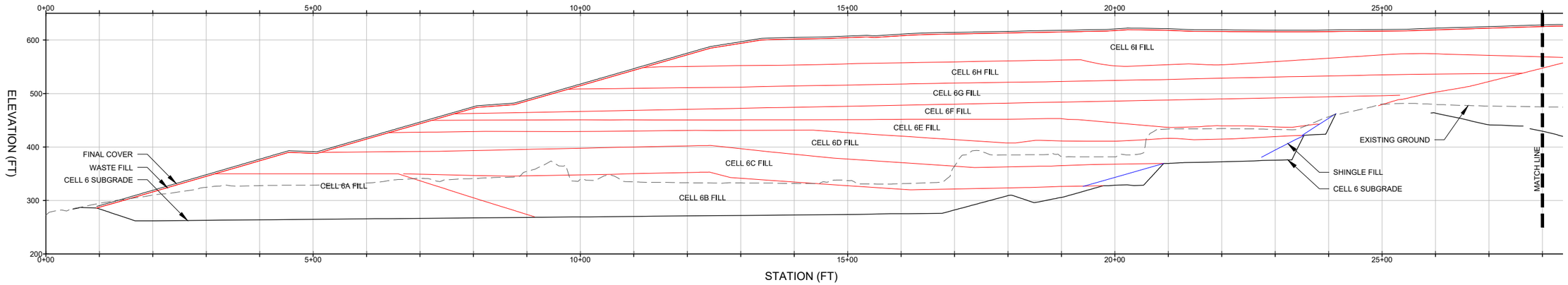

SECTION A-A'

HORIZ. SCALE: 1" = 100'
VERT. SCALE: 1" = 100'

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VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL

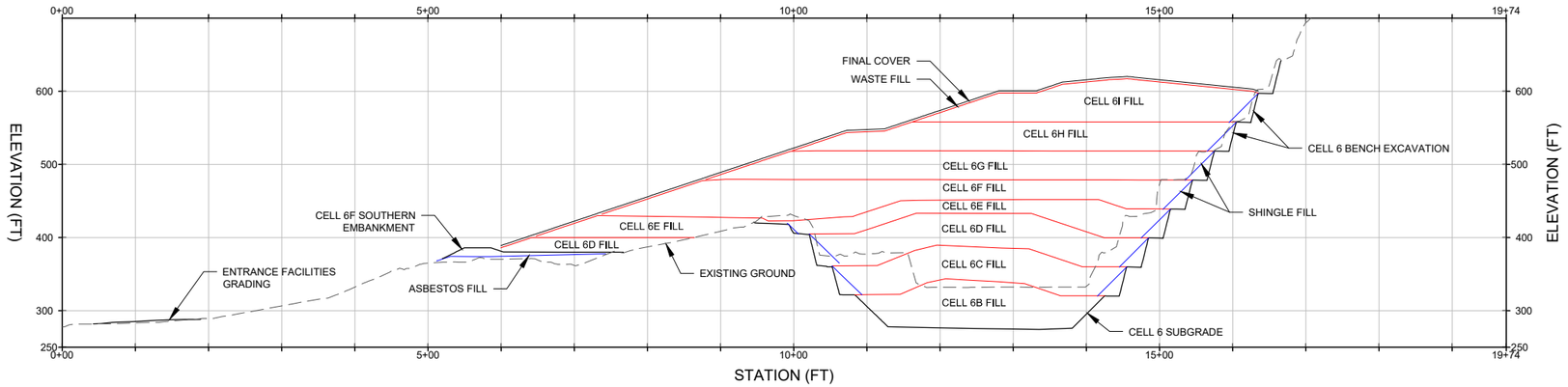
SITE DEVELOPMENT PLAN

BENTON COUNTY, OREGON

CROSS SECTIONS

DRAWING NO.
C15

PROJECT NO.
AU20.1210



SECTION B-B'

HORIZ. SCALE: 1" = 100'
VERT. SCALE: 1" = 100'

SECTION C-C'

HORIZ. SCALE: 1" = 100'
VERT. SCALE: 1" = 100'

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VALLEY LANDFILLS, INC.

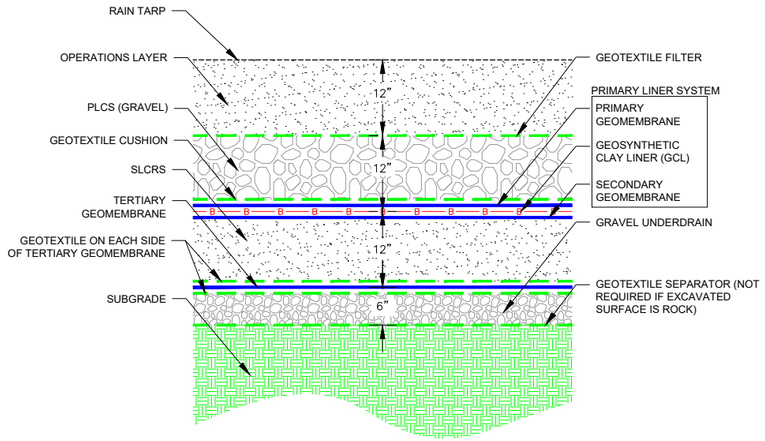
COFFIN BUTTE LANDFILL

SITE DEVELOPMENT PLAN

BENTON COUNTY, OREGON

CROSS SECTIONS

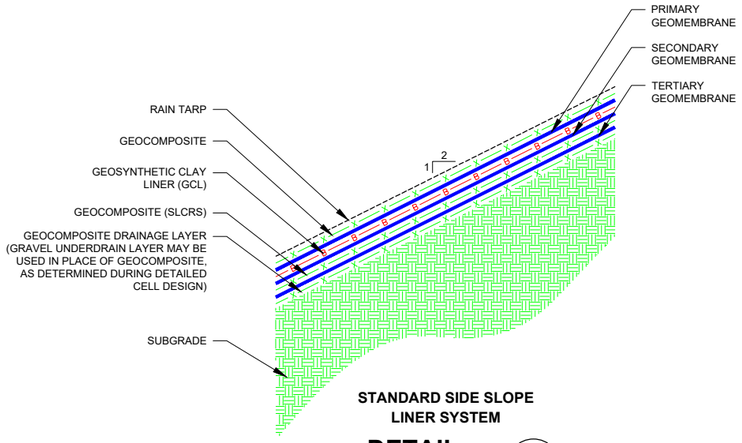
DRAWING NO.
C16
PROJECT NO.
AU20.1210



STANDARD FLOOR LINER SYSTEM

DETAIL 1 (C02 | C20)

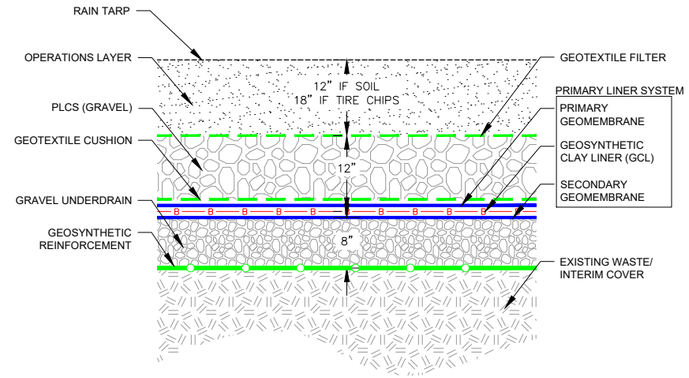
1" = 1'



STANDARD SIDE SLOPE LINER SYSTEM

DETAIL 2 (C02 | C20)

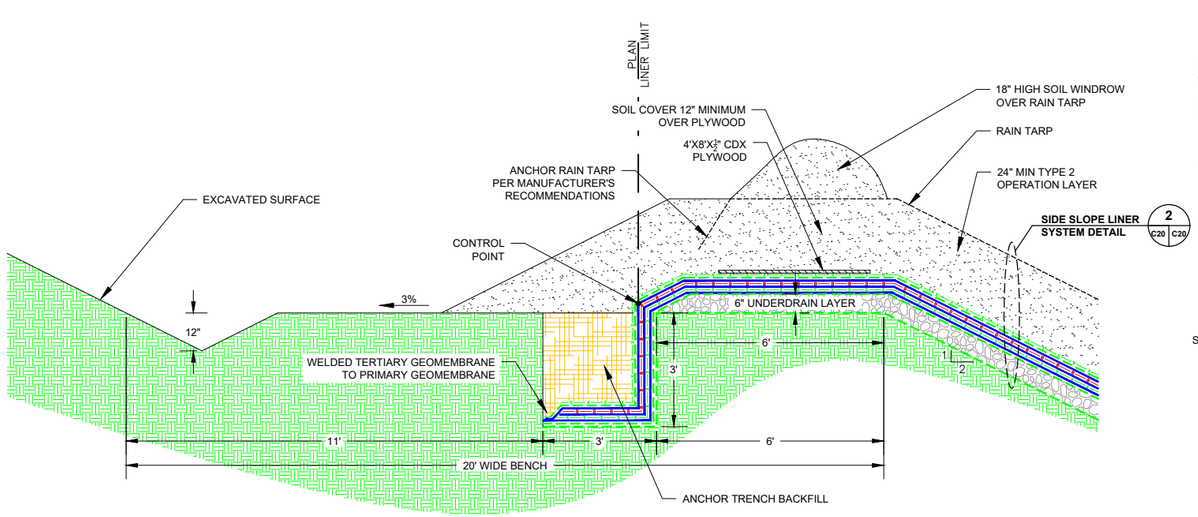
1" = 1'



PIGGY BAK LINER SYSTEM

DETAIL 3 (C07 | C20)

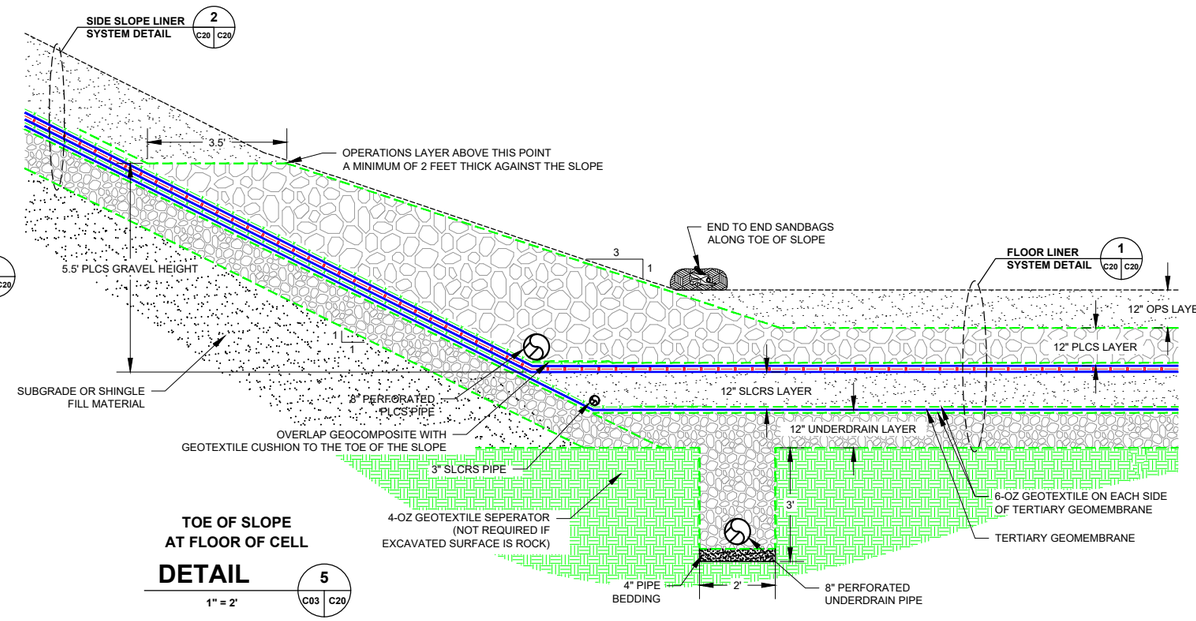
1" = 1'



BENCH LINER TERMINATION

DETAIL 4 (C01 | C20)

1" = 2'



TOE OF SLOPE AT FLOOR OF CELL

DETAIL 5 (C03 | C20)

1" = 2'

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COFFIN BUTTE LANDFILL

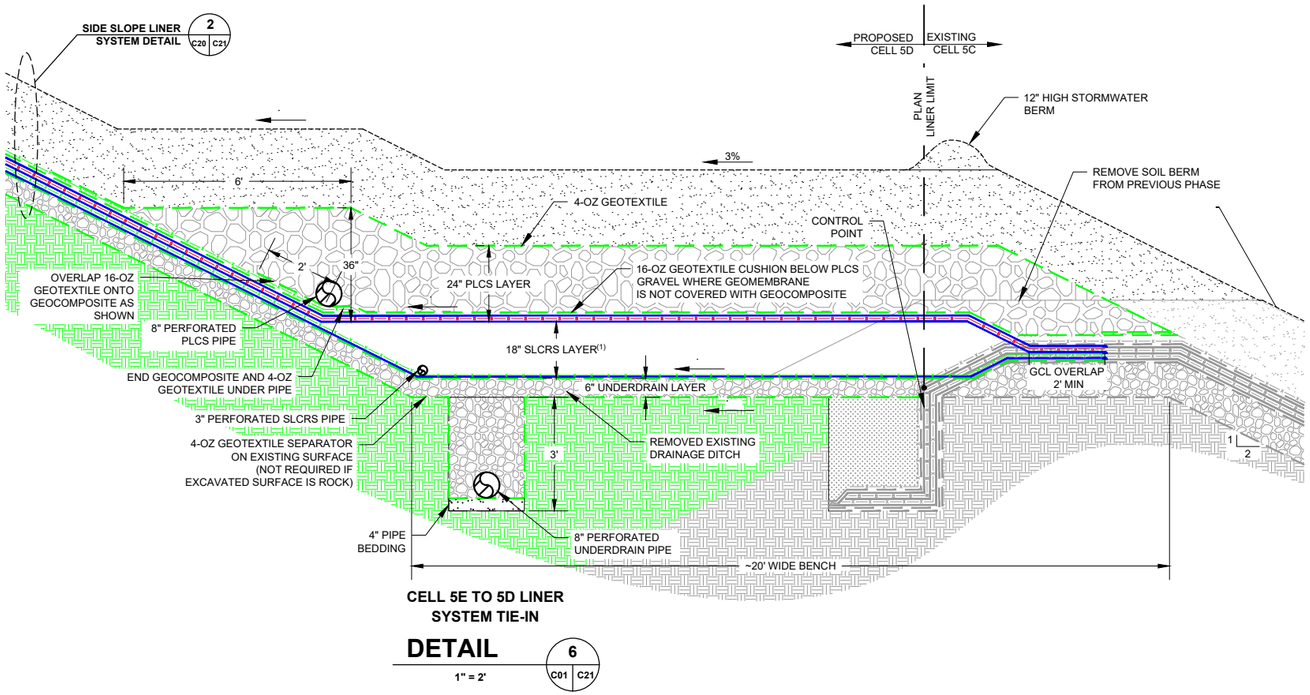
SITE DEVELOPMENT PLAN

BENTON COUNTY, OREGON

DETAILS - LINER SYSTEM

DRAWING NO. C20

PROJECT NO. AU20.1210



CELL 5E TO 5D LINER SYSTEM TIE-IN

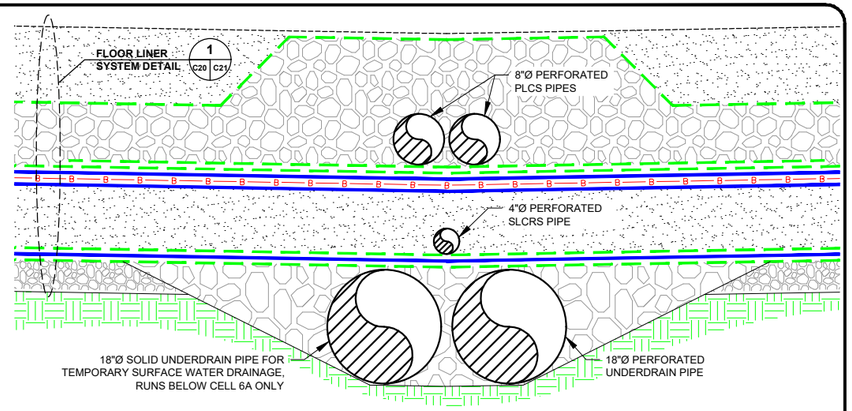
DETAIL 6 (C01 | C21)

1" = 2'

LEACHATE COLLECTION AND UNDERDRAIN SYSTEM HEADER

DETAIL 7 (C02 | C21)

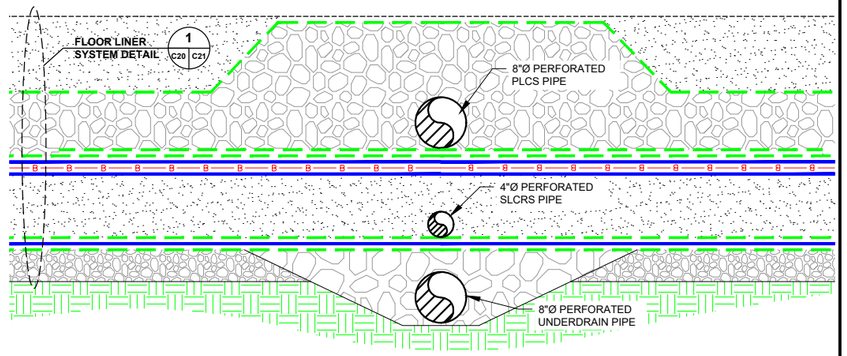
1" = 2'

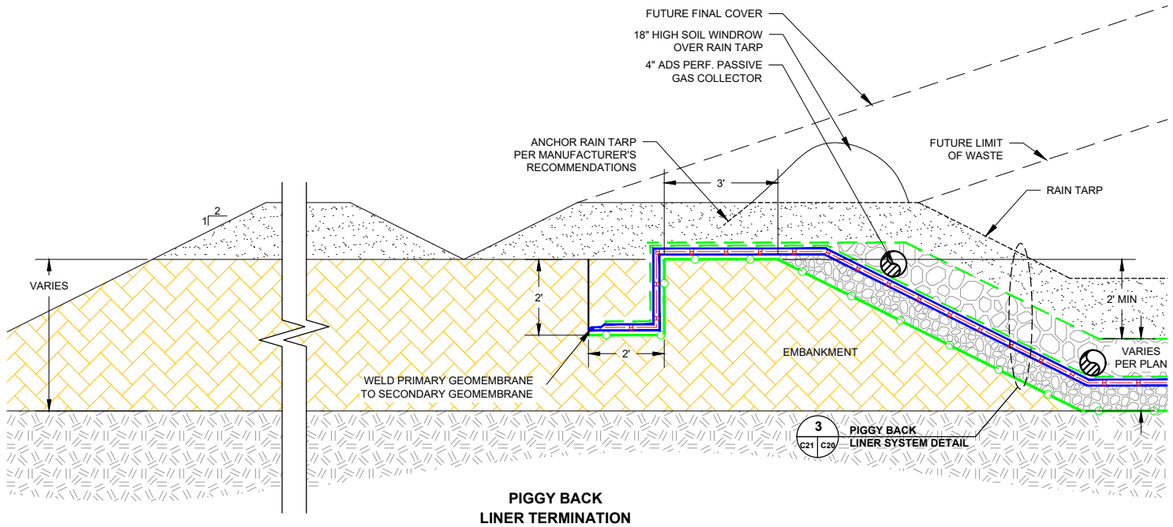


LEACHATE COLLECTION AND UNDERDRAIN SYSTEM LATERAL

DETAIL 8 (C02 | C21)

1" = 2'

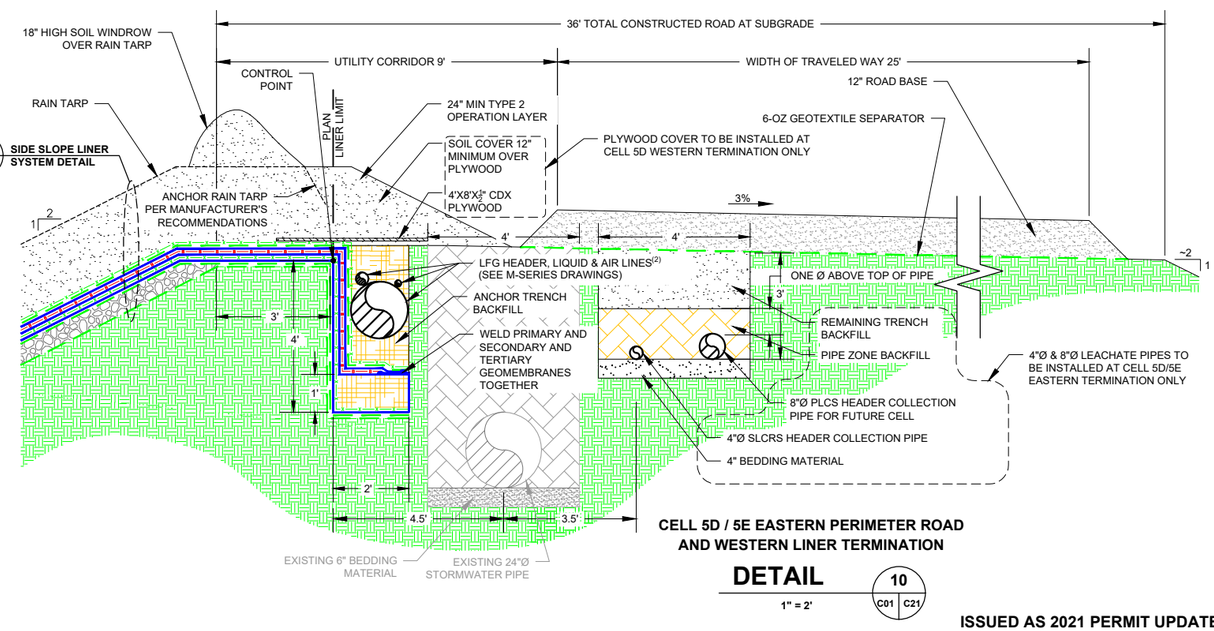




PIGGY BACK LINER TERMINATION

DETAIL 9 (C07 | C21)

1" = 2'



CELL 5D / 5E EASTERN PERIMETER ROAD AND WESTERN LINER TERMINATION

DETAIL 10 (C01 | C21)

1" = 2'

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COFFIN BUTTE LANDFILL

SITE DEVELOPMENT PLAN

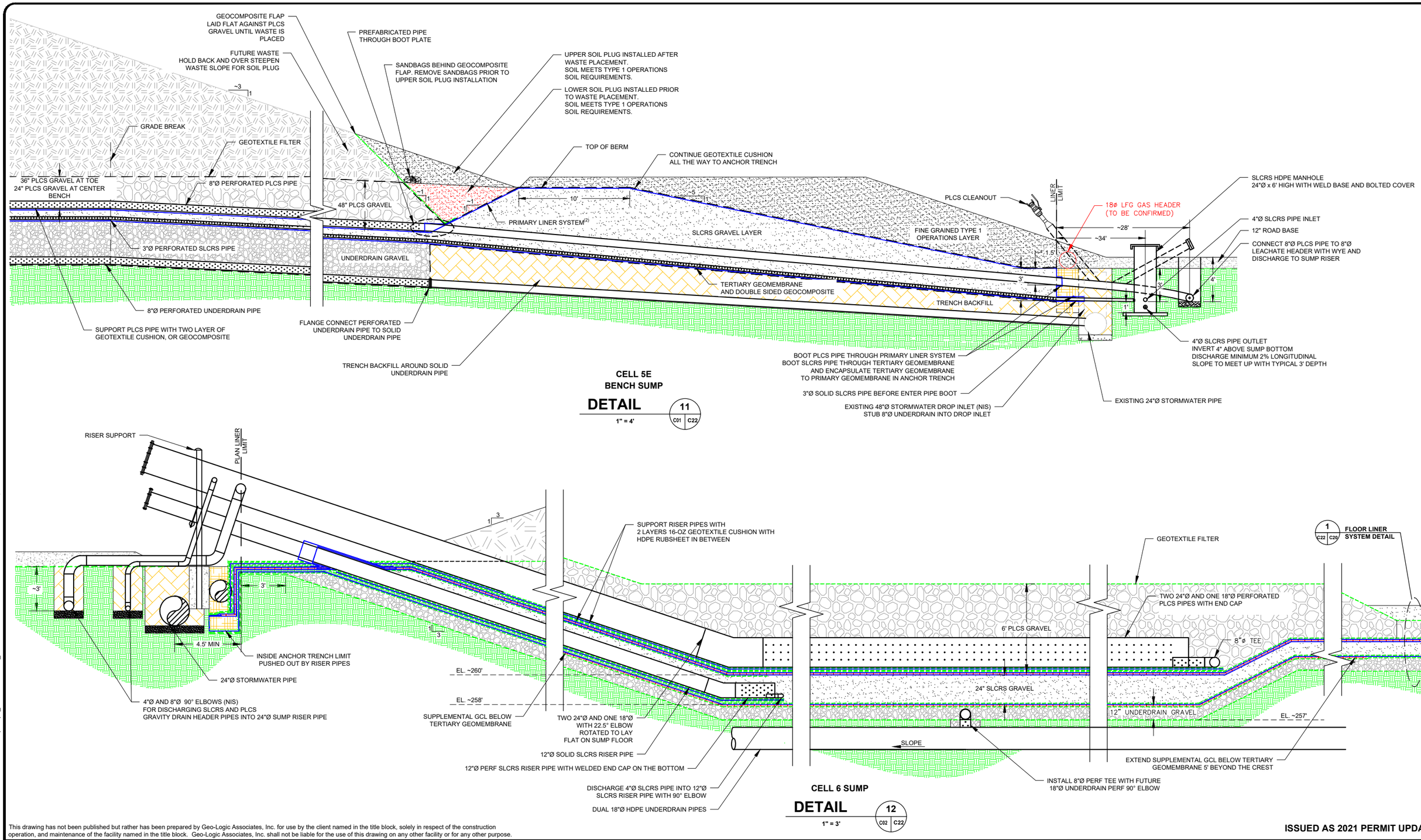
BENTON COUNTY, OREGON

DETAILS - LINER SYSTEM

DRAWING NO. C21

PROJECT NO. AU20.1210

N:\COFFIN BUTTE\AU20.1211 - SITE DEVELOPMENT PLAN (SDP)\5_ENGINEERING\1_CIVIL\DRAWINGS\C20-C29 DETAILS.DWG December 30, 2021 - 3:00 PM BY: GLA LISER



CELL 5E BENCH SUMP

DETAIL 11 (C01 | C22)

1" = 4'

CELL 6 SUMP

DETAIL 12 (C02 | C22)

1" = 3'

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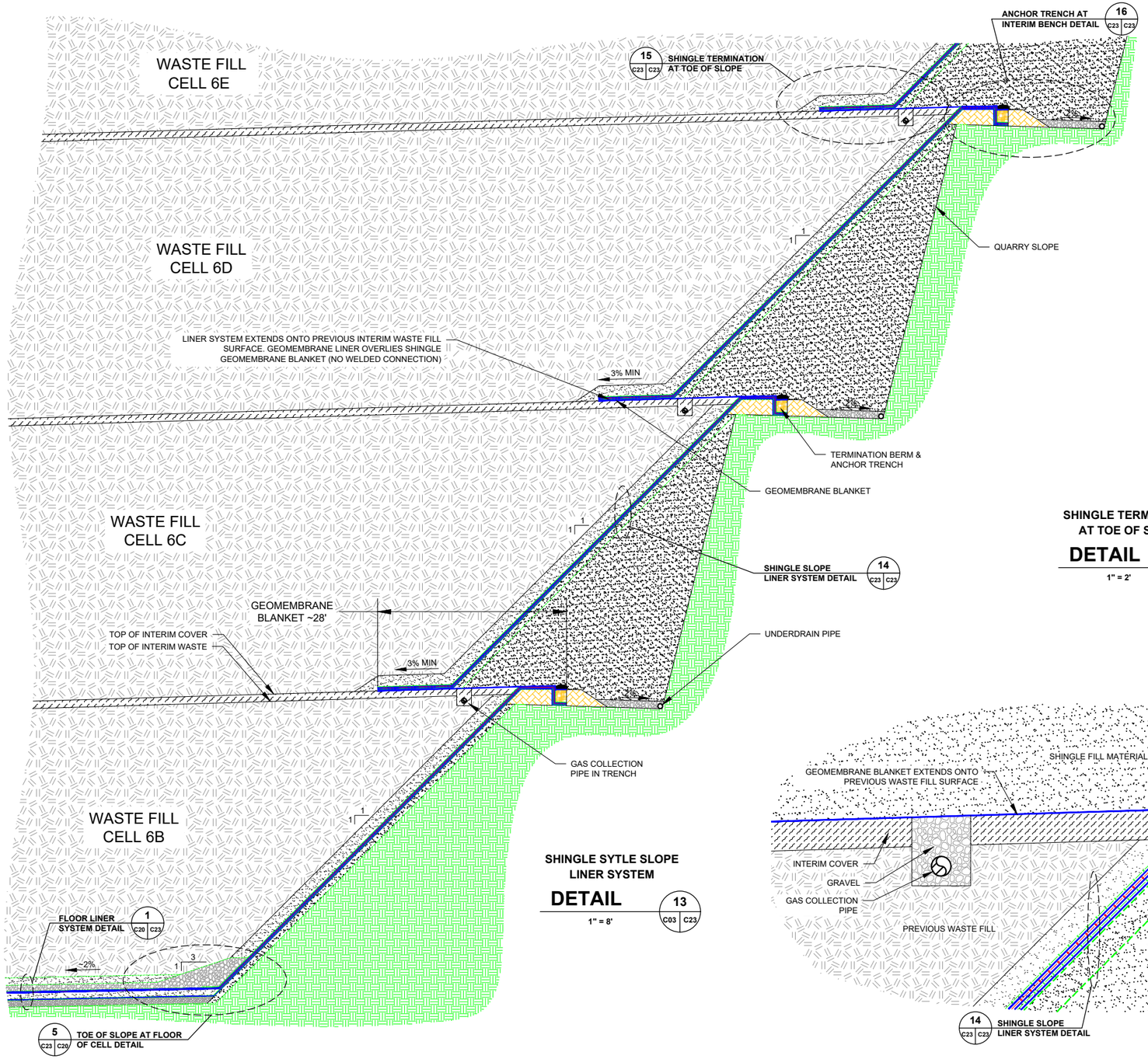
COFFIN BUTTE LANDFILL
SITE DEVELOPMENT PLAN
BENTON COUNTY, OREGON
DETAILS - LINER SYSTEM

DRAWING NO. **C22**
PROJECT NO. AU20.1210



SHINGLE SYTLE SLOPE LINER SYSTEM

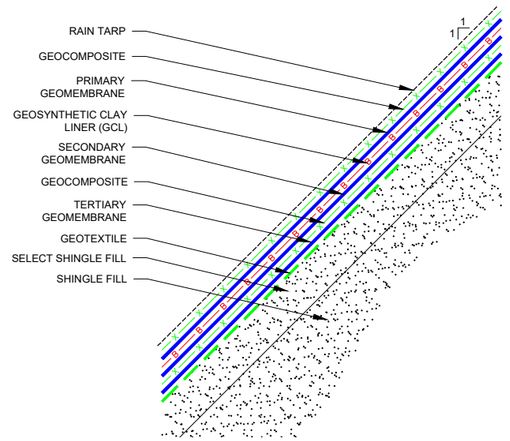
DETAIL 13 C03 C23

1" = 8'

SHINGLE SLOPE LINER SYSTEM

DETAIL 14 C23 C23

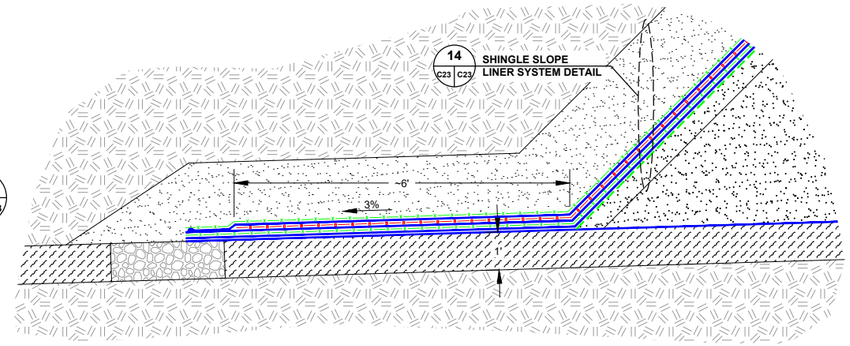
1" = 2'

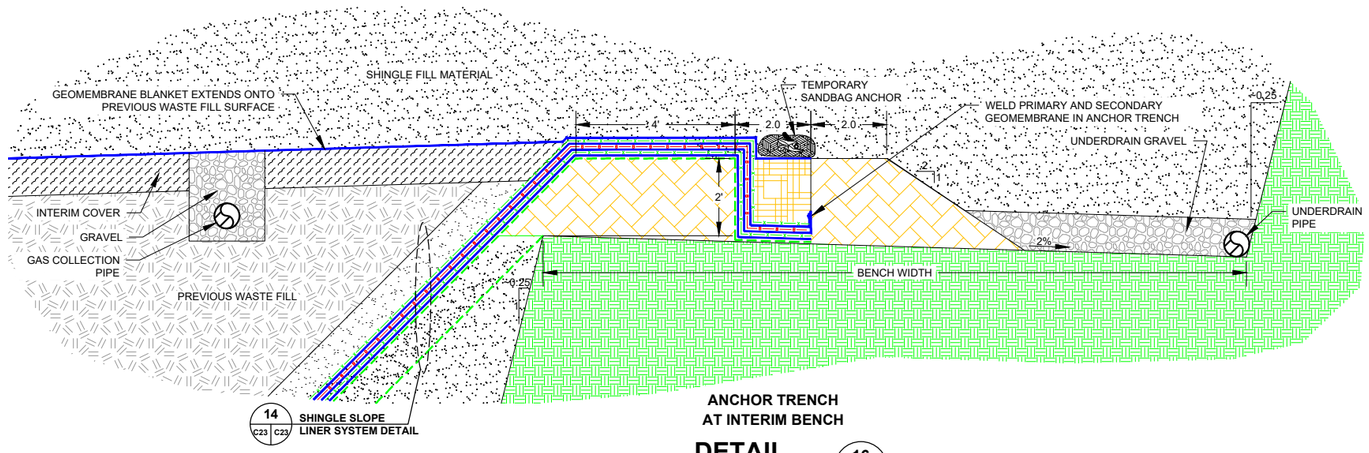


SHINGLE TERMINATION AT TOE OF SLOPE

DETAIL 15 C23 C23

1" = 2'





ANCHOR TRENCH AT INTERIM BENCH

DETAIL 16 C23 C23

1" = 2'

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COFFIN BUTTE LANDFILL

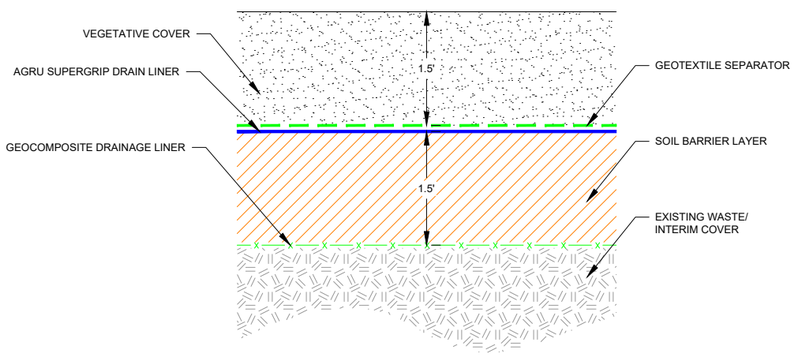
SITE DEVELOPMENT PLAN

BENTON COUNTY, OREGON

DETAILS - SHINGLE FILL

DRAWING NO. C23

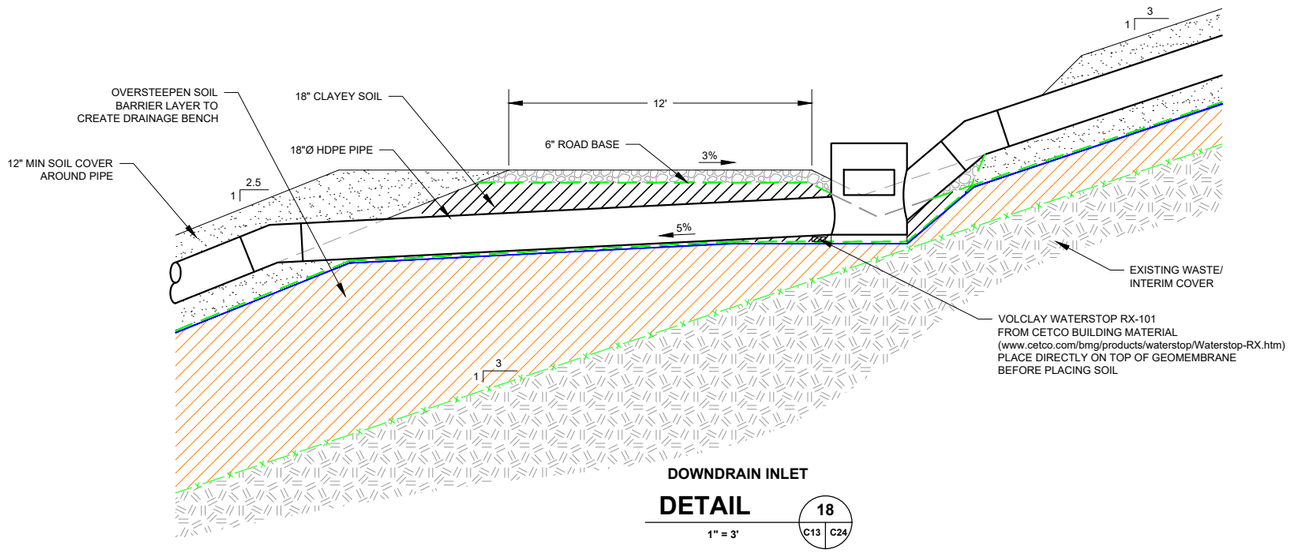
PROJECT NO. AU20.1210



FINAL COVER SYSTEM

DETAIL 17 (C13 | C24)

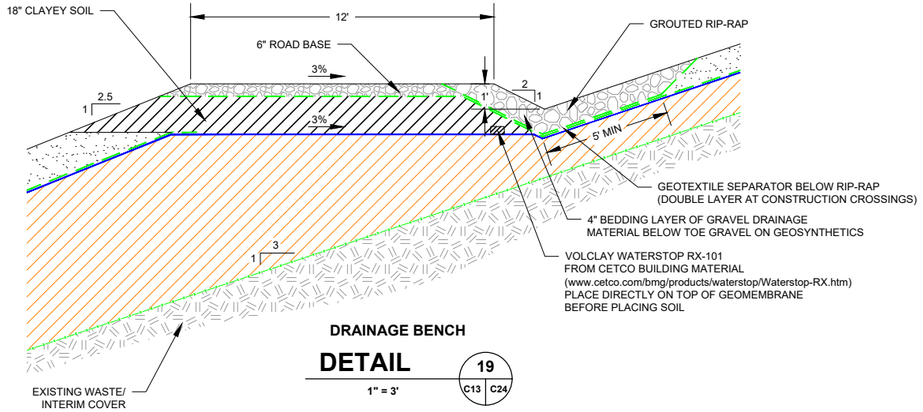
1" = 1'



DOWNDRAIN INLET

DETAIL 18 (C13 | C24)

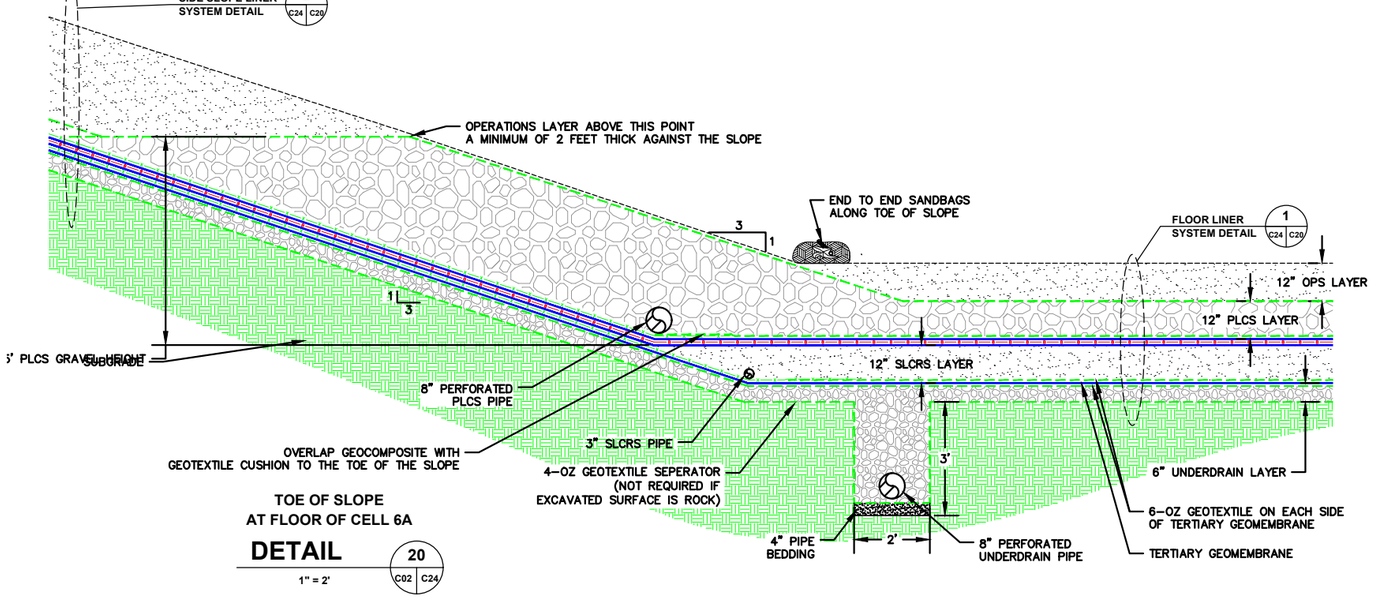
1" = 3'



DRAINAGE BENCH

DETAIL 19 (C13 | C24)

1" = 3'



TOE OF SLOPE
AT FLOOR OF CELL 6A

DETAIL 20 (C02 | C24)

1" = 2'

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VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL

SITE DEVELOPMENT PLAN

BENTON COUNTY, OREGON

DETAILS

DRAWING NO. C24

PROJECT NO. AU20.1210

APPENDIX B

SITE LIFE CALCULATIONS

Site:	Coffin Butte Landfill
Project Name:	2021 Site Development Plan Update
Date:	12/23/2021
Calc By:	ASO
Reviewed By:	RB

Projected Daily Waste Receipt 2,959 tons/day (from 2021 5 Yr Fill Plans)

Assume [1] 0.0 % growth rate
Operational Density 0.8 ton/cy (from 2021 5 Yr Fill Plans)
Operational Days 286 days/year

Remaining Site Life 18 Years

Note [1]: Growth Rate Based On Site Aerial Budget Model

Year	Consumed Airspace (cy)	Remaining Airspace (cy)	
2021	1,072,037	4,834,330	*Cell 5D/5E Constructed Remaining from 3/30/21 survey date
2022	1,057,700	3,776,631	
2023	1,057,700	2,718,931	
2024	1,057,700	1,661,232	
2025	1,057,700	603,532	
2026	1,057,700	1,028,093	Construct Phase 6A (Add 1,482,260 cy)
2027	1,057,700	999,823	Construct Phase 6B (Add 1,029,430 cy)
2028	1,057,700	1,684,254	Construct Phase 6C (Add 1,742,130 cy)
2029	1,057,700	626,554	
2030	1,057,700	1,428,675	Construct Phase 6D (Add 1,859,820 cy)
2031	1,057,700	370,975	
2032	1,057,700	391,696	Construct Phase 6E (Add 1,078,420 cy)
2033	1,057,700	1,020,066	Construct Phase 6F (Add 1,686,070 cy)
2034	1,057,700	1,977,627	Construct Phase 6G (Add 2,015,260 cy)
2035	1,057,700	919,927	
2036	1,057,700	1,157,678	Construct Phase 6H (Add 1,295,450 cy)
2037	1,057,700	99,978	
2038	1,057,700	664,409	Construct Phase 6I (Add 1,622,130 cy)
2039	664,409	0	

APPENDIX C

SLOPE STABILITY ANALYSES

Slope Stability Report
Cell 6

Coffin Butte Landfill
Benton County, Oregon

Submitted to:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, Oregon 97330

Prepared by:

Geo-Logic ASSOCIATES

803 SW Industrial Way, Suite 211
Bend, Oregon 97702
www.geo-logic.com

Project #AU20.1210.00

December 2021

Certification

This report was prepared in accordance with generally accepted professional engineering principles and practices. This report makes no other warranties, either expressed or implied as to the professional advice or data included in it. This report has not been prepared for use by parties or projects other than those named or described herein. It may not contain sufficient information for other parties or purposes.

