AECOM

Engineering Report
Kekaha Landfill Phase II
Lateral Expansion

Site:
Kekaha Landfill Phase II
Lateral Expansion
Kekaha, Kaua`i, Hawai`i

Submitted to:
County of Kaua`i
Department of Public Works Name

Prepared for:
County of Kaua`i
Department of Public Works
4444 Rice Street
Lihu`e, Kaua`i, HI 96766

Prepared by:
Earth Tech AECOM
841 Bishop Street, Suite 500
Honolulu, HI 96813

January 2009

Earth Tech AECOM Project No. 95561

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EXECUTIVE SUMMARY

The County of Kaua`i currently owns and operates a landfill facility located near the town of Kekaha in the coastal area on the southwest side of the island of Kaua`i. The facility, as permitted, has two noncontiguous landfill phases, Phase I and Phase II. The County of Kaua`i is proposing the expansion of the facility horizontally (laterally) to obtain additional airspace while future landfill sites are evaluated and eventually permitted.

The expansion will include the construction of one additional cell, an engineered waste disposal area. The disposal area is identified as Cell 1 and is located immediately adjacent to the west side of the existing Phase II, resulting in approximately 6.4 acres of additional waste filling area. Construction of Cell 1 will create a continuous Subtitle D base liner system that is connected to Phase II with the necessary drainage slopes and leachate collection system.

An estimated 481,000 cubic yards of gross airspace will be available based upon the proposed expansion limits and a final cover elevation of 85 feet above mean sea level (msl). Based upon current landfill waste mass density and daily tonnage rates, the facility could potentially remain open for approximately another 3.1 years from the time Cell 1 is constructed.

Although the proposed expansion provides the needed airspace to operate the facility, current site operating systems such as leachate management and surface water management will need to be redefined and modified. Currently, the leachate extracted from Phase II is collected and managed in an evaporation pond west of Phase II and within the limits of proposed Cell 1. This pond will need to be abandoned and replaced with a proposed new leachate evaporation pond.

Surface water features will also need to be redefined. Presently, surface water that is collected discharges to an infiltration ditch located between Phases I and II as well as to infiltration ditches located around the perimeter of Phase II. The location of Cell 1, as well as the increase in final cover area, will require further assistance from a 2-acre area infiltration basin and a new infiltration ditch to successfully manage surface water. The infiltration basin will only be required to be excavated to a depth of 2.5 feet. Further excavation can be completed for future expansion if necessary.

In March 1996, the facility became subject to compliance with the Municipal Solid Waste Landfill, New Source Performance Standards. On June 5, 1996, the County submitted a report demonstrating that the facility did not exceed the 2.5 million megagrams (Mg) or cubic meters of design capacity. Even with the proposed expansion, the design capacity of the facility will not exceed the 2.5 million Mg and cubic meters of design capacity. Because the limit will not be exceeded, neither a Tier 1 nor Tier 2 analyses (which are performed to establish the requirement to install a gas collection and control system to ensure that nonmethane organic compound emissions are less than 50 Mg/year) will be required. As a consequence, a gas extraction system will not be required pursuant to those standards. However, as part of the Closure Plan, an extension of the proposed gas system for Phase II (at closure) into the lateral expansion is presented and will include gas extraction wells and header piping. Gas extracted is expected to be burned at a flare permitted upon installation of the system at landfill closure. In addition, the facility will not be required to apply for an Initial Covered Source Operating Permit; however, a Covered Source Construction Air Permit will be required since the landfill is a source of air emissions.

The proposed design was evaluated for stability of the facility at final buildout, installation of the base liner system, and installation of the final cover system. The analysis determined that factors of safety greater than 1.5 for static conditions and 1.2 for seepage conditions (for the final cover system) were obtainable and the proposed design and material assumption provide a stable facility. Seepage conditions represent the suitability and performance of a geosynthetic drainage layer for a specified storm event.

Drawings depicting the facility geometry and design features accompany this report. The design as proposed and evaluated in this report demonstrates that the lateral expansion of Phase II is feasible.

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
cm/sec	centimeters per second
CWA	Clean Water Act
DLNR	Department of Land and Natural Resources, State of Hawai`i
DOH	Department of Health, State of Hawai`i
EPA	Environmental Protection Agency, United States
FML	flexible membrane liner
g	gravitational pull
GCL	geosynthetic clay liner
gpd	gallons per day
gpad	gallons per acre day
HAR	Hawai`i Administrative Rules
HDPE	high-density polyethylene
HELP	Hydraulic Evaluation of Landfill Performance
HLA	Harding Lawson Associates
kPa	kilopascal
Mg	megagrams
msl	mean sea level
MSWLF	municipal solid waste landfill
NESHAP	National Emissions for Standards for Hazardous Air Pollutants
NMOC	nonmethane organic compound
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
PGE	Pacific Geotechnical Engineers, Inc.
POCA	point of compliance assessment
psf	pounds per square foot
RCRA	Resource Conservation and Recovery Act
SDR	standard dimension ratio
SHPD	State Historic Preservation Division
SMA	Special Management Area
U.S.	United States
yd^3	cubic yards

1.0 INTRODUCTION

The County of Kaua`i is proposing to laterally expand the Kekaha Landfill Facility at Phase II to provide additional air space volume for placement of refuse during the siting, designing, and construction of a future landfill facility.

The proposed lateral expansion component is an extension of the permitted footprint of Phase II to the northwest over the leachate evaporation pond and stockpile areas. A result of the proposed lateral expansion will be a continuous Resource Conservation and Recovery Act (RCRA) Subtitle D base liner constructed as an extension of the existing Phase II base liner system.

1.1 SITE BACKGROUND

The Kekaha Landfill facility (consisting of two phases, Phases I and II) is located near the town of Kekaha in the coastal area on the southwest side of the island of Kaua`i as shown on Figure 1. Kekaha Landfill is located in the southwestern portion of the island of Kaua`i at mile marker 28 of the Kaumuali`i Highway (Highway 50), about 2 miles west of Kekaha. Phases I and II are noncontiguous landfills at the facility.

1.2 PHASE I

Phase I occupies approximately 33 acres and varies in elevation from 10 to 50 feet above mean sea level (msl). The County of Kaua`i opened the Phase I landfill in 1953, and accepted solid wastes at the facility until operations ceased on October 8, 1993. The Phase I landfill has no base liner system beneath the refuse.

The final cover for the Phase I landfill was designed and constructed in accordance with the following environmental rules and regulations in effect at the time of construction:

- United States (U.S.) Environmental Protection Agency (EPA) *Solid Waste Disposal Facility Criteria*, under the Resource Conservation and Recovery Act (RCRA) Subtitle D, published as 40 Code of Federal Regulations (CFR) Part 258 on October 9, 1991.
- State of Hawai`i Department of Health (DOH) *Solid Waste Management Control and Interim Guidelines for Landfill Closure*, Draft, Hawai`i Administrative Rule (HAR) Title 11, Chapter 58 (DOH 1994).

1.3 PHASE II

Phase II of the Kekaha Landfill facility, constructed to meet RCRA Subtitle D criteria, is situated immediately to the northeast of Phase I and is currently an active municipal solid waste landfill (MSWLF). Phase II was initially permitted to fill to a maximum elevation of 37 feet above msl. To accommodate waste generated by Hurricane Iniki in 1992, a vertical expansion was proposed in 1998 to raise the maximum fill elevation to 60 feet above msl. The first vertical expansion was approved and Kekaha Landfill was permitted to a maximum elevation of 60 feet above msl. In November 2004, the County of Kaua`i prepared, submitted, and gained approval of a second vertical expansion to 85 feet above msl.

The Phase II landfill facility constructed in 1993 is bounded by Kaumuali`i Highway to the northeast, an unpaved access road and agriculture to the southeast, aquaculture to the northwest, and the Phase I area to the southwest. The landfill base liner elevations and leachate collection system of Phase II varies from about 12 feet above msl to about 7 feet above msl and drains towards the northeast. The existing Phase II landfill sideslopes are 3.5:1 (horizontal:vertical), with a 3 percent topslope. Phase II liner area encompasses 32 acres and is subdivided into 14 lined subcells (each about 2.3 acres).

The existing base liner system of Phase II consists of (bottom to top):

- Granular subbase.

- Geosynthetic Clay Liner (GCL) consisting of a smooth 20-mil high-density polyethylene (HDPE) geomembrane with an adhered bentonite powder layer on one side (Gundseal). The GCL was installed with the smooth side in direct contact with the granular subbase and the bentonite component side up.
- Single-sided textured 60-mil HDPE geomembrane (textured side down) against bentonite component of the GCL on the sideslope.
- Smooth 60-mil HDPE geomembrane against bentonite component of the GCL on the base.
- Sand drainage layer (base and sideslope).

Placement of refuse is ongoing in Phase II. Kekaha Landfill is currently operated by Waste Management of Hawai`i.

2.0 SITE EXPLORATION

AECOM subcontracted Pacific Geotechnical Engineers, Inc. (PGE) to complete a site exploration and investigation for geotechnical properties and descriptions of existing soils around Phase II, around the existing leachate evaporation pond, proposed infiltration basin area, and the proposed leachate evaporation pond.

On-site exploration was completed in late November and early December 2006. PGE completed a total of 11 soil borings and 7 test pits. The approximate locations of the boring and test pits are presented on Plot Plan, Plate 2 of the pre-final letter report (PGE 2007; Appendix A).

Three grab samples were also collected from the embankment of Phase I for laboratory analysis.

Samples collected from the borings and test pits were analyzed by PGE's laboratory in Honolulu, Hawai`i. Tests completed included soil index and classification, moisture-density relationship (i.e., Modified Proctor), single point laboratory California Bearing Ratio, strength and permeability. Grab samples from Phase I were tested for Atterberg Limits, soil classification, and grain size analysis. Laboratory test results are located in Appendix A.

Three field percolation tests were also performed at a depth of 2 feet in general accordance with the DOH guidelines. Results of the tests determined percolation rates of 4 to 6 minutes per inch.

Based upon the borings, test pits, and laboratory results, the predominant on-site foundation soils are poorly graded sands containing little fines. From a geotechnical standpoint, it appears that the project site is suitable for construction of the proposed expansion.

The exploration and report further defined minimum construction requirements for grading, excavation, materials and compaction, slabs on grade, and lateral resistance requirements for underground structures. This information is provided in detail in Appendix A and will be utilized in the analysis of the proposed design and incorporated into the final construction specifications of the project.

3.0 DESIGN AND CAPACITY

Accompanying this report are drawings titled, *Engineering Report, Phase II Lateral Expansion, Kekaha Sanitary Landfill, Kaua`i, Hawai`i*, prepared by Earth Tech AECOM, dated January 2009. These drawings are referenced in the following sections highlighting the components of the proposed lateral expansion.

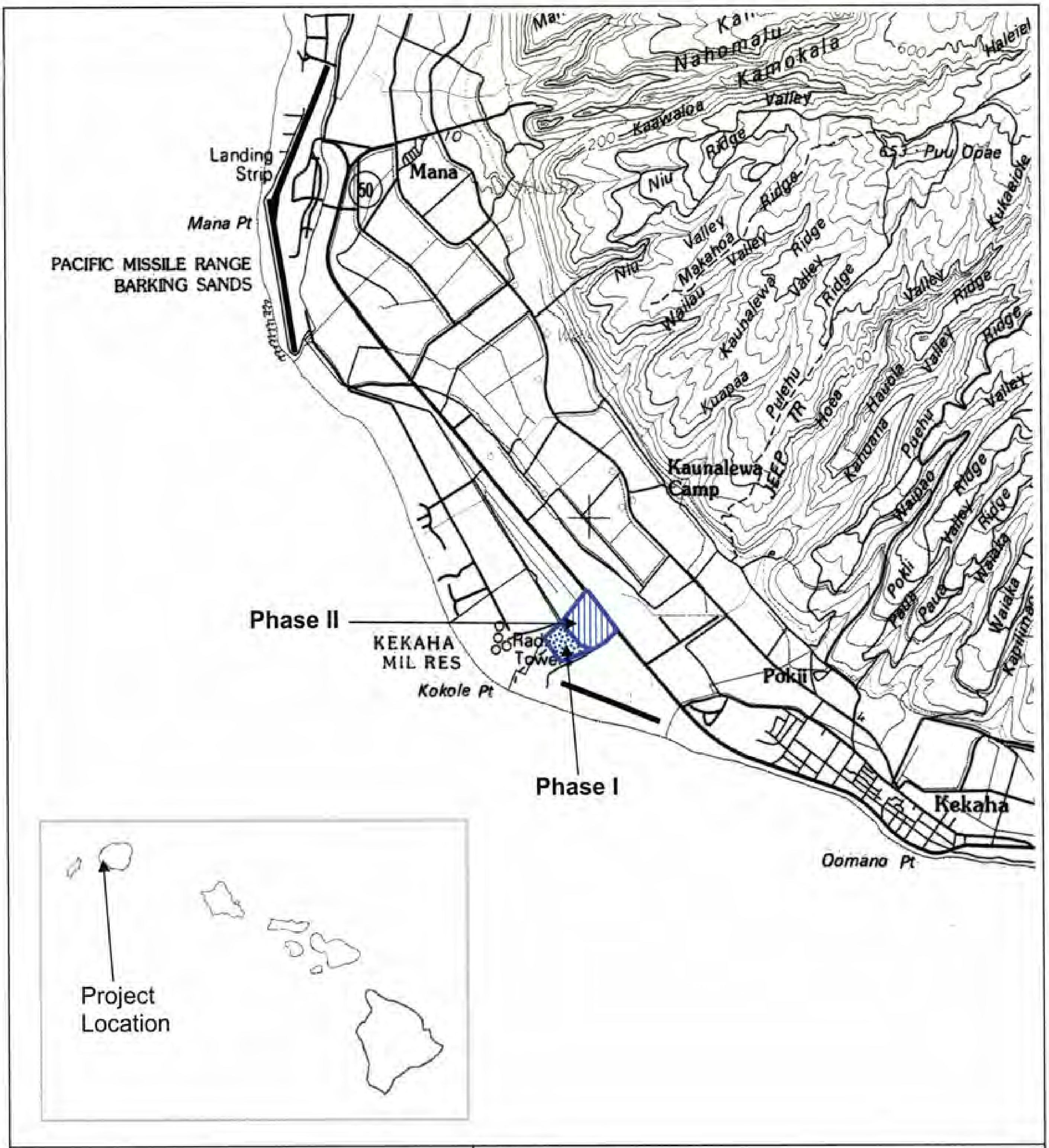

Figure 1-1
Site Location Map

County of Kauai
Kekaha Landfill Phase II Lateral Expansion

3.1 BASE LINER DESIGN

HAR 11-58.1-14(b)(2) (DOH 1994) requires lateral expansions have a base liner that is a composite base liner and contains a leachate collection system that is designed and constructed to maintain leachate at a level of 30 centimeters (12 inches) across the liner system. Defined further by HAR 11-58.1-14(c), the composite liner must consist of two components.

1. Upper component: 30-mil flexible membrane liner (FML) with a minimum permeability of 1×10^{-7} centimeters per second (cm/sec) or if HDPE is used for the construction of the FML, the minimum thickness shall be 60 mils. The installed FML must be in direct contact with the underlying compacted soil.
2. Lower component: Compacted soil layer with a minimum thickness of 2 feet and permeability of 1×10^{-7} cm/sec.

The base liner system for the lateral expansion will be similar to the approved base liner of Phase II. The base liner systems as proposed is (from bottom to top):

- Prepared subbase grade
- Subbase 60-mil HDPE geomembrane, textured on both sides of geomembrane
- GCL (lower component)
- 60-mil HDPE geomembrane (upper component), textured on both sides of geomembrane ✓
- Nonwoven cushion geotextile 16 oz/yd²
- 12-inch granular drainage layer (leachate collection)
- Nonwoven separator geotextile 6 oz/yd²
- 24-inch operations layer

Refer to Detail 1 on Drawing No. 15 for graphic representation of the liner system. Various liner details incorporating anchor trenches and tie-ins to the Phase II existing base liner system are included in the Drawings.

bottom

Unlike the existing base liner system of Phase II, which incorporates a geomembrane/bentonite layer style GCL (Gundseal), the proposed GCL for the lateral expansion is a composite product consisting of a bentonite powder/granules encapsulated between a carrier woven geotextile and a cover nonwoven geotextile. The resulting composite of the bentonite and geotextiles are then needle-punched for additional strength. GCLs are widely accepted substitutes for the lower component of a composite liner system with the incorporation of a prepared subbase surface for which the GCL is installed upon.

increase

The subbase 60-mil HDPE geomembrane is incorporated in the design as a separation barrier between groundwater and the GCL. GCLs comprised of sodium bentonite when in contact with calcareous soils may exhibit a reduction in permeability due to ion exchange. Modeling of the base liner for all comparisons for liner performance does not include this geomembrane as an added means of conservatism in the calculations.

Since the existing base liner system of Phase II consists of a GCL versus a 2-foot compacted soil layer with a minimum permeability of 1×10^{-7} cm/sec, a point of compliance assessment (POCA) was completed by Harding Lawson Associates (HLA) in September 1993. The POCA used the EPA Hydraulic Evaluation of Landfill Performance (HELP) model, Version 2, to determine equivalency of the GCL to a 2-foot compacted soil layer. Appendix B-7 is an updated POCA for the proposed lateral expansion of Phase II. The updated POCA utilizes the EPA HELP model, Version 3.07, The Multimedia Exposure Assessment Model (MULTIMED) program for exposure assessment which simulates the movement of contaminants leaching from a waste disposal facility, proposed material properties, and recent on-site weather data to determine equivalency of the proposed GCL to a 2-foot compacted soil layer and evaluates any additional impacts to groundwater. Based upon the updated POCA, no increased groundwater impacts are expected than previously determined in the HLA POCA. The POCA is presented in Appendix B.

To accommodate potential groundwater elevation changes, the lowest elevation of the base liner will not be below elevations 10.5.

Design calculations for selection of the cushion and separation geotextiles are presented in Appendix B. Geosynthetic material properties in relation to thickness, strength properties, composition, and unique properties such as texturing for geomembrane, as required, are specified in Appendix E.

3.2 CELL GEOMETRY

The proposed expansion will consist of one new containment area called Cell 1 which is geometrically subdivided for leachate management and extraction into four subcells Cell 1A, Cell 1B, Cell 1C, and Cell 1D. Subbase grades, which represent the surface at which the base liner is constructed for Cell 1, are shown on Drawing No. 4.

Cell 1 is located immediately adjacent to the northwest side of Phase II. Cell 1 is approximately 6.4 acres. The centerline, or leachate collection piping flowline, of each Cell 1 subcell is sloped at a minimum 2 percent slope to the pipe penetration and collection area.

Slope perpendicular to the cell centerline/flowline is 2 percent to promote leachate collection to the cell centerline and leachate collection piping. Subbase liner elevations range from 10.5 to just over 17 feet msl. The sideslopes of Cell 1 will be a maximum 3:1 slope. Leachate from the collection piping and subbase grade slope will leave each subcell through a gravity drain pipe that penetrates the base liner system in each subcell. For subcells 1A, 1B, and 1C the leachate will collected in a new leachate pump station #3 wet well and subsequently pumped to existing leachate collection manhole LCM-14 of Phase II. For subcell 1D, the leachate will be discharged directly to LCM-14.

The base liner of Cell 1 will be tied into Phase II and will provide a continuous base liner system.

Location and construction of Cell 1 will require the abandoning and removal of the existing leachate evaporation pond. The leachate evaporation pond will be replaced by a proposed new leachate evaporation pond. Further discussion in relation to existing leachate collection system modifications follow in Section 7.0 and are shown in the Drawings.

3.3 FINAL COVER DESIGN

HAR 11-58.1-17(a)(1) requires that landfill covers have an 18-inch infiltration layer with a permeability of less than or equal to the permeability of any bottom (base) liner system or 1×10^{-5} cm/sec, whichever is less, and a minimum 6-inch erosion layer that can sustain native plant growth or equivalent alternatives. Both the existing Phase II landfill base liner system and the proposed Cell 1 base liner system consist of a prepared subgrade, GCL, and a 60-mil HDPE liner. Upon demonstration that less surface water infiltration is allowed through the proposed final cover than exfiltration through the bottom liner, the requirements of HAR 11-58.1-17(a)(1) will have been met. Supporting calculations and design discussion of the proposed final cover cross section and the permitted bottom liner are in Appendix B.

40 mil

The proposed lateral expansion as well as the permitted Phase II will utilize the following proposed cover system and is shown in Detail 1 on 16.

- 18-inch vegetative/protective soil layer
- Geocomposite drainage layer
- 40-mil linear low-density polyethylene liner (textured)
- 6-inch minimum grading layer

does not comply
with EPA reqmts

- 12 inches of intermediate cover material
- Top of waste

Geosynthetic material properties in relation to thickness, strength properties, composition, and unique properties such as texturing for geomembrane, as required, are specified in Appendix E.

3.4 LANDFILL CAPACITY

Recently the site was permitted for a second vertical expansion to a height of 85 feet above msl resulting in an increase of total capacity of 685,149 cubic yards (yd^3) for total design capacity of 2,454,616 yd^3 (Table 1). Assuming a waste ratio of 5:1 and a compaction rate of 1,400 pounds/yd^3, the landfill received an additional 570,957 yd^3 capacity for waste mass or a capacity of 399,670 tons.

Table 1: Current Landfill Capacity

Landfill Height (feet)	Total Design Volume (yd^3)	Soil Cover to Waste Ratio	Capacity for Waste (yd^3)	Capacity (Tons)
85	2,454,616	5:1	2,045,513	1,431,859

Assumptions:
(1) Soil Cover to Waste Ratio of 5:1 from Addendum Operations Manual for Kekaha Sanitary Landfill - Phase II (EMCON 1998)
(2) Compaction of 1,400 pounds/yd^3 from Addendum Operations Manual for Kekaha Sanitary Landfill - Phase II (EMCON 1998)

The existing grading design of the final cover consists of 3.5:1 (horizontal:vertical) sideslopes with a 15-foot-wide bench and 3 percent top grade. The lateral expansion creates an overlay on to Phase II. The overlay by design matches the same maximum elevation of the permitted design for Phase II. Design grading plans are shown on Drawing No. 4 and Drawing No 8.

The approximate design capacity from the lateral expansion is shown in Table 2.

Table 2: Estimated Additional Landfill Capacity

Expansion Area	Additional Design Volume (yd^3)	Soil Cover to Waste Ratio	Capacity for Waste (yd^3)	Capacity (Tons)	Rate of Refuse Acceptance (tons/day)	Additional Years of Capacity With Vertical Expansion
Cell 1	481,000	5:1	401,000	281,000	248	3.1

Assumptions:
(1) Soil Cover to Waste Ratio of 5:1 from Addendum Operations Manual for Kekaha Sanitary Landfill - Phase II (EMCON 1998)
(2) Compaction of 1,400 pounds/yd^3 from Addendum Operations Manual for Kekaha Sanitary Landfill - Phase II (EMCON 1998)
(3) Rate of Refuse Acceptance of 248 tons/day from personal communication with Waste Management as 12/12/06.
(4) Design volume determined to be the volume from the bottom of the 12-inch intermediate cover soil of the final cover system to the top of the 24-inch operation layer of the base liner system of Cell 1.

The resulting design volumes provide up to approximately 3.1 years of additional site life. The geometry of the proposed lateral expansion allows future expansions as well.

4.0 GEOTECHNICAL DESIGN

4.1 FOUNDATION SETTLEMENT

Foundation settlement analysis evaluates the long-term performance of the landfill's base liner and leachate collection systems. The foundation settlement analysis estimates the expected settlement of the foundation soils under the landfill and tensile strain on the landfill liner with the introduction of additional waste and determines whether the leachate collection piping system will maintain positive drainage with this settlement.

Because the foundation soils at the site are sandy (HLA 1993, PGE 2007), total settlement is comprised only of elastic settlement for design evaluation.

Cell 1, as analyzed, has a determined settlement from placement of waste, which is expected to be consistent across the base liner and leachate collection system. For each foot of sand foundation soils, the estimated settlement would be 0.001 to 0.002 feet. Assuming uniform sand foundation soil thickness, the cell would not experience large areas of differential settlement. The settlement calculation assumes "instant" base liner construction, waste mass placement, and final cover construction. The use of instant loading for the calculation introduces added conservatism as the overall settlement of the foundation soils will be less than estimated as the soil is allowed to dissipate overburden pressures over time as cell filling will be over periods of years.

Foundation settlement calculations are detailed in Appendix B.

4.2 IMPACT ON LEACHATE COLLECTION SYSTEM

Cell 1 was evaluated for impact on the leachate collection systems as proposed. Based upon the foundation settlement calculation, the base liner for Cell 1 will realize settlement consistent across the base of Cell 1. Therefore, after settlement, the slope is expected to maintain positive flow towards the sumps after waste has been placed in the landfill.

Supporting calculations are presented in Appendix B.

4.3 STRAIN ON LINER

The strain on the geomembrane base liners, or elongation, of Cell 1 is estimated to be minimal as settlement across the cell base will be consistent due to the uniform sandy foundation soils. As a result of consistent settlement, the geomembrane base liner will experience minimal elongation.

Supporting calculations are presented in Appendix B.

4.4 BUILDOUT SLOPE STABILITY EVALUATION

The final geometry of the proposed lateral expansion with a maximum elevation of 85 feet above msl was verified for slope stability at final buildout. The final buildout condition represents the site's final shape after waste placement has ceased and final cover has been installed. Top slopes are designed to be sloped at 3 percent. Final cover sideslopes are designed to be sloped at a ratio of 3.5 horizontal to 1 vertical.

The buildout stability analysis looked at three different failure scenarios based upon the geometry of the facility, foundation soils, and waste mass. The first failure scenario analyzes the stability of the landfill against a block type failure along the base liner critical interface. The second failure scenario involves circular type failures that reside completely within the waste mass. The third and final scenario is a circular failure that passes through the foundation soils or support structures, such as perimeter berms, and also passes through the waste mass.

Based on the assumptions detailed in Appendix B, a factor of safety was calculated using the slope stability software, STABL Version 3.0, and compared to the minimum factor of safety of 1.50 for each of the three scenarios. The scenarios were evaluated in the "worst-case" cross-sections as presented in Appendix B.

Section A-A was analyzed as it represented a combination of waste mass height and low perimeter berm height. Section B-B was derived to evaluate the stability of the maximum waste thickness as part of the overlay onto Phase II. Finally, Section C-C represents the stability for the area of lowest berm height.

Modeled factor of safeties are summarized in Table 3.

Table 3: Buildout Slope Stability Factor of Safety Summary

'Worst-case' Cross-Section	Condition	Failure Condition	Calculated Factor of Safety	Minimum Factor of Safety
A-A	Base Liner	Block	1.94	1.50
	Waste Mass	Circular	3.06	1.50
	Foundation	Circular	3.12	1.50
B-B	Base Liner	Block	1.87	1.50
	Waste Mass	Circular	3.41	1.50
	Foundation	Circular	3.03	1.50
C-C	Base Liner	Block	1.85	1.50
	Waste Mass	Circular	3.16	1.50
	Foundation	Circular	3.13	1.50

As noted in Section 3.1, the geomembrane is textured on both sides to promote stability. Even though textured geomembrane provides higher friction angles, conservative analysis assumed a minimum interface friction angle of 10 degrees as the governing interface. The installation of textured geomembrane will increase the overall factor safety for buildout stability. The landfill with the proposed lateral expansion is expected to remain stable based on assumed minimum interface friction angles and soil and waste mass properties presented in Appendix B. Verification of interface friction angles should be completed by interface friction angle testing of materials received on site at time of construction.

4.4.1 Summary of Assumptions

The waste mass properties were defined based upon discussions with the site operators and published articles on waste mass properties. Currently the site maintains a waste density of approximately 55 pounds per cubic foot. Waste mass properties are dependent upon the amount of compaction, lift thickness, composition and waste stream, moisture, and the amount of daily cover soil or alternate daily cover used.

A published paper entitled *Shear Strength of Municipal Solid Waste: A Laboratory Study*, authored by Motan, E. Sabri; Benson, Craig H.; Tuncer, B. Edil (Motan et al. ND), proposed waste mass strength values of 35 degrees and cohesion of 20 kilopascals (kPa) (418 pounds per square foot [psf]) for municipal solid waste. Given the current site waste stream of municipal solid waste and construction and demolition debris, the waste mass strength values are determined as representative for the site. In the slope stability analysis, waste mass properties of 33 degrees and cohesion of 200 psf were similar to those used in the Phase II vertical expansion. These values are less than those proposed in the paper, adding further conservatism to the design.

In addition to the waste mass properties, consideration given to the critical interface of the proposed base liner system is required. A critical interface typically governs the overall site stability. Based upon the proposed base liner system design, the critical interface was determined to be created between the textured geomembrane to woven geotextile of the GCL. This interface exists between the bottom layer of the GCL (woven geotextile) to the bottom of the top of the textured geomembrane. Based upon typical published and expected literature values for this interface, a typical interface friction angle of 18 degrees is expected with 11 kPa of adhesion. For added conservatism, the model was completed with a critical interface friction angle of 10 degrees. Use of textured geomembrane through out the facility on the sideslopes and base will further assist in overall stability. Further discussion on the sideslope geomembrane and drainage layer stability is provided in Section 4.5.

4.5 DRAINAGE LAYER STABILITY

Placement of the granular drainage layer and the operations layer during construction provides challenges without adding increased stress to the base liner system. Installation of the soil material is typically completed by the use of a low-ground pressure dozer pushing the materials to the required thickness up the sideslope. The proposed lateral expansion base liner utilizes a cushion geotextile under the granular drainage layer and a separation geotextile between the granular drainage layer and the operations layer.

To not increase tension in the geomembrane during installation of the granular drainage layer and/or the operations layer, the geotextiles must either be placed in tension by being anchored to the top of the sideslope through the use of an anchor trench, or the base liner system must remain stable by use of interface friction angles. Given the variability of geotextiles, the drainage layer stability analysis was completed based solely upon interface friction angles.

The analysis was completed to determine the minimum critical interface friction angles required for placement of the granular drainage layer and the overlying operations layer in 1-foot-thick increments up the sideslope. Placement is assumed to be completed by a Caterpillar D-6H LGP, which is defined as low ground pressure dozer since the surface contact of the dozer tracks is less than 5 pounds per square inch. The resulting critical interface friction angle of 19.3 degrees is required for placement of the granular drainage layer up the entire sideslope for a factor of safety of 1.1. A factor of safety of 1.1 was used as the qualifier for stability as placement of drainage materials up a sideslope is brief condition and is only realized when the placement equipment is on the slope. As the combined thickness of the granular drainage layer and operations layer increases, the required critical friction angle decreases as a result of buttress effect of soils at the toe of slope. The proposed lateral expansion sideslopes will be constructed with 60-mil HDPE textured geomembrane. Texturing will be required on both sides of the geomembrane.

Supporting calculations are presented in Appendix B.

4.6 FINAL COVER STABILITY EVALUATION

The final cover slope stability was evaluated under both static and seepage conditions for the proposed lateral expansion final cover presented in Section 3.3.

For the static condition, the minimum friction angle of 23.1 degrees was calculated to obtain a factor of safety of 1.5 based on the infinite slope stability analysis. An infinite slope stability analysis determines the minimum interface friction angle required for a slope's stability regardless of final cover soil thickness, slope length, or cover soil permeability. This type of analysis is conservative as it also does not depend upon buttress effect of the cover soils at the toe of slope.

The seepage condition evaluated an assumed 100-year, 24-hour storm event to verify the performance of the final cover soils and the proposed geocomposite drainage layer. The seepage analysis defines the maximum permeability of the final cover soils, such that any infiltration to the geocomposite through the cover soils is managed within the thickness of the geocomposite for the maximum expected slope length of the geocomposite and a minimum factor of safety is obtained. The factor of safety employed for the seepage stability analysis was 1.2 as this condition is a short-term condition. The maximum slope length of the geocomposite is estimated to be 150 feet. Based upon this maximum slope length, the minimum critical interface friction angle of 23.1 degrees, and the 100-year, 24-hour storm event, the maximum final cover soil permeability allowed is 5.5×10^{-5} cm/sec. Final cover soils that are higher permeability will require the geocomposite length to be shortened and daylighted or drained to the cover surface.

Verification of interface friction angles should be completed by interface friction angle testing of materials received on site at time of construction.

Supporting calculations are presented in Appendix B.

4.7 SEISMICITY AND LIQUEFACTION EVALUATIONS

4.7.1 Seismicity Evaluation

HAR § 11-58.1-13(e) and the CFR, Section 40 (Subtitle D), Part 258.14 require that "new municipal solid waste landfill (MSWLF) units and lateral expansions shall not be located in seismic impact zones unless the owner or operator demonstrates that all containment structures are designed to resist the maximum horizontal acceleration in lithified earth material for the site." "Seismic impact zone" is defined as an area with a 10 percent or greater probability that the maximum horizontal acceleration in lithified earth material (rock), expressed as a percentage of the earth's gravitational pull (g) will exceed 0.1 g in 250 years (EMCON 1998).

In the preparation of the *Addendum Operations Manual* (EMCON 1998), EMCON contracted a seismology consultant to determine the maximum horizontal acceleration at Kekaha Landfill. The consultant's report stated that the controlling horizontal peak ground acceleration is 0.06 g on rock with an associated mean magnitude earthquake of 6.2. The peak ground acceleration at the site is less than the 0.1 g threshold requiring an evaluation of seismic effects for both foundation soil and waste stability under seismic loading (EMCON 1998). Therefore, an evaluation of seismic loading effects on the stability of the vertical expansion is not required.

4.7.2 Liquefaction Evaluation

Beneath the landfill is a cohesionless medium-dense sand layer. Increased pore pressures during the design earthquake might cause this layer to have decreased shear strength, causing liquefaction. Liquefaction may cause ground failures such as settlement or lateral spreading.

In the preparation of the *Addendum Operations Manual* (EMCON 1998), EMCON determined whether this layer is liquefiable based on the analysis method developed by Seed and Idriss (1982). Liquefaction settlement was estimated using a relationship between the cyclic stress ratio, corrected penetration resistance, and volumetric strain for saturated, clean sands. The estimated settlement of the medium-dense sand layer during the design earthquake is approximately 1 inch (EMCON 1998) as compared to the 1.5 inches predicted in the Geotechnical Investigation (HLA 1993). Based on the computed factor of safety, there should be no lateral spreading during the design earthquake (EMCON 1998).

PGE completed an empirical review of initial soil liquefaction based upon methods by Seed and Idriss (1982) as part of the site exploration. Based upon a Richter Scale magnitude 5.0 earthquake and a peak ground acceleration of 0.075 g, the site generally has low liquefaction potential.

4.8 GEOSYNTHETIC MATERIAL PROPERTIES

Geosynthetic material properties in relation to thickness, strength properties, composition, and unique properties such as texturing for geomembrane, as required, are specified in Appendix E.

4.9 GEOMEMBRANE COMPATIBILITY

Geomembranes are manufactured from high density polyethylene, which has a high UV and chemical resistance while providing flexibility. The geomembrane application for Cell 1 and leachate evaporation pond will experience two different situations. The first will be direct contact with leachate and the second in contact with groundwater, in this case seawater. Geomembranes as noted have a high resistance to chemicals and is the predominant means of liner systems for landfills.

The instance where seawater would be in contact with the geomembrane would be in the sump area or in cases of extreme tidal fluctuation. Seawater has a typical pH range of 8.1 to 8.3 (Krauskopf 1995) or slightly basic. This range of pH is not harmful to geomembranes. Fresh water is neutral or a pH of 7. The dissolved salts in seawater are mostly the ions of sodium chloride (Na^+ and Cl^-). Sodium chloride as listed on the geomembrane chemical resistance chart in Appendix B-8 displays satisfactory performance.

5.0 SURFACE WATER MANAGEMENT

The surface water management system is shown on Drawing No. 8 and Drawing No. 9. The proposed surface water management system is similar to the permitted Phase II design in means of storm water conveyance; however, with the increase in final cover area, surface water is transferred to the existing infiltration ditches and to a proposed infiltration basin on the northwest corner of the facility. In addition, the infiltration ditch that will be removed by the construction of Cell 1 will be relocated immediately between Cell 1 and the northwest property line.

The system includes diversion berms at the perimeter of the landfill top deck and sideslope that direct surface water to rock-lined downdrains. Each downdrain has a trapezoidal cross-section with each downdrain conveying water to an infiltration drainage ditch.

The surface water analyses are included in Appendix C. The analyses were completed using SEDCAD+ a computer program developed by the University of Kentucky to assist in the design and evaluation of surface water management system components. The program is capable of computing peak flows, runoff volume, sizing channels and culverts, and calculating the hydraulic performance of sedimentation basins. The methods utilized in SEDCAD+ include SCS Upland Curve Method for calculating time of concentration, Muskinghum's Method for routing between structures, and SCS Technical Release - 55 (TR-55) parameters for runoff volumes.

The surface water analysis evaluated site conditions under three different storm events. This included the following:

- 100-year, 1-hour storm event of 3 inches of rainfall.
- 2-year, 24-hour storm event of 4.5 inches of rainfall.
- 25-year, 24-hour storm event of 8 inches of rainfall.

The peak rainfall values are based on the design plates associated with County of Kaua`i Department of Public Works' *Storm Water Runoff System Manual* (DPW 2001).

The infiltration basin has been designed to accommodate all three design storms and all the surface water from the proposed lateral expansion. The infiltration rate from the bottom of the basin was equal to 1 inch per 6 minutes (PGE 2007; Appendix A). Cross sections of the infiltration basin are presented on Drawing No. 9. The overall design of the basin is such that the infiltration basin is excavated at existing grade of approximately 11 to 12 feet msl with a bottom elevation of 7.5 feet msl, which correlates to the invert elevation of the infiltration ditches. The 2.2-acre basin is expected to perform in the same manner and in conjunction with the existing infiltration ditches.

The surface water diversion berms have been designed to conservatively convey runoff from a 100-year, 1-hour storm event and the 25-year, 24-hour storm event with minimal freeboard in place. Each of the seven downslope channels has been analyzed. Each of the channels has sideslopes of 2:1 and varies in width from 1 to 2 feet. In all cases, the channels are to be lined with riprap for erosion protection. Specific downslope channel sizes are detailed in Appendix C.

6.0 LANDFILL GAS SYSTEM

The following section discusses the regulatory requirements and impacts that the proposed lateral expansion will have on the landfill gas collection system for the site.

6.1 APPLICABLE REQUIREMENTS

The Kekaha Phase II landfill is currently permitted to an elevation of 85 feet above msl for a design capacity of 1,899,995 cubic meters. When combined with the total volume of the Phase I landfill, the total site capacity is currently 3,202,923 cubic meters as shown in Table 4.

Pursuant to Section 60.750(a) of the New Source Performance Standards (NSPS) found in 40 CFR 60, Subpart WWW, the standards apply to each municipal solid waste landfill that commenced construction, reconstruction, or modification on or after May 30, 1991. The County received an expansion after this date and thus became subject to the rule.

Section 60.752(a) of the NSPS found in 40 CFR 60, Subpart WWW requires sites with a design capacity less than 2.5 million megagrams (Mg) ***or*** cubic meters to submit an initial Design Capacity Report upon becoming subject to the standard. The County became subject to the standard in March 1996 and subsequently submitted its Initial Design Capacity Report on June 5, 1996, demonstrating that the facility did not exceed 2.5 million Mg ***or*** cubic meters.

Section 60.757(a)(3) of the NSPS found in 40 CFR 60 requires that an amended Design Capacity Report be submitted within 90 days of an increase in the maximum design capacity of the landfill to or above 2.5 million Mg ***and*** 2.5 million cubic meters. The currently proposed lateral expansion to 85 feet above msl will result in a maximum design capacity that will not exceed 2.5 million cubic meters and 2.5 million Mg as shown in Table 4. Given that Section 60.757(a)(3)—which specifies that both the volume ***and*** mass must exceed 2.5 million—is ***not*** met by this expansion, an amended Design Capacity Report of the landfill is not triggered nor is the applicability of the Tier I calculation that would establish the requirement to install a gas collection and control system.

Table 4: Current and Proposed Amount of Waste for Kekaha Landfill

Phase	Design Capacity by Volume (yd^3)	Design Capacity by Volume (cubic meters)	Design Capacity by Weight [a] (Mg)
Phase I	1,717,245	1,312,928	545,107
Phase II (Landfill Height of 60 ft above MSL)	1,769,467	1,352,855	1,203,388
Phase II (Landfill Height of 85 ft above MSL)	715,632	547,140	454,245
Current Permitted Amount of Waste	4,202,344	3,202,923	2,202,740
Lateral Expansion (Landfill Height of 85 ft above MSL)	401,000	306,582[b]	254,647[c]
Proposed Total Amount of Waste Following Lateral Expansion	4,603,344	3,509,505	2,457,387

ft	feet
msl	mean sea level

[a] Approximate refuse density for Phase I is 700 lb/yd^3 (0.415 Mg/cubic meters). Approximate refuse density for Phase II w/Landfill Height of 60 ft msl is 1,500 lb/yd^3 (0.89 Mg/cubic meters). Approximate refuse density for Phase II w/Landfill Height of 85 ft msl is 1,400 lb/yd^3 (0.7 ton/yd^3 or 0.83 Mg/cubic meters). Approximate refuse density for Lateral Expansion w/Landfill Height of 85 ft msl is 1,400 lb/yd^3 (0.7 ton/yd^3 or 0.83 Mg/cubic meters).

[b] 401,000 yd^3 x 0.764544 cubic meters/yd^3 = 306,582 cubic meters

[c] (401,000 yd^3 x 1,400 lb/yd^3 x 0.907185 Mg/ton x 1 ton/2,000 lbs) = 254,647 Mg

Therefore, the NSPS requirements will not apply to Kekaha Landfill for the proposed lateral expansion. The County may elect to install a gas collection and control system to prevent migration of methane gas or for energy recovery purposes, however.

6.1.1 Liquefaction Evaluation

Landfills have both NSPS and NESHAP (National Emissions Standards for Hazardous Air Pollutants) regulations promulgated under Section 111 and 112 of the Clean Air Act. In accordance with HAR, such facilities are covered sources.

Sites with a design capacity greater than 2.5 million Mg ***and*** 2.5 million cubic meters are required to submit a timely application for an operating permit under 40 CFR 70 or 71. The lateral expansion does ***not*** meet this requirement.

The proposed lateral expansion will trigger the need for a Non-major Initial Non-Covered Source Air Permit Application to DOH pursuant to HAR Chapter 11-60.1-62 "Applicability" which states that "no person shall... begin construction, reconstruction, modification, relocation or operation of an emissions unit or air pollution control equipment of any non-covered source without first obtaining a non-covered source permit from Director" (DOH 2003). For the purposes of the application, the source can be considered a non-major non-covered source.

6.1.2 Landfill Gas Collection System Design

A gas collection system was not required pursuant to the standards in 40 CFR 60 Subpart WWW for the previous vertical expansion to 85 MSL, however, one was designed for the Phase II landfill area as part of the Closure Plan to address gas migration or odor concerns as necessary and it will consist of vertical gas extraction wells, horizontal collectors or other available gas collection locations such as leachate clean-out risers and manholes and associated header piping. The Closure Plan was not required to and did not incorporate the Phase 1 landfill area. Phase 1 currently only has passive vents.

The proposed lateral expansion will also not trigger the NSPS requirements found in 40 CFR 60 Subpart WWW. However, the current landfill gas collection system design developed as part of the Closure Plan will be amended to include the lateral expansion. Gas extracted is expected to be burned at a flare permitted upon installation of the system at landfill closure.

6.2 IMPLEMENTATION SCHEDULE

The facility may elect to install a gas collection and control system for energy recovery purposes, or for purposes other than those stipulated by the NSPS as described above. The design and installation would be subject to agreements and other considerations related to either endeavor. Since the facility may become subject to the design, monitoring and recordkeeping requirements of the NSPS at some point, the modification to the existing collection system design will be conducted as necessary to achieve the objectives as stated above and in the NSPS.

Lastly, as described above, the proposed lateral expansion at Kekaha MSWLF will require an air permit and subsequent approval before the start of construction.

7.0 LEACHATE MANAGEMENT

Water entering Kekaha Landfill and the proposed lateral expansion from rain events percolates through the waste and collects in the granular drainage layer overlying the liner system and is removed by leachate collection and transmission pipes located in this layer.

The leachate collection and transmission pipes for Phase II are spaced at 100-foot intervals and were constructed with 0.5 percent slope towards leachate collection manholes which discharge into leachate transmission lines. The transmission lines lead to two leachate pump stations (#1 and #2 Wet Wells), which pump the leachate to the existing 2-acre leachate evaporation pond for evaporation. The existing collection pipes in Phase II are constructed of 8-inch diameter perforated HDPE with a standard dimension ratio (SDR) of 9.3 to protect against crushing. The Preliminary Engineering Report (Earth Tech 2003) previously determined the leachate collection pipe strength and deflection are acceptable with the proposed second vertical expansion.

The leachate collection pipes for Cell 1 were analyzed for pipe strength. The leachate collection pipes for Cell 1 are also proposed to be constructed of 8-inch diameter perforated HDPE with a minimum SDR of 9.3. The maximum waste depth for Cell 1 overlying the leachate collection pipe on the cell floor is approximately 62 feet. This waste mass thickness is the result of the overlay onto the existing Phase II from Cell 1 and orientation of the leachate collection pipes. This geometry will not realize the same maximum waste height of 85 feet above msl as permitted for Phase II over the limits of Cell 1. The pipe strength calculations have determined that the proposed pipe sizing, perforations, and wall thickness will obtain suitable factors of safety. Supporting calculations are presented in Appendix D.

Cell 1 construction will require the abandonment of the existing leachate evaporation pond and the construction of a new leachate evaporation pond. Location of the proposed new leachate evaporation pond is on Drawing No. 2 and with grades and representative cross sections shown on Drawing No. 3. Verification of the new leachate evaporation pond sizing is discussed further in Section 7.4.

Leachate collected in the subcells of Cell 1 by the leachate collection piping will be transferred from each subcell by gravity to a new leachate pump station #3 wet well for subcells 1A, 1B, and 1C. Subcell 1D will gravity drain directly to existing leachate collection manhole LCM-14 of the Phase II leachate management system. Piping will exit each subcell base liner through an engineered pipe penetration as shown on Drawing No. 18, Detail 1.

All pipe penetration pipe inverts are set at elevation 10.92 leaving each subcell. To accommodate the further installation of the sideslope riser pipe cleanout, wye fitting, and connection of the perforated leachate collection pipe to the pipe penetration, a recessed area resides under the pipe penetration. The depth of this recessed area is approximately 5 inches below the pipe penetration invert of elevation 10.5. As designed, the pipe penetration utilizes two sheets of flatstock factory welded to a solid piece of 8-inch SDR-9.3 HDPE pipe. The resulting space of 1-inch between the flatstock will be sealed along the top flatstock to the bottom flatstock creating an area that can be factory and field air tested for leakage. Upon completion of satisfactory field air testing, the void will be field backfilled with grout and grout openings field extrusion welded shut. The recessed area will be 5 feet wide by 10 feet long to accommodate the bottom flatstock and provide a durable area for pipe connection installation verses directly over a geomembrane layer.

The proposed design of the pipe penetration will maintain a leachate level less than 12 inches on the base liner and in the recessed areas of Cell 1.

7.1 LEACHATE GENERATION

The amount of leachate entering leachate collection and transmission pipes was estimated using the EPA HELP Model Version 3.07 computer modeling program as presented in Appendix D.

The amount of leachate generated at a facility is based upon the total area of the site that is open at any given time for waste disposal. The HELP analysis has determined a daily generation value based upon an acre basis for leachate management. Leachate evaporation pond sizing will depend ultimately on coordination of intermediate cover placement, closure of portions of the facility at final grade, and the promotion of surface water drainage and management during interim active conditions.

Based upon average monthly results, the lateral expansion during open conditions is estimated to generate 724 gallons/acre/day. This result is based upon the following assumptions:

- 50 percent flow off the open condition area
- Good geomembrane base liner installation (2 defects/acre) and a pinhole density of 1 pinhole per acre to account for manufacturing defects
- The waste mass is at field capacity, therefore, not absorbing water

For the 6.4-acre expansion, the daily generation based upon average monthly results is 4,636 gallons per day (gpd). Existing Phase II from September 2004 through June 2007 generated approximately 733,300 gallons per year, or 2,009 gpd. This leachate generation quantity includes leachate generated during 2005 and 2006, which were 2 years above average rainfall. The resulting estimated maximum leachate generation for Phase II and the Cell 1 lateral expansion is 6,645 gpd. The estimated daily generation rate for Cell 1 is based upon an open condition which allows for only 50 percent surface water run-off thereby creating larger daily generation rates than the existing Phase II which currently has intermediate and daily cover in place.

Temperature, precipitation, and average wind speed data was obtained from site records from January 2001 through December 2006. Missing data is viewed by the model as a "0". Therefore, to avoid skewing the data, missing temperature data for 2001 and 2002 was filled in using temperatures from days adjacent to the missing data. Data is missing for a total of 5 days in April of 2001 and 2002. Data from 2004 is missing from April 9 through May 3, and May 26 through June 19. To avoid skewing the data, these blocks of missing data from 2004 were filled in using data from the same dates in 2003. There is no missing data from 2003, 2005, and 2006. Inputs into the HELP Model and the output are detailed in Appendix D.

7.2 LEACHATE COLLECTION PIPE SPACING

The allowable leachate collection pipe flow was calculated using Manning's equation, conservatively assuming a full pipe as shown in Appendix D. Assuming that the pipes will have a minimum slope of 1 to 2 percent after settlement, an allowable flow of 587,520 gpd and 833,760 gpd respectively was calculated. The maximum generation rate of leachate is approximately 3,692 gpad for open conditions. One single pipe at slopes of 1 to 2 percent can accommodate leachate flows under open conditions from over 159 to 225 acres. Therefore, the perforated leachate collection piping capacity is adequate to convey the leachate collected from the subcells and indicates that pipe spacing for the design of the lateral expansion is not a governing dimension as the largest subcell (1A) is approximately 1.8 acres.

Perforation sizing of the leachate collection pipe was also verified to insure proper flow into the pipe a removal of the leachate from the base liner. Half inch perforations spaced 5 inches on center are adequate for leachate pipe flow. Calculations are provided in Appendix D.

7.3 LEACHATE TRANSFER SYSTEM

Leachate accumulated in the leachate collection pipes located in each subcell gravity drains along the 2% base grade until it reaches the edge of the recessed area of the pipe penetration. The leachate collection pipe then slopes at 1% to and through the pipe penetration as shown on Detail 1 on Drawing No. 18. For subcells 1A, 1B, and 1C, leachate further gravity drains from the pipe penetration to a new leachate pump station #3 wet well located in the west perimeter berm next to Cell 1B. For subcell 1D, leachate also gravity drains from the pipe penetration, however it drains directly to existing leachate collection manhole LCM-14 of the Phase II leachate management system. All gravity piping just past the pipe penetrations to the #3 wet well and to LCM-14 is proposed to be dual HDPE containment piping. This style of piping provides additional level of safety against leakage.

The new wet well is proposed to be a dual containment HDPE manhole. Detail 3 on Drawing No. 17 depicts the new wet well construction, pipe fittings, and pump features. Leachate will be transferred from the wet well to LCM-14 by a dual containment forcemain. The manhole will house two leachate pumps that will operate on alternate pumping cycles and will provide essentially a backup pumping system should one pump go down or is need of repair. The dual containment design of the manhole allows for monitoring of leakage from the primary manhole and the gravity carrier (inside) pipe. The wet well as analyzed for resistance to uplift pressures from fluctuating groundwater elevations. Based upon the deign of the wet well geometry and the weight and depth of the wet well, a factor of safety of 2.0 was determined against the wet well uplifting. Supporting uplift calculation for the wet well is presented in Appendix D.

Drawings Nos. 6 and 7 show in plan view and profile the leachate collection system and the leachate transfer system.

Leachate levels in the wet well are controlled by the use of pressure transducers set for specific elevations for pump on, pump off, and high alarm based minimum leachate head requirements. The controls for the leachate pump are proposed to be housed in a control panel near the manhole. To assist in operation of a future gas extraction and management system, straw drains located next to the manhole as part of the dual containment gravity pipes from subcell 1A and subcells 1B and 1C as well as a permanent liquid level in the wet well will provide a means to keep landfill gases out of the wet well and will also keep air from entering the gas extraction system from the wet well. The straw drains provide 48 inches of vacuum draw for the gas extraction system.

Supporting calculations for the Cell 1 leachate system as well as the #3 wet well design are located in Appendix D.

7.4 LEACHATE EVAPORATION POND SIZING

The current and preferred means of disposing of leachate is by evaporation. With the construction of the lateral expansion, the existing leachate evaporation pond will need to be abandoned and reconstructed elsewhere on site. The proposed location of the new leachate evaporation pond is shown on Drawing No. 2 and Drawing No. 3.

The new leachate evaporation pond was verified by calculation to insure enough holding volume and surface area will be present to promote leachate evaporation (Appendix D). The evaporation pond verification calculation utilized existing leachate quantities, estimated lateral expansion leachate quantities, rainfall, and evaporation rates. Existing leachate generation data from September 2004 through June 2007 was reviewed. To conservatively include the months of greatest recorded leachate generation, leachate generation rates from the existing landfill for 2006 are used. Leachate generation from the Cell 1 of the lateral expansion was estimated using the HELP model. Average monthly rainfall quantities were obtained from site records from January 2001 through December 2006. Estimated pan evaporation rates per the Ground Water Atlas of the United States near Hawai`i over open-ocean is 65 inches/year whereas actual evaporation rates based upon the weather station in Lihu`e, Kaua`i may be as high as 77 inches/year. To be conservative, an evaporation rate of approximately 64.5 inches/year is used.

It is calculated that a maximum of approximately 4,631 yd^3 (935,300 gallons) of leachate storage will be required in the evaporation pond. The new evaporation pond as designed will retain approximately 3,699,000 gallons and is in similar size to the existing evaporation pond. This design also provides additional volume for major storm events, future expansion, and placement of drainage/protective layer. Weather data suggests the wettest months, or months generating leachate quantities greater than evaporation rates, are March and April. Months prior to and after provide negative leachate balance; therefore, the evaporation pond as sized is adequate for evaporation, and retention of estimated leachate and rainfall quantities. Appendix D presents the supporting calculation for the liquid balance in the new evaporation pond.

7.5 LEACHATE EVAPORATION POND BASE LINER DESIGN

The leachate evaporation pond will be the focus point for the evaporation of the leachate generated from Phase II. As with the landfill base liner and sumps, the leachate evaporation pond is lined with a geosynthetic composite liner system. The base liner system of the evaporation pond will be (from top to bottom
~~bottom~~):
TOP

- Prepared subbase grade
- 60-mil HDPE geomembrane, textured on both sides of geomembrane
- GCL
- 60-mil HDPE geomembrane, textured on both sides of geomembrane
- GCL
- 60-mil HDPE geomembrane, textured on both sides of geomembrane
- Nonwoven cushion geotextile 16 oz/yd^2
- 12-inch granular operation layer
- Woven separator geotextile

On the sideslopes, a nonwoven cushion geotextile will be used as well as a geoweb filled with granular materials. The geoweb provides reinforcement of slope granular material for varying levels of leachate. Detail 1 on Drawing No. 11 graphically depicts the base liner (sideslope and base) for the leachate evaporation pond.

No.

Material properties for all geosynthetic base liner materials for the leachate evaporation pond are presented in Appendix E.

8.0 ENVIRONMENTAL PERMITS, CONSULTATIONS, AND APPROVALS

Implementation of the proposed action requires coordination and consultation with the federal, state, or county agencies for the following permits, clearances, or approvals:

Environmental Assessment. The proposed project occurs on State of Hawai`i land and would use State of Hawai`i funds; therefore, the project triggers the environmental review process mandated under Hawai`i Revised Statutes Chapter 343. As part of the environmental review process, an environmental assessment is being prepared for the proposed action. The administrative authority of the environmental review process is the Office of Environmental Quality Control.

Solid Waste Management Permit. Expansion of a MSWLF must be authorized under a Solid Waste Management Permit issued by the DOH Solid and Hazardous Waste Branch.

Historic Preservation Review. State and county projects that may affect a historic property must obtain a concurrence of "no historic properties affected" from the State Historic Preservation Division (SHPD), prior to commencement. The administrative authority is DLNR SHPD.

Clean Water Act (CWA) § 402 National Pollutant Discharge Elimination System (NPDES) Permit(s). Section 402 of the CWA establishes the NPDES program regulating the discharge of pollutants to waters of the United States. NPDES permits are required to authorize discharges of storm water associated with construction activities that result in disturbance of one acre or more of total land area. The administrative authority is DOH Clean Water Branch.

Grading Permit. A grading permit is required for grading which exceeds 100 yd^3 of cut or fill or exceeds 5 feet in vertical height at its deepest point. The administrative authority is County of Kaua`i Department of Public Works, Engineering Division.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluations conducted in this report, the proposed lateral expansion of Phase II is feasible.

10.0 REFERENCES

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Appendix A
Geotechnical Exploration Pre-Final Letter Report

FINAL LETTER REPORT

GEOTECHNICAL EXPLORATION

PGE Job No. 8950-020

for

HORIZONTAL EXPANSION OF THE KEKAHA MSW PHASE II LANDFILL KEKAHA, KAUAI, HAWAII

October 7, 2008

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October 7, 2008
8950-020

Earth Tech, Inc.
841 Bishop Street, Suite 500
Honolulu, Hawaii 96813

Attention: Mr. Jeffrey Impens

Subject: Final Letter Report
Geotechnical Exploration
Horizontal Expansion of the
Kekaha MSW Phase II Landfill
Kekaha, Kauai, Hawaii

Gentlemen:

1.0 INTRODUCTION

This final letter report presents the results of the geotechnical exploration that we performed for the proposed horizontal expansion of the Kekaha Municipal Solid Waste (MSW) Phase II Landfill located on Kauai. Our services were performed in general accordance with our May 3, 2006 proposal. A pre-final letter report dated March 20, 2007 was previously submitted for review and comment. This final report addresses the comments regarding our pre-final report.

The approximate location of the project site is shown on the Map of Area, Plate 1. A general layout of the site is shown on the Plot Plan, Plate 2.

2.0 PROJECT CONSIDERATIONS

This project generally includes the lateral expansion of the Kekaha Phase II MSW Landfill. The lateral expansion component will be an extension of the permitted footprint of Phase II to the northwest over the Leachate Evaporation Lagoon and soil stockpile areas. We understand that a landfill height of approximately 85 feet or 100 feet above Mean Sea Level (MSL) is being considered for the expansion. We further understand that a slope inclination of 3.5 horizontal to one vertical (3.5H:1V) or flatter is planned for the landfill embankment.

A new Leachate Evaporation Lagoon is planned to replace the existing lagoon. The new lagoon will be located near the current material drop off area. In addition, a new storm water collection infiltration pond is planned in the area north of the current site access road.

According to Earth Tech, Inc.'s (ETI's) April 25, 2006 transmittal, a geotechnical exploration is needed for the design of the horizontal landfill expansion and leachate storage tank system. Geotechnical feed back regarding percolation rates will also be needed for the storm water collection pond. It was requested that the exploration include permeability and/or percolation testing and grab samples of the Phase I cover material for gradation and plasticity testing.

3.0 SCOPE OF SERVICES

Based on the above project considerations and ETI's request, we performed the following scope of services:

1. *Review of Readily Available Data* - Readily available subsurface information and geologic conditions near the project site were reviewed. The sources of this review included information in our files, readily available record drawings of the Phase II Landfill, a previous report by others, and other readily available information.

2. *Coordination with ETI and DPW, and Underground Utility Checking* - Prior to the start of the field work, we coordinated our work with ETI, Department of Public Works (DPW), and our drilling subcontractor. Readily available underground utility plans were reviewed to check the proposed boring and test pit locations for possible underground lines. The borings and test pits were toned using a metal detector as a final check for underground utilities.

3. *Field Exploration* - Subsurface conditions at the site were explored by performing eleven (11) soil test borings and seven (7) test pits as follows:

   Horizontal Landfill Expansion

   - Nine (9) soil test borings, designated as Borings 1 through 6, and 9 through 11, each approximately 30 to 40 feet in depth below existing grades.
   - Six (6) test pits, designated as Test Pit 1 through 3, and 5 through 7, to depths ranging from 3.3 to 8.7 feet below existing grades.

   Replacement Leachate Evaporation Lagoon

   - Two (2) soil test borings, designated as Borings 7 and 8, to depths of 30 and 30.5 feet below existing grades.
   - One test pit, designated as Test Pit 4, to a depth of 6.7 feet below existing grades.

We understand that after the completion of the field exploration program, the location of the Replacement Leachate Evaporation Lagoon was relocated to its current location near the drop off area. Because of the relocation, the borings and test pits were not center at the new facility location.

The approximate locations of the borings and test pits are shown on the Plot Plan, Plate 2. The locations and elevations of the borings and test pits were estimated based on information provided on the project topographic plan and our field measurement using a 100-foot long tape.

The drilling of soil test borings and excavation of test pits were performed under the observation of our engineering personnel, who maintained a log of the subsurface materials encountered in each boring and test pit, and obtained relatively undisturbed and disturbed soil samples for further examination and laboratory testing.

The logs of the borings and test pits are presented on Plates 3.1.1 through 3.11.2 and Plates 4.1 through 4.4, respectively. The soils encountered were initially classified in the field according to American Society for Testing and Materials (ASTM) D2488 and the Unified Soil Classification System (USCS) presented on Plates 5.1 and 5.2. Additional field data from observation of the drilling, soil cuttings, color, drilling rate, soil sampling were used to supplement our field classification. The field classifications were later refined based on the results of laboratory tests performed on selected soil samples.

4. *Site Reconnaissance* - During the field work, our engineer performed a site reconnaissance to observe surface soils and other major geologic features in readily accessible areas of the Phase II Landfill.

5. *Laboratory Testing* - The soil samples retrieved from the borings and test pits were transported to our laboratory in Honolulu for further examination and testing. The testing included tests for index and classification, moisture-density relations, single point laboratory California Bearing Ratio (CBR), strength, and permeability. The permeability tests were performed on samples of recompacted sand.

The results of moisture content and dry density determination are presented on the boring logs and test pit logs, at the appropriate sample depths. The Atterberg Limits test results are presented on Plate 6. The gradation test results are presented on Plates 7.1 through 7.5. The moisture-density relations and CBR test results are presented on Plates 8.1 through 8.3, and Plates 9.1 through 9.3, respectively. The shear strength test results are presented in Table 1. The laboratory permeability test results are presented in Table 2.

6. *Engineering Analysis and Letter Report Preparation* - Based on the results of the data review, and field and laboratory testing, engineering analysis was performed and comments and recommendations were developed regarding:
   a. Site preparation,
   b. Anticipated excavation conditions,
   c. Permanent cut and fill slopes,
   d. Fill materials, placement, and compaction,
   e. Foundation subgrade preparation and support, including parameters for foundation design, and
   f. Lateral resistance.

The results of the geotechnical exploration complete with field and laboratory test data have been summarized in this letter report.

4.0 REVIEW OF READILY AVAILABLE DATA

Readily available record drawings, a 1993 geotechnical investigation report by Harding Lawson Associates (HLA) for the Phase II Landfill Design, and other available information on geologic and subsurface conditions were reviewed.

According to HLA's boring logs for the Phase II Landfill Design, subsurface conditions at the site generally consisted of medium dense to dense calcareous sand to the bottom of the borings at about 26 feet below the ground surface. At the time of their investigation, the site area was relatively level with a surface elevation at about +10 feet. All elevations in this letter report are referenced to Mean Sea Level datum.

According to as-built record drawings for the Phase II Landfill, the landfill perimeter road generally consists of a gravel road. The road is approximately 16 feet wide with an exterior side slope of 2H:1V and an interior side slope of 3H:1V. An infiltration ditch is provided at the base of the exterior slope.

5.0 SITE CONDITIONS

5.1 GENERAL GEOLOGY

The Mana coastal plain is located in southwestern Kauai and lies at the foot of an ancient sea cliff composed of lava flows of the Waimea Canyon Volcanic series. The plain stretches from Waimea on the south to Polihale on the north. It is mainly composed of thick deposits of alluvium consisting of clay, silt, and other detritus derived from weathered basalt. Seaward portions of the plain are largely overlain by calcareous sediments. The calcareous sediments are mainly composed of beach and dune sand. Lagoonal deposits composed of a mixture of calcareous and alluvial sediments are also present in the plain.

According to the United States Department of Agriculture Soil Conservation Service (SCS), the surface soil at the site is classified as Jaucas loamy fine sand (JfB), 0 to 8 percent slopes. JfB soil is a calcareous soil that developed in wind and water-deposited sand derived from coral and seashells.

5.2 SURFACE CONDITIONS

The Phase II Landfill site is bounded by Kaumualii Highway on the north, Phase I Landfill on the south, a Navy access road on the west, and a landfill perimeter road on the east.

The project site is currently occupied by the Phase I and Phase II Landfills. An existing leachate lagoon and soil stockpile area is located in the area west of the Phase II Landfill. The area north of the Phase II Landfill is generally undeveloped and is currently used as a storage area for sand. Other facilities at the site include asphaltic concrete (AC) paved parking areas and recycle areas, and two single story buildings.

5.3 ANTICIPATED SUBSURFACE CONDITIONS

Subsurface conditions encountered in the borings and test pits performed at the project site are illustrated on the boring and test pit logs presented on Plates 3.1.1 through 3.11.2 and Plates 4.1 through 4.4, respectively. Because the borings and test pits are relatively widely spaced, the actual field occurrence of the geological units, and subsurface and groundwater conditions may differ from that shown on the logs.

Subsurface conditions encountered in the borings and test pits generally consisted of a thin layer of fill material on the surface. The fill material consisted of approximately 6 inches of basaltic gravel in areas of the perimeter road, and elastic silt in areas outside of the perimeter road. Below the fill, subsurface conditions generally consisted of medium dense to very dense coralline sand to the maximum depths explored in the borings at 30 to 40 feet and in the test pits at 3.3 to 8.7 feet.

Ground water was encountered in all of the borings and Test Pits 2, 3 and 7 at depths ranging from approximately 2.8 feet to 19 feet below the existing grades. These depths correspond to elevations of approximately +4 to +5 feet. Ground water was not encountered in the remaining test pits probably because of the relatively higher ground elevations and shallow depths of the test pit. Because of the proximity of the site to the ocean, it is anticipated that fluctuations in the groundwater levels may occur due to the tidal changes and rainfall landward of the site.

5.4 ATTERBERG LIMITS AND GRADATION TESTS

Three (3) grab samples of near surface soil were taken from the Phase I Landfill embankment for laboratory testing. The laboratory tests included Atterberg Limits and gradation to evaluate their soil classification and grain size distribution. The Atterberg Limits and gradation test results are presented on Plates 6 and 7.5, respectively. The test results indicate the tested materials generally consisted of sandy lean clay, fat clay with sand, and clayey sand.

5.5 PERCOLATION TESTS

Field percolation tests were performed in three (3) test holes located near Borings 4, 6 and 10 at a depth of approximately 2 feet below the existing site grades. The tests were performed in general accordance with the State of Hawaii Department of Health guidelines. The test results are summarized below.

Test Location	Subsurface Material Tested	Percolation Rate (min/inch)
Near Boring 4	coralline sand	5
Near Boring 6	coralline sand	6
Near Boring 10	coralline sand	4

6.0 DISCUSSION

6.1 GENERAL

Based on a review of readily available subsurface information, and the results of this field exploration and laboratory testing, it is our opinion that the project site is suitable for construction of the proposed expansion from a geotechnical engineering standpoint.

Potential main geotechnical concerns at the site for this project include:

- *Presence of poorly graded sand deposits.* The on-site sand is poorly graded and appears to contain little fines. Proper compaction of poorly graded sand is anticipated to be difficult.
- *Presence of relatively shallow groundwater conditions.* The sand deposits are anticipated to be relatively permeable and will not be stable at steep slope angles. Temporary open-cut excavations may require slopes approaching the angle of repose for this material or proper sheeting and shoring may need to be installed. Excavations that extend below the groundwater table may be difficult to excavate and dewater without proper sheeting and shoring.

More detailed discussion and recommendations regarding site preparation, anticipated excavation conditions, and foundation support are presented in the following letter report sections.

6.2 SOIL LIQUEFACTION

Soil liquefaction occurs when saturated granular soils experience a temporary loss of strength due to buildup of excess pore water pressure during cyclic loadings, such as in an earthquake. Soil liquefaction could result in loss of soil strength and foundation support, ground subsidence, and lateral spreading or lateral flow.

The lateral and vertical extent of submerged granular material at this site that could potentially liquefy under moderate earthquake shaking is not known. An initial soil liquefaction analysis of readily available subsurface information from this geotechnical exploration was performed based on empirical methods by Seed and Idriss (1982). Based on an assumed Richter magnitude 5.0 earthquake and a peak ground acceleration of 0.075g, it is estimated that the site generally has low liquefaction potential. Information regarding a site specific soil column analysis that may be needed to determine peak ground acceleration was not readily available at the time of this exploration.

7.0 RECOMMENDATIONS

7.1 SITE PREPARATION

1. Prior to grading, the areas of proposed development should be prepared by stripping the ground surface of all vegetation, trees, and the top at least 6 inches of soils containing vegetation, roots, and organic matter. Deeper stripping may be needed where

vegetation and organic material extend to deeper depths. The stripped and grubbed materials should be hauled to a suitable disposal site off of the County's property. All soft sediments in the existing leacheate lagoon should be completely removed.

2. The on-site elastic silt and clayey soils may be stockpiled for possible reuse in landscape or non-structural area provided they conform to the project landscaping requirements.

3. Existing trees that may interfere with the proposed improvements should be completely removed or relocated. The roots and stumps of these trees should be completely grubbed and the resulting excavations backfilled with structural fill placed and compacted as described in subsection 7.4 of this report.

4. Existing underground utility lines within the proposed construction limits and any remaining underground structures that may interfere with the construction should be completely removed and/or relocated, if still in use. The remaining portions of any lines to be left in-place should be properly cut and plugged.

5. After clearing and grubbing, and excavating to the proper subgrade level, the subgrade should be proofrolled using a heavy roller weighing at least 20 tons to check for yielding and soft areas. Yielding or soft areas in the subgrade should be excavated to firm material and backfilled with properly compacted structural fill.

6. Prior to placing any new fill, the subgrade beneath areas to receive fill should be scarified to a depth of at least 6 inches, thoroughly moisture conditioned to between optimum moisture content and 3 percent wet of the optimum moisture content for this material, and compacted to a relative compaction of at least 95 percent in structural areas and at least 90 percent in non-structural or landscape areas.

   Relative compaction in this letter report is defined as the dry unit weight of the compacted material expressed as a percentage of the maximum dry unit weight of the same material based on ASTM D1557-02 procedures.

   Any soft or yielding zones detected during the subgrade compaction should be treated by removing the soft or loose materials to firm soils and replacing the excavated materials with properly compacted structural fill.

7.2 ANTICIPATED EXCAVATION CONDITIONS

1. Temporary excavations, sheeting, shoring, and dewatering that may be required for constructing the proposed improvements, utility lines, and below grade

structures is the responsibility of the Contractor. All construction excavations and dewatering should be performed and supported in accordance with applicable Federal and local safety regulations, including current OSHA excavation and trench safety standards.

The Contractor's excavation support and dewatering systems should protect against instability of the excavations, boiling and/or blowout of the excavation and trench bottoms, damage to existing structures, and settlement and/or movement in existing structures, slabs, and pavements.

2. Excavations to the depths required for constructing the proposed improvements are anticipated to encounter mainly sandy soils. It is anticipated that these materials can generally be excavated with conventional earthwork equipment. Excavation and removal of boulders and highly cemented layers, if encountered, may require the use of a hydraulic hoe ram, rock excavator, or other suitable rock excavation equipment.

3. It is anticipated that excavations into granular deposits present at the site would tend to slough and cave-in, if not properly shored and braced. The Contractor should utilize proper sheeting and shoring to protect their workmen and surrounding properties, where necessary.

4. Ground water was encountered in the borings and some of the test pits at the time of the field exploration at elevations ranging from approximately +4 to +5 feet. Based on the water levels encountered at the site and the planned construction, some amount of dewatering will likely be needed in excavations that extend below the water table to allow for proper cleaning.

   To reduce the potential for settlement related damage, draw downs of the groundwater levels outside of the excavation should be minimized as much as practical. The dewatering system should include properly designed filters and/or geotextile filter fabric to reduce the potential for removal of fines during pumping. All pumped water from the dewatering operations should be properly filtered and treated in accordance with applicable Federal and local discharge regulations before being discharged.

7.3 PERMANENT CUT AND FILL SLOPES

1. Permanent cut slopes constructed in the natural sand deposits should not be steeper than 2H:1V.

2. Permanent fill slopes for the landfill expansion should not be steeper than 3.5H:1V. All fills placed on slopes steeper than 5H:1V should be continuously keyed and benched into the existing hillside. All fill slopes should be overbuilt and trimmed back to expose firm, compacted material at the finish grade.

3. To reduce the amount of erosion that may occur, permanent benches should be provided in cut or fill slopes that are greater than 15 feet in height. The benches should be provided every 15 feet of elevation change, except where only one bench is required. In this case, the bench should be provided at the mid height of the slope. The benches should be at least 8 feet wide and should be sloped slightly inward to drain to a suitable drainage structure.

   All permanent cut and fill slopes should be vegetated as soon as practical to reduce overall erosion. Because of the presence of mainly sandy and clayey soils with a high potential for soil erosion, a program of surface drainage control measures, such as swales and ditches should be implemented during and after grading to reduce overall erosion during and after construction.

4. The ground surface along the top of cut and fill slopes should be graded to keep surface water from running down the slope faces or a cutoff ditch or swale should be provided along the top of the slopes. Uncontrolled surface runoff could potentially result in severe slope erosion.

7.4 FILL MATERIALS, PLACEMENT, AND COMPACTION

1. Imported structural fill and backfill should consist of a granular material classified as GW, GW-GM, GP-GM, SW, SW-SM, or SP-SM according to the USCS and ASTM D2487. It should be free of organic matter, debris, clayey soils, and particles larger than 3 inches in maximum dimension. It should have not more than 15 percent by weight of material passing a U.S. Standard No. 200 sieve. It should have a CBR value of at least 30, a CBR swell of less than one percent when compacted at optimum moisture content and after 4 days of soaking, a liquid limit of less than 25, and a plasticity index of less than 10.

   Soil materials classified as MH, ML, CH, CL, PT, OL, and OH, according to the USCS are not suitable for use in structural fill and backfill.

2. Fill in landscape and non-structural areas should be relatively free of vegetation, debris, trash, concrete, old pavements, and particles larger than 3 inches in maximum dimension.

3. Structural fill and backfill should be placed in not more than 8-inch thick loose lifts, moisture conditioned to within two percent of the optimum moisture content for these materials, and compacted to a relative compaction of at least 95 percent.

4. Fill in landscape and non-structural areas should be placed in not more than 10-inch thick loose lifts, moisture conditioned to between optimum and 3 percent wet of optimum moisture content for these materials, and compacted to a relative compaction of at least 85 percent for cohesive material and at least 90 percent for granular material.

   All on-site and imported materials should be checked and tested by a qualified and experienced geotechnical engineer prior to their use in fills at the site.

7.5 SLABS-ON-GRADE

1. To provide for a more uniform support for slabs-on-grade, the top at least 12 inches of the existing soils directly below the slabs should be excavated and replaced with structural fill as described in subsection 7.4 of this letter report. The excavation should extend at least 12 inches beyond the edge of the slabs.

2. The subgrade should be proofrolled and compacted as recommended in subsection 7.1 of this letter report. A subgrade modulus of 250 pounds per square inch per inch (psi/in) may be used for slabs supported on properly compacted subgrade and structural fill.

3. Subgrade proofrolling and compaction should be observed by a qualified and experienced licensed geotechnical engineer for suitable bearing materials and cleaning prior to backfilling and placing steel and concrete. It is recommended that we be retained to perform this checking.

7.6 LATERAL RESISTANCE

1. Resistance to lateral loads will be provided by passive pressures on the faces of underground structural elements and by frictional resistance between the concrete and soil along the bases of these elements. Passive pressure on the faces of the structural elements may be computed using a passive equivalent fluid pressure of 300 pound per square foot per foot of depth (psf/ft). This value should be reduced to 150 psf/ft for sloping fill conditions with grades as steep as 2H:1V in front of the structure.

2. The top at least 12 inches of overburden soil should be neglected in calculating passive resistance along the perimeter of structures unless it is permanently confined by pavements.

3. A friction factor of 0.35 may be used for structural elements founded on properly compacted structural fill.

7.7 LATERAL EARTH PRESSURES

1. An equivalent at-rest fluid pressure of 60 psf/ft should be used to design the below grade structures that are restrained from movements, backfilled with granular free draining materials, and with level backfill conditions.

2. The above lateral earth pressure does not include seismic loads. For design, an additional lateral earth pressure equal to 10 psf/ft should be added to the above earth pressures for level backfill conditions. The point of application for the seismic force acts at average height of 0.6 times the wall height above the bottom of the structures.

3. Any surcharge from equipment, foundations, traffic, and construction equipment that may be present should be added to the above earth pressures.

4. The walls for underground structures should be backfilled with properly compacted, free draining select granular fill. The fill should be placed in not more than 6-inch thick horizontal loose lifts, moisture conditioned to with 2 percent of optimum moisture content for this material, and compacted to a relative compaction of at least 90 percent.

5. The top at least 24 inches of the backfill should be compacted to a relative compaction of at least 95 percent. Care should be taken during the compaction to not over compact the backfill. Over compaction could result in the development of high lateral earth pressures.

7.8 SITE CLASS

Based on the general geology of the area and readily available subsurface information, it is recommended that site structures that may be needed for the Phase II improvements be designed based on Site Class D according to Table 1615.1.1 of Chapter 16 of 2003 International Building Code.

8.0 LIMITATIONS

This geotechnical exploration letter report has been prepared for the use of Earth Tech Inc., in accordance with generally accepted soils and foundation engineering practices. No warranty or guarantee, expressed or implied, or other representation, is made as to the professional advice included in this letter report and none should be inferred.This letter report has been developed specifically for the use of Earth Tech Inc., for the purpose of designing the horizontal expansion of the Kekaha MSW Phase II landfill on Kauai. It does not contain sufficient information for purposes of other parties of for other uses. Pacific Geotechnical Engineers, Inc. (PGE) is not responsible for any claims, damages, or liability associated with the use of the information presented in this letter report by any other party without the written consent of PGE.

This letter report does not reflect variations which may occur in the subsurface conditions between borings and test pits. The nature and extent of variations of the subsurface conditions may not become evident until construction. This letter report does not reflect the presence or absence of debris and/or obstructions that may be encountered at or below the ground surface.

Ground water was encountered in the borings and some of the test pits at the time of our field exploration. The measured water levels are indicated on the logs of borings and test pits. However, fluctuations in the groundwater level may occur due to variations in rainfall, seepage, perched zones, construction activities, temperature and other factors that may be different from the conditions that existed at the time of the measurements.

The comments and recommendations presented in this letter report are based on the anticipated construction described herein. Should the actual construction differ from that described in this letter report, we should be notified and retained to check if any modifications to the recommendations presented in this letter report are needed. The comments and recommendations presented in this letter report shall not be considered valid unless the changes are reviewed by us and the recommendations of this letter report verified or modified in writing.

The field exploration portion of this consultation may not have disclosed the presence of underground structures such as landfills, cesspools, buried debris, drywells, storage tanks, sumps, and pits, etc., that may be present at the site. Should these items be encountered during construction, we should be notified and retained to provide appropriate recommendations for their disposal and/or treatment. Assessment of the presence or absence of these structures was not included in the scope of this consultation.

The scope of our services for this project was limited to conventional geotechnical engineering services and did not include any environmental assessment or evaluations. Silence in this letter report regarding any environmental aspects of the site does not indicate the absence of potential environmental problems.

Our scope of services specifically excluded the investigation, detection, or assessment of the presence of Biological Pollutants in or around any existing or planned structures. Accordingly, this letter report includes no interpretations, recommendations, findings, or conclusions for the purpose of detecting, preventing, assessing, or abating Biological Pollutants.

The term "Biological Pollutants" includes, but is not limited to molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

- o0o -

The following plates, tables, and references are attached and complete this letter report:

Plate 1 - Map of Area
Plate 2 - Plot Plan
Plates 3.1.1 through 3.11.2 - Log of Boring, Boring 1 through 11
Plates 4.1 through 4.4 - Log of Test Pit, Test Pit 1 through 7
Plates 5.1 and 5.2 - Unified Soil Classification System
Plate 6 - Atterberg Limits
Plates 7.1 through 7.5 - Gradation Curve
Plates 8.1 through 8.3 - Compaction Test Data
Plates 9.1 through 9.3 - California Bearing Ratio (CBR) Test Results

Table 1 - Shear Strength Test Results
Table 2 - Laboratory Permeability Test Results

References

KENNETH K. FAN
No. 6729-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION
Kenneth Fan

EXP. April 30, 2010

Respectfully submitted,

PACIFIC GEOTECHNICAL ENGINEERS, INC.

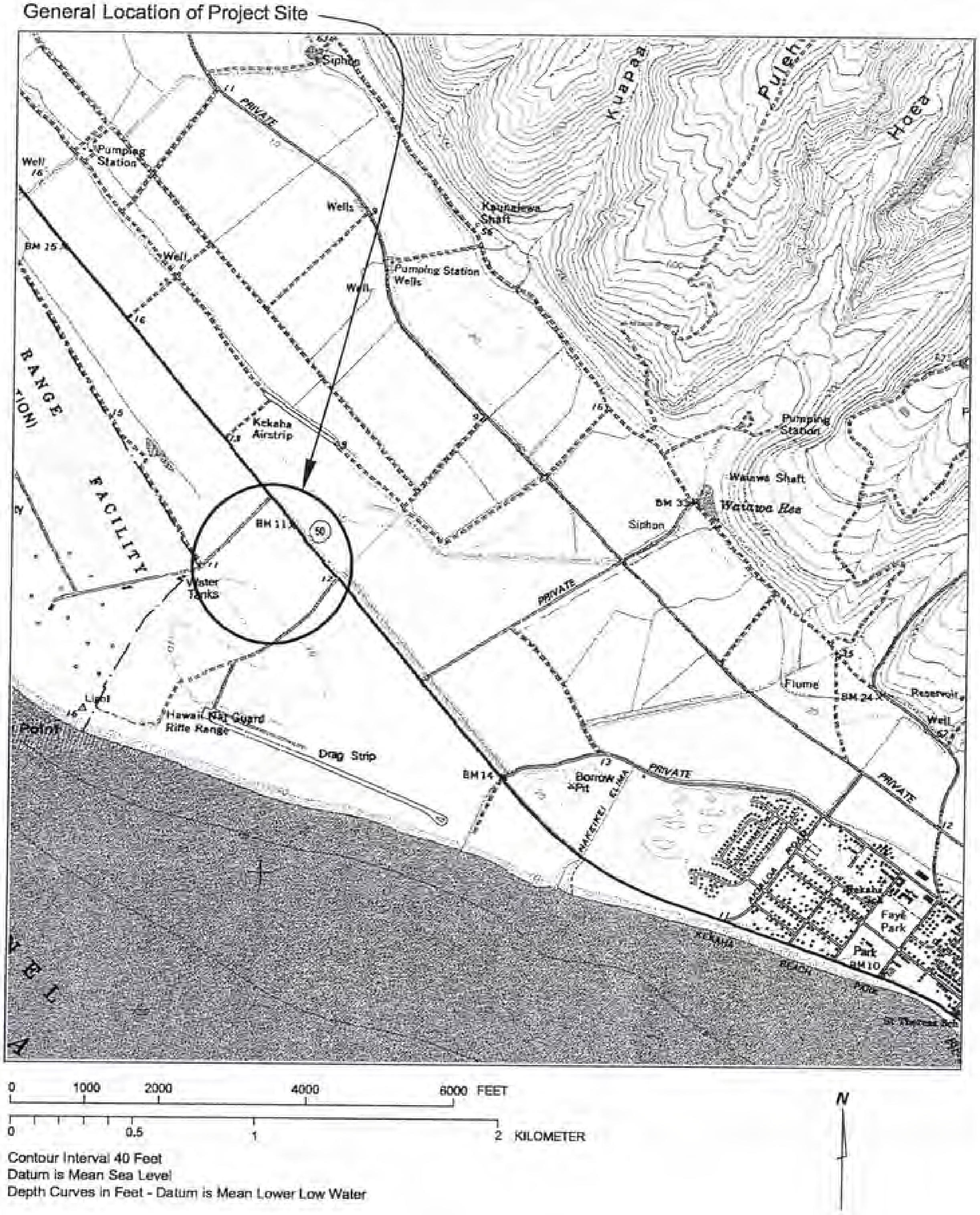
Kenneth Fan

Kenneth K. Fan, P.E.
Project Manager

KKF(8950-020 final rpt)
(One copy by e-mail

Cc: Earth Tech, Inc.
Attention: Mr. Kenneth Bergschultz

8950-020 moa.dwg (02-20-07)

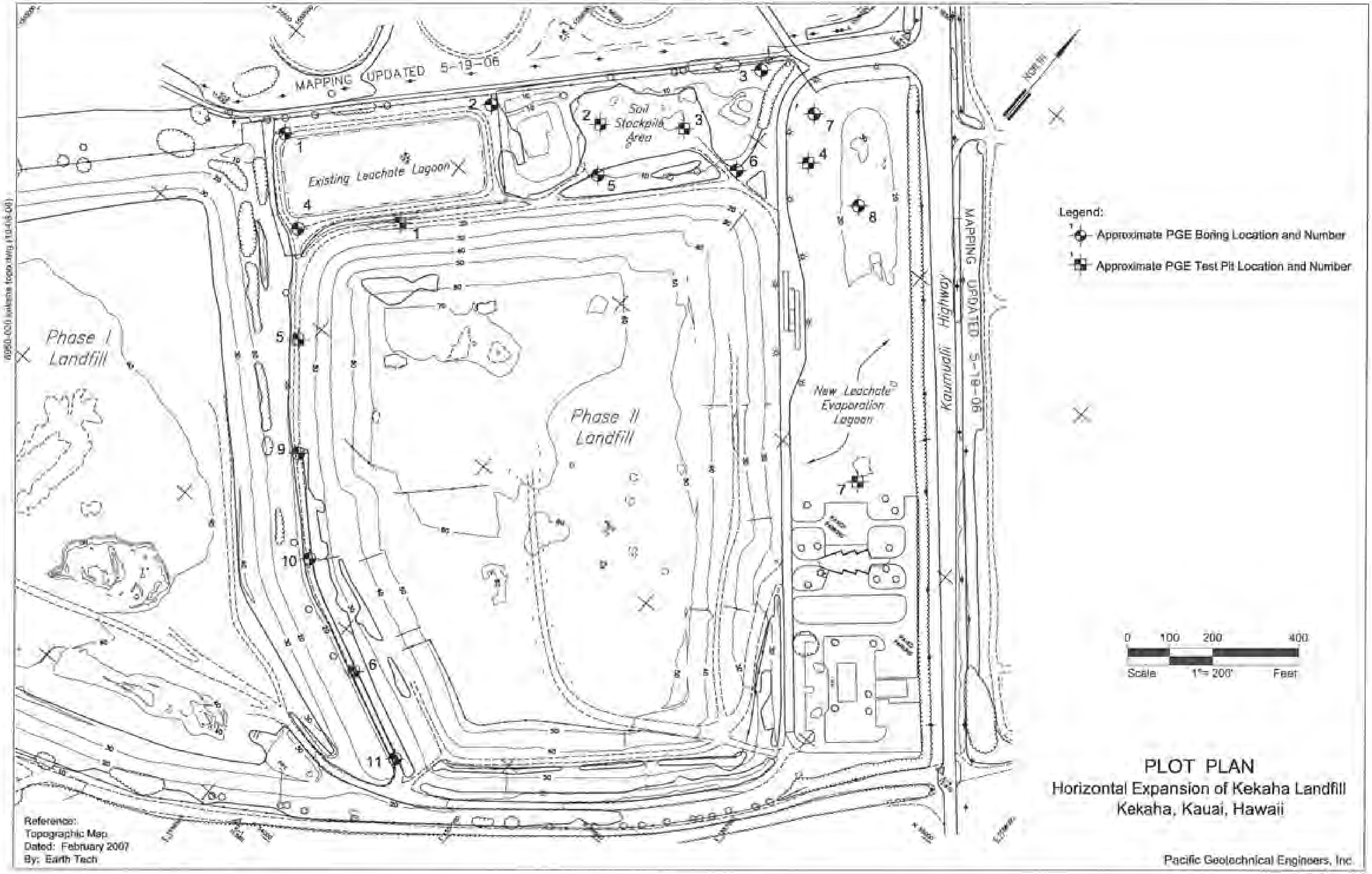


Contour Interval 40 Feet
Datum is Mean Sea Level
Depth Curves in Feet - Datum is Mean Lower Low Water

MAP OF AREA

Reference:
U.S.G.S. Topographic Map
Kekaha, Kauai, Hawaii
Dated: 1983

Pacific Geotechnical Engineers, Inc.



Legend:

- Approximate PGE Boring Location and Number
- Approximate PGE Test Pit Location and Number

Reference:
Topographic Map
Dated: February 2007
By: Earth Tech

PLOT PLAN

Horizontal Expansion of Kekaha Landfill
Kekaha, Kauai, Hawaii

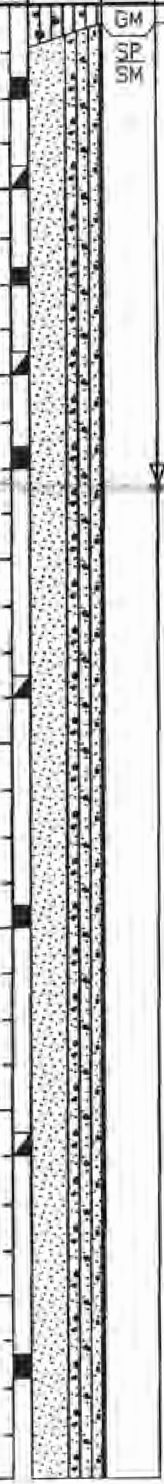
Pacific Geotechnical Engineers, Inc.

PLATE 2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 1 (Page 1 of 2)

SURFACE ELEVATION *±15* ± Feet
DATUM *Mean Sea Level*



LAB DATA MOISTURE CONTENT %	LAB DATA DRY DENSITY (pcf)	CORE INFO CORE TYPE	CORE INFO RECOVERY %	CORE INFO RQD % or (RQD) %	BLOWS/FT.	DEPTH (feet)	SOIL CLASS	DESCRIPTION
							GM	Gray silty basaltic gravel with sand, moist (fill)
							SP-SM	Brown poorly graded coralline sand with silt, very dense, moist
					110			
								grades medium dense
					20	4		
4	103				88			
								grades light yellowish brown and very dense
					69	8		
7	100				78			grades wet to saturated and dense
								(Water level at 1157 hours on 11-30-06)
						12		
					22			grades medium dense
						16		
								grades medium dense to dense
25	100				71	20		
						24		grades grayish brown and dense
					40			
						28		
								grades very dense
19	109				85/6"			
						32		

15
10.3
4'7

NOTES:
- ■ - 3.3-inch outside diam. relatively undisturbed sample
- ☒ - Disturbed sample
- ☐ - Sample lost during extraction
- ◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- I - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

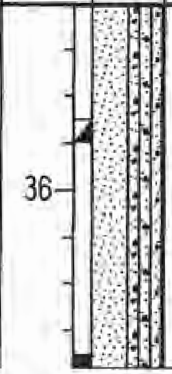
LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 3.1.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 1 (Page 2 of 2)



LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									SP/SM	
					84					
						36				
32	93				100/4"					

Boring completed at 38.8 feet on 11-30-06.

NOTES:
- ■ – 3.3-inch outside diam. relatively undisturbed sample
- ☒ – Disturbed sample
- ☐ – Sample lost during extraction
- ◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- Ⲓ – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

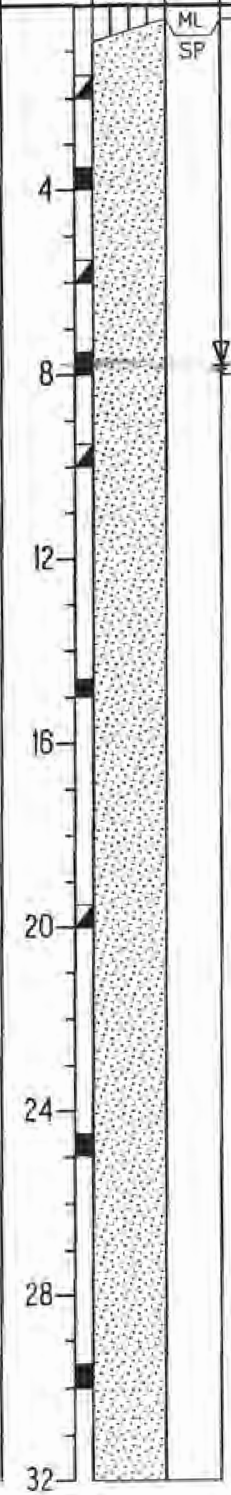
PLATE

3.1.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 2 (Page 1 of 2)

SURFACE ELEVATION *+13* ± Feet
DATUM *Mean Sea Level*



LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									ML	Brown sandy silt, moist (fill)
									SP	Light yellowish brown poorly graded coralline sand, medium dense, moist
					26					
5	97				47	4				
					63					
19	99				86/6"	8				(Water level at 1813 hours on 11-30-06) grades grayish brown and saturated
					86					grades yellowish brown
						12				
										grades medium dense
29	94				31					
						16				
					23	20				grades light grayish brown
						24				grades with trace of shell fragments
26	98				71					
						28				
					101					
						32				

13
7.4
— 5.6

NOTES:
■ – 3.3-inch-outside diam. relatively undisturbed sample
☒ – Disturbed sample
☐ – Sample lost during extraction
◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
Ɪ – Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

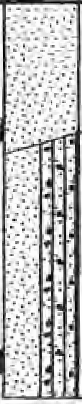
LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE
3.2.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 2 (Page 2 of 2)



LAB DATA		CORE INFO							
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	SOIL CLASS	DESCRIPTION
								SP	
					63		◪	SP SM	Light gray poorly graded coralline sand, very dense, with silt, saturated
						36			
									grades medium dense
31	92				70	40	■		

Boring completed at 40.5 feet on 12-01-06.

NOTES:

■ – 3.3-inch outside diam. relatively undisturbed sample

☒ – Disturbed sample

☐ – Sample lost during extraction

◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)

⌶ – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

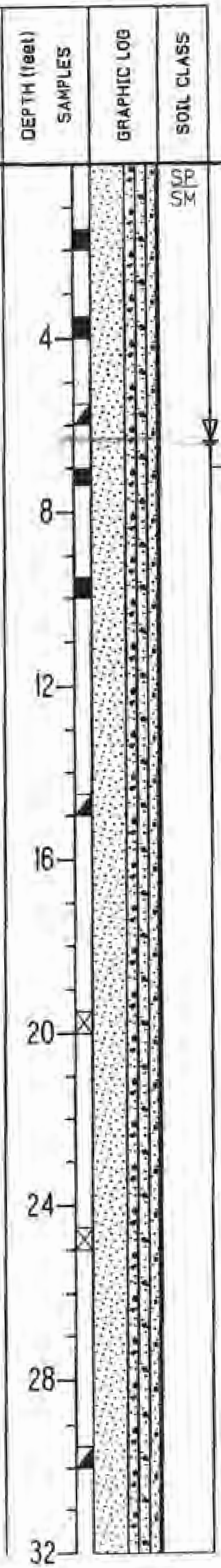
PLATE 3.2.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 3 (Page 1 of 2)

SURFACE ELEVATION *+11* ± Feet
DATUM *Mean Sea Level*

LAB DATA		CORE INFO				
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	
10	97				38	
					101	
					42	
22	106				81	
					111	
					15	
					84	
23					88	
					63	



DESCRIPTION

Yellowish brown poorly graded coraline sand, medium dense, with silt, moist

grades dense

grades light grayish brown and light yellowish brown

(Water level at 1413 hours on 12-06-08)

grades light yellowish brown and saturated

grades very dense

11
6.3
4.7

grades medium dense

grades dense

grades light brownish gray to yellowish brown and very dense

NOTES:

- ■ – 3.3-inch outside diam. relatively undisturbed sample
- ☒ – Disturbed sample
- ☐ – Sample lost during extraction
- ◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- I – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE 3.3.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 3 (Page 2 of 2)

LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
26	88				89/6"	36			SP SM	
					16	40			SM	White to light grayish brown silty coralline sand, medium dense, with coralline gravel, saturated

Boring completed at 40.5 feet on 12-06-06.

NOTES:
- ■ - 3.3-inch outside diam. relatively undisturbed sample
- ☒ - Disturbed sample
- ☐ - Sample lost during extraction
- ◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- ⌶ - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

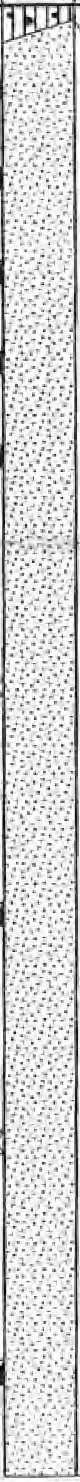
Pacific Geotechnical Engineers, Inc.

PLATE 3.3.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 4 (Page 1 of 2)

SURFACE ELEVATION *+17* ± Feet
DATUM *Mean Sea Level*



LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									GM	Gray silty basaltic gravel with sand, moist (fill)
									SP	Light yellowish brown poorly graded coraline sand, dense to very dense, moist
4					50		◪			
										grades dark brown
										grades light yellowish brown
					104	4	■			
										grades medium dense
5	101				78		◪			
										grades loose
					22	8	■			
					75		◪			
						12			∇	(Water level at 1512 hours on 11-29-06)
19					110/6"		☒			
						16				
					28	20	◪			
										grades light yellowish brown to light brown
						24				grades dense
28					88		☒			
						28				
					42		◪			
						32				

17
12.7
4.3

NOTES:
■ - 3.3-inch outside diam. relatively undisturbed sample
☒ - Disturbed sample
☐ - Sample lost during extraction

◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE
3.4.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 4 (Page 2 of 2)

LAB DATA		CORE INFO							
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet) SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
								SP	
23	102				110	■			grades very dense
						36			
					72	40 ◪			

Boring completed at 40.0 feet on 11-30-06.

NOTES:

■ - 3.3-inch outside diam. relatively undisturbed sample

☒ - Disturbed sample

☐ - Sample lost during extraction

◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)

⌶ - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE

3.4.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 5 (Page 1 of 2)

SURFACE ELEVATION *+9* ± Feet
DATUM *Mean Sea Level*

LAB DATA		CORE INFO							
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	SOIL CLASS	DESCRIPTION
								ML	Reddish brown sandy silt, with some basaltic gravel, moist (fill)
5	92				103		■	SP-SM	Light yellowish brown poorly graded coralline sand, dense, with silt, moist
								∇	(Water level at 1215 hours on 12-07-06)
					74	4	■		
									grades very dense and saturated
					79		◪		
									grades dense and locally weakly cemented
					98	8	■		
									grades medium dense and uncemented
23	99				47		■		
						12			
					25		◪		grades light yellowish brown to light brownish gray
						16			
									grades dense
32	90				88	20	■		
						24			grades very dense
					133		☒		
						28			
28					50		◪		grades dense to very dense
						32			

9
3.3
5.7

NOTES:
- ■ – 3.3-inch outside diam. relatively undisturbed sample
- ☒ – Disturbed sample
- ☐ – Sample lost during extraction
- ◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- ⌶ – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

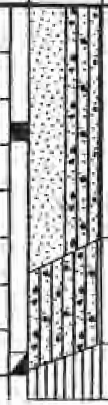
LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE 3.5.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 5 (Page 2 of 2)



LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY [pcf]	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									SP/SM	
37	78				168/11"		■			grades gray
						36				
									SM	Light brown silty coralline sand, medium dense, with coralline gravel, saturated
					11	40	◪		MH	Dark brown elastic silt, stiff, with coralline sand, saturated

Boring completed at 40.5 feet on 12-04-06.

NOTES:
- ■ – 3.3-inch outside diam. relatively undisturbed sample
- ☒ – Disturbed sample
- ☐ – Sample lost during extraction
- ◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- ⌶ – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE

3.5.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 6 (Page 1 of 2)

SURFACE ELEVATION *+12* ± Feet
DATUM *Mean Sea Level*

LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									MH	Reddish brown elastic silt, with coralline sand, msoit (fill)
									SP SM	Brown poorly graded coralline sand, dense, with silt, moist
					42		◪			
										grades light yellowish brown and very dense
6	98				145	4	■			
		NX	0	0			I			
									▽	(Water level at 0928 hours on 12-07-06)
						8				
										grades locally weakly cemented and saturated
					75		◪			
						12				
37					74		☒			grades dense and uncemented
						16				
										grades very dense
27	96				108	20	■			
						24				
					43		◪			grades dense
						28				
										grades very dense
23	98				100/6"		■			
						32				

12
7
5

NOTES:
■ – 3.3-inch outside diam. relatively undisturbed sample
☒ – Disturbed sample
☐ – Sample lost during extraction
◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
I – Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE
3.6.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 6 (Page 2 of 2)

LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
					120	36	⊠		SP SM	
31					37	40	◪		SM	White to light grayish brown silty coralline sand, dense, with coralline gravel, saturated

Boring completed at 40.5 feet on 12-06-06.

NOTES:

■ – 3.3-inch outside diam. relatively undisturbed sample

⊠ – Disturbed sample

☐ – Sample lost during extraction

◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)

⌶ – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

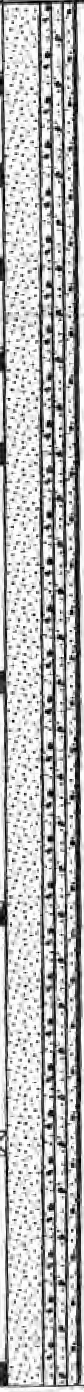
PLATE 3.6.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 7 (Page 1 of 1)

SURFACE ELEVATION *+12* ± Feet
DATUM *Mean Sea Level*

LAB DATA		CORE INFO							
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQD) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	SOIL CLASS	DESCRIPTION
								SP SM	Light brown poorly graded coralline sand, dense, with silt, moist
					31		◩		
7	93				95	4	■		grades light yellowish brown
					49		■		grades medium dense, locally weakly cemenid, and with coralline gravel
								▽	(Water level at 1052 hours on 12-07-06) ≈5.2 msL
					82	8	◩		grades very dense and without coralline gravel
24	104				122/6"		■		
						12			
									grades dense
					92		■		
						16			
					44	20	◩		
						24			
					82		☒		
						28			grades very dense
20	108				81/6"		■		



Boring completed at 30.0 feet on 12-07-06.

12
6.8
5.2

NOTES:
■ - 3.3-inch outside diam. relatively undisturbed sample
☒ - Disturbed sample
☐ - Sample lost during extraction
◩ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE
3.7

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 8 (Page 1 of 1)

SURFACE ELEVATION *+13* ± Feet
DATUM *Mean Sea Level*

LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									SP	Yellowis brown poorly graded coralline sand, medium dense, moist
7	93				55		■			
18	92				124	4	■			grades light yellowish brown, very dense, and locally weakly cemented
										grades medium dense
					28		◪			
									▽	grades dense
29	96				83	8	■			(Water level at 1513 hours on 12-07-06)
										grades uncemented and saturated
28	95				112		■			grades very dense
						12				
										grades dense
					31		◪			
						16				
29	95				75	20	■			
						24				grades medium dense
23	101				49		■			
						28				
					38		◪			grades dense

Boring completed at 30.5 feet on 12-07-06.

NOTES:
- ■ - 3.3-inch outside diam. relatively undisturbed sample
- ☒ - Disturbed sample
- ☐ - Sample lost during extraction
- ◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- ⌶ - Core run

DRIVING ENERGY: 140-lb dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

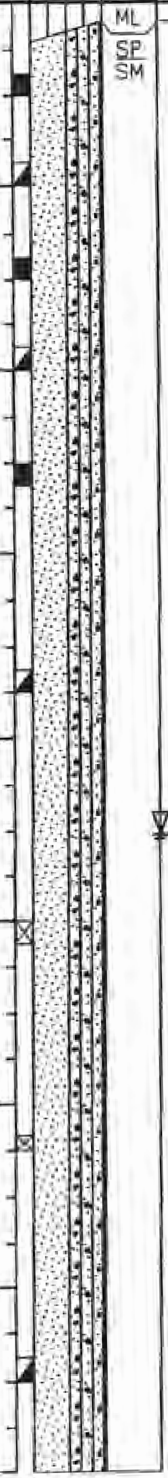
PLATE

3.8

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *jml*

BORING 9 (Page 1 of 2)

SURFACE ELEVATION *+23* ± Feet
DATUM *Mean Sea Level*



LAB DATA: MOISTURE CONTENT %	LAB DATA: DRY DENSITY (pcf)	CORE INFO: CORE TYPE	CORE INFO: RECOVERY %	CORE INFO: RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	SOIL CLASS	DESCRIPTION
								ML	Brown sandy silt with some basaltic gravel, moist (fill)
								SP SM	Light brown poorly graded coralline sand, dense, with silt, moist
6	97				72		■		
					44	4	◪		
8	92				103		■		
					33	8	◪		grades brown
11	93				48		■		
						12			
									grades light grayish brown and dense
9					45		◪		
						16			
								▽	(Water level at 1038 hours on 11-29-06)
20					45/6"	20	☒		
						24			grades light yellowish brown and very dense
					108		☒		
						28			grades brown and dense
28					35		◪		
						32			

NOTES:

■ - 3.3-inch outside diam. relatively undisturbed sample

☒ - Disturbed sample

☐ - Sample lost during extraction

◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)

I - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

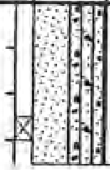
LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE 3.9.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 9 (Page 2 of 2)

LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
					87		☒		SP SM	

Boring completed at 35.5 feet on 11-28-06.

