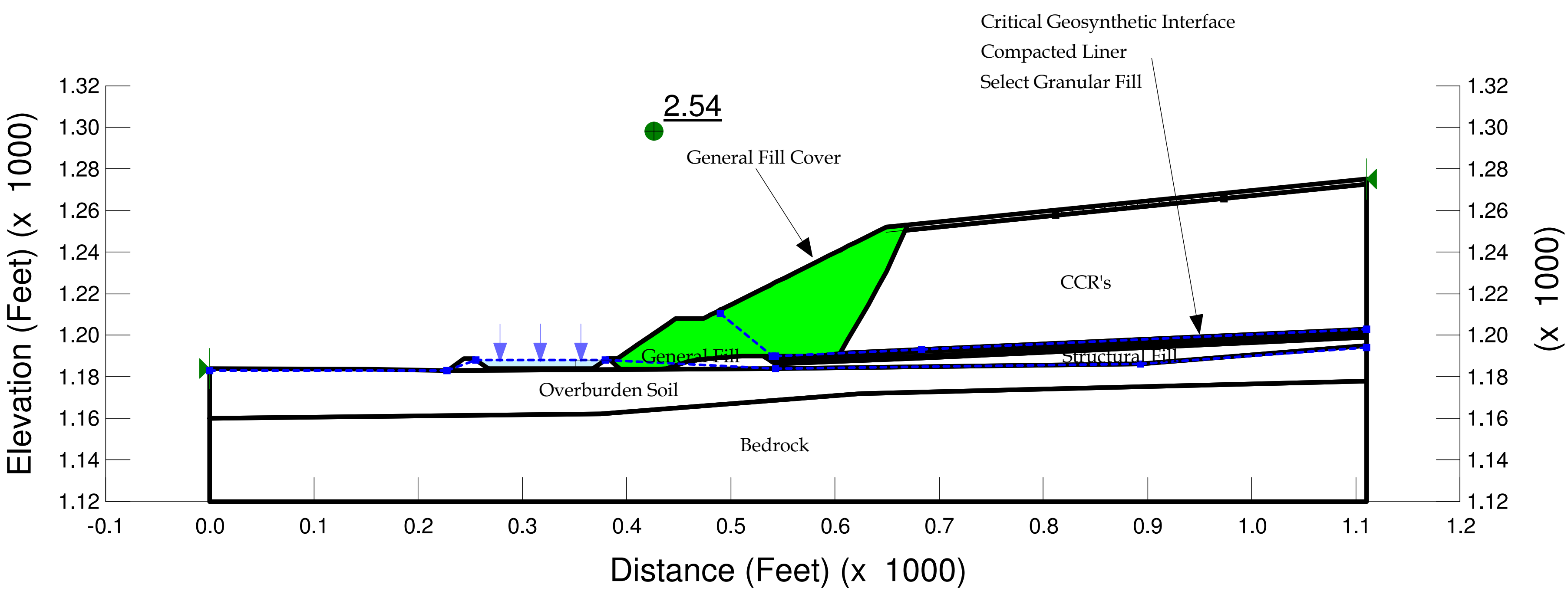

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Appendix J

Fugitive Dust Control Plan

GEI Consultants

Consulting
Engineers and
Scientists

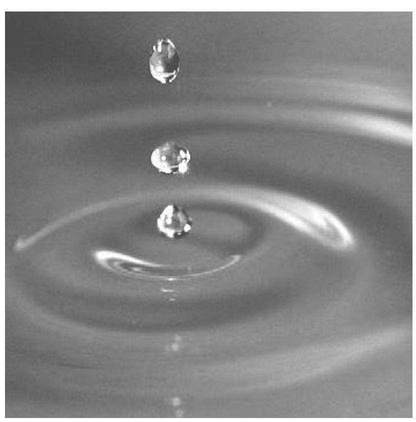
Fugitive Dust Control Plan

Weston Disposal Site No. 3
Town of Knowlton, Wisconsin

Submitted to:
WEC Energy Group
333 West Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920-455-8200

September 2023, Revision 1



John M. Trast, P.E., D.GE
Vice President/Waste Management
Leader

Andrew J. Schwoerer, P.G.
Project Professional

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Revision History

Revision 0 – Original fugitive dust control plan dated October 13, 2015.

Revision 1 – Update of the original fugitive dust control plan for the Plan of Operation Modification submittal to comply with the updated NR 500 of the Wisconsin Administrative Code.

1. Introduction

The Weston Disposal Site No. 3 landfill (WDS3) is used for the disposal of coal combustion residuals (CCR) from the Wisconsin Public Service Corporation's (WPSC) Weston Units 3 & 4. This landfill is permitted by the Wisconsin Department of Natural Resources (WDNR) under license number 3067. WPSC owns approximately 200 acres with 56.7 acres permitted for CCR disposal withing the Town of Knowlton, Marathon County, Wisconsin.

This fugitive dust control plan has been prepared to meet the requirements of 40 CFR 257.80(b) Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and NR 514.07(10)(a) of the Wisconsin Administrative Code. Revision 0 of the fugitive dust control plan was issued on October 13, 2015, for the active Cells 1 and 2 of the WDS3 landfill. Revision 1 updates the fugitive dust control plan to comply with all requirements of NR 514.07(10)(a) for the active cells of WDS3.

2. Fugitive Dust Control Measures

2.1 Conditioning and Delivery of CCR

All CCR delivered to WDS3 are conditioned with water at the source prior to transporting the materials to the landfill. Water is added to the CCR at the source in sufficient quantities such that the CCR is not dusty during transport or delivery. Trucks delivering CCR to the facility are required to be covered. CCR will also be conditioned at the source as necessary to the extent that the delivered CCR does not contain free water.

2.2 Access Road

To minimize CCR track-out onto the access road, a stone tracking pad, a wheel wash station and/or a cattle guard will be used to loosen and remove material stuck to tired prior to trucks and equipment leaving the active landfill area.

The access roads within WDS3 will be maintained through wetting and grooming to reduce dust generation from vehicles transporting CCR to the active cells. Vehicle speeds are posted with a speed limit to reduce the generation of fugitive dust.

2.3 Compaction and Grooming

At WDS3, the CCR is discharge from the new trucks in the designated active area of the cell. The newly deposited material is graded, conditioned with additional water or leachate, if necessary, and compacted. Dust suppression within the active cell will be maintained by moisture conditioning, grooming, and compaction of CCR. The generation of windborne fugitive dust is effectively minimized by regularly wetting exposed CCR surfaces with a water truck and compacting.

2.4 Control of Wind Generated Dust in Active Area

WDS3 is designed and operated to have filling areas at different elevations to assist in the prevention of windblown dust during adverse weather conditions. In general, CCR is deposited in the designated active area of the cell, spread, and compacted to prevent fugitive dust generation. The location of the active area can be adjusted by site personnel based on weather and wind conditions with the objective of depositing CCR at locations where dust generation is least susceptible.

2.5 Temporary Final Cover

In areas of the landfill that are not being filled or are inactive, soil stabilization/dust control products may be applied as necessary to help reduce the potential for windblown CCR. The selected soil stabilization/dust control product is applied and maintained in accordance with the manufacturers' recommendations. Additional measures may also be considered including but not limited to the placement of bottom ash, installation of temporary geomembrane or geotextile covers, erosion fabrics/mulch matting, hydro mulch, or temporary soil covers with or without vegetation. Sections of final cover are installed after final CCR grades are achieved over a sufficient area to support a practical final cover installation scope.

3. Citizen Complaints

Citizen complaints involving CCR fugitive dust events at the facility will be routed to the Site Operator for the Weston Disposal Site No. 3 landfill. Citizen complaints are generally received by the Wisconsin Public Service Corporation Call Center at (800) 450-7260 but may also be received by the Town of Knowlton. The Site Operator will prepare a complaint summary including information provided by the citizen (such as name, date, time, and nature of complaint), a summary of conversations with the citizen, and a summary of any actions taken to address the citizen complaint. Complaint summaries will be included in the annual fugitive dust control report as required by 40 CFR 257.80(c) and NR 506.20(3)(a).

4. Assessment and Amendments of the Fugitive Dust Control Plan

The fugitive dust control measures outlined in this plan were developed as part of the Plan of Operation Modification for WDS3 in accordance with NR 514.07(10)(a) of the Wisconsin Administrative Code. These fugitive dust control measures have been effective in minimizing the generation of airborne dust at the facility. The continuing effectiveness of this fugitive dust control plan will be evaluated with a visual inspection at least every 7 days in accordance with NR 514.07(10)(a)3, and during the annual inspections required by 40 CFR 257.84 and NR 514.07(10)(a)5. An annual fugitive dust control report will be submitted by a licensed Professional Engineer by January 31 of each year in accordance with NR 506.20(3)(a). In accordance with NR 514.07(10)(a)(4), the fugitive dust control plan will be modified following NR 514.04(6) whenever there is a change in conditions that may substantially affect the Plan of Operation Modification.

5. Certification

The fugitive dust control plan was completed under the direction of John M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 3, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR Part 257 Subpart D and NR 500 of the Wisconsin Administrative Code.

John M. Trast, P.E., D.GE
Professional Engineer License No. 31792

Appendix K

Run-on and Run-off Control Plan

Consulting
Engineers and
Scientists

Regulation Compliance Report

Run-on and Run-off Control Plan

Weston Disposal Site No. 3
Town of Knowlton, Marathon County, Wisconsin

Submitted to:
WEC Energy Group – Business Services
333 W. Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920.455.8200

September 2023, Revision 1
Project 2203724

John M. Trast, P.E., D.GE.
Vice President

Andrew J. Schwoerer, P.G.
Project Professional

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Tables

Appendices

Revision Schedule

Revision 0 October 2016
Revision 1 Update of the original Run-on and Run-off Control Plan for the Plan of Operation Modification submittal to comply with the updated NR 500 of the Wisconsin Administrative Code.

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1. Introduction

WEC Energy Group (WEC) owns and operates the Weston Disposal Site No. 3 Landfill, located in the E 1/2 of the NW 1/4 and W 1/2 of the NE 1/4, Section 23, Township 26 North, Range 7 East, Town of Knowlton, Marathon County, Wisconsin. The WEC Weston Disposal Site No. 3 Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 3067, FID No. 737025120. Cells 1 and 2 were constructed during the 2015 construction season. Construction included the new landfill cells and installation of a leachate force main, storage tanks, and load-out system in late December 2015. The construction of Cells 1 and 2 was approved by WDNR on April 22, 2016, and Cell 2 was placed into service on June 27, 2016. WEC has filled Cell 2 episodically since it was placed into service and has constructed approximately 2.7 acres of final cover system over the exterior slopes of Cell 2. Cell 1 was placed into service August 27, 2021.

In addition to the state regulations, the landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.* Weston Disposal Site No. 3 Landfill, Cells 1 and 2 are defined as a CCR units and existing CCR landfills in accordance with § 257.53 since construction commenced prior to October 14, 2015. Future landfill cells are permitted by the WDNR in the approved Plan of Operation and defined as lateral expansions under § 257.53 when constructed.

This report fulfills the requirements of § 257.81 - *Run-on and run-off controls for CCR landfills* for the Weston Disposal Site No. 3, Cells 1 and 2, which specifies that the owner or operator must complete the assessments every five years. In accordance with § 257.81(c)(1) this report describes how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements and supported by appropriate engineering calculations.

This run-off and run-on system control plan includes the following sections:

Section 1 – Introduction

Section 2 – Storm and Stormwater Volume Determination

Section 3 – Run-on Control System

Section 4 – Run-off Control System

Section 5 – Conclusion and Certification

Section 6 – References

2. Storm and Stormwater Volume Determination

§ 257.81 *Run-on and run-off controls for CCR landfills* requires that the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

Cell 1 of the Weston Disposal Site No. 2 is approximately 6.6 acres in size, while Cell 2 is approximately 8.6 acres in size. All precipitation that falls into the permitted limits of waste is contained within the cell and handled as leachate. Any precipitation that falls outside the limits of waste is directed away from the active landfill. Drawing C-1 – Weston Disposal Site No. 3 Cells 1 and 2 located in Appendix A shows the proposed operational filling grades for Cells 1 and 2 of the Weston Disposal Site No. 3.

The rainfall estimates for a 24-hour, 25-year storm for the Weston Disposal Site No. 3 was determined following the procedures outlined in Precipitation-Frequency Atlas of the United States, Atlas 14, Volume 8, Version 2: Wisconsin. For the Weston Disposal Site No. 3, a 24-hour, 25-year storm will result in 4.47 inches of rainfall. Calculations for determining the 24-hour, 25-year storm event are included in Appendix B: NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume.

Table 2-1 summarizes the storm recurrence interval, rainfall depth, lined area of the CCR landfill, and minimum stormwater volume required to be managed within Cells 1 and 2.

Table 2-1 Summary of Rainfall Precipitation and Run-off Volume Data

Storm Recurrence Interval	Rainfall Depth (inches)	Cell 1 and 2 Active Area (acres)	Run-off Volume (acre-ft)
24-hour, 25-year	4.47	15.2	5.7

3. Run-on Control System

§ 257.81 (a)(1) requires a run-on control system to prevent flow onto the active portions of the CCR unit during the peak discharge from a 24-hour, 25-year storm. The federal rule defines "Run-on" as "*any rainwater, leachate, or other liquid that drains over land onto any part of a CCR landfill.*"

In order to control stormwater and prevent run-on into the active landfill, permanent perimeter berms have been established around the east, north, and south sides of the landfill to direct stormwater run-on away from the landfill. Temporary intercell berms perform the same function on the west and south sides of Cell 1 and the west sides of Cell 2. Approximately 2.7 acres of the Cell 2 perimeter slopes on the south and east sides of Cell 2 have received final cover. The stormwater flow from the final cover is routed by to a perimeter ditch and discharges into Storm Water Basin No. 3.

Based on a review of current topography and stormwater calculations, Weston Disposal Site No. 3, Cells 1 and 2 have an acceptable run-on control system that follows current engineering standards and is compliant with § 257.81(a)(1).

3.1 Stormwater Control Construction Procedures

Existing stormwater control structures were constructed to site specifications with construction oversight directed by a professional engineer licensed in the State of Wisconsin. Construction documentation reports for the stormwater management features were prepared, submitted, and approved by the WDNR.

A schedule for construction of the future stormwater control structures, in accordance with NR 514.07(10)(b)3, is provided in the table below.

Table 3-1 Stormwater Control Structures Construction Schedule

Phase	Stormwater Control Structures	Date of Construction
Cell 3	Permanent south perimeter berm, temporary west perimeter berm	Fall 2025
Cells 4A and 4B	Permanent north and south perimeter berms, temporary west perimeter berm	Fall 2029
Cells 5A and 5B	Stormwater Basin No. 4, permanent north and south perimeter berms, temporary west perimeter berm	Fall 2040

Cells 6A and 6B	Permanent north and south perimeter berms, temporary west perimeter berm	Fall 2049
Cells 7A and 7B	Permanent north and south perimeter berms, temporary west perimeter berm	Fall 2058
Cell 8	Stormwater Basin No. 5, Stormwater Basin No. 6, permanent west and south perimeter berms, temporary north perimeter berm	Fall 2067
Cell 9	Stormwater Basin No. 7, permanent north and west perimeter berms	Fall 2072

4. Run-off Control System

§ 257.81 (a)(2) requires a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm. The federal rule defines "Run-off" as "*any rainwater, leachate, or other liquid that drains overland from any part of a CCR landfill.*"

During the operation and filling of Cells 1 and 2 precipitations within the landfill is handled as contact stormwater and treated as leachate in accordance with § 257.3-3. The contact stormwater is directed to the perimeter containment ditches on the inside of the perimeter berms and routed to a stormwater surge area along the Cell 2-3 intercell berm area, where it is allowed to infiltrate into the leachate collection system. The water is then managed as leachate in accordance with the landfill's Plan of Operations.

A stormwater run-off model was completed to confirm the current run-off control system for the operation of Cells 1 and 2 at the Weston Disposal Site No. 3 landfill can adequately manage a 24-hour, 25-year precipitation event. Stormwater flow was modeled using HydroCAD 10.0 to model the existing conditions. The stormwater run-off calculations for Cells 1 and 2 of the landfills are included in Appendix C: Stormwater Run-off Calculations.

In general, stormwater is conveyed off the slopes of Cells 1 and 2 as sheet flow until it is intercepted by temporary containment ditches. The temporary containment ditches at the perimeter of the landfill cell are a minimum of 2-feet-deep and have a 3H:1V exterior slope and 2H:1V interior side slope. The exterior slope of the ditch is the top of the granular drainage layer of the leachate collection system. The interior slope is cut into the CCR disposed of in the landfill. Upon closure of the landfill, the temporary stormwater containment ditch will be filled with soil or CCR prior to placement of the final cover system.

The results of the stormwater modeling calculations indicate that the perimeter ditches located along Cells 1 and 2 are able to contain and convey the flow of runoff resulting from the 25-year, 24-hour storm, and route it to one of the four detention areas. Appendix C shows that each of the four detention areas is able to contain the 25-year, 24-hour storm without overtopping.

5. Conclusion and Certification

The Weston Disposal Site No. 3 is regulated under 40 CFR Part 257 Subpart D as an existing CCR landfill. The Rule specifies that existing CCR landfills must develop plans to meet certain operating criteria designated by October 17, 2016, and that the owner or operator must also conduct and complete the assessments required by this section every five (5) years maximum based on the completion date of this plan. This report is the 5-year update to the original plan. The revised plan must be placed in the facility's operating record as required by §257.105(g). The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

This report documents the Weston Disposal Site No. 3 landfill has an established run-on and run-off control system design capable of controlling the peak discharge from a 25-year, 24-hour storm event and complies with § 257.81 *Run-on and run-off controls for CCR landfills*. All leachate that is collected at the Weston Disposal Site No. 3 either recycled for use as a dust control within the active landfill or hauled to the wastewater treatment facility at Weston Power Plant in accordance with the approved operating plan complying with § 257.3-3.

The plan was completed under the direction of John M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR Part 257 Subpart D.

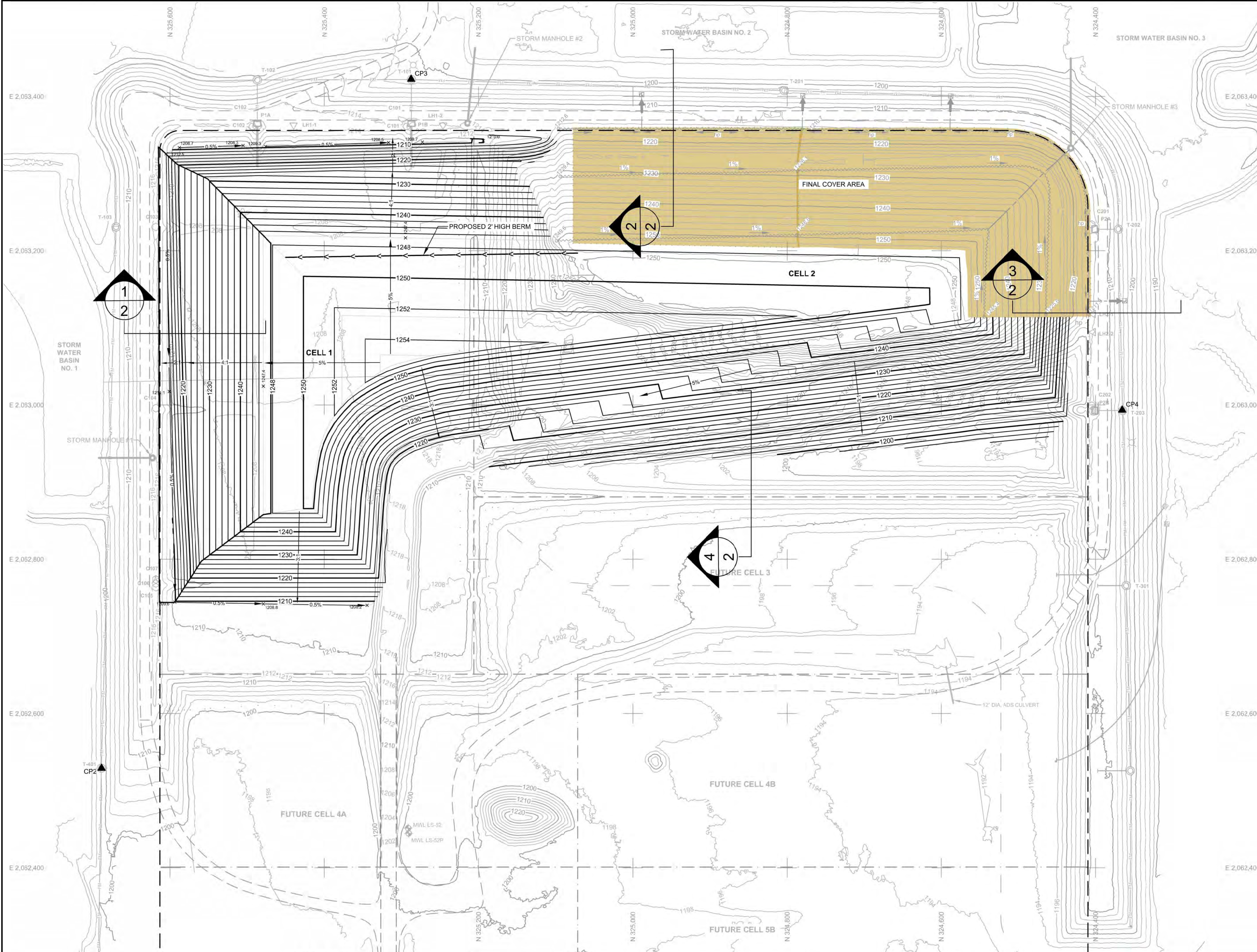
6. References

Perica, S., D. Martin, S. Pavlovic, I. Roy, M. St. Laurent, C. Trypaluk, D. Unruh, M. Yekta, G. Bonnin (2013). NOAA Atlas 14 Volume 8 Version 2.0, *Precipitation-Frequency Atlas of the United States, Midwestern States*. National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland.

US Department of Commerce. National Oceanic and Atmospheric Administration, National Weather Service. (2016). Precipitation Frequency Data Server (PFDS). http://hdsc.nws.noaa.gov/hdsc/pdfs/.

Appendix A

Drawings



LEGEND

- EXISTING GROUND SURFACE CONTOUR
- ROAD, NON PAVED
- ROAD, PAVED
- FENCE
- CULVERT
- STRUCTURE
- POWER POLE
- LIGHT POLE
- MANHOLE
- POST
- OBJECT
- SURVEY CONTROL MONUMENT
- CATCH BASIN ROUND (CB)
- MONITORING WELL (MW)
- SWAMP
- WATER
- TREE DECIDUOUS/CONIFEROUS
- BUSH
- BRUSH/HEDGE
- APPROXIMATE LANDFILL LIMIT OF WASTE
- APPROXIMATE LANDFILL CELL BOUNDARY
- GEOMEMBRANE LIMIT
- LEACHATE FORCE MAIN
- LEACHATE HEADWELL
- LEACHATE CLEANOUT
- PERIMETER ACCESS MANHOLE
- TRANSFER MANHOLE
- STORM WATER MANHOLE & DOWNSLOPE PIPE
- 6" DIA. NON-PERFORATED DRAIN PIPE
- 24" DIA. NON-PERFORATED DRAIN PIPE
- 4" DIA. NON-PERFORATED TOE DRAIN OUTLET & RIPRAP
- 4" DIA. PERFORATED SIDESLOPE INTERCEPT & TOE DRAIN WITH TOP OF PIPE ELEV.
- PROPOSED SURFACE CONTOUR
- PROPOSED 2' HIGH BERM

NOTES:

1. THE TOPOGRAPHIC BASE MAP HAS BEEN CREATED FROM AERIAL PHOTOGRAPHY AND LIDAR ACQUISITION BY AERO-METRIC, INC., SHEBOYGAN, WI. DATE FLOWN: NOVEMBER 5, 2010.
2. PLAN OF OPERATION, WESTON DISPOSAL SITE NO. 3 EXPANSION, BY BY TRC ENVIRONMENTAL CORPORATION, MADISON, WISCONSIN, MARCH 2014.
3. EXISTING CONDITIONS WERE SURVEYED BY RIVERVIEW CONSTRUCTION, INC., GREEN BAY, WISCONSIN, MAY 5, 2020.
4. HORIZONTAL DATUM IS REFERENCED TO WISCONSIN STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NORTH AMERICAN DATUM (NAD 83/2007), US SURVEY FEET.
5. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88). CONTOUR INTERVAL IS 2 FEET.
6. APPROXIMATE PROPERTY BOUNDARY IS BASED ON EXETER DESIGN, INC. GROUND SURVEY, DATED OCTOBER 9, 2014.