GEO-LOGIC ASSOCIATES

Aaron Ogorzalek, PE
Senior Engineer
Geo-Logic Associates
803 SW Industrial Way, Suite 211
Bend, Oregon 97702

December 22, 2021

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1. Introduction

1.1 Project Description

The Coffin Butte Landfill (CBL), owned and operated by Valley Landfills, Inc. (VLI), is an active municipal solid waste (MSW) disposal facility located in Benton County, Oregon approximately 10 miles north of the city of Corvallis. The CBL operates under Oregon Department of Environmental Quality (ODEQ) Solid Waste Permit No. 306. The site address is 28972 Coffin Butte Road, Corvallis, Oregon. The permitted landfill site encompasses approximately 178.1 acres inside the site's landfill zoning boundary. To date, the developed landfill footprint consists of approximately 123.5 acres. The CBL receives approximately 0.9 million tons of waste per year.

The CBL is constructed in individual major units/cells, named Cell 1, 2, 3, etc., and subcells named Cell 5A, 5B, 5C, etc. Existing cells consist of Cell 1 through Cell 5C. Cell 5D was constructed during 2021 and is awaiting final approval for waste placement. Cell 5E is the final subcell in Cell 5 and is anticipated to be constructed during 2023. At this time, Cell 6 is the final cell of the landfill and will be located where an existing quarry operates to the west of the active landfill operations in Cell 5.

The CBL is in the process of updating its Site Development Plan (SDP) as part of its regular Solid Waste Permit renewal issuance. The 2021 SDP update provides a revised conceptual design of Cell 6 with site development details, phase sequencing, and supporting engineering analyses. This report was prepared in conjunction with the 2021 SDP update and is intended to describe the slope stability analyses that were performed for the development of Cell 6.

1.2 Purpose and Scope

The objective of this report is to present an assessment of the slope stability of the CBL associated with the conceptual design of Cell 6 as presented in the 2021 SDP update. The scope of work performed to meet this objective included:

- Review of the proposed waste grading and base grading plans and selection of representative cross sections for analysis
- Review of available data describing existing liner system configurations and identification of material properties for use in analyses

- Update the seismic hazard evaluation for the landfill and site-specific response analysis
- Completion of static and seismic stability modeling and calculations
- Preparation of this report summarizing the results of the analyses

The evaluations described below were focused on global stability of the landfill along the liner system for the proposed final buildout conditions of the landfill. The final buildout fill plan and exterior slopes of the landfill have not changed relative to the previous SDP evaluation (Thiel Engineering, 2013). Subsurface investigation and laboratory testing were outside the scope of this study and were not performed. Because all material properties used for this analysis were assumed, shear strength testing during construction of future expansion areas should be performed to confirm that all materials used for construction will meet or exceed the material strengths assumed herein.

1.3 Background

The slope stability of the CBL was evaluated as part of the most recent revision to the Site Development Plan prepared by Ausenco Vector (2011) and Thiel Engineering (2013). The focus of these stability evaluations was on the development of Cell 5 (subcells 5A through 5E). While a conceptual design for Cell 6 was presented, no slope stability cross sections through Cell 6 were evaluated.

An evaluation of the slope stability of Cell 5B using site-specific interface strength test results from construction conformance testing was reported by GLA (2017). GLA (2017) concluded that the critical failure surfaces through Cell 5 do not extend back into the profiles far enough to pass through Cell 5B (i.e. critical failure surfaces remain closer to the toes of the slopes through Cells 5A and Cell 2, respectively), and that when modeled failure surfaces were forced through the Cell 5B liner system, the measured interface shear strengths for Cell 5B provided acceptable factors of safety for slope stability. Similar evaluations were performed for Cell 5C by GLA (2018) and for Cell 5D by GLA (2019) with similar conclusions.

2. Design Criteria

The CBL is designed and regulated in accordance with the requirements set forth in the Oregon Administrative Rules (OAR) 340-094 and Title 40 of the Code of Federal Regulations (CFR), Part

258, Subtitle D. For slope stability design of landfills, results are typically expressed as a factor of safety (FS) against failure. The state of practice for static stability of landfill slopes is to design for a FS equal to or greater than 1.5 for final slopes. Interim slopes are often designed with a lower minimum static FS criterion, such as 1.3. The slopes of the CBL that are being evaluated herein represent final buildout conditions of the landfill. Thus, a minimum static FS criterion of 1.5 was adopted for the current evaluation.

For seismic stability of landfill slopes, the state-of-practice approach is not to express a FS, but to calculate the amount of permanent displacement accumulated during a design seismic event. For lined landfills, a displacement threshold of no more than 12 inches is generally considered acceptable, and for unlined facilities and landfill covers that do not contain geosynthetic components, a threshold of up to 1 meter is considered acceptable (Seed and Bonaparte, 1992).

3. Method of Analysis

The slope stability of proposed slopes was evaluated using the computer program SLOPE/W (v. 11.1.2) to calculate the 2D safety factors for two critical cross sections using the Morgenstern-Price (1965) limit equilibrium method. SLOPE/W is a 2D slope stability analysis program based on the limit equilibrium principles. It allows for evaluation of FS of a sliding mass based upon assumptions of rigid body behavior, shape of failure surface, and inclination of interslice forces within a failure surface. The FS against failure is defined as the ratio of total shear stress calculated along the critical failure surface to available shear strength along that same surface.

The calculations of FS of the slopes were performed for non-circular translational failure surfaces through the MSW and along the liner system. The surface optimization tool, as coded in SLOPE/W, was used. With the surface optimization tool, the lowest FS for a potential slip surface at the end of a standard limit-equilibrium search is iterated on a segment-wise basis to find potentially lower FS (and often non-circular) slip surfaces. Use of this procedure will always result in a FS that is as low or lower than if it had not been used (i.e., it is conservative).

Seismic-induced permanent displacements due to the design earthquake were estimated using a simplified procedure developed by Bray and Macedo (2019). The procedure is an update to the commonly used Bray and Travasarou (2007) procedure and is based on the sliding block analogy described by Newmark (1965) and statistical processing of generic input parameters. It is also based on the premise that the sliding block will undergo displacement only during the

periods when the maximum ground acceleration (k_{max}) exceeds the yield acceleration (k_y) for the sliding block, (i.e., displacements occur when k_{max} is greater than k_y).

4. Conditions Analyzed

4.1 Cross Sectional Profiles

The global stability of the proposed landfill base grades and waste slopes was assessed with three two-dimensional (2D) cross sections through the landfill that were judged to be critical. The cross sections were "cut" using Civil 3D from three-dimensional surfaces representing the landfill's as-built and future expansion subgrade plan and the permitted top-of-waste fill plan. The three cross sections are named Section 1, Section 2, and Section 3. The section locations, the proposed fill plan, subgrade plan, and existing site conditions are shown in Figures 1 and 2. The detailed cross sections are depicted in Figure 3. A phreatic water surface was not included in the analyses, as it is assumed that the leachate collection system will remain functional and a phreatic surface will not form above the liner system.

4.2 Liner Systems

The various liner systems that have been employed in past cells at the CBL are discussed in detail in Section 4.3 of the SDP report. The approved "standard" bottom liner system in the 2013 SDP generally consists of a triple geomembrane liner system with an encapsulated geosynthetic clay liner (GCL), primary and secondary leachate collection layers, and an underdrain layer. The 2013 SDP also describes a slip surface design above the primary geomembrane on steep (2:1) side slopes to accommodate downdrag settlement without adding additional stress to the primary geomembrane. Existing Cells 5A, 5B, 5C, and 5D employed the aforementioned liner system with slight variations to achieve the desired slip interface. Future Cell 5E and Cell 6 will employ the same standard liner system in floor areas and side slope areas. Cell 6 will also incorporate two other liner systems: the "piggy back" liner system and the quarry-wall liner system. The piggy back liner system will be used to line over existing waste in areas of the unlined Cell 1/1A. The quarry-wall liner system will be used to line the walls of the existing quarry that is currently active within the footprint of Cell 6. Note that the quarry-wall liner system concept has been amended relative to the 2013 SDP and will consist of a shingle-fill style slope liner system with the same general components as the standard liner system, as described in Section 4.3.3 of the 2021 SDP.

5. Material Properties

The material properties of the bottom liner system were specified using assumed values that are consistent with past stability analyses at the site (Ausenco Vector, 2011, Thiel, 2013, GLA, 2017, GLA 2018, and GLA 2019). Liner systems were modeled as a single layer with assumed shear strength parameters representing the weakest interface in the system. Where available, lower-bound shear-normal functions based on measured interface shear strengths from construction conformance testing were used to model the critical composite liner system interface (Cells 5B, 5C, and 5D in Section 3). Design values were used to represent existing cell liners where no shear strength testing data was available (Cell 3 in Section 3) as well as future cells (Cell 5E and 6). A summary of the material properties used for analyses is shown in Table 1, and shear-normal plots are shown in Figure 4.

Subgrade materials in and around Cell 6 consist primarily of slightly weathered to fresh basalt that has been excavated to depth by the existing quarry. Considering the desire to evaluate the effects of the liner system on stability, GLA assigned an infinite strength model to subgrade materials below the liner to force block failures along or above the landfill liner.

The material properties of the refuse were based on information published by Kavazanjian et al. (2013) for municipal solid waste.

Table 1
Summary of Material Properties

Composite Liner System	Unit Weight (pcf)	Floor		Slope	
		Phi	c (psf)	Phi	c (psf)
Cell 3	100	17	0	11	0
Cell 5B	100	Shear-Normal Function[1]			
Cell 5C	100	Shear-Normal Function[1]			
Cell 5D	100	Shear-Normal Function[1]			
Cell 5E	100	17	0	11	0
Cell 6 Standard Liner	100	17	0	11	0
Cell 6 "Piggy-Back" Liner	100	17	0	17	0
Cell 6 Quarry-Wall Liner	100	NA	NA	11	0
MSW	85	31	900	31	900

Notes: [1] - See Figure 4.

6. Seismic Hazard

A site-specific probabilistic seismic hazard assessment (PSHA) update was performed for the site using up-to-date tools for earthquake assessment. Details of the seismic hazard analysis are described in Attachment 1 and are summarized herein.

The PSHA was performed to calculate the acceleration response spectrum of the site with a 2% probability of exceedance in 50 years, which corresponds to an event with a 2,475-year return period. The United States Geological Survey (USGS) national seismic hazard model for the Western United States, as implement by Risk (2021) into EZ-FRISK (v 8.07) was used to define the seismic sources for the ground-response analysis. Site conditions were characterized by Site Class B – "Rock." This assumption was based on site-specific shear wave velocity measurements of the subgrade in the Cell 6 footprint (GLA, 2016). The resulting PSHA spectrum is shown in Figure 1 of Attachment 1, which indicates a design peak ground acceleration (PGA) of 0.34g.

The peak ground velocity (PGV), which is a parameter that is required as input for the Bray and Macedo (2019) seismic displacement calculation, was estimated using a deterministic approach. Input parameters for this calculation are from deaggregation of seismic hazard at zero period. The

Design Moment Magnitude of M = 8.48 and site-to-source distance of R = 61 km (38 miles) resulted in a corresponding PGV of 24 cm/s.

7. Results

Results of the slope stability analyses that incorporate the proposed subgrade plan and waste grading plan are summarized in Table 2, and SLOPE/W output files are included in Attachment 2. The output from SLOPE/W shows the cross-section dimensions, the material properties, material transitions, and the locations of the critical failure surfaces with the lowest factors of safety. Seismic displacement calculations are included in Attachment 3.

Table 2

Summary of Stability Results

Cross Section	Condition Analyzed	Static FS_{min}	Seismic Yield, K_y	Estimated Seismic Displacement (in)
1	West Slope – Cell 6	1.9	0.20g	1.0
2	South Slope – Cell 6 Piggy-Back	1.5	0.14g	6.2
3	South Slope – Cells 3, 5B-5E & 6I	1.6	0.01g	10.2

8. Conclusions and Recommendations

The results indicate a minimum static FS greater than 1.5 and estimated permanent seismic deformation of 12 inches or less for the proposed waste slopes represented by the three cross sections evaluated. Given the range of conditions evaluated, the stability results were found to be acceptable relative to the design criteria presented in Section 2 of this report, the standards set forth in 40 CFR Part 258, OAR 340-094, and generally accepted standard of practice for landfill slope stability.

The analyses presented herein are based largely on assumed parameters and on information gathered by others. The shear strengths for the specific materials that will be used for the construction of future expansions of the landfill should be verified by CQA testing during construction, and the acceptability of test results below those assumed herein must be verified by slope stability analyses based on test results.

9. Limitations

The data, analyses, results, and recommendations presented in this document pertain only to the Coffin Butte Landfill site in Benton County, Oregon and assume that the conditions do not deviate substantially from those reported. If any variations or conditions are encountered that are materially inconsistent with those used in this document, or if the proposed development differs from that anticipated herein, GLA should be notified so that supplemental evaluations can be provided.

This document has not been prepared for use by parties or projects other than those named above. It may not contain sufficient information for other parties or other purposes. This document conforms to generally accepted civil and geoenvironmental engineering practice and makes no other warranties, either expressed or implied, as to the professional advice or data included.

10. References

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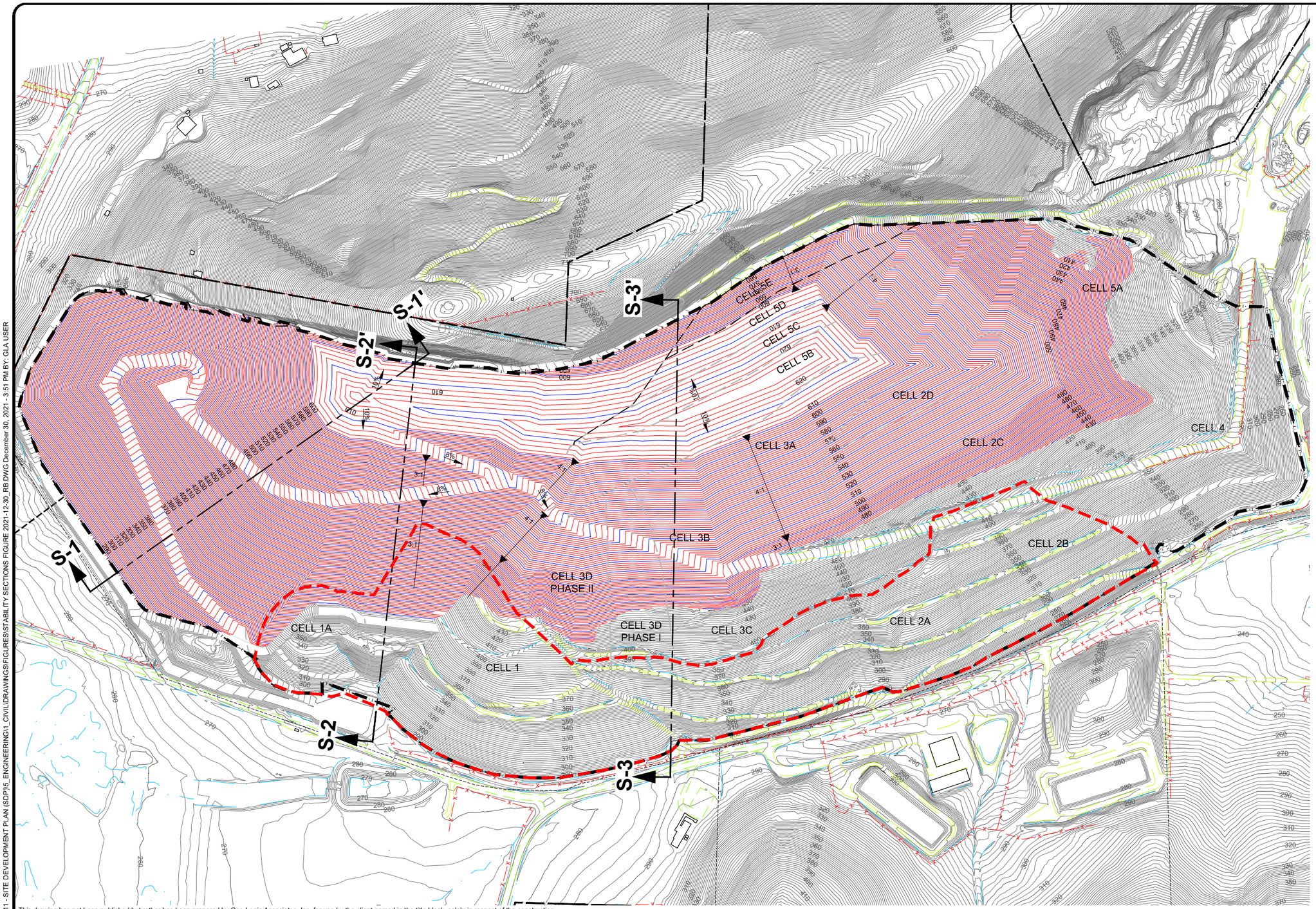
FIGURES



LEGEND

- EXISTING 10' CONTOUR(1)
- EXISTING 2' CONTOUR(1)
- PROPOSED 10' WASTE FILL CONTOUR
- PROPOSED 2' WASTE FILL CONTOUR
- EXISTING FENCE
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING DRAINAGE
- EXISTING LINER LIMITS
- PROPERTY LINE
- AREA PERMITTED FOR LANDFILL USE
- FUTURE CELL BOUNDARY

NOTES

1. REFERENCE AERIAL TOPOGRAPHY BASED ON MARCH 30, 2021 AERIAL SURVEY PERFORMED BY COOPER AERIAL SURVEYS COMPANY.

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 12/30/2021
DESIGNED BY: RPB/AO
DRAWN BY: RPB
CHECKED BY:
APPROVED BY:

Geo-Logic ASSOCIATES
803 SW Industrial Way, Suite 211, Bend, OR 97702
geo-logic.com | 541.678.5733

VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL

SLOPE STABILITY REPORT

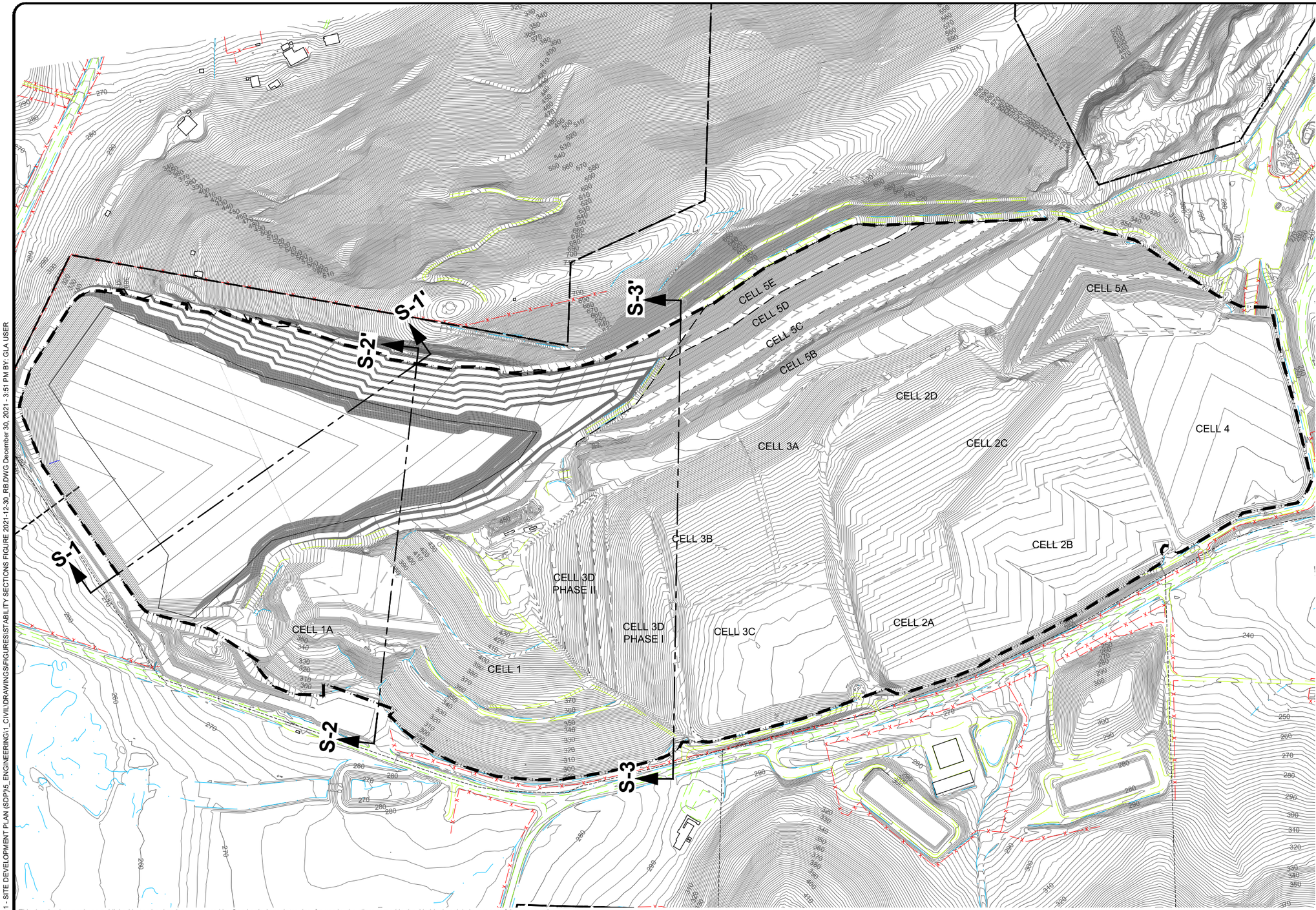
BENTON COUNTY, OREGON

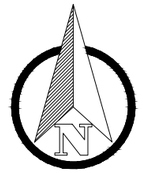
TOP OF FINAL COVER GRADES
STABILITY ALIGNMENT LOCATIONS

FIGURE NO. 1

PROJECT NO. AU20.1210

N:\COFFIN BUTTE\AU20.1211 - SITE DEVELOPMENT PLAN (SDP)\5_ENGINEERING\1_CIVIL\DRAWINGS\FIGURES\STABILITY SECTIONS FIGURE 2021-12-30_RB.DWG December 30, 2021 - 3:51 PM BY: GLA USER





200' 0' 100' 200' 400'

LEGEND

- EXISTING 10' CONTOUR[1]
- EXISTING 2' CONTOUR[1]
- PROPOSED 10' WASTE FILL CONTOUR
- PROPOSED 2' WASTE FILL CONTOUR
- PROPOSED 10' SHINGLE FILL CONTOUR
- PROPOSED 2' SHINGLE FILL CONTOUR
- EXISTING FENCE
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING DRAINAGE
- EXISTING LINER LIMITS
- PROPOSED CELL 6 LINER
- PREVIOUS CELL 6 LINER
- PROPERTY LINE
- AREA PERMITTED FOR LANDFILL USE
- FUTURE CELL BOUNDARY

NOTES

1. REFERENCE AERIAL TOPOGRAPHY BASED ON MARCH 30, 2021 AERIAL SURVEY PERFORMED BY COOPER AERIAL SURVEYS COMPANY.

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VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL

SLOPE STABILITY REPORT

BENTON COUNTY, OREGON

BASE GRADES
STABILITY ALIGNMENT LOCATIONS

FIGURE NO. 2

PROJECT NO. AU20.1210

N:\COFFIN BUTTE\AU20.1211 - SITE DEVELOPMENT PLAN (SDP)\5_ENGINEERING\1_CIVIL\DRAWINGS\FIGURES\STABILITY SECTIONS FIGURE 2021-12-30_RB.DWG December 30, 2021 - 3:51 PM BY: GLA USER

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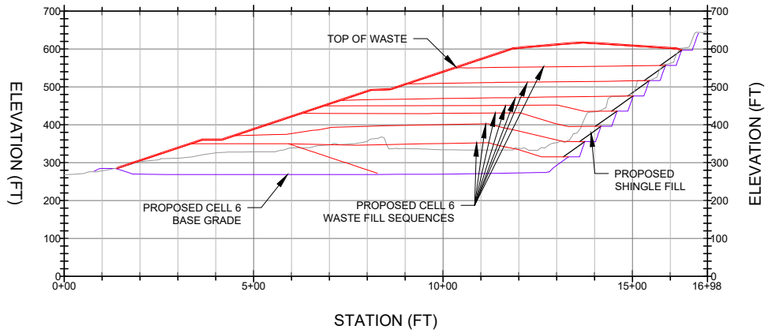

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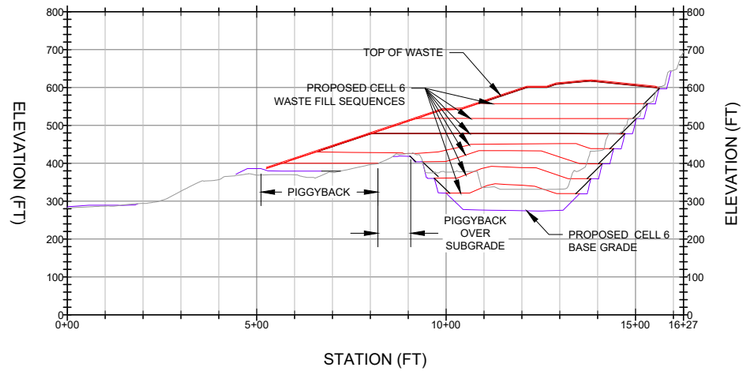

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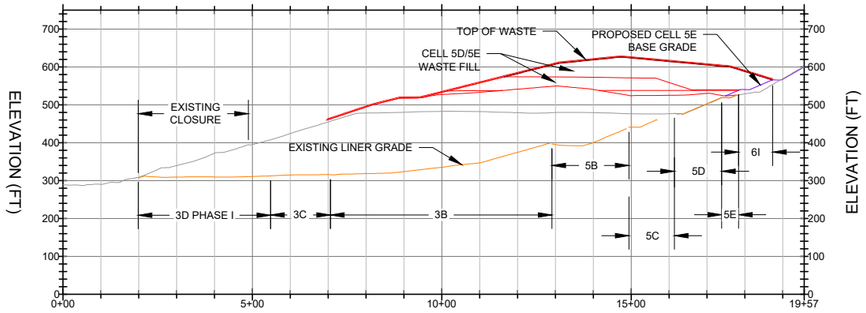

REV. NO.	DATE	DESCRIPTION	APPROVED BY

DATE OF ISSUE: 12/30/2021
DESIGNED BY: RPB/AO
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APPROVED BY:

Geo-Logic ASSOCIATES
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VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL

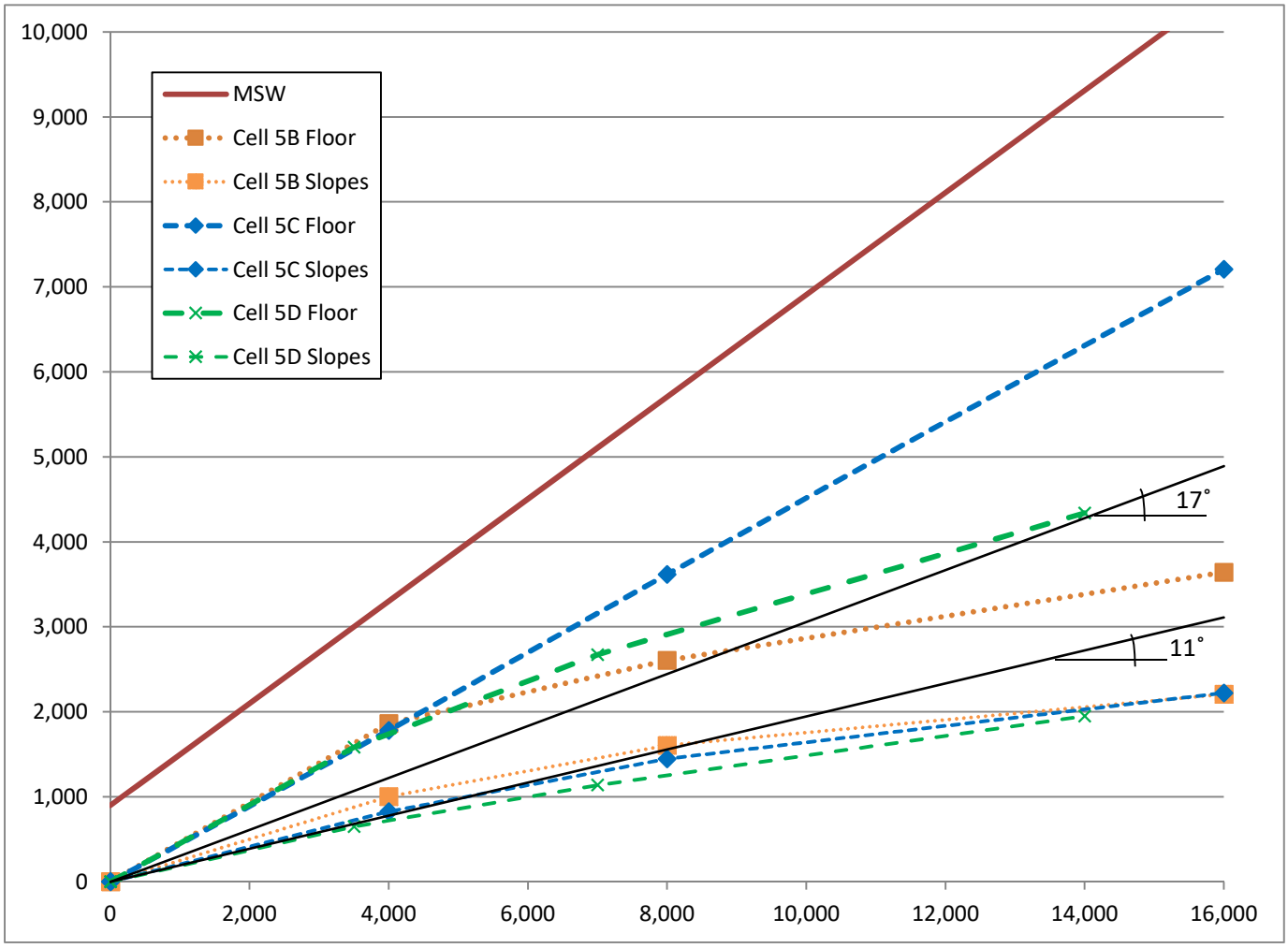
SLOPE STABILITY REPORT

BENTON COUNTY, OREGON

STABILITY SECTIONS

FIGURE NO. 3

PROJECT NO. AU20.1210



Geo-Logic ASSOCIATES

Coffin Butte Landfill SDP Stability Evaluation			2021
Shear Strength Functions			
Date:	12/22/2021	Figure No.	4
Project No.	AU20.1210.00		

ATTACHMENT 1

SITE-SPECIFIC GROUND MOTION HAZARD ANALYSIS

Geo-Logic ASSOCIATES

December 22, 2021
GLA Project No. AU20.1210.00

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, Oregon 97330

Attention: Mr. Ian Macnab

SITE-SPECIFIC GROUND MOTION HAZARD ANALYSIS
COFFIN BUTE LANDFILL
CORVALLIS, OREGON

Dear Mr. Macnab:

GENERAL

Geo-Logic Associates, Inc. (GLA) is pleased to submit this letter report to Valley Landfills, Inc. This letter report documents the Site-Specific Ground Motion Hazard Analysis SSGMHA for the Coffin Butte Landfill near Corvallis, Oregon. This SSGMHA was performed as part of the 2021 Site Development Plan (SDP) update.

The SSGMHA evaluations are based upon the results of site-specific measurement of shear wave velocity. Based upon the results of these measurements, the site was classified according to the National Earthquake Hazard Reduction Program (NEHRP) Site Class B.

The site-specific probabilistic seismic hazard calculations were performed in accordance with the Federal (Subtitle D) and State (Oregon) regulations. The results are presented in a form of the site-specific design acceleration response spectrum for NEHRP Site Class B. Peak Ground Velocity (PGV) was also evaluated for the same site class.

BACKGROUND

The approximate coordinates of the geometric center of the site are 44.698 degrees North Latitude and -123.237degrees East Longitude. The street address is 28972 Coffin Butte Road Corvallis, Oregon.

SEISMIC HAZARD EVALUATION

Seismic Source Model

The United States Geological Survey (USGS) national seismic hazard model for the Western United States, as implemented by Risk (2021) into EZ-FRISK (V 8.07), was used to define the seismic sources for the ground-response analysis described herein. Faults located within 300 km of the site were included in the analysis.

Ground Motion Prediction Equations Employed

Four NGA West-2 Ground Motion Prediction Equations (GMPEs), as implemented in EZ-FRISK, were used in this analysis. In particular, Abrahamson, Silva, and Kamai (2014); Boore et al. (2014); Campbell and Bozorgnia (2014); and Chiou and Youngs (2014); were used for shallow crustal events. A standard USGS set of GMPEs for subduction events including, Atkinson and Boore (2003); Zhao et al. (2006); BC Hydro (2012); and Atkinson and Macias (2009), was also used.

For faults closer than 25 km (R_{rup}) from the site, Near Fault Adjustment factors were applied.

Site Conditions

The shear wave velocity profile was established in bedrock at the site by means of Refraction Microtremor (Remi) geophysical survey beneath the former burn dump area in the footprint of future Cell 6 (GLA, 2016). Bedrock shear wave velocity was measured at approximately 1,150 m/s (3,772 ft/s). This shear wave velocity is assumed to be representative of site conditions from ground surface to the depth of 30 m (100 ft), corresponding to the NEHRP Site Class B, "Rock."

Seismic Hazard Analysis Results

The seismic hazard analysis documented herein has two distinct parts - the Probabilistic and Deterministic Seismic Hazard Analysis (PSHA, and DSHA, respectively). The PSHA was performed to calculate the acceleration response spectrum with a 2% probability of exceedance in 50 years, which corresponds to an event with a 2,475-year return period.

The PSHA spectrum is shown in Figure 1 below. For comparison, the above discussed geometric mean response spectrum (1,150 m/s) is compared with the acceleration response spectrum calculated using USGS unified hazard tool and assuming Site Class B/C (760 m/s). The spectral ordinates of the site-specific PSHA response spectra are lower. This is expected because site-specific PSHA response spectrum is calculated for higher than reference shear wave velocity of 760 m/s and for a specific geographic coordinate.

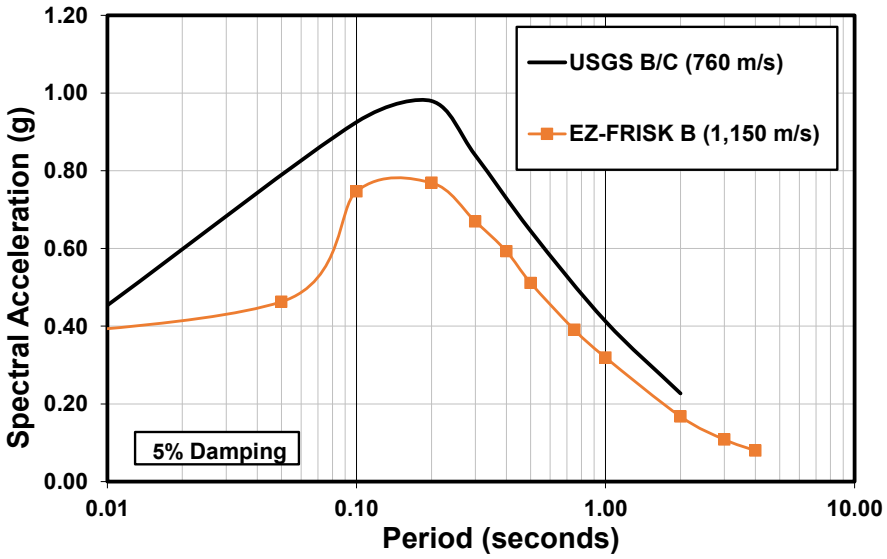


Figure 1 – Acceleration Response Spectra

The DSHA was performed to evaluate PGV. Input parameters for this calculation are from de-aggregation of seismic hazard at zero period. The Design Moment Magnitude is **M** = 8.48, and site-to-source distance is R = 61 km (38 miles). The corresponding Peak Ground Velocity in bedrock is estimated to be PGV = 24 cm/s.

Additional details related to the evaluations explained above are provided in Appendix A (the echo of input data for the EZ-FRISK program), Appendix B (PSHA using USGS unified hazard tool, including de-aggregation of seismic hazard at zero period), Appendix C (probabilistic seismic hazard analysis response spectrum, the output of the EZ-FRISK) and Appendix D (deterministic evaluation of PGV). Note that the EZ-FRISK "echo" file is over 1,800 pages long. Therefore, only the first five pages are enclosed as appendix.

SUMMARY AND RECOMMENDATIONS

This letter report documents the Site-Specific Ground Motion Hazard Analysis SSGMHA for the Coffin Butte Landfill near Corvallis, Oregon. The SSGMHA evaluations are based upon the results of site-specific measurement of shear wave velocity. Based upon the results of these measurements, the site was classified as the National Earthquake Hazard Reduction Program (NEHRP) Site Class B.

The site-specific probabilistic seismic hazard calculations were performed in accordance with the Federal (Subtitle D) and State (Oregon) regulations. The results are presented in a graphic form, i.e., as a site-specific design acceleration response spectrum for NEHRP Site Class B. Peak Ground Velocity (PGV) of 24 cm/s was also estimated for the same site class.

LIMITATIONS

In preparing the findings and professional opinions presented in this letter report, Geo-Logic Associates (GLA) has endeavoured to follow generally accepted principles and practices of the engineering geologic and geotechnical engineering professions in the area, and at the time our services were performed. No warranty, express or implied, is provided.

The conclusions and recommendations contained in this letter report are based, in part, on information that has been provided to us. In the event that the general development concept or general location and type of structures are modified, our conclusions and recommendations shall not be considered valid unless we are retained to review such changes and to make any necessary additions or changes to our recommendations.

The findings, conclusions, and recommendations presented in this letter report are applicable only to the specific project development on this specific site. These data should not be used for other projects, sites, or purposes unless they are reviewed by GLA or a qualified geotechnical professional.

CLOSURE

Dr. Neven Matasovic provided senior peer review of this document. We appreciate the opportunity to be of service on this project. Should you have questions or require further explanation, please contact the undersigned.

Sincerely,

Geo-Logic Associates, Inc.