NOTES:

■ - 3.3-inch outside diam. relatively undisturbed sample

☒ - Disturbed sample

☐ - Sample lost during extraction

◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)

⌶ - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

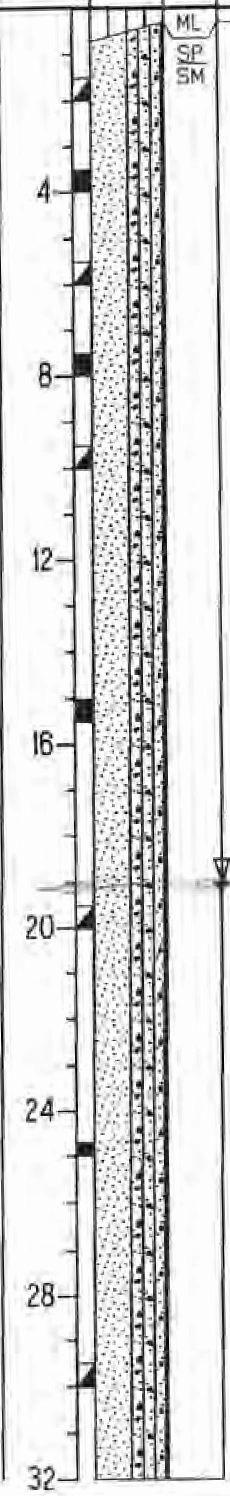
PLATE 3.9.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 10 (Page 1 of 2)

SURFACE ELEVATION *+24* ± Feet
DATUM *Mean Sea Level*

LAB DATA		CORE INFO				
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)
					43	
9	102				73	4
					41	
8	94				106	8
					47	
13	86				68	16
					62	20
19	107				79	24
					35	28



DESCRIPTION

ML — Brown sandy silt with some basaltic gravel, moist (fill)

SP/SM — Light brown poorly graded coralline sand, dense, with silt, moist

grades very dense

grades dark brown and dense

grades medium dense

(Water level at 1353 hours on 11-28-06)

grades light yellowish brown, very dense, and saturated

grades dense

grades light brown

NOTES:
- ■ – 3.3-inch outside diam. relatively undisturbed sample
- ☒ – Disturbed sample
- ☐ – Sample lost during extraction
- ◪ – 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- ⌶ – Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

Pacific Geotechnical Engineers, Inc.

PLATE 3.10.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 10 (Page 2 of 2)

LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
30					35		◪	▨	SP SM	

Boring completed at 35.5 feet on 11-28-06.

NOTES:

- ■ - 3.3-inch outside diam. relatively undisturbed sample
- ☒ - Disturbed sample
- ☐ - Sample lost during extraction
- ◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
- ⌶ - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

PGE Pacific Geotechnical Engineers, Inc.

PLATE **3.10.2**

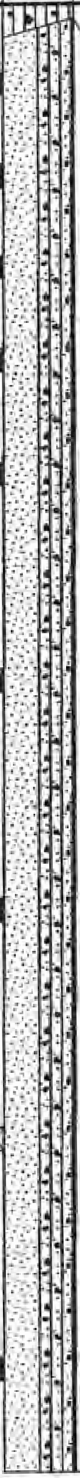
PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

LOCATION *Kekaha, Kauai* DRAWN BY *lml*

BORING 11 (Page 1 of 2)

SURFACE ELEVATION *+21* ± Feet

DATUM *Mean Sea Level*



LAB DATA		CORE INFO							
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQD) %	BLOWS/FT.	DEPTH (feet)	SAMPLES	SOIL CLASS	DESCRIPTION
								GM	Gray and brown silty basaltic gravel, moist (fill)
								SP-SM	Light yellowish brown poorly graded coralline sand, dense, with silt, moist
8	99				90		■		
									grades light brown
					48	4	◪		
11	103				70		■		grades brown and medium dense
					35	8	◪		grades dense
17	98				41		■		grades dark grayish brown and medium dense
						12			
					27		◪		grades light brown
						16		▽	(Water level at 1440 hours on 11-27-06)
									grades light yellowish brown and dense
21	106				104	20	■		
						24			
					49		☒		grades light brown and medium dense
						28			
24	99				71		■		
						32			grades dense

NOTES:

■ - 3.3-inch outside diam. relatively undisturbed sample

☒ - Disturbed sample

☐ - Sample lost during extraction

◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)

I - Core run

DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

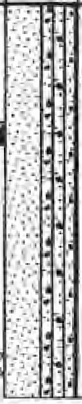
PGE Pacific Geotechnical Engineers, Inc.

PLATE

3.11.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*

BORING 11 (Page 2 of 2)

LAB DATA		CORE INFO			BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI) %						
									SP/SM	
					42		◪			
						36				
					100	40	☒			

Boring completed at 40.5 feet on 11-28-06.

NOTES:
■ - 3.3-inch outside diam. relatively undisturbed sample
☒ - Disturbed sample
☐ - Sample lost during extraction
◪ - 2-inch outside diam. standard penetration test sample (split-spoon sampler)
I - Core run
DRIVING ENERGY: 140-lb. dropping 30 inches

LOG OF BORING

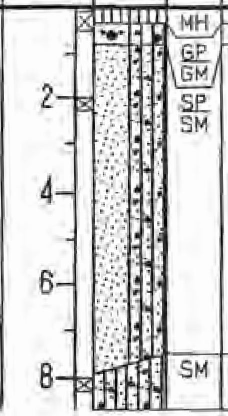
Pacific Geotechnical Engineers, Inc.

PLATE 3.11.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

TEST PIT 1

SURFACE ELEVATION *+19* ± Feet
DATUM *Mean Sea Level*



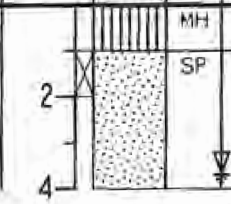
LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI %)	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
12							☒		MH	Reddish brown elastic silt with coralline sand, moist (fill)
									GP GM	Gray poorly graded basaltic gravel with silt, moist (fill)
5						2	☒		SP SM	Yellowish brown poorly graded coralline sand, moist
23						8	☒		SM	Dark gray silty sand, with roots

Test pit completed at 8.7 feet on 12-14-06.

Ground water not encountered.

TEST PIT 2

SURFACE ELEVATION *+9* ± Feet
DATUM *Mean Sea Level*



LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI %)	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									MH	Brown elastic silt with coralline sand and roots, moist (fill)
21						2	☒		SP	Mottled light yellowish brown and light grayish brown poorly graded coralline sand, moist
						4				(Water level at 1245 hours on 12-14-06)

Test pit completed at 4.0 feet on 12-14-06.

NOTES:
■ - 2.4-inch diameter relatively undisturbed hand sample
☒ - Disturbed hand sample

Soil sampled by hand sampling method

LOG OF TEST PIT

Pacific Geotechnical Engineers, Inc.

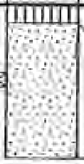
PLATE

4.1

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

TEST PIT 3

SURFACE ELEVATION *+8* ± Feet
DATUM *Mean Sea Level*

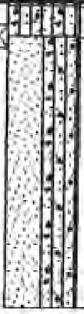


LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI %)	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
									MH	Brown elastic silt with coralline sand and roots, moist (fill)
7						2	☒		SP	Light yellowish brown poorly graded coralline sand, moist (Water level at 1345 hours on 12-14-06)

Test pit completed at 3.3 feet on 12-14-06.

TEST PIT 4

SURFACE ELEVATION *+12* ± Feet
DATUM *Mean Sea Level*



LAB DATA		CORE INFO								
MOISTURE CONTENT %	DRY DENSITY (pcf)	CORE TYPE	RECOVERY %	RQD % or (RQI %)	BLOWS/FT.	DEPTH (feet)	SAMPLES	GRAPHIC LOG	SOIL CLASS	DESCRIPTION
5							☒		SM	Grayish brown sandy silt with roots, moist (fill)
									SP-SM	Grayish brown silty sand with roots, moist (fill)
						2 4 6				Light yellowish brown poorly graded coralline sand, with silt, moist

Test pit completed at 6.7 feet on 12-14-06.

Ground water not encountered.

NOTES:
■ – 2.4-inch diameter relatively undisturbed hand sample
☒ – Disturbed hand sample

Soil sampled by hand sampling method

LOG OF TEST PIT

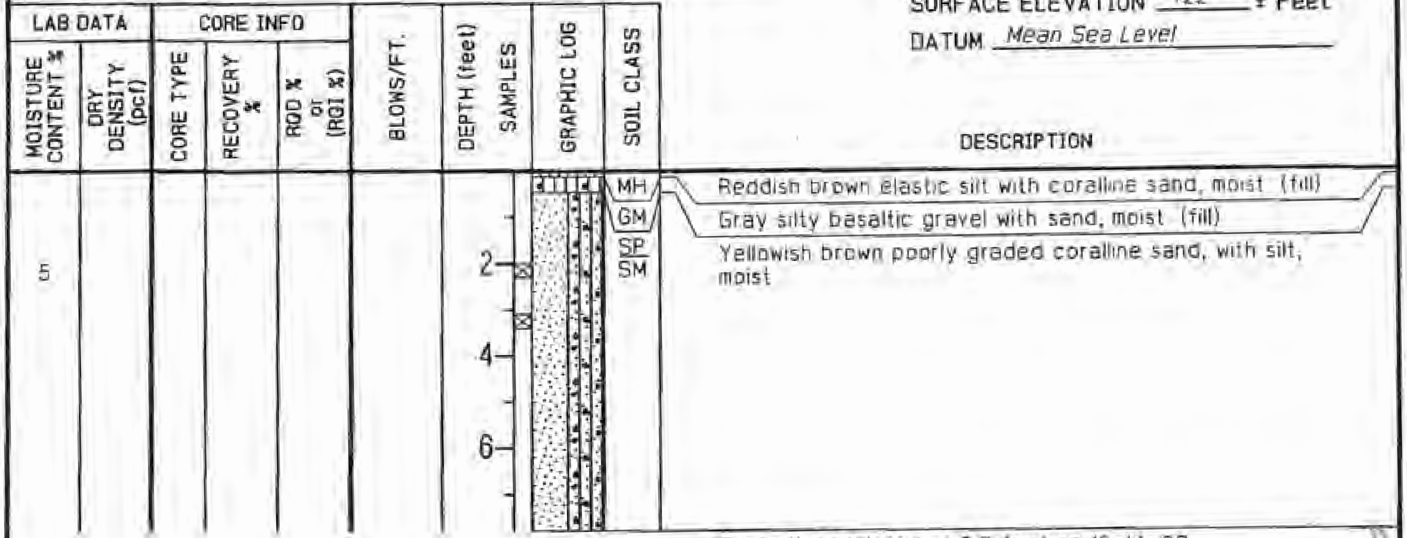
Pacific Geotechnical Engineers, Inc.

PLATE
4.2

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

TEST PIT 5

SURFACE ELEVATION *+22* ± Feet
DATUM *Mean Sea Level*



SOIL CLASS	DESCRIPTION
MH	Reddish brown elastic silt with coralline sand, moist (fill)
GM	Gray silty basaltic gravel with sand, moist (fill)
SP SM	Yellowish brown poorly graded coralline sand, with silt, moist

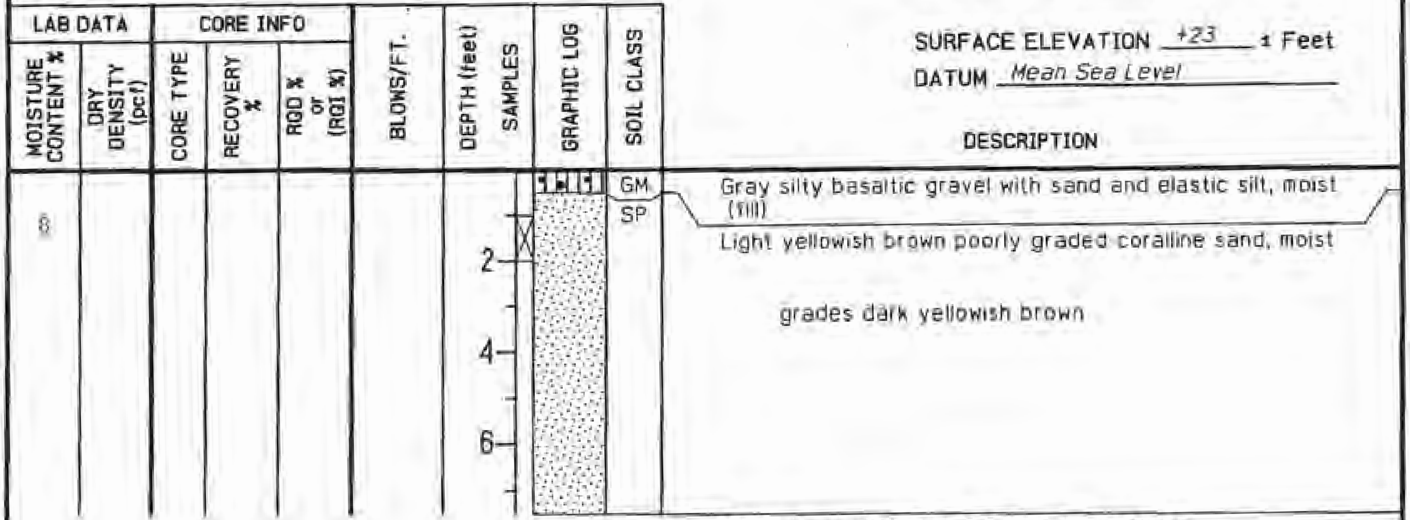
Test pit completed at 7.8 feet on 12-14-06.

Ground water not encountered.

+22
7.8
14.2 msl

TEST PIT 6

SURFACE ELEVATION *+23* ± Feet
DATUM *Mean Sea Level*



SOIL CLASS	DESCRIPTION
GM	Gray silty basaltic gravel with sand and elastic silt, moist (fill)
SP	Light yellowish brown poorly graded coralline sand, moist grades dark yellowish brown

Test pit completed at 7.5 feet on 12-14-06.

Ground water not encountered.

NOTES:
■ - 2.4-inch diameter relatively undisturbed hand sample
☒ - Disturbed hand sample

Soil sampled by hand sampling method

LOG OF TEST PIT

Pacific Geotechnical Engineers, Inc.

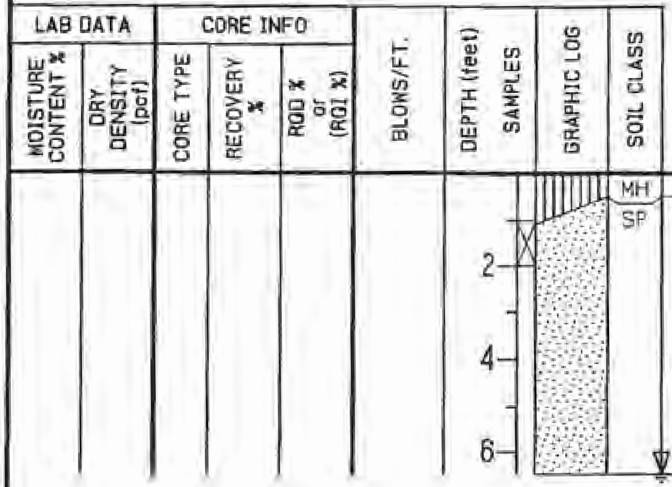
PLATE

4.3

PROJECT *Expansion MSW Phase II Landfill* JOB No. *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml*

TEST PIT 7

SURFACE ELEVATION *+11* ± Feet
DATUM *Mean Sea Level*



DESCRIPTION

MH Reddish brown elastic silt with coralline sand, moist (fill)

SP Light yellowish bornw poorly graded coralline sand, moist

(Water level at 1000 hours on 12-14-06)

Test pit completed at 6.5 feet on 12-14-06.

NOTES:
■ – 2.4-inch diameter relatively undisturbed hand sample
☒ – Disturbed hand sample

Soil sampled by hand samping method

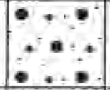
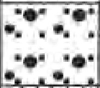
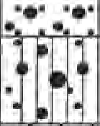
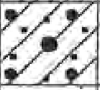
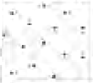
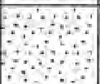
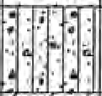
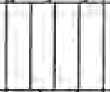
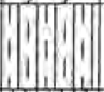
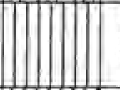
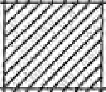
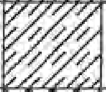
LOG OF TEST PIT

Pacific Geotechnical Engineers, Inc.

PLATE 4.4

CHECKED BY/DATE:

UNIFIED SOIL CLASSIFICATION SYSTEM – (ASTM D2487-00)

MAJOR DIVISIONS			LETTER SYMBOL	GRAPHIC SYMBOL	GROUP NAMES
COARSE-GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	GW		WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND
			GP		POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND
		GRAVELS WITH MORE THAN 12% FINES	GM		SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC		CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
	SANDS 50% OR MORE OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND LESS THAN 5% FINES	SW		WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
			SP		POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
		SANDS WITH MORE THAN 12% FINES	SM		SILTY SAND, SILTY SAND WITH GRAVEL
			SC		CLAYEY SAND, CLAYEY SAND WITH GRAVEL
FINE-GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		SILT, SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY SILT
			CL		LEAN CLAY, LEAN CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY LEAN CLAY
			OL		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE		MH		ELASTIC SILT, ELASTIC SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY ELASTIC SILT
			CH		FAT CLAY, FAT CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY FAT CLAY
			OH		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
HIGHLY ORGANIC SOILS			PT		PEAT

NOTE:
DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS. REFER TO ASTM D2487 FOR BORDERLINE CLASSIFICATIONS GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, AND SP-SC.

PGE JOB NO. 9... USCS3.DWG

UNIFIED SOIL CLASSIFICATION SYSTEM

(SHEET 1 OF 2)

Pacific Geotechnical Engineers, Inc.

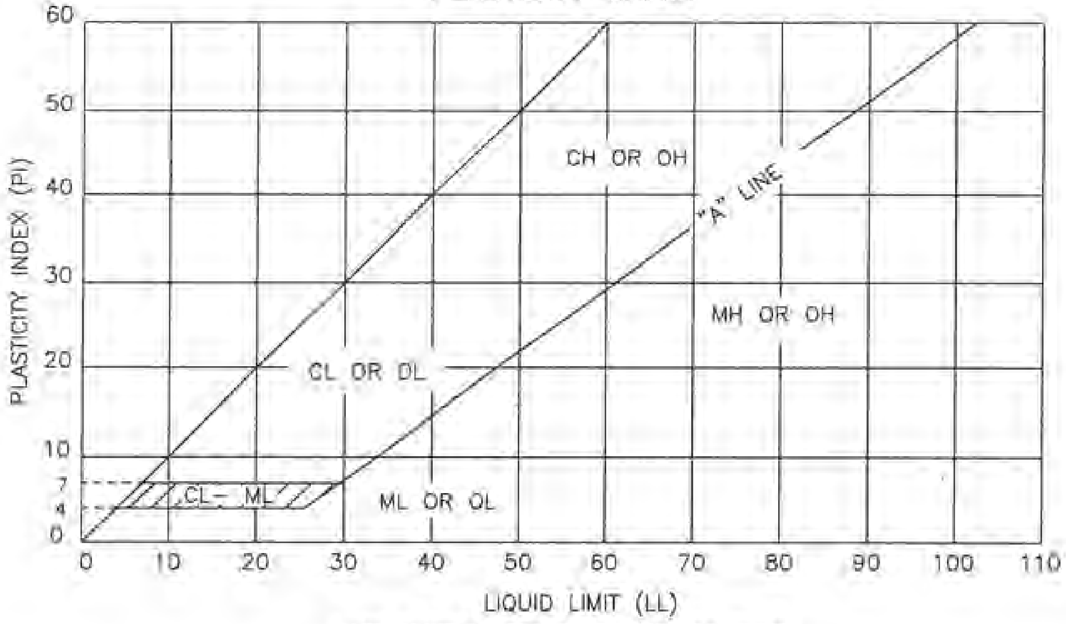
PLATE 5.1

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE **	MILLIMETERS	SIEVE SIZE **
SAND				
FINE	0.075	#200 **	0.425	#40 **
MEDIUM	0.425	#40 **	2.00	#10 **
COARSE	2.00	#10 **	4.75	#4 **
GRAVEL				
FINE	4.75	#4 **	19.0	3/4" *
COARSE	19.0	3/4" *	75.0	3" *
COBBLES	75.0	3" *	300	12" *
BOULDERS	300	12" *	----	----

** U.S. STANDARD SIEVE   * SQUARE OPENINGS

PLASTICITY CHART



FOR CLASSIFICATION OF FINE-GRAINED SOILS
AND FINE-GRAINED FRACTION OF
COARSE-GRAINED SOILS

NOTE:
WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF COHESIONLESS SOILS.

COHESIVE SOILS

	APPROXIMATE SHEAR STRENGTH IN KSF
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
MEDIUM STIFF	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

COHESIONLESS SOILS

- VERY LOOSE
- LOOSE
- MEDIUM DENSE
- DENSE
- VERY DENSE

THESE ARE USUALLY BASED ON AN EXAMINATION OF SOIL SAMPLES, PENETRATION RESISTANCE, AND SOIL DENSITY DATA.

UNIFIED SOIL CLASSIFICATION SYSTEM

(SHEET 2 OF 2)

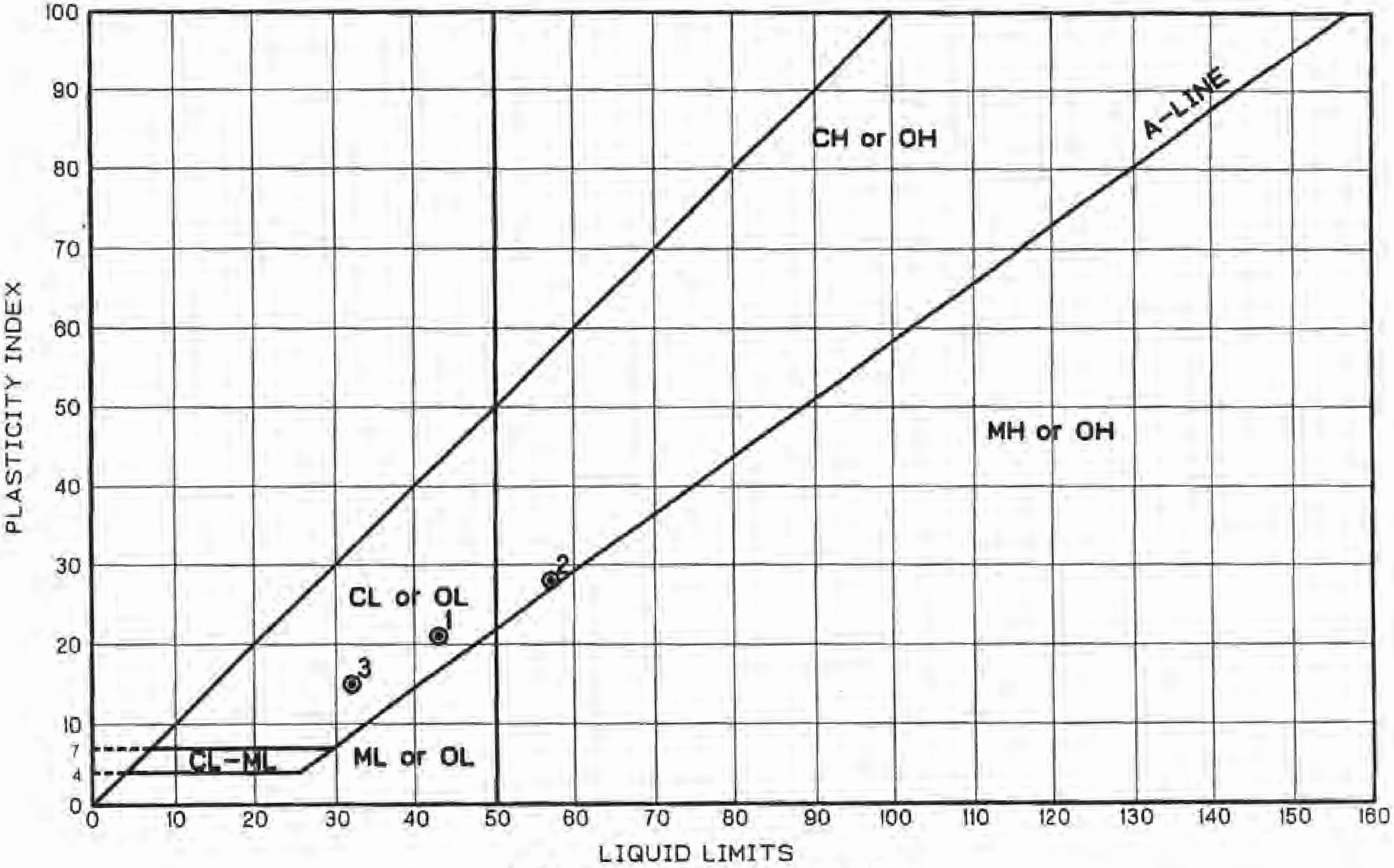
Pacific Geotechnical Engineers, Inc.

PLATE 5.2

CHECKED BY/DATE:

PGE JOB NO. 9011 USCS4.DWG

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml* DATE DRAWN *01-12-07*



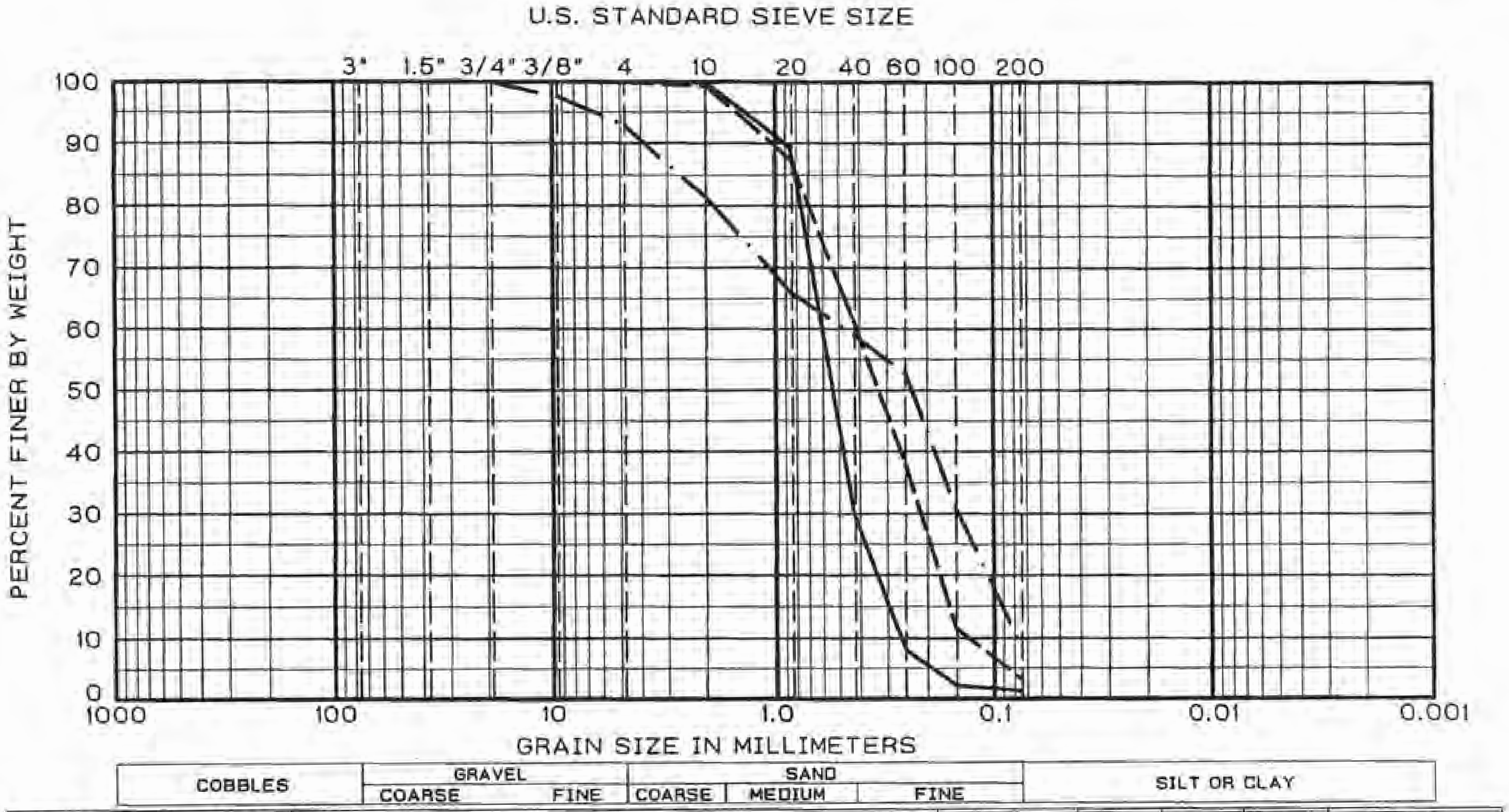
ATTERBERG LIMITS

KEY	LOCATION	SAMPLE DEPTH (ft)	LIQUID LIMIT	PLASTICITY INDEX
1	Grab Sample 1	0.5	43	21
2	Grab Sample 2	0.5	57	28
3	Grab Sample 3	0.5	32	15

Pacific Geotechnical Engineers, Inc.

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020*

LOCATION *Kekaha, Kauai* DRAWN BY *lml* DATE DRAWN *01/12/07*

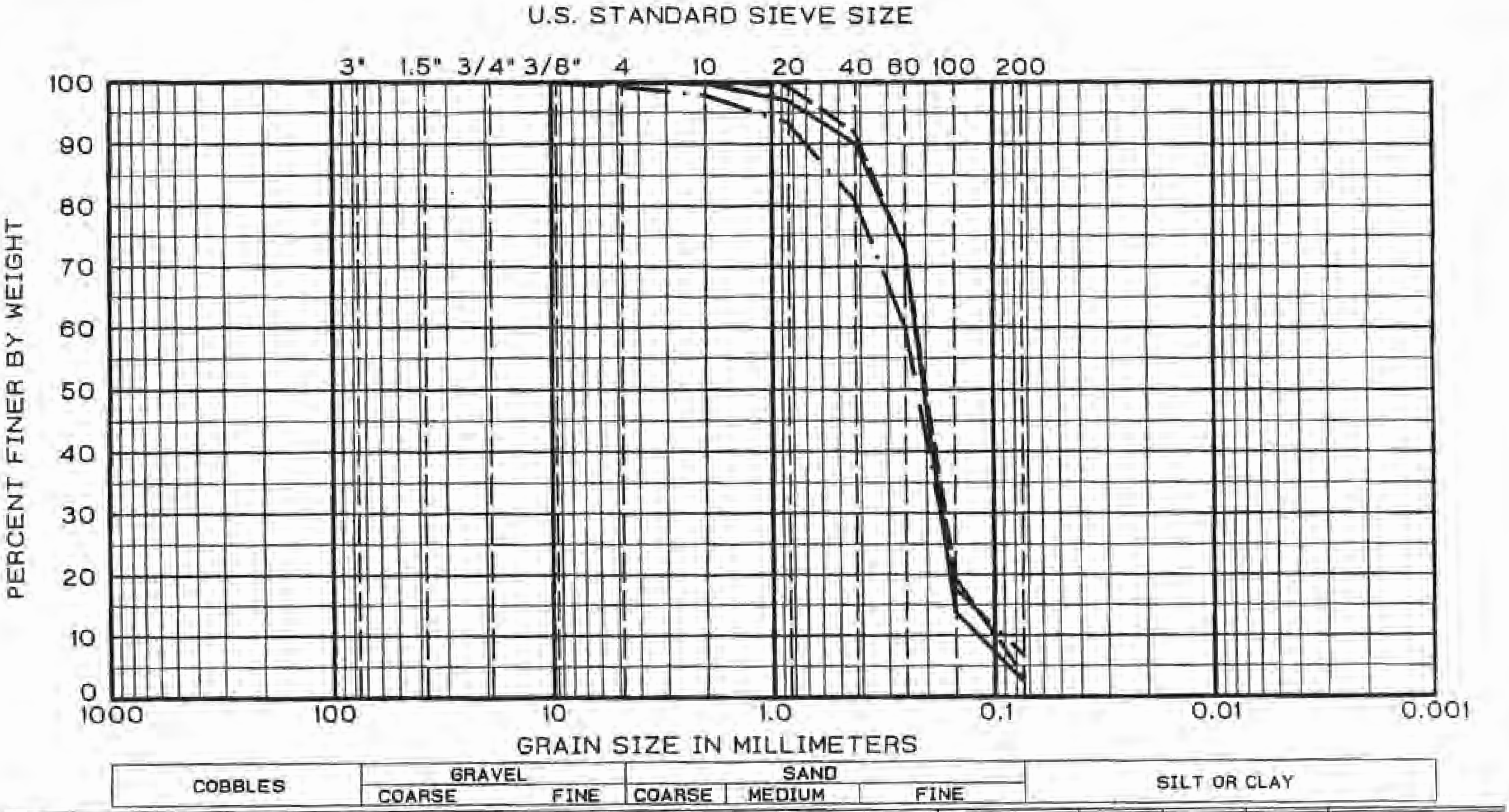


LOCATION	DEPTH (ft)	CLASSIFICATION		NAT. WC	LL	PL	PI	SYMBOL
Boring 2	3.5	SP	Yellowish brown poorly graded sand	5				———
Boring 2	24.5	SP	Light grayish brownn poorly graded sand	26				— — —
Boring 2	39.7	SP-SM	Light gray poorly graded sand with silt	31				— · — ·

GRADATION CURVE

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020*

LOCATION *Kekaha, Kauai* DRAWN BY *lml* DATE DRAWN *01/12/07*

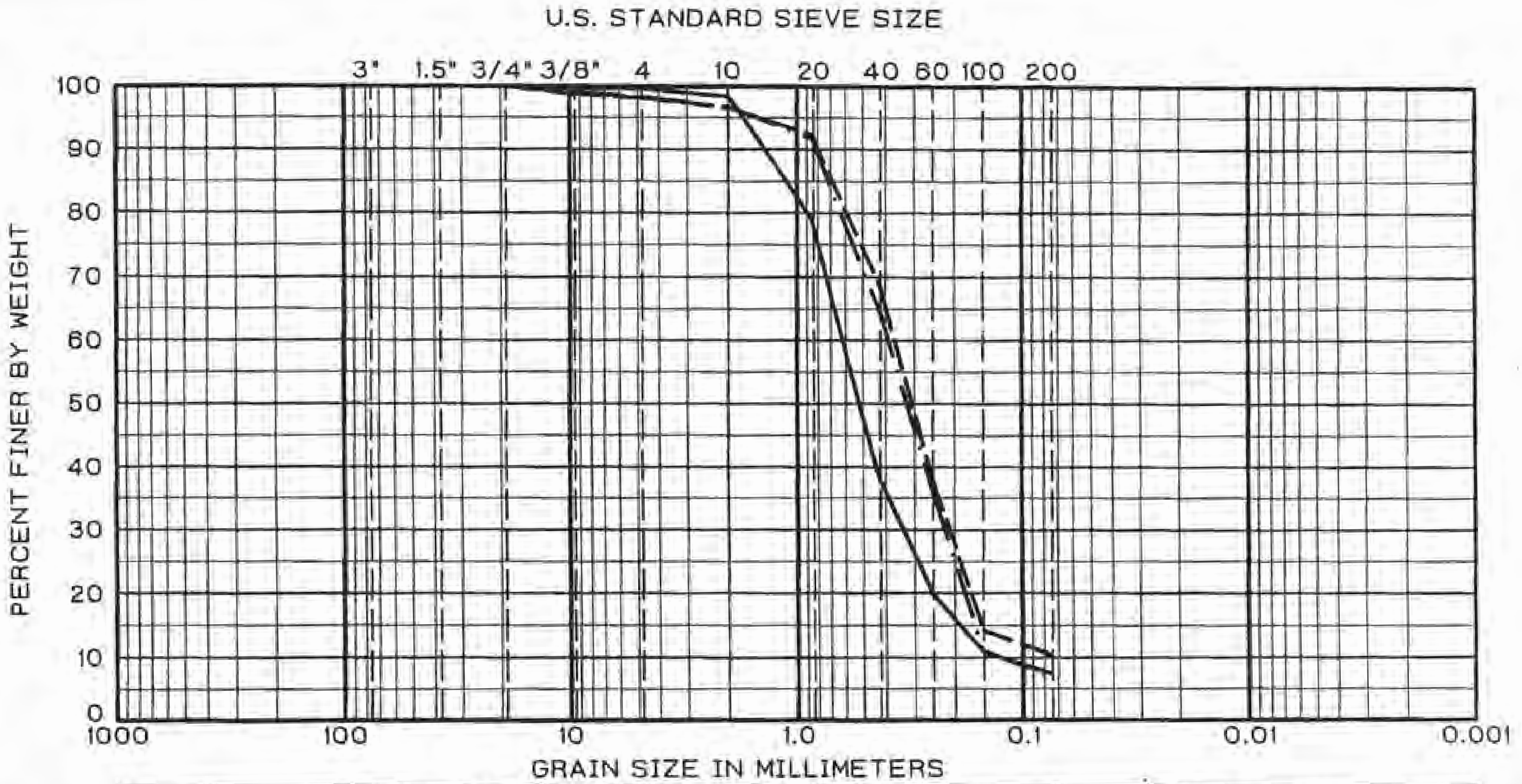


LOCATION	DEPTH (ft)	CLASSIFICATION		NAT. WC	LL	PL	PI	SYMBOL
Boring 4	24.5	SP	Light yellowish brown poorly graded sand	28				———
Boring 8	9.5	SP	Yellowish brown poorly graded sand	29				— — — —
Boring 9	1.5	SP-SM	Light brown poorly graded sand with silt	6				— · — ·

GRADATION CURVE

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020*

LOCATION *Kekaha, Kauai* DRAWN BY *lml* DATE DRAWN *01/12/07*



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

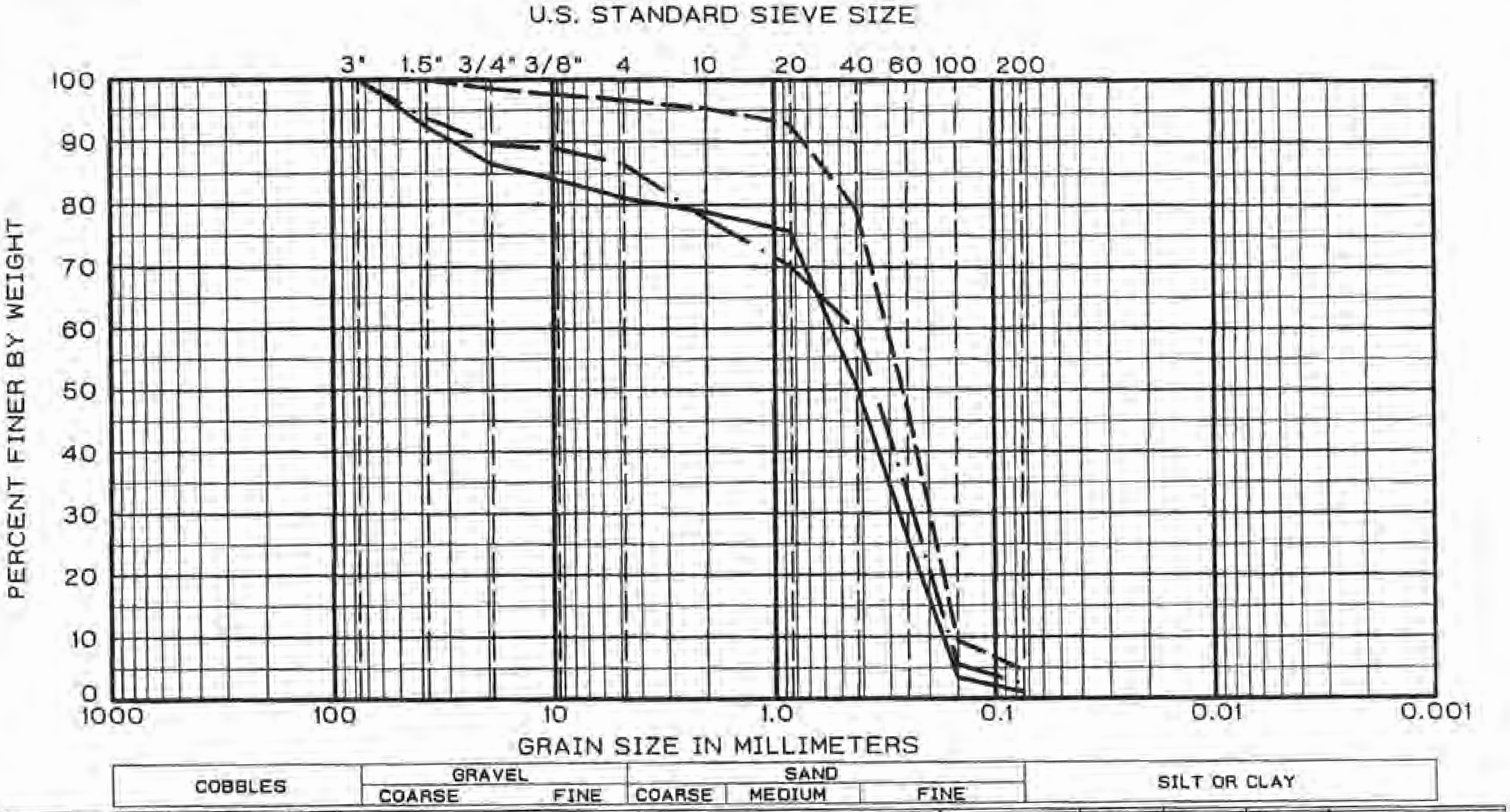
LOCATION	DEPTH (ft)	CLASSIFICATION		NAT. WC	LL	PL	PI	SYMBOL
Boring 9	14.5 & 20.0	SP-SM	Light brown poorly graded sand with silt	15				———
Boring 10	14.5	SP-SM	Light yellowish brown poorly graded sand with silt	13				— — — —
Boring 11	5.5	SP-SM	Light yellowish brown poorly graded sand with silt	11				— · — ·

GRADATION CURVE

Pacific Geotechnical Engineers, Inc.
PLATE 7.3

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020*

LOCATION *Kekaha, Kauai* DRAWN BY *lml* DATE DRAWN *01/12/07*



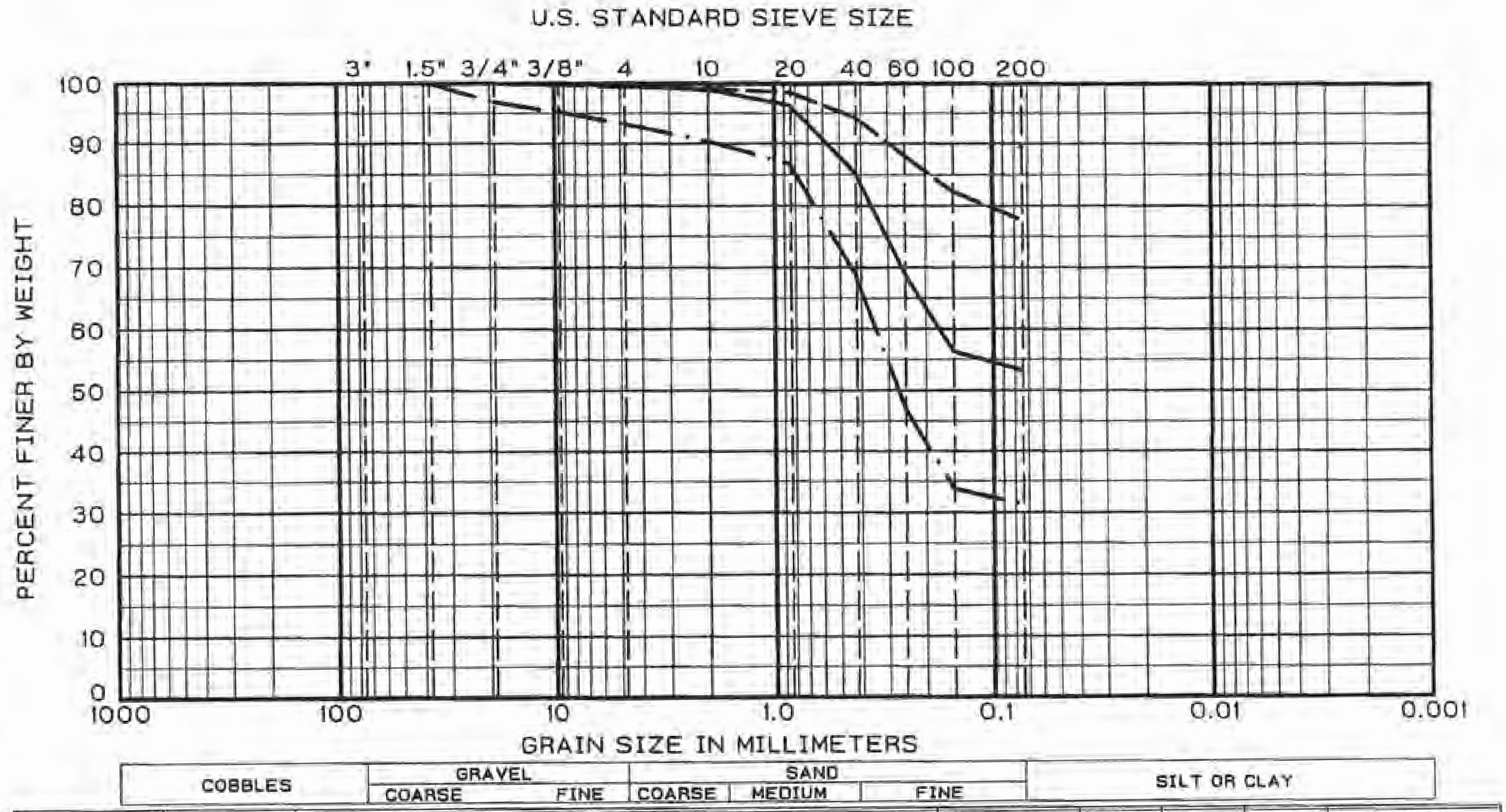
LOCATION	DEPTH (ft)	CLASSIFICATION		NAT. WC	LL	PL	PI	SYMBOL
Test Pit 2	1 – 2	SP	Mottled light yellowish brown poorly graded sand	21				———
Test Pit 6	1 – 2	SP	Light yellowish brown poorly graded sand	8				— — — —
Test Pit 7	1 – 2	SP	Light yellowish brown poorly graded sand	7				— · — ·

GRADATION CURVE

Pacific Geotechnical Engineers, Inc.

PLATE 7.4

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020*
LOCATION *Kekaha, Kauai* DRAWN BY *lml* DATE DRAWN *01/22/07*



LOCATION	DEPTH (ft)	CLASSIFICATION		NAT. WC	LL	PL	PI	SYMBOL
Grab Sample 1	0.5	CL	Dark brown sandy lean clay	16				———
Grab Sample 2	0.5	CH	Brown fat clay with sand	19				— — — —
Grab Sample 3	0.5	SC	Brown clayey sand	9				— · — ·

GRADATION CURVE

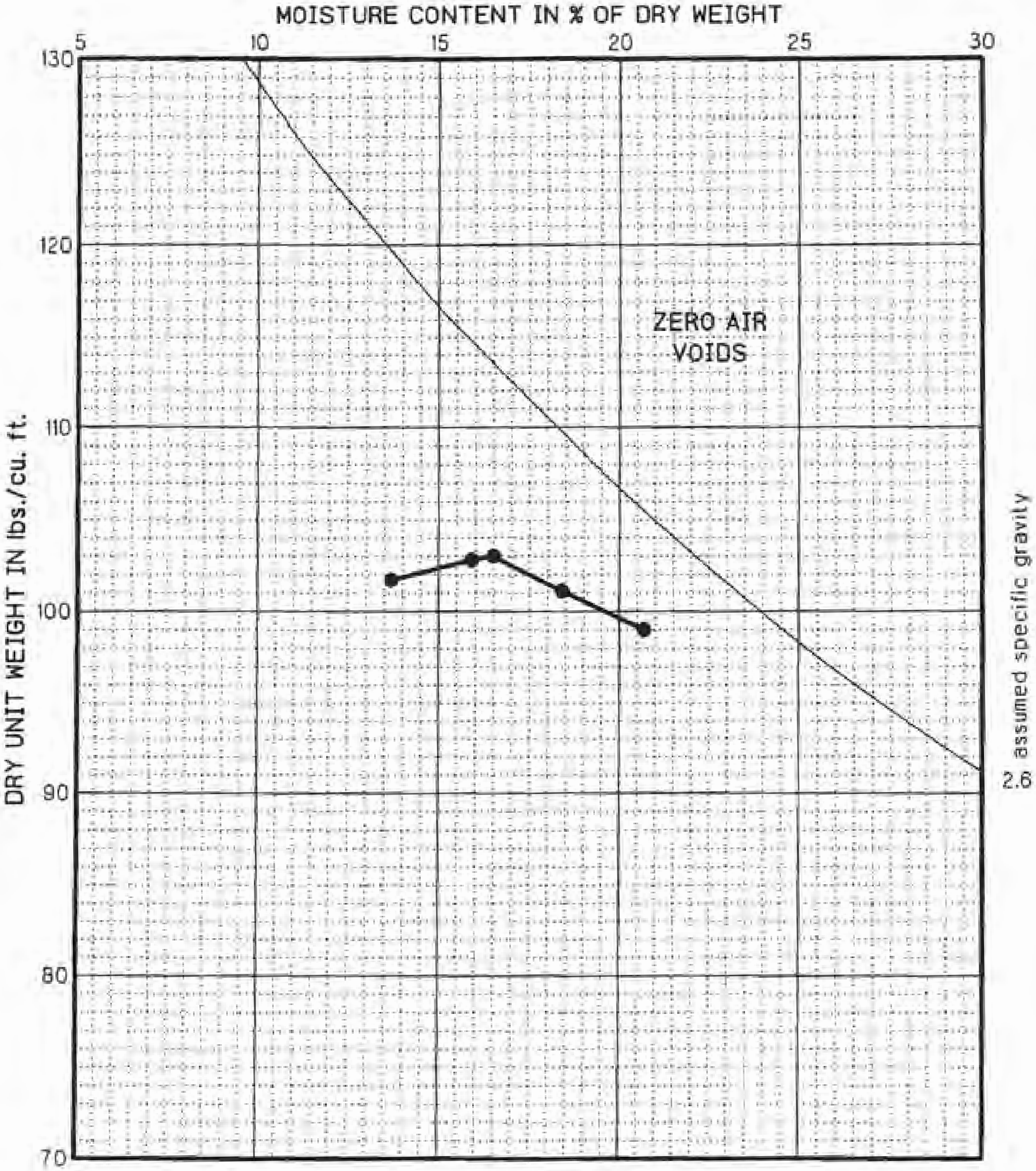
Pacific Geotechnical Engineers, Inc.
PLATE 7.5

SAMPLE DEPTH 1.0 - 2.0 ft.
ELEVATION .0 ft.±
SOIL Yellowish brown poorly graded fine sand (SP)
COMPACTION METHOD ASTM D1557-02
OPTIMUM MOISTURE CONTENT 16.5 %
MAXIMUM DRY UNIT WEIGHT 103 pcf

JOB NUMBER: 8950-020
PROJECT: Kekaha Landfill Expansion
Kekaha, Kauai
DRAWN BY: lml (02/14/2007)

BULK 1

SAMPLE LOCATION: Near Test Pit 6



COMPACTION TEST DATA

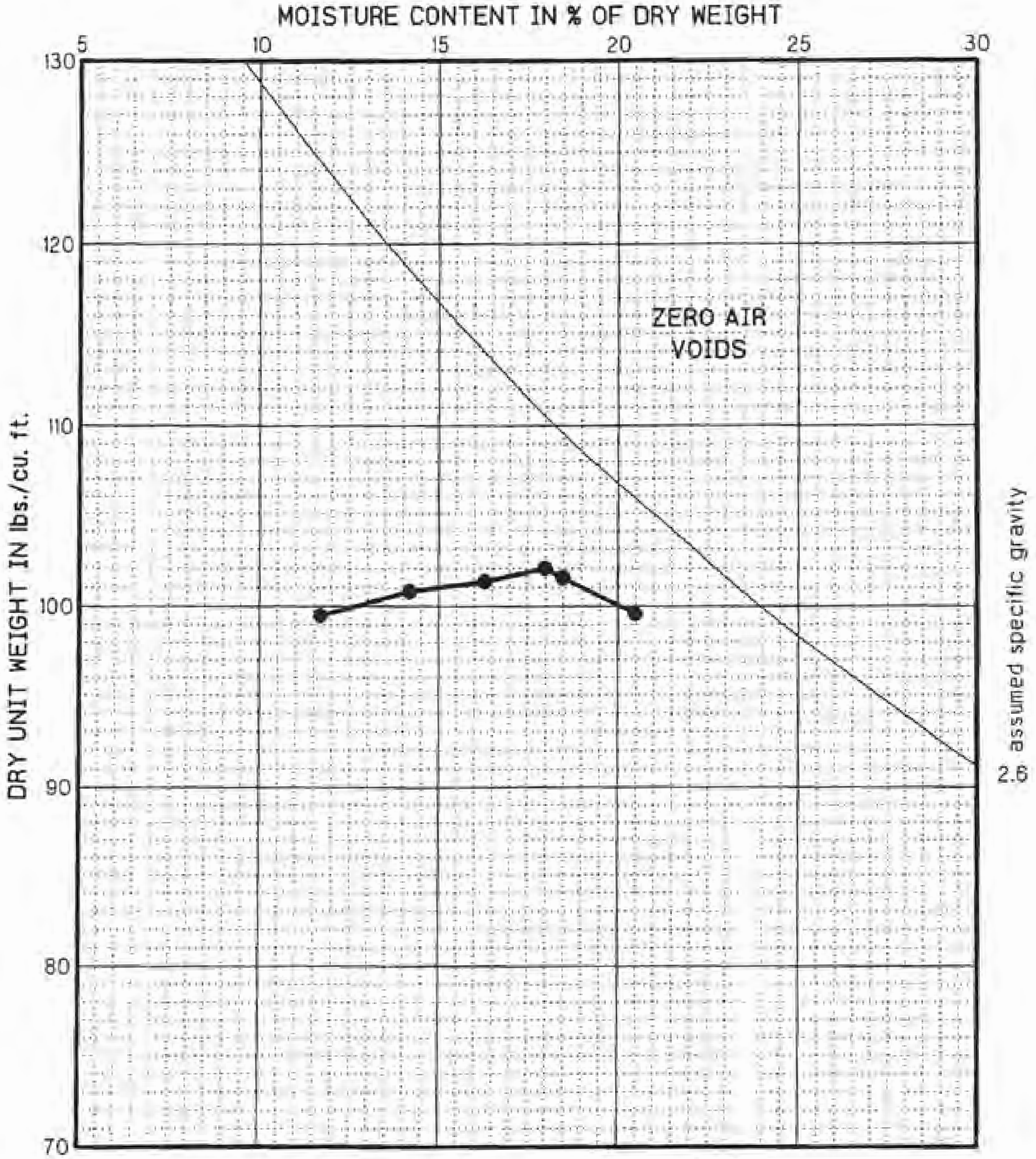
Pacific Geotechnical Engineers, Inc.
PLATE 8.1

SAMPLE DEPTH 1.0 – 2.0 ft.
ELEVATION .0 ft.±
SOIL Yellowish brown poorly graded coarse sand (SP)
COMPACTION METHOD ASTM D1557-02
OPTIMUM MOISTURE CONTENT 18 %
MAXIMUM DRY UNIT WEIGHT 102 pcf

JOB NUMBER: 8950-020
PROJECT: Kekaha Landfill Expansion
Kekaha, Kauai
DRAWN BY: lml (02/14/2007)

BULK 2

SAMPLE LOCATION: Near Test Pit 7



COMPACTION TEST DATA

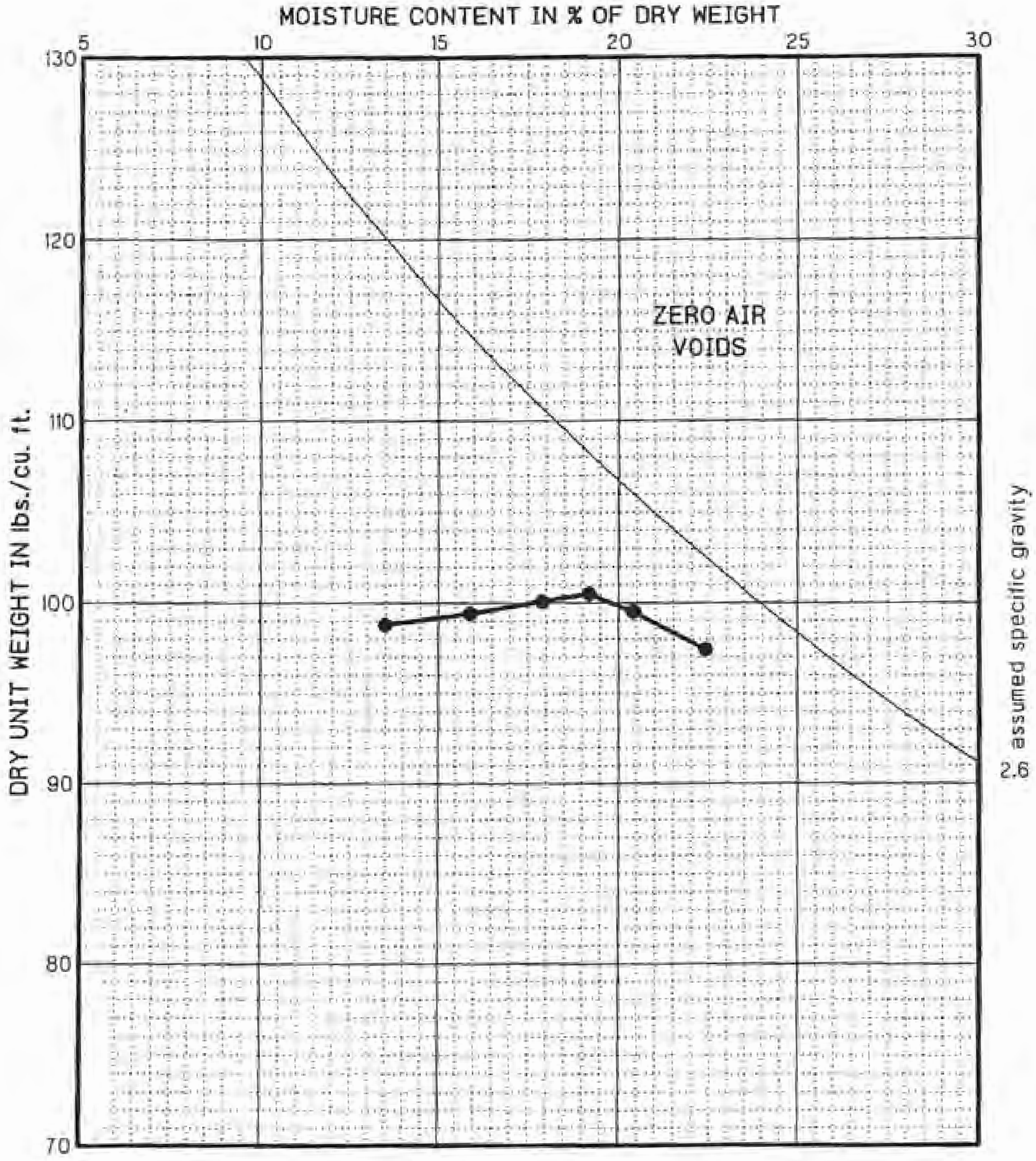
Pacific Geotechnical Engineers, Inc.
PLATE 8.2

SAMPLE DEPTH 1.0 - 2.0 ft.
ELEVATION .0 ft.±
SOIL Poorly graded sand with gravel (SP)
COMPACTION METHOD ASTM D1557-02
OPTIMUM MOISTURE CONTENT 19.2 %
MAXIMUM DRY UNIT WEIGHT 101 pcf

JOB NUMBER: 8950-020
PROJECT: Kekaha Landfill Expansion
Kekaha, Kauai
DRAWN BY: lml (02/14/2007)

BULK 3

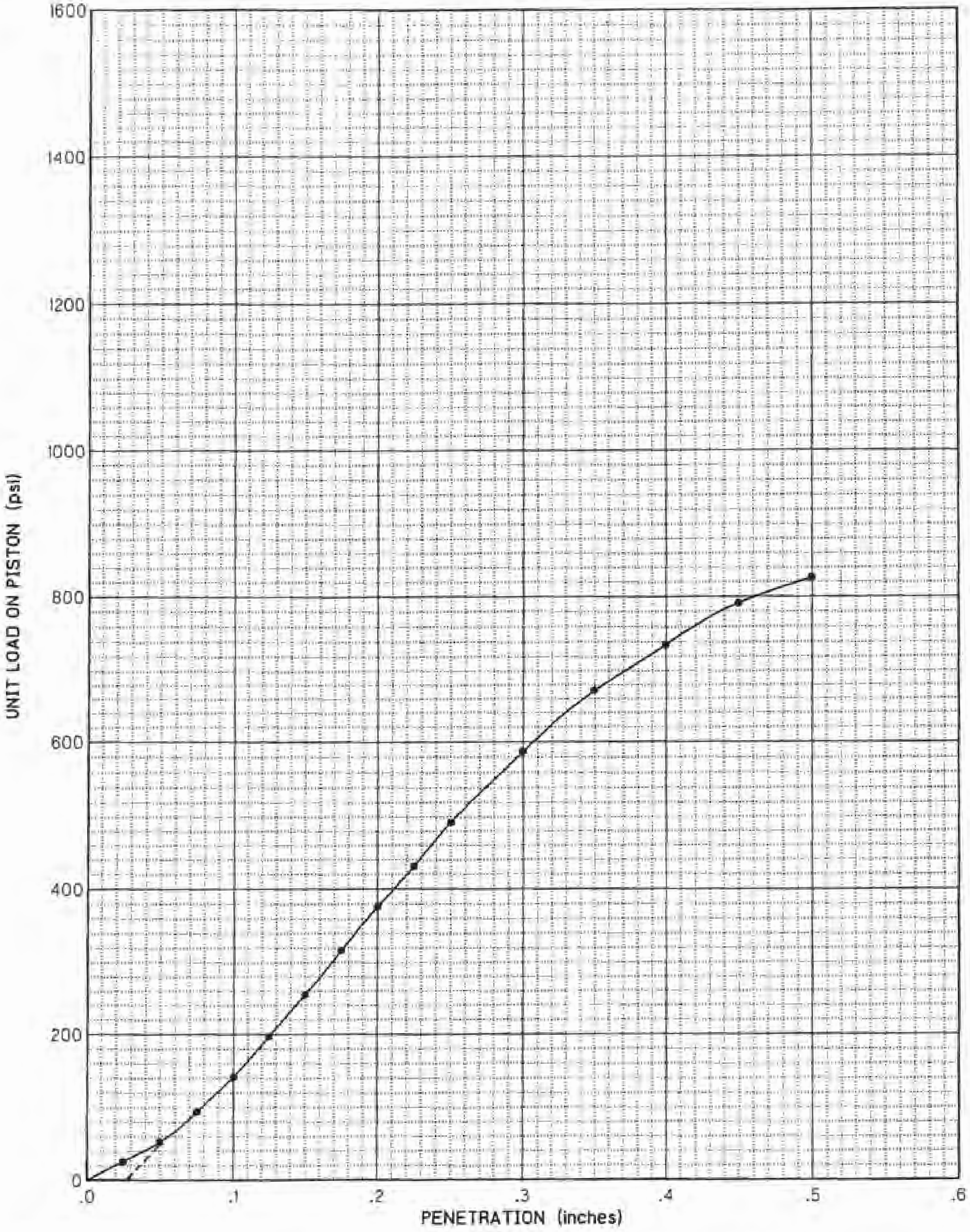
SAMPLE LOCATION: Near Test Pit 2



COMPACTION TEST DATA

Pacific Geotechnical Engineers, Inc.
PLATE 8.3

PROJECT *Kekaha Landfill Expansion*
JOB NUMBER *8950-020*
DATE *01/22/07*
DRAWN BY *lml*



LABORATORY CALIFORNIA BEARING RATIO (CBR) TEST RESULTS

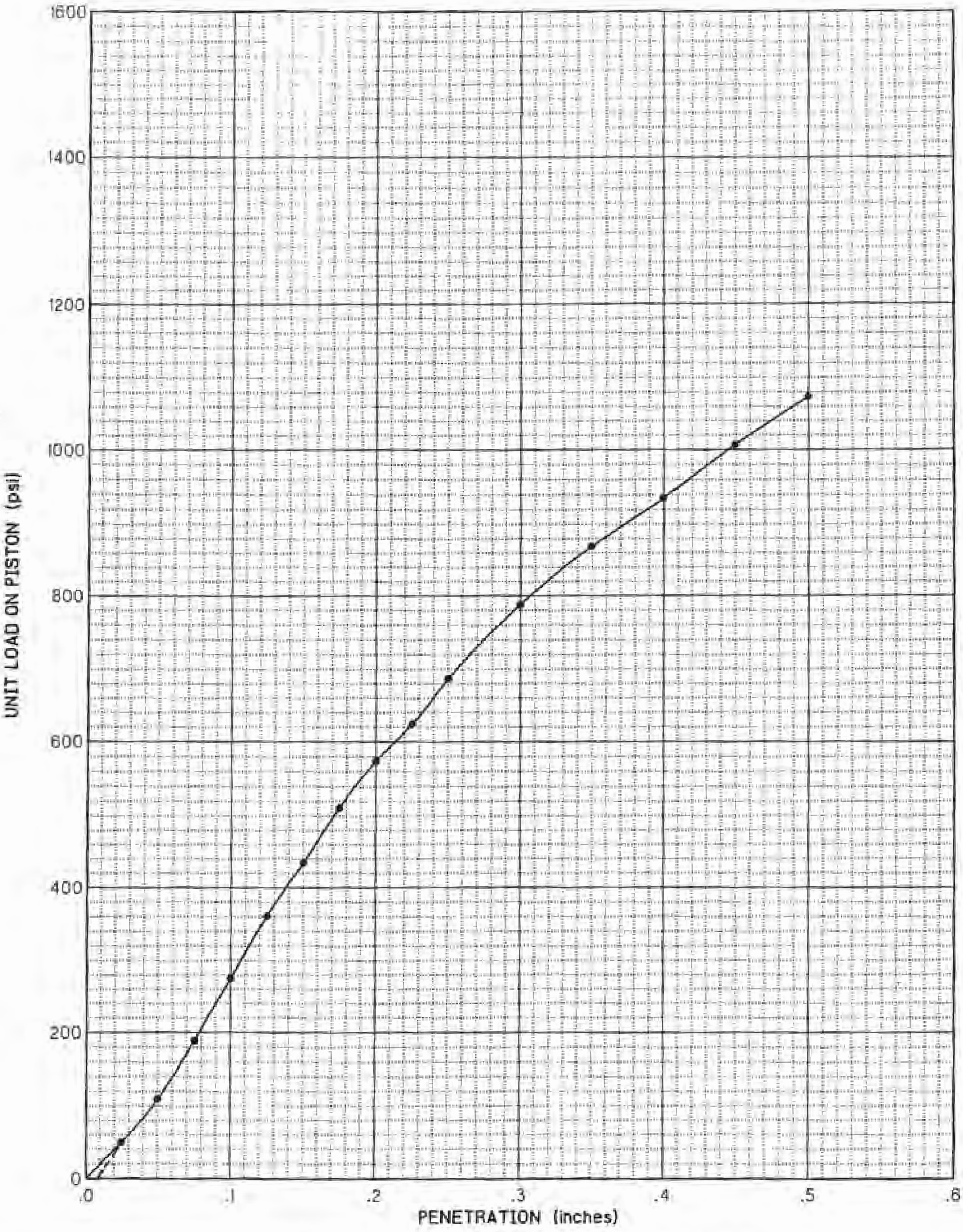
Bulk No.	Depth (ft)	Before Soaking		After Soaking			Laboratory CBR Value	
		Moisture Content (%)	Dry Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	% Swell	@ 0.1"	@ 0.2"
1	*1 - 2*	*14.6*	*97.8*	*22.2*	*97.9*	*-0.1*	*21*	*29*

Soil Description (USCS) *Yellowish brown poorly graded fine sand (SP)*

Test Method *ASTM D 1883-99*

Pacific Geotechnical Engineers, Inc.

Plate 9.1



LABORATORY CALIFORNIA BEARING RATIO (CBR) TEST RESULTS

Bulk No.	Depth (ft)	Before Soaking		After Soaking			Laboratory CBR Value	
		Moisture Content (%)	Dry Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	% Swell	@ 0.1"	@ 0.2"
2	1 - 2	19.9	96.9	22.5	96.9	0	31	39

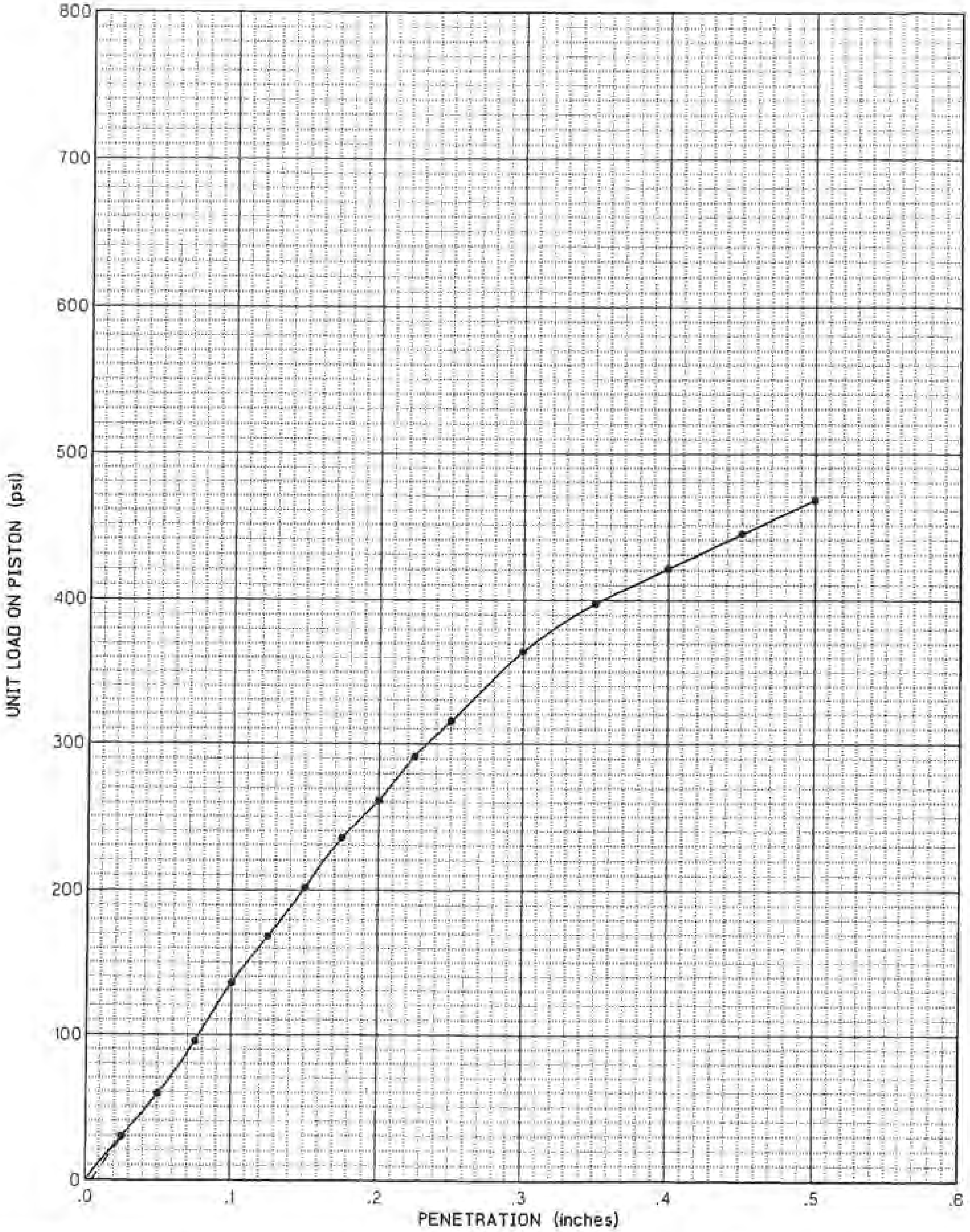
Soil Description (USCS) *Yellowish brown poorly graded coarse sand (SP)*

Test Method *ASTM D 1883-99*

Pacific Geotechnical Engineers, Inc.

Plate 9.2

PROJECT *Kekaha Landfill Expansion* JOB NUMBER *8950-020* DATE *01/22/07* DRAWN BY *lml*



LABORATORY CALIFORNIA BEARING RATIO (CBR) TEST RESULTS

Bulk No.	Depth (ft)	Before Soaking		After Soaking			Laboratory CBR Value	
		Moisture Content (%)	Dry Unit Weight (pcf)	Moisture Content (%)	Dry Unit Weight (pcf)	% Swell	@ 0.1"	@ 0.2"
3	1 - 2	20.2	88	28.9	88	0	14	17

Soil Description (USCS) Poorly graded sand with gravel (SP)

Test Method ASTM D 1883-99

PROJECT Kekaha Landfill Expansion JOB NUMBER 8950-020 DATE 01/22/07 DRAWN BY lml

Pacific Geotechnical Engineers, Inc.

Plate 9.3

REFERENCES

1. Geologic and Topographic Map of the Island of Kauai, Hawaii, Division of Hydrography, State of Hawaii, Geological Survey, United States Department of the Interior, 1960.

2. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, United States Department of Agriculture, Soil Conservation Service, August 1972.

3. H. Bolton Seed and I.M. Idriss, Ground Motions and Soil Liquefaction During Earthquakes, Engineering Research Institute, 1982.

4. Macdonald G.A., Abbott, T.T., and Peterson, F.L., Volcanoes in the Sea, The Geology of Hawaii, University of Hawaii Press, Honolulu, 1983.

5. Geotechnical Investigation, Kekaha Landfill Development, Phase II Design, Harding Lawson Associates, February 26, 1993.

6. Kekaha Sanitary Landfill, Phase 2, Kauai, Hawaii, As-Built drawings, Harding Lawson Associates, March 1993.

TABLE 1

SHEAR STRENGTH TEST RESULTS

Location	Depth (feet)	Unified Soil Class.	Before Saturation		After Saturation		Confining Pressure (psf)	Peak Shear Strength (psf)	Test Type
			Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)			
B-2	24.5	SP	26.0	98.5	26.0	-	400	5,300	TX/UU
B-5	9.5	SP-SM	23.4	99.3	23.4	-	300	2,420	TX/UU
B-6	19.5	SP-SM	27.3	96.3	27.3	-	500	5,830	TX/UU
B-8	1.5	SP	6.2	93.2	27.7	96.2	300	3,640	TX/CU
B-9	1.5	SP-SM	6.4	96.9	6.4	-	100	1,115	TX/UU
B-10	14.5	SP-SM	12.9	95.6	12.9	-	800	2,415	TX/UU
B-11	5.5	SP-SM	10.6	102.6	10.6	-	300	1,520	TX/UU
B-11	10	SP-SM	16.5	98.3	27.8	99.1	400	4,735	TX/CU
B-11	29.5	SP-SM	23.8	99.4	23.8	-	700	4,835	TX/UU

Test Type: TX/UU - unconsolidated undrained triaxial shear strength test
TX/CU - consolidated undrained triaxial shear strength test

TABLE 2

LABORATORY PERMEABILITY TEST RESULTS

Location	Depth (feet)	Unified Soil Class.	Before Test		After Test		Confining Pressure (psf)	Permeability (cm/sec)
			Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)		
B-1	9.5	SP-SM	6.9	99.5	25.3	101.2	288	3.5 x 10-3
B-8	24.5	SP	22.5	101.2	25.6	101.5	700	7.5 x 10-4
B-9	5.5	SP-SM	8.3	92.3	25.7	96.1	288	1.7 x 10-3
B-11	1.5	SP-SM	7.7	99.4	23.6	99.9	288	1.9 x 10-3
TP-2 (1)	N/A	SP-SM	16.8	90.8	32.8	90.8	288	1.4 x 10-3

Note: (1) Soil sample prepared at a relative compaction of 90 percent for the permeability test.

Appendix B
Geotechnical Calculations

Appendix B-1
Cell 1 Settlement and Base Liner Strain Analysis

CALCULATION SHEET

AECOM

Page 1 **Of** 5

Project No. 95561

Client	County of Kaua'i	**Subject**	Cell 1 Settlement	**Prepared By**	MZ	**Date**	12/22/08
Project	Kekaha Landfill		And Base Liner Strain	**Reviewed By**	KJB	**Date**	12/30/08
Phase II Lateral Expansion			Analysis	**Approved By**	KJB	**Date**	12/30/08

CELL 1 SETTLEMENT AND BASE LINER STRAIN ANALYSIS

Objective

Estimate the settlement of the foundations soils of proposed Cell 1 as a result of the increased overburden pressure from the Phase II lateral expansion at Kekaha Landfill. Determine the estimated strain on the proposed Cell 1 base liner geomembrane on the interior sideslope as a result of the settlement.

Design Criteria and Assumptions

1. Waste mass unit weight is 55 pcf.
2. The foundation soils for Cell 1 are fine to coarse grained, medium dense to very dense calcareous sands USCS of SP and SP-SM (References 1 and 2). Conservative analysis that the foundation soils are compacted to a minimum of 95% dry density of a Standard Proctor due to existing conditions.
3. Depth to bedrock or actual thickness of foundation sandy soils is not known and is greater than 50 feet in depth and may exceed 400 feet in areas underlying the site. (References 1 and 2).
4. Section D-D (Figure 1) was chosen for the settlement based upon waste depth and orientation to the leachate collection lines of Cell 1.
5. The proposed Cell 1 base liner is presented as Figure 2 (Reference 5).
6. The proposed final cover system of the lateral expansion is presented as Figure 3 (Reference 5).
7. This calculation assumes the waste filling of Cell 1 is instant. This method is conservative as actual waste mass filling activities will occur over many years and settlement of the foundation soils are expected to be less than calculated.

Calculations

Landfill settlement determination is pertinent for the long-term performance of the landfill's base liner, overlay liners, and leachate collection systems. Landfills with thick layers of soft fine-grained soil, such as clays, could experience large consolidation settlement. For the determination of settlement, both primary consolidation and secondary settlement should be reviewed and considered. Standard soil mechanics theories and equations apply along with a time period at least equal to the active and post-closure care period of the landfill.

By determining the settlement of the foundation soils, the following can be determined:

- The estimated amount of tensile strain applied to the Cell 1 base liner geomembrane. The tensile strain applied should not exceed the maximum allowable elongation. Strain is the result of large differential settlement between points.
- Upon settlement, the Cell 1 base grades and leachate collection system must still provide positive grade and avoid grade-reversal and ponding of leachate.

AECOM

CALCULATION SHEET

Page 2 **Of** 5
Project No. 95561

Client	County of Kaua'i	**Subject**	Cell 1 Settlement	**Prepared By**	MZ	**Date**	12/22/08
Project	Kekaha Landfill		And Base Liner Strain	**Reviewed By**	KJB	**Date**	12/30/08
Phase II Lateral Expansion			Analysis	**Approved By**	KJB	**Date**	12/30/08

Typically landfill foundation soils total settlement is comprised of three components: 1. elastic settlement, 2. primary consolidation settlement, and 3. secondary consolidation settlement. For clay, the total settlement is equal to sum of all three components. Whereas for sand foundation soils, the total settlement is equal only to the elastic settlement.

Since Cell 1 is overlying sandy soils, we discuss elastic settlement only for the foundation soils.

Elastic Settlement – Foundation Soils (Sandy Soils)

Elastic settlement (Reference 4) is defined as:

$$Z_c = (\Delta\sigma / M_s) H_o$$

Where:
Z_c = elastic settlement of soil layer, ft or m
$\Delta\sigma$ = increment of vertical stress, lb/ft^2 or kN/m^2
M_s = constrained modulus of soil, lb/ft^2 or kN/m^2
H_o = Initial thickness of soil layer, ft or m

Constrained modulus of soil is further defined as (Reference 4):

$$M_s = \frac{E_s(1 - \upsilon_s)}{(1 + \nu_s)(1 - 2\nu_s)}$$

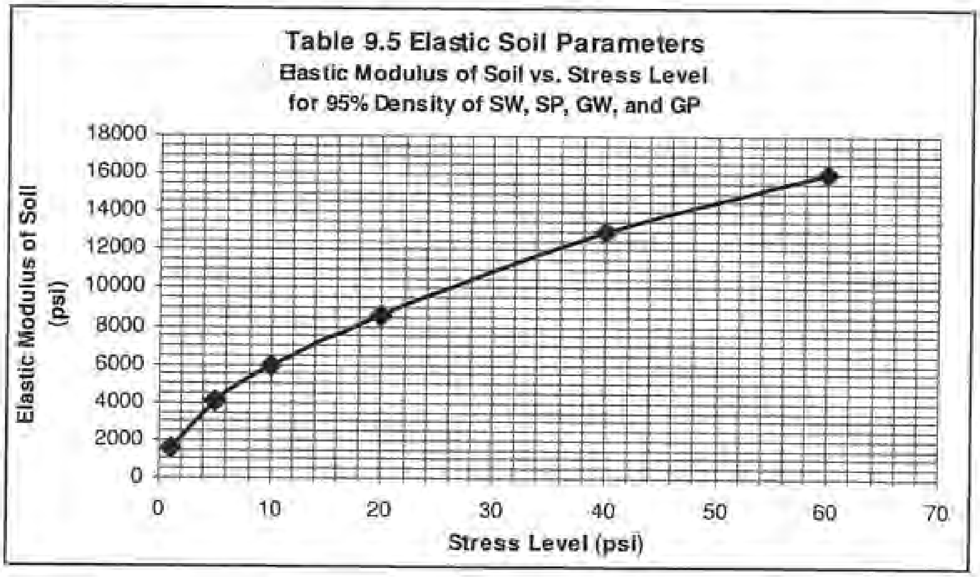
Solving:
M_s = constrained modulus of soil, lb/ft^2 or kN/m^2
E_s = elastic modulus of soil, Table 9.5 and charts below (Reference 4)
υ_s = Poisson's Ratio, Table 9.5 and charts below (Reference 4)

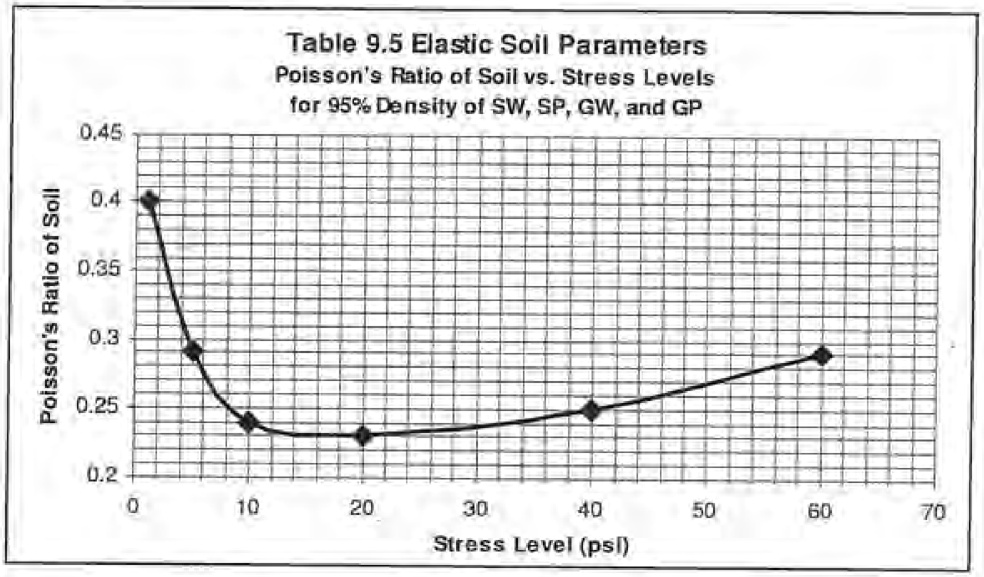
TABLE 9.5 Elastic Soil Parameters (Selig, 1990)

Soil Type	Stress Level		85% Standard Density			95% Standard Density		
			E_s			E_s		
	psi	kPa	psi	MPa	ν_s	psi	MPa	ν_s
SW, SP, GW, GP	1	7	1,300	9	0.26	1,600	11	0.40
	5	35	2,100	14	0.21	4,100	28	0.29
	10	70	2,600	18	0.19	6,000	41	0.24
	20	140	3,300	23	0.19	8,600	59	0.23
	40	280	4,100	28	0.23	13,000	90	0.25
	60	420	4,700	32	0.28	16,000	110	0.29
GM, SM, ML, and GC, SC with < 20% fines	1	7	600	4	0.25	1,800	12	0.34
	5	35	700	5	0.24	2,500	17	0.29
	10	70	800	6	0.23	2,900	20	0.27
	20	140	850	6	0.30	3,200	22	0.29
	40	280	900	6	0.38	3,700	25	0.32
	60	420	1,000	7	0.41	4,100	28	0.35
CL, MH, GC, SC	1	7	100	1	0.33	400	3	0.42
	5	35	250	2	0.29	800	6	0.35
	10	70	400	3	0.28	1,100	8	0.32
	20	140	600	4	0.25	1,300	9	0.30
	40	280	700	5	0.35	1,400	10	0.35
	60	420	800	6	0.40	1,500	10	0.38

Table 9.5 from Reference 4

Table 5 is then interpreted in the following charts for SW, SP, GW, and GP soils.





Spreadsheets were created to determine the increase in overburden pressures due to the Cell 1 construction and waste placement. The spreadsheets are included with this calculation as Attachments 1 which represents Points 1 and 2 on Figure 1.

The following table was created to calculate elastic settlement for varying overburden pressures at Points 1 and 2 (Attachments 1) for Cell 1 (base liner, waste mass, and final cover system), and Table 9.5 input variables.

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CALCULATION SHEET

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Project No. 95561

Client	County of Kaua'i	**Subject**	Cell 1 Settlement	**Prepared By**	MZ	**Date**	12/22/08
Project	Kekaha Landfill		And Base Liner Strain	**Reviewed By**	KJB	**Date**	12/30/08
	Phase II Lateral Expansion		Analysis	**Approved By**	KJB	**Date**	12/30/08

Determination of Elastic Settlement Variables

Point	Overburden Increase ($\Delta\sigma$)		From Table 9.5			Constr. Modulus of Soil (Ms)	$\Delta\sigma$/Ms
			Elastic Modulus, Es		Poisson's Ratio		
	psf	psi	psi	psf	(υ)	psf	
1	1,517	11	6,260	901,440	0.24	1,062,491	0.001
2	3,938	27	10,140	1,460,160	0.24	1,721,032	0.002

The above table when applied to elastic settlement presented earlier defines that for every 1 foot of soil thickness, settlement will be 0.001 to 0.002 feet.

To be conservative, the thickness of underlying sand layer is 400 feet across the Cell 1 area. The difference of settlement between Points 1 and 2 is 0.4 ft (400 ft x (0.002-0.001)).

Leachate Collection Pipe Drainage Slope

The pre-settlement slope on the base grade between Points 1 and 2:

$$(14.54-10.50)/185 \times 100\% = 2.2\%$$

The post-settlement slope on the base grade between Points 1 and 2:

$$(14.54-10.50-0.4)/185 \times 100\% = 2.0\%$$

Therefore, the positive drainage slope of leachate collection pipe is maintained.

Geomembrane Liner Strains on Interior sideslope

As Points 1 and 2 on Figure 1 undergo settlement, the overall length of the geomembrane liner on the interior interior sideslope may increase slightly. The settlement at Point 2 is greater than that at Point 1, which indicates that the potential increase of geomembrane length on the interior sideslope at Point 2 will be higher. The length of the geomembrane liner on the 3H:1V interior sideslope is approximately 12.649 feet for a plan length of 12 feet and a vertical drop of 4 feet along the slope. Given the total settlement of 0.8 feet at Point 2 (400 ft x 0.002, by assuming a maximum thickness of 400 feet for the underlying sand layer), the final length of the geomembrane on the interior sideslope is calculated as:

Initial Length of Geomembrane = 12.649 ft

Stretched Length of Geomembrane = $\sqrt{(12\text{ ft})^2 + (4\text{ ft} + 0.8\text{ ft})^2}$
= 12.924 ft

Therefore, the tensile strain in the geomembrane on the interior sideslope is:

$$\varepsilon = (12.924\text{ ft} - 12.649\text{ ft})/\ 12.649\text{ ft} = 0.022\ (2.2\text{ percent})$$

In this analysis, the settlement at the top of the interior sideslope was assumed zero. This is conservative, as there will be a small settlement and usually some slack in the geomembrane at this location which reduces the actual tensile strain.

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CALCULATION SHEET

Page 5 **Of** 5
Project No. 95561
Client County of Kaua'i **Subject** Cell 1 Settlement And Base Liner Strain Analysis
Project Kekaha Landfill Phase II Lateral Expansion
Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

The factor of safety of the geomembrane liner on the interior sideslope against yield is calculated by dividing the wide-width yield tensile strain of the 60-mil double-sided, textured HDPE geomembrane liner (12%) by the tensile strain calculated above:

$$F.S. = 12\% / 2.2\% = 5$$

Around the landfill perimeter, the value of the safety factor will vary slightly as a function of the interior sideslope toe settlement and the length of the geomembrane on the interior sideslope. However, the strain developed in the geomembrane on the interior sideslope due to the differential settlement will not exceed the geomembrane yield strain at any location because of a factor of safety of 5 at Point 2.

Conclusions

The construction, waste mass filling and installation of the final cover system of Cell 1 is expected to result in settlement of the foundation soils of Cell 1. The amount of settlement is directly related to the depth of sandy foundations soils. By conservatively assuming a thickness of 400 ft of the underlying sand layer in Cell 1, an average positive drainage slope of 1.9 percent will be retained between Points 1 and 2 after settlement. Therefore, the positive drainage slope of leachate collection pipe is maintained. Actual settlement is expected to be less with the consideration that the analysis assumes "instant" waste mass placement whereas placement will be over time allowing pore pressures to disseminate in the foundations soils.

The tensile strain in the geomembrane on the interior sideslope that develops in response to the vertical settlement of the interior sideslope toe is approximately 2.2 percent. This provides a factor of safety of 5 against geomembrane liner tearing on the interior sideslope as a result of base settlements. The geomembrane liner has sufficient strength and durability to function within the landfill for the design period under the maximum expected loadings during construction and operation.

References

1. Appendix D, "Engineering Report, Kekaha Landfill Phase II, Kekaha, Kauai, Hawaii," prepared by Harding Lawson Associates, dated August 5, 1993.
2. "Pre-Final Letter Report, Geotechnical Exploration, PGE Job No. 8950-020, for Horizontal Expansion of the Kekaha MSW Phase II Landfill, Kekaha, Kauai, Hawaii", prepared by Pacific Geotechnical Engineers, Inc., dated March 20, 2007.
3. "Kekaha Sanitary Landfill, Phase I, Closure/Postclosure Plan", prepared for County of Kauai Department of Public Works, prepared by Harding Lawson Associates, dated January 13, 1994.
4. Qian, Xuede; Koerner, Robert M.; Gray, Donald H; "Geotechnical Aspects of Landfill Design and Construction," published 2002, pages 310, and 469 to 470.
5. Drawings titled, "Engineering Report, Phase II Lateral Expansion, Kekaha Landfill", prepared by AECOM, dated January 2009.

FIGURE 1

SECTION D-D

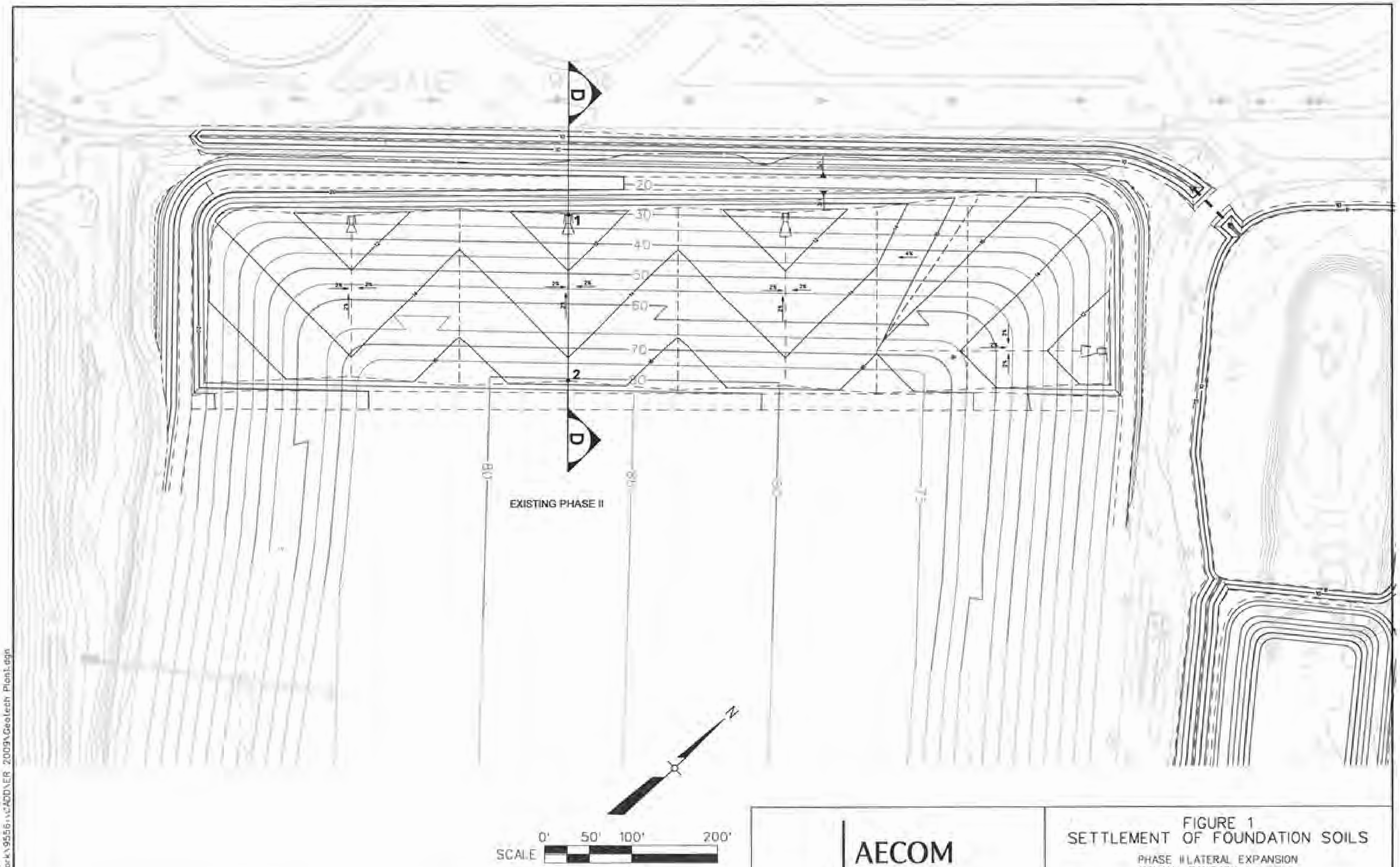

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FIGURE 1
SETTLEMENT OF FOUNDATION SOILS

PHASE II LATERAL EXPANSION
KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

95561

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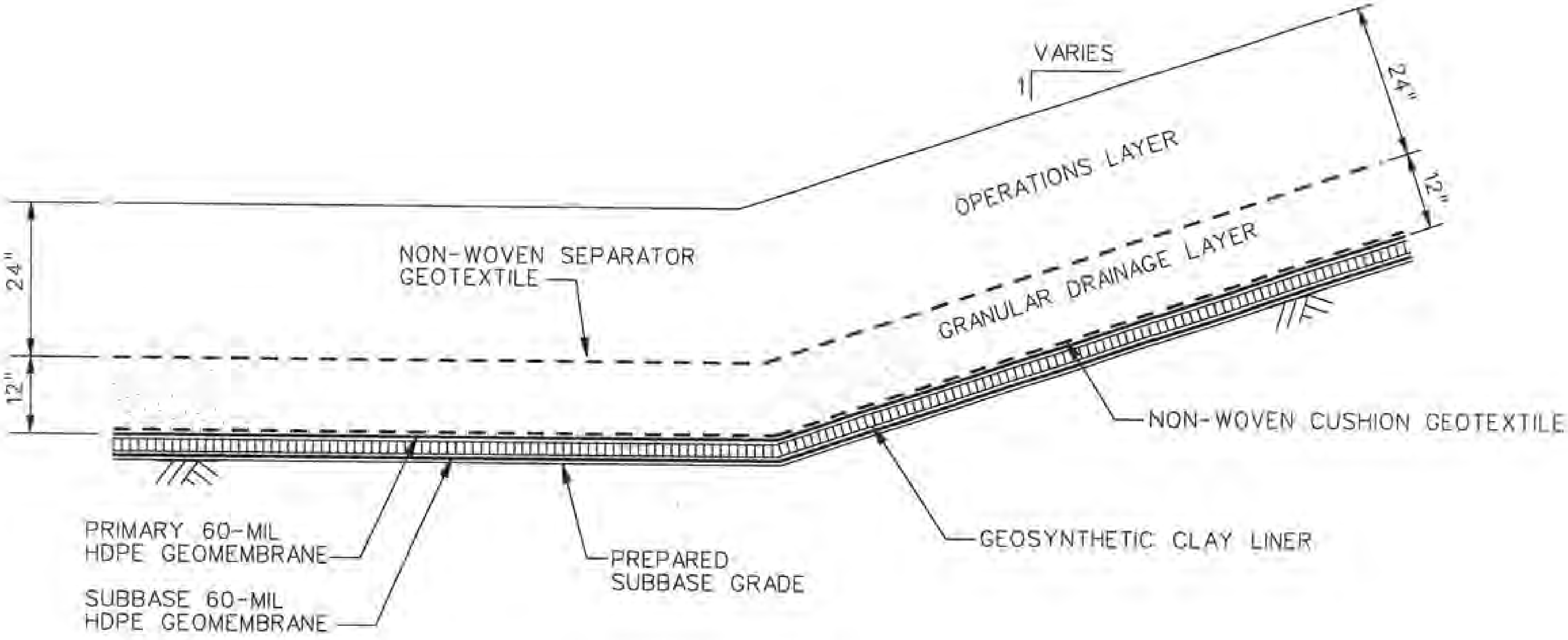
FIGURE 2

PROPOSED CELL 1 BASE LINER SYSTEM DETAILS



TYPICAL BASE LINER DETAIL - CELL 1 1

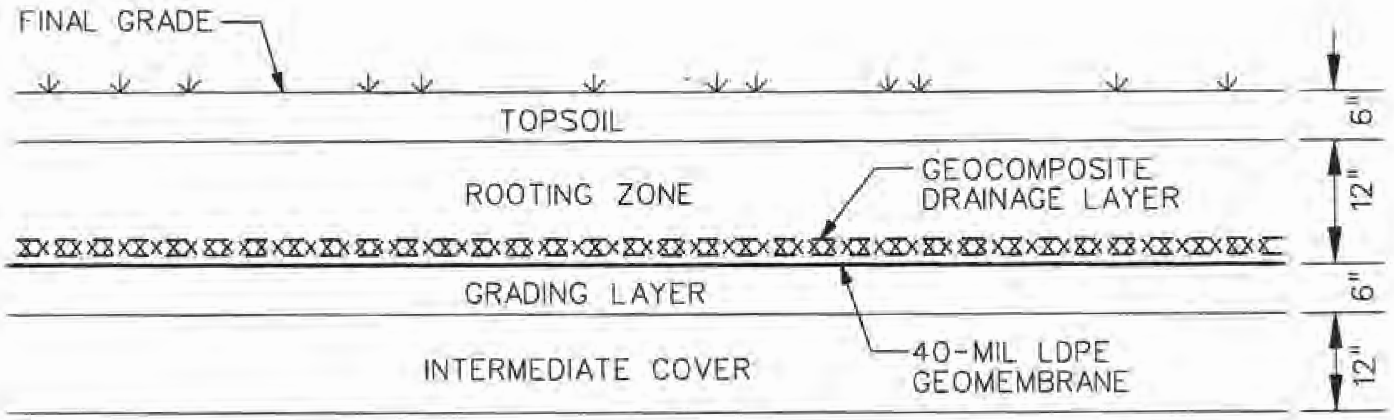
NTS

NOTES:

1. ALL GEOMEMBRANE IS TEXTURED ON BOTH SIDES.
2. WHEN DEPLOYING GCL OR GEOTEXTILES OVER TEXTURED GEOMEMBRANE OR WHEN DEPLOYING TEXTURED GEOMEMBRANE OVER GCL OR GEOTEXTILES, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.

FIGURE 3

PROPOSED FINAL COVER SYSTEM



FINAL COVER SYSTEM 1

NTS

ATTACHMENT 1

CELL 1 FOUNDATION SETTLEMENT AT POINTS 1 AND 2 ALONG SECTION D-D

Attachment 1
Cell 1 Foundation Settlement and Strain Analysis
Section D-D – Point 1

Cross Section Elevations	**Point 1**	
Top of Final Cover	32.63 feet	
Proposed Subbase	10.5 feet	
Top of Existing Grade	10.5 feet	(design subbase is below existing grade, conservative to be equal to subbase grade)

Calculate $\Delta\sigma$			Overburden Pressure	
Proposed Base Liner System	(Figure 2)			
Compacted fill soil thickness		0 feet		= Proposed subbase minus top existing grade
Compacted fill soil unit weight		115 pcf	0 psf	=Table 1 , Appendix B, Phase I Closure/Postclosure Plan
Granular drainage layer thickness		1 feet		=Design thickness
Granular drainage layer unit weight		130 pcf	130 psf	=Phase I aggregate layer
Operations layer thickness		2 feet		=Design thickness
Operations layer unit weight		100 pcf	200 psf	=Phase I soil buffer layer
Cell waste mass thickness		16.13 feet		=Top of final cover minus subbase minus 3' for base liner section and 3' for final cover section)
Cell waste mass unit weight		55 pcf	887.15 psf	
Proposed Overlay Final Cover	(Figure 3)			
Int. cover and grading layer thickness		1.5 feet		=Design thickness
Int. cover and grading layer unit weight		100 pcf	150 psf	(Phase I Closure/Postclosure Plan)
Rooting zone/topsoil layer thickness		1.5 feet		=Design thickness
Rooting zone/topsoil layer unit weight		100 pcf	150 psf	(Phase I Closure/Postclosure Plan)

Total overburden increase from vertical expansion $\Delta\sigma$= 1517.15 psf

Attachment 1
Cell 1 Foundation Settlement and Strain Analysis
Section D-D - Point 2

Cross Section Elevations	**Point 2**	
Top of Final Cover	80.68 feet	
Proposed Subbase	14.54 feet	
Top of Existing Grade	14.54 feet	(design subbase is below existing grade, conservative to be equal to subbase grade)

Calculate Δσ			Overburden Pressure	
Proposed Base Liner System	(Figure 2)			
Compacted fill soil thickness		0 feet		= Proposed subbase minus top existing grade
Compacted fill soil unit weight		115 pcf	0 psf	=Table 1 , Appendix B, Phase I Closure/Postclosure Plan
Granular drainage layer thickness		1 feet		=Design thickness
Granular drainage layer unit weight		130 pcf	130 psf	=Phase I aggregate layer
Operations layer thickness		2 feet		=Design thickness
Operations layer unit weight		100 pcf	200 psf	=Phase I soil buffer layer
Cell waste mass thickness		60.14 feet		=Top of final cover minus subbase minus 3' for base liner section and 3' for final cover section)
Cell waste mass unit weight		55 pcf	3307.7 psf	
Proposed Overlay Final Cover	(Figure 3)			
Int. cover and grading layer thickness		1.5 feet		=Design thickness
Int. cover and grading layer unit weight		100 pcf	150 psf	(Phase I Closure/Postclosure Plan)
Rooting zone/topsoil layer thickness		1.5 feet		=Design thickness
Rooting zone/topsoil layer unit weight		100 pcf	150 psf	(Phase I Closure/Postclosure Plan)
Total overburden increase from vertical expansion Δσ=			3937.7 psf	

ATTACHMENT 2

GSE 60-mil HDPE TEXTURED GEOMEMBRANE PRODUCT DATA SHEET

GSE STANDARD PRODUCTS

Product Data Sheet

GSE HD Textured Geomembranes

GSE HD Textured is the textured version of GSE HD. It is a high quality, high density polyethylene (HDPE) geomembrane with one or two coextruded, textured surfaces, and consisting of approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. The resin used is specially formulated, virgin polyethylene and is designed specifically for flexible geomembrane applications. GSE HD Textured has excellent resistance to UV radiation and is suitable for exposed conditions. This product allows projects with greater slopes to be designed since frictional characteristics are enhanced. *These product specifications meet or exceed GRI GM13.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDT 030G000	HDT 040G000	HDT 060G000	HDT 080G000	HDT 100G000
Thickness, (minimum average) mil (mm)	ASTM D 5994	every roll	29 (0.73)	38 (0.96)	57 (1.45)	76 (1.93)	95 (2.41)
Lowest individual for 8 out of 10 values			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Lowest individual for any of the 10 values			26 (0.66)	34 (0.86)	51 (1.30)	68 (1.73)	85 (2.16)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)(1)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		45 (8)	60 (11)	90 (16)	120(21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		100	100	100	100	100
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	45 (200)	60 (267)	90 (400)	120 (534)	150 (667)
Carbon Black Content, %	ASTM D 1603*/4218	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load(2), hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300	300
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length(3) (approximate), ft (m)	Standard Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
Roll Width(3), ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft^2 (m^2)			18,674 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE HD Standard Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- (1)The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- (2)NCTL for HD Textured is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.
- (3)Roll lengths and widths have a tolerance of ± 1%.
- *Modified.