CONTROL POINT COORDINATES AND ELEVATIONS

POINT I.D.	NORTH	EAST	ELEVATION	DESCRIPTION
CP1	325,993.77	2,061,281.40	1187.37	MONUMENT BRASS MHT-1000
CP2	325,688.83	2,062,529.07	1200.35	MONUMENT BRASS MHT-401
CP3	325,287.26	2,063,422.35	1202.18	MONUMENT BRASS MHT-101
CP4	324,365.46	2,062,993.43	1206.51	MONUMENT BRASS MHT-203

May 3, 2016

Attention: 0 1" If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
0	X	X	X

Designed: JXT
Checked: JXT
Drawn: JLC
Submittal Date: 10/8/2021

GEI Consultants
3159 Voyager Drive
Green Bay, Wisconsin 54311
920-455-8200

WE ENERGIES
333 WEST EVERETT STREET
MILWAUKEE, WISCONSIN

GEI Project 1600630

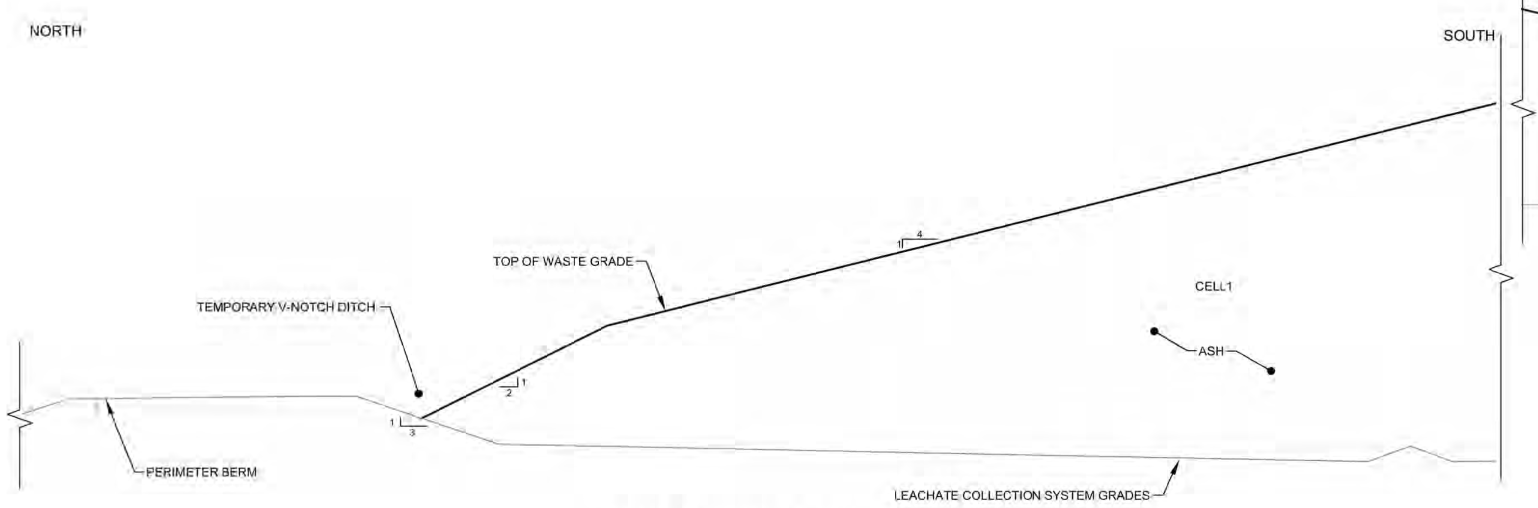
REGULATION COMPLIANCE REPORT
RUN-ON AND RUN-OFF CONTROL PLAN

WESTON DISPOSAL SITE NO. 3
CELLS 1 & 2

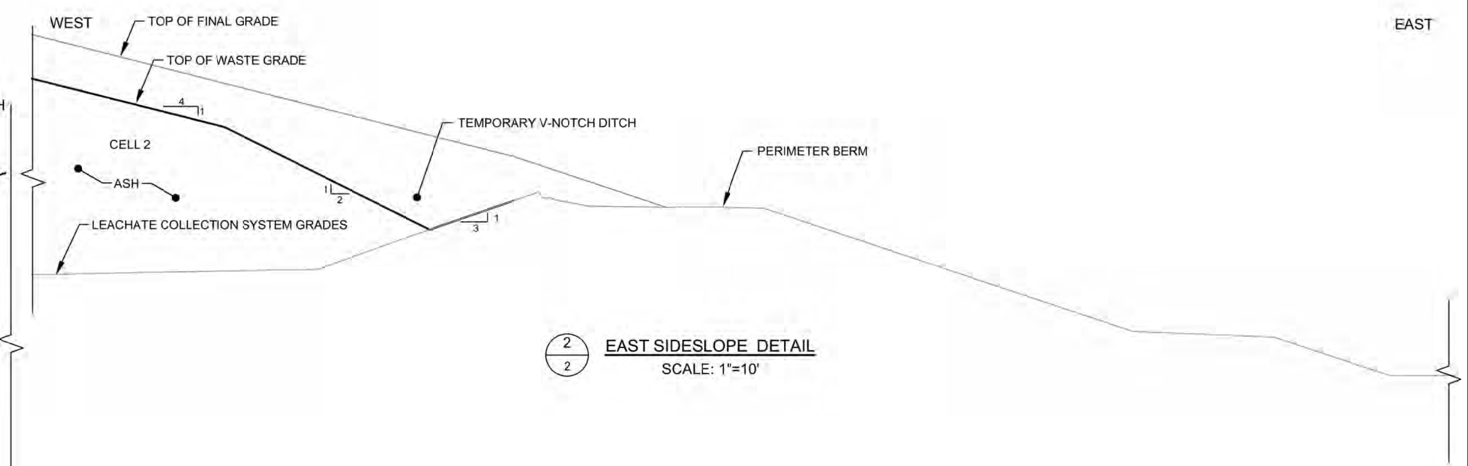
DWG. NO. C-1

SHEET NO. 1

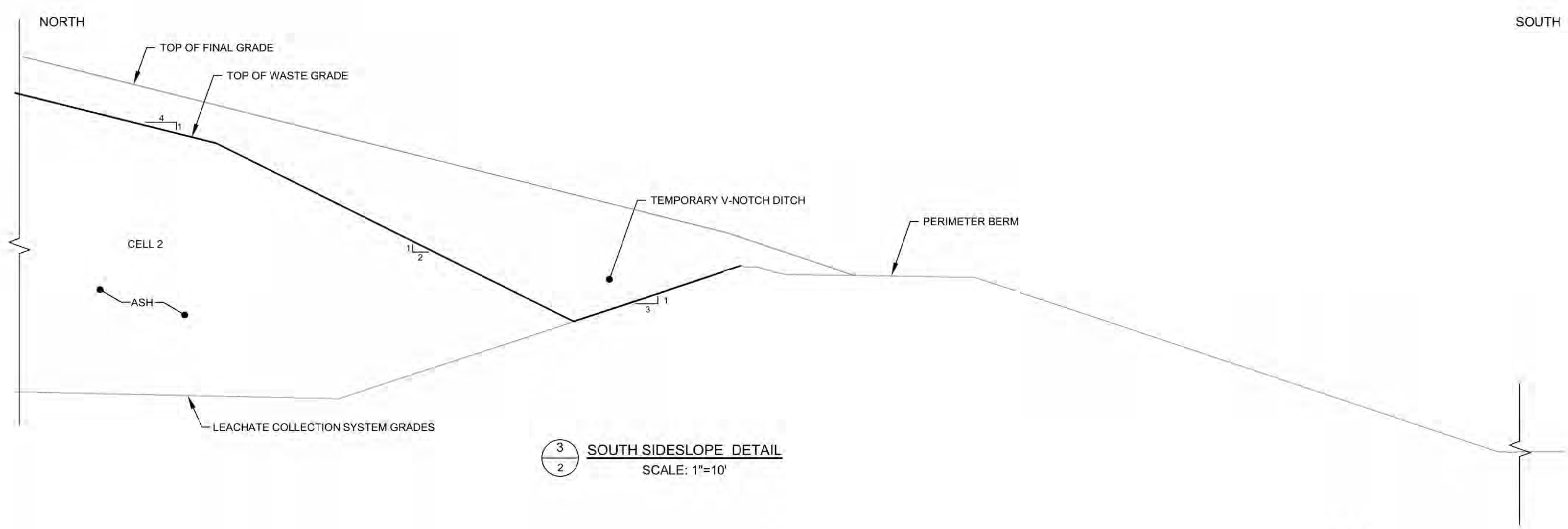
Filename: J:\LANDFILLS\WE - WESTON DISPOSAL SITE NO 3\1600630_RUN-ON RUN-OFF CONTROL PLAN\DWG\2021\1600630001_2021.DWG Last saved by: JCALAWAY Last Plotted: 2021-10-08



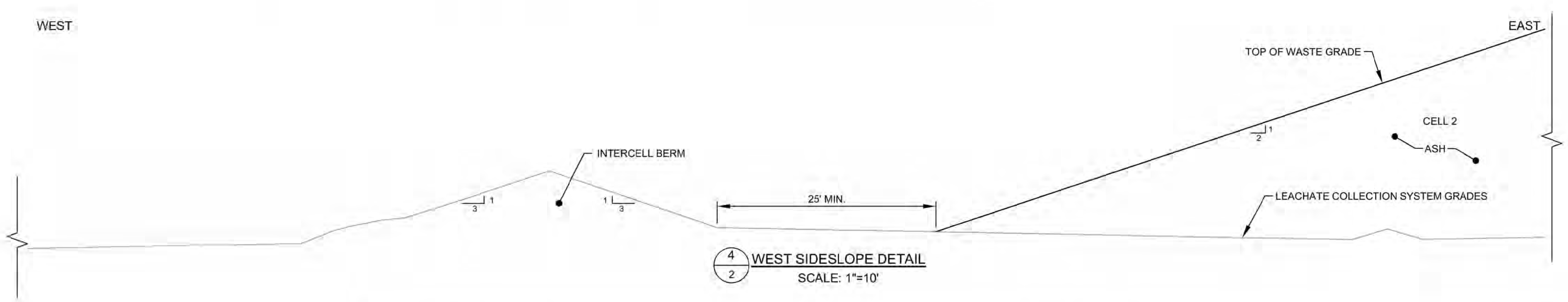
1/2 NORTH SIDESLOPE DETAIL
SCALE: 1"=10'



2/2 EAST SIDESLOPE DETAIL
SCALE: 1"=10'



3/2 SOUTH SIDESLOPE DETAIL
SCALE: 1"=10'



4/2 WEST SIDESLOPE DETAIL
SCALE: 1"=10'

Attention: If this scale bar does not measure 1" then drawing is not original scale.	0	X	X	X	
	NO.	DATE	ISSUE/REVISION	APP	

Designed: JXT
Checked: JXT
Drawn: JLC
Submittal Date: 10/8/2021

GEI Consultants
3159 Voyager Drive
Green Bay, Wisconsin 54311
920-455-8200

WE ENERGIES
333 WEST EVERETT STREET
MILWAUKEE, WISCONSIN

GEI Project 1600630

REGULATION COMPLIANCE REPORT
RUN-ON AND RUN-OFF CONTROL PLAN

WESTON DISPOSAL SITE NO. 3
CELLS 1 & 2 DETAILS

DWG. NO. C-2
SHEET NO. 3

Filename: J:\LANDFILLS\WE - WESTON DISPOSAL SITE NO 3\1600630_RUN-ON RUN-OFF CONTROL PLAN\DWG\2021\1600630002_2021.DWG Last saved by: JCALAWAY Last Plotted: 2021-10-08

Appendix B

NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume

Purpose:

The purpose of this calculation is to estimate the 24-hour, 25-year precipitation event at Weston Disposal Site No. 3. The 24-hour, 25-year precipitation event is required for the run-on and run-off control system plan for the landfill.

Procedure:

The rainfall depth estimation follows the procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Wisconsin).

As instructed in Atlas 14, the user is referred to the NOAA Precipitation Frequency Data Server (PFDS) http://hdsc.nws.noaa.gov/hdsc/pfds/index.html. The approximate center of the landfill was input into the PFDS and the PF estimates were returned.

Landfill Centroid Coordinates

44°43'27.12"N	44.7242°
89°38'12.84"W	-89.6369°

GEI Consultants	Client	WEC Energy Group			Page	2 of 4
	Project	Weston Disposal Site No. 3 Run-on and Run-off Control Plan			Pg. Rev.	
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	06/21/2021	Date	08/23/2021	Date	08/23/2021
GEI Project No.	1803049	Document No.	N/A			
Subject	NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume					

Tabular Output from the PFDS:

PDS-based 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	0.315 (0.260–0.386)	0.372 (0.306–0.456)	0.470 (0.386–0.577)	0.557 (0.454–0.685)	0.684 (0.542–0.869)	0.788 (0.608–1.01)	0.897 (0.669–1.17)	1.01 (0.724–1.34)	1.18 (0.807–1.58)	1.31 (0.869–1.77)
10-min	0.462 (0.381–0.566)	0.545 (0.448–0.668)	0.688 (0.565–0.845)	0.815 (0.665–1.00)	1.00 (0.793–1.27)	1.15 (0.891–1.48)	1.31 (0.979–1.71)	1.49 (1.06–1.96)	1.72 (1.18–2.32)	1.91 (1.27–2.59)
15-min	0.563 (0.464–0.690)	0.664 (0.547–0.814)	0.839 (0.689–1.03)	0.994 (0.811–1.22)	1.22 (0.968–1.55)	1.41 (1.09–1.80)	1.60 (1.19–2.08)	1.81 (1.29–2.39)	2.10 (1.44–2.83)	2.33 (1.55–3.16)
30-min	0.793 (0.654–0.971)	0.934 (0.769–1.15)	1.18 (0.968–1.45)	1.40 (1.14–1.72)	1.72 (1.36–2.18)	1.98 (1.53–2.53)	2.26 (1.68–2.93)	2.55 (1.82–3.38)	2.96 (2.03–3.99)	3.29 (2.19–4.46)
60-min	1.02 (0.840–1.25)	1.19 (0.981–1.46)	1.50 (1.23–1.84)	1.77 (1.44–2.18)	2.18 (1.73–2.78)	2.52 (1.95–3.23)	2.88 (2.15–3.75)	3.27 (2.34–4.33)	3.82 (2.62–5.15)	4.26 (2.83–5.77)
2-hr	1.25 (1.03–1.51)	1.45 (1.20–1.76)	1.81 (1.50–2.20)	2.14 (1.76–2.61)	2.64 (2.12–3.34)	3.05 (2.38–3.88)	3.50 (2.64–4.52)	3.98 (2.88–5.24)	4.67 (3.24–6.25)	5.22 (3.52–7.01)
3-hr	1.38 (1.15–1.67)	1.60 (1.33–1.93)	1.99 (1.65–2.40)	2.35 (1.94–2.85)	2.89 (2.33–3.64)	3.35 (2.63–4.24)	3.85 (2.92–4.95)	4.39 (3.19–5.74)	5.16 (3.60–6.87)	5.78 (3.91–7.72)
6-hr	1.64 (1.38–1.96)	1.89 (1.58–2.26)	2.33 (1.95–2.79)	2.74 (2.28–3.29)	3.36 (2.73–4.20)	3.89 (3.08–4.88)	4.46 (3.41–5.69)	5.08 (3.73–6.60)	5.97 (4.22–7.89)	6.69 (4.58–8.86)
12-hr	1.94 (1.64–2.30)	2.23 (1.88–2.64)	2.74 (2.31–3.25)	3.21 (2.69–3.82)	3.91 (3.20–4.82)	4.49 (3.58–5.57)	5.12 (3.95–6.46)	5.80 (4.30–7.45)	6.76 (4.82–8.84)	7.54 (5.22–9.90)
24-hr	2.28 (1.94–2.67)	2.61 (2.22–3.06)	3.18 (2.70–3.74)	3.70 (3.13–4.37)	4.47 (3.68–5.45)	5.11 (4.11–6.26)	5.78 (4.50–7.21)	6.50 (4.86–8.26)	7.52 (5.42–9.74)	8.33 (5.84–10.8)
2-day	2.64 (2.27–3.07)	3.01 (2.58–3.50)	3.65 (3.12–4.25)	4.22 (3.59–4.93)	5.07 (4.20–6.10)	5.76 (4.67–6.99)	6.49 (5.10–8.01)	7.27 (5.49–9.15)	8.36 (6.09–10.7)	9.24 (6.55–11.9)
3-day	2.89 (2.49–3.34)	3.30 (2.84–3.81)	4.00 (3.44–4.63)	4.62 (3.95–5.37)	5.54 (4.62–6.63)	6.29 (5.12–7.59)	7.08 (5.58–8.69)	7.91 (6.01–9.90)	9.08 (6.66–11.6)	10.0 (7.15–12.9)
4-day	3.12 (2.69–3.58)	3.55 (3.07–4.09)	4.31 (3.71–4.97)	4.97 (4.26–5.75)	5.94 (4.96–7.07)	6.72 (5.50–8.08)	7.55 (5.98–9.23)	8.43 (6.43–10.5)	9.65 (7.10–12.2)	10.6 (7.61–13.6)
7-day	3.76 (3.27–4.29)	4.25 (3.70–4.86)	5.09 (4.42–5.83)	5.82 (5.02–6.68)	6.86 (5.77–8.09)	7.70 (6.33–9.15)	8.56 (6.83–10.4)	9.47 (7.28–11.7)	10.7 (7.96–13.5)	11.7 (8.47–14.9)
10-day	4.36 (3.81–4.95)	4.89 (4.27–5.56)	5.78 (5.03–6.58)	6.54 (5.66–7.47)	7.62 (6.42–8.91)	8.47 (6.99–10.0)	9.35 (7.49–11.2)	10.3 (7.92–12.6)	11.5 (8.58–14.4)	12.5 (9.07–15.7)
20-day	6.08 (5.35–6.83)	6.71 (5.90–7.54)	7.73 (6.79–8.71)	8.58 (7.50–9.70)	9.75 (8.27–11.2)	10.7 (8.86–12.4)	11.5 (9.33–13.7)	12.5 (9.71–15.1)	13.7 (10.3–16.9)	14.6 (10.7–18.2)
30-day	7.49 (6.63–8.37)	8.23 (7.28–9.20)	9.42 (8.31–10.6)	10.4 (9.11–11.7)	11.7 (9.95–13.4)	12.7 (10.6–14.6)	13.6 (11.0–16.0)	14.5 (11.4–17.5)	15.7 (11.9–19.3)	16.6 (12.3–20.7)
45-day	9.25 (8.22–10.3)	10.2 (9.04–11.3)	11.7 (10.3–13.0)	12.8 (11.3–14.3)	14.3 (12.2–16.3)	15.5 (13.0–17.7)	16.5 (13.5–19.3)	17.5 (13.8–20.9)	18.8 (14.3–22.9)	19.7 (14.7–24.4)
60-day	10.7 (9.57–11.9)	11.9 (10.6–13.1)	13.6 (12.1–15.1)	15.0 (13.3–16.7)	16.8 (14.3–18.9)	18.0 (15.2–20.6)	19.2 (15.7–22.3)	20.3 (16.1–24.1)	21.7 (16.6–26.3)	22.6 (17.0–27.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

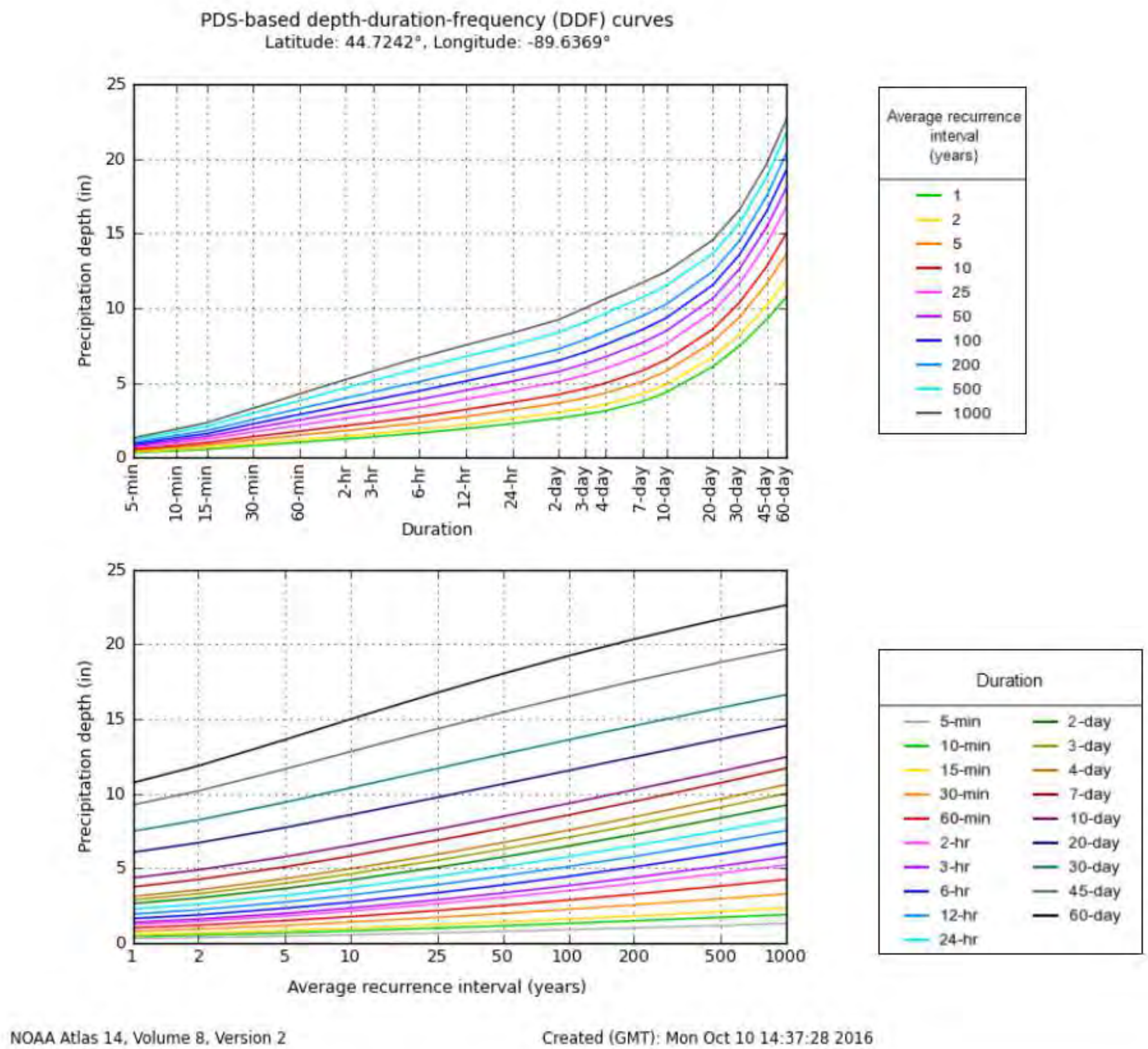
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

GEI Consultants	**Client**	WEC Energy Group		**Page**	3 of 4
	Project	Weston Disposal Site No. 3 Run-on and Run-off Control Plan		**Pg. Rev.**	
	By	W. Reybrock	**Chk.** A. Schwoerer	**App.**	A. Schwoerer
	Date	06/21/2021	**Date** 08/23/2021	**Date**	08/23/2021

GEI Project No.	1803049	**Document No.**	N/A
Subject	NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume		

Graphical Output from the PFDS:



	Client	WEC Energy Group			Page	4 of 4
GEI Consultants	Project	Weston Disposal Site No. 3 Run-on and Run-off Control Plan			Pg. Rev.	
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	06/21/2021	Date	08/23/2021	Date	08/23/2021
GEI Project No.	1803049	Document No.	N/A			
Subject	NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume					

Regulations:

The Weston Disposal Site No. 3 is regulated under 40 CFR Part 257 Subpart D – Standards for Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments as an existing landfill. The regulations specify that landfill must have the following plans in place:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

Conclusion:

The 24-hour, 25-year storm for the Weston Disposal Site No. 3 is 4.47 inches. This value will be utilized in the stormwater run-off model (under a separate calculation package).

Appendix C

Stormwater Run-off Calculations

GEI Consultants	Client	WEC Energy Group			Page	1 of 2
	Project	WDS3 LF Run-on and Run-off Control Plan			Rev.	0
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	10/11/2021	Date	10/11/2021	Date	10/11/2021
GEI Project No.	1803049	Document No.	N/A			
Subject	Stormwater Run-off Calculations					

Purpose:

The purpose of this calculation is to model the stormwater run-off associated with a 24-hour, 25-year precipitation event at Weston Disposal Site No. 3 (WDS3) from Cells 1 and 2. In addition, this analysis was completed to confirm the current run-off control system for the construction of Cells 1 and 2 can adequately manage the 24-hour, 25-year precipitation event.

Design Criteria and Assumptions:

1. The rainfall depth estimation for the 24-hour, 25-year precipitation event was determined to be 4.47 inches (included under a separate calculation package). The rainfall depth was determined by following procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Wisconsin).
2. The southeastern 2.7 acres of the cell that has already been closed flows south and east off Cell 2 as shown in Figure 1. Cell 1 has a total area of 6.6 acres, while Cell 2 has a total area of 8.6 acres.
3. The landfill surface was modeled as bare ash, assuming hydrologic soil group C and a Runoff Curve Number (CN) of 91.
4. Perimeter ditches were modeled as 3-foot deep V-shaped channels with sides of 2H:1V on one side and 3H:1V on the other side. Perimeter ditch slopes ranged from 0.5% to 1%.
5. The size and geometry of the Cells 1 and 2 ash slopes were obtained from Sheet C-1 from Appendix A of this report.
6. Stormwater on the active portion of the Cell was divided into 11 subcatchments and 4 stormwater ponding areas : north, west, middle, and stormwater ponding areas, as shown on Figure 1. Flow from all subcatchments will consist of sheet flow until it is collected by a conveyance channel at the toe of each slope. The main stormwater ponding area is 1P on the southwest corner of Cell 2. Ponding area 3P, will have a 12-in diameter culvert allowing flow to ponding area 2P, which will have a 12-in diameter culvert flowing to ponding area 1P. Ponding area 4P does not have culverts to any other ponding areas. In all four stormwater surge areas (1P, 2P, 3P, and 4P), the water infiltrates into leachate collection granular drainage layer and is treated as leachate. Stormwater subcatchments and the stormwater surge areas are shown on Figure 1.
7. HydroCAD 10.0 was used to model the stormwater associated with Cell 1 of the PPPP landfill.
8. Subcatchment, reach, and detention parameters are included in the attached HydroCAD Report.

Results:

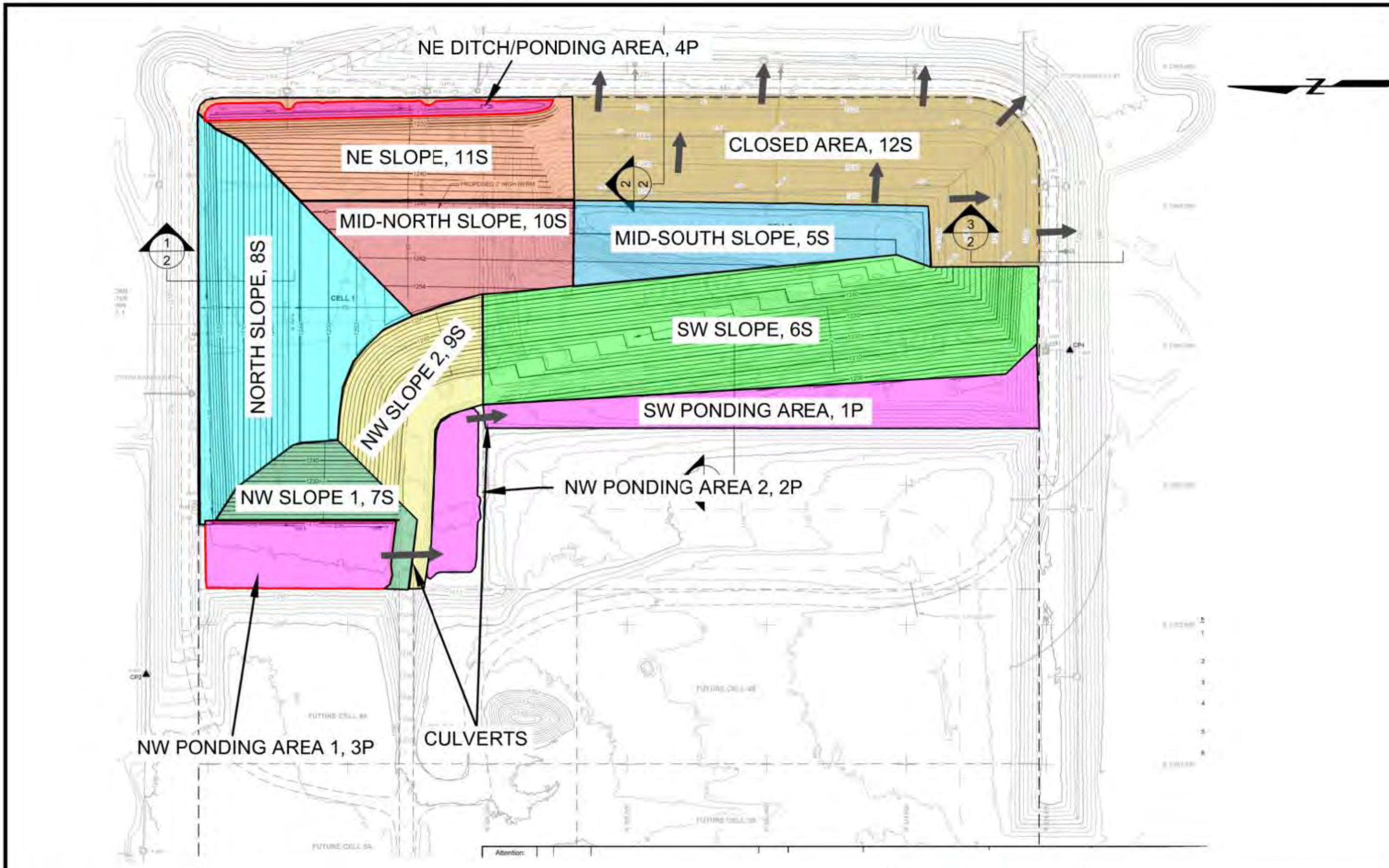
In general, stormwater is conveyed off the slopes of Cells 1 and 2 as sheet flow until it is intercepted by temporary containment ditches. The temporary containment ditches at the perimeter of the landfill cell are a minimum of 2-feet-deep and have a 3H:1V exterior slope and 2H:1V interior side slope. The exterior slope of the ditch is the top of the granular drainage layer of the leachate collection system. The interior slope is cut into the CCR disposed of in the landfill. Upon closure of the landfill, the temporary stormwater containment ditch will be filled with soil or CCR prior to placement of the final cover system.