Aaron Ogorzalek, PE
Senior Engineer

Enclosures:

- Appendix A - Seismic Hazard Analysis - Echo of Input Data for the EZ-FRISK Program
- Appendix B - Evaluation of PSHA using USGS Unified Hazard Tool, Including De-aggregation of Seismic Hazard at Zero Period
- Appendix C - Probabilistic Acceleration Response Spectra, Output of the EZ-FRISK Program
- Appendix D - Deterministic Evaluation of Peak Ground Velocity

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APPENDICES

(Appendices A, B, C and D)

APPENDIX A

(Seismic Hazard Analysis - Echo of Input Data for the EZ-FRISK Program;
1st Five Pages Only)

```
                ********************************************
                *****              EZ-FRISK              *****
                ***** SEISMIC HAZARD ANALYSIS DEFINITION *****
                *****       FUGRO CONSULTANTS, INC.      *****
                *****        WALNUT CREEK, CA  USA       *****
                ********************************************

  PROGRAM VERSION
    EZ-FRISK 8.07 Build 044

  ANALYSIS TITLE:
    Coffin Butte Landfill

  ANALYSIS TYPE:
    Single Site Analysis

  SITE COORDINATES
    Latitude 44.698
    Longitude -123.237

  INTENSITY TYPE:  Spectral Response @ 5% Damping

  HAZARD DEAGGREGATION
    Status: OFF

  SOIL AMPLIFICATION
    Method: Do not use soil amplification

  ATTENUATION EQUATION SITE PARAMETERS
    Depth[Vs=1000m/s] (m): -1
    Estimate Z1 from Vs30 for CY NGA: 1
    Regional Code: California
    Subduction Zone Setting: Forearc
    Vs30 (m/s): 1150
    Vs30 Is Measured: 0
    Z25 (km): 3

  AMPLITUDES - Acceleration (g)
    0.0001
    0.001
    0.01
    0.02
    0.05
    0.07
    0.1
    0.2
    0.3
```

```
    0.4
    0.5
    0.7
    1
    2
    3

  PERIODS (s)
    PGA
    0.05
    0.1
    0.2
    0.3
    0.4
    0.5
    0.75
    1
    2
    3
    4

  DETERMINISTIC FRACTILES
    0.5
    0.8413
    Mean

  PLOTTING PARAMETERS
    Period at which to plot PGA: 0.005

  CALCULATIONAL PARAMETERS
    Fault Seismic Sources -
      Maximum inclusion distance           :   300 km
      Down dip integration increment       :   1 km
      Horizontal integration increment     :   1 km
      Number rupture length per earthquake :   1
    Subduction Interface Seismic Sources -
      Maximum inclusion distance           :   1000 km
      Down dip integration increment       :   5 km
      Horizontal integration increment     :   20 km
      Number rupture length per earthquake :   1
    Subduction Slab Seismic Sources -
      Maximum inclusion distance           :   300 km
      Down dip integration increment       :   5 km
      Horizontal integration increment     :   20 km
      Number rupture length per earthquake :   1
    Area Seismic Sources -
      Maximum inclusion distance           :   200 km
```

```
      Vertical integration increment       :   3 km
      Number of rupture azimuths           :   3
      Minimum epicentral distance step     :   0.5 km
      Maximum epicentral distance step     :   10 km
    Gridded Seismic Sources -
      Maximum inclusion distance            :   300 km
      Default number of rupture azimuths    :   20
      Maximum distance for default azimuths :   40 km
      Minimum distance for one azimuth      :   150
      Use binned calcuations if possible    :   true
      Bins per decade in distance (km)      :   20
    All Seismic Sources -
      Magnitude integration step           :   0.1 M
      Apply magnitude scaling              :   NO
      Include near-source directivity      :   YES
        Method    :  Huang, Whittaker, and Luco (2008)
        Component :  Maximum
        Hypocenter integration increment  :   5 km

  ATTENUATION EQUATIONS

    Name: Abrahamson-et al (2014) NGA West 2 USGS 2014
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Abrahamson-et al 2014 NGA West 2
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: Atkinson-Boore (2003) Cascadia Subduction USGS 2008
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Atkinson-Boore 2003-3
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: Atkinson-Boore (2003) Worldwide Subduction USGS 2008
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Atkinson-Boore 2003-3
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: Atkinson-Macias (2009) USGS 2014
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
```

```
    Base: Atkinson-Macias 2009
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: BCHydro (2012) USGS 2014
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: BCHydro 2012
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: Boore-et al (2014) NGA West 2 USGS 2014
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Boore-et al 2014 NGA West 2
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Horizontal Distance To Rupture

    Name: Campbell-Bozorgnia (2014) NGA West 2 USGS 2014
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Campbell-Bozorgnia 2014 NGA West 2
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: Chiou-Youngs (2014) NGA West 2 USGS 2014
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Chiou-Youngs 2014 NGA West 2
    Truncation Type: USGS 2008 NSHM Truncation
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

    Name: Zhao et al (2006) USGS 2008
    Database: C:\Program Files (x86)\EZ-FRISK 8.07\Files\standard.bin-attendb
    Base: Zhao et al 2006 Japan
    Truncation Type: Trunc Sigma*Value
    Truncation Value: 3
    Magnitude Scale: Moment Magnitude
    Distance Type: Distance To Rupture

  SEISMIC SOURCE SUMMARY TABLE
```

Source	Region	Closest Distance	Deterministic Magnitude	Fault Mechanism	Dip Angle	Dips To	Site Lies
Bartlett Springs	USGS 2008 California - 2014 Rates Excluded	493.18	7.3000	Strike Slip	90.0000	--	N
Blackwater	USGS 2008 California - 2014 Rates Excluded	1140.20	7.1000	Strike Slip	90.0000	--	NW
Brawley Gridded, Strike Slip	USGS 2008 California - 2014 Rates Excluded	1390.85	6.5000	Strike Slip	90.0000	--	NW
Burnt Mtn	USGS 2008 California - 2014 Rates Excluded	1309.87	6.8000	Strike Slip	67.0000	W	NW
Calaveras	USGS 2008 California - 2014 Rates Excluded	771.52	7.0250	Strike Slip	90.0000	--	N
Calico-Hidalgo	USGS 2008 California - 2014 Rates Excluded	1205.16	7.4000	Strike Slip	90.0000	--	NW
Chino	USGS 2008 California - 2014 Rates Excluded	1274.92	6.8000	Strike Slip	50-65	SW	N
Cleghorn	USGS 2008 California - 2014 Rates Excluded	1255.15	6.8000	Strike Slip	90.0000	--	N
Collayomi	USGS 2008 California - 2014 Rates Excluded	634.78	6.7000	Strike Slip	90.0000	--	N
Coronado Bank	USGS 2008 California - 2014 Rates Excluded	1348.84	7.4000	Strike Slip	90.0000	--	N
Death Valley	USGS 2008 California - 2014 Rates Excluded	871.49	7.9000	Strike Slip	60-90	SW,W	NW
Earthquake Valley	USGS 2008 California - 2014 Rates Excluded	1401.97	6.8000	Strike Slip	90.0000	--	N
Elmore Ranch	USGS 2008 California - 2014 Rates Excluded	1431.36	6.7000	Strike Slip	90.0000	--	NW
Elsinore	USGS 2008 California - 2014 Rates Excluded	1267.02	7.8490	Strike Slip	75-90	NE	N
Eureka Peak	USGS 2008 California - 2014 Rates Excluded	1312.81	6.7000	Strike Slip	90.0000	--	NW
Garlock	USGS 2008 California - 2014 Rates Excluded	1130.84	7.7230	Strike Slip	90.0000	--	NW
Gravel Hills-Harper Lk	USGS 2008 California - 2014 Rates Excluded	1158.37	7.1000	Strike Slip	90.0000	--	NW
Great Valley 5, Pittsburg Kirby Hills	USGS 2008 California - 2014 Rates Excluded	720.56	6.7000	Strike Slip	90.0000	--	N
Green Valley Connected	USGS 2008 California - 2014 Rates Excluded	707.37	6.8000	Strike Slip	90.0000	--	N
Greenville Connected	USGS 2008 California - 2014 Rates Excluded	766.28	7.0000	Strike Slip	90.0000	--	N
Greenville Connected U	USGS 2008 California - 2014 Rates Excluded	766.28	7.0000	Strike Slip	90.0000	--	N
Hayward-Rodgers Creek	USGS 2008 California - 2014 Rates Excluded	681.48	7.3340	Strike Slip	90.0000	--	N
Helendale-So Lockhart	USGS 2008 California - 2014 Rates Excluded	1168.43	7.4000	Strike Slip	90.0000	--	NW
Hollywood	USGS 2008 California - 2014 Rates Excluded	1243.18	6.7000	Strike Slip	70.0000	N	N
Honey Lake	USGS 2008 California - 2014 Rates Excluded	533.87	7.0000	Strike Slip	90.0000	--	NW
Hosgri	USGS 2008 California - 2014 Rates Excluded	958.33	7.3000	Strike Slip	80.0000	NE	N
Hunter Mountain Connected	USGS 2008 California - 2014 Rates Excluded	971.08	7.6000	Strike Slip	90.0000	--	NW
Hunter Mountain-Saline Valley	USGS 2008 California - 2014 Rates Excluded	971.08	7.2000	Strike Slip	90.0000	--	NW
Hunting Creek-Berryessa	USGS 2008 California - 2014 Rates Excluded	643.52	7.1000	Strike Slip	90.0000	--	N
Imp Extensional Gridded, Char, Strike Slip	USGS 2008 California - 2014 Rates Excluded	1234.54	7.0000	Strike Slip	90.0000	--	NW
Imp Extensional Gridded, GR, Strike Slip	USGS 2008 California - 2014 Rates Excluded	1234.54	7.0000	Strike Slip	90.0000	--	NW
Imperial	USGS 2008 California - 2014 Rates Excluded	1466.21	7.0000	Strike Slip	82.0000	NE	NW
Johnson Valley (No)	USGS 2008 California - 2014 Rates Excluded	1257.42	6.9000	Strike Slip	90.0000	--	NW
Laguna Salada	USGS 2008 California - 2014 Rates Excluded	1473.81	7.3000	Strike Slip	90.0000	--	NW
Landers	USGS 2008 California - 2014 Rates Excluded	1217.23	7.4000	Strike Slip	90.0000	--	NW
Lenwood-Lockhart-Old Woman Springs	USGS 2008 California - 2014 Rates Excluded	1151.27	7.5000	Strike Slip	90.0000	--	N
Likely	USGS 2008 California - 2014 Rates Excluded	425.63	7.0000	Strike Slip	90.0000	--	NW
Little Lake	USGS 2008 California - 2014 Rates Excluded	1076.62	6.9000	Strike Slip	90.0000	--	NW
Maacama-Garberville	USGS 2008 California - 2014 Rates Excluded	496.76	7.4000	Strike Slip	90.0000	--	N
Malibu Coast	USGS 2008 California - 2014 Rates Excluded	1235.49	7.0000	Strike Slip	74-75	N	N
Mojave Shear Gridded	USGS 2008 California - 2014 Rates Excluded	1143.01	7.6000	Strike Slip	90.0000	--	NW

APPENDIX B

(Evaluation of PSHA using USGS Unified Hazard Tool, Including De-aggregation of Seismic Hazard at Zero Period)

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (v…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

44.698

Time Horizon

Return period in years

2475

Longitude

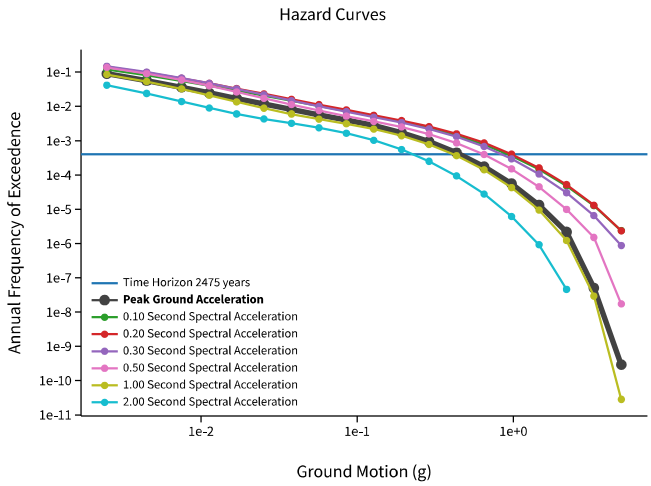
Decimal degrees, negative values for western longitudes

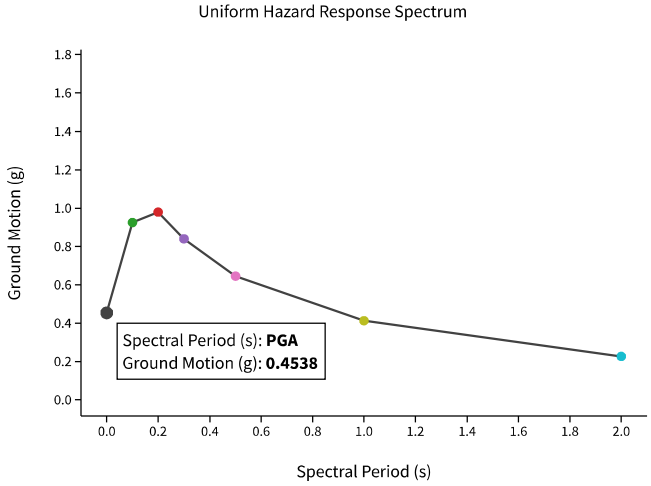
-123.237

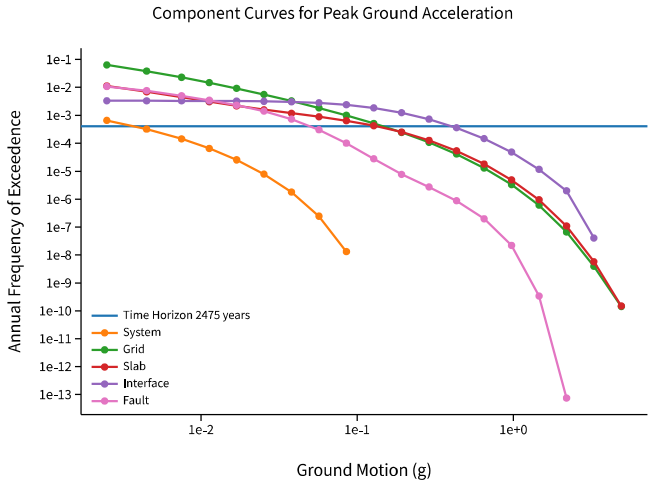
Site Class

760 m/s (B/C boundary)

Hazard Curve





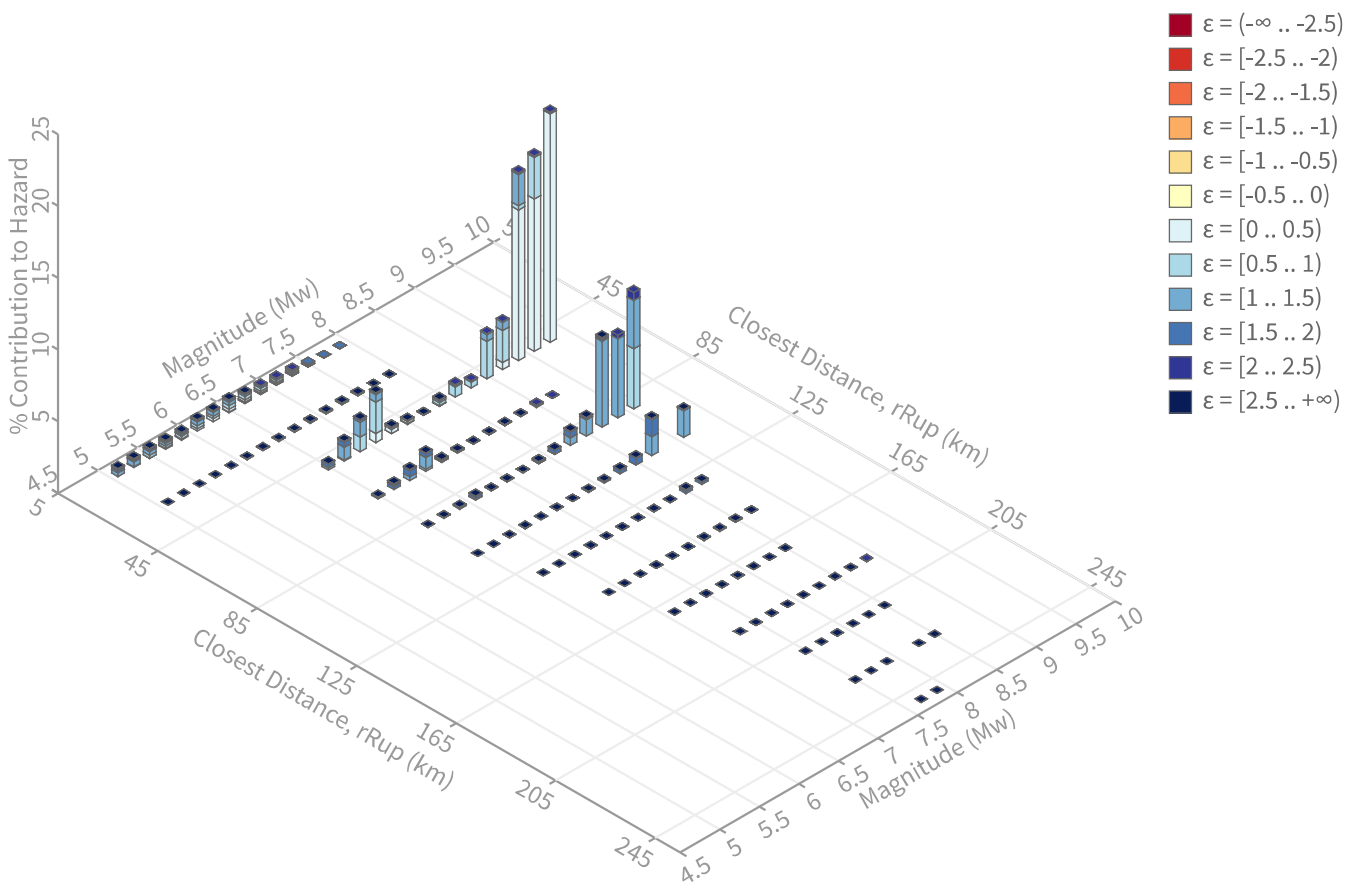


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.45376084 g

Recovered targets

Return period: 2467.8123 yrs
Exceedance rate: 0.00040521721 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.53 %

Mean (over all sources)

m: 8.48
r: 60.62 km
ε_0: 0.85 σ

Mode (largest m-r bin)

m: 9.34
r: 50.17 km
ε_0: 0.31 σ
Contribution: 16 %

Mode (largest m-r-ε_0 bin)

m: 9.34
r: 50.17 km
ε_0: 0.3 σ
Contribution: 15.91 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
sub0_ch_bot.in	Interface							40.40
Cascadia Megathrust - whole CSZ Characteristic		50.17	9.09	0.43	123.734°W	44.757°N	279.62	40.40
sub0_ch_mid.in	Interface							18.78
Cascadia Megathrust - whole CSZ Characteristic		91.12	8.92	1.18	124.356°W	44.742°N	273.59	18.78
coastalOR_deep.in	Slab							6.01
coastalOR_deep.in	Slab							4.35
sub0_ch_top.in	Interface							4.30
Cascadia Megathrust - whole CSZ Characteristic		106.58	8.82	1.44	124.567°W	44.738°N	272.90	4.30
sub2_ch_bot.in	Interface							3.92
Cascadia Megathrust - Goldfinger Case C Characteristic		49.73	8.72	0.62	123.734°W	44.757°N	279.62	3.92
sub1_GRb0_bot.in	Interface							2.03
Cascadia floater over southern zone - Goldfinger Case B		52.19	8.45	0.80	123.734°W	44.757°N	279.62	2.03
sub1_ch_bot.in	Interface							1.91
Cascadia Megathrust - Goldfinger Case B Characteristic		49.71	8.85	0.55	123.734°W	44.757°N	279.62	1.91
sub1_GRb1_bot.in	Interface							1.59
Cascadia floater over southern zone - Goldfinger Case B		52.68	8.34	0.88	123.734°W	44.757°N	279.62	1.59
sub2_ch_mid.in	Interface							1.33
Cascadia Megathrust - Goldfinger Case C Characteristic		90.71	8.47	1.46	124.356°W	44.742°N	273.59	1.33
WUSmap_2014_fixSm.ch.in (opt)	Grid							1.29
noPuget_2014_fixSm.ch.in (opt)	Grid							1.29
WUSmap_2014_fixSm.gr.in (opt)	Grid							1.29
noPuget_2014_fixSm.gr.in (opt)	Grid							1.29

APPENDIX C

(Probabilistic Acceleration Response Spectra - Output of the EZ-FRISK Program)

Probabilistic Spectra results for EZ-FRISK 8.07 Build 044

ANNUAL FREQUENCY OF EXCEEDANCE: 4.041e-004
RETURN PERIOD: 2474.9
PROBABILITY OF EXCEEDENCE: 2.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Abrahamson-et al (2014) NGA West 2 USGS 2014
Column 4: Acceleration (g) for: Boore-et al (2014) NGA West 2 USGS 2014
Column 5: Acceleration (g) for: Campbell-Bozorgnia (2014) NGA West 2 USGS 2014
Column 6: Acceleration (g) for: Chiou-Youngs (2014) NGA West 2 USGS 2014
Column 7: Acceleration (g) for: Atkinson-Boore (2003) Cascadia Subduction USGS 2008
Column 8: Acceleration (g) for: Atkinson-Boore (2003) Worldwide Subduction USGS 2008
Column 9: Acceleration (g) for: Zhao et al (2006) USGS 2008
Column 10: Acceleration (g) for: BCHydro (2012) USGS 2014
Column 11: Acceleration (g) for: Atkinson-Macias (2009) USGS 2014

1	2	3	4	5	6	7	8	9	10
PGA	3.365e-001	1.384e-001	1.199e-001	1.296e-001	1.210e-001	6.005e-002	2.180e-001	2.199e-001	4.618e-001
0.05	4.632e-001	1.810e-001	1.814e-001	2.266e-001	2.041e-001	8.312e-002	3.368e-001	3.177e-001	5.632e-001
0.1	7.473e-001	2.743e-001	2.910e-001	3.022e-001	2.915e-001	9.854e-002	4.225e-001	6.331e-001	9.389e-001
0.2	7.691e-001	2.740e-001	2.600e-001	2.687e-001	2.812e-001	1.488e-001	5.219e-001	7.247e-001	9.296e-001
0.3	6.695e-001	2.049e-001	1.943e-001	2.220e-001	2.170e-001	1.430e-001	5.818e-001	6.531e-001	7.626e-001
0.4	5.929e-001	1.606e-001	1.530e-001	1.773e-001	1.691e-001	1.392e-001	6.405e-001	5.711e-001	6.548e-001
0.5	5.116e-001	1.355e-001	1.250e-001	1.446e-001	1.363e-001	1.216e-001	5.507e-001	5.088e-001	5.363e-001
0.75	3.906e-001	9.194e-002	8.393e-002	1.038e-001	8.846e-002	9.716e-002	4.216e-001	3.999e-001	3.780e-001
1	3.192e-001	6.747e-002	6.211e-002	7.465e-002	6.202e-002	8.033e-002	3.467e-001	3.254e-001	2.985e-001
2	1.675e-001	3.776e-002	2.745e-002	3.170e-002	2.737e-002	3.822e-002	1.466e-001	1.830e-001	1.291e-001
3	1.083e-001	2.542e-002	1.828e-002	1.940e-002	1.567e-002	1.672e-002	7.348e-002	1.052e-001	8.139e-002
4	7.962e-002	1.798e-002	1.449e-002	1.363e-002	9.936e-003	1.233e-002	5.457e-002	6.462e-002	6.174e-002

APPENDIX D

(Deterministic Evaluation of Peak Ground Velocity)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	**Geometric**	*Weighted average of the natural logarithm of the spectral values*

GMPEs	**ASK14**	**BSSA14**	**CB14**	**CY14**	**I14**
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and *IMs*

Input variables **Errors and warnings**

M_w	8.48	
R_{RUP} (km)	61	
R_{JB} (km)	61	
R_X (km)	61	
Ry0 (km)	999	*If unknown use 999*
V_{S30} (m/sec)	1000	
U (BSSA13)	0	*1: Unspecified fault mech.*
F_{RV}	1	*1: reverse fault*
F_{NM}	0	*1: normal fault*
F_{HW}	1	*1: hanging wall side*
Dip (deg)	20	
Z_{TOR} (km)	999	*If unknown use 999*
Z_{HYP} (km)	999	*If unknown use 999*
$Z_{1.0}$ (km)	999	*If unknown use 999*
$Z_{2.5}$ (km)	999	*If unknown use 999*
W (km)	999	*If unknown use 999*
Vs30Flag	inferred	*Choose options for V_{s30} from the list*
F_{AS}	no	*Aftershock effect is not applicable.*
Region	California	*Choose region from the list*

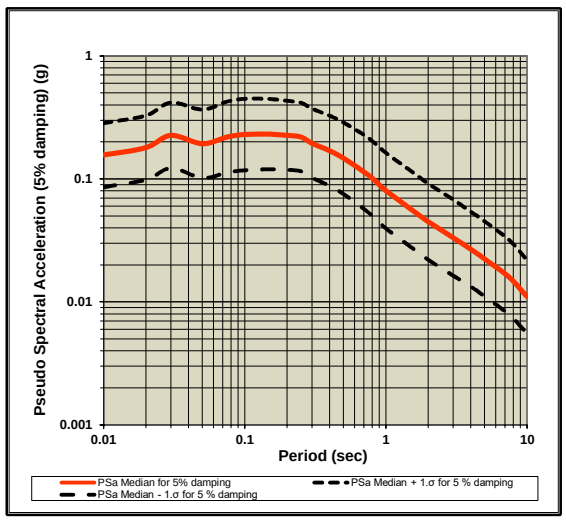
Calculated Variables/Flags

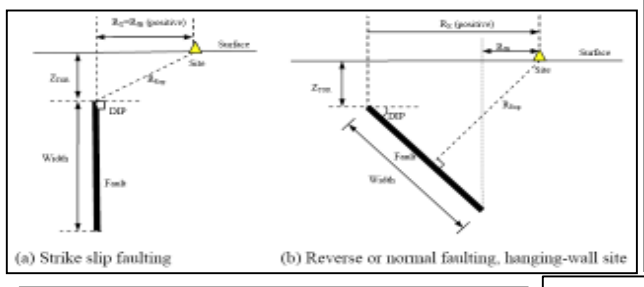
ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.128	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	0	*auto calculated*
$V_{s30Flag}$	0	*inferred*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*

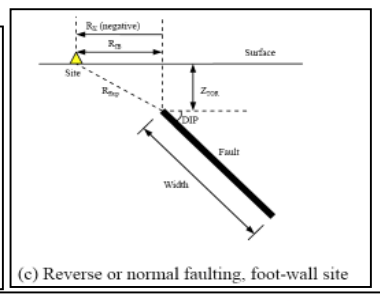
Option for Sa value

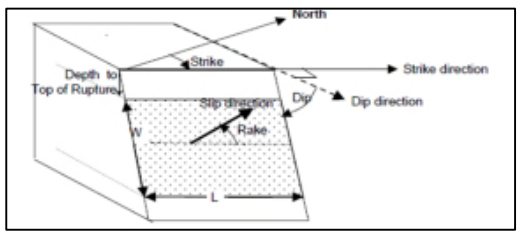
1 *Weighted average of the natural logarithm of the spectral values*

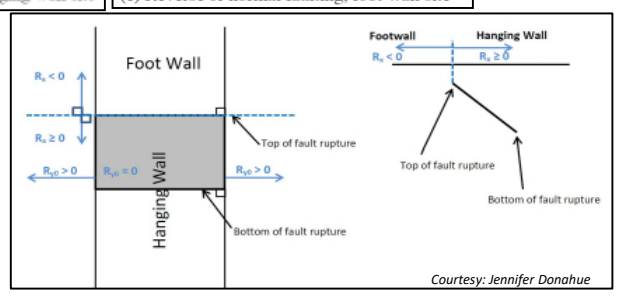
GMP	T (s)	Baseline: 5% Damping: PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	User defined: 5% Damping: PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	**0.01**	0.15662	0.28512	0.08603	0.00039	0.15662	0.28512	0.08603	0.00039
	0.02	0.18000	0.32839	0.09866	0.00179	0.18000	0.32839	0.09866	0.00179
	0.03	0.22663	0.41854	0.12272	0.00506	0.22641	0.41812	0.12260	0.00506
	0.05	0.19330	0.36671	0.10189	0.01200	0.19350	0.36708	0.10200	0.01201
	0.075	0.21888	0.42471	0.11280	0.03056	0.21954	0.42599	0.11314	0.03065
	0.1	0.22901	0.44719	0.11727	0.05685	0.22992	0.44898	0.11774	0.05708
	0.15	0.23105	0.44604	0.11968	0.12905	0.23174	0.44738	0.12004	0.12944
	0.2	0.22567	0.43061	0.11827	0.22408	0.22635	0.43190	0.11862	0.22475
	0.25	0.21991	0.41769	0.11578	0.34119	0.21991	0.41769	0.11578	0.34119
	0.3	0.19471	0.37212	0.10188	0.43501	0.19529	0.37323	0.10219	0.43631
	0.4	0.16930	0.32644	0.08780	0.67241	0.16964	0.32709	0.08798	0.67376
	0.5	0.14766	0.28861	0.07555	0.91639	0.14766	0.28861	0.07555	0.91639
	0.75	0.10749	0.21580	0.05354	1.50093	0.10760	0.21601	0.05360	1.50243
	1	0.08041	0.16313	0.03964	1.99607	0.08049	0.16329	0.03968	1.99807
	1.5	0.05713	0.11648	0.02802	3.19117	0.05719	0.11660	0.02805	3.19436
	2	0.04498	0.09176	0.02205	4.46672	0.04494	0.09167	0.02203	4.46225
	3	0.03335	0.06795	0.01637	7.45173	0.03339	0.06802	0.01639	7.45918
	4	0.02695	0.05433	0.01337	10.70557	0.02690	0.05422	0.01334	10.68416
	5	0.02250	0.04541	0.01115	13.96178	0.02245	0.04532	0.01112	13.93385
	7.5	0.01594	0.03205	0.00793	22.26376	0.01582	0.03179	0.00787	22.08565
	10	0.01110	0.02205	0.00559	27.54815	0.01103	0.02192	0.00555	27.38286
PGA (g)	**0**	0.12602	0.22923	0.06928	0.00031	0.12602	0.22923	0.06928	0.00031
PGV (cm/s)	**-1**	13.27160	24.23580	7.26757	0.03295	NA	NA	NA	NA











Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	999.00			43.857		
$Z_{1.0}$ (km)	999.000	0.009			0.008	
$\delta Z_{1.0}$ (km)	0.000		0.000			
$Z_{2.5}$ (V_{S30}=1100)(km)	999.000			0.398		
$Z_{2.5}$ (V_{S30})(km)	999.000			0.443		
Z_{hyp} (km)	999.00			5.000		
Z_{tor} (km)	999.00			0.000	0.000	
Z_{BOR} (km)	-			15.000		

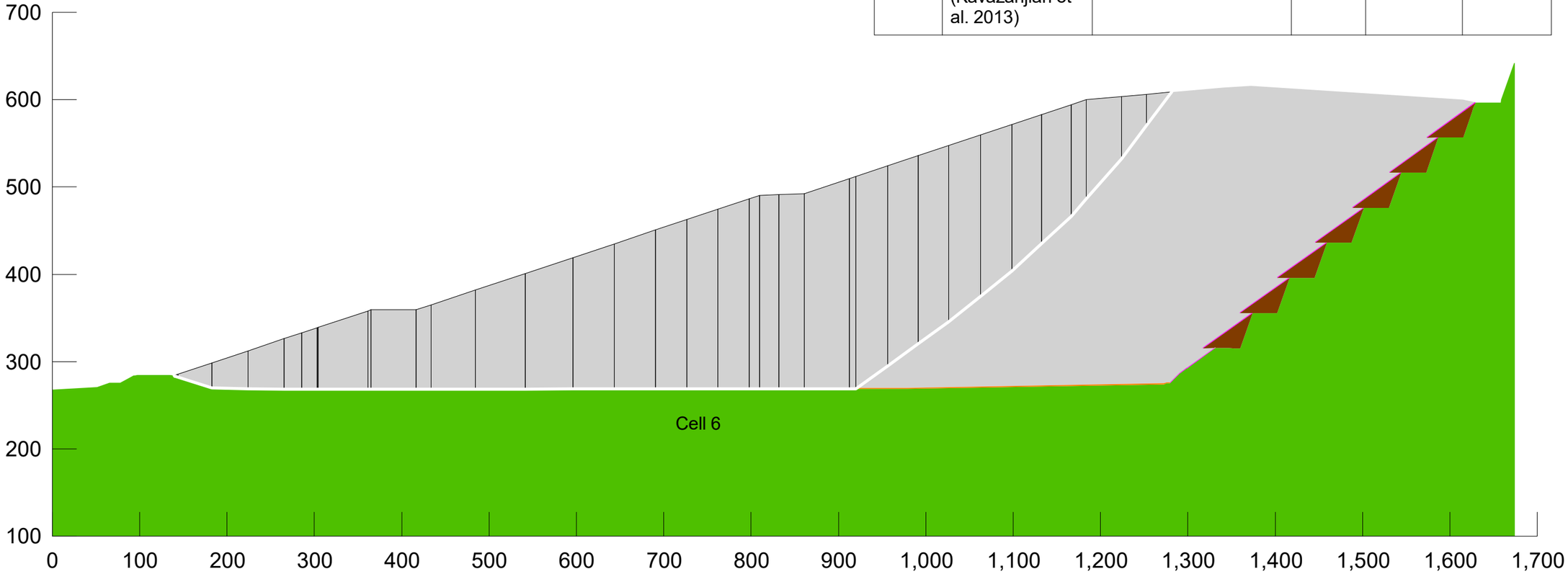
ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Horz Seismic Coef.: 0

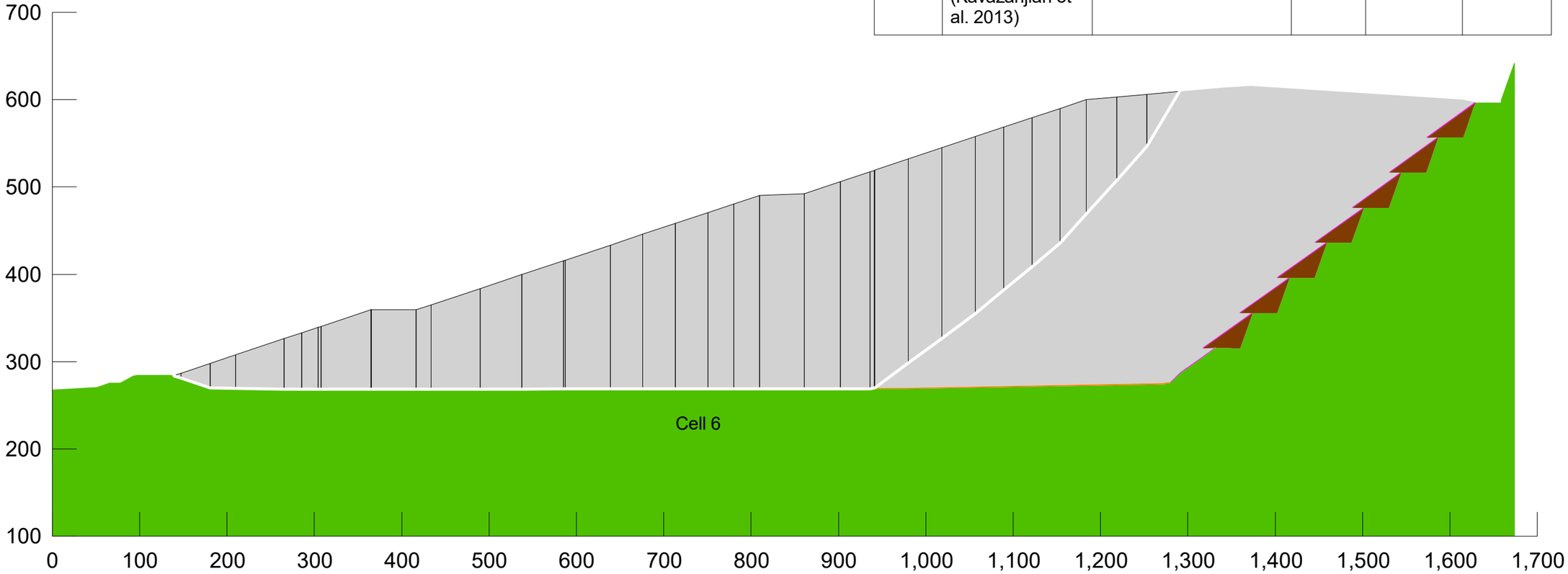
Color	Name	Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Cell 6 Floor Liner	Mohr-Coulomb	100	0	17
	Cell 6 Slope Liner	Mohr-Coulomb	100	0	11
	Shingle Fill	Mohr-Coulomb	130	500	40
	Shingle Liner	Mohr-Coulomb	100	0	11
	Subgrade	Bedrock (Impenetrable)			
	Waste (Kavazanjian et al. 2013)	Mohr-Coulomb	85	900	31



Coffin Butte Landfill Description: Section 1	
CBL_2021 SDP_Section 1.gsz	
12/21/2021	1:1,500

Horz Seismic Coef.: 0.2

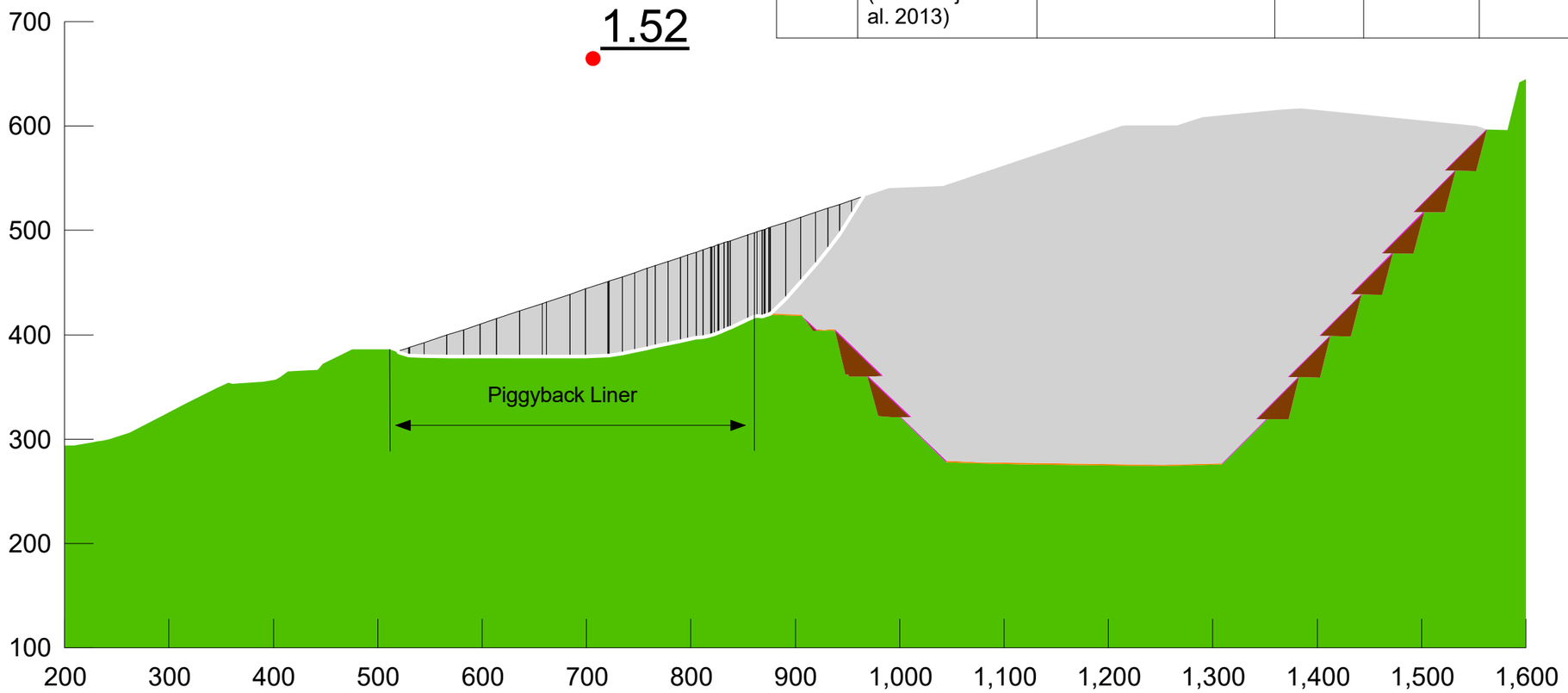
Color	Name	Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Cell 6 Floor Liner	Mohr-Coulomb	100	0	17
	Cell 6 Slope Liner	Mohr-Coulomb	100	0	11
	Shingle Fill	Mohr-Coulomb	130	500	40
	Shingle Liner	Mohr-Coulomb	100	0	11
	Subgrade	Bedrock (Impenetrable)			
	Waste (Kavazanjian et al. 2013)	Mohr-Coulomb	85	900	31



Coffin Butte Landfill Description: Section 1	
CBL_2021 SDP_Section 1_EQ.gsz	
12/21/2021	1:1,500