DS006 HDtex R01/08/06

North America	GSE Lining Technology, Inc.	Houston, Texas	800.435.2008	281.443.8564	Fax: 281.230.6739
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56.2.595.4200	Fax: 56.2.595.4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66.2.937.0091	Fax: 66.2.937.0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49.40.767420	Fax: 49.40.7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		20.2.828.8888	Fax: 20.2.828.8889

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Appendix B-2
Final Buildout Stability

AECOM

CALCULATION SHEET

				Page 1	**Of** 15
				Project No. 95561	
Client	County of Kaua'i	**Subject**	Final Buildout	**Prepared By** MZ	**Date** 12/22/08
Project	Kekaha Landfill	Stability		**Reviewed By** KJB	**Date** 12/30/08
Phase II Lateral Expansion				**Approved By** KJB	**Date** 12/30/08

FINAL BUILDOUT STABILITY

Objective

Determine the stability at final buildout for the proposed Phase II lateral expansion at Kekaha Sanitary Landfill.

Design Criteria and Assumptions

1. No seismic conditions have been evaluated.
2. The stability analysis was conducted using computer slope stability software named "STABL Version 3.0 for Windows". This program is the Windows version of "PCSTABL6 for DOS" developed by Purdue University. This program allows the use of several different methods for determining slope stability of circular and non-circular failure surfaces. The computer program performs an automatic search to identify potential slip surface that has the least factor of safety. The method utilized for completion of this analysis was Janbu's Simplified Method.
3. Three representative cross sections were modeled for the analysis, Sections A-A; B-B and C-C. These cross section locations are presented as Figure 1 in Attachment 1. Section A-A represents a combination of waste mass thickness in Cell 1 and a low perimeter berm height. Section B-B represents the maximum waste mass in Cell 1 as part of the overlay onto the currently permitted Phase II. Section C-C represents the lowest perimeter berm in Cell 1.
4. The proposed final cover slope will be a maximum 3.5:1 (H:V) with a minimum 3% slope on the cover crown.
5. Leachate recirculation will not be performed.
6. Modes of Failure: The following modes of failure are considered (see Attachment 2):
    a. Circular Failure: A circular failure surface that lies entirely within the waste mass or passes through the waste mass and foundation soils.
    b. Base Liner Non-circular Failure: A non-circular failure surface originating along the base liner then up through the waste mass.
7. Factor of safety of 1.5 will be employed for determining acceptance of proposed final landfill geometry.
8. Seismic analysis will not be completed as the site specific horizontal peak ground acceleration is 0.06 g and is less than 0.10 g required by Subtitle D for seismic analysis (Reference 1).

Calculations

Material Properties

Waste Mass

Waste mass properties are dependant upon the amount of compaction, lift thickness, composition and waste stream, moisture, and the amount of daily cover soil or alternate daily cover used. Conversations with Kekaha Landfill staff verify a typically waste unit weight of approximately 55 pcf.

Reference 3 completed a literature review and determined resulting in internal friction angles of 25 to 51 degrees with cohesion varying from 0 to 42 kPa (0 to 877 psf) can be expected for MSW landfills. The reference concluded municipal solid waste strength properties can be considered as reasonable at friction angle of 35 degrees and cohesion 20kPa (418 psf). To provide consistency with the previous permitted documents the waste friction angle value of 33 degrees was maintained.

Waste Mass: $\gamma_{buildout}$ = 55 pcf
$\phi_{buildout}$ = 33 degrees (References 1 and 3) (conservative)
$c_{buildout}$ = varies <= 418 psf (Reference 3) (conservative)

By observation the critical failure surface will be a block type failure and reside along the critical base liner interfaces. Cohesion of the waste mass was assumed to be only 200 psf for conservative analysis.

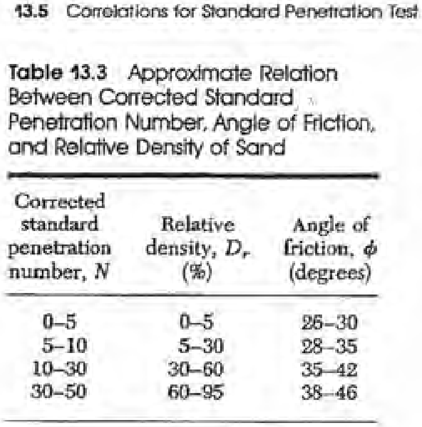
Compacted Fill

Areas of the facility that will require berming or fill soils to meet subbase grades are expected to be constructed of sandy soils. The following material properties are applied:

Compacted Fill: γ = 115 pcf
ϕ = 30 degrees
c = 0 psf

Insitu Soils – Above Groundwater

Review of Borings 1 though 6 of Reference 6, which reside within the footprint of Cell 1, the average unit weight of insitu sandy soils was determined for soils above the groundwater elevation. In addition, review of Table 13.3 of Reference 2 and correcting the standard penetration numbers for split spoon locations for Borings 1 through 6, the insitu soils have an estimated internal friction angle. The corrected standard penetration numbers ranged from 31 to 92 which according to Table 13.3 results in internal friction angles of greater than 38 degrees.



13.5 Correlations for Standard Penetration Test

Table 13.3 Approximate Relation Between Corrected Standard Penetration Number, Angle of Friction, and Relative Density of Sand

Corrected standard penetration number, N	Relative density, D_r (%)	Angle of friction, ϕ (degrees)
0–5	0–5	26–30
5–10	5–30	28–35
10–30	30–60	35–42
30–50	60–95	38–46

The following material properties are applied:

Insitu Soils: γ = 101.5 pcf
ϕ = 35 degrees (conservative)
c = 0 psf (granular soils, no cohesion)

Insitu Soils – Below Groundwater

Repeating the same process for the soils located below the groundwater elevation for Borings 1 through 6 of Reference 6, the average unit weight of insitu sandy soils was determined. In addition, review of Table 13.3 of Reference 2 and correcting the standard penetration numbers for split spoon locations for Borings 1 through 6, the insitu soils have an estimated internal friction angle. The corrected standard penetration numbers ranged from 10 to 103 which according to Table 13.3 results in internal friction angles of greater than 35 degrees.

The following material properties are applied:

Insitu Soils: γ = 123.4 pcf
ϕ = 35 degrees (conservative)
c = 0 psf (granular soils, no cohesion)

Groundwater Elevation

Review of the Borings 1 through 6 of Reference 6 determines the average groundwater elevation is 5 ft msl.
above

Critical Interface Friction Angle (Geosynthetics)

Interfaces exist when dissimilar materials come in contact. The frictional properties of these interfaces depend on test conditions, which include normal loading, rate of shearing, degree of submergence, size of apparatus, manufacturer, etc.

The proposed base liner system details are included as Attachment 3.

The GCL proposed for the horizontal and vertical expansion is assumed to be a composite product comprised of granular bentonite encapsulated between a nonwoven geotextile and a woven geotextile and subsequently needle-punched.

The resulting interfaces of the proposed base liner system details and typical interface friction angles based upon Reference 4 are:

Critical Base Liner Interfaces and Friction Angles

	Typical Interface Friction Test Results	
Interface	**Friction Angle (degrees)**	**Adhesion (kPa)**
Nonwoven geotextile (separator and cushion) / granular drainage layer (gravel) or operations layer	33	0
Nonwoven geotextile (geocomposite and cushion) / textured HDPE geomembrane	25	8
Nonwoven geotextile (GCL) / textured HDPE geomembrane	23	8
Woven geotextile (GCL) / textured HDPE Geomembrane	18	11
Textured HDPE geomembrane to subbase (sand)	34	0
Needle-punched GCL (internal friction angle)	39.7	19.9

Upon review of the above table, the critical interface of the base liner for Cell is the interface between the woven geotextile of the GCL and textured geomembrane of 18 degrees. For this analysis, this interface is assumed to be 10 degrees, adding conservatism to analysis. The critical interface was modeled as a 0.20-foot thick layer under the waste mass.

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CALCULATION SHEET

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Project No. 95561

Client County of Kaua'i **Subject** Final Buildout Stability **Prepared By** MZ **Date** 12/22/08

Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** KJB **Date** 12/30/08

Approved By KJB **Date** 12/30/08

Model Output

Note: All elevations presented are +100 feet for modeling purposes only.

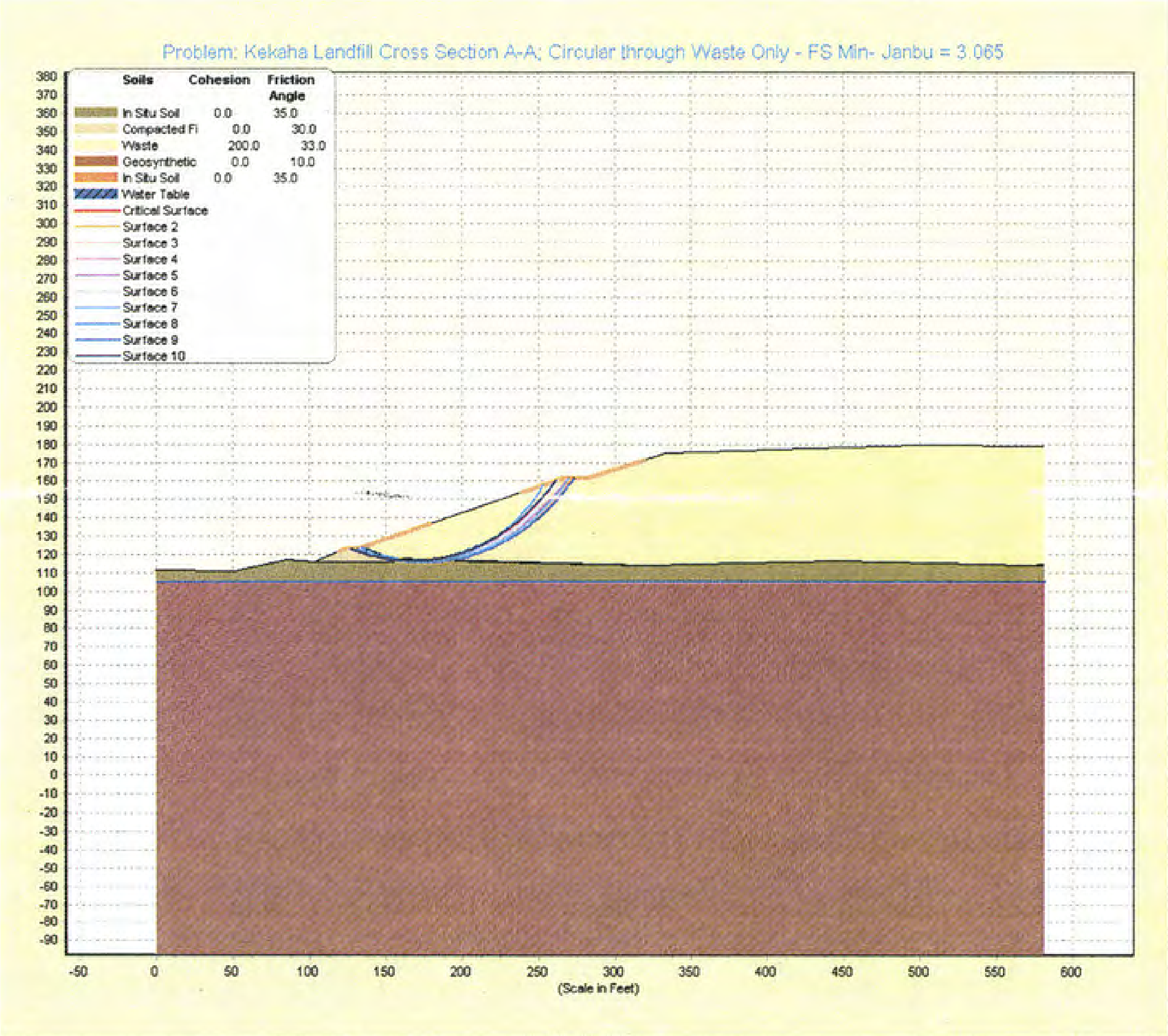

Figure 1 – Section AA, Circular Failure, Waste Mass of Cell 1

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CALCULATION SHEET

Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Final Buildout
Stability

Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

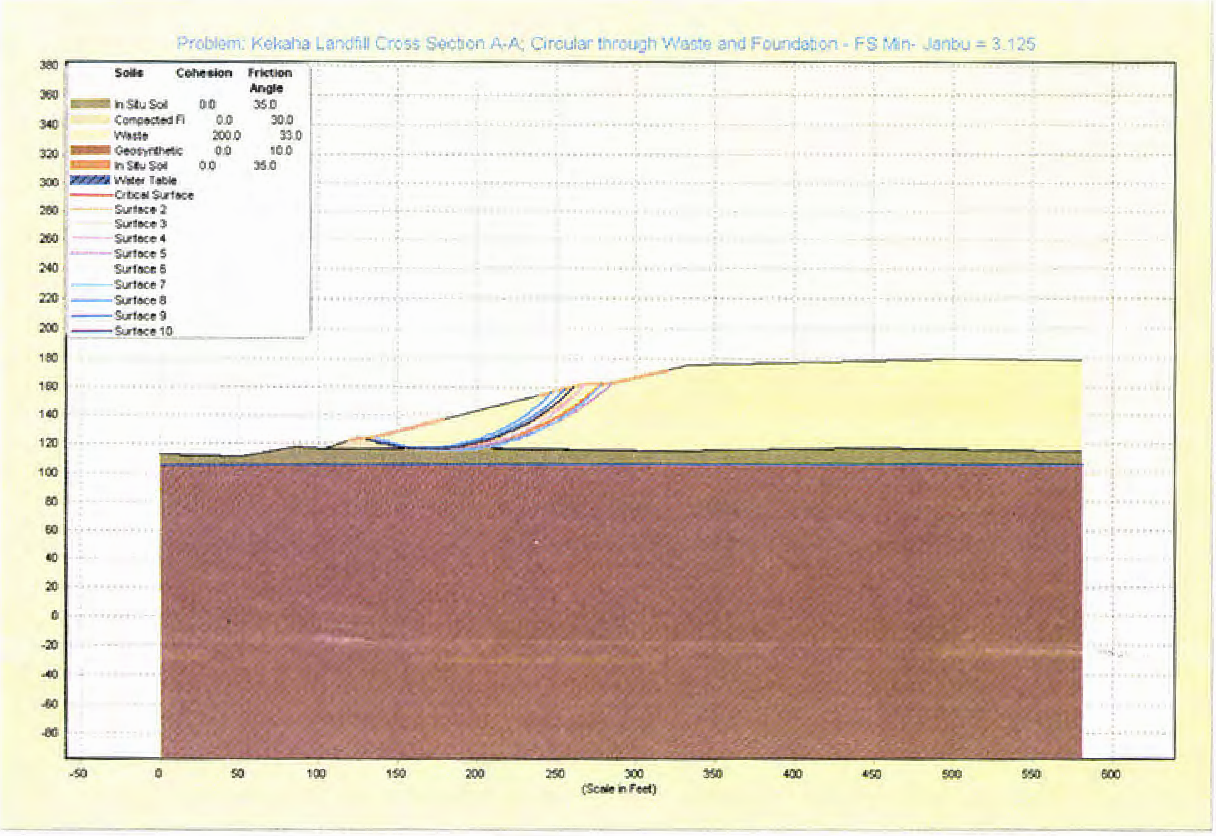

Figure 2 – Section AA, Circular Failure, Waste Mass and Foundation Soils, Through Cell 1

**Model surface allowed to pass through to elevation 30. Resulting critical failure surface resides in waste mass and through structural fill soils of berm.

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CALCULATION SHEET

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Project No. 95561

Client	County of Kaua'i	**Subject**	Final Buildout	**Prepared By**	MZ	**Date**	12/22/08
Project	Kekaha Landfill	Stability		**Reviewed By**	KJB	**Date**	12/30/08
Phase II Lateral Expansion				**Approved By**	KJB	**Date**	12/30/08

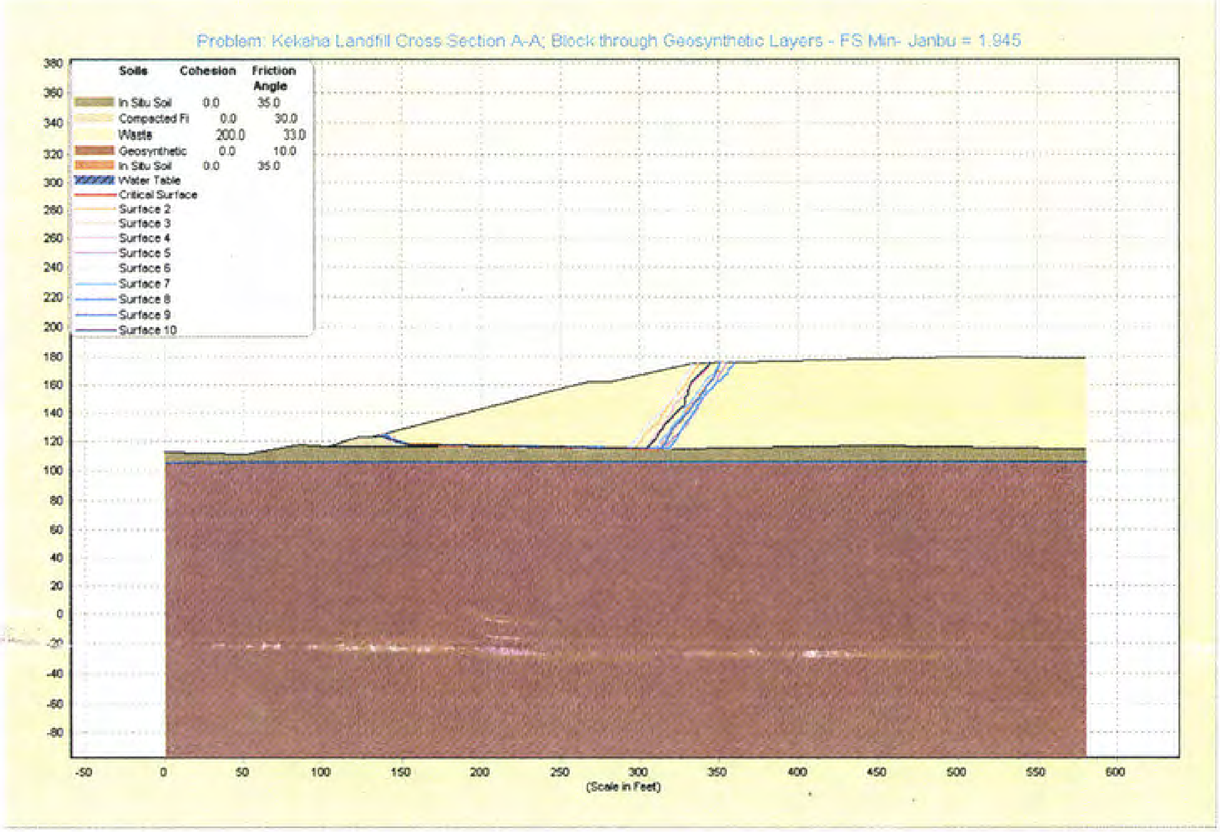

Figure 3 – Section AA, Block Failure in Cell 1

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CALCULATION SHEET

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Project No. 95561
Client County of Kaua'i **Subject** Final Buildout Stability
Project Kekaha Landfill Phase II Lateral Expansion
Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

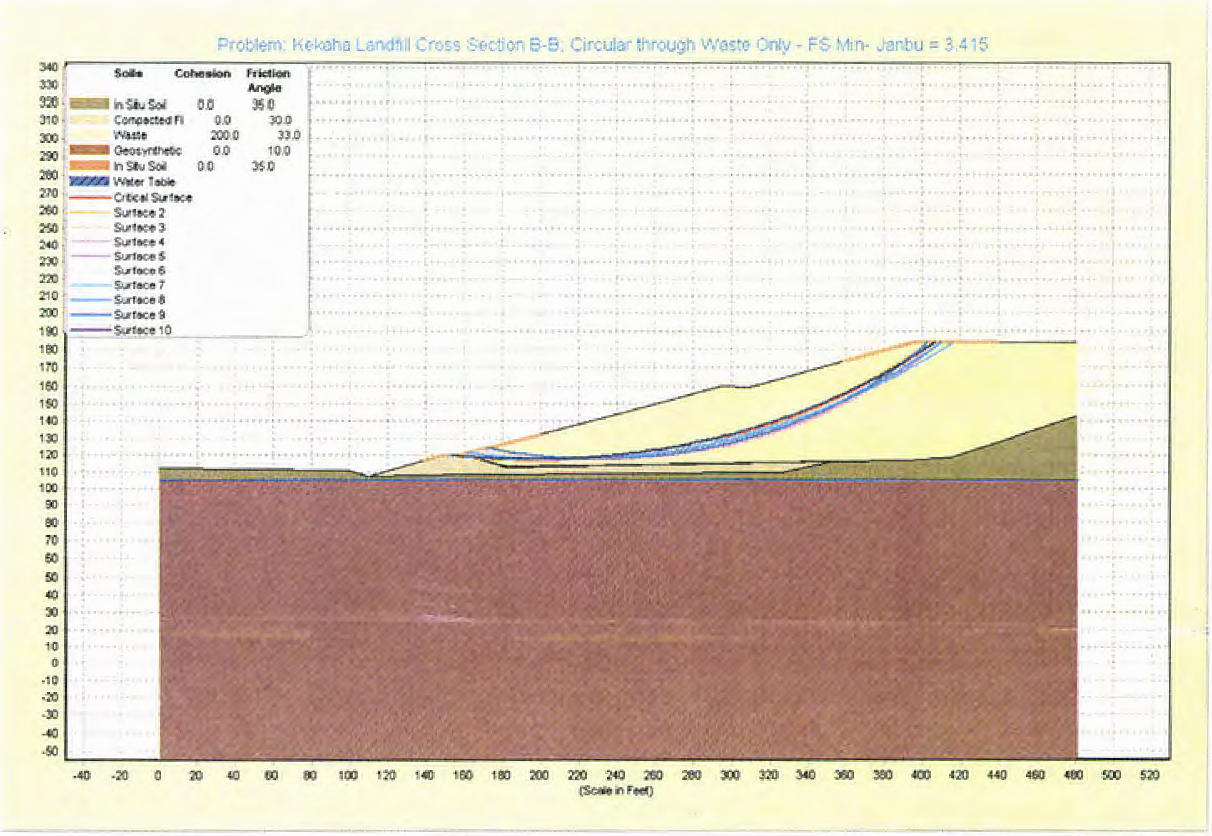

Figure 4 – Section BB, Circular Failure, Waste Mass of Cell 1

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CALCULATION SHEET

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Project No. 95561

Client County of Kaua'i **Subject** Final Buildout Stability **Prepared By** MZ **Date** 12/22/08
Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

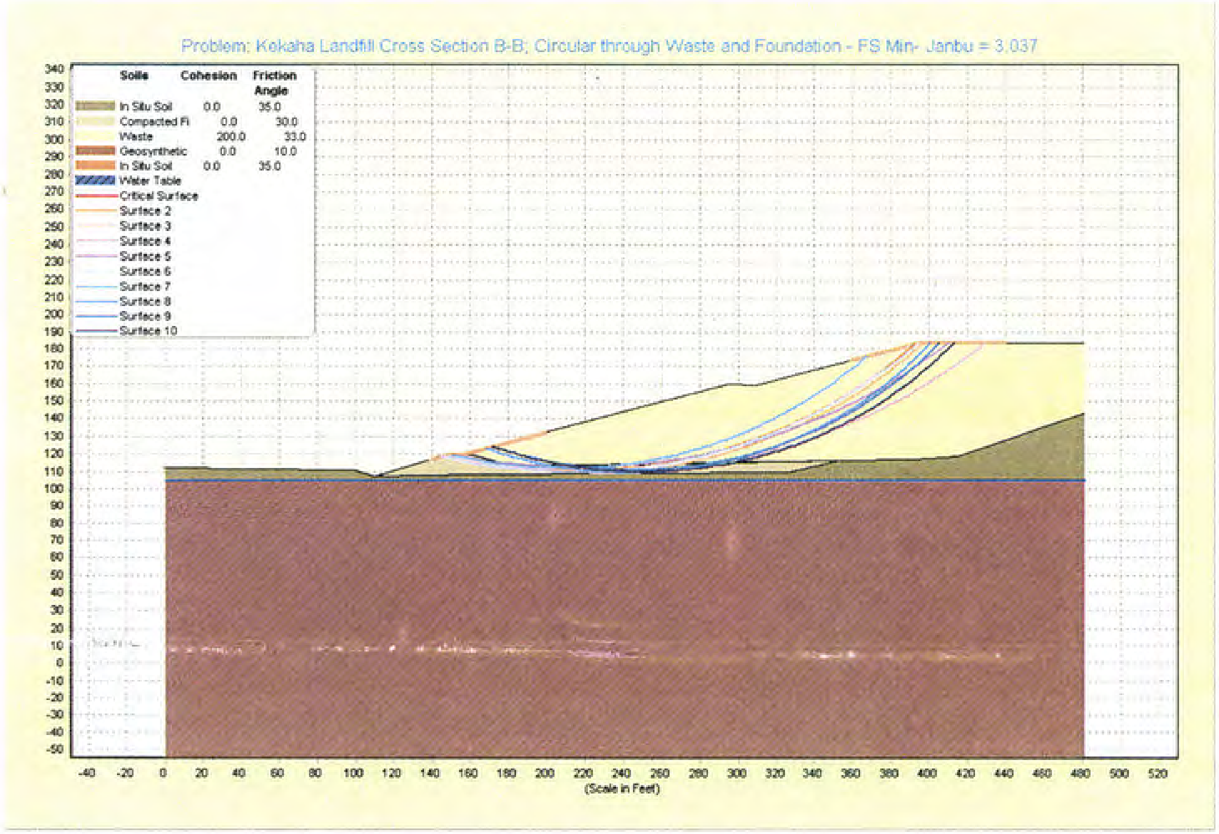

Figure 5 – Section BB, Circular Failure, Waste Mass and Foundation Soils, Through Cell 1

**Model surface allowed to pass through to elevation 30. Resulting critical failure surface resides in waste mass and through structural fill soils of berm.

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CALCULATION SHEET

Page 10 **Of** 15

Project No. 95561

Client County of Kaua'i **Subject** Final Buildout Stability

Project Kekaha Landfill Phase II Lateral Expansion

Prepared By MZ **Date** 12/22/08

Reviewed By KJB **Date** 12/30/08

Approved By KJB **Date** 12/30/08

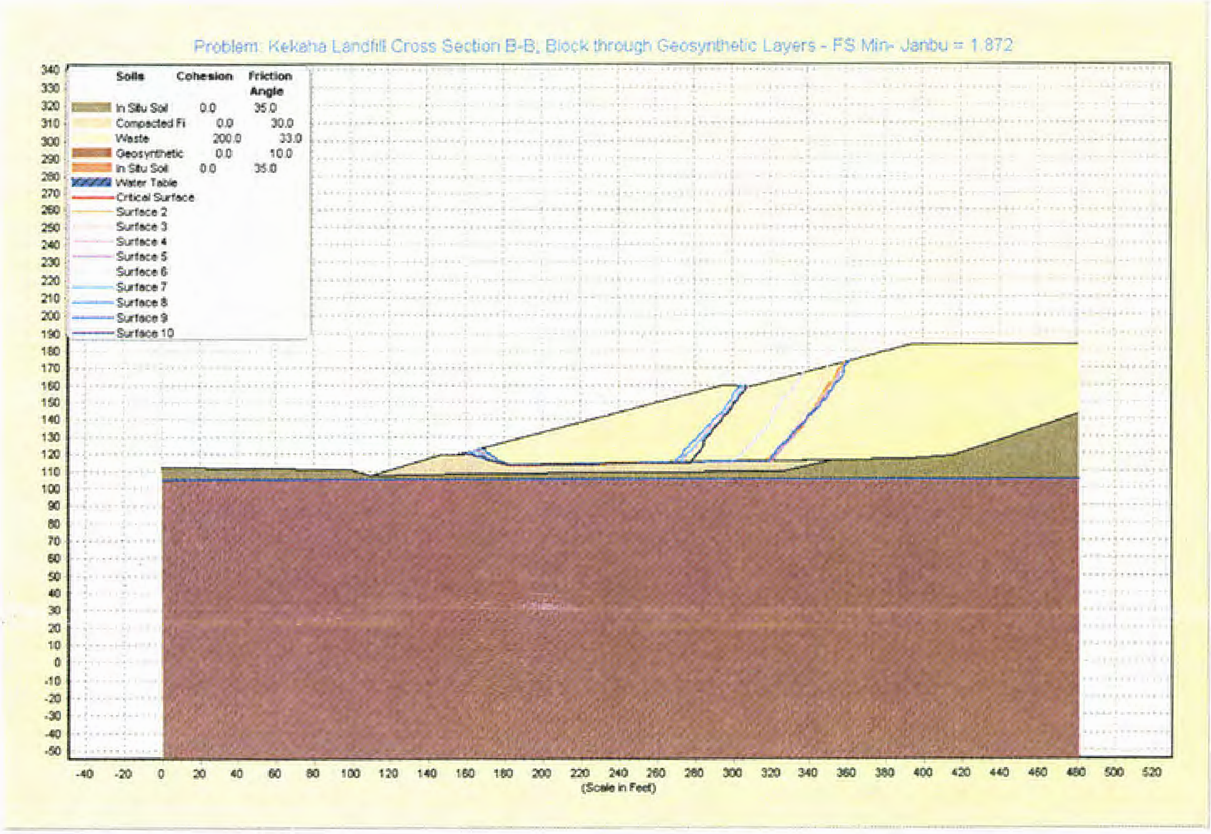

Figure 6 – Section BB, Block Failure in Cell 1

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CALCULATION SHEET

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Project No. 95561

Client County of Kaua'i **Subject** Final Buildout
Project Kekaha Landfill Stability
Phase II Lateral Expansion

Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

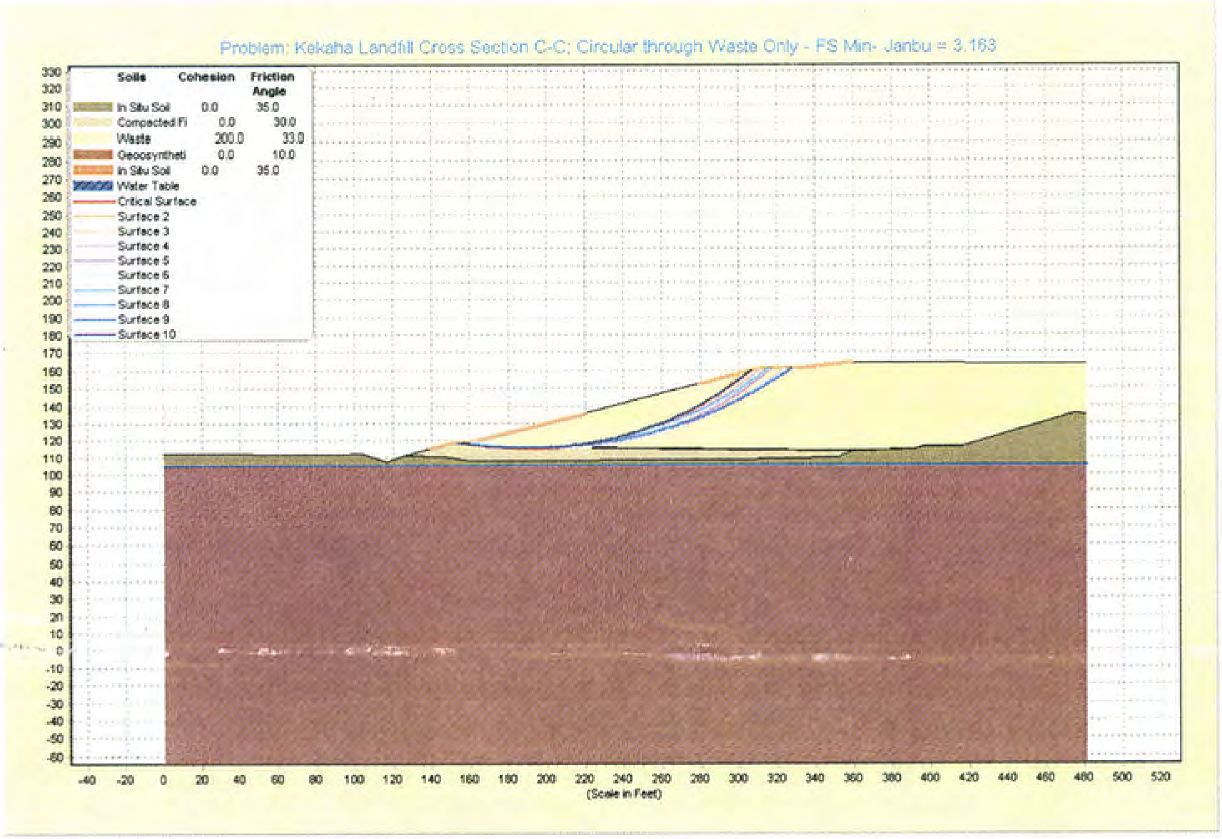

Figure 7 – Section CC, Circular Failure, Waste Mass of Cell 1

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CALCULATION SHEET

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Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Final Buildout
Stability

Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

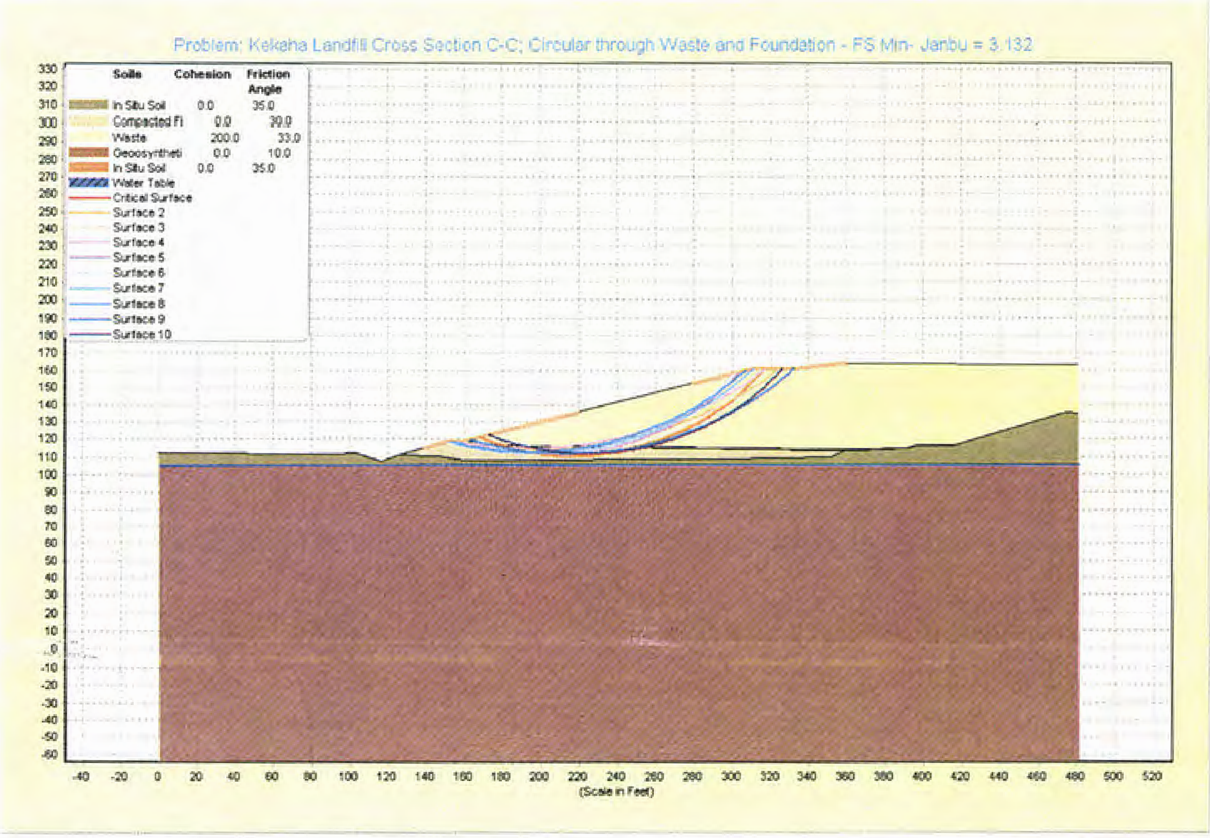

Figure 8 – Section CC, Circular Failure, Waste Mass and Foundation Soils, Through Cell 1

**Model surface allowed to pass through to elevation 30. Resulting critical failure surface resides in waste mass and through structural fill soils of berm.

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CALCULATION SHEET

Page 13 **Of** 15
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Final Buildout
Stability

Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

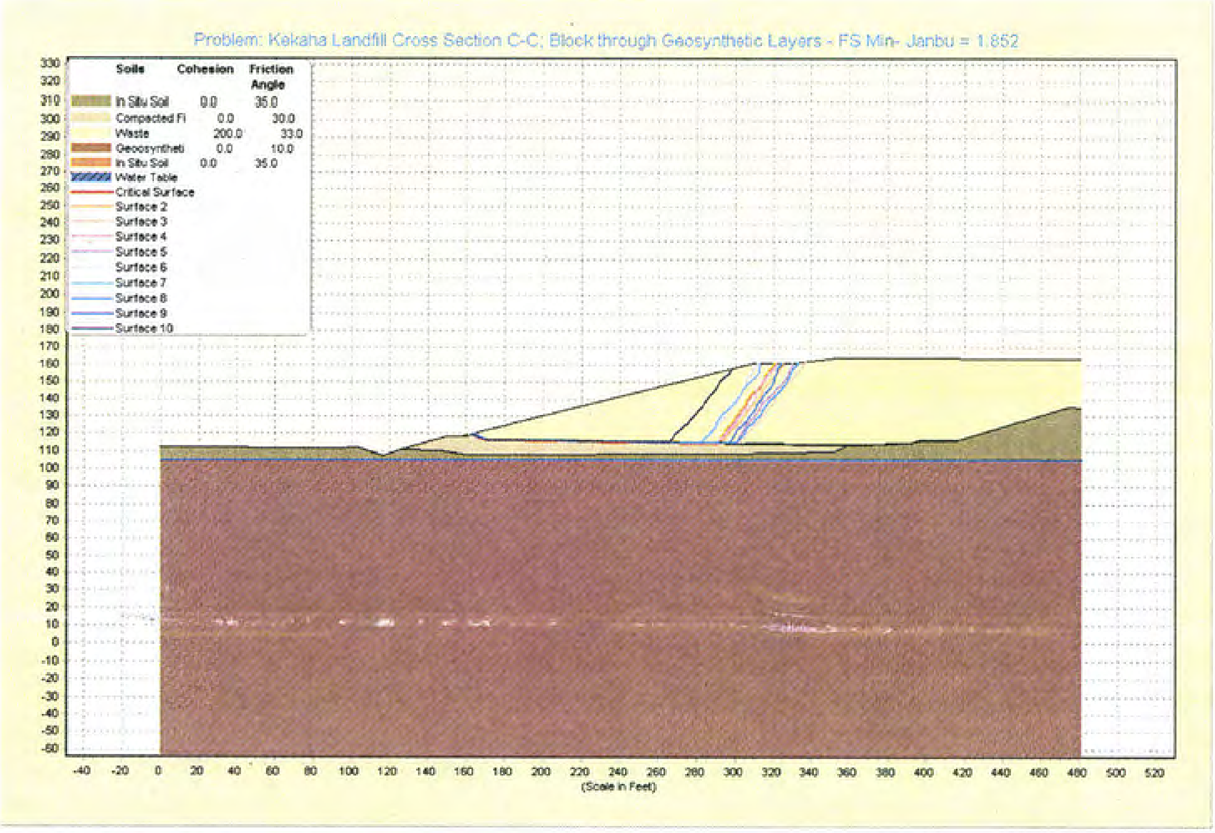

Figure 9 – Section CC, Block Failure in Cell 1

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CALCULATION SHEET

Page 14 **Of** 15
Project No. 95561

Client County of Kaua'i **Subject** Final Buildout Stability **Prepared By** MZ **Date** 12/22/08
Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

Conclusions

The results of the computer modeling are:

Section	Waste Properties (degrees, cohesion)	Condition	Failure Mode	Factor of Safety	Figure
AA	33 degrees, 200 psf	Waste Mass	Circular	3.065 > 1.50	1
		Waste Mass and Foundation Soils	Circular	3.125 > 1.50	2
		Base Liner	Block	1.945 > 1.50	3
BB	33 degrees, 200 psf	Waste Mass	Circular	3.415 > 1.50	4
		Waste Mass and Foundation Soils	Circular	3.037 > 1.50	5
		Base Liner	Block	1.872 > 1.50	6
CC	33 degrees, 200 psf	Waste Mass	Circular	3.163 > 1.50	7
		Waste Mass and Foundation Soils	Circular	3.132 > 1.50	8
		Base Liner	Block	1.852 > 1.50	9

The proposed geometry of the facility and vertical expansion is expected to remain stable based upon the presented interface friction angles, soil and waste mass properties. The critical interface was modeled at 10 degrees and no adhesion.

Interface friction angle testing should be completed prior to construction as well as after changes in manufacturer or significant material property changes.

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CALCULATION SHEET

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		Project No. 95561			
Client County of Kaua'i	**Subject** Final Buildout	**Prepared By**	MZ	**Date**	12/22/08
Project Kekaha Landfill	Stability	**Reviewed By**	KJB	**Date**	12/30/08
Phase II Lateral Expansion		**Approved By**	KJB	**Date**	12/30/08

References

1. "Addendum Operations Manual For Kekaha Sanitary Landfill – Phase II," prepared by EMCON, May 1998.
2. Table 13.3, Das, Braja M, "Principles of Geotechnical Engineering ", 1985, pages 538 to 541.
3. Motan, E. Sabri; Benson, Craig H.; Tuncer, B. Edil, "Shear Strength of Municipal Solid Waste: A Laboratory Study".
4. Koerner, George R. and Najero, Dhani, "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces", Geosynthetic Research Institute, GRI Report #30, June 14, 2005.
5. Drawings titled, "Engineering Report, Phase II Lateral Expansion, Kekaha Landfill", prepared by AECOM, dated January 2009.
6. "Pre-Final Letter Report, Geotechnical Exploration, PGE Job No. 8950-020, for Horizontal Expansion of the Kekaha MSW Phase II Landfill, Kekaha, Kauai, Hawaii", prepared by Pacific Geotechnical Engineers, Inc., dated March 20, 2007.

ATTACHMENT 1

FIGURE 1, CROSS SECTION LOCATIONS FOR FINAL BUILDOUT STABILITY ANALYSIS

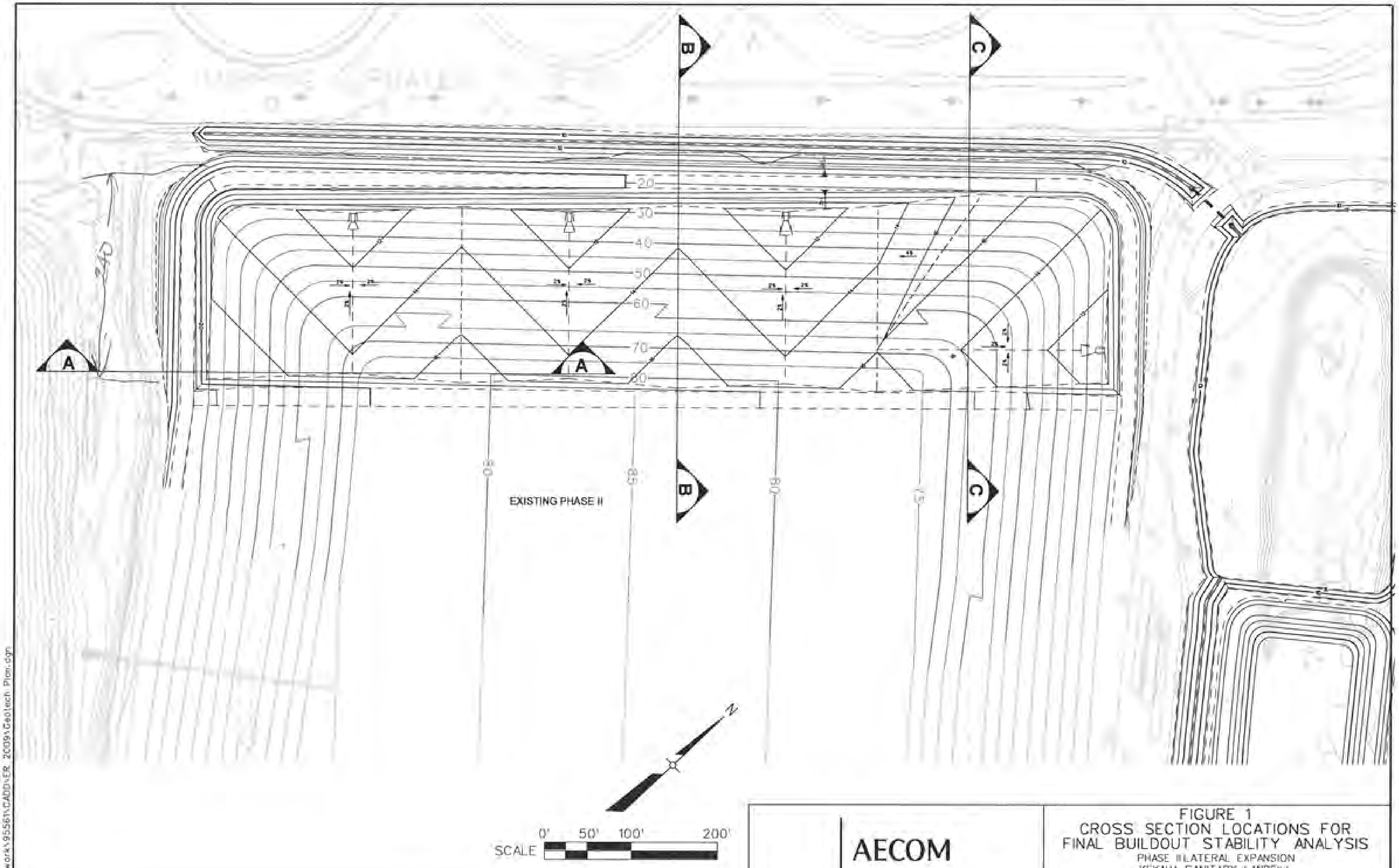

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FIGURE 1
CROSS SECTION LOCATIONS FOR
FINAL BUILDOUT STABILITY ANALYSIS
PHASE II LATERAL EXPANSION
KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

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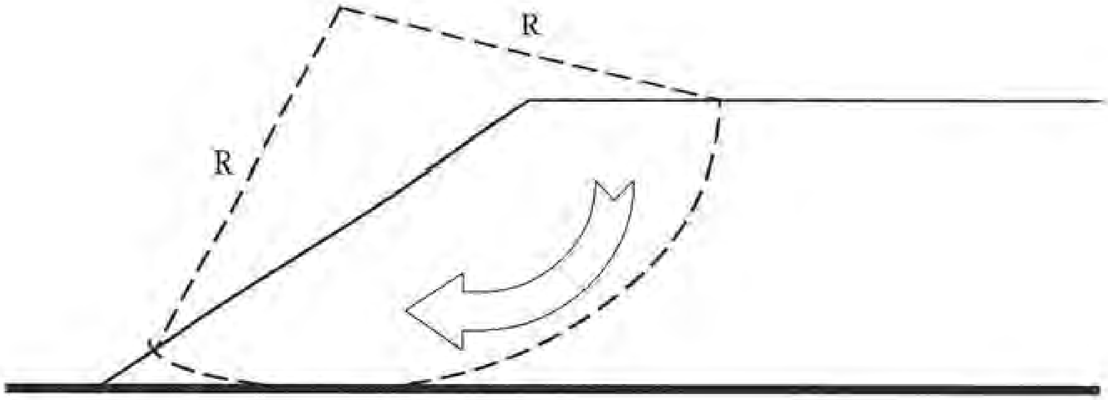
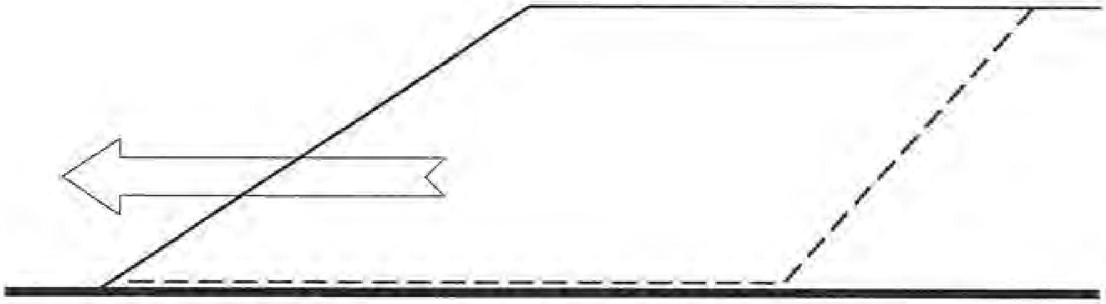
ATTACHMENT 2

FAILURE MODES



A. ROTATIONAL



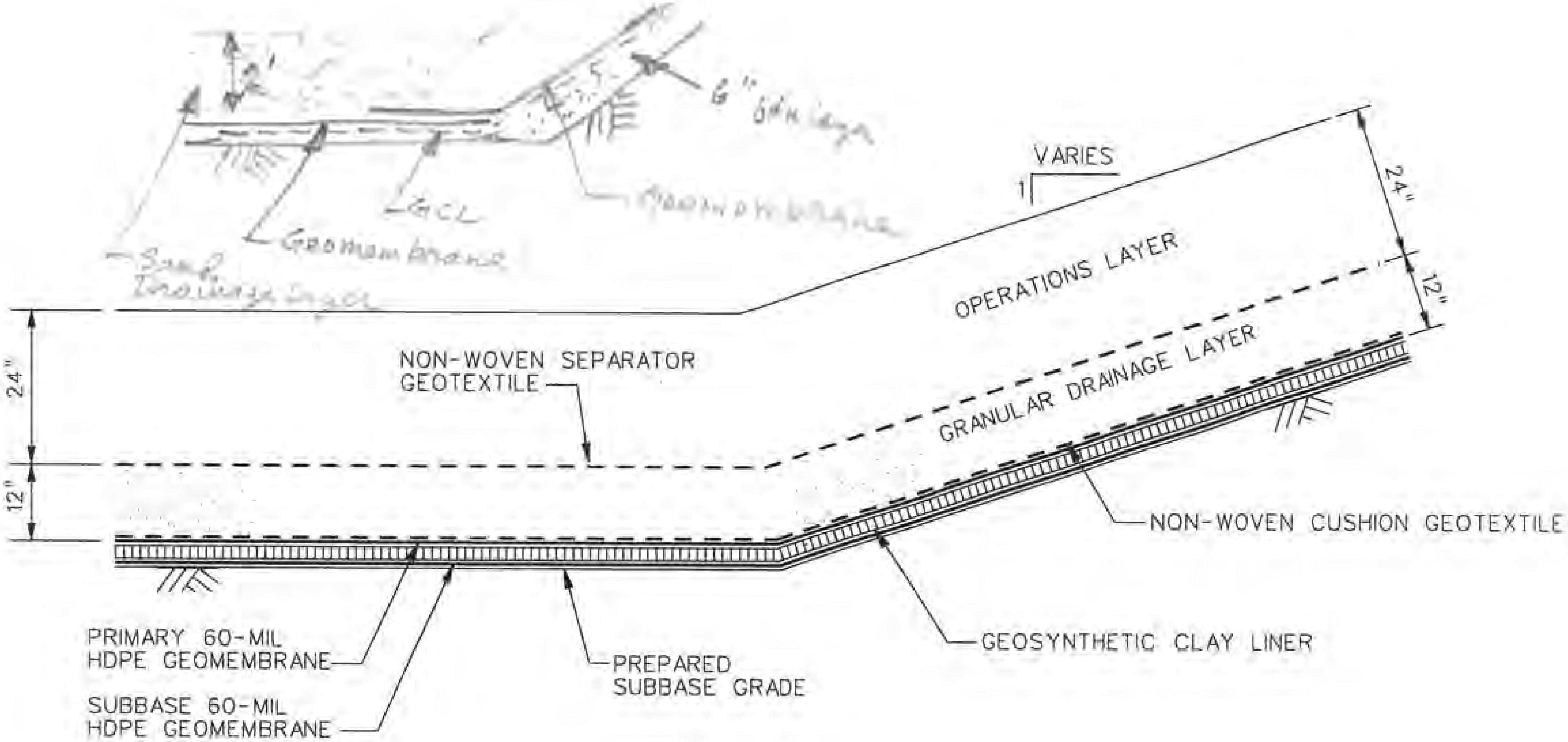
B. WEDGE BLOCK

AECOM

FAILURE MODES
KEKAHA LANDFILL

ATTACHMENT 3

PROPOSED CELL 1 BASE LINER SYSTEM DETAILS



TYPICAL BASE LINER DETAIL - CELL 1 1

NTS

NOTES:

1. ALL GEOMEMBRANE IS TEXTURED ON BOTH SIDES.
2. WHEN DEPLOYING GCL OR GEOTEXTILES OVER TEXTURED GEOMEMBRANE OR WHEN DEPLOYING TEXTURED GEOMEMBRANE OVER GCL OR GEOTEXTILES, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.

Appendix B-3
Drainage Layer Stability Analysis with Equipment Loadings

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CALCULATION SHEET

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Project No. 95561

Client County of Kaua'i	**Subject** Drainage Layer	**Prepared By** MZ	**Date** 12/22/08
Project Kekaha Landfill	Stability Analysis with	**Reviewed By** KJB	**Date** 12/30/08
Phase II Lateral Expansion	Equipment Loading	**Approved By** KJB	**Date** 12/30/08

DRAINAGE LAYER STABILITY ANALYSIS WITH EQUIPMENT LOADING

Objective

Determine the maximum slope length for granular drainage layer placement and operations layer placement over the geosynthetic base liner on the sideslopes of Cell 1.

Design Criteria and Assumptions

1. The base liner systems for Cell 1 is depicted in Figure 1 from Reference 1.
2. The drainage layer material is expected to be a sub-angular or angular gravel.
3. The placement of the granular drainage layer and the operations layer will be completed in two stages. The first stage would be placement of the 1-foot granular drainage layer and installation of the separator geotextile. After installation of the geotextile the 2-foot operations layer will be placed. This analysis will evaluate both conditions including placement of the operations layer in two 1-foot lifts as well. It is also assumed that the granular drainage layer or operations layer will be inplace across the cell floor prior to placement on the sideslope.
4. This analysis will determine the minimum critical interface friction angles required for varied slope lengths from a typical length of 10 feet to the maximum slope length for the proposed expansion. Slope length will be dependant upon equipment loadings, placement of the granular drainage layer and/or the operations layer on the slope, and assumed no tension applied to the geotextile or geomembrane.
5. Slope length for granular drainage layer and operations layer placement is defined as the actual slope length, not a vertical or horizontal length.
6. Sideslopes are a maximum 3:1 (H:V) slope.
7. The dozer to be used for deployment of the drainage layer is expected to be a Caterpillar D6H LGP. This dozer has a ground pressure of less than 5 psi, typical for placement of soil material layers over geosynthetics. Model specifications are included as Attachment 1.
8. The dozer is operated from the bottom of the slope with no abrupt braking or change in direction during granular drainage layer placement.
9. Interface friction angle testing will be completed prior to cell construction or a resulting change of geosynthetic materials.

Calculations

Caterpillar D6H LGP Dozer Properties (Attachment 1, Reference 5)

Dozer track width:	36 inches
Track length on ground:	128.5 inches (10.7 ft)
Ground pressure:	4.88 psi (702.7 psf) < 5 psi

Drainage Layer Properties

Unit Weight:	130 pcf
Internal friction angle:	*34+ degrees

*Table 3.31 of Reference 2 for SM, SP, SW, GM, GP, GW soils that could be used as drainage layer materials.

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CALCULATION SHEET

Page 2 **Of** 4
Project No. 95561

Client County of Kaua'i	**Subject** Drainage Layer	**Prepared By** MZ	**Date** 12/22/08
Project Kekaha Landfill	Stability Analysis with	**Reviewed By** KJB	**Date** 12/30/08
Phase II Lateral Expansion	Equipment Loading	**Approved By** KJB	**Date** 12/30/08

For conservatism, the internal friction angle used in the model and analysis is 33 degrees which is equal to the typical interface friction angle between sand/nonwoven geotextiles and gravel/nonwoven geotextile (Table 1, Reference 4). This will allow the model to evaluate a uniform layer thickness (granular drainage layer or with the added operations layer) with the separator geotextile included to determine the critical interface friction angle needed on the sideslope base liner system.

Maximum Slope Angle

3H:1V: $\tan^{-1}(1/3) = 18.4$ *degrees*

Maximum Slope Length

Based upon visual observation of the base liner grades shown on Drawing 4 of Reference 1, the maximum slope height for Cell 1 is 11 feet (vertical) on the west sideslope of Cell 1A. The resulting maximum slope length is determined to be:

$$(11)\left(\sqrt{3^2+1^2}\right) = 34.8 \text{ feet or } 35 \text{ feet, say} \Rightarrow 40 \text{ feet}$$

Typical Interface Friction Angles

A review of Reference 4 for typical peak interface friction angles and peak adhesion in relation to the proposed base liner system include:

Table 1
Critical Base Liner Interfaces and Friction Angles

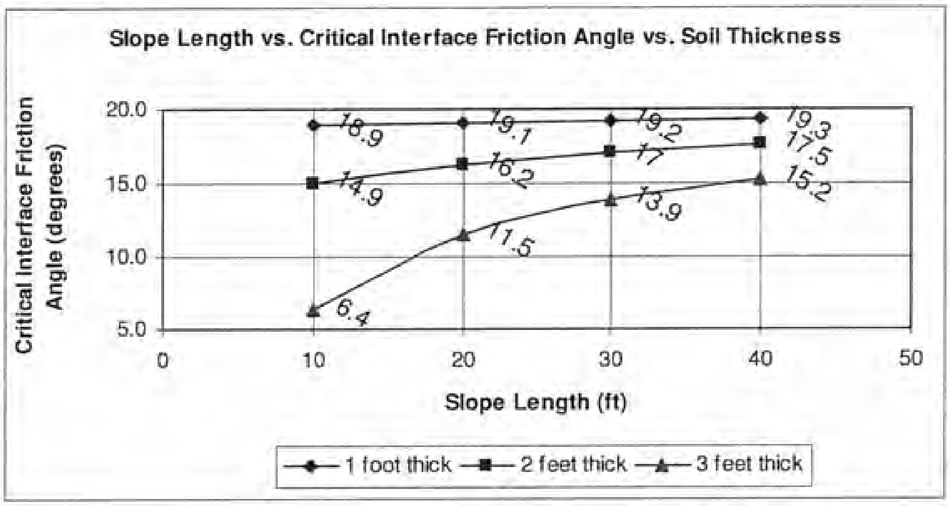
Interface	**Typical Interface Friction Test Results**	
	Friction Angle (degrees)	**Adhesion (kPa)**
Nonwoven geotextile (separator and cushion) / granular drainage layer (gravel) or operations layer	33	0
Nonwoven geotextile (geocomposite and cushion) / textured HDPE geomembrane	25	8
Nonwoven geotextile (GCL) / textured HDPE geomembrane	23	8
Woven geotextile (GCL) / textured HDPE Geomembrane	18	11
Textured HDPE geomembrane to subbase (sand)	34	0
Needle-punched GCL (internal friction angle)	39.7	19.9

Client County of Kaua'i	**Subject** Drainage Layer	**Prepared By**	MZ	**Date** 12/22/08
Project Kekaha Landfill	Stability Analysis with	**Reviewed By**	KJB	**Date** 12/30/08
Phase II Lateral Expansion	Equipment Loading	**Approved By**	KJB	**Date** 12/30/08

Method of Analysis

Attached as Figures 2, 3 and 4, is a calibrated spreadsheet depicting the analysis presented by Koerner and Soong, 1998 (Reference 3). This spreadsheet depicts the driving and resisting forces experienced along the critical interface with the incorporation of equipment loading. A factor of safety of 1.1 was deemed as a qualifier for slope stability as equipment loading is a brief and temporary load condition.

Table 2
Slope Length vs. Critical Interface Friction Angles vs. Soil Thickness



By varying the slope lengths in Figures 2, 3, and 4, varying drainage layer and operations layer thickness on the sideslope, and calculating the minimum critical interface friction angle for the specific slope length, the resulting Table 2 above was derived. The table itself specifically defines the critical interface solely as friction without the application of apparent adhesion that could occur between the interfaces of geosynthetic layers to geosynthetics layers or a geosynthetic layer to a soil layer. Added conservatism is provided by not considering adhesion.

Conclusions

Upon review of Table 2, the critical placement period will be during the placement of the 1-foot granular drainage layer. In order to place the entire lift up the sideslope, a minimum critical interface friction angle of 19.3 degrees is required. As the lift thickness increases (the 1-foot drainage layer is then overlain by the operations layer) the critical interface requirement decreases as a result of the increased buttress effect at the toe of slope and distribution of the equipment loading through the granular soils.

Review of the typical peak values in Table 1 determines that the sideslope geomembrane should be textured to allow for placement of the granular drainage layer on the sideslopes without added tension to the underlying geotextile or geomembrane.

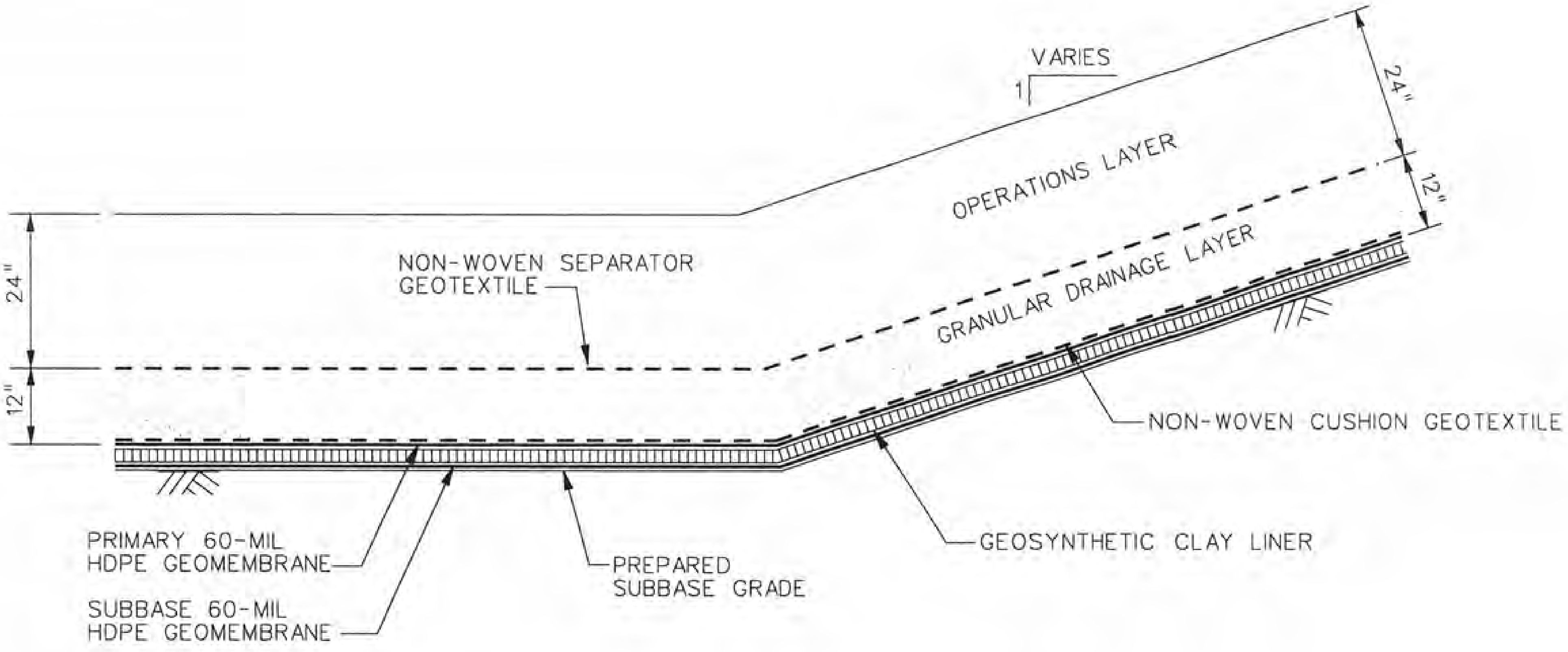
This calculation should be revisited if placement equipment is different or a change in the granular drainage layer. This calculation should also be revisited for the addition of any further base liner components or removal of any of the proposed base liner components.

References

1. Drawings entitled, "Engineering Report, Phase II Lateral Expansion, Kekaha Landfill", prepared by AECOM, dated January 2009.
2. Table 3.31, Hunt, Roy E., "Geotechnical Engineering Investigation Manual," 1984.
3. Koerner, R. M. and Soong, T.-Y. (1998), "Analysis and Design of Veneer Cover Soils" *Proc. 6th Int. Conf. on Geosynthetics, Atlanta*, USA, IFAI, pp. 1-23.
4. Koerner, George R. and Nejaro, Dhani, "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces," Geosynthetic Research Institute, GRI Report #30, June 14, 2005.
5. "Caterpillar Performance Handbook," Edition 24, pages 1-8 and 1-21.

FIGURE 1

TYPICAL CELL 1 BASE LINER SYSTEM DETAILS



TYPICAL BASE LINER DETAIL - CELL 1 1

NTS

NOTES:

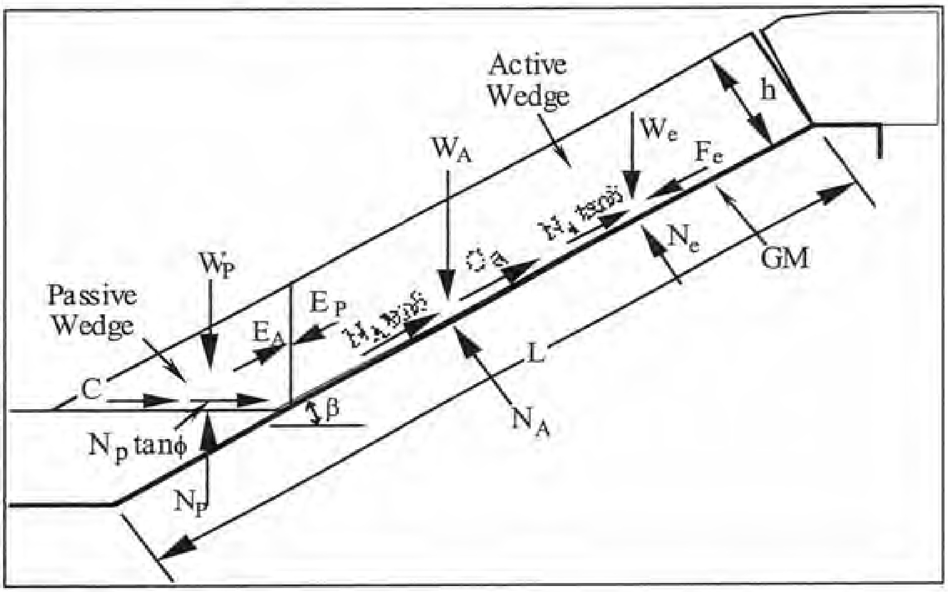
1. ALL GEOMEMBRANE IS TEXTURED ON BOTH SIDES.
2. WHEN DEPLOYING GCL OR GEOTEXTILES OVER TEXTURED GEOMEMBRANE OR WHEN DEPLOYING TEXTURED GEOMEMBRANE OVER GCL OR GEOTEXTILES, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.

FIGURE 2

DRAINAGE LAYER STABILITY CALCULATION WITH EQUIPMENT LOADING (MAXIMUM SLOPE LENGTH ONLY, 1-FOOT GRANULAR DRAINAGE LAYER)

Figure 2

Uniform Cover Soil Thickness with the Incorporation of Equipment Loads
1-foot Thickness (1-foot Granular Drainage Layer Placed Only)



Calculation of FS

Active Wedge:

Wa= 4766.5 kpounds
Na= 4522.8 kpounds

Passive Wedge:

Wp= 217.0 kpounds

$$\boxed{FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}}$$

a= 3612.1
b= -4719
c= 820.5

FS= 1.10

thickness of cover soil = h = 1.00 ft
soil slope angle beneath the geomembrane = β = 18.4 ° *= 0.32 (rad.)*
finished cover soil slope angle = ω = 18.4 ° *= 0.32 (rad.)*
length of slope measured along the geomembrane = L = 40.0 ft
unit weight of the cover soil = γ = 130.0 pcf
friction angle of the cover soil = ϕ = 33.0 ° *= 0.58 (rad.)*
cohesion of the cover soil = c = 0.0 psf *C= 0 kpounds*
interface friction angle between cover soil and geomembrane δ = 19.3 ° *= 0.34 (rad.)*
adhesion between cover soil and geomembrane = ca = 0.0 psf *Ca= 0 kpounds*

thickness of cover soil = h = 1.00 ft *b/h= 3.0*
equipment ground pressure (= wt. of equipment/(2wb))= q = 702.7 psf *We=q w I= 7293.3*
length of each equipment track = w = 10.7 ft *Ne=Wecos β = 6920.5*
width of each equipment track = b = 3.0 ft *Fe=We (a/g) = 0.0*
influence factor* at geomembrane interface = I = 0.97
acceleration/deceleration of the bulldozer = a = 0.00 g

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
^{2} 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
^{3} 1000 mm	0.95	0.75	0.30

Note: numbers in boxes are input values

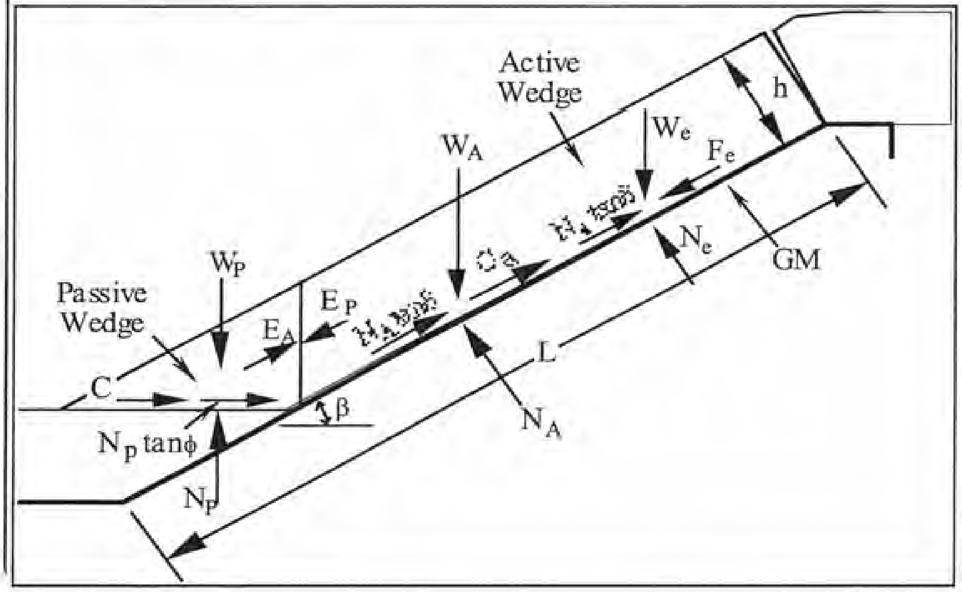
numbers in Italics are calculated values

FIGURE 3

DRAINAGE LAYER STABILITY CALCULATION WITH EQUIPMENT LOADING (MAXIMUM SLOPE LENGTH ONLY, 1-FOOT GRANULAR DRAINAGE LAYER WITH 1-FOOT OF OPERATIONS LAYER)

Figure 3

Uniform Cover Soil Thickness with the Incorporation of Equipment Loads
2-foot Thickness (1-foot Granular Drainage Layer and 1-foot Operations Layer)



Calculation of FS

Active Wedge:

Wa= 8666.1 kpounds

Na= 8223.1 kpounds

Passive Wedge:

Wp= 868.1 kpounds

$$\boxed{FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}}$$

a= 4667.4

b= -6005

c= 957.7

FS= 1.10

thickness of cover soil = h = 2.00 ft

soil slope angle beneath the geomembrane = β = 18.4 ° *= 0.32 (rad.)*

finished cover soil slope angle = ω = 18.4 ° *= 0.32 (rad.)*

length of slope measured along the geomembrane = L = 40.0 ft

unit weight of the cover soil = γ = 130.0 pcf

friction angle of the cover soil = ϕ = 33.0 ° *= 0.58 (rad.)*

cohesion of the cover soil = c = 0.0 psf *C= 0 kpounds*

interface friction angle between cover soil and geomembrane = δ = 17.5 ° *= 0.31 (rad.)*

adhesion between cover soil and geomembrane = ca = 0.0 psf *Ca= 0 kpounds*

thickness of cover soil = h = 2.00 ft *b/h= 1.5*

equipment ground pressure (= wt. of equipment/(2wb)) = q = 702.7 psf *We=q w I= 6917.4*

length of each equipment track = w = 10.7 ft *Ne=Wecos β = 6563.7*

width of each equipment track = b = 3.0 ft *Fe=We (a/g) = 0.0*

influence factor* at geomembrane interface = I = 0.92

acceleration/deceleration of the bulldozer = a = 0.00 g

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
^{2} 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
^{3} 1000 mm	0.95	0.75	0.30

Note: numbers in boxes are input values

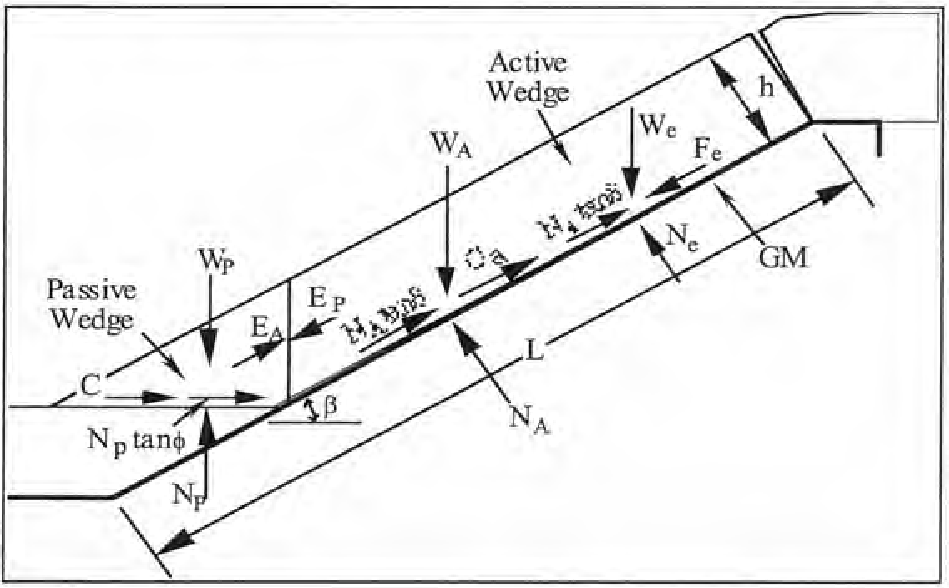
numbers in Italics are calculated values

FIGURE 4

DRAINAGE LAYER STABILITY CALCULATION WITH EQUIPMENT LOADING (MAXIMUM SLOPE LENGTH ONLY, 1-FOOT GRANULAR DRAINAGE LAYER WITH 2-FEET OF OPERATIONS LAYER)

Figure 4

Uniform Cover Soil Thickness with the Incorporation of Equipment Loads
3-foot Thickness (1-foot Granular Drainage Layer and 2-foot Operations Layer)



Calculation of FS

Active Wedge:

Wa= 11698.7 kpounds

Na= 11100.7 kpounds

Passive Wedge:

Wp= 1953.2 kpounds

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 5575.7

b= -7032

c= 984.9

FS= 1.10

thickness of cover soil = h = 3.00 ft

soil slope angle beneath the geomembrane = β = 18.4 ° *= 0.32 (rad.)*

finished cover soil slope angle = ω = 18.4 ° *= 0.32 (rad.)*

length of slope measured along the geomembrane = L = 40.0 ft

unit weight of the cover soil = γ = 130.0 pcf

friction angle of the cover soil = ϕ = 33.0 ° *= 0.58 (rad.)*

cohesion of the cover soil = c = 0.0 psf *C= 0 kpounds*

interface friction angle between cover soil and geomembrane δ = 15.2 ° *= 0.27 (rad.)*

adhesion between cover soil and geomembrane = ca = 0.0 psf *Ca= 0 kpounds*

thickness of cover soil = h = 3.00 ft *b/h= 1.0*

equipment ground pressure (= wt. of equipment/(2wb))= q = 702.7 psf *We=q w I= 6917.4*

length of each equipment track = w = 10.7 ft *Ne=Wecos β= 6563.7*

width of each equipment track = b = 3.0 ft *Fe=We (a/g) = 0.0*

influence factor* at geomembrane interface = I = 0.92

acceleration/deceleration of the bulldozer = a = 0.00 g

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
^{2} 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
^{3} 1000 mm	0.95	0.75	0.30

Note: numbers in boxes are input values

numbers in Italics are calculated values

ATTACHMENT 1

EQUIPMENT PROPERTIES FOR CATERPILLAR D6H LGP DOZER




MODEL	D6H XR Series II		D6H LGP Series II		D7G		D7H Series II	
Flywheel Power	130 kW	175 hp	127 kW	170 hp	149 kW	200 hp	160 kW	215 hp
Operating Weight*								
(Power Shift)	18 684 kg	41,192 lb	19 814 kg	43,590 lb	20 666 kg	45,560 lb	24 694 kg	54,401 lb
(Direct Drive)	—		19 989 kg	43,976 lb	20 510 kg	45,218 lb	—	
(Power Shift Differential Steer)	18 799 kg	41,444 lb	—		—		24 993 kg	55,100 lb
Engine Model	3306		3306		3306		3306	
Rated Engine RPM	1900		1900		2000		2100	
No. of Cylinders	6		6		6		6	
Bore	121 mm	4.75"	121 mm	4.75"	121 mm	4.75"	121 mm	4.75"
Stroke	152 mm	6"	152 mm	6"	152 mm	6"	152 mm	6"
Displacement	10.5 L	638 in³	10.5 L	638 in³	10.5 L	638 in³	10.5 L	638 in³
Track Rollers (Each Side)	7		8		6		7	
Width of Standard Track Shoe	560 mm	22"	915 mm	36"	508 mm	20"	560 mm	22"
Length of Track on Ground	2.77 m	9'1"	3.27 m	10'8.5"	2.70 m	8'11"	2.90 m	9'6"
Ground Contact Area (W/Std. Shoe)	3.11 m²	4815 in²	5.97 m²	9254 in²	2.76 m²	4280 in²	3.24 m²	5016 in²
Track Gauge	1.88 m	6'2"	2.23 m	7'3"	1.98 m	6'5"	1.98 m	6'6"
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.26 m	7'5"	2.32 m	7'7"	2.27 m	7'5"	2.44 m	8'0"
Height (To Top of ROPS)	3.12 m	10'3"	3.16 m	10'5"	3.20 m	10'6"	3.33 m	10'11"
Height (To Top of Cab ROPS)	3.12 m	10'3"	3.16 m	10'5"	—		3.42	11'3"
Height (To Top of ROPS Canopy)	—		3.16 m	10'5"	—		—	
Overall Length (With P Blade)	—		5.18 m	17'0"	—		—	
(Without Blade)	—		4.49 m	14'9"	—		—	
Overall Length (With S Blade)	5.26 m	17'3"	—		5.28 m	17'4"	6.03 m	19'9"
(Without Blade)	4.21 m	13'10"	—		4.19 m	13'9"	4.73 m	15'6"
Width (Over Trunnion)	2.64 m	8'8"	3.43 m	11'3"	—		2.86 m	9'5"
Width (W/O Trunnion — Std. Shoe)	2.44 m	8'0"	3.14 m	10'3.6"	2.55 m	8'5"	2.54 m	8'4"
Ground Clearance	377 mm	14.8"	382 mm	15"	347 mm	13.7"	406 mm	16"
Blade Types and Widths:								
Straight	3.36 m	11'0"	3.99 m	13'1"	3.66 m	12'0"	3.91 m	12'10"
Angle	—		—		4.27 m	14'0"	—	
Angle Straight	4.16 m	13'8"	—		—		4.49 m	14'9"
Full Angle	3.78 m	12'5"	—		—		4.08 m	13'5"
Universal	—		—		3.81 m	12'6"	3.98 m	13'1"
Semi-U	3.26 m	10'8"	—		—		3.68 m	12'1"
Fuel Tank Refill Capacity	397 L	105 U.S. gal	337 L	89 U.S. gal	435 L	115 U.S. gal	479 L	127 U.S. gal

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluid, straight dozer with tilt, horn, back-up alarm, retrieval hich and front pull hook.
— D7G includes end track guiding guards.

**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

GROUND PRESSURES

Pressures computed from operating weights given earlier in this section in the specifications tables.

MODEL	SHOE WIDTH		CONTACT AREA		GROUND PRESSURE	
	mm	in	m²	in²	kPa	psi
D3C Series II ◄	356	14	1.35	2097	52	7.2
	406	16	1.54	2394	44	6.45
D3C LGP Series II	635	25	2.61	4045	29	4.2
D3C LGP-S Series II	990	39	4.85	7524	17	2.52
D4C Series II	406	16	1.67	2589	44	6.44
D4C LGP Series II	635	25	2.61	4045	30	4.3
D5C	457	18	1.92	3038	42.3	6.14
D5C LGP	660	26	2.83	4389	31.0	4.51
D4H Series II	360	14	1.59	2464	64	9.1
	410	16	1.82	2826	56	8.0
◄	460	18	2.05	3168	50	7.1
D4H XL Series III ◄	510	20	2.45	3799	47	6.73
	560	22	2.69	4172	44	6.17
D4H LGP	610	24	3.20	4953	38	5.34
Series III ◄	760	30	4.03	6252	31	4.39
	770	30	3.98	6170	31	4.41
D5E	406	16	1.77	2745	62	9.0
◄	457	18	1.99	3085	55	7.98
	508	20	2.21	3426	49.8	7.22
	560	22	2.44	3784	45	6.53
D5H Series II	460	18	2.11	3276	50.9	8.69
◄	510	20	2.35	3646	54.4	7.9
D5H XL Series II	560	22	2.78	4309	50	7.10
◄	600	24	3.63	4689	47	6.67
D5H LGP	710	28	4.43	6866	36	5.15
Series II ◄	860	34	5.37	8321	30	4.24
	865	34	5.40	8369	29	4.17
D6D	457	18	2.17	3364	65	9.42
◄	508	20	2.41	3736	59	8.56
	560	22	2.65	4108	53	7.68
	610	24	2.89	4480	49	7.10
D6E	457	18	2.43	3766	60	8.70
◄	508	20	2.71	4200	54	7.83
	560	22	2.98	4619	49	7.10
	610	24	3.25	5040	45	6.54
D6H Series II	508	20	2.67	4140	65.0	9.44
◄	560	22	2.94	4564	59.0	8.56
	610	24	3.21	4971	54.2	7.86

◄Standard Shoe

MODEL	SHOE WIDTH		CONTACT AREA		GROUND PRESSURE	
	mm	in	m²	in²	kPa	psi
D6H XL Series II	510	20	2.89	4484	66	9.42
◄	560	22	3.18	4923	60	8.49
	610	24	3.46	5363	55	7.88
D6H XR Series II	508	20	2.83	4386	67	9.48
◄	560	22	3.11	4815	60	8.55
	610	24	3.38	5246	56	7.93
D6H LGP	760	30	4.96	7296	40	5.74
Series II ◄	915	36	5.97	9261	34	4.88
	1000	39	6.53	10,122	32	4.48
D7G ◄	508	20	2.76	4280	73	10.6
◄	559	22	3.04	4708	66	9.6
	610	24	3.31	5136	60	8.8
D7H Series II	510	20	2.94	4560	82	11.7
◄	560	22	3.24	5016	75	10.6
	610	24	3.53	5472	69	9.8
	660	26	3.82	5928	64	9.1
D7H XR Series II	560	22	3.43	5315	71.5	10.16
◄	610	24	3.75	5808	65.9	9.37
	660	26	4.06	6282	61.2	8.70
D7H LGP	760	30	4.8	7504	54	7.74
Series II	915	36	5.82	9029	46	6.55
D8N ◄	560	22	3.59	5565	100.6	14.6
	610	24	3.91	6062	92.3	13.4
	660	26	4.23	6559	85.4	12.4
	710	28	4.55	7056	79.2	11.5
D8N LGP*	965	38	6.2	9576	53.7	7.8
D9N	560	22	3.86	6009	107.0	15.51
◄	610	24	4.21	6555	99.1	14.37
	685	27	4.74	7374	89.2	12.94
	760	30	5.26	8194	79.4	11.51
D10N ◄	610	24	4.73	7326	124.1	18.0
	710	28	5.50	8527	107.8	15.6
	860	31.5	6.66	10,328	89.8	13.0
D11N ◄	710	28	6.31	9781	150.2	21.8
	810	32	7.20	11,159	132.7	19.3
	915	36	8.13	12,605	118.6	17.2

◄Standard shoe. *Offered as a Custom Product.

NOTE: Ground contact area = width of track shoe × length of track on ground × 2.

$$\text{Ground pressure} = \frac{\text{operating weight}}{\text{ground contact area}}$$

ATTACHMENT 2

TABLE 3.31 TYPICAL PROPERTIES OF COMPACTED SOILS

TABLE 3.31
TYPICAL PROPERTIES OF COMPACTED SOILS*

				Typical value of compression		Typical strength characteristics						
				Percent of original height								
Group symbol	Soil type	Range of maximum dry unit weight, pcf	Range of optimum moisture, %	At 1.4 tsf (20 psi)	At 3.5 tsf (50 psi)	Cohesion (as compacted), psf	Cohesion (saturated), psf	Effective stress envelope ϕ, degrees	tan ϕ	Typical coefficient of permeability, ft/min	Range of CBR values	Range of subgrade modulus k_s, lb/in³
GW	Well-graded clean gravels, gravel-sand mixtures	125–135	11–8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40–80	300–500
GP	Poorly graded clean gravels, gravel-sand mix	115–125	14–11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30–60	250–400
GM	Silty gravels, poorly graded gravel-sand silt	120–135	12–8	0.5	1.1	...	...	>34	>0.67	$>10^{-6}$	20–60	100–400
GC	Clayey gravels, poorly graded gravel-sand-clay	115–130	14–9	0.7	1.6	...	...	>31	>0.60	$>10^{-7}$	20–40	100–300
SW	Well-graded clean sands, gravelly sands	110–130	16–9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20–40	200–300
SP	Poorly-graded clean sands, sand-gravel mix	100–120	21–12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10–40	200–300
SM	Silty sands, poorly graded sand-silt mix	110–125	16–11	0.8	1.6	1050	420	34	0.67	5×10^{-5}	10–40	100–300
SM-SC	Sand-silt clay mix with slightly plastic fines	110–130	15–11	0.8	1.4	1050	300	33	0.66	2×10^{-6}	...	
SC	Clayey sands, poorly graded sand-clay mix	105–125	19–11	1.1	2.2	1550	230	31	0.60	5×10^{-7}	5–20	100–300
ML	Inorganic silts and clayey silts	95–120	24–12	0.9	1.7	1400	190	32	0.62	10^{-5}	15 or less	100–200
ML-CL	Mixture of inorganic silt and clay	100–120	22–12	1.0	2.2	1350	460	32	0.62	5×10^{-7}	...	
CL	Inorganic clays of low to medium plasticity	95–120	24–12	1.3	2.5	1800	270	28	0.54	10^{-7}	15 or less	50–200
OL	Organic silts and silt-clays, low plasticity	80–100	33–21	...	...	...	...	...	...	...	5 or less	50–100
MH	Inorganic clayey silts, elastic silts	70–95	40–24	2.0	3.8	1500	420	25	0.47	5×10^{-7}	10 or less	50–100
CH	Inorganic clays of high plasticity	75–105	36–19	2.6	3.9	2150	230	19	0.35	10^{-7}	15 or less	50–150
OH	Organic clays and silty clays	65–100	45–21	...	...	...	...	...	...	...	5 or less	25–100

*From NAVFAC Manual DM 7 (1971).[8] All properties are for condition of "standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data. Compression values are for vertical loading with complete lateral confinement. (. . .) Indicates insufficient data available for an estimate.

Appendix B-4
Geotextile Cushion and Separation Analysis

AECOM

CALCULATION SHEET

Page 1 Of 4
Project No. 95561
Client County of Kaua'i
Subject Geotextile Cushion Analysis
Project Kekaha Landfill Phase II Lateral Expansion
Prepared By MZ Date 12/22/08
Reviewed By KJB Date 12/30/08
Approved By KJB Date 12/30/08

GEOTEXTILE CUSHION ANALYSIS

Objective

Determine the geotextile required to resist damage due to impact and puncture during the placement of the granular drainage layer over the geotextile/geomembrane as well as from overburden pressures from in place waste mass and final cover system of Cell 1 of the proposed lateral expansion of Phase II.

Design Criteria and Assumptions

1. The base liner system details for Cell 1 are depicted in Figure 1 from Reference 1.
2. The proposed final cover system for Cell 1 is depicted in Figure 2 from Reference 1.
3. The drainage layer material is assumed to be gravel with particles that are angular in shape with an average particle size (d_{50} of the sieve analysis) of 1 inch or 25 mm.
4. The base liner geomembrane is a 60-mil HDPE geomembrane.
5. The geotextile proposed as a cushion layer will be a nonwoven needle punched product and a minimum mass per unit area of 16 oz/yd^2.
6. The maximum surface pressure allowed on top of the 1-foot granular drainage layer by a dozer is 5 psi. This surface pressure represents the placement of the granular drainage layer with low ground pressure equipment such as a Caterpillar D6H LGP dozer. If larger or different equipment is utilized, this analysis should be reviewed.
7. All vehicles that are not low ground pressure, such as dump trucks, will be required to traverse over the base liner on a minimum a 3-foot thick gravel access road.

Calculations

Granular Drainage Layer (Base Liner)

Unit Weight: γ_{moist} = 130 pcf (average for all cover soils)
Thickness: 1 foot
Internal Friction Angle: 35 degrees
Overburden Pressure: (1 foot)(130 pcf * 1 foot) = 130 psf = 6.2 KPa
Average Particle Size (d_{50}): 1 inch (25 mm)

Vehicle Pressure on Geomembrane (Dozer) (Reference 3)

Vehicle weight 43,976 lbs., say 44,000 lbs.
Dozer track width: 36 inches (3 ft)
Track length on ground: 128.5 inches (10.7 ft)
Ground pressure: 4.88 psi (702.7 psf)

AECOM

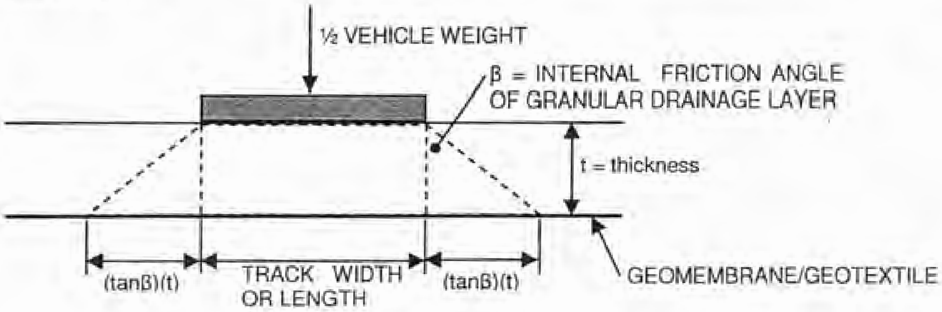
CALCULATION SHEET

Page 2 **Of** 4

Project No. 95561

Client	County of Kaua'i	**Subject**	Geotextile Cushion	**Prepared By**	MZ	**Date**	12/22/08
Project	Kekaha Landfill	Analysis		**Reviewed By**	KJB	**Date**	12/30/08
Phase II Lateral Expansion				**Approved By**	KJB	**Date**	12/30/08

Pressure on the geomembrane from a Caterpillar D6H LPG dozer can be determined using the following pressure prism:



Solving:

Surface area of the prism on the geomembrane/geotextile:

= [3 feet + (2((tan 35)(1 foot)))] * [10.7 feet + (2((tan 35)(1 foot)))]
= 53.2 sf

Resulting pressure on the geomembrane/geotextile is:

= ((1/2)(44,000 lbs)) / 53.2 sf = 413.5 psf (2.9 psi) = 19.8 kPa (kN/m^2)

Overburden Pressure on Geomembrane (Soils and Waste Mass)

Total overburden pressure on geomembrane/geotextile is determined in the same means as the settlement calculations for Cell 1. However, the maximum waste mass thickness is assumed to be 85 feet to account for future waste mass placement from expansion or overlay. The resulting overburden as calculated based upon Figures 1 and 2 is provided as Attachment 1 and estimated as 5,305 psf or 254 KPa.

Methodology

The following method is based upon landfill design for drainage layers in which a nonwoven geotextile can provide puncture protection. The method based upon 60-mil HDPE geomembrane (1.5 mm thick) for a firm base liner system subbase. Based upon Reference 2, the method is:

$$FS = \frac{p_{allow}}{p_{actual}}$$

where:

FS = Factor of safety against geomembrane puncture
p_{allow} = allowable pressure for different types of geotextiles and site-specific conditions
p_{actual} = actual pressure due to surface impoundment

modifying for vehicle loading:

$$FS = \frac{p_{allow}}{p_{actual} + p_{vehicle}}$$

where: $p_{vehicle}$ = distributed vehicle surface pressure on the geomembrane surface

Based upon numerous ASTM 5514 experiments an empirical formula for p_{allow} has been determined:

$$p_{allow} = \left(50 + 0.00045\frac{M}{H^2}\right)\left[\frac{1}{(MF_S)(MF_{PD})(MF_A)}\right]\left[\frac{1}{(RF_{CR})(RF_{CBD})}\right]$$

where:
p_{allow} = allowable pressure (kPa)
M = geotextile mass per unit area (g/m^2)
H = protrusion height (m)
MF_S = modification factor for protrusion shape
MF_{PD} = modification factor for packing density
MF_A = modification factor for arching solids
RF_{CR} = reduction for long-term creep
RF_{CBD} = reduction factor for long-term chemical/biological degradation

All modification and reduction factors are based upon Table 5.18 of Reference 2 (Attachment 2). Note that all MF values are $\leq$ 1.0 and RF values are $\geq$ 1.0

Modification and Reduction Factor Selection

Factors	Vehicle Loading	Buildout Loading (Protrusion height (H) limited to half the average particle size)	Buildout Loading (Protrusion height (H) equal to the average particle size)
MF_S	1.0 (angular particles)	1.0 (angular particles)	1.0 (angular particles)
MF_{PD}	0.67 (granular drainage layer installed as a continuous layer)	0.67 (granular drainage layer installed as a continuous layer)	0.67 (granular drainage layer installed as a continuous layer)
MF_A	0.75 (granular drainage layer being installed, no waste mass in place)	0.25 (waste mass and final cover installed)	0.25 (waste mass and final cover installed)
RF_{CBD}	1.0 (no leachate present at time of granular drainage layer placement)	1.3 (moderate leachate, typical of site leachate)	1.3 (moderate leachate, typical of site leachate)
RF_{CR}	2.0 (assume average particle as protrusion height into geomembrane, very conservative)	1.5 (protrusion height assumed to be half of the average particle size, conservative)	2.0 (protrusion height assumed to be average particle size, very conservative)

For ease and repetitive calculations, the above calculation was repeated in the following table/spreadsheet:

AECOM

CALCULATION SHEET

Page 4 **Of** 4
Project No. 95561
Client County of Kaua'i **Subject** Geotextile Cushion Analysis **Prepared By** MZ **Date** 12/22/08
Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

Particle Shape	Protrusion Height, H (m)	Geomembrane Protection Modification/Reduction					Geotextile Mass, M (g/m^2)	Pallow (kPa)	Pactual (kPa)	Vehicle Type	Vehicle (kPa)	FS
		MFs	MFpd	Mfa	RFcbd	RFcr						
Gravel (d50 = 25 mm or 0.025 m)												
Angular	0.025	1.00	0.67	0.75	1.00	2.00	542	438.0	6.2	Dozer	19.8	16.8
Angular	0.013	1.00	0.67	0.25	1.30	1.50	542	4571.6	254	None	0.0	18.0
Angular	0.025	1.00	0.67	0.25	1.30	2.00	542	1010.9	254	None	0.0	4.0

Conclusions

Based upon the above calculations, material properties, and design and equipment assumptions, the proposed 16 oz/yd^2 nonwoven geotextile will provide puncture resistance of the geomembrane during granular drainage layer placement and after achieving final buildout geometry of the facility.

The geotextile shall have minimum material properties for nonwoven geotextile in accordance with Appendix E-3 of the "Engineering Report, Phase II Lateral Expansion, Kekaha Landfill", prepared by AECOM, dated January 2009.

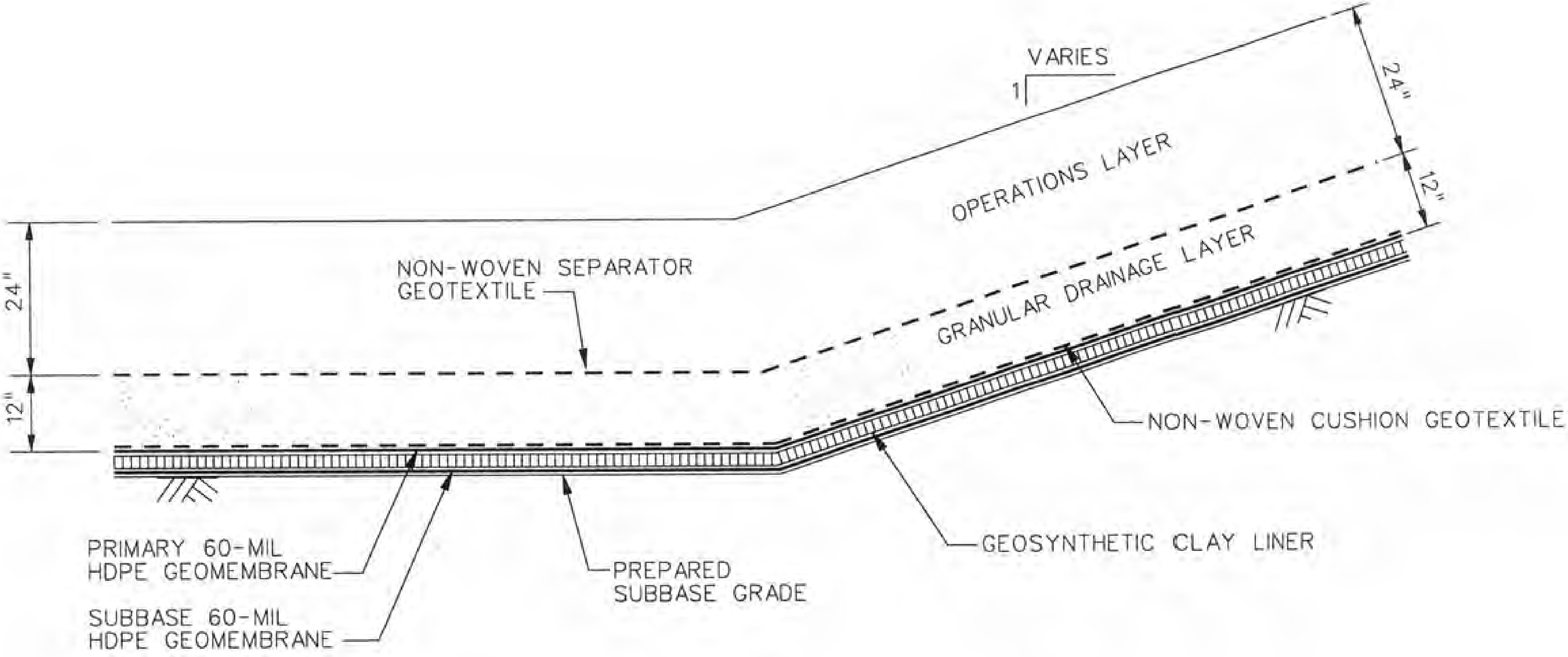
If different equipment, different drainage layer material proposed, or alternate geotextile materials are proposed at the time of construction, this calculation should be revisited.

References

1. Drawings entitled, "Engineering Report, Phase II Lateral Expansion, Kekaha Landfill", prepared by AECOM, dated January 2009.
2. Koerner, Robert M., "Designing with Geosynthetics," Fourth Edition, pps. 535-537.
3. "Caterpillar Performance Handbook," Edition 24, pages 1-8 and 1-21.
4. Koerner, Robert M., "Modification to the GRI-Method for the RF$_{CR}$-Factor Used in the Design of Geotextiles for Puncture Protection of Geomembranes," GRI White Paper #14, Geosynthetic Institute, November 2008.

FIGURE 1

TYPICAL CELL 1 BASE LINER SYSTEM DETAILS



TYPICAL BASE LINER DETAIL - CELL 1 1

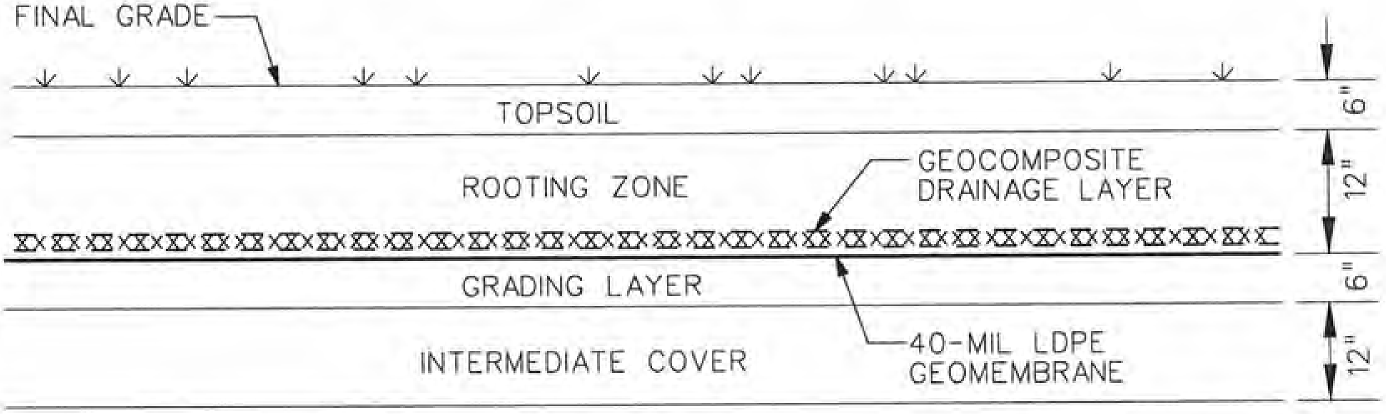
NTS

NOTES:

1. ALL GEOMEMBRANE IS TEXTURED ON BOTH SIDES.
2. WHEN DEPLOYING GCL OR GEOTEXTILES OVER TEXTURED GEOMEMBRANE OR WHEN DEPLOYING TEXTURED GEOMEMBRANE OVER GCL OR GEOTEXTILES, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.

FIGURE 2

FINAL COVER SYSTEM



FINAL COVER SYSTEM 1

NTS

ATTACHMENT 1

OVERBURDEN CALCULATION

Attachment 1
Cell 1 Overburden Pressure - Cushion Geotextile Analysis

Calculate Δσ

			Overburden Pressure	
Proposed Base Liner System	(Figure 1)			
Granular drainage layer thickness		1 feet		=Design thickness
Granular drainage layer unit weight		130 pcf	130 psf	=Phase I aggregate layer
Operations layer thickness		2 feet		=Design thickness
Operations layer unit weight		100 pcf	200 psf	=Phase I soil buffer layer
Cell waste mass thickness		85 feet		=Top of final cover minus subbase minus 3' for base liner section and 3' for final cover section)
Cell waste mass unit weight		55 pcf	4675 psf	
Proposed Overlay Final Cover	(Figure 2)			
Int. cover and grading layer thickness		1.5 feet		=Design thickness
Int. cover and grading layer unit weight		100 pcf	150 psf	(Phase I Closure/Postclosure Plan)
Rooting zone/topsoil layer thickness		1.5 feet		=Design thickness
Rooting zone/topsoil layer unit weight		100 pcf	150 psf	(Phase I Closure/Postclosure Plan)
Total overburden increase from vertical expansion Δσ=			**5305 psf** **254 KPa**	

ATTACHMENT 2

TABLE 5.18 MODIFICATION FACTORS AND REDUCTION FACTORS FOR GEOMEMBRANE PROTECTION DESIGN USING NONWOVEN NEEDLE-PUNCHED GEOTEXTILES

TABLE 5.18 MODIFICATION FACTORS AND REDUCTION FACTORS FOR GEOMEMBRANE PROTECTION DESIGN USING NONWOVEN NEEDLE-PUNCHED GEOTEXTILES

Modification Factors

MF_S		MF_{PD}		MF_A	
Angular	1.0	Isolated	1.0	Hydrostatic	1.0
Subrounded	0.5	Dense, 38 mm	0.83	Geostatic, shallow	0.75
Rounded	0.25	Dense, 25 mm	0.67	Geostatic, mod.	0.50
		Dense, 12 mm	0.50	Geostatic, deep	0.25

Reduction Factors

		RF_{CR}			
			Protrusion (mm)		
RF_{CBD}		Mass per unit area (g/m²)	38	25	12
Mild leachate	1.1	Geomembrane alone	N/R	N/R	N/R
Moderate leachate	1.3	270	N/R	N/R	> 1.5
Harsh leachate	1.5	550	N/R	1.5	1.3
		1100	1.3	1.2	1.1
		> 1100	≅ 1.2	≅ 1.1	≅ 1.0

N/R = Not recommended

ATTACHMENT 3

TABLE 3 REVISED VALUES FOR "RF$_{CR}$" TO BE USED INGEOTEXTILE PROTECTION MATERIALS DESIGN (FROM GRI WHITE PAPER #14)

Table 3. Revised values for "RF_{CR}" to be used in Equation 2 for geotextile protection materials design.