The results of the stormwater modeling calculations indicate that the perimeter ditches located along Cells 1 and 2 are able to contain and convey the flow of runoff resulting from the 25-year, 24-hour precipitation event, and route it to one of the four ponding areas. The table below shows the assumed starting elevations, the maximum ponding elevations, and amount of freeboard anticipated following the 25-year, 24-hour storm.

Stormwater Surge Area	Starting Elevation (ft)	Max Elevation (ft)	Top of Pond Elevation (ft)	Freeboard (ft)
SW Ponding Area, 1P	1196.00	1203.45	1208.00	4.55
NW Ponding Area 2, 2P	1208.00	1209.25	1210.00	0.75
NW Ponding Area 1, 3P	1209.00	1211.25	1212.00	0.75
NE Ditch/Ponding Area, 4P	1208.00	1212.89	1213.00	0.11

Attachments:

- Figure 1 –Stormwater Conveyance Diagram
- HydroCAD Summary Report



SOURCE:

1. PLAN BASED ON DWG. C-1, WESTON DISPOSAL SITE No. 3., SUBMITTAL DATE 10/08/2021

Run-on and Run-off Control Plan
Weston Disposal Site No. 3
Marathon County, Wisconsin

We Energies
Milwaukee, Wisconsin

GEI Consultants

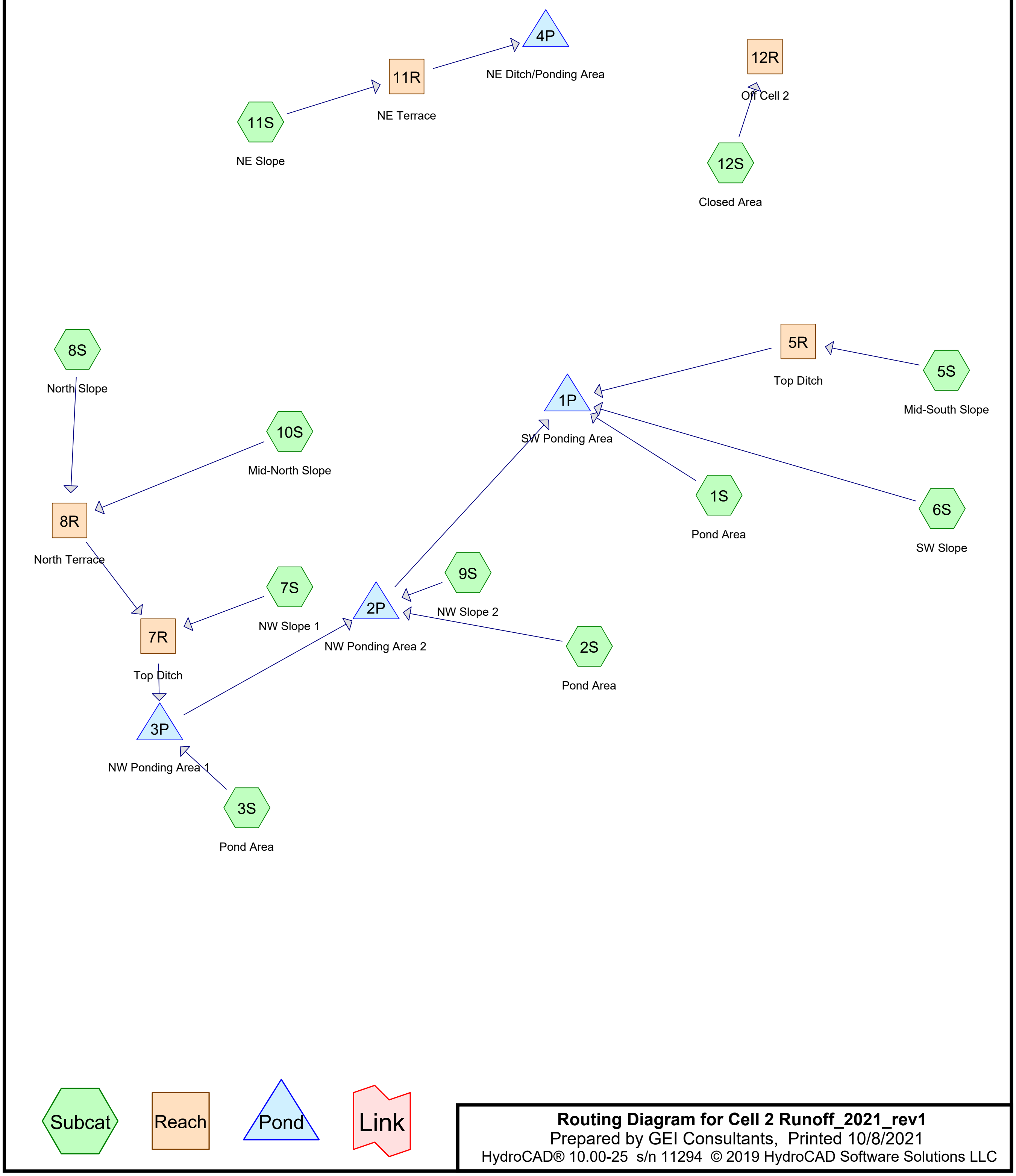
Project 1803049

Run-Off Stormwater Flow Diagram

October 2021

Fig. 1

\\grb-pzcc-1\ J:\Landfills\WE - Weston Disposal Site No 3\1600630_run-on run-off control plan\dwg\2021\1600630001_SW_Run-Off.dwg - 10/8/2021



Routing Diagram for Cell 2 Runoff_2021_rev1
Prepared by GEI Consultants, Printed 10/8/2021
HydroCAD® 10.00-25 s/n 11294 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
13.121	91	Newly graded area, HSG C (5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S)
1.988	98	Water Surface, HSG C (1S, 2S, 3S)
15.109	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
15.109	HSG C	1S, 2S, 3S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S
0.000	HSG D	
0.000	Other	
15.109		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	13.121	0.000	0.000	13.121	Newly graded area	5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S
0.000	0.000	1.988	0.000	0.000	1.988	Water Surface	1S, 2S, 3S
0.000	**0.000**	**15.109**	**0.000**	**0.000**	**15.109**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2P	1,208.00	1,203.00	50.0	0.1000	0.013	12.0	0.0	0.0
2	3P	1,210.00	1,208.00	65.0	0.0308	0.013	12.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: Pond Area Runoff Area=46,160 sf 100.00% Impervious Runoff Depth=4.23"
Tc=0.0 min CN=98 Runoff=7.57 cfs 0.374 af

Subcatchment2S: Pond Area Runoff Area=14,567 sf 100.00% Impervious Runoff Depth=4.23"
Tc=0.0 min CN=98 Runoff=2.39 cfs 0.118 af

Subcatchment3S: Pond Area Runoff Area=25,866 sf 100.00% Impervious Runoff Depth=4.23"
Tc=0.0 min CN=98 Runoff=4.24 cfs 0.210 af

Subcatchment5S: Mid-South Slope Runoff Area=48,779 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=70' Slope=0.0500 '/' Tc=0.7 min CN=91 Runoff=7.26 cfs 0.324 af

Subcatchment6S: SW Slope Runoff Area=131,027 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=180' Slope=0.3300 '/' Tc=0.7 min CN=91 Runoff=19.49 cfs 0.870 af

Subcatchment7S: NW Slope 1 Runoff Area=23,549 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=110' Slope=0.3300 '/' Tc=0.5 min CN=91 Runoff=3.52 cfs 0.156 af

Subcatchment8S: North Slope Runoff Area=95,763 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=225' Tc=1.3 min CN=91 Runoff=13.89 cfs 0.636 af

Subcatchment9S: NW Slope 2 Runoff Area=42,752 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=150' Slope=0.3300 '/' Tc=0.6 min CN=91 Runoff=6.38 cfs 0.284 af

Subcatchment10S: Mid-North Slope Runoff Area=44,723 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=130' Slope=0.0500 '/' Tc=1.1 min CN=91 Runoff=6.55 cfs 0.297 af

Subcatchment11S: NE Slope Runoff Area=69,100 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=135' Slope=0.3300 '/' Tc=0.6 min CN=91 Runoff=10.31 cfs 0.459 af

Subcatchment12S: Closed Area Runoff Area=115,870 sf 0.00% Impervious Runoff Depth=3.47"
Flow Length=200' Slope=0.0500 '/' Tc=1.6 min CN=91 Runoff=16.57 cfs 0.769 af

Reach 5R: Top Ditch Avg. Flow Depth=0.98' Max Vel=2.60 fps Inflow=7.26 cfs 0.324 af
n=0.022 L=580.0' S=0.0043 '/' Capacity=124.23 cfs Outflow=6.06 cfs 0.324 af

Reach 7R: Top Ditch Avg. Flow Depth=1.53' Max Vel=3.32 fps Inflow=19.81 cfs 1.089 af
n=0.022 L=260.0' S=0.0038 '/' Capacity=117.35 cfs Outflow=19.02 cfs 1.089 af

Reach 8R: North Terrace Avg. Flow Depth=1.45' Max Vel=3.56 fps Inflow=20.44 cfs 0.932 af
n=0.022 L=585.0' S=0.0048 '/' Capacity=44.40 cfs Outflow=18.31 cfs 0.932 af

Reach 11R: NE Terrace Avg. Flow Depth=1.28' Max Vel=2.12 fps Inflow=10.31 cfs 0.459 af
n=0.022 L=500.0' S=0.0020 '/' Capacity=28.70 cfs Outflow=8.46 cfs 0.459 af

Reach 12R: Off Cell 2 Inflow=16.57 cfs 0.769 af
Outflow=16.57 cfs 0.769 af

Pond 1P: SW Ponding Area Peak Elev=1,203.45' Storage=142,884 cf Inflow=33.30 cfs 3.075 af
Outflow=0.00 cfs 0.000 af

Pond 2P: NW Ponding Area 2 Peak Elev=1,209.25' Storage=9,092 cf Inflow=10.09 cfs 1.509 af
12.0" Round Culvert n=0.013 L=50.0' S=0.1000 '/' Outflow=3.28 cfs 1.508 af

Pond 3P: NW Ponding Area 1 Peak Elev=1,211.25' Storage=30,882 cf Inflow=20.05 cfs 1.298 af
12.0" Round Culvert n=0.013 L=65.0' S=0.0308 '/' Outflow=3.27 cfs 1.107 af

Pond 4P: NE Ditch/Ponding Area Peak Elev=1,212.89' Storage=19,976 cf Inflow=8.46 cfs 0.459 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 15.109 ac Runoff Volume = 4.495 af Average Runoff Depth = 3.57"
86.84% Pervious = 13.121 ac 13.16% Impervious = 1.988 ac

Summary for Subcatchment 1S: Pond Area

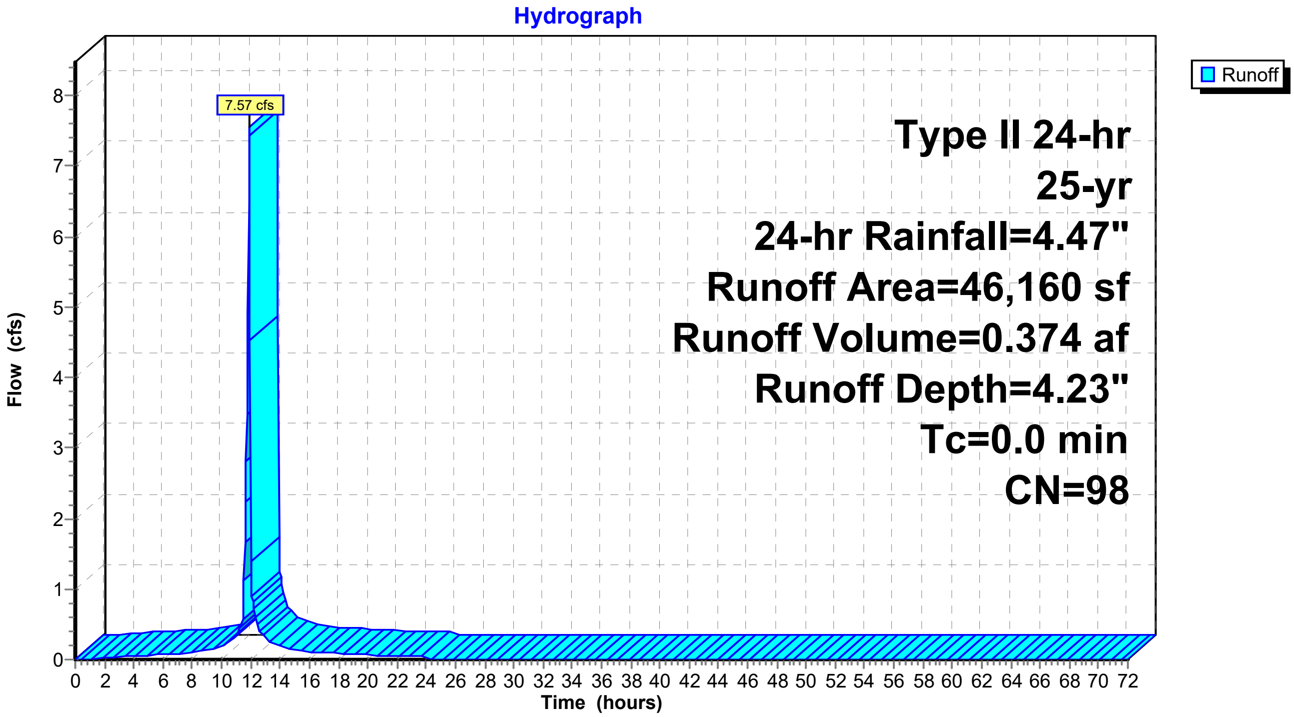
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 7.57 cfs @ 11.89 hrs, Volume= 0.374 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
46,160	98	Water Surface, HSG C
46,160		100.00% Impervious Area

Subcatchment 1S: Pond Area



Summary for Subcatchment 2S: Pond Area

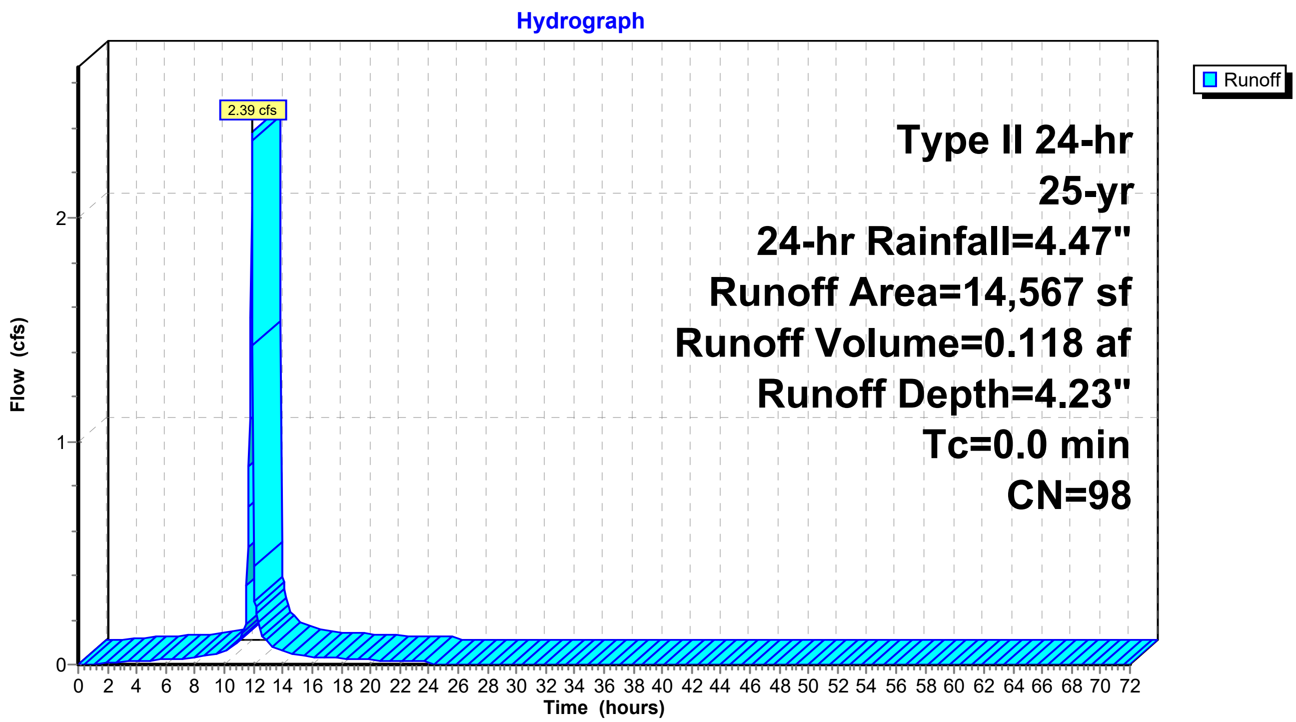
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 2.39 cfs @ 11.89 hrs, Volume= 0.118 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
14,567	98	Water Surface, HSG C
14,567		100.00% Impervious Area

Subcatchment 2S: Pond Area



Summary for Subcatchment 3S: Pond Area

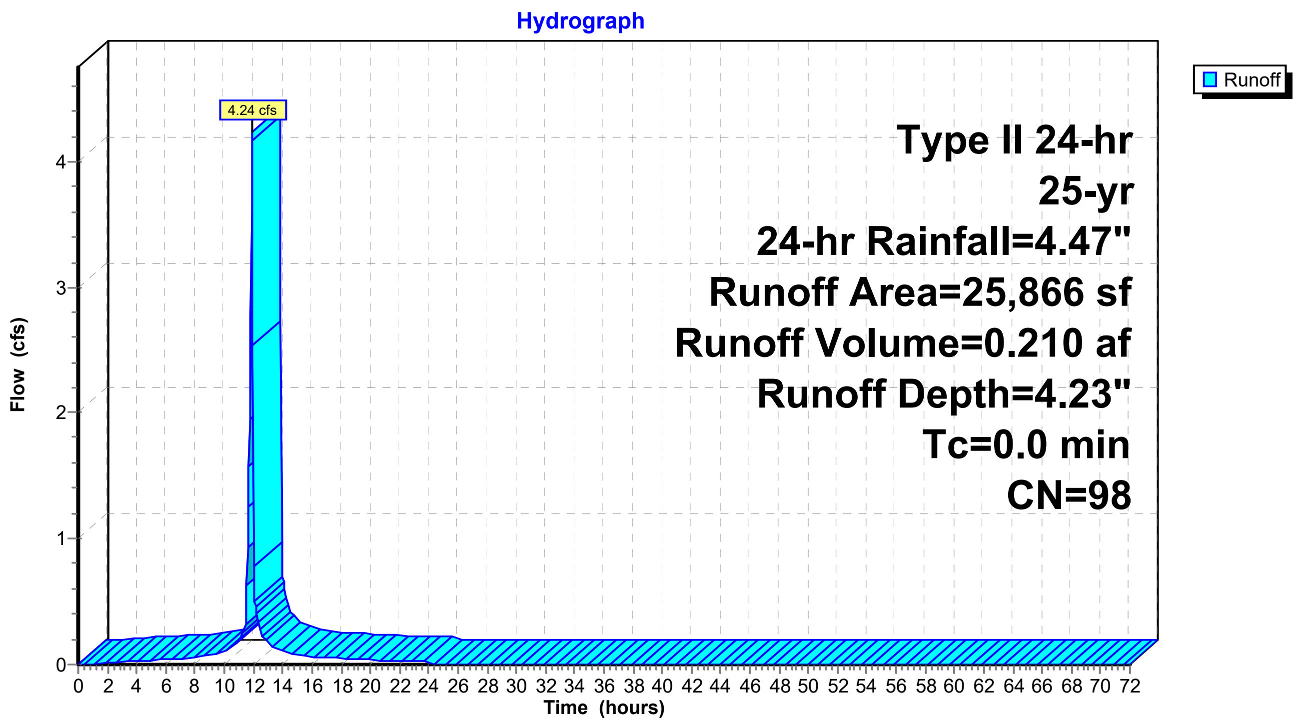
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 4.24 cfs @ 11.89 hrs, Volume= 0.210 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
25,866	98	Water Surface, HSG C
25,866		100.00% Impervious Area

Subcatchment 3S: Pond Area



Summary for Subcatchment 5S: Mid-South Slope

[49] Hint: Tc<2dt may require smaller dt

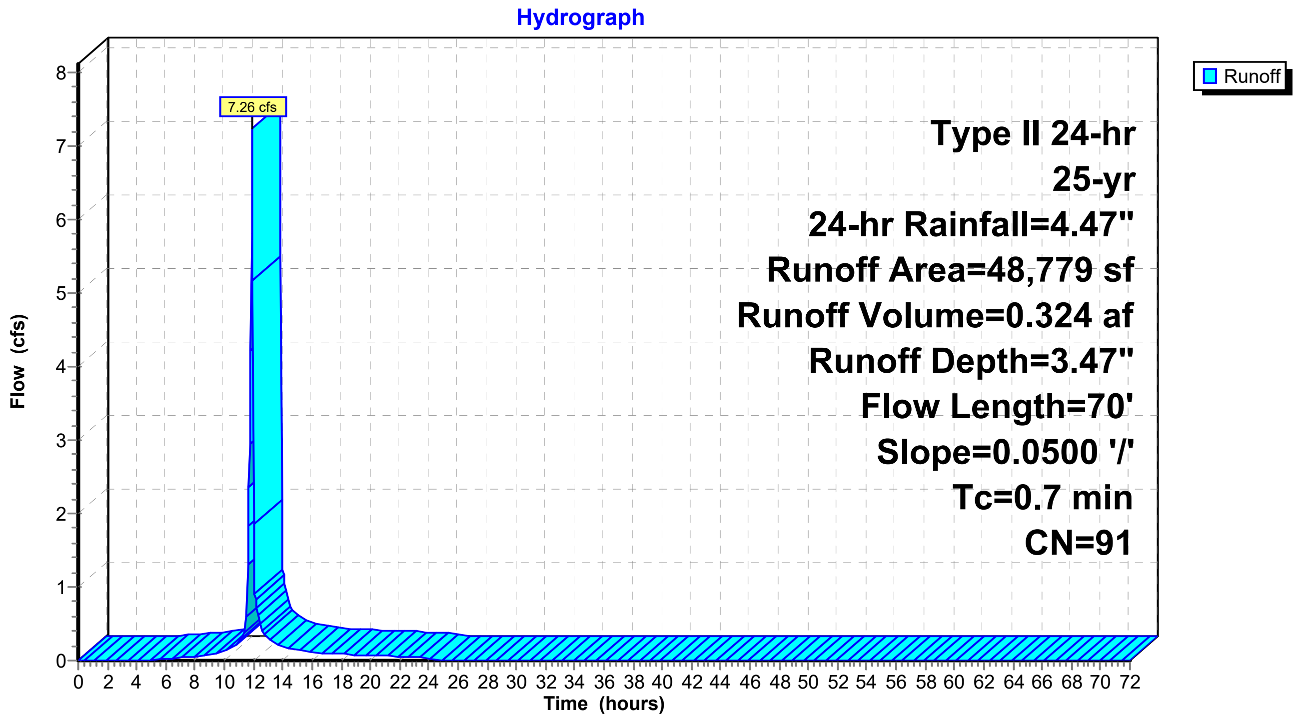
Runoff = 7.26 cfs @ 11.90 hrs, Volume= 0.324 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
48,779	91	Newly graded area, HSG C
48,779		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	70	0.0500	1.67		**Sheet Flow, Upper Slopes** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 5S: Mid-South Slope



Summary for Subcatchment 6S: SW Slope

[49] Hint: Tc<2dt may require smaller dt

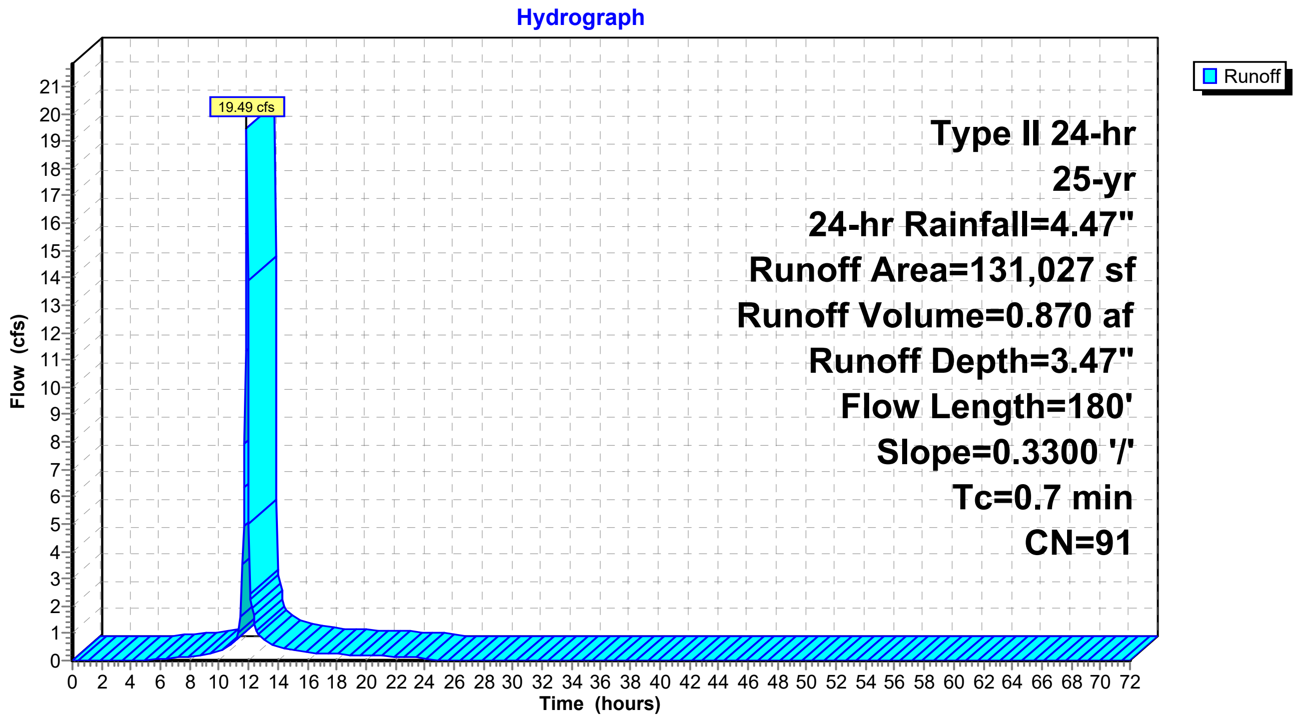
Runoff = 19.49 cfs @ 11.90 hrs, Volume= 0.870 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
131,027	91	Newly graded area, HSG C
131,027		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	180	0.3300	4.29		**Sheet Flow, SW Slope** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 6S: SW Slope