Horz Seismic Coef.: 0

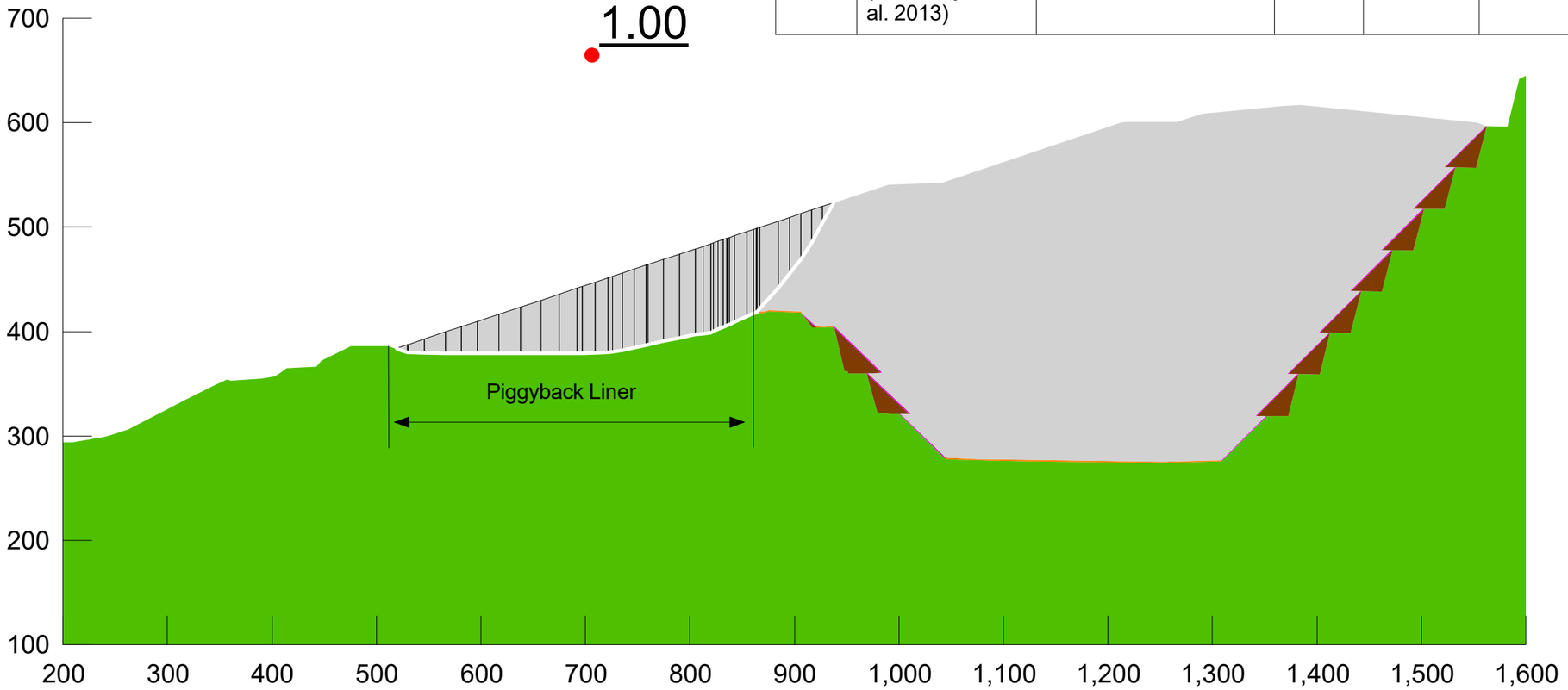
Color	Name	Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Cell 6 Floor Liner	Mohr-Coulomb	100	0	17
	Piggy-Back Liner	Mohr-Coulomb	100	0	17
	Shingle Fill	Mohr-Coulomb	130	500	40
	Shingle Liner	Mohr-Coulomb	100	0	11
	Subgrade	Bedrock (Impenetrable)			
	Waste (Kavazanjian et al. 2013)	Mohr-Coulomb	85	900	31



Coffin Butte Landfill Description: Section 2	
CBL_2021 SDP_Section 2.gsz	
12/21/2021	1:1,500

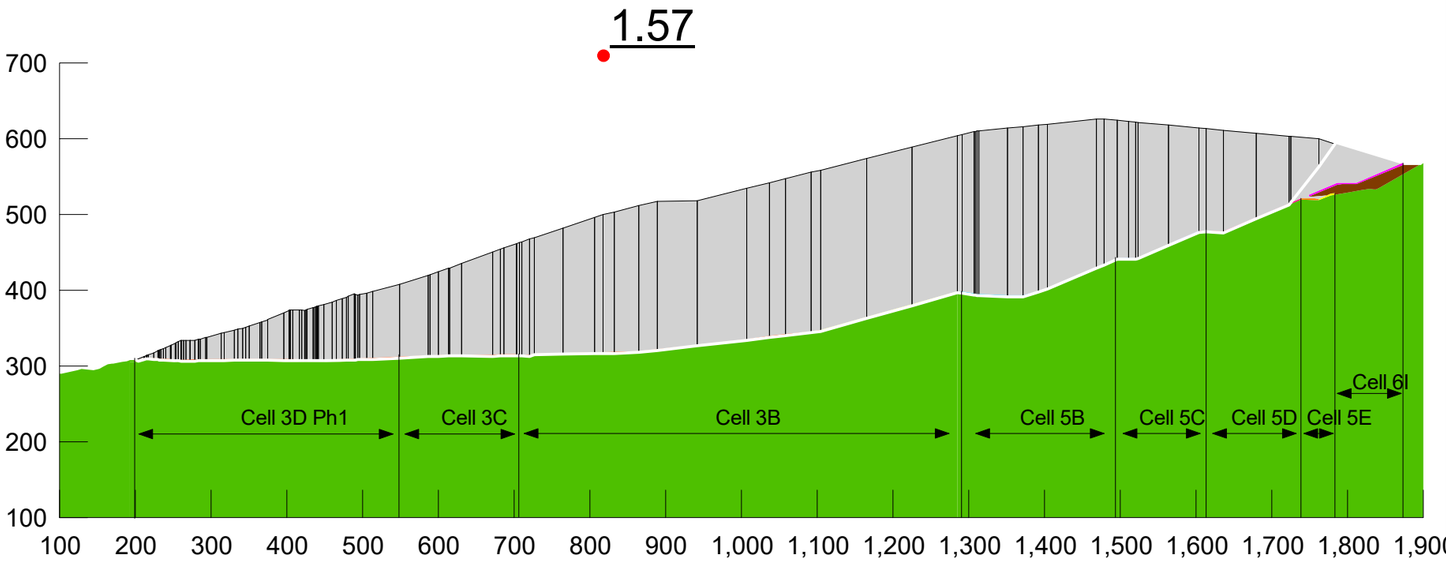
Horz Seismic Coef.: 0.137

Color	Name	Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Cell 6 Floor Liner	Mohr-Coulomb	100	0	17
	Piggy-Back Liner	Mohr-Coulomb	100	0	17
	Shingle Fill	Mohr-Coulomb	130	500	40
	Shingle Liner	Mohr-Coulomb	100	0	11
	Subgrade	Bedrock (Impenetrable)			
	Waste (Kavazanjian et al. 2013)	Mohr-Coulomb	85	900	31



Coffin Butte Landfill Description: Section 2	
CBL_2021 SDP_Section 2_EQ.gsz	
12/21/2021	1:1,500

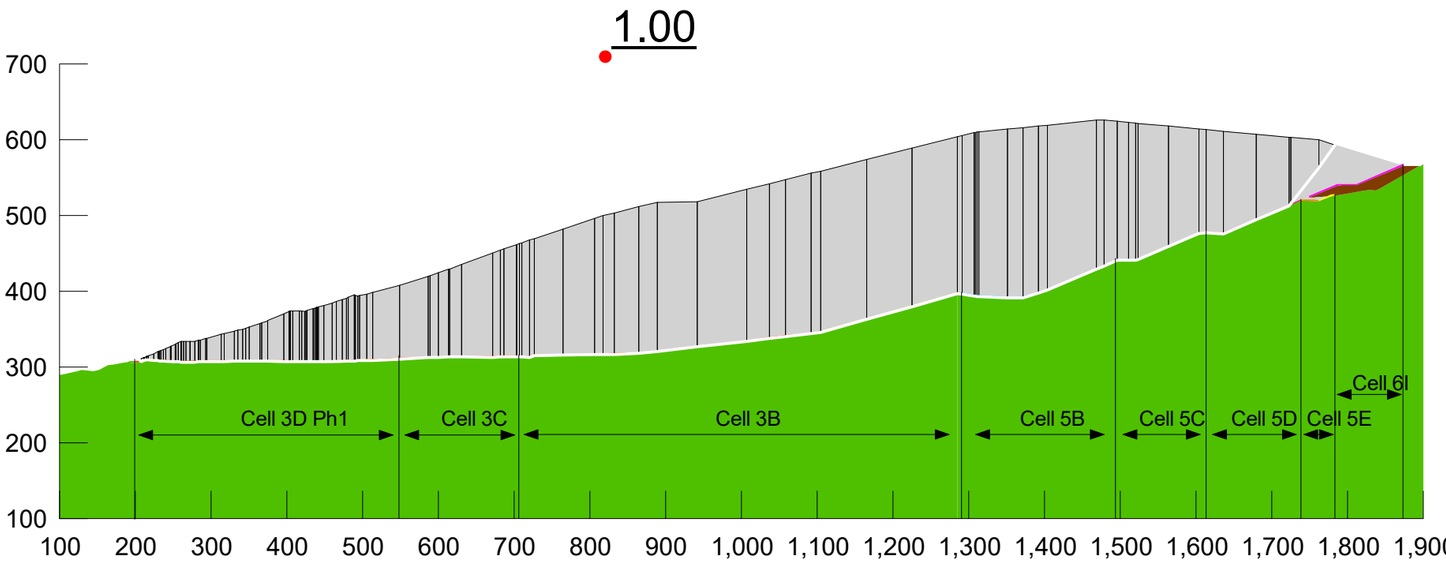
Horz Seismic Coef.: 0



Color	Name	Material Model	Unit Weight (pcf)	Strength Function	Effective Cohesion (psf)	Effective Friction Angle (°)
	Cell 3 Floor Liner	Mohr-Coulomb	100		0	17
	Cell 3 Slope Liner	Mohr-Coulomb	100		0	11
	Cell 5B Floor Liner	Shear/Normal Fn.	100	CB 5B_Lower Bound_Floor (Peak)		
	Cell 5B Slope Liner	Shear/Normal Fn.	100	CB 5B_Lower Bound_Slopes (Residual)		
	Cell 5C Floor Liner	Shear/Normal Fn.	100	CB 5C_Lower Bound_Floor (Peak)		
	Cell 5C Slope Liner	Shear/Normal Fn.	100	CB 5C_Lower Bound_Slopes (Residual)		
	Cell 5D Floor Liner	Shear/Normal Fn.	100	CB 5D_Lower Bound_Floor (Peak)		
	Cell 5D Slope Liner	Shear/Normal Fn.	100	CB 5D_Lower Bound_Slopes (Residual)		
	Cell 5E Floor Liner	Mohr-Coulomb	100		0	17
	Cell 5E Slope Liner	Mohr-Coulomb	100		0	11
	Shingle Fill	Mohr-Coulomb	130		500	40
	Shingle Liner	Mohr-Coulomb	100		0	11
	Subgrade	Bedrock (Impenetrable)				
	Waste (Kavazanjian et al. 2013)	Mohr-Coulomb	85		900	31

Coffin Butte Landfill Description: Section 3	
CBL_2021 SDP_Section 3.gsz	
12/21/2021	1:2,400

Horz Seismic Coef.: 0.099



Color	Name	Material Model	Unit Weight (pcf)	Strength Function	Effective Cohesion (psf)	Effective Friction Angle (°)
	Cell 3 Floor Liner	Mohr-Coulomb	100		0	17
	Cell 3 Slope Liner	Mohr-Coulomb	100		0	11
	Cell 5B Floor Liner	Shear/Normal Fn.	100	CB 5B_Lower Bound_Floor (Peak)		
	Cell 5B Slope Liner	Shear/Normal Fn.	100	CB 5B_Lower Bound_Slopes (Residual)		
	Cell 5C Floor Liner	Shear/Normal Fn.	100	CB 5C_Lower Bound_Floor (Peak)		
	Cell 5C Slope Liner	Shear/Normal Fn.	100	CB 5C_Lower Bound_Slopes (Residual)		
	Cell 5D Floor Liner	Shear/Normal Fn.	100	CB 5D_Lower Bound_Floor (Peak)		
	Cell 5D Slope Liner	Shear/Normal Fn.	100	CB 5D_Lower Bound_Slopes (Residual)		
	Cell 5E Floor Liner	Mohr-Coulomb	100		0	17
	Cell 5E Slope Liner	Mohr-Coulomb	100		0	11
	Shingle Fill	Mohr-Coulomb	130		500	40
	Shingle Liner	Mohr-Coulomb	100		0	11
	Subgrade	Bedrock (Impenetrable)				
	Waste (Kavazanjian et al. 2013)	Mohr-Coulomb	85		900	31

Coffin Butte Landfill Description: Section 3	
CBL_2021 SDP_Section 3_EQ.gsz	
12/21/2021	1:2,400

ATTACHMENT 3

SEISMIC DISPLACEMENT CALCULATIONS

Coffin Butte Landfill
2021 SDP Displacement Analysis
Input Summary Page

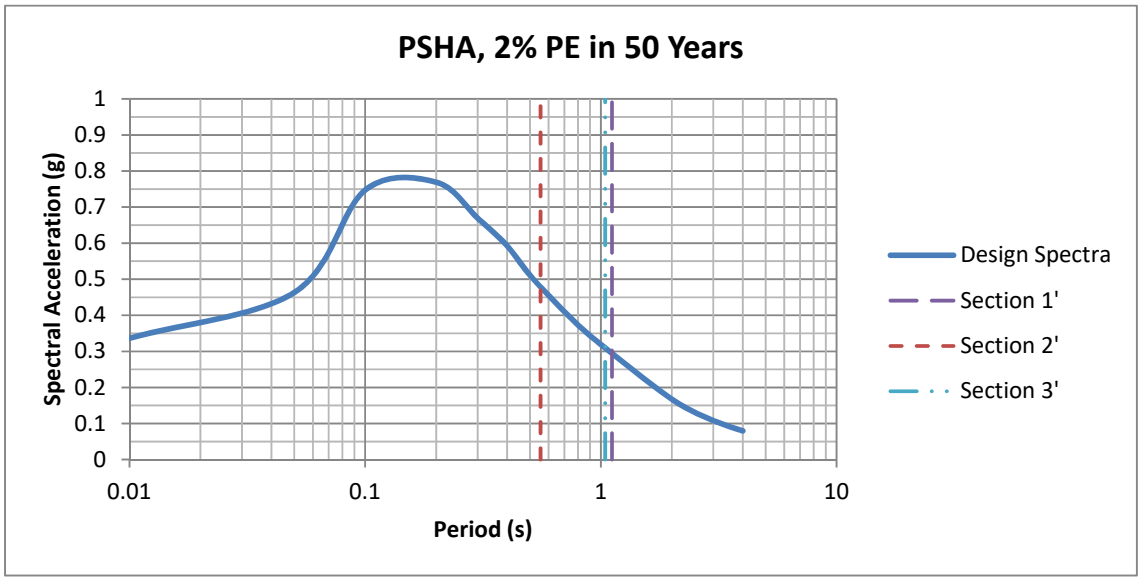
Geo-Logic ASSOCIATES

Summary:
Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes
by Jonathan D. Bray and Jorge Macedo (2019)

Input Parameters and Calclated Maximum Permanent Seismic Displacements

Cross Section	K_y (g)	H_{eqv} (ft)	$(V_s)_{avg}$ (ft/s)	T_s (s)	T_d (s)	S_a @ T_d (g)	PGV (cm/s)	D_{50} (in)
Section 1	0.200	273	1050	0.857	1.115	0.29	24	1.0
Section 2	0.137	114	885	0.427	0.555	0.47	24	6.2
Section 3	0.090	246	1010	0.802	1.043	0.31	24	10.2

k_y = yield acceleration of sliding mass (from pseudostatic slope stabiliy evaluation)
H = Representative thickness of waste fill from pseudostatic slope stability evaluation
$(V_s)_{avg}$ = Average (over H) shear wave velocity of waste fill
T_s = Initial fundamental period of waste fill (3.3 H / $(V_s)_{avg}$)
T_d = 1.3 T_s = Degraded initial fundamental period of waste fill
S_a = Spectral Acceleration (mean value)
S_a @ T_d = Spectral Acceleration evaluated at T_d (see chart below)
D_{50} = Displacement with a 50 percent probability of exceedance



References:

Bray, J.D. and Macedo, J. (2019), *"Procedure for Estimating Shear-Induced Seismic Slope Displacements for Shallow Crustal Earthquakes," Journal of Geotechnical and Geoenvironmental Engineering,* ASCE, Vol 145, No. 12, pp 1-13.

Kavazanjian, E., Matasovic, N., and Bachus, R.C. (2013), *"11th Peck Lecture: Pre-Design Geotechnical Investigation for the OII Superfund Site Landfill," ASCE Journal of Geoenvironmental Engineering* , Vol. 139, No. 11, pp 1849-1863.

Matasovic, N. and Thiel, R. (2021), "Discussion of "Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes"," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol 147, No. 5, 1-2.

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes

by Jonathan D. Bray and Jorge Macedo, UC Berkeley and Georgia Tech

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes, ASCE JGGE Journal, in press.

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters			
Case	OrdinaryGM (EQ2&3)		*** Select Ordinary or Pulse or Combined Equations**
Yield Coefficient (ky)[a]	0.20		**(a) Based on pseudostatic analysis**
Initial Fundamental Period (Ts)[b]	0.86	seconds	**(b) 1D: Ts=4H/Vs 2D: Ts=2.6H/Vs**
Degraded Period (1.3Ts)	1.11	seconds	**(c) Input the Spectral Acceleration (g) at the base of the sliding mass assuming there is no material above it.**
Moment Magnitude (Mw)	8.5		
Spectral Acceleration (Sa(1.3Ts)) [c]	0.3	g	
Peak Ground Velocity (PGV) [d]	24.0	cm/s	**(d) PGV (cm/s) estimated at the base of the sliding mass assuming there is no material above it.**
Percentile (if Pulse ground Motion) [e]	No Pulse		
			(e) If Pulse motion the percentile is given as either D100 or D50. D100 should be used for fault-normal direction
Additional Input Parameters			
Probability of Exceedance #1 (P1)	84	%	
Probability of Exceedance #2 (P2)	50	%	
Probability of Exceedance #3 (P3)	16	%	
Displacement Threshold (d_threshold)	30	cm	
Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	6.2	cm	eq. (3) or (5) or (7) or (9)
Standard Deviation of Non-Zero Seismic D	0.72		
Results			
Probability of Negligible Displ. (P(D=0))	**0.44**		eq. (2) or (4) or (6) or (8)
D1	**<0.5**	**cm**	calc. using eq. (11)
D2	**2.5**	**cm**	calc. using eq. (11)
D3	**9.4**	**cm**	calc. using eq. (11)
P(D>d_threshold)	**0.01**		eq. (11)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow heading.
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1)
4. The 16%, 50%, and 84% percentile displacement values at selected ky values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
6. ky may range between 0.01 and 0.8, Ts between 0 and 2 s, Sa between 0.002 and 4.5 g, M between 5.5 and 9
7. Rigid slope is assumed for Ts < 0.05 s, i.e. Ts = 0.0. If Ts is just less than 0.05 s, set Ts = 0.050 s
8. When a value for D is not calculated, D is < 0.5 cm
9. ky should be estimated with a slope stability program; the simplified equations shown below provide approximate values.
10. Examples of how Ts is estimated are shown below.
11. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs2)]/(h1 + h2)

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes

by Jonathan D. Bray and Jorge Macedo, UC Berkeley and Georgia Tech

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes, ASCE JGGE Journal, in press.

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters			
Case	OrdinaryGM (EQ2&3)		*** Select Ordinary or Pulse or Combined Equations**
Yield Coefficient (ky)[a]	0.14		**(a) Based on pseudostatic analysis**
Initial Fundamental Period (Ts)[b]	0.43	seconds	**(b) 1D: Ts=4H/Vs 2D: Ts=2.6H/Vs**
Degraded Period (1.3Ts)	0.56	seconds	**(c) Input the Spectral Acceleration (g) at the base of the sliding mass assuming there is no material above it.**
Moment Magnitude (Mw)	8.5		
Spectral Acceleration (Sa(1.3Ts)) [c]	0.5	g	
Peak Ground Velocity (PGV) [d]	24.0	cm/s	**(d) PGV (cm/s) estimated at the base of the sliding mass assuming there is no material above it.**
Percentile (if Pulse ground Motion) [e]	No Pulse		
			(e) If Pulse motion the percentile is given as either D100 or D50. D100 should be used for fault-normal direction
Additional Input Parameters			
Probability of Exceedance #1 (P1)	84	%	
Probability of Exceedance #2 (P2)	50	%	
Probability of Exceedance #3 (P3)	16	%	
Displacement Threshold (d_threshold)	30	cm	
Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	16.0	cm	eq. (3) or (5) or (7) or (9)
Standard Deviation of Non-Zero Seismic D	0.72		
Results			
Probability of Negligible Displ. (P(D=0))	**0.01**		eq. (2) or (4) or (6) or (8)
D1	**7.5**	**cm**	calc. using eq. (11)
D2	**15.8**	**cm**	calc. using eq. (11)
D3	**32.5**	**cm**	calc. using eq. (11)
P(D>d_threshold)	**0.19**		eq. (11)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow heading.
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1)
4. The 16%, 50%, and 84% percentile displacement values at selected ky values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
6. ky may range between 0.01 and 0.8, Ts between 0 and 2 s, Sa between 0.002 and 4.5 g, M between 5.5 and 9
7. Rigid slope is assumed for Ts < 0.05 s, i.e. Ts = 0.0. If Ts is just less than 0.05 s, set Ts = 0.050 s
8. When a value for D is not calculated, D is < 0.5 cm
9. ky should be estimated with a slope stability program; the simplified equations shown below provide approximate values.
10. Examples of how Ts is estimated are shown below.
11. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs2)]/(h1 + h2)

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes

by Jonathan D. Bray and Jorge Macedo, UC Berkeley and Georgia Tech

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes, ASCE JGGE Journal, in press.

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters			
Case	OrdinaryGM (EQ2&3)		*** Select Ordinary or Pulse or Combined Equations**
Yield Coefficient (ky)[a]	0.10		**(a) Based on pseudostatic analysis**
Initial Fundamental Period (Ts)[b]	0.80	seconds	**(b) 1D: Ts=4H/Vs 2D: Ts=2.6H/Vs**
Degraded Period (1.3Ts)	1.04	seconds	**(c) Input the Spectral Acceleration (g) at the base of the sliding mass assuming there is no material above it.**
Moment Magnitude (Mw)	8.5		
Spectral Acceleration (Sa(1.3Ts)) [c]	0.3	g	
Peak Ground Velocity (PGV) [d]	24.0	cm/s	**(d) PGV (cm/s) estimated at the base of the sliding mass assuming there is no material above it.**
Percentile (if Pulse ground Motion) [e]	No Pulse		
			(e) If Pulse motion the percentile is given as either D100 or D50. D100 should be used for fault-normal direction
Additional Input Parameters			
Probability of Exceedance #1 (P1)	84	%	
Probability of Exceedance #2 (P2)	50	%	
Probability of Exceedance #3 (P3)	16	%	
Displacement Threshold (d_threshold)	30	cm	
Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	25.8	cm	eq. (3) or (5) or (7) or (9)
Standard Deviation of Non-Zero Seismic D	0.72		
Results			
Probability of Negligible Displ. (P(D=0))	**0.00**		eq. (2) or (4) or (6) or (8)
D1	**12.6**	**cm**	calc. using eq. (11)
D2	**25.8**	**cm**	calc. using eq. (11)
D3	**52.8**	**cm**	calc. using eq. (11)
P(D>d_threshold)	**0.42**		eq. (11)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow heading.
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1)
4. The 16%, 50%, and 84% percentile displacement values at selected ky values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
6. ky may range between 0.01 and 0.8, Ts between 0 and 2 s, Sa between 0.002 and 4.5 g, M between 5.5 and 9
7. Rigid slope is assumed for Ts < 0.05 s, i.e. Ts = 0.0. If Ts is just less than 0.05 s, set Ts = 0.050 s
8. When a value for D is not calculated, D is < 0.5 cm
9. ky should be estimated with a slope stability program; the simplified equations shown below provide approximate values.
10. Examples of how Ts is estimated are shown below.
11. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs2)]/(h1 + h2)

APPENDIX D

LCRS DESIGN CALCULATIONS

APPENDIX D.1

HELP MODEL INPUT/OUTPUT

```
♠
*******************************************************************************
*******************************************************************************
**                                                                           **
**                                                                           **
**              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:    C:\HELP3\CBL.D4
TEMPERATURE DATA FILE:      c:\help3\CBL.D7
SOLAR RADIATION DATA FILE:  c:\help3\CBL.D13
EVAPOTRANSPIRATION DATA:    c:\help3\CBL.D11
SOIL AND DESIGN DATA FILE:  c:\help3\CBL_01.D10
OUTPUT DATA FILE:           C:\HELP3\CBL_01.OUT


TIME:  11:47     DATE:  12/13/2021



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

     TITLE:  COFFIN BUTTE LANDFILL_SDP_10-FT WASTE_12-IN SOIL DAILY COVER

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



     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  10
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.3980 VOL/VOL
          FIELD CAPACITY              =      0.2440 VOL/VOL
          WILTING POINT               =      0.1360 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2927 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC



                                LAYER  2
                                --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
          THICKNESS                   =    120.00   INCHES
          POROSITY                    =      0.6710 VOL/VOL
          FIELD CAPACITY              =      0.2920 VOL/VOL
          WILTING POINT               =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3624 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                                LAYER  3
                                --------

                    TYPE 1 - VERTICAL PERCOLATION 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  =      0.1393 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC



                                LAYER  4
                                --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.3970 VOL/VOL
          FIELD CAPACITY              =      0.0320 VOL/VOL
          WILTING POINT               =      0.0130 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.0376 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =   10.0000000000     CM/SEC
```

```
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    500.0    FEET
```

LAYER 5

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          =      3.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

```
THICKNESS                    =      0.20   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 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 10

```
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.3980 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2078 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 100. FEET.

```
SCS RUNOFF CURVE NUMBER             =     94.30
FRACTION OF AREA ALLOWING RUNOFF    =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      3.513  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.776  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.632  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =     51.767  INCHES
TOTAL INITIAL WATER                 =     51.767  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CORVALLIS OREGON

```
STATION LATITUDE                      =  44.70 DEGREES
MAXIMUM LEAF AREA INDEX               =   0.00
START OF GROWING SEASON (JULIAN DATE) =    126
END OF GROWING SEASON (JULIAN DATE)   =    289
EVAPORATIVE ZONE DEPTH                =  12.0  INCHES
AVERAGE ANNUAL WIND SPEED             =   7.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  79.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  70.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  65.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  82.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SALEM OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
6.62	5.04	4.42	2.58	1.99	1.23
0.36	0.51	1.46	3.21	6.36	7.07

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.80	42.80	46.20	50.40	55.70	61.10
66.40	66.50	61.80	53.50	45.30	40.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON
AND STATION LATITUDE = 44.70 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.18	145853.437	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	17.081	62002.949	42.51
DRAINAGE COLLECTED FROM LAYER 4	23.0927	83826.375	57.47
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.020	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0285		
PERC./LEAKAGE THROUGH LAYER 7	0.109005	395.689	0.27
CHANGE IN WATER STORAGE	-0.102	-371.621	-0.25
SOIL WATER AT START OF YEAR	51.767	187915.953	
SOIL WATER AT END OF YEAR	51.665	187544.328	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.055	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.67	169412.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	13.743	49886.492	29.45
DRAINAGE COLLECTED FROM LAYER 4	33.6913	122299.375	72.19
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.026	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0422		
PERC./LEAKAGE THROUGH LAYER 7	0.061728	224.073	0.13
CHANGE IN WATER STORAGE	-0.826	-2997.896	-1.77
SOIL WATER AT START OF YEAR	51.665	187544.328	
SOIL WATER AT END OF YEAR	50.839	184546.437	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.078	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.09	174566.703	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.619	56697.930	32.48
DRAINAGE COLLECTED FROM LAYER 4	30.1405	109409.922	62.68
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0370		
PERC./LEAKAGE THROUGH LAYER 7	0.042375	153.821	0.09
CHANGE IN WATER STORAGE	2.288	8305.015	4.76
SOIL WATER AT START OF YEAR	50.839	184546.437	
SOIL WATER AT END OF YEAR	51.577	187224.859	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.550	5626.590	3.22
ANNUAL WATER BUDGET BALANCE	0.0000	0.013	0.00

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.65	143929.531	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	13.971	50715.055	35.24
DRAINAGE COLLECTED FROM LAYER 4	32.1620	116748.164	81.11
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.025	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0395		
PERC./LEAKAGE THROUGH LAYER 7	0.032930	119.536	0.08
CHANGE IN WATER STORAGE	-6.516	-23653.266	-16.43
SOIL WATER AT START OF YEAR	51.577	187224.859	
SOIL WATER AT END OF YEAR	46.611	169198.172	
SNOW WATER AT START OF YEAR	1.550	5626.590	3.91
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.043	0.00

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.70	140481.000	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	13.425	48733.789	34.69
DRAINAGE COLLECTED FROM LAYER 4	20.7805	75433.273	53.70
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.019	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0259		
PERC./LEAKAGE THROUGH LAYER 7	0.026599	96.555	0.07
CHANGE IN WATER STORAGE	4.468	16217.381	11.54
SOIL WATER AT START OF YEAR	46.611	169198.172	

SOIL WATER AT END OF YEAR	51.079	185415.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.006	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.22	145998.625	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	16.972	61607.023	42.20
DRAINAGE COLLECTED FROM LAYER 4	25.5652	92801.664	63.56
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0318		
PERC./LEAKAGE THROUGH LAYER 7	0.022057	80.065	0.05
CHANGE IN WATER STORAGE	-2.339	-8490.115	-5.82
SOIL WATER AT START OF YEAR	51.079	185415.562	
SOIL WATER AT END OF YEAR	48.740	176925.437	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.021	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.81	162660.281	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.081	54744.562	33.66
DRAINAGE COLLECTED FROM LAYER 4	29.0446	105431.937	64.82
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.023	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0363		
PERC./LEAKAGE THROUGH LAYER 7	0.017826	64.709	0.04
CHANGE IN WATER STORAGE	0.666	2419.063	1.49
SOIL WATER AT START OF YEAR	48.740	176925.437	
SOIL WATER AT END OF YEAR	49.406	179344.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.003	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.27	175220.109	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	16.322	59247.430	33.81
DRAINAGE COLLECTED FROM LAYER 4	31.4780	114265.273	65.21

PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0392		
PERC./LEAKAGE THROUGH LAYER 7	0.015863	57.582	0.03
CHANGE IN WATER STORAGE	0.454	1649.815	0.94
SOIL WATER AT START OF YEAR	49.406	179344.500	
SOIL WATER AT END OF YEAR	49.861	180994.328	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.016	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.82	159066.594	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.935	57842.820	36.36
DRAINAGE COLLECTED FROM LAYER 4	27.0320	98125.992	61.69
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0336		
PERC./LEAKAGE THROUGH LAYER 7	0.014446	52.437	0.03
CHANGE IN WATER STORAGE	0.839	3045.373	1.91
SOIL WATER AT START OF YEAR	49.861	180994.328	
SOIL WATER AT END OF YEAR	49.438	179459.531	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.262	4580.171	2.88
ANNUAL WATER BUDGET BALANCE	0.0000	-0.022	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.26	142513.828	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	14.135	51308.953	36.00
DRAINAGE COLLECTED FROM LAYER 4	27.2715	98995.430	69.46
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0336		
PERC./LEAKAGE THROUGH LAYER 7	0.012749	46.277	0.03
CHANGE IN WATER STORAGE	-2.159	-7836.861	-5.50
SOIL WATER AT START OF YEAR	49.438	179459.531	
SOIL WATER AT END OF YEAR	48.541	176202.828	
SNOW WATER AT START OF YEAR	1.262	4580.171	3.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.019	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.84	119209.258	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.697	56979.387	47.80
DRAINAGE COLLECTED FROM LAYER 4	20.7823	75439.672	63.28
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.018	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0255		
PERC./LEAKAGE THROUGH LAYER 7	0.011251	40.840	0.03
CHANGE IN WATER STORAGE	-3.650	-13250.736	-11.12
SOIL WATER AT START OF YEAR	48.541	176202.828	
SOIL WATER AT END OF YEAR	44.748	162434.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.143	517.824	0.43
ANNUAL WATER BUDGET BALANCE	0.0000	0.097	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.45	143203.562	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	13.022	47268.969	33.01
DRAINAGE COLLECTED FROM LAYER 4	21.3970	77670.937	54.24
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.019	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0264		
PERC./LEAKAGE THROUGH LAYER 7	0.010459	37.965	0.03
CHANGE IN WATER STORAGE	5.021	18225.605	12.73
SOIL WATER AT START OF YEAR	44.748	162434.281	
SOIL WATER AT END OF YEAR	49.911	181177.703	
SNOW WATER AT START OF YEAR	0.143	517.824	0.36
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.086	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.66	151225.766	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	16.378	59453.797	39.31
DRAINAGE COLLECTED FROM LAYER 4	28.3976	103083.156	68.17
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.023	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0355		
PERC./LEAKAGE THROUGH LAYER 7	0.009638	34.986	0.02
CHANGE IN WATER STORAGE	-3.126	-11346.173	-7.50
SOIL WATER AT START OF YEAR	49.911	181177.703	
SOIL WATER AT END OF YEAR	46.786	169831.531	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.006	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.16	109480.805	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	12.161	44145.004	40.32
DRAINAGE COLLECTED FROM LAYER 4	16.5008	59898.031	54.71
PERC./LEAKAGE THROUGH LAYER 6	0.000004	0.016	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0202		
PERC./LEAKAGE THROUGH LAYER 7	0.008935	32.434	0.03
CHANGE IN WATER STORAGE	1.489	5405.281	4.94
SOIL WATER AT START OF YEAR	46.786	169831.531	
SOIL WATER AT END OF YEAR	47.133	171092.797	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.142	4144.008	3.79
ANNUAL WATER BUDGET BALANCE	0.0000	0.057	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.44	154057.187	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	14.897	54074.770	35.10
DRAINAGE COLLECTED FROM LAYER 4	25.9566	94222.633	61.16
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.021	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0322		
PERC./LEAKAGE THROUGH LAYER 7	0.008345	30.292	0.02
CHANGE IN WATER STORAGE	1.578	5729.527	3.72
SOIL WATER AT START OF YEAR	47.133	171092.797	
SOIL WATER AT END OF YEAR	49.853	180966.344	
SNOW WATER AT START OF YEAR	1.142	4144.008	2.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.027	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.62	132930.625	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.336	55668.871	41.88
DRAINAGE COLLECTED FROM LAYER 4	24.1768	87761.680	66.02
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.020	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0298		

PERC./LEAKAGE THROUGH LAYER 7	0.007850	28.495	0.02
CHANGE IN WATER STORAGE	-2.900	-10528.515	-7.92
SOIL WATER AT START OF YEAR	49.853	180966.344	
SOIL WATER AT END OF YEAR	46.953	170437.828	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.093	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.79	177107.703	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	17.267	62678.648	35.39
DRAINAGE COLLECTED FROM LAYER 4	25.4777	92483.906	52.22
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.021	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0315		
PERC./LEAKAGE THROUGH LAYER 7	0.007512	27.269	0.02
CHANGE IN WATER STORAGE	6.038	21917.795	12.38
SOIL WATER AT START OF YEAR	46.953	170437.828	
SOIL WATER AT END OF YEAR	52.991	192355.609	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.086	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.13	156561.922	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	12.179	44210.230	28.24
DRAINAGE COLLECTED FROM LAYER 4	31.3555	113820.445	72.70
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.025	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0388		
PERC./LEAKAGE THROUGH LAYER 7	0.007087	25.724	0.02
CHANGE IN WATER STORAGE	-0.412	-1494.475	-0.95
SOIL WATER AT START OF YEAR	52.991	192355.609	
SOIL WATER AT END OF YEAR	52.579	190861.141	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT

PRECIPITATION	40.36	146506.812	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	13.615	49423.906	33.73
DRAINAGE COLLECTED FROM LAYER 4	31.2366	113388.945	77.39
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0385		
PERC./LEAKAGE THROUGH LAYER 7	0.006597	23.947	0.02
CHANGE IN WATER STORAGE	-4.499	-16329.956	-11.15
SOIL WATER AT START OF YEAR	52.579	190861.141	
SOIL WATER AT END OF YEAR	48.004	174254.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.076	276.909	0.19
ANNUAL WATER BUDGET BALANCE	0.0000	-0.026	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.71	133257.297	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	17.343	62953.902	47.24
DRAINAGE COLLECTED FROM LAYER 4	17.0592	61924.793	46.47
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.017	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0211		
PERC./LEAKAGE THROUGH LAYER 7	0.006407	23.258	0.02
CHANGE IN WATER STORAGE	2.302	8355.309	6.27
SOIL WATER AT START OF YEAR	48.004	174254.281	
SOIL WATER AT END OF YEAR	50.382	182886.500	
SNOW WATER AT START OF YEAR	0.076	276.909	0.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.037	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.04	174385.219	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	14.851	53908.328	30.91
DRAINAGE COLLECTED FROM LAYER 4	33.5396	121748.570	69.82
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.026	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0414		
PERC./LEAKAGE THROUGH LAYER 7	0.005927	21.514	0.01
CHANGE IN WATER STORAGE	-0.356	-1293.343	-0.74
SOIL WATER AT START OF YEAR	50.382	182886.500	
SOIL WATER AT END OF YEAR	50.026	181593.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.147	0.00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.41	172098.312	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	16.989	61671.469	35.84
DRAINAGE COLLECTED FROM LAYER 4	32.8387	119204.461	69.27
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.025	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0404		
PERC./LEAKAGE THROUGH LAYER 7	0.005689	20.653	0.01
CHANGE IN WATER STORAGE	-2.424	-8798.274	-5.11
SOIL WATER AT START OF YEAR	50.026	181593.156	
SOIL WATER AT END OF YEAR	47.602	172794.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.001	0.00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.09	156416.734	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.970	57971.516	37.06
DRAINAGE COLLECTED FROM LAYER 4	25.5334	92686.133	59.26
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.021	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0319		
PERC./LEAKAGE THROUGH LAYER 7	0.005412	19.645	0.01
CHANGE IN WATER STORAGE	1.581	5739.395	3.67
SOIL WATER AT START OF YEAR	47.602	172794.875	
SOIL WATER AT END OF YEAR	49.183	178534.266	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.042	0.00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.01	141606.328	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.524	38201.023	26.98
DRAINAGE COLLECTED FROM LAYER 4	26.5043	96210.695	67.94
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0328		
PERC./LEAKAGE THROUGH LAYER 7	0.005229	18.981	0.01
CHANGE IN WATER STORAGE	1.977	7175.614	5.07

SOIL WATER AT START OF YEAR	49.183	178534.266	
SOIL WATER AT END OF YEAR	51.160	185709.891	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.021	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.48	125162.453	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	16.366	59408.121	47.46
DRAINAGE COLLECTED FROM LAYER 4	22.5024	81683.703	65.26
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.020	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0276		
PERC./LEAKAGE THROUGH LAYER 7	0.004908	17.817	0.01
CHANGE IN WATER STORAGE	-4.393	-15947.288	-12.74
SOIL WATER AT START OF YEAR	51.160	185709.891	
SOIL WATER AT END OF YEAR	46.767	169762.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.101	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.74	126106.164	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	14.405	52291.770	41.47
DRAINAGE COLLECTED FROM LAYER 4	20.1010	72966.477	57.86
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.018	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0249		
PERC./LEAKAGE THROUGH LAYER 7	0.004749	17.238	0.01
CHANGE IN WATER STORAGE	0.229	830.716	0.66
SOIL WATER AT START OF YEAR	46.767	169762.594	
SOIL WATER AT END OF YEAR	46.995	170593.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.036	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.51	179721.359	100.00
RUNOFF	0.000	0.000	0.00

EVAPOTRANSPIRATION	15.524	56350.312	31.35
DRAINAGE COLLECTED FROM LAYER 4	33.1060	120174.844	66.87
PERC./LEAKAGE THROUGH LAYER 6	0.000007	0.025	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0416		
PERC./LEAKAGE THROUGH LAYER 7	0.004572	16.596	0.01
CHANGE IN WATER STORAGE	0.876	3179.546	1.77
SOIL WATER AT START OF YEAR	46.995	170593.312	
SOIL WATER AT END OF YEAR	47.871	173772.859	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.062	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.25	120697.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	14.800	53724.730	44.51
DRAINAGE COLLECTED FROM LAYER 4	20.7349	75267.516	62.36
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.019	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0253		
PERC./LEAKAGE THROUGH LAYER 7	0.004387	15.924	0.01
CHANGE IN WATER STORAGE	-2.289	-8310.654	-6.89
SOIL WATER AT START OF YEAR	47.871	173772.859	
SOIL WATER AT END OF YEAR	45.582	165462.203	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.014	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.47	132386.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	11.635	42233.461	31.90
DRAINAGE COLLECTED FROM LAYER 4	19.3372	70194.008	53.02
PERC./LEAKAGE THROUGH LAYER 6	0.000005	0.018	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0242		
PERC./LEAKAGE THROUGH LAYER 7	0.004237	15.381	0.01
CHANGE IN WATER STORAGE	5.494	19943.232	15.06
SOIL WATER AT START OF YEAR	45.582	165462.203	
SOIL WATER AT END OF YEAR	51.076	185405.437	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.048	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.88	159284.422	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	15.033	54568.535	34.26
DRAINAGE COLLECTED FROM LAYER 4	27.6230	100271.383	62.95
PERC./LEAKAGE THROUGH LAYER 6	0.000006	0.023	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0341		
PERC./LEAKAGE THROUGH LAYER 7	0.004107	14.910	0.01
CHANGE IN WATER STORAGE	1.220	4429.504	2.78
SOIL WATER AT START OF YEAR	51.076	185405.437	
SOIL WATER AT END OF YEAR	52.296	189834.937	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.087	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.36	4.68	5.04	2.33	2.04	1.21
	0.60	0.61	1.27	2.60	6.34	7.98
STD. DEVIATIONS	1.85	1.86	1.85	1.06	0.80	0.68
	0.42	0.51	0.93	0.95	1.70	2.48
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	0.748	1.088	2.205	2.877	1.990	1.237
	0.668	0.544	0.893	1.196	0.816	0.612
STD. DEVIATIONS	0.119	0.174	0.203	0.807	0.778	0.733
	0.442	0.418	0.796	0.430	0.076	0.098
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	6.7205	5.1999	4.4708	3.0495	0.5712	0.0980
	0.0516	0.0339	0.0448	0.1581	1.0614	4.6875
STD. DEVIATIONS	1.9744	1.6633	1.4992	1.6230	0.6353	0.0604
	0.0162	0.0067	0.0601	0.1888	0.7203	1.5327
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
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0017	0.0014	0.0015	0.0015	0.0015	0.0014
	0.0014	0.0014	0.0012	0.0010	0.0012	0.0012
STD. DEVIATIONS	0.0026	0.0022	0.0023	0.0020	0.0020	0.0018
	0.0018	0.0017	0.0016	0.0011	0.0014	0.0014