Mass per unit area (g/m^2)	"RF_{CR}"-Values		
	Protrusion Height (mm)		
	38	25	12
Geomembrane alone	N/R	N/R	N/R
270	N/R	N/R	N/R
550	N/R	N/R	>1.5
1100	N/R	1.5	1.3
>1100	1.3	1.2	1.1

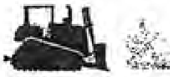
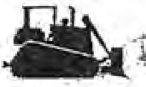
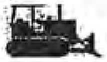
Abbreviation: N/R = Not recommended

Lastly, the entry of ">1.5" for a 12 mm cone height associated with a 550 g/m^2 geotextile is felt to be appropriate considering the following items.

- The geotextiles used at present are made from polypropylene fibers versus the tested geotextiles which were made from polyester fibers. Since the specific gravity of PP is 0.91 and that of PET is between 1.22 and 1.38, one has from 25% to 34% more filaments in an equivalent mass per unit area geotextile using polypropylene fibers. This provides for considerably greater protection capability.
- The area of yield for the six $\simeq$ 12 mm cone heights was extremely small and the thicknesses of the remaining geomembrane was such that considerable deformation could still be sustained before break is even close to occurring.
- The ">1.5" recommendation is precisely for additional conservatism and safety and if a designer wishes to be more conservative than the new recommended table suggests he/she is free to do so.

ATTACHMENT 4

EQUIPMENT PROPERTIES FOR CATERPILLAR D6H LGP DOZER


MODEL	D6H XR Series II		D6H LGP Series II		D7G		D7H Series II	
Flywheel Power	130 kW	175 hp	127 kW	170 hp	149 kW	200 hp	160 kW	215 hp
Operating Weight*								
(Power Shift)	18 684 kg	41,192 lb	19 814 kg	43,590 lb	20 666 kg	45,560 lb	24 694 kg	54,401 lb
(Direct Drive)	—		19 989 kg	43,976 lb	20 510 kg	45,218 lb	—	
(Power Shift Differential Steer)	18 799 kg	41,444 lb	—		—		24 993 kg	55,100 lb
Engine Model	3306		3306		3306		3306	
Rated Engine RPM	1900		1900		2000		2100	
No. of Cylinders	6		6		6		6	
Bore	121 mm	4.75"	121 mm	4.75"	121 mm	4.75"	121 mm	4.75"
Stroke	152 mm	6"	152 mm	6"	152 mm	6"	152 mm	6"
Displacement	10.5 L	638 in³	10.5 L	638 in³	10.5 L	638 in³	10.5 L	638 in³
Track Rollers (Each Side)	7		8		6		7	
Width of Standard Track Shoe	560 mm	22"	915 mm	36"	508 mm	20"	560 mm	22"
Length of Track on Ground	2.77 m	9'1"	3.27 m	10'8.5"	2.70 m	8'11"	2.90 m	9'6"
Ground Contact Area (W/Std. Shoe)	3.11 m²	4815 in²	5.97 m²	9254 in²	2.76 m²	4280 in²	3.24 m²	5016 in²
Track Gauge	1.88 m	6'2"	2.23 m	7'3"	1.98 m	6'5"	1.98 m	6'6"
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.26 m	7'5"	2.32 m	7'7"	2.27 m	7'5"	2.44 m	8'0"
Height (To Top of ROPS)	3.12 m	10'3"	3.16 m	10'5"	3.20 m	10'6"	3.33 m	10'11"
Height (To Top of Cab ROPS)	3.12 m	10'3"	3.16 m	10'5"	—		3.42	11'3"
Height (To Top of ROPS Canopy)	—		3.16 m	10'5"	—		—	
Overall Length (With P Blade)	—		5.18 m	17'0"	—		—	
(Without Blade)	—		4.49 m	14'9"	—		—	
Overall Length (With S Blade)	5.26 m	17'3"	—		5.28 m	17'4"	6.03 m	19'9"
(Without Blade)	4.21 m	13'10"	—		4.19 m	13'9"	4.73 m	15'6"
Width (Over Trunnion)	2.64 m	8'8"	3.43 m	11'3"	—		2.86 m	9'5"
Width (W/O Trunnion — Std. Shoe)	2.44 m	8'0"	3.14 m	10'3.6"	2.55 m	8'5"	2.54 m	8'4"
Ground Clearance	377 mm	14.8"	382 mm	15"	347 mm	13.7"	406 mm	16"
Blade Types and Widths:								
Straight	3.36 m	11'0"	3.99 m	13'1"	3.66 m	12'0"	3.91 m	12'10"
Angle	—		—		4.27 m	14'0"	—	
Angle Straight	4.16 m	13'8"	—		—		4.49 m	14'9"
Full Angle	3.78 m	12'5"	—		—		4.08 m	13'5"
Universal	—		—		3.81 m	12'6"	3.98 m	13'1"
Semi-U	3.26 m	10'8"	—				3.68 m	12'1"
Fuel Tank Refill Capacity	397 L	105 U.S. gal	337 L	89 U.S. gal	435 L	115 U.S. gal	479 L	127 U.S. gal

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluid, straight dozer with tilt, horn, back-up alarm, retrieval hitch and front pull hook.
— D7G includes end track guiding guards.

**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

GROUND PRESSURES

Pressures computed from operating weights given earlier in this section in the specifications tables.

MODEL	SHOE WIDTH		CONTACT AREA		GROUND PRESSURE	
	mm	in	m²	in²	kPa	psi
D3C Series II ◄	356	14	1.35	2097	52	7.2
	406	16	1.54	2394	44	6.45
D3C LGP Series II	635	25	2.61	4045	29	4.2
D3C LGP-S Series II	990	39	4.85	7524	17	2.52
D4C Series II	406	16	1.67	2589	44	6.44
D4C LGP Series II	635	25	2.61	4045	30	4.3
D5C	457	18	1.92	3038	42.3	6.14
D5C LGP	660	26	2.83	4389	31.0	4.51
D4H Series II	360	14	1.59	2464	64	9.1
	410	16	1.82	2826	56	8.0
◄	460	18	2.05	3168	50	7.1
D4H XL Series III ◄	510	20	2.45	3799	47	6.73
	560	22	2.69	4172	44	6.17
D4H LGP	610	24	3.20	4953	38	5.34
Series III ◄	760	30	4.03	6252	31	4.39
	770	30	3.98	6170	31	4.41
D5E	406	16	1.77	2745	62	9.0
◄	457	18	1.99	3085	55	7.98
	508	20	2.21	3426	49.8	7.22
	560	22	2.44	3784	45	6.53
D5H Series II	460	18	2.11	3276	50.9	8.69
◄	510	20	2.35	3646	54.4	7.9
D5H XL Series II	560	22	2.78	4309	50	7.10
◄	600	24	3.63	4689	47	6.67
D5H LGP	710	28	4.43	6866	36	5.15
Series II ◄	860	34	5.37	8321	30	4.24
	865	34	5.40	8369	29	4.17
D6D	457	18	2.17	3364	65	9.42
◄	508	20	2.41	3736	59	8.56
	560	22	2.65	4108	53	7.68
	610	24	2.89	4480	49	7.10
D6E	457	18	2.43	3766	60	8.70
◄	508	20	2.71	4200	54	7.83
	560	22	2.98	4619	49	7.10
	610	24	3.25	5040	45	6.54
D6H Series II	508	20	2.67	4140	65.0	9.44
◄	560	22	2.94	4564	59.0	8.56
	610	24	3.21	4971	54.2	7.86

◄Standard Shoe

MODEL	SHOE WIDTH		CONTACT AREA		GROUND PRESSURE	
	mm	in	m²	in²	kPa	psi
D6H XL Series II	510	20	2.89	4484	66	9.42
◄	560	22	3.18	4923	60	8.49
	610	24	3.46	5363	55	7.88
D6H XR Series II	508	20	2.83	4386	67	9.48
◄	560	22	3.11	4815	60	8.55
	610	24	3.38	5246	56	7.93
D6H LGP	760	30	4.96	7296	40	5.74
Series II ◄	915	36	5.97	9261	34	4.88
	1000	39	6.53	10,122	32	4.48
D7G ◄	508	20	2.76	4280	73	10.6
◄	559	22	3.04	4708	66	9.6
	610	24	3.31	5136	60	8.8
D7H Series II	510	20	2.94	4560	82	11.7
◄	560	22	3.24	5016	75	10.6
	610	24	3.53	5472	69	9.8
	660	26	3.82	5928	64	9.1
D7H XR Series II	560	22	3.43	5315	71.5	10.16
◄	610	24	3.75	5808	65.9	9.37
	660	26	4.06	6282	61.2	8.70
D7H LGP	760	30	4.8	7504	54	7.74
Series II	915	36	5.82	9029	46	6.55
D8N ◄	560	22	3.59	5565	100.6	14.6
	610	24	3.91	6062	92.3	13.4
	660	26	4.23	6559	85.4	12.4
	710	28	4.55	7056	79.2	11.5
D8N LGP*	965	38	6.2	9576	53.7	7.8
D9N	560	22	3.86	6009	107.0	15.51
◄	610	24	4.21	6555	99.1	14.37
	685	27	4.74	7374	89.2	12.94
	760	30	5.26	8194	79.4	11.51
D10N ◄	610	24	4.73	7326	124.1	18.0
	710	28	5.50	8527	107.8	15.6
	860	31.5	6.66	10,328	89.8	13.0
D11N ◄	710	28	6.31	9781	150.2	21.8
	810	32	7.20	11,159	132.7	19.3
	915	36	8.13	12,605	118.6	17.2

◄Standard shoe. *Offered as a Custom Product.

NOTE: Ground contact area = width of track shoe × length of track on ground × 2.

$$\text{Ground pressure} = \frac{\text{operating weight}}{\text{ground contact area}}$$

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Client County of Kaua'i **Subject** Geotextile Separation Analysis **Prepared By** MZ **Date** 12/22/08
Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

GEOTEXTILE SEPARATION ANALYSIS

OBJECTIVE

A nonwoven geotextile is proposed as a filter and as a separation layer between the operations layer and the granular drainage layer on the base of Cell 1. The use of the nonwoven geotextile will be used to prevent fines from entering the drainage layer from the operations layer and overlaying waste mass. Therefore, the geotextile filter was evaluated for 1) soil retention, 2) permeability, and 3) long-term effectiveness.

DESIGN CRITERIA AND ASSUMPTIONS

1. The application of a geotextile as a separation layer requires the review of specific material properties including Apparent Opening Size (AOS), permittivity, and permeability.
2. The separation geotextile will be a nonwoven geotextile with a minimum mass per unit area of 6 oz/yd^2.

CALCULATIONS

Material Properties

The material design properties for the separation geotextile are:

Table 1 – Separation Geotextile Properties

Property	ASTM Test Method	Value
Mass per unit area (oz/yd^2)	D5261	6
Apparent Opening Size (US Sieve)	D4751	70
Permittivity (sec^{-1})	D4491	1.5
Permeability (cm/sec)	D4491	0.30
Geotextile Structure	Nonwoven, needle-punched	

Notes:
(1) All values are minimum average roll value (MARV) except for Apparent Opening Size which is a maximum average roll value.

Soil Retention Analysis

Geotextile functioning as a filtration media should have an AOS small enough to retain fines on the upstream of the fabric. For an adequate AOS, the Taskforce #25 (AASHTO - ABC - ARBTA) specification M-288-96 shown below as Table 2 was used to evaluate the capability of geotextile filtration:

Table 2 - M-288-96 Specification
Maximum Apparent Opening Size Requirements

Application	**1996 - Percent In-Situ Soil Passing 0.075 mm (US Sieve No. 200)**		
	<15	**15 to 50**	**>50**
Subsurface Drainage	0.43 mm	0.25 mm	0.22 mm
Temporary Erosion Control	0.43 mm	0.25 mm	0.22 mm
Separation		Class 2 geotextile with 0.60 mm	
Stabilization		Class 1 geotextile with 0.43 mm	

Based upon Table 2, the geotextile should have an AOS = 0.22 mm or smaller openings. For the proposed 6 oz/yd^2 geotextile an AOS equal to the US No. 70 sieve which is equivalent square opening of 0.212 mm is specified. Therefore, the geotextile will have an AOS small enough to retain fines for all conditions and soil types listed in Table 2, especially separation and for soils with more than 50% passing a US No. 200 sieve.

Geotextile Permeability

Geotextile functioning as a filtration media should have an adequate permeability to percolate liquid into the leachate granular drainage layer and to provide effective clogging protection. The M-288-96 specification for geotextile permittivity is shown in Table 3.

Table 3 - M-288-96 Specification
Permittivity Requirements

Application	**1996 - Percent In-Situ Soil Passing 0.075 mm (US Sieve No. 200)**		
	<15	**15 to 50**	**>50**
Subsurface Drainage	0.5 sec^{-1}	0.2 sec^{-1}	0.1 sec^{-1}
Temporary Erosion Control	0.7 sec^{-1}	0.2 sec^{-1}	0.1 sec^{-1}
Separation	---	Class 2 geotextile with 0.2 sec^{-1}	---
Stabilization	---	Class 1 geotextile with 0.5 sec^{-1}	---

The permittivity of the selected geotextile shall be1.5 sec^{-1} based on the geotextiles MARV values.

The design permittivity is greater than the minimum M-288-96 specification requirement of 0.5 sec^{-1}, for geotextiles used in subsurface drainage or 0.2 sec^{-1} for separation indicating an adequate permittivity of the geotextile. As a comparison, the factor of safety would be equal to (1.5 sec^{-1} / 0.5 sec^{-1}) = 3.0.

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Client County of Kaua'i **Subject** Geotextile **Prepared By** MZ **Date** 12/22/08

Project Kekaha Landfill Separation Analysis **Reviewed By** KJB **Date** 12/30/08

Phase II Lateral Expansion **Approved By** KJB **Date** 12/30/08

Long-Term Flow Equilibrium

The following equation from Reference 2 is used to evaluate the geotextile long-term flow equilibrium:

$$\text{F.S.} = \frac{K_{\text{allowable}}}{K_{\text{required}} \times \text{DCF}}$$

where: $K_{\text{allowable}}$ = the allowable geotextile permeability
K_{required} = the required flow rate per unit area
DCF = Drainage Correction Factor

The required flow capacity was determined through use of the average monthly rate for open conditions as calculated by HELP. An average monthly rate of 724.4 gallons/acre/day (refer to Appendix D-1) will be used.

Converting gallons/acre/day to cm/sec for K_{required}:

K_{required} = (724.4 gallons/acre/day)(0.13368 ft^3/gallon)(1 acre/43,560 ft^2) = 0.002223 ft/day
(0.002223 ft/day) (12 inches / ft) (1day / 86,400 sec) = 3.1 $\times 10^{-7}$ inches /day
(3.1 $\times 10^{-7}$ inches /day) (2.54 cm /in) = 7.9 $\times 10^{-7}$ cm/sec

K_{required} = 7.9 $\times 10^{-7}$ cm/sec

The design permeability of the proposed geotextile is 0.30 cm/sec, or $K_{\text{allowable}} = 3\text{x}10^{-1}$ cm/sec

According to Reference 2, Figure 6 (a) presented as Attachment 1, for the case of geotextile to be used as the entire cell filter, DCF = 1. Therefore,

$$\text{F.S.} = \frac{K_{\text{allowable}}}{K_{\text{required}} \times \text{DCF}} = \frac{3\text{x}10^{-1}\ \text{cm/sec}}{(7.9\text{x}10^{-7}\ \text{cm/sec})(1)} = 3.8x10^{5}$$

The drainage correction factor DCF is defined as the total cell area divided by the actual area for flow into the downstream drains of the leachate collection system. Therefore, the value of DCF could vary in a wide range based upon the various designs of the leachate collection system of landfills as shown in Figure 6 (Attachment 1). The above calculated factor of safety for permeability is extremely large and takes into consideration of various conditions for the leachate collection system of the landfill.

Conclusion

The proposed geotextile minimum material properties for a readily available nonwoven geotextile demonstrated the geotextile will perform readily as separation geotextile for soil retention, permeability, and long-term flow.

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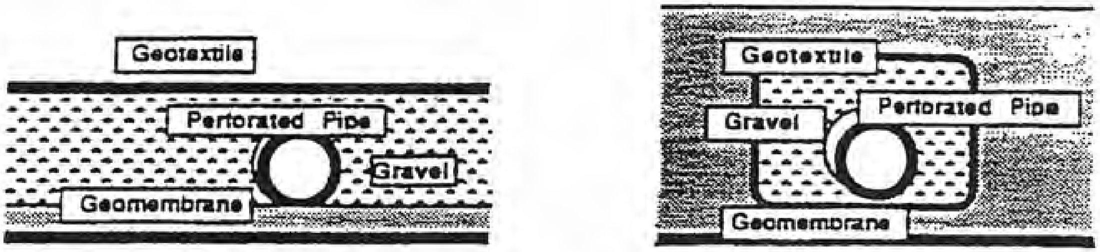
Client County of Kaua'i **Subject** Geotextile **Prepared By** MZ **Date** 12/22/08
Project Kekaha Landfill Separation Analysis **Reviewed By** KJB **Date** 12/30/08
Phase II Lateral Expansion **Approved By** KJB **Date** 12/30/08

References

1. L. David Suits, "Review of the Updated American Association of State Highway and Transportation Officials Geotextile Specification," Volume 2, Geosynthetics 1997 Conference Proceedings, Long Beach, CA, March 1997.
2. G. R. Koerner, "Geotextile Filters Used for Leachate Collection Systems: Testing, Design and Field Behavior," GRI-151, 1993.

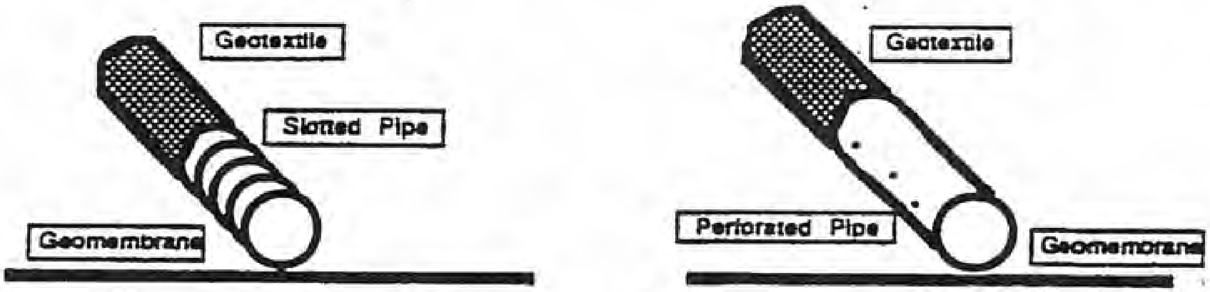
ATTACHMENT 1

FIGURE 6, "Range of Drain Correction Factors (DCF) for Several Different Leachate Collection Drainage Configurations"



a) Entire cell filter (DCF = 1)

b) Geotextile wrapped drain (DCF = 10 - 40)



c) Socked corrugated pipe (DCF = 60 -260)

d) Socked smooth walled perforated pipe
(DCF = 7,500 -24,000)

Fig. 6. Range of Drain Correction Factors (DCF) for Several Different Leachate Collection Drainage Configurations.

Appendix B-5
Final Cover Drainage Layer Analysis and Slope Stability

AECOM

CALCULATION SHEET

Page 1 **Of** 6
Project No. 95561

Client County of Kaua'i	**Subject** Final Cover	**Prepared By** MZ	**Date** 12/22/08
Project Kekaha Landfill	Drainage Layer Capacity	**Reviewed By** KJB	**Date** 12/30/08
Phase II Lateral Expansion	And Slope Stability	**Approved By** KJB	**Date** 12/30/08

FINAL COVER DRAINAGE LAYER CAPACITY AND SLOPE STABILITY

Objective

Evaluate the final cover slope stability under static and seepage conditions for the proposed Phase II Lateral Expansion at Kekaha Landfill that incorporates the use of geosynthetics and soil materials.

Design Criteria & Assumptions

1. The attached final cover cross section is applicable (Figure 1).
2. A 100-year 24-hour rain event of 12 inches is the assumed rain event for the seepage condition.
3. Interface friction angle testing as well as transmissivity testing should be completed prior to construction and use of the proposed materials. This calculation is completed to evaluate the acceptability of the proposed drainage materials under expected normal loadings and minimum interface friction angles.
4. The geocomposite drainage layer will consist of a HDPE geonet with a nonwoven geotextile heat-bonded to both sides.
5. A factor of safety of 1.5 will be used to determine slope stability under static conditions (consistent with past permitted approvals). A factor of safety of 1.2 and a drainage layer capacity greater than one (DLC >=1) for seepage conditions (short-term condition) in defining minimum material requirements. By defining a DLC >=1 all infiltration through the protective cover soil will be managed in the thickness of the geocomposite drainage layer. Under short-term conditions, the final cover protective cover soil layer above the geocomposite drainage layer is assumed to be at field capacity and a temporary condition.
6. Seismic analysis will not be completed as the site specific horizontal peak ground acceleration is 0.06 g and is less than 0.10 g required by Subtitle D for analysis (Reference 1).

Calculations

The stability of the final cover is primarily dependent upon the shear resistance of the weakest interface, slope length, slope inclination, and the seepage condition. The following information was collected/selected before conducting the actual stability analysis.

Material/Design Properties

Final cover material properties are based upon Appendix B of Reference 1 for unit weight.

Protective Cover Soil (well graded sand, Reference 1):

Unit weight, moist	γ_{moist} = 110 pcf = 17.3 kN/m^3
Unit weight, saturated (assumed)	$\gamma_{saturated}$ = 120 pcf = 18.9 kN/m^3
Permeability	$k_{c.s.}$ = varies
Thickness (permitted)	$h_{c.s.}$ = 18 inches = 457.2 mm
Internal friction angle	$\phi_{c.s.}$ = 30 degrees (conservative)

AECOM

CALCULATION SHEET

Page 2 **Of** 6
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Final Cover
Drainage Layer Capacity
And Slope Stability

Prepared By MZ **Date** 12/22/08
Reviewed By KJB **Date** 12/30/08
Approved By KJB **Date** 12/30/08

Runoff Coefficient:

Runoff coefficient is an estimated percentage of precipitation allowed to runoff the final cover prior to infiltration. The runoff coefficient is dependant upon the type of soils and slope steepness. The proposed protective cover soil will be consisting of on-site well graded sands. The runoff coefficient based upon Reference 5 (Attachment 1) is estimated at:

Clayey soils, slopes greater than 7% RC = 0.25 to 0.35
Sandy soils, slopes greater than 7% RC = 0.15 to 0.20

For conservatism, a runoff coefficient of RC = 0.15 will used.

Slope Inclination:

Slope inclination (3.5:1): $\beta = 3.5H:1V = \tan^{-1}(1/3.5) = 15.9$ degrees

Design rainfall intensity (Reference 7):

100-year, 24-hour storm event
I = 12 inches/24 hours
I = (12/24) inches/hour = 0.50 inches/hr
I = 12.7 mm/hr

Geocomposite Drainage Layer Properties (Attachment 2):

Geocomposite thickness (geonet only): $t_{composite}$ = 200 mil or 5 mm (per GSI)

Transmissivity (design) $\theta = 1x10^{-4}\ m^2/sec$

Permeability:

$$k_d = \left(\frac{1x10^{-4}\ \mathrm{m}^2/\mathrm{sec}}{5\,\mathrm{mm}}\right)\left(\frac{100\,\mathrm{cm}}{1\,\mathrm{m}}\right)^2\left(\frac{10\,\mathrm{mm}}{1\,\mathrm{cm}}\right) = 2\ \mathrm{cm/sec}$$

Maximum slope length (Reference 2):

Maximum slope length for the 3.5:1 cover slope (northwest sideslope) based upon longest change in elevation

$$(\mathrm{El.}\,65 - \mathrm{El.}\,25)\left(\sqrt{3.5^2 + 1^2}\right) = 145.6\ \mathrm{feet} \Rightarrow 150\ \mathrm{feet\ or}\ 45.7\ \mathrm{m}$$

Infinite Slope Stability

The infinite slope stability is determined by force summation along the sideslope angle resulting in a factor of safety (Reference 6) without a buttress effect at the toe of slope or:

$$FS = \frac{\text{resisting forces}}{\text{driving forces}} = \frac{F}{W \sin\beta} = \frac{N \tan\delta}{W \sin\beta} = \frac{W \cos\beta \tan\delta}{W \sin\beta}$$

$$FS = \frac{\tan\delta}{\tan\beta}$$

where:

FS = Factor of Safety
δ = critical interface friction angle
β = sideslope angle

Solving for 3.5:1 slope (15.9 degrees) and Factor of Safety of 1.5, the minimum critical interface friction angle is:

$$FS = \frac{\tan\delta}{\tan\beta} \Rightarrow 1.5 = \frac{\tan\delta_{3.5:1}}{\tan 15.9} = \delta_{3.5:1} = \tan^{-1}(1.5 * \tan 15.9)$$

$$\delta_{3.5:1} = 23.1\,\text{degrees}$$

The infinite slope stability is not dependent upon cover soil thickness, slope length, or cover soil permeability.

Methodology for Drainage Layer Capacity Analysis

The degree of submergence of the final cover under the design precipitation should be determined prior to conducting the final cover stability analysis. In order to quantify the degree of submergence, the drainage layer capacity (DLC) of the design option will be determined first. The procedure is based upon those presented by Soong and Koerner, 1997 (Reference 3).

The procedure is:

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

For geocomposite drainage layer:

$FLUX_{allow}$ = Allowable flux (flow rate per unit width of final cover)
= $k_d iA$
= $k_d \sin\beta(t*1)$
= $(k_d*t)\sin\beta$
= $\theta\sin\beta$

where:

k_d = permeability of drainage material

i = hydraulic gradient = sinβ
β= slope angle
A = cross-sectional area of the drainage layer per unit width of final cover
t = thickness of drainage layer
θ = transmissivity of geocomposite

$\text{FLUX}_{\text{req'd}}$ = Required flux per unit width of sideslope
= (PERC)L*cosβ(1.0)

where:

$$\text{PERC} = \text{percolation } = \begin{cases} I & (k_{\text{cover soil}} \geq I) \\ k_{\text{cover soils.}} & (k_{\text{cover soils}} < I) \end{cases}$$

I = design rainfall intensity
$k_{\text{cover soils}}$ = permeability of vegetative/protective cover
L = slope length
β = slope angle

Methodology for Seepage Slope Stability Analysis

The final cover stability analysis is conducted using procedures developed specifically for veneer cover situations; see Koerner and Soong, 1998 (Reference 4). Spreadsheet program, based on the procedures recommended in the above referenced literature for seepage conditions was constructed, calibrated, and used in this analysis. Note that the input values were previously converted as needed into SI units for ease of spreadsheet input and analysis.

Conclusions

The following conditions are considered in the final cover stability analyses. These consisted of:

1. Static condition: Determine the minimum interface friction angle based upon infinite slope stability analysis (see section above), and
2. Seepage condition: Determine the correlations between the maximum length of continuous geocomposite drainage layer, permeability of protective soils and the critical interface friction angle.

The results of the final cover stability have been completed in previous section and on spreadsheets with the results attached and summarized below in Table 1.

Table 1
Slope Stability Results For Static and Seepage Conditions

Condition	**Slope (H:V)**	**Rain Event**	**Maximum Protective Cover Permeability (cm/sec)**	**Slope Length Feet, (meters)**	**Cover Soil Thickness Feet, (mm)**	**Critical Friction Angle**	**Factor of Safety**	**DLC**	**Figure**
Static	3.5:1	Infinite slope stability analysis, these parameters are not applied.				23.1	1.50 = 1.50	NA	NA
Seepage	3.5:1	100-year	$1x10^{-3}$	31.2 (9.5)	1.5 (457.2)	23.1	1.66 > 1.20	1.0 = 1.0	2
			$5x10^{-4}$	31.2 (9.5)			1.66 > 1.20	1.0 = 1.0	3
			$1x10^{-4}$	93.4 (28.5)			1.54 > 1.20	1.0 = 1.0	4
			$5.5x10^{-5}$	150 (45.7)			1.53 > 1.20	1.0 = 1.0	5

Based upon the above results, the minimum friction angle for the final cover system should be a minimum of 23.1 degrees. Also based upon the above results, the maximum slope length can be covered with a continuous layer of geocomposite if the protective cover soils immediately overlying the geocomposite has a maximum permeability of $5.5x10^{-5}$ cm/sec. If the permeability of the cover soils is greater than $5.5x10^{-5}$ cm/sec, then the geocomposite will need to be daylighted along the slope length at the maximum slope length intervals listed. If the transmissivity and correlating permeability of a site specific geocomposite is greater than the design requirement, this calculation should be revisited and slope lengths may increase for a continuous layer of geocomposite with higher permeability protective cover soils.

Please note continuous geocomposite slope lengths can not be increased by increasing the critical friction angle since the DLC factor governs the suitability of the geocomposite. The overall factor of safety would increase, but the performance of the geocomposite still governs maximum continuous geocomposite slope length.

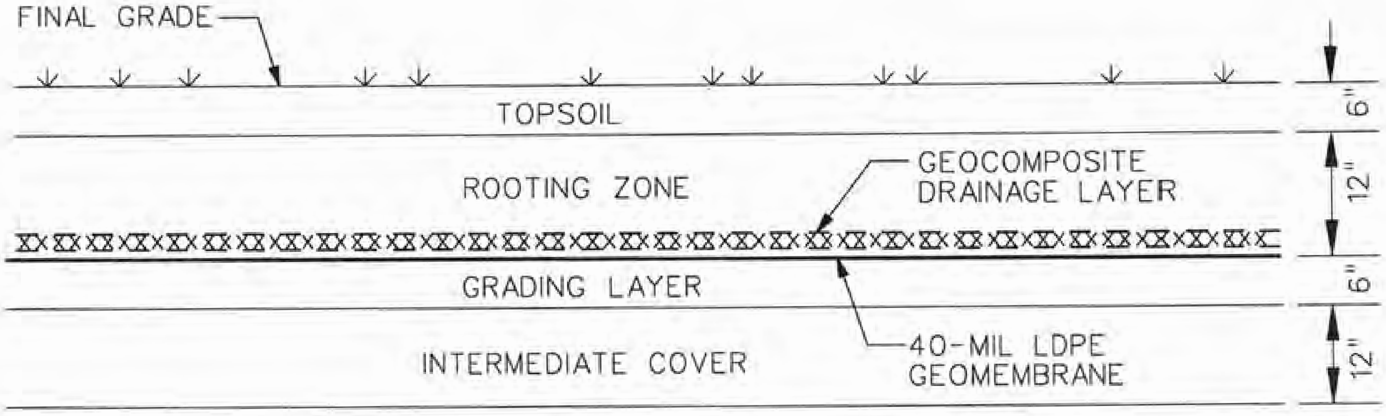
The above calculation also assumes that the drainage from the proposed crown of the facility (3% slope to NE and SW) is daylighted or drained prior to the 3.5:1 slopes.

References

1. "Addendum Operations Manual For Kekaha Sanitary Landfill – Phase II," prepared by EMCON, May 1998.
2. Drawings titled, "Engineering Report, Phase II Lateral Expansion, Kekaha Landfill", prepared by AECOM, dated January 2009.
3. Soong, T.-Y. and Koerner, R.M. (1997) "The Design of Drainage Systems Over Geosynthetically Lined Slopes", Report #19, Geosynthetic Research Institute, Philadelphia, PA 19104, 88 pgs.
4. Koerner, R. M. and Soong, T.-Y. (1998), "Analysis and Design of Veneer Cover Soils" *Proc. 6th Int. Conf. on Geosynthetics, Atlanta*, USA, IFAI, pp. 1-23.
5. Daniel, David E., "Geotechnical Practice for Waste Disposal", page 216.
6. Koerner, R. M., "Designing with Geosynthetics," Fourth Edition, pps. 478 and 480.
7. Department of Engineering, County of Kauai. 2001. Stormwater Runoff System Manual. July. Lihue, Kauai, Hawaii

FIGURE 1

TYPICAL FINAL COVER LINER CROSS SECTION



FINAL COVER SYSTEM 1

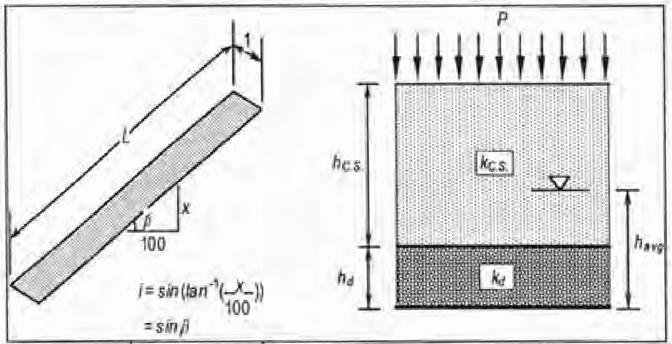
NTS

FIGURES 2 THROUGH 5

SLOPE STABILITY UNDER SEEPAGE CONDITIONS FIGURES
3.5:1 SLOPE, VARIOUS SLOPE LENGTHS, 18-INCH PROTECTIVE COVER THICKNESS

Calculation of stability under seepage condition

Calculation of DLC and PSR



31.2 ft

L = 9.5 m

β = 15.9 °

$h_{C.S.}$ = 457.2 mm

h_d or t_{GS} = 5.0 mm

$k_{C.S.}$ = 1.00E-03 cm/s

k_d or k_{GS} = 2.00E+00 cm/s

P = 12.70 mm/hr

RC = 0.15

i = 0.2740

$L(\cos\beta)$ = 9.14 m

x = 2.60 m

$h_{C.S.}$ = 0.5 m

h_d or t_{GS} = 0.01 m

$h_{C.S.} + h_d$ = 0.46 m

$k_{C.S.}$ = 1.0E-05 m/s

k_d or k_{GS} = 2.0E-02 m/s

$P (RC)$ = 1.9 mm/hr

Actual runoff = 1.91 mm/hr

PERC = 10.80 mm/hı

$FLUX_{actual}$ = 0.099 m^3/hr

$FLUX_{allow}$ = 0.099 m^3/hr ***DLC = 1.0000***

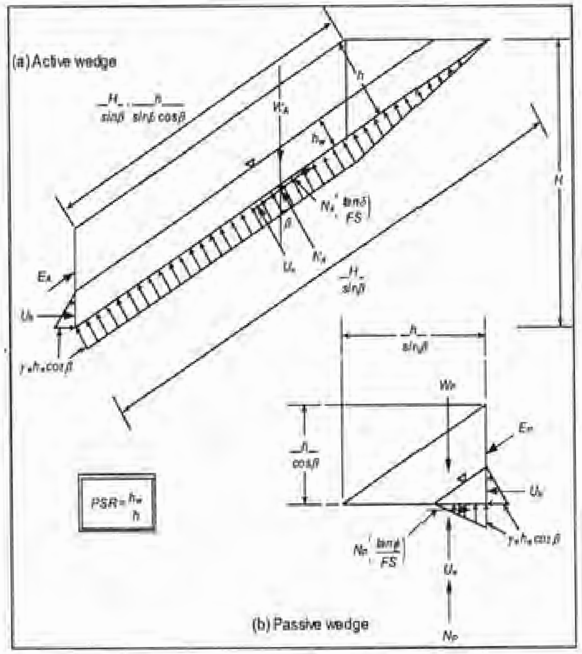
q = 2.7E-05 m^3/sec

h_{avg} = 0.01 m

PSR = 0.012

Results:

DLC	***1.000***
PSR	***0.012***
FS	***1.669***



thickness of cover soil = h = *0.46* m

length of slope measured along the top of clay layer = L = *10* m

soil slope angle along top of clay = β = *15.9* ° = *0.28* (rad.)

vertical height of the slope measured from the toe = H = *2.6* m

parallel submergence ratio = PSR = *0.01*

depth of the water surface measured from the top of clay layer = h_w = *0.01* m

dry unit weight of the cover soil = γ_{moist} = 17.3 kN/m³

saturated unit weight of the cover soil = γ_{satd} = 18.9 kN/m³

unit weight of water = γ_w = 9.81 kN/m³

friction angle of the cover soil = ϕ = 30.0 ° = *0.52* (rad.)

critical interface = δ = 23.1 ° = *0.40* (rad.)

Calculation of FS

Active Wedge:

W_A = *69.0327 kN*

U_n = *0.4892 kN*

U_h = *0.00015 kN*

N_A = *65.9024 kN*

Passive Wedge:

W_P = *7.01355 kN*

U_V = *0.00051 kN*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = *18.2*

b = *-33.0*

c = *4.4*

FS= 1.669

Note: numbers in boxes are input values

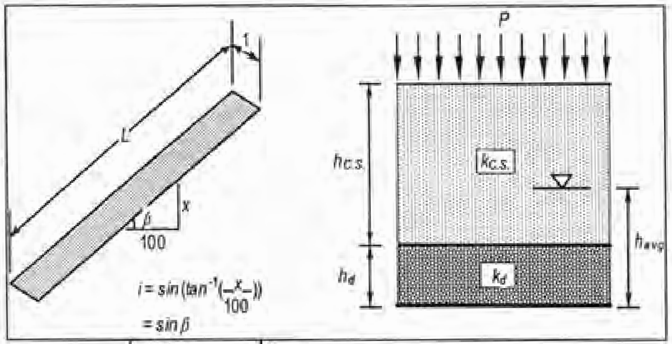
numbers in italics are calculated values

Constructed by Te-Yang Soong

Figure 2

Calculation of stability under seepage condition

Calculation of DLC and PSR



31.2 ft

$L =$ 9.5 m

$\beta =$ 15.9 °

$h_{C.S.} =$ 457.2 mm

h_d or $t_{GS} =$ 5.0 mm

$k_{C.S.} =$ 5.00E-04 cm/s

k_d or $k_{GS} =$ 2.00E+00 cm/s

$P =$ 12.70 mm/hr

$RC =$ 0.15

i = 0.2740

$L(\cos\beta) =$ *9.14* m

x = 2.60 m

$h_{C.S.} =$ *0.5* m

h_d or $t_{GS} =$ *0.01* m

$h_{C.S.} + h_d =$ *0.46* m

$k_{C.S.} =$ *5.0E-06* m/s

k_d or $k_{GS} =$ *2.0E-02* m/s

P (RC) = 1.9 mm/hr

Actual runoff = 1.91 mm/hr

PERC = 10.80 mm/hı

$FLUX_{actual} =$ *0.099* m³/hr

$FLUX_{allow} =$ *0.099* m³/hr ***DLC = 1.0000***

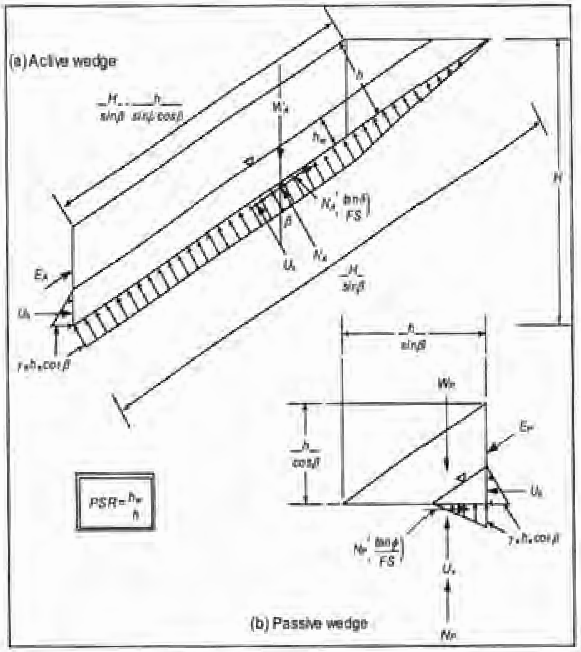
q = 2.7E-05 m³/sec

$h_{avg} =$ *0.01* m

PSR = 0.013

Results:

DLC	*1.000*
PSR	*0.013*
FS	*1.668*



thickness of cover soil = $h =$ *0.46* m

length of slope measured along the top of clay layer = $L =$ *10* m

soil slope angle along top of clay = $\beta =$ *15.9* ° = *0.28* (rad.)

vertical height of the slope measured from the toe = $H =$ *2.6* m

parallel submergence ratio = $PSR =$ *0.01*

depth of the water surface measured from the top of clay layer = $h_w =$ *0.01* m

dry unit weight of the cover soil = $\gamma_{moist} =$ 17.3 kN/m³

saturated unit weight of the cover soil = $\gamma_{satd} =$ 18.9 kN/m³

unit weight of water = $\gamma_w =$ 9.81 kN/m³

friction angle of the cover soil = $\phi =$ 30.0 ° = *0.52* (rad.)

critical interface = $\delta =$ 23.1 ° = *0.40* (rad.)

Calculation of FS

Active Wedge:

$W_A =$ *69.0398 kN*

$U_n =$ *0.53069 kN*

$U_h =$ *0.00017 kN*

$N_A =$ *65.8676 kN*

Passive Wedge:

$W_P =$ *7.01356 kN*

$U_v =$ *0.00061 kN*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where $a =$ *18.2*

$b =$ *-33.0*

$c =$ *4.4*

FS= 1.668

Note: numbers in boxes are input values

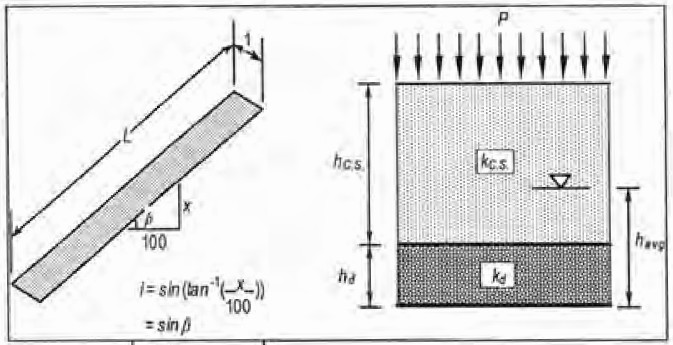
numbers in Italics are calculated values

Constructed by Te-Yang Soong

Figure 3

Calculation of stability under seepage condition

Calculation of DLC and PSR



93.4 ft

L = 28.5 m

β = 15.9 °

$h_{C.S.}$ = 457.2 mm

h_d or t_{GS} = 5.0 mm

$k_{C.S.}$ = 1.00E-04 cm/s

k_d or k_{GS} = 2.00E+00 cm/s

P = 12.70 mm/hr

RC = 0.15

i = 0.2740

$L(\cos\beta)$ = *27.39* m

x = 7.80 m

$h_{C.S.}$ = *0.5* m

h_d or t_{GS} = *0.01* m

$h_{C.S.} + h_d$ = *0.46* m

$k_{C.S.}$ = *1.0E-06* m/s

k_d or k_{GS} = *2.0E-02* m/s

P (RC) = 1.9 mm/hr

Actual runoff = 9.10 mm/hr

PERC = 3.60 mm/hr

$FLUX_{actual}$ = *0.099* m^3/hr

$FLUX_{allow}$ = *0.099* m^3/hr **DLC = 1.0003**

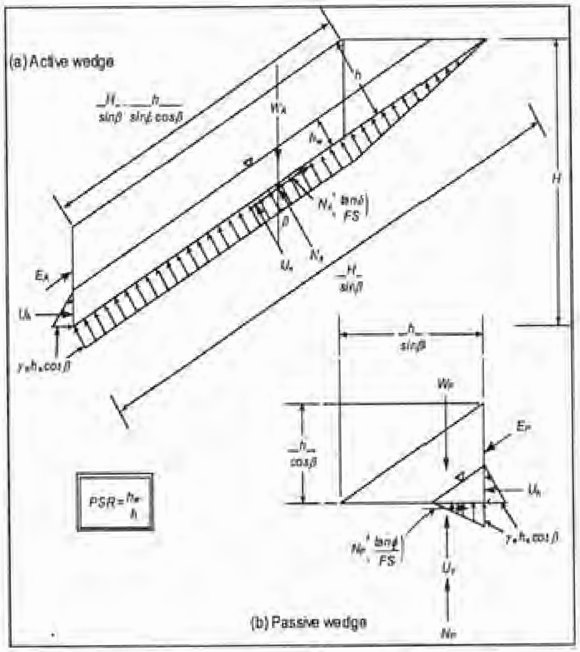
q = 2.7E-05 m^3/sec

h_{avg} = *0.00* m

PSR = 0.011

Results:

DLC	*1.000*
PSR	*0.011*
FS	*1.545*



thickness of cover soil = h = *0.46* m

length of slope measured along the top of clay layer = L = *28* m

soil slope angle along top of clay = β = *15.9* ° = *0.28* (rad.)

vertical height of the slope measured from the toe = H = *7.8* m

parallel submergence ratio = PSR = *0.01*

depth of the water surface measured from the top of clay layer = h_w = *0.00* m

dry unit weight of the cover soil = γ_{moist} = 17.3 kN/m^3

saturated unit weight of the cover soil = $\gamma_{sat'd}$ = 18.9 kN/m^3

unit weight of water = γ_w = 9.81 kN/m^3

friction angle of the cover soil = ϕ = 30.0 ° = *0.52* (rad.)

critical interface = δ = 23.1 ° = *0.40* (rad.)

Calculation of FS

Active Wedge:

W_A = *220.929 kN*

U_n = *1.34263 kN*

U_h = *0.00012 kN*

N_A = *211.134 kN*

Passive Wedge:

W_P = *7.01353 kN*

U_V = *0.00043 kN*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = *58.2*

b = *-99.2*

c = *14.2*

FS= 1.545

Note: numbers in boxes are input values

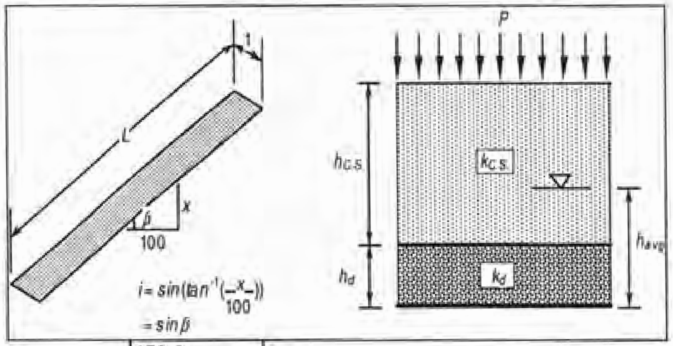
numbers in italics are calculated values

Constructed by Te-Yang Soong

Figure 4

Calculation of stability under seepage condition

Calculation of DLC and PSR



	150.0	ft
L =	45.7	m
β =	15.9	°

$i = 0.2740$

$L(\cos\beta) = 43.97$ m

$x = 12.53$ m

Results:

DLC	1.133
PSR	0.010
FS	1.525

$h_{C.S.}$ = 457.2 mm

h_d or t_{GS} = 5.0 mm

$h_{C.S.} = 0.5$ m

h_d or $t_{GS} = 0.01$ m

$h_{C.S.} + h_d = 0.46$ m

$k_{C.S.}$ = 5.50E-05 cm/s

k_d or k_{GS} = 2.00E+00 cm/s

$k_{C.S.}$ = 5.5E-07 m/s

k_d or k_{GS} = 2.0E-02 m/s

P = 12.70 mm/hr

RC = 0.15

$P\,(RC) = 1.9$ mm/hr

Actual runoff = 10.72 mm/hr

PERC = 1.98 mm/hi

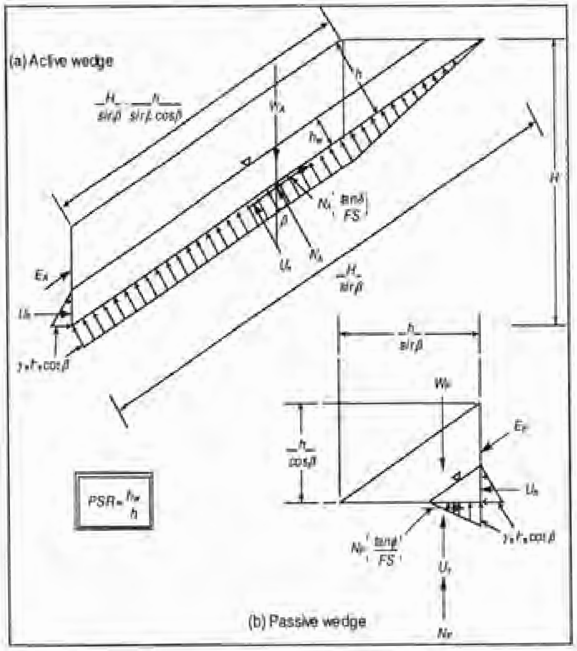
$FLUX_{actual} = 0.087$ m³/hr

$FLUX_{allow} = 0.099$ m³/hr **DLC = 1.1328**

q = 2.4E-05 m³/sec

$h_{avg} = 0.00$ m

PSR = 0.010



thickness of cover soil = h = 0.46 m

length of slope measured along the top of clay layer = L = 46 m

soil slope angle along top of clay = β = 15.9 ° = 0.28 (rad.)

vertical height of the slope measured from the toe = H = 12.5 m

parallel submergence ratio = PSR = 0.01

depth of the water surface measured from the top of clay layer = h_w = 0.00 m

dry unit weight of the cover soil = γ_{moist} = 17.3 kN/m³

saturated unit weight of the cover soil = $\gamma_{sat'd}$ = 18.9 kN/m³

unit weight of water = γ_w = 9.81 kN/m³

friction angle of the cover soil = ϕ = 30.0 ° = 0.52 (rad.)

critical interface = δ = 23.1 ° = 0.40 (rad.)

Calculation of FS

Active Wedge:

W_A = 358.889 kN

U_n = 1.90356 kN

U_h = 9.6E-05 kN

N_A = 343.255 kN

Passive Wedge:

W_P = 7.01352 kN

U_v = 0.00034 kN

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = 94.6

b = -159.4

c = 23.2

FS= 1.525

Note: numbers in boxes are input values

numbers in italics are calculated values

Constructed by Te-Yang Soong

Figure 5

ATTACHMENT 1

RUNOFF COEFFICIENT REFERENCE

10.2.1 Thornthwaite method

The earliest, comprehensive method for water balance analysis was developed by Thornthwaite and Mather (1957). Fenn *et al.* (1975) developed for the US Environmental Protection Agency (EPA) a water balance method for predicting leachate generation for solid waste disposal sites based on the Thornthwaite method, proposing runoff coefficients for landfills and moisture storage values for municipal waste. The water balance method employs average monthly values of precipitation and other climatic parameters. To determine monthly infiltration (*IN*) into the cover, one subtracts monthly runoff (*R*) from monthly precipitation (*P*).

$$IN = P - R \tag{10.1}$$

Runoff can be calculated from precipitation, as follows

$$R = CP \tag{10.2}$$

where C is a runoff coefficient that can be estimated from the guidance provided by Fenn *et al.* (1975):

description of the grass-covered soil		slope of ground surface	runoff coefficient (C)
sandy soil		flat (<2%)	0.05–0.10
		mild (2 – 7%)	0.10–0.15
	[illegible] →	steep (>7%)	0.15–0.20
clayey soil		flat (<2%)	0.13–0.17
		mild (2 – 7%)	0.18–0.22
	[illegible] →	steep (>7%)	0.25–0.35

Potential evapotranspiration (*PET*), which depends on mean temperature, heat index, and hours of sunlight, can be calculated from tables provided by Thornthwaite and Mather (1957). The cumulative monthly infiltration minus potential evapotranspiration (*IN* − *PET*) is calculated. A negative number for *IN* − *PET* indicates that the cover has a tendency to dry out; a positive value indicates that there is a tendency for the cover soil to become wetter. If *IN* − *PET* is negative, water may evapotranspire from the cover soil, but if the soil is already dry, no further drying will occur. The amount of drying depends not only on *IN* − *PET* but also on the water content of the soil.

If *IN* − *PET* is positive, water may be stored in the cover soil (which would produce an increase in water content). However, if the water content is already very high, the soil can store no additional water and water will percolate downward through the cover soil. The field capacity of the soil is the maximum water content that a soil can attain without draining water by gravity. Field capacity can be determined by

REFERENCE: "GEOTECHNICAL PRACTICE FOR WASTE DISPOSAL", DANIEL, DAVID E., PG 216.

ATTACHMENT 2

TYPICAL GEOCOMPOSITE PROPERTIES

GSE STANDARD PRODUCTS

Product Data Sheet

GSE FabriNet Geocomposites

GSE FabriNet geocomposite consists of GSE HyperNet geonet heat-laminated on one or both sides with a GSE nonwoven needlepunched geotextile. GSE HyperNet is a 200 mil thick geonet manufactured from a premium grade high density polyethylene resin. For the purpose of lamination to geonets, GSE nonwoven needlepunched geotextiles are available in mass per unit area range of 6 oz/yd^2 (200 g/m^2) to 16 oz/yd^2 (540 g/m^2). GSE FabriNet geocomposites are designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions. Index properties for the product are provided in the table below. Please contact GSE for further information regarding performance under site-specific conditions.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
Geocomposite			6 oz/yd^2	8 oz/yd^2	10 oz/yd^2
Product Code			F42060060S	F42080080S	F42100100S
Transmissivity[a], gal/min/ft (m^2/sec)	ASTM D 4716-00	1/540,000 ft^2	0.48 (1 x 10^{-4})	0.48 (1 x 10^{-4})	0.43 (9 x 10^{-5})
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft^2	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length, ft (m)			230 (70.1)	200 (60.9)	190 (58.0)
Roll Area, ft^2 (m^2)			3,335 (310)	2,900 (269)	2,755 (256)
Geonet core[b]					
Transmissivity,[a] gal/min/ft (m^2/sec)	ASTM D 4716-00		9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft^2	200 (5)	200 (5)	200 (5)
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft^2	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft^2	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd^2 (g/m^2)	ASTM D 5261	1/90,000 ft^2	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft^2	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft^2	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft^2	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec^{-1})	ASTM D 4491	1/540,000 ft^2	1.5	1.5	1.2
Flow Rate, gpm/ft^2 (lpm/m^2)	ASTM D 4491	1/540,000 ft^2	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a] Gradient of 0.1, normal load of 10,000 psf, water at 70° F between steel plates for 15 minutes.
- [b] Component properties prior to lamination.
- [c] Several geotextiles are available and may be supplied as determined by GSE.
- [d] These are MARV values that are based on the cumulative results of specimens tested and determined by GSE. AOS in mm is maximum average roll value.

DS018 R07/07/03

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

Appendix B-6
Final Cover Equivalency Analysis

CALCULATION SHEET

		Page 1	**Of** 5		
		Project No. 95561			
Client County of Kaua'i	**Subject** Final Cover	**Prepared By**	TCR	**Date**	12/30/08
Project Kekaha Landfill	Equivalency Analysis	**Reviewed By**	MZ	**Date**	12/30/08
Phase II Lateral Expansion		**Approved By**	KJB	**Date**	12/31/08

FINAL COVER EQUIVALENCY ANALYSIS

Objective

Evaluate and compare the infiltration through the proposed Kekaha Landfill Phase II cover and the permitted bottom liner to determine the effectiveness of the proposed cover. Infiltration through the cover and bottom liner is estimated using the USEPA Hydraulic Evaluation of Landfill Performance Version 3.07 (HELP) computer modeling program.

Criteria, Assumptions And Methodology

1. This analysis was performed to evaluate the effectiveness of the proposed final cover for the Phase II landfill.

2. The required cover specified in HAR Section 11-58.1-17 requires the same or less infiltration as the bottom liner.

3. The bottom liner will be evaluated with 12 inches of head, which is the maximum head allowed by HAR during the post closure care period.

HELP Model Version 3.07 Input:

1. Solar radiation data can be default data, user input or synthetically generated by the HELP model. Synthetically generated solar radiation data for Honolulu, Hawaii was used to simulate site weather conditions.

2. Temperature, precipitation, and average wind speed data was obtained from site records from January 2001 through December 2006. Missing data is viewed by the model as a "0". Therefore, to avoid skewing the data, missing temperature data for 2001 and 2002 was filled in using temperatures from days adjacent to the missing data. Data is missing for a total of 5 days in April of 2001 and 2002. Data from 2004 is missing from April 9 through May 3, and May 26 through June 19. To avoid skewing the data, these blocks of missing data from 2004 were filled in using data from the same dates in 2003. There is no missing data from 2003, 2005, and 2006.

3. Geomembrane liner pinhole density and size were assumed to account for possible manufacturing defects during geomembrane production. The HELP Model User's Guide for Version 3.07 states that the pinhole density for a typical geomembrane is 0.5 to 1 pinhole per acre. One pinhole per acre was assumed to be present.

4. The placement quality for the geomembrane liner was assumed to be "good". A placement quality of "good" according to the HELP Model User's Guide "assumes good field installation with well prepared, smooth soil surface and geomembrane wrinkle control". The HELP Model User's Guide suggests 1 to 4 installation defects for an installation quality of "good". To be conservative, 2 installation defects per acre were assumed for the geomembrane liner.

5. Only the relatively gentle top slopes of the landfill are used in the HELP analysis. The relatively gentle slopes allow the maximum infiltration through the cover.

6. The initial moisture content of the final cover layers was computed by the HELP model software to be steady state conditions.

7. For the cover analysis the curve number was calculated by the HELP model based on the soil type and final cover slopes. Through the use of top deck diversion berms or other engineered features, the shallowest, longest slope for the cover will be 3 percent and 325 feet. The slope and length are based on the flatter top areas of the landfill.

8. The HAR allows a maximum of 1 foot of head on the bottom liner during the post closure period. The head on the bottom liner directly affects the amount of infiltration through the bottom liner. A larger head produces greater infiltration. To determine the performance of the permitted bottom liner with a maximum of 1 foot of head the HELP model analysis of the bottom liner includes the GCL, geomembrane and only 1 foot of the drainage layer. The bottom liner HELP analysis was performed only to determine infiltration through the liner with a maximum of 1 foot of head. Therefore, rainfall and weather data does not impact the results but were input to allow the HELP model software to perform the desired calculations.

9. To maintain a head at a maximum of 1 foot during the bottom liner analysis, only the bottom liner was modeled, no run-off was allowed, and the top sand layer was modeled as a vertical percolation layer. This analysis setup maintained the head on the liner near the HAR allowed depth.

10. The permitted bottom liner system consists of a GCL and 60-mil HDPE geomembrane.

11. A one-acre design area was used for modeling purposes to compute unit quantities.

12. Permitted Bottom Liner Inputs for existing Phase II (see also Table 2):

    - 12 inches of drainage layer
    - Geomembrane
    - GCL
    - No vegetation on cover (does not affect this analysis)
    - Evaporative zone depth = 1 in. (minimum required for HELP Model software requirements) (does not affect this analysis)
    - Maximum leaf area index = 0 (recommended by HELP Model for Bare ground conditions) (does not affect this analysis)
    - Fraction of area allowing runoff = 0 percent
    - Runoff curve number = 84.7 (HELP model calculated, Soil No. 2, 0.51% slope-minimum allowed by HELP software, 1 ft slope length) (does not affect this analysis)
    - Length of model run = 6 years (length of run based on length of available data, solar radiation data was synthetically generated for 6 years)

13. Proposed Final Cover Inputs (see also Table 1):

- 6 inch topsoil/vegetative layer
- 12 inch vegetative/protective soil layer
- Geocomposite drainage layer
- Geomembrane
- 18" soil layer (6" grading layer and 12" intermediate cover)
- Good vegetation on cover
- Evaporative zone depth = 22 in. (recommended by HELP Model for fair vegetation conditions for Honolulu, Hawaii) Note that the HELP model uses an actual evaporative zone depth based on the cover soil depths. The maximum evaporative zone depth is limited to 22 inches.
- Maximum leaf area index = 2 (recommended by HELP Model for fair vegetation conditions)
- Fraction of area allowing runoff = 100 percent
- Runoff curve number = 81.8 (HELP model calculated, Soil No. 9, 3% slope, 325 ft slope length)
- Length of model run = 6 years (length of run based on length of available data, solar radiation data was synthetically generated for 6 years)

Help Model General Layout

Table 1: Proposed Final Cover – HELP Model Layout

(Layer Number) Layer Description	Flow	Thickness	Saturated Hydraulic Conductivity	Soil Type/ Texture Number
(1)vertical percolation	↓	6 inches	1.9×10^{-4} cm/sec	Topsoil/Vegetative Layer/#9
(1)vertical percolation	↓	12 inches	4.2×10^{-5} cm/sec	Vegetative/Protective Soil Layer/#12
(12)lateral drainage	→	0.197 inches	$1.0 \times 10^{+1}$ cm/sec	Geocomposite/ #20
(13)40-mil LDPE geomembrane Liner	↓	0.04 inch	4.0×10^{-13} cm/sec	LDPE geomembrane/#36
(14)barrier soil layer	↓	18 inches	4.2×10^{-5} cm/sec	Grading layer and intermediate cover/#12

Table 2: Bottom Liner – HELP Model Layout

(Layer Number) Layer Description	Flow	Thickness	Saturated Hydraulic Conductivity	Soil Type/ Texture Number
(1)vertical percolation	↓	12 inches	6.0×10^{-3} cm/sec	Drainage Layer/#61
(13)60-mil HDPE geomembrane Liner	↓	0.06 inch	2.0×10^{-13} cm/sec	HDPE geomembrane/#35
(14)Geosynthetic Clay Layer	↓	0.24 inches	3.0×10^{-9} cm/sec	Bentonite mat/#17

Table 3: Soil Texture Properties

Soil Texture	Soil Classification		Comments, Properties, and Uses
	USDA	USCS	
61	FS	SW	Sand drainage layer. Based on HELP model default soil no. 2 with the hydraulic conductivity changed from 5.8×10^{-3} cm/sec to 6×10^{-3} cm/sec.
36	---	---	HELP model default parameters for Low Density Polyethylene (LDPE) geomembrane.
20	---	---	HELP model default parameters for geocomposite (drainage net, 0.5 cm/ 0.197 inches thick)
18	---	---	HELP model default parameter for municipal solid waste.
17	---	---	HELP model default parameter for a bentonite mat (0.6 cm/0.24 in. thick).
12	SiCL	CL	Used for vegetative/protective cover. HELP model default parameter.
9	SiL	ML	Used for topsoil/vegetative cover. HELP model default parameter.

Note: All soil properties are defaults of the HELP Model, Version 3.07 unless otherwise designated.

AECOM

CALCULATION SHEET

				Page 5	**Of** 5
				Project No. 95561	
Client	County of Kaua'i	**Subject**	Final Cover	**Prepared By** TCR	**Date** 12/30/08
Project	Kekaha Landfill		Equivalency Analysis	**Reviewed By** MZ	**Date** 12/30/08
Phase II Lateral Expansion				**Approved By** KJB	**Date** 12/31/08

Calculations

Calculations performed by the HELP Model are included in the output located in Attachments 1 and 2. See Table 4 for the modeling results based on peak average annual values.

Table 4: Calculated Results From HELP Analysis Output

Parameter	Average Annual Value	
	Proposed Final Cover	**Permitted Bottom Liner**
Total Rainfall	17.12 inches	17.12 inches
Average head : Cover Geomembrane	0.050 inches	---
Infiltration through final cover	8.005 cf/acre	---
Average head: Bottom Liner Geomembrane	---	11.456 inches
Infiltration through bottom liner system	---	8.025 cf/acre

NOTE: Refer to the attached HELP model output files Attachment 1 for the bottom liner, file name "BotLiner.out", and Attachment 2 for the proposed final cover, file name "PropCov.out".

Conclusion

The evaluation of the proposed cover shows that the proposed cover allows less infiltration than the permitted bottom liner (see Table 4). The proposed final cover which includes a geocomposite, 40-mil geomembrane, and grading layer allows approximately 8.005 cf/acre of surface water infiltration. The permitted bottom liner which includes a 60-mil geomembrane and GCL allows approximately 8.025 cf/acre of infiltration.

References

1. "Engineering Report, Kekaha Landfill Phase II, Kekaha, Kauai, Hawaii," prepared by Harding Lawson Associates, dated August 5, 1993.
2. "Engineering Report, Kekaha Landfill Phase II, Second Vertical Expansion to 85' MSL, Kekaha, Kauai, Hawaii," prepared by Earth Tech, dated November 2004.

ATTACHMENT 1

BOTTOM LINER HELP MODEL 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:\temp\KEK6_BOT.D4
TEMPERATURE DATA FILE:        C:\temp\KEK6_BOT.D7
SOLAR RADIATION DATA FILE:    c:\temp\KEK6_BOT.D13
EVAPOTRANSPIRATION DATA:      c:\temp\KEK6_BOT.D11
SOIL AND DESIGN DATA FILE:    c:\temp\BOTLINER.D10
OUTPUT DATA FILE:             c:\temp\BOTLINER.OUT


TIME:  17: 2     DATE:   9/ 3/2007


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

    TITLE:  Kekaha Landfill Phase II- Bottom Liner Analysis- 12" Head

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


    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  61
          THICKNESS                  =     12.00   INCHES
          POROSITY                   =      0.4370 VOL/VOL
          FIELD CAPACITY             =      0.0620 VOL/VOL
          WILTING POINT              =      0.0240 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.4166 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.600000005000E-02 CM/SEC


                                  LAYER  2
                                  --------

                        TYPE 4 - FLEXIBLE MEMBRANE LINER
```

```
                 MATERIAL TEXTURE NUMBER  35
   THICKNESS                     =       0.06    INCHES
   POROSITY                      =       0.0000 VOL/VOL
   FIELD CAPACITY                =       0.0000 VOL/VOL
   WILTING POINT                 =       0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT    =       0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =   0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY           =       1.00    HOLES/ACRE
   FML INSTALLATION DEFECTS      =       2.00    HOLES/ACRE
   FML PLACEMENT QUALITY         =   3 - GOOD


                            LAYER  3
                            --------

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


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

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE # 2 WITH BARE
           GROUND CONDITIONS, A SURFACE SLOPE OF  1.% AND
           A SLOPE LENGTH OF     1. FEET.

 SCS RUNOFF CURVE NUMBER             =       84.70
 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   =        0.192   INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =        0.437   INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =        0.024   INCHES
 INITIAL SNOW WATER                  =        0.000   INCHES
 INITIAL WATER IN LAYER MATERIALS    =        5.179   INCHES
 TOTAL INITIAL WATER                 =        5.179   INCHES
 TOTAL SUBSURFACE INFLOW             =        0.00    INCHES/YEAR


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

  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           HONOLULU              HAWAII

     STATION LATITUDE                         =  21.33 DEGREES
     MAXIMUM LEAF AREA INDEX                  =   0.00
     START OF GROWING SEASON (JULIAN DATE)    =     0
     END OF GROWING SEASON (JULIAN DATE)      =   367
```

```
            EVAPORATIVE ZONE DEPTH                          =   1.0  INCHES
            AVERAGE ANNUAL WIND SPEED                       =  11.70 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY           =  72.00 %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY           =  66.00 %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY           =  66.00 %
            AVERAGE 4TH QUARTER RELATIVE HUMIDITY           =  70.00 %


        NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE          HAWAII
                 WAS ENTERED FROM AN ASCII DATA FILE.


        NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE          HAWAII
                 WAS ENTERED FROM AN ASCII DATA FILE.


        NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                 COEFFICIENTS FOR    HONOLULU              HAWAII
                   AND STATION LATITUDE  =  21.33 DEGREES




   HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  2
   DRAIN #1:  LATERAL DRAINAGE FROM LAYER  1 (RECIRCULATION AND COLLECTION)
   LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  3

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

                        DAILY OUTPUT FOR YEAR 2001
-------------------------------------------------------------------------
         S
  DAY  A O  RAIN  RUNOFF   ET   E. ZONE   HEAD      DRAIN      LEAK
       I I                        WATER    #1        #1         #1
       R L   IN.    IN.    IN.  IN./IN.   IN.       IN.        IN.
  ---  - -  ----- ------ ------ ------- --------- ---------- ---------

   1         0.06  0.000  0.014  0.2380   11.3152 .0000E+00 .5940E-05
   2         0.00  0.000  0.013  0.2246   11.3752 .0000E+00 .5987E-05
   3         0.00  0.000  0.013  0.2114   11.4103 .0000E+00 .6014E-05
   4         0.00  0.000  0.013  0.1986   11.4136 .0000E+00 .6017E-05
   5         0.00  0.000  0.013  0.1860   11.3998 .0000E+00 .6006E-05
   6         0.00  0.000  0.012  0.1736   11.3686 .0000E+00 .5982E-05
   7         0.00  0.000  0.012  0.1614   11.3380 .0000E+00 .5958E-05
   8         0.00  0.000  0.012  0.1494   11.3196 .0000E+00 .5943E-05
   9         0.00  0.000  0.012  0.1377   11.2888 .0000E+00 .5919E-05
  10         0.00  0.000  0.012  0.1261   11.2576 .0000E+00 .5894E-05
  11         0.00  0.000  0.011  0.1147   11.2269 .0000E+00 .5871E-05
  12         0.00  0.000  0.011  0.1035   11.1967 .0000E+00 .5847E-05
  13         0.00  0.000  0.011  0.0925   11.1702 .0000E+00 .5826E-05
  14         0.00  0.000  0.011  0.0816   11.1548 .0000E+00 .5814E-05
  15         0.00  0.000  0.011  0.0709   11.1258 .0000E+00 .5792E-05
  16         0.00  0.000  0.011  0.0603   11.0973 .0000E+00 .5770E-05
  17         0.00  0.000  0.010  0.0498   11.0692 .0000E+00 .5748E-05
  18         0.00  0.000  0.010  0.0395   11.0414 .0000E+00 .5726E-05
  19         0.00  0.000  0.010  0.0293   11.0140 .0000E+00 .5705E-05
  20         0.00  0.000  0.005  0.0240   10.9998 .0000E+00 .5694E-05
```

```
21          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
22          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
23          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
24          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
25          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
26          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
27          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
28          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
29          0.10   0.000   0.007   0.1171     10.9997  .0000E+00  .5694E-05
30          0.01   0.000   0.009   0.1181     11.0147  .0000E+00  .5706E-05
31          0.00   0.000   0.009   0.1091     11.0623  .0000E+00  .5743E-05
32          0.00   0.000   0.009   0.1002     11.0694  .0000E+00  .5748E-05
33          0.00   0.000   0.009   0.0914     11.0743  .0000E+00  .5752E-05
34          0.00   0.000   0.009   0.0827     11.0753  .0000E+00  .5753E-05
35          0.00   0.000   0.009   0.0741     11.0768  .0000E+00  .5754E-05
36          0.00   0.000   0.009   0.0655     11.0834  .0000E+00  .5759E-05
37          0.00   0.000   0.008   0.0570     11.0797  .0000E+00  .5756E-05
38          0.00   0.000   0.008   0.0486     11.0626  .0000E+00  .5743E-05
39          0.00   0.000   0.008   0.0403     11.0402  .0000E+00  .5725E-05
40          1.64   0.000   0.009   0.4370     11.7564  .0000E+00  .6294E-05
41          0.05   0.000   0.148   0.4370     11.9998  .0000E+00  .6487E-05
42          0.00   0.000   0.229   0.4370     11.9998  .0000E+00  .6487E-05
43          0.00   0.000   0.203   0.4370     11.9998  .0000E+00  .6487E-05
44          0.00   0.000   0.187   0.4370     11.9998  .0000E+00  .6487E-05
45          0.00   0.000   0.212   0.4370     11.9998  .0000E+00  .6487E-05
46          0.00   0.000   0.201   0.4370     11.9998  .0000E+00  .6487E-05
47          0.00   0.000   0.155   0.3864     11.9492  .0000E+00  .6446E-05
48          0.00   0.000   0.133   0.2532     11.7165  .0000E+00  .6258E-05
49          0.00   0.000   0.147   0.1061     11.3773  .0000E+00  .5989E-05
50          0.00   0.000   0.079   0.0274     11.1090  .0000E+00  .5779E-05
51          0.00   0.000   0.003   0.0240     10.9998  .0000E+00  .5694E-05
52          0.04   0.000   0.023   0.0408     10.9998  .0000E+00  .5694E-05
53          0.12   0.000   0.028   0.1324     10.9998  .0000E+00  .5694E-05
54          0.00   0.000   0.032   0.1004     11.0137  .0000E+00  .5705E-05
55          0.03   0.000   0.031   0.0990     11.0599  .0000E+00  .5741E-05
56          2.64   0.000   0.028   0.4370     11.7663  .0000E+00  .6301E-05
57          0.09   0.000   0.136   0.4370     11.9998  .0000E+00  .6487E-05
58          0.00   0.000   0.198   0.4370     11.9998  .0000E+00  .6487E-05
59          0.00   0.000   0.171   0.4370     11.9998  .0000E+00  .6487E-05
60          0.00   0.000   0.187   0.4370     11.9998  .0000E+00  .6487E-05
61          0.00   0.000   0.192   0.4370     11.9998  .0000E+00  .6487E-05
62          0.00   0.000   0.211   0.4370     11.9998  .0000E+00  .6487E-05
63          0.00   0.000   0.169   0.4370     11.9998  .0000E+00  .6487E-05
64          0.00   0.000   0.231   0.4370     11.9998  .0000E+00  .6487E-05
65          0.02   0.000   0.122   0.4370     11.9998  .0000E+00  .6487E-05
66          0.00   0.000   0.178   0.4370     11.9998  .0000E+00  .6487E-05
67          0.00   0.000   0.241   0.4370     11.9998  .0000E+00  .6487E-05
68          0.00   0.000   0.209   0.4370     11.9998  .0000E+00  .6487E-05
69          0.00   0.000   0.205   0.3702     11.9326  .0000E+00  .6432E-05
70          0.00   0.000   0.152   0.2181     11.6553  .0000E+00  .6209E-05
71          0.00   0.000   0.137   0.0809     11.3129  .0000E+00  .5938E-05
72          0.00   0.000   0.057   0.0240     11.0778  .0000E+00  .5755E-05
73          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
74          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
75          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
76          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
77          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
78          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
79          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
80          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
81          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
82          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
83          0.05   0.000   0.009   0.0650     10.9996  .0000E+00  .5694E-05
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 84          0.04  0.000  0.013  0.0915    10.9996 .0000E+00 .5694E-05
 85          0.00  0.000  0.017  0.0748    10.9996 .0000E+00 .5694E-05
 86          0.00  0.000  0.017  0.0577    10.9996 .0000E+00 .5694E-05
 87          0.00  0.000  0.016  0.0416    10.9996 .0000E+00 .5694E-05
 88          0.00  0.000  0.014  0.0275    10.9996 .0000E+00 .5694E-05
 89          0.61  0.000  0.017  0.4370    11.4286 .0000E+00 .6033E-05
 90          0.07  0.000  0.158  0.4370    11.9998 .0000E+00 .6487E-05
 91          0.00  0.000  0.175  0.3576    11.9197 .0000E+00 .6422E-05
 92          0.00  0.000  0.161  0.1961    11.6221 .0000E+00 .6183E-05
 93          0.01  0.000  0.115  0.0909    11.2964 .0000E+00 .5925E-05
 94          0.01  0.000  0.055  0.0464    11.1080 .0000E+00 .5778E-05
 95          0.01  0.000  0.024  0.0319    11.0135 .0000E+00 .5705E-05
 96          0.00  0.000  0.006  0.0263    10.9998 .0000E+00 .5694E-05
 97          0.00  0.000  0.002  0.0246    10.9998 .0000E+00 .5694E-05
 98          0.04  0.000  0.013  0.0518    10.9998 .0000E+00 .5694E-05
 99          0.00  0.000  0.017  0.0351    10.9998 .0000E+00 .5694E-05
100          0.03  0.000  0.019  0.0461    10.9998 .0000E+00 .5694E-05
101          0.00  0.000  0.010  0.0362    10.9998 .0000E+00 .5694E-05
102          0.00  0.000  0.010  0.0262    10.9998 .0000E+00 .5694E-05
103          0.00  0.000  0.002  0.0245    10.9998 .0000E+00 .5694E-05
104          0.00  0.000  0.000  0.0241    10.9998 .0000E+00 .5694E-05
105          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
106          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
107          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
108          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
109          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
110          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
111          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
112          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
113          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
114          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
115          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
116          0.01  0.000  0.002  0.0321    10.9996 .0000E+00 .5694E-05
117          0.00  0.000  0.005  0.0266    10.9996 .0000E+00 .5694E-05
118          0.00  0.000  0.002  0.0247    10.9996 .0000E+00 .5694E-05
119          0.01  0.000  0.002  0.0323    10.9996 .0000E+00 .5694E-05
120          0.00  0.000  0.005  0.0269    10.9996 .0000E+00 .5694E-05
121          0.06  0.000  0.009  0.0784    10.9996 .0000E+00 .5694E-05
122          0.00  0.000  0.010  0.0686    10.9996 .0000E+00 .5694E-05
123          0.02  0.000  0.012  0.0770    10.9996 .0000E+00 .5694E-05
124          0.01  0.000  0.012  0.0749    10.9996 .0000E+00 .5694E-05
125          0.02  0.000  0.012  0.0829    10.9996 .0000E+00 .5694E-05
126          0.00  0.000  0.011  0.0720    10.9996 .0000E+00 .5694E-05
127          0.00  0.000  0.011  0.0612    10.9995 .0000E+00 .5694E-05
128          0.00  0.000  0.011  0.0502    10.9995 .0000E+00 .5694E-05
129          0.02  0.000  0.012  0.0586    10.9996 .0000E+00 .5694E-05
130          0.00  0.000  0.011  0.0480    10.9996 .0000E+00 .5694E-05
131          0.00  0.000  0.010  0.0377    10.9996 .0000E+00 .5694E-05
132          0.00  0.000  0.010  0.0279    10.9996 .0000E+00 .5694E-05
133          0.00  0.000  0.003  0.0247    10.9995 .0000E+00 .5694E-05
134          0.00  0.000  0.001  0.0240    10.9995 .0000E+00 .5694E-05
135          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
136          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
137          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
138          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
139          0.01  0.000  0.002  0.0322    10.9994 .0000E+00 .5694E-05
140          0.00  0.000  0.004  0.0282    10.9994 .0000E+00 .5694E-05
141          0.00  0.000  0.003  0.0249    10.9994 .0000E+00 .5694E-05
142          0.00  0.000  0.001  0.0242    10.9994 .0000E+00 .5694E-05
143          0.00  0.000  0.000  0.0241    10.9994 .0000E+00 .5694E-05
144          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
145          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
146          0.00  0.000  0.000  0.0240    10.9993 .0000E+00 .5694E-05
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147          0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
148          0.06  0.000  0.005  0.0793    10.9993  .0000E+00  .5694E-05
149          0.00  0.000  0.007  0.0722    10.9993  .0000E+00  .5694E-05
150          0.00  0.000  0.008  0.0639    10.9993  .0000E+00  .5694E-05
151          0.32  0.000  0.009  0.3744    11.1076  .0000E+00  .5778E-05
152          0.03  0.000  0.010  0.3948    11.8384  .0000E+00  .6356E-05
153          0.09  0.000  0.009  0.4370    11.9494  .0000E+00  .6446E-05
154          0.03  0.000  0.048  0.4370    11.9998  .0000E+00  .6487E-05
155          0.03  0.000  0.030  0.4370    11.9998  .0000E+00  .6487E-05
156          0.00  0.000  0.029  0.4288    11.9916  .0000E+00  .6480E-05
157          0.00  0.000  0.008  0.4208    11.9701  .0000E+00  .6463E-05
158          0.00  0.000  0.008  0.4127    11.9500  .0000E+00  .6446E-05
159          0.03  0.000  0.009  0.4336    11.9464  .0000E+00  .6443E-05
160          0.00  0.000  0.008  0.4257    11.9829  .0000E+00  .6473E-05
161          0.00  0.000  0.008  0.4179    11.9615  .0000E+00  .6456E-05
162          0.00  0.000  0.008  0.4101    11.9425  .0000E+00  .6440E-05
163          0.00  0.000  0.008  0.4023    11.9230  .0000E+00  .6424E-05
164          0.00  0.000  0.008  0.3947    11.9025  .0000E+00  .6408E-05
165          0.04  0.000  0.009  0.4259    11.9070  .0000E+00  .6411E-05
166          0.03  0.000  0.009  0.4370    11.9838  .0000E+00  .6474E-05
167          0.00  0.000  0.018  0.4295    11.9923  .0000E+00  .6481E-05
168          0.00  0.000  0.007  0.4220    11.9718  .0000E+00  .6464E-05
169          0.00  0.000  0.007  0.4146    11.9530  .0000E+00  .6449E-05
170          0.00  0.000  0.007  0.4072    11.9347  .0000E+00  .6434E-05
171          0.00  0.000  0.007  0.3999    11.9158  .0000E+00  .6419E-05
172          0.00  0.000  0.007  0.3926    11.8963  .0000E+00  .6403E-05
173          0.03  0.000  0.008  0.4143    11.8934  .0000E+00  .6400E-05
174          0.00  0.000  0.007  0.4071    11.9300  .0000E+00  .6430E-05
175          0.00  0.000  0.007  0.3999    11.9146  .0000E+00  .6418E-05
176          0.07  0.000  0.008  0.4370    11.9503  .0000E+00  .6447E-05
177          0.00  0.000  0.032  0.4299    11.9927  .0000E+00  .6481E-05
178          0.00  0.000  0.007  0.4229    11.9734  .0000E+00  .6465E-05
179          0.12  0.000  0.008  0.4370    11.9904  .0000E+00  .6479E-05
180          0.00  0.000  0.105  0.4301    11.9929  .0000E+00  .6481E-05
181          0.00  0.000  0.007  0.4231    11.9741  .0000E+00  .6466E-05
182          0.00  0.000  0.007  0.4163    11.9568  .0000E+00  .6452E-05
183          0.00  0.000  0.007  0.4094    11.9399  .0000E+00  .6438E-05
184          0.00  0.000  0.007  0.4027    11.9223  .0000E+00  .6424E-05
185          0.00  0.000  0.007  0.3959    11.9043  .0000E+00  .6409E-05
186          0.00  0.000  0.007  0.3892    11.8863  .0000E+00  .6395E-05
187          0.00  0.000  0.007  0.3825    11.8684  .0000E+00  .6380E-05
188          0.00  0.000  0.007  0.3758    11.8506  .0000E+00  .6366E-05
189          0.00  0.000  0.007  0.3692    11.8309  .0000E+00  .6350E-05
190          0.00  0.000  0.007  0.3626    11.8217  .0000E+00  .6343E-05
191          0.00  0.000  0.007  0.3561    11.8100  .0000E+00  .6333E-05
192          0.00  0.000  0.007  0.3496    11.7944  .0000E+00  .6321E-05
193          0.06  0.000  0.008  0.4021    11.7942  .0000E+00  .6320E-05
194          0.00  0.000  0.006  0.3956    11.9030  .0000E+00  .6408E-05
195          0.00  0.000  0.006  0.3892    11.8858  .0000E+00  .6394E-05
196          0.00  0.000  0.006  0.3828    11.8687  .0000E+00  .6380E-05
197          0.00  0.000  0.006  0.3765    11.8517  .0000E+00  .6367E-05
198          0.00  0.000  0.006  0.3701    11.8315  .0000E+00  .6350E-05
199          0.00  0.000  0.006  0.3638    11.8231  .0000E+00  .6344E-05
200          0.00  0.000  0.006  0.3576    11.8124  .0000E+00  .6335E-05
201          0.00  0.000  0.006  0.3513    11.7986  .0000E+00  .6324E-05
202          0.00  0.000  0.006  0.3451    11.7820  .0000E+00  .6311E-05
203          0.00  0.000  0.006  0.3389    11.7655  .0000E+00  .6297E-05
204          0.01  0.000  0.007  0.3417    11.7495  .0000E+00  .6284E-05
205          0.01  0.000  0.007  0.3446    11.7366  .0000E+00  .6274E-05
206          0.00  0.000  0.006  0.3385    11.7309  .0000E+00  .6269E-05
207          0.00  0.000  0.006  0.3324    11.7282  .0000E+00  .6267E-05
208          0.00  0.000  0.006  0.3264    11.7203  .0000E+00  .6261E-05
209          0.01  0.000  0.007  0.3293    11.7109  .0000E+00  .6253E-05
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210           0.05  0.000  0.007  0.3723    11.7224 .0000E+00 .6263E-05
211           0.02  0.000  0.007  0.3853    11.8066 .0000E+00 .6330E-05
212           0.00  0.000  0.006  0.3794    11.8477 .0000E+00 .6363E-05
213           0.00  0.000  0.006  0.3735    11.8359 .0000E+00 .6354E-05
214           0.04  0.000  0.007  0.4066    11.8514 .0000E+00 .6366E-05
215           0.08  0.000  0.007  0.4370    11.9652 .0000E+00 .6459E-05
216           0.02  0.000  0.050  0.4370    11.9998 .0000E+00 .6487E-05
217           0.00  0.000  0.019  0.4312    11.9940 .0000E+00 .6482E-05
218           0.00  0.000  0.006  0.4254    11.9782 .0000E+00 .6469E-05
219           0.00  0.000  0.006  0.4196    11.9632 .0000E+00 .6457E-05
220           0.00  0.000  0.006  0.4138    11.9491 .0000E+00 .6446E-05
221           0.00  0.000  0.006  0.4081    11.9348 .0000E+00 .6434E-05
222           0.00  0.000  0.006  0.4024    11.9199 .0000E+00 .6422E-05
223           0.00  0.000  0.006  0.3967    11.9046 .0000E+00 .6410E-05
224           0.00  0.000  0.006  0.3910    11.8895 .0000E+00 .6397E-05
225           0.00  0.000  0.006  0.3854    11.8744 .0000E+00 .6385E-05
226           0.00  0.000  0.006  0.3798    11.8594 .0000E+00 .6373E-05
227           0.00  0.000  0.006  0.3742    11.8429 .0000E+00 .6360E-05
228           0.00  0.000  0.006  0.3686    11.8299 .0000E+00 .6349E-05
229           0.00  0.000  0.006  0.3630    11.8216 .0000E+00 .6342E-05
230           0.00  0.000  0.006  0.3575    11.8119 .0000E+00 .6335E-05
231           0.00  0.000  0.006  0.3520    11.7991 .0000E+00 .6324E-05
232           0.00  0.000  0.005  0.3465    11.7844 .0000E+00 .6312E-05
233           0.00  0.000  0.005  0.3410    11.7697 .0000E+00 .6301E-05
234           0.00  0.000  0.005  0.3355    11.7551 .0000E+00 .6289E-05
235           0.00  0.000  0.005  0.3301    11.7406 .0000E+00 .6277E-05
236           0.00  0.000  0.005  0.3246    11.7261 .0000E+00 .6266E-05
237           0.00  0.000  0.005  0.3192    11.7116 .0000E+00 .6254E-05
238           0.00  0.000  0.005  0.3138    11.6972 .0000E+00 .6242E-05
239           0.00  0.000  0.005  0.3085    11.6829 .0000E+00 .6231E-05
240           0.00  0.000  0.005  0.3031    11.6691 .0000E+00 .6220E-05
241           0.00  0.000  0.005  0.2978    11.6624 .0000E+00 .6215E-05
242           0.00  0.000  0.005  0.2925    11.6552 .0000E+00 .6209E-05
243           0.00  0.000  0.005  0.2872    11.6429 .0000E+00 .6199E-05
244           0.00  0.000  0.005  0.2819    11.6288 .0000E+00 .6188E-05
245           0.00  0.000  0.005  0.2766    11.6147 .0000E+00 .6177E-05
246           0.15  0.000  0.006  0.4205    11.6483 .0000E+00 .6203E-05
247           0.01  0.000  0.006  0.4243    11.9578 .0000E+00 .6453E-05
248           0.00  0.000  0.005  0.4191    11.9592 .0000E+00 .6454E-05
249           0.00  0.000  0.005  0.4139    11.9474 .0000E+00 .6444E-05
250           0.00  0.000  0.005  0.4088    11.9347 .0000E+00 .6434E-05
251           0.00  0.000  0.005  0.4036    11.9218 .0000E+00 .6423E-05
252           0.00  0.000  0.005  0.3984    11.9084 .0000E+00 .6413E-05
253           0.00  0.000  0.005  0.3933    11.8947 .0000E+00 .6401E-05
254           0.00  0.000  0.005  0.3882    11.8810 .0000E+00 .6390E-05
255           0.00  0.000  0.005  0.3831    11.8674 .0000E+00 .6379E-05
256           0.00  0.000  0.005  0.3780    11.8538 .0000E+00 .6368E-05
257           0.00  0.000  0.005  0.3729    11.8358 .0000E+00 .6354E-05
258           0.00  0.000  0.005  0.3679    11.8287 .0000E+00 .6348E-05
259           0.00  0.000  0.005  0.3629    11.8209 .0000E+00 .6342E-05
260           0.00  0.000  0.005  0.3578    11.8121 .0000E+00 .6335E-05
261           0.00  0.000  0.005  0.3528    11.8006 .0000E+00 .6325E-05
262           0.00  0.000  0.005  0.3478    11.7872 .0000E+00 .6315E-05
263           0.00  0.000  0.005  0.3429    11.7739 .0000E+00 .6304E-05
264           0.00  0.000  0.005  0.3379    11.7607 .0000E+00 .6293E-05
265           0.06  0.000  0.006  0.3921    11.7646 .0000E+00 .6297E-05
266           0.00  0.000  0.005  0.3871    11.8643 .0000E+00 .6377E-05
267           0.00  0.000  0.005  0.3822    11.8648 .0000E+00 .6377E-05
268           0.00  0.000  0.005  0.3773    11.8516 .0000E+00 .6367E-05
269           0.00  0.000  0.005  0.3724    11.8352 .0000E+00 .6353E-05
270           0.00  0.000  0.005  0.3675    11.8276 .0000E+00 .6347E-05
271           0.00  0.000  0.005  0.3627    11.8200 .0000E+00 .6341E-05
272           0.00  0.000  0.005  0.3578    11.8116 .0000E+00 .6334E-05
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273        0.00  0.000  0.005  0.3530    11.8007  .0000E+00  .6326E-05
274        0.00  0.000  0.005  0.3482    11.7878  .0000E+00  .6315E-05
275        0.00  0.000  0.005  0.3434    11.7750  .0000E+00  .6305E-05
276        0.00  0.000  0.005  0.3386    11.7622  .0000E+00  .6295E-05
277        0.00  0.000  0.005  0.3338    11.7494  .0000E+00  .6284E-05
278        0.12  0.000  0.006  0.4370    11.7987  .0000E+00  .6324E-05
279        0.00  0.000  0.016  0.4322    11.9950  .0000E+00  .6483E-05
280        0.00  0.000  0.005  0.4275    11.9824  .0000E+00  .6473E-05
281        0.00  0.000  0.005  0.4228    11.9691  .0000E+00  .6462E-05
282        0.00  0.000  0.005  0.4180    11.9575  .0000E+00  .6452E-05
283        0.00  0.000  0.005  0.4133    11.9460  .0000E+00  .6443E-05
284        0.00  0.000  0.005  0.4086    11.9343  .0000E+00  .6434E-05
285        0.00  0.000  0.005  0.4039    11.9223  .0000E+00  .6424E-05
286        0.00  0.000  0.005  0.3993    11.9098  .0000E+00  .6414E-05
287        0.00  0.000  0.005  0.3946    11.8973  .0000E+00  .6404E-05
288        0.03  0.000  0.005  0.4191    11.9017  .0000E+00  .6407E-05
289        0.00  0.000  0.005  0.4145    11.9456  .0000E+00  .6443E-05
290        0.00  0.000  0.005  0.4099    11.9363  .0000E+00  .6435E-05
291        0.00  0.000  0.005  0.4053    11.9250  .0000E+00  .6426E-05
292        0.00  0.000  0.005  0.4007    11.9134  .0000E+00  .6417E-05
293        0.00  0.000  0.005  0.3961    11.9011  .0000E+00  .6407E-05
294        0.00  0.000  0.005  0.3915    11.8889  .0000E+00  .6397E-05
295        0.00  0.000  0.005  0.3869    11.8767  .0000E+00  .6387E-05
296        0.00  0.000  0.005  0.3824    11.8645  .0000E+00  .6377E-05
297        0.00  0.000  0.005  0.3778    11.8524  .0000E+00  .6367E-05
298        0.14  0.000  0.005  0.4370    11.9371  .0000E+00  .6436E-05
299        0.00  0.000  0.080  0.4325    11.9953  .0000E+00  .6483E-05
300        0.01  0.000  0.005  0.4370    11.9924  .0000E+00  .6481E-05
301        0.00  0.000  0.005  0.4325    11.9953  .0000E+00  .6483E-05
302        0.00  0.000  0.004  0.4280    11.9833  .0000E+00  .6473E-05
303        0.00  0.000  0.004  0.4235    11.9705  .0000E+00  .6463E-05
304        0.00  0.000  0.004  0.4191    11.9598  .0000E+00  .6454E-05
305        0.00  0.000  0.004  0.4146    11.9489  .0000E+00  .6445E-05
306        0.00  0.000  0.004  0.4101    11.9379  .0000E+00  .6436E-05
307        0.00  0.000  0.004  0.4057    11.9266  .0000E+00  .6427E-05
308        0.00  0.000  0.004  0.4013    11.9147  .0000E+00  .6418E-05
309        0.00  0.000  0.004  0.3969    11.9029  .0000E+00  .6408E-05
310        0.00  0.000  0.004  0.3925    11.8912  .0000E+00  .6399E-05
311        0.00  0.000  0.004  0.3881    11.8794  .0000E+00  .6389E-05
312        0.00  0.000  0.004  0.3837    11.8677  .0000E+00  .6380E-05
313        0.00  0.000  0.004  0.3793    11.8560  .0000E+00  .6370E-05
314        0.00  0.000  0.004  0.3749    11.8426  .0000E+00  .6359E-05
315        0.00  0.000  0.004  0.3706    11.8314  .0000E+00  .6350E-05
316        0.00  0.000  0.004  0.3662    11.8253  .0000E+00  .6345E-05
317        0.01  0.000  0.005  0.3711    11.8186  .0000E+00  .6340E-05
318        0.00  0.000  0.004  0.3667    11.8124  .0000E+00  .6335E-05
319        0.00  0.000  0.004  0.3624    11.8080  .0000E+00  .6331E-05
320        0.00  0.000  0.004  0.3581    11.8015  .0000E+00  .6326E-05
321        0.00  0.000  0.004  0.3538    11.7949  .0000E+00  .6321E-05
322        0.00  0.000  0.004  0.3495    11.7879  .0000E+00  .6315E-05
323        0.00  0.000  0.004  0.3452    11.7791  .0000E+00  .6308E-05
324        0.00  0.000  0.004  0.3410    11.7677  .0000E+00  .6299E-05
325        0.00  0.000  0.004  0.3367    11.7563  .0000E+00  .6290E-05
326        0.00  0.000  0.004  0.3324    11.7449  .0000E+00  .6281E-05
327        0.00  0.000  0.004  0.3282    11.7336  .0000E+00  .6272E-05
328        0.00  0.000  0.004  0.3240    11.7223  .0000E+00  .6263E-05
329        0.00  0.000  0.004  0.3197    11.7110  .0000E+00  .6254E-05
330        1.13  0.000  0.005  0.4370    11.9258  .0000E+00  .6427E-05
331        0.41  0.000  0.131  0.4370    11.9998  .0000E+00  .6487E-05
332        0.03  0.000  0.158  0.4370    11.9998  .0000E+00  .6487E-05
333        0.00  0.000  0.137  0.4370    11.9998  .0000E+00  .6487E-05
334        0.01  0.000  0.121  0.4370    11.9998  .0000E+00  .6487E-05
335        0.00  0.000  0.168  0.4370    11.9998  .0000E+00  .6487E-05
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336          0.01  0.000  0.144  0.4370    11.9998  .0000E+00  .6487E-05
337          0.00  0.000  0.157  0.4370    11.9998  .0000E+00  .6487E-05
338          0.00  0.000  0.204  0.4370    11.9998  .0000E+00  .6487E-05
339          0.00  0.000  0.194  0.4370    11.9998  .0000E+00  .6487E-05
340          0.00  0.000  0.152  0.3379    11.8956  .0000E+00  .6402E-05
341          0.00  0.000  0.121  0.2171    11.6157  .0000E+00  .6178E-05
342          0.00  0.000  0.148  0.0693    11.2975  .0000E+00  .5926E-05
343          0.00  0.000  0.045  0.0240    11.0584  .0000E+00  .5740E-05
344          0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
345          0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
346          0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
347          0.01  0.000  0.004  0.0304    10.9997  .0000E+00  .5694E-05
348          0.00  0.000  0.005  0.0254    10.9997  .0000E+00  .5694E-05
349          0.00  0.000  0.001  0.0244    10.9997  .0000E+00  .5694E-05
350          0.00  0.000  0.000  0.0241    10.9997  .0000E+00  .5694E-05
351          0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
352          0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
353          0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
354          0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
355          0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
356          0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
357          0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
358          0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
359          0.11  0.000  0.012  0.1223    10.9996  .0000E+00  .5694E-05
360          0.01  0.000  0.015  0.1169    11.0180  .0000E+00  .5708E-05
361          0.00  0.000  0.015  0.1019    11.0740  .0000E+00  .5752E-05
362          0.04  0.000  0.016  0.1261    11.0775  .0000E+00  .5754E-05
363          0.00  0.000  0.015  0.1114    11.0795  .0000E+00  .5756E-05
364          0.11  0.000  0.015  0.2063    11.0817  .0000E+00  .5758E-05
365          0.00  0.000  0.014  0.1923    11.2389  .0000E+00  .5880E-05

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


    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  2
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  1 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  3

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

                      DAILY OUTPUT FOR YEAR 2002
-------------------------------------------------------------------------
          S
DAY  A    O   RAIN  RUNOFF   ET    E. ZONE    HEAD      DRAIN      LEAK
     I    I                         WATER      #1        #1         #1
     R    L   IN.    IN.     IN.   IN./IN.     IN.       IN.        IN.
---  -    -  -----  ------ ------  -------  --------- ---------  ---------