Summary for Subcatchment 7S: NW Slope 1

[49] Hint: Tc<2dt may require smaller dt

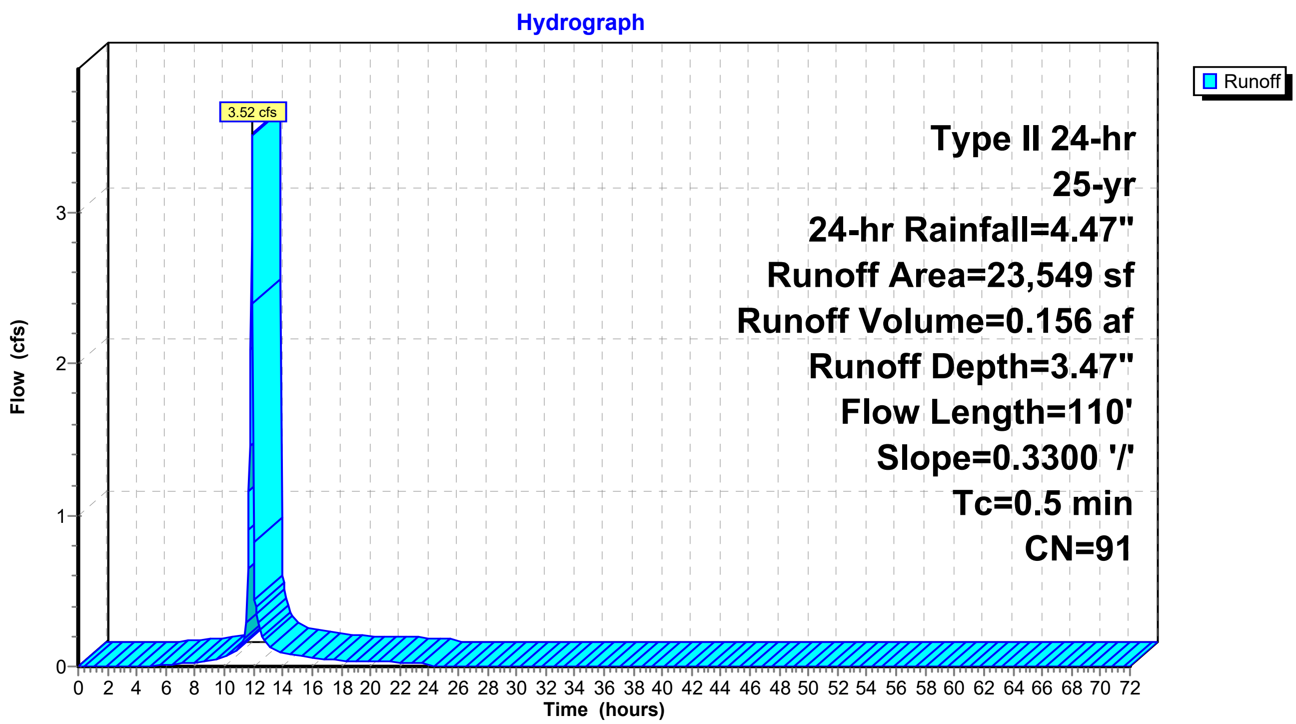
Runoff = 3.52 cfs @ 11.89 hrs, Volume= 0.156 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
23,549	91	Newly graded area, HSG C
23,549		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	3.89		**Sheet Flow, NW Slope 1** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 7S: NW Slope 1



Summary for Subcatchment 8S: North Slope

[49] Hint: Tc<2dt may require smaller dt

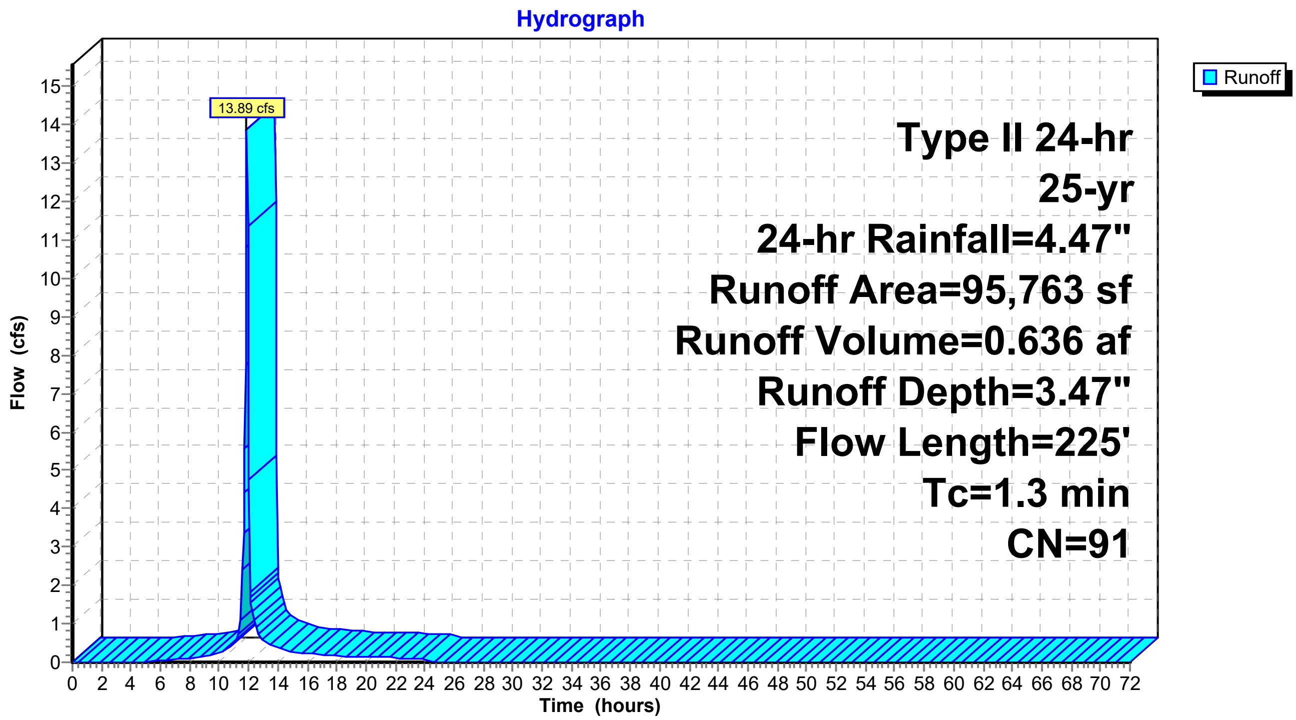
Runoff = 13.89 cfs @ 11.90 hrs, Volume= 0.636 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
95,763	91	Newly graded area, HSG C
95,763		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	150	0.3300	4.13		**Sheet Flow, North Slope** Smooth surfaces n= 0.011 P2= 2.61"
0.7	75	0.0500	1.69		**Sheet Flow, 5%** Smooth surfaces n= 0.011 P2= 2.61"
1.3	225	Total			

Subcatchment 8S: North Slope



Summary for Subcatchment 9S: NW Slope 2

[49] Hint: Tc<2dt may require smaller dt

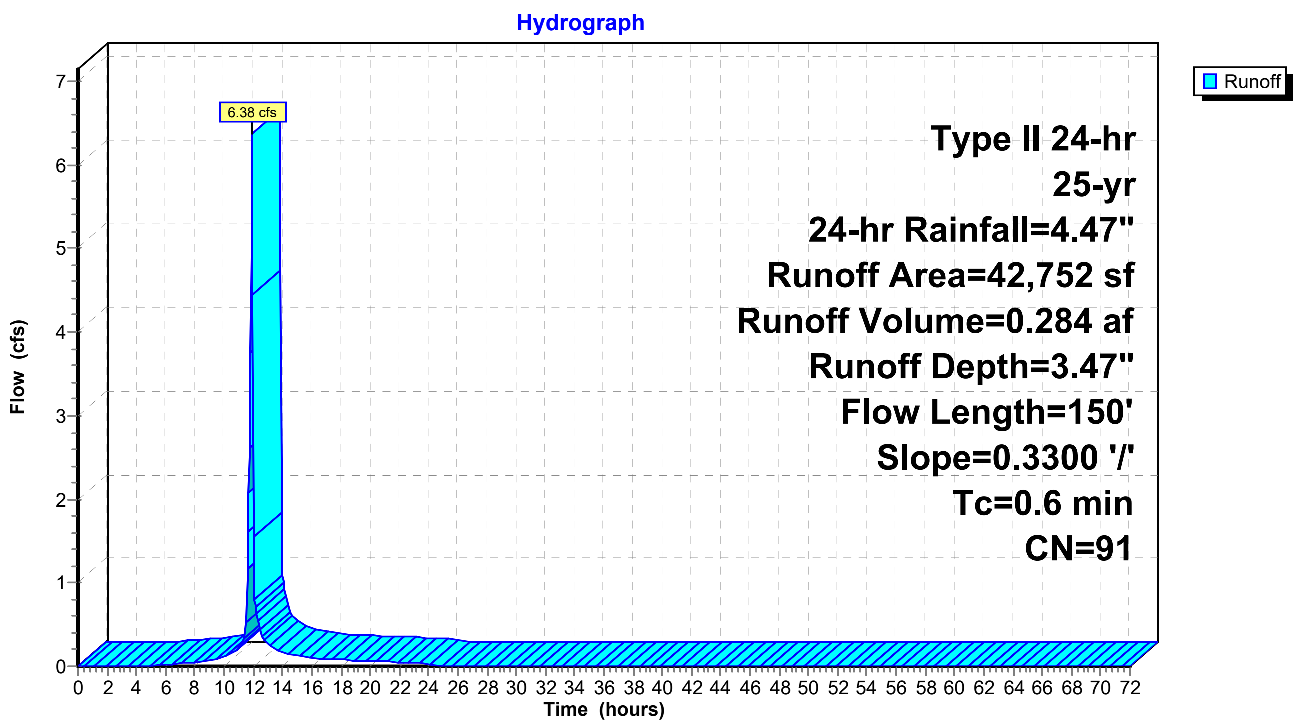
Runoff = 6.38 cfs @ 11.89 hrs, Volume= 0.284 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
42,752	91	Newly graded area, HSG C
42,752		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	150	0.3300	4.13		**Sheet Flow, NW Slope 2** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 9S: NW Slope 2



Summary for Subcatchment 10S: Mid-North Slope

[49] Hint: Tc<2dt may require smaller dt

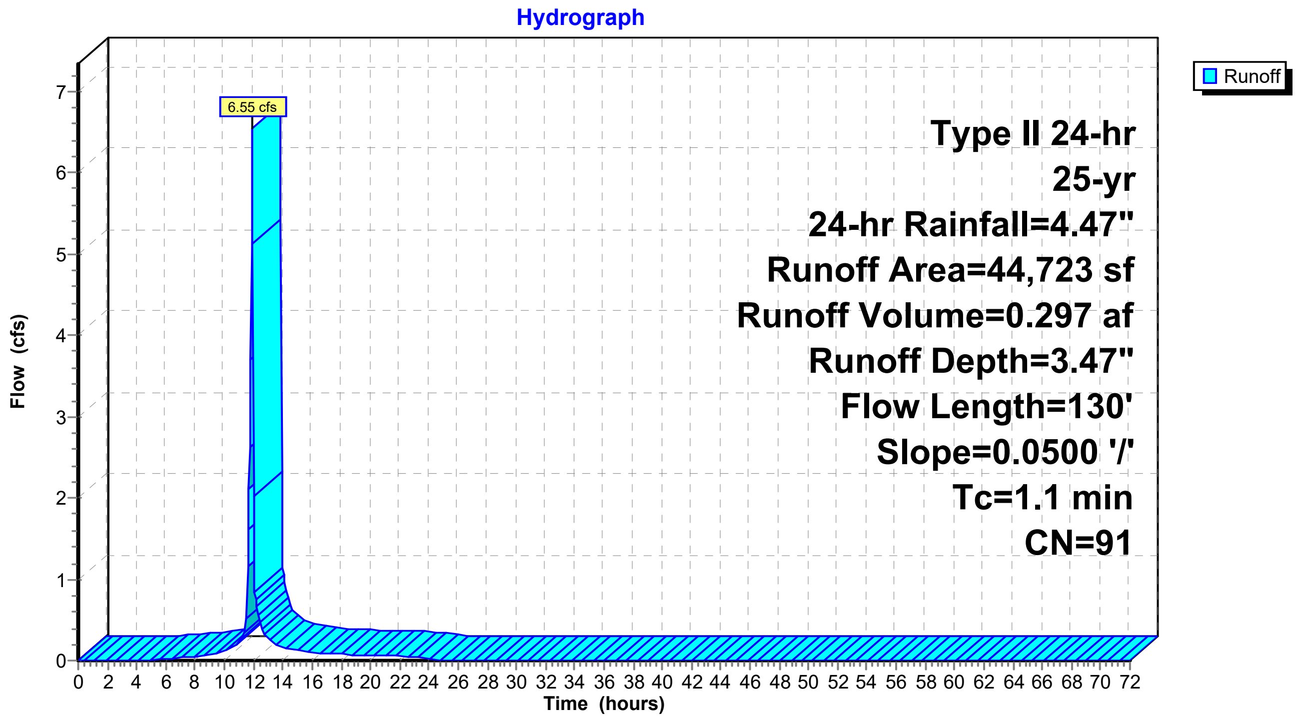
Runoff = 6.55 cfs @ 11.90 hrs, Volume= 0.297 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
44,723	91	Newly graded area, HSG C
44,723		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	130	0.0500	1.89		**Sheet Flow, Upper Slopes** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 10S: Mid-North Slope



Summary for Subcatchment 11S: NE Slope

[49] Hint: Tc<2dt may require smaller dt

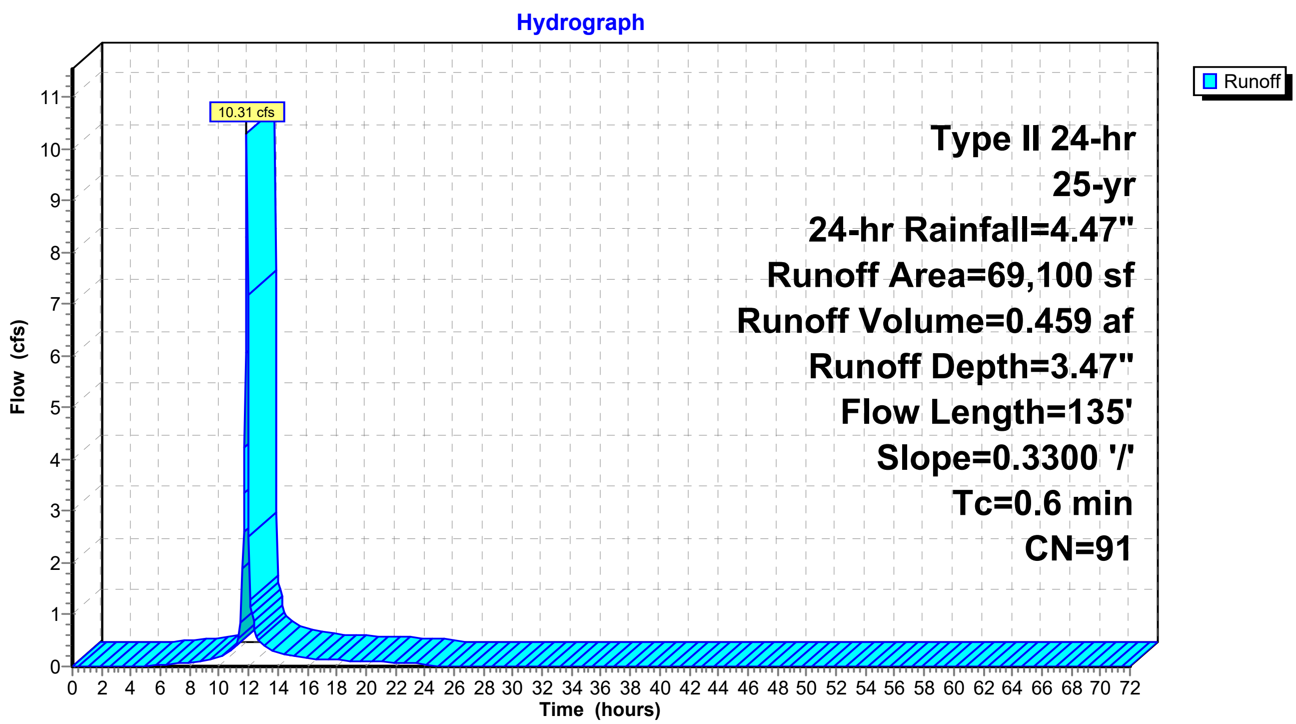
Runoff = 10.31 cfs @ 11.89 hrs, Volume= 0.459 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
69,100	91	Newly graded area, HSG C
69,100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	135	0.3300	4.05		**Sheet Flow, North Slope** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 11S: NE Slope



Summary for Subcatchment 12S: Closed Area

[49] Hint: Tc<2dt may require smaller dt

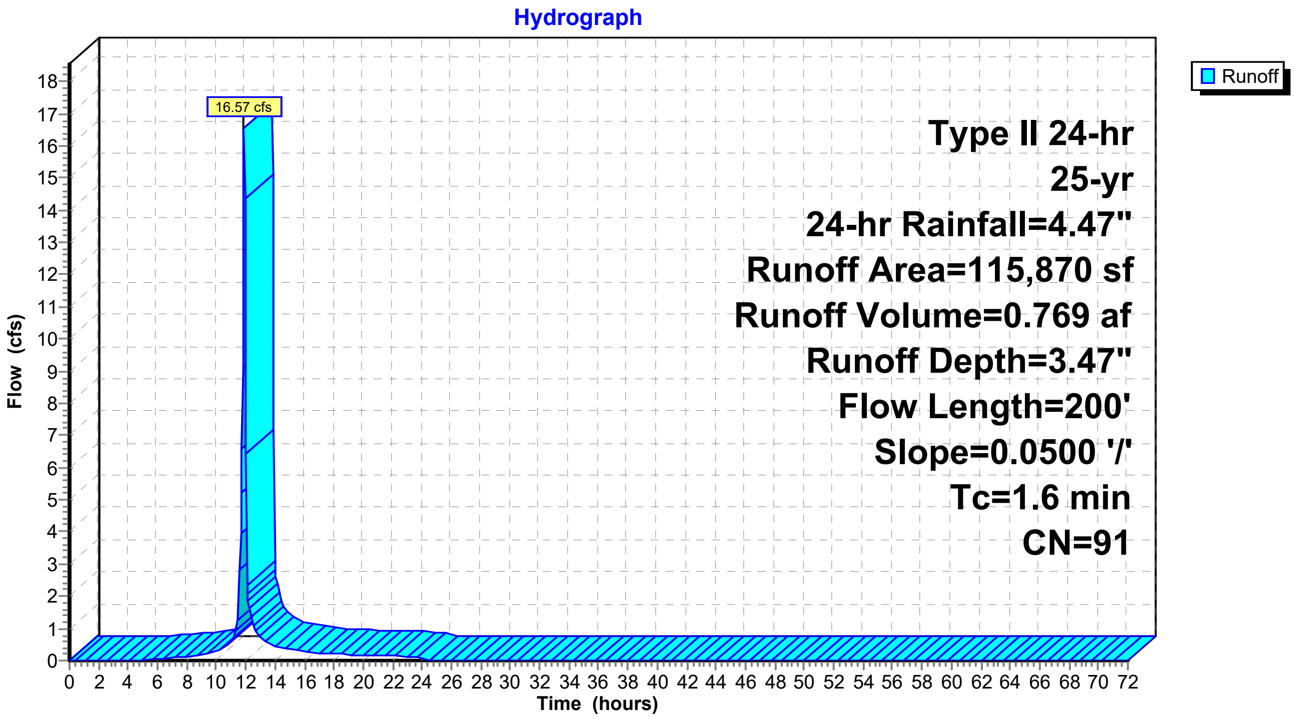
Runoff = 16.57 cfs @ 11.91 hrs, Volume= 0.769 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.47"

Area (sf)	CN	Description
115,870	91	Newly graded area, HSG C
115,870		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	200	0.0500	2.06		**Sheet Flow, Upper Slopes** Smooth surfaces n= 0.011 P2= 2.61"

Subcatchment 12S: Closed Area



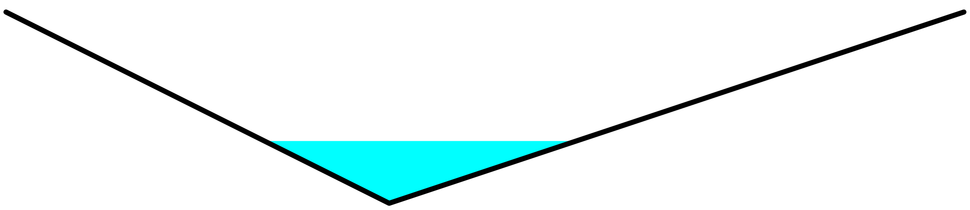
Summary for Reach 5R: Top Ditch

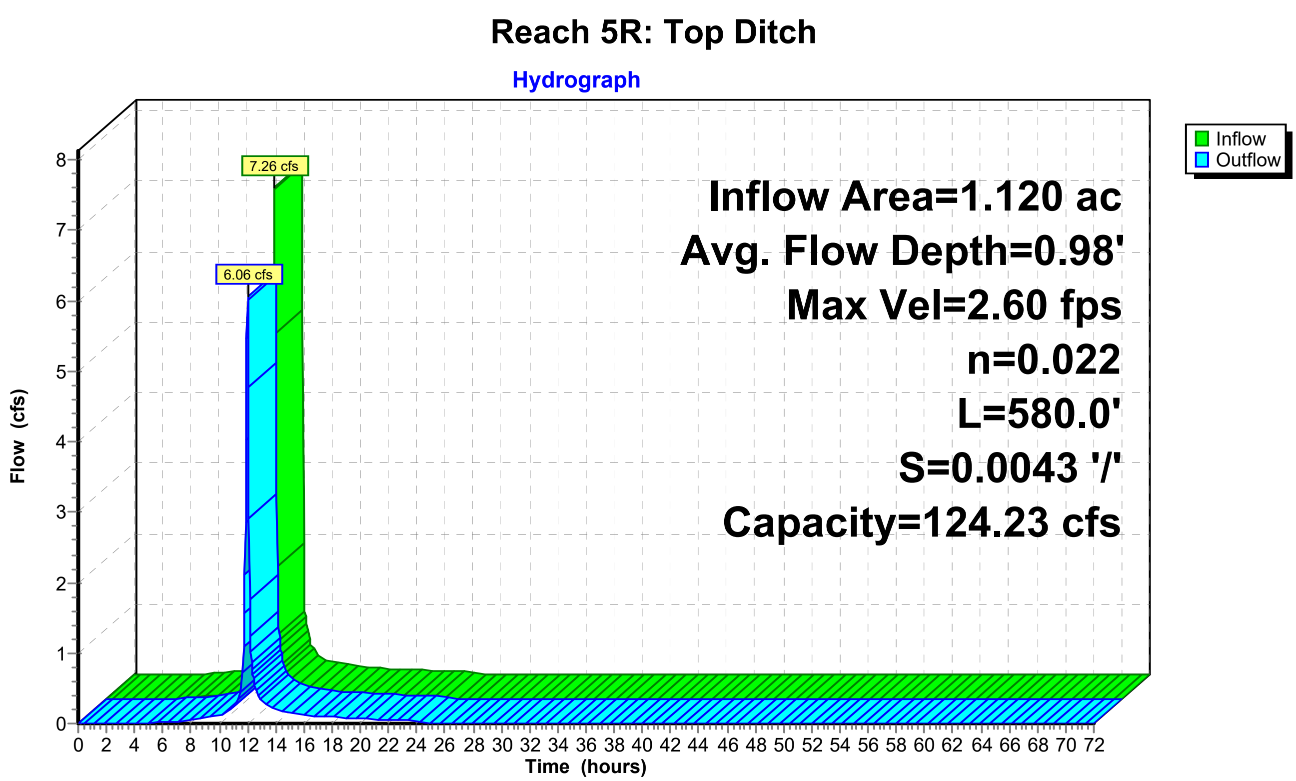
Inflow Area = 1.120 ac, 0.00% Impervious, Inflow Depth = 3.47" for 25-yr, 24-hr event
Inflow = 7.26 cfs @ 11.90 hrs, Volume= 0.324 af
Outflow = 6.06 cfs @ 11.99 hrs, Volume= 0.324 af, Atten= 17%, Lag= 5.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.60 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 11.6 min

Peak Storage= 1,383 cf @ 11.93 hrs
Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 3.00' Flow Area= 22.5 sf, Capacity= 124.23 cfs

0.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 3.0 '/' Top Width= 15.00'
Length= 580.0' Slope= 0.0043 '/'
Inlet Invert= 1,240.50', Outlet Invert= 1,238.00'





Summary for Reach 7R: Top Ditch

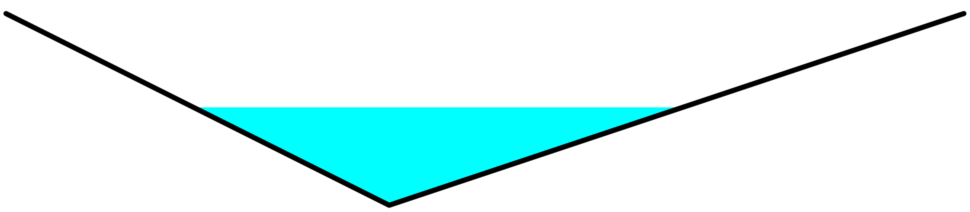
[62] Hint: Exceeded Reach 8R OUTLET depth by 0.41' @ 12.05 hrs