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0975	0.0824	0.0644	0.0449	0.0081	0.0014
	0.0007	0.0005	0.0007	0.0023	0.0164	0.0693
STD. DEVIATIONS	0.0285	0.0260	0.0215	0.0239	0.0090	0.0009
	0.0002	0.0001	0.0009	0.0027	0.0109	0.0226

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.06 (5.263)	149036.9	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	14.876 (1.7659)	53999.13	36.232
LATERAL DRAINAGE COLLECTED FROM LAYER 4	26.14729 (5.09178)	94914.648	63.68533
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00001 (0.00000)	0.022	0.00001
AVERAGE HEAD ON TOP OF LAYER 5	0.032 (0.006)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.01630 (0.02175)	59.154	0.03969
CHANGE IN WATER STORAGE	0.018 (3.0674)	63.97	0.043

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	2.80	10164.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.76251	2767.91162
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00047
AVERAGE HEAD ON TOP OF LAYER 5	0.336	
MAXIMUM HEAD ON TOP OF LAYER 5	0.657	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	11.6 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000451	1.63548
SNOW WATER	3.56	12925.0859

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3980

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1360

*** 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 30

LAYER	(INCHES)	(VOL/VOL)
1	3.2245	0.2687
2	44.6365	0.3720
3	1.8123	0.1510

4	0.4685	0.0390
5	0.0000	0.0000
6	0.1500	0.7500
7	2.0043	0.1670
SNOW WATER	0.000	

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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:    C:\HELP3\CBL.D4
TEMPERATURE DATA FILE:      c:\help3\CBL.D7
SOLAR RADIATION DATA FILE:  c:\help3\CBL.D13
EVAPOTRANSPIRATION DATA:    c:\help3\CBL.D11
SOIL AND DESIGN DATA FILE:  c:\help3\CBL_02.D10
OUTPUT DATA FILE:           C:\HELP3\CBL_02.OUT


TIME:  12: 1     DATE:  12/13/2021



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     TITLE:  COFFIN BUTTE LANDFILL_SDP_10-FT WASTE_RAIN TARP COVER

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



                                LAYER  1
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                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  50
          THICKNESS                   =      0.01   INCHES
          POROSITY                    =      0.3200 VOL/VOL
          FIELD CAPACITY              =      0.0500 VOL/VOL
          WILTING POINT               =      0.0200 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.0200 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.200000003000     CM/SEC



                                LAYER  2
                                --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  37
          THICKNESS                   =      0.01   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.   =  0.199999999000E-10 CM/SEC
          FML PINHOLE DENSITY         =      5.00   HOLES/ACRE
          FML INSTALLATION DEFECTS    =      5.00   HOLES/ACRE
          FML PLACEMENT QUALITY       =  5 - BAD



                                LAYER  3
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  10
          THICKNESS                   =     12.00   INCHES
          POROSITY                    =      0.3980 VOL/VOL
          FIELD CAPACITY              =      0.2440 VOL/VOL
          WILTING POINT               =      0.1360 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2588 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC



                                LAYER  4
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
          THICKNESS                   =    120.00   INCHES
          POROSITY                    =      0.6710 VOL/VOL
          FIELD CAPACITY              =      0.2920 VOL/VOL
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WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION 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 = 0.0926 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999978000E-02 CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS = 12.00 INCHES
POROSITY = 0.3970 VOL/VOL
FIELD CAPACITY = 0.0320 VOL/VOL
WILTING POINT = 0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 10.0000000000 CM/SEC
SLOPE = 2.00 PERCENT
DRAINAGE LENGTH = 500.0 FEET

LAYER 7

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 = 3.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 3.00 HOLES/ACRE
FML PLACEMENT QUALITY = 3 - GOOD

LAYER 8

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS = 0.20 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 9

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 10

THICKNESS = 12.00 INCHES
POROSITY = 0.3980 VOL/VOL
FIELD CAPACITY = 0.2440 VOL/VOL
WILTING POINT = 0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2099 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER = 98.00
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 0.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 0.000 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 0.003 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 0.000 INCHES

INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 42.309 INCHES
TOTAL INITIAL WATER = 42.309 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
CORVALLIS OREGON

STATION LATITUDE = 44.70 DEGREES
MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 126
END OF GROWING SEASON (JULIAN DATE) = 289
EVAPORATIVE ZONE DEPTH = 0.0 INCHES
AVERAGE ANNUAL WIND SPEED = 7.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 79.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 70.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 65.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 82.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
6.62	5.04	4.42	2.58	1.99	1.23
0.36	0.51	1.46	3.21	6.36	7.07

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.80	42.80	46.20	50.40	55.70	61.10
66.40	66.50	61.80	53.50	45.30	40.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON
AND STATION LATITUDE = 44.70 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.18	145853.437	100.00
RUNOFF	38.131	138417.234	94.90
EVAPOTRANSPIRATION	0.476	1726.383	1.18
PERC./LEAKAGE THROUGH LAYER 2	1.572940	5709.771	3.91
AVG. HEAD ON TOP OF LAYER 2	0.0026		
DRAINAGE COLLECTED FROM LAYER 6	1.5730	5709.927	3.91
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0019		
PERC./LEAKAGE THROUGH LAYER 9	0.120163	436.190	0.30
CHANGE IN WATER STORAGE	-0.120	-436.358	-0.30
SOIL WATER AT START OF YEAR	45.237	164211.969	
SOIL WATER AT END OF YEAR	45.117	163775.609	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.065	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.67	169412.125	100.00
RUNOFF	44.063	159950.344	94.41
EVAPOTRANSPIRATION	0.689	2500.586	1.48
PERC./LEAKAGE THROUGH LAYER 2	1.917679	6961.173	4.11
AVG. HEAD ON TOP OF LAYER 2	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	1.7008	6173.901	3.64
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0021		
PERC./LEAKAGE THROUGH LAYER 9	0.061605	223.628	0.13
CHANGE IN WATER STORAGE	0.155	563.643	0.33
SOIL WATER AT START OF YEAR	45.117	163775.609	
SOIL WATER AT END OF YEAR	45.273	164339.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.026	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.09	174566.703	100.00
RUNOFF	44.042	159870.703	91.58
EVAPOTRANSPIRATION	0.614	2228.131	1.28
PERC./LEAKAGE THROUGH LAYER 2	1.881649	6830.386	3.91
AVG. HEAD ON TOP OF LAYER 2	0.0031		
DRAINAGE COLLECTED FROM LAYER 6	1.9283	6999.866	4.01
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0024		
PERC./LEAKAGE THROUGH LAYER 9	0.044112	160.125	0.09
CHANGE IN WATER STORAGE	1.462	5307.879	3.04
SOIL WATER AT START OF YEAR	45.273	164339.250	
SOIL WATER AT END OF YEAR	45.185	164020.547	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.550	5626.590	3.22
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.65	143929.531	100.00
RUNOFF	38.902	141215.891	98.11
EVAPOTRANSPIRATION	0.595	2158.817	1.50
PERC./LEAKAGE THROUGH LAYER 2	1.705855	6192.254	4.30
AVG. HEAD ON TOP OF LAYER 2	0.0027		
DRAINAGE COLLECTED FROM LAYER 6	1.8724	6796.859	4.72
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00

AVG. HEAD ON TOP OF LAYER 7	0.0023		
PERC./LEAKAGE THROUGH LAYER 9	0.033162	120.378	0.08
CHANGE IN WATER STORAGE	-1.753	-6362.438	-4.42
SOIL WATER AT START OF YEAR	45.185	164020.547	
SOIL WATER AT END OF YEAR	44.982	163284.703	
SNOW WATER AT START OF YEAR	1.550	5626.590	3.91
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.022	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.70	140481.000	100.00
RUNOFF	36.691	133190.031	94.81
EVAPOTRANSPIRATION	0.532	1929.846	1.37
PERC./LEAKAGE THROUGH LAYER 2	1.473899	5350.252	3.81
AVG. HEAD ON TOP OF LAYER 2	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	1.5058	5466.088	3.89
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.027463	99.689	0.07
CHANGE IN WATER STORAGE	-0.056	-204.664	-0.15
SOIL WATER AT START OF YEAR	44.982	163284.703	
SOIL WATER AT END OF YEAR	44.926	163080.031	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.017	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.22	145998.625	100.00
RUNOFF	38.303	139039.531	95.23
EVAPOTRANSPIRATION	0.460	1670.270	1.14
PERC./LEAKAGE THROUGH LAYER 2	1.459962	5299.664	3.63
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.4601	5300.081	3.63
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.021755	78.970	0.05
CHANGE IN WATER STORAGE	-0.025	-90.257	-0.06
SOIL WATER AT START OF YEAR	44.926	163080.031	
SOIL WATER AT END OF YEAR	44.901	162989.781	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.020	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.81	162660.281	100.00
RUNOFF	42.512	154318.031	94.87
EVAPOTRANSPIRATION	0.613	2225.545	1.37
PERC./LEAKAGE THROUGH LAYER 2	1.685051	6116.736	3.76
AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.6192	5877.534	3.61
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		
PERC./LEAKAGE THROUGH LAYER 9	0.018805	68.260	0.04
CHANGE IN WATER STORAGE	0.047	170.946	0.11
SOIL WATER AT START OF YEAR	44.901	162989.781	
SOIL WATER AT END OF YEAR	44.948	163160.719	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.031	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.27	175220.109	100.00
RUNOFF	46.000	166979.234	95.30
EVAPOTRANSPIRATION	0.570	2069.547	1.18
PERC./LEAKAGE THROUGH LAYER 2	1.700081	6171.293	3.52
AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.6428	5963.339	3.40
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		
PERC./LEAKAGE THROUGH LAYER 9	0.016552	60.083	0.03
CHANGE IN WATER STORAGE	0.041	147.876	0.08
SOIL WATER AT START OF YEAR	44.948	163160.719	
SOIL WATER AT END OF YEAR	44.989	163308.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.033	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.82	159066.594	100.00
RUNOFF	40.354	146485.969	92.09
EVAPOTRANSPIRATION	0.541	1962.719	1.23
PERC./LEAKAGE THROUGH LAYER 2	1.663427	6038.240	3.80

AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.7217	6249.951	3.93
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0021		
PERC./LEAKAGE THROUGH LAYER 9	0.014777	53.641	0.03
CHANGE IN WATER STORAGE	1.189	4314.273	2.71
SOIL WATER AT START OF YEAR	44.989	163308.594	
SOIL WATER AT END OF YEAR	44.918	163054.141	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.259	4568.732	2.87
ANNUAL WATER BUDGET BALANCE	0.0000	0.038	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.26	142513.828	100.00
RUNOFF	38.393	139367.047	97.79
EVAPOTRANSPIRATION	0.494	1791.534	1.26
PERC./LEAKAGE THROUGH LAYER 2	1.634938	5934.824	4.16
AVG. HEAD ON TOP OF LAYER 2	0.0027		
DRAINAGE COLLECTED FROM LAYER 6	1.6297	5915.910	4.15
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		
PERC./LEAKAGE THROUGH LAYER 9	0.012856	46.668	0.03
CHANGE IN WATER STORAGE	-1.269	-4607.380	-3.23
SOIL WATER AT START OF YEAR	44.918	163054.141	
SOIL WATER AT END OF YEAR	44.908	163015.484	
SNOW WATER AT START OF YEAR	1.259	4568.732	3.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.037	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.84	119209.258	100.00
RUNOFF	30.822	111885.070	93.86
EVAPOTRANSPIRATION	0.434	1574.324	1.32
PERC./LEAKAGE THROUGH LAYER 2	1.438313	5221.076	4.38
AVG. HEAD ON TOP OF LAYER 2	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	1.6482	5982.828	5.02
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		
PERC./LEAKAGE THROUGH LAYER 9	0.011867	43.077	0.04
CHANGE IN WATER STORAGE	-0.076	-276.087	-0.23
SOIL WATER AT START OF YEAR	44.908	163015.484	
SOIL WATER AT END OF YEAR	44.689	162221.578	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.143	517.824	0.43
ANNUAL WATER BUDGET BALANCE	0.0000	0.040	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.45	143203.562	100.00
RUNOFF	37.464	135994.844	94.97
EVAPOTRANSPIRATION	0.566	2055.788	1.44
PERC./LEAKAGE THROUGH LAYER 2	1.565187	5681.628	3.97
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.4639	5314.022	3.71
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.010206	37.049	0.03
CHANGE IN WATER STORAGE	-0.055	-198.158	-0.14
SOIL WATER AT START OF YEAR	44.689	162221.578	
SOIL WATER AT END OF YEAR	44.777	162541.250	
SNOW WATER AT START OF YEAR	0.143	517.824	0.36
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.008	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.66	151225.766	100.00
RUNOFF	39.665	143985.016	95.21
EVAPOTRANSPIRATION	0.544	1975.089	1.31
PERC./LEAKAGE THROUGH LAYER 2	1.448634	5258.540	3.48
AVG. HEAD ON TOP OF LAYER 2	0.0024		
DRAINAGE COLLECTED FROM LAYER 6	1.3790	5005.801	3.31
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0017		
PERC./LEAKAGE THROUGH LAYER 9	0.009895	35.918	0.02
CHANGE IN WATER STORAGE	0.062	223.926	0.15
SOIL WATER AT START OF YEAR	44.777	162541.250	
SOIL WATER AT END OF YEAR	44.839	162765.172	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.018	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.16	109480.805	100.00
RUNOFF	27.067	98252.398	89.74

EVAPOTRANSPIRATION	0.585	2123.724	1.94
PERC./LEAKAGE THROUGH LAYER 2	1.365541	4956.915	4.53
AVG. HEAD ON TOP OF LAYER 2	0.0022		
DRAINAGE COLLECTED FROM LAYER 6	1.4769	5361.276	4.90
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.009239	33.537	0.03
CHANGE IN WATER STORAGE	1.022	3709.894	3.39
SOIL WATER AT START OF YEAR	44.839	162765.172	
SOIL WATER AT END OF YEAR	44.719	162331.062	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.142	4144.008	3.79
ANNUAL WATER BUDGET BALANCE	0.0000	-0.023	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.44	154057.187	100.00
RUNOFF	41.435	150407.906	97.63
EVAPOTRANSPIRATION	0.486	1765.484	1.15
PERC./LEAKAGE THROUGH LAYER 2	1.663540	6038.648	3.92
AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.5359	5575.341	3.62
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0019		
PERC./LEAKAGE THROUGH LAYER 9	0.008715	31.637	0.02
CHANGE IN WATER STORAGE	-1.026	-3723.118	-2.42
SOIL WATER AT START OF YEAR	44.719	162331.062	
SOIL WATER AT END OF YEAR	44.835	162751.953	
SNOW WATER AT START OF YEAR	1.142	4144.008	2.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.054	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.62	132930.625	100.00
RUNOFF	34.763	126191.383	94.93
EVAPOTRANSPIRATION	0.464	1682.819	1.27
PERC./LEAKAGE THROUGH LAYER 2	1.392964	5056.460	3.80
AVG. HEAD ON TOP OF LAYER 2	0.0023		
DRAINAGE COLLECTED FROM LAYER 6	1.4922	5416.700	4.07
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.008062	29.264	0.02
CHANGE IN WATER STORAGE	-0.107	-389.609	-0.29
SOIL WATER AT START OF YEAR	44.835	162751.953	

SOIL WATER AT END OF YEAR	44.728	162362.344	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.070	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.79	177107.703	100.00
RUNOFF	46.359	168284.031	95.02
EVAPOTRANSPIRATION	0.587	2130.921	1.20
PERC./LEAKAGE THROUGH LAYER 2	1.840738	6681.878	3.77
AVG. HEAD ON TOP OF LAYER 2	0.0030		
DRAINAGE COLLECTED FROM LAYER 6	1.7142	6222.399	3.51
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0021		
PERC./LEAKAGE THROUGH LAYER 9	0.007624	27.675	0.02
CHANGE IN WATER STORAGE	0.122	442.700	0.25
SOIL WATER AT START OF YEAR	44.728	162362.344	
SOIL WATER AT END OF YEAR	44.850	162805.031	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.024	0.00

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.13	156561.922	100.00
RUNOFF	40.770	147995.625	94.53
EVAPOTRANSPIRATION	0.602	2185.771	1.40
PERC./LEAKAGE THROUGH LAYER 2	1.757725	6380.540	4.08
AVG. HEAD ON TOP OF LAYER 2	0.0029		
DRAINAGE COLLECTED FROM LAYER 6	1.8226	6615.956	4.23
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0022		
PERC./LEAKAGE THROUGH LAYER 9	0.007045	25.572	0.02
CHANGE IN WATER STORAGE	-0.072	-260.981	-0.17
SOIL WATER AT START OF YEAR	44.850	162805.031	
SOIL WATER AT END OF YEAR	44.778	162544.062	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.028	0.00

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.36	146506.812	100.00
RUNOFF	37.887	137528.875	93.87
EVAPOTRANSPIRATION	0.583	2117.811	1.45
PERC./LEAKAGE THROUGH LAYER 2	1.813548	6583.178	4.49
AVG. HEAD ON TOP OF LAYER 2	0.0030		
DRAINAGE COLLECTED FROM LAYER 6	1.7334	6292.401	4.29
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0021		
PERC./LEAKAGE THROUGH LAYER 9	0.006653	24.152	0.02
CHANGE IN WATER STORAGE	0.150	543.554	0.37
SOIL WATER AT START OF YEAR	44.778	162544.062	
SOIL WATER AT END OF YEAR	44.851	162810.703	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.076	276.909	0.19
ANNUAL WATER BUDGET BALANCE	0.0000	0.026	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.71	133257.297	100.00
RUNOFF	34.589	125559.320	94.22
EVAPOTRANSPIRATION	0.528	1916.909	1.44
PERC./LEAKAGE THROUGH LAYER 2	1.671864	6068.866	4.55
AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.7415	6321.534	4.74
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0021		
PERC./LEAKAGE THROUGH LAYER 9	0.006581	23.889	0.02
CHANGE IN WATER STORAGE	-0.155	-564.366	-0.42
SOIL WATER AT START OF YEAR	44.851	162810.703	
SOIL WATER AT END OF YEAR	44.772	162523.250	
SNOW WATER AT START OF YEAR	0.076	276.909	0.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.04	174385.219	100.00
RUNOFF	45.833	166374.953	95.41
EVAPOTRANSPIRATION	0.509	1848.353	1.06
PERC./LEAKAGE THROUGH LAYER 2	1.694894	6152.465	3.53
AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.6476	5980.687	3.43
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		

PERC./LEAKAGE THROUGH LAYER 9	0.005882	21.351	0.01
CHANGE IN WATER STORAGE	0.044	159.840	0.09
SOIL WATER AT START OF YEAR	44.772	162523.250	
SOIL WATER AT END OF YEAR	44.816	162683.078	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.032	0.00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.41	172098.312	100.00
RUNOFF	45.403	164813.484	95.77
EVAPOTRANSPIRATION	0.466	1691.674	0.98
PERC./LEAKAGE THROUGH LAYER 2	1.542055	5597.658	3.25
AVG. HEAD ON TOP OF LAYER 2	0.0026		
DRAINAGE COLLECTED FROM LAYER 6	1.6237	5894.065	3.42
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		
PERC./LEAKAGE THROUGH LAYER 9	0.005704	20.706	0.01
CHANGE IN WATER STORAGE	-0.089	-321.674	-0.19
SOIL WATER AT START OF YEAR	44.816	162683.078	
SOIL WATER AT END OF YEAR	44.728	162361.406	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.057	0.00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.09	156416.734	100.00
RUNOFF	41.152	149381.156	95.50
EVAPOTRANSPIRATION	0.429	1557.593	1.00
PERC./LEAKAGE THROUGH LAYER 2	1.507424	5471.949	3.50
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.5291	5550.550	3.55
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0019		
PERC./LEAKAGE THROUGH LAYER 9	0.005424	19.691	0.01
CHANGE IN WATER STORAGE	-0.025	-92.251	-0.06
SOIL WATER AT START OF YEAR	44.728	162361.406	
SOIL WATER AT END OF YEAR	44.702	162269.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.01	141606.328	100.00
RUNOFF	36.804	133599.703	94.35
EVAPOTRANSPIRATION	0.657	2386.372	1.69
PERC./LEAKAGE THROUGH LAYER 2	1.551278	5631.139	3.98
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.4410	5230.781	3.69
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.004969	18.037	0.01
CHANGE IN WATER STORAGE	0.102	371.441	0.26
SOIL WATER AT START OF YEAR	44.702	162269.156	
SOIL WATER AT END OF YEAR	44.805	162640.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.005	0.00

ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.48	125162.453	100.00
RUNOFF	32.456	117816.227	94.13
EVAPOTRANSPIRATION	0.470	1707.691	1.36
PERC./LEAKAGE THROUGH LAYER 2	1.550296	5627.575	4.50
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.5034	5457.213	4.36
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.005077	18.430	0.01
CHANGE IN WATER STORAGE	0.045	162.817	0.13
SOIL WATER AT START OF YEAR	44.805	162640.594	
SOIL WATER AT END OF YEAR	44.849	162803.422	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.077	0.00

ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.74	126106.164	100.00
RUNOFF	32.901	119429.969	94.71
EVAPOTRANSPIRATION	0.440	1598.091	1.27
PERC./LEAKAGE THROUGH LAYER 2	1.401934	5089.020	4.04
AVG. HEAD ON TOP OF LAYER 2	0.0023		
DRAINAGE COLLECTED FROM LAYER 6	1.5748	5716.402	4.53

PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0019		
PERC./LEAKAGE THROUGH LAYER 9	0.004666	16.939	0.01
CHANGE IN WATER STORAGE	-0.180	-655.201	-0.52
SOIL WATER AT START OF YEAR	44.849	162803.422	
SOIL WATER AT END OF YEAR	44.669	162148.219	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.035	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.51	179721.359	100.00
RUNOFF	47.332	171816.109	95.60
EVAPOTRANSPIRATION	0.487	1768.844	0.98
PERC./LEAKAGE THROUGH LAYER 2	1.690450	6136.333	3.41
AVG. HEAD ON TOP OF LAYER 2	0.0028		
DRAINAGE COLLECTED FROM LAYER 6	1.6682	6055.592	3.37
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.007	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0021		
PERC./LEAKAGE THROUGH LAYER 9	0.004486	16.285	0.01
CHANGE IN WATER STORAGE	0.018	64.459	0.04
SOIL WATER AT START OF YEAR	44.669	162148.219	
SOIL WATER AT END OF YEAR	44.687	162212.672	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.078	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.25	120697.500	100.00
RUNOFF	31.149	113071.758	93.68
EVAPOTRANSPIRATION	0.552	2002.214	1.66
PERC./LEAKAGE THROUGH LAYER 2	1.549174	5623.500	4.66
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.4726	5345.379	4.43
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0018		
PERC./LEAKAGE THROUGH LAYER 9	0.004345	15.773	0.01
CHANGE IN WATER STORAGE	0.072	262.352	0.22
SOIL WATER AT START OF YEAR	44.687	162212.672	
SOIL WATER AT END OF YEAR	44.759	162475.031	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.025	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.47	132386.125	100.00
RUNOFF	34.278	124430.219	93.99
EVAPOTRANSPIRATION	0.520	1888.859	1.43
PERC./LEAKAGE THROUGH LAYER 2	1.668357	6056.136	4.57
AVG. HEAD ON TOP OF LAYER 2	0.0027		
DRAINAGE COLLECTED FROM LAYER 6	1.5068	5469.861	4.13
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0019		
PERC./LEAKAGE THROUGH LAYER 9	0.004111	14.924	0.01
CHANGE IN WATER STORAGE	0.160	582.240	0.44
SOIL WATER AT START OF YEAR	44.759	162475.031	
SOIL WATER AT END OF YEAR	44.919	163057.266	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.028	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.88	159284.422	100.00
RUNOFF	41.866	151972.047	95.41
EVAPOTRANSPIRATION	0.527	1911.612	1.20
PERC./LEAKAGE THROUGH LAYER 2	1.487804	5400.729	3.39
AVG. HEAD ON TOP OF LAYER 2	0.0025		
DRAINAGE COLLECTED FROM LAYER 6	1.6283	5910.820	3.71
PERC./LEAKAGE THROUGH LAYER 8	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 7	0.0020		
PERC./LEAKAGE THROUGH LAYER 9	0.004190	15.211	0.01
CHANGE IN WATER STORAGE	-0.145	-525.299	-0.33
SOIL WATER AT START OF YEAR	44.919	163057.266	
SOIL WATER AT END OF YEAR	44.775	162531.969	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.027	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.36	4.68	5.04	2.33	2.04	1.21

	0.60	0.61	1.27	2.60	6.34	7.98
STD. DEVIATIONS	1.85	1.86	1.85	1.06	0.80	0.68
	0.42	0.51	0.93	0.95	1.70	2.48

RUNOFF

TOTALS	6.023	4.585	4.809	2.154	1.900	1.114
	0.557	0.535	1.180	2.443	6.074	7.540
STD. DEVIATIONS	1.803	1.840	1.798	1.028	0.775	0.661
	0.401	0.478	0.893	0.914	1.677	2.474

EVAPOTRANSPIRATION

TOTALS	0.093	0.070	0.056	0.043	0.029	0.021
	0.009	0.016	0.020	0.034	0.055	0.087
STD. DEVIATIONS	0.044	0.043	0.031	0.035	0.009	0.007
	0.006	0.010	0.010	0.011	0.018	0.027

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	0.2407	0.1657	0.1702	0.1330	0.1103	0.0766
	0.0327	0.0573	0.0701	0.1166	0.1821	0.2546
STD. DEVIATIONS	0.0702	0.0656	0.0398	0.0361	0.0344	0.0256
	0.0214	0.0308	0.0359	0.0382	0.0398	0.0604

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.1853	0.2193	0.2216	0.1815	0.1733	0.1386
	0.1158	0.0689	0.0550	0.0578	0.0756	0.1159
STD. DEVIATIONS	0.0524	0.0611	0.0453	0.0344	0.0312	0.0331
	0.0248	0.0180	0.0185	0.0235	0.0234	0.0237

PERCOLATION/LEAKAGE THROUGH LAYER 8

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 9

TOTALS	0.0017	0.0016	0.0017	0.0016	0.0016	0.0014
	0.0014	0.0013	0.0011	0.0010	0.0012	0.0012
STD. DEVIATIONS	0.0027	0.0025	0.0026	0.0023	0.0022	0.0019
	0.0017	0.0017	0.0016	0.0013	0.0015	0.0015

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0045	0.0035	0.0033	0.0027	0.0022	0.0016
	0.0006	0.0011	0.0014	0.0023	0.0037	0.0048
STD. DEVIATIONS	0.0012	0.0012	0.0007	0.0007	0.0007	0.0005
	0.0004	0.0006	0.0007	0.0007	0.0008	0.0010

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0027	0.0035	0.0032	0.0027	0.0025	0.0021
	0.0017	0.0010	0.0008	0.0008	0.0012	0.0017
STD. DEVIATIONS	0.0007	0.0009	0.0006	0.0005	0.0004	0.0005
	0.0004	0.0003	0.0003	0.0003	0.0004	0.0003

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.06	(5.263)	149036.9	100.00
RUNOFF	38.913	(5.1649)	141254.14	94.778
EVAPOTRANSPIRATION	0.534	(0.0670)	1938.44	1.301
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.60991	(0.14692)	5843.961	3.92115
AVERAGE HEAD ON TOP OF LAYER 2	0.003	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	1.60857	(0.13280)	5839.103	3.91789

PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000	(0.00000)	0.008	0.00001
AVERAGE HEAD ON TOP OF LAYER 7	0.002	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.01687	(0.02348)	61.225	0.04108
CHANGE IN WATER STORAGE	-0.015	(0.6037)	-56.00	-0.038

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	2.80	10164.000
RUNOFF	2.780	10089.8965
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.018686	67.82902
AVERAGE HEAD ON TOP OF LAYER 2	0.010	
DRAINAGE COLLECTED FROM LAYER 6	0.02712	98.46072
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00004
AVERAGE HEAD ON TOP OF LAYER 7	0.012	
MAXIMUM HEAD ON TOP OF LAYER 7	0.022	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	38.9 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000533	1.93522
SNOW WATER	3.56	12925.0859

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3200
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0200

*** 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 30

LAYER	(INCHES)	(VOL/VOL)
1	0.0032	0.3200
2	0.0000	0.0000
3	3.1125	0.2594
4	35.0400	0.2920
5	1.1425	0.0952
6	0.3854	0.0321
7	0.0000	0.0000
8	0.1500	0.7500
9	2.0131	0.1678
SNOW WATER	0.000	

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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:    C:\HELP3\CBL.D4
TEMPERATURE DATA FILE:      c:\help3\CBL.D7
SOLAR RADIATION DATA FILE:  c:\help3\CBL.D13
EVAPOTRANSPIRATION DATA:    c:\help3\CBL_03.D11
SOIL AND DESIGN DATA FILE:  c:\help3\CBL_03.D10
OUTPUT DATA FILE:           C:\HELP3\CBL_03.OUT


TIME:  12:14     DATE:  12/13/2021



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     TITLE:  COFFIN BUTTE LANDFILL_SDP_10-FT WASTE_OPEN CELL (NO COVER)

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



                                LAYER  1
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                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  18
          THICKNESS                    =    120.00   INCHES
          POROSITY                     =      0.6710 VOL/VOL
          FIELD CAPACITY               =      0.2920 VOL/VOL
          WILTING POINT                =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.3623 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC



                                LAYER  2
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                    TYPE 1 - VERTICAL PERCOLATION 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   =      0.1446 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC



                                LAYER  3
                                --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.3970 VOL/VOL
          FIELD CAPACITY               =      0.0320 VOL/VOL
          WILTING POINT                =      0.0130 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.0330 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =   10.0000000000     CM/SEC
          SLOPE                        =      2.00   PERCENT
          DRAINAGE LENGTH              =    500.0    FEET



                                LAYER  4
                                --------

                    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
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INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY = 3.00 HOLES/ACRE
FML INSTALLATION DEFECTS = 3.00 HOLES/ACRE
FML PLACEMENT QUALITY = 3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS = 0.20 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 10

THICKNESS = 12.00 INCHES
POROSITY = 0.3980 VOL/VOL
FIELD CAPACITY = 0.2440 VOL/VOL
WILTING POINT = 0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2075 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER = 0.00
FRACTION OF AREA ALLOWING RUNOFF = 0.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.000 ACRES
EVAPORATIVE ZONE DEPTH = 1.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 0.367 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 0.671 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 0.077 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 48.253 INCHES
TOTAL INITIAL WATER = 48.253 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
CORVALLIS OREGON

STATION LATITUDE = 44.70 DEGREES
MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 126
END OF GROWING SEASON (JULIAN DATE) = 289
EVAPORATIVE ZONE DEPTH = 1.0 INCHES
AVERAGE ANNUAL WIND SPEED = 7.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 79.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 70.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 65.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 82.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
6.62	5.04	4.42	2.58	1.99	1.23
0.36	0.51	1.46	3.21	6.36	7.07

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.80	42.80	46.20	50.40	55.70	61.10
66.40	66.50	61.80	53.50	45.30	40.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALEM OREGON
AND STATION LATITUDE = 44.70 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.18	145853.437	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.408	37779.680	25.90
DRAINAGE COLLECTED FROM LAYER 3	29.7718	108071.570	74.10
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.023	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0360		
PERC./LEAKAGE THROUGH LAYER 6	0.106755	387.519	0.27
CHANGE IN WATER STORAGE	-0.106	-385.372	-0.26
SOIL WATER AT START OF YEAR	48.253	175157.672	
SOIL WATER AT END OF YEAR	48.147	174772.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.047	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.67	169412.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	8.562	31078.246	18.34
DRAINAGE COLLECTED FROM LAYER 3	38.5618	139979.437	82.63
PERC./LEAKAGE THROUGH LAYER 5	0.000008	0.028	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0469		
PERC./LEAKAGE THROUGH LAYER 6	0.061014	221.480	0.13
CHANGE IN WATER STORAGE	-0.514	-1867.025	-1.10
SOIL WATER AT START OF YEAR	48.147	174772.312	
SOIL WATER AT END OF YEAR	47.632	172905.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.019	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.09	174566.703	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.973	39833.746	22.82
DRAINAGE COLLECTED FROM LAYER 3	34.9575	126895.867	72.69
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.026	0.00

AVG. HEAD ON TOP OF LAYER 4	0.0423		
PERC./LEAKAGE THROUGH LAYER 6	0.042966	155.966	0.09
CHANGE IN WATER STORAGE	2.116	7681.122	4.40
SOIL WATER AT START OF YEAR	47.632	172905.281	
SOIL WATER AT END OF YEAR	48.198	174959.812	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.550	5626.590	3.22
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.65	143929.531	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.493	34458.480	23.94
DRAINAGE COLLECTED FROM LAYER 3	36.7764	133498.469	92.75
PERC./LEAKAGE THROUGH LAYER 5	0.000008	0.028	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0444		
PERC./LEAKAGE THROUGH LAYER 6	0.032701	118.706	0.08
CHANGE IN WATER STORAGE	-6.652	-24146.135	-16.78
SOIL WATER AT START OF YEAR	48.198	174959.812	
SOIL WATER AT END OF YEAR	43.096	156440.266	
SNOW WATER AT START OF YEAR	1.550	5626.590	3.91
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.003	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.70	140481.000	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.114	33084.086	23.55
DRAINAGE COLLECTED FROM LAYER 3	24.5848	89242.680	63.53
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.021	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0298		
PERC./LEAKAGE THROUGH LAYER 6	0.025855	93.853	0.07
CHANGE IN WATER STORAGE	4.975	18060.449	12.86
SOIL WATER AT START OF YEAR	43.096	156440.266	
SOIL WATER AT END OF YEAR	48.072	174500.719	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.068	0.00

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT

PRECIPITATION	40.22	145998.625	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.793	39178.199	26.83
DRAINAGE COLLECTED FROM LAYER 3	31.9272	115895.562	79.38
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.025	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0387		
PERC./LEAKAGE THROUGH LAYER 6	0.021766	79.011	0.05
CHANGE IN WATER STORAGE	-2.522	-9154.234	-6.27
SOIL WATER AT START OF YEAR	48.072	174500.719	
SOIL WATER AT END OF YEAR	45.550	165346.484	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.078	0.00

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.81	162660.281	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.317	37449.789	23.02
DRAINAGE COLLECTED FROM LAYER 3	33.8859	123005.883	75.62
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.026	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0411		
PERC./LEAKAGE THROUGH LAYER 6	0.018683	67.819	0.04
CHANGE IN WATER STORAGE	0.589	2136.826	1.31
SOIL WATER AT START OF YEAR	45.550	165346.484	
SOIL WATER AT END OF YEAR	46.139	167483.312	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.039	0.00

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.27	175220.109	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.901	39569.613	22.58
DRAINAGE COLLECTED FROM LAYER 3	37.1102	134710.141	76.88
PERC./LEAKAGE THROUGH LAYER 5	0.000008	0.027	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0450		
PERC./LEAKAGE THROUGH LAYER 6	0.016003	58.092	0.03
CHANGE IN WATER STORAGE	0.243	882.215	0.50
SOIL WATER AT START OF YEAR	46.139	167483.312	
SOIL WATER AT END OF YEAR	46.382	168365.531	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.064	0.00

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.82	159066.594	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	11.247	40826.066	25.67
DRAINAGE COLLECTED FROM LAYER 3	31.6379	114845.672	72.20
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0386		
PERC./LEAKAGE THROUGH LAYER 6	0.014211	51.585	0.03
CHANGE IN WATER STORAGE	0.921	3343.283	2.10
SOIL WATER AT START OF YEAR	46.382	168365.531	
SOIL WATER AT END OF YEAR	46.044	167140.078	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.259	4568.732	2.87
ANNUAL WATER BUDGET BALANCE	0.0000	-0.006	0.00

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.26	142513.828	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.850	35756.867	25.09
DRAINAGE COLLECTED FROM LAYER 3	31.4317	114097.164	80.06
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.025	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0382		
PERC./LEAKAGE THROUGH LAYER 6	0.012767	46.345	0.03
CHANGE IN WATER STORAGE	-2.035	-7386.543	-5.18
SOIL WATER AT START OF YEAR	46.044	167140.078	
SOIL WATER AT END OF YEAR	45.268	164322.266	
SNOW WATER AT START OF YEAR	1.259	4568.732	3.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.013	0.00

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	32.84	119209.258	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.053	36493.035	30.61
DRAINAGE COLLECTED FROM LAYER 3	26.5279	96296.117	80.78
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0322		
PERC./LEAKAGE THROUGH LAYER 6	0.011803	42.846	0.04

CHANGE IN WATER STORAGE	-3.753	-13622.787	-11.43
SOIL WATER AT START OF YEAR	45.268	164322.266	
SOIL WATER AT END OF YEAR	41.372	150181.656	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.143	517.824	0.43
ANNUAL WATER BUDGET BALANCE	0.0000	0.048	0.00

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.45	143203.562	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	8.586	31166.254	21.76
DRAINAGE COLLECTED FROM LAYER 3	25.8510	93839.062	65.53
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.021	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0312		
PERC./LEAKAGE THROUGH LAYER 6	0.010602	38.485	0.03
CHANGE IN WATER STORAGE	5.003	18159.719	12.68
SOIL WATER AT START OF YEAR	41.372	150181.656	
SOIL WATER AT END OF YEAR	46.518	168859.203	
SNOW WATER AT START OF YEAR	0.143	517.824	0.36
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.040	0.00

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.66	151225.766	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.299	33753.824	22.32
DRAINAGE COLLECTED FROM LAYER 3	35.2738	128043.937	84.67
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.027	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0432		
PERC./LEAKAGE THROUGH LAYER 6	0.009893	35.910	0.02
CHANGE IN WATER STORAGE	-2.922	-10607.833	-7.01
SOIL WATER AT START OF YEAR	46.518	168859.203	
SOIL WATER AT END OF YEAR	43.595	158251.359	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.066	0.00

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	30.16	109480.805	100.00
RUNOFF	0.000	0.000	0.00

EVAPOTRANSPIRATION	8.063	29269.014	26.73
DRAINAGE COLLECTED FROM LAYER 3	20.8571	75711.102	69.15
PERC./LEAKAGE THROUGH LAYER 5	0.000005	0.019	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0252		
PERC./LEAKAGE THROUGH LAYER 6	0.009054	32.866	0.03
CHANGE IN WATER STORAGE	1.231	4467.829	4.08
SOIL WATER AT START OF YEAR	43.595	158251.359	
SOIL WATER AT END OF YEAR	43.685	158575.187	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.142	4144.008	3.79
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.44	154057.187	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.532	34600.434	22.46
DRAINAGE COLLECTED FROM LAYER 3	31.2822	113554.398	73.71
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0379		
PERC./LEAKAGE THROUGH LAYER 6	0.008494	30.832	0.02
CHANGE IN WATER STORAGE	1.618	5871.601	3.81
SOIL WATER AT START OF YEAR	43.685	158575.187	
SOIL WATER AT END OF YEAR	46.444	168590.797	
SNOW WATER AT START OF YEAR	1.142	4144.008	2.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.072	0.00

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.62	132930.625	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.641	34995.836	26.33
DRAINAGE COLLECTED FROM LAYER 3	29.8384	108313.352	81.48
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0361		
PERC./LEAKAGE THROUGH LAYER 6	0.008001	29.042	0.02
CHANGE IN WATER STORAGE	-2.867	-10407.642	-7.83
SOIL WATER AT START OF YEAR	46.444	168590.797	
SOIL WATER AT END OF YEAR	43.577	158183.156	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.037	0.00

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.79	177107.703	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	12.546	45543.793	25.72
DRAINAGE COLLECTED FROM LAYER 3	30.1957	109610.352	61.89
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0366		
PERC./LEAKAGE THROUGH LAYER 6	0.007562	27.450	0.02
CHANGE IN WATER STORAGE	6.040	21926.186	12.38
SOIL WATER AT START OF YEAR	43.577	158183.156	
SOIL WATER AT END OF YEAR	49.617	180109.344	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.073	0.00

ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.13	156561.922	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.993	29013.746	18.53
DRAINAGE COLLECTED FROM LAYER 3	35.6818	129524.812	82.73
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.027	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0432		
PERC./LEAKAGE THROUGH LAYER 6	0.007015	25.466	0.02
CHANGE IN WATER STORAGE	-0.552	-2002.064	-1.28
SOIL WATER AT START OF YEAR	49.617	180109.344	
SOIL WATER AT END OF YEAR	49.065	178107.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.042	0.00