  1          0.00  0.000  0.014  0.1786    11.3152  .0000E+00  .5940E-05
  2          0.00  0.000  0.013  0.1657    11.3195  .0000E+00  .5943E-05
  3          0.00  0.000  0.009  0.1565    11.3243  .0000E+00  .5947E-05
  4          0.00  0.000  0.013  0.1436    11.3065  .0000E+00  .5933E-05
  5          0.00  0.000  0.013  0.1310    11.2724  .0000E+00  .5906E-05
  6          0.02  0.000  0.013  0.1379    11.2442  .0000E+00  .5884E-05
  7          0.05  0.000  0.013  0.1750    11.2251  .0000E+00  .5869E-05
  8          0.06  0.000  0.013  0.2223    11.2203  .0000E+00  .5865E-05
  9          0.03  0.000  0.012  0.2399    11.3182  .0000E+00  .5942E-05
 10          0.01  0.000  0.012  0.2376    11.3948  .0000E+00  .6002E-05
 11          0.01  0.000  0.012  0.2355    11.4076  .0000E+00  .6012E-05
 12          0.01  0.000  0.012  0.2336    11.4057  .0000E+00  .6011E-05
 13          0.00  0.000  0.011  0.2225    11.4021  .0000E+00  .6008E-05
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14          0.00   0.000   0.011   0.2116     11.3971  .0000E+00  .6004E-05
15          0.00   0.000   0.011   0.2008     11.3942  .0000E+00  .6002E-05
16          0.00   0.000   0.011   0.1902     11.3927  .0000E+00  .6001E-05
17          0.00   0.000   0.010   0.1798     11.3803  .0000E+00  .5991E-05
18          0.00   0.000   0.010   0.1694     11.3542  .0000E+00  .5970E-05
19          0.00   0.000   0.010   0.1592     11.3316  .0000E+00  .5953E-05
20          0.01   0.000   0.011   0.1584     11.3174  .0000E+00  .5941E-05
21          0.01   0.000   0.011   0.1577     11.2962  .0000E+00  .5925E-05
22          0.00   0.000   0.010   0.1478     11.2808  .0000E+00  .5913E-05
23          0.00   0.000   0.010   0.1381     11.2680  .0000E+00  .5903E-05
24          0.00   0.000   0.009   0.1288     11.2559  .0000E+00  .5893E-05
25          0.00   0.000   0.010   0.1193     11.2354  .0000E+00  .5877E-05
26          0.02   0.000   0.010   0.1291     11.2146  .0000E+00  .5861E-05
27          0.00   0.000   0.009   0.1198     11.2001  .0000E+00  .5850E-05
28          0.12   0.000   0.010   0.2297     11.1880  .0000E+00  .5840E-05
29          0.11   0.000   0.010   0.3298     11.3263  .0000E+00  .5949E-05
30          0.07   0.000   0.010   0.3900     11.6969  .0000E+00  .6242E-05
31          0.10   0.000   0.010   0.4370     11.9302  .0000E+00  .6430E-05
32          0.03   0.000   0.053   0.4370     11.9998  .0000E+00  .6487E-05
33          0.03   0.000   0.030   0.4370     11.9998  .0000E+00  .6487E-05
34          0.05   0.000   0.030   0.4370     11.9998  .0000E+00  .6487E-05
35          0.04   0.000   0.050   0.4370     11.9998  .0000E+00  .6487E-05
36          0.03   0.000   0.040   0.4370     11.9998  .0000E+00  .6487E-05
37          0.02   0.000   0.030   0.4370     11.9998  .0000E+00  .6487E-05
38          0.07   0.000   0.020   0.4370     11.9998  .0000E+00  .6487E-05
39          0.02   0.000   0.171   0.3463     11.9065  .0000E+00  .6411E-05
40          0.01   0.000   0.009   0.3472     11.7606  .0000E+00  .6293E-05
41          0.01   0.000   0.009   0.3481     11.7431  .0000E+00  .6279E-05
42          0.01   0.000   0.009   0.3491     11.7391  .0000E+00  .6276E-05
43          0.01   0.000   0.009   0.3502     11.7418  .0000E+00  .6278E-05
44          0.01   0.000   0.009   0.3514     11.7447  .0000E+00  .6281E-05
45          0.00   0.000   0.008   0.3433     11.7472  .0000E+00  .6283E-05
46          0.00   0.000   0.008   0.3354     11.7421  .0000E+00  .6278E-05
47          0.00   0.000   0.008   0.3274     11.7302  .0000E+00  .6269E-05
48          0.00   0.000   0.008   0.3196     11.7155  .0000E+00  .6257E-05
49          0.00   0.000   0.008   0.3118     11.6958  .0000E+00  .6241E-05
50          0.00   0.000   0.008   0.3041     11.6751  .0000E+00  .6225E-05
51          0.00   0.000   0.008   0.2964     11.6622  .0000E+00  .6214E-05
52          0.00   0.000   0.008   0.2888     11.6506  .0000E+00  .6205E-05
53          0.00   0.000   0.008   0.2812     11.6307  .0000E+00  .6189E-05
54          0.00   0.000   0.008   0.2736     11.6105  .0000E+00  .6173E-05
55          0.00   0.000   0.007   0.2662     11.5905  .0000E+00  .6157E-05
56          0.00   0.000   0.007   0.2587     11.5706  .0000E+00  .6141E-05
57          0.00   0.000   0.007   0.2514     11.5508  .0000E+00  .6126E-05
58          0.00   0.000   0.007   0.2440     11.5312  .0000E+00  .6110E-05
59          0.00   0.000   0.007   0.2367     11.5117  .0000E+00  .6095E-05
60          0.00   0.000   0.007   0.2295     11.4983  .0000E+00  .6084E-05
61          0.00   0.000   0.007   0.2223     11.4893  .0000E+00  .6077E-05
62          0.00   0.000   0.007   0.2152     11.4708  .0000E+00  .6062E-05
63          0.01   0.000   0.008   0.2171     11.4524  .0000E+00  .6048E-05
64          0.00   0.000   0.007   0.2100     11.4374  .0000E+00  .6036E-05
65          0.00   0.000   0.007   0.2035     11.4279  .0000E+00  .6028E-05
66          0.00   0.000   0.007   0.1968     11.4181  .0000E+00  .6021E-05
67          0.00   0.000   0.007   0.1900     11.4027  .0000E+00  .6008E-05
68          0.00   0.000   0.007   0.1831     11.3849  .0000E+00  .5994E-05
69          0.00   0.000   0.007   0.1762     11.3665  .0000E+00  .5980E-05
70          0.00   0.000   0.007   0.1694     11.3482  .0000E+00  .5966E-05
71          0.00   0.000   0.007   0.1626     11.3335  .0000E+00  .5954E-05
72          0.00   0.000   0.007   0.1558     11.3263  .0000E+00  .5948E-05
73          0.18   0.000   0.008   0.3282     11.3164  .0000E+00  .5941E-05
74          0.07   0.000   0.008   0.3905     11.6875  .0000E+00  .6235E-05
75          0.05   0.000   0.008   0.4329     11.8906  .0000E+00  .6398E-05
76          0.03   0.000   0.122   0.3410     11.8878  .0000E+00  .6396E-05
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 77      0.01  0.000  0.008  0.3434   11.7439 .0000E+00 .6280E-05
 78      0.01  0.000  0.008  0.3459   11.7328 .0000E+00 .6271E-05
 79      0.00  0.000  0.007  0.3394   11.7332 .0000E+00 .6271E-05
 80      0.00  0.000  0.007  0.3328   11.7305 .0000E+00 .6269E-05
 81      0.00  0.000  0.006  0.3264   11.7215 .0000E+00 .6262E-05
 82      0.00  0.000  0.006  0.3199   11.7112 .0000E+00 .6254E-05
 83      0.18  0.000  0.007  0.4370   11.8317 .0000E+00 .6351E-05
 84      0.09  0.000  0.136  0.4370   11.9998 .0000E+00 .6487E-05
 85      0.09  0.000  0.180  0.3571   11.9070 .0000E+00 .6412E-05
 86      0.08  0.000  0.175  0.2625   11.6637 .0000E+00 .6216E-05
 87      0.05  0.000  0.121  0.1915   11.4672 .0000E+00 .6059E-05
 88      0.02  0.000  0.051  0.1605   11.3409 .0000E+00 .5960E-05
 89      0.02  0.000  0.041  0.1391   11.2865 .0000E+00 .5917E-05
 90      0.02  0.000  0.036  0.1235   11.2283 .0000E+00 .5872E-05
 91      0.00  0.000  0.029  0.0947   11.1789 .0000E+00 .5833E-05
 92      0.00  0.000  0.027  0.0677   11.1395 .0000E+00 .5802E-05
 93      0.00  0.000  0.025  0.0423   11.0728 .0000E+00 .5751E-05
 94      0.00  0.000  0.018  0.0240   11.0144 .0000E+00 .5706E-05
 95      0.02  0.000  0.010  0.0343   10.9998 .0000E+00 .5694E-05
 96      0.01  0.000  0.010  0.0345   10.9998 .0000E+00 .5694E-05
 97      0.00  0.000  0.007  0.0272   10.9998 .0000E+00 .5694E-05
 98      0.00  0.000  0.002  0.0248   10.9997 .0000E+00 .5694E-05
 99      0.01  0.000  0.003  0.0316   10.9998 .0000E+00 .5694E-05
100      0.00  0.000  0.005  0.0262   10.9998 .0000E+00 .5694E-05
101      0.00  0.000  0.002  0.0245   10.9998 .0000E+00 .5694E-05
102      0.00  0.000  0.000  0.0241   10.9998 .0000E+00 .5694E-05
103      0.00  0.000  0.000  0.0241   10.9998 .0000E+00 .5694E-05
104      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
105      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
106      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
107      0.01  0.000  0.002  0.0318   10.9997 .0000E+00 .5694E-05
108      0.00  0.000  0.005  0.0266   10.9997 .0000E+00 .5694E-05
109      0.10  0.000  0.010  0.1164   10.9997 .0000E+00 .5694E-05
110      0.13  0.000  0.013  0.2331   11.0237 .0000E+00 .5713E-05
111      0.02  0.000  0.014  0.2389   11.3047 .0000E+00 .5932E-05
112      0.00  0.000  0.013  0.2260   11.4275 .0000E+00 .6028E-05
113      0.00  0.000  0.013  0.2134   11.4273 .0000E+00 .6028E-05
114      0.00  0.000  0.012  0.2010   11.4231 .0000E+00 .6025E-05
115      0.00  0.000  0.012  0.1889   11.4080 .0000E+00 .6013E-05
116      0.00  0.000  0.012  0.1769   11.3768 .0000E+00 .5988E-05
117      0.00  0.000  0.012  0.1652   11.3451 .0000E+00 .5963E-05
118      0.00  0.000  0.012  0.1536   11.3246 .0000E+00 .5947E-05
119      0.12  0.000  0.012  0.2611   11.3078 .0000E+00 .5934E-05
120      0.01  0.000  0.012  0.2588   11.4227 .0000E+00 .6024E-05
121      0.00  0.000  0.011  0.2477   11.4927 .0000E+00 .6080E-05
122      0.00  0.000  0.011  0.2368   11.4932 .0000E+00 .6080E-05
123      0.00  0.000  0.011  0.2261   11.4906 .0000E+00 .6078E-05
124      0.00  0.000  0.011  0.2155   11.4771 .0000E+00 .6067E-05
125      0.00  0.000  0.010  0.2050   11.4493 .0000E+00 .6045E-05
126      0.08  0.000  0.011  0.2736   11.4285 .0000E+00 .6029E-05
127      0.12  0.000  0.011  0.3823   11.5356 .0000E+00 .6114E-05
128      0.05  0.000  0.011  0.4212   11.8571 .0000E+00 .6371E-05
129      0.02  0.000  0.011  0.4301   11.9603 .0000E+00 .6455E-05
130      0.00  0.000  0.010  0.4203   11.9713 .0000E+00 .6464E-05
131      0.01  0.000  0.011  0.4195   11.9517 .0000E+00 .6448E-05
132      0.38  0.000  0.011  0.4370   11.9873 .0000E+00 .6477E-05
133      0.31  0.000  0.244  0.4370   11.9998 .0000E+00 .6487E-05
134      0.04  0.000  0.226  0.4370   11.9998 .0000E+00 .6487E-05
135      0.03  0.000  0.166  0.4370   11.9998 .0000E+00 .6487E-05
136      0.01  0.000  0.162  0.3804   11.9436 .0000E+00 .6441E-05
137      0.01  0.000  0.192  0.1989   11.6405 .0000E+00 .6197E-05
138      0.01  0.000  0.151  0.0584   11.2573 .0000E+00 .5894E-05
139      0.01  0.000  0.044  0.0240   11.0403 .0000E+00 .5726E-05
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140       0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
141       0.01  0.000  0.005  0.0285   10.9998 .0000E+00 .5694E-05
142       0.00  0.000  0.004  0.0247   10.9998 .0000E+00 .5694E-05
143       0.00  0.000  0.001  0.0242   10.9997 .0000E+00 .5694E-05
144       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
145       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
146       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
147       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
148       0.04  0.000  0.010  0.0537   10.9997 .0000E+00 .5694E-05
149       0.00  0.000  0.014  0.0397   10.9997 .0000E+00 .5694E-05
150       0.00  0.000  0.014  0.0262   10.9996 .0000E+00 .5694E-05
151       0.00  0.000  0.002  0.0245   10.9996 .0000E+00 .5694E-05
152       0.00  0.000  0.000  0.0241   10.9996 .0000E+00 .5694E-05
153       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
154       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
155       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
156       0.00  0.000  0.000  0.0240   10.9995 .0000E+00 .5694E-05
157       0.00  0.000  0.000  0.0240   10.9995 .0000E+00 .5694E-05
158       0.00  0.000  0.000  0.0240   10.9995 .0000E+00 .5694E-05
159       0.02  0.000  0.007  0.0368   10.9995 .0000E+00 .5694E-05
160       0.09  0.000  0.011  0.1162   10.9995 .0000E+00 .5694E-05
161       0.00  0.000  0.013  0.1033   10.9995 .0000E+00 .5694E-05
162       0.02  0.000  0.015  0.1086   11.0281 .0000E+00 .5716E-05
163       0.00  0.000  0.013  0.0952   11.0358 .0000E+00 .5722E-05
164       0.00  0.000  0.013  0.0820   11.0371 .0000E+00 .5723E-05
165       0.00  0.000  0.013  0.0692   11.0393 .0000E+00 .5725E-05
166       0.00  0.000  0.010  0.0596   11.0401 .0000E+00 .5725E-05
167       0.00  0.000  0.010  0.0496   11.0498 .0000E+00 .5733E-05
168       0.00  0.000  0.012  0.0374   11.0390 .0000E+00 .5725E-05
169       0.02  0.000  0.013  0.0444   11.0118 .0000E+00 .5704E-05
170       0.08  0.000  0.013  0.1116   10.9999 .0000E+00 .5694E-05
171       0.00  0.000  0.012  0.1000   11.0023 .0000E+00 .5696E-05
172       0.00  0.000  0.011  0.0886   11.0138 .0000E+00 .5705E-05
173       0.00  0.000  0.011  0.0774   11.0203 .0000E+00 .5710E-05
174       0.00  0.000  0.011  0.0663   11.0239 .0000E+00 .5713E-05
175       0.00  0.000  0.011  0.0554   11.0285 .0000E+00 .5716E-05
176       0.00  0.000  0.010  0.0453   11.0386 .0000E+00 .5724E-05
177       0.00  0.000  0.011  0.0347   11.0291 .0000E+00 .5717E-05
178       0.00  0.000  0.010  0.0242   11.0039 .0000E+00 .5697E-05
179       0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
180       0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
181       0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
182       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
183       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
184       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
185       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
186       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
187       0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
188       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
189       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
190       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
191       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
192       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
193       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
194       0.00  0.000  0.000  0.0240   10.9996 .0000E+00 .5694E-05
195       0.00  0.000  0.000  0.0240   10.9995 .0000E+00 .5694E-05
196       0.00  0.000  0.000  0.0240   10.9995 .0000E+00 .5694E-05
197       0.00  0.000  0.000  0.0240   10.9995 .0000E+00 .5694E-05
198       0.02  0.000  0.005  0.0394   10.9995 .0000E+00 .5694E-05
199       0.00  0.000  0.004  0.0359   10.9995 .0000E+00 .5694E-05
200       0.00  0.000  0.006  0.0303   10.9995 .0000E+00 .5694E-05
201       0.00  0.000  0.005  0.0251   10.9994 .0000E+00 .5694E-05
202       0.00  0.000  0.001  0.0241   10.9994 .0000E+00 .5694E-05
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203          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
204          0.00  0.000   0.000   0.0240     10.9995 .0000E+00 .5694E-05
205          0.00  0.000   0.000   0.0240     10.9995 .0000E+00 .5694E-05
206          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
207          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
208          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
209          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
210          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
211          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
212          0.00  0.000   0.000   0.0240     10.9994 .0000E+00 .5694E-05
213          0.00  0.000   0.000   0.0240     10.9993 .0000E+00 .5694E-05
214          0.00  0.000   0.000   0.0240     10.9993 .0000E+00 .5694E-05
215          0.00  0.000   0.000   0.0240     10.9993 .0000E+00 .5694E-05
216          0.00  0.000   0.000   0.0240     10.9993 .0000E+00 .5694E-05
217          0.00  0.000   0.000   0.0240     10.9993 .0000E+00 .5694E-05
218          0.00  0.000   0.000   0.0240     10.9993 .0000E+00 .5694E-05
219          0.00  0.000   0.000   0.0240     10.9992 .0000E+00 .5694E-05
220          0.00  0.000   0.000   0.0240     10.9992 .0000E+00 .5694E-05
221          0.00  0.000   0.000   0.0240     10.9992 .0000E+00 .5694E-05
222          0.02  0.000   0.004   0.0399     10.9992 .0000E+00 .5694E-05
223          0.00  0.000   0.003   0.0369     10.9992 .0000E+00 .5694E-05
224          0.00  0.000   0.005   0.0322     10.9992 .0000E+00 .5694E-05
225          0.03  0.000   0.006   0.0561     10.9992 .0000E+00 .5694E-05
226          0.05  0.000   0.006   0.0996     10.9991 .0000E+00 .5694E-05
227          0.00  0.000   0.006   0.0932     10.9991 .0000E+00 .5694E-05
228          0.00  0.000   0.007   0.0863     10.9991 .0000E+00 .5694E-05
229          0.00  0.000   0.007   0.0794     10.9991 .0000E+00 .5694E-05
230          0.00  0.000   0.007   0.0726     10.9991 .0000E+00 .5694E-05
231          0.00  0.000   0.007   0.0658     10.9991 .0000E+00 .5694E-05
232          0.00  0.000   0.007   0.0590     10.9993 .0000E+00 .5694E-05
233          0.00  0.000   0.007   0.0521     10.9996 .0000E+00 .5694E-05
234          0.00  0.000   0.007   0.0454     11.0050 .0000E+00 .5698E-05
235          0.00  0.000   0.007   0.0388     11.0225 .0000E+00 .5712E-05
236          0.00  0.000   0.007   0.0321     11.0156 .0000E+00 .5706E-05
237          0.00  0.000   0.007   0.0256     11.0011 .0000E+00 .5695E-05
238          0.00  0.000   0.002   0.0240     10.9998 .0000E+00 .5694E-05
239          0.04  0.000   0.004   0.0602     10.9998 .0000E+00 .5694E-05
240          0.00  0.000   0.004   0.0558     10.9998 .0000E+00 .5694E-05
241          0.00  0.000   0.005   0.0505     10.9997 .0000E+00 .5694E-05
242          0.00  0.000   0.005   0.0452     10.9997 .0000E+00 .5694E-05
243          0.00  0.000   0.006   0.0394     10.9997 .0000E+00 .5694E-05
244          0.00  0.000   0.006   0.0336     10.9997 .0000E+00 .5694E-05
245          0.00  0.000   0.006   0.0278     10.9997 .0000E+00 .5694E-05
246          0.33  0.000   0.007   0.3505     10.9997 .0000E+00 .5694E-05
247          0.01  0.000   0.008   0.3529     11.7054 .0000E+00 .6249E-05
248          0.00  0.000   0.006   0.3467     11.7677 .0000E+00 .6299E-05
249          0.00  0.000   0.006   0.3405     11.7623 .0000E+00 .6295E-05
250          0.00  0.000   0.006   0.3344     11.7529 .0000E+00 .6287E-05
251          0.00  0.000   0.006   0.3282     11.7368 .0000E+00 .6274E-05
252          0.00  0.000   0.006   0.3221     11.7205 .0000E+00 .6261E-05
253          0.12  0.000   0.007   0.4348     11.7659 .0000E+00 .6298E-05
254          0.00  0.000   0.006   0.4287     11.9878 .0000E+00 .6477E-05
255          0.00  0.000   0.006   0.4226     11.9714 .0000E+00 .6464E-05
256          0.01  0.000   0.007   0.4254     11.9618 .0000E+00 .6456E-05
257          0.01  0.000   0.007   0.4282     11.9683 .0000E+00 .6461E-05
258          0.00  0.000   0.006   0.4223     11.9700 .0000E+00 .6463E-05
259          0.01  0.000   0.007   0.4251     11.9608 .0000E+00 .6455E-05
260          0.00  0.000   0.006   0.4192     11.9607 .0000E+00 .6455E-05
261          0.00  0.000   0.006   0.4133     11.9471 .0000E+00 .6444E-05
262          0.00  0.000   0.006   0.4075     11.9328 .0000E+00 .6432E-05
263          0.00  0.000   0.006   0.4016     11.9180 .0000E+00 .6420E-05
264          0.08  0.000   0.007   0.4370     11.9585 .0000E+00 .6453E-05
265          0.00  0.000   0.043   0.4312     11.9940 .0000E+00 .6482E-05
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266        0.00  0.000  0.006  0.4254    11.9783 .0000E+00 .6469E-05
267        0.00  0.000  0.006  0.4197    11.9633 .0000E+00 .6457E-05
268        0.05  0.000  0.007  0.4370    11.9776 .0000E+00 .6469E-05
269        0.06  0.000  0.033  0.4370    11.9998 .0000E+00 .6487E-05
270        0.13  0.000  0.060  0.4370    11.9998 .0000E+00 .6487E-05
271        0.00  0.000  0.129  0.4313    11.9941 .0000E+00 .6482E-05
272        0.03  0.000  0.007  0.4370    11.9960 .0000E+00 .6484E-05
273        0.00  0.000  0.023  0.4314    11.9942 .0000E+00 .6482E-05
274        0.00  0.000  0.006  0.4258    11.9792 .0000E+00 .6470E-05
275        0.00  0.000  0.006  0.4202    11.9642 .0000E+00 .6458E-05
276        0.00  0.000  0.006  0.4146    11.9506 .0000E+00 .6447E-05
277        0.00  0.000  0.006  0.4091    11.9369 .0000E+00 .6436E-05
278        0.00  0.000  0.006  0.4036    11.9226 .0000E+00 .6424E-05
279        0.00  0.000  0.005  0.3981    11.9079 .0000E+00 .6412E-05
280        0.00  0.000  0.005  0.3926    11.8933 .0000E+00 .6400E-05
281        0.00  0.000  0.005  0.3871    11.8787 .0000E+00 .6389E-05
282        0.00  0.000  0.005  0.3817    11.8641 .0000E+00 .6377E-05
283        0.00  0.000  0.005  0.3762    11.8496 .0000E+00 .6365E-05
284        0.00  0.000  0.005  0.3708    11.8317 .0000E+00 .6351E-05
285        0.00  0.000  0.005  0.3654    11.8245 .0000E+00 .6345E-05
286        0.00  0.000  0.005  0.3601    11.8162 .0000E+00 .6338E-05
287        0.03  0.000  0.006  0.3838    11.8078 .0000E+00 .6331E-05
288        0.01  0.000  0.006  0.3875    11.8499 .0000E+00 .6365E-05
289        0.00  0.000  0.005  0.3822    11.8609 .0000E+00 .6374E-05
290        0.03  0.000  0.006  0.4060    11.8671 .0000E+00 .6379E-05
291        0.22  0.000  0.006  0.4370    11.9769 .0000E+00 .6468E-05
292        0.09  0.000  0.189  0.4370    11.9998 .0000E+00 .6487E-05
293        0.06  0.000  0.090  0.4370    11.9998 .0000E+00 .6487E-05
294        0.04  0.000  0.060  0.4370    11.9998 .0000E+00 .6487E-05
295        0.02  0.000  0.040  0.4370    11.9998 .0000E+00 .6487E-05
296        0.01  0.000  0.020  0.4370    11.9998 .0000E+00 .6487E-05
297        0.00  0.000  0.009  0.4318    11.9946 .0000E+00 .6483E-05
298        0.00  0.000  0.005  0.4267    11.9808 .0000E+00 .6471E-05
299        0.00  0.000  0.005  0.4215    11.9663 .0000E+00 .6460E-05
300        0.00  0.000  0.005  0.4164    11.9541 .0000E+00 .6450E-05
301        0.00  0.000  0.005  0.4113    11.9416 .0000E+00 .6439E-05
302        0.00  0.000  0.005  0.4062    11.9287 .0000E+00 .6429E-05
303        0.00  0.000  0.005  0.4011    11.9153 .0000E+00 .6418E-05
304        0.00  0.000  0.005  0.3960    11.9018 .0000E+00 .6407E-05
305        0.00  0.000  0.005  0.3910    11.8883 .0000E+00 .6396E-05
306        0.01  0.000  0.006  0.3951    11.8793 .0000E+00 .6389E-05
307        0.00  0.000  0.005  0.3901    11.8814 .0000E+00 .6391E-05
308        0.00  0.000  0.005  0.3851    11.8701 .0000E+00 .6382E-05
309        0.00  0.000  0.005  0.3801    11.8578 .0000E+00 .6372E-05
310        0.00  0.000  0.005  0.3751    11.8435 .0000E+00 .6360E-05
311        0.00  0.000  0.005  0.3701    11.8310 .0000E+00 .6350E-05
312        0.00  0.000  0.005  0.3652    11.8242 .0000E+00 .6344E-05
313        0.00  0.000  0.005  0.3602    11.8165 .0000E+00 .6338E-05
314        0.00  0.000  0.005  0.3553    11.8069 .0000E+00 .6331E-05
315        0.00  0.000  0.005  0.3504    11.7940 .0000E+00 .6320E-05
316        0.00  0.000  0.005  0.3455    11.7809 .0000E+00 .6310E-05
317        0.06  0.000  0.006  0.3998    11.7851 .0000E+00 .6313E-05
318        0.01  0.000  0.006  0.4042    11.9032 .0000E+00 .6408E-05
319        0.02  0.000  0.006  0.4185    11.9184 .0000E+00 .6421E-05
320        0.00  0.000  0.005  0.4137    11.9434 .0000E+00 .6441E-05
321        0.03  0.000  0.006  0.4370    11.9518 .0000E+00 .6448E-05
322        0.00  0.000  0.006  0.4322    11.9950 .0000E+00 .6483E-05
323        0.00  0.000  0.005  0.4274    11.9822 .0000E+00 .6472E-05
324        0.00  0.000  0.005  0.4226    11.9689 .0000E+00 .6462E-05
325        0.00  0.000  0.005  0.4178    11.9572 .0000E+00 .6452E-05
326        0.00  0.000  0.005  0.4131    11.9455 .0000E+00 .6443E-05
327        0.00  0.000  0.005  0.4083    11.9337 .0000E+00 .6433E-05
328        0.00  0.000  0.005  0.4036    11.9214 .0000E+00 .6423E-05
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 329          0.17  0.000  0.006  0.4370   11.9782 .0000E+00 .6469E-05
 330          0.00  0.000  0.193  0.3746   11.9371 .0000E+00 .6436E-05
 331          0.34  0.000  0.005  0.4370   11.9575 .0000E+00 .6453E-05
 332          0.10  0.000  0.174  0.4370   11.9998 .0000E+00 .6487E-05
 333          0.00  0.000  0.177  0.4370   11.9998 .0000E+00 .6487E-05
 334          0.00  0.000  0.165  0.2925   11.8396 .0000E+00 .6357E-05
 335          0.00  0.000  0.115  0.1775   11.5105 .0000E+00 .6094E-05
 336          0.00  0.000  0.105  0.0727   11.2421 .0000E+00 .5883E-05
 337          0.00  0.000  0.049  0.0240   11.0640 .0000E+00 .5744E-05
 338          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 339          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 340          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 341          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 342          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 343          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 344          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 345          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 346          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 347          0.03  0.000  0.010  0.0444   10.9997 .0000E+00 .5694E-05
 348          0.00  0.000  0.008  0.0363   10.9996 .0000E+00 .5694E-05
 349          0.00  0.000  0.010  0.0262   10.9996 .0000E+00 .5694E-05
 350          0.00  0.000  0.002  0.0245   10.9996 .0000E+00 .5694E-05
 351          0.00  0.000  0.000  0.0241   10.9996 .0000E+00 .5694E-05
 352          0.01  0.000  0.002  0.0318   10.9997 .0000E+00 .5694E-05
 353          0.00  0.000  0.005  0.0263   10.9997 .0000E+00 .5694E-05
 354          0.04  0.000  0.010  0.0565   10.9997 .0000E+00 .5694E-05
 355          0.03  0.000  0.012  0.0748   10.9997 .0000E+00 .5694E-05
 356          0.00  0.000  0.013  0.0622   10.9997 .0000E+00 .5694E-05
 357          0.00  0.000  0.013  0.0488   10.9997 .0000E+00 .5694E-05
 358          0.00  0.000  0.013  0.0357   10.9997 .0000E+00 .5694E-05
 359          0.00  0.000  0.010  0.0259   10.9997 .0000E+00 .5694E-05
 360          0.00  0.000  0.002  0.0240   10.9998 .0000E+00 .5694E-05
 361          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 362          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 363          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 364          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
 365          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05

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


    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  2
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  1 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  3

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

                      DAILY OUTPUT FOR YEAR 2003
 ----------------------------------------------------------------------
           S
 DAY  A    O   RAIN   RUNOFF    ET    E. ZONE    HEAD     DRAIN     LEAK
      I    I                             WATER     #1       #1       #1
      R    L    IN.     IN.     IN.   IN./IN.     IN.      IN.      IN.
 ---  -    -  -----  ------  ------  -------  --------  --------  --------

  1             0.02  0.000  0.006  0.0381   10.9997 .0000E+00 .5694E-05
  2             0.00  0.000  0.005  0.0331   10.9997 .0000E+00 .5694E-05
  3             0.00  0.000  0.007  0.0257   10.9997 .0000E+00 .5694E-05
  4             0.06  0.000  0.007  0.0783   10.9997 .0000E+00 .5694E-05
  5             0.00  0.000  0.010  0.0686   10.9996 .0000E+00 .5694E-05
  6             0.00  0.000  0.011  0.0580   10.9996 .0000E+00 .5694E-05
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  7           0.00   0.000   0.011   0.0473     10.9996  .0000E+00  .5694E-05
  8           0.00   0.000   0.011   0.0368     10.9996  .0000E+00  .5694E-05
  9           0.00   0.000   0.010   0.0266     10.9996  .0000E+00  .5694E-05
 10           0.03   0.000   0.008   0.0486     10.9996  .0000E+00  .5694E-05
 11           0.00   0.000   0.007   0.0416     10.9996  .0000E+00  .5694E-05
 12           0.00   0.000   0.007   0.0346     10.9995  .0000E+00  .5694E-05
 13           0.00   0.000   0.008   0.0263     10.9995  .0000E+00  .5694E-05
 14           0.17   0.000   0.010   0.1861     10.9995  .0000E+00  .5694E-05
 15           0.24   0.000   0.011   0.4150     11.2470  .0000E+00  .5888E-05
 16           0.01   0.000   0.011   0.4142     11.9387  .0000E+00  .6437E-05
 17           0.00   0.000   0.010   0.4045     11.9280  .0000E+00  .6428E-05
 18           0.00   0.000   0.010   0.3948     11.9049  .0000E+00  .6410E-05
 19           0.16   0.000   0.010   0.4370     11.9622  .0000E+00  .6456E-05
 20           0.09   0.000   0.118   0.4370     11.9998  .0000E+00  .6487E-05
 21           0.00   0.000   0.089   0.4277     11.9905  .0000E+00  .6479E-05
 22           0.00   0.000   0.009   0.4184     11.9654  .0000E+00  .6459E-05
 23           0.00   0.000   0.009   0.4093     11.9427  .0000E+00  .6440E-05
 24           0.13   0.000   0.010   0.4370     11.9820  .0000E+00  .6472E-05
 25           0.10   0.000   0.102   0.4370     11.9998  .0000E+00  .6487E-05
 26           0.02   0.000   0.144   0.4027     11.9620  .0000E+00  .6456E-05
 27           0.00   0.000   0.160   0.2424     11.7217  .0000E+00  .6262E-05
 28           0.00   0.000   0.105   0.1371     11.3982  .0000E+00  .6005E-05
 29           0.05   0.000   0.055   0.1324     11.2364  .0000E+00  .5878E-05
 30           0.02   0.000   0.042   0.1107     11.1717  .0000E+00  .5827E-05
 31           0.00   0.000   0.032   0.0789     11.1458  .0000E+00  .5807E-05
 32           0.00   0.000   0.030   0.0493     11.0921  .0000E+00  .5766E-05
 33           0.00   0.000   0.025   0.0242     11.0235  .0000E+00  .5713E-05
 34           0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
 35           0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
 36           0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
 37           0.18   0.000   0.018   0.1857     10.9997  .0000E+00  .5694E-05
 38           0.00   0.000   0.019   0.1663     11.1201  .0000E+00  .5788E-05
 39           0.00   0.000   0.017   0.1488     11.3013  .0000E+00  .5929E-05
 40           0.00   0.000   0.018   0.1308     11.2780  .0000E+00  .5910E-05
 41           0.00   0.000   0.018   0.1131     11.2325  .0000E+00  .5875E-05
 42           0.00   0.000   0.017   0.0961     11.1866  .0000E+00  .5839E-05
 43           0.00   0.000   0.016   0.0796     11.1530  .0000E+00  .5813E-05
 44           0.27   0.000   0.017   0.3325     11.1297  .0000E+00  .5795E-05
 45           0.51   0.000   0.017   0.4370     11.8580  .0000E+00  .6373E-05
 46           0.00   0.000   0.152   0.4370     11.9998  .0000E+00  .6487E-05
 47           0.00   0.000   0.146   0.4370     11.9998  .0000E+00  .6487E-05
 48           0.00   0.000   0.197   0.3315     11.8847  .0000E+00  .6393E-05
 49           0.00   0.000   0.178   0.1530     11.5335  .0000E+00  .6112E-05
 50           0.00   0.000   0.107   0.0459     11.1843  .0000E+00  .5837E-05
 51           0.00   0.000   0.022   0.0240     11.0200  .0000E+00  .5710E-05
 52           0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
 53           0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
 54           0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
 55           0.02   0.000   0.011   0.0332     10.9997  .0000E+00  .5694E-05
 56           0.00   0.000   0.007   0.0265     10.9997  .0000E+00  .5694E-05
 57           0.00   0.000   0.002   0.0246     10.9997  .0000E+00  .5694E-05
 58           0.00   0.000   0.000   0.0242     10.9997  .0000E+00  .5694E-05
 59           0.05   0.000   0.011   0.0630     10.9997  .0000E+00  .5694E-05
 60           0.00   0.000   0.015   0.0481     10.9998  .0000E+00  .5694E-05
 61           0.00   0.000   0.017   0.0311     10.9998  .0000E+00  .5694E-05
 62           0.00   0.000   0.006   0.0253     10.9997  .0000E+00  .5694E-05
 63           0.00   0.000   0.001   0.0243     10.9997  .0000E+00  .5694E-05
 64           0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
 65           0.45   0.000   0.019   0.4370     11.1263  .0000E+00  .5793E-05
 66           0.25   0.000   0.036   0.4370     11.9998  .0000E+00  .6487E-05
 67           0.10   0.000   0.228   0.4370     11.9998  .0000E+00  .6487E-05
 68           0.01   0.000   0.153   0.3976     11.9588  .0000E+00  .6453E-05
 69           0.00   0.000   0.142   0.2556     11.7271  .0000E+00  .6267E-05
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  70        0.00  0.000  0.110  0.1460   11.4263 .0000E+00 .6027E-05
  71        0.00  0.000  0.054  0.0924   11.2375 .0000E+00 .5879E-05
  72        0.00  0.000  0.041  0.0511   11.1240 .0000E+00 .5790E-05
  73        0.00  0.000  0.027  0.0240   11.0281 .0000E+00 .5716E-05
  74        0.02  0.000  0.010  0.0336   10.9998 .0000E+00 .5694E-05
  75        0.00  0.000  0.007  0.0267   10.9998 .0000E+00 .5694E-05
  76        0.00  0.000  0.002  0.0247   10.9998 .0000E+00 .5694E-05
  77        0.00  0.000  0.001  0.0242   10.9997 .0000E+00 .5694E-05
  78        0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
  79        0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
  80        0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
  81        0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
  82        0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
  83        0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
  84        0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
  85        0.17  0.000  0.015  0.1794   10.9997 .0000E+00 .5694E-05
  86        0.17  0.000  0.017  0.3328   11.1325 .0000E+00 .5797E-05
  87        0.02  0.000  0.017  0.3362   11.6594 .0000E+00 .6212E-05
  88        0.00  0.000  0.015  0.3211   11.6987 .0000E+00 .6244E-05
  89        0.53  0.000  0.016  0.4370   11.9232 .0000E+00 .6425E-05
  90        0.42  0.000  0.139  0.4370   11.9998 .0000E+00 .6487E-05
  91        0.34  0.000  0.136  0.4370   11.9998 .0000E+00 .6487E-05
  92        0.00  0.000  0.213  0.4370   11.9998 .0000E+00 .6487E-05
  93        0.23  0.000  0.188  0.4370   11.9998 .0000E+00 .6487E-05
  94        1.02  0.000  0.213  0.4370   11.9998 .0000E+00 .6487E-05
  95        0.01  0.000  0.220  0.4370   11.9998 .0000E+00 .6487E-05
  96        0.19  0.000  0.189  0.4370   11.9998 .0000E+00 .6487E-05
  97        0.18  0.000  0.229  0.4370   11.9998 .0000E+00 .6487E-05
  98        0.00  0.000  0.248  0.4370   11.9998 .0000E+00 .6487E-05
  99        0.10  0.000  0.196  0.4370   11.9998 .0000E+00 .6487E-05
 100        0.00  0.000  0.246  0.4370   11.9998 .0000E+00 .6487E-05
 101        0.00  0.000  0.256  0.4370   11.9998 .0000E+00 .6487E-05
 102        0.00  0.000  0.273  0.4370   11.9998 .0000E+00 .6487E-05
 103        0.00  0.000  0.230  0.3505   11.9103 .0000E+00 .6414E-05
 104        0.00  0.000  0.193  0.1572   11.5697 .0000E+00 .6141E-05
 105        0.00  0.000  0.111  0.0467   11.1872 .0000E+00 .5840E-05
 106        0.00  0.000  0.023  0.0240   11.0212 .0000E+00 .5711E-05
 107        0.07  0.000  0.023  0.0707   10.9998 .0000E+00 .5694E-05
 108        0.01  0.000  0.031  0.0502   10.9998 .0000E+00 .5694E-05
 109        0.00  0.000  0.021  0.0293   10.9998 .0000E+00 .5694E-05
 110        0.00  0.000  0.004  0.0252   10.9997 .0000E+00 .5694E-05
 111        0.00  0.000  0.001  0.0241   10.9998 .0000E+00 .5694E-05
 112        0.01  0.000  0.003  0.0310   10.9998 .0000E+00 .5694E-05
 113        0.01  0.000  0.008  0.0334   10.9998 .0000E+00 .5694E-05
 114        0.00  0.000  0.006  0.0270   10.9998 .0000E+00 .5694E-05
 115        0.00  0.000  0.002  0.0247   10.9997 .0000E+00 .5694E-05
 116        0.00  0.000  0.001  0.0242   10.9997 .0000E+00 .5694E-05
 117        0.00  0.000  0.000  0.0241   10.9998 .0000E+00 .5694E-05
 118        0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 119        0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 120        0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
 121        0.06  0.000  0.008  0.0762   10.9997 .0000E+00 .5694E-05
 122        0.00  0.000  0.013  0.0631   10.9997 .0000E+00 .5694E-05
 123        0.00  0.000  0.014  0.0489   10.9997 .0000E+00 .5694E-05
 124        0.09  0.000  0.015  0.1235   10.9997 .0000E+00 .5694E-05
 125        0.00  0.000  0.014  0.1092   11.0132 .0000E+00 .5705E-05
 126        0.00  0.000  0.014  0.0953   11.0686 .0000E+00 .5747E-05
 127        0.02  0.000  0.015  0.1002   11.0737 .0000E+00 .5751E-05
 128        0.00  0.000  0.014  0.0865   11.0783 .0000E+00 .5755E-05
 129        0.00  0.000  0.012  0.0747   11.0846 .0000E+00 .5760E-05
 130        0.00  0.000  0.011  0.0635   11.0880 .0000E+00 .5762E-05
 131        0.00  0.000  0.013  0.0508   11.0748 .0000E+00 .5752E-05
 132        0.00  0.000  0.013  0.0382   11.0415 .0000E+00 .5726E-05
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133        0.01  0.000  0.013  0.0347    11.0098  .0000E+00  .5702E-05
134        0.00  0.000  0.008  0.0268    10.9998  .0000E+00  .5694E-05
135        0.01  0.000  0.004  0.0329    10.9998  .0000E+00  .5694E-05
136        0.00  0.000  0.005  0.0275    10.9998  .0000E+00  .5694E-05
137        0.01  0.000  0.004  0.0332    10.9997  .0000E+00  .5694E-05
138        0.01  0.000  0.006  0.0367    10.9998  .0000E+00  .5694E-05
139        0.00  0.000  0.005  0.0319    10.9998  .0000E+00  .5694E-05
140        0.00  0.000  0.006  0.0255    10.9997  .0000E+00  .5694E-05
141        0.00  0.000  0.001  0.0244    10.9997  .0000E+00  .5694E-05
142        0.00  0.000  0.000  0.0241    10.9997  .0000E+00  .5694E-05
143        0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
144        0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
145        0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
146        0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
147        0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
148        0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
149        0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
150        0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
151        0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
152        0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
153        0.12  0.000  0.007  0.1366    10.9996  .0000E+00  .5694E-05
154        0.01  0.000  0.010  0.1369    11.0318  .0000E+00  .5719E-05
155        0.00  0.000  0.009  0.1276    11.1285  .0000E+00  .5794E-05
156        0.00  0.000  0.009  0.1185    11.1296  .0000E+00  .5795E-05
157        0.00  0.000  0.009  0.1094    11.1323  .0000E+00  .5797E-05
158        0.02  0.000  0.010  0.1193    11.1342  .0000E+00  .5798E-05
159        0.00  0.000  0.009  0.1105    11.1359  .0000E+00  .5800E-05
160        0.36  0.000  0.010  0.4370    11.2616  .0000E+00  .5898E-05
161        0.15  0.000  0.033  0.4370    11.9998  .0000E+00  .6487E-05
162        0.01  0.000  0.150  0.4370    11.9998  .0000E+00  .6487E-05
163        0.00  0.000  0.009  0.4284    11.9912  .0000E+00  .6480E-05
164        0.00  0.000  0.008  0.4199    11.9684  .0000E+00  .6461E-05
165        0.00  0.000  0.008  0.4115    11.9475  .0000E+00  .6444E-05
166        0.01  0.000  0.009  0.4121    11.9307  .0000E+00  .6431E-05
167        0.00  0.000  0.008  0.4038    11.9236  .0000E+00  .6425E-05
168        0.00  0.000  0.008  0.3956    11.9041  .0000E+00  .6409E-05
169        0.00  0.000  0.008  0.3874    11.8836  .0000E+00  .6393E-05
170        0.00  0.000  0.008  0.3793    11.8623  .0000E+00  .6375E-05
171        0.00  0.000  0.008  0.3713    11.8391  .0000E+00  .6357E-05
172        0.00  0.000  0.008  0.3633    11.8239  .0000E+00  .6344E-05
173        0.00  0.000  0.008  0.3554    11.8098  .0000E+00  .6333E-05
174        0.00  0.000  0.008  0.3476    11.7913  .0000E+00  .6318E-05
175        0.00  0.000  0.008  0.3398    11.7704  .0000E+00  .6301E-05
176        0.00  0.000  0.008  0.3320    11.7497  .0000E+00  .6285E-05
177        0.03  0.000  0.009  0.3533    11.7323  .0000E+00  .6271E-05
178        0.00  0.000  0.008  0.3456    11.7509  .0000E+00  .6286E-05
179        0.03  0.000  0.009  0.3670    11.7526  .0000E+00  .6287E-05
180        0.00  0.000  0.008  0.3595    11.7881  .0000E+00  .6315E-05
181        0.00  0.000  0.007  0.3520    11.7871  .0000E+00  .6315E-05
182        0.00  0.000  0.007  0.3446    11.7759  .0000E+00  .6306E-05
183        0.00  0.000  0.007  0.3372    11.7619  .0000E+00  .6294E-05
184        0.00  0.000  0.007  0.3298    11.7432  .0000E+00  .6279E-05
185        0.00  0.000  0.007  0.3226    11.7237  .0000E+00  .6264E-05
186        0.00  0.000  0.007  0.3153    11.7043  .0000E+00  .6248E-05
187        0.00  0.000  0.007  0.3081    11.6850  .0000E+00  .6233E-05
188        0.00  0.000  0.007  0.3010    11.6674  .0000E+00  .6219E-05
189        0.00  0.000  0.007  0.2939    11.6580  .0000E+00  .6211E-05
190        0.00  0.000  0.007  0.2868    11.6448  .0000E+00  .6201E-05
191        0.00  0.000  0.007  0.2798    11.6260  .0000E+00  .6186E-05
192        0.00  0.000  0.007  0.2728    11.6073  .0000E+00  .6171E-05
193        0.00  0.000  0.007  0.2658    11.5887  .0000E+00  .6156E-05
194        0.00  0.000  0.007  0.2589    11.5702  .0000E+00  .6141E-05
195        0.00  0.000  0.007  0.2521    11.5518  .0000E+00  .6126E-05
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196          0.00  0.000  0.007  0.2452   11.5336 .0000E+00 .6112E-05
197          0.00  0.000  0.007  0.2384   11.5154 .0000E+00 .6098E-05
198          0.00  0.000  0.007  0.2317   11.5001 .0000E+00 .6085E-05
199          0.00  0.000  0.007  0.2250   11.4926 .0000E+00 .6079E-05
200          0.00  0.000  0.007  0.2183   11.4783 .0000E+00 .6068E-05
201          0.00  0.000  0.007  0.2116   11.4605 .0000E+00 .6054E-05
202          0.00  0.000  0.007  0.2050   11.4428 .0000E+00 .6040E-05
203          0.03  0.000  0.008  0.2274   11.4280 .0000E+00 .6028E-05
204          0.01  0.000  0.008  0.2298   11.4194 .0000E+00 .6022E-05
205          0.00  0.000  0.007  0.2233   11.4139 .0000E+00 .6017E-05
206          0.00  0.000  0.006  0.2168   11.4094 .0000E+00 .6014E-05
207          0.03  0.000  0.007  0.2393   11.4063 .0000E+00 .6011E-05
208          0.02  0.000  0.007  0.2519   11.4061 .0000E+00 .6011E-05
209          0.04  0.000  0.007  0.2844   11.4381 .0000E+00 .6036E-05
210          0.00  0.000  0.006  0.2781   11.5302 .0000E+00 .6109E-05
211          0.00  0.000  0.006  0.2718   11.5503 .0000E+00 .6125E-05
212          0.00  0.000  0.006  0.2655   11.5510 .0000E+00 .6126E-05
213          0.00  0.000  0.006  0.2592   11.5495 .0000E+00 .6125E-05
214          0.00  0.000  0.006  0.2530   11.5444 .0000E+00 .6121E-05
215          0.00  0.000  0.006  0.2467   11.5354 .0000E+00 .6113E-05
216          0.00  0.000  0.006  0.2406   11.5200 .0000E+00 .6101E-05
217          0.00  0.000  0.006  0.2344   11.5040 .0000E+00 .6089E-05
218          0.00  0.000  0.006  0.2283   11.4967 .0000E+00 .6083E-05
219          0.00  0.000  0.006  0.2222   11.4878 .0000E+00 .6076E-05
220          0.00  0.000  0.006  0.2161   11.4715 .0000E+00 .6063E-05
221          0.00  0.000  0.006  0.2101   11.4554 .0000E+00 .6050E-05
222          0.00  0.000  0.006  0.2040   11.4393 .0000E+00 .6037E-05
223          0.00  0.000  0.006  0.1980   11.4233 .0000E+00 .6025E-05
224          0.00  0.000  0.006  0.1921   11.4073 .0000E+00 .6012E-05
225          0.00  0.000  0.006  0.1861   11.3914 .0000E+00 .6000E-05
226          0.00  0.000  0.006  0.1802   11.3756 .0000E+00 .5987E-05
227          0.00  0.000  0.006  0.1743   11.3598 .0000E+00 .5975E-05
228          0.00  0.000  0.006  0.1684   11.3441 .0000E+00 .5962E-05
229          0.01  0.000  0.007  0.1717   11.3329 .0000E+00 .5954E-05
230          0.01  0.000  0.007  0.1749   11.3303 .0000E+00 .5951E-05
231          0.00  0.000  0.006  0.1691   11.3245 .0000E+00 .5947E-05
232          0.00  0.000  0.006  0.1633   11.3170 .0000E+00 .5941E-05
233          0.00  0.000  0.006  0.1576   11.3119 .0000E+00 .5937E-05
234          0.00  0.000  0.005  0.1526   11.3077 .0000E+00 .5934E-05
235          0.01  0.000  0.007  0.1560   11.3020 .0000E+00 .5929E-05
236          0.00  0.000  0.006  0.1503   11.2918 .0000E+00 .5921E-05
237          0.00  0.000  0.006  0.1446   11.2841 .0000E+00 .5915E-05
238          0.00  0.000  0.005  0.1396   11.2775 .0000E+00 .5910E-05
239          0.00  0.000  0.005  0.1342   11.2677 .0000E+00 .5902E-05
240          0.00  0.000  0.006  0.1286   11.2539 .0000E+00 .5892E-05
241          0.00  0.000  0.006  0.1230   11.2393 .0000E+00 .5880E-05
242          0.00  0.000  0.006  0.1174   11.2244 .0000E+00 .5869E-05
243          0.00  0.000  0.006  0.1119   11.2096 .0000E+00 .5857E-05
244          0.00  0.000  0.006  0.1064   11.1949 .0000E+00 .5846E-05
245          0.00  0.000  0.005  0.1009   11.1801 .0000E+00 .5834E-05
246          0.00  0.000  0.005  0.0954   11.1677 .0000E+00 .5824E-05
247          0.00  0.000  0.005  0.0899   11.1633 .0000E+00 .5821E-05
248          0.00  0.000  0.005  0.0845   11.1532 .0000E+00 .5813E-05
249          0.00  0.000  0.005  0.0790   11.1387 .0000E+00 .5802E-05
250          0.00  0.000  0.005  0.0736   11.1243 .0000E+00 .5791E-05
251          0.00  0.000  0.005  0.0682   11.1099 .0000E+00 .5779E-05
252          0.00  0.000  0.005  0.0629   11.0955 .0000E+00 .5768E-05
253          0.00  0.000  0.005  0.0575   11.0812 .0000E+00 .5757E-05
254          0.00  0.000  0.005  0.0522   11.0670 .0000E+00 .5746E-05
255          0.04  0.000  0.006  0.0860   11.0550 .0000E+00 .5737E-05
256          0.02  0.000  0.006  0.0998   11.0481 .0000E+00 .5732E-05
257          0.04  0.000  0.006  0.1337   11.0443 .0000E+00 .5729E-05
258          0.08  0.000  0.006  0.2076   11.0776 .0000E+00 .5754E-05
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259        0.04  0.000  0.006  0.2415    11.2731 .0000E+00 .5907E-05
260        0.20  0.000  0.006  0.4354    11.5053 .0000E+00 .6090E-05
261        0.13  0.000  0.006  0.4370    11.9987 .0000E+00 .6486E-05
262        0.10  0.000  0.202  0.4370    11.9998 .0000E+00 .6487E-05
263        0.05  0.000  0.207  0.3008    11.8521 .0000E+00 .6367E-05
264        0.00  0.000  0.095  0.2055    11.5325 .0000E+00 .6111E-05
265        0.00  0.000  0.047  0.1587    11.3693 .0000E+00 .5982E-05
266        0.10  0.000  0.042  0.2166    11.3063 .0000E+00 .5933E-05
267        0.11  0.000  0.036  0.2910    11.3258 .0000E+00 .5948E-05
268        0.00  0.000  0.026  0.2647    11.5322 .0000E+00 .6111E-05
269        0.01  0.000  0.028  0.2462    11.5381 .0000E+00 .6116E-05
270        0.01  0.000  0.026  0.2302    11.4920 .0000E+00 .6079E-05
271        0.00  0.000  0.021  0.2091    11.4594 .0000E+00 .6053E-05
272        0.00  0.000  0.022  0.1875    11.4156 .0000E+00 .6019E-05
273        0.00  0.000  0.021  0.1665    11.3630 .0000E+00 .5977E-05
274        0.02  0.000  0.021  0.1657    11.3255 .0000E+00 .5948E-05
275        0.19  0.000  0.020  0.3358    11.3114 .0000E+00 .5937E-05
276        0.00  0.000  0.018  0.3175    11.6574 .0000E+00 .6211E-05
277        0.41  0.000  0.018  0.4370    11.8683 .0000E+00 .6380E-05
278        0.00  0.000  0.236  0.4370    11.9998 .0000E+00 .6487E-05
279        0.02  0.000  0.194  0.2990    11.8485 .0000E+00 .6364E-05
280        0.02  0.000  0.152  0.1671    11.5034 .0000E+00 .6088E-05
281        0.00  0.000  0.116  0.0515    11.2010 .0000E+00 .5850E-05
282        0.01  0.000  0.037  0.0243    11.0270 .0000E+00 .5715E-05
283        0.00  0.000  0.000  0.0241    10.9998 .0000E+00 .5694E-05
284        0.00  0.000  0.000  0.0241    10.9998 .0000E+00 .5694E-05
285        0.05  0.000  0.015  0.0588    10.9998 .0000E+00 .5694E-05
286        0.08  0.000  0.021  0.1175    10.9997 .0000E+00 .5694E-05
287        0.00  0.000  0.025  0.0920    10.9997 .0000E+00 .5694E-05
288        0.00  0.000  0.022  0.0701    11.0320 .0000E+00 .5719E-05
289        0.00  0.000  0.022  0.0477    11.0445 .0000E+00 .5729E-05
290        0.00  0.000  0.022  0.0254    11.0238 .0000E+00 .5713E-05
291        0.00  0.000  0.001  0.0240    10.9998 .0000E+00 .5694E-05
292        0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
293        0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
294        0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
295        0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
296        0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
297        0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
298        0.40  0.000  0.017  0.4072    11.1145 .0000E+00 .5784E-05
299        0.00  0.000  0.016  0.3917    11.9077 .0000E+00 .6412E-05
300        0.02  0.000  0.016  0.3959    11.8770 .0000E+00 .6387E-05
301        0.64  0.000  0.015  0.4370    11.9701 .0000E+00 .6463E-05
302        0.19  0.000  0.233  0.4370    11.9998 .0000E+00 .6487E-05
303        0.23  0.000  0.234  0.4370    11.9998 .0000E+00 .6487E-05
304        0.22  0.000  0.146  0.4370    11.9998 .0000E+00 .6487E-05
305        0.13  0.000  0.192  0.4370    11.9998 .0000E+00 .6487E-05
306        0.09  0.000  0.209  0.4370    11.9998 .0000E+00 .6487E-05
307        0.07  0.000  0.231  0.4370    11.9998 .0000E+00 .6487E-05
308        0.04  0.000  0.171  0.4370    11.9998 .0000E+00 .6487E-05
309        0.03  0.000  0.171  0.4321    11.9949 .0000E+00 .6483E-05
310        0.02  0.000  0.130  0.3220    11.8640 .0000E+00 .6377E-05
311        0.00  0.000  0.137  0.1847    11.5500 .0000E+00 .6125E-05
312        0.00  0.000  0.126  0.0587    11.2313 .0000E+00 .5874E-05
313        0.00  0.000  0.035  0.0241    11.0403 .0000E+00 .5726E-05
314        0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
315        0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
316        0.03  0.000  0.018  0.0362    10.9998 .0000E+00 .5694E-05
317        0.01  0.000  0.013  0.0332    10.9997 .0000E+00 .5694E-05
318        0.00  0.000  0.008  0.0249    10.9997 .0000E+00 .5694E-05
319        0.02  0.000  0.011  0.0340    10.9997 .0000E+00 .5694E-05
320        0.00  0.000  0.007  0.0269    10.9997 .0000E+00 .5694E-05
321        0.00  0.000  0.002  0.0247    10.9997 .0000E+00 .5694E-05
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322          0.00  0.000  0.001  0.0242   10.9997 .0000E+00 .5694E-05
323          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
324          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
325          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
326          0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
327          0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
328          0.06  0.000  0.008  0.0763   10.9997 .0000E+00 .5694E-05
329          0.15  0.000  0.014  0.2121   10.9997 .0000E+00 .5694E-05
330          0.01  0.000  0.017  0.2055   11.2008 .0000E+00 .5850E-05
331          0.00  0.000  0.015  0.1904   11.3525 .0000E+00 .5969E-05
332          0.00  0.000  0.015  0.1754   11.3452 .0000E+00 .5963E-05
333          0.00  0.000  0.014  0.1618   11.3379 .0000E+00 .5957E-05
334          0.03  0.000  0.015  0.1768   11.3238 .0000E+00 .5946E-05
335          0.23  0.000  0.015  0.3922   11.3765 .0000E+00 .5988E-05
336          0.12  0.000  0.014  0.4370   11.9514 .0000E+00 .6448E-05
337          0.06  0.000  0.075  0.4370   11.9998 .0000E+00 .6487E-05
338          0.03  0.000  0.060  0.4370   11.9998 .0000E+00 .6487E-05
339          0.03  0.000  0.030  0.4370   11.9998 .0000E+00 .6487E-05
340          0.00  0.000  0.029  0.4244   11.9872 .0000E+00 .6476E-05
341          0.00  0.000  0.012  0.4120   11.9541 .0000E+00 .6450E-05
342          0.00  0.000  0.012  0.3998   11.9233 .0000E+00 .6425E-05
343          0.00  0.000  0.012  0.3879   11.8915 .0000E+00 .6399E-05
344          0.00  0.000  0.012  0.3761   11.8598 .0000E+00 .6373E-05
345          0.00  0.000  0.012  0.3645   11.8282 .0000E+00 .6348E-05
346          0.00  0.000  0.011  0.3531   11.8085 .0000E+00 .6332E-05
347          0.00  0.000  0.011  0.3419   11.7818 .0000E+00 .6310E-05
348          0.00  0.000  0.011  0.3309   11.7521 .0000E+00 .6286E-05
349          0.00  0.000  0.011  0.3200   11.7227 .0000E+00 .6263E-05
350          0.03  0.000  0.011  0.3385   11.6983 .0000E+00 .6243E-05
351          0.00  0.000  0.011  0.3279   11.7084 .0000E+00 .6251E-05
352          0.00  0.000  0.010  0.3175   11.7019 .0000E+00 .6246E-05
353          0.00  0.000  0.010  0.3071   11.6838 .0000E+00 .6232E-05
354          0.00  0.000  0.010  0.2969   11.6641 .0000E+00 .6216E-05
355          0.00  0.000  0.010  0.2868   11.6484 .0000E+00 .6203E-05
356          0.00  0.000  0.010  0.2769   11.6232 .0000E+00 .6183E-05
357          0.00  0.000  0.010  0.2670   11.5967 .0000E+00 .6162E-05
358          0.00  0.000  0.010  0.2573   11.5706 .0000E+00 .6141E-05
359          0.00  0.000  0.010  0.2477   11.5447 .0000E+00 .6121E-05
360          0.00  0.000  0.010  0.2381   11.5191 .0000E+00 .6101E-05
361          0.26  0.000  0.010  0.4370   11.6146 .0000E+00 .6177E-05
362          0.02  0.000  0.164  0.3435   11.9012 .0000E+00 .6407E-05
363          0.00  0.000  0.009  0.3342   11.7525 .0000E+00 .6287E-05
364          0.60  0.000  0.010  0.4370   11.9344 .0000E+00 .6434E-05
365          0.32  0.000  0.196  0.4370   11.9998 .0000E+00 .6487E-05

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    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  2
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  1 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  3

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                         DAILY OUTPUT FOR YEAR 2004
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         S
 DAY  A  O  RAIN  RUNOFF   ET   E. ZONE   HEAD      DRAIN     LEAK
      I  I                      WATER      #1        #1        #1
      R  L   IN.    IN.    IN.  IN./IN.    IN.       IN.       IN.
 ---  -  -  -----  ------ ------ ------- --------- --------- ---------
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 1      0.30  0.000  0.175  0.4370   11.9998 .0000E+00 .6487E-05
 2      0.18  0.000  0.127  0.4370   11.9998 .0000E+00 .6487E-05
 3      0.12  0.000  0.115  0.4370   11.9998 .0000E+00 .6487E-05
 4      0.03  0.000  0.130  0.4370   11.9998 .0000E+00 .6487E-05
 5      0.00  0.000  0.164  0.4370   11.9998 .0000E+00 .6487E-05
 6      0.00  0.000  0.160  0.4370   11.9998 .0000E+00 .6487E-05
 7      0.00  0.000  0.176  0.4370   11.9998 .0000E+00 .6487E-05
 8      0.00  0.000  0.164  0.4370   11.9998 .0000E+00 .6487E-05
 9      0.00  0.000  0.168  0.2989   11.8460 .0000E+00 .6362E-05
10      0.00  0.000  0.153  0.1458   11.4788 .0000E+00 .6069E-05
11      0.00  0.000  0.102  0.0442   11.1779 .0000E+00 .5832E-05
12      0.02  0.000  0.038  0.0263   11.0174 .0000E+00 .5708E-05
13      0.00  0.000  0.001  0.0250   10.9998 .0000E+00 .5694E-05
14      0.23  0.000  0.050  0.2053   10.9998 .0000E+00 .5694E-05
15      0.00  0.000  0.027  0.1783   11.1826 .0000E+00 .5836E-05
16      0.00  0.000  0.031  0.1468   11.3260 .0000E+00 .5948E-05
17      0.00  0.000  0.031  0.1162   11.2630 .0000E+00 .5899E-05
18      0.04  0.000  0.028  0.1278   11.1957 .0000E+00 .5846E-05
19      0.08  0.000  0.026  0.1816   11.1659 .0000E+00 .5823E-05
20      0.00  0.000  0.023  0.1583   11.1753 .0000E+00 .5830E-05
21      0.00  0.000  0.021  0.1375   11.2107 .0000E+00 .5858E-05
22      0.69  0.000  0.022  0.4370   11.6063 .0000E+00 .6173E-05
23      0.56  0.000  0.178  0.4370   11.9998 .0000E+00 .6487E-05
24      0.00  0.000  0.127  0.4370   11.9998 .0000E+00 .6487E-05
25      0.00  0.000  0.162  0.4370   11.9998 .0000E+00 .6487E-05
26      0.05  0.000  0.114  0.4370   11.9998 .0000E+00 .6487E-05
27      0.00  0.000  0.138  0.4370   11.9998 .0000E+00 .6487E-05
28      0.00  0.000  0.173  0.4370   11.9998 .0000E+00 .6487E-05
29      0.00  0.000  0.181  0.3408   11.8989 .0000E+00 .6405E-05
30      0.00  0.000  0.151  0.1893   11.5918 .0000E+00 .6159E-05
31      0.00  0.000  0.131  0.0584   11.2406 .0000E+00 .5881E-05
32      0.00  0.000  0.034  0.0240   11.0403 .0000E+00 .5726E-05
33      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
34      0.05  0.000  0.023  0.0508   10.9998 .0000E+00 .5694E-05
35      0.00  0.000  0.021  0.0300   10.9998 .0000E+00 .5694E-05
36      0.00  0.000  0.005  0.0251   10.9997 .0000E+00 .5694E-05
37      0.00  0.000  0.001  0.0243   10.9997 .0000E+00 .5694E-05
38      0.05  0.000  0.012  0.0618   10.9997 .0000E+00 .5694E-05
39      0.00  0.000  0.017  0.0447   10.9997 .0000E+00 .5694E-05
40      0.00  0.000  0.017  0.0281   10.9997 .0000E+00 .5694E-05
41      0.11  0.000  0.020  0.1183   10.9997 .0000E+00 .5694E-05
42      0.00  0.000  0.019  0.0993   11.0127 .0000E+00 .5704E-05
43      0.00  0.000  0.020  0.0793   11.0534 .0000E+00 .5736E-05
44      0.00  0.000  0.016  0.0628   11.0584 .0000E+00 .5740E-05
45      0.00  0.000  0.018  0.0444   11.0556 .0000E+00 .5737E-05
46      0.01  0.000  0.018  0.0360   11.0212 .0000E+00 .5711E-05
47      0.00  0.000  0.010  0.0263   10.9998 .0000E+00 .5694E-05
48      0.00  0.000  0.002  0.0246   10.9998 .0000E+00 .5694E-05
49      0.00  0.000  0.000  0.0241   10.9998 .0000E+00 .5694E-05
50      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
51      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
52      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
53      0.00  0.000  0.000  0.0240   10.9998 .0000E+00 .5694E-05
54      0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
55      0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
56      0.00  0.000  0.000  0.0240   10.9997 .0000E+00 .5694E-05
57      1.76  0.000  0.014  0.4370   11.7498 .0000E+00 .6289E-05
58      2.91  0.000  0.116  0.4370   11.9998 .0000E+00 .6487E-05
59      0.11  0.000  0.143  0.4370   11.9998 .0000E+00 .6487E-05
60      0.00  0.000  0.205  0.4370   11.9998 .0000E+00 .6487E-05
61      0.00  0.000  0.222  0.4370   11.9998 .0000E+00 .6487E-05
62      0.00  0.000  0.204  0.4370   11.9998 .0000E+00 .6487E-05
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 63       0.00   0.000   0.232   0.4370    11.9998  .0000E+00  .6487E-05
 64       0.00   0.000   0.217   0.4370    11.9998  .0000E+00  .6487E-05
 65       0.00   0.000   0.179   0.4370    11.9998  .0000E+00  .6487E-05
 66       0.00   0.000   0.191   0.4370    11.9998  .0000E+00  .6487E-05
 67       0.00   0.000   0.197   0.4370    11.9998  .0000E+00  .6487E-05
 68       0.00   0.000   0.200   0.4370    11.9998  .0000E+00  .6487E-05
 69       0.00   0.000   0.186   0.4370    11.9998  .0000E+00  .6487E-05
 70       0.00   0.000   0.194   0.4370    11.9998  .0000E+00  .6487E-05
 71       0.00   0.000   0.240   0.4370    11.9998  .0000E+00  .6487E-05
 72       0.00   0.000   0.212   0.4370    11.9998  .0000E+00  .6487E-05
 73       0.06   0.000   0.180   0.4370    11.9998  .0000E+00  .6487E-05
 74       0.00   0.000   0.216   0.4370    11.9998  .0000E+00  .6487E-05
 75       0.00   0.000   0.200   0.4370    11.9998  .0000E+00  .6487E-05
 76       0.00   0.000   0.199   0.4370    11.9998  .0000E+00  .6487E-05
 77       0.00   0.000   0.230   0.4370    11.9998  .0000E+00  .6487E-05
 78       0.00   0.000   0.193   0.4370    11.9998  .0000E+00  .6487E-05
 79       0.00   0.000   0.167   0.4370    11.9998  .0000E+00  .6487E-05
 80       0.00   0.000   0.174   0.3548    11.9144  .0000E+00  .6418E-05
 81       0.00   0.000   0.184   0.1706    11.5876  .0000E+00  .6155E-05
 82       0.00   0.000   0.118   0.0524    11.2094  .0000E+00  .5857E-05
 83       0.00   0.000   0.028   0.0240    11.0303  .0000E+00  .5718E-05
 84       0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
 85       0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
 86       0.05   0.000   0.015   0.0589    10.9998  .0000E+00  .5694E-05
 87       0.00   0.000   0.019   0.0394    10.9997  .0000E+00  .5694E-05
 88       0.16   0.000   0.023   0.1760    10.9997  .0000E+00  .5694E-05
 89       0.00   0.000   0.022   0.1540    11.0950  .0000E+00  .5768E-05
 90       0.00   0.000   0.024   0.1303    11.2551  .0000E+00  .5893E-05
 91       0.00   0.000   0.022   0.1080    11.2273  .0000E+00  .5871E-05
 92       0.01   0.000   0.020   0.0976    11.1734  .0000E+00  .5829E-05
 93       0.00   0.000   0.019   0.0790    11.1458  .0000E+00  .5807E-05
 94       0.00   0.000   0.019   0.0604    11.1070  .0000E+00  .5777E-05
 95       0.00   0.000   0.018   0.0421    11.0607  .0000E+00  .5741E-05
 96       0.00   0.000   0.018   0.0245    11.0144  .0000E+00  .5706E-05
 97       0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
 98       0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
 99       0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
100       0.10   0.000   0.011   0.1129    10.9997  .0000E+00  .5694E-05
101       0.00   0.000   0.014   0.0991    10.9997  .0000E+00  .5694E-05
102       0.00   0.000   0.014   0.0849    11.0387  .0000E+00  .5724E-05
103       0.00   0.000   0.014   0.0709    11.0472  .0000E+00  .5731E-05
104       0.00   0.000   0.014   0.0569    11.0592  .0000E+00  .5740E-05
105       0.00   0.000   0.014   0.0432    11.0517  .0000E+00  .5734E-05
106       0.00   0.000   0.013   0.0298    11.0207  .0000E+00  .5710E-05
107       0.00   0.000   0.006   0.0240    10.9998  .0000E+00  .5694E-05
108       0.07   0.000   0.006   0.0879    10.9998  .0000E+00  .5694E-05
109       0.01   0.000   0.011   0.0867    10.9998  .0000E+00  .5694E-05
110       0.00   0.000   0.012   0.0747    10.9997  .0000E+00  .5694E-05
111       0.00   0.000   0.012   0.0630    10.9997  .0000E+00  .5694E-05
112       0.00   0.000   0.012   0.0510    10.9997  .0000E+00  .5694E-05
113       0.01   0.000   0.013   0.0484    10.9997  .0000E+00  .5694E-05
114       0.01   0.000   0.012   0.0459    11.0001  .0000E+00  .5695E-05
115       0.00   0.000   0.011   0.0346    11.0001  .0000E+00  .5695E-05
116       0.00   0.000   0.009   0.0253    10.9998  .0000E+00  .5694E-05
117       0.00   0.000   0.001   0.0243    10.9998  .0000E+00  .5694E-05
118       0.00   0.000   0.000   0.0241    10.9997  .0000E+00  .5694E-05
119       0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
120       0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
121       0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
122       0.06   0.000   0.005   0.0788    10.9997  .0000E+00  .5694E-05
123       0.00   0.000   0.008   0.0704    10.9997  .0000E+00  .5694E-05
124       0.00   0.000   0.010   0.0607    10.9997  .0000E+00  .5694E-05
125       0.00   0.000   0.010   0.0510    10.9996  .0000E+00  .5694E-05
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126         0.00  0.000  0.010  0.0415    10.9996 .0000E+00 .5694E-05
127         0.00  0.000  0.009  0.0321    10.9996 .0000E+00 .5694E-05
128         0.00  0.000  0.006  0.0259    10.9996 .0000E+00 .5694E-05
129         0.00  0.000  0.002  0.0240    10.9996 .0000E+00 .5694E-05
130         0.01  0.000  0.002  0.0322    10.9996 .0000E+00 .5694E-05
131         0.13  0.000  0.007  0.1549    10.9996 .0000E+00 .5694E-05
132         0.00  0.000  0.009  0.1458    11.0555 .0000E+00 .5737E-05
133         0.00  0.000  0.009  0.1370    11.1506 .0000E+00 .5811E-05
134         0.00  0.000  0.009  0.1280    11.1537 .0000E+00 .5813E-05
135         0.35  0.000  0.010  0.4370    11.3073 .0000E+00 .5934E-05
136         0.03  0.000  0.216  0.2818    11.8216 .0000E+00 .6343E-05
137         0.01  0.000  0.010  0.2818    11.6013 .0000E+00 .6166E-05
138         0.00  0.000  0.009  0.2730    11.5842 .0000E+00 .6152E-05
139         0.00  0.000  0.009  0.2643    11.5734 .0000E+00 .6144E-05
140         0.00  0.000  0.009  0.2556    11.5620 .0000E+00 .6135E-05
141         0.01  0.000  0.010  0.2560    11.5421 .0000E+00 .6119E-05
142         0.02  0.000  0.010  0.2664    11.5241 .0000E+00 .6104E-05
143         0.00  0.000  0.008  0.2580    11.5136 .0000E+00 .6096E-05
144         0.00  0.000  0.008  0.2497    11.5033 .0000E+00 .6088E-05
145         0.00  0.000  0.008  0.2414    11.4968 .0000E+00 .6083E-05
146         0.00  0.000  0.008  0.2331    11.4956 .0000E+00 .6082E-05
147         0.00  0.000  0.008  0.2250    11.4903 .0000E+00 .6078E-05
148         0.00  0.000  0.008  0.2169    11.4770 .0000E+00 .6067E-05
149         0.00  0.000  0.008  0.2089    11.4555 .0000E+00 .6050E-05
150         0.00  0.000  0.008  0.2009    11.4342 .0000E+00 .6033E-05
151         0.00  0.000  0.008  0.1930    11.4130 .0000E+00 .6017E-05
152         0.00  0.000  0.008  0.1852    11.3920 .0000E+00 .6000E-05
153         0.00  0.000  0.008  0.1774    11.3711 .0000E+00 .5984E-05
154         0.12  0.000  0.009  0.2886    11.3556 .0000E+00 .5971E-05
155         0.01  0.000  0.009  0.2898    11.5261 .0000E+00 .6106E-05
156         0.00  0.000  0.008  0.2822    11.5868 .0000E+00 .6154E-05
157         0.00  0.000  0.008  0.2746    11.5813 .0000E+00 .6150E-05
158         0.00  0.000  0.008  0.2671    11.5750 .0000E+00 .6145E-05
159         0.02  0.000  0.009  0.2785    11.5685 .0000E+00 .6140E-05
160         0.00  0.000  0.007  0.2711    11.5616 .0000E+00 .6134E-05
161         0.36  0.000  0.008  0.4370    11.7808 .0000E+00 .6311E-05
162         0.15  0.000  0.233  0.4370    11.9998 .0000E+00 .6487E-05
163         0.01  0.000  0.238  0.3115    11.8628 .0000E+00 .6376E-05
164         0.00  0.000  0.219  0.0929    11.4464 .0000E+00 .6043E-05
165         0.00  0.000  0.069  0.0240    11.0872 .0000E+00 .5762E-05
166         0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
167         0.01  0.000  0.004  0.0295    10.9998 .0000E+00 .5694E-05
168         0.00  0.000  0.004  0.0251    10.9998 .0000E+00 .5694E-05
169         0.00  0.000  0.001  0.0243    10.9997 .0000E+00 .5694E-05
170         0.00  0.000  0.000  0.0241    10.9997 .0000E+00 .5694E-05
171         0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
172         0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
173         0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
174         0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
175         0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
176         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
177         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
178         0.02  0.000  0.008  0.0356    10.9996 .0000E+00 .5694E-05
179         0.00  0.000  0.007  0.0285    10.9996 .0000E+00 .5694E-05
180         0.00  0.000  0.004  0.0247    10.9996 .0000E+00 .5694E-05
181         0.00  0.000  0.001  0.0242    10.9996 .0000E+00 .5694E-05
182         0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
183         0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
184         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
185         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
186         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
187         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
188         0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
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189          0.00  0.000  0.000  0.0240    10.9996 .0000E+00  .5694E-05
190          0.11  0.000  0.010  0.1243    10.9995 .0000E+00  .5694E-05
191          0.00  0.000  0.012  0.1127    11.0207 .0000E+00  .5710E-05
192          0.00  0.000  0.012  0.1003    11.0851 .0000E+00  .5760E-05
193          0.00  0.000  0.012  0.0885    11.0879 .0000E+00  .5762E-05
194          0.00  0.000  0.010  0.0784    11.0916 .0000E+00  .5765E-05
195          0.00  0.000  0.010  0.0688    11.1012 .0000E+00  .5773E-05
196          0.00  0.000  0.012  0.0573    11.0909 .0000E+00  .5765E-05
197          0.00  0.000  0.011  0.0459    11.0602 .0000E+00  .5741E-05
198          0.00  0.000  0.011  0.0346    11.0300 .0000E+00  .5718E-05
199          0.00  0.000  0.011  0.0240    11.0038 .0000E+00  .5697E-05
200          0.01  0.000  0.002  0.0320    10.9998 .0000E+00  .5694E-05
201          0.35  0.000  0.011  0.3705    11.0997 .0000E+00  .5772E-05
202          0.01  0.000  0.012  0.3689    11.8119 .0000E+00  .6335E-05
203          0.00  0.000  0.010  0.3584    11.7983 .0000E+00  .6324E-05
204          0.00  0.000  0.010  0.3481    11.7853 .0000E+00  .6313E-05
205          0.00  0.000  0.010  0.3379    11.7667 .0000E+00  .6298E-05
206          0.00  0.000  0.010  0.3278    11.7423 .0000E+00  .6279E-05
207          0.00  0.000  0.010  0.3178    11.7155 .0000E+00  .6257E-05
208          0.00  0.000  0.010  0.3080    11.6890 .0000E+00  .6236E-05
209          0.00  0.000  0.010  0.2982    11.6661 .0000E+00  .6218E-05
210          0.00  0.000  0.010  0.2886    11.6515 .0000E+00  .6206E-05
211          0.00  0.000  0.010  0.2791    11.6283 .0000E+00  .6187E-05
212          0.01  0.000  0.010  0.2786    11.6038 .0000E+00  .6168E-05
213          0.00  0.000  0.009  0.2693    11.5840 .0000E+00  .6152E-05
214          0.00  0.000  0.009  0.2604    11.5706 .0000E+00  .6141E-05
215          0.02  0.000  0.010  0.2702    11.5572 .0000E+00  .6131E-05
216          0.01  0.000  0.010  0.2701    11.5431 .0000E+00  .6119E-05
217          0.56  0.000  0.010  0.4370    11.7941 .0000E+00  .6321E-05
218          0.00  0.000  0.298  0.4370    11.9998 .0000E+00  .6487E-05
219          0.01  0.000  0.218  0.3137    11.8653 .0000E+00  .6378E-05
220          0.00  0.000  0.009  0.3048    11.6789 .0000E+00  .6228E-05
221          0.00  0.000  0.009  0.2960    11.6616 .0000E+00  .6214E-05
222          0.00  0.000  0.009  0.2873    11.6484 .0000E+00  .6203E-05
223          0.00  0.000  0.009  0.2786    11.6257 .0000E+00  .6185E-05
224          0.02  0.000  0.009  0.2891    11.6063 .0000E+00  .6170E-05
225          0.01  0.000  0.009  0.2897    11.5930 .0000E+00  .6159E-05
226          0.00  0.000  0.008  0.2813    11.5820 .0000E+00  .6150E-05
227          0.00  0.000  0.008  0.2729    11.5754 .0000E+00  .6145E-05
228          0.00  0.000  0.008  0.2646    11.5688 .0000E+00  .6140E-05
229          0.00  0.000  0.008  0.2564    11.5597 .0000E+00  .6133E-05
230          0.00  0.000  0.008  0.2483    11.5439 .0000E+00  .6120E-05
231          0.00  0.000  0.008  0.2402    11.5222 .0000E+00  .6103E-05
232          0.00  0.000  0.008  0.2322    11.5022 .0000E+00  .6087E-05
233          0.00  0.000  0.008  0.2242    11.4917 .0000E+00  .6079E-05
234          0.02  0.000  0.009  0.2354    11.4784 .0000E+00  .6068E-05
235          0.00  0.000  0.008  0.2275    11.4661 .0000E+00  .6059E-05
236          0.00  0.000  0.008  0.2197    11.4560 .0000E+00  .6050E-05
237          0.00  0.000  0.008  0.2120    11.4496 .0000E+00  .6045E-05
238          0.01  0.000  0.009  0.2134    11.4408 .0000E+00  .6038E-05
239          0.07  0.000  0.008  0.2749    11.4292 .0000E+00  .6029E-05
240          0.00  0.000  0.008  0.2674    11.4754 .0000E+00  .6066E-05
241          0.00  0.000  0.008  0.2598    11.4987 .0000E+00  .6084E-05
242          0.00  0.000  0.007  0.2524    11.5200 .0000E+00  .6101E-05
243          0.00  0.000  0.007  0.2449    11.5168 .0000E+00  .6099E-05
244          0.00  0.000  0.007  0.2384    11.5072 .0000E+00  .6091E-05
245          0.82  0.000  0.008  0.4370    11.8758 .0000E+00  .6387E-05
246          0.62  0.000  0.247  0.4370    11.9998 .0000E+00  .6487E-05
247          0.38  0.000  0.158  0.4370    11.9998 .0000E+00  .6487E-05
248          0.00  0.000  0.233  0.4370    11.9998 .0000E+00  .6487E-05
249          0.00  0.000  0.251  0.4370    11.9998 .0000E+00  .6487E-05
250          0.05  0.000  0.211  0.4370    11.9998 .0000E+00  .6487E-05
251          0.00  0.000  0.270  0.4370    11.9998 .0000E+00  .6487E-05
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252          0.00   0.000   0.270   0.4370     11.9998  .0000E+00  .6487E-05
253          0.00   0.000   0.228   0.2318     11.7761  .0000E+00  .6306E-05
254          0.00   0.000   0.162   0.0693     11.3073  .0000E+00  .5934E-05
255          0.00   0.000   0.045   0.0240     11.0584  .0000E+00  .5740E-05
256          0.03   0.000   0.025   0.0286     10.9998  .0000E+00  .5694E-05
257          0.08   0.000   0.034   0.0743     10.9998  .0000E+00  .5694E-05
258          0.00   0.000   0.031   0.0436     10.9998  .0000E+00  .5694E-05
259          0.00   0.000   0.017   0.0269     10.9997  .0000E+00  .5694E-05
260          0.00   0.000   0.002   0.0245     10.9997  .0000E+00  .5694E-05
261          0.00   0.000   0.001   0.0240     10.9997  .0000E+00  .5694E-05
262          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
263          0.13   0.000   0.017   0.1373     10.9997  .0000E+00  .5694E-05
264          0.00   0.000   0.019   0.1187     11.0267  .0000E+00  .5715E-05
265          0.24   0.000   0.022   0.3369     11.1527  .0000E+00  .5813E-05
266          0.03   0.000   0.021   0.3461     11.6544  .0000E+00  .6208E-05
267          0.09   0.000   0.020   0.4162     11.7891  .0000E+00  .6316E-05
268          0.01   0.000   0.019   0.4071     11.9305  .0000E+00  .6430E-05
269          0.00   0.000   0.018   0.3894     11.9016  .0000E+00  .6407E-05
270          0.00   0.000   0.017   0.3723     11.8559  .0000E+00  .6370E-05
271          0.00   0.000   0.016   0.3558     11.8190  .0000E+00  .6340E-05
272          0.00   0.000   0.016   0.3398     11.7843  .0000E+00  .6312E-05
273          0.00   0.000   0.016   0.3243     11.7421  .0000E+00  .6278E-05
274          0.00   0.000   0.015   0.3092     11.7011  .0000E+00  .6246E-05
275          0.00   0.000   0.014   0.2956     11.6662  .0000E+00  .6218E-05
276          0.00   0.000   0.014   0.2812     11.6421  .0000E+00  .6198E-05
277          0.00   0.000   0.014   0.2672     11.6042  .0000E+00  .6168E-05
278          0.00   0.000   0.014   0.2535     11.5672  .0000E+00  .6139E-05
279          0.00   0.000   0.013   0.2401     11.5310  .0000E+00  .6110E-05
280          0.00   0.000   0.012   0.2279     11.5003  .0000E+00  .6086E-05
281          0.04   0.000   0.014   0.2543     11.4854  .0000E+00  .6074E-05
282          0.00   0.000   0.013   0.2417     11.4687  .0000E+00  .6061E-05
283          0.00   0.000   0.012   0.2293     11.4596  .0000E+00  .6053E-05
284          0.00   0.000   0.012   0.2172     11.4575  .0000E+00  .6052E-05
285          0.00   0.000   0.012   0.2052     11.4463  .0000E+00  .6043E-05
286          0.00   0.000   0.012   0.1935     11.4206  .0000E+00  .6023E-05
287          0.00   0.000   0.012   0.1819     11.3894  .0000E+00  .5998E-05
288          0.00   0.000   0.011   0.1705     11.3588  .0000E+00  .5974E-05
289          0.58   0.000   0.012   0.4370     11.6694  .0000E+00  .6223E-05
290          0.00   0.000   0.198   0.4370     11.9998  .0000E+00  .6487E-05
291          0.00   0.000   0.213   0.3280     11.8795  .0000E+00  .6389E-05
292          0.04   0.000   0.165   0.2029     11.5784  .0000E+00  .6148E-05
293          0.04   0.000   0.115   0.1277     11.3329  .0000E+00  .5954E-05
294          0.00   0.000   0.087   0.0411     11.1420  .0000E+00  .5804E-05
295          0.00   0.000   0.017   0.0246     11.0097  .0000E+00  .5702E-05
296          0.00   0.000   0.000   0.0242     10.9998  .0000E+00  .5694E-05
297          0.04   0.000   0.015   0.0489     10.9998  .0000E+00  .5694E-05
298          0.01   0.000   0.020   0.0390     10.9998  .0000E+00  .5694E-05
299          0.08   0.000   0.021   0.0980     10.9998  .0000E+00  .5694E-05
300          0.09   0.000   0.024   0.1640     10.9998  .0000E+00  .5694E-05
301          0.18   0.000   0.024   0.3196     11.1517  .0000E+00  .5812E-05
302          0.00   0.000   0.022   0.2976     11.5871  .0000E+00  .6155E-05
303          0.00   0.000   0.021   0.2765     11.6209  .0000E+00  .6181E-05
304          0.10   0.000   0.021   0.3558     11.6048  .0000E+00  .6169E-05
305          0.00   0.000   0.184   0.1715     11.5508  .0000E+00  .6126E-05
306          0.00   0.000   0.018   0.1535     11.3284  .0000E+00  .5950E-05
307          0.00   0.000   0.018   0.1351     11.2929  .0000E+00  .5922E-05
308          0.00   0.000   0.018   0.1174     11.2446  .0000E+00  .5884E-05
309          0.24   0.000   0.018   0.3397     11.2165  .0000E+00  .5862E-05
310          1.43   0.000   0.017   0.4370     11.8730  .0000E+00  .6385E-05
311          0.06   0.000   0.177   0.4370     11.9998  .0000E+00  .6487E-05
312          0.01   0.000   0.162   0.4370     11.9998  .0000E+00  .6487E-05
313          0.00   0.000   0.200   0.4370     11.9998  .0000E+00  .6487E-05
314          0.04   0.000   0.135   0.4370     11.9998  .0000E+00  .6487E-05
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315          0.11  0.000  0.130  0.4370    11.9998 .0000E+00 .6487E-05
316          0.00  0.000  0.225  0.4370    11.9998 .0000E+00 .6487E-05
317          0.12  0.000  0.177  0.4370    11.9998 .0000E+00 .6487E-05
318          0.04  0.000  0.182  0.4370    11.9998 .0000E+00 .6487E-05
319          0.00  0.000  0.217  0.4370    11.9998 .0000E+00 .6487E-05
320          0.00  0.000  0.149  0.3795    11.9420 .0000E+00 .6440E-05
321          0.00  0.000  0.144  0.2357    11.6910 .0000E+00 .6238E-05
322          0.00  0.000  0.107  0.1289    11.3800 .0000E+00 .5991E-05
323          0.00  0.000  0.088  0.0412    11.1542 .0000E+00 .5814E-05
324          0.00  0.000  0.017  0.0240    11.0129 .0000E+00 .5704E-05
325          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
326          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
327          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
328          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
329          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
330          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
331          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
332          0.02  0.000  0.010  0.0341    10.9997 .0000E+00 .5694E-05
333          0.03  0.000  0.010  0.0543    10.9997 .0000E+00 .5694E-05
334          0.10  0.000  0.015  0.1396    10.9996 .0000E+00 .5694E-05
335          0.00  0.000  0.019  0.1204    11.0341 .0000E+00 .5721E-05
336          0.00  0.000  0.019  0.1018    11.0855 .0000E+00 .5761E-05
337          0.00  0.000  0.013  0.0884    11.0896 .0000E+00 .5764E-05
338          0.00  0.000  0.018  0.0707    11.1002 .0000E+00 .5772E-05
339          0.01  0.000  0.018  0.0631    11.0894 .0000E+00 .5764E-05
340          0.01  0.000  0.017  0.0560    11.0562 .0000E+00 .5738E-05
341          0.00  0.000  0.016  0.0400    11.0309 .0000E+00 .5718E-05
342          0.00  0.000  0.014  0.0255    11.0056 .0000E+00 .5699E-05
343          0.00  0.000  0.001  0.0243    10.9998 .0000E+00 .5694E-05
344          0.00  0.000  0.000  0.0241    10.9998 .0000E+00 .5694E-05
345          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
346          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
347          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
348          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
349          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
350          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
351          0.21  0.000  0.011  0.2230    10.9997 .0000E+00 .5694E-05
352          0.01  0.000  0.011  0.2223    11.2708 .0000E+00 .5905E-05
353          0.00  0.000  0.012  0.2101    11.4221 .0000E+00 .6024E-05
354          0.02  0.000  0.013  0.2175    11.4150 .0000E+00 .6018E-05
355          0.13  0.000  0.012  0.3352    11.4171 .0000E+00 .6020E-05
356          1.15  0.000  0.012  0.4370    11.8963 .0000E+00 .6403E-05
357          0.20  0.000  0.159  0.4370    11.9998 .0000E+00 .6487E-05
358          0.15  0.000  0.171  0.4370    11.9998 .0000E+00 .6487E-05
359          0.22  0.000  0.175  0.4370    11.9998 .0000E+00 .6487E-05
360          0.15  0.000  0.128  0.4370    11.9998 .0000E+00 .6487E-05
361          1.06  0.000  0.119  0.4370    11.9998 .0000E+00 .6487E-05
362          0.68  0.000  0.118  0.4370    11.9998 .0000E+00 .6487E-05
363          0.01  0.000  0.145  0.4370    11.9998 .0000E+00 .6487E-05
364          0.04  0.000  0.170  0.4370    11.9998 .0000E+00 .6487E-05
365          2.46  0.000  0.120  0.4370    11.9998 .0000E+00 .6487E-05
366          0.93  0.000  0.150  0.4370    11.9998 .0000E+00 .6487E-05

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    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  2
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  1 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  3

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                         DAILY OUTPUT FOR YEAR 2005
-------------------------------------------------------------------------------
         S
DAY  A   O   RAIN  RUNOFF    ET    E. ZONE    HEAD      DRAIN      LEAK
     I   I                          WATER      #1        #1         #1
     R   L    IN.    IN.     IN.   IN./IN.     IN.       IN.        IN.
---  -   -  -----  ------  ------  -------  ---------  ---------  ---------

  1         4.04   0.000   0.111   0.4370    11.9998  .0000E+00  .6487E-05
  2         0.01   0.000   0.108   0.4370    11.9998  .0000E+00  .6487E-05
  3         0.01   0.000   0.120   0.4370    11.9998  .0000E+00  .6487E-05
  4         0.00   0.000   0.119   0.4370    11.9998  .0000E+00  .6487E-05
  5         0.00   0.000   0.132   0.4370    11.9998  .0000E+00  .6487E-05
  6         0.00   0.000   0.150   0.4370    11.9998  .0000E+00  .6487E-05
  7         0.00   0.000   0.178   0.4370    11.9998  .0000E+00  .6487E-05
  8         0.92   0.000   0.171   0.4370    11.9998  .0000E+00  .6487E-05
  9         0.01   0.000   0.144   0.4370    11.9998  .0000E+00  .6487E-05
 10         0.00   0.000   0.149   0.4370    11.9998  .0000E+00  .6487E-05
 11         0.00   0.000   0.154   0.4370    11.9998  .0000E+00  .6487E-05
 12         0.00   0.000   0.161   0.4370    11.9998  .0000E+00  .6487E-05
 13         0.31   0.000   0.166   0.4370    11.9998  .0000E+00  .6487E-05
 14         0.29   0.000   0.146   0.4370    11.9998  .0000E+00  .6487E-05
 15         0.23   0.000   0.189   0.4370    11.9998  .0000E+00  .6487E-05
 16         1.80   0.000   0.161   0.4370    11.9998  .0000E+00  .6487E-05
 17         0.13   0.000   0.146   0.4370    11.9998  .0000E+00  .6487E-05
 18         0.05   0.000   0.162   0.4370    11.9998  .0000E+00  .6487E-05
 19         0.00   0.000   0.183   0.4370    11.9998  .0000E+00  .6487E-05
 20         0.02   0.000   0.117   0.4370    11.9998  .0000E+00  .6487E-05
 21         0.13   0.000   0.122   0.4370    11.9998  .0000E+00  .6487E-05
 22         0.00   0.000   0.191   0.4370    11.9998  .0000E+00  .6487E-05
 23         0.00   0.000   0.212   0.4370    11.9998  .0000E+00  .6487E-05
 24         0.40   0.000   0.153   0.4370    11.9998  .0000E+00  .6487E-05
 25         0.56   0.000   0.146   0.4370    11.9998  .0000E+00  .6487E-05
 26         0.00   0.000   0.196   0.4370    11.9998  .0000E+00  .6487E-05
 27         0.00   0.000   0.209   0.4370    11.9998  .0000E+00  .6487E-05
 28         0.07   0.000   0.162   0.4370    11.9998  .0000E+00  .6487E-05
 29         0.00   0.000   0.190   0.4370    11.9998  .0000E+00  .6487E-05
 30         0.00   0.000   0.198   0.4370    11.9998  .0000E+00  .6487E-05
 31         0.74   0.000   0.184   0.4370    11.9998  .0000E+00  .6487E-05
 32         0.30   0.000   0.159   0.4370    11.9998  .0000E+00  .6487E-05
 33         0.21   0.000   0.148   0.4370    11.9998  .0000E+00  .6487E-05
 34         0.16   0.000   0.127   0.4370    11.9998  .0000E+00  .6487E-05
 35         0.03   0.000   0.115   0.4370    11.9998  .0000E+00  .6487E-05
 36         0.01   0.000   0.169   0.4370    11.9998  .0000E+00  .6487E-05
 37         0.00   0.000   0.195   0.4370    11.9998  .0000E+00  .6487E-05
 38         0.00   0.000   0.223   0.4370    11.9998  .0000E+00  .6487E-05
 39         0.00   0.000   0.182   0.4370    11.9998  .0000E+00  .6487E-05
 40         0.00   0.000   0.225   0.4370    11.9998  .0000E+00  .6487E-05
 41         0.00   0.000   0.162   0.4370    11.9998  .0000E+00  .6487E-05
 42         0.10   0.000   0.190   0.4370    11.9998  .0000E+00  .6487E-05
 43         0.01   0.000   0.182   0.4370    11.9998  .0000E+00  .6487E-05
 44         0.00   0.000   0.208   0.4370    11.9998  .0000E+00  .6487E-05
 45         0.00   0.000   0.173   0.4370    11.9998  .0000E+00  .6487E-05
 46         0.00   0.000   0.182   0.4370    11.9998  .0000E+00  .6487E-05
 47         0.00   0.000   0.213   0.4370    11.9998  .0000E+00  .6487E-05
 48         0.00   0.000   0.202   0.4370    11.9998  .0000E+00  .6487E-05
 49         0.00   0.000   0.192   0.4370    11.9998  .0000E+00  .6487E-05
 50         0.00   0.000   0.163   0.4370    11.9998  .0000E+00  .6487E-05
 51         0.00   0.000   0.168   0.4370    11.9998  .0000E+00  .6487E-05
 52         0.00   0.000   0.141   0.4370    11.9998  .0000E+00  .6487E-05
 53         0.00   0.000   0.168   0.4370    11.9998  .0000E+00  .6487E-05
 54         0.00   0.000   0.217   0.4370    11.9998  .0000E+00  .6487E-05
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   55         0.00   0.000   0.179   0.4370    11.9998  .0000E+00  .6487E-05
   56         0.00   0.000   0.167   0.4370    11.9998  .0000E+00  .6487E-05
   57         0.00   0.000   0.193   0.4370    11.9998  .0000E+00  .6487E-05
   58         0.00   0.000   0.196   0.4370    11.9998  .0000E+00  .6487E-05
   59         0.00   0.000   0.223   0.4370    11.9998  .0000E+00  .6487E-05
   60         0.00   0.000   0.176   0.4370    11.9998  .0000E+00  .6487E-05
   61         0.00   0.000   0.170   0.4370    11.9998  .0000E+00  .6487E-05
   62         0.00   0.000   0.183   0.4370    11.9998  .0000E+00  .6487E-05
   63         0.00   0.000   0.196   0.4370    11.9998  .0000E+00  .6487E-05
   64         0.08   0.000   0.155   0.4370    11.9998  .0000E+00  .6487E-05
   65         0.01   0.000   0.153   0.4370    11.9998  .0000E+00  .6487E-05
   66         0.00   0.000   0.151   0.4370    11.9998  .0000E+00  .6487E-05
   67         0.03   0.000   0.143   0.4370    11.9998  .0000E+00  .6487E-05
   68         0.01   0.000   0.159   0.4370    11.9998  .0000E+00  .6487E-05
   69         0.00   0.000   0.220   0.4370    11.9998  .0000E+00  .6487E-05
   70         0.00   0.000   0.208   0.4370    11.9998  .0000E+00  .6487E-05
   71         0.10   0.000   0.122   0.4370    11.9998  .0000E+00  .6487E-05
   72         0.02   0.000   0.123   0.4370    11.9998  .0000E+00  .6487E-05
   73         0.03   0.000   0.116   0.4370    11.9998  .0000E+00  .6487E-05
   74         0.07   0.000   0.153   0.4370    11.9998  .0000E+00  .6487E-05
   75         0.00   0.000   0.186   0.4370    11.9998  .0000E+00  .6487E-05
   76         0.00   0.000   0.233   0.4370    11.9998  .0000E+00  .6487E-05
   77         0.00   0.000   0.173   0.4370    11.9998  .0000E+00  .6487E-05
   78         0.00   0.000   0.211   0.4370    11.9998  .0000E+00  .6487E-05
   79         0.00   0.000   0.152   0.4370    11.9998  .0000E+00  .6487E-05
   80         0.00   0.000   0.228   0.4370    11.9998  .0000E+00  .6487E-05
   81         0.00   0.000   0.194   0.4370    11.9998  .0000E+00  .6487E-05
   82         0.00   0.000   0.211   0.4370    11.9998  .0000E+00  .6487E-05
   83         0.00   0.000   0.181   0.4370    11.9998  .0000E+00  .6487E-05
   84         0.01   0.000   0.125   0.4370    11.9998  .0000E+00  .6487E-05
   85         0.00   0.000   0.183   0.4370    11.9998  .0000E+00  .6487E-05
   86         0.00   0.000   0.154   0.4370    11.9998  .0000E+00  .6487E-05
   87         0.00   0.000   0.209   0.4370    11.9998  .0000E+00  .6487E-05
   88         0.08   0.000   0.128   0.4370    11.9998  .0000E+00  .6487E-05
   89         0.00   0.000   0.262   0.4370    11.9998  .0000E+00  .6487E-05
   90         0.00   0.000   0.224   0.4370    11.9998  .0000E+00  .6487E-05
   91         0.00   0.000   0.256   0.4370    11.9998  .0000E+00  .6487E-05
   92         0.00   0.000   0.236   0.4370    11.9998  .0000E+00  .6487E-05
   93         0.00   0.000   0.239   0.4370    11.9998  .0000E+00  .6487E-05
   94         0.00   0.000   0.247   0.4370    11.9998  .0000E+00  .6487E-05
   95         0.00   0.000   0.182   0.2617    11.8006  .0000E+00  .6326E-05
   96         0.00   0.000   0.187   0.0750    11.3455  .0000E+00  .5964E-05
   97         0.00   0.000   0.051   0.0240    11.0680  .0000E+00  .5747E-05
   98         0.01   0.000   0.010   0.0240    10.9998  .0000E+00  .5694E-05
   99         0.01   0.000   0.005   0.0293    10.9998  .0000E+00  .5694E-05
  100         0.00   0.000   0.004   0.0250    10.9998  .0000E+00  .5694E-05
  101         0.00   0.000   0.001   0.0242    10.9997  .0000E+00  .5694E-05
  102         0.00   0.000   0.000   0.0241    10.9997  .0000E+00  .5694E-05
  103         0.02   0.000   0.010   0.0338    10.9998  .0000E+00  .5694E-05
  104         0.09   0.000   0.017   0.1065    10.9998  .0000E+00  .5694E-05
  105         0.00   0.000   0.021   0.0853    10.9998  .0000E+00  .5694E-05
  106         0.00   0.000   0.021   0.0648    10.9998  .0000E+00  .5694E-05
  107         0.00   0.000   0.021   0.0440    11.0014  .0000E+00  .5695E-05
  108         0.00   0.000   0.018   0.0264    11.0028  .0000E+00  .5697E-05
  109         0.00   0.000   0.002   0.0240    10.9998  .0000E+00  .5694E-05
  110         0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
  111         0.00   0.000   0.000   0.0240    10.9998  .0000E+00  .5694E-05
  112         0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
  113         0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
  114         0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
  115         0.00   0.000   0.000   0.0240    10.9997  .0000E+00  .5694E-05
  116         0.14   0.000   0.010   0.1536    10.9997  .0000E+00  .5694E-05
  117         0.21   0.000   0.015   0.3490    11.0782  .0000E+00  .5755E-05
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118          0.00  0.000  0.014  0.3347    11.7205 .0000E+00 .6261E-05
119          0.00  0.000  0.014  0.3207    11.7285 .0000E+00 .6268E-05
120          0.00  0.000  0.014  0.3070    11.6928 .0000E+00 .6239E-05
121          0.20  0.000  0.014  0.4370    11.8099 .0000E+00 .6333E-05
122          0.01  0.000  0.070  0.4335    11.9963 .0000E+00 .6484E-05
123          0.00  0.000  0.013  0.4206    11.9776 .0000E+00 .6469E-05
124          0.00  0.000  0.013  0.4080    11.9451 .0000E+00 .6442E-05
125          0.00  0.000  0.012  0.3956    11.9130 .0000E+00 .6416E-05
126          0.00  0.000  0.012  0.3835    11.8802 .0000E+00 .6390E-05
127          0.00  0.000  0.012  0.3715    11.8469 .0000E+00 .6363E-05
128          0.00  0.000  0.012  0.3598    11.8211 .0000E+00 .6342E-05
129          0.00  0.000  0.012  0.3482    11.7985 .0000E+00 .6324E-05
130          0.00  0.000  0.011  0.3368    11.7684 .0000E+00 .6300E-05
131          0.00  0.000  0.011  0.3256    11.7382 .0000E+00 .6275E-05
132          0.00  0.000  0.011  0.3145    11.7085 .0000E+00 .6251E-05
133          0.00  0.000  0.011  0.3036    11.6791 .0000E+00 .6228E-05
134          0.00  0.000  0.011  0.2929    11.6585 .0000E+00 .6211E-05
135          0.00  0.000  0.011  0.2822    11.6386 .0000E+00 .6196E-05
136          0.00  0.000  0.010  0.2718    11.6104 .0000E+00 .6173E-05
137          0.00  0.000  0.010  0.2614    11.5826 .0000E+00 .6151E-05
138          0.00  0.000  0.010  0.2512    11.5552 .0000E+00 .6129E-05
139          0.00  0.000  0.010  0.2411    11.5281 .0000E+00 .6108E-05
140          0.00  0.000  0.010  0.2312    11.5030 .0000E+00 .6088E-05
141          0.00  0.000  0.010  0.2213    11.4884 .0000E+00 .6076E-05
142          0.01  0.000  0.010  0.2210    11.4664 .0000E+00 .6059E-05
143          0.00  0.000  0.010  0.2114    11.4460 .0000E+00 .6043E-05
144          0.00  0.000  0.009  0.2027    11.4317 .0000E+00 .6031E-05
145          0.00  0.000  0.009  0.1933    11.4148 .0000E+00 .6018E-05
146          0.00  0.000  0.009  0.1840    11.3912 .0000E+00 .5999E-05
147          0.03  0.000  0.010  0.2041    11.3703 .0000E+00 .5983E-05
148          0.00  0.000  0.009  0.1950    11.3584 .0000E+00 .5974E-05
149          0.00  0.000  0.009  0.1859    11.3505 .0000E+00 .5967E-05
150          0.00  0.000  0.009  0.1769    11.3441 .0000E+00 .5962E-05
151          0.00  0.000  0.009  0.1681    11.3384 .0000E+00 .5958E-05
152          0.06  0.000  0.009  0.2186    11.3324 .0000E+00 .5953E-05
153          0.02  0.000  0.009  0.2292    11.3303 .0000E+00 .5951E-05
154          0.02  0.000  0.009  0.2399    11.3533 .0000E+00 .5970E-05
155          0.00  0.000  0.009  0.2314    11.3956 .0000E+00 .6003E-05
156          0.00  0.000  0.008  0.2229    11.4117 .0000E+00 .6016E-05
157          0.00  0.000  0.008  0.2144    11.4124 .0000E+00 .6016E-05
158          0.00  0.000  0.008  0.2061    11.4146 .0000E+00 .6018E-05
159          0.00  0.000  0.008  0.1978    11.4140 .0000E+00 .6017E-05
160          0.00  0.000  0.008  0.1896    11.4037 .0000E+00 .6009E-05
161          0.00  0.000  0.008  0.1814    11.3826 .0000E+00 .5993E-05
162          0.00  0.000  0.008  0.1734    11.3609 .0000E+00 .5976E-05
163          0.00  0.000  0.008  0.1653    11.3397 .0000E+00 .5959E-05
164          0.00  0.000  0.008  0.1574    11.3282 .0000E+00 .5950E-05
165          0.00  0.000  0.008  0.1495    11.3137 .0000E+00 .5938E-05
166          0.00  0.000  0.008  0.1416    11.2927 .0000E+00 .5922E-05
167          0.12  0.000  0.009  0.2531    11.2771 .0000E+00 .5910E-05
168          0.00  0.000  0.008  0.2453    11.3791 .0000E+00 .5990E-05
169          0.00  0.000  0.008  0.2376    11.4758 .0000E+00 .6066E-05
170          0.85  0.000  0.008  0.4370    11.8691 .0000E+00 .6382E-05
171          0.00  0.000  0.269  0.4370    11.9998 .0000E+00 .6487E-05
172          0.00  0.000  0.271  0.4370    11.9998 .0000E+00 .6487E-05
173          0.00  0.000  0.275  0.2642    11.8029 .0000E+00 .6328E-05
174          0.00  0.000  0.189  0.0756    11.3518 .0000E+00 .5969E-05
175          0.00  0.000  0.052  0.0240    11.0689 .0000E+00 .5748E-05
176          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
177          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
178          0.00  0.000  0.000  0.0240    10.9998 .0000E+00 .5694E-05
179          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
180          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
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181          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
182          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
183          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
184          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
185          0.01  0.000  0.003  0.0315    10.9997 .0000E+00 .5694E-05
186          0.00  0.000  0.005  0.0261    10.9996 .0000E+00 .5694E-05
187          0.00  0.000  0.002  0.0245    10.9996 .0000E+00 .5694E-05
188          0.00  0.000  0.000  0.0241    10.9996 .0000E+00 .5694E-05
189          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
190          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
191          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
192          0.05  0.000  0.007  0.0666    10.9996 .0000E+00 .5694E-05
193          0.00  0.000  0.010  0.0561    10.9996 .0000E+00 .5694E-05
194          0.00  0.000  0.014  0.0424    10.9995 .0000E+00 .5694E-05
195          0.00  0.000  0.012  0.0306    10.9995 .0000E+00 .5694E-05
196          0.00  0.000  0.005  0.0254    10.9995 .0000E+00 .5694E-05
197          0.00  0.000  0.001  0.0241    10.9996 .0000E+00 .5694E-05
198          0.03  0.000  0.007  0.0474    10.9996 .0000E+00 .5694E-05
199          0.00  0.000  0.009  0.0384    10.9995 .0000E+00 .5694E-05
200          0.00  0.000  0.009  0.0296    10.9995 .0000E+00 .5694E-05
201          0.00  0.000  0.005  0.0247    10.9995 .0000E+00 .5694E-05
202          0.00  0.000  0.000  0.0244    10.9995 .0000E+00 .5694E-05
203          0.00  0.000  0.000  0.0241    10.9995 .0000E+00 .5694E-05
204          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
205          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
206          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
207          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
208          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
209          0.02  0.000  0.006  0.0384    10.9994 .0000E+00 .5694E-05
210          0.01  0.000  0.006  0.0428    10.9994 .0000E+00 .5694E-05
211          0.00  0.000  0.007  0.0355    10.9994 .0000E+00 .5694E-05
212          0.00  0.000  0.007  0.0283    10.9994 .0000E+00 .5694E-05
213          0.00  0.000  0.003  0.0248    10.9993 .0000E+00 .5694E-05
214          0.00  0.000  0.001  0.0242    10.9993 .0000E+00 .5694E-05
215          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
216          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
217          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
218          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
219          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
220          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
221          0.01  0.000  0.002  0.0322    10.9993 .0000E+00 .5694E-05
222          0.00  0.000  0.004  0.0282    10.9993 .0000E+00 .5694E-05
223          0.00  0.000  0.003  0.0249    10.9993 .0000E+00 .5694E-05
224          0.00  0.000  0.001  0.0242    10.9993 .0000E+00 .5694E-05
225          0.00  0.000  0.000  0.0241    10.9993 .0000E+00 .5694E-05
226          0.00  0.000  0.000  0.0240    10.9993 .0000E+00 .5694E-05
227          0.00  0.000  0.000  0.0240    10.9993 .0000E+00 .5694E-05
228          0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
229          0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
230          0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
231          0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
232          0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
233          0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
234          0.00  0.000  0.000  0.0240    10.9991 .0000E+00 .5694E-05
235          0.00  0.000  0.000  0.0240    10.9991 .0000E+00 .5694E-05
236          0.00  0.000  0.000  0.0240    10.9991 .0000E+00 .5694E-05
237          0.00  0.000  0.000  0.0240    10.9991 .0000E+00 .5694E-05
238          0.00  0.000  0.000  0.0240    10.9991 .0000E+00 .5694E-05
239          0.00  0.000  0.000  0.0240    10.9991 .0000E+00 .5694E-05
240          0.36  0.000  0.009  0.3749    11.1032 .0000E+00 .5775E-05
241          0.00  0.000  0.008  0.3668    11.8306 .0000E+00 .6350E-05
242          0.00  0.000  0.008  0.3589    11.8170 .0000E+00 .6339E-05
243          0.00  0.000  0.008  0.3510    11.8005 .0000E+00 .6325E-05
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244          0.00  0.000  0.008  0.3431    11.7794  .0000E+00  .6308E-05
245          0.00  0.000  0.008  0.3353    11.7586  .0000E+00  .6292E-05
246          0.00  0.000  0.008  0.3276    11.7378  .0000E+00  .6275E-05
247          0.01  0.000  0.009  0.3289    11.7179  .0000E+00  .6259E-05
248          0.02  0.000  0.009  0.3403    11.7017  .0000E+00  .6246E-05
249          0.00  0.000  0.008  0.3327    11.7144  .0000E+00  .6256E-05
250          0.00  0.000  0.008  0.3252    11.7133  .0000E+00  .6255E-05
251          0.00  0.000  0.007  0.3177    11.7030  .0000E+00  .6247E-05
252          0.00  0.000  0.007  0.3103    11.6894  .0000E+00  .6236E-05
253          0.00  0.000  0.007  0.3029    11.6716  .0000E+00  .6222E-05
254          0.00  0.000  0.007  0.2956    11.6607  .0000E+00  .6213E-05
255          0.00  0.000  0.007  0.2883    11.6491  .0000E+00  .6204E-05
256          0.00  0.000  0.007  0.2810    11.6297  .0000E+00  .6188E-05
257          0.00  0.000  0.007  0.2738    11.6104  .0000E+00  .6173E-05
258          0.05  0.000  0.008  0.3158    11.5943  .0000E+00  .6160E-05
259          0.02  0.000  0.008  0.3277    11.6222  .0000E+00  .6183E-05
260          0.00  0.000  0.007  0.3207    11.6551  .0000E+00  .6209E-05
261          0.00  0.000  0.007  0.3136    11.6626  .0000E+00  .6215E-05
262          0.00  0.000  0.007  0.3067    11.6632  .0000E+00  .6215E-05
263          0.00  0.000  0.007  0.2997    11.6603  .0000E+00  .6213E-05
264          0.00  0.000  0.007  0.2928    11.6537  .0000E+00  .6208E-05
265          0.00  0.000  0.007  0.2859    11.6422  .0000E+00  .6198E-05
266          0.00  0.000  0.007  0.2791    11.6239  .0000E+00  .6184E-05
267          0.33  0.000  0.008  0.4370    11.8058  .0000E+00  .6330E-05
268          0.00  0.000  0.171  0.4302    11.9930  .0000E+00  .6481E-05
269          0.00  0.000  0.007  0.4235    11.9751  .0000E+00  .6467E-05
270          0.00  0.000  0.007  0.4168    11.9581  .0000E+00  .6453E-05
271          0.00  0.000  0.007  0.4102    11.9416  .0000E+00  .6439E-05
272          0.00  0.000  0.007  0.4036    11.9245  .0000E+00  .6426E-05
273          0.00  0.000  0.007  0.3970    11.9069  .0000E+00  .6411E-05
274          0.03  0.000  0.007  0.4196    11.9061  .0000E+00  .6411E-05
275          0.04  0.000  0.007  0.4370    11.9751  .0000E+00  .6467E-05
276          0.03  0.000  0.023  0.4370    11.9998  .0000E+00  .6487E-05
277          0.01  0.000  0.030  0.4370    11.9998  .0000E+00  .6487E-05
278          0.00  0.000  0.009  0.4306    11.9934  .0000E+00  .6482E-05
279          0.00  0.000  0.006  0.4242    11.9760  .0000E+00  .6467E-05
280          0.00  0.000  0.006  0.4178    11.9595  .0000E+00  .6454E-05
281          0.00  0.000  0.006  0.4115    11.9440  .0000E+00  .6441E-05
282          0.02  0.000  0.007  0.4244    11.9381  .0000E+00  .6437E-05
283          0.01  0.000  0.007  0.4273    11.9641  .0000E+00  .6458E-05
284          0.00  0.000  0.006  0.4210    11.9661  .0000E+00  .6459E-05
285          0.00  0.000  0.006  0.4148    11.9518  .0000E+00  .6448E-05
286          0.00  0.000  0.006  0.4087    11.9366  .0000E+00  .6435E-05
287          0.00  0.000  0.006  0.4025    11.9209  .0000E+00  .6423E-05
288          0.00  0.000  0.006  0.3964    11.9045  .0000E+00  .6409E-05
289          0.00  0.000  0.006  0.3903    11.8882  .0000E+00  .6396E-05
290          0.00  0.000  0.006  0.3842    11.8719  .0000E+00  .6383E-05
291          0.00  0.000  0.006  0.3781    11.8558  .0000E+00  .6370E-05
292          0.00  0.000  0.006  0.3721    11.8357  .0000E+00  .6354E-05
293          0.09  0.000  0.007  0.4370    11.8907  .0000E+00  .6398E-05
294          0.00  0.000  0.024  0.4310    11.9938  .0000E+00  .6482E-05
295          0.00  0.000  0.006  0.4251    11.9775  .0000E+00  .6469E-05
296          0.00  0.000  0.006  0.4192    11.9621  .0000E+00  .6456E-05
297          0.00  0.000  0.006  0.4133    11.9477  .0000E+00  .6444E-05
298          0.10  0.000  0.007  0.4370    11.9775  .0000E+00  .6469E-05
299          0.00  0.000  0.075  0.4312    11.9940  .0000E+00  .6482E-05
300          0.00  0.000  0.006  0.4253    11.9781  .0000E+00  .6469E-05
301          0.00  0.000  0.006  0.4195    11.9630  .0000E+00  .6457E-05
302          0.00  0.000  0.006  0.4137    11.9489  .0000E+00  .6445E-05
303          0.00  0.000  0.006  0.4080    11.9345  .0000E+00  .6434E-05
304          0.00  0.000  0.006  0.4023    11.9195  .0000E+00  .6422E-05
305          0.00  0.000  0.006  0.3965    11.9043  .0000E+00  .6409E-05
306          0.00  0.000  0.006  0.3909    11.8891  .0000E+00  .6397E-05
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307          0.00  0.000  0.006  0.3852    11.8739 .0000E+00 .6385E-05
308          0.00  0.000  0.006  0.3795    11.8588 .0000E+00 .6372E-05
309          0.01  0.000  0.006  0.3832    11.8388 .0000E+00 .6356E-05
310          0.00  0.000  0.006  0.3776    11.8406 .0000E+00 .6358E-05
311          0.00  0.000  0.006  0.3720    11.8312 .0000E+00 .6350E-05
312          0.00  0.000  0.006  0.3664    11.8245 .0000E+00 .6345E-05
313          0.03  0.000  0.006  0.3901    11.8173 .0000E+00 .6339E-05
314          0.00  0.000  0.006  0.3846    11.8674 .0000E+00 .6379E-05
315          0.03  0.000  0.006  0.4084    11.8738 .0000E+00 .6385E-05
316          0.00  0.000  0.005  0.4029    11.9161 .0000E+00 .6419E-05
317          0.00  0.000  0.005  0.3974    11.9048 .0000E+00 .6410E-05
318          0.00  0.000  0.005  0.3920    11.8912 .0000E+00 .6399E-05
319          0.00  0.000  0.005  0.3866    11.8771 .0000E+00 .6387E-05
320          0.00  0.000  0.005  0.3812    11.8627 .0000E+00 .6376E-05
321          0.00  0.000  0.005  0.3758    11.8483 .0000E+00 .6364E-05
322          0.00  0.000  0.005  0.3704    11.8316 .0000E+00 .6350E-05
323          0.03  0.000  0.006  0.3943    11.8269 .0000E+00 .6347E-05
324          0.00  0.000  0.005  0.3889    11.8786 .0000E+00 .6388E-05
325          0.92  0.000  0.006  0.4370    11.9680 .0000E+00 .6461E-05
326          0.02  0.000  0.137  0.4370    11.9998 .0000E+00 .6487E-05
327          0.02  0.000  0.165  0.4370    11.9998 .0000E+00 .6487E-05
328          0.15  0.000  0.156  0.4370    11.9998 .0000E+00 .6487E-05
329          0.04  0.000  0.183  0.4370    11.9998 .0000E+00 .6487E-05
330          0.10  0.000  0.153  0.4370    11.9998 .0000E+00 .6487E-05
331          0.00  0.000  0.171  0.4370    11.9998 .0000E+00 .6487E-05
332          0.00  0.000  0.139  0.4370    11.9998 .0000E+00 .6487E-05
333          0.01  0.000  0.121  0.4183    11.9803 .0000E+00 .6471E-05
334          0.00  0.000  0.116  0.3028    11.8243 .0000E+00 .6345E-05
335          0.00  0.000  0.140  0.1631    11.5098 .0000E+00 .6093E-05
336          0.00  0.000  0.113  0.0496    11.1979 .0000E+00 .5848E-05
337          0.00  0.000  0.026  0.0240    11.0256 .0000E+00 .5714E-05
338          0.13  0.000  0.085  0.0690    10.9998 .0000E+00 .5694E-05
339          0.00  0.000  0.026  0.0432    10.9998 .0000E+00 .5694E-05
340          0.00  0.000  0.016  0.0275    10.9998 .0000E+00 .5694E-05
341          0.00  0.000  0.003  0.0244    10.9997 .0000E+00 .5694E-05
342          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
343          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
344          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
345          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
346          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
347          0.00  0.000  0.000  0.0240    10.9997 .0000E+00 .5694E-05
348          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
349          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
350          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
351          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
352          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
353          0.00  0.000  0.000  0.0240    10.9996 .0000E+00 .5694E-05
354          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
355          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
356          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
357          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
358          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
359          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
360          0.00  0.000  0.000  0.0240    10.9995 .0000E+00 .5694E-05
361          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
362          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
363          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
364          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05
365          0.00  0.000  0.000  0.0240    10.9994 .0000E+00 .5694E-05