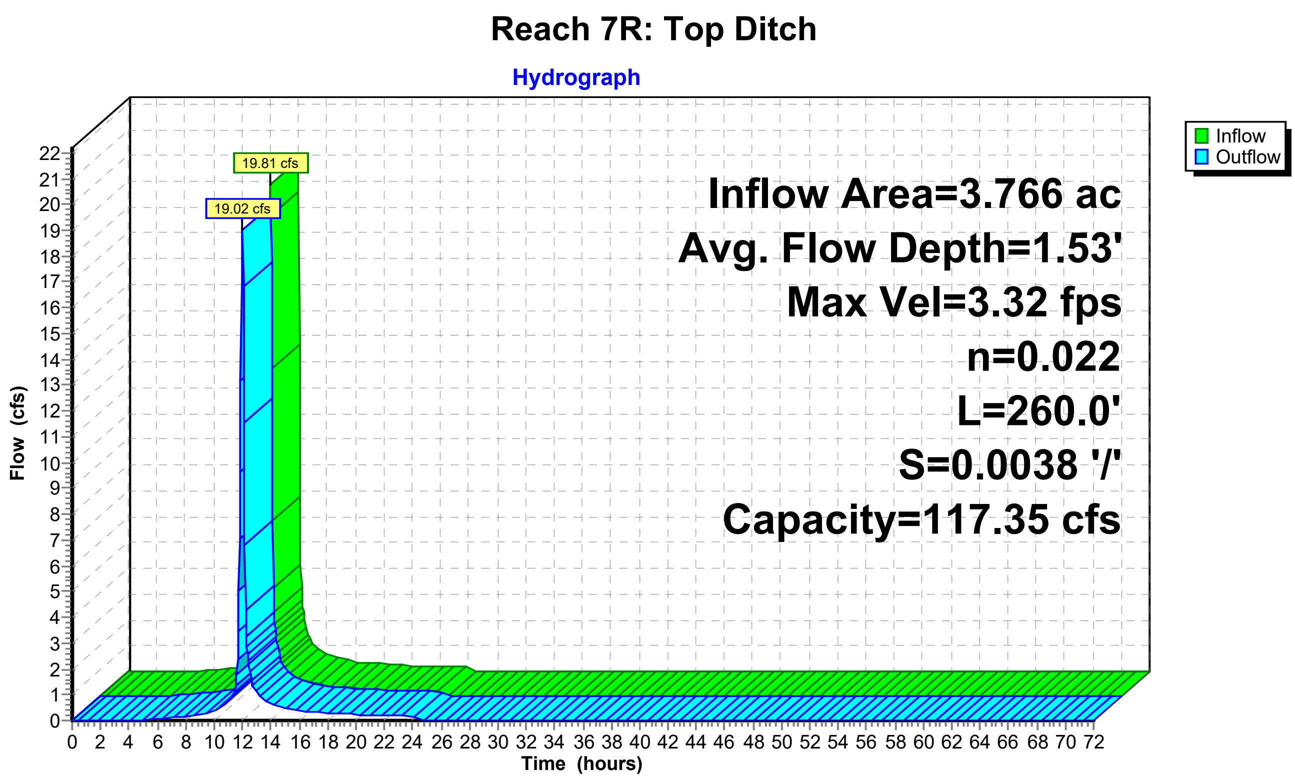
Inflow Area = 3.766 ac, 0.00% Impervious, Inflow Depth = 3.47" for 25-yr, 24-hr event
Inflow = 19.81 cfs @ 11.96 hrs, Volume= 1.089 af
Outflow = 19.02 cfs @ 12.00 hrs, Volume= 1.089 af, Atten= 4%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.32 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.05 fps, Avg. Travel Time= 4.1 min

Peak Storage= 1,530 cf @ 11.98 hrs
Average Depth at Peak Storage= 1.53'
Bank-Full Depth= 3.00' Flow Area= 22.5 sf, Capacity= 117.35 cfs

0.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 3.0 '/' Top Width= 15.00'
Length= 260.0' Slope= 0.0038 '/'
Inlet Invert= 1,209.20', Outlet Invert= 1,208.20'





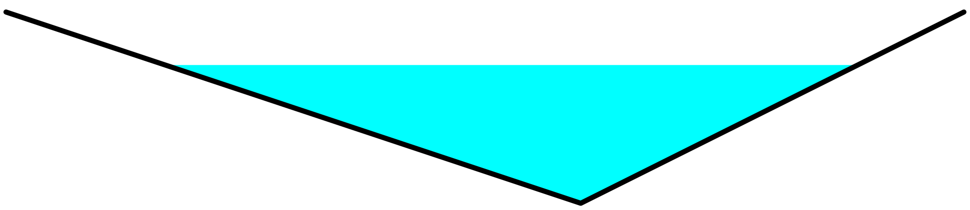
Summary for Reach 8R: North Terrace

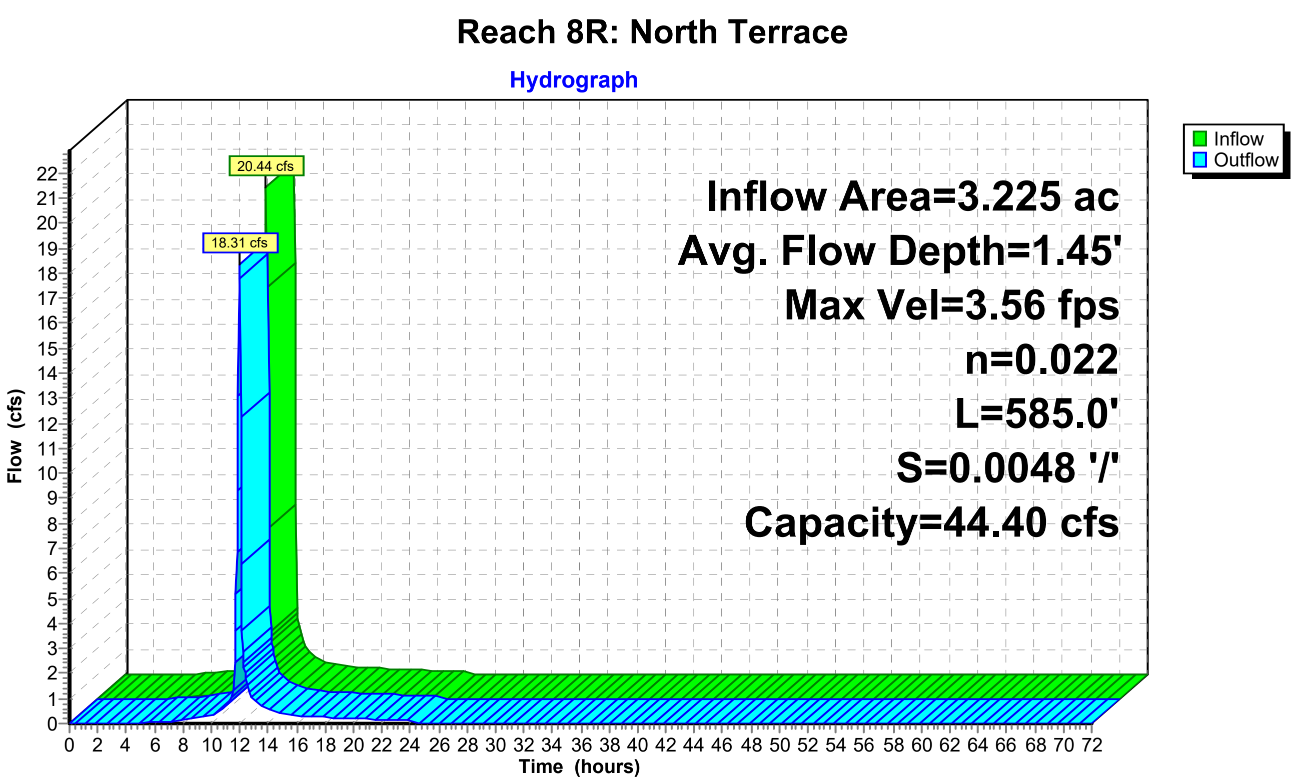
Inflow Area = 3.225 ac, 0.00% Impervious, Inflow Depth = 3.47" for 25-yr, 24-hr event
Inflow = 20.44 cfs @ 11.90 hrs, Volume= 0.932 af
Outflow = 18.31 cfs @ 11.98 hrs, Volume= 0.932 af, Atten= 10%, Lag= 4.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.56 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 8.9 min

Peak Storage= 3,052 cf @ 11.93 hrs
Average Depth at Peak Storage= 1.45'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 44.40 cfs

0.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 2.0 '/' Top Width= 10.00'
Length= 585.0' Slope= 0.0048 '/'
Inlet Invert= 1,212.00', Outlet Invert= 1,209.20'





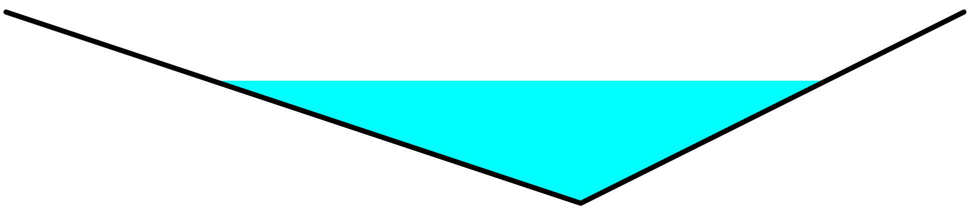
Summary for Reach 11R: NE Terrace

Inflow Area = 1.586 ac, 0.00% Impervious, Inflow Depth = 3.47" for 25-yr, 24-hr event
Inflow = 10.31 cfs @ 11.89 hrs, Volume= 0.459 af
Outflow = 8.46 cfs @ 11.99 hrs, Volume= 0.459 af, Atten= 18%, Lag= 5.9 min

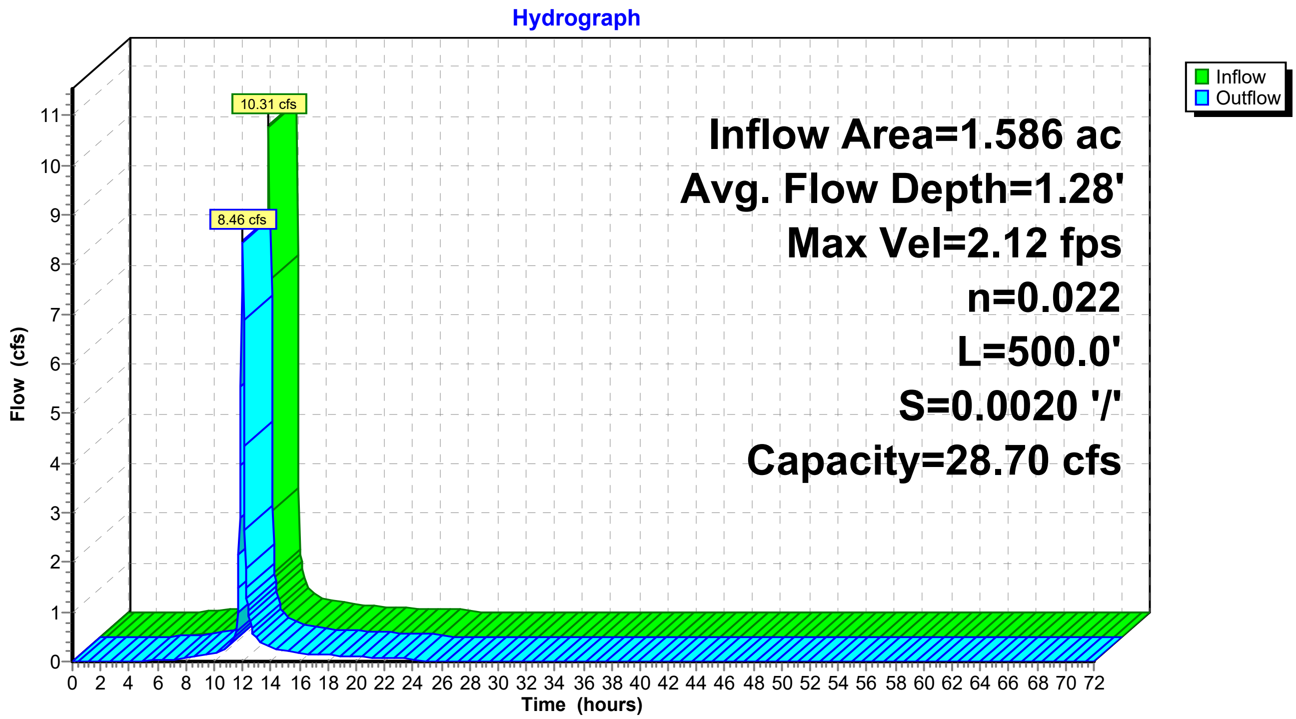
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 13.0 min

Peak Storage= 2,052 cf @ 11.93 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 28.70 cfs

0.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 2.0 '/' Top Width= 10.00'
Length= 500.0' Slope= 0.0020 '/'
Inlet Invert= 1,209.00', Outlet Invert= 1,208.00'



Reach 11R: NE Terrace



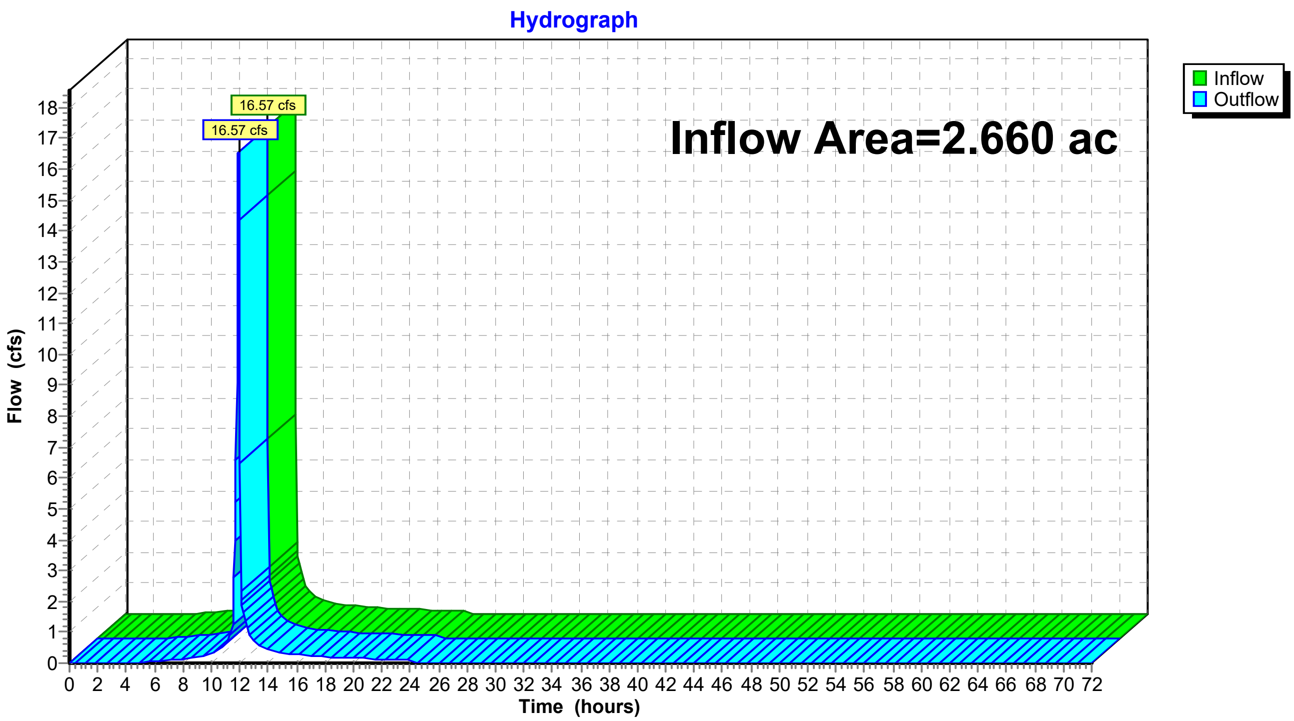
Summary for Reach 12R: Off Cell 2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.660 ac, 0.00% Impervious, Inflow Depth = 3.47" for 25-yr, 24-hr event
Inflow = 16.57 cfs @ 11.91 hrs, Volume= 0.769 af
Outflow = 16.57 cfs @ 11.91 hrs, Volume= 0.769 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Reach 12R: Off Cell 2



Summary for Pond 1P: SW Ponding Area

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 0.45'

Inflow Area = 10.863 ac, 18.30% Impervious, Inflow Depth = 3.40" for 25-yr, 24-hr event
Inflow = 33.30 cfs @ 11.90 hrs, Volume= 3.075 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

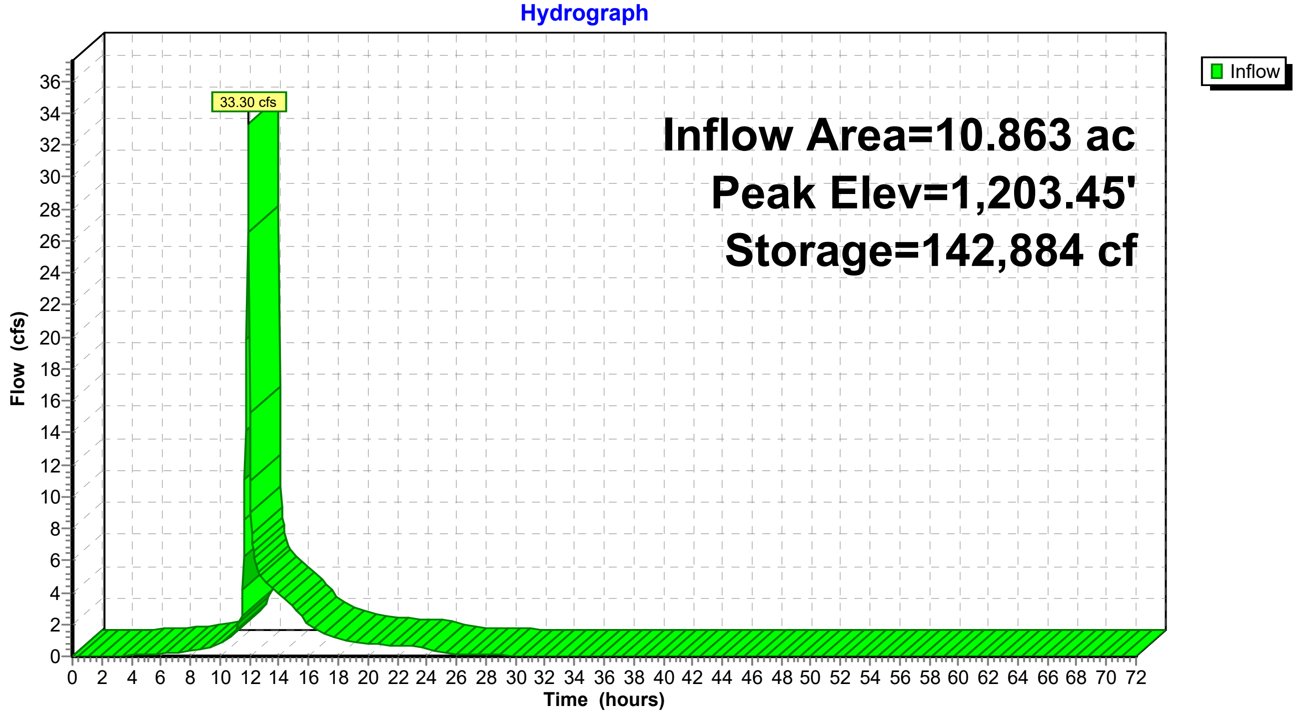
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 1,196.00' Surf.Area= 6,415 sf Storage= 8,935 cf
Peak Elev= 1,203.45' @ 72.00 hrs Surf.Area= 32,462 sf Storage= 142,884 cf (133,949 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,194.00'	342,222 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,194.00	2,520	0	0
1,196.00	6,415	8,935	8,935
1,198.00	11,611	18,026	26,961
1,200.00	18,014	29,625	56,586
1,202.00	25,896	43,910	100,496
1,204.00	34,935	60,831	161,327
1,206.00	44,960	79,895	241,222
1,208.00	56,040	101,000	342,222

Pond 1P: SW Ponding Area



Summary for Pond 2P: NW Ponding Area 2

[79] Warning: Submerged Pond 3P Primary device # 1 OUTLET by 1.25'

Inflow Area = 5.675 ac, 16.36% Impervious, Inflow Depth > 3.19" for 25-yr, 24-hr event
Inflow = 10.09 cfs @ 11.90 hrs, Volume= 1.509 af
Outflow = 3.28 cfs @ 13.02 hrs, Volume= 1.508 af, Atten= 67%, Lag= 67.3 min
Primary = 3.28 cfs @ 13.02 hrs, Volume= 1.508 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 1,209.25' @ 13.02 hrs Surf.Area= 11,938 sf Storage= 9,092 cf

Plug-Flow detention time= 41.4 min calculated for 1.507 af (100% of inflow)
Center-of-Mass det. time= 40.4 min (956.7 - 916.3)

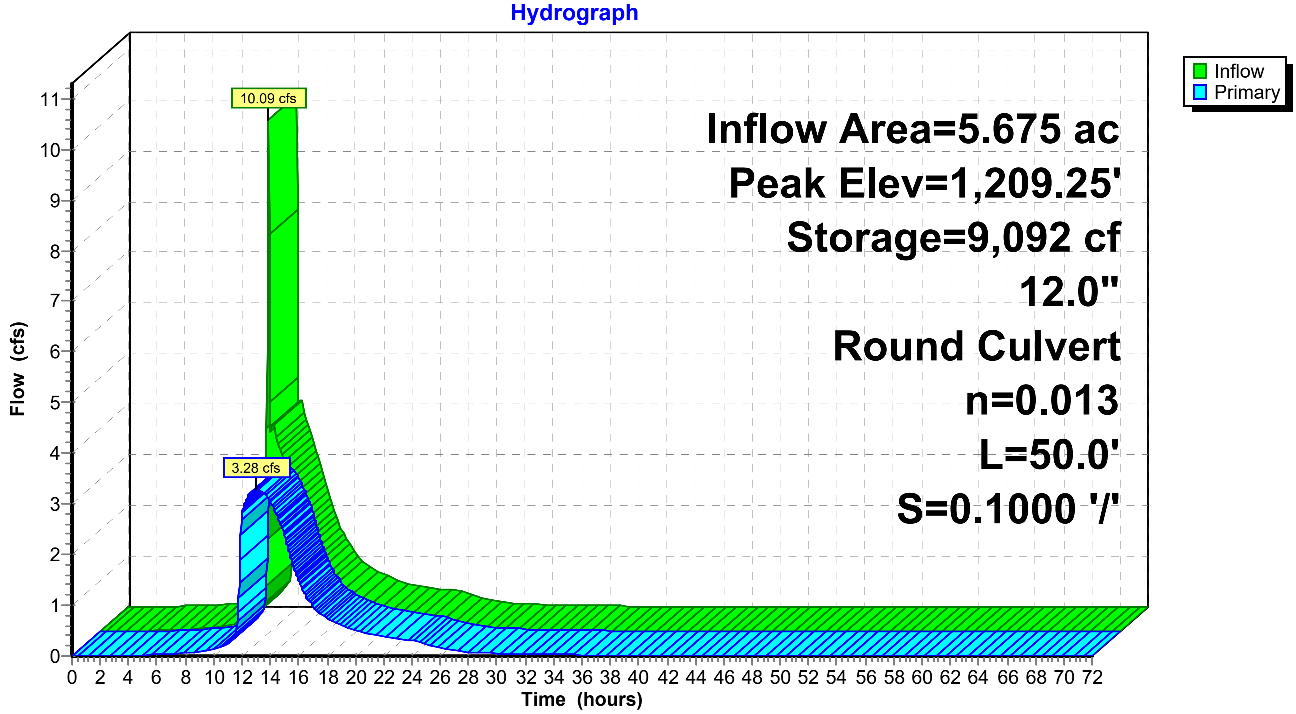
Volume	Invert	Avail.Storage	Storage Description
#1	1,208.00'	18,987 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,208.00	1,315	0	0
1,209.00	11,046	6,181	6,181
1,210.00	14,566	12,806	18,987

Device	Routing	Invert	Outlet Devices
#1	Primary	1,208.00'	**12.0" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 1,208.00' / 1,203.00' S= 0.1000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.28 cfs @ 13.02 hrs HW=1,209.25' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.28 cfs @ 4.18 fps)

Pond 2P: NW Ponding Area 2



Summary for Pond 3P: NW Ponding Area 1

[63] Warning: Exceeded Reach 7R INLET depth by 1.42' @ 12.70 hrs

Inflow Area = 4.360 ac, 13.62% Impervious, Inflow Depth = 3.57" for 25-yr, 24-hr event
Inflow = 20.05 cfs @ 11.98 hrs, Volume= 1.298 af
Outflow = 3.27 cfs @ 12.30 hrs, Volume= 1.107 af, Atten= 84%, Lag= 19.0 min
Primary = 3.27 cfs @ 12.30 hrs, Volume= 1.107 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 1,211.25' @ 12.30 hrs Surf.Area= 22,685 sf Storage= 30,882 cf

Plug-Flow detention time= 250.3 min calculated for 1.106 af (85% of inflow)
Center-of-Mass det. time= 184.5 min (969.4 - 784.9)

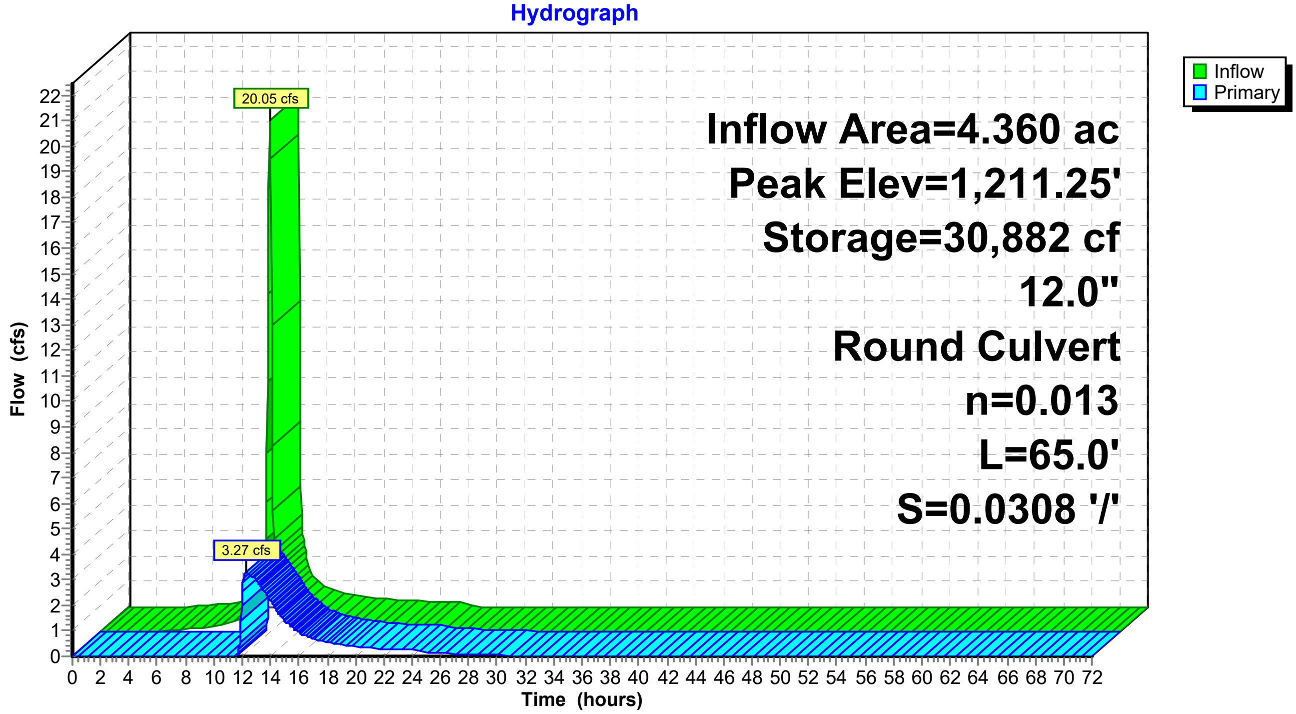
Volume	Invert	Avail.Storage	Storage Description
#1	1,209.00'	49,170 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,209.00	3,389	0	0
1,210.00	12,897	8,143	8,143
1,211.00	21,635	17,266	25,409
1,212.00	25,886	23,761	49,170