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.36	146506.812	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.897	35925.910	24.52
DRAINAGE COLLECTED FROM LAYER 3	34.8865	126637.891	86.44
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.027	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0422		
PERC./LEAKAGE THROUGH LAYER 6	0.006607	23.982	0.02
CHANGE IN WATER STORAGE	-4.430	-16080.980	-10.98
SOIL WATER AT START OF YEAR	49.065	178107.281	

SOIL WATER AT END OF YEAR	44.559	161749.391	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.076	276.909	0.19
ANNUAL WATER BUDGET BALANCE	0.0000	0.016	0.00

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.71	133257.297	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.416	37810.633	28.37
DRAINAGE COLLECTED FROM LAYER 3	23.9031	86768.156	65.11
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.020	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0288		
PERC./LEAKAGE THROUGH LAYER 6	0.006156	22.346	0.02
CHANGE IN WATER STORAGE	2.385	8656.142	6.50
SOIL WATER AT START OF YEAR	44.559	161749.391	
SOIL WATER AT END OF YEAR	47.020	170682.437	
SNOW WATER AT START OF YEAR	0.076	276.909	0.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.025	0.00

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.04	174385.219	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.167	36907.789	21.16
DRAINAGE COLLECTED FROM LAYER 3	38.1954	138649.484	79.51
PERC./LEAKAGE THROUGH LAYER 5	0.000008	0.028	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0464		
PERC./LEAKAGE THROUGH LAYER 6	0.005963	21.646	0.01
CHANGE IN WATER STORAGE	-0.329	-1193.780	-0.68
SOIL WATER AT START OF YEAR	47.020	170682.437	
SOIL WATER AT END OF YEAR	46.691	169488.656	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.081	0.00

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.41	172098.312	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.264	37257.480	21.65
DRAINAGE COLLECTED FROM LAYER 3	39.6399	143892.922	83.61

PERC./LEAKAGE THROUGH LAYER 5	0.000008	0.029	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0481		
PERC./LEAKAGE THROUGH LAYER 6	0.005612	20.373	0.01
CHANGE IN WATER STORAGE	-2.499	-9072.466	-5.27
SOIL WATER AT START OF YEAR	46.691	169488.656	
SOIL WATER AT END OF YEAR	44.192	160416.187	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.09	156416.734	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	11.164	40526.422	25.91
DRAINAGE COLLECTED FROM LAYER 3	30.3978	110343.977	70.54
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0371		
PERC./LEAKAGE THROUGH LAYER 6	0.005401	19.607	0.01
CHANGE IN WATER STORAGE	1.523	5526.686	3.53
SOIL WATER AT START OF YEAR	44.192	160416.187	
SOIL WATER AT END OF YEAR	45.714	165942.875	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.039	0.00

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.01	141606.328	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.181	26068.043	18.41
DRAINAGE COLLECTED FROM LAYER 3	29.6390	107589.477	75.98
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.024	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0360		
PERC./LEAKAGE THROUGH LAYER 6	0.005219	18.946	0.01
CHANGE IN WATER STORAGE	2.185	7929.796	5.60
SOIL WATER AT START OF YEAR	45.714	165942.875	
SOIL WATER AT END OF YEAR	47.899	173872.672	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.070	0.00

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.48	125162.453	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.737	35345.465	28.24
DRAINAGE COLLECTED FROM LAYER 3	29.3155	106415.312	85.02
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.023	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0355		
PERC./LEAKAGE THROUGH LAYER 6	0.004927	17.884	0.01
CHANGE IN WATER STORAGE	-4.577	-16616.309	-13.28
SOIL WATER AT START OF YEAR	47.899	173872.672	
SOIL WATER AT END OF YEAR	43.321	157256.359	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.100	0.00

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	34.74	126106.164	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	7.319	26568.477	21.07
DRAINAGE COLLECTED FROM LAYER 3	27.0288	98114.578	77.80
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.022	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0329		
PERC./LEAKAGE THROUGH LAYER 6	0.004687	17.013	0.01
CHANGE IN WATER STORAGE	0.387	1406.143	1.12
SOIL WATER AT START OF YEAR	43.321	157256.359	
SOIL WATER AT END OF YEAR	43.709	158662.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.043	0.00

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.51	179721.359	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	11.064	40163.535	22.35
DRAINAGE COLLECTED FROM LAYER 3	37.7025	136859.937	76.15
PERC./LEAKAGE THROUGH LAYER 5	0.000008	0.028	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0462		
PERC./LEAKAGE THROUGH LAYER 6	0.004565	16.571	0.01
CHANGE IN WATER STORAGE	0.739	2681.276	1.49
SOIL WATER AT START OF YEAR	43.709	158662.500	
SOIL WATER AT END OF YEAR	44.447	161343.781	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.045	0.00

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.25	120697.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	9.303	33770.371	27.98
DRAINAGE COLLECTED FROM LAYER 3	26.1530	94935.531	78.66
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.021	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0316		
PERC./LEAKAGE THROUGH LAYER 6	0.004380	15.901	0.01
CHANGE IN WATER STORAGE	-2.211	-8024.305	-6.65
SOIL WATER AT START OF YEAR	44.447	161343.781	
SOIL WATER AT END OF YEAR	42.237	153319.484	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.47	132386.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	8.094	29380.443	22.19
DRAINAGE COLLECTED FROM LAYER 3	23.0755	83763.937	63.27
PERC./LEAKAGE THROUGH LAYER 5	0.000006	0.020	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0281		
PERC./LEAKAGE THROUGH LAYER 6	0.004290	15.572	0.01
CHANGE IN WATER STORAGE	5.296	19226.133	14.52
SOIL WATER AT START OF YEAR	42.237	153319.484	
SOIL WATER AT END OF YEAR	47.533	172545.609	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.048	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.88	159284.422	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	8.506	30876.520	19.38
DRAINAGE COLLECTED FROM LAYER 3	33.8277	122794.406	77.09
PERC./LEAKAGE THROUGH LAYER 5	0.000007	0.026	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0408		

PERC./LEAKAGE THROUGH LAYER 6	0.004054	14.717	0.01
CHANGE IN WATER STORAGE	1.542	5598.858	3.52
SOIL WATER AT START OF YEAR	47.533	172545.609	
SOIL WATER AT END OF YEAR	49.076	178144.469	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.080	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.36	4.68	5.04	2.33	2.04	1.21
	0.60	0.61	1.27	2.60	6.34	7.98
STD. DEVIATIONS	1.85	1.86	1.85	1.06	0.80	0.68
	0.42	0.51	0.93	0.95	1.70	2.48
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	0.741	0.881	1.492	1.471	1.144	0.658
	0.272	0.318	0.516	0.828	0.751	0.611
STD. DEVIATIONS	0.120	0.193	0.307	0.648	0.482	0.368
	0.140	0.245	0.370	0.272	0.110	0.099
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	6.7473	5.1933	4.5353	3.4781	1.5610	0.7499
	0.5129	0.3647	0.4270	1.0224	1.7727	4.9660
STD. DEVIATIONS	1.9871	1.6652	1.4320	1.2454	0.7539	0.4136
	0.3454	0.2605	0.3328	0.4868	0.7574	1.6046
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	0.0016	0.0014	0.0015	0.0014	0.0014	0.0013
	0.0013	0.0013	0.0012	0.0012	0.0012	0.0012
STD. DEVIATIONS	0.0026	0.0022	0.0022	0.0019	0.0019	0.0018
	0.0017	0.0015	0.0014	0.0014	0.0014	0.0014

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0960	0.0811	0.0645	0.0511	0.0222	0.0110
	0.0073	0.0052	0.0063	0.0145	0.0261	0.0707
STD. DEVIATIONS	0.0283	0.0258	0.0204	0.0183	0.0107	0.0061
	0.0049	0.0037	0.0049	0.0069	0.0111	0.0228

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT

PRECIPITATION	41.06 (5.263)	149036.9	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	9.683 (1.2561)	35148.39	23.584
LATERAL DRAINAGE COLLECTED FROM LAYER 3	31.33059 (5.03881)	113730.023	76.30997
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001 (0.00000)	0.024	0.00002
AVERAGE HEAD ON TOP OF LAYER 4	0.038 (0.006)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.01623 (0.02137)	58.928	0.03954
CHANGE IN WATER STORAGE	0.027 (3.0962)	99.56	0.067

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	2.80	10164.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.87484	3175.66943
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00054
AVERAGE HEAD ON TOP OF LAYER 4	0.386	
MAXIMUM HEAD ON TOP OF LAYER 4	0.752	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	12.9 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000443	1.60712
SNOW WATER	3.56	12925.0859

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5161
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0770

*** 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 30

LAYER	(INCHES)	(VOL/VOL)
1	44.5638	0.3714
2	1.9099	0.1592
3	0.4484	0.0374
4	0.0000	0.0000
5	0.1500	0.7500
6	2.0035	0.1670
SNOW WATER	0.000	

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APPENDIX D.2

LCRS DRAINAGE LAYER CALCULATIONS

Job Name:	Coffin Butte Landfill - Cell 6		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/13/2021

Transmissivity calculations based on HELP model impingement rate and specified material properties

GRAVEL DRAINAGE LAYER_OPEN CELL-NO COVER

HELP lat. drainage input here

Input (From HELP Model):

	Symbol	Value	Units			
Impingment Rate (peak daily drainage_from HELP analysis)	q_h =	**2.56E-07**	m/s	=	0.87	in/day
Maximum drainage distance of liquid collection layer	L =	**152.4**	m	=	500	feet
Thickness of liquid collection layer	t =	**0.30480**	m	=	12.0	inches
Slope	b =	**1.15**	degrees	=	2	%

Calculations:

Maximum liquid depth	h_{max}	**0.2531**	m	=	9.96 inches
Required Transmissivity	$T_{required}$	**1.9E-03**	m^2/s	$T_{required} = \frac{q_h \cdot L}{\sin(b)}$	
Safety Factor for intrusion/elastic deformation	SF_{in}	**2.0**	1.5 - 2.0		
Safety Factor for creep deformation	SF_{cr}	**2.0**	1.4 - 2.0		
Safety Factor for chemical clogging	SF_{cc}	**2.0**	1.5 - 2.0		
Safety Factor for biological clogging	SF_{bc}	**2.0**	1.5 - 2.0		
Overall Safety Factor	SF_{Total}	**16.0**			
Allowable (Specified) Transmissivity	T_{allow}	**3.1E-02**	m^2/s	$T_{allow} = T_{required} \cdot RF_{Total}$	
Allowable (Specified) Permeability	K_{allow}	**10.2**	cm/s		

References:

Giroud, J.P., Zhao, A., and Zornberg, J.G. (2000). Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers, *Geosynthetics International,* Special Issue on Liquid Collection Systems, Vol 7, Nos. 4-6, pp. 285-380.

Koerner, R.M. and Koerner, G.R. (2007). Reduction Factors (RFs) Used in Geosynthetic Design, GSI White Paper #4, *Geosynthetic Institute*, Folsom, PA, Rev. #1, March 1, 2007.

Job Name:	Coffin Butte Landfill - Cell 6		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/7/2021

Transmissivity calculations based on HELP model impingement rate and specified material properties

GRAVEL DRAINAGE LAYER_20% "NO COVER," 80% "RAIN TARP"

HELP lat. drainage input here

Input (From HELP Model):

	Symbol	Value	Units			
Impingment Rate (peak daily drainage_from HELP analysis)	q_h =	**5.88E-08**	m/s	=	0.20	in/day
Maximum drainage distance of liquid collection layer	L =	**152.4**	m	=	500	feet
Thickness of liquid collection layer	t =	**0.30480**	m	=	12.0	inches
Slope	b =	**1.15**	degrees	=	2	%

Calculations:

Maximum liquid depth	h_{max}	**0.2531**	m	=	9.96 inches
Required Transmissivity	$T_{required}$	**4.5E-04**	m^2/s	$T_{required} = \frac{q_h \cdot L}{\sin(b)}$	
Safety Factor for intrusion/elastic deformation	SF_{in}	**2.0**	1.5 - 2.0		
Safety Factor for creep deformation	SF_{cr}	**2.0**	1.4 - 2.0		
Safety Factor for chemical clogging	SF_{cc}	**2.0**	1.5 - 2.0		
Safety Factor for biological clogging	SF_{bc}	**2.0**	1.5 - 2.0		
Additional Factor of Safety	SF	**4.2**			
Overall Safety Factor	SF_{Total}	**67.2**			
Allowable (Specified) Transmissivity	T_{allow}	**3.0E-02**	m^2/s	$T_{allow} = T_{required} \cdot RF_{Total}$	
Allowable (Specified) Permeability	K_{allow}	**9.9**	cm/s		

References:

Giroud, J.P., Zhao, A., and Zornberg, J.G. (2000). Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers, *Geosynthetics International,* Special Issue on Liquid Collection Systems, Vol 7, Nos. 4-6, pp. 285-380.

Koerner, R.M. and Koerner, G.R. (2007). Reduction Factors (RFs) Used in Geosynthetic Design, GSI White Paper #4, *Geosynthetic Institute*, Folsom, PA, Rev. #1, March 1, 2007.

APPENDIX D.3

PIPE CALCULATIONS

Job Name:	Coffin Butte Landfill - Site Development Plan		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/10/2021

PIPE CAPACITY CALCULATION: CELL 6 CENTER COLLECTION PIPE

Mannings Equation for Pipe Flow:

$$Q_{ult} = (1.49/n) \bullet A \bullet r_h^{2/3} \bullet S^{1/2}$$

$$FS = \frac{Q_{ult}}{Q_{reqd}}$$

Input

D_O =	8	Pipe Outside Diamter (in)
SDR =	11	Standard Dimension Ratio
n =	0.011	Manning's Roughness Coefficient (for HDPE Pipe)
S =	1.0%	Slope of Pipe
q_{reqd} =	5,377	gal/acre/day (Peak Daily Rate from HELP Model)
Cell Area =	27.8	acres (largest contributing area of pipe)

Calculations

D_i =	6.5	Inner Pipe Diameter (in)
r_h =	0.136	Hydraulic Radius (=D_i/4 for full pipe flow, ft)
A =	0.234	Area of Pipe in Flow (ft^2)
Q_{ult} =	376.2	Ultimate Pipe Capacity (cfs)
Q_{reqd} =	103.8	Peak Daily Leachate Flow (cfs)
FS =	**3.6**	

REFERENCES:

Qian, X., Koerner, R.M., and Gray, D.H. (2002). Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall Inc., Upper Saddle River, New Jersey, pp. 304-314.

Job Name:	Coffin Butte Landfill - Site Development Plan		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/10/2021

PIPE CAPACITY CALCULATION: CELL 6 SUMP PIPE

Mannings Equation for Pipe Flow:

$$Q_{ult} = (1.49/n) \bullet A \bullet r_h^{2/3} \bullet S^{1/2}$$

Input

D_O =	24	Pipe Outside Diamter (in)
SDR =	11	Standard Dimension Ratio
n =	0.011	Manning's Roughness Coefficient (for HDPE Pipe)
S =	1.0%	Slope of Pipe
q_{reqd} =	5,377	gal/acre/day (Peak Daily Rate from HELP Model)
Cell Area =	56.6	acres (largest contributing area of pipe)

$$FS = \frac{Q_{ult}}{Q_{reqd}}$$

Calculations

D_i =	19.6	Inner Pipe Diameter (in)
r_h =	0.409	Hydraulic Radius (=D_i/4 for full pipe flow, ft)
A =	2.102	Area of Pipe in Flow (ft^2)
Q_{ult} =	7041.9	Ultimate Pipe Capacity (cfs)
Q_{reqd} =	211.3	Peak Daily Leachate Flow (cfs)
FS =	**33.3**	

REFERENCES:

Qian, X., Koerner, R.M., and Gray, D.H. (2002). Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall Inc., Upper Saddle River, New Jersey, pp. 304-314.

Job Name:	Coffin Butte Landfill - Site Development Plan		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/10/2021

PIPE PERFORATION CALCULATION: CELL 6 CENTER COLLECTION PIPE

Bernoulii Equation for Inflow Capacity per Perforation:

$$Q_B = C \bullet A_b \bullet \upsilon_{ent}$$

$$N = Q_{in} / Q_B$$

Input

9/16"

d =	0.5625	Perforation Diameter (inches)
C =	0.62	Dischage Coefficient
v_{ent} =	0.1	Limiting Entrance Velocity (ft/s)
$(A_u)_{unit}$	675.0	Unit Width of Maximum Contributing Area (ft)
q_{reqd} =	5,377	gal/acre/day (Peak Daily Rate from HELP Model)

Calculations

A_b =	0.001725	ft^2
Q_B =	9.24	Capacity per Orifice (ft^3/day)
Q_{in} =	11.1	Max Inflow Per Foot of Pipe (ft^3/day/ft)
N	**1**	**Number of Perforations Per Foot Required**

Design has 12 perforations per foot, OK

REFERENCES:

Qian, X., Koerner, R.M., and Gray, D.H. (2002). Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall Inc., Upper Saddle River, New Jersey, pp. 304-314.

STRUCTURAL PIPE CALCULATION WORKSHEET

Geo-Logic ASSOCIATES

Project Name: Coffin Butte Landfill
Site Development Plan
Project Number: AU20.1210.00
Calculation By: ASO
Calculation Date: December 10, 2021

Description: Calculate Required Pipe Strength for Cell 6 Design

Compressive Stress

Description	Units	Cell 6 Main	Cell 6 Laterals	Cell 6 Sump
Unit Weight of Waste	pcf	85.0	85.0	85.0
Waste Fill Height	ft	335	225	60
Final Cover Unit Weight	pcf	120	120	120
Final Cover Height	ft	3	3	3
Overburden Stress	psf	28835	19485	5460
Overburden Stress	psi	200	135	38
Nominal Outer Diameter of Pipe	in	8	8	24
Outer Diameter of Pipe	in	9.05	9.05	24
Dimension Ratio (DR)	--	11	11	17
Pipe Wall Thickness (t)	in	0.82	0.82	1.41
Mean Radius of Pipe (r_m)	in	4.11	4.11	11.29
Perforation Diameter	in	0.5625	0.375	0.5625
Perforation Spacing	in	4	4	4
Number of Perforations Around Pipe	--	4	4	4
Reduced Pipe Length Accounting for Perforations (L_p)	in	6.75	4.5	6.75
Length Based on Overburden Correction	in	2.29	1.60	2.29
Reduced Pipe Area to Account for Perforations (L_a)	in^2	2.98	1.33	2.98
Area Based Overburden Correction	--	1.020	1.009	1.007
Design Overburden Stress	psf	29400	19653	5499
Design Overburden Stress	psi	204	136	38
Constrained Modulus of Pipe Backfill (M_s) Assumes Gravelly Sand/Gravel at 90% Std Proctor (McGrath, 1998)	psi	5024	3856	2103
Assumed Pipe Temperature	˚F	100	100	100
Assumed Load Duration	years	100	100	100
Pipe Apparent Elastic Modulus (E)	psi	28000	28000	28000
Temperature Multiplier	--	0.73	0.73	0.73
Long Term Pipe Modulus of Elasticity (E)	psi	20440	20440	20440
Hoop Thrust Stiffness (S_A)	--	1.76	1.35	1.18
Vertical Arching Factor (VAF)	--	0.75	0.82	0.85
Radial Directed Earth Pressure (P_{RD})	psf	22158	16030	4651
Ring Compressive Stress (S)	psi	846.3	612.3	274.5
Allowable Compressive Stress at 100˚F	psi	897	897	897
Compressive Stress OK?	--	YES	YES	YES

Ring Deflection Using the Watkins-Gaube Graph

Description		Cell 6 Main	Cell 6 Laterals	Cell 6 Sump
Poisson's Ratio of Backfill Material (μ)	--	0.3	0.3	0.3
Secant Modulus of Soil (E_S)	psi	3732	2864	1562
Ridgitity Factor (R_F)	--	2191	1682	3756
Deformation Factor (D_F)	--	1.4	1.4	1.6
Soil Strain (ε_s)	%	5.4	4.7	2.4
Deflection	%	7.5	6.6	3.9
Acceptable Deflection	%	7.5	7.5	7.5
Defelction OK?	--	YES	YES	YES

Moore-Selig Constrained Pipe Wall Buckling (for dry soil)

Description	Units	Cell 6 Main	Cell 6 Laterals	Cell 6 Sump
Calibration Factor (φ)	--	0.55	0.55	0.55
Geometry Factor (R_H)	--	1.0	1.0	1.0
Pipe Wall Moment of Inertia (I)	in^4/in	0.046	0.046	0.234
Mod Secant Modulus of Soil (E_S*)	--	5332	4092	2231
Moore-Selig Critical Buckling Pressure (P_{CR})	psi	481.1	403.3	168.2
Acceptable Factor of Safety	--	2	2	2
Factor of Safety	--	3.13	3.62	5.21
Buckling OK?	--	YES	YES	YES

Luscher Constrained Pipe Wall Buckling

Description	Units	Cell 6 Main	Cell 6 Laterals	Cell 6 Sump
Height of Fill (H)	ft	335	225	60
Height of Groundwater (H_{GW})	ft	0	0	0
Elastic Support Coefficient (B')	--	1.0	1.0	0.9
Buoyancy Reduction Factor (R)	--	1.0	1.0	1.0
Luscher's Critical Buckling Pressure (P_{CR} @ N=1)	psi	522.7	457.9	160.7
Acceptable Factor of Safety	--	2	2	2
Factor of Safety	--	3.4	4.1	5.0
Buckling OK?	--	YES	YES	YES

STRUCTURAL PIPE CALCULATION WORKSHEET

Pipe calculations are as presented by the Plastic Pipe Institute in the Second Edition Handbook of PE Pipe

(3-21) $$VAF = 0.88 - 0.71\left|\frac{S_A - 1}{S_A + 2.5}\right|$$

WHERE

VAF = Vertical Arching Factor

S_A = Hoop Thrust Stiffness Ratio

(3-22) $$S_A = \frac{1.43\, M_S\, r_{CENT}}{EA}$$

WHERE

r_{CENT} = radius to centroidal axis of pipe, in

M_s = one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi (See Appendix, Chapter 3)

A = profile wall average cross-sectional area, in²/in, or wall thickness (in) for DR pipe

(3-23) $$P_{RD} = (VAF)wH$$

WHERE

P_{RD} = radial directed earth pressure, lb/ft²

W = unit weight of soil, pcf

H = depth of cover, ft

(3-13) $$S = \frac{(P_E + P_L)\, DR}{288}$$

WHERE

P_E = vertical soil pressure due to earth load, psf

P_L = vertical soil pressure due to live-load, psf

S = pipe wall compressive stress, lb/in²

DR = Dimension Ratio, D_O/t

D_O = pipe outside diameter (for profile pipe $D_O = D_I + 2H_P$), in

D_I = pipe inside diameter, in

H_P = profile wall height, in

A = profile wall average cross-sectional area, in²/in
(Obtain the profile wall area from the manufacturer of the profile pipe.)

(3-26) $$E_S = M_S\frac{(1+\mu)(1-2\mu)}{(1-\mu)}$$

TABLE 3-13
Typical range of Poisson's Ratio for Soil (Bowles[21])

Soil Type	Poisson's Ratio, μ
Saturated Clay	0.4-0.5
Unsaturated Clay	0.1-0.3
Sandy Clay	0.2-0.3
Silt	0.3-0.35
Sand (Dense)	0.2-0.4
Coarse Sand (Void Ratio 0.4-0.7)	0.15
Fine-grained Sand (Void Ratio 0.4-0.7)	0.25

(3-24) $$R_F = \frac{12\, E_S\, (DR-1)^3}{E}$$

WHERE

DR = Dimension Ratio

E_S = Secant modulus of the soil, psi

E = Apparent modulus of elasticity of pipe material, psi

I = Pipe wall moment of inertia of pipe, in⁴/in

D_m = Mean diameter (D_I + 2z or D_O – t), in

(3-27) $$\varepsilon_S = \frac{wH}{144 E_S}$$

WHERE

w = unit weight of soil, pcf

H = depth of cover (height of fill above pipe crown), ft

E_S = secant modulus of the soil, psi

The designer can find the pipe deflection as a percent of the diameter by multiplying the soil strain, in percent, by the deformation factor:

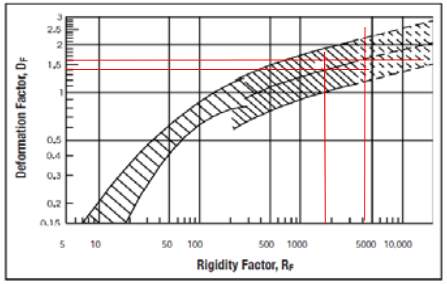


Figure 3-6 Watkins-Gaube Graph

(3-28) $$\frac{\Delta X}{D_M}(100) = D_F \varepsilon_S$$

(3-29) $$P_{CR} = \frac{2.4\,\varphi\, R_H}{D_M}(EI)^{\frac{1}{3}}(E_S^*)^{\frac{2}{3}}$$

WHERE

P_{CR} = Critical constrained buckling pressure, psi

φ = Calibration Factor, 0.55 for granular soils

R_H = Geometry Factor

E = Apparent modulus of elasticity of pipe material, psi

I = Pipe wall moment of Inertia, in⁴/in ($t^3/12$, if solid wall construction)

E_S^* = $E_S/(1-\mu)$

E_S = Secant modulus of the soil, psi

μ_S = Poisson's Ratio of Soil (Consult a textbook on soil for values. Bowles (1982) gives typical values for sand and rock ranging from 0.1 to 0.4.)

(3-17) $$R = 1 - 0.33\frac{H_{GW}}{H}$$

WHERE

R = buoyancy reduction factor

H_{GW} = height of ground water above pipe, ft

H = depth of cover, ft

(3-18) $$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

WHERE

e = natural log base number, 2.71828

E' = soil reaction modulus, psi

E = apparent modulus of elasticity, psi

DR = Dimension Ratio

I = pipe wall moment of inertia, in⁴/in ($t^3/12$, if solid wall construction)

D_M = Mean diameter (D_I + 2z or D_O – t), in

(3-15) $$P_{WC} = \frac{5.65}{N}\sqrt{RB'E'\frac{E}{12(DR-1)^3}}$$

WHERE

P_{WC} = allowable constrained buckling pressure, lb/in²

N = safety factor

Reference Information:

Plastic Pipe Institute, 2012. *Handbook of Polyethlyene Pipe,* 2nd Edition, June 6. Retrieved from: https://plasticpipe.org/publications/pe-handbook.html. Retrieved on April 17, 2018.

Plastic Pipe Institute, 2010. *Large Scale Constrained Modulus Test,* February 8. Retrieved from https://plasticpipe.org/pdf/ms-study-report.pdf. Retrieved on April 17, 2018.

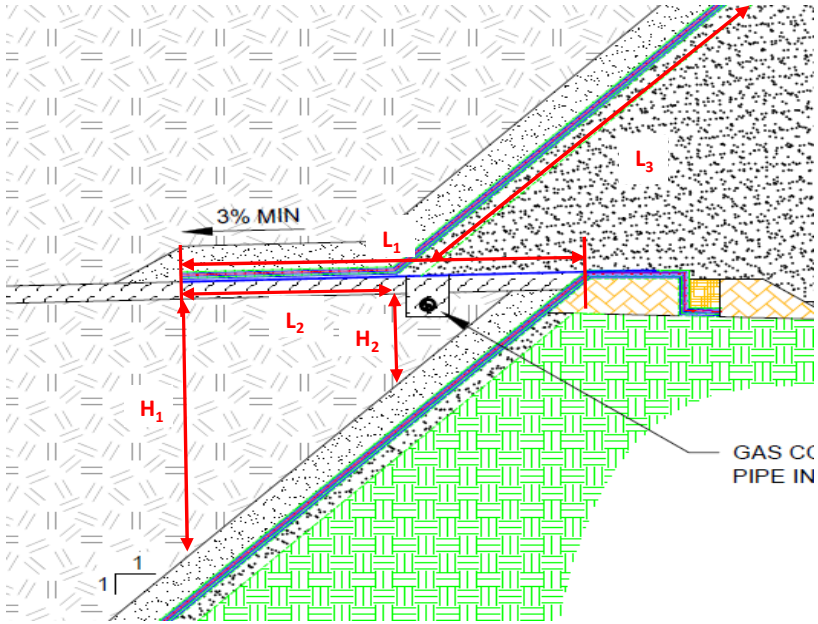
APPENDIX E

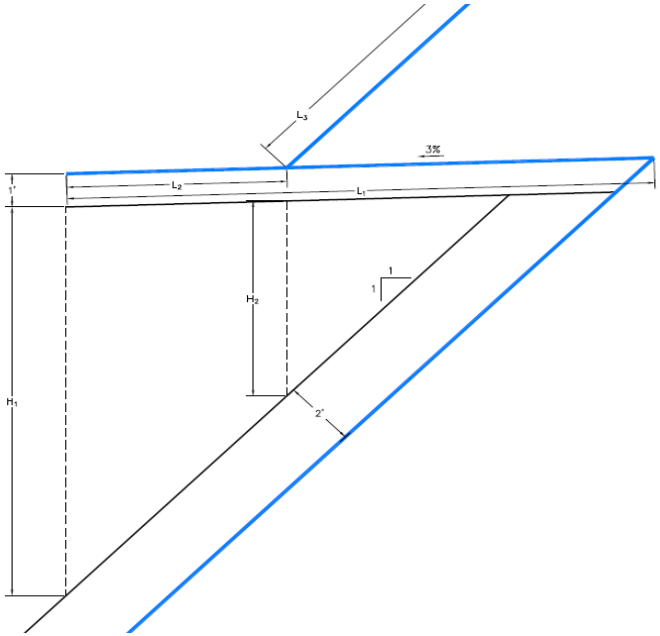
QUARRY FILL LINER CALCULATIONS

Job Name:	Coffin Butte Landfill - Site Development Plan		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/22/2021
Reviewed by:	RPB	Date:	12/30/2021

CELL 6 SHINGLE LINER STRAIN CALCULATION

Problem Definition:





Slope Inclination =	45	degrees
Shingle Slope Height =	40	feet
Foundation Layer Thickness =	1	feet
Operations Layer Thickness =	2	feet

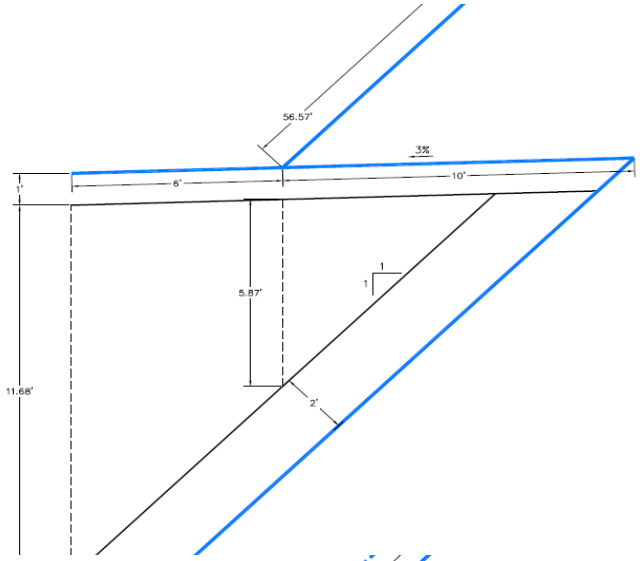
L_1 =	16	feet
L_2 =	6	feet
L_3 =	56.6	feet
H_1 =	11.7	feet
H_2 =	5.9	feet

Job Name:	Coffin Butte Landfill - Site Development Plan		
Client:	Republic Services		
Job No.:	AU20.1210.00		
Calc by:	ASO	Date:	12/22/2021
Reviewed by:	RPB	Date:	12/30/2021

Blanket Geomembrane Strain Calculation: Calculate strain in geomembrane due to maximum settlement of waste @ H_1

Initial Geomembrane Length = L_{1i} =	16	feet
Initial Waste Thickness = H_{1i} =	11.7	feet
Assumed Waste Settlement =	30	%
Waste Settlement = ΔH =	3.5	feet
Final Waste Thickness = H_{1f} =	8.2	feet
Final Geomembrane Length = L_{1f} =	16.6	
Maximum Strain = ε =	**3.8**	**%**

Initial Condition:

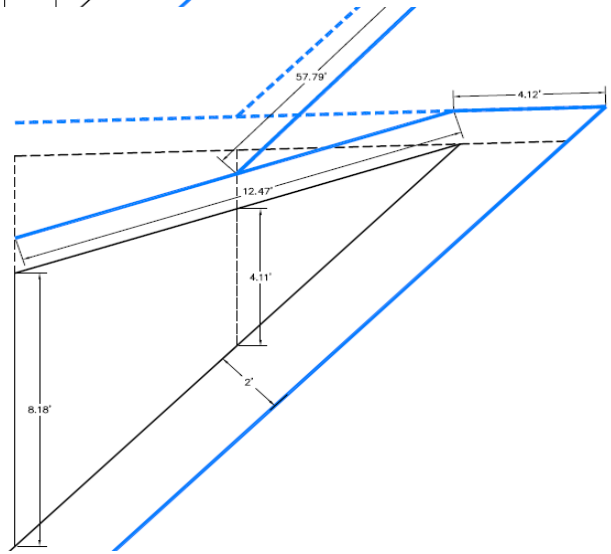


Calculated Strain is Less Than Assumed Yield Strain of 13% for HDPE

Shingle Liner Strain Calculation: Calculate strain in geomembrane due to maximum settlement of waste @ H_2

Initial Geomembrane Length = L_{3i} =	56.6	feet
Initial Waste Thickness = H_{2i} =	5.9	feet
Assumed Waste Settlement =	30	%
Waste Settlement = ΔH =	1.8	feet
Final Waste Thickness = H_{2f} =	4.1	feet
Final Slope Inclination = α_f =	46.2	degrees
Final Geomembrane Length = L_{3f} =	57.8	
Maximum Strain = ε =	**2.2**	**%**

Final Condition:



Calculated Strain is Less Than Assumed Yield Strain of 13% for HDPE

APPENDIX F

STORM WATER MASTER PLAN

STORMWATER MASTER PLAN REVISION
COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

DECEMBER 2015
PROJECT NO. 2015.A021

SUBMITTED TO:

VALLEY LANDFILLS, INC.

Valley Landfills, Inc.
28972 Coffin Butte Rd
Corvallis, OR 97330

PREPARED BY:

Geo-Logic ASSOCIATES

Geo-Logic Associates
803 SW Industrial Way, Suite 211
Bend, Oregon 97702
(541) 678-5733

SIGNATURE PAGE

Engineering material and data in this Stormwater Master Plan Revision Report was prepared under the direct supervision of Aaron Ogorzalek, PE, a registered professional engineer in the State of Oregon.

Geo-Logic Associates

December 21, 2015

Aaron S. Ogorzalek, PE
Project Manager

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

Geo-Logic Associates has prepared the following Stormwater Master Plan Revision for the Coffin Butte Landfill (CBL), which is owned and operated by Valley Landfills, Inc. (VLI). The purpose of this work is to update the stormwater master plan for the site by incorporating the revised site grading plan from the 2013 update and the 2011 Site Development Plan (SDP) (Thiel Engineering, 2013); as well as, accounting for the increased surface runoff that the site has experienced from the use of EDPM membrane cover for interim closures of waste fill areas.

The most recent stormwater master plan for the site was performed by Thiel Engineering (2000), which is the basis for the current stormwater collection systems at the CBL. In 2010, HBH Consulting Engineers performed stormwater calculations for the design of new sedimentation ponds located on the southeast end of the site (HBH, 2010). The 2010 sedimentation pond design incorporated flows that were established in the Thiel Engineering (2000) report.

As part of the current stormwater analyses, GLA has performed stormwater calculations and drainage structure design to update the stormwater infrastructure plan. The plan includes location and sizing of culverts, channels, and detention ponds required to control the stormwater, in accordance with the site's NPDES permit, the Oregon Department of Environmental Quality (DEQ)'s Solid Waste Landfill Guidance Document, Section 7.11 – Surface Water Control Systems, and the Standard Local Operating Procedures for Endangered Species (SLOPES).

The stormwater drainage analyses described herein are based on the pre-landfill grades (western drainage) and the final grades shown in the Top of Waste/Interim Cover and Closure Plan, as depicted in Drawing No. C08 (Thiel Engineering, 2013).

This submittal includes a short stormwater design report summarizing the methods, results and recommendations of GLA's evaluation. The appendices included within this report contain calculations and drawings detailing the size and locations of the recommended stormwater control features.

2.0 SURFACE WATER DRAINAGE ANALYSIS

2.1 General

The drainage control systems for the CBL have been designed to accommodate the anticipated volume of precipitation and resulting run-off generated from the peak 25-year, 24-hour rainfall event. In addition, the western detention pond was designed to accommodate the volume of precipitation and resulting run-off generated from the 33% of the 2-year, 24-hour, 42% of the 2-year, 24-hour, and 50% of the 2-year, 24-hour, 5-year, 24-hour, and 10-year, 24-hour storm

events. The overall configuration of the landfill and corresponding pre-development and post-development sub areas that were analyzed are shown on Figures 1 and 2.

In general, run-off from the landfill is to be collected by a series of berms, diversion channels, down drains, and culverts, and then directed towards one of three detention pond and biofiltration swale locations: two existing locations to the east of Cell 4 and a proposed western location to the south of future Cell 6. Run-on is collected by perimeter channels on the northern side of the landfill and diverted to one of the three aforementioned pond locations. The flow of run-on is divided at a high point near the Cell 5/6 boundary. Stormwater on the Cell 5 side is diverted towards the existing ponds to the east of Cell 4, and the Cell 6 stormwater will be sent to the western pond to the south of future Cell 6. The drainage patterns of the surface water control systems are shown on Figure 2.

The surface water hydrology of the CBL was calculated using WinTR-55. This program provides a graphical user interface to the TR-55 method developed by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS), 1986. This method calculates the peak run-off amounts for a drainage area that is generated during a specific rainfall event, based on simplified input variables such as soil type/runoff coefficients, rainfall data, and time of concentration. Drainage calculation worksheets are included in Appendix A, and WinTR-55 output sheets are included in Appendix B.

2.2 Rainfall Distribution

Rainfall distribution is represented in the TR-55 manual as one of four regional time-distribution types, which define the portion of rainfall that falls at any time within the 24-hour storm event. Shown in Figure 3, all of western Oregon including the CBL is located within the Soil Conservation Service (SCS) Type IA rainfall distribution zone. Thus, the Type IA rainfall distribution was used for the current drainage analyses.

2.3 Rainfall Amount

The rainfall amounts used in the hydrologic analysis of the CBL were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 2 rainfall frequency maps. The peak 2-year, 5-year, 10-year, and 25-year, 24-hour storm events were determined to be 3.1, 3.8, 4.4, and 5.1 inches, respectively. The corresponding rainfall frequency maps are shown in Figures 4, 5, 6, and 7.

3.0 PEAK RUN-OFF DETERMINATION

3.1 Description of Method

The Tabular Hydrograph method within the WinTR-55 program was used to calculate the peak run-off generated from the design 25-year, 24-hour storm event (USDA, Soil Conservation

Service, 1986). This method is widely accepted for determining stormwater run-off for small watersheds and can be used to describe a heterogeneous watershed that is divided into a number of homogeneous sub-watersheds. The Tabular Hydrograph method relates rainfall depth, a run-off curve number (CN), time of concentration (T_c), and drainage area to determine the peak run-off from a drainage area.

In calculating the surface hydrology, it is conservatively assumed that all the precipitation impacting a particular sub-area is eventually diverted into designed drainage channels. It is also assumed that the design storm event will have a duration that exceeds the time of concentration of overland flow.

Prior to beginning the run-off calculations, various input parameters were identified. First, the 24-hour rainfall depths were determined as described in Section 2.3 above. This data was then used as a basis for determining the run-off potential from the landfill and overall pond sizing. The entire drainage area (approximately 216 acres) was divided into 99 sub-areas, shown in Figure 2. It should be noted that this total drainage area is larger than the permitted landfill footprint because it includes areas of run-on from outside of the landfill footprint.

3.2 Runoff Curve Numbers

A runoff curve number (CN) was determined for each sub-area based on the hydrologic soil group, cover type, soil treatment, hydrologic condition, and antecedent run-off condition. In order to account for the landfill's use of temporary tarps as interim cover conditions, two different cover scenarios and corresponding runoff curve numbers were used. The condition of temporary tarps was modeled using a runoff curve number of 98, which represents a relatively impervious material with high runoff potential, described as paved parking lots, roofs and driveways. For all other existing and future closure conditions, a runoff curve number of 84 was used, which is representative of a hydrologic soil type D material with grass covering 50-75% of the area.

It was conservatively assumed that the point in time that would result in the most runoff would be the time period immediately prior to the next closure, estimated to be near the year 2029. At that time, the majority of the southeastern corner of the landfill would be built out and lined with tarps, with a curve number of 98 (i.e., high runoff potential). In total, the critical condition that was evaluated for surface runoff of the eastern drainage consisted of approximately 97.3 acres with a CN of 84 and 26.6 acres with a CN of 98. For the western drainage, the entire area of approximately 93 acres was evaluated with a CN of 84, representing the final closure condition.

3.3 Results

The design 25-year, 24-hour storm event was estimated to generate a total site peak discharge of approximately 181 cubic feet/second (cfs) of run-on and runoff, based on the assumptions discussed above. This water will be concentrated in channels and ultimately directed to perimeter ditches. These perimeter ditches will be directed to one of the three ponds/biofiltration swales servicing the eastern and western site drainages, respectively. The total peak flows are diverted such that 101 cfs are being received by the existing ponds to the east of Cell 4 with the remaining 80 cfs being received by the future pond and biofiltration swale to the south of Cell 6 (i.e., western drainage). These flows are depicted in Figure 2, and a routing calculation worksheet is included as Appendix C.