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     HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  2
     DRAIN #1:  LATERAL DRAINAGE FROM LAYER  1 (RECIRCULATION AND COLLECTION)
     LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  3

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                         DAILY OUTPUT FOR YEAR 2006
------------------------------------------------------------------------------
          S
DAY   A   O   RAIN  RUNOFF   ET    E. ZONE    HEAD      DRAIN      LEAK
      I   I                         WATER      #1        #1         #1
      R   L   IN.     IN.    IN.   IN./IN.     IN.       IN.        IN.
---   -   -  -----  ------  ------ -------  --------- ---------  ---------

  1          0.00   0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
  2          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  3          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  4          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  5          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  6          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  7          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  8          0.00   0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
  9          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 10          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 11          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 12          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 13          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 14          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 15          0.00   0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
 16          0.00   0.000  0.000  0.0240    10.9991  .0000E+00  .5694E-05
 17          0.00   0.000  0.000  0.0240    10.9991  .0000E+00  .5694E-05
 18          0.00   0.000  0.000  0.0240    10.9991  .0000E+00  .5694E-05
 19          0.00   0.000  0.000  0.0240    10.9991  .0000E+00  .5694E-05
 20          0.00   0.000  0.000  0.0240    10.9991  .0000E+00  .5694E-05
 21          0.00   0.000  0.000  0.0240    10.9991  .0000E+00  .5694E-05
 22          0.00   0.000  0.000  0.0240    10.9990  .0000E+00  .5694E-05
 23          0.00   0.000  0.000  0.0240    10.9990  .0000E+00  .5694E-05
 24          0.12   0.000  0.007  0.1373    10.9990  .0000E+00  .5694E-05
 25          0.28   0.000  0.010  0.4074    11.2054  .0000E+00  .5855E-05
 26          0.49   0.000  0.010  0.4370    11.9576  .0000E+00  .6453E-05
 27          0.00   0.000  0.206  0.4370    11.9998  .0000E+00  .6487E-05
 28          0.00   0.000  0.208  0.4370    11.9998  .0000E+00  .6487E-05
 29          0.00   0.000  0.152  0.3220    11.8723  .0000E+00  .6384E-05
 30          0.00   0.000  0.173  0.1490    11.5159  .0000E+00  .6098E-05
 31          0.00   0.000  0.103  0.0457    11.1837  .0000E+00  .5837E-05
 32          0.01   0.000  0.027  0.0288    11.0197  .0000E+00  .5710E-05
 33          0.02   0.000  0.016  0.0327    10.9998  .0000E+00  .5694E-05
 34          0.00   0.000  0.007  0.0261    10.9998  .0000E+00  .5694E-05
 35          0.00   0.000  0.002  0.0244    10.9998  .0000E+00  .5694E-05
 36          0.00   0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
 37          0.00   0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
 38          0.00   0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
 39          0.00   0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
 40          0.00   0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
 41          0.00   0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
 42          0.06   0.000  0.009  0.0753    10.9997  .0000E+00  .5694E-05
 43          0.00   0.000  0.015  0.0602    10.9997  .0000E+00  .5694E-05
 44          0.00   0.000  0.016  0.0445    10.9997  .0000E+00  .5694E-05
 45          0.00   0.000  0.014  0.0307    10.9998  .0000E+00  .5694E-05
 46          0.00   0.000  0.006  0.0252    10.9998  .0000E+00  .5694E-05
 47          0.17   0.000  0.015  0.1801    10.9998  .0000E+00  .5694E-05
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48     0.06  0.000  0.015  0.2252   11.1149 .0000E+00 .5784E-05
49     0.00  0.000  0.015  0.2101   11.3253 .0000E+00 .5948E-05
50     0.00  0.000  0.015  0.1954   11.3736 .0000E+00 .5986E-05
51     0.09  0.000  0.015  0.2703   11.3750 .0000E+00 .5987E-05
52     0.29  0.000  0.015  0.4370   11.7055 .0000E+00 .6251E-05
53     0.03  0.000  0.123  0.4370   11.9998 .0000E+00 .6487E-05
54     0.01  0.000  0.030  0.4328   11.9956 .0000E+00 .6483E-05
55     0.00  0.000  0.013  0.4197   11.9758 .0000E+00 .6467E-05
56     0.01  0.000  0.014  0.4161   11.9478 .0000E+00 .6444E-05
57     0.10  0.000  0.013  0.4370   11.9850 .0000E+00 .6475E-05
58     0.01  0.000  0.148  0.3647   11.9285 .0000E+00 .6429E-05
59     0.12  0.000  0.013  0.4370   11.8917 .0000E+00 .6399E-05
60     3.97  0.000  0.133  0.4370   11.9998 .0000E+00 .6487E-05
61     1.60  0.000  0.150  0.4370   11.9998 .0000E+00 .6487E-05
62     0.30  0.000  0.221  0.4370   11.9998 .0000E+00 .6487E-05
63     0.00  0.000  0.212  0.4370   11.9998 .0000E+00 .6487E-05
64     0.00  0.000  0.183  0.4370   11.9998 .0000E+00 .6487E-05
65     0.00  0.000  0.238  0.4370   11.9998 .0000E+00 .6487E-05
66     0.00  0.000  0.219  0.4370   11.9998 .0000E+00 .6487E-05
67     0.01  0.000  0.183  0.4370   11.9998 .0000E+00 .6487E-05
68     1.62  0.000  0.175  0.4370   11.9998 .0000E+00 .6487E-05
69     0.20  0.000  0.181  0.4370   11.9998 .0000E+00 .6487E-05
70     0.01  0.000  0.214  0.4370   11.9998 .0000E+00 .6487E-05
71     0.00  0.000  0.216  0.4370   11.9998 .0000E+00 .6487E-05
72     1.32  0.000  0.188  0.4370   11.9998 .0000E+00 .6487E-05
73     1.26  0.000  0.179  0.4370   11.9998 .0000E+00 .6487E-05
74     2.19  0.000  0.156  0.4370   11.9998 .0000E+00 .6487E-05
75     2.29  0.000  0.125  0.4370   11.9998 .0000E+00 .6487E-05
76     1.20  0.000  0.171  0.4370   11.9998 .0000E+00 .6487E-05
77     0.02  0.000  0.127  0.4370   11.9998 .0000E+00 .6487E-05
78     0.00  0.000  0.239  0.4370   11.9998 .0000E+00 .6487E-05
79     0.00  0.000  0.255  0.4370   11.9998 .0000E+00 .6487E-05
80     0.16  0.000  0.192  0.4370   11.9998 .0000E+00 .6487E-05
81     0.84  0.000  0.158  0.4370   11.9998 .0000E+00 .6487E-05
82     0.13  0.000  0.202  0.4370   11.9998 .0000E+00 .6487E-05
83     0.02  0.000  0.135  0.4370   11.9998 .0000E+00 .6487E-05
84     0.01  0.000  0.170  0.4370   11.9998 .0000E+00 .6487E-05
85     1.39  0.000  0.171  0.4370   11.9998 .0000E+00 .6487E-05
86     1.59  0.000  0.153  0.4370   11.9998 .0000E+00 .6487E-05
87     0.71  0.000  0.199  0.4370   11.9998 .0000E+00 .6487E-05
88     0.01  0.000  0.215  0.4370   11.9998 .0000E+00 .6487E-05
89     0.48  0.000  0.169  0.4370   11.9998 .0000E+00 .6487E-05
90     0.12  0.000  0.186  0.4370   11.9998 .0000E+00 .6487E-05
91     0.01  0.000  0.190  0.4370   11.9998 .0000E+00 .6487E-05
92     0.51  0.000  0.151  0.4370   11.9998 .0000E+00 .6487E-05
93     0.02  0.000  0.216  0.4370   11.9998 .0000E+00 .6487E-05
94     0.18  0.000  0.205  0.4370   11.9998 .0000E+00 .6487E-05
95     0.00  0.000  0.212  0.4370   11.9998 .0000E+00 .6487E-05
96     0.00  0.000  0.260  0.4370   11.9998 .0000E+00 .6487E-05
97     0.00  0.000  0.286  0.4370   11.9998 .0000E+00 .6487E-05
98     0.00  0.000  0.244  0.4370   11.9998 .0000E+00 .6487E-05
99     0.00  0.000  0.207  0.4370   11.9998 .0000E+00 .6487E-05
100    0.00  0.000  0.257  0.4370   11.9998 .0000E+00 .6487E-05
101    0.00  0.000  0.257  0.4370   11.9998 .0000E+00 .6487E-05
102    0.00  0.000  0.260  0.4370   11.9998 .0000E+00 .6487E-05
103    0.00  0.000  0.202  0.4370   11.9998 .0000E+00 .6487E-05
104    0.00  0.000  0.226  0.4370   11.9998 .0000E+00 .6487E-05
105    0.00  0.000  0.259  0.4370   11.9998 .0000E+00 .6487E-05
106    0.00  0.000  0.283  0.4370   11.9998 .0000E+00 .6487E-05
107    0.00  0.000  0.259  0.4370   11.9998 .0000E+00 .6487E-05
108    0.00  0.000  0.260  0.4370   11.9998 .0000E+00 .6487E-05
109    0.00  0.000  0.274  0.4370   11.9998 .0000E+00 .6487E-05
110    0.00  0.000  0.254  0.4370   11.9998 .0000E+00 .6487E-05
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111       0.00   0.000   0.215   0.4370     11.9998  .0000E+00  .6487E-05
112       0.00   0.000   0.249   0.4370     11.9998  .0000E+00  .6487E-05
113       0.00   0.000   0.244   0.4370     11.9998  .0000E+00  .6487E-05
114       0.00   0.000   0.264   0.4370     11.9998  .0000E+00  .6487E-05
115       0.00   0.000   0.300   0.4370     11.9998  .0000E+00  .6487E-05
116       0.00   0.000   0.298   0.4370     11.9998  .0000E+00  .6487E-05
117       0.00   0.000   0.295   0.4370     11.9998  .0000E+00  .6487E-05
118       0.00   0.000   0.293   0.4370     11.9998  .0000E+00  .6487E-05
119       0.00   0.000   0.303   0.4370     11.9998  .0000E+00  .6487E-05
120       0.00   0.000   0.251   0.4370     11.9998  .0000E+00  .6487E-05
121       0.01   0.000   0.226   0.4370     11.9998  .0000E+00  .6487E-05
122       0.00   0.000   0.284   0.4370     11.9998  .0000E+00  .6487E-05
123       0.00   0.000   0.252   0.4370     11.9998  .0000E+00  .6487E-05
124       0.00   0.000   0.265   0.4370     11.9998  .0000E+00  .6487E-05
125       0.08   0.000   0.196   0.4370     11.9998  .0000E+00  .6487E-05
126       0.00   0.000   0.289   0.4370     11.9998  .0000E+00  .6487E-05
127       0.00   0.000   0.282   0.4370     11.9998  .0000E+00  .6487E-05
128       0.00   0.000   0.311   0.4370     11.9998  .0000E+00  .6487E-05
129       0.00   0.000   0.304   0.4370     11.9998  .0000E+00  .6487E-05
130       0.00   0.000   0.283   0.4370     11.9998  .0000E+00  .6487E-05
131       0.00   0.000   0.273   0.4370     11.9998  .0000E+00  .6487E-05
132       0.00   0.000   0.285   0.4370     11.9998  .0000E+00  .6487E-05
133       0.06   0.000   0.281   0.4370     11.9998  .0000E+00  .6487E-05
134       0.00   0.000   0.249   0.4370     11.9998  .0000E+00  .6487E-05
135       0.00   0.000   0.288   0.4370     11.9998  .0000E+00  .6487E-05
136       0.00   0.000   0.297   0.4370     11.9998  .0000E+00  .6487E-05
137       0.00   0.000   0.274   0.4370     11.9998  .0000E+00  .6487E-05
138       0.00   0.000   0.250   0.4370     11.9998  .0000E+00  .6487E-05
139       0.00   0.000   0.281   0.4370     11.9998  .0000E+00  .6487E-05
140       0.00   0.000   0.247   0.4370     11.9998  .0000E+00  .6487E-05
141       0.00   0.000   0.260   0.4370     11.9998  .0000E+00  .6487E-05
142       0.00   0.000   0.215   0.4370     11.9998  .0000E+00  .6487E-05
143       0.00   0.000   0.312   0.4370     11.9998  .0000E+00  .6487E-05
144       0.00   0.000   0.280   0.4370     11.9998  .0000E+00  .6487E-05
145       0.00   0.000   0.282   0.4370     11.9998  .0000E+00  .6487E-05
146       0.00   0.000   0.311   0.4370     11.9998  .0000E+00  .6487E-05
147       0.00   0.000   0.319   0.4370     11.9998  .0000E+00  .6487E-05
148       0.00   0.000   0.276   0.4370     11.9998  .0000E+00  .6487E-05
149       0.00   0.000   0.298   0.4370     11.9998  .0000E+00  .6487E-05
150       0.00   0.000   0.290   0.4370     11.9998  .0000E+00  .6487E-05
151       0.00   0.000   0.269   0.4370     11.9998  .0000E+00  .6487E-05
152       0.00   0.000   0.258   0.4370     11.9998  .0000E+00  .6487E-05
153       0.00   0.000   0.297   0.4370     11.9998  .0000E+00  .6487E-05
154       0.00   0.000   0.238   0.2831     11.8228  .0000E+00  .6344E-05
155       0.00   0.000   0.198   0.0852     11.4018  .0000E+00  .6008E-05
156       0.00   0.000   0.061   0.0240     11.0743  .0000E+00  .5752E-05
157       0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
158       0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
159       0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
160       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
161       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
162       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
163       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
164       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
165       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
166       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
167       0.00   0.000   0.000   0.0240     10.9996  .0000E+00  .5694E-05
168       0.01   0.000   0.002   0.0322     10.9996  .0000E+00  .5694E-05
169       0.00   0.000   0.006   0.0263     10.9996  .0000E+00  .5694E-05
170       0.00   0.000   0.002   0.0246     10.9996  .0000E+00  .5694E-05
171       0.00   0.000   0.000   0.0241     10.9996  .0000E+00  .5694E-05
172       0.00   0.000   0.000   0.0240     10.9996  .0000E+00  .5694E-05
173       0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
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174          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
175          0.20   0.000   0.013   0.2114     10.9996  .0000E+00  .5694E-05
176          1.17   0.000   0.015   0.4370     11.7498  .0000E+00  .6289E-05
177          0.00   0.000   0.311   0.4370     11.9998  .0000E+00  .6487E-05
178          0.00   0.000   0.292   0.4370     11.9998  .0000E+00  .6487E-05
179          0.00   0.000   0.331   0.4327     11.9955  .0000E+00  .6483E-05
180          0.00   0.000   0.237   0.1953     11.7190  .0000E+00  .6261E-05
181          0.00   0.000   0.137   0.0584     11.2485  .0000E+00  .5888E-05
182          0.00   0.000   0.034   0.0240     11.0403  .0000E+00  .5726E-05
183          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
184          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
185          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
186          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
187          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
188          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
189          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
190          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
191          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
192          0.02   0.000   0.009   0.0354     10.9997  .0000E+00  .5694E-05
193          0.00   0.000   0.008   0.0275     10.9996  .0000E+00  .5694E-05
194          0.00   0.000   0.003   0.0248     10.9996  .0000E+00  .5694E-05
195          0.00   0.000   0.001   0.0242     10.9996  .0000E+00  .5694E-05
196          0.00   0.000   0.000   0.0241     10.9996  .0000E+00  .5694E-05
197          0.00   0.000   0.000   0.0240     10.9996  .0000E+00  .5694E-05
198          0.01   0.000   0.002   0.0324     10.9996  .0000E+00  .5694E-05
199          0.00   0.000   0.005   0.0270     10.9995  .0000E+00  .5694E-05
200          0.00   0.000   0.002   0.0248     10.9995  .0000E+00  .5694E-05
201          0.00   0.000   0.000   0.0244     10.9995  .0000E+00  .5694E-05
202          0.00   0.000   0.000   0.0241     10.9995  .0000E+00  .5694E-05
203          0.00   0.000   0.000   0.0240     10.9995  .0000E+00  .5694E-05
204          0.00   0.000   0.000   0.0240     10.9995  .0000E+00  .5694E-05
205          0.00   0.000   0.000   0.0240     10.9995  .0000E+00  .5694E-05
206          0.00   0.000   0.000   0.0240     10.9994  .0000E+00  .5694E-05
207          0.00   0.000   0.000   0.0240     10.9994  .0000E+00  .5694E-05
208          0.04   0.000   0.006   0.0584     10.9994  .0000E+00  .5694E-05
209          0.00   0.000   0.008   0.0501     10.9994  .0000E+00  .5694E-05
210          0.00   0.000   0.010   0.0401     10.9994  .0000E+00  .5694E-05
211          0.16   0.000   0.011   0.1894     10.9994  .0000E+00  .5694E-05
212          0.00   0.000   0.011   0.1778     11.1260  .0000E+00  .5792E-05
213          1.08   0.000   0.012   0.4370     11.8259  .0000E+00  .6348E-05
214          0.00   0.000   0.316   0.4370     11.9998  .0000E+00  .6487E-05
215          0.00   0.000   0.272   0.4370     11.9998  .0000E+00  .6487E-05
216          0.00   0.000   0.298   0.3601     11.9222  .0000E+00  .6424E-05
217          0.00   0.000   0.208   0.1517     11.5725  .0000E+00  .6143E-05
218          0.00   0.000   0.108   0.0440     11.1771  .0000E+00  .5832E-05
219          0.02   0.000   0.038   0.0264     11.0171  .0000E+00  .5708E-05
220          0.00   0.000   0.001   0.0250     10.9998  .0000E+00  .5694E-05
221          0.00   0.000   0.001   0.0243     10.9998  .0000E+00  .5694E-05
222          0.00   0.000   0.000   0.0241     10.9998  .0000E+00  .5694E-05
223          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
224          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
225          0.11   0.000   0.018   0.1165     10.9998  .0000E+00  .5694E-05
226          0.00   0.000   0.019   0.0970     10.9997  .0000E+00  .5694E-05
227          0.00   0.000   0.021   0.0755     11.0470  .0000E+00  .5731E-05
228          0.00   0.000   0.016   0.0591     11.0560  .0000E+00  .5738E-05
229          0.00   0.000   0.020   0.0390     11.0466  .0000E+00  .5730E-05
230          0.00   0.000   0.015   0.0240     11.0097  .0000E+00  .5702E-05
231          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
232          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
233          0.00   0.000   0.000   0.0240     10.9998  .0000E+00  .5694E-05
234          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
235          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
236          0.00   0.000   0.000   0.0240     10.9997  .0000E+00  .5694E-05
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237         0.05  0.000  0.007  0.0672     10.9997  .0000E+00  .5694E-05
238         0.01  0.000  0.010  0.0668     10.9997  .0000E+00  .5694E-05
239         0.00  0.000  0.013  0.0537     10.9997  .0000E+00  .5694E-05
240         0.00  0.000  0.013  0.0407     10.9996  .0000E+00  .5694E-05
241         0.00  0.000  0.012  0.0289     10.9996  .0000E+00  .5694E-05
242         0.00  0.000  0.004  0.0250     10.9996  .0000E+00  .5694E-05
243         0.00  0.000  0.001  0.0240     10.9996  .0000E+00  .5694E-05
244         0.00  0.000  0.000  0.0240     10.9996  .0000E+00  .5694E-05
245         0.00  0.000  0.000  0.0240     10.9996  .0000E+00  .5694E-05
246         0.00  0.000  0.000  0.0240     10.9996  .0000E+00  .5694E-05
247         0.04  0.000  0.006  0.0583     10.9995  .0000E+00  .5694E-05
248         0.42  0.000  0.013  0.4370     11.1226  .0000E+00  .5790E-05
249         0.64  0.000  0.041  0.4370     11.9998  .0000E+00  .6487E-05
250         0.03  0.000  0.197  0.4370     11.9998  .0000E+00  .6487E-05
251         0.00  0.000  0.281  0.4370     11.9998  .0000E+00  .6487E-05
252         0.00  0.000  0.231  0.3856     11.9483  .0000E+00  .6445E-05
253         0.00  0.000  0.179  0.2062     11.6578  .0000E+00  .6211E-05
254         0.00  0.000  0.144  0.0619     11.2750  .0000E+00  .5908E-05
255         0.00  0.000  0.038  0.0240     11.0461  .0000E+00  .5730E-05
256         0.00  0.000  0.000  0.0240     10.9998  .0000E+00  .5694E-05
257         0.00  0.000  0.000  0.0240     10.9998  .0000E+00  .5694E-05
258         0.02  0.000  0.011  0.0332     10.9998  .0000E+00  .5694E-05
259         0.03  0.000  0.013  0.0498     10.9997  .0000E+00  .5694E-05
260         0.05  0.000  0.019  0.0809     10.9997  .0000E+00  .5694E-05
261         0.00  0.000  0.020  0.0605     10.9997  .0000E+00  .5694E-05
262         0.00  0.000  0.022  0.0389     10.9997  .0000E+00  .5694E-05
263         0.00  0.000  0.012  0.0268     10.9997  .0000E+00  .5694E-05
264         0.00  0.000  0.003  0.0240     10.9997  .0000E+00  .5694E-05
265         0.00  0.000  0.000  0.0240     10.9997  .0000E+00  .5694E-05
266         0.08  0.000  0.013  0.0905     10.9996  .0000E+00  .5694E-05
267         0.00  0.000  0.015  0.0754     10.9996  .0000E+00  .5694E-05
268         0.00  0.000  0.017  0.0583     10.9996  .0000E+00  .5694E-05
269         0.00  0.000  0.015  0.0433     10.9996  .0000E+00  .5694E-05
270         0.06  0.000  0.017  0.0861     11.0034  .0000E+00  .5697E-05
271         0.00  0.000  0.016  0.0701     11.0045  .0000E+00  .5698E-05
272         0.00  0.000  0.016  0.0545     11.0001  .0000E+00  .5695E-05
273         0.00  0.000  0.014  0.0406     10.9998  .0000E+00  .5694E-05
274         0.00  0.000  0.013  0.0279     10.9998  .0000E+00  .5694E-05
275         0.00  0.000  0.004  0.0240     10.9998  .0000E+00  .5694E-05
276         0.20  0.000  0.012  0.2118     10.9997  .0000E+00  .5694E-05
277         0.00  0.000  0.013  0.1985     11.2187  .0000E+00  .5865E-05
278         0.00  0.000  0.013  0.1851     11.3863  .0000E+00  .5995E-05
279         0.00  0.000  0.013  0.1720     11.3657  .0000E+00  .5979E-05
280         0.00  0.000  0.012  0.1598     11.3351  .0000E+00  .5955E-05
281         0.00  0.000  0.013  0.1472     11.3155  .0000E+00  .5940E-05
282         1.61  0.000  0.013  0.4370     11.8235  .0000E+00  .6346E-05
283         0.00  0.000  0.184  0.4370     11.9998  .0000E+00  .6487E-05
284         0.11  0.000  0.206  0.4370     11.9998  .0000E+00  .6487E-05
285         0.00  0.000  0.242  0.4370     11.9998  .0000E+00  .6487E-05
286         0.00  0.000  0.229  0.4370     11.9998  .0000E+00  .6487E-05
287         2.64  0.000  0.173  0.4370     11.9998  .0000E+00  .6487E-05
288         0.04  0.000  0.178  0.4370     11.9998  .0000E+00  .6487E-05
289         0.07  0.000  0.198  0.4370     11.9998  .0000E+00  .6487E-05
290         0.01  0.000  0.167  0.4370     11.9998  .0000E+00  .6487E-05
291         0.00  0.000  0.239  0.4370     11.9998  .0000E+00  .6487E-05
292         0.00  0.000  0.243  0.4370     11.9998  .0000E+00  .6487E-05
293         0.00  0.000  0.200  0.4370     11.9998  .0000E+00  .6487E-05
294         0.22  0.000  0.153  0.4370     11.9998  .0000E+00  .6487E-05
295         0.25  0.000  0.130  0.4370     11.9998  .0000E+00  .6487E-05
296         0.00  0.000  0.202  0.4370     11.9998  .0000E+00  .6487E-05
297         0.00  0.000  0.209  0.4370     11.9998  .0000E+00  .6487E-05
298         0.00  0.000  0.182  0.4370     11.9998  .0000E+00  .6487E-05
299         0.00  0.000  0.154  0.4370     11.9998  .0000E+00  .6487E-05
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300      0.00  0.000  0.232  0.4370    11.9998  .0000E+00  .6487E-05
301      0.00  0.000  0.230  0.4370    11.9998  .0000E+00  .6487E-05
302      0.00  0.000  0.153  0.4370    11.9998  .0000E+00  .6487E-05
303      0.00  0.000  0.158  0.4370    11.9998  .0000E+00  .6487E-05
304      0.00  0.000  0.198  0.4370    11.9998  .0000E+00  .6487E-05
305      0.16  0.000  0.152  0.4370    11.9998  .0000E+00  .6487E-05
306      0.04  0.000  0.193  0.4370    11.9998  .0000E+00  .6487E-05
307      0.00  0.000  0.225  0.4370    11.9998  .0000E+00  .6487E-05
308      0.00  0.000  0.187  0.2661    11.8046  .0000E+00  .6329E-05
309      0.00  0.000  0.189  0.0768    11.3627  .0000E+00  .5977E-05
310      0.00  0.000  0.053  0.0240    11.0709  .0000E+00  .5749E-05
311      0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
312      0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
313      0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
314      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
315      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
316      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
317      0.74  0.000  0.026  0.4370    11.4631  .0000E+00  .6061E-05
318      0.22  0.000  0.179  0.4370    11.9998  .0000E+00  .6487E-05
319      0.00  0.000  0.177  0.4370    11.9998  .0000E+00  .6487E-05
320      0.00  0.000  0.174  0.4277    11.9905  .0000E+00  .6479E-05
321      0.01  0.000  0.144  0.2939    11.8298  .0000E+00  .6349E-05
322      0.00  0.000  0.134  0.1599    11.4952  .0000E+00  .6082E-05
323      0.00  0.000  0.111  0.0489    11.1954  .0000E+00  .5846E-05
324      0.00  0.000  0.025  0.0240    11.0245  .0000E+00  .5713E-05
325      0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
326      0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
327      0.00  0.000  0.000  0.0240    10.9998  .0000E+00  .5694E-05
328      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
329      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
330      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
331      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
332      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
333      0.00  0.000  0.000  0.0240    10.9997  .0000E+00  .5694E-05
334      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
335      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
336      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
337      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
338      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
339      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
340      0.00  0.000  0.000  0.0240    10.9996  .0000E+00  .5694E-05
341      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
342      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
343      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
344      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
345      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
346      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
347      0.00  0.000  0.000  0.0240    10.9995  .0000E+00  .5694E-05
348      0.00  0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
349      0.00  0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
350      0.00  0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
351      0.00  0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
352      0.00  0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
353      0.00  0.000  0.000  0.0240    10.9994  .0000E+00  .5694E-05
354      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
355      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
356      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
357      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
358      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
359      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
360      0.00  0.000  0.000  0.0240    10.9993  .0000E+00  .5694E-05
361      0.00  0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
362      0.00  0.000  0.000  0.0240    10.9992  .0000E+00  .5694E-05
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363        0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
364        0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05
365        0.00  0.000  0.000  0.0240    10.9992 .0000E+00 .5694E-05

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      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------

                        JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                        -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                 2.47     2.13     4.33     0.69     0.48     0.77
                          0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS        3.62     2.09     8.41     0.76     0.37     0.41
                          0.16     0.47     0.81     1.90     0.57     2.92

 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                 1.788    1.734    3.391    2.257    1.854    0.928
                          0.152    0.462    0.937    1.404    1.458    0.784

   STD. DEVIATIONS        1.896    1.774    2.126    2.794    3.299    0.803
                          0.085    0.535    0.837    1.556    0.618    0.647

 PERCOLATION/LEAKAGE THROUGH LAYER  3
 ------------------------------------
   TOTALS                 0.0002   0.0002   0.0002   0.0002   0.0002   0.0002
                          0.0002   0.0002   0.0002   0.0002   0.0002   0.0002

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


------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  2
 -------------------------------------
   AVERAGES              11.4454  11.4823  11.6504  11.3221  11.3951  11.4107
                         11.2794  11.3336  11.5702  11.7222  11.6124  11.2463

   STD. DEVIATIONS        0.3241   0.3363   0.3067   0.3663   0.3803   0.3315
                          0.3473   0.3180   0.2760   0.2684   0.3035   0.3054

******************************************************************************
```

```
*******************************************************************************

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------
                                  INCHES             CU. FEET       PERCENT
                            -------------------   -------------   ---------
 PRECIPITATION               17.12   (  10.514)      62151.7     100.00

 RUNOFF                       0.000  (  0.0000)         0.00       0.000

 EVAPOTRANSPIRATION          17.148  ( 10.3329)      62245.61    100.151

 PERCOLATION/LEAKAGE THROUGH   0.00221 (  0.00002)        8.025     0.01291
   LAYER  3

 AVERAGE HEAD ON TOP          11.456 (    0.082)
   OF LAYER  2

 CHANGE IN WATER STORAGE      -0.028  (  3.4503)       -102.00     -0.164

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


▯
******************************************************************************

          PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
  ------------------------------------------------------------------------
                                                 (INCHES)     (CU. FT.)
                                                ----------   -------------
    PRECIPITATION                                  4.04        14665.200

    RUNOFF                                         0.000           0.0000

    PERCOLATION/LEAKAGE THROUGH LAYER  3           0.000006        0.02355

    AVERAGE HEAD ON TOP OF LAYER  2               12.000

    SNOW WATER                                     0.00            0.0000

    MAXIMUM VEG. SOIL WATER (VOL/VOL)                       0.4370

    MINIMUM VEG. SOIL WATER (VOL/VOL)                       0.0240

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


▯
******************************************************************************

            FINAL WATER STORAGE AT END OF YEAR 2006
  ----------------------------------------------------------------------
              LAYER        (INCHES)        (VOL/VOL)
              -----        --------        ---------
                1           4.8307          0.4026

                2           0.0000          0.0000
```

```
                  3             0.1800          0.7500

            SNOW WATER          0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 2

PROPOSED FINAL COVER HELP MODEL 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:\temp\KEK6_TOP.D4
TEMPERATURE DATA FILE:        C:\temp\KEK6_TOP.D7
SOLAR RADIATION DATA FILE:    c:\temp\KEK6_TOP.D13
EVAPOTRANSPIRATION DATA:      c:\temp\KEK6_TOP.D11
SOIL AND DESIGN DATA FILE:    c:\temp\PROPCOV.D10
OUTPUT DATA FILE:             c:\temp\PROPCOV.OUT


TIME:  17:36      DATE:   9/11/2007


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

     TITLE:  Kekaha Landfill Phase II- Lateral Exp. Final Cover Analysis

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


     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   9
          THICKNESS                   =       6.00   INCHES
          POROSITY                    =       0.5010 VOL/VOL
          FIELD CAPACITY              =       0.2840 VOL/VOL
          WILTING POINT               =       0.1350 VOL/VOL
          INITIAL SOIL WATER CONTENT  =       0.1490 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.190000006000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


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

```
               TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER 12
    THICKNESS                     =     12.00    INCHES
    POROSITY                      =      0.4710 VOL/VOL
    FIELD CAPACITY                =      0.3420 VOL/VOL
    WILTING POINT                 =      0.2100 VOL/VOL
    INITIAL SOIL WATER CONTENT    =      0.2066 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.419999997000E-04 CM/SEC


                            LAYER 3
                            --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER 20
    THICKNESS                     =      0.20    INCHES
    POROSITY                      =      0.8500 VOL/VOL
    FIELD CAPACITY                =      0.0100 VOL/VOL
    WILTING POINT                 =      0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT    =      0.1968 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =   10.0000000000      CM/SEC
    SLOPE                         =      3.00    PERCENT
    DRAINAGE LENGTH               =    325.0     FEET


                            LAYER 4
                            --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER 36
    THICKNESS                     =      0.04    INCHES
    POROSITY                      =      0.0000 VOL/VOL
    FIELD CAPACITY                =      0.0000 VOL/VOL
    WILTING POINT                 =      0.0000 VOL/VOL
    INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.399999993000E-12 CM/SEC
    FML PINHOLE DENSITY           =      1.00    HOLES/ACRE
    FML INSTALLATION DEFECTS      =      2.00    HOLES/ACRE
    FML PLACEMENT QUALITY         =  3 - GOOD


                            LAYER 5
                            --------

                   TYPE 3 - BARRIER SOIL LINER
                   MATERIAL TEXTURE NUMBER 12
    THICKNESS                     =     18.00    INCHES
    POROSITY                      =      0.4710 VOL/VOL
    FIELD CAPACITY                =      0.3420 VOL/VOL
    WILTING POINT                 =      0.2100 VOL/VOL
    INITIAL SOIL WATER CONTENT    =      0.4710 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =  0.419999997000E-04 CM/SEC
```

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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
          FAIR STAND OF GRASS, A SURFACE SLOPE OF  3.%
          AND A SLOPE LENGTH OF  325. FEET.

 SCS RUNOFF CURVE NUMBER            =      81.80
 FRACTION OF AREA ALLOWING RUNOFF   =     100.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE =       1.000  ACRES
 EVAPORATIVE ZONE DEPTH             =      18.2    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE  =       3.412  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE =       8.825  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE =       3.331  INCHES
 INITIAL SNOW WATER                 =       0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS   =      11.890  INCHES
 TOTAL INITIAL WATER                =      11.890  INCHES
 TOTAL SUBSURFACE INFLOW            =       0.00   INCHES/YEAR


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

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          HONOLULU             HAWAII

      STATION LATITUDE                         =  21.33 DEGREES
      MAXIMUM LEAF AREA INDEX                  =   2.00
      START OF GROWING SEASON (JULIAN DATE)    =     0
      END OF GROWING SEASON (JULIAN DATE)      =   367
      EVAPORATIVE ZONE DEPTH                   =  18.2  INCHES
      AVERAGE ANNUAL WIND SPEED                =   3.78 MPH
      AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
      AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  66.00 %
      AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  66.00 %
      AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %


 NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    HONOLULU             HAWAII
            AND STATION LATITUDE  =  21.33 DEGREES
```

```
HEAD  #1:   AVERAGE HEAD ON TOP OF LAYER  4
DRAIN #1:   LATERAL DRAINAGE FROM LAYER  3 (RECIRCULATION AND COLLECTION)
LEAK  #1:   PERCOLATION OR LEAKAGE THROUGH LAYER  5

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

                      DAILY OUTPUT FOR YEAR 2001
-------------------------------------------------------------------------------
          S
DAY   A   O   RAIN  RUNOFF   ET    E. ZONE    HEAD      DRAIN      LEAK
      I   I                         WATER      #1        #1         #1
      R   L   IN.    IN.     IN.   IN./IN.     IN.       IN.        IN.
---   -   -  -----  ------  ------ -------  --------- ---------  ---------

  1           0.06  0.000  0.049  0.1881    0.0000  .0000E+00  .0000E+00
  2           0.00  0.000  0.016  0.1872    0.0000  .0000E+00  .0000E+00
  3           0.00  0.000  0.038  0.1852    0.0000  .0000E+00  .0000E+00
  4           0.00  0.000  0.015  0.1843    0.0000  .0000E+00  .0000E+00
  5           0.00  0.000  0.016  0.1834    0.0000  .0000E+00  .0000E+00
  6           0.00  0.000  0.005  0.1831    0.0000  .0000E+00  .0000E+00
  7           0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
  8           0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
  9           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 10           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 11           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 12           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 13           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 14           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 15           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 16           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 17           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 18           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 19           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 20           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 21           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 22           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 23           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 24           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 25           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 26           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 27           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 28           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 29           0.10  0.000  0.017  0.1876    0.0000  .0000E+00  .0000E+00
 30           0.01  0.000  0.012  0.1875    0.0000  .0000E+00  .0000E+00
 31           0.00  0.000  0.032  0.1858    0.0000  .0000E+00  .0000E+00
 32           0.00  0.000  0.018  0.1848    0.0000  .0000E+00  .0000E+00
 33           0.00  0.000  0.023  0.1835    0.0000  .0000E+00  .0000E+00
 34           0.00  0.000  0.006  0.1832    0.0000  .0000E+00  .0000E+00
 35           0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
 36           0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
 37           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 38           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 39           0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 40           1.64  0.036  0.055  0.2682    0.0000  .0000E+00  .0000E+00
 41           0.05  0.000  0.090  0.2660    0.0000  .0000E+00  .0000E+00
 42           0.00  0.000  0.153  0.2577    0.0000  .0000E+00  .0000E+00
 43           0.00  0.000  0.146  0.2496    0.0000  .0000E+00  .0000E+00
 44           0.00  0.000  0.130  0.2425    0.0000  .0000E+00  .0000E+00
 45           0.00  0.000  0.153  0.2341    0.0000  .0000E+00  .0000E+00
 46           0.00  0.000  0.143  0.2262    0.0000  .0000E+00  .0000E+00
 47           0.00  0.000  0.105  0.2204    0.0000  .0000E+00  .0000E+00
 48           0.00  0.000  0.117  0.2140    0.0000  .0000E+00  .0000E+00
 49           0.00  0.000  0.130  0.2069    0.0000  .0000E+00  .0000E+00
```

```
50      0.00  0.000  0.148  0.1988    0.0000  .0000E+00  .0000E+00
51      0.00  0.000  0.110  0.1927    0.0000  .0000E+00  .0000E+00
52      0.04  0.000  0.147  0.1868    0.0000  .0000E+00  .0000E+00
53      0.12  0.000  0.066  0.1898    0.0000  .0000E+00  .0000E+00
54      0.00  0.000  0.045  0.1873    0.0000  .0000E+00  .0000E+00
55      0.03  0.000  0.042  0.1866    0.0000  .0000E+00  .0000E+00
56      2.64  0.304  0.060  0.3117    0.0000  .0000E+00  .0000E+00
57      0.09  0.000  0.086  0.3120    0.0000  .0000E+00  .0000E+00
58      0.00  0.000  0.149  0.3038    0.0000  .0000E+00  .0000E+00
59      0.00  0.000  0.124  0.2970    0.0000  .0000E+00  .0000E+00
60      0.00  0.000  0.139  0.2893    0.0000  .0000E+00  .0000E+00
61      0.00  0.000  0.144  0.2814    0.0000  .0000E+00  .0000E+00
62      0.00  0.000  0.163  0.2724    0.0000  .0000E+00  .0000E+00
63      0.00  0.000  0.125  0.2655    0.0000  .0000E+00  .0000E+00
64      0.00  0.000  0.187  0.2553    0.0000  .0000E+00  .0000E+00
65      0.02  0.000  0.080  0.2520    0.0000  .0000E+00  .0000E+00
66      0.00  0.000  0.134  0.2446    0.0000  .0000E+00  .0000E+00
67      0.00  0.000  0.197  0.2338    0.0000  .0000E+00  .0000E+00
68      0.00  0.000  0.166  0.2246    0.0000  .0000E+00  .0000E+00
69      0.00  0.000  0.166  0.2155    0.0000  .0000E+00  .0000E+00
70      0.00  0.000  0.105  0.2098    0.0000  .0000E+00  .0000E+00
71      0.00  0.000  0.132  0.2025    0.0000  .0000E+00  .0000E+00
72      0.00  0.000  0.060  0.1992    0.0000  .0000E+00  .0000E+00
73      0.00  0.000  0.175  0.1896    0.0000  .0000E+00  .0000E+00
74      0.00  0.000  0.119  0.1831    0.0000  .0000E+00  .0000E+00
75      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
76      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
77      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
78      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
79      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
80      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
81      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
82      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
83      0.05  0.000  0.034  0.1839    0.0000  .0000E+00  .0000E+00
84      0.04  0.000  0.029  0.1845    0.0000  .0000E+00  .0000E+00
85      0.00  0.000  0.012  0.1838    0.0000  .0000E+00  .0000E+00
86      0.00  0.000  0.009  0.1834    0.0000  .0000E+00  .0000E+00
87      0.00  0.000  0.003  0.1832    0.0000  .0000E+00  .0000E+00
88      0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
89      0.61  0.000  0.077  0.2124    0.0000  .0000E+00  .0000E+00
90      0.07  0.000  0.063  0.2128    0.0000  .0000E+00  .0000E+00
91      0.00  0.000  0.092  0.2077    0.0000  .0000E+00  .0000E+00
92      0.00  0.000  0.107  0.2018    0.0000  .0000E+00  .0000E+00
93      0.01  0.000  0.092  0.1974    0.0000  .0000E+00  .0000E+00
94      0.01  0.000  0.107  0.1920    0.0000  .0000E+00  .0000E+00
95      0.01  0.000  0.073  0.1886    0.0000  .0000E+00  .0000E+00
96      0.00  0.000  0.078  0.1843    0.0000  .0000E+00  .0000E+00
97      0.00  0.000  0.019  0.1833    0.0000  .0000E+00  .0000E+00
98      0.04  0.000  0.030  0.1838    0.0000  .0000E+00  .0000E+00
99      0.00  0.000  0.009  0.1833    0.0000  .0000E+00  .0000E+00
100     0.03  0.000  0.032  0.1832    0.0000  .0000E+00  .0000E+00
101     0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
102     0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
103     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
104     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
105     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
106     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
107     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
108     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
109     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
110     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
111     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
112     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
```

```
113        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
114        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
115        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
116        0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
117        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
118        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
119        0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
120        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
121        0.06  0.000  0.031  0.1847    0.0000  .0000E+00  .0000E+00
122        0.00  0.000  0.011  0.1840    0.0000  .0000E+00  .0000E+00
123        0.02  0.000  0.032  0.1834    0.0000  .0000E+00  .0000E+00
124        0.01  0.000  0.014  0.1832    0.0000  .0000E+00  .0000E+00
125        0.02  0.000  0.022  0.1831    0.0000  .0000E+00  .0000E+00
126        0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
127        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
128        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
129        0.02  0.000  0.020  0.1831    0.0000  .0000E+00  .0000E+00
130        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
131        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
132        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
133        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
134        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
135        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
136        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
137        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
138        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
139        0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
140        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
141        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
142        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
143        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
144        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
145        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
146        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
147        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
148        0.06  0.000  0.033  0.1845    0.0000  .0000E+00  .0000E+00
149        0.00  0.000  0.013  0.1838    0.0000  .0000E+00  .0000E+00
150        0.00  0.000  0.008  0.1834    0.0000  .0000E+00  .0000E+00
151        0.32  0.000  0.082  0.1964    0.0000  .0000E+00  .0000E+00
152        0.03  0.000  0.103  0.1924    0.0000  .0000E+00  .0000E+00
153        0.09  0.000  0.136  0.1899    0.0000  .0000E+00  .0000E+00
154        0.03  0.000  0.062  0.1881    0.0000  .0000E+00  .0000E+00
155        0.03  0.000  0.053  0.1869    0.0000  .0000E+00  .0000E+00
156        0.00  0.000  0.019  0.1858    0.0000  .0000E+00  .0000E+00
157        0.00  0.000  0.034  0.1840    0.0000  .0000E+00  .0000E+00
158        0.00  0.000  0.013  0.1833    0.0000  .0000E+00  .0000E+00
159        0.03  0.000  0.033  0.1831    0.0000  .0000E+00  .0000E+00
160        0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
161        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
162        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
163        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
164        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
165        0.04  0.000  0.035  0.1833    0.0000  .0000E+00  .0000E+00
166        0.03  0.000  0.033  0.1832    0.0000  .0000E+00  .0000E+00
167        0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
168        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
169        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
170        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
171        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
172        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
173        0.03  0.000  0.030  0.1831    0.0000  .0000E+00  .0000E+00
174        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
175        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
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176        0.07   0.000   0.041   0.1847    0.0000  .0000E+00  .0000E+00
177        0.00   0.000   0.016   0.1838    0.0000  .0000E+00  .0000E+00
178        0.00   0.000   0.009   0.1833    0.0000  .0000E+00  .0000E+00
179        0.12   0.000   0.048   0.1873    0.0000  .0000E+00  .0000E+00
180        0.00   0.000   0.019   0.1863    0.0000  .0000E+00  .0000E+00
181        0.00   0.000   0.044   0.1838    0.0000  .0000E+00  .0000E+00
182        0.00   0.000   0.011   0.1832    0.0000  .0000E+00  .0000E+00
183        0.00   0.000   0.002   0.1831    0.0000  .0000E+00  .0000E+00
184        0.00   0.000   0.001   0.1831    0.0000  .0000E+00  .0000E+00
185        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
186        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
187        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
188        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
189        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
190        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
191        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
192        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
193        0.06   0.000   0.041   0.1841    0.0000  .0000E+00  .0000E+00
194        0.00   0.000   0.011   0.1835    0.0000  .0000E+00  .0000E+00
195        0.00   0.000   0.005   0.1832    0.0000  .0000E+00  .0000E+00
196        0.00   0.000   0.002   0.1831    0.0000  .0000E+00  .0000E+00
197        0.00   0.000   0.001   0.1831    0.0000  .0000E+00  .0000E+00
198        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
199        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
200        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
201        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
202        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
203        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
204        0.01   0.000   0.010   0.1831    0.0000  .0000E+00  .0000E+00
205        0.01   0.000   0.010   0.1831    0.0000  .0000E+00  .0000E+00
206        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
207        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
208        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
209        0.01   0.000   0.010   0.1831    0.0000  .0000E+00  .0000E+00
210        0.05   0.000   0.038   0.1837    0.0000  .0000E+00  .0000E+00
211        0.02   0.000   0.026   0.1834    0.0000  .0000E+00  .0000E+00
212        0.00   0.000   0.004   0.1832    0.0000  .0000E+00  .0000E+00
213        0.00   0.000   0.001   0.1831    0.0000  .0000E+00  .0000E+00
214        0.04   0.000   0.037   0.1832    0.0000  .0000E+00  .0000E+00
215        0.08   0.000   0.042   0.1853    0.0000  .0000E+00  .0000E+00
216        0.02   0.000   0.029   0.1848    0.0000  .0000E+00  .0000E+00
217        0.00   0.000   0.023   0.1836    0.0000  .0000E+00  .0000E+00
218        0.00   0.000   0.008   0.1831    0.0000  .0000E+00  .0000E+00
219        0.00   0.000   0.001   0.1831    0.0000  .0000E+00  .0000E+00
220        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
221        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
222        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
223        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
224        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
225        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
226        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
227        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
228        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
229        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
230        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
231        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
232        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
233        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
234        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
235        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
236        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
237        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
238        0.00   0.000   0.000   0.1831    0.0000  .0000E+00  .0000E+00
```

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239         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
240         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
241         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
242         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
243         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
244         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
245         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
246         0.15  0.000  0.043  0.1889     0.0000  .0000E+00  .0000E+00
247         0.01  0.000  0.042  0.1872     0.0000  .0000E+00  .0000E+00
248         0.00  0.000  0.052  0.1843     0.0000  .0000E+00  .0000E+00
249         0.00  0.000  0.017  0.1834     0.0000  .0000E+00  .0000E+00
250         0.00  0.000  0.004  0.1832     0.0000  .0000E+00  .0000E+00
251         0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
252         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
253         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
254         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
255         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
256         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
257         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
258         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
259         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
260         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
261         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
262         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
263         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
264         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
265         0.06  0.000  0.040  0.1842     0.0000  .0000E+00  .0000E+00
266         0.00  0.000  0.012  0.1835     0.0000  .0000E+00  .0000E+00
267         0.00  0.000  0.005  0.1832     0.0000  .0000E+00  .0000E+00
268         0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
269         0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
270         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
271         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
272         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
273         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
274         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
275         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
276         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
277         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
278         0.12  0.000  0.038  0.1876     0.0000  .0000E+00  .0000E+00
279         0.00  0.000  0.016  0.1867     0.0000  .0000E+00  .0000E+00
280         0.00  0.000  0.045  0.1842     0.0000  .0000E+00  .0000E+00
281         0.00  0.000  0.016  0.1834     0.0000  .0000E+00  .0000E+00
282         0.00  0.000  0.004  0.1832     0.0000  .0000E+00  .0000E+00
283         0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
284         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
285         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
286         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
287         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
288         0.03  0.000  0.030  0.1831     0.0000  .0000E+00  .0000E+00
289         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
290         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
291         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
292         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
293         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
294         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
295         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
296         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
297         0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
298         0.14  0.000  0.039  0.1886     0.0000  .0000E+00  .0000E+00
299         0.00  0.000  0.019  0.1876     0.0000  .0000E+00  .0000E+00
300         0.01  0.000  0.037  0.1861     0.0000  .0000E+00  .0000E+00
301         0.00  0.000  0.022  0.1849     0.0000  .0000E+00  .0000E+00
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302    0.00  0.000  0.024  0.1835    0.0000  .0000E+00  .0000E+00
303    0.00  0.000  0.006  0.1832    0.0000  .0000E+00  .0000E+00
304    0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
305    0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
306    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
307    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
308    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
309    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
310    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
311    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
312    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
313    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
314    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
315    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
316    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
317    0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
318    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
319    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
320    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
321    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
322    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
323    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
324    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
325    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
326    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
327    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
328    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
329    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
330    1.13  0.000  0.051  0.2424    0.0000  .0000E+00  .0000E+00
331    0.41  0.000  0.068  0.2612    0.0000  .0000E+00  .0000E+00
332    0.03  0.000  0.093  0.2577    0.0000  .0000E+00  .0000E+00
333    0.00  0.000  0.058  0.2545    0.0000  .0000E+00  .0000E+00
334    0.01  0.000  0.057  0.2519    0.0000  .0000E+00  .0000E+00
335    0.00  0.000  0.092  0.2469    0.0000  .0000E+00  .0000E+00
336    0.01  0.000  0.076  0.2433    0.0000  .0000E+00  .0000E+00
337    0.00  0.000  0.080  0.2389    0.0000  .0000E+00  .0000E+00
338    0.00  0.000  0.125  0.2320    0.0000  .0000E+00  .0000E+00
339    0.00  0.000  0.113  0.2258    0.0000  .0000E+00  .0000E+00
340    0.00  0.000  0.083  0.2213    0.0000  .0000E+00  .0000E+00
341    0.00  0.000  0.077  0.2170    0.0000  .0000E+00  .0000E+00
342    0.00  0.000  0.114  0.2108    0.0000  .0000E+00  .0000E+00
343    0.00  0.000  0.113  0.2045    0.0000  .0000E+00  .0000E+00
344    0.00  0.000  0.111  0.1984    0.0000  .0000E+00  .0000E+00
345    0.00  0.000  0.104  0.1927    0.0000  .0000E+00  .0000E+00
346    0.00  0.000  0.103  0.1871    0.0000  .0000E+00  .0000E+00
347    0.01  0.000  0.062  0.1842    0.0000  .0000E+00  .0000E+00
348    0.00  0.000  0.013  0.1835    0.0000  .0000E+00  .0000E+00
349    0.00  0.000  0.008  0.1831    0.0000  .0000E+00  .0000E+00
350    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
351    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
352    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
353    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
354    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
355    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
356    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
357    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
358    0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
359    0.11  0.000  0.039  0.1869    0.0000  .0000E+00  .0000E+00
360    0.01  0.000  0.017  0.1866    0.0000  .0000E+00  .0000E+00
361    0.00  0.000  0.023  0.1853    0.0000  .0000E+00  .0000E+00
362    0.04  0.000  0.038  0.1854    0.0000  .0000E+00  .0000E+00
363    0.00  0.000  0.010  0.1848    0.0000  .0000E+00  .0000E+00
364    0.11  0.000  0.049  0.1882    0.0000  .0000E+00  .0000E+00
```

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365          0.00  0.000  0.012  0.1875     0.0000 .0000E+00 .0000E+00

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


    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  4
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  3 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  5

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

                        DAILY OUTPUT FOR YEAR 2002
 --------------------------------------------------------------------------
          S
 DAY  A   O   RAIN  RUNOFF   ET    E. ZONE    HEAD     DRAIN      LEAK
      I   I                        WATER      #1       #1         #1
      R   L   IN.     IN.    IN.   IN./IN.    IN.      IN.        IN.
 ---  -   -  ----- ------ ------ -------- --------- --------- ---------

  1          0.00  0.000  0.018  0.1866     0.0000 .0000E+00 .0000E+00
  2          0.00  0.000  0.026  0.1851     0.0000 .0000E+00 .0000E+00
  3          0.00  0.000  0.010  0.1845     0.0000 .0000E+00 .0000E+00
  4          0.00  0.000  0.014  0.1838     0.0000 .0000E+00 .0000E+00
  5          0.00  0.000  0.010  0.1832     0.0000 .0000E+00 .0000E+00
  6          0.02  0.000  0.020  0.1832     0.0000 .0000E+00 .0000E+00
  7          0.05  0.000  0.030  0.1843     0.0000 .0000E+00 .0000E+00
  8          0.06  0.000  0.032  0.1858     0.0000 .0000E+00 .0000E+00
  9          0.03  0.000  0.026  0.1861     0.0000 .0000E+00 .0000E+00
 10          0.01  0.000  0.016  0.1857     0.0000 .0000E+00 .0000E+00
 11          0.01  0.000  0.023  0.1850     0.0000 .0000E+00 .0000E+00
 12          0.01  0.000  0.017  0.1847     0.0000 .0000E+00 .0000E+00
 13          0.00  0.000  0.012  0.1840     0.0000 .0000E+00 .0000E+00
 14          0.00  0.000  0.014  0.1833     0.0000 .0000E+00 .0000E+00
 15          0.00  0.000  0.003  0.1831     0.0000 .0000E+00 .0000E+00
 16          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
 17          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 18          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 19          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 20          0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
 21          0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
 22          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 23          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 24          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 25          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 26          0.02  0.000  0.020  0.1831     0.0000 .0000E+00 .0000E+00
 27          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 28          0.12  0.000  0.036  0.1876     0.0000 .0000E+00 .0000E+00
 29          0.11  0.000  0.041  0.1914     0.0000 .0000E+00 .0000E+00
 30          0.07  0.000  0.048  0.1927     0.0000 .0000E+00 .0000E+00
 31          0.10  0.000  0.053  0.1953     0.0000 .0000E+00 .0000E+00
 32          0.03  0.000  0.051  0.1941     0.0000 .0000E+00 .0000E+00
 33          0.03  0.000  0.051  0.1930     0.0000 .0000E+00 .0000E+00
 34          0.05  0.000  0.067  0.1920     0.0000 .0000E+00 .0000E+00
 35          0.04  0.000  0.085  0.1896     0.0000 .0000E+00 .0000E+00
 36          0.03  0.000  0.070  0.1873     0.0000 .0000E+00 .0000E+00
 37          0.02  0.000  0.036  0.1865     0.0000 .0000E+00 .0000E+00
 38          0.07  0.000  0.048  0.1877     0.0000 .0000E+00 .0000E+00
 39          0.02  0.000  0.029  0.1871     0.0000 .0000E+00 .0000E+00
 40          0.01  0.000  0.037  0.1857     0.0000 .0000E+00 .0000E+00
 41          0.01  0.000  0.020  0.1851     0.0000 .0000E+00 .0000E+00
 42          0.01  0.000  0.021  0.1845     0.0000 .0000E+00 .0000E+00
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 43     0.01  0.000  0.020  0.1840    0.0000  .0000E+00  .0000E+00
 44     0.01  0.000  0.021  0.1833    0.0000  .0000E+00  .0000E+00
 45     0.00  0.000  0.004  0.1831    0.0000  .0000E+00  .0000E+00
 46     0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
 47     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 48     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 49     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 50     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 51     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 52     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 53     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 54     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 55     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 56     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 57     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 58     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 59     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 60     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 61     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 62     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 63     0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
 64     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 65     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 66     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 67     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 68     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 69     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 70     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 71     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 72     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 73     0.18  0.000  0.040  0.1908    0.0000  .0000E+00  .0000E+00
 74     0.07  0.000  0.081  0.1901    0.0000  .0000E+00  .0000E+00
 75     0.05  0.000  0.055  0.1899    0.0000  .0000E+00  .0000E+00
 76     0.03  0.000  0.050  0.1888    0.0000  .0000E+00  .0000E+00
 77     0.01  0.000  0.059  0.1861    0.0000  .0000E+00  .0000E+00
 78     0.01  0.000  0.025  0.1853    0.0000  .0000E+00  .0000E+00
 79     0.00  0.000  0.024  0.1839    0.0000  .0000E+00  .0000E+00
 80     0.00  0.000  0.011  0.1833    0.0000  .0000E+00  .0000E+00
 81     0.00  0.000  0.003  0.1831    0.0000  .0000E+00  .0000E+00
 82     0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
 83     0.18  0.000  0.040  0.1907    0.0000  .0000E+00  .0000E+00
 84     0.09  0.000  0.058  0.1925    0.0000  .0000E+00  .0000E+00
 85     0.09  0.000  0.077  0.1932    0.0000  .0000E+00  .0000E+00
 86     0.08  0.000  0.086  0.1929    0.0000  .0000E+00  .0000E+00
 87     0.05  0.000  0.079  0.1913    0.0000  .0000E+00  .0000E+00
 88     0.02  0.000  0.064  0.1889    0.0000  .0000E+00  .0000E+00
 89     0.02  0.000  0.061  0.1866    0.0000  .0000E+00  .0000E+00
 90     0.02  0.000  0.037  0.1857    0.0000  .0000E+00  .0000E+00
 91     0.00  0.000  0.021  0.1845    0.0000  .0000E+00  .0000E+00
 92     0.00  0.000  0.021  0.1834    0.0000  .0000E+00  .0000E+00
 93     0.00  0.000  0.004  0.1832    0.0000  .0000E+00  .0000E+00
 94     0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
 95     0.02  0.000  0.020  0.1831    0.0000  .0000E+00  .0000E+00
 96     0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
 97     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 98     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
 99     0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
100     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
101     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
102     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
103     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
104     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
105     0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
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106        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
107        0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
108        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
109        0.10  0.000  0.046  0.1860    0.0000  .0000E+00  .0000E+00
110        0.13  0.000  0.049  0.1905    0.0000  .0000E+00  .0000E+00
111        0.02  0.000  0.077  0.1874    0.0000  .0000E+00  .0000E+00
112        0.00  0.000  0.042  0.1850    0.0000  .0000E+00  .0000E+00
113        0.00  0.000  0.023  0.1838    0.0000  .0000E+00  .0000E+00
114        0.00  0.000  0.008  0.1833    0.0000  .0000E+00  .0000E+00
115        0.00  0.000  0.003  0.1832    0.0000  .0000E+00  .0000E+00
116        0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
117        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
118        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
119        0.12  0.000  0.045  0.1872    0.0000  .0000E+00  .0000E+00
120        0.01  0.000  0.021  0.1866    0.0000  .0000E+00  .0000E+00
121        0.00  0.000  0.040  0.1844    0.0000  .0000E+00  .0000E+00
122        0.00  0.000  0.016  0.1835    0.0000  .0000E+00  .0000E+00
123        0.00  0.000  0.006  0.1832    0.0000  .0000E+00  .0000E+00
124        0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
125        0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
126        0.08  0.000  0.048  0.1848    0.0000  .0000E+00  .0000E+00
127        0.12  0.000  0.048  0.1888    0.0000  .0000E+00  .0000E+00
128        0.05  0.000  0.061  0.1882    0.0000  .0000E+00  .0000E+00
129        0.02  0.000  0.054  0.1863    0.0000  .0000E+00  .0000E+00
130        0.00  0.000  0.025  0.1850    0.0000  .0000E+00  .0000E+00
131        0.01  0.000  0.037  0.1835    0.0000  .0000E+00  .0000E+00
132        0.38  0.000  0.082  0.1998    0.0000  .0000E+00  .0000E+00
133        0.31  0.000  0.113  0.2106    0.0000  .0000E+00  .0000E+00
134        0.04  0.000  0.122  0.2062    0.0000  .0000E+00  .0000E+00
135        0.03  0.000  0.082  0.2033    0.0000  .0000E+00  .0000E+00
136        0.01  0.000  0.074  0.1997    0.0000  .0000E+00  .0000E+00
137        0.01  0.000  0.130  0.1931    0.0000  .0000E+00  .0000E+00
138        0.01  0.000  0.133  0.1864    0.0000  .0000E+00  .0000E+00
139        0.01  0.000  0.063  0.1834    0.0000  .0000E+00  .0000E+00
140        0.00  0.000  0.004  0.1832    0.0000  .0000E+00  .0000E+00
141        0.01  0.000  0.011  0.1831    0.0000  .0000E+00  .0000E+00
142        0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
143        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
144        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
145        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
146        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
147        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
148        0.04  0.000  0.040  0.1831    0.0000  .0000E+00  .0000E+00
149        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
150        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
151        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
152        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
153        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
154        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
155        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
156        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
157        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
158        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
159        0.02  0.000  0.020  0.1831    0.0000  .0000E+00  .0000E+00
160        0.09  0.000  0.056  0.1849    0.0000  .0000E+00  .0000E+00
161        0.00  0.000  0.019  0.1839    0.0000  .0000E+00  .0000E+00
162        0.02  0.000  0.030  0.1834    0.0000  .0000E+00  .0000E+00
163        0.00  0.000  0.004  0.1832    0.0000  .0000E+00  .0000E+00
164        0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
165        0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
166        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
167        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
168        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
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169          0.02   0.000   0.020   0.1831     0.0000  .0000E+00  .0000E+00
170          0.08   0.000   0.048   0.1848     0.0000  .0000E+00  .0000E+00
171          0.00   0.000   0.018   0.1838     0.0000  .0000E+00  .0000E+00
172          0.00   0.000   0.009   0.1833     0.0000  .0000E+00  .0000E+00
173          0.00   0.000   0.003   0.1832     0.0000  .0000E+00  .0000E+00
174          0.00   0.000   0.001   0.1831     0.0000  .0000E+00  .0000E+00
175          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
176          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
177          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
178          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
179          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
180          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
181          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
182          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
183          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
184          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
185          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
186          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
187          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
188          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
189          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
190          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
191          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
192          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
193          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
194          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
195          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
196          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
197          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
198          0.02   0.000   0.020   0.1831     0.0000  .0000E+00  .0000E+00
199          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
200          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
201          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
202          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
203          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
204          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
205          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
206          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
207          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
208          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
209          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
210          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
211          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
212          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
213          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
214          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
215          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
216          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
217          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
218          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
219          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
220          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
221          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
222          0.02   0.000   0.020   0.1831     0.0000  .0000E+00  .0000E+00
223          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
224          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
225          0.03   0.000   0.028   0.1831     0.0000  .0000E+00  .0000E+00
226          0.05   0.000   0.044   0.1835     0.0000  .0000E+00  .0000E+00
227          0.00   0.000   0.004   0.1832     0.0000  .0000E+00  .0000E+00
228          0.00   0.000   0.002   0.1831     0.0000  .0000E+00  .0000E+00
229          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
230          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
231          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
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232         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
233         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
234         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
235         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
236         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
237         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
238         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
239         0.04  0.000  0.037  0.1832    0.0000 .0000E+00 .0000E+00
240         0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
241         0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
242         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
243         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
244         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
245         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
246         0.33  0.000  0.086  0.1965    0.0000 .0000E+00 .0000E+00
247         0.01  0.000  0.117  0.1906    0.0000 .0000E+00 .0000E+00
248         0.00  0.000  0.118  0.1841    0.0000 .0000E+00 .0000E+00
249         0.00  0.000  0.012  0.1834    0.0000 .0000E+00 .0000E+00
250         0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
251         0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
252         0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
253         0.12  0.000  0.045  0.1872    0.0000 .0000E+00 .0000E+00
254         0.00  0.000  0.017  0.1863    0.0000 .0000E+00 .0000E+00
255         0.00  0.000  0.042  0.1839    0.0000 .0000E+00 .0000E+00
256         0.01  0.000  0.023  0.1832    0.0000 .0000E+00 .0000E+00
257         0.01  0.000  0.012  0.1831    0.0000 .0000E+00 .0000E+00
258         0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
259         0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
260         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
261         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
262         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
263         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
264         0.08  0.000  0.047  0.1849    0.0000 .0000E+00 .0000E+00
265         0.00  0.000  0.016  0.1840    0.0000 .0000E+00 .0000E+00
266         0.00  0.000  0.010  0.1834    0.0000 .0000E+00 .0000E+00
267         0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
268         0.05  0.000  0.042  0.1836    0.0000 .0000E+00 .0000E+00
269         0.06  0.000  0.042  0.1846    0.0000 .0000E+00 .0000E+00
270         0.13  0.000  0.049  0.1890    0.0000 .0000E+00 .0000E+00
271         0.00  0.000  0.035  0.1871    0.0000 .0000E+00 .0000E+00
272         0.03  0.000  0.065  0.1852    0.0000 .0000E+00 .0000E+00
273         0.00  0.000  0.022  0.1840    0.0000 .0000E+00 .0000E+00
274         0.00  0.000  0.010  0.1834    0.0000 .0000E+00 .0000E+00
275         0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
276         0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
277         0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
278         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
279         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
280         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
281         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
282         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
283         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
284         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
285         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
286         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
287         0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
288         0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
289         0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
290         0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
291         0.22  0.000  0.053  0.1922    0.0000 .0000E+00 .0000E+00
292         0.09  0.000  0.087  0.1924    0.0000 .0000E+00 .0000E+00
293         0.06  0.000  0.067  0.1920    0.0000 .0000E+00 .0000E+00
294         0.04  0.000  0.060  0.1910    0.0000 .0000E+00 .0000E+00
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295          0.02   0.000   0.055   0.1890      0.0000  .0000E+00  .0000E+00
296          0.01   0.000   0.052   0.1867      0.0000  .0000E+00  .0000E+00
297          0.00   0.000   0.032   0.1849      0.0000  .0000E+00  .0000E+00
298          0.00   0.000   0.027   0.1835      0.0000  .0000E+00  .0000E+00
299          0.00   0.000   0.005   0.1832      0.0000  .0000E+00  .0000E+00
300          0.00   0.000   0.002   0.1831      0.0000  .0000E+00  .0000E+00
301          0.00   0.000   0.001   0.1831      0.0000  .0000E+00  .0000E+00
302          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
303          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
304          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
305          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
306          0.01   0.000   0.010   0.1831      0.0000  .0000E+00  .0000E+00
307          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
308          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
309          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
310          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
311          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
312          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
313          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
314          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
315          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
316          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
317          0.06   0.000   0.040   0.1841      0.0000  .0000E+00  .0000E+00
318          0.01   0.000   0.015   0.1838      0.0000  .0000E+00  .0000E+00
319          0.02   0.000   0.029   0.1833      0.0000  .0000E+00  .0000E+00
320          0.00   0.000   0.004   0.1831      0.0000  .0000E+00  .0000E+00
321          0.03   0.000   0.030   0.1831      0.0000  .0000E+00  .0000E+00
322          0.00   0.000   0.001   0.1831      0.0000  .0000E+00  .0000E+00
323          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
324          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
325          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
326          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
327          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
328          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
329          0.17   0.000   0.049   0.1897      0.0000  .0000E+00  .0000E+00
330          0.00   0.000   0.040   0.1875      0.0000  .0000E+00  .0000E+00
331          0.34   0.000   0.080   0.2018      0.0000  .0000E+00  .0000E+00
332          0.10   0.000   0.084   0.2027      0.0000  .0000E+00  .0000E+00
333          0.00   0.000   0.044   0.2003      0.0000  .0000E+00  .0000E+00
334          0.00   0.000   0.068   0.1966      0.0000  .0000E+00  .0000E+00
335          0.00   0.000   0.042   0.1943      0.0000  .0000E+00  .0000E+00
336          0.00   0.000   0.033   0.1924      0.0000  .0000E+00  .0000E+00
337          0.00   0.000   0.049   0.1897      0.0000  .0000E+00  .0000E+00
338          0.00   0.000   0.045   0.1873      0.0000  .0000E+00  .0000E+00
339          0.00   0.000   0.059   0.1840      0.0000  .0000E+00  .0000E+00
340          0.00   0.000   0.011   0.1834      0.0000  .0000E+00  .0000E+00
341          0.00   0.000   0.004   0.1832      0.0000  .0000E+00  .0000E+00
342          0.00   0.000   0.001   0.1831      0.0000  .0000E+00  .0000E+00
343          0.00   0.000   0.001   0.1831      0.0000  .0000E+00  .0000E+00
344          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
345          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
346          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
347          0.03   0.000   0.029   0.1831      0.0000  .0000E+00  .0000E+00
348          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
349          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
350          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
351          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
352          0.01   0.000   0.010   0.1831      0.0000  .0000E+00  .0000E+00
353          0.00   0.000   0.000   0.1831      0.0000  .0000E+00  .0000E+00
354          0.04   0.000   0.031   0.1836      0.0000  .0000E+00  .0000E+00
355          0.03   0.000   0.029   0.1836      0.0000  .0000E+00  .0000E+00
356          0.00   0.000   0.006   0.1833      0.0000  .0000E+00  .0000E+00
357          0.00   0.000   0.003   0.1831      0.0000  .0000E+00  .0000E+00
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358            0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
359            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
360            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
361            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
362            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
363            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
364            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
365            0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00

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    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  4
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  3 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  5

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                        DAILY OUTPUT FOR YEAR 2003
-----------------------------------------------------------------------
         S
DAY  A   O   RAIN  RUNOFF    ET   E. ZONE    HEAD      DRAIN      LEAK
     I   I                         WATER     #1         #1         #1
     R   L   IN.    IN.     IN.   IN./IN.    IN.        IN.        IN.
---  -   -  -----  ------  ------ -------  --------- ---------  ---------

  1          0.02  0.000  0.020  0.1831    0.0000 .0000E+00 .0000E+00
  2          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
  3          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
  4          0.06  0.000  0.038  0.1843    0.0000 .0000E+00 .0000E+00
  5          0.00  0.000  0.004  0.1840    0.0000 .0000E+00 .0000E+00
  6          0.00  0.000  0.010  0.1835    0.0000 .0000E+00 .0000E+00
  7          0.00  0.000  0.005  0.1832    0.0000 .0000E+00 .0000E+00
  8          0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
  9          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
 10          0.03  0.000  0.026  0.1833    0.0000 .0000E+00 .0000E+00
 11          0.00  0.000  0.002  0.1832    0.0000 .0000E+00 .0000E+00
 12          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
 13          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
 14          0.17  0.000  0.047  0.1898    0.0000 .0000E+00 .0000E+00
 15          0.24  0.000  0.055  0.2000    0.0000 .0000E+00 .0000E+00
 16          0.01  0.000  0.024  0.1993    0.0000 .0000E+00 .0000E+00
 17          0.00  0.000  0.022  0.1981    0.0000 .0000E+00 .0000E+00
 18          0.00  0.000  0.036  0.1961    0.0000 .0000E+00 .0000E+00
 19          0.16  0.000  0.079  0.2006    0.0000 .0000E+00 .0000E+00
 20          0.09  0.000  0.068  0.2018    0.0000 .0000E+00 .0000E+00
 21          0.00  0.000  0.022  0.2006    0.0000 .0000E+00 .0000E+00
 22          0.00  0.000  0.039  0.1984    0.0000 .0000E+00 .0000E+00
 23          0.00  0.000  0.036  0.1964    0.0000 .0000E+00 .0000E+00
 24          0.13  0.000  0.099  0.1981    0.0000 .0000E+00 .0000E+00
 25          0.10  0.000  0.071  0.1997    0.0000 .0000E+00 .0000E+00
 26          0.02  0.000  0.043  0.1984    0.0000 .0000E+00 .0000E+00
 27          0.00  0.000  0.038  0.1964    0.0000 .0000E+00 .0000E+00
 28          0.00  0.000  0.057  0.1932    0.0000 .0000E+00 .0000E+00
 29          0.05  0.000  0.046  0.1934    0.0000 .0000E+00 .0000E+00
 30          0.02  0.000  0.055  0.1915    0.0000 .0000E+00 .0000E+00
 31          0.00  0.000  0.080  0.1871    0.0000 .0000E+00 .0000E+00
 32          0.00  0.000  0.059  0.1839    0.0000 .0000E+00 .0000E+00
 33          0.00  0.000  0.009  0.1834    0.0000 .0000E+00 .0000E+00
 34          0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
 35          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
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36          0.00   0.000   0.001   0.1831     0.0000  .0000E+00  .0000E+00
37          0.18   0.000   0.053   0.1900     0.0000  .0000E+00  .0000E+00
38          0.00   0.000   0.045   0.1876     0.0000  .0000E+00  .0000E+00
39          0.00   0.000   0.046   0.1850     0.0000  .0000E+00  .0000E+00
40          0.00   0.000   0.018   0.1841     0.0000  .0000E+00  .0000E+00
41          0.00   0.000   0.012   0.1834     0.0000  .0000E+00  .0000E+00
42          0.00   0.000   0.004   0.1832     0.0000  .0000E+00  .0000E+00
43          0.00   0.000   0.001   0.1831     0.0000  .0000E+00  .0000E+00
44          0.27   0.000   0.053   0.1950     0.0000  .0000E+00  .0000E+00
45          0.51   0.000   0.060   0.2198     0.0000  .0000E+00  .0000E+00
46          0.00   0.000   0.075   0.2156     0.0000  .0000E+00  .0000E+00
47          0.00   0.000   0.071   0.2117     0.0000  .0000E+00  .0000E+00
48          0.00   0.000   0.118   0.2052     0.0000  .0000E+00  .0000E+00
49          0.00   0.000   0.121   0.1986     0.0000  .0000E+00  .0000E+00
50          0.00   0.000   0.086   0.1938     0.0000  .0000E+00  .0000E+00
51          0.00   0.000   0.131   0.1867     0.0000  .0000E+00  .0000E+00
52          0.00   0.000   0.055   0.1837     0.0000  .0000E+00  .0000E+00
53          0.00   0.000   0.008   0.1832     0.0000  .0000E+00  .0000E+00
54          0.00   0.000   0.003   0.1831     0.0000  .0000E+00  .0000E+00
55          0.02   0.000   0.020   0.1831     0.0000  .0000E+00  .0000E+00
56          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
57          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
58          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
59          0.05   0.000   0.038   0.1837     0.0000  .0000E+00  .0000E+00
60          0.00   0.000   0.007   0.1834     0.0000  .0000E+00  .0000E+00
61          0.00   0.000   0.004   0.1832     0.0000  .0000E+00  .0000E+00
62          0.00   0.000   0.001   0.1831     0.0000  .0000E+00  .0000E+00
63          0.00   0.000   0.001   0.1831     0.0000  .0000E+00  .0000E+00
64          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
65          0.45   0.000   0.098   0.2024     0.0000  .0000E+00  .0000E+00
66          0.25   0.000   0.093   0.2110     0.0000  .0000E+00  .0000E+00
67          0.10   0.000   0.125   0.2097     0.0000  .0000E+00  .0000E+00
68          0.01   0.000   0.077   0.2060     0.0000  .0000E+00  .0000E+00
69          0.00   0.000   0.095   0.2008     0.0000  .0000E+00  .0000E+00
70          0.00   0.000   0.079   0.1964     0.0000  .0000E+00  .0000E+00
71          0.00   0.000   0.106   0.1906     0.0000  .0000E+00  .0000E+00
72          0.00   0.000   0.094   0.1855     0.0000  .0000E+00  .0000E+00
73          0.00   0.000   0.031   0.1838     0.0000  .0000E+00  .0000E+00
74          0.02   0.000   0.028   0.1833     0.0000  .0000E+00  .0000E+00
75          0.00   0.000   0.003   0.1832     0.0000  .0000E+00  .0000E+00
76          0.00   0.000   0.003   0.1831     0.0000  .0000E+00  .0000E+00
77          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
78          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
79          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
80          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
81          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
82          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
83          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
84          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
85          0.17   0.000   0.057   0.1893     0.0000  .0000E+00  .0000E+00
86          0.17   0.000   0.081   0.1941     0.0000  .0000E+00  .0000E+00
87          0.02   0.000   0.089   0.1903     0.0000  .0000E+00  .0000E+00
88          0.00   0.000   0.090   0.1854     0.0000  .0000E+00  .0000E+00
89          0.53   0.000   0.086   0.2098     0.0000  .0000E+00  .0000E+00
90          0.42   0.000   0.074   0.2288     0.0000  .0000E+00  .0000E+00
91          0.34   0.000   0.079   0.2431     0.0000  .0000E+00  .0000E+00
92          0.00   0.000   0.119   0.2366     0.0000  .0000E+00  .0000E+00
93          0.23   0.000   0.122   0.2425     0.0000  .0000E+00  .0000E+00
94          1.02   0.002   0.142   0.2907     0.0000  .0000E+00  .0000E+00
95          0.01   0.000   0.141   0.2834     0.0000  .0000E+00  .0000E+00
96          0.19   0.000   0.129   0.2868     0.0000  .0000E+00  .0000E+00
97          0.18   0.000   0.164   0.2877     0.0000  .0000E+00  .0000E+00
98          0.00   0.000   0.178   0.2779     0.0000  .0000E+00  .0000E+00
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  99        0.10  0.000  0.139  0.2758     0.0000  .0000E+00  .0000E+00
 100        0.00  0.000  0.187  0.2655     0.0000  .0000E+00  .0000E+00
 101        0.00  0.000  0.198  0.2546     0.0000  .0000E+00  .0000E+00
 102        0.00  0.000  0.211  0.2430     0.0000  .0000E+00  .0000E+00
 103        0.00  0.000  0.176  0.2333     0.0000  .0000E+00  .0000E+00
 104        0.00  0.000  0.196  0.2225     0.0000  .0000E+00  .0000E+00
 105        0.00  0.000  0.146  0.2145     0.0000  .0000E+00  .0000E+00
 106        0.00  0.000  0.202  0.2034     0.0000  .0000E+00  .0000E+00
 107        0.07  0.000  0.139  0.1996     0.0000  .0000E+00  .0000E+00
 108        0.01  0.000  0.170  0.1908     0.0000  .0000E+00  .0000E+00
 109        0.00  0.000  0.097  0.1855     0.0000  .0000E+00  .0000E+00
 110        0.00  0.000  0.042  0.1831     0.0000  .0000E+00  .0000E+00
 111        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
 112        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 113        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 114        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 115        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 116        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 117        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 118        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 119        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 120        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 121        0.06  0.000  0.054  0.1834     0.0000  .0000E+00  .0000E+00
 122        0.00  0.000  0.004  0.1832     0.0000  .0000E+00  .0000E+00
 123        0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
 124        0.09  0.000  0.055  0.1850     0.0000  .0000E+00  .0000E+00
 125        0.00  0.000  0.020  0.1839     0.0000  .0000E+00  .0000E+00
 126        0.00  0.000  0.010  0.1834     0.0000  .0000E+00  .0000E+00
 127        0.02  0.000  0.024  0.1832     0.0000  .0000E+00  .0000E+00
 128        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
 129        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
 130        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 131        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 132        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 133        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 134        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 135        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 136        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 137        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 138        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 139        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 140        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 141        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 142        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 143        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 144        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 145        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 146        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 147        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 148        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 149        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 150        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 151        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 152        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 153        0.12  0.000  0.061  0.1863     0.0000  .0000E+00  .0000E+00
 154        0.01  0.000  0.028  0.1853     0.0000  .0000E+00  .0000E+00
 155        0.00  0.000  0.034  0.1835     0.0000  .0000E+00  .0000E+00
 156        0.00  0.000  0.005  0.1832     0.0000  .0000E+00  .0000E+00
 157        0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
 158        0.02  0.000  0.021  0.1831     0.0000  .0000E+00  .0000E+00
 159        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 160        0.36  0.000  0.091  0.1978     0.0000  .0000E+00  .0000E+00
 161        0.15  0.000  0.116  0.1997     0.0000  .0000E+00  .0000E+00
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162        0.01  0.000  0.091  0.1953    0.0000 .0000E+00 .0000E+00
163        0.00  0.000  0.128  0.1882    0.0000 .0000E+00 .0000E+00
164        0.00  0.000  0.074  0.1841    0.0000 .0000E+00 .0000E+00
165        0.00  0.000  0.012  0.1834    0.0000 .0000E+00 .0000E+00
166        0.01  0.000  0.015  0.1832    0.0000 .0000E+00 .0000E+00
167        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
168        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
169        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
170        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
171        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
172        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
173        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
174        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
175        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
176        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
177        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
178        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
179        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
180        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
181        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
182        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
183        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
184        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
185        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
186        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
187        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
188        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
189        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
190        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
191        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
192        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
193        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
194        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
195        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
196        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
197        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
198        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
199        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
200        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
201        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
202        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
203        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
204        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
205        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
206        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
207        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
208        0.02  0.000  0.020  0.1831    0.0000 .0000E+00 .0000E+00
209        0.04  0.000  0.040  0.1831    0.0000 .0000E+00 .0000E+00
210        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
211        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
212        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
213        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
214        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
215        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
216        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
217        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
218        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
219        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
220        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
221        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
222        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
223        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
224        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
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225          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
226          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
227          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
228          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
229          0.01  0.000  0.010  0.1831      0.0000 .0000E+00 .0000E+00
230          0.01  0.000  0.010  0.1831      0.0000 .0000E+00 .0000E+00
231          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
232          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
233          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
234          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
235          0.01  0.000  0.010  0.1831      0.0000 .0000E+00 .0000E+00
236          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
237          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
238          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
239          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
240          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
241          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
242          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
243          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
244          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
245          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
246          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
247          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
248          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
249          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
250          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
251          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
252          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
253          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
254          0.00  0.000  0.000  0.1831      0.0000 .0000E+00 .0000E+00
255          0.04  0.000  0.038  0.1832      0.0000 .0000E+00 .0000E+00
256          0.02  0.000  0.021  0.1831      0.0000 .0000E+00 .0000E+00
257          0.04  0.000  0.041  0.1831      0.0000 .0000E+00 .0000E+00
258          0.08  0.000  0.051  0.1847      0.0000 .0000E+00 .0000E+00
259          0.04  0.000  0.038  0.1848      0.0000 .0000E+00 .0000E+00
260          0.20  0.000  0.053  0.1929      0.0000 .0000E+00 .0000E+00
261          0.13  0.000  0.095  0.1948      0.0000 .0000E+00 .0000E+00
262          0.10  0.000  0.086  0.1955      0.0000 .0000E+00 .0000E+00
263          0.05  0.000  0.086  0.1936      0.0000 .0000E+00 .0000E+00
264          0.00  0.000  0.104  0.1878      0.0000 .0000E+00 .0000E+00
265          0.00  0.000  0.048  0.1852      0.0000 .0000E+00 .0000E+00
266          0.10  0.000  0.075  0.1866      0.0000 .0000E+00 .0000E+00
267          0.11  0.000  0.065  0.1890      0.0000 .0000E+00 .0000E+00
268          0.00  0.000  0.039  0.1869      0.0000 .0000E+00 .0000E+00
269          0.01  0.000  0.048  0.1848      0.0000 .0000E+00 .0000E+00
270          0.01  0.000  0.028  0.1838      0.0000 .0000E+00 .0000E+00
271          0.00  0.000  0.008  0.1834      0.0000 .0000E+00 .0000E+00
272          0.00  0.000  0.003  0.1832      0.0000 .0000E+00 .0000E+00
273          0.00  0.000  0.001  0.1831      0.0000 .0000E+00 .0000E+00
274          0.02  0.000  0.021  0.1831      0.0000 .0000E+00 .0000E+00
275          0.19  0.000  0.064  0.1900      0.0000 .0000E+00 .0000E+00
276          0.00  0.000  0.051  0.1872      0.0000 .0000E+00 .0000E+00
277          0.41  0.000  0.115  0.2034      0.0000 .0000E+00 .0000E+00
278          0.00  0.000  0.094  0.1983      0.0000 .0000E+00 .0000E+00
279          0.02  0.000  0.118  0.1929      0.0000 .0000E+00 .0000E+00
280          0.02  0.000  0.093  0.1888      0.0000 .0000E+00 .0000E+00
281          0.00  0.000  0.078  0.1845      0.0000 .0000E+00 .0000E+00
282          0.01  0.000  0.027  0.1836      0.0000 .0000E+00 .0000E+00
283          0.00  0.000  0.006  0.1833      0.0000 .0000E+00 .0000E+00
284          0.00  0.000  0.002  0.1832      0.0000 .0000E+00 .0000E+00
285          0.05  0.000  0.041  0.1837      0.0000 .0000E+00 .0000E+00
286          0.08  0.000  0.044  0.1856      0.0000 .0000E+00 .0000E+00
287          0.00  0.000  0.014  0.1849      0.0000 .0000E+00 .0000E+00
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288          0.00  0.000  0.026  0.1835    0.0000 .0000E+00 .0000E+00
289          0.00  0.000  0.006  0.1832    0.0000 .0000E+00 .0000E+00
290          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
291          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
292          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
293          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
294          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
295          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
296          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
297          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
298          0.40  0.000  0.080  0.2006    0.0000 .0000E+00 .0000E+00
299          0.00  0.000  0.076  0.1964    0.0000 .0000E+00 .0000E+00
300          0.02  0.000  0.121  0.1909    0.0000 .0000E+00 .0000E+00
301          0.64  0.000  0.139  0.2184    0.0000 .0000E+00 .0000E+00
302          0.19  0.000  0.120  0.2222    0.0000 .0000E+00 .0000E+00
303          0.23  0.000  0.145  0.2269    0.0000 .0000E+00 .0000E+00
304          0.22  0.000  0.086  0.2343    0.0000 .0000E+00 .0000E+00
305          0.13  0.000  0.117  0.2350    0.0000 .0000E+00 .0000E+00
306          0.09  0.000  0.122  0.2332    0.0000 .0000E+00 .0000E+00
307          0.07  0.000  0.144  0.2291    0.0000 .0000E+00 .0000E+00
308          0.04  0.000  0.105  0.2255    0.0000 .0000E+00 .0000E+00
309          0.03  0.000  0.104  0.2215    0.0000 .0000E+00 .0000E+00
310          0.02  0.000  0.073  0.2186    0.0000 .0000E+00 .0000E+00
311          0.00  0.000  0.085  0.2139    0.0000 .0000E+00 .0000E+00
312          0.00  0.000  0.088  0.2091    0.0000 .0000E+00 .0000E+00
313          0.00  0.000  0.104  0.2034    0.0000 .0000E+00 .0000E+00
314          0.00  0.000  0.094  0.1982    0.0000 .0000E+00 .0000E+00
315          0.00  0.000  0.109  0.1922    0.0000 .0000E+00 .0000E+00
316          0.03  0.000  0.101  0.1883    0.0000 .0000E+00 .0000E+00
317          0.01  0.000  0.082  0.1844    0.0000 .0000E+00 .0000E+00
318          0.00  0.000  0.019  0.1833    0.0000 .0000E+00 .0000E+00
319          0.02  0.000  0.025  0.1831    0.0000 .0000E+00 .0000E+00
320          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
321          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
322          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
323          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
324          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
325          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
326          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
327          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
328          0.06  0.000  0.041  0.1841    0.0000 .0000E+00 .0000E+00
329          0.15  0.000  0.052  0.1895    0.0000 .0000E+00 .0000E+00
330          0.01  0.000  0.043  0.1877    0.0000 .0000E+00 .0000E+00
331          0.00  0.000  0.036  0.1857    0.0000 .0000E+00 .0000E+00
332          0.00  0.000  0.014  0.1849    0.0000 .0000E+00 .0000E+00
333          0.00  0.000  0.017  0.1840    0.0000 .0000E+00 .0000E+00
334          0.03  0.000  0.032  0.1839    0.0000 .0000E+00 .0000E+00
335          0.23  0.000  0.053  0.1936    0.0000 .0000E+00 .0000E+00
336          0.12  0.000  0.071  0.1963    0.0000 .0000E+00 .0000E+00
337          0.06  0.000  0.055  0.1966    0.0000 .0000E+00 .0000E+00
338          0.03  0.000  0.049  0.1955    0.0000 .0000E+00 .0000E+00
339          0.03  0.000  0.064  0.1936    0.0000 .0000E+00 .0000E+00
340          0.00  0.000  0.033  0.1918    0.0000 .0000E+00 .0000E+00
341          0.00  0.000  0.054  0.1888    0.0000 .0000E+00 .0000E+00
342          0.00  0.000  0.046  0.1863    0.0000 .0000E+00 .0000E+00
343          0.00  0.000  0.042  0.1840    0.0000 .0000E+00 .0000E+00
344          0.00  0.000  0.012  0.1833    0.0000 .0000E+00 .0000E+00
345          0.00  0.000  0.003  0.1831    0.0000 .0000E+00 .0000E+00
346          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
347          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
348          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
349          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
350          0.03  0.000  0.026  0.1833    0.0000 .0000E+00 .0000E+00
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351          0.00  0.000  0.002  0.1831     0.0000 .0000E+00 .0000E+00
352          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
353          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
354          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
355          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
356          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
357          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
358          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
359          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
360          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
361          0.26  0.000  0.053  0.1944     0.0000 .0000E+00 .0000E+00
362          0.02  0.000  0.039  0.1934     0.0000 .0000E+00 .0000E+00
363          0.00  0.000  0.028  0.1919     0.0000 .0000E+00 .0000E+00
364          0.60  0.000  0.086  0.2201     0.0000 .0000E+00 .0000E+00
365          0.32  0.000  0.098  0.2323     0.0000 .0000E+00 .0000E+00

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   HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  4
   DRAIN #1:  LATERAL DRAINAGE FROM LAYER  3 (RECIRCULATION AND COLLECTION)
   LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  5

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                      DAILY OUTPUT FOR YEAR 2004
    --------------------------------------------------------------------
          S
DAY  A    O   RAIN  RUNOFF    ET    E. ZONE     HEAD      DRAIN      LEAK
     I    I                          WATER      #1        #1         #1
     R    L   IN.     IN.     IN.   IN./IN.     IN.       IN.        IN.
---  -    -  -----  ------  ------  -------  --------- --------- ---------