Device	Routing	Invert	Outlet Devices
#1	Primary	1,210.00'	**12.0" Round Culvert** L= 65.0' Ke= 0.500 Inlet / Outlet Invert= 1,210.00' / 1,208.00' S= 0.0308 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.27 cfs @ 12.30 hrs HW=1,211.25' (Free Discharge)
└—**1=Culvert** (Inlet Controls 3.27 cfs @ 4.16 fps)

Pond 3P: NW Ponding Area 1



Summary for Pond 4P: NE Ditch/Ponding Area

[63] Warning: Exceeded Reach 11R INLET depth by 3.89' @ 53.40 hrs

Inflow Area = 1.586 ac, 0.00% Impervious, Inflow Depth = 3.47" for 25-yr, 24-hr event
Inflow = 8.46 cfs @ 11.99 hrs, Volume= 0.459 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

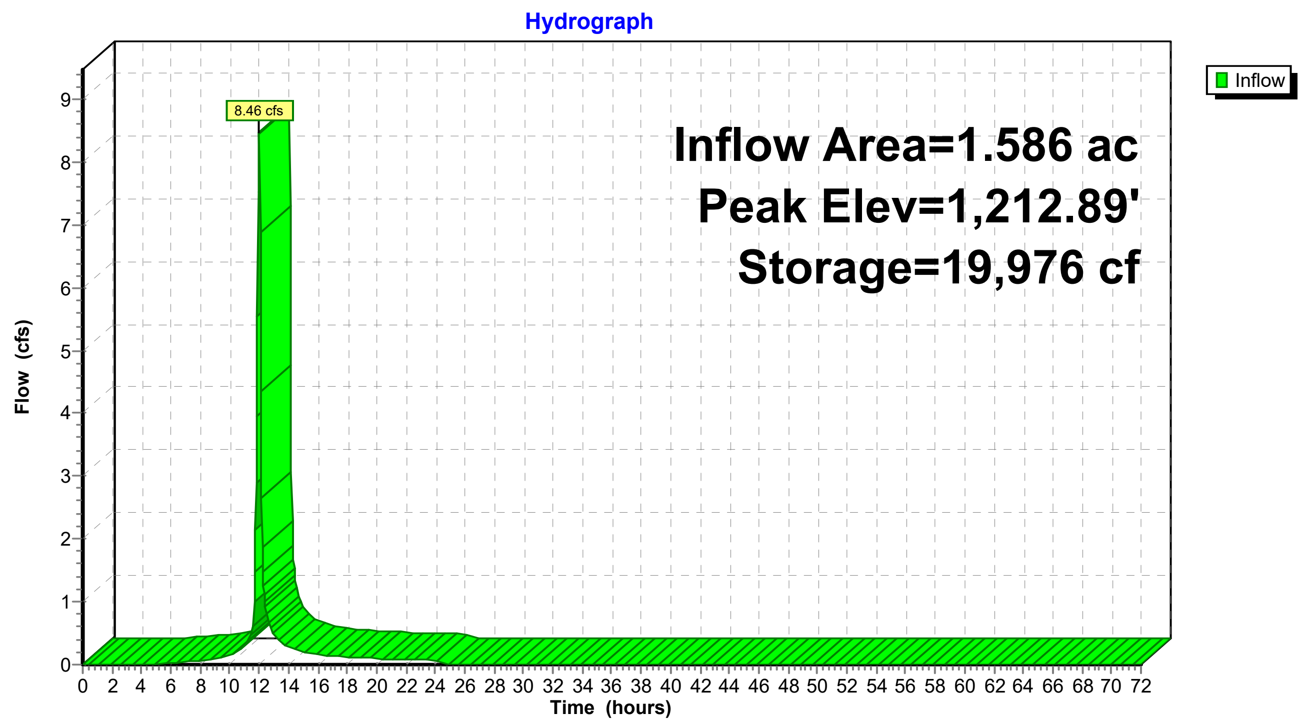
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 1,212.89' @ 46.55 hrs Surf.Area= 10,241 sf Storage= 19,976 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,208.00'	21,144 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

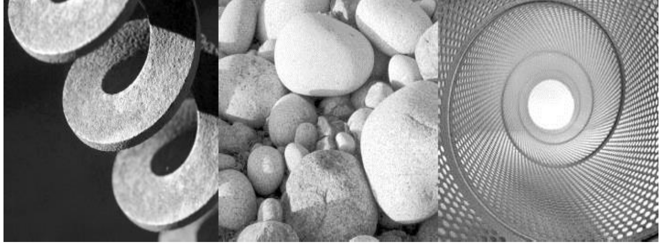
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,208.00	100	0	0
1,209.00	200	150	150
1,210.00	2,825	1,513	1,663
1,211.00	4,990	3,908	5,570
1,212.00	7,804	6,397	11,967
1,213.00	10,549	9,177	21,144

Pond 4P: NE Ditch/Ponding Area



Appendix L

Closure Plan



Consulting
Engineers and
Scientists

Regulation Compliance Report

Closure Plan

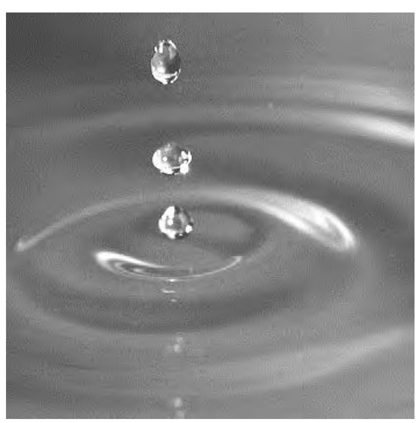
Weston Disposal Site No. 3 Landfill
Town of Knowlton, Marathon County, Wisconsin

Submitted to:
WEC Energy Group
333 West Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920-455-8200

September 2023, Revision 1

Project 2203724



John M. Trast, P.E., D.GE
Vice President/Senior
Waste Management Leader

Andrew J. Schwoerer, P.G.
Project Professional

Table of Contents

Revision History

Revision 0 – Original Closure Plan dated October 2016.
Revision 1 – Update of the original Closure Plan for the Plan of Operation Modification submittal to comply with the updated NR 500 of the Wisconsin Administrative Code.

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B:\Working\WEC ENERGY GROUP\2203724 CCR Landfill Permitting\05_In_Progress\Response to WDNR Incompletness Determination\WDS3\WDS3 Plan of Operation_Revision 2

1. Introduction

Wisconsin Public Service Corporation (WPSC) owns and operates the Weston Disposal Site No. 3 Landfill, located in the E 1/2 of the NW 1/4 and W 1/2 of the NE 1/4, Section 23, Township 26 North, Range 7 East, Town of Knowlton, Marathon County, Wisconsin. The WPSC Weston Disposal Site No. 3 Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 3067, FID No. 737025120. The construction of Cells 1 and 2 commenced in May 2015. Cell 2 was placed into operation in 2016 and has received two phases of final cover over the south and east slopes in 2018 and 2020. Cell 1 was placed into service in 2021. Cells 3 through 9 are currently unconstructed and have a permitted area of 42.5 acres.

In addition to the state regulations, the landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.* Weston Disposal Site No. 3 Landfill, Cells 1 & 2 is defined as a CCR unit and existing CCR landfill in accordance with § 257.53 since construction commenced prior to October 14, 2015. Future landfill cells are permitted by the WDNR in the conditionally approved Plan of Operation and defined as lateral expansions under §257.53 when constructed.

This report fulfills the requirements for a written Closure Plan of the Weston Disposal Site No. 3, Cells 1 and 2 in accordance with § 257.102 - *Criteria for Conducting the Closure or Retrofit of CCR Units* and NR 514.07(10(c) of the Wisconsin Administrative Code. In accordance with § 257.102(b)(1) and NR 514.07(10)(c)1, this report describes the engineering design of the landfill, phased development, a description of the final cover system and how the final cover will be constructed, and how the final cover system will meet the applicable performance standards contained in § 257.102(d) and NR 506.083(6). In addition, it also includes an estimate of the maximum inventory of CCR, an estimate of the maximum open area that would require closure at one time, and a generalized schedule based on the anticipated landfill filling rates and disposal volumes.

This closure plan includes the following sections:

Section 1 Introduction

Section 2 Closure Narrative

Section 3 Final Cover System

Section 4 Schedule for Closure

Section 5 Conclusion and Certification

2. Closure Narrative

This section provides the closure narrative as required by § 257.102(b)(i) and NR 514.07(10)(c)1. Closure of Cells 1 and 2 will be accomplished by leaving the CCR in place and installing a final cover meeting the requirements of § 257.102(d)(3) and NR 504.07 over the CCR. The final cover system is described in Section 3. The areal limits of Cells 1 and 2 are shown on Drawing PM-6 – Cell 1 & 2 Site Preparation in Appendix A. Closure activities for remaining active areas of Cell 1 and 2 will commence when CCR disposed in the cell reach final waste grades shown on Drawings PM-7– Cell 3 Site Preparation, Area A Closure and PM-14 – Top of Waste Grades in Appendix A. It will be necessary to laterally expand the landfill with the construction of Cell 3 before final waste grades are completed in Cell 1 and 2. At that time this closure plan will be updated to comply with the federal rules.

§ 257.102(b)(1)(iv)/NR 514.07(10)(c)4 requires an estimate of the maximum inventory of CCR ever on the site over the active life of the CCR unit. The design capacity of Cell 1 and 2 is approximately 650,000 cubic yards. Therefore, prior to lateral expansion of the Weston Disposal Site No. 3 Landfill, in accordance with the approved Plan of Operation, the maximum CCR inventory of the landfill is 650,000 cubic yards.

§ 257.102(b)(1)(v)/NR 514.07(10)(c)5 requires an estimate of the largest area of the CCR unit ever requiring final cover, at any time during the active life of the CCR unit. The largest open area of the landfill after lateral expansion is during operation of Cell 3, which is approximately 19.3 acres. The area of Cells 1 and 2 is 15.2 acres. Therefore, the largest area of the CCR unit a final cover during the CCR unit's active life is 19.3 acres.

§ 257.102(d)(1)(i)/NR 514.07(10)(c)2. The final cover system described in Section 3 is a composite final cover system which will envelop the CCR, minimizing post-closure infiltration and the potential release of CCR, leachate, or contaminated run-off from the closed unit. The landfill with the final cover is shown on Drawing PM-15 – Final Grades and final cover cross-sections are shown on Drawings PM-19 – Engineering Cross-Section 324,700N, PM-20 – Engineering Cross-Section 325,300N, and PM-27 – Details. Fugitive dust from exposed CCR before and during final cover construction will be managed in accordance with the Fugitive Dust Control Plan. Surface water that has come into contact with CCR before and during final cover construction will be managed as leachate in accordance with the Run-on and Run-off Control Plan.

§ 257.102(d)(1)(iii)/NR 514.07(10)(c)3. Slope stability of the CCR and final cover is enhanced in the manner in which the CCR is conditioned, placed, and compacted; how the facility is operated to promote storm and contact water management; and how the leachate collection system is designed and monitored to ensure leachate is being removed from the waste and not allowed to build-up within the landfill. The permitted final cover slopes will be at a 5% minimum slope at the top of the landfill to promote surface water drainage and prevent ponding due to the settlement of the final cover system.

The perimeter side slopes of the landfill will be at a maximum slope of 25% to provide long-term stable slopes that promote stormwater drainage, can be protected from excessive erosion, and safely maintained.

§ 257.102(d)(1)(iv)/NR 514.07(10)(c)3. The final cover system described in Section 3 will minimize infiltration, which in turn minimizes the demand on the leachate collection system. The final cover will be vegetated with grass to promote evapotranspiration and prevent erosion. The final cover system vegetation will be maintained by fertilizing as necessary to develop a well-established vegetative cover and periodic mowing to stimulate root growth and prevent the establishment of woody vegetation. Final slopes will be between 5% and 25% to facilitate mowing. Slopes greater than 10% will be covered with erosion matting after seeding to minimize erosion during the establishment of vegetative cover.

§ 257.102(d)(1)(v)/NR 514.07(10)(c)3. The final cover system described in Section 3 uses readily available equipment and materials and can easily be completed in a single construction season.

NR 514.07(10)(c)7. This plan shall be modified in accordance with s. NR 514.04(6) whenever there is a change in conditions that may substantially affect the written closure plan or unanticipated events necessitate a revision of the written closure plan. The modification shall be submitted to the department in writing at least 60 days prior to a planned change in the operation of the CCR landfill, or no later than 60 days after an unanticipated event requires the need to revise an existing written closure plan. If a written closure plan is revised after closure activities have commenced for a CCR landfill, the owner or operator shall submit the modification request to the department no later than 30 days following the triggering event.

3. Final Cover System

This section is included to fulfill the requirements of § 257.102(b)(1)(iii) and NR 514.07(10)(c)2.

Filling to final contours will result in a final slope no greater than 25% sloping downward from the center of the fill area to the perimeter of the site. The top portion of the landfill will be graded to no less than 5% sloping downward from the center to ensure positive drainage to the perimeter of the site. Drainage features, such as the perimeter ditches, terraces, and runoff channels will be constructed, as necessary, to accommodate surface runoff from phased closure.

The final cover system has been designed to minimize leachate generation by limiting percolation through the final cover barrier layer, promoting subsurface drainage to limit head on the barrier layer, and establishing vigorous plant growth to maximize evapotranspiration. The final cover system has also been designed for stability and to reduce maintenance. Specifically, the final cover from top down will consist of 6 inches of topsoil, 30 inches of general fill for the rooting zone layer, a geocomposite drainage layer, which may be substituted with select granular fill meeting NR 504 of the Wisconsin Administrative Code, a 40-mil linear low density polyethylene geomembrane and either 24 inches of compacted clay, 24 inches of compacted ash, or a GCL with 24 inches of compacted barrier soils.

The hydraulic conductivity of the final cover system is required by § 257.102(d)(3)(i)(A) and NR 504.12(4)(b)1 to be less than or equal to the hydraulic conductivity of the bottom liner system or natural subsoils present or a hydraulic conductivity no greater than 1×10^{-5} cm/sec, whichever is less. The Weston Disposal Site No. 3 Landfill is designed and constructed with a composite base liner system consisting of two feet of compacted soil, geosynthetic clay liner, and polyethylene geomembrane. The approved final cover system is a composite final cover consisting of a 2-foot-thick clay compacted barrier layer with a permeability of 1×10^{-7} cm/sec or a GCL overlaying a 2-foot-thick soil barrier layer polyethylene geomembrane, drainage layer, and vegetated soil layers. The final cover system meets the requirements of § 257.102(d)(3)(i)(A) and NR 504.12(4)(b)1.

Construction equipment and methods normally used in developing landfills and performing earth-moving projects will be used. The following sub-sections discuss the construction of the individual components of the final cover system. Layout and details of the final cover system are shown on the drawings included in Appendix A.

3.1 Compacted Barrier Layer

A minimum 2-foot-thick layer of compacted barrier layer constructed of clay or soil will be used as the soil component of the composite barrier layer. The materials will be placed and compacted with a large vibratory smooth-drum roller, with a minimum operating weight of 15,000 pounds, and while in vibratory mode, can provide 30,000 pounds of compactive energy. The barrier layer will be placed and compacted in lifts not exceeding six inches. The prepared barrier layer shall provide a firm, smooth surface for deployment of the geomembrane. The barrier layer should be free of any angular particles protruding from the surface greater than 0.5 inches, sharp breaks in grade or excessive rutting greater than 0.2 feet. The select clay barrier layer material will be placed and compacted to a minimum density of 90 percent of the modified Proctor or 95 percent of the standard Proctor density at moisture content at least 2 percent wet of optimum if using the modified Proctor method and wet of optimum if using the standard Proctor method. For the fine-grained soil barrier layer meeting the classification specified in NR 504.07(4)(a)(12), the soil layer will be compacted to the 90 percent modified or 95 percent standard Proctor density or greater at a moisture content at or wet of optimum.

3.2 Geosynthetic Clay Liner (GCL)

If soil barrier layer is utilized, GCL will be installed above the barrier layer in accordance with NR 504.07(4)(a). Specifications for the materials, installation, and documentation of the GCL are included in the CQA Plan in Appendix N.

Before the GCL is placed, the compacted soil barrier layer surface will be examined for protruding rocks, foreign objects, holes left from rock or stake removal, loose material, desiccation, and overall smoothness of the surface. Coarse gravel or cobbles larger than 2-inches in diameter will be removed from the surface by hand. Other courses of remedy that may be practiced include smooth drum-rolling the surface, filling in ruts or holes with fill, a sand/bentonite mixture, or bentonite, and watering the surface.

The GCL panels will be placed in an orientation that runs directly down the sideslopes. The GCL panels will be placed with a minimum 6-inch longitudinal overlap and a minimum of 20 inches of overlap at the panel end seams. A seal of loose bentonite will be placed in the seam overlaps at a minimum of one quarter pound per linear foot of seam unless additional overlap has been approved as an alternative by the WDNR. The GCL will be installed dry and covered the same day.

3.3 Geomembrane

The geomembrane component of the final cover system will be a 40-mil textured linear low-density polyethylene (LLDPE) geomembrane. The LLDPE geomembrane has been selected in order to provide flexibility of the final cover system to accommodate expected settling and subsidence in accordance with § 257.102(d)(3)(i)(D)/NR 504.07(5). Geomembrane panels will be positioned by suspending rolls of material with a front-end loader and unrolling the suspended material by hand or with the aid of an ATV, as the loader remains stationary. The geomembrane will be installed in a loose and relaxed condition. Panels will be overlapped approximately 4 inches and fusion-welded together. At seam intersections and other repair locations, a geomembrane patch extending a minimum of twelve inches beyond the intersection or repair will be extrusion-welded into place. All seams will be non-destructively tested by air or vacuum testing. The integrity of fusion welds will be air tested, and extrusion welds will be vacuum tested.

3.4 Drainage/Rooting Layer and Topsoil

A geocomposite drainage layer and a 30-inch-thick rooting zone layer meeting the requirements of § 257.102(d)(3)(i)(B) and NR 504.07(6) will be installed above the geomembrane final cover. The drainage layer will be installed to aid in the removal of subsurface storm water drainage; the rooting zone layer will be installed to support vegetative growth, and both layers will provide protection of the geomembrane and compacted barrier layer. The geocomposite will be deployed such that the seams run perpendicular to the contour lines of the slope to the extent possible. The geonet will be cable-tied every 3 feet along the edge of the panels and every 6 inches for end seams and in the anchor trenches. The top geotextile will be sewn. The rooting layer will be placed over the geocomposite in a single lift using low ground pressure dozers. The material will be classified as SW, SP, SM, SC, ML, or CL and have a maximum particle size of 3 inches. The rooting layer will consist of on-site or off-site soils. As an alternative, the geocomposite drainage layer can be replaced by a 12-inch-thick sand drainage layer having a minimum hydraulic conductivity of $1x10^{-3}$ cm/s and a maximum particle size of 0.25 inches. If the granular drainage layer is used the rooting zone thickness will be reduced to 18 inches.

Meeting the requirements of § 257.102(d)(3)(i)(C) and NR 504.07(7), topsoil capable of sustaining vegetative growth will be placed and spread into a uniform loose lift thickness of 6 inches. Once placed, the topsoil will be fertilized, seeded, and mulched. The seed mix used on the final cover will be selected per Section 630 of the Wisconsin Department of Transportation specifications. Fertilizer and mulch application rates used to establish vegetation will be in accordance with rates specified by the topsoil nutrient analysis and Section 630 on all slopes greater than 10%, a temporary straw mulch blanket will be used to limit erosion and protect the seed prior to the establishment of vegetation.

4. Schedule for Closure

This section is included to fulfill § 257.102(b)(1)(v) and NR 514.07(10)(c)(6). The first phase of construction, Cells 1 and 2, were completed in 2015. Cell 2 was placed into service in 2016 and Cell 1 was placed into service in 2021. In accordance with the WDNR approved Plan of Operation, the landfill has a phased development plan, describing the construction, operation, and closure of each phase of the landfill from the construction of Cell 1 to the closure of Cell 9. In general, the development plan requires active landfill cells which have reached final waste grades be closed as soon as practical to limit the maximum open area, leachate generation, and the potential operational problems.

In accordance with § 257.102(b)(1)(vi) and NR 514.07(10)(c)(6), a schedule for completion of all closure activities, including the area to receive final cover and estimate of the year in which all closure activities for the CCR landfill will be completed, is provided in the table below at the current CCR disposal rate:

Phase	Area to Receive Final Cover (Acres)	Estimated Closure Date
Area A	4.6	Fall 2026
Area B	5.4	Fall 2029
Area C	8.0	Fall 2040
Area D	7.1	Fall 2049
Area E	6.8	Fall 2058
Area F	7.6	Fall 2067
Area G	5.4	Fall 2072
Area H	10.9	Fall 2089

The estimated year in which all closure activities will be completed for each area as necessary to satisfy the closure criteria is dependent on CCR generation rates, beneficial reuse programs, and disposal rate volumes. However, final closure of the landfill will begin no later than 30 days following the final waste receipt for the CCR unit in accordance with §257.102(e)(1). A preliminary closure schedule, including the sequential steps and major milestones for closing Area A of the WDS3 Ash Landfill, is provided in Appendix B.

Final cover construction at the Weston Disposal Site No. 3 Landfill will be completed in accordance with the WDNR approved Plan of Operation under License No. 3067. Therefore no additional state or local approvals are required for WPSC to begin construction of the next phase of the landfill or closure of an existing phase. The final cover system described in Section 3 uses standard and readily available equipment and materials and can easily be completed in a single construction season.

5. Conclusion and Certification

WPSC owns and operates the Weston Disposal Site No. 3 Landfill, located in the E 1/2 of the NW 1/4 and W 1/2 of the NE 1/4, Section 23, Township 26 North, Range 7 East, Town of Knowlton, Marathon County, Wisconsin. The Weston Disposal Site No. 3 Landfill is required to comply with 40 CFR Part 257 Subpart D — *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and NR 500 of the Wisconsin Administrative Code. This plan fulfills the requirements for a written Closure Plan of the Weston Disposal Site No. 3 Landfill , Cell 1 and 2 in accordance with § 257.102 - *Criteria for Conducting the Closure or Retrofit of CCR Units* and NR 514.07(10)(c) describing the engineering design and construction of the final cover system, how the final cover system will meet the applicable performance standards contained in § 257.102(d) and NR 514.07(10)(c)3, an estimate of the maximum inventory of CCR, an estimate of the maximum open area that would require closure at one time, and a generalized schedule based on the anticipated landfill filling rates and disposal volumes.

The Closure Plan was completed under the direction of John M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR Part 257 Subpart D and NR 500 of the Wisconsin Administrative Code.

John M. Trast, P.E., D.GE
Professional Engineer License No. 31792

Table 1 - Closure Cost Estimate
Wisconsin Public Service Corporation
Weston Disposal Site No. 3
GEI Consultants, Inc.
September 29, 2023

Item[1]	*Quantity*	*Unit*[3][4]	*Unit Cost*	*Total*
Engineering Plans and Specifications				
Engineering Plans and Specifications	1	LS	$30,000.00	$30,000.00
Final Cover Construction				
Mobilization	1	LS	$10,000.00	$10,000.00
Surveying	1	LS	$20,000.00	$20,000.00
Borrow Source and Soil Stockpile Restoration	1	LS	$10,000.00	$10,000.00
24-inch Soil Barrier Layer (clay or soil) - Haul, Place, and Compact	62,275	cy	$15.00	$934,125.00
Geosynthetic Clay Liner (GCL)	840,700	sf	$0.75	$630,525.00
40-mil LLDPE Geomembrane Textured	840,700	sf	$0.60	$504,420.00
Geocomposite Drainage Layer	840,700	sf	$0.75	$630,525.00
Rooting Zone Soil (30-inches)	77,850	cy	$15.30	$1,191,105.00
Diversion Berm	3,130	LF	$15.30	$47,889.00
Topsoil (6-inches)	15,570	cy	$8.00	$124,560.00
Seed, Mulch, Fertilizer, Lime	19.3	acre	$5,000.00	$96,500.00
Downslope Flume/Drop Manhole	3.0	LS	$20,000.00	$60,000.00
Drainage Layer Discharge Trench[5]	2,750.0	LF	$25.00	$68,750.00
Construction QA & Documentation				
Construction QA & Documentation	19.3	acre	$25,000.00	$482,500.00

Subtotal Closure Cost	4,840,899.00
Contingency (10%)	484,089.90
Total Closure Cost	5,324,988.90

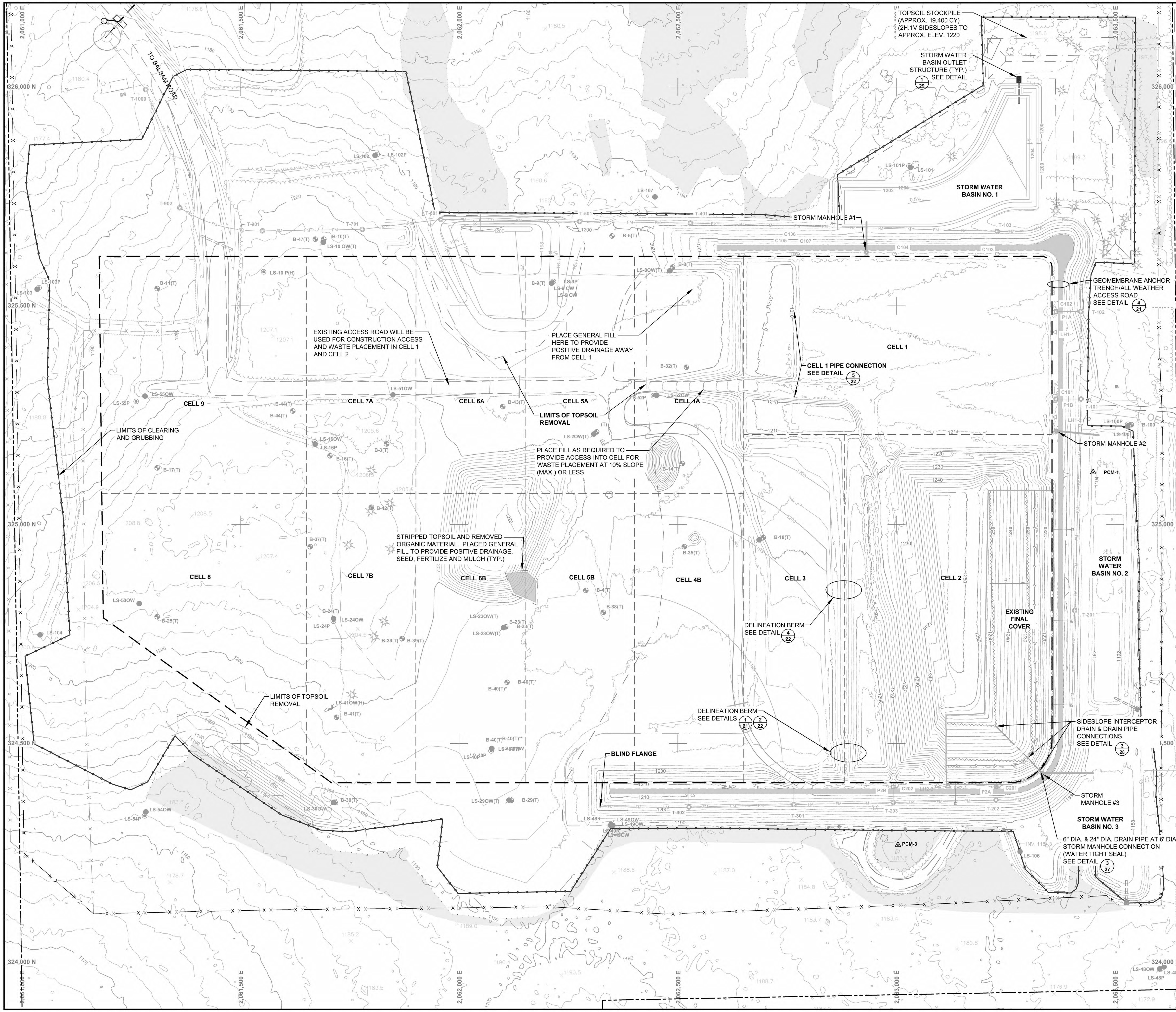
Notes

[1]This closure cost estimate is based on the largest open area of the staged construction plan of 19.3 acres.
[2]The final cover cross-section is based on the Plan of Operation Modfiction dated August 2023.
[3]Unit prices are based on previous liner/final cover construction projects and vendor cost estimates.
[4]Costs are in 2023 dollars.
[5]Includes perforated drainage pipe, non-perforated discharge pipe, geotextile, and pipe bedding.