4.0 CONTROL STRUCTURE DESIGN

4.1 Drainage Channel Sizing

All open channels were sized using the computer program Flow Master (Bentley, 2009). The detailed calculations and report sheets for open channel and other drainage structure sizing are included in Appendix D.

To reduce the amount of erosion during peak run-off events, it is recommended that top deck berm and drainage benches are lined with an erosion control layer as noted in the Hydraulic Drainage Structure summary table, included in Appendix D. The perimeter channels at the toe of the landfill and adjacent to Coffin Butte Road should also be lined with the recommended erosion control mechanism (Appendix D), or equivalent, including grouted rip-rap aprons at the outlets of the downdrains. The inlets to each of the downdrains should transition to concrete for 20 feet on either side on the inlet. The northern run-on diversion channel and the runoff channel will both be trapezoidal channels (2-foot bottom width with 2:1 side slopes) that will be lined with grouted rip-rap due to their steep slopes, upwards of 25%.

4.2 Culvert Sizing

The culverts and downdrains were sized using the computer programs Culvert Master, Flowmaster, and various MS Excel spreadsheets developed by GLA. The detailed calculations and report sheets for open channel and other drainage structure sizing are included in Appendix E. Calculations generally included the following:

- Required sizes of new downdrains to be installed at various closures.
- Required size of new culvert section (Culvert #1) being installed as part of Cell 5B-E excavation project.
- Verify the required size of the existing section of Culvert #1 that was installed during Cell 5A construction.

- Required size of new culvert section (Culvert #2) that will direct western drainage stormwater to the proposed pond south of future Cell 6.

The detailed recommendations are included in the Hydraulic Drainage Structure summary table, located in Appendix E. In summary, it was determined that 18 inch diameter HDPE pipes with smooth interiors should have sufficient capacity for all downdrain pipe sections however, GLA recommends that the landfill consider using 24 inch diameter downdrain pipes for an added factor of safety and to address possible operational issues that may arise. The new section of Culvert #1 was designed as a 24 inch diameter HDPE pipe with smooth interior. The existing sections of Culvert #1 were checked to account for the increase in design flows anticipated by use of temporary plastic tarps. Based on the assumptions of the current analysis, it was calculated that the existing sections of Culvert #1 should be sufficient for the additional anticipated flows. Finally, Culvert #2, which services the western drainage going to the proposed pond south of future Cell 6 was designed to ultimately have a size of a 48 inch diameter HDPE inlet and culvert with smooth interior. The capacity of this culvert may be accomplished through a combination of multiple smaller pipes and inlets, which, if implemented, should be re-analyzed upon the design of Cell 6.

4.3 Western Detention Pond

Runoff from the west side of the facility is to be diverted through a detention pond and biofilter strip to mitigate the increase in peak flow and sediment load due to site development. The detention pond was sized using HydroCAD V10.00 developed by HydroCAD Software Solutions. HydroCAD utilizes the TR-55 methodology (as described above) to calculate peak flow rates, runoff volumes, and runoff hydrographs. See Appendix F for the detention pond sizing analysis and Appendix G for the pond design drawings and details.

The proposed detention pond is located on the southwest end of the site, near future Cell 6, to the south of Coffin Butte Road. The detention pond is approximately 300-feet long with a 70-foot bottom width that slopes at 3% from the east to the west. The interior of the pond is configured with 3 to 1 (horizontal to vertical) side slopes with a maximum depth that ranges in height from 7.3-feet to 15.5-feet (at zero freeboard).

The outlet consists of a 48-inch diameter stand pipe with 3 tiers of orifice holes and a 36-inch diameter outlet culvert to pass flow into the downstream biofiltration strip. The lower tier consists of a single 12-inch diameter orifice, the middle tier consists of two 6-inch diameter orifice holes, and the upper tier consists of two 6-inch diameter orifice holes. The 36-inch diameter outlet culvert has capacity to pass the 25-year, 24-hour peak flow with 6.9-feet of head, which is 3.6-feet below the top of the stand pipe. The 48-inch diameter stand pipe has the capacity to pass the 25-year, 24-hour peak flow with 1.4-feet of head, which is 0.6-feet below the emergency overflow weir crest and provides 2.6-feet of freeboard.

An emergency overflow weir has been designed to pass flow during a larger than design storm event and/or in the case of plugging of the orifice or stand pipe. The overflow weir has capacity to pass the design storm with less than 1.25-feet of head while still providing 0.75-feet of freeboard.

Attenuated discharge from the 36-inch diameter detention pond outlet culvert goes into the biofiltration strip where it is slowed and spread by a tee at the outlet and short concrete weir. The biofiltration strip is designed as a swale that is approximately 540-feet long that ranges from 70-feet to 100-feet in width, with 3 to 1 (horizontal to vertical) sideslopes that slope at 0.5% from east to west. The normal depth of attenuated 25-year, 24-hour flow was calculated to be 0.3-feet at a velocity of 1 ft/s. The shallow depth and low velocities will allow any remaining sediment or other pollutants not retained within the detention pond to further settle out before being discharged offsite. The designed swale performance for runoff generated from the 50% of the 2-year, 24-hour storm event is compared to typical swale performance guidelines at the end of Appendix F.

As part of the permitting process for the western detention pond and swale, runoff/discharge amounts were calculated for pre- and post-development conditions at multiple storm flows. Based on the State of Oregon and SLOPES requirements, storm flows to be evaluated consist of the following: 33% of the 2-year, 24-hour event, 42% of the 2-year, 24-hour event, and 50% of the 2-year, 24-hour, 5-year, 24-hour, 10-year, 24-hour, and 25-year, 24-hour storm events. These storm events were modeled using HydroCAD, as described above. Figure 1 shows the pre-development hydrologic sub-area as delineated around the existing rock quarry area, and Figure 2 shows the post-development hydrologic sub-areas. It was conservatively assumed that the runoff CN for the pre-development area is 79. The pre- and post-development runoff/discharge rate comparison is summarized in a table near the end of Appendix F. Based on results presented in Appendix F and associated assumptions, it can be concluded that the post-development discharge from the detention pond is lower than the pre-development condition.

5.0 REFERENCES

Bentley Systems, Inc. (2014). “Bentley Culvert Master V3.3”, Watertown, Connecticut.

Bentley Systems, Inc. (2009). “Bentley FlowMaster V8i (SELECT series 1)”, Watertown, Connecticut.

Goldman, Steven J., Jackson, Katherine, and Bursztynsky, Tara A. (1986). *“Erosion and Sediment Control Handbook”*, McGraw-Hill, Inc. pp 5.1 – 5.33.

HydroCAD Software Solutions LLC, “HydroCAD V10.00”, Chocorua, New Hampshire.

HBH Consulting Engineers (2010). "Storm Water Calculations," Valley Landfills, Inc, Coffin Butte Landfill, Job # 2010-030, November 30, 2010.

Thiel Engineering (2000). "Final Closure Drainage," Coffin Butte LF, February 27, 2000.

Thiel Engineering (2013). "Year 2011 Site Development Plan Amendment 1," Coffin Butte Landfill, Benton County, Oregon, October 29, 2013.

FIGURES

LEGEND

- EXISTING 10 FT CONTOUR
- EXISTING 2 FT CONTOUR
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- CULVERT/DOWNDRAIN
- 25-YR STORM FLOW
- CONCENTRATION POINT
- HYDROLOGIC SUB-AREA
- HYDROLOGIC SUB-AREA

NOTES:
1. EXISTING TOPOGRAPHY BASED ON AERIAL SURVEY BY COOPER AERIAL SURVEYS CO. ON APRIL 7, 2014, UPDATED BY GROUND SURVEY PERFORMED BY NORTHSTAR SURVEYING, INC. ON JANUARY 27, 2015.

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
A	10/08/15	ISSUED FOR REVIEW	BGA	BGA	AO	AO

DATE OF ISSUE: 10/08/2015
DESIGNED BY: BGA
DRAWN BY: BGA
CHECKED BY: AO
APPROVED BY: AO

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VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL
STORMWATER MASTER PLAN REVISION
BENTON COUNTY, OREGON

PRE-DEVELOPMENT DRAINAGE PLAN

FIGURE NO. 1

PROJECT NO. 2015.A021

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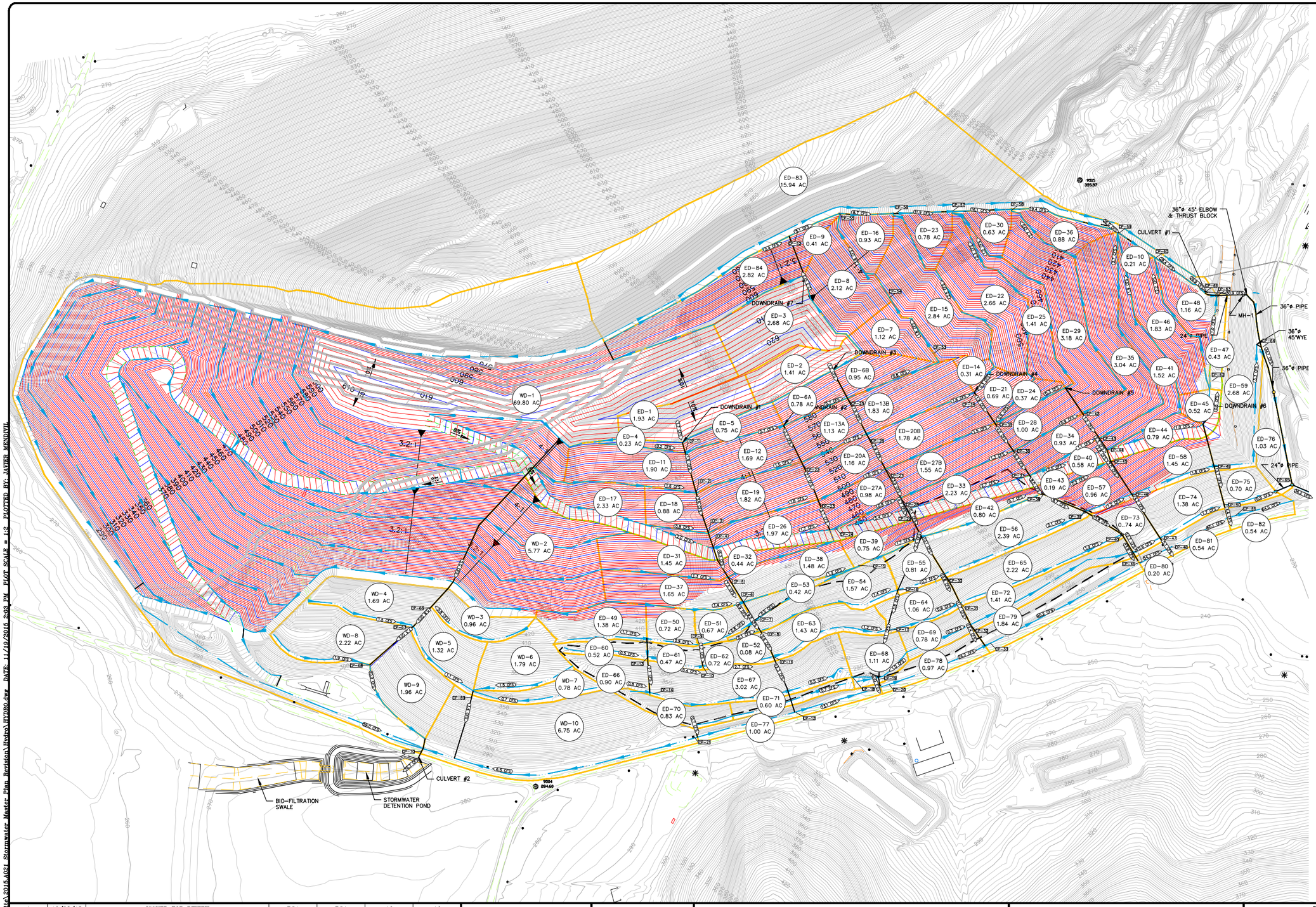

NOTES:
1. EXISTING TOPOGRAPHY BASED ON AERIAL SURVEY BY COOPER AERIAL SURVEYS CO. ON APRIL 7, 2014, UPDATED BY GROUND SURVEY PERFORMED BY NORTHSTAR SURVEYING, INC. ON JANUARY 27, 2015.

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VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL
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BENTON COUNTY, OREGON
FINAL CLOSURE DRAINAGE PLAN

FIGURE NO. 2
PROJECT NO. 2015.A021

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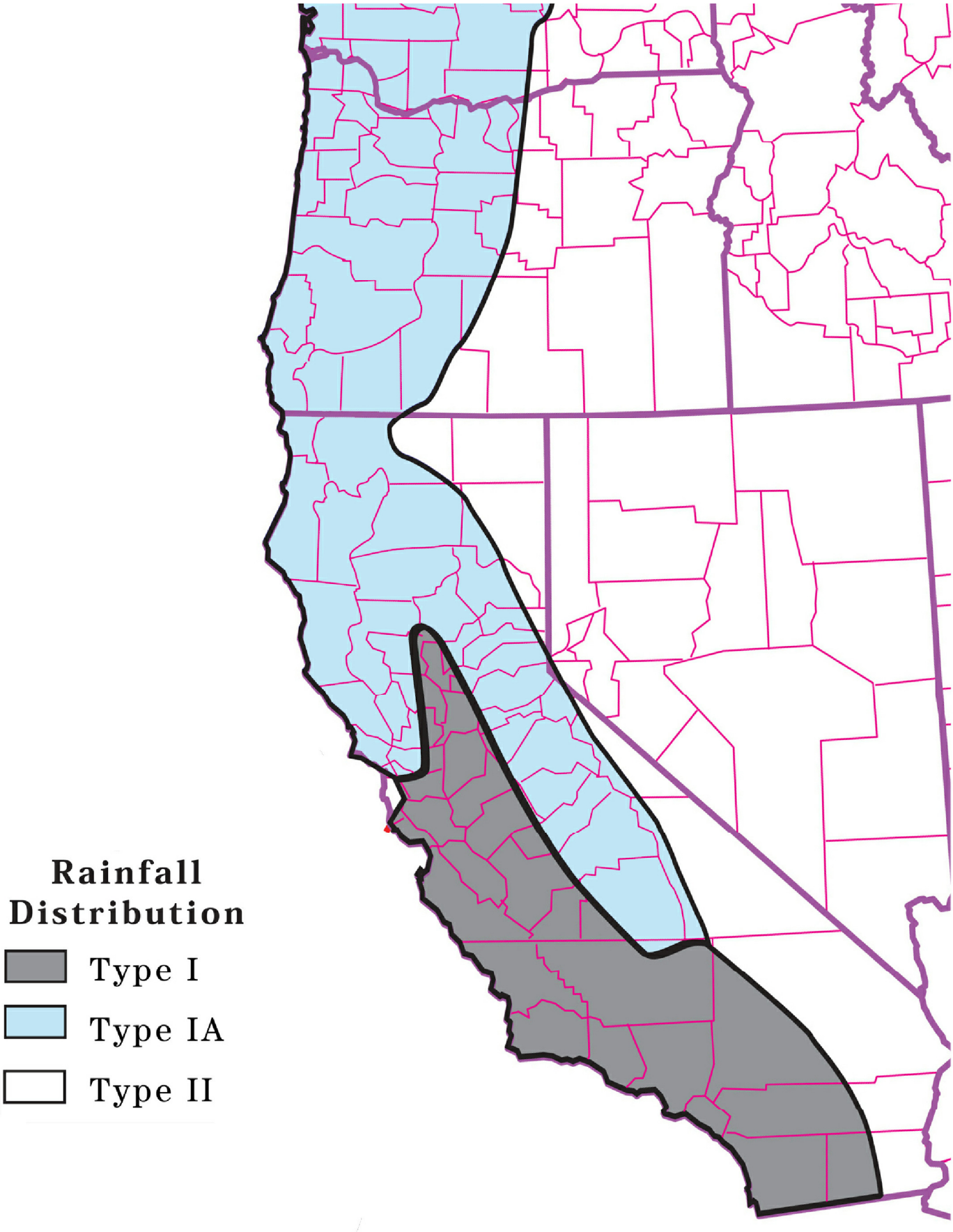

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DATE OF ISSUE: 03/30/2015
DESIGNED BY: BGA
DRAWN BY: BGA
CHECKED BY: AO
APPROVED BY: AO

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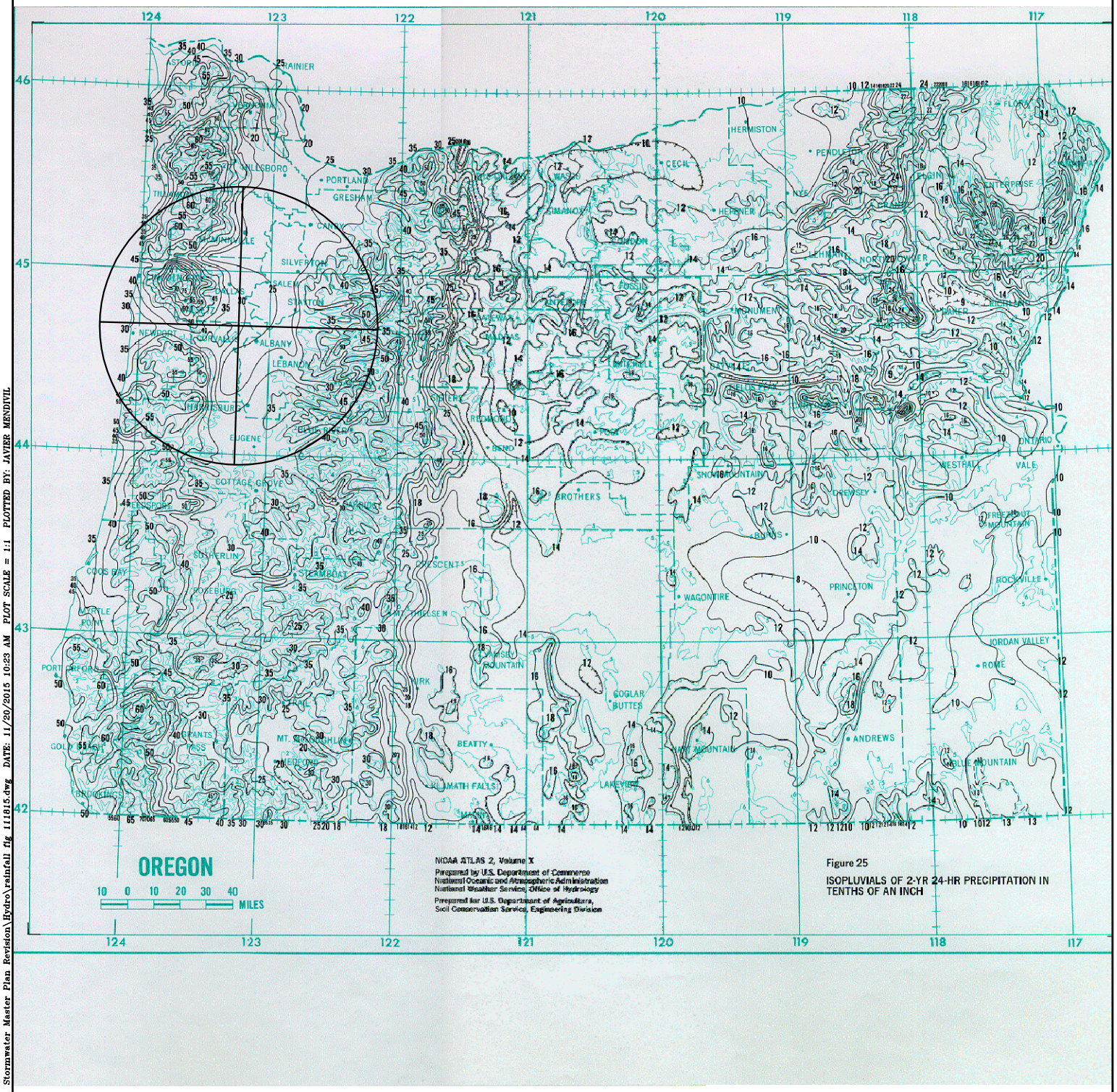
STORMWATER MASTER PLAN REVISION
BENTON COUNTY, OREGON

SCS RAINFALL DISTRIBUTION

FIGURE NO.
3

PROJECT NO.
2015.A021

ISSUED FOR REVIEW



2–YEAR 24–HOUR STORM = 3.10 IN.

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DATE OF ISSUE: 03/30/2015
DESIGNED BY: BGA
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CHECKED BY: AO
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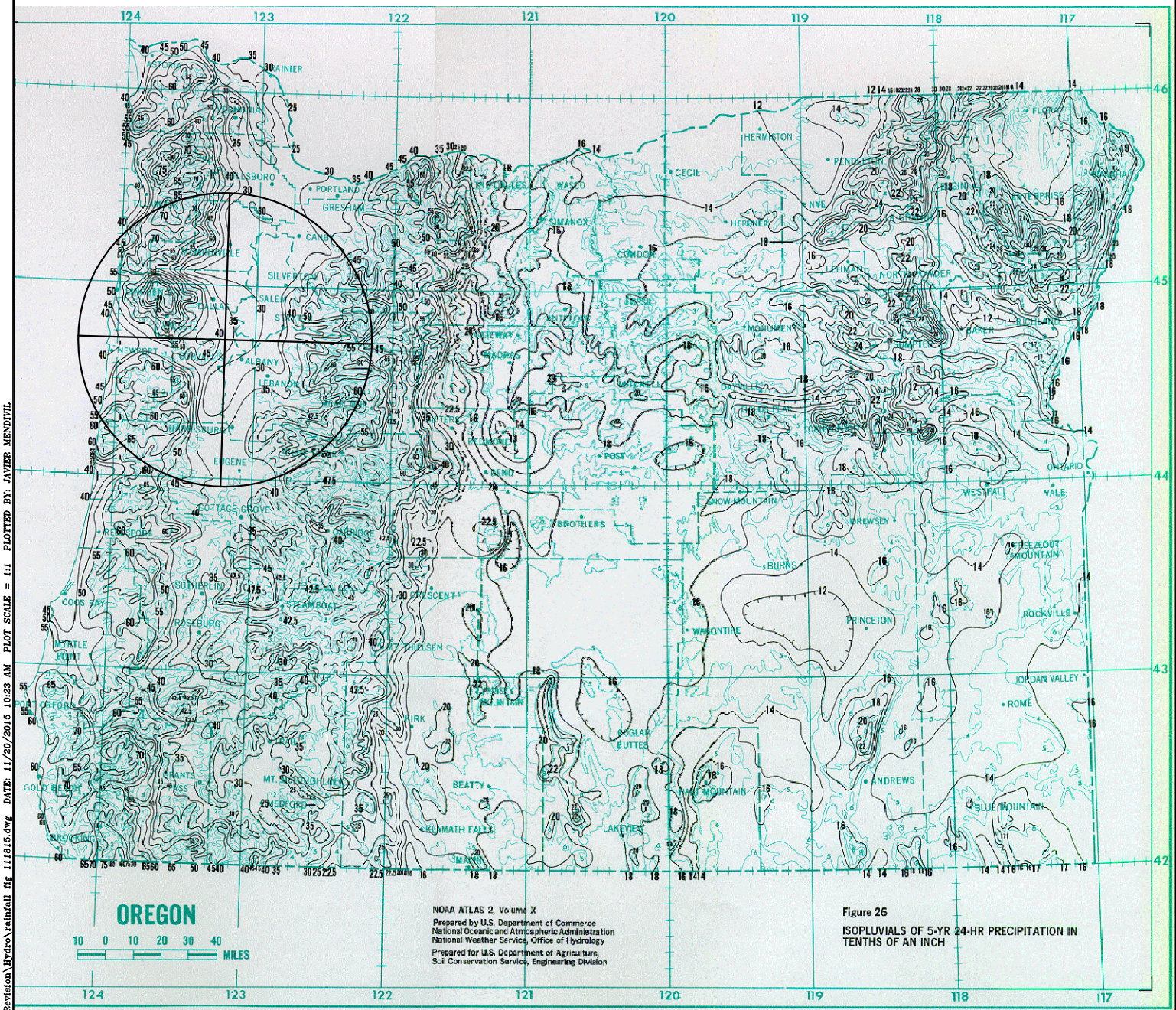
COFFIN BUTTE LANDFILL
STORMWATER MASTER PLAN REVISION
BENTON COUNTY, OREGON

2–YR 24–HR RAINFALL DISTRIBUTION MAP

FIGURE NO. 4

PROJECT NO. 2015.A021

ISSUED FOR REVIEW



5–YEAR 24–HOUR STORM = 3.8 IN

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DATE OF ISSUE: 03/30/2015
DESIGNED BY: BGA
DRAWN BY: BGA
CHECKED BY: AO
APPROVED BY: AO

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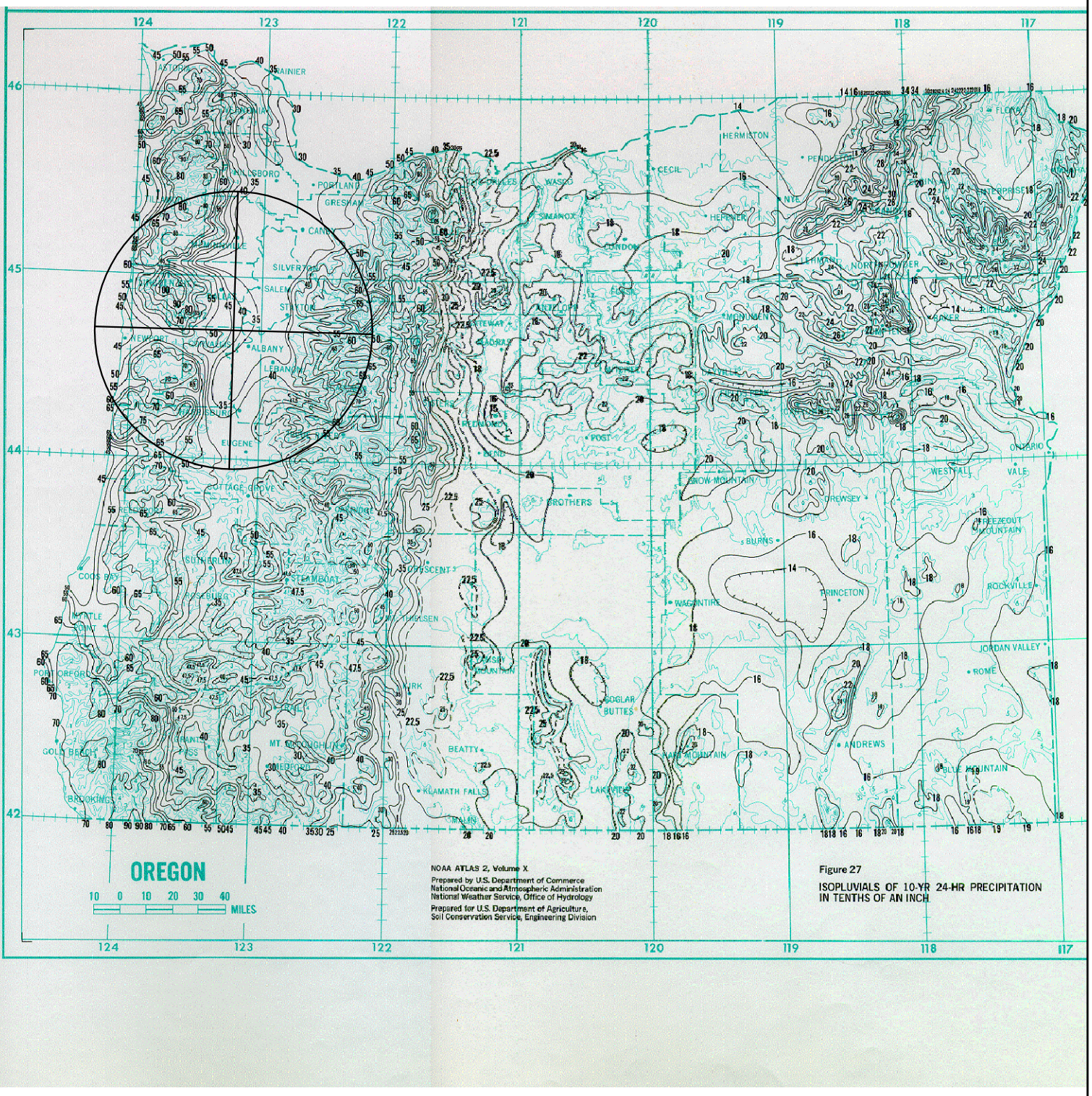
COFFIN BUTTE LANDFILL
STORMWATER MASTER PLAN REVISION
BENTON COUNTY, OREGON

5–YR 24–HR RAINFALL DISTRIBUTION MAP

FIGURE NO. 5

PROJECT NO. 2015.A021

ISSUED FOR REVIEW



10–YEAR 24–HOUR STORM = 4.4 IN.

LOCATION: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\rainfall fig 111815.dwg DATE: 11/20/2015 10:22 AM PLOT SCALE = 1:1 PLOTTED BY: JAVIER MENDIVIL

DATE OF ISSUE: 03/30/2015
DESIGNED BY: BGA
DRAWN BY: BGA
CHECKED BY: AO
APPROVED BY: AO

Geo-Logic ASSOCIATES
143E Spring Hill Dr, Grass Valley, California 95945
geo-logic.com | 530.272.2448

COFFIN BUTTE LANDFILL
STORMWATER MASTER PLAN REVISION
BENTON COUNTY, OREGON

10–YR 24–HR RAINFALL DISTRIBUTION MAP

FIGURE NO. **6**

PROJECT NO. 2015.A021

ISSUED FOR REVIEW

25–YEAR 24–HOUR STORM = 5.10 IN.

LOCATION: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\rainfall fig 111815.dwg DATE: 11/20/2015 10:22 AM PLOT SCALE = 1:1 PLOTTED BY: JAVIER MENDIVIL

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COFFIN BUTTE LANDFILL
STORMWATER MASTER PLAN REVISION
BENTON COUNTY, OREGON

25–YR 24–HR RAINFALL DISTRIBUTION MAP

FIGURE NO. 7

PROJECT NO. 2015.A021

ISSUED FOR REVIEW

APPENDIX A

DRAINAGE CALCULATION WORKSHEETS

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-1 Area (acres): 1.93

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	10.00	SHEET	
48	10.00	SHALLOW	
307	0.50	CHANNEL	1.72

Sub-Area Name: ED-2 Area (acres): 1.41

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	10.00	SHEET	
48	10.00	SHALLOW	
63	0.50	CHANNEL	1.60

Sub-Area Name: ED-3 Area (acres): 2.68

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	10.00	SHEET	
138	10.00	SHALLOW	
429	0.50	CHANNEL	1.90

Sub-Area Name: ED-4 Area (acres): 0.23

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
41	25.00	SHEET	
13	3.00	CHANNEL	2.34

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-5 Area (acres): 0.75

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
7	25.00	SHALLOW	

Sub-Area Name: ED-6A Area (acres): 0.78

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
29	25.00	SHALLOW	

Sub-Area Name: ED-6B Area (acres): 0.95

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
53	25.00	SHALLOW	
264	3.00	CHANNEL	3.30

Sub-Area Name: ED-7 Area (acres): 1.12

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
122	24.59	SHALLOW	
79	3.00	CHANNEL	3.30

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-8 Area (acres): 2.12

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
133	25.00	SHALLOW	
447	3.00	CHANNEL	3.93

Sub-Area Name: ED-9 Area (acres): 0.41

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
73	31.25	SHALLOW	
232	3.00	CHANNEL	2.78

Sub-Area Name: ED-10 Area (acres): 0.21

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
28	31.25	SHALLOW	

Sub-Area Name: ED-11 Area (acres): 1.90

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
70	25.00	SHALLOW	
395	3.00	CHANNEL	3.93

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-12 Area (acres): 1.69

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	24.00	SHEET	
72	24.00	SHALLOW	
457	3.00	CHANNEL	3.93

Sub-Area Name: ED-13A Area (acres): 1.13

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
68	25.00	SHALLOW	
295	3.00	CHANNEL	
			1.00

Sub-Area Name: ED-13B Area (acres): 1.83

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
71	25.00	SHALLOW	
480	3.00	CHANNEL	3.93

Sub-Area Name: ED-14 Area (acres): 0.31

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
69	25.00	SHALLOW	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-15 Area (acres): 2.84

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	22.60	SHEET	
121	22.60	SHALLOW	
252	3.00	CHANNEL	4.35
279	8.00	CHANNEL	6.28

Sub-Area Name: ED-16 Area (acres): 0.93

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
92	25.00	SHEET	
178	25.00	SHALLOW	

Sub-Area Name: ED-17 Area (acres): 2.33

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
62	25.00	SHALLOW	

Sub-Area Name: ED-18 Area (acres): 0.88

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
62	25.00	SHALLOW	
263	3.00	CHANNEL	3.30

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-19 Area (acres): 1.82

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	24.56	SHEET	
74	24.56	SHALLOW	
477	3.00	CHANNEL	3.65

Sub-Area Name: ED-20A Area (acres): 1.16

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
70	25.00	SHALLOW	
308	3.00	CHANNEL	3..3

Sub-Area Name: ED-20B Area (acres): 1.78

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
67	25.00	SHALLOW	
494	3.00	CHANNEL	3.65

Sub-Area Name: ED-21 Area (acres): 0.69

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
65	25.00	SHALLOW	
148	8.00	CHANNEL	4.01

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-22 Area (acres): 2.66

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
63	25.00	SHALLOW	
714	7.84	CHANNEL	5.95

Sub-Area Name: ED-23 Area (acres): 0.78

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	28.00	SHEET	
157	26.75	SHALLOW	

Sub-Area Name: ED-24 Area (acres): 0.37

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
91	31.25	SHEET	
83	3.00	CHANNEL	2.34

Sub-Area Name: ED-25 Area (acres): 1.41

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
18	31.25	SHALLOW	
826	3.00	CHANNEL	3.30

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-26 Area (acres): 1..97

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
35	31.25	SHALLOW	

Sub-Area Name: ED-27A Area (acres): 0.98

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
35	31.25	SHALLOW	
321	3.00	CHANNEL	3.07

Sub-Area Name: ED-27B Area (acres): 1.55

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
35	31.25	SHALLOW	
508	3.00	CHANNEL	3.40

Sub-Area Name: ED-28 Area (acres): 1.00

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
38	31.25	SHALLOW	
328	3.00	CHANNEL	2.86

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-29 Area (acres): 3.18

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
29	31.25	SHALLOW	
1155	3.00	CHANNEL	4.27

Sub-Area Name: ED-30 Area (acres): 0.63

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
15	31.25	SHALLOW	
93	28.24	SHALLOW	

Sub-Area Name: ED-31 Area (acres): 1.45

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
60	31.25	SHALLOW	
427	3.00	CHANNEL	3.40

Sub-Area Name: ED-32 Area (acres): 0.44

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
83	31.25	SHEET	
468	3.00	CHANNEL	
			0.25

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-33 Area (acres): 2.23

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
24	31.25	SHALLOW	

Sub-Area Name: ED-34 Area (acres): 0.93

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
23	31.25	SHALLOW	
329	3.00	CHANNEL	4.50

Sub-Area Name: ED-35 Area (acres): 3.04

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
27	31.25	SHALLOW	
682	3.00	CHANNEL	7.43
391	8.00	CHANNEL	10.72

Sub-Area Name: ED-36 Area (acres): 0.88

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
48	31.25	SHALLOW	
137	3.00	CHANNEL	3.17

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-37 Area (acres): 1.65

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
36	31.25	SHALLOW	
578	2.42	CHANNEL	

Sub-Area Name: ED-38 Area (acres): 1.48

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	34.00	SHEET	
23	34.78	SHALLOW	
484	3.72	CHANNEL	

Sub-Area Name: ED-39 Area (acres): 0.75

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	34.00	SHEET	
28	28.57	SHALLOW	
308	3.90	CHANNEL	

Sub-Area Name: ED-40 Area (acres): 0.58

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
57	31.25	SHEET	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-41 Area (acres): 1.52

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
57	31.25	SHEET	
1160	3.00	CHANNEL	5.92

Sub-Area Name: ED-42 Area (acres): 0.80

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
82	34.15	SHEET	
532	4.89	CHANNEL	4.08

Sub-Area Name: ED-43 Area (acres): 0.19

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
37	43.24	SHEET	
318	2.52	CHANNEL	2.81

Sub-Area Name: ED-44 Area (acres): 0.79

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
63	31.25	SHEET	
81	9.00	CHANNEL	5.13

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-45 Area (acres): 0.52

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
17	31.25	SHALLOW	
76	9.00	CHANNEL	2.87

Sub-Area Name: ED-46 Area (acres): 1.83

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
32	31.25	SHALLOW	
632	3.00	CHANNEL	3.36

Sub-Area Name: ED-47 Area (acres): 0.43

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
392	6.63	CHANNEL	3.85

Sub-Area Name: ED-48 Area (acres): 1.16

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
33	31.25	SHALLOW	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-49 Area (acres): 1.38

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	30.00	SHEET	
10	30.00	SHALLOW	
331	3.63	CHANNEL	6.37

Sub-Area Name: ED-50 Area (acres): 0.72

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	32.00	SHEET	
43	23.26	SHALLOW	
220	2.73	CHANNEL	5.17

Sub-Area Name: ED-51 Area (acres): 0.67

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
94	34.04	SHEET	
243	3.29	CHANNEL	5.16

Sub-Area Name: ED-52 Area (acres): 0.08

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
42	33.33	SHEET	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Sub-Area Name: ED-53 Area (acres): 0.42

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
90	31.11	SHEET	

Sub-Area Name: ED-54 Area (acres): 1.57

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	26.00	SHEET	
55	36.36	SHALLOW	

Sub-Area Name: ED-55 Area (acres): 0.81

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	26.00	SHEET	
55	36.36	SHALLOW	
204	3.92	CHANNEL	3.50

Sub-Area Name: ED-56 Area (acres): 2.39

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	22.00	SHEET	
81	33.33	SHALLOW	
642	4.21	CHANNEL	4.59

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Sub-Area Name: ED-57 Area (acres): 0.96

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
40	31.25	SHALLOW	
187	7.00	CHANNEL	7.37

Sub-Area Name: ED-58 Area (acres): 1.45

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.25	SHEET	
64	31.25	SHALLOW	
362	6.63	CHANNEL	7.98

Sub-Area Name: ED-59 Area (acres): 2.68

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	37.00	SHEET	
17	35.29	SHALLOW	
658	5.32	CHANNEL	8.73

Sub-Area Name: ED-60 Area (acres): 0.52

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
56	32.14	SHEET	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Sub-Area Name: ED-61 Area (acres): 0.47

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
56	32.14	SHEET	
234	4.27	CHANNEL	3.26

Sub-Area Name: ED-62 Area (acres): 0.72

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
90	28.89	SHEET	
298	4.70	CHANNEL	3.38

Sub-Area Name: ED-63 Area (acres): 1.43

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	28.00	SHEET	
15	26.67	SHALLOW	
506	4.74	CHANNEL	4.03

Sub-Area Name: ED-64 Area (acres): 1.06

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	26.00	SHEET	
22	27.27	SHALLOW	
329	4.56	CHANNEL	3.98

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Sub-Area Name: ED-65 Area (acres): 2.22

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	32.00	SHEET	
20	30.00	SHALLOW	
733	4.77	CHANNEL	4.81

Sub-Area Name: ED-66 Area (acres): 0.90

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	33.00	SHEET	
32	25.00	SHALLOW	

Sub-Area Name: ED-67 Area (acres): 3.02

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	33.00	SHEET	
32	25.00	SHALLOW	
895	6.37	CHANNEL	5.67

Sub-Area Name: ED-68 Area (acres): 1.11

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	38.00	SHEET	
95	22.11	SHALLOW	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Sub-Area Name: ED-69 Area (acres): 0.78

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
95	34.74	SHEET	

Sub-Area Name: ED-70 Area (acres): 0.83

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
81	38.27	SHEET	

Sub-Area Name: ED-71 Area (acres): 0.60

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
57	36.84	SHEET	
523	3.82	CHANNEL	3.12

Sub-Area Name: ED-72 Area (acres): 1.41

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
53	52.83	SHEET	
766	4.96	CHANNEL	4.10

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
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Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-73 Area (acres): 0.74

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	44.00	SHEET	
93	21.51	SHALLOW	

Sub-Area Name: ED-74 Area (acres): 1.38

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	44.00	SHEET	
93	21.51	SHALLOW	
303	0.66	CHANNEL	1.92

Sub-Area Name: ED-75 Area (acres): 0.70

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	34.00	SHEET	
49	16.33	SHALLOW	
221	0.50	CHANNEL	1.46

Sub-Area Name: ED-76 Area (acres): 1.03

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	29.00	SHEET	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-77 Area (acres): 1.00

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
17	50.00	SHEET	
742	2.70	CHANNEL	3.27

Sub-Area Name: ED-78 Area (acres): 0.97

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
469	3.41	CHANNEL	3.32

Sub-Area Name: ED-79 Area (acres): 1.84

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
78	50.00	SHEET	
728	2.20	CHANNEL	3.35

Sub-Area Name: ED-80 Area (acres): 0.20

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
36	50.00	SHEET	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: ED-81 Area (acres): 0.54

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
36	50.00	SHEET	

Sub-Area Name: ED-82 Area (acres): 0.54

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
36	50.00	SHEET	

Sub-Area Name: ED-83 Area (acres): 15.94

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	21.00	SHEET	
232	50.86	SHALLOW	
1134	3.00	CHANNEL	4.64
1560	17.31	CHANNEL	8.95

Sub-Area Name: ED-84 Area (acres): 2.82

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
21	10.00	SHEET	
122	31.25	SHALLOW	
446	3.00	CHANNEL	4.47