  1          0.30  0.000  0.094  0.2437     0.0000 .0000E+00 .0000E+00
  2          0.18  0.000  0.073  0.2496     0.0000 .0000E+00 .0000E+00
  3          0.12  0.000  0.061  0.2528     0.0000 .0000E+00 .0000E+00
  4          0.03  0.000  0.046  0.2519     0.0000 .0000E+00 .0000E+00
  5          0.00  0.000  0.040  0.2497     0.0000 .0000E+00 .0000E+00
  6          0.00  0.000  0.039  0.2475     0.0000 .0000E+00 .0000E+00
  7          0.00  0.000  0.047  0.2450     0.0000 .0000E+00 .0000E+00
  8          0.00  0.000  0.043  0.2426     0.0000 .0000E+00 .0000E+00
  9          0.00  0.000  0.060  0.2393     0.0000 .0000E+00 .0000E+00
 10          0.00  0.000  0.060  0.2360     0.0000 .0000E+00 .0000E+00
 11          0.00  0.000  0.040  0.2338     0.0000 .0000E+00 .0000E+00
 12          0.02  0.000  0.061  0.2316     0.0000 .0000E+00 .0000E+00
 13          0.00  0.000  0.058  0.2284     0.0000 .0000E+00 .0000E+00
 14          0.23  0.000  0.067  0.2374     0.0000 .0000E+00 .0000E+00
 15          0.00  0.000  0.041  0.2351     0.0000 .0000E+00 .0000E+00
 16          0.00  0.000  0.056  0.2320     0.0000 .0000E+00 .0000E+00
 17          0.00  0.000  0.052  0.2292     0.0000 .0000E+00 .0000E+00
 18          0.04  0.000  0.056  0.2283     0.0000 .0000E+00 .0000E+00
 19          0.08  0.000  0.075  0.2286     0.0000 .0000E+00 .0000E+00
 20          0.00  0.000  0.045  0.2261     0.0000 .0000E+00 .0000E+00
 21          0.00  0.000  0.062  0.2227     0.0000 .0000E+00 .0000E+00
 22          0.69  0.000  0.096  0.2553     0.0000 .0000E+00 .0000E+00
 23          0.56  0.000  0.098  0.2807     0.0000 .0000E+00 .0000E+00
 24          0.00  0.000  0.024  0.2794     0.0000 .0000E+00 .0000E+00
 25          0.00  0.000  0.041  0.2771     0.0000 .0000E+00 .0000E+00
 26          0.05  0.000  0.047  0.2773     0.0000 .0000E+00 .0000E+00
 27          0.00  0.000  0.026  0.2759     0.0000 .0000E+00 .0000E+00
 28          0.00  0.000  0.044  0.2735     0.0000 .0000E+00 .0000E+00
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29           0.00  0.000  0.053  0.2706    0.0000 .0000E+00 .0000E+00
30           0.00  0.000  0.058  0.2674    0.0000 .0000E+00 .0000E+00
31           0.00  0.000  0.159  0.2586    0.0000 .0000E+00 .0000E+00
32           0.00  0.000  0.150  0.2504    0.0000 .0000E+00 .0000E+00
33           0.00  0.000  0.142  0.2426    0.0000 .0000E+00 .0000E+00
34           0.05  0.000  0.107  0.2394    0.0000 .0000E+00 .0000E+00
35           0.00  0.000  0.138  0.2318    0.0000 .0000E+00 .0000E+00
36           0.00  0.000  0.075  0.2277    0.0000 .0000E+00 .0000E+00
37           0.00  0.000  0.164  0.2187    0.0000 .0000E+00 .0000E+00
38           0.05  0.000  0.165  0.2124    0.0000 .0000E+00 .0000E+00
39           0.00  0.000  0.170  0.2030    0.0000 .0000E+00 .0000E+00
40           0.00  0.000  0.179  0.1932    0.0000 .0000E+00 .0000E+00
41           0.11  0.000  0.117  0.1928    0.0000 .0000E+00 .0000E+00
42           0.00  0.000  0.098  0.1874    0.0000 .0000E+00 .0000E+00
43           0.00  0.000  0.056  0.1843    0.0000 .0000E+00 .0000E+00
44           0.00  0.000  0.016  0.1834    0.0000 .0000E+00 .0000E+00
45           0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
46           0.01  0.000  0.011  0.1831    0.0000 .0000E+00 .0000E+00
47           0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
48           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
49           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
50           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
51           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
52           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
53           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
54           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
55           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
56           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
57           1.76  0.055  0.070  0.2729    0.0000 .0000E+00 .0000E+00
58           2.91  0.795  0.071  0.3853    0.0000 .0000E+00 .0000E+00
59           0.11  0.000  0.099  0.3780    0.4214 .1431     .5484E-04
60           0.00  0.000  0.160  0.3516    0.9445 .3208     .1249E-03
61           0.00  0.000  0.179  0.3334    0.4463 .1516     .6334E-04
62           0.00  0.000  0.161  0.3192    0.2892 .9823E-01 .4286E-04
63           0.00  0.000  0.190  0.3050    0.1986 .6744E-01 .3055E-04
64           0.00  0.000  0.173  0.2927    0.1491 .5065E-01 .2360E-04
65           0.00  0.000  0.134  0.2832    0.1164 .3953E-01 .1886E-04
66           0.00  0.000  0.147  0.2738    0.0699 .2372E-01 .1191E-04
67           0.00  0.000  0.153  0.2645    0.0452 .1537E-01 .8055E-05
68           0.00  0.000  0.156  0.2554    0.0324 .1099E-01 .5960E-05
69           0.00  0.000  0.145  0.2469    0.0235 .7981E-02 .4467E-05
70           0.00  0.000  0.151  0.2386    0.0012 .3061E-03 .1941E-06
71           0.00  0.000  0.197  0.2278    0.0001 .0000E+00 .0000E+00
72           0.00  0.000  0.168  0.2186    0.0000 .0000E+00 .0000E+00
73           0.06  0.000  0.137  0.2144    0.0000 .0000E+00 .0000E+00
74           0.00  0.000  0.168  0.2051    0.0000 .0000E+00 .0000E+00
75           0.00  0.000  0.155  0.1966    0.0000 .0000E+00 .0000E+00
76           0.00  0.000  0.156  0.1880    0.0000 .0000E+00 .0000E+00
77           0.00  0.000  0.090  0.1831    0.0000 .0000E+00 .0000E+00
78           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
79           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
80           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
81           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
82           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
83           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
84           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
85           0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
86           0.05  0.000  0.039  0.1837    0.0000 .0000E+00 .0000E+00
87           0.00  0.000  0.007  0.1833    0.0000 .0000E+00 .0000E+00
88           0.16  0.000  0.061  0.1888    0.0000 .0000E+00 .0000E+00
89           0.00  0.000  0.029  0.1872    0.0000 .0000E+00 .0000E+00
90           0.00  0.000  0.039  0.1851    0.0000 .0000E+00 .0000E+00
91           0.00  0.000  0.022  0.1839    0.0000 .0000E+00 .0000E+00
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 92        0.01  0.000  0.019  0.1834     0.0000 .0000E+00 .0000E+00
 93        0.00  0.000  0.004  0.1832     0.0000 .0000E+00 .0000E+00
 94        0.00  0.000  0.002  0.1831     0.0000 .0000E+00 .0000E+00
 95        0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
 96        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 97        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 98        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
 99        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
100        0.10  0.000  0.056  0.1855     0.0000 .0000E+00 .0000E+00
101        0.00  0.000  0.017  0.1845     0.0000 .0000E+00 .0000E+00
102        0.00  0.000  0.021  0.1834     0.0000 .0000E+00 .0000E+00
103        0.00  0.000  0.004  0.1832     0.0000 .0000E+00 .0000E+00
104        0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
105        0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
106        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
107        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
108        0.07  0.000  0.043  0.1845     0.0000 .0000E+00 .0000E+00
109        0.01  0.000  0.023  0.1838     0.0000 .0000E+00 .0000E+00
110        0.00  0.000  0.009  0.1833     0.0000 .0000E+00 .0000E+00
111        0.00  0.000  0.003  0.1832     0.0000 .0000E+00 .0000E+00
112        0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
113        0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
114        0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
115        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
116        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
117        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
118        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
119        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
120        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
121        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
122        0.06  0.000  0.054  0.1834     0.0000 .0000E+00 .0000E+00
123        0.00  0.000  0.004  0.1832     0.0000 .0000E+00 .0000E+00
124        0.00  0.000  0.002  0.1831     0.0000 .0000E+00 .0000E+00
125        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
126        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
127        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
128        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
129        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
130        0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
131        0.13  0.000  0.057  0.1871     0.0000 .0000E+00 .0000E+00
132        0.00  0.000  0.020  0.1860     0.0000 .0000E+00 .0000E+00
133        0.00  0.000  0.042  0.1837     0.0000 .0000E+00 .0000E+00
134        0.00  0.000  0.009  0.1832     0.0000 .0000E+00 .0000E+00
135        0.35  0.000  0.115  0.1962     0.0000 .0000E+00 .0000E+00
136        0.03  0.000  0.107  0.1919     0.0000 .0000E+00 .0000E+00
137        0.01  0.000  0.110  0.1864     0.0000 .0000E+00 .0000E+00
138        0.00  0.000  0.039  0.1843     0.0000 .0000E+00 .0000E+00
139        0.00  0.000  0.015  0.1835     0.0000 .0000E+00 .0000E+00
140        0.00  0.000  0.005  0.1832     0.0000 .0000E+00 .0000E+00
141        0.01  0.000  0.012  0.1831     0.0000 .0000E+00 .0000E+00
142        0.02  0.000  0.020  0.1831     0.0000 .0000E+00 .0000E+00
143        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
144        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
145        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
146        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
147        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
148        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
149        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
150        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
151        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
152        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
153        0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
154        0.12  0.000  0.060  0.1864     0.0000 .0000E+00 .0000E+00
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155      0.01  0.000  0.019  0.1859    0.0000  .0000E+00  .0000E+00
156      0.00  0.000  0.032  0.1841    0.0000  .0000E+00  .0000E+00
157      0.00  0.000  0.013  0.1834    0.0000  .0000E+00  .0000E+00
158      0.00  0.000  0.005  0.1832    0.0000  .0000E+00  .0000E+00
159      0.02  0.000  0.022  0.1831    0.0000  .0000E+00  .0000E+00
160      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
161      0.36  0.000  0.073  0.1988    0.0000  .0000E+00  .0000E+00
162      0.15  0.000  0.107  0.2012    0.0000  .0000E+00  .0000E+00
163      0.01  0.000  0.102  0.1962    0.0000  .0000E+00  .0000E+00
164      0.00  0.000  0.136  0.1887    0.0000  .0000E+00  .0000E+00
165      0.00  0.000  0.081  0.1842    0.0000  .0000E+00  .0000E+00
166      0.00  0.000  0.014  0.1835    0.0000  .0000E+00  .0000E+00
167      0.01  0.000  0.015  0.1832    0.0000  .0000E+00  .0000E+00
168      0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
169      0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
170      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
171      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
172      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
173      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
174      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
175      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
176      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
177      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
178      0.02  0.000  0.020  0.1831    0.0000  .0000E+00  .0000E+00
179      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
180      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
181      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
182      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
183      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
184      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
185      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
186      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
187      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
188      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
189      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
190      0.11  0.000  0.063  0.1856    0.0000  .0000E+00  .0000E+00
191      0.00  0.000  0.019  0.1846    0.0000  .0000E+00  .0000E+00
192      0.00  0.000  0.021  0.1834    0.0000  .0000E+00  .0000E+00
193      0.00  0.000  0.004  0.1832    0.0000  .0000E+00  .0000E+00
194      0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
195      0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
196      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
197      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
198      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
199      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
200      0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
201      0.35  0.000  0.094  0.1971    0.0000  .0000E+00  .0000E+00
202      0.01  0.000  0.098  0.1923    0.0000  .0000E+00  .0000E+00
203      0.00  0.000  0.127  0.1853    0.0000  .0000E+00  .0000E+00
204      0.00  0.000  0.036  0.1833    0.0000  .0000E+00  .0000E+00
205      0.00  0.000  0.003  0.1832    0.0000  .0000E+00  .0000E+00
206      0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
207      0.00  0.000  0.001  0.1831    0.0000  .0000E+00  .0000E+00
208      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
209      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
210      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
211      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
212      0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
213      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
214      0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
215      0.02  0.000  0.020  0.1831    0.0000  .0000E+00  .0000E+00
216      0.01  0.000  0.010  0.1831    0.0000  .0000E+00  .0000E+00
217      0.56  0.000  0.084  0.2092    0.0000  .0000E+00  .0000E+00
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218        0.00  0.000  0.101  0.2036    0.0000 .0000E+00 .0000E+00
219        0.01  0.000  0.127  0.1972    0.0000 .0000E+00 .0000E+00
220        0.00  0.000  0.137  0.1897    0.0000 .0000E+00 .0000E+00
221        0.00  0.000  0.109  0.1837    0.0000 .0000E+00 .0000E+00
222        0.00  0.000  0.007  0.1833    0.0000 .0000E+00 .0000E+00
223        0.00  0.000  0.002  0.1832    0.0000 .0000E+00 .0000E+00
224        0.02  0.000  0.022  0.1831    0.0000 .0000E+00 .0000E+00
225        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
226        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
227        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
228        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
229        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
230        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
231        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
232        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
233        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
234        0.02  0.000  0.020  0.1831    0.0000 .0000E+00 .0000E+00
235        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
236        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
237        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
238        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
239        0.07  0.000  0.056  0.1838    0.0000 .0000E+00 .0000E+00
240        0.00  0.000  0.008  0.1834    0.0000 .0000E+00 .0000E+00
241        0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
242        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
243        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
244        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
245        0.82  0.000  0.099  0.2227    0.0000 .0000E+00 .0000E+00
246        0.62  0.000  0.144  0.2488    0.0000 .0000E+00 .0000E+00
247        0.38  0.000  0.085  0.2651    0.0000 .0000E+00 .0000E+00
248        0.00  0.000  0.145  0.2571    0.0000 .0000E+00 .0000E+00
249        0.00  0.000  0.163  0.2482    0.0000 .0000E+00 .0000E+00
250        0.05  0.000  0.145  0.2430    0.0000 .0000E+00 .0000E+00
251        0.00  0.000  0.194  0.2323    0.0000 .0000E+00 .0000E+00
252        0.00  0.000  0.195  0.2216    0.0000 .0000E+00 .0000E+00
253        0.00  0.000  0.219  0.2095    0.0000 .0000E+00 .0000E+00
254        0.00  0.000  0.167  0.2004    0.0000 .0000E+00 .0000E+00
255        0.00  0.000  0.184  0.1903    0.0000 .0000E+00 .0000E+00
256        0.03  0.000  0.137  0.1844    0.0000 .0000E+00 .0000E+00
257        0.08  0.000  0.069  0.1850    0.0000 .0000E+00 .0000E+00
258        0.00  0.000  0.023  0.1838    0.0000 .0000E+00 .0000E+00
259        0.00  0.000  0.008  0.1833    0.0000 .0000E+00 .0000E+00
260        0.00  0.000  0.003  0.1832    0.0000 .0000E+00 .0000E+00
261        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
262        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
263        0.13  0.000  0.053  0.1873    0.0000 .0000E+00 .0000E+00
264        0.00  0.000  0.012  0.1867    0.0000 .0000E+00 .0000E+00
265        0.24  0.000  0.069  0.1961    0.0000 .0000E+00 .0000E+00
266        0.03  0.000  0.072  0.1938    0.0000 .0000E+00 .0000E+00
267        0.09  0.000  0.080  0.1943    0.0000 .0000E+00 .0000E+00
268        0.01  0.000  0.078  0.1906    0.0000 .0000E+00 .0000E+00
269        0.00  0.000  0.080  0.1863    0.0000 .0000E+00 .0000E+00
270        0.00  0.000  0.036  0.1843    0.0000 .0000E+00 .0000E+00
271        0.00  0.000  0.012  0.1836    0.0000 .0000E+00 .0000E+00
272        0.00  0.000  0.006  0.1832    0.0000 .0000E+00 .0000E+00
273        0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
274        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
275        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
276        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
277        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
278        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
279        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
280        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
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281        0.04  0.000  0.033  0.1834    0.0000  .0000E+00  .0000E+00
282        0.00  0.000  0.004  0.1832    0.0000  .0000E+00  .0000E+00
283        0.00  0.000  0.002  0.1831    0.0000  .0000E+00  .0000E+00
284        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
285        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
286        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
287        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
288        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
289        0.58  0.000  0.111  0.2088    0.0000  .0000E+00  .0000E+00
290        0.00  0.000  0.062  0.2054    0.0000  .0000E+00  .0000E+00
291        0.00  0.000  0.127  0.1985    0.0000  .0000E+00  .0000E+00
292        0.04  0.000  0.114  0.1944    0.0000  .0000E+00  .0000E+00
293        0.04  0.000  0.066  0.1930    0.0000  .0000E+00  .0000E+00
294        0.00  0.000  0.099  0.1876    0.0000  .0000E+00  .0000E+00
295        0.00  0.000  0.050  0.1848    0.0000  .0000E+00  .0000E+00
296        0.00  0.000  0.020  0.1837    0.0000  .0000E+00  .0000E+00
297        0.04  0.000  0.044  0.1835    0.0000  .0000E+00  .0000E+00
298        0.01  0.000  0.015  0.1833    0.0000  .0000E+00  .0000E+00
299        0.08  0.000  0.047  0.1851    0.0000  .0000E+00  .0000E+00
300        0.09  0.000  0.051  0.1872    0.0000  .0000E+00  .0000E+00
301        0.18  0.000  0.056  0.1941    0.0000  .0000E+00  .0000E+00
302        0.00  0.000  0.044  0.1916    0.0000  .0000E+00  .0000E+00
303        0.00  0.000  0.070  0.1878    0.0000  .0000E+00  .0000E+00
304        0.10  0.000  0.070  0.1894    0.0000  .0000E+00  .0000E+00
305        0.00  0.000  0.048  0.1868    0.0000  .0000E+00  .0000E+00
306        0.00  0.000  0.038  0.1847    0.0000  .0000E+00  .0000E+00
307        0.00  0.000  0.017  0.1837    0.0000  .0000E+00  .0000E+00
308        0.00  0.000  0.008  0.1833    0.0000  .0000E+00  .0000E+00
309        0.24  0.000  0.056  0.1934    0.0000  .0000E+00  .0000E+00
310        1.43  0.014  0.106  0.2655    0.0000  .0000E+00  .0000E+00
311        0.06  0.000  0.112  0.2626    0.0000  .0000E+00  .0000E+00
312        0.01  0.000  0.082  0.2586    0.0000  .0000E+00  .0000E+00
313        0.00  0.000  0.112  0.2524    0.0000  .0000E+00  .0000E+00
314        0.04  0.000  0.079  0.2503    0.0000  .0000E+00  .0000E+00
315        0.11  0.000  0.078  0.2521    0.0000  .0000E+00  .0000E+00
316        0.00  0.000  0.129  0.2450    0.0000  .0000E+00  .0000E+00
317        0.12  0.000  0.122  0.2449    0.0000  .0000E+00  .0000E+00
318        0.04  0.000  0.119  0.2405    0.0000  .0000E+00  .0000E+00
319        0.00  0.000  0.120  0.2339    0.0000  .0000E+00  .0000E+00
320        0.00  0.000  0.066  0.2303    0.0000  .0000E+00  .0000E+00
321        0.00  0.000  0.082  0.2258    0.0000  .0000E+00  .0000E+00
322        0.00  0.000  0.047  0.2232    0.0000  .0000E+00  .0000E+00
323        0.00  0.000  0.080  0.2188    0.0000  .0000E+00  .0000E+00
324        0.00  0.000  0.101  0.2133    0.0000  .0000E+00  .0000E+00
325        0.00  0.000  0.079  0.2089    0.0000  .0000E+00  .0000E+00
326        0.00  0.000  0.067  0.2052    0.0000  .0000E+00  .0000E+00
327        0.00  0.000  0.081  0.2008    0.0000  .0000E+00  .0000E+00
328        0.00  0.000  0.065  0.1972    0.0000  .0000E+00  .0000E+00
329        0.00  0.000  0.074  0.1931    0.0000  .0000E+00  .0000E+00
330        0.00  0.000  0.102  0.1875    0.0000  .0000E+00  .0000E+00
331        0.00  0.000  0.064  0.1840    0.0000  .0000E+00  .0000E+00
332        0.02  0.000  0.037  0.1831    0.0000  .0000E+00  .0000E+00
333        0.03  0.000  0.030  0.1831    0.0000  .0000E+00  .0000E+00
334        0.10  0.000  0.046  0.1860    0.0000  .0000E+00  .0000E+00
335        0.00  0.000  0.007  0.1856    0.0000  .0000E+00  .0000E+00
336        0.00  0.000  0.017  0.1847    0.0000  .0000E+00  .0000E+00
337        0.00  0.000  0.014  0.1839    0.0000  .0000E+00  .0000E+00
338        0.00  0.000  0.012  0.1832    0.0000  .0000E+00  .0000E+00
339        0.01  0.000  0.012  0.1831    0.0000  .0000E+00  .0000E+00
340        0.01  0.000  0.011  0.1831    0.0000  .0000E+00  .0000E+00
341        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
342        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
343        0.00  0.000  0.000  0.1831    0.0000  .0000E+00  .0000E+00
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344          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
345          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
346          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
347          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
348          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
349          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
350          0.00   0.000   0.000   0.1831     0.0000  .0000E+00  .0000E+00
351          0.21   0.000   0.052   0.1917     0.0000  .0000E+00  .0000E+00
352          0.01   0.000   0.028   0.1907     0.0000  .0000E+00  .0000E+00
353          0.00   0.000   0.023   0.1895     0.0000  .0000E+00  .0000E+00
354          0.02   0.000   0.035   0.1887     0.0000  .0000E+00  .0000E+00
355          0.13   0.000   0.066   0.1922     0.0000  .0000E+00  .0000E+00
356          1.15   0.000   0.081   0.2510     0.0000  .0000E+00  .0000E+00
357          0.20   0.000   0.088   0.2571     0.0000  .0000E+00  .0000E+00
358          0.15   0.000   0.092   0.2603     0.0000  .0000E+00  .0000E+00
359          0.22   0.000   0.095   0.2672     0.0000  .0000E+00  .0000E+00
360          0.15   0.000   0.069   0.2716     0.0000  .0000E+00  .0000E+00
361          1.06   0.018   0.068   0.3252     0.0000  .0000E+00  .0000E+00
362          0.68   0.004   0.068   0.3586     0.0000  .0000E+00  .0000E+00
363          0.01   0.000   0.045   0.3567     0.0000  .0000E+00  .0000E+00
364          0.04   0.000   0.078   0.3527     0.1021  .3469E-01  .1549E-04
365          2.46   0.545   0.068   0.4416     0.6728  .2285      .8983E-04
366          0.93   0.165   0.089   0.4236     6.8944  1.003      .7699E-03

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


     HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  4
     DRAIN #1:  LATERAL DRAINAGE FROM LAYER  3 (RECIRCULATION AND COLLECTION)
     LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  5

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

                    DAILY OUTPUT FOR YEAR 2005
---------------------------------------------------------------------
          S
DAY  A    O   RAIN  RUNOFF    ET    E. ZONE    HEAD      DRAIN      LEAK
     I    I                          WATER      #1        #1         #1
     R    L    IN.    IN.     IN.   IN./IN.     IN.       IN.        IN.
---  -    -  -----  ------  ------  -------  --------  ---------  ---------

 1           4.04   2.244   0.067   0.4619   10.6678  1.030      .1165E-02
 2           0.01   0.000   0.026   0.4043   13.3800  1.031      .1447E-02
 3           0.01   0.000   0.032   0.3609    3.2320  .7671      .3787E-03
 4           0.00   0.000   0.023   0.3459    0.7377  .2505      .9966E-04
 5           0.00   0.000   0.032   0.3375    0.3562  .1210      .5173E-04
 6           0.00   0.000   0.043   0.3301    0.2697  .9159E-01  .4026E-04
 7           0.00   0.000   0.062   0.3231    0.1941  .6593E-01  .2993E-04
 8           0.92   0.000   0.106   0.3653    0.1353  .4594E-01  .2162E-04
 9           0.01   0.000   0.048   0.3609    0.1213  .4121E-01  .1954E-04
10           0.00   0.000   0.044   0.3536    0.2655  .9018E-01  .3910E-04
11           0.00   0.000   0.045   0.3435    0.4026  .1367      .5781E-04
12           0.00   0.000   0.051   0.3345    0.3335  .1133      .4876E-04
13           0.31   0.000   0.102   0.3415    0.2379  .8081E-01  .3595E-04
14           0.29   0.000   0.089   0.3495    0.1649  .5600E-01  .2583E-04
15           0.23   0.000   0.115   0.3534    0.1297  .4404E-01  .2080E-04
16           1.80   0.301   0.099   0.4224    0.4259  .1447      .5666E-04
17           0.13   0.000   0.085   0.3800    3.0041  .8164      .3561E-03
18           0.05   0.000   0.085   0.3589    1.0214  .3469      .1340E-03
19           0.00   0.000   0.070   0.3459    0.4954  .1682      .6961E-04
20           0.02   0.000   0.040   0.3398    0.2675  .9086E-01  .3997E-04
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21      0.13  0.000  0.072  0.3385   0.2405  .8168E-01  .3631E-04
22      0.00  0.000  0.081  0.3308   0.1723  .5851E-01  .2687E-04
23      0.00  0.000  0.093  0.3231   0.1402  .4762E-01  .2233E-04
24      0.40  0.000  0.094  0.3375   0.1294  .4395E-01  .2076E-04
25      0.56  0.000  0.087  0.3620   0.0795  .2699E-01  .1336E-04
26      0.00  0.000  0.088  0.3559   0.0653  .2217E-01  .1117E-04
27      0.00  0.000  0.098  0.3474   0.1717  .5832E-01  .2606E-04
28      0.07  0.000  0.095  0.3389   0.3771  .1281      .5450E-04
29      0.00  0.000  0.086  0.3286   0.2999  .1019      .4428E-04
30      0.00  0.000  0.093  0.3204   0.1679  .5703E-01  .2625E-04
31      0.74  0.000  0.140  0.3511   0.1206  .4095E-01  .1947E-04
32      0.30  0.000  0.117  0.3595   0.0871  .2959E-01  .1453E-04
33      0.21  0.000  0.108  0.3636   0.0775  .2633E-01  .1308E-04
34      0.16  0.000  0.085  0.3658   0.1047  .3555E-01  .1680E-04
35      0.03  0.000  0.073  0.3577   0.3082  .1047      .4539E-04
36      0.01  0.000  0.125  0.3458   0.3002  .1020      .4436E-04
37      0.00  0.000  0.150  0.3323   0.2770  .9408E-01  .4124E-04
38      0.00  0.000  0.178  0.3186   0.2138  .7262E-01  .3266E-04
39      0.00  0.000  0.138  0.3076   0.1804  .6128E-01  .2803E-04
40      0.00  0.000  0.181  0.2948   0.1510  .5128E-01  .2386E-04
41      0.00  0.000  0.118  0.2860   0.1273  .4325E-01  .2047E-04
42      0.10  0.000  0.148  0.2818   0.0836  .2841E-01  .1401E-04
43      0.01  0.000  0.141  0.2736   0.0532  .1805E-01  .9313E-05
44      0.00  0.000  0.167  0.2637   0.0382  .1296E-01  .6912E-05
45      0.00  0.000  0.116  0.2568   0.0279  .9492E-02  .5225E-05
46      0.00  0.000  0.141  0.2489   0.0126  .4254E-02  .2446E-05
47      0.00  0.000  0.171  0.2395   0.0000  .0000E+00  .0000E+00
48      0.00  0.000  0.160  0.2307   0.0000  .0000E+00  .0000E+00
49      0.00  0.000  0.102  0.2250   0.0000  .0000E+00  .0000E+00
50      0.00  0.000  0.078  0.2207   0.0000  .0000E+00  .0000E+00
51      0.00  0.000  0.125  0.2138   0.0000  .0000E+00  .0000E+00
52      0.00  0.000  0.099  0.2084   0.0000  .0000E+00  .0000E+00
53      0.00  0.000  0.126  0.2015   0.0000  .0000E+00  .0000E+00
54      0.00  0.000  0.137  0.1940   0.0000  .0000E+00  .0000E+00
55      0.00  0.000  0.130  0.1868   0.0000  .0000E+00  .0000E+00
56      0.00  0.000  0.069  0.1831   0.0000  .0000E+00  .0000E+00
57      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
58      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
59      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
60      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
61      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
62      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
63      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
64      0.08  0.000  0.031  0.1857   0.0000  .0000E+00  .0000E+00
65      0.01  0.000  0.017  0.1854   0.0000  .0000E+00  .0000E+00
66      0.00  0.000  0.016  0.1845   0.0000  .0000E+00  .0000E+00
67      0.03  0.000  0.030  0.1845   0.0000  .0000E+00  .0000E+00
68      0.01  0.000  0.018  0.1841   0.0000  .0000E+00  .0000E+00
69      0.00  0.000  0.014  0.1833   0.0000  .0000E+00  .0000E+00
70      0.00  0.000  0.003  0.1831   0.0000  .0000E+00  .0000E+00
71      0.10  0.000  0.030  0.1870   0.0000  .0000E+00  .0000E+00
72      0.02  0.000  0.020  0.1870   0.0000  .0000E+00  .0000E+00
73      0.03  0.000  0.032  0.1868   0.0000  .0000E+00  .0000E+00
74      0.07  0.000  0.035  0.1888   0.0000  .0000E+00  .0000E+00
75      0.00  0.000  0.031  0.1870   0.0000  .0000E+00  .0000E+00
76      0.00  0.000  0.037  0.1850   0.0000  .0000E+00  .0000E+00
77      0.00  0.000  0.019  0.1839   0.0000  .0000E+00  .0000E+00
78      0.00  0.000  0.012  0.1833   0.0000  .0000E+00  .0000E+00
79      0.00  0.000  0.003  0.1832   0.0000  .0000E+00  .0000E+00
80      0.00  0.000  0.001  0.1831   0.0000  .0000E+00  .0000E+00
81      0.00  0.000  0.001  0.1831   0.0000  .0000E+00  .0000E+00
82      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
83      0.00  0.000  0.000  0.1831   0.0000  .0000E+00  .0000E+00
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  84        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
  85        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  86        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  87        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  88        0.08  0.000  0.030  0.1858     0.0000  .0000E+00  .0000E+00
  89        0.00  0.000  0.014  0.1851     0.0000  .0000E+00  .0000E+00
  90        0.00  0.000  0.026  0.1836     0.0000  .0000E+00  .0000E+00
  91        0.00  0.000  0.009  0.1831     0.0000  .0000E+00  .0000E+00
  92        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
  93        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  94        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  95        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  96        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  97        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
  98        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
  99        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 100        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 101        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 102        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 103        0.02  0.000  0.020  0.1831     0.0000  .0000E+00  .0000E+00
 104        0.09  0.000  0.037  0.1860     0.0000  .0000E+00  .0000E+00
 105        0.00  0.000  0.015  0.1852     0.0000  .0000E+00  .0000E+00
 106        0.00  0.000  0.029  0.1836     0.0000  .0000E+00  .0000E+00
 107        0.00  0.000  0.007  0.1832     0.0000  .0000E+00  .0000E+00
 108        0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
 109        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
 110        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 111        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 112        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 113        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 114        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 115        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 116        0.14  0.000  0.037  0.1887     0.0000  .0000E+00  .0000E+00
 117        0.21  0.000  0.070  0.1964     0.0000  .0000E+00  .0000E+00
 118        0.00  0.000  0.054  0.1934     0.0000  .0000E+00  .0000E+00
 119        0.00  0.000  0.094  0.1883     0.0000  .0000E+00  .0000E+00
 120        0.00  0.000  0.075  0.1842     0.0000  .0000E+00  .0000E+00
 121        0.20  0.000  0.052  0.1923     0.0000  .0000E+00  .0000E+00
 122        0.01  0.000  0.058  0.1897     0.0000  .0000E+00  .0000E+00
 123        0.00  0.000  0.084  0.1851     0.0000  .0000E+00  .0000E+00
 124        0.00  0.000  0.025  0.1837     0.0000  .0000E+00  .0000E+00
 125        0.00  0.000  0.009  0.1833     0.0000  .0000E+00  .0000E+00
 126        0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
 127        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
 128        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 129        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 130        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 131        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 132        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 133        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 134        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 135        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 136        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 137        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 138        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 139        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 140        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 141        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 142        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
 143        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 144        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 145        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
 146        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
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147        0.03  0.000  0.028  0.1831    0.0000 .0000E+00 .0000E+00
148        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
149        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
150        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
151        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
152        0.06  0.000  0.032  0.1846    0.0000 .0000E+00 .0000E+00
153        0.02  0.000  0.035  0.1838    0.0000 .0000E+00 .0000E+00
154        0.02  0.000  0.028  0.1833    0.0000 .0000E+00 .0000E+00
155        0.00  0.000  0.003  0.1832    0.0000 .0000E+00 .0000E+00
156        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
157        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
158        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
159        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
160        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
161        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
162        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
163        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
164        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
165        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
166        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
167        0.12  0.000  0.039  0.1875    0.0000 .0000E+00 .0000E+00
168        0.00  0.000  0.019  0.1865    0.0000 .0000E+00 .0000E+00
169        0.00  0.000  0.048  0.1838    0.0000 .0000E+00 .0000E+00
170        0.85  0.000  0.125  0.2236    0.0000 .0000E+00 .0000E+00
171        0.00  0.000  0.144  0.2158    0.0000 .0000E+00 .0000E+00
172        0.00  0.000  0.145  0.2078    0.0000 .0000E+00 .0000E+00
173        0.00  0.000  0.181  0.1978    0.0000 .0000E+00 .0000E+00
174        0.00  0.000  0.163  0.1889    0.0000 .0000E+00 .0000E+00
175        0.00  0.000  0.072  0.1849    0.0000 .0000E+00 .0000E+00
176        0.00  0.000  0.021  0.1838    0.0000 .0000E+00 .0000E+00
177        0.00  0.000  0.006  0.1834    0.0000 .0000E+00 .0000E+00
178        0.00  0.000  0.006  0.1831    0.0000 .0000E+00 .0000E+00
179        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
180        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
181        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
182        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
183        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
184        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
185        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
186        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
187        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
188        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
189        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
190        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
191        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
192        0.05  0.000  0.043  0.1834    0.0000 .0000E+00 .0000E+00
193        0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
194        0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
195        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
196        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
197        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
198        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
199        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
200        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
201        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
202        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
203        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
204        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
205        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
206        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
207        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
208        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
209        0.02  0.000  0.020  0.1831    0.0000 .0000E+00 .0000E+00
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210        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
211        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
212        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
213        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
214        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
215        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
216        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
217        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
218        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
219        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
220        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
221        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
222        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
223        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
224        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
225        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
226        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
227        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
228        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
229        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
230        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
231        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
232        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
233        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
234        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
235        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
236        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
237        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
238        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
239        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
240        0.36  0.000  0.088  0.1980     0.0000  .0000E+00  .0000E+00
241        0.00  0.000  0.106  0.1922     0.0000  .0000E+00  .0000E+00
242        0.00  0.000  0.126  0.1853     0.0000  .0000E+00  .0000E+00
243        0.00  0.000  0.033  0.1835     0.0000  .0000E+00  .0000E+00
244        0.00  0.000  0.005  0.1832     0.0000  .0000E+00  .0000E+00
245        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
246        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
247        0.01  0.000  0.010  0.1831     0.0000  .0000E+00  .0000E+00
248        0.02  0.000  0.020  0.1831     0.0000  .0000E+00  .0000E+00
249        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
250        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
251        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
252        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
253        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
254        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
255        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
256        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
257        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
258        0.05  0.000  0.036  0.1838     0.0000  .0000E+00  .0000E+00
259        0.02  0.000  0.024  0.1836     0.0000  .0000E+00  .0000E+00
260        0.00  0.000  0.007  0.1832     0.0000  .0000E+00  .0000E+00
261        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
262        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
263        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
264        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
265        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
266        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
267        0.33  0.000  0.090  0.1963     0.0000  .0000E+00  .0000E+00
268        0.00  0.000  0.107  0.1904     0.0000  .0000E+00  .0000E+00
269        0.00  0.000  0.114  0.1842     0.0000  .0000E+00  .0000E+00
270        0.00  0.000  0.013  0.1835     0.0000  .0000E+00  .0000E+00
271        0.00  0.000  0.005  0.1832     0.0000  .0000E+00  .0000E+00
272        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
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273        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
274        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
275        0.04  0.000  0.039  0.1831    0.0000 .0000E+00 .0000E+00
276        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
277        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
278        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
279        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
280        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
281        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
282        0.02  0.000  0.020  0.1831    0.0000 .0000E+00 .0000E+00
283        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
284        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
285        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
286        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
287        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
288        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
289        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
290        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
291        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
292        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
293        0.09  0.000  0.044  0.1856    0.0000 .0000E+00 .0000E+00
294        0.00  0.000  0.012  0.1850    0.0000 .0000E+00 .0000E+00
295        0.00  0.000  0.025  0.1836    0.0000 .0000E+00 .0000E+00
296        0.00  0.000  0.008  0.1831    0.0000 .0000E+00 .0000E+00
297        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
298        0.10  0.000  0.039  0.1864    0.0000 .0000E+00 .0000E+00
299        0.00  0.000  0.012  0.1858    0.0000 .0000E+00 .0000E+00
300        0.00  0.000  0.029  0.1842    0.0000 .0000E+00 .0000E+00
301        0.00  0.000  0.013  0.1834    0.0000 .0000E+00 .0000E+00
302        0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
303        0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
304        0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
305        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
306        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
307        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
308        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
309        0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
310        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
311        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
312        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
313        0.03  0.000  0.030  0.1831    0.0000 .0000E+00 .0000E+00
314        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
315        0.03  0.000  0.025  0.1833    0.0000 .0000E+00 .0000E+00
316        0.00  0.000  0.003  0.1832    0.0000 .0000E+00 .0000E+00
317        0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
318        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
319        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
320        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
321        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
322        0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
323        0.03  0.000  0.026  0.1833    0.0000 .0000E+00 .0000E+00
324        0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
325        0.92  0.000  0.064  0.2302    0.0000 .0000E+00 .0000E+00
326        0.02  0.000  0.064  0.2278    0.0000 .0000E+00 .0000E+00
327        0.02  0.000  0.084  0.2243    0.0000 .0000E+00 .0000E+00
328        0.15  0.000  0.084  0.2279    0.0000 .0000E+00 .0000E+00
329        0.04  0.000  0.114  0.2238    0.0000 .0000E+00 .0000E+00
330        0.10  0.000  0.096  0.2241    0.0000 .0000E+00 .0000E+00
331        0.00  0.000  0.090  0.2191    0.0000 .0000E+00 .0000E+00
332        0.00  0.000  0.055  0.2161    0.0000 .0000E+00 .0000E+00
333        0.01  0.000  0.045  0.2141    0.0000 .0000E+00 .0000E+00
334        0.00  0.000  0.051  0.2113    0.0000 .0000E+00 .0000E+00
335        0.00  0.000  0.080  0.2069    0.0000 .0000E+00 .0000E+00
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336          0.00  0.000  0.091  0.2020    0.0000 .0000E+00 .0000E+00
337          0.00  0.000  0.081  0.1975    0.0000 .0000E+00 .0000E+00
338          0.13  0.000  0.073  0.2007    0.0000 .0000E+00 .0000E+00
339          0.00  0.000  0.075  0.1966    0.0000 .0000E+00 .0000E+00
340          0.00  0.000  0.089  0.1917    0.0000 .0000E+00 .0000E+00
341          0.00  0.000  0.065  0.1881    0.0000 .0000E+00 .0000E+00
342          0.00  0.000  0.061  0.1848    0.0000 .0000E+00 .0000E+00
343          0.00  0.000  0.024  0.1835    0.0000 .0000E+00 .0000E+00
344          0.00  0.000  0.004  0.1832    0.0000 .0000E+00 .0000E+00
345          0.00  0.000  0.003  0.1831    0.0000 .0000E+00 .0000E+00
346          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
347          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
348          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
349          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
350          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
351          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
352          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
353          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
354          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
355          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
356          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
357          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
358          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
359          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
360          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
361          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
362          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
363          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
364          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
365          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00

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    HEAD  #1:  AVERAGE HEAD ON TOP OF LAYER  4
    DRAIN #1:  LATERAL DRAINAGE FROM LAYER  3 (RECIRCULATION AND COLLECTION)
    LEAK  #1:  PERCOLATION OR LEAKAGE THROUGH LAYER  5

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                       DAILY OUTPUT FOR YEAR 2006
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          S
 DAY  A   O   RAIN  RUNOFF   ET    E. ZONE   HEAD      DRAIN     LEAK
      I   I                         WATER     #1        #1        #1
      R   L   IN.    IN.     IN.   IN./IN.    IN.       IN.       IN.
 ---  -   -  -----  ------ ------  -------  --------- --------- ---------

   1          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   2          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   3          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   4          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   5          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   6          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   7          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   8          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
   9          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
  10          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
  11          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
  12          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
  13          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
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14          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
15          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
16          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
17          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
18          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
19          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
20          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
21          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
22          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
23          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
24          0.12  0.000  0.042  0.1873    0.0000 .0000E+00 .0000E+00
25          0.28  0.000  0.078  0.1984    0.0000 .0000E+00 .0000E+00
26          0.49  0.000  0.058  0.2221    0.0000 .0000E+00 .0000E+00
27          0.00  0.000  0.068  0.2184    0.0000 .0000E+00 .0000E+00
28          0.00  0.000  0.068  0.2147    0.0000 .0000E+00 .0000E+00
29          0.00  0.000  0.052  0.2119    0.0000 .0000E+00 .0000E+00
30          0.00  0.000  0.069  0.2081    0.0000 .0000E+00 .0000E+00
31          0.00  0.000  0.080  0.2037    0.0000 .0000E+00 .0000E+00
32          0.01  0.000  0.076  0.2001    0.0000 .0000E+00 .0000E+00
33          0.02  0.000  0.085  0.1965    0.0000 .0000E+00 .0000E+00
34          0.00  0.000  0.128  0.1894    0.0000 .0000E+00 .0000E+00
35          0.00  0.000  0.086  0.1847    0.0000 .0000E+00 .0000E+00
36          0.00  0.000  0.021  0.1835    0.0000 .0000E+00 .0000E+00
37          0.00  0.000  0.005  0.1833    0.0000 .0000E+00 .0000E+00
38          0.00  0.000  0.004  0.1831    0.0000 .0000E+00 .0000E+00
39          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
40          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
41          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
42          0.06  0.000  0.037  0.1843    0.0000 .0000E+00 .0000E+00
43          0.00  0.000  0.012  0.1836    0.0000 .0000E+00 .0000E+00
44          0.00  0.000  0.007  0.1833    0.0000 .0000E+00 .0000E+00
45          0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
46          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
47          0.17  0.000  0.045  0.1900    0.0000 .0000E+00 .0000E+00
48          0.06  0.000  0.063  0.1898    0.0000 .0000E+00 .0000E+00
49          0.00  0.000  0.061  0.1864    0.0000 .0000E+00 .0000E+00
50          0.00  0.000  0.025  0.1850    0.0000 .0000E+00 .0000E+00
51          0.09  0.000  0.052  0.1871    0.0000 .0000E+00 .0000E+00
52          0.29  0.000  0.088  0.1982    0.0000 .0000E+00 .0000E+00
53          0.03  0.000  0.103  0.1942    0.0000 .0000E+00 .0000E+00
54          0.01  0.000  0.099  0.1893    0.0000 .0000E+00 .0000E+00
55          0.00  0.000  0.094  0.1842    0.0000 .0000E+00 .0000E+00
56          0.01  0.000  0.024  0.1834    0.0000 .0000E+00 .0000E+00
57          0.10  0.000  0.051  0.1861    0.0000 .0000E+00 .0000E+00
58          0.01  0.000  0.018  0.1857    0.0000 .0000E+00 .0000E+00
59          0.12  0.000  0.052  0.1894    0.0000 .0000E+00 .0000E+00
60          3.97  0.948  0.081  0.3510    0.0000 .0000E+00 .0000E+00
61          1.60  0.450  0.101  0.4086    0.0000 .0000E+00 .0000E+00
62          0.30  0.000  0.177  0.3847    1.6429 .5580     .2036E-03
63          0.00  0.000  0.169  0.3581    0.9277 .3151     .1226E-03
64          0.00  0.000  0.141  0.3415    0.4736 .1608     .6693E-04
65          0.00  0.000  0.195  0.3237    0.3797 .1290     .5481E-04
66          0.00  0.000  0.175  0.3098    0.2340 .7949E-01 .3542E-04
67          0.01  0.000  0.138  0.2993    0.1814 .6162E-01 .2815E-04
68          1.62  0.068  0.131  0.3757    0.0940 .3194E-01 .1555E-04
69          0.20  0.000  0.138  0.3745    0.2469 .8385E-01 .3620E-04
70          0.01  0.000  0.171  0.3540    0.6230 .2116     .8575E-04
71          0.00  0.000  0.172  0.3375    0.3731 .1267     .5391E-04
72          1.32  0.051  0.145  0.3941    0.2802 .9518E-01 .4167E-04
73          1.26  0.199  0.136  0.4161    1.5437 .5243     .1925E-03
74          2.19  0.773  0.112  0.4380    5.6448 .9050     .6346E-03
75          2.29  0.941  0.082  0.4509   13.6886 1.031     .1479E-02
76          1.20  0.327  0.126  0.4352   13.7018 1.031     .1481E-02
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 77          0.02  0.000  0.084  0.3791    6.5765 .9564       .7347E-03
 78          0.00  0.000  0.195  0.3469    1.1512 .3910       .1490E-03
 79          0.00  0.000  0.210  0.3264    0.4833 .1642       .6813E-04
 80          0.16  0.000  0.147  0.3218    0.2834 .9624E-01 .4207E-04
 81          0.84  0.000  0.116  0.3579    0.1984 .6738E-01 .3052E-04
 82          0.13  0.000  0.157  0.3536    0.1489 .5059E-01 .2358E-04
 83          0.02  0.000  0.089  0.3488    0.0567 .1927E-01 .9704E-05
 84          0.01  0.000  0.124  0.3402    0.1224 .4157E-01 .1960E-04
 85          1.39  0.074  0.129  0.4019    0.1945 .6605E-01 .2997E-04
 86          1.59  0.362  0.109  0.4218    2.5257 .7555       .3031E-03
 87          0.71  0.025  0.156  0.4064    2.9987 .8095       .3555E-03
 88          0.01  0.000  0.170  0.3688    1.5439 .5244       .1952E-03
 89          0.48  0.000  0.128  0.3721    0.8600 .2921       .1146E-03
 90          0.12  0.000  0.143  0.3620    0.4697 .1595       .6638E-04
 91          0.01  0.000  0.144  0.3495    0.2761 .9378E-01 .4107E-04
 92          0.51  0.000  0.098  0.3659    0.3341 .1135       .4883E-04
 93          0.02  0.000  0.163  0.3538    0.2291 .7783E-01 .3473E-04
 94          0.18  0.000  0.153  0.3517    0.1909 .6483E-01 .2932E-04
 95          0.00  0.000  0.160  0.3368    0.3259 .1107       .4777E-04
 96          0.00  0.000  0.209  0.3207    0.2502 .8499E-01 .3761E-04
 97          0.00  0.000  0.233  0.3044    0.1822 .6188E-01 .2827E-04
 98          0.00  0.000  0.192  0.2911    0.1498 .5086E-01 .2369E-04
 99          0.00  0.000  0.156  0.2806    0.1039 .3530E-01 .1703E-04
100          0.00  0.000  0.206  0.2681    0.0622 .2114E-01 .1074E-04
101          0.00  0.000  0.196  0.2566    0.0415 .1411E-01 .7459E-05
102          0.00  0.000  0.205  0.2448    0.0271 .9187E-02 .5054E-05
103          0.00  0.000  0.148  0.2367    0.0005 .9502E-04 .6473E-07
104          0.00  0.000  0.172  0.2272    0.0000 .0000E+00 .0000E+00
105          0.00  0.000  0.144  0.2193    0.0000 .0000E+00 .0000E+00
106          0.00  0.000  0.229  0.2067    0.0000 .0000E+00 .0000E+00
107          0.00  0.000  0.200  0.1957    0.0000 .0000E+00 .0000E+00
108          0.00  0.000  0.148  0.1876    0.0000 .0000E+00 .0000E+00
109          0.00  0.000  0.083  0.1831    0.0000 .0000E+00 .0000E+00
110          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
111          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
112          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
113          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
114          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
115          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
116          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
117          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
118          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
119          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
120          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
121          0.01  0.000  0.010  0.1831    0.0000 .0000E+00 .0000E+00
122          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
123          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
124          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
125          0.08  0.000  0.034  0.1856    0.0000 .0000E+00 .0000E+00
126          0.00  0.000  0.015  0.1847    0.0000 .0000E+00 .0000E+00
127          0.00  0.000  0.025  0.1834    0.0000 .0000E+00 .0000E+00
128          0.00  0.000  0.003  0.1832    0.0000 .0000E+00 .0000E+00
129          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
130          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
131          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
132          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
133          0.06  0.000  0.038  0.1843    0.0000 .0000E+00 .0000E+00
134          0.00  0.000  0.013  0.1836    0.0000 .0000E+00 .0000E+00
135          0.00  0.000  0.006  0.1832    0.0000 .0000E+00 .0000E+00
136          0.00  0.000  0.002  0.1831    0.0000 .0000E+00 .0000E+00
137          0.00  0.000  0.001  0.1831    0.0000 .0000E+00 .0000E+00
138          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
139          0.00  0.000  0.000  0.1831    0.0000 .0000E+00 .0000E+00
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140          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
141          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
142          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
143          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
144          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
145          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
146          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
147          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
148          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
149          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
150          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
151          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
152          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
153          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
154          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
155          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
156          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
157          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
158          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
159          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
160          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
161          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
162          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
163          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
164          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
165          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
166          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
167          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
168          0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
169          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
170          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
171          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
172          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
173          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
174          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
175          0.20  0.000  0.034  0.1922     0.0000 .0000E+00 .0000E+00
176          1.17  0.000  0.057  0.2533     0.0000 .0000E+00 .0000E+00
177          0.00  0.000  0.172  0.2438     0.0000 .0000E+00 .0000E+00
178          0.00  0.000  0.195  0.2331     0.0000 .0000E+00 .0000E+00
179          0.00  0.000  0.226  0.2207     0.0000 .0000E+00 .0000E+00
180          0.00  0.000  0.245  0.2073     0.0000 .0000E+00 .0000E+00
181          0.00  0.000  0.205  0.1960     0.0000 .0000E+00 .0000E+00
182          0.00  0.000  0.179  0.1862     0.0000 .0000E+00 .0000E+00
183          0.00  0.000  0.045  0.1837     0.0000 .0000E+00 .0000E+00
184          0.00  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
185          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
186          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
187          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
188          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
189          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
190          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
191          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
192          0.02  0.000  0.020  0.1831     0.0000 .0000E+00 .0000E+00
193          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
194          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
195          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
196          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
197          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
198          0.01  0.000  0.010  0.1831     0.0000 .0000E+00 .0000E+00
199          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
200          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
201          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
202          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
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203          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
204          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
205          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
206          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
207          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
208          0.04  0.000  0.033  0.1834     0.0000 .0000E+00 .0000E+00
209          0.00  0.000  0.004  0.1832     0.0000 .0000E+00 .0000E+00
210          0.00  0.000  0.002  0.1831     0.0000 .0000E+00 .0000E+00
211          0.16  0.000  0.040  0.1897     0.0000 .0000E+00 .0000E+00
212          0.00  0.000  0.046  0.1871     0.0000 .0000E+00 .0000E+00
213          1.08  0.000  0.086  0.2418     0.0000 .0000E+00 .0000E+00
214          0.00  0.000  0.177  0.2321     0.0000 .0000E+00 .0000E+00
215          0.00  0.000  0.178  0.2223     0.0000 .0000E+00 .0000E+00
216          0.00  0.000  0.203  0.2112     0.0000 .0000E+00 .0000E+00
217          0.00  0.000  0.180  0.2013     0.0000 .0000E+00 .0000E+00
218          0.00  0.000  0.202  0.1902     0.0000 .0000E+00 .0000E+00
219          0.02  0.000  0.133  0.1840     0.0000 .0000E+00 .0000E+00
220          0.00  0.000  0.009  0.1835     0.0000 .0000E+00 .0000E+00
221          0.00  0.000  0.009  0.1831     0.0000 .0000E+00 .0000E+00
222          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
223          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
224          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
225          0.11  0.000  0.050  0.1864     0.0000 .0000E+00 .0000E+00
226          0.00  0.000  0.019  0.1853     0.0000 .0000E+00 .0000E+00
227          0.00  0.000  0.034  0.1835     0.0000 .0000E+00 .0000E+00
228          0.00  0.000  0.005  0.1832     0.0000 .0000E+00 .0000E+00
229          0.00  0.000  0.002  0.1831     0.0000 .0000E+00 .0000E+00
230          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
231          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
232          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
233          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
234          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
235          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
236          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
237          0.05  0.000  0.041  0.1835     0.0000 .0000E+00 .0000E+00
238          0.01  0.000  0.014  0.1833     0.0000 .0000E+00 .0000E+00
239          0.00  0.000  0.003  0.1831     0.0000 .0000E+00 .0000E+00
240          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
241          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
242          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
243          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
244          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
245          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
246          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
247          0.04  0.000  0.037  0.1832     0.0000 .0000E+00 .0000E+00
248          0.42  0.000  0.073  0.2023     0.0000 .0000E+00 .0000E+00
249          0.64  0.000  0.065  0.2339     0.0000 .0000E+00 .0000E+00
250          0.03  0.000  0.101  0.2300     0.0000 .0000E+00 .0000E+00
251          0.00  0.000  0.151  0.2217     0.0000 .0000E+00 .0000E+00
252          0.00  0.000  0.145  0.2137     0.0000 .0000E+00 .0000E+00
253          0.00  0.000  0.142  0.2059     0.0000 .0000E+00 .0000E+00
254          0.00  0.000  0.190  0.1955     0.0000 .0000E+00 .0000E+00
255          0.00  0.000  0.198  0.1846     0.0000 .0000E+00 .0000E+00
256          0.00  0.000  0.022  0.1834     0.0000 .0000E+00 .0000E+00
257          0.00  0.000  0.004  0.1831     0.0000 .0000E+00 .0000E+00
258          0.02  0.000  0.021  0.1831     0.0000 .0000E+00 .0000E+00
259          0.03  0.000  0.028  0.1831     0.0000 .0000E+00 .0000E+00
260          0.05  0.000  0.038  0.1838     0.0000 .0000E+00 .0000E+00
261          0.00  0.000  0.008  0.1834     0.0000 .0000E+00 .0000E+00
262          0.00  0.000  0.004  0.1832     0.0000 .0000E+00 .0000E+00
263          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
264          0.00  0.000  0.001  0.1831     0.0000 .0000E+00 .0000E+00
265          0.00  0.000  0.000  0.1831     0.0000 .0000E+00 .0000E+00
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266        0.08  0.000  0.044  0.1850     0.0000  .0000E+00  .0000E+00
267        0.00  0.000  0.012  0.1844     0.0000  .0000E+00  .0000E+00
268        0.00  0.000  0.020  0.1833     0.0000  .0000E+00  .0000E+00
269        0.00  0.000  0.003  0.1831     0.0000  .0000E+00  .0000E+00
270        0.06  0.000  0.039  0.1843     0.0000  .0000E+00  .0000E+00
271        0.00  0.000  0.013  0.1836     0.0000  .0000E+00  .0000E+00
272        0.00  0.000  0.006  0.1832     0.0000  .0000E+00  .0000E+00
273        0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
274        0.00  0.000  0.001  0.1831     0.0000  .0000E+00  .0000E+00
275        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
276        0.20  0.000  0.042  0.1917     0.0000  .0000E+00  .0000E+00
277        0.00  0.000  0.047  0.1891     0.0000  .0000E+00  .0000E+00
278        0.00  0.000  0.069  0.1853     0.0000  .0000E+00  .0000E+00
279        0.00  0.000  0.028  0.1838     0.0000  .0000E+00  .0000E+00
280        0.00  0.000  0.010  0.1833     0.0000  .0000E+00  .0000E+00
281        0.00  0.000  0.002  0.1831     0.0000  .0000E+00  .0000E+00
282        1.61  0.032  0.114  0.2636     0.0000  .0000E+00  .0000E+00
283        0.00  0.000  0.110  0.2576     0.0000  .0000E+00  .0000E+00
284        0.11  0.000  0.134  0.2562     0.0000  .0000E+00  .0000E+00
285        0.00  0.000  0.157  0.2476     0.0000  .0000E+00  .0000E+00
286        0.00  0.000  0.162  0.2387     0.0000  .0000E+00  .0000E+00
287        2.64  0.370  0.117  0.3570     0.0000  .0000E+00  .0000E+00
288        0.04  0.000  0.122  0.3526     0.0000  .0000E+00  .0000E+00
289        0.07  0.000  0.149  0.3479     0.0198  .6736E-02  .3231E-05
290        0.01  0.000  0.118  0.3361     0.3121  .1060      .4592E-04
291        0.00  0.000  0.190  0.3210     0.2471  .8392E-01  .3718E-04
292        0.00  0.000  0.195  0.3072     0.1644  .5585E-01  .2577E-04
293        0.00  0.000  0.151  0.2961     0.1539  .5226E-01  .2428E-04
294        0.22  0.000  0.105  0.3000     0.1270  .4312E-01  .2042E-04
295        0.25  0.000  0.082  0.3074     0.0967  .3283E-01  .1596E-04
296        0.00  0.000  0.153  0.2978     0.0648  .2201E-01  .1114E-04
297        0.00  0.000  0.160  0.2882     0.0451  .1533E-01  .8039E-05
298        0.00  0.000  0.133  0.2803     0.0317  .1078E-01  .5858E-05
299        0.00  0.000  0.106  0.2740     0.0230  .7816E-02  .4389E-05
300        0.00  0.000  0.170  0.2646     0.0058  .1831E-02  .1077E-05
301        0.00  0.000  0.182  0.2546     0.0000  .0000E+00  .0000E+00
302        0.00  0.000  0.105  0.2488     0.0000  .0000E+00  .0000E+00
303        0.00  0.000  0.110  0.2427     0.0000  .0000E+00  .0000E+00
304        0.00  0.000  0.150  0.2345     0.0000  .0000E+00  .0000E+00
305        0.16  0.000  0.105  0.2375     0.0000  .0000E+00  .0000E+00
306        0.04  0.000  0.144  0.2318     0.0000  .0000E+00  .0000E+00
307        0.00  0.000  0.175  0.2221     0.0000  .0000E+00  .0000E+00
308        0.00  0.000  0.185  0.2120     0.0000  .0000E+00  .0000E+00
309        0.00  0.000  0.182  0.2020     0.0000  .0000E+00  .0000E+00
310        0.00  0.000  0.105  0.1962     0.0000  .0000E+00  .0000E+00
311        0.00  0.000  0.174  0.1866     0.0000  .0000E+00  .0000E+00
312        0.00  0.000  0.065  0.1831     0.0000  .0000E+00  .0000E+00
313        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
314        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
315        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
316        0.00  0.000  0.000  0.1831     0.0000  .0000E+00  .0000E+00
317        0.74  0.000  0.049  0.2210     0.0000  .0000E+00  .0000E+00
318        0.22  0.000  0.083  0.2286     0.0000  .0000E+00  .0000E+00
319        0.00  0.000  0.087  0.2238     0.0000  .0000E+00  .0000E+00
320        0.00  0.000  0.085  0.2191     0.0000  .0000E+00  .0000E+00
321        0.01  0.000  0.099  0.2142     0.0000  .0000E+00  .0000E+00
322        0.00  0.000  0.080  0.2099     0.0000  .0000E+00  .0000E+00
323        0.00  0.000  0.135  0.2025     0.0000  .0000E+00  .0000E+00
324        0.00  0.000  0.095  0.1972     0.0000  .0000E+00  .0000E+00
325        0.00  0.000  0.135  0.1898     0.0000  .0000E+00  .0000E+00
326        0.00  0.000  0.104  0.1841     0.0000  .0000E+00  .0000E+00
327        0.00  0.000  0.015  0.1833     0.0000  .0000E+00  .0000E+00
328        0.00  0.000  0.003  0.1831     0.0000  .0000E+00  .0000E+00
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329          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
330          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
331          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
332          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
333          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
334          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
335          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
336          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
337          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
338          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
339          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
340          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
341          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
342          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
343          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
344          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
345          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
346          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
347          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
348          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
349          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
350          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
351          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
352          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
353          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
354          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
355          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
356          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
357          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
358          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
359          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
360          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
361          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
362          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
363          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
364          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00
365          0.00   0.000   0.000   0.1831    0.0000 .0000E+00 .0000E+00

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


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

         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                  2.47     2.13     4.33     0.69     0.48     0.77
                           0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS         3.62     2.09     8.41     0.76     0.37     0.41
                           0.16     0.47     0.81     1.90     0.57     2.92

 RUNOFF
 ------
   TOTALS                 0.424    0.198    0.703    0.000    0.000    0.000
                          0.000    0.000    0.000    0.067    0.002    0.122

   STD. DEVIATIONS        1.039    0.347    1.722    0.001    0.000    0.000
```

```
                        0.000    0.000    0.000    0.164    0.006    0.299

  EVAPOTRANSPIRATION
  ------------------
    TOTALS              1.058    1.720    2.022    1.335    0.454    0.769
                        0.221    0.458    1.043    1.205    1.266    0.732

    STD. DEVIATIONS     0.831    0.944    1.453    1.391    0.398    0.325
                        0.180    0.501    0.809    1.174    0.817    0.523

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS              1.0333   0.1929   1.7006   0.1230   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0731   0.0000   0.2111

    STD. DEVIATIONS     2.5311   0.3076   3.9417   0.3013   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.1790   0.0000   0.5170

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS              0.0007   0.0001   0.0011   0.0001   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0001

    STD. DEVIATIONS     0.0018   0.0001   0.0027   0.0001   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0001   0.0000   0.0004

-------------------------------------------------------------------------------
             AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES            0.2033   0.0200   0.3173   0.0121   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0069   0.0000   0.0412

    STD. DEVIATIONS     0.4979   0.0321   0.7558   0.0296   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0170   0.0000   0.1010

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


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

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------
                                 INCHES            CU. FEET          PERCENT
                           -------------------  --------------     ---------
 PRECIPITATION               17.12    (  10.514)     62151.7         100.00

 RUNOFF                       1.517   (  1.8260)      5506.68          8.860

 EVAPOTRANSPIRATION          12.282   (  4.8285)     44583.68         71.734

 LATERAL DRAINAGE COLLECTED   3.33400 (  4.57762)    12102.416       19.47239
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH  0.00221 (  0.00307)        8.005        0.01288
   LAYER  5

 AVERAGE HEAD ON TOP          0.050 (    0.070)
```

```
  OF LAYER  4

 CHANGE IN WATER STORAGE         -0.014   ( 2.5332)       -49.12      -0.079
*******************************************************************************


□
*******************************************************************************

          PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------
                                              (INCHES)      (CU. FT.)
                                             ----------   -------------
    PRECIPITATION                               4.04        14665.200

    RUNOFF                                      2.244        8145.0112

    DRAINAGE COLLECTED FROM LAYER  3            1.03075      3741.61572

    PERCOLATION/LEAKAGE THROUGH LAYER  5        0.001481        5.37542

    AVERAGE HEAD ON TOP OF LAYER  4            13.702

    MAXIMUM HEAD ON TOP OF LAYER  4            20.383

    LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)               83.1 FEET

    SNOW WATER                                  0.00           0.0000


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.4619

    MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.1831

     ***  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.

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


□
*******************************************************************************

             FINAL WATER STORAGE AT END OF YEAR 2006
-----------------------------------------------------------------------
               LAYER          (INCHES)        (VOL/VOL)
               -----          --------        ---------
                 1             0.8148          0.1358

                 2             2.4774          0.2065

                 3             0.0387          0.1967
```

```
                4            0.0000         0.0000

                5            8.4780         0.4710

           SNOW WATER        0.000

***************************************************************************************
***************************************************************************************
```

Appendix B-7
Base Liner Evaluation – Point of Compliance Update

Point of Compliance Assessment Update Kekaha Sanitary Landfill Phase II Lateral Expansion Kekaha, Kaua‘i, Hawai‘i

Prepared for

County of Kaua'i
Department of Public Works
4444 Rice Street
Lihu'e, Kaua'i 96766

Prepared by

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January 2009

POINT OF COMPLIANCE ASSESSMENT UPDATE
KEKAHA SANITARY LANDFILL
PHASE II LATERAL EXPANSION
KEKAHA, KAUA'I, HAWAI'I

JANUARY 2009

TABLE OF CONTENTS

LIST OF APPENDICES

1.0 INTRODUCTION

Kekaha Landfill is proposing a lateral expansion of the existing Phase II solid waste facility. The expansion, as proposed, will consist of approximately 6.4 acres and be comprised of a composite geosynthetic base liner system and will include a leachate collection and extraction system.

This Point of Compliance Assessment update is to determine the equivalency of the proposed base liner system of the lateral expansion using a GCL as the barrier layer verses the same liner system with a 2-foot recompacted clay liner as the barrier layer. This update will also determine additional impacts, if any, to the groundwater as previously determined in 1993 by Harding Lawson Associates (HLA) in their report titled, "Point of Compliance Assessment, Kekaha Landfill Phase II, Kekaha, Kauai, Hawaii," prepared for the County of Kauai for Phase II based upon the existing liner system

1.1 Existing Phase II Base Liner System

The Phase II landfill facility constructed in 1993 is bounded by Kaumuali'i Highway to the northeast, an unpaved access road and agriculture to the southeast, aquaculture to the northwest, and the Phase I area to the southwest. The landfill base liner elevations and leachate collection system of Phase II varies from about 12 feet above msl to about 7 feet above msl and drains towards the northeast. The existing Phase II landfill sideslopes are 3.5:1 (horizontal:vertical), with a 3% topslope. Phase II liner area encompasses 32 acres and is subdivided into 14 lined subcells (each about 2.3 acres).

The existing base liner system of Phase II consists of (bottom to top):

- Granular subbase.
- Geosynthetic Clay Liner (GCL) consisting of a smooth 20-mil high-density polyethylene (HDPE) geomembrane with an adhered bentonite powder layer on one side (Gundseal). The GCL was installed with the smooth side in direct contact with the granular subbase and the bentonite component side up.
- Single-sided textured 60-mil HDPE geomembrane (textured side down) against bentonite component of the GCL on the sideslope.
- Smooth 60-mil HDPE geomembrane against bentonite component of the GCL on the base.
- Sand drainage layer (base and sideslope).

HLA of Aiea, Hawaii completed a Point of Compliance Assessment (POCA) to demonstrate equivalency of a 2-foot recompacted clay liner to a GCL while meeting compliance requirements for chemical concentrations in the groundwater at the point of compliance. Using the USEPA Hydrologic Evaluation of Landfill Performance (HELP) model Version 2 and practices at that time, HLA determined that a GCL with a maximum permeability of $1x10^{-9}$ cm/sec performed as an equivalent or better barrier layer to a 2-foot of recompacted clay liner with a $1x10^{-7}$ cm/sec maximum permeability.

Performance standards calculated by HLA used the HELP model results for the GCL liner system which estimated 11 ft^3 of leachate per year per acre would infiltrate through the base liner. With an area of 32 acres for Phase II, this would equal approximately 350 ft^3/year. Table 2 - Typical Landfill Leachate Concentrations and Estimated Concentrations at the Point of Compliance, of the HLA POCA report determined estimated chemical concentrations in groundwater are at least one order of magnitude below corresponding maximum contaminant levels (MCLs).

1.2 Lateral Expansion Base Liner System

The base liner system for the Phase II lateral expansion is similar with the approved base liner of Phase II. The base liner is expected to consist of (bottom to top):

- Prepared subbase grade
- 60-mil HDPE geomembrane
- GCL ✓
- 60-mil HDPE geomembrane
- Nonwoven cushion geotextile
- 12-inch granular drainage layer (leachate collection)
- Nonwoven separator geotextile
- 24-inch operations layer

The GCL proposed for the expansion however is different than the existing Phase II base liner. The proposed GCL for the lateral expansion is a composite product consisting of a bentonite powder/granules encapsulated between a carrier woven geotextile and a cover nonwoven geotextile. The resulting composite of the bentonite and geotextiles are then needle punched for additional strength. GCLs are widely accepted substitutes for the lower component of a composite liner system with the incorporation a prepared subbase surface for the GCL to be installed upon. The maximum permeability of this GCL is modeled as 5.0×10^{-9} cm/sec, typical for GCLs available today.

A graphic depiction of the proposed base liner design for Cell 1 is provided in Appendix A. ?

The proposed leachate collection and extraction system for Cell 1 consists of an 8-inch HDPE perforated pipe for each subcell of Cell 1. The leachate collection pipe is sloped to the perimeter berm where the pipe exits the landfill liner system through a pipe penetration. The pipe penetration is comprised of two ½" thick HDPE flatstock factory welded to the pipe with the resulting void between the flatstock filled with grout completing the pipe penetration design.

For review of performance equivalency of the proposed Cell 1 base liner and the pipe penetration in comparison to a 2 foot thick recompacted clay liner, a HELP model for each liner system was completed. For conservative analysis, the HELP model for Cell 1 was modeled to represent the baseliner with just a 60-mil HDPE geomembrane and GCL. Additional layers of geosynthetics further reduce possible leakage rates. HELP model inputs and outputs are discussed further in Section 2.

2.0 LINER EVALUATION – HELP MODEL

To verify the performance of the proposed base liner system and pipe penetration in relation to the HLA POCA and the equivalency of the proposed GCL to a 2-foot recompacted clay liner, a hydrologic evaluation was performed. The evaluation was performed using the USEPA HELP Model, Version 3.07

2.1 HELP Model Description

The quantity of leachate expected to be generated within the lateral expansion was calculated using the HELP computer model, Version 3.07, dated November 1, 1997. HELP was developed by the USACE Waterways Experiment Station for the USEPA to evaluate water movement through landfills. The program is used to calculate the amount of evapotranspiration, surface water run-off, percolation through installed covers, leachate generation and leachate head that may be expected from a wide variety of landfill designs, and is based upon various climatologic and soil data.

HELP requires weather data to be input for evapotranspiration, precipitation, temperature, and solar radiation. Evapotranspiration data includes weather station latitude, evaporative zone depth, maximum leaf area index, growing season start and end dates, wind speed, and relative humidity.

HELP also requires soil and design data for general landfill information, layer design (cover and liner components), and the run-off curve number.

- General landfill information includes the waste footprint area, percentage of the landfill where run-off is possible, method of initializing moisture contents, and initial snow water storage.
- Layer data includes layer type, layer thickness, soil characteristics, and initial soil water content. The following four layer types can be used: barrier soil liner, geomembrane liner, lateral drainage, and vertical percolation.
- Soil characteristics which must be input include porosity, field capacity, wilting point, and saturated hydraulic conductivity. The user can input each soil characteristic, or use default characteristics which are provided for 42 different types of soils/materials.
- For lateral drainage layers, the user must input the maximum drainage length and drain slope.
- For geomembranes, the user must input data regarding assumed manufacturing and installation defects (holes per acre) and the quality of the liner placement.
- Soil types and thickness used in modeling the landfill cross-section are based on engineering design.

Design criteria and assumptions used for model inputs are provided in Appendix B.

The soil information input into HELP uses a combination of default and user defined data to describe a typical cross-section through the landfill. The data input to describe the typical cross-section includes the landfill base liner profile from the top to the bottom of the liner system.

Leachate quantities were calculated based upon open conditions, representing the entire footprint actively accepting waste. All rainfall was also not allowed to leave the active area as well for the model. Both of these conditions provide a conservative analysis.

2.2 HELP Model Definitions

2.2.1 Layers

For the analysis of the landfill using HELP, each component of the landfill cross-section is modeled as one of the four layer types used in HELP (vertical percolation, lateral drainage, barrier soil liner, or geomembrane liner). The classification of layers is based on the flow of liquid through the layers. HELP model layer classifications and corresponding design layers are presented in Table 1 of Appendix B. HELP user's guide for Version 3 (Schroeder, 1994) provides the following descriptions:

- Barrier soil liner: This layer is a soil layer intended to restrict drainage (percolation/ leakage). Liquid only has the potential to flow vertically through this layer when there is a positive head, or standing liquid, on top of the layer.
- Geomembrane liner: This layer is a low permeability synthetic membrane that reduces the amount of vertical liquid movement. Vertical movement of liquid through this layer can occur primarily through assumed defects in the geomembrane when there is a positive head on top of the layer.
- Lateral drainage layer: This layer can be soil or a geosynthetic material that is located directly above a liner that allows the horizontal (lateral) as well as vertical movement of liquids. HELP assumes the lateral movement of liquid in this layer to be unrestricted, meaning that there is a discharge from a lateral drainage layer.
- Vertical percolation layer: This layer can be soil or a geosynthetic material that provides moisture storage and allows the vertical movement of liquid (precipitation and leachate).

2.2.2 Landfill Conditions

At any given time during landfill construction and waste filling, the landfill will be under one of three conditions. The three conditions are active areas (open), areas with intermediate cover (intermediate), and areas with final cover in place (closed). The primary difference between the three conditions is the cover material over the waste. The proposed base liner system is the same for each condition while the thickness of daily, intermediate and final cover varies. For purposes of this evaluation, the landfill was modeled in open condition with no intermediate cover in place and allowing no runoff. By not allowing runoff in the model, this process increases the quantity of leachate generated. Open conditions for a landfill are the times at which leachate generation is the greatest.

Consistent with the HLA POCA, the HELP program determined initial moisture content. A 1-acre unit area is modeled to simplify unit comparisons. For the open condition modeled in the HELP analysis is consistent with the HLA POCA with 40 feet of waste in place. The base liner was modeled as depicted in Appendix B for the Cell 1 composite liner system with the GCL, the pipe penetration, and a 2-foot recompacted clay liner in place of the GCL.

Temperature, precipitation, and average wind speed data was obtained from site records from January 2001 through December 2006. Missing data is viewed by the model as a "0". Therefore, to avoid skewing the data, missing temperature data for 2001 and 2002 was filled in using temperatures from days adjacent to the missing data. Data is missing for a total of 5 days in April of 2001 and 2002. Data from 2004 is missing from April 9 through May 3, and May 26 through June 19. To avoid skewing the data, these blocks of missing data from 2004 were filled in using data from the same dates in 2003. There is no missing data from 2003, 2005, and 2006. Use of site-specific data verses synthetic data provides results realistic to actual conditions at the facility.

Solar radiation data can be default data, user input or synthetically generated by the HELP model. Synthetically generated solar radiation data for Honolulu, Hawaii was used to simulate site weather conditions.

2.2.3 Geomembrane Manufacturing and Installation

Controlling factors in the HELP model include the defects per acre from manufacturing defects (pinholes) and placement quality of the geomembrane. Pinhole density is assumed to account for possible manufacturing defects during geomembrane production. The Help user guide for HELP Version 3.07 states pinhole density for a typical geomembrane is 0.5 to 1 pinhole per acre. For conservative analysis, a pinhole density of 1 was assumed.

Installation placement quality is dependant upon installation techniques, well prepared subbase, and design requirements through project specifications and the use of qualified installers. Project specifications for the expansion specify these requirements and will be enforced during liner installation.

Based upon this, placement quality of "good" was applied and reflects the HELP user guide definition of "...assumes good field installation with a well prepared, smooth soil surface and wrinkle control".

With an installation quality of "good", the number of installation defects recommended by the HELP user guide is 1 to 4 installation defects per acre. For this analysis, each base liner system was analyzed for three scenarios: 1, 2, and 4 defects per acre for the geomembrane. In the case of the HDPE flatstock for the pipe penetration, the thickness and durability of the flatstock, the defects per acre were set to zero.

2.2.4 Leachate Flow Length

Leachate head, or head on the base, is the depth of leachate on top of the base liner system. Leachate head buildup is dependent on several factors, including drainage distance, drainage slope, permeability of granular drainage layer material and the leachate generation rate.

Drainage distance is the distance leachate travels on the composite liner through the granular drainage layer to reach the leachate collection pipes. The maximum drainage distance for the expansion is 260 feet. The leachate drainage slope represents the slope of the base liner towards the leachate collection pipe. The landfill is designed with a 2.0 percent slope of the base perpendicular to the collection pipes and a 2.0 percent slope of the collection pipes toward the collection sumps. Based on these slopes, the drainage slope for the landfill base is 2.8 percent. The base grades and leachate collection system are shown in Appendix A. ?

2.3 Model Output

Completion of the HELP model analysis has determined the proposed GCL and flatstock of the pipe penetration provides equivalent or better performance as a barrier than a recompacted clay liner for the proposed base liner system of the Phase II lateral expansion.

Assuming 4 defects per acre, the recompacted clay liner is expected to allow 5 times more infiltration than a GCL with a maximum permeability of $5x10^{-9}$ cm/sec.

Summary of Results from HELP Analysis Output

Peak Daily Results	Barrier Layer						
	GCL			Flatstock	2-foot Recompacted Clay		
	1	2	4	0	1	2	4
Infiltration Through Base Liner (ft^3/acre/day)	0.00106	0.00145	0.00221	0.00006	0.00428	0.00664	0.01136
Maximum Leachate Head on Base Liner (inches)	2.131	2.131	2.131	2.131	2.131	2.131	2.131

The model as stated in Section 2.2.2, was performed at open conditions and no runoff was allowed. Actual landfill operation will afford run off of surface water and use of an intermediate cover which reduces the leachate generated. Appendix D-1 of the accompany report titled, "Engineering Report, Kekaha Landfill Phase II, Lateral Expansion," prepared by AECOM, dated January 2009 models the landfill at open conditions with intermediate cover inplace and runoff allowed. This model determined the estimated leachate head to be 1.4 inches, thereby confirming the above liner evaluation is conservative and is less than Subtitle D requirements of less than 12 inches (30 cm). The head on liner also demonstrates the model setup above the geomembrane layer was consistent for each modeled scenario.

The leachate extraction system in Cell 1 is a gravity pipe system. Based upon the pipe inverts and slopes the leachate in Cell 1 is always managed at levels less than 12 inches.

3.0 LINER EVALUATION – MULTIMED

Additional analyses have also been completed to concentrations from possible leakage through the proposed liner system at the Point of Compliance.

3.1 MULTIMED Model and Input

MULTIMED Version 2.0 was used to model the landfill expansion. MULTIMED runs as a DOS based program in Windows XP. MULTIMED has pre-processing, executable and post-processing modules. The MULTIMED pre-processing program was used to create the model input files. MULTIMED executable reads the input program and creates model output files which are denoted with a .OUT file extension. Both the input and output files are ASCII text files which can be edited and reviewed in a text editor

MULTIMED input is based on site measured data, local and regional hydrogeologic data, and literature based values. Table 1 presents MULTIMED model input and source of data. Site and local data was used for most MULTIMED input.

The source area was modeled as a constant concentration source over the model time period. The contaminant source concentration in the source area is 1 mg/L throughout the contaminant source area. This yields normalized values representing potential contaminant concentrations migrating from beneath the landfill area. By using a normalized concentration approach, the constant source concentration is assigned the surrogate concentration value of 1 mg/L and resulting modeled surrogate isoconcentrations below the source area are thus a fraction of this initial value and represent a dilution attenuation factor (DAF). The model derived DAF can be used to predict the point of compliance (POC) concentrations for all constituents found in the source leachate. A comparison of each predicted concentration at the POC to the Hawaii Administrative Rules, Title 11, Department of Health (DOH), Chapter 20, Rules Relating to Potable Water Systems, Section 11-20-3 maximum contaminant levels for inorganic chemicals and Section 11-20-4 maximum contaminant levels for organic chemicals will determine if a potential impact will occur within the site life.

Model inputs are listed in Table 1 located in Appendix C. 7

3.2 MULTIMED Model Results

MULTIMED model was modeled to steady-state conditions. The model results represent the most conservative conditions. The model results in a DAF of 3.157x10^{-7} at the POC. This DAF factor was applied to the average leachate concentrations from the facility. Table 2 presents the leachate sample results from June 2008, the average, predicted concentrations, and Hawaii DOH MCLs. Based on the results, no predicted concentrations are above Hawaii Department of Health MCLs.

Model results are present as Table 2 in Appendix C.

4.0 CONCLUSIONS

The proposed base liner system of the Phase II lateral expansion which includes a GCL as the barrier layer and pipe penetration system, has been determined to be equivalent or better in performance to a 2-foot recompacted clay liner in that less infiltration through the base liner is expected with the use of a GCL. Infiltration through a recompacted clay liner is estimated to be several times greater than when a GCL is installed. The determination was completed using the USEPA HELP model Version 3.07 as well a MULTIMED analyses with the following criteria and conservative inputs:

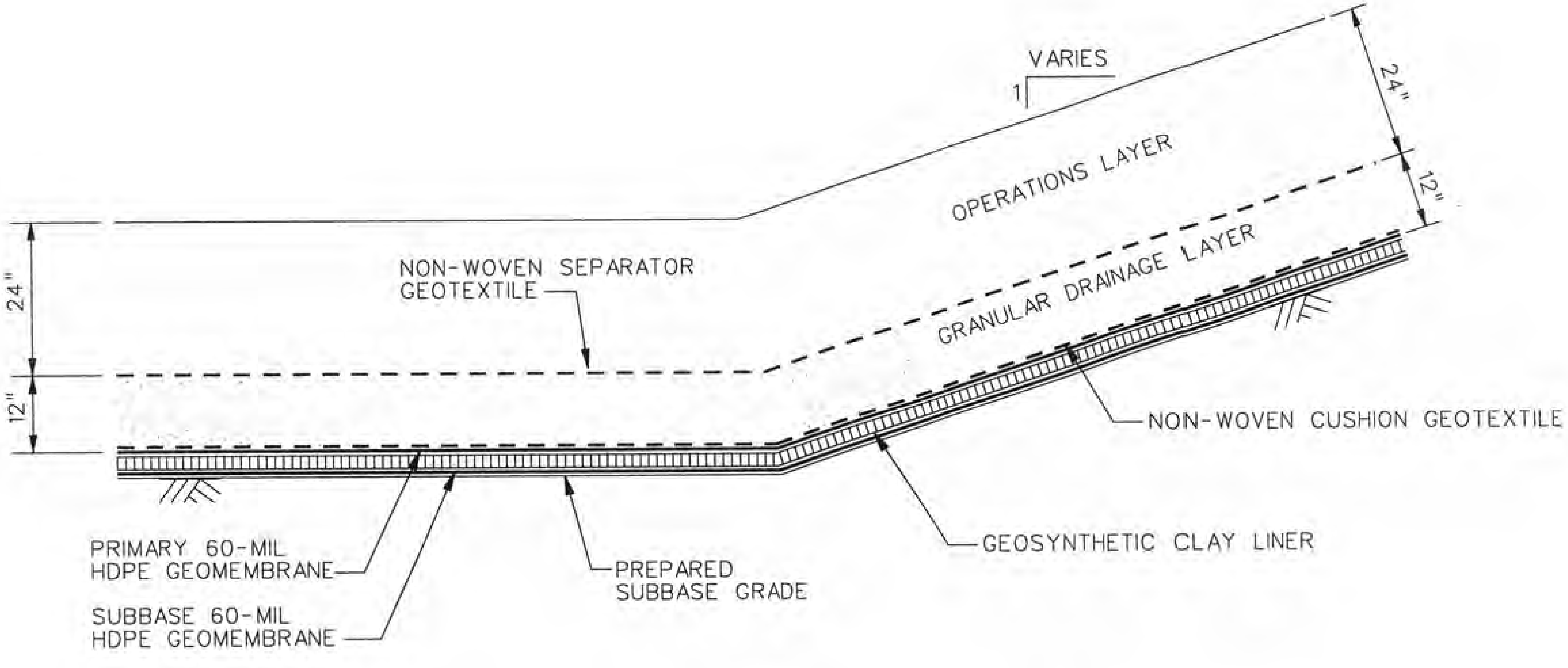
- Site specific weather data was utilized.
- The waste mass was modeled at open conditions with no intermediate or final cover inplace.
- Waste mass thickness was 40 feet consistent with the HLA POCA.
- No runoff was allowed off of the waste mass, thereby adding conservatism.
- Installation of the geomembrane was designated as "good" in reflection of project specifications and design requirements.
- Maximum permeability of the GCL was $5x10^{-9}$ cm/sec, represents currently available GCLs.
- Actual onsite leachate test data was used to determine potential concentrations.

Appendix A

Design Details and Drawings

Appendix A-1

Cell 1 Base Liner Detail



TYPICAL BASE LINER DETAIL - CELL 1 1

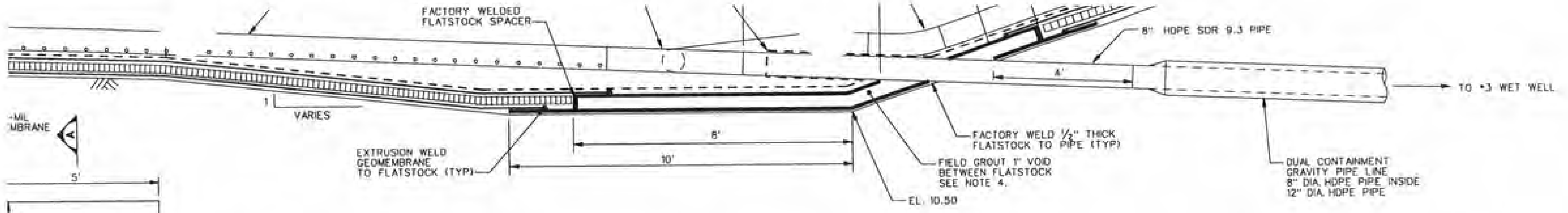
NTS

NOTES:

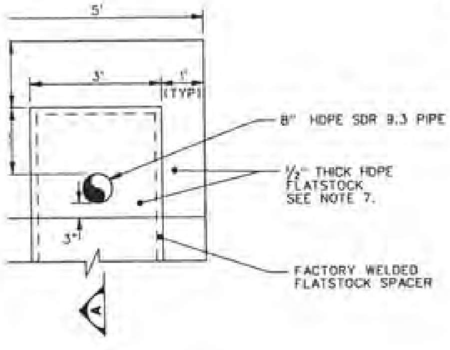
1. ALL GEOMEMBRANE IS TEXTURED ON BOTH SIDES.
2. WHEN DEPLOYING GCL OR GEOTEXTILES OVER TEXTURED GEOMEMBRANE OR WHEN DEPLOYING TEXTURED GEOMEMBRANE OVER GCL OR GEOTEXTILES, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.

Appendix A-2

Pipe Penetration Details



SECTION A-A



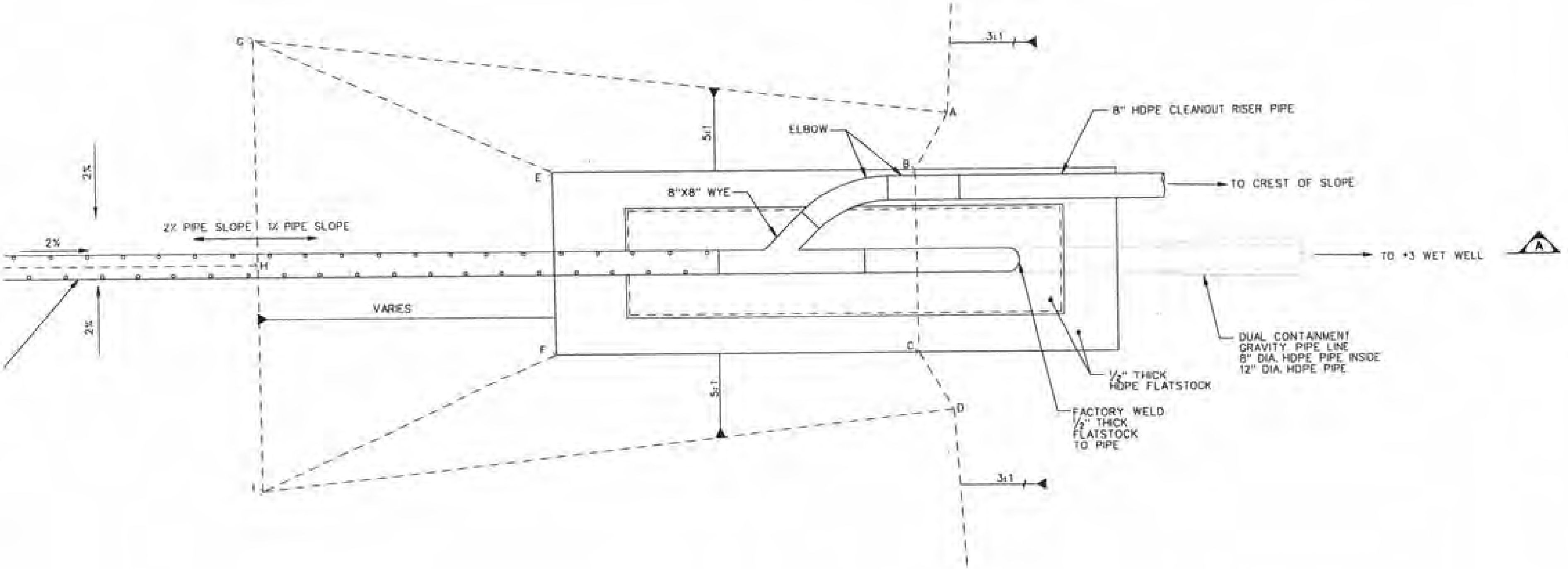
PLAN

PIPE PENETRATION DETAIL 1

NTS

NOTES:

1. GEOMEMBRANE PANELS IMMEDIATELY ADJACENT TO PIPE PENETRATION TO BE 80-MIL HDPE GEOMEMBRANE.
2. EXTRUSION WELD GEOMEMBRANE TO HDPE FLATSTOCK WITH A MINIMUM 6 INCHES OF OVERLAP.
3. ALL GEOMEMBRANE IS TEXTURED ON BOTH SIDES.
4. PIPE PENETRATION ASSEMBLY TO BE FACTORY AND FIELD AIR TESTED FOR WATER TIGHTNESS. FIELD GROUT AFTER SATISFACTORY AIR TESTING AND EXTRUSION WELD TEST/GROUT OPENINGS.
5. PLACE MULTIPLE LAYER OF GCL FOR EACH TRANSITION AND THICKNESS ALONG TOP FLATSTOCK.
6. PIPE CONNECTIONS TO BE FIELD CONNECTIONS USING ELECTRO-FUSION COUPLINGS.
7. ROUND ALL CORNERS AND EDGES OF FLATSTOCK.



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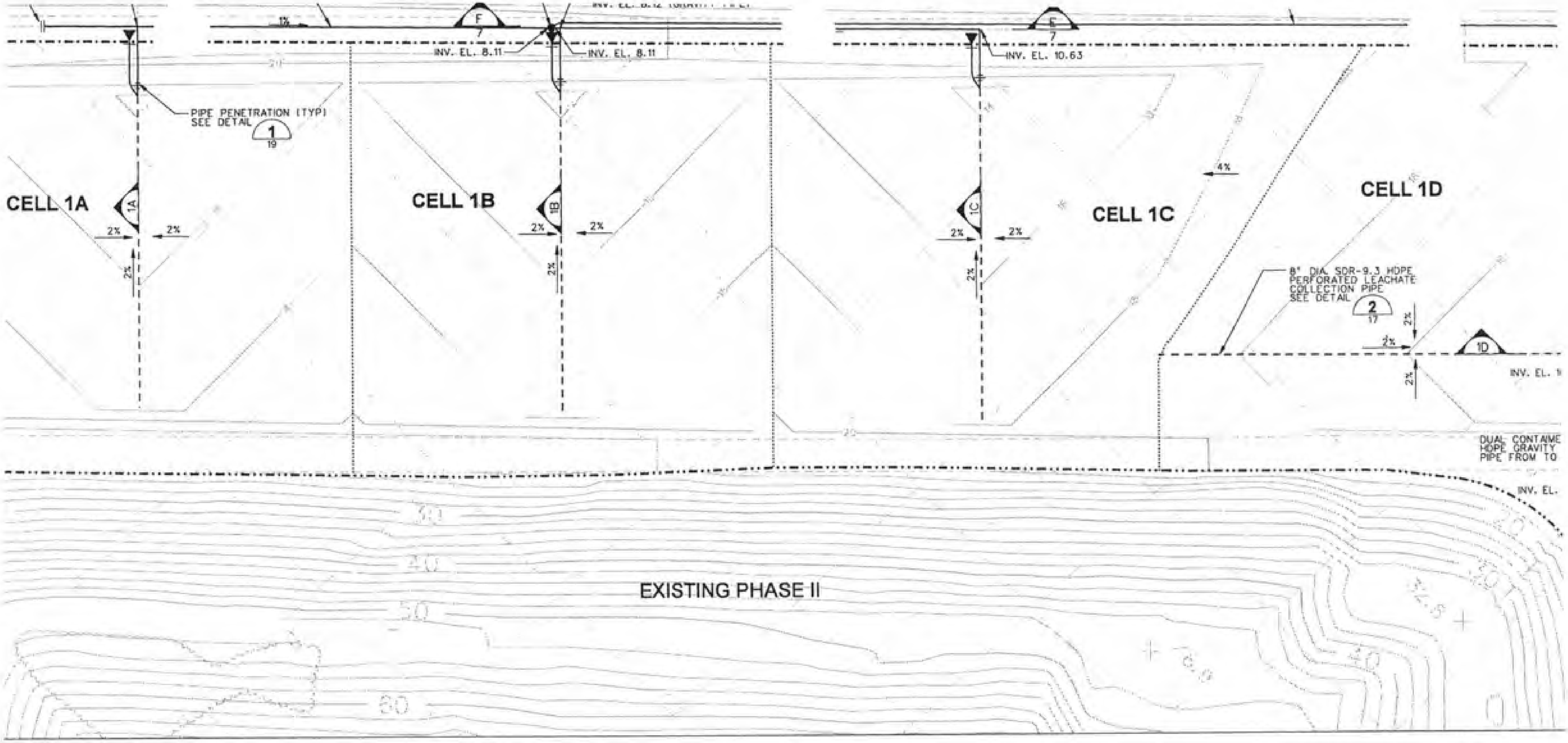
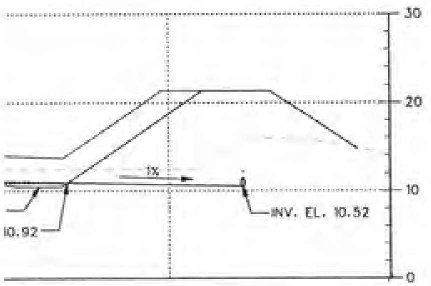
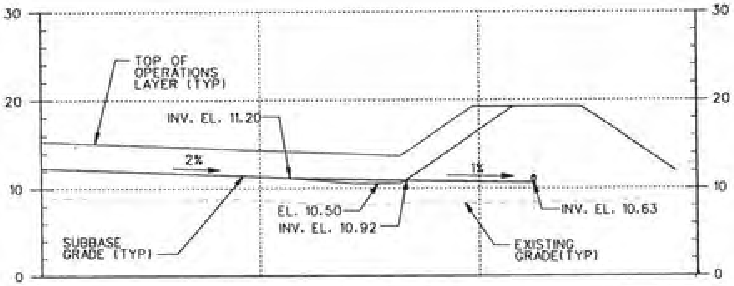
Appendix A-3

Cell 1 Leachate Management System

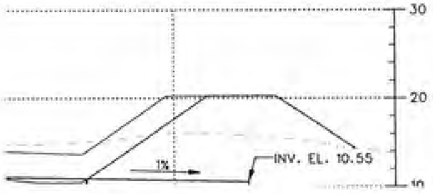


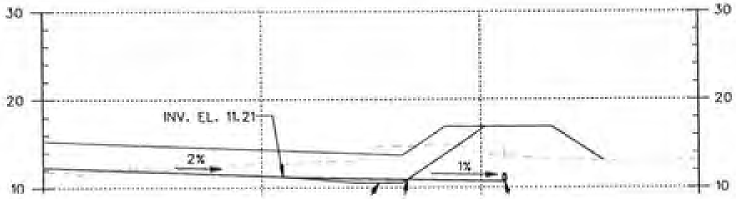


ROFILE 1A



PROFILE 1C





LEGEND

NOTES:

1. TOPOGRAPHIC MAP PI
SEATTLE, WASHINGTO
AND PORTIONS ARE
GROUND SURVEY.

2. HORIZONTAL DATUM
VERTICAL DATUM BAS

3. GRADES SHOWN REPF

4. GRANULAR DRAINAGE
GRADE TO BE FIELD
ELEVATIONS.

Appendix B

Liner Evaluation

AECOM

CALCULATION SHEET

Page 1 **Of** 4
Project No. 95561

Client County of Kaua'i **Subject** Liner Evaluation **Prepared By** TCR **Date** 12/24/08
Project Kekaha Landfill **Reviewed By** NKW **Date** 12/30/08
Phase II Lateral Expansion **Approved By** KJB **Date** 12/31/08

LINER EVALUATION

Objective

Evaluate the performance of two liner configuration under various scenarios using the USEPA Hydraulic Evaluation of Landfill Performance Version 3.07 (HELP) computer modeling program and site data. The leachate collection pipe collar at the liner penetration is also evaluated.

Criteria, Assumptions And Methodology

1. This analysis was performed to evaluate two liner configurations. The first liner configuration consists of the designed liner which includes a geosynthetic clay liner (GCL). The second liner configuration is identical to the first configuration except that the GCL is replaced with 2-foot clay liner. The leachate collection pipe collar consists of a ½ -inch HDPE flatstock.

2. The two liner configurations were modeled under various scenarios by altering the assumed number of geomembrane installation defects per acre.

3. Due to the thickness of the flatstock and the resulting resistance to damage, the leachate collection pipe collar will be modeled with 0 installation defects and 0 manufacturing defects.

what kind of leakage -

4. This calculation is intended only to evaluate the differences in the liner configurations and is not an estimate of leachate generation quantities.

5. Except for the GCL and 2-foot clay layer, all HELP model inputs are identical for each liner configuration to facilitate the comparison of the GCL and 2-foot clay layer.

HELP Model Version 3.07 Input:

1. Solar radiation data can be default data, user input or synthetically generated by the HELP model. Synthetically generated solar radiation data for Honolulu, Hawaii was used to simulate site weather conditions.

2. Temperature, precipitation, and average wind speed data was obtained from site records from January 2001 through December 2006. Missing data is viewed by the model as a "0". Therefore, to avoid skewing the data, missing temperature data for 2001 and 2002 was filled in using temperatures from days adjacent to the missing data. Data is missing for a total of 5 days in April of 2001 and 2002. Data from 2004 is missing from April 9 through May 3, and May 26 through June 19. To avoid skewing the data, these blocks of missing data from 2004 were filled in using data from the same dates in 2003. There is no missing data from 2003, 2005, and 2006.

3. Geomembrane liner pinhole density and size were assumed to account for possible manufacturing defects during geomembrane production. The HELP Model User's Guide for Version 3.07 states that the pinhole density for a typical geomembrane is 0.5 to 1 pinhole per acre. One pinhole per acre was assumed to be present.

AECOM

CALCULATION SHEET

Page 2 **Of** 4
Project No. 95561
Client County of Kaua'i **Subject** Liner Evaluation **Prepared By** TCR **Date** 12/24/08
Project Kekaha Landfill **Reviewed By** NKW **Date** 12/30/08
Phase II Lateral Expansion **Approved By** KJB **Date** 12/31/08

4. The placement quality for the geomembrane liner was assumed to be "good". A placement quality of "good" according to the HELP Model User's Guide "assumes good field installation with well prepared, smooth soil surface and geomembrane wrinkle control".

5. The HELP Model User's Guide suggests 1 to 4 installation defects for an installation quality of "good". The number of installation defects evaluated include 1, 2, and 4 defects per acre.

6. It is assumed that 0 percent of the area will allow rainwater runoff. This assumption will increase leachate quantities and assist with the liner evaluation.

7. A curve number of 1 was input to provide necessary model inputs, but due to the area allowing run-off, the curve number will not impact the calculations.

8. The initial moisture content of the waste, soil, and geosynthetic materials input into the model were computed by the HELP model to be nearly steady state.

9. Soil layers were generally modeled using HELP model default soil characteristics (porosity, field capacity, wilting point, saturated hydraulic conductivity) with two exceptions. The operations layer is assumed to have a hydraulic conductivity of $6.0\text{x}10^{-3}$ cm/sec. The GCL was modified to have a hydraulic conductivity of $5.0\text{x}10^{-9}$ cm/sec to reflect manufacturer data.

10. The longest flow path and shallowest slope along the base liner was input, resulting in the highest potential leachate head estimate. For the liner, the longest flow path is 260 feet and the slope is 2.8 percent. The longest slope occurs in Cell 1A.

11. A 1-acre design area was used for modeling purposes to compute unit quantities.

12. Active Condition Inputs (see also Table 1):

    - 40 feet of waste
    - Bare ground conditions
    - Evaporative zone depth = 10 in. (recommended by HELP Model for bare ground for Honolulu, Hawaii)
    - Maximum leaf area index = 0 (recommended by HELP Model for bare ground)
    - Fraction of area allowing runoff = 0 percent (assumes no runoff)
    - Runoff curve number = 1 (user specified)
    - Length of model run = 6 years

AECOM

CALCULATION SHEET

Page 3 **Of** 4
Project No. 95561
Client County of Kaua'i **Subject** Liner Evaluation **Prepared By** TCR **Date** 12/24/08
Project Kekaha Landfill **Reviewed By** NKW **Date** 12/30/08
Phase II Lateral Expansion **Approved By** KJB **Date** 12/31/08

Help Model General Layout

Table 1: Active Condition – HELP Model Layout

(Layer Number) Layer Description	Flow	Thickness	Sat. Hydraulic Conductivity	Soil Type/ Texture Number
(1)vertical percolation	↓	480 inches	$1.0x10^{-3}$ cm/sec	waste/#18
(2)vertical percolation	↓	24 inches	$6.0x10^{-3}$ cm/sec	operations layer/ #61
(3)lateral drainage	→	12 inches	$3.0x10^{-1}$ cm/sec	gravel/ #21
(4)60-mil geomembrane Liner	↓	0.06 inch	$2.0x10^{-13}$ cm/sec	geomembrane/#35
(4) ½-inch HDPE flatstock (for one configuration)[1]	↓	0.5 inch	$2.0x10^{-13}$ cm/sec	HDPE/#35
(5)Geosynthetic Clay Layer (for one configuration)	↓	0.24 inches	$5.0x10^{-9}$ cm/sec	Bentonite mat/#62
(5)Clay Liner (for one configuration)	↓	24 inches	$1.0x10^{-7}$ cm/sec	clay/#16

Note 1: To evaluate the Leachate collection pipe collar, layer 4 is modeled as ½ inch of HDPE and there is no Layer 5. The ½-inch HDPE layer is not included in the liner evaluations.

Table 2: Soil Texture Properties

Soil Texture	Soil Classification		Comments, Properties, and Uses
	USDA	USCS	
62	---	---	Based on HELP model default parameter for a bentonite mat (0.6 cm or 0.24 inches thick) with the hydraulic conductivity changed from $3x10^{-9}$ cm/sec to $5x10^{-9}$ cm/sec.
61	S	SW	Operations layer. Based on HELP model default soil parameter no. 2 with the hydraulic conductivity changed from $5.8x10^{-3}$ cm/sec to $6x10^{-3}$ cm/sec.
35	---	---	HELP model default parameters for High Density Polyethylene (HDPE). Used to model HDPE geomembrane and HDPE flatstock.
21	---	---	Gravel drainage layer. HELP model default soil parameter for gravel, hydraulic conductivity $3.0x10^{-1}$ cm/sec
18	---	---	HELP model default parameter for municipal solid waste.
16	--	--	HELP model default parameter for barrier soil layer, hydraulic conductivity of $1.0x10^{-7}$ cm/sec.

Note: All soil properties are defaults of the HELP Model, Version 3.07 unless otherwise designated.

AECOM

CALCULATION SHEET

Page 4 **Of** 4
Project No. 95561

Client County of Kaua'i **Subject** Liner Evaluation **Prepared By** TCR **Date** 12/24/08
Project Kekaha Landfill **Reviewed By** NKW **Date** 12/30/08
Phase II Lateral Expansion **Approved By** KJB **Date** 12/31/08

Calculations

Calculations performed by the HELP Model are included in the output located in Attachments 1 through 7. See Table 3 for the modeling results based on peak daily values.

Table 3: Summary of Results From HELP Analysis Output

	GCL			2-foot Clay			Flatstock
Peak Daily Results	1 Def/Ac	2 Def/ac	4 Def/Ac	1 Def/Ac	2 Def/ac	4 Def/Ac	0 Def/Ac
Infiltration Through Base Liner (cf/acre/day)	0.00106	0.00145	0.00221	0.00428	0.00664	0.01136	0.00006
Maximum Leachate Head on Base (inches)	2.131	2.131	2.131	2.131	2.131	2.131	2.131

Conclusion

The liner evaluation indicates that the GCL and HDPE flatstock both perform better than a 2-foot soil liner.

ATTACHMENT 1

HELP MODEL OUTPUT
(FILENAME: GCL1.OUT)

```
*******************************************************************************
*******************************************************************************
**                                                                           **
**                                                                           **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:       C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:   c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:     c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:   c:\temp\GCL1.D10
OUTPUT DATA FILE:            c:\temp\GCL1.OUT


TIME:  13:30      DATE:  12/24/2008


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

     TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, 1 def, GCL

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


     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  18
           THICKNESS                 =   480.00   INCHES
           POROSITY                  =     0.6710 VOL/VOL
           FIELD CAPACITY            =     0.2920 VOL/VOL
           WILTING POINT             =     0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =    0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC
```

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

               TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER  61
   THICKNESS                    =     24.00    INCHES
   POROSITY                     =      0.4370 VOL/VOL
   FIELD CAPACITY               =      0.0620 VOL/VOL
   WILTING POINT                =      0.0240 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.0921 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    = 0.600000005000E-02 CM/SEC


                             LAYER  3
                             --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER  21
   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   =      0.0322 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    = 0.300000012000       CM/SEC
   SLOPE                        =      2.80    PERCENT
   DRAINAGE LENGTH              =    260.0     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
   INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    = 0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY          =      1.00    HOLES/ACRE
   FML INSTALLATION DEFECTS     =      1.00    HOLES/ACRE
   FML PLACEMENT QUALITY        = 3 - GOOD


                             LAYER  5
                             --------

                  TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER  62
   THICKNESS                    =      0.24    INCHES
   POROSITY                     =      0.7500 VOL/VOL
   FIELD CAPACITY               =      0.7470 VOL/VOL
   WILTING POINT                =      0.4000 VOL/VOL
   INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    = 0.499999997000E-08 CM/SEC
```

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

  NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER            =      1.00
 FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH             =     10.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE  =      1.178  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE =      6.710  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE =      0.770  INCHES
 INITIAL SNOW WATER                 =      0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS   =    141.193  INCHES
 TOTAL INITIAL WATER                =    141.193  INCHES
 TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


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

  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           HONOLULU               HAWAII

      STATION LATITUDE                         =  21.33 DEGREES
      MAXIMUM LEAF AREA INDEX                  =   0.00
      START OF GROWING SEASON (JULIAN DATE)    =      0
      END OF GROWING SEASON (JULIAN DATE)      =    367
      EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
      AVERAGE ANNUAL WIND SPEED                =   3.78 MPH
      AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
      AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  66.00 %
      AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  66.00 %
      AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %

  NOTE:  PRECIPITATION DATA FOR      KEKAHA/SITE          HAWAII
           WAS ENTERED FROM AN ASCII DATA FILE.

  NOTE:  TEMPERATURE DATA FOR      KEKAHA/SITE          HAWAII
           WAS ENTERED FROM AN ASCII DATA FILE.


  NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
           COEFFICIENTS FOR    HONOLULU             HAWAII
             AND STATION LATITUDE =  21.33 DEGREES
```

```
*******************************************************************************

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS               2.47     2.13     4.33     0.69     0.48     0.77
                        0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS      3.62     2.09     8.41     0.76     0.37     0.41
                        0.16     0.47     0.81     1.90     0.57     2.92

 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              1.426    1.162    1.775    1.153    0.538    0.301
                       0.265    0.676    0.611    1.028    1.296    0.839

   STD. DEVIATIONS     1.407    0.789    1.443    1.279    0.649    0.167
                       0.064    0.723    0.688    1.142    0.879    0.555

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
   TOTALS             0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                      0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

   STD. DEVIATIONS    0.2483   1.3614   1.5042   1.3953   2.0147   1.5358
                      1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

 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


-------------------------------------------------------------------------------
         AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
   AVERAGES           0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                      0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

   STD. DEVIATIONS    0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                      0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
*******************************************************************************

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

      AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------

                                        INCHES            CU. FEET    PERCENT
                                   -------------------  ------------  ---------
  PRECIPITATION                    17.12    ( 10.514)      62151.7    100.00

  RUNOFF                            0.000   ( 0.0000)         0.00      0.000

  EVAPOTRANSPIRATION               11.071   ( 4.0044)     40188.14     64.661

  LATERAL DRAINAGE COLLECTED        6.01753 ( 7.66922)    21843.650   35.14572
    FROM LAYER  3

  PERCOLATION/LEAKAGE THROUGH       0.00001 ( 0.00001)        0.036    0.00006
    LAYER  5

  AVERAGE HEAD ON TOP               0.091 (    0.115)
    OF LAYER  4

  CHANGE IN WATER STORAGE           0.033   ( 3.7415)       119.83      0.193

*******************************************************************************
```

```
******************************************************************************

          PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
    PRECIPITATION                                4.04        14665.200

    RUNOFF                                       0.000           0.0000

    DRAINAGE COLLECTED FROM LAYER  3             0.21015       762.85217

    PERCOLATION/LEAKAGE THROUGH LAYER  5         0.000000        0.00106

    AVERAGE HEAD ON TOP OF LAYER  4              1.148

    MAXIMUM HEAD ON TOP OF LAYER  4              2.131

    LOCATION OF MAXIMUM HEAD IN LAYER  3
          (DISTANCE FROM DRAIN)                 18.6 FEET

    SNOW WATER                                   0.00            0.0000


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                     0.5771

    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.