Appendix A

WPS Weston Disposal Site No. 3 Expansion, Wisconsin Public Service, WDNR License No. 3067, Plan of Operation Modification Drawings, Revision 1, Dated: September 29, 2023

Drawing PM-6 – Cell 1 & 2 Site Preparation
Drawing PM-7 – Cell 3 Site Preparation, Area A Closure
Drawing PM-14– Top of Waste Grades
Drawing PM-15 – Final Grades
Drawing PM-19 – Engineering Cross-Section 324,700N
Drawing PM-20 – Engineering Cross-Section 325,300N
Drawing PM-27 – Details



NOTES:

1. REFER TO PLAN SHEET 2 OF THE PLAN SET FOR LEGEND AND BASE MAP NOTES.
2. CELLS 1 & 2 WERE SURVEYED BY RIVERVIEW CONSTRUCTION, INC., WAUSAU, WI, OCTOBER 21, 2021.
3. AUXILIARY SEDIMENT TRAPS WILL BE CONSTRUCTED AS NECESSARY DURING DEVELOPMENT OF EACH CELL.

GEI Consultants
GEI CONSULTANTS, INC.
3159 VOYAGER DRIVE
GREEN BAY, WI 54311
(920)455-8200

WESTON DISPOSAL SITE NO. 3 EXPANSION PLAN OF OPERATION MODIFICATION

P.E. No.:	
Approved:	JXT
Checked:	JXT
Drawn:	JLC
Designed:	JLC
GEI Project:	2203724

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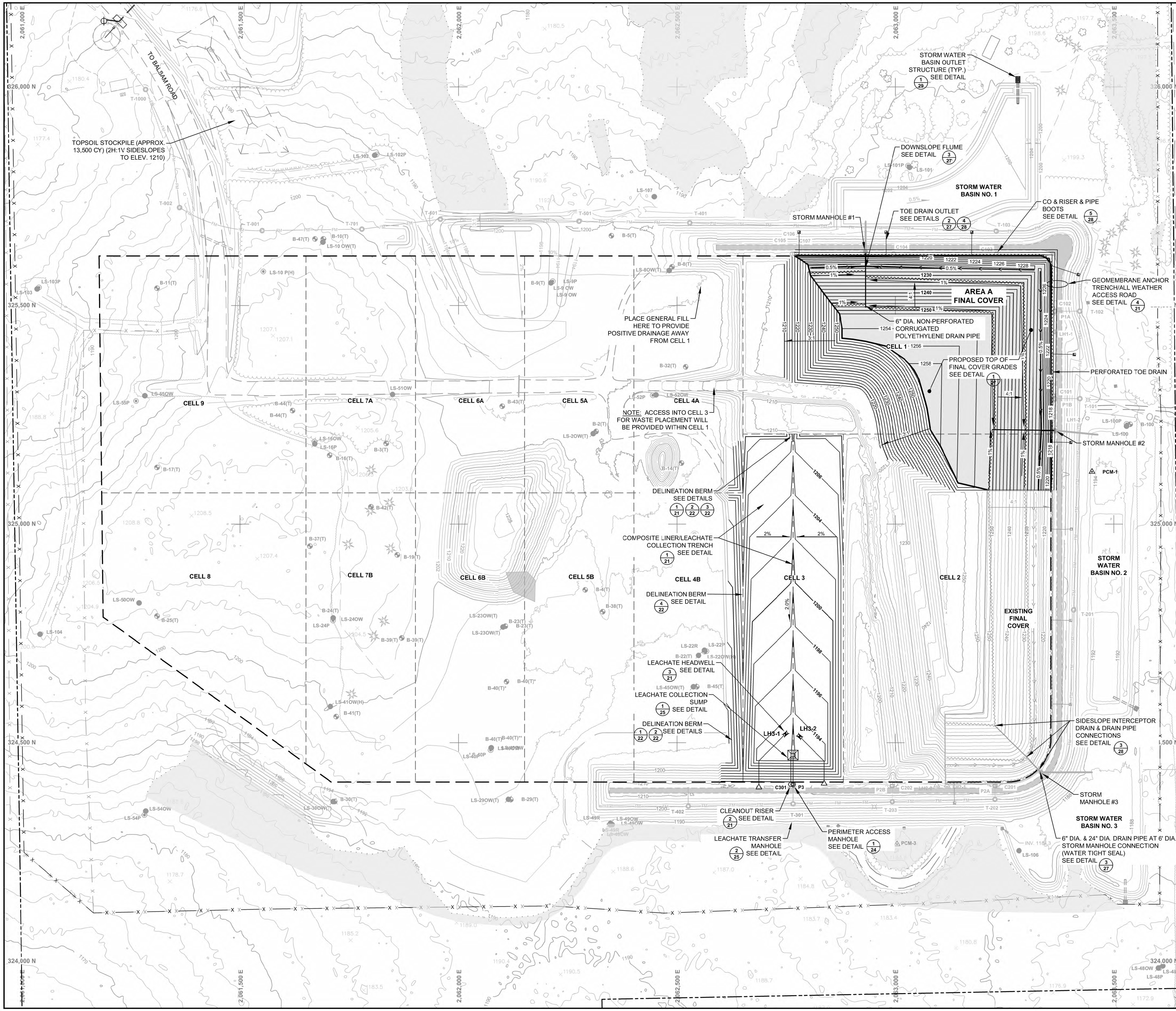
NO.	DATE	ISSUE/REVISION	APP
1	9/29/2023	PLAN MOD	JXT

CELL 1 & 2 SITE PREPARATION

DWG. NO. PM-6



CELL 3 BASE LINER CONSTRUCTION QUANTITIES

COMPOSITE LINER		
Topsoil Stockpile Volume	10,700	CY
Structural Fill	29,800	CY
Geotextile, gradient control trench	750	SY
Select Aggregate, gradient control trench	240	CY
Select Granular Fill, gradient control system	1,360	CY
Compacted Clay	13,600	CY
Cell Delineation Berm	750	LF
Geosynthetic Clay Liner	20,300	SY
60-mil Textured HDPE Geomembrane	20,300	SY
Geotextile Cushion	1,300	SY
Select Aggregate, leachate collection system	490	CY
Select Granular Fill, leachate collection system	6,800	CY
Perimeter Access Road	225	LF
PIPE		
Leachate Headwell Pipe	280	LF
Leachate Collection Pipe, perforated	725	LF
Leachate Collection Pipe, solid	70	LF
Gradient Control Pipe, perforated	725	LF
Gradient Control Pipe, solid	210	LF
Riser Pipe, perforated	15	LF
Riser Pipe, solid	70	LF
Perimeter Access Manhole	1	EA
Subermsible Pump with Conrol Panel	1	EA
Cleanout	1	EA

Note:
Volumes are in-place volumes. Quantities are subject to change based on in-field conditions at the time of construction. System appurtenances are not included in quantities.

AREA A FINAL COVER CONSTRUCTION QUANTITIES

COMPOSITE LINER		
Select Clay or Soil Barrier Layer	15,000	CY
GCL (if soil barrier layer is utilized)	22,500	SY
40-mil Geomembrane	22,500	SY
Geocomposite Drainage Layer	22,500	SY
General Fill, Rooting Zone	18,750	CY
4-inch Diameter Drainage Pipe	2,950	LF
Surface Water Diversion Berm	1,050	LF
Topsoil	3,750	CY
Toe Drain Outlet	6	EA
Storm Water Manhole	2	EA
Downslope Flume	2	EA

Note:
Volumes are in-place volumes. Quantities are subject to change based on in-field conditions at the time of construction. System appurtenances are not included in quantities.

NOTES:

1. REFER TO PLAN SHEET 2 OF THE PLAN SET FOR LEGEND AND BASE MAP NOTES.
2. CELLS 1 & 2 WERE SURVEYED BY RIVERVIEW CONSTRUCTION, INC., WAUSAU, WI, OCTOBER 21, 2021.
3. AUXILIARY SEDIMENT TRAPS WILL BE CONSTRUCTED AS NECESSARY DURING DEVELOPMENT OF EACH CELL.

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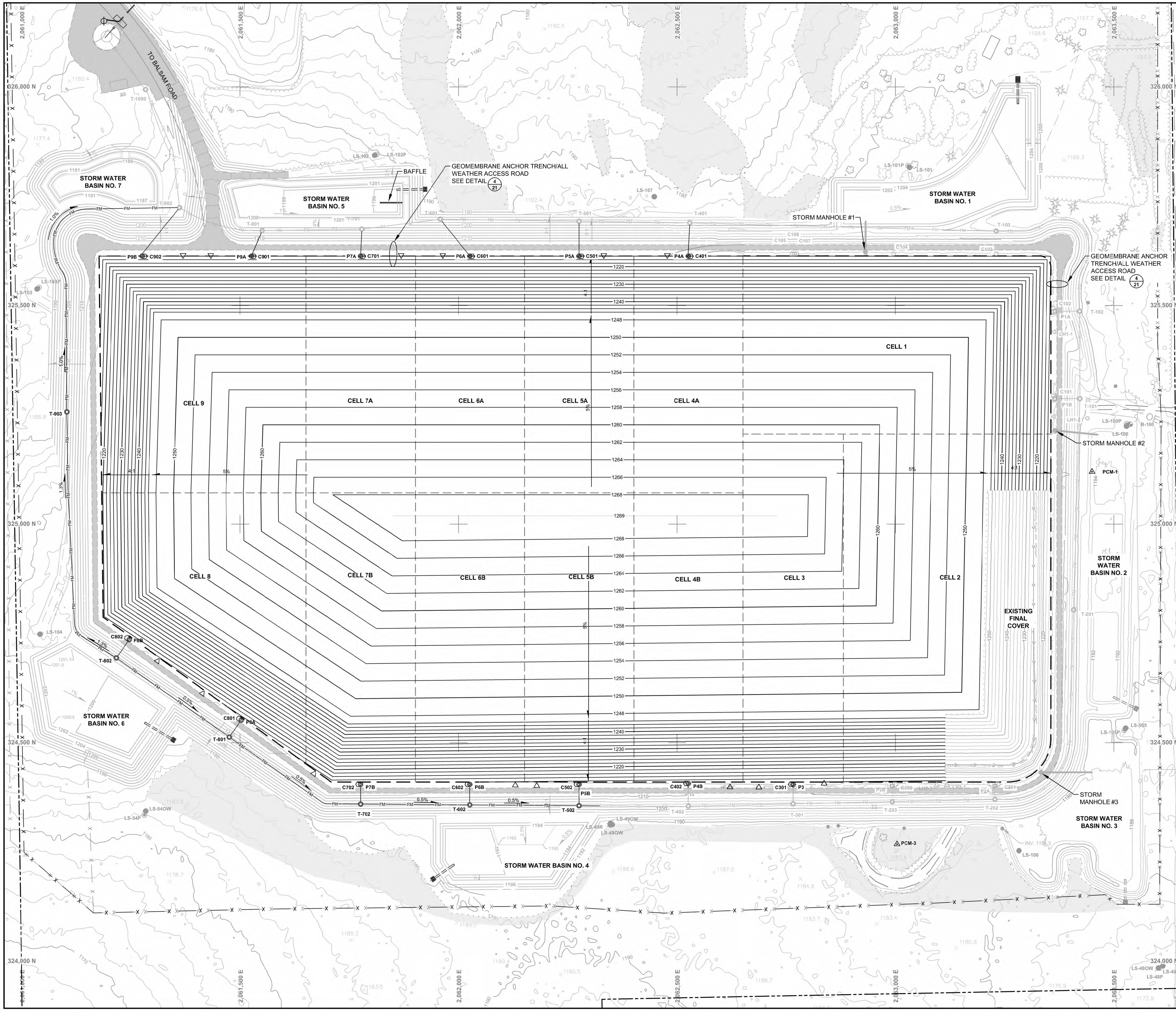
CELL 3 SITE PREPARATION, AREA A CLOSURE

DWG. NO.
PM-7

CALAWAY, JAMES B:\Working\WEC ENERGY GROUP_General\WE - Weston Disposal Site No 3\PM22\2203724007WDSN3.dwg - 9/29/2023



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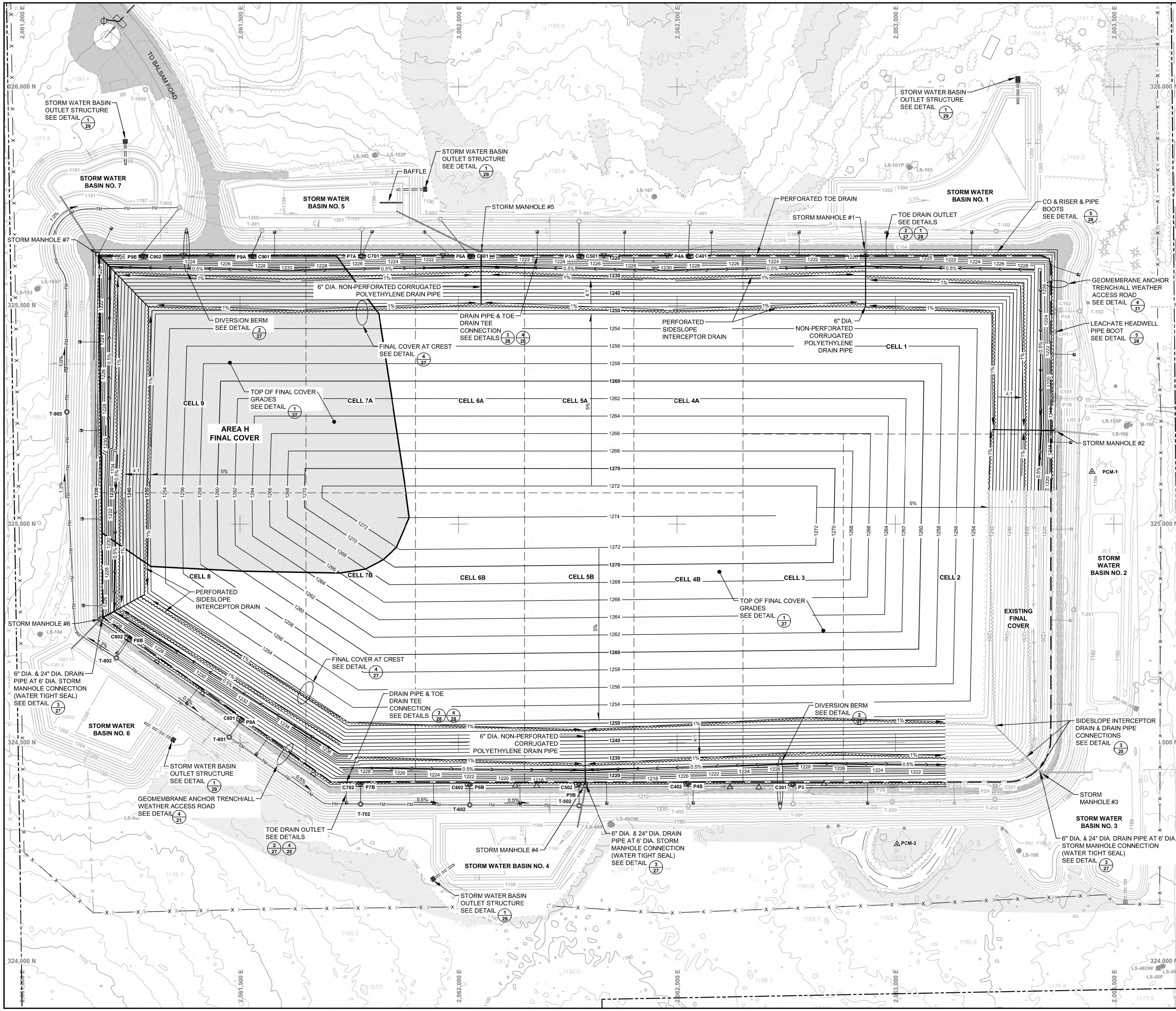
TOP OF WASTE GRADES

NOTES:

1. REFER TO PLAN SHEET 2 OF THE PLAN SET FOR LEGEND AND BASE MAP NOTES.
2. CELLS 1 & 2 WERE SURVEYED BY RIVERVIEW CONSTRUCTION, INC., WAUSAU, WI, OCTOBER 21, 2021.
3. CONTOURS REPRESENT TOP OF WASTE (BOTTOM OF FINAL COVER) WITHIN THE LIMITS OF WASTE AND FINISHED GRADE (TOP OF TOPSOIL, ETC.) BEYOND (EXCEPT AS NOTED ON DETAILS).
4. DAILY COVER WILL NOT BE UTILIZED.
5. INTERMEDIATE COVER MAY BE UTILIZED FOR TEMPORARY SLOPES DEPENDING ON WASTE GENERATION RATES, BENEFICIAL REUSE AND THE FINAL COVER CONSTRUCTION SCHEDULE.

DWG. NO.
PM-14

SHEET NO.
14 OF 29



AREA H FINAL COVER CONSTRUCTION QUANTITIES

COMPOSITE LINER		
Select Clay or Soil Barrier Layer	35,100	CY
GCL (if soil barrier layer is utilized)	52,600	SY
40-mil Geomembrane	52,600	SY
Geocomposite Drainage Layer	52,600	SY
General Fill, Rooting Zone	43,800	CY
4-inch Diameter Drainage Pipe	3,375	LF
Surface Water Diversion Berm	1,125	LF
Topsoil	8,800	CY
Toe Drain Outlet	6	EA

Note:
Volumes are in-place volumes. Quantities are subject to change based on in-field conditions at the time of construction. System appurtenances are not included in quantities.

NOTES:

1. REFER TO PLAN SHEET 2 OF THE PLAN SET FOR LEGEND AND BASE MAP NOTES.
2. CELLS 1 & 2 WERE SURVEYED BY RIVERVIEW CONSTRUCTION, INC., WAUSAU, WI, OCTOBER 21, 2021.
3. CONTOURS REPRESENT FINAL GRADES (TOP OF FINAL COVER) WITHIN THE LIMITS OF WASTE AND FINISHED GRADE (TOP OF TOPSOIL, TOP OF ROAD SURFACE, ETC.) BEYOND.
4. LOCATIONS OF FINAL COVER DRAINAGE LAYER DISCHARGE PIPE MAY VARY BASED UPON WASTE DISPOSAL RATES AND AREAS OF FINAL COVER CONSTRUCTION.

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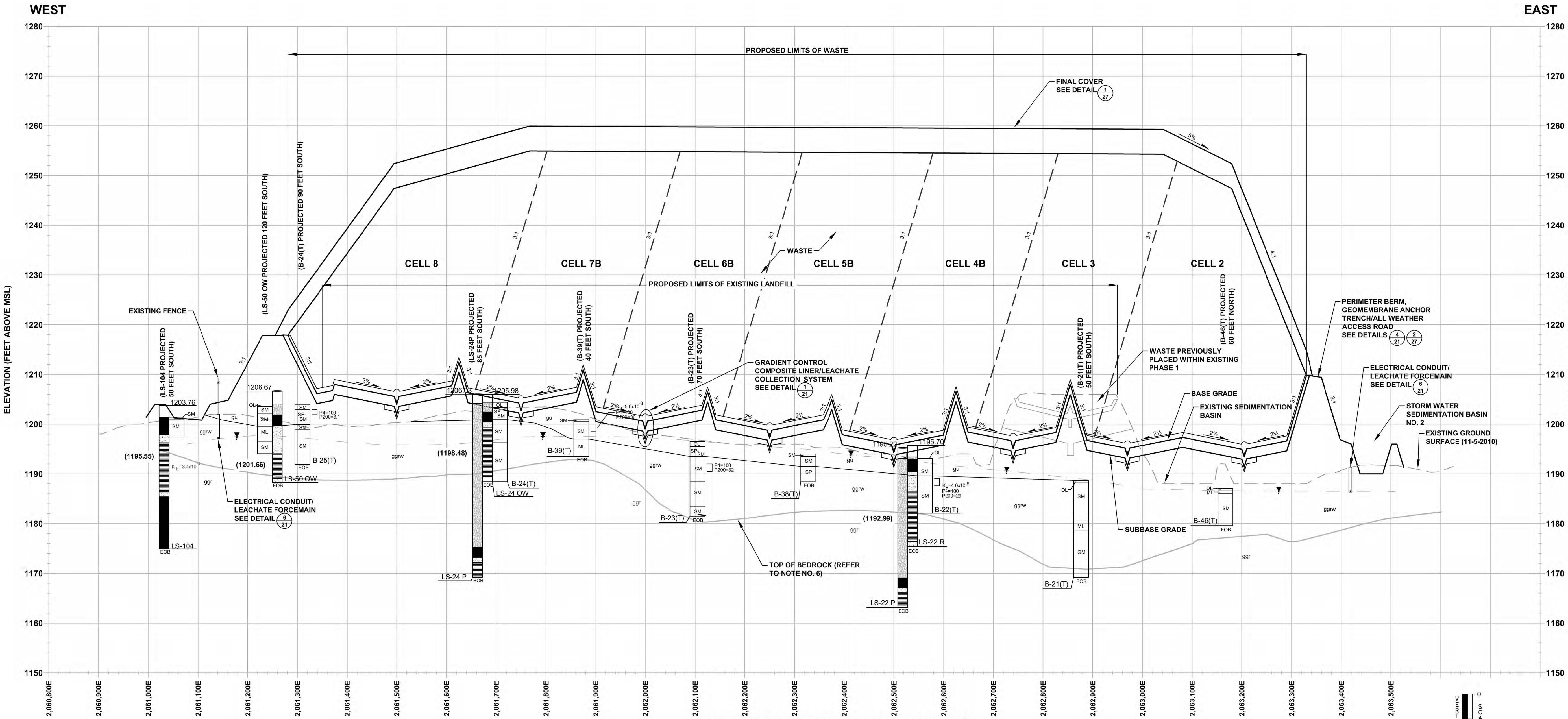
FINAL GRADES

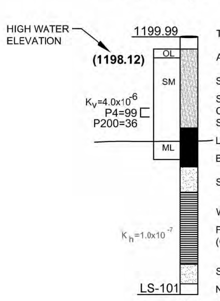
DWG. NO.
PM-15
SHEET NO.
15 OF 29



CROSS SECTION 324,700N (LOOKING NORTH)

LEGEND

- EXISTING GROUND SURFACE
- LITHOSTRATIGRAPHIC UNIT (DASHED WHERE APPROXIMATE)
- COMPETENT BEDROCK SURFACE (DASHED WHERE APPROXIMATE)
- HIGH TABLE SURFACE - (REFER TO NOTE NO. 5 BELOW)



- TOP OF PVC ELEVATION
- ANNULAR SPACE SEAL
- SOIL CLASSIFICATION (USCS)
- SAMPLE INTERVAL WITH LABORATORY (VERTICAL) HYDRAULIC CONDUCTIVITY (CENTIMETERS/SECOND) (K_v), % PASSING No. 4 SIEVE (P4), AND % PASSING No. 200 (P200)
- LITHOSTRATIGRAPHIC CONTACT (DASHED WHERE APPROXIMATE)
- BENTONITE SEAL
- SAND FILTER PACK
- WELL SCREEN
- FIELD (HORIZONTAL) HYDRAULIC CONDUCTIVITY (K_h) (CENTIMETERS/SECOND)
- SOIL BORING/MONITORING WELL DESIGNATION — * - ORIGINAL BORING; ** - REPLACEMENT BORING
- NATURAL CAVE IN OR SAND FILL
- EOB — END OF BORING

STRATIGRAPHIC UNIT

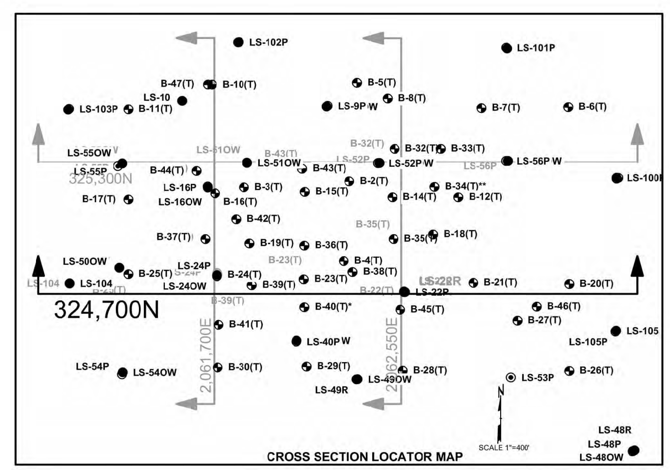
PLEISTOCENE	gu - MARATHON FORMATION, UNDIFFERENTIATED (Attig and Muldoon, 1989) BROWN TO DARK BROWN SAND TO SILTY SAND DERIVED FROM TILL, RESIDUUM, OR HILLSLOPE SEDIMENT ggrw - WEATHERED BEDROCK. YELLOWISH BROWN TO DARK BROWN SILTY SAND DERIVED FROM LOWER PROTEROZOIC BEDROCK (ggr).
LOWER PROTEROZOIC	ggr - GNEISSIC GRANITE (LaBerge and Myers, 1983) LIGHT GREY TO PINK QUARTZ DIORITE AND RED TO PINK GRANITE, WITH TRACE BLACK AMPHIBOLITE

UNIFIED SOIL CLASSIFICATION

GW	WELL GRADED GRAVELS & GRAVEL WITH SAND
GP	POORLY GRADED GRAVELS & GRAVEL WITH SAND
GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
GC	CLAYEY GRAVELS, CLAYEY GRAVEL WITH SAND
SW	WELL GRADED SANDS & SAND WITH GRAVEL
SP	POORLY GRADED SANDS & SANDS WITH GRAVEL
SP-SM	POORLY GRADED SAND WITH SILT, SAND WITH SILT & GRAVEL
SM	SILTY SANDS, SILTY SAND WITH GRAVEL
SC	CLAYEY SANDS, CLAYEY SANDS WITH GRAVEL
CH	HIGH PLASTICITY CLAY
CL-ML	SILTY CLAY TO CLAYEY SILT
CL	LOW PLASTICITY CLAY, GRAVELLY-SANDY CLAYS
ML	SILT, GRAVELLY-SANDY SILT
OL	ORGANIC CLAY, SANDY-GRAVELLY ORGANIC SOIL
OH	ORGANIC, HIGH PLASTICITY, SILTY CLAY
PT	PEAT, MUCK, ORGANIC SOILS

NOTES

1. THE CORRELATION LINES ARE BASED ON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.
2. HORIZONTAL DISTANCES ARE MEASURED AND WATER TABLE DATA ARE PLOTTED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION. WELL CONSTRUCTION SCHEMATICS ARE OFFSET FOR CLARITY.
3. THE EXISTING GROUND SURFACE/SUBBASE GRADES/BASEGRADES/FINAL GRADES ARE BASED ON THE INFORMATION PRESENTED ON PLAN SHEETS 3, 4, 5, AND 15 RESPECTIVELY.
4. ELEVATIONS ARE SHOWN IN REFERENCE TO USGS MEAN SEA LEVEL (MSL) DATUM.
5. HIGH WATER TABLE BASED ON SURFACE PRESENTED ON HIGH WATER TABLE MAP FR-6 (REV. 1) THAT WAS SUBMITTED WITHIN ADDENDUM NO. 2 OF THE FEASIBILITY REPORT, DATED JULY 18, 2013. THE WATER TABLE SURFACE IS BASED UPON DEPTH TO WATER MEASUREMENTS RECORDED ON APRIL 22, 2013 (FOR EXISTING MONITORING WELLS INSTALLED PRIOR TO 2011) AND WATER DEPTH TO WATER MEASUREMENTS RECORDED ON MAY 13, 2013 (FOR THE 100 - SERIES MONITORING WELLS).
6. TOP OF BEDROCK SURFACE IS BASED ON A DIGITAL TERRAIN MODEL (DTM) PREPARED WITH THE TOP OF BEDROCK ELEVATIONS AT EACH SOIL BORING LOCATION.
7. FOR DETAILED LITHOLOGICAL DESCRIPTIONS, REFER TO WELL CONSTRUCTION DETAILS AND THE SOILS LABORATORY TEST RESULTS IN THE FEASIBILITY REPORT.
8. THE DEVELOPMENT/PROGRESSION OF EACH CELL MAY VARY BASED UPON WASTE DISPOSAL SCHEDULE, BENEFICIAL REUSE PROJECT OPPORTUNITIES, AND THE NUMBER/SIZE OF BULK-HAULING EVENTS FROM EACH OF THE POWER PLANTS.