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: WD-1 Area (acres): 69.80

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	10.00	SHEET	
145	10.00	SHALLOW	
5090	5.78	CHANNEL	12.09

Sub-Area Name: WD-2 Area (acres): 5.77

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	25.00	SHEET	
100	25.00	SHALLOW	
645	3.00	CHANNEL	5.08

Sub-Area Name: WD-3 Area (acres): 0.96

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
93	33.3.3	SHEET	

Sub-Area Name: WD-4 Area (acres): 1.69

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	33.33	SHEET	
68	33.33	SHALLOW	

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: WD-5 Area (acres): 1.32

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	33.33	SHEET	
114	33.33	SHALLOW	

Sub-Area Name: WD-6 Area (acres): 1.79

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	22.00	SHEET	
172	11.63	SHALLOW	
285	6.67	CHANNEL	5.08

Sub-Area Name: WD-7 Area (acres): 0.78

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
93	24.73	SHEET	
447	2.24	CHANNEL	2.56

Sub-Area Name: WD-8 Area (acres): 2.22

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	32.00	SHEET	
128	23.44	SHALLOW	
258	5.04	CHANNEL	4.91

Project: Coffin Butte Landfill - Stormwater Master Plan Revision
Client: Valley Landfills, Inc.
Job No: 2015.A021

Calculated By: BGA
Date: 03/12/2015

Sub-Area Name: WD-9 Area (acres): 1.96

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	26.00	SHEET	
226	15.93	SHALLOW	
394	5.08	CHANNEL	4.76

Sub-Area Name: WD-10 Area (acres): 6.75

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)
100	31.00	SHEET	
190	22.63	SHALLOW	
541	1.11	CHANNEL	3.66

Sub-Area Name: _____ Area (acres): _____

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)

Sub-Area Name: _____ Area (acres): _____

Drainage Length (feet)	Slope (%)	Flow Type (sheet / shallow / channel)	Approximate Velocity (fps)

APPENDIX B

TR-55 OUTPUT

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-01.w55

Date: 3/17/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-1		Outlet	1.93	84	.14
ED-2		Outlet	1.41	84	.101
ED-3		Outlet	2.68	84	.158
ED-4		Outlet	0.23	84	0.1
ED-5		Outlet	0.75	84	0.1
ED-6A		Outlet	0.78	84	0.1
ED-6B		Outlet	0.95	84	0.1
ED-7		Outlet	1.12	84	0.1
ED-8		Outlet	2.12	84	0.1
ED-9		Outlet	0.41	84	0.1

Total area: 12.38 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-02.w55

Date: 3/17/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-10		Outlet	0.21	84	0.1
ED-11		Outlet	1.9	84	0.1
ED-12		Outlet	1.69	84	0.1
ED-13A		Outlet	1.13	84	0.1
ED-13B		Outlet	1.83	84	0.1
ED-14		Outlet	0.31	84	0.1
ED-15		Outlet	2.84	84	0.1
ED-16		Outlet	0.93	84	0.1
ED-17		Outlet	2.33	84	0.1
ED-18		Outlet	0.88	84	0.1

Total area: 14.05 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-03.w55

Date: 3/17/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-19		Outlet	1.82	84	.1
ED-20A		Outlet	1.16	84	0.1
ED-20B		Outlet	1.78	84	.1
ED-21		Outlet	0.69	84	0.1
ED-22		Outlet	2.66	84	0.1
ED-23		Outlet	0.78	84	0.1
ED-24		Outlet	0.37	84	0.1
ED-25		Outlet	1.41	84	.126
ED-26		Outlet	1.97	84	0.1
ED-27A		Outlet	0.98	84	0.1

Total area: 13.62 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-04.w55

Date: 3/17/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-27B		Outlet	1.55	84	0.1
ED-2B		Outlet	1	84	0.1
ED-29		Outlet	3.18	84	.131
ED-30		Outlet	0.63	84	0.1
ED-31		Outlet	1.45	84	0.1
ED-32		Outlet	0.44	84	.102
ED-33		Outlet	2.23	98	0.1
ED-34		Outlet	0.93	98	0.1
ED-35		Outlet	3.04	98	0.1
ED-36		Outlet	0.88	98	0.1

Total area: 15.33 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-04B.w55

Date: 3/24/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-37		Outlet	1.65	84	.112
ED-3B		Outlet	1.48	84	.101
ED-39		Outlet	1.39	84	0.1
ED-40		Outlet	0.58	84	0.1

Total area: 5.10 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-05.w55

Date: 3/17/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-41		Outlet	1.52	98	.103
ED-42		Outlet	0.8	84	0.1
ED-43		Outlet	0.19	98	0.1
ED-44		Outlet	0.79	98	0.1
ED-45		Outlet	0.52	98	0.1
ED-46		Outlet	1.83	98	0.1
ED-47		Outlet	0.43	84	0.1
ED-48		Outlet	1.16	98	0.1
ED-49		Outlet	1.38	98	0.1
ED-50		Outlet	0.72	98	0.1

Total area: 9.34 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-06.w55

Date: 3/18/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-51		Outlet	0.67	98	0.1
ED-52		Outlet	0.08	98	0.1
ED-53		Outlet	0.42	98	0.1
ED-54		Outlet	1.57	84	0.1
ED-55		Outlet	0.81	84	0.1
ED-56		Outlet	2.39	84	.105
ED-57		Outlet	0.96	98	0.1
ED-58		Outlet	1.45	98	0.1
ED-59		Outlet	2.68	98	0.1
ED-60		Outlet	0.52	84	0.1

Total area: 11.55 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-07.w55

Date: 3/18/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-61		Outlet	0.47	84	0.1
ED-62		Outlet	0.72	84	0.1
ED-63		Outlet	1.43	84	0.1
ED-64		Outlet	1.06	84	0.1
ED-65		Outlet	2.22	84	0.1
ED-66		Outlet	0.9	84	0.1
ED-67		Outlet	3.02	84	0.1
ED-68		Outlet	1.11	84	0.1
ED-69		Outlet	0.78	84	0.1
ED-70		Outlet	0.83	84	0.1

Total area: 12.54 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-08.w55

Date: 3/18/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-71		Outlet	0.83	84	0.1
ED-72		Outlet	1.41	84	0.1
ED-73		Outlet	0.74	98	0.1
ED-74		Outlet	1.38	98	0.1
ED-75		Outlet	0.7	98	0.1
ED-76		Outlet	1.03	98	0.1
ED-77		Outlet	1	84	0.1
ED-78		Outlet	0.97	84	0.1
ED-79		Outlet	1.84	84	0.1
ED-80		Outlet	0.2	98	0.1

Total area: 10.10 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-09.w55

Date: 3/18/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
ED-81		Outlet	0.54	98	0.1
ED-82		Outlet	0.54	98	0.1
ED-83		Outlet	15.94	84	.187
ED-84		Outlet	2.82	84	0.1
WD-1		Outlet	69.8	84	.212
WD-2		Outlet	5.77	84	0.1
WD-3		Outlet	0.96	84	0.1
WD-4		Outlet	1.69	84	0.1
WD-5		Outlet	1.32	84	0.1
WD-6		Outlet	1.79	84	0.1

Total area: 101.17 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

WinTR-55 Current Data Description

--- Identification Data ---

User: BGA
Project: Coffin Butte Landfill
SubTitle: Stormwater Master Plan Revision
State: Oregon
County: Benton
Filename: N:\Coffin Butte\2015.A021 Stormwater Master Plan Revision\Hydro\TR-55\25YR-10.w55

Date: 3/18/2015
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
WD-7		Outlet	0.78	84	.106
WD-8		Outlet	2.22	84	0.1
WD-9		Outlet	1.96	84	0.1
WD-10		Outlet	6.75	84	.103

Total area: 11.71 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.1	.0	.0	5.1	.0	.0	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

Coffin Butte Landfill
Stormwater Master Plan Revision
Benton County, Oregon

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-1	Open space; grass cover 50% to 75% (fair)	D	1.93	84
	Total Area / Weighted Curve Number		1.93	84
ED-2	Open space; grass cover 50% to 75% (fair)	D	1.41	84
	Total Area / Weighted Curve Number		1.41	84
ED-3	Open space; grass cover 50% to 75% (fair)	D	2.68	84
	Total Area / Weighted Curve Number		2.68	84
ED-4	Open space; grass cover 50% to 75% (fair)	D	.23	84
	Total Area / Weighted Curve Number		.23	84
ED-5	Open space; grass cover 50% to 75% (fair)	D	.75	84
	Total Area / Weighted Curve Number		.75	84
ED-6A	Open space; grass cover 50% to 75% (fair)	D	.78	84
	Total Area / Weighted Curve Number		.78	84
ED-6B	Open space; grass cover 50% to 75% (fair)	D	.95	84
	Total Area / Weighted Curve Number		.95	84
ED-7	Open space; grass cover 50% to 75% (fair)	D	1.12	84
	Total Area / Weighted Curve Number		1.12	84
ED-8	Open space; grass cover 50% to 75% (fair)	D	2.12	84
	Total Area / Weighted Curve Number		2.12	84
ED-9	Open space; grass cover 50% to 75% (fair)	D	.41	84
	Total Area / Weighted Curve Number		.41	84

BGA

Coffin Butte Landfill
Stormwater Master Plan Revision
Benton County, Oregon

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-10	Open space; grass cover 50% to 75% (fair)	D	.21	84
	Total Area / Weighted Curve Number		.21	84
ED-11	Open space; grass cover 50% to 75% (fair)	D	1.9	84
	Total Area / Weighted Curve Number		1.9	84
ED-12	Open space; grass cover 50% to 75% (fair)	D	1.69	84
	Total Area / Weighted Curve Number		1.69	84
ED-13A	Open space; grass cover 50% to 75% (fair)	D	1.13	84
	Total Area / Weighted Curve Number		1.13	84
ED-13B	Open space; grass cover 50% to 75% (fair)	D	1.83	84
	Total Area / Weighted Curve Number		1.83	84
ED-14	Open space; grass cover 50% to 75% (fair)	D	.31	84
	Total Area / Weighted Curve Number		.31	84
ED-15	Open space; grass cover 50% to 75% (fair)	D	2.84	84
	Total Area / Weighted Curve Number		2.84	84
ED-16	Open space; grass cover 50% to 75% (fair)	D	.93	84
	Total Area / Weighted Curve Number		.93	84
ED-17	Open space; grass cover 50% to 75% (fair)	D	2.33	84
	Total Area / Weighted Curve Number		2.33	84
ED-18	Open space; grass cover 50% to 75% (fair)	D	.88	84
	Total Area / Weighted Curve Number		.88	84

BGA

Coffin Butte Landfill
Stormwater Master Plan Revision
Benton County, Oregon

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-19	Open space; grass cover 50% to 75% (fair)	D	1.82	84
	Total Area / Weighted Curve Number		1.82	84
ED-20A	Open space; grass cover 50% to 75% (fair)	D	1.16	84
	Total Area / Weighted Curve Number		1.16	84
ED-20B	Open space; grass cover 50% to 75% (fair)	D	1.78	84
	Total Area / Weighted Curve Number		1.78	84
ED-21	Open space; grass cover 50% to 75% (fair)	D	.69	84
	Total Area / Weighted Curve Number		.69	84
ED-22	Open space; grass cover 50% to 75% (fair)	D	2.66	84
	Total Area / Weighted Curve Number		2.66	84
ED-23	Open space; grass cover 50% to 75% (fair)	D	.78	84
	Total Area / Weighted Curve Number		.78	84
ED-24	Open space; grass cover 50% to 75% (fair)	D	.37	84
	Total Area / Weighted Curve Number		.37	84
ED-25	Open space; grass cover 50% to 75% (fair)	D	1.41	84
	Total Area / Weighted Curve Number		1.41	84
ED-26	Open space; grass cover 50% to 75% (fair)	D	1.97	84
	Total Area / Weighted Curve Number		1.97	84
ED-27A	Open space; grass cover 50% to 75% (fair)	D	.98	84
	Total Area / Weighted Curve Number		.98	84

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-27B	Open space; grass cover 50% to 75% (fair)	D	1.55	84
	Total Area / Weighted Curve Number		1.55	84
ED-2B	Open space; grass cover 50% to 75% (fair)	D	1	84
	Total Area / Weighted Curve Number		1	84
ED-29	Open space; grass cover 50% to 75% (fair)	D	3.18	84
	Total Area / Weighted Curve Number		3.18	84
ED-30	Open space; grass cover 50% to 75% (fair)	D	.63	84
	Total Area / Weighted Curve Number		.63	84
ED-31	Open space; grass cover 50% to 75% (fair)	D	1.45	84
	Total Area / Weighted Curve Number		1.45	84
ED-32	Open space; grass cover 50% to 75% (fair)	D	.44	84
	Total Area / Weighted Curve Number		.44	84
ED-33	Paved parking lots, roofs, driveways	D	2.23	98
	Total Area / Weighted Curve Number		2.23	98
ED-34	Paved parking lots, roofs, driveways	D	.93	98
	Total Area / Weighted Curve Number		.93	98
ED-35	Paved parking lots, roofs, driveways	D	3.04	98
	Total Area / Weighted Curve Number		3.04	98
ED-36	Paved parking lots, roofs, driveways	D	.88	98
	Total Area / Weighted Curve Number		.88	98

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-37	Open space; grass cover 50% to 75% (fair)	D	1.65	84
	Total Area / Weighted Curve Number		1.65	84
ED-3B	Open space; grass cover 50% to 75% (fair)	D	1.48	84
	Total Area / Weighted Curve Number		1.48	84
ED-39	Open space; grass cover 50% to 75% (fair)	D	1.39	84
	Total Area / Weighted Curve Number		1.39	84
ED-40	Open space; grass cover 50% to 75% (fair)	D	.58	84
	Total Area / Weighted Curve Number		.58	84

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-41	Paved parking lots, roofs, driveways	D	1.52	98
	Total Area / Weighted Curve Number		1.52	98
ED-42	Open space; grass cover 50% to 75% (fair)	D	.8	84
	Total Area / Weighted Curve Number		.8	84
ED-43	Paved; curbs and storm sewers	D	.19	98
	Total Area / Weighted Curve Number		.19	98
ED-44	Paved parking lots, roofs, driveways	D	.79	98
	Total Area / Weighted Curve Number		.79	98
ED-45	Paved parking lots, roofs, driveways	D	.52	98
	Total Area / Weighted Curve Number		.52	98
ED-46	Paved parking lots, roofs, driveways	D	1.83	98
	Total Area / Weighted Curve Number		1.83	98
ED-47	Open space; grass cover 50% to 75% (fair)	D	.43	84
	Total Area / Weighted Curve Number		.43	84
ED-48	Paved parking lots, roofs, driveways	D	1.16	98
	Total Area / Weighted Curve Number		1.16	98
ED-49	Paved parking lots, roofs, driveways	D	1.38	98
	Total Area / Weighted Curve Number		1.38	98
ED-50	Paved parking lots, roofs, driveways	D	.72	98
	Total Area / Weighted Curve Number		.72	98

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-51	Paved parking lots, roofs, driveways	D	.67	98
	Total Area / Weighted Curve Number		.67	98
ED-52	Paved parking lots, roofs, driveways	D	.08	98
	Total Area / Weighted Curve Number		.08	98
ED-53	Paved parking lots, roofs, driveways	D	.42	98
	Total Area / Weighted Curve Number		.42	98
ED-54	Open space; grass cover 50% to 75% (fair)	D	1.57	84
	Total Area / Weighted Curve Number		1.57	84
ED-55	Open space; grass cover 50% to 75% (fair)	D	.81	84
	Total Area / Weighted Curve Number		.81	84
ED-56	Open space; grass cover 50% to 75% (fair)	D	2.39	84
	Total Area / Weighted Curve Number		2.39	84
ED-57	Paved parking lots, roofs, driveways	D	.96	98
	Total Area / Weighted Curve Number		.96	98
ED-58	Paved parking lots, roofs, driveways	D	1.45	98
	Total Area / Weighted Curve Number		1.45	98
ED-59	Paved parking lots, roofs, driveways	D	2.68	98
	Total Area / Weighted Curve Number		2.68	98
ED-60	Open space; grass cover 50% to 75% (fair)	D	.52	84
	Total Area / Weighted Curve Number		.52	84

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-61	Open space; grass cover 50% to 75% (fair)	D	.47	84
	Total Area / Weighted Curve Number		.47	84
ED-62	Open space; grass cover 50% to 75% (fair)	D	.72	84
	Total Area / Weighted Curve Number		.72	84
ED-63	Open space; grass cover 50% to 75% (fair)	D	1.43	84
	Total Area / Weighted Curve Number		1.43	84
ED-64	Open space; grass cover 50% to 75% (fair)	D	1.06	84
	Total Area / Weighted Curve Number		1.06	84
ED-65	Open space; grass cover 50% to 75% (fair)	D	2.22	84
	Total Area / Weighted Curve Number		2.22	84
ED-66	Open space; grass cover 50% to 75% (fair)	D	.9	84
	Total Area / Weighted Curve Number		.9	84
ED-67	Open space; grass cover 50% to 75% (fair)	D	3.02	84
	Total Area / Weighted Curve Number		3.02	84
ED-68	Open space; grass cover 50% to 75% (fair)	D	1.11	84
	Total Area / Weighted Curve Number		1.11	84
ED-69	Open space; grass cover 50% to 75% (fair)	D	.78	84
	Total Area / Weighted Curve Number		.78	84
ED-70	Open space; grass cover 50% to 75% (fair)	D	.83	84
	Total Area / Weighted Curve Number		.83	84

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-71	Open space; grass cover 50% to 75% (fair)	D	.83	84
	Total Area / Weighted Curve Number		.83	84
ED-72	Open space; grass cover 50% to 75% (fair)	D	1.41	84
	Total Area / Weighted Curve Number		1.41	84
ED-73	Paved parking lots, roofs, driveways	D	.74	98
	Total Area / Weighted Curve Number		.74	98
ED-74	Paved parking lots, roofs, driveways	D	1.38	98
	Total Area / Weighted Curve Number		1.38	98
ED-75	Paved parking lots, roofs, driveways	D	.7	98
	Total Area / Weighted Curve Number		.7	98
ED-76	Paved parking lots, roofs, driveways	D	1.03	98
	Total Area / Weighted Curve Number		1.03	98
ED-77	Open space; grass cover 50% to 75% (fair)	D	1	84
	Total Area / Weighted Curve Number		1	84
ED-78	Open space; grass cover 50% to 75% (fair)	D	.97	84
	Total Area / Weighted Curve Number		.97	84
ED-79	Open space; grass cover 50% to 75% (fair)	D	1.84	84
	Total Area / Weighted Curve Number		1.84	84
ED-80	Paved parking lots, roofs, driveways	D	.2	98
	Total Area / Weighted Curve Number		.2	98

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Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
ED-81	Paved parking lots, roofs, driveways	D	.54	98
	Total Area / Weighted Curve Number		.54	98
ED-82	Paved parking lots, roofs, driveways	D	.54	98
	Total Area / Weighted Curve Number		.54	98
ED-83	Open space; grass cover 50% to 75% (fair)	D	15.94	84
	Total Area / Weighted Curve Number		15.94	84
ED-84	Open space; grass cover 50% to 75% (fair)	D	2.82	84
	Total Area / Weighted Curve Number		2.82	84
WD-1	Open space; grass cover 50% to 75% (fair)	D	69.8	84
	Total Area / Weighted Curve Number		69.8	84
WD-2	Open space; grass cover 50% to 75% (fair)	D	5.77	84
	Total Area / Weighted Curve Number		5.77	84
WD-3	Open space; grass cover 50% to 75% (fair)	D	.96	84
	Total Area / Weighted Curve Number		.96	84
WD-4	Open space; grass cover 50% to 75% (fair)	D	1.69	84
	Total Area / Weighted Curve Number		1.69	84
WD-5	Open space; grass cover 50% to 75% (fair)	D	1.32	84
	Total Area / Weighted Curve Number		1.32	84
WD-6	Open space; grass cover 50% to 75% (fair)	D	1.79	84
	Total Area / Weighted Curve Number		1.79	84

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Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
WD-7	Open space; grass cover 50% to 75% (fair)	D	.78	84
	Total Area / Weighted Curve Number		.78	84
WD-8	Open space; grass cover 50% to 75% (fair)	D	2.22	84
	Total Area / Weighted Curve Number		2.22	84
WD-9	Open space; grass cover 50% to 75% (fair)	D	1.96	84
	Total Area / Weighted Curve Number		1.96	84
WD-10	Open space; grass cover 50% to 75% (fair)	D	6.75	84
	Total Area / Weighted Curve Number		6.75	84

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-1							
SHEET	100	0.1000	0.150				0.087
SHALLOW	48	0.1000	0.050				0.003
CHANNEL	307					1.720	0.050
					Time of Concentration		.14
ED-2							
SHEET	100	0.1000	0.150				0.087
SHALLOW	48	0.1000	0.050				0.003
CHANNEL	63					1.600	0.011
					Time of Concentration		.101
ED-3							
SHEET	100	0.1000	0.150				0.087
SHALLOW	138	0.1000	0.050				0.008
CHANNEL	429					1.900	0.063
					Time of Concentration		.158
ED-4							
SHEET	41	0.2500	0.150				0.030
CHANNEL	13					2.340	0.002
					Time of Concentration		0.1
ED-5							
SHEET	100	0.2500	0.150				0.060
SHALLOW	7	0.2500	0.050				0.000
					Time of Concentration		0.1
ED-6A							
SHEET	100	0.2500	0.150				0.060
SHALLOW	29	0.2500	0.050				0.001
					Time of Concentration		0.1
ED-6B							
SHEET	100	0.2500	0.150				0.060
SHALLOW	53	0.2500	0.050				0.002
CHANNEL	264					3.300	0.022
					Time of Concentration		0.1
ED-7							
SHEET	100	0.2500	0.150				0.060
SHALLOW	122	0.2459	0.050				0.004
CHANNEL	79					3.300	0.007
					Time of Concentration		0.1
ED-8							

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Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SHEET	100	0.2500	0.150				0.060
SHALLOW	133	0.2500	0.050				0.005
CHANNEL	447					3.930	0.032
					Time of Concentration		0.1
ED-9							
SHEET	100	0.3125	0.150				0.055
SHALLOW	73	0.3125	0.050				0.002
CHANNEL	232					2.780	0.023
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-10							
SHEET	100	0.3125	0.150				0.055
SHALLOW	28	0.3125	0.050				0.001
					Time of Concentration		0.1
ED-11							
SHEET	100	0.2500	0.150				0.060
SHALLOW	70	0.2500	0.050				0.002
CHANNEL	395					3.930	0.028
					Time of Concentration		0.1
ED-12							
SHEET	100	0.2400	0.150				0.061
SHALLOW	72	0.2400	0.050				0.003
CHANNEL	457					3.930	0.032
					Time of Concentration		0.1
ED-13A							
SHEET	100	0.2500	0.150				0.060
SHALLOW	68	0.2500	0.050				
CHANNEL	295					3.300	0.025
					Time of Concentration		0.1
ED-13B							
SHEET	100	0.2500	0.150				0.060
SHALLOW	71	0.2500	0.050				0.002
CHANNEL	480					3.930	0.034
					Time of Concentration		0.1
ED-14							
SHEET	100	0.2500	0.150				0.060
SHALLOW	69	0.2500	0.050				0.002
					Time of Concentration		0.1
ED-15							
SHEET	100	0.2260	0.150				0.063
SHALLOW	122	0.2260	0.050				0.004
CHANNEL	252					4.350	0.016
CHANNEL	279					6.280	0.012
					Time of Concentration		0.1
ED-16							
SHEET	92	0.2500	0.150				0.057
SHALLOW	178	0.2500	0.050				0.006
					Time of Concentration		0.1

Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-17							
SHEET	100	0.2500	0.150				0.060
SHALLOW	62	0.2500	0.050				0.002
					Time of Concentration		0.1
ED-18							
SHEET	100	0.2500	0.150				0.060
SHALLOW	62	0.2500	0.050				0.002
CHANNEL	263					3.300	0.022
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-19							
SHEET	100	0.2456	0.150				0.061
SHALLOW	74	0.2456	0.050				0.003
CHANNEL	477					3.650	0.036
					Time of Concentration		.1
ED-20A							
SHEET	100	0.2500	0.150				0.060
SHALLOW	70	0.2500	0.050				0.002
CHANNEL	308					3.300	0.026
					Time of Concentration		0.1
ED-20B							
SHEET	100	0.2500	0.150				0.060
SHALLOW	67	0.2500	0.050				0.002
CHANNEL	494					3.650	0.038
					Time of Concentration		.1
ED-21							
SHEET	100	0.2500	0.150				0.060
SHALLOW	65	0.2500	0.050				
CHANNEL	148					4.010	0.010
					Time of Concentration		0.1
ED-22							
SHEET	100	0.2500	0.150				0.060
SHALLOW	63	0.2500	0.050				0.002
CHANNEL	714					5.950	0.033
					Time of Concentration		0.1
ED-23							
SHEET	100	0.2800	0.150				0.058
SHALLOW	157	0.2635	0.050				0.005
					Time of Concentration		0.1
ED-24							
SHEET	91	0.3125	0.150				0.051
CHANNEL	83					2.340	0.010
					Time of Concentration		0.1
ED-25							
SHEET	100	0.3125	0.150				0.055
SHALLOW	18	0.3125	0.050				0.001
CHANNEL	826					3.300	0.070
					Time of Concentration		.126

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Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-26							
SHEET	100	0.3125	0.150				0.055
SHALLOW	35	0.3125	0.050				0.001
					Time of Concentration		0.1
ED-27A							
SHEET	100	0.3125	0.150				0.055
SHALLOW	35	0.3125	0.050				0.001
CHANNEL	321					3.070	0.029
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-27B							
SHEET	100	0.3125	0.150				0.055
SHALLOW	35	0.3125	0.050				0.001
CHANNEL	508					3.400	0.042
					Time of Concentration		0.1
ED-2B							
SHEET	100	0.3125	0.150				0.055
SHALLOW	38	0.3125	0.050				0.001
CHANNEL	328					2.860	0.032
					Time of Concentration		0.1
ED-29							
SHEET	100	0.3125	0.150				0.055
SHALLOW	29	0.3125	0.050				0.001
CHANNEL	1155					4.270	0.075
					Time of Concentration		.131
ED-30							
SHEET	100	0.3125	0.150				0.055
SHALLOW	15	0.3125	0.050				0.000
SHALLOW	93	0.2824	0.050				0.003
					Time of Concentration		0.1
ED-31							
SHEET	100	0.3125	0.150				0.055
SHALLOW	60	0.3125	0.050				0.002
CHANNEL	427					3.400	0.035
					Time of Concentration		0.1
ED-32							
SHEET	83	0.3125	0.150				0.048
CHANNEL	468					2.400	0.054
					Time of Concentration		.102
ED-33							
SHEET	100	0.3125	0.150				0.055
SHALLOW	24	0.3125	0.050				0.001
					Time of Concentration		0.1
ED-34							
SHEET	100	0.3125	0.150				0.055
SHALLOW	23	0.3125	0.050				0.001
CHANNEL	329					4.500	0.020
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-35							
SHEET	100	0.3125	0.150				0.055
SHALLOW	27	0.3125	0.050				0.001
CHANNEL	682					7.430	0.025
CHANNEL	391					10.720	0.010
					Time of Concentration		0.1
ED-36							
SHEET	100	0.3125	0.150				0.055
SHALLOW	48	0.3125	0.050				0.001
CHANNEL	137					3.170	0.012
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-37							
SHEET	100	0.3125	0.150				0.055
SHALLOW	26	0.3125	0.050				0.001
CHANNEL	578					2.860	0.056
					Time of Concentration		.112
ED-3B							
SHEET	100	0.3400	0.150				0.053
SHALLOW	23	0.3400	0.050				0.001
CHANNEL	484					2.860	0.047
					Time of Concentration		.101
ED-39							
SHEET	100	0.3400	0.150				0.053
SHALLOW	28	0.2857	0.050				0.001
CHANNEL	308					4.270	0.020
					Time of Concentration		0.1
ED-40							
SHEET	57	0.3125	0.150				0.035
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-41							
SHEET	87	0.3125	0.150				0.049
CHANNEL	1160					5.920	0.054
					Time of Concentration		.103
ED-42							
SHEET	82	0.3415	0.150				0.045
CHANNEL	532					4.080	0.036
					Time of Concentration		0.1
ED-43							
SHEET	37	0.4324	0.011				0.003
CHANNEL	318					2.810	0.031
					Time of Concentration		0.1
ED-44							
SHEET	63	0.3125	0.011				0.005
CHANNEL	81					5.130	0.004
					Time of Concentration		0.1
ED-45							
SHEET	100	0.3125	0.011				0.007
SHALLOW	17	0.3125	0.050				0.001
CHANNEL	76					2.870	0.007
					Time of Concentration		0.1
ED-46							
SHEET	100	0.3125	0.011				0.007
SHALLOW	32	0.3125	0.050				0.001
CHANNEL	632					2.360	0.074
					Time of Concentration		0.1
ED-47							
CHANNEL	392					3.850	0.028
					Time of Concentration		0.1
ED-48							
SHEET	100	0.3125	0.011				0.007
SHALLOW	33	0.3125	0.050				0.001
					Time of Concentration		0.1

ED-49							
SHEET	100	0.3000	0.011				0.007
SHALLOW	10	0.3000	0.050				0.000
CHANNEL	331					6.370	0.014

Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
					Time of Concentration		0.1
ED-50							
SHEET	100	0.3125	0.011				0.007
SHALLOW	43	0.3125	0.050				0.001
CHANNEL	220					5.170	0.012
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-51							
SHEET	94	0.3404	0.011				0.006
CHANNEL	243					5.160	0.013
					Time of Concentration		0.1
ED-52							
SHEET	42	0.3333	0.011				0.003
					Time of Concentration		0.1
ED-53							
SHEET	90	0.3111	0.011				0.006
					Time of Concentration		0.1
ED-54							
SHEET	100	0.2600	0.150				0.059
SHALLOW	55	0.3636	0.050				0.002
					Time of Concentration		0.1
ED-55							
SHEET	100	0.2600	0.150				0.059
SHALLOW	55	0.3636	0.050				0.002
CHANNEL	204					3.500	0.016
					Time of Concentration		0.1
ED-56							
SHEET	100	0.2200	0.150				0.064
SHALLOW	81	0.3333	0.050				0.002
CHANNEL	642					4.590	0.039
					Time of Concentration		.105
ED-57							
SHEET	100	0.3125	0.011				0.007
SHALLOW	40	0.3125	0.050				0.001
CHANNEL	187					7.370	0.007
					Time of Concentration		0.1
ED-58							
SHEET	100	0.3125	0.011				0.007
SHALLOW	64	0.3125	0.050				0.002
CHANNEL	362					7.980	0.013
					Time of Concentration		0.1

ED-59							
SHEET	100	0.3700	0.011				0.006
SHALLOW	17	0.3529	0.050				0.000
CHANNEL	658					8.730	0.021

Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
					Time of Concentration		0.1
ED-60							
SHEET	56	0.3214	0.150				0.034
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-61							
SHEET	56	0.3214	0.150				0.034
CHANNEL	234					3.260	0.020
					Time of Concentration		0.1
ED-62							
SHEET	90	0.2889	0.150				0.052
CHANNEL	298					3.380	0.024
					Time of Concentration		0.1
ED-63							
SHEET	100	0.2800	0.150				0.058
SHALLOW	15	0.2667	0.050				0.001
CHANNEL	506					4.030	0.035
					Time of Concentration		0.1
ED-64							
SHEET	100	0.2600	0.150				0.059
SHALLOW	22	0.2727	0.050				0.001
CHANNEL	329					39.000	0.002
					Time of Concentration		0.1
ED-65							
SHEET	100	0.3200	0.150				0.055
SHALLOW	20	0.3000	0.050				0.001
CHANNEL	733					4.810	0.042
					Time of Concentration		0.1
ED-66							
SHEET	100	0.3300	0.150				0.054
SHALLOW	32	0.2500	0.050				0.001
					Time of Concentration		0.1
ED-67							
SHEET	100	0.3300	0.150				0.054
SHALLOW	32	0.2500	0.050				0.001
CHANNEL	895					5.670	0.044
					Time of Concentration		0.1
ED-68							
SHEET	100	0.3800	0.150				0.051
SHALLOW	95	0.2211	0.050				0.003
					Time of Concentration		0.1
ED-69							
SHEET	95	0.3474	0.150				0.051

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Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
					Time of Concentration		0.1
ED-70							
SHEET	81	0.3827	0.150				0.043
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-71							
SHEET	57	0.3684	0.150				0.033
CHANNEL	523					3.120	0.047
					Time of Concentration		0.1
ED-72							
SHEET	53	0.5283	0.150				0.027
CHANNEL	766					4.100	0.052
					Time of Concentration		0.1
ED-73							
SHEET	100	0.4400	0.011				0.006
SHALLOW	93	0.2151	0.050				0.003
					Time of Concentration		0.1
ED-74							
SHEET	100	0.4400	0.011				0.006
SHALLOW	93	0.2151	0.050				0.003
CHANNEL	303					1.920	0.044
					Time of Concentration		0.1
ED-75							
SHEET	100	0.3400	0.011				0.007
SHALLOW	49	0.1633	0.050				0.002
CHANNEL	221					1.460	0.042
					Time of Concentration		0.1
ED-76							
SHEET	100	0.2900	0.011				0.007
					Time of Concentration		0.1
ED-77							
SHEET	17	0.5000	0.150				0.011
CHANNEL	742					3.270	0.063
					Time of Concentration		0.1
ED-78							
CHANNEL	469					3.320	0.039
					Time of Concentration		0.1
ED-79							
SHEET	78	0.5000	0.150				0.038
CHANNEL	728					3.350	0.060
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-80							
SHEET	36	0.5000	0.011				0.003
						Time of Concentration	0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
ED-81							
SHEET	36	0.5000	0.011				0.003
					Time of Concentration		0.1
ED-82							
SHEET	36	0.5000	0.011				0.003
					Time of Concentration		0.1
ED-83							
SHEET	100	0.2100	0.150				0.065
SHALLOW	232	0.5086	0.050				0.006
CHANNEL	1134					4.640	0.068
CHANNEL	1560					8.950	0.048
					Time of Concentration		.187
ED-84							
SHEET	21	0.1000	0.150				0.025
SHALLOW	122	0.3125	0.050				0.004
CHANNEL	446					4.470	0.028
					Time of Concentration		0.1
WD-1							
SHEET	100	0.1000	0.150				0.087
SHALLOW	145	0.1000	0.050				0.008
CHANNEL	5090					12.090	0.117
					Time of Concentration		.212
WD-2							
SHEET	100	0.2500	0.150				0.060
SHALLOW	100	0.2500	0.050				0.003
CHANNEL	645					5.080	0.035
					Time of Concentration		0.1
WD-3							
SHEET	93	0.3333	0.150				0.051
					Time of Concentration		0.1
WD-4							
SHEET	100	0.3333	0.150				0.054
SHALLOW	68	0.3333	0.050				0.002
					Time of Concentration		0.1
WD-5							
SHEET	100	0.3333	0.150				0.054
SHALLOW	114	0.3333	0.050				

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Sub-Area Time of Concentration Details (continued)

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
					Time of Concentration		0.1
WD-6							
SHEET	100	0.2200	0.011				0.008
SHALLOW	172	0.1163	0.050				0.009
CHANNEL	285					5.080	0.016
					Time of Concentration		0.1

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Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
WD-7							
SHEET	93	0.2473	0.150				0.057
CHANNEL	447					2.560	0.049
					Time of Concentration		.106
WD-8							
SHEET	100	0.3200	0.150				0.055
SHALLOW	128	0.2344	0.050				0.005
CHANNEL	258					4.910	0.015
					Time of Concentration		0.1
WD-9							
SHEET	100	0.2600	0.150				0.059
SHALLOW	226	0.1593	0.050				0.010
CHANNEL	394					4.760	0.023
					Time of Concentration		0.1
WD-10							
SHEET	100	0.3100	0.150				0.055
SHALLOW	190	0.2263	0.050				0.007
CHANNEL	541					3.660	0.041
					Time of Concentration		.103

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-1	0.73	7.97	1.66	7.94
ED-2	0.54	7.94	1.21	7.93
ED-3	1.01	8.00	2.29	7.96
ED-4	0.09	7.94	0.20	7.93
ED-5	0.29	7.94	0.65	7.93
ED-6A	0.30	7.94	0.67	7.93
ED-6B	0.36	7.94	0.82	7.93
ED-7	0.43	7.94	0.97	7.93
ED-8	0.81	7.94	1.83	7.93
ED-9	0.16	7.94	0.35	7.93
REACHES				
OUTLET	4.70		10.63	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-10	0.08	7.94	0.18	7.93
ED-11	0.73	7.94	1.64	7.93
ED-12	0.65	7.94	1.46	7.93
ED-13A	0.43	7.94	0.98	7.93
ED-13B	0.70	7.94	1.58	7.93
ED-14	0.12	7.94	0.26	7.93
ED-15	1.09	7.94	2.45	7.93
ED-16	0.35	7.94	0.80	7.93
ED-17	0.89	7.94	2.01	7.93
ED-18	0.34	7.94	0.76	7.93
REACHES				
OUTLET	5.37		12.11	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-19	0.69	7.94	1.57	7.93
ED-20A	0.44	7.94	1.00	7.93
ED-20B	0.68	7.94	1.53	7.93
ED-21	0.26	7.94	0.60	7.93
ED-22	1.02	7.94	2.29	7.93
ED-23	0.30	7.94	0.67	7.93
ED-24	0.14	7.94	0.32	7.93
ED-25	0.54	7.96	1.21	7.94
ED-26	0.75	7.94	1.70	7.93
ED-27A	0.37	7.94	0.84	7.93
REACHES				
OUTLET	5.20		11.73	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-27B	0.59	7.94	1.34	7.93
ED-2B	0.38	7.94	0.86	7.93
ED-29	1.21	7.96	2.73	7.94
ED-30	0.24	7.94	0.54	7.93
ED-31	0.55	7.94	1.25	7.93
ED-32	0.17	7.94	0.38	7.93
ED-33	1.63	7.84	2.72	7.84
ED-34	0.68	7.84	1.13	7.84
ED-35	2.22	7.84	3.71	7.84
ED-36	0.65	7.84	1.08	7.84
REACHES				
OUTLET	8.27		15.67	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-37	0.63	7.94	1.42	7.93
ED-3B	0.56	7.94	1.27	7.93
ED-39	0.53	7.94	1.20	7.93
ED-40	0.22	7.94	0.50	7.93
REACHES				
OUTLET	1.95		4.39	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-41	1.11	7.85	1.86	7.84
ED-42	0.31	7.94	0.69	7.93
ED-43	0.14	7.84	0.23	7.84
ED-44	0.58	7.84	0.96	7.84
ED-45	0.38	7.84	0.63	7.84
ED-46	1.34	7.84	2.23	7.84
ED-47	0.16	7.94	0.37	7.93
ED-48	0.85	7.84	1.41	7.84
ED-49	1.01	7.84	1.69	7.84
ED-50	0.53	7.84	0.88	7.84
REACHES				
OUTLET	6.38		10.94	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-51	0.49	7.84	0.82	7.84
ED-52	0.06	7.84	0.10	7.84
ED-53	0.31	7.84	0.52	7.84
ED-54	0.60	7.94	1.35	7.93
ED-55	0.31	7.94	0.70	7.93
ED-56	0.91	7.94	2.06	7.92
ED-57	0.70	7.84	1.17	7.84
ED-58	1.06	7.84	1.77	7.84
ED-59	1.96	7.84	3.27	7.84
ED-60	0.20	7.94	0.45	7.93
REACHES				
OUTLET	6.57		12.16	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-61	0.18	7.94	0.40	7.93
ED-62	0.28	7.94	0.62	7.93
ED-63	0.55	7.94	1.23	7.93
ED-64	0.41	7.94	0.92	7.93
ED-65	0.85	7.94	1.91	7.93
ED-66	0.34	7.94	0.78	7.93
ED-67	1.15	7.94	2.60	7.93
ED-68	0.42	7.94	0.95	7.93
ED-69	0.30	7.94	0.67	7.93
ED-70	0.32	7.94	0.72	7.93
REACHES				
OUTLET	4.79		10.81	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-71	0.32	7.94	0.72	7.93
ED-72	0.54	7.94	1.21	7.93
ED-73	0.54	7.84	0.91	7.84
ED-74	1.01	7.84	1.69	7.84
ED-75	0.51	7.84	0.85	7.84
ED-76	0.75	7.84	1.26	7.84
ED-77	0.38	7.94	0.86	7.93
ED-78	0.37	7.94	0.84	7.93
ED-79	0.70	7.94	1.59	7.93
ED-80	0.14	7.84	0.24	7.84
REACHES				
OUTLET	5.25		10.13	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs)	(hr)	25-Yr (cfs)	(hr)
SUBAREAS				
ED-81	0.39	7.84	0.66	7.84
ED-82	0.39	7.84	0.66	7.84
ED-83	6.00	8.01	13.54	7.98
ED-84	1.08	7.94	2.43	7.93
WD-1	26.08	8.02	58.97	8.01
WD-2	2.21	7.94	4.98	7.93
WD-3	0.37	7.94	0.83	7.93
WD-4	0.65	7.94	1.46	7.93
WD-5	0.50	7.94	1.14	7.93
WD-6	0.68	7.94	1.54	7.93
REACHES				
OUTLET	38.24		85.85	

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 25-Yr (cfs)	(hr)	(cfs)	(hr)
SUBAREAS				
WD-7	0.30	7.94	0.67	7.93
WD-8	0.85	7.94	1.91	7.93
WD-9	0.75	7.94	1.69	7.93
WD-10	2.58	7.94	5.82	7.92
REACHES				
OUTLET	4.47		10.09	