CROSS SECTION LOCATOR MAP

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GREEN BAY, WI 54311
(920)455-8200

WESTON DISPOSAL SITE NO. 3 EXPANSION PLAN OF OPERATION MODIFICATION

P.E. No.:
Approved: JXT
Checked: JXT
Drawn: JLC
Designed: JLC
GEI Project: 2203724

Attention: 0 1"
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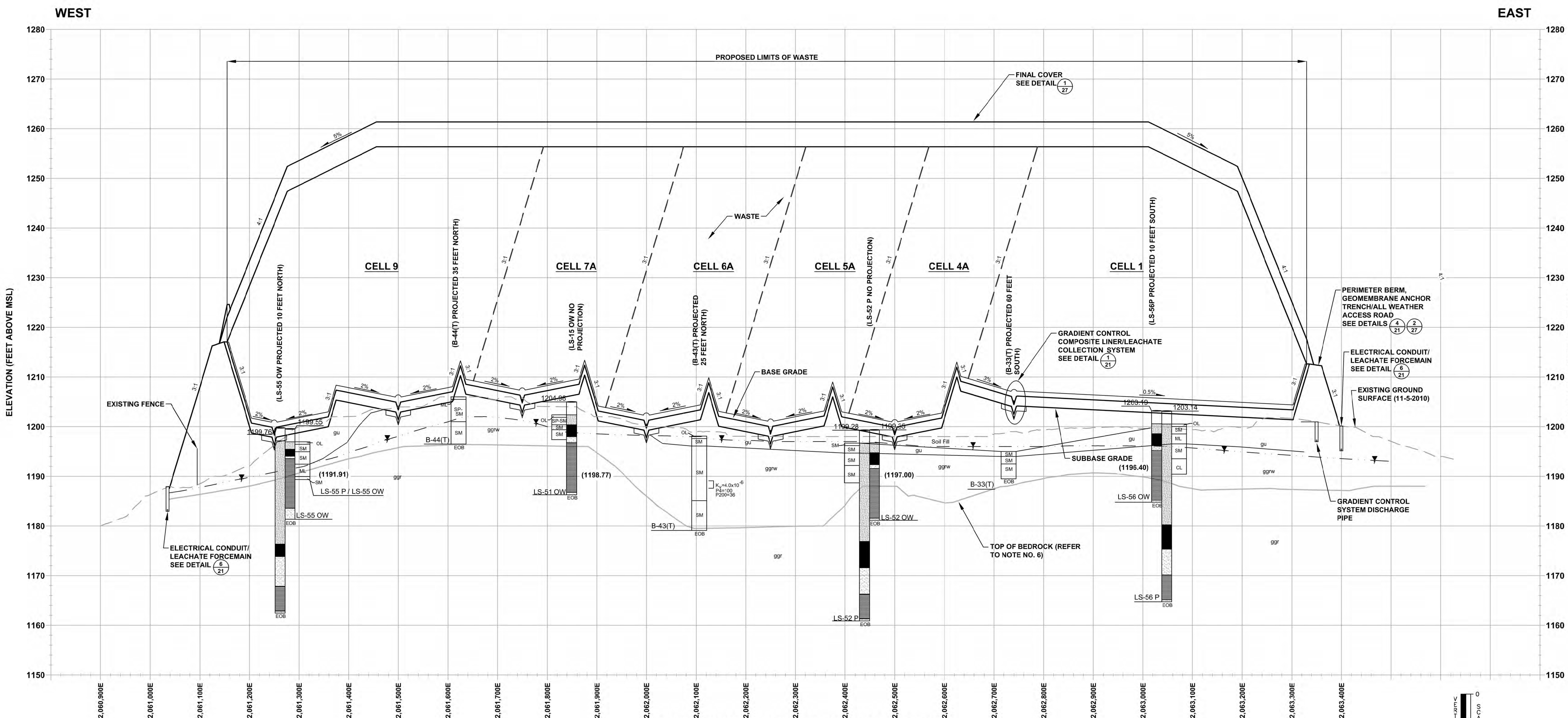
ENGINEERING CROSS SECTION 324,700N

DWG. NO. PM-19
SHEET NO. 19 OF 29



CROSS SECTION 325,300N (LOOKING NORTH)

NOTES

1. THE CORRELATION LINES ARE BASED ON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.
2. HORIZONTAL DISTANCES ARE MEASURED AND WATER TABLE DATA ARE PLOTTED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION. WELL CONSTRUCTION SCHEMATICS ARE OFFSET FOR CLARITY.
3. THE EXISTING GROUND SURFACE/SUBBASE GRADES/BASEGRADES/FINAL GRADES ARE BASED ON THE INFORMATION PRESENTED ON PLAN SHEETS 3, 4, 5, AND 15 RESPECTIVELY.
4. ELEVATIONS ARE SHOWN IN REFERENCE TO USGS MEAN SEA LEVEL (MSL) DATUM.
5. HIGH WATER TABLE BASED ON SURFACE PRESENTED ON HIGH WATER TABLE MAP FR-6 (REV. 1) THAT WAS SUBMITTED WITHIN ADDENDUM NO. 2 OF THE FEASIBILITY REPORT, DATED JULY 18, 2013. THE WATER TABLE SURFACE IS BASED UPON DEPTH TO WATER MEASUREMENTS RECORDED ON APRIL 22, 2013 (FOR EXISTING MONITORING WELLS INSTALLED PRIOR TO 2011) AND WATER DEPTH TO WATER MEASUREMENTS RECORDED ON MAY 13, 2013 (FOR THE 100 - SERIES MONITORING WELLS).
6. TOP OF BEDROCK SURFACE IS BASED ON A DIGITAL TERRAIN MODEL (DTM) PREPARED WITH THE TOP OF BEDROCK ELEVATIONS AT EACH SOIL BORING LOCATION.
7. FOR DETAILED LITHOLOGICAL DESCRIPTIONS, REFER TO WELL CONSTRUCTION DETAILS AND THE SOILS LABORATORY TEST RESULTS IN THE FEASIBILITY REPORT.
8. THE DEVELOPMENT/PROGRESSION OF EACH CELL MAY VARY BASED UPON WASTE DISPOSAL SCHEDULE, BENEFICIAL REUSE PROJECT OPPORTUNITIES, AND THE NUMBER/SIZE OF BULK-HAULING EVENTS FROM EACH OF THE POWER PLANTS.

LEGEND

- EXISTING GROUND SURFACE
- LITHOSTRATIGRAPHIC UNIT (DASHED WHERE APPROXIMATE)
- COMPETENT BEDROCK SURFACE (DASHED WHERE APPROXIMATE)
- HIGH TABLE SURFACE - (REFER TO NOTE NO. 5 BELOW)

HIGH WATER ELEVATION (1198.12)

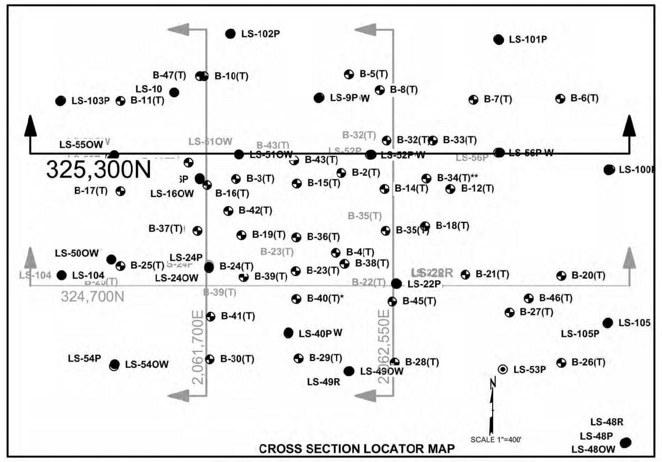
- 1199.99 — TOP OF PVC ELEVATION
- ANNULAR SPACE SEAL
- SOIL CLASSIFICATION (USCS)
- K_V=4.0x10^{-6} P4=99 P200=36 — SAMPLE INTERVAL WITH LABORATORY (VERTICAL) HYDRAULIC CONDUCTIVITY (CENTIMETERS/SECOND) (K_V), % PASSING No. 4 SIEVE (P4), AND % PASSING No. 200 (P200)
- LITHOSTRATIGRAPHIC CONTACT (DASHED WHERE APPROXIMATE)
- BENTONITE SEAL
- SAND FILTER PACK
- WELL SCREEN
- K_h=1.0x10^{-7} — FIELD (HORIZONTAL) HYDRAULIC CONDUCTIVITY (K_h) (CENTIMETERS/SECOND)
- SOIL BORING/MONITORING WELL DESIGNATION — * - ORIGINAL BORING; ** - REPLACEMENT BORING
- LS-101 — NATURAL CAVE IN OR SAND FILL
- EOB — END OF BORING

STRATIGRAPHIC UNIT

PLEISTOCENE	gu	MARATHON FORMATION, UNDIFFERENTIATED (Attig and Muldoon, 1989) BROWN TO DARK BROWN SAND TO SILTY SAND DERIVED FROM TILL, RESIDUUM, OR HILLSLOPE SEDIMENT
	ggrw	WEATHERED BEDROCK. YELLOWISH BROWN TO DARK BROWN SILTY SAND DERIVED FROM LOWER PROTEROZOIC BEDROCK (ggr).
LOWER PROTEROZOIC	ggr	GNEISSIC GRANITE (LaBerge and Myers, 1983) LIGHT GREY TO PINK QUARTZ DIORITE AND RED TO PINK GRANITE, WITH TRACE BLACK AMPHIBOLITE

UNIFIED SOIL CLASSIFICATION

GW	WELL GRADED GRAVELS & GRAVEL WITH SAND
GP	POORLY GRADED GRAVELS & GRAVEL WITH SAND
GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
GC	CLAYEY GRAVELS, CLAYEY GRAVEL WITH SAND
SW	WELL GRADED SANDS & SAND WITH GRAVEL
SP	POORLY GRADED SANDS & SANDS WITH GRAVEL
SP-SM	POORLY GRADED SAND WITH SILT, SAND WITH SILT & GRAVEL
SM	SILTY SANDS, SILTY SAND WITH GRAVEL
SC	CLAYEY SANDS, CLAYEY SANDS WITH GRAVEL
CH	HIGH PLASTICITY CLAY
CL-ML	SILTY CLAY TO CLAYEY SILT
CL	LOW PLASTICITY CLAY, GRAVELLY-SANDY CLAYS
ML	SILT, GRAVELLY-SANDY SILT
OL	ORGANIC CLAY, SANDY-GRAVELLY ORGANIC SOIL
OH	ORGANIC, HIGH PLASTICITY, SILTY CLAY
PT	PEAT, MUCK, ORGANIC SOILS



CROSS SECTION LOCATOR MAP

VERTICAL SCALE 0 5 10
HORIZONTAL SCALE 0 100 200

VERTICAL EXAGGERATION = 10X

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WESTON DISPOSAL SITE NO. 3 EXPANSION PLAN OF OPERATION MODIFICATION

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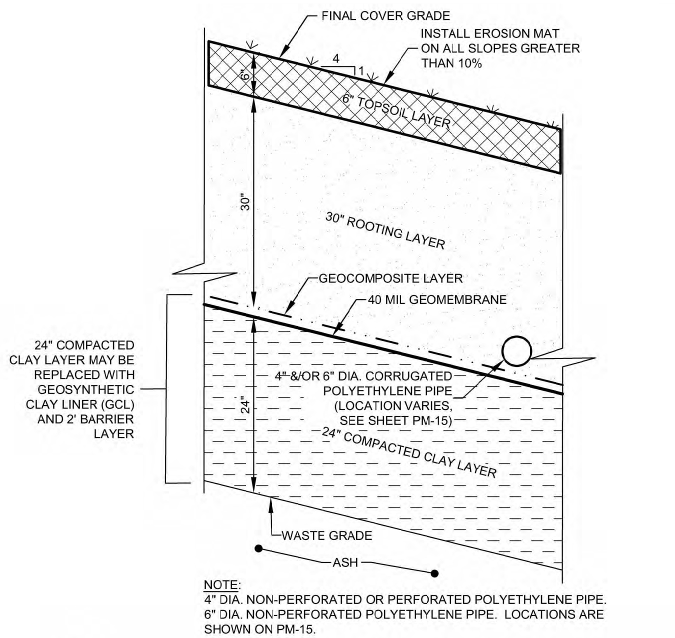
ENGINEERING CROSS SECTION 325,300N

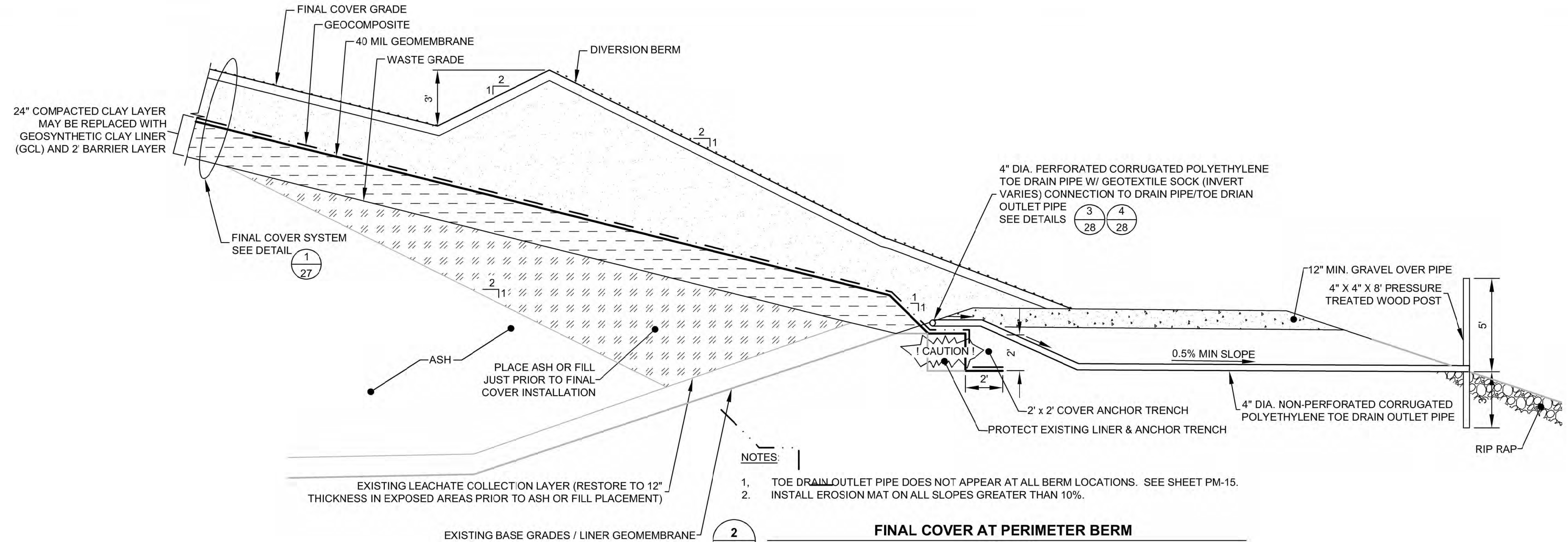
DWG. NO. PM-20

SHEET NO. 20 OF 29



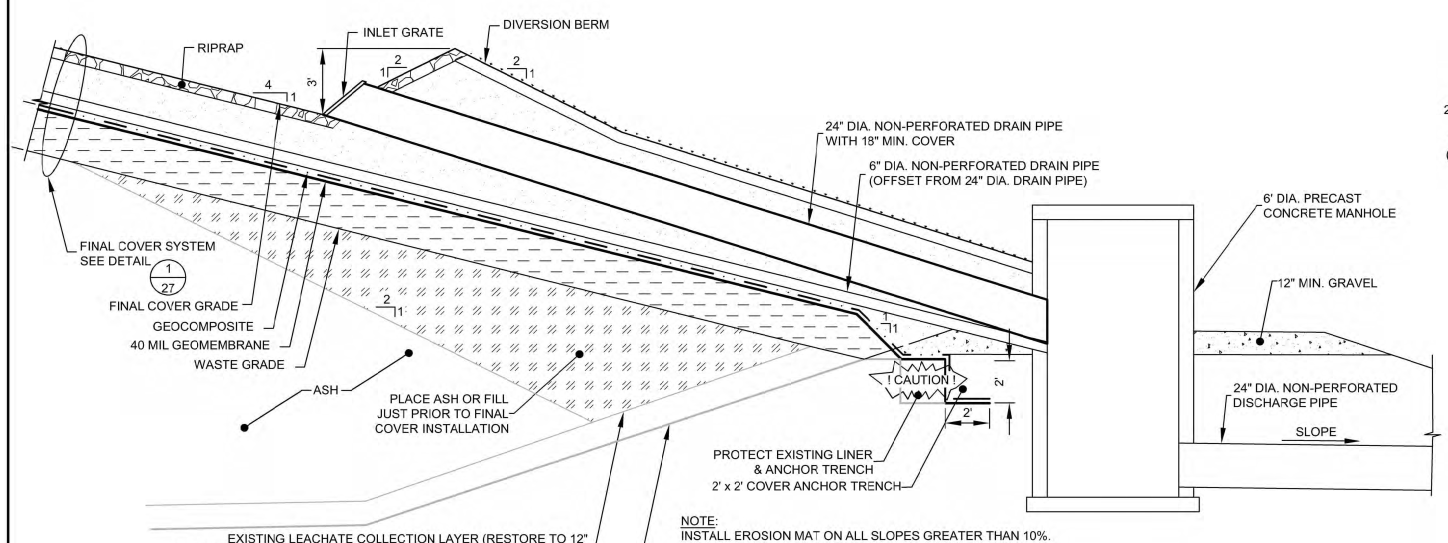
1/27 **FINAL COVER**

SCALE: 1"=1'



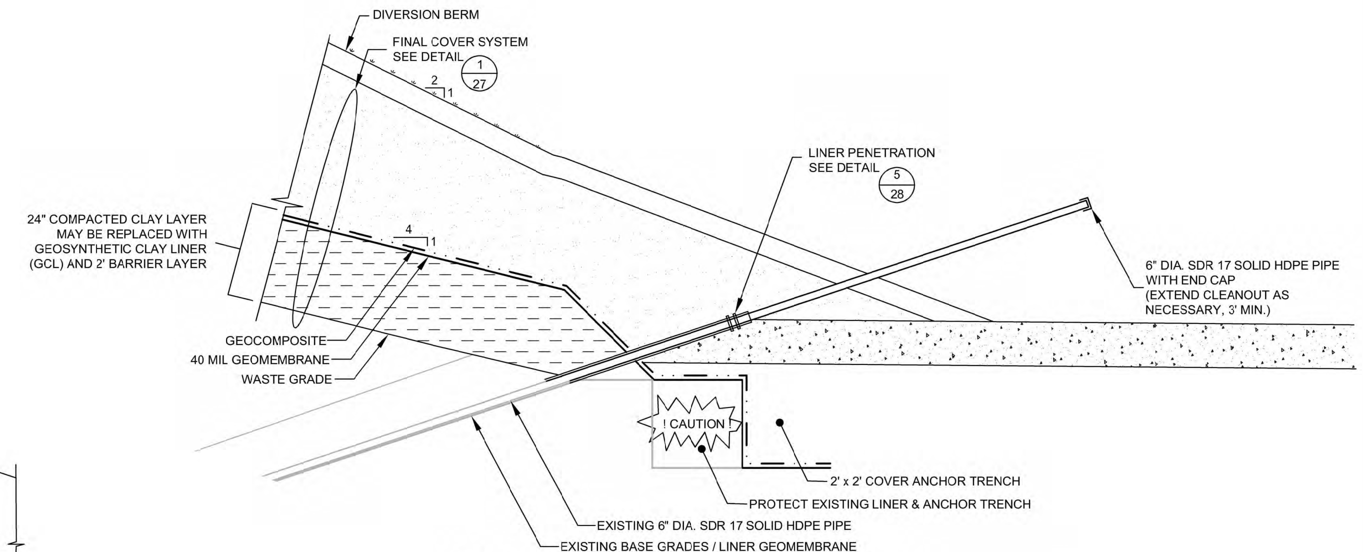
2/27 **FINAL COVER AT PERIMETER BERM**

SCALE: 1"=4'



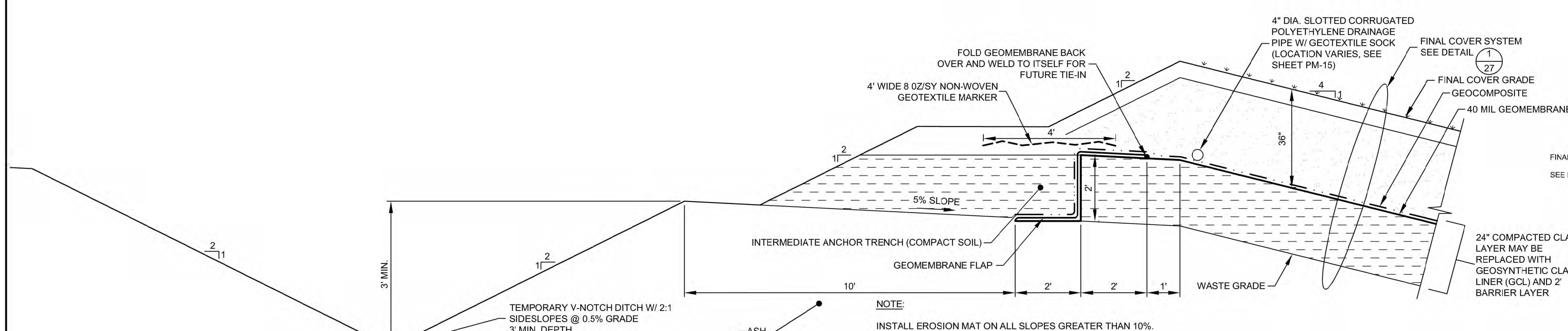
3/27 **STORM MANHOLE AND DISCHARGE PIPE**

SCALE: 1"=4'



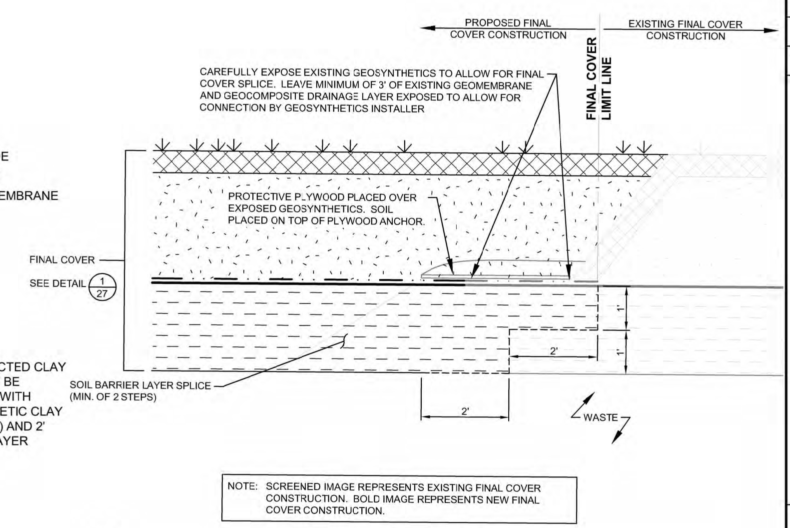
5/27 **PIPE BOOT TIE-IN TO CLEANOUT**

SCALE: 1"=2'



4/27 **FINAL COVER INTERMEDIATE TERMINATION WITH V-NOTCH TRENCH**

SCALE: 1"=2'



6/27 **FINAL COVER SPLICE**

SCALE: 1"=2'

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DETAILS

DWG. NO.
PM-27
SHEET NO.
27 OF 29

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