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

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

            FINAL WATER STORAGE AT END OF YEAR 2006
    ----------------------------------------------------------------------
               LAYER        (INCHES)       (VOL/VOL)
               -----        --------       ---------
                 1          138.0099         0.2875

                 2            2.7999         0.1167

                 3            0.4010         0.0334

                 4            0.0000         0.0000

                 5            0.1800         0.7500

             SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 2

HELP MODEL OUTPUT
(FILENAME: GCL2.OUT)

```
*******************************************************************************
*******************************************************************************
**                                                                           **
**                                                                           **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:        C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:    c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:      c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:    c:\temp\GCL2.D10
OUTPUT DATA FILE:             c:\temp\GCL2.OUT


TIME:  13:30       DATE:  12/24/2008


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

     TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, 2 def, GCL

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


     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  18
           THICKNESS                     =   480.00    INCHES
           POROSITY                      =     0.6710 VOL/VOL
           FIELD CAPACITY                =     0.2920 VOL/VOL
           WILTING POINT                 =     0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT    =     0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
```

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

           TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  61
THICKNESS                    =     24.00    INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0921 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.600000005000E-02 CM/SEC


                       LAYER  3
                       --------

             TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
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   =      0.0322 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000       CM/SEC
SLOPE                        =      2.80    PERCENT
DRAINAGE LENGTH              =    260.0     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
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      1.00    HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                       LAYER  5
                       --------

               TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  62
THICKNESS                    =      0.24    INCHES
POROSITY                     =      0.7500 VOL/VOL
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC
```

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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER               =       1.00
FRACTION OF AREA ALLOWING RUNOFF      =       0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE    =       1.000  ACRES
EVAPORATIVE ZONE DEPTH                =      10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE     =       1.178  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE    =       6.710  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE    =       0.770  INCHES
INITIAL SNOW WATER                    =       0.000  INCHES
INITIAL WATER IN LAYER MATERIALS      =     141.193  INCHES
TOTAL INITIAL WATER                   =     141.193  INCHES
TOTAL SUBSURFACE INFLOW               =       0.00   INCHES/YEAR


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

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           HONOLULU             HAWAII

     STATION LATITUDE                        =  21.33 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   0.00
     START OF GROWING SEASON (JULIAN DATE)   =      0
     END OF GROWING SEASON (JULIAN DATE)     =    367
     EVAPORATIVE ZONE DEPTH                  =  10.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   3.78 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  66.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  66.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  70.00 %


 NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE         HAWAII
           WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE         HAWAII
           WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
           COEFFICIENTS FOR     HONOLULU             HAWAII
             AND STATION LATITUDE  =  21.33 DEGREES
```

```
*******************************************************************************

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------

                     JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                     -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS              2.47     2.13     4.33     0.69     0.48     0.77
                       0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS     3.62     2.09     8.41     0.76     0.37     0.41
                       0.16     0.47     0.81     1.90     0.57     2.92

 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             1.426    1.162    1.775    1.153    0.538    0.301
                      0.265    0.676    0.611    1.028    1.296    0.839

   STD. DEVIATIONS    1.407    0.789    1.443    1.279    0.649    0.167
                      0.064    0.723    0.688    1.142    0.879    0.555

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
   TOTALS             0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                      0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

   STD. DEVIATIONS    0.2483   1.3614   1.5042   1.3953   2.0147   1.5358
                      1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

 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


-------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
   AVERAGES           0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                      0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

   STD. DEVIATIONS    0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                      0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
*******************************************************************************


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

      AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------
                                    INCHES            CU. FEET         PERCENT
                              -------------------   -------------     ---------
  PRECIPITATION                 17.12   (  10.514)     62151.7        100.00

  RUNOFF                         0.000  (  0.0000)         0.00         0.000

  EVAPOTRANSPIRATION            11.071  (  4.0044)     40188.14        64.661

  LATERAL DRAINAGE COLLECTED     6.01753 (  7.66921)   21843.645      35.14571
    FROM LAYER  3

  PERCOLATION/LEAKAGE THROUGH    0.00001 (  0.00001)       0.046       0.00007
    LAYER  5

  AVERAGE HEAD ON TOP            0.091 (    0.115)
    OF LAYER  4

  CHANGE IN WATER STORAGE        0.033  (  3.7415)       119.83         0.193

*******************************************************************************
```

```
******************************************************************************

            PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
 ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
   PRECIPITATION                                 4.04         14665.200

   RUNOFF                                        0.000            0.0000

   DRAINAGE COLLECTED FROM LAYER  3              0.21015        762.85187

   PERCOLATION/LEAKAGE THROUGH LAYER  5          0.000000         0.00145

   AVERAGE HEAD ON TOP OF LAYER  4               1.148

   MAXIMUM HEAD ON TOP OF LAYER  4               2.131

   LOCATION OF MAXIMUM HEAD IN LAYER  3
             (DISTANCE FROM DRAIN)              18.6 FEET

   SNOW WATER                                    0.00             0.0000


   MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.5771

   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.

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

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

              FINAL WATER STORAGE AT END OF YEAR 2006
  ----------------------------------------------------------------------
               LAYER         (INCHES)        (VOL/VOL)
               -----         --------        ---------
                 1           138.0099         0.2875

                 2             2.7999         0.1167

                 3             0.4010         0.0334

                 4             0.0000         0.0000

                 5             0.1800         0.7500

             SNOW WATER        0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 3

HELP MODEL OUTPUT
(FILENAME: GCL4.OUT)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:        C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:    c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:      c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:    c:\temp\GCL4.D10
OUTPUT DATA FILE:             c:\temp\GCL4.OUT


TIME:  13:30      DATE:  12/24/2008


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

     TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, 4 def, GCL

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


     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  18
           THICKNESS                  =   480.00    INCHES
           POROSITY                   =     0.6710 VOL/VOL
           FIELD CAPACITY             =     0.2920 VOL/VOL
           WILTING POINT              =     0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =     0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
```

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

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  61
THICKNESS                 =        24.00    INCHES
POROSITY                  =         0.4370 VOL/VOL
FIELD CAPACITY            =         0.0620 VOL/VOL
WILTING POINT             =         0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT =        0.0921 VOL/VOL
EFFECTIVE SAT. HYD. COND. =  0.600000005000E-02 CM/SEC


                       LAYER  3
                       --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  21
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 =        0.0322 VOL/VOL
EFFECTIVE SAT. HYD. COND. =  0.300000012000       CM/SEC
SLOPE                     =         2.80    PERCENT
DRAINAGE LENGTH           =       260.0     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
INITIAL SOIL WATER CONTENT =        0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND. =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY       =         1.00    HOLES/ACRE
FML INSTALLATION DEFECTS  =         4.00    HOLES/ACRE
FML PLACEMENT QUALITY     =  3 - GOOD


                       LAYER  5
                       --------

                  TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER  62
THICKNESS                 =         0.24    INCHES
POROSITY                  =         0.7500 VOL/VOL
FIELD CAPACITY            =         0.7470 VOL/VOL
WILTING POINT             =         0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT =        0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND. =  0.499999997000E-08 CM/SEC
```

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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER              =       1.00
FRACTION OF AREA ALLOWING RUNOFF     =       0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =       1.000  ACRES
EVAPORATIVE ZONE DEPTH               =      10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =       1.178  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =       6.710  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =       0.770  INCHES
INITIAL SNOW WATER                   =       0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =     141.193  INCHES
TOTAL INITIAL WATER                  =     141.193  INCHES
TOTAL SUBSURFACE INFLOW              =       0.00   INCHES/YEAR


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

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          HONOLULU              HAWAII

    STATION LATITUDE                             = 21.33 DEGREES
    MAXIMUM LEAF AREA INDEX                      =  0.00
    START OF GROWING SEASON (JULIAN DATE)        =     0
    END OF GROWING SEASON (JULIAN DATE)          =   367
    EVAPORATIVE ZONE DEPTH                       = 10.0  INCHES
    AVERAGE ANNUAL WIND SPEED                    =  3.78 MPH
    AVERAGE 1ST QUARTER RELATIVE HUMIDITY        = 72.00 %
    AVERAGE 2ND QUARTER RELATIVE HUMIDITY        = 66.00 %
    AVERAGE 3RD QUARTER RELATIVE HUMIDITY        = 66.00 %
    AVERAGE 4TH QUARTER RELATIVE HUMIDITY        = 70.00 %


 NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    HONOLULU              HAWAII
            AND STATION LATITUDE  =  21.33 DEGREES
```

```
******************************************************************************

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------

                      JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                      -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS               2.47     2.13     4.33     0.69     0.48     0.77
                        0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS      3.62     2.09     8.41     0.76     0.37     0.41
                        0.16     0.47     0.81     1.90     0.57     2.92

 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              1.426    1.162    1.775    1.153    0.538    0.301
                       0.265    0.676    0.611    1.028    1.296    0.839

   STD. DEVIATIONS     1.407    0.789    1.443    1.279    0.649    0.167
                       0.064    0.723    0.688    1.142    0.879    0.555

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
   TOTALS             0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                      0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

   STD. DEVIATIONS    0.2483   1.3614   1.5042   1.3953   2.0146   1.5358
                      1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

 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

------------------------------------------------------------------------------
           AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
   AVERAGES           0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                      0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

   STD. DEVIATIONS    0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                      0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
*******************************************************************************

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

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------
                                 INCHES             CU. FEET        PERCENT
                           -------------------    -------------    ---------
  PRECIPITATION              17.12    ( 10.514)      62151.7       100.00

  RUNOFF                      0.000   ( 0.0000)          0.00        0.000

  EVAPOTRANSPIRATION         11.071   ( 4.0044)      40188.14       64.661

  LATERAL DRAINAGE COLLECTED  6.01753 ( 7.66921)     21843.623    35.14567
    FROM LAYER  3

  PERCOLATION/LEAKAGE THROUGH 0.00002 ( 0.00002)         0.066     0.00011
    LAYER  5

  AVERAGE HEAD ON TOP         0.091 (     0.115)
    OF LAYER  4

  CHANGE IN WATER STORAGE     0.033   ( 3.7415)        119.83       0.193

*******************************************************************************
```

```
******************************************************************************

          PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------
                                                 (INCHES)     (CU. FT.)
                                                ----------  -------------
    PRECIPITATION                                 4.04       14665.200

    RUNOFF                                        0.000          0.0000

    DRAINAGE COLLECTED FROM LAYER  3              0.21015      762.85114

    PERCOLATION/LEAKAGE THROUGH LAYER  5          0.000001       0.00221

    AVERAGE HEAD ON TOP OF LAYER  4               1.148

    MAXIMUM HEAD ON TOP OF LAYER  4               2.131

    LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)                18.6 FEET

    SNOW WATER                                    0.00           0.0000


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                     0.5771

    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.

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

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

            FINAL WATER STORAGE AT END OF YEAR 2006
------------------------------------------------------------------------
              LAYER        (INCHES)       (VOL/VOL)
              -----        --------       ---------
                1          138.0099         0.2875

                2            2.7999         0.1167

                3            0.4010         0.0334

                4            0.0000         0.0000

                5            0.1800         0.7500

            SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 4

HELP MODEL OUTPUT
(FILENAME: SOIL1.OUT)

```
*******************************************************************************
*******************************************************************************
**                                                                           **
**                                                                           **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:       C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:   c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:     c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:   c:\temp\SOIL1.D10
OUTPUT DATA FILE:            c:\temp\SOIL1.OUT


TIME:  13:31     DATE:  12/24/2008


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

     TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, 1 def, Soil

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


     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  18
           THICKNESS                   =    480.00    INCHES
           POROSITY                    =      0.6710 VOL/VOL
           FIELD CAPACITY              =      0.2920 VOL/VOL
           WILTING POINT               =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

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

              TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  61
THICKNESS                    =       24.00    INCHES
POROSITY                     =        0.4370 VOL/VOL
FIELD CAPACITY               =        0.0620 VOL/VOL
WILTING POINT                =        0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =        0.0921 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.600000005000E-02 CM/SEC


                         LAYER  3
                         --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER  21
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   =        0.0322 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000012000     CM/SEC
SLOPE                        =        2.80    PERCENT
DRAINAGE LENGTH              =      260.0     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
INITIAL SOIL WATER CONTENT   =        0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =        1.00    HOLES/ACRE
FML INSTALLATION DEFECTS     =        1.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  5
                         --------

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

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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER              =      1.00
FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      1.178  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      6.710  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.770  INCHES
INITIAL SNOW WATER                   =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =    151.261  INCHES
TOTAL INITIAL WATER                  =    151.261  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


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

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          HONOLULU              HAWAII

     STATION LATITUDE                         =  21.33 DEGREES
     MAXIMUM LEAF AREA INDEX                  =   0.00
     START OF GROWING SEASON (JULIAN DATE)    =      0
     END OF GROWING SEASON (JULIAN DATE)      =    367
     EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
     AVERAGE ANNUAL WIND SPEED                =   3.78 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  66.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  66.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %


 NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    HONOLULU             HAWAII
            AND STATION LATITUDE  =  21.33 DEGREES
```

```
******************************************************************************

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------

                        JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                        -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                2.47     2.13     4.33     0.69     0.48     0.77
                          0.19     0.45     1.04     1.67     1.29     1.61

    STD. DEVIATIONS       3.62     2.09     8.41     0.76     0.37     0.41
                          0.16     0.47     0.81     1.90     0.57     2.92

  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               1.426    1.162    1.775    1.153    0.538    0.301
                         0.265    0.676    0.611    1.028    1.296    0.839

    STD. DEVIATIONS      1.407    0.789    1.443    1.279    0.649    0.167
                         0.064    0.723    0.688    1.142    0.879    0.555

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS              0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                        0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

    STD. DEVIATIONS     0.2483   1.3614   1.5042   1.3953   2.0146   1.5358
                        1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

  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


------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES            0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                        0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

    STD. DEVIATIONS     0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                        0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
******************************************************************************

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

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------
                                 INCHES            CU. FEET        PERCENT
                            ----------------    -------------    ---------
 PRECIPITATION              17.12   (  10.514)     62151.7       100.00

 RUNOFF                      0.000  (  0.0000)        0.00         0.000

 EVAPOTRANSPIRATION         11.071  (  4.0044)     40188.14       64.661

 LATERAL DRAINAGE COLLECTED  6.01751 (  7.66918)    21843.551     35.14555
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH  0.00004 (  0.00004)       0.141      0.00023
   LAYER  5

 AVERAGE HEAD ON TOP          0.091 (     0.115)
   OF LAYER  4

 CHANGE IN WATER STORAGE      0.033  (  3.7415)       119.83       0.193

******************************************************************************
```

```
******************************************************************************

              PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
--------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------    -------------
    PRECIPITATION                                4.04        14665.200

    RUNOFF                                       0.000           0.0000

    DRAINAGE COLLECTED FROM LAYER  3             0.21015       762.84924

    PERCOLATION/LEAKAGE THROUGH LAYER  5         0.000001        0.00428

    AVERAGE HEAD ON TOP OF LAYER  4              1.148

    MAXIMUM HEAD ON TOP OF LAYER  4              2.131

    LOCATION OF MAXIMUM HEAD IN LAYER  3
              (DISTANCE FROM DRAIN)             18.6 FEET

    SNOW WATER                                   0.00            0.0000

    MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.5771

    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.

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

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

                FINAL WATER STORAGE AT END OF YEAR 2006
--------------------------------------------------------------------------
              LAYER        (INCHES)       (VOL/VOL)
              -----        --------       ---------
                1          138.0099        0.2875

                2            2.7999        0.1167

                3            0.4010        0.0334

                4            0.0000        0.0000

                5           10.2480        0.4270

             SNOW WATER      0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 5

HELP MODEL OUTPUT
(FILENAME: SOIL2.OUT)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:       C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:   c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:     c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:   c:\temp\SOIL2.D10
OUTPUT DATA FILE:            c:\temp\SOIL2.OUT


TIME:  13:31     DATE:  12/24/2008


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

     TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, 2 def, Soil

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


     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  18
           THICKNESS                  =     480.00   INCHES
           POROSITY                   =       0.6710 VOL/VOL
           FIELD CAPACITY             =       0.2920 VOL/VOL
           WILTING POINT              =       0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
```

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

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  61
 THICKNESS                  =      24.00    INCHES
 POROSITY                   =       0.4370 VOL/VOL
 FIELD CAPACITY             =       0.0620 VOL/VOL
 WILTING POINT              =       0.0240 VOL/VOL
 INITIAL SOIL WATER CONTENT =       0.0921 VOL/VOL
 EFFECTIVE SAT. HYD. COND.  = 0.600000005000E-02 CM/SEC


                  LAYER  3
                  --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
 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 =       0.0322 VOL/VOL
 EFFECTIVE SAT. HYD. COND.  = 0.300000012000     CM/SEC
 SLOPE                      =       2.80    PERCENT
 DRAINAGE LENGTH            =     260.0     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
 INITIAL SOIL WATER CONTENT =       0.0000 VOL/VOL
 EFFECTIVE SAT. HYD. COND.  = 0.199999996000E-12 CM/SEC
 FML PINHOLE DENSITY        =       1.00    HOLES/ACRE
 FML INSTALLATION DEFECTS   =       2.00    HOLES/ACRE
 FML PLACEMENT QUALITY      = 3 - GOOD


                  LAYER  5
                  --------

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

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

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER             =      1.00
 FRACTION OF AREA ALLOWING RUNOFF    =      0.0     PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE  =      1.000   ACRES
 EVAPORATIVE ZONE DEPTH              =     10.0     INCHES
 INITIAL WATER IN EVAPORATIVE ZONE   =      1.178   INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =      6.710   INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.770   INCHES
 INITIAL SNOW WATER                  =      0.000   INCHES
 INITIAL WATER IN LAYER MATERIALS    =    151.261   INCHES
 TOTAL INITIAL WATER                 =    151.261   INCHES
 TOTAL SUBSURFACE INFLOW             =      0.00    INCHES/YEAR


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

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          HONOLULU              HAWAII

     STATION LATITUDE                         =  21.33 DEGREES
     MAXIMUM LEAF AREA INDEX                  =   0.00
     START OF GROWING SEASON (JULIAN DATE)    =      0
     END OF GROWING SEASON (JULIAN DATE)      =    367
     EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
     AVERAGE ANNUAL WIND SPEED                =   3.78 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  66.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  66.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %


 NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE          HAWAII
          WAS ENTERED FROM AN ASCII DATA FILE.


 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    HONOLULU             HAWAII
            AND STATION LATITUDE  =  21.33 DEGREES
```

```
******************************************************************************

          AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------

                       JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                       -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                 2.47     2.13     4.33     0.69     0.48     0.77
                          0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS        3.62     2.09     8.41     0.76     0.37     0.41
                          0.16     0.47     0.81     1.90     0.57     2.92

 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                1.426    1.162    1.775    1.153    0.538    0.301
                         0.265    0.676    0.611    1.028    1.296    0.839

   STD. DEVIATIONS       1.407    0.789    1.443    1.279    0.649    0.167
                         0.064    0.723    0.688    1.142    0.879    0.555

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
   TOTALS               0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                        0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

   STD. DEVIATIONS      0.2483   1.3614   1.5042   1.3953   2.0146   1.5358
                        1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

 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


------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
   AVERAGES             0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                        0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

   STD. DEVIATIONS      0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                        0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
*******************************************************************************

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

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------
                                       INCHES             CU. FEET     PERCENT
                                  -------------------  -------------  ---------
  PRECIPITATION                   17.12     ( 10.514)     62151.7     100.00

  RUNOFF                           0.000    ( 0.0000)         0.00      0.000

  EVAPOTRANSPIRATION              11.071    ( 4.0044)     40188.14     64.661

  LATERAL DRAINAGE COLLECTED       6.01749 ( 7.66916)    21843.477   35.14544
    FROM LAYER  3

  PERCOLATION/LEAKAGE THROUGH      0.00006 ( 0.00007)        0.217    0.00035
    LAYER  5

  AVERAGE HEAD ON TOP              0.091 (    0.115)
    OF LAYER  4

  CHANGE IN WATER STORAGE          0.033    ( 3.7415)       119.83      0.193

*******************************************************************************
```

```
******************************************************************************

           PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
  ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
    PRECIPITATION                                4.04        14665.200

    RUNOFF                                       0.000           0.0000

    DRAINAGE COLLECTED FROM LAYER  3             0.21015       762.84705

    PERCOLATION/LEAKAGE THROUGH LAYER  5         0.000002        0.00664

    AVERAGE HEAD ON TOP OF LAYER  4              1.148

    MAXIMUM HEAD ON TOP OF LAYER  4              2.131

    LOCATION OF MAXIMUM HEAD IN LAYER  3
         (DISTANCE FROM DRAIN)                  18.6 FEET

    SNOW WATER                                   0.00            0.0000


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                   0.5771

    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.

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

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

             FINAL WATER STORAGE AT END OF YEAR 2006
  ------------------------------------------------------------------------
               LAYER        (INCHES)       (VOL/VOL)
               -----        --------       ---------
                 1          138.0099         0.2875

                 2            2.7999         0.1167

                 3            0.4010         0.0334

                 4            0.0000         0.0000

                 5           10.2480         0.4270

             SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 6

HELP MODEL OUTPUT
(FILENAME: SOIL4.OUT)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:       C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:   c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:     c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:   c:\temp\SOIL4.D10
OUTPUT DATA FILE:            c:\temp\SOIL4.OUT


TIME:  13:31     DATE:  12/24/2008


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

     TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, 4 def, Soil

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


     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  18
           THICKNESS                  =    480.00   INCHES
           POROSITY                   =      0.6710 VOL/VOL
           FIELD CAPACITY             =      0.2920 VOL/VOL
           WILTING POINT              =      0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
```

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

              TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER  61
   THICKNESS                 =      24.00    INCHES
   POROSITY                  =       0.4370 VOL/VOL
   FIELD CAPACITY            =       0.0620 VOL/VOL
   WILTING POINT             =       0.0240 VOL/VOL
   INITIAL SOIL WATER CONTENT =      0.0921 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.600000005000E-02 CM/SEC


                         LAYER  3
                         --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER  21
   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 =      0.0322 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.300000012000       CM/SEC
   SLOPE                     =       2.80    PERCENT
   DRAINAGE LENGTH           =     260.0     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
   INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY       =       1.00    HOLES/ACRE
   FML INSTALLATION DEFECTS  =       4.00    HOLES/ACRE
   FML PLACEMENT QUALITY     =  3 - GOOD


                         LAYER  5
                         --------

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

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

   NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

   SCS RUNOFF CURVE NUMBER               =       1.00
   FRACTION OF AREA ALLOWING RUNOFF      =       0.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE    =       1.000  ACRES
   EVAPORATIVE ZONE DEPTH                =      10.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE     =       1.178  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE    =       6.710  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE    =       0.770  INCHES
   INITIAL SNOW WATER                    =       0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS      =     151.261  INCHES
   TOTAL INITIAL WATER                   =     151.261  INCHES
   TOTAL SUBSURFACE INFLOW               =       0.00   INCHES/YEAR


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

   NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            HONOLULU             HAWAII

        STATION LATITUDE                         = 21.33 DEGREES
        MAXIMUM LEAF AREA INDEX                  =  0.00
        START OF GROWING SEASON (JULIAN DATE)    =     0
        END OF GROWING SEASON (JULIAN DATE)      =   367
        EVAPORATIVE ZONE DEPTH                   = 10.0  INCHES
        AVERAGE ANNUAL WIND SPEED                =  3.78 MPH
        AVERAGE 1ST QUARTER RELATIVE HUMIDITY    = 72.00 %
        AVERAGE 2ND QUARTER RELATIVE HUMIDITY    = 66.00 %
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY    = 66.00 %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY    = 70.00 %


   NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE          HAWAII
            WAS ENTERED FROM AN ASCII DATA FILE.


   NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE          HAWAII
            WAS ENTERED FROM AN ASCII DATA FILE.


   NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    HONOLULU             HAWAII
              AND STATION LATITUDE  =  21.33 DEGREES
```

```
*******************************************************************************

       AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
  TOTALS                    2.47     2.13     4.33     0.69     0.48     0.77
                            0.19     0.45     1.04     1.67     1.29     1.61

  STD. DEVIATIONS           3.62     2.09     8.41     0.76     0.37     0.41
                            0.16     0.47     0.81     1.90     0.57     2.92

 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                   1.426    1.162    1.775    1.153    0.538    0.301
                           0.265    0.676    0.611    1.028    1.296    0.839

  STD. DEVIATIONS          1.407    0.789    1.443    1.279    0.649    0.167
                           0.064    0.723    0.688    1.142    0.879    0.555

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
  TOTALS                  0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                          0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

  STD. DEVIATIONS         0.2483   1.3614   1.5042   1.3953   2.0146   1.5358
                          1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

 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


-------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
  AVERAGES                0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                          0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

  STD. DEVIATIONS         0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                          0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
******************************************************************************

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

      AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------
                                     INCHES            CU. FEET     PERCENT
                               -------------------  -------------  ---------
  PRECIPITATION                 17.12    ( 10.514)     62151.7      100.00

  RUNOFF                         0.000   ( 0.0000)         0.00       0.000

  EVAPOTRANSPIRATION            11.071   ( 4.0044)     40188.14      64.661

  LATERAL DRAINAGE COLLECTED     6.01744 ( 7.66911)    21843.318    35.14518
    FROM LAYER  3

  PERCOLATION/LEAKAGE THROUGH    0.00010 ( 0.00012)        0.368     0.00059
    LAYER  5

  AVERAGE HEAD ON TOP            0.091 (    0.115)
    OF LAYER  4

  CHANGE IN WATER STORAGE        0.033   ( 3.7415)       119.83       0.193

******************************************************************************
```

```
******************************************************************************

            PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
  ------------------------------------------------------------------------
                                                 (INCHES)      (CU. FT.)
                                                ----------   -------------
    PRECIPITATION                                  4.04         14665.200

    RUNOFF                                         0.000            0.0000

    DRAINAGE COLLECTED FROM LAYER  3               0.21015        762.84265

    PERCOLATION/LEAKAGE THROUGH LAYER  5           0.000003         0.01136

    AVERAGE HEAD ON TOP OF LAYER  4                1.148

    MAXIMUM HEAD ON TOP OF LAYER  4                2.131

    LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)                 18.6 FEET

    SNOW WATER                                     0.00             0.0000


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.5771

    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.

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

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

              FINAL WATER STORAGE AT END OF YEAR 2006
  ----------------------------------------------------------------------
               LAYER          (INCHES)         (VOL/VOL)
               -----          --------         ---------
                 1            138.0099          0.2875

                 2              2.7999          0.1167

                 3              0.4010          0.0334

                 4              0.0000          0.0000

                 5             10.2480          0.4270

             SNOW WATER         0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 7

HELP MODEL OUTPUT
(FILENAME: FLAT.OUT)

```
*******************************************************************************
*******************************************************************************
**                                                                           **
**                                                                           **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:       C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:   c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:     c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:   c:\temp\FLAT.D10
OUTPUT DATA FILE:            c:\temp\FLAT.OUT


TIME:  13:25     DATE:  12/24/2008


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

    TITLE:  Kekaha Phase II- Cell 1 Lateral Exp, Liner Eval, Flatstock

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


    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  18
           THICKNESS                  =   480.00   INCHES
           POROSITY                   =     0.6710 VOL/VOL
           FIELD CAPACITY             =     0.2920 VOL/VOL
           WILTING POINT              =     0.0770 VOL/VOL
           INITIAL SOIL WATER CONTENT =     0.2884 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
```

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

              TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  61
     THICKNESS                  =      24.00   INCHES
     POROSITY                   =       0.4370 VOL/VOL
     FIELD CAPACITY             =       0.0620 VOL/VOL
     WILTING POINT              =       0.0240 VOL/VOL
     INITIAL SOIL WATER CONTENT =       0.0921 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.600000005000E-02 CM/SEC


                        LAYER  3
                        --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER  21
     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 =       0.0322 VOL/VOL
     EFFECTIVE SAT. HYD. COND.  =  0.300000012000     CM/SEC
     SLOPE                      =       2.80   PERCENT
     DRAINAGE LENGTH            =     260.0    FEET


                        LAYER  4
                        --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
     THICKNESS                  =       0.50   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        =       0.00   HOLES/ACRE
     FML INSTALLATION DEFECTS   =       0.00   HOLES/ACRE
     FML PLACEMENT QUALITY      =  3 - GOOD
```

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

     NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

    SCS RUNOFF CURVE NUMBER              =      1.00
    FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
    AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
    EVAPORATIVE ZONE DEPTH               =     10.0    INCHES
    INITIAL WATER IN EVAPORATIVE ZONE    =      1.178  INCHES
    UPPER LIMIT OF EVAPORATIVE STORAGE   =      6.710  INCHES
    LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.770  INCHES
    INITIAL SNOW WATER                   =      0.000  INCHES
    INITIAL WATER IN LAYER MATERIALS     =    141.013  INCHES
    TOTAL INITIAL WATER                  =    141.013  INCHES
    TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


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

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              HONOLULU              HAWAII

         STATION LATITUDE                         =  21.33 DEGREES
         MAXIMUM LEAF AREA INDEX                  =   0.00
         START OF GROWING SEASON (JULIAN DATE)    =     0
         END OF GROWING SEASON (JULIAN DATE)      =   367
         EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
         AVERAGE ANNUAL WIND SPEED                =   3.78 MPH
         AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
         AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  66.00 %
         AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  66.00 %
         AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %


     NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE         HAWAII
              WAS ENTERED FROM AN ASCII DATA FILE.


     NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE         HAWAII
              WAS ENTERED FROM AN ASCII DATA FILE.


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR    HONOLULU            HAWAII
                AND STATION LATITUDE  =  21.33 DEGREES
```

```
******************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                  2.47     2.13     4.33     0.69     0.48     0.77
                           0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS         3.62     2.09     8.41     0.76     0.37     0.41
                           0.16     0.47     0.81     1.90     0.57     2.92

 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                 1.426    1.162    1.775    1.153    0.538    0.301
                          0.265    0.676    0.611    1.028    1.296    0.839

   STD. DEVIATIONS        1.407    0.789    1.443    1.279    0.649    0.167
                          0.064    0.723    0.688    1.142    0.879    0.555

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
   TOTALS                0.1280   0.5799   0.7611   1.3193   1.0819   0.7555
                         0.6110   0.1541   0.0783   0.0554   0.3721   0.1209

   STD. DEVIATIONS       0.2483   1.3614   1.5042   1.3953   2.0147   1.5358
                         1.2869   0.2247   0.0755   0.0396   0.8380   0.2005

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 ------------------------------------
   TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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


------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  4
 -------------------------------------
   AVERAGES              0.0226   0.1131   0.1342   0.2403   0.1907   0.1376
                         0.1077   0.0272   0.0143   0.0098   0.0678   0.0213

   STD. DEVIATIONS       0.0438   0.2657   0.2651   0.2541   0.3551   0.2797
                         0.2268   0.0396   0.0138   0.0070   0.1526   0.0353
```

```
******************************************************************************

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

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------------
                                    INCHES             CU. FEET      PERCENT
                               -------------------  --------------  ---------
  PRECIPITATION                17.12    (  10.514)     62151.7      100.00

  RUNOFF                        0.000   (  0.0000)         0.00       0.000

  EVAPOTRANSPIRATION           11.071   (  4.0044)     40188.14      64.661

  LATERAL DRAINAGE COLLECTED    6.01754 (  7.66923)    21843.684   35.14577
    FROM LAYER  3

  PERCOLATION/LEAKAGE THROUGH   0.00000 (  0.00000)        0.009    0.00002
    LAYER  4

  AVERAGE HEAD ON TOP           0.091 (    0.115)
    OF LAYER  4

  CHANGE IN WATER STORAGE       0.033   (  3.7415)       119.83       0.193

******************************************************************************
```

```
******************************************************************************

                PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
      ------------------------------------------------------------------------
                                                  (INCHES)      (CU. FT.)
                                                 ----------   -------------
      PRECIPITATION                                4.04         14665.200

      RUNOFF                                       0.000            0.0000

      DRAINAGE COLLECTED FROM LAYER  3             0.21015        762.85309

      PERCOLATION/LEAKAGE THROUGH LAYER  4         0.000000         0.00006

      AVERAGE HEAD ON TOP OF LAYER  4              1.148

      MAXIMUM HEAD ON TOP OF LAYER  4              2.131

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)                 18.6 FEET

      SNOW WATER                                   0.00             0.0000


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.5771

      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.

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

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

                  FINAL WATER STORAGE AT END OF YEAR 2006
      ----------------------------------------------------------------------
                LAYER          (INCHES)          (VOL/VOL)
                -----          --------          ---------
                  1            138.0099            0.2875

                  2              2.7999            0.1167

                  3              0.4010            0.0334

                  4              0.0000            0.0000

              SNOW WATER         0.000

******************************************************************************
******************************************************************************
```

Appendix C

MULTIMED Tables

Table 1
MULTIMED Input Parameters
Kekaha Sanitary Landfill
Kekaha, Kauai, Hawaii

Parameter	Data Source	Baseline Value
Vadose Zone Flow		
Percolation rate from facility	From HELP model	2.54x10-7 m/yr (1.0x10-5 in/yr)
Layer 1		
Material Associated with layer	From Pre-Final Letter Report, Geotechnical Exploration, Pacific Geotechnical Engineers, March 2007	SP
Saturated Hydraulic Conductivity	From Pre-Final Letter Report, Geotechnical Exploration, Pacific Geotechnical Engineers, March 2007	6.14 cm/hr (1.71x10^{-3} cm/s)
Unsaturated zone porosity	Based on literature	0.25
Air entry pressure head	MULTIMED default	0
Thickness of layer	Based on site soil borings	3.048 m (10 ft)
Residual water content	From Pre-Final Letter Report, Geotechnical Exploration, Pacific Geotechnical Engineers, March 2007	0.0778
Van Genuchten Alfa coefficient	Based on literature for sand	0.145
Van Genuchten Beta coefficient	Based on literature for sand	2.68
Vadose Zone Transport Layer 1		
Thickness of layer	Based on site soil borings	3.048 m (10.0 ft)
Longitudinal dispersivity	MULTIMED Derived	DERIVED
Percent organic matter	Based on USDA soil data for site	1.00
Bulk density of soil for layer	Based on site soil boring geotechnical data	1.53 g/cc
Biological decay coefficient	MULTIMED Default	0
Aquifer Specific		
Porosity		0.25
Particle Diameter	MULTIMED Derived	DERIVED
Bulk Density	Based on site soil boring geotechnical data	1.57 g/cc
Aquifer thickness	Based on site soil borings	9.144 m (30 ft)
Hydraulic conductivity	Based on site soil borings	52,813 m/yr (1.71x10-3 cm/s)
Hydraulic gradient	Groundwater Monitoring Plan, Kekaha Landfill Phase II, Earth Tech, December 2007	0.0005 m/m (0.0005 ft/ft)
Longitudinal dispersivity	Based on calculation using Point of Compliance width = 100 ft	3.05 m (10 ft)
Transverse dispersivity	Based on calculation	1.02 m (3.3 ft)
Vertical dispersivity	Based on calculation	0.171 m (0.6 ft)
Temperature of the aquifer	Based on groundwater data	30.8 C
pH	Based on groundwater data	7.22
Organic carbon content	Based on USDA soil data	0
Well distance from the site	Based on Point of Compliance Width = 100 ft	30.5 m (100 ft)
Source Specific		
Infiltration (leakage) rate	From HELP model	2.54x10^{-7} m/yr
Area of waste disposal unit	From design drawings	18,654 m2
Recharge rate	USGS WRIR-95-4128	0.254 m/yr (10 in/yr)
Initial concentration at landfill	Normalized concentration	1.0 ug/L
Chemical Specific		
Acid catalyzed hydrolysis rate	MULTIMED default	0.00 1/M-yr
Neutral hydrolysis rate constant	MULTIMED default	0.00 1/yr
Base catalyzed hydrolysis rate	MULTIMED default	0.00 1/M-yr
Normalized distribution coefficient	MULTIMED default	10 ml/g
Air diffusion coefficient	MULTIMED default	0.00 cm2/s
Reference temperature for air diffusion	MULTIMED default	0.00 C
Molecular weight	MULTIMED default	0.00 g/M
Mole fraction of solute	MULTIMED default	0
Vapor pressure of solute	MULTIMED default	0.00 mm Hg
Henry's law constant	MULTIMED default	0.00 atm-m3/M

Notes:

Point of Compliance Width from Hawaii Administrative Rules, Title 11, DOH Chapter 58.1 is 150 m from waste management unit boundary

Table 2
MULTIMED Predicted Concentration Based Upon Summary of Leachate Analytical Results Dated June 10, 2008
Kekaha Sanitary Landfill
Kekaha, Kauai, Hawaii

Leachate Parameters	Analyte	Method	Unit	Wet Well-1	Wet Well-2	Average	Predicted Concentration	MCL
VOCs	1,1-Dichloroethane	SW846 8260B	µg/L	0.19 J	< 2.5	1.345	4.25E-07	–
	1,2-Dichloroethane	SW846 8260B	µg/L	0.36 J	0.25 J	0.305	9.63E-08	5
	1,4-Dichlorobenzene	SW846 8260B	µg/L	7.3	9.2	8.25	2.60E-06	–
	2-Butanone (MEK)	SW846 8260B	µg/L	< 9.7	3.3 J	6.5	2.05E-06	–
	4-Methyl-2-pentanone	SW846 8260B	µg/L	3.2	3.3	3.25	1.03E-06	–
	Acetone	SW846 8260B	µg/L	7.3 J B	8.5 J B	7.9	2.49E-06	–
	Benzene	SW846 8260B	µg/L	1.6 J	2.5 J	2.05	6.47E-07	5
	Chlorobenzene	SW846 8260B	µg/L	0.18 J	0.58 J	0.38	1.20E-07	–
	cis-1,2-Dichloroethene	SW846 8260B	µg/L	2.1 J	2.2 J	2.15	6.79E-07	7
	Ethylbenzene	SW846 8260B	µg/L	7.4	20	13.7	4.33E-06	700
	Methylene chloride	SW846 8260B	µg/L	0.46 J B	0.41 J B	0.435	1.37E-07	5
	Styrene	SW846 8260B	µg/L	0.45 J	1.2 J	0.825	2.60E-07	100
	Toluene	SW846 8260B	µg/L	4.1	8.4	6.25	1.97E-06	1000
	Trichloroethene	SW846 8260B	µg/L	0.25 J	0.33 J	0.29	9.16E-08	5
	Xylenes (total)	SW846 8260B	µg/L	20	44	32	1.01E-05	10000
Total Metals	Arsenic	SW846 6010B	µg/L	95	320	207.5	6.55E-05	10
	Barium	SW846 6020	µg/L	110	71	90.5	2.86E-05	2000
	Cadmium	SW846 6020	µg/L	0.067 B	0.096 B	0.0815	2.57E-08	5
	Chromium	SW846 6020	µg/L	9.5	9.9	9.7	3.06E-06	100
	Cobalt	SW846 6020	µg/L	7.6	7.2	7.4	2.34E-06	–
	Copper	SW846 6020	µg/L	1.3 B	1.2 B	1.25	3.95E-07	–
	Iron	SW846 6010B	µg/L	3,300	7,600	5,450	1.72E-03	–
	Nickel	SW846 6020	µg/L	18	32	25	7.89E-06	–
	Silicon	SW846 6010B	µg/L	29,000	28,000	28,500	9.00E-03	–
	Thallium	SW846 6020	µg/L	< 2	0.039 B	1.0195	3.22E-07	2
	Vanadium	SW846 6020	µg/L	6.3	5.7	6	1.89E-06	–
	Zinc	SW846 6020	µg/L	6.8	38	22.4	7.07E-06	–
Major Cations and Anions	Sulfate	MCAWW 300.0A	mg/L	40 G	1.4 B G	20.7	6.53E-06	–
	Bicarbonate Alkalinity	SM18 2320 B	mg/L	1,500	1,700	1,600	5.05E-04	–
	Calcium	SW846 6010B	µg/L	93,000	61,000	77,000	2.43E-02	–
	Magnesium	SW846 6010B	µg/L	210,000	240,000	225,000	7.10E-02	–
	Manganese	SW846 6020	µg/L	190	83	136.5	4.31E-05	–
	Potassium	SW846 6010B	µg/L	110,000	140,000	125,000	3.95E-02	–
	Sodium	SW846 6010B	µg/L	410,000	400,000	405,000	1.28E-01	–
Leachate Indicators	TDS	SM18 2540 C	mg/L	2,400 Q	2,400 Q	2400	7.58E-04	–
	Chloride	MCAWW 300.0A	mg/L	640 Q	790 J Q	715	2.26E-04	–
	Total Alkalinity	SM18 2320 B	mg/L	1,500	1,700	1,600	5.05E-04	–
	Chemical Oxygen Demand	MCAWW 410.4	mg/L	350 Q	310 Q	330	1.04E-04	–
	TOC	SM18 5310B	mg/L	100 Q	89 Q	94.5	2.98E-05	–
Other Constituents	Ammonia as N	MCAWW 350.1	mg/L	150 Q	210 Q	180	5.68E-05	–
	Bromide	MCAWW 300.0A	mg/L	8 G	7.7 G	7.85	2.48E-06	–
	Cyanide, Total	SW846 9012A	mg/L	0.003 B	< 0.02	0.0115	3.63E-09	0.2
	Total Kjeldahl Nitrogen	MCAWW 351.2	mg/L	190 Q	300 Q	245	7.73E-05	–

<	not detected above the listed reporting limit
MEK	methyl ethyl ketone
B	(Inorganic method) Estimated result. Result is below the reporting limit.
B	(Organic method) Method blank contamination. The method blank result is below the reporting limit but above the method detection limit.
G	Elevated reporting limit due to matrix interference
J	(Inorganic method) Method blank contamination. The method blank result is below the reporting limit but above the method detection limit.
J	(Organic method) Estimated result. Result is below the reporting limit .
Q	Elevated reporting limit due to high analyte level

Appendix B-8
Geomembrane Compatibility

Technical Note

GSE Polyethylene Geomembranes

Polyethylene has proved to be the most popular geomembrane lining material. This popularity is due to polyethylene's high UV and chemical resistance in addition to its flexibility. Through developments in resin technology, today's polyethylene geomembranes exhibit outstanding resistance to stress cracking and thermal aging.

Crude oil is the primary source for a wide range of intermediate organic products including gases and liquid mixtures. One of the products obtained from the refinement of crude oil is ethylene. The ethylene molecule is two carbon atoms bonded with a double bond and two hydrogen atoms attached to each carbon.

Ethylene molecules are able to participate in a chemical reaction called "polymerization". Polymerization is the process by which small molecules are combined to form large molecules called polymers. The polymerization of ethylene molecules occurs in a stepwise fashion. First, two ethylene molecules are bonded together, then another is added and so on until the reaction terminates. In this way, long molecules that fold, bend and intermingle are formed.

The reaction occurs in large reactors that can be pressurized and heated. A catalyst is typically required and a comonomer is often employed. Selection of pressure, temperature, catalyst and comonomer determine the particular grade of polyethylene that is produced. Pressure and elevated temperatures force the gaseous ethylene molecules together in close proximity. A comonomer can be used to further control the molecular structure of the finished product. A comonomer is commonly added in small amounts during polymerization to control or alter the molecular structure, in particular the branching, and performance of the polymer. With the great number of variations and combinations, there can be a great number of unique types of polyethylene materials.

The finished product is characterized primarily by: molecular weight, molecular weight distribution and degree of branching. Molecular weight is a quantitative measure of a single molecule's mass. Polymerization reactions do not result in molecules that all demonstrate the same molecular weight. As a result, the finished product contains a range of molecular weights; that is quantified by the molecular weight distribution. Since the molecules exist as discrete chains, the way those chains are ordered is important. The degree of crystallinity is closely related to density and has an effect on the material's stress crack resistance. Variations of these polymer characteristics may have a significant effect on both the processing characteristics and the life expectancy of the finished product.

There are two primary types of extrusion processes used to manufacture polyethylene into sheet goods, those with a round die and those with a flat die. Each method requires the polyethylene resin used to exhibit some range of properties. The world's polyethylene geomembrane manufacturers are charged with the responsibility of bridging the gap between resin processing characteristics and long term survivability as a containment liner.

Considerations for environmental projects include resistance to chemical, UV and thermal degradation. Polyethylene's stress crack resistance is not always a concern to resin suppliers since they supply so many different markets. This is in strong contrast to the environmental market where long term performance is of the utmost importance. As a result, polyethylene geomembrane manufacturers must work closely with their resin supplier(s) to achieve the longest lifespan of the material. Since the finished product is only as good as the raw material, special relationships between the resin supplier and the geomembrane manufacturer must be established and maintained.

North America	GSE Lining Technology, Inc.	Houston, Texas	800 435 2008	281 443 8564	Fax: 281 230 8650
South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56 2 595 4200	Fax: 56 2 595 4290
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GSE®

Technical Note

Chemical Resistance Chart

GSE is the world's leading supplier of high quality, polyethylene geomembranes. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. Note that the effect of chemicals on any material is influenced by a number of variable factors such as temperature, concentration, exposed area and duration. Many tests have been performed that use geomembranes and certain specific chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for, and various criteria may be used to judge performance. Reported performance ratings may not apply to all applications of a given material in the same chemical. Therefore, these ratings are offered as a guide only. This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information.

Medium	Concentration	Resistance at: 20 °C (68 °F)	60 °C (140 °F)
A			
Acetic acid	100%	S	L
Acetic acid	10%	S	S
Acetic acid anhydride	100%	S	L
Acetone	100%	L	L
Adipic acid	sat. sol.	S	S
Allyl alcohol	96%	S	S
Aluminum chloride	sat. sol.	S	S
Aluminum fluoride	sat. sol.	S	S
Aluminum sulfate	sat. sol.	S	S
Alum	sol.	S	S
Ammonia, aqueous	dil. sol.	S	S
Ammonia, gaseous dry	100%	S	S
Ammonia, liquid	100%	S	S
Ammonium chloride	sat. sol.	S	S
Ammonium fluoride	sol.	S	S
Ammonium nitrate	sat. sol.	S	S
Ammonium sulfate	sat. sol.	S	S
Ammonium sulfide	sol.	S	S
Amyl acetate	100%	S	L
Amyl alcohol	100%	S	L
Aniline	100%	S	L
Antimony trichloride	90%	S	S
Arsenic acid	sat. sol.	S	S
Aqua regia	HCI-HNO3	U	U
B			
Barium carbonate	sat. sol.	S	S
Barium chloride	sat. sol.	S	S
Barium hydroxide	sat. sol.	S	S
Barium sulfate	sat. sol.	S	S
Barium sulfide	sol.	S	S
Benzaldehyde	100%	S	L
Benzene	—	L	L
Benzoic acid	sat. sol.	S	S
Beer	—	S	S
Borax (sodium tetraborate)	sat. sol.	S	S
Boric acid	sat. sol.	S	S
Bromine, gaseous dry	100%	U	U
Bromine, liquid	100%	U	U
Butane, gaseous	100%	S	S
1-Butanol	100%	S	S
Butyric acid	100%	S	L
C			
Calcium carbonate	sat. sol.	S	S
Calcium chlorate	sat. sol.	S	S
Calcium chloride	sat. sol.	S	S
Calcium nitrate	sat. sol	S	S
Calcium sulfate	sat. sol.	S	S
Calcium sulfide	dil. sol.	L	L
Carbon dioxide, gaseous dry	100%	S	S
Carbon disulfide	100%	L	U
Carbon monoxide	100%	S	S
Chloracetic acid	sol.	S	S
Carbon tetrachloride	100%	L	U
Chlorine, aqueous solution	sat. sol.	L	U
Chlorine, gaseous dry	100%	L	U
Chloroform	100%	U	U
Chromic acid	20%	S	L
Chromic acid	50%	S	L
Citric acid	sat. sol.	S	S
Copper chloride	sat. sol.	S	S
Copper nitrate	sat. sol.	S	S
Copper sulfate	sat. sol.	S	S
Cresylic acid	sat. sol.	L	—
Cyclohexanol	100%	S	S
Cyclohexanone	100%	S	L
D			
Decahydronaphthalene	100%	S	L
Dextrine	sol.	S	S
Diethyl ether	100%	L	—
Dioctylphthalate	100%	S	L
Dioxane	100%	S	S
E			
Ethanediol	100%	S	S
Ethanol	40%	S	L
Ethyl acetate	100%	S	U
Ethylene trichloride	100%	U	U
F			
Ferric chloride	sat. sol.	S	S
Ferric nitrate	sol.	S	S
Ferric sulfate	sat. sol.	S	S
Ferrous chloride	sat. sol.	S	S
Ferrous sulfate	sat. sol.	S	S
Fluorine, gaseous	100%	U	U
Fluorosilicic acid	40%	S	S
Formaldehyde	40%	S	S
Formic acid	50%	S	S
Formic acid	98-100%	S	S
Furfuryl alcohol	100%	S	L
G			
Gasoline	—	S	L
Glacial acetic acid	96%	S	L
Glucose	sat. sol.	S	S
Glycerine	100%	S	S
Glycol	sol.	S	S
H			
Heptane	100%	S	U
Hydrobromic acid	50%	S	S
Hydrobromic acid	100%	S	S
Hydrochloric acid	10%	S	S
Hydrochloric acid	35%	S	S
Hydrocyanic acid	10%	S	S
Hydrofluoric acid	4%	S	S
Hydrofluoric acid	60%	S	L
Hydrogen	100%	S	S
Hydrogen peroxide	30%	S	L
Hydrogen peroxide	90%	S	U
Hydrogen sulfide, gaseous	100%	S	S
L			
Lactic acid	100%	S	S
Lead acetate	sat. sol.	S	—
M			
Magnesium carbonate	sat. sol.	S	S
Magnesium chloride	sat. sol.	S	S
Magnesium hydroxide	sat. sol.	S	S
Magnesium nitrate	sat. sol.	S	S
Maleic acid	sat. sol.	S	S
Mercuric chloride	sat. sol.	S	S

- Continued -

Medium	Concentration	Resistance at: 20 °C (68 °F)	Resistance at: 60 °C (140 °F)
Mercuric cyanide	sat. sol.	S	S
Mercuric nitrate	sol.	S	S
Mercury	100%	S	S
Methanol	100%	S	S
Methylene chloride	100%	L	—
Milk	—	S	S
Molasses	—	S	S
N			
Nickel chloride	sat. sol.	S	S
Nickel nitrate	sat. sol.	S	S
Nickel sulfate	sat. sol.	S	S
Nicotinic acid	dil. sol.	S	—
Nitric acid	25%	S	S
Nitric acid	50%	S	U
Nitric acid	75%	U	U
Nitric acid	100%	U	U
O			
Oils and Grease	—	S	L
Oleic acid	100%	S	L
Orthophosphoric acid	50%	S	S
Orthophosphoric acid	95%	S	L
Oxalic acid	sat. sol.	S	S
Oxygen	100%	S	L
Ozone	100%	L	U
P			
Petroleum (kerosene)	—	S	L
Phenol	sol.	S	S
Phosphorus trichloride	100%	S	L
Photographic developer	cust. conc.	S	S
Picric acid	sat. sol.	S	—
Potassium bicarbonate	sat. sol.	S	S
Potassium bisulfide	sol.	S	S
Potassium bromate	sat. sol.	S	S
Potassium bromide	sat. sol.	S	S
Potassium carbonate	sat. sol.	S	S
Potassium chlorate	sat. sol.	S	S
Potassium chloride	sat. sol.	S	S
Potassium chromate	sat. sol.	S	S
Potassium cyanide	sol.	S	S
Potassium dichromate	sat. sol.	S	S
Potassium ferricyanide	sat. sol.	S	S
Potassium ferrocyanide	sat. sol.	S	S
Potassium fluoride	sat. sol.	S	S
Potassium hydroxide	10%	S	S
Potassium hydroxide	sol.	S	S
Potassium hypochlorite	sol.	S	L
Potassium nitrate	sat. sol.	S	S
Potassium orthophosphate	sat. sol.	S	S
Potassium perchlorate	sat. sol.	S	S
Potassium permanganate	20%	S	S
Potassium persulfate	sat. sol.	S	S
Potassium sulfate	sat. sol.	S	S
Potassium sulfite	sol.	S	S
Propionic acid	50%	S	S
Propionic acid	100%	S	L
Pyridine	100%	S	L
Q			
Quinol (Hydroquinone)	sat. sol.	S	S
S			
Salicylic acid	sat. sol.	S	S

Medium	Concentration	Resistance at: 20 °C (68 °F)	Resistance at: 60 °C (140 °F)
Silver acetate	sat. sol.	S	S
Silver cyanide	sat. sol.	S	S
Silver nitrate	sat. sol.	S	S
Sodium benzoate	sat. sol.	S	S
Sodium bicarbonate	sat. sol.	S	S
Sodium biphosphate	sat. sol.	S	S
Sodium bisulfite	sol.	S	S
Sodium bromide	sat. sol.	S	S
Sodium carbonate	sat. sol.	S	S
Sodium chlorate	sat. sol.	S	S
Sodium chloride	sat. sol.	S	S
Sodium cyanide	sat. sol.	S	S
Sodium ferricyanide	sat. sol.	S	S
Sodium ferrocyanide	sat. sol.	S	S
Sodium fluoride	sat. sol.	S	S
Sodium hydroxide	40%	S	S
Sodium hydroxide	sat. sol.	S	S
Sodium hypochlorite	15% active chlorine	S	S
Sodium nitrate	sat. sol.	S	S
Sodium nitrite	sat. sol.	S	S
Sodium orthophosphate	sat. sol.	S	S
Sodium sulfate	sat. sol.	S	S
Sodium sulfide	sat. sol.	S	S
Sulfur dioxide, dry	100%	S	S
Sulfur trioxide	100%	U	U
Sulfuric acid	10%	S	S
Sulfuric acid	50%	S	S
Sulfuric acid	98%	S	U
Sulfuric acid	fuming	U	U
Sulfurous acid	30%	S	S
T			
Tannic acid	sol.	S	S
Tartaric acid	sol.	S	S
Thionyl chloride	100%	L	U
Toluene	100%	L	U
Triethylamine	sol.	S	L
U			
Urea	sol.	S	S
Urine	—	S	S
W			
Water	—	S	S
Wine vinegar	—	S	S
Wines and liquors	—	S	S
X			
Xylenes	100%	L	U
Y			
Yeast	sol.	S	S
Z			
Zinc carbonate	sat. sol.	S	S
Zinc chloride	sat. sol.	S	S
Zinc (II) chloride	sat. sol.	S	S
Zinc (IV) chloride	sat. sol.	S	S
Zinc oxide	sat. sol.	S	S
Zinc sulfate	sat. sol.	S	S

Specific immersion testing should be undertaken to ascertain the suitability of chemicals not listed above with reference to special requirements.

NOTES:

(S) Satisfactory: *Liner material is resistant to the given reagent at the given concentration and temperature. No mechanical or chemical degradation is observed.*

(L) Limited Application Possible: *Liner material may reflect some attack. Factors such as concentration, pressure and temperature directly affect liner performance against the given media. Application, however, is possible under less severe conditions, e.g. lower concentration, secondary containment, additional liner protections, etc.*

(U) Unsatisfactory: ***Liner material is not resistant to the given reagent at the given concentration and temperature. Mechanical and/or chemical degradation is observed.***

(–) Not tested

sat. sol. = *Saturated aqueous solution, prepared at 20°C (68°F)*
sol. = *aqueous solution with concentration above 10% but below saturation level*
dil. sol. = *diluted aqueous solution with concentration below 10%*
cust. conc. = *customary service concentration*

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Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66 2 937 0091	Fax: 66 2 937 0097
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Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		202 2 828 8888	Fax: 202 2 828 8889

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ACOUSTICAL

Sound Velocity in Polyethylene - The sound velocity in Marlex HDPE is 2.21×10^3 m/sec.$^+$

$^+$Data from Naval Weapons Laboratory in Dahlgren, Virginia

CHEMICAL

Fungus Resistance

The fungus resistance of Marlex HDPE was determined using a test method described in Military Specification, MIL-E-5262A. In this procedure, tensile bars were sprayed with a suspension containing a specified mixture of five groups of fungi drawn from 16-day old cultures. The exposed tensile specimens were suspended over water in a vessel that was then sealed. To produce 95 ± 5% relative humidity in the chamber, the entire assembly was heated up to 86 ± 2°F (30° ± 1°C) and so maintained for a period of 28 days. After conditioning, the exposed samples were washed in alcohol, wiped dry and tested for tensile strength according to standard ASTM procedures. As a control, unexposed samples were conditioned and tested in the same manner.

Marlex HDPE showed no evidence of deterioration or corrosion due to fungus exposure.

TABLE 1

Fungus Resistance of Marlex High Density Polyethylene

	Control	Tensile Bars Sprayed with Fungus* Suspension
Tensile, psi (MPa)	4530 (31.2)	4530 (31.2)
Elongation, %	21	21

*Group I	Chaetonium globosum
Group II	Rhizopus nigricans
Group III	Aspergillus flavus
Group IV	Penicillium funiculosum
Group V	Fusarium moniliforme

Chemical Resistance

Marlex polyethylenes are very resistant to chemical attack. However, they are sometimes affected by aggressive chemical environments. A few strong oxidizing agents and mineral acids can react with the resins. Other low molecular weight chemicals and oils absorb into and permeate through the resins. The absorption of liquid can affect appearance and dimensional accuracy of formed parts. When dispersed throughout the HDPE, a few liquids can act as an internal lubricant and reduce its toughness and mechanical strength. To determine the effects of most typical commercial and industrial chemicals, Marlex HDPE has been tested before and after immersion in a number of liquid chemicals selected to represent most of the types in common use. Both chemical reactivity and absorption depend heavily on temperature so the entire test procedure was conducted at room and elevated temperatures to quantify that dependency.

Effect of Chemicals on Tensile and Elongation - Tensile specimens as specified by ASTM D638 were immersed in various test liquids contained in glass jars. The jars were then sealed and brought to test temperatures in forced draft ovens held at 80°, 120° and 150°F (27, 49 and 66°C). After exposure for three months, the specimens were removed and tested on an Instron tensile testing machine. Unexposed samples were tested for control. A rapid strain rate of 20 inches (508 mm) per minute was employed to emphasize any decay of strength.

Most significant changes in mechanical strength were accompanied by some visible change in appearance. Oxidizing acids may not only cause a slight increase in weight but also cause color changes to occur. For example, concentrated sulfuric acid at 150°F (66°C) oxidized the samples so much that they turned black. Concentrated nitric acid caused yellowing.

To determine the extent of absorption, the change in weight was determined. A coupon measuring 1 inch x 2 inch (25.4 x 50.8 mm) was weighed and then immersed for three months at a temperature of 80°, 120° or 150°F (27, 49 or 66°C) in the test material. After exposure, the coupon was removed, wiped dry and weighed. Most of the organic chemicals that were used caused an increase in weight of the specimens due to a permeability of the chemical into the HDPE sample.

An examination of this data reflects the excellent chemical resistance of Marlex HDPE. Exposure periods longer than 3 months result in very little additional change in properties.

TABLE 2

Ultimate Tensile Strength, Elongation and Absorption of Marlex® HDPE after Three Months

	Temp.		Tensile Strength			Elongation		% Weight
Chemical	°F	°C	psi.	MPa	% Change	% Elong.	% Change	Change
Battery Acid (36%)	80	27	4480	30.9	-2.6	22	-4.3	-0.01
	120	49	4360	30.0	-5.2	27	+17.4	-0.01
	150	66	4670	32.2	+1.5	31	+34.8	-0.03
Nitric Acid (70%)	80	27	4670	32.2	+1.5	20	-13.0	+1.09
Hydrofluoric Acid (52 – 55%)	80	27	4460	30.7	-3.1	26	+13.0	+0.01
	120	49	4500	31.0	-2.1	28	+21.7	–
Phosphoric Acid (85%)	80	27	4580	31.6	-0.4	23	+0.0	+0.00
	120	49	4490	31.0	-2.3	30	+30.4	+0.00
	150	66	4680	32.2	-1.7	29	+26.1	-0.06
Chromic Acid (25%)	80	27	4610	31.8	+0.2	23	+0.0	-0.55
	120	49	4500	31.0	-2.2	28	+21.7	-0.07
	150	66	4300	29.6	-5.9	31	+34.8	-0.51
Hydrochloric Acid (37%)	80	27	4620	31.8	-0.4	22	-4.3	+0.04
	120	49	4370	30.1	-5.1	20	-13.0	+0.07
	150	66	4590	31.6	-0.2	30	+30.4	-0.03
Glacial Acetic Acid	80	27	4580	31.6	-0.4	26	+13.0	+0.81
	120	49	4440	30.6	-3.4	32	+39.1	+0.73
	150	66	4550	31.4	-1.0	33	+43.5	+0.39
NaOH (50%)	80	27	4590	31.6	-0.3	24	+4.3	+0.07
	120	49	4320	29.8	-0.6	24	+4.3	+0.09
	150	66	4650	32.0	-1.0	33	+43.5	-0.02
Nitrobenzene	80	27	4420	30.5	-3.9	30	+30.4	+2.25
	120	49	4070	28.0	-11.6	41	+78.3	+2.94
	150	66	4410	30.4	-4.1	40	+73.9	+3.47
Phenol	80	27	4590	31.6	-0.2	24	+4.3	+2.70
	120	49	4540	31.3	-1.3	28	+21.7	+0.41
	150	66	4730	32.6	+2.8	29	+26.1	+0.54
10 Wt. Motor Oil	80	27	4440	30.6	-3.5	28	+21.7	+1.87
	120	49	3770	26.0	-8.0	49	+113.0	+6.31
	150	66	4130	28.5	-10.1	53	+130.4	+6.86
Hydrogen Peroxide (30%)	80	27	4440	30.6	-3.4	25	+8.7	+0.01
	120	49	4410	30.4	-4.1	26	+13.0	-0.05
	150	66	4710	32.5	+0.5	32	+39.1	-0.03
Clorox	80	27	4550	31.4	-1.0	25	+1.1	+0.01
	120	49	4520	31.1	-1.8	25	+8.7	-0.06
	150	66	4580	31.5	-0.5	37	+60.9	-0.24
Methyl Salicylate	80	27	4260	29.4	-7.3	32	+39.1	+3.76
	120	49	4050	27.9	-12.0	42	+82.6	+4.92
	150	66	4110	28.3	-10.7	47	+104.3	+6.63
Ethylene Glycol	80	27	4520	31.1	-1.8	21	-4.3	+0.01
	120	49	4450	30.6	-3.3	27	+17.4	-0.06
	150	66	4710	32.5	-2.4	30	+30.4	-0.01
Tetralin	80	27	4020	27.7	-12.7	42	+82.6	+7.08
	120	49	3590	24.7	-22.0	53	+130.4	+7.08
	150	66	3620	24.9	-6.9	48	+108.7	+16.06
Benzaldehyde	80	27	4280	29.5	-7.0	27	+17.6	+2.08
	120	49	4130	28.5	-10.2	37	+61.0	+2.76
	150	66	4280	29.5	-6.9	37	+65.2	+16.06

TABLE 2 - continued

Ultimate Tensile Strength, Elongation and Absorption of Marlex® HDPE after Three Months

	Temp.		Tensile Strength			Elongation		% Weight
Chemical	°F	°C	psi	MPa	% Change	% Elong.	% Change	Change
Acetophenone	80	27	4200	28.9	-8.7	33	+43.5	+2.13
	120	49	4110	28.3	-10.7	37	+61.0	+2.79
	150	66	4250	29.3	-7.5	37	+60.9	+3.90
Chlorobenzene	80	27	4280	29.5	-6.9	31	+34.8	+5.33
	120	49	3980	27.4	-13.5	43	+87.0	+4.91
	150	66	4150	28.6	-9.7	40	+73.9	+9.25
Butyl Carbitol	80	27	4390	30.2	-4.6	27	+17.6	+0.53
	120	49	4420	30.5	-3.8	29	+26.1	+1.38
	150	66	4150	28.6	-9.7	40	+73.9	+1.66
Toluene	80	27	4060	28.0	-11.8	36	+56.5	+4.40
	120	49	3950	27.2	-11.9	43	+87.0	+3.86
	150	66	4110	28.3	-2.0	43	+87.0	+5.58
Mineral Oil	80	27	4510	31.1	-2.0	29	+26.0	+0.82
	120	49	4200	29.0	-8.8	45	+95.7	+5.70
	150	66	4040	27.9	12.1	55	+139.1	+5.86
Aniline	80	27	4520	31.1	-1.7	24	+4.3	+0.76
	120	49	4300	29.6	-6.5	30	+30.4	+1.15
	150	66	4530	32.0	-1.6	37	+60.9	+1.45
Xylene	80	27	3980	27.4	-13.3	49	+113.0	+5.29
	120	49	3900	26.9	-15.2	44	+91.3	+5.02
	150	66	4040	27.9	-12.1	44	+91.3	+7.07
Diethylene Triamine	80	27	4440	30.6	-3.5	22	-4.3	+0.17
	120	49	4410	30.4	-4.1	32	+39.1	+0.39
	150	66	4610	31.8	-2.1	31	+34.6	+0.23
5% Soap Solution	80	27	4460	30.8	-3.0	30	+30.4	+0.06
	120	49	4620	31.9	+0.5	23	+0.0	+0.10
	150	66	4740	32.7	+3.0	30	+30.4	+0.04
Water	80	27	4530	31.2	-1.5	25	+8.7	+0.02
	120	49	4570	31.5	-0.7	28	+21.7	+0.02
	150	66	4620	31.8	+0.4	32	+39.1	+0.02
Air	80	27	4590	31.6	-0.3	23	+0.0	-0.03
	120	49	4430	30.5	-3.8	25	+8.7	+0.02
	150	66	4710	32.4	-2.3	27	+17.4	-0.02
Ethyl Alcohol	80	27	4580	31.6	-0.4	27	+17.4	+0.26
Amyl Acetate	80	27	4110	28.3	-10.6	47	+104.3	+3.31
Diethyl Ether	80	27	4200	29.0	-8.8	49	+113.0	+3.07
Turpentine	80	27	3970	27.4	-13.6	58	+152.2	+6.65
Tetrachloroethane	80	27	4110	28.3	-10.7	40	+74.0	+8.59
N-Heptane	80	27	4100	28.3	-10.8	45	+95.7	+4.99
Cyclohexane	80	27	3940	27.1	-14.3	45	+95.7	+6.52
Ethyl Acetate	80	27	4260	29.4	-7.4	45	+95.7	+2.23
Carbon Tetrachloride	80	27	4070	28.1	-11.5	34	+47.8	+14.00
Benzene	80	27	4300	29.6	-6.5	24	+4.3	+5.50
Bromine Water	80	27	4530	31.2	-1.6	24	+4.3	+3.75
NH_4OH (28%)	80	27	4640	32.0	+0.9	23	+0.0	+0.02

Additional information regarding the chemical resistance of Marlex polyethylene is presented in other PTC documents. This data is provided for use only as a guideline in the preliminary determination of packageability, because chemical compatibility is highly dependent on storage and use conditions. Furthermore, many products are combinations of chemicals, so the ultimate compatibility with the packaging material involves testing the combination of the product material and its proposed container.

Appendix C
Surface Water Management Calculations

Appendix C-1
Surface Water Runoff Parameters and Design Storm Requirements

AECOM

CALCULATION SHEET

Page 1 **Of** 10
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Surface Water
Runoff Parameters and
Design Storm Requirements

Prepared By NKW **Date** 12/23/08
Reviewed By TCR **Date** 12/30/08
Approved By KJB **Date** 12/30/08

SURFACE WATER RUNOFF PARAMETERS AND DESIGN STORM REQUIREMENTS

Objective

Determine rainfall value and curve number to be used as input in SEDCAD+. The curve number is used to determine how much precipitation becomes runoff. The curve number is primarily a function of soil type, cover type and treatment, and hydrologic condition. SEDCAD+ uses SCS methods to compute runoff volume.

Design Criteria and Assumptions

1. SEDCAD+, a computer program, was used to design and evaluate the surface water management system for the Kekaha Landfill Expansion. SEDCAD+ is a program developed at the University of Kentucky to assist in the design and evaluation of surface water management system components.

   The program is capable of computing peak flow, calculating runoff volume, sizing channels and culverts, and computing the hydraulic performance of sedimentation basins. SEDCAD+ utilizes the following methods within the program:

   - SCS Upland Curve Method for calculating time of concentration.
   - Muskingum's Method for routing between structures.
   - SCS Technical Release - 55 (TR-55) parameter for runoff volume.

   Within this appendix are calculations for each element of the surface water management system along with SEDCAD+ program input/output.

2. Currently, there are no downstream (i.e., off-site) drainage systems from the Kekaha Landfill. The Kekaha Landfill property is located on soils with high infiltration rates. Testing at the site revealed a percolation rate of 1 inch per 6 minutes. The current surface water management system design is for surface water runoff to be routed to infiltration ditches located around the perimeter of the permitted landfill. Any collected surface water percolates into the ground within these ditches.

   This submittal proposes to route surface water to the existing infiltration ditches and to the northeast side of the site where an infiltration basin will be added to detain the water until it percolates into the ground. The existing infiltration ditches will be left in place to collect surface water for infiltration in combination with the proposed infiltration basin.

3. Evaluate the following storm events for surface water management structures and infiltration basin:

   a. 100-year, 1-hour storm event.
   b. 2-year, 24-hour storm event.
   c. 25-year, 24-hour storm event.

AECOM

CALCULATION SHEET

		Page 2 **Of** 10				
		Project No. 95561				
Client County of Kaua'i	**Subject** Surface Water	**Prepared By**	NKW	**Date**	12/23/08	
Project Kekaha Landfill	Runoff Parameters and	**Reviewed By**	TCR	**Date**	12/30/08	
Phase II Lateral Expansion	Design Storm Requirements	**Approved By**	KJB	**Date**	12/30/08	

4. Determine peak rainfall values based on the attached Design Plates from the County of Kauai, Department of Public Works Stormwater Runoff System Manual.

5. Use SCS storm distribution Type I, per attached figure.

6. Determine curve number, assuming final cover conditions are pasture, grassland, or range, fair condition, and hydrologic soil group C. Determine curve number from tables provided in SCS TR-55. See attached table for curve number determination.

Conclusions

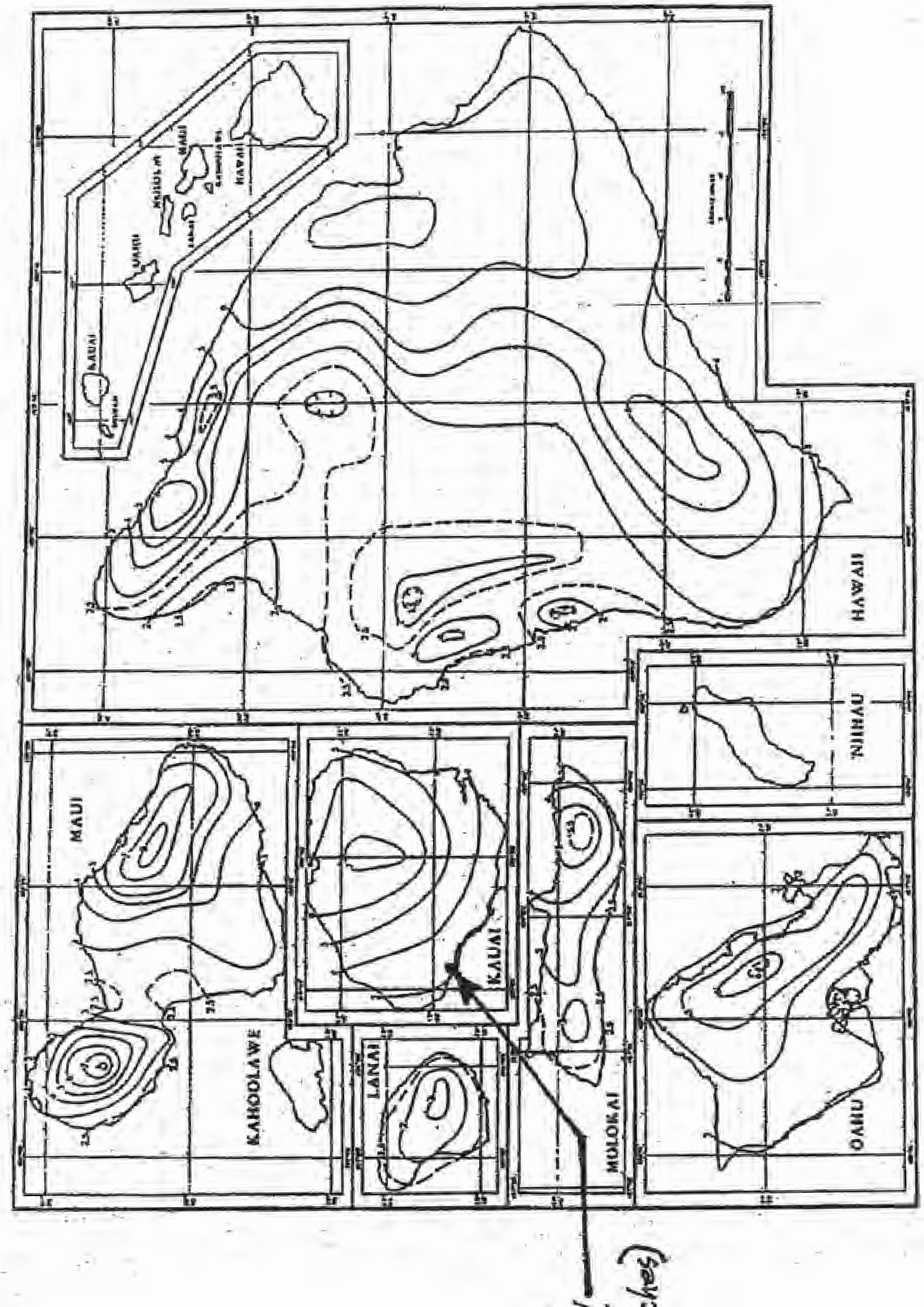
1. A 100-year, 1-hour storm event yields 3.0 inches of rainfall.

2. A 2-year, 24-hour storm event yields 4.5 inches of rainfall.

3. A 25-year, 24-hour storm event yields 8 inches of rainfall.

4. The curve number is 79 for the landfill final cover condition.

PLATE 4

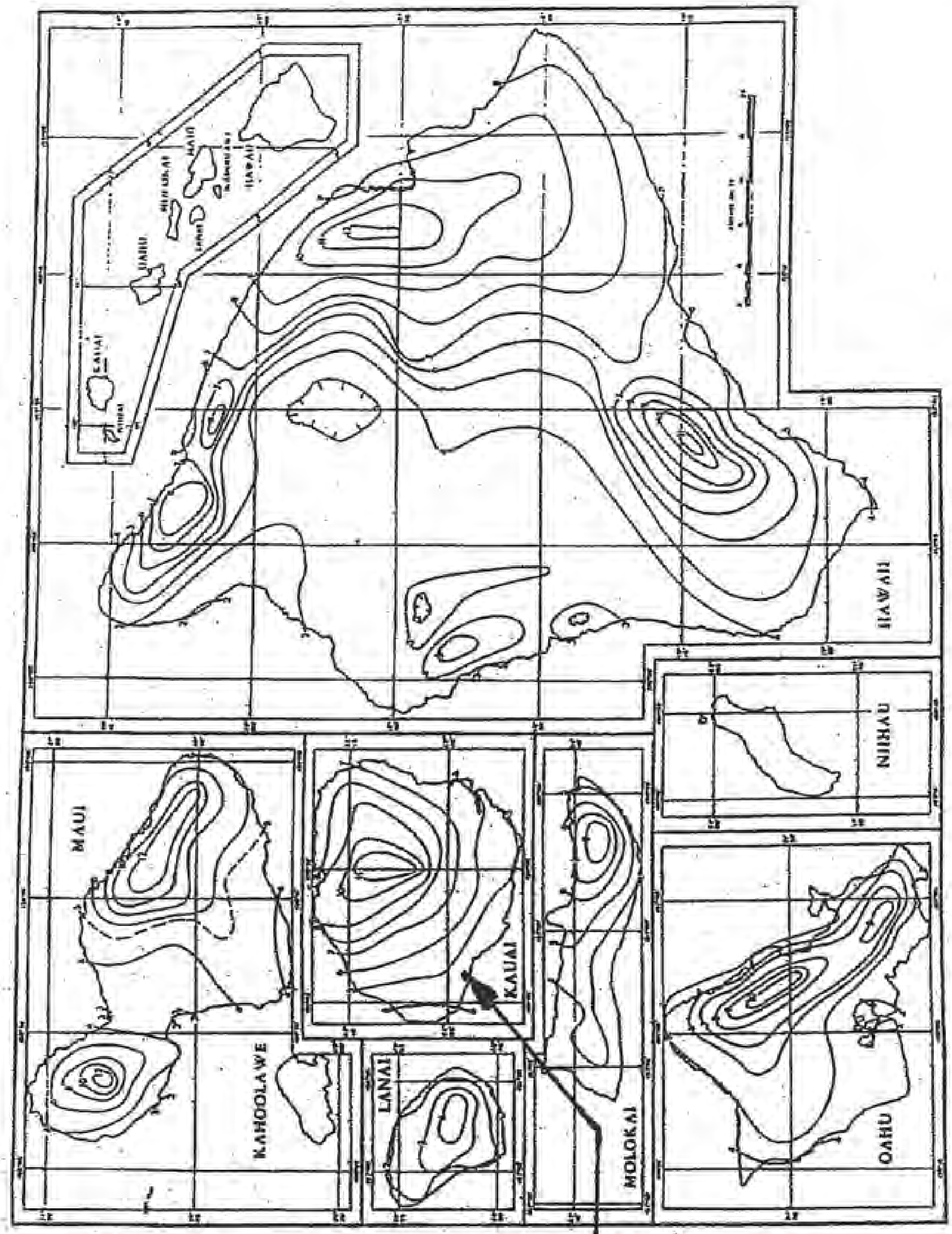


100-Year 1-Hour Rainfall (in.)

Kekaha
Landfill
(3-Inches)

4/10

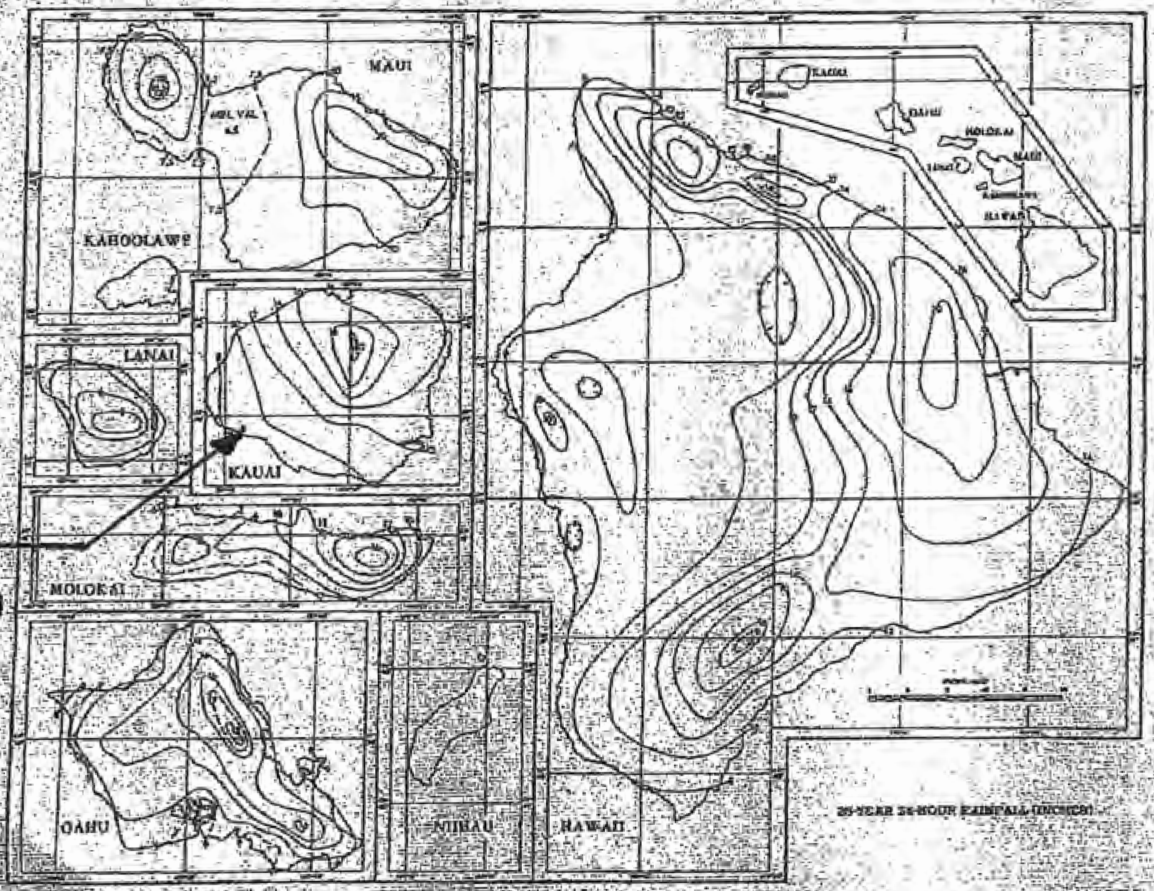
PLATE 5



Kekaha Landfill (4.5-Inches)

2-Year 24-Hour Rainfall (in.)

5/10



Kekaha Landfill (8-Inches)

FIGURE 54.—25-yr. 24-hr. rainfall (in.)

6/10

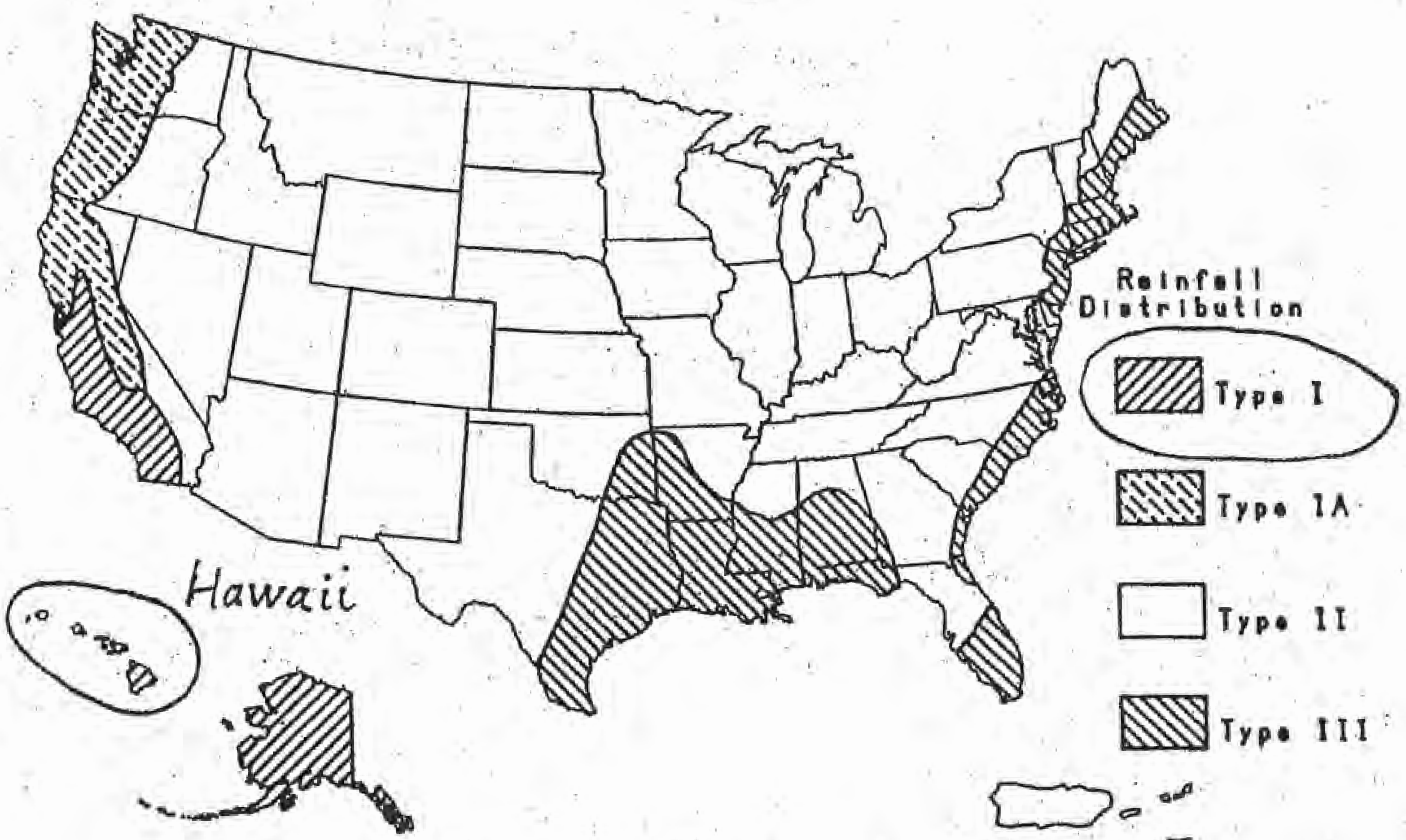
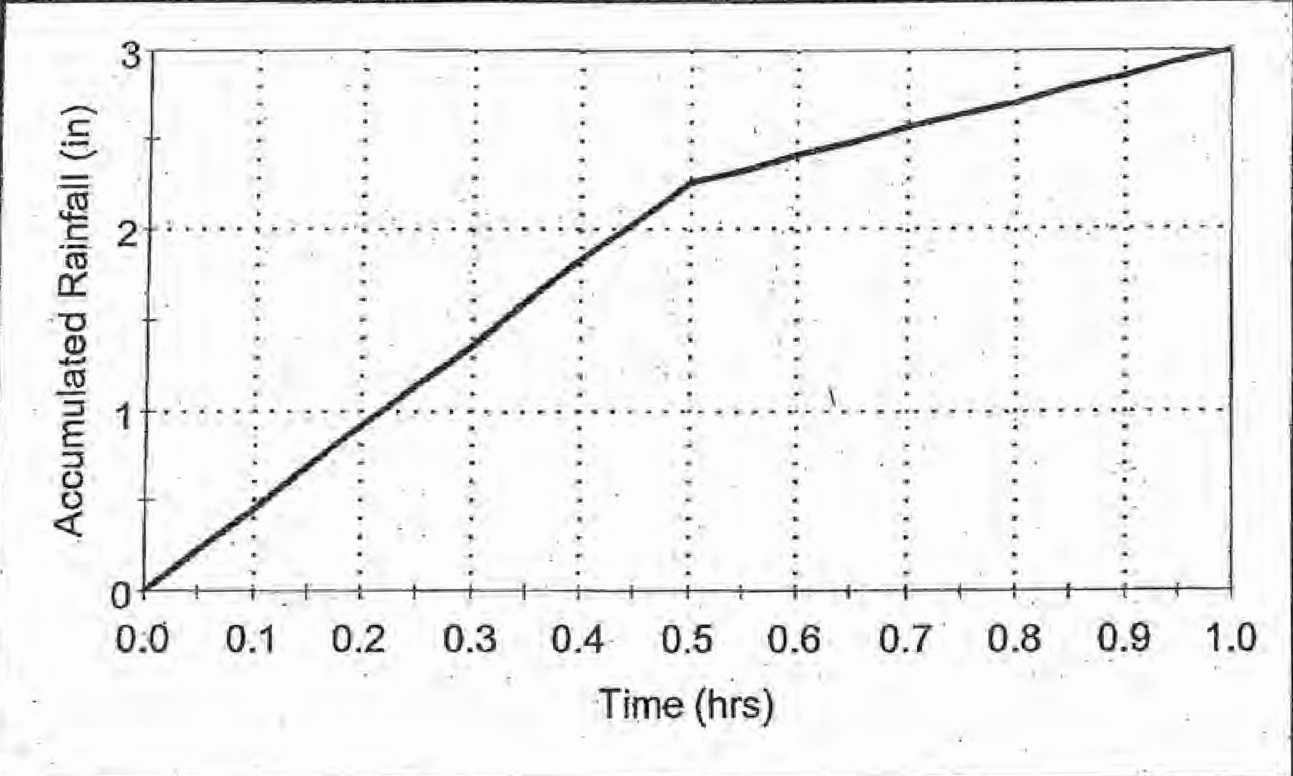


Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

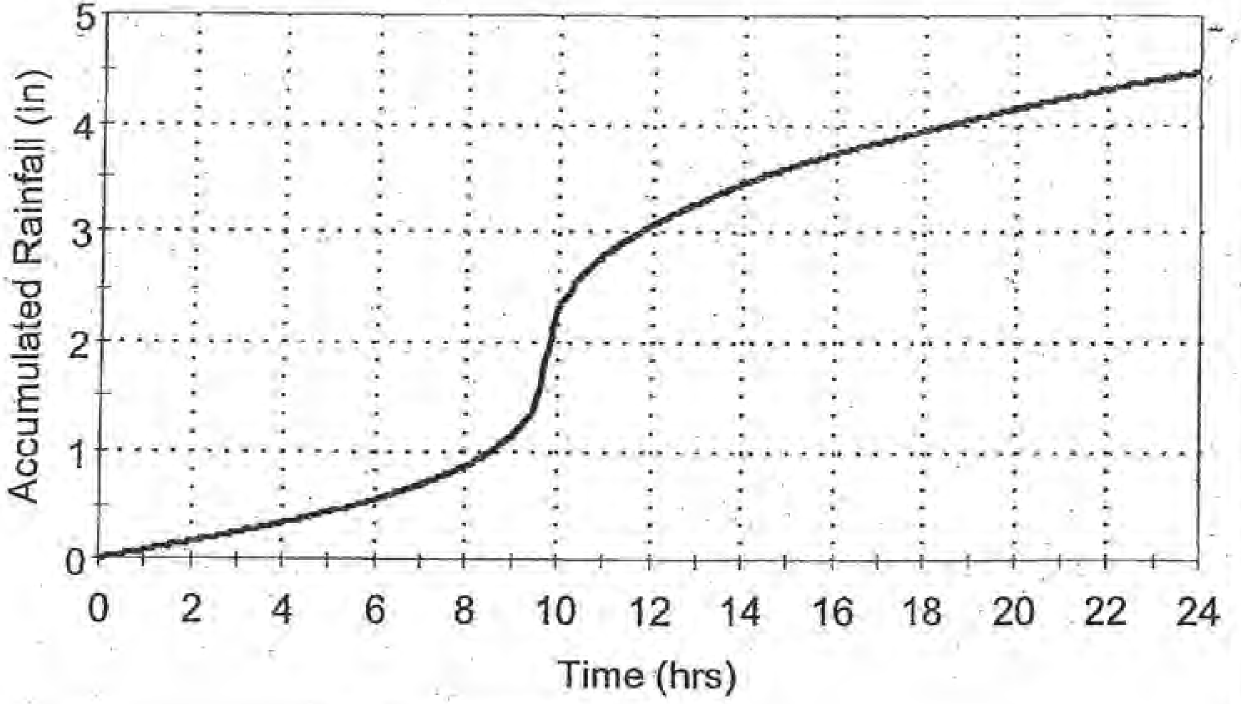
7/10

NRCS Type I, 100 yr - 1 hr Storm

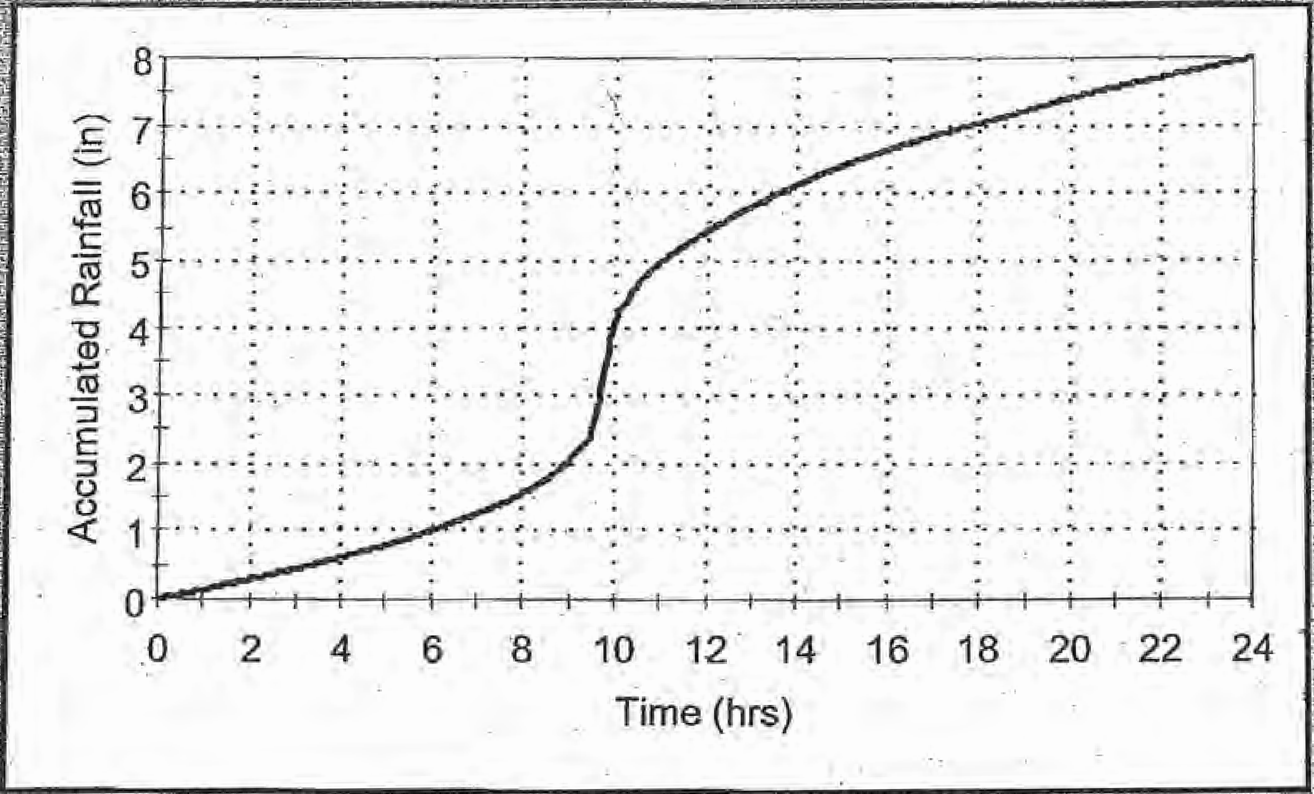


8/10

NRCS Type I, 2 yr - 24 hr Storm



NRCS Type I, 25 yr - 24 hr Storm



10/10

Table 2-2c.—Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3] *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Appendix C-2
Surface Water Infiltration Basin Analysis

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CALCULATION SHEET

Page 1 Of 2
Project No. 95561

Client County of Kaua'i	**Subject** Surface Water	**Prepared By**	NKW	**Date**	12/30/08
Project Kekaha Landfill	Infiltration Basin Analysis	**Reviewed By**	TCR	**Date**	12/31/08
Phase II Lateral Expansion		**Approved By**	KJB	**Date**	12/31/08

SURFACE WATER INFILTRATION BASIN ANALYSIS

Objective

Design the infiltration basin to add infiltration in addition to the existing infiltration channels for the expansion at Kekaha Landfill.

Design Criteria and Assumptions

1. Existing perimeter infiltration channels will be used in combination with a proposed, shallow infiltration basin near the site entrance.

2. Analyze the infiltration basin and ditch for final cover conditions. Assume entire landfill has final cover. The basin and ditch system is designed to comply with the requirements of the County of Kauai Department of Public Works Stormwater Runoff System Manual and the Hawaii Administrative Rules and Federal Regulations.

3. The basin and ditch system is designed to detain the design storm events. The basin and ditch will empty by infiltration within one day of the storm event.

4. There will not be any discharge structures in the basin. The SEDCAD+ surface water model shows user-defined discharge which increases as the depth of water in the basin and channel increases. This discharge is based upon measured percolation rates for the soils on-site.

5. Figure 1 shows the surface water management system network with subbasin drainage areas and structure labels.

Calculations

1. SEDCAD+ was used to determine the stage-storage-discharge relationships for the basin. SEDCAD+ output for the basin is attached. The basin was analyzed for the 100-year, 1-hour; 2-year, 24-hour; and the 25-year, 24-hour storm events. Table 1 summarizes the results from the SEDCAD+ analyses. SEDCAD+ output files are presented herein in Attachments 2A, 2B and 2C.

2. The slowest measured percolation rate at Kekaha Landfill is;

   1 inch/6 minutes

   Pond dewatering rate =

$$\frac{1\text{ inch}}{6\text{ minutes}} \times \frac{1\text{ minute}}{60\text{ seconds}} \times \frac{1\text{ ft}}{12\text{ inches}} \frac{43{,}560\text{ ft}^2}{\text{acre}} = \frac{10.083\text{ ft}^3}{\text{sec.}-\text{acre}}$$

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CALCULATION SHEET

Page 2 **Of** 2
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Surface Water
Infiltration Basin Analysis

Prepared By NKW **Date** 12/30/08
Reviewed By TCR **Date** 12/31/08
Approved By KJB **Date** 12/31/08

For the proposed infiltration basin, the output in ft^3/sec for the different elevations depend on the areas (in acres) of the pond contours for each different elevation multiplied by 10.083.

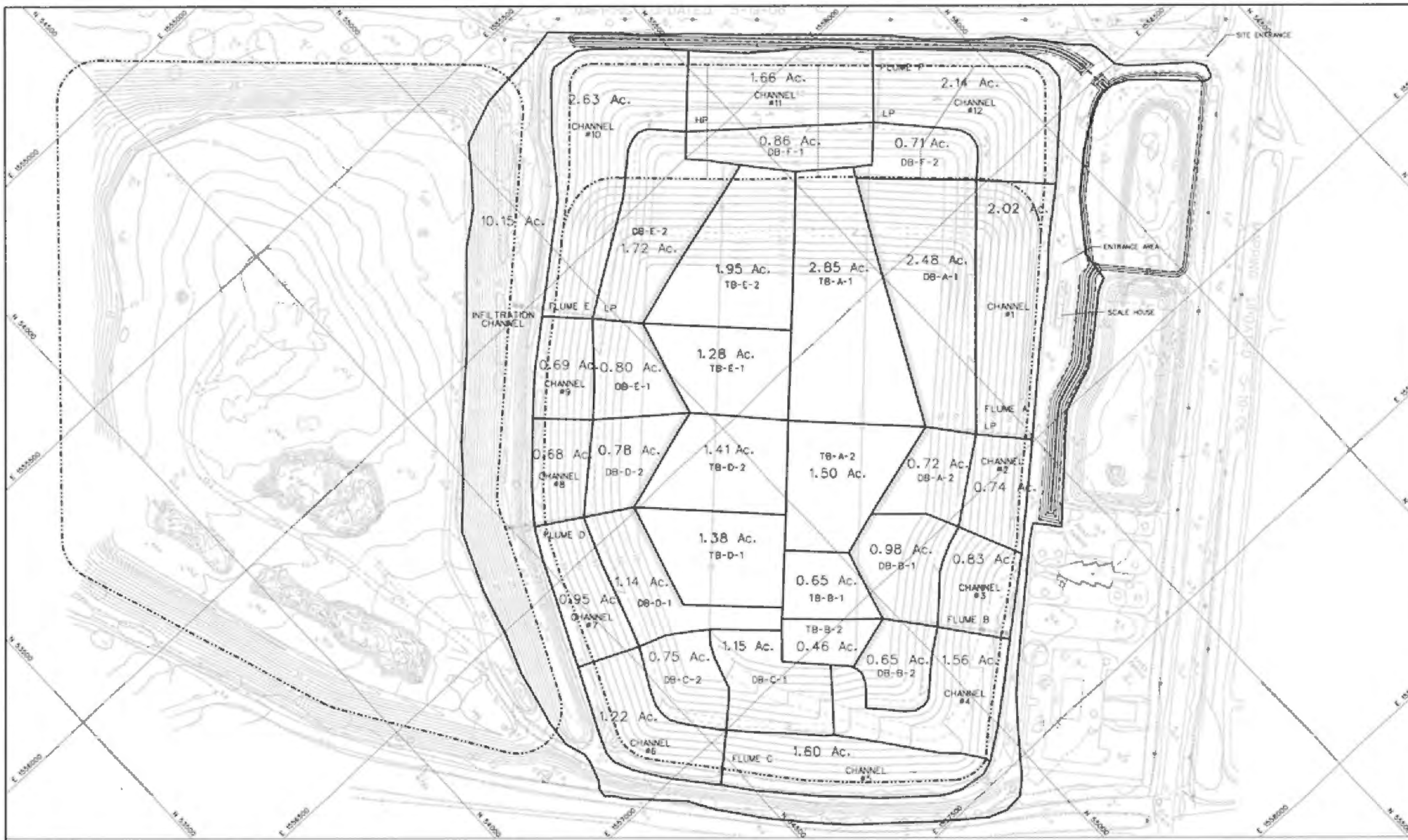
Conclusions

1. The proposed infiltration basin in combination with the existing infiltration channels will detain the three design storm events.

2. The following Table 1 summarizes the results from the SEDCAD+ analyses.

TABLE 1 – SUMMARY OF INFILTRATION BASIN ANALYSES

	Infiltration Basin		
Parameter	100-Year, 1-Hour Storm	2-Year, 24-Hour Storm	25-Year, 24-Hour Storm
Total Drainage Area (ac)	53.44		
Peak Flow In (cfs)	141.58	64.18	147.69
Peak Flow Out (cfs)	30.00	24.43	35.64
Peak Water Elevation (ft.)	8.80	8.13	9.48
Dewatering Time (days)	0.07	0.59	0.58
Volume of Permanent Pool (ac-ft)	0.02		
Top of Berm Elevation	10.0		
Bottom of Basin Elevation	7.5		



LEGEND

▨	EXISTING TOPOGRAPHY
— - — - —	PROPERTY LINE
— · · — · · —	EXISTING LIMITS OF WASTE
— · — · —	PROPOSED LIMIT OF WASTE
———	CELL DEVELOPMENT LIMIT

NOTES:

1. TOPOGRAPHIC MAP PREPARED BY WALKER AND ASSOCIATES, SEATTLE, WASHINGTON. DATE OF FLIGHT: MAY 19, 2006 AND PORTIONS ARE ANTICIPATED TO BE UPDATED BASED ON GROUND SURVEY.
2. HORIZONTAL DATUM IS BASED ON NAD83 (1986), HAWAII ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL.

SCALE 0' 50' 100' 200'

ENGINEERING REPORT
PHASE II LATERAL EXPANSION
KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

SURFACE WATER MANAGEMENT NETWORK

PREPARED BY

AECOM

Sheboygan, Wisconsin

DRN	DBB
DES	TCR/NKW
CHK	KJB
APP	KJB

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NO	REVISIONS	DRN	CHK	DATE

DATE JANUARY 2008
PROJECT NO 95561
FILENAME
SHEET NO
DRAWING NO
FIGURE 1

ATTACHMENT 2A

INFILTRATION BASIN DESIGN
SEDCAD+ OUTPUT
100-YEAR, 1-HOUR STORM EVENT

Perimeter Infiltration Ditch and Pond
Engineering Report
Kekaha Landfill
Phase II Lateral Expansion
100-Year, 1-Hour Storm Event

Nancy K. Wright

AECOM
4135 Technology Parkway
Sheboygan, WI 53083

Phone: 920-458-8711

General Information

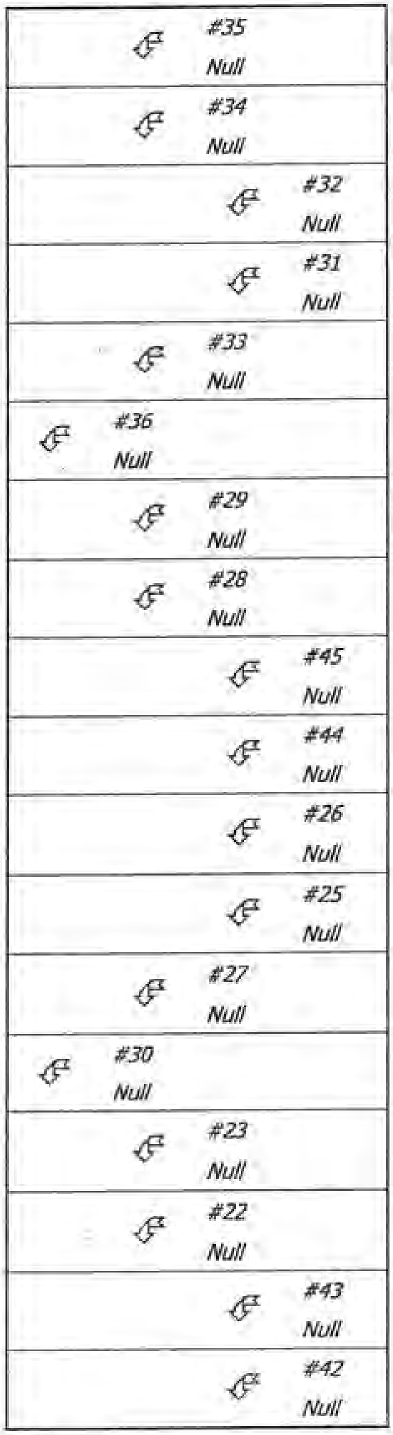
Storm Information:

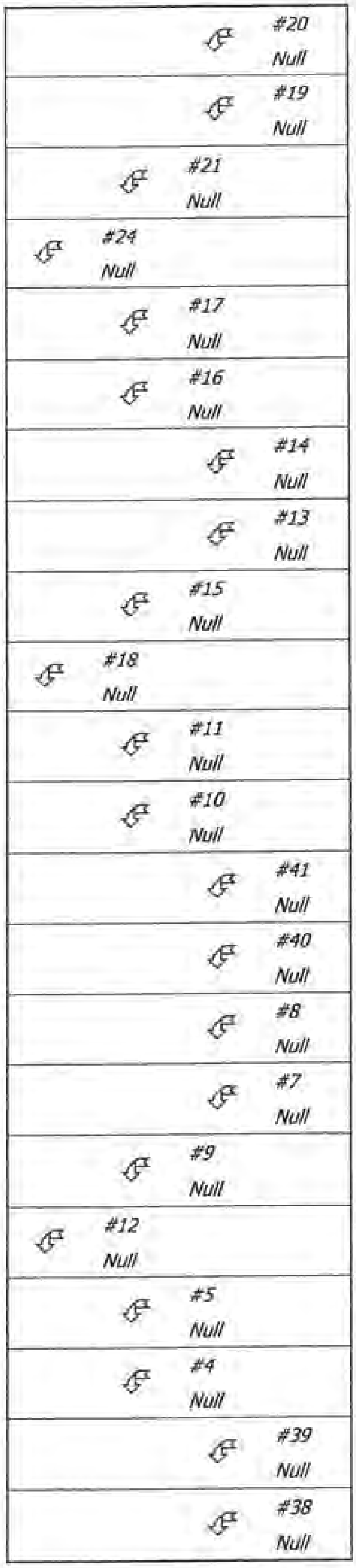
Storm Type:	NRCS Type I
Design Storm:	100 yr - 1 hr
Rainfall Depth:	3.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.000	0.000	DB-A-1
Null	#2	==>	#3	0.000	0.000	DB-A-2
Null	#3	==>	#6	0.000	0.000	Flume A
Null	#4	==>	#6	0.000	0.000	Channel #1
Null	#5	==>	#6	0.000	0.000	Channel #2
Null	#6	==>	#37	0.000	0.000	Flume A Discharge
Null	#7	==>	#9	0.000	0.000	DB-B-1
Null	#8	==>	#9	0.000	0.000	DB-B-2
Null	#9	==>	#12	0.000	0.000	Flume B
Null	#10	==>	#12	0.000	0.000	Channel #3
Null	#11	==>	#12	0.000	0.000	Channel #4
Null	#12	==>	#37	0.000	0.000	Flume B Discharge
Null	#13	==>	#15	0.000	0.000	DB-C-1
Null	#14	==>	#15	0.000	0.000	DB-C-2
Null	#15	==>	#18	0.000	0.000	Flume C
Null	#16	==>	#18	0.000	0.000	Channel #5
Null	#17	==>	#18	0.000	0.000	Channel #6
Null	#18	==>	#37	0.000	0.000	Flume C Discharge
Null	#19	==>	#21	0.000	0.000	DB-D-1
Null	#20	==>	#21	0.000	0.000	DB-D-2
Null	#21	==>	#24	0.000	0.000	Flume D
Null	#22	==>	#24	0.000	0.000	Channel #7
Null	#23	==>	#24	0.000	0.000	Channel #8
Null	#24	==>	#37	0.000	0.000	Flume D Discharge
Null	#25	==>	#27	0.000	0.000	DB-E-1
Null	#26	==>	#27	0.000	0.000	DB-E-2
Null	#27	==>	#30	0.000	0.000	Flume E
Null	#28	==>	#30	0.000	0.000	Channel #9
Null	#29	==>	#30	0.000	0.000	Channel #10
Null	#30	==>	#37	0.000	0.000	Flume E Discharge
Null	#31	==>	#33	0.000	0.000	DB-F-1
Null	#32	==>	#33	0.000	0.000	DB-F-2
Null	#33	==>	#36	0.000	0.000	Flume F
Null	#34	==>	#36	0.000	0.000	Channel # 11
Null	#35	==>	#36	0.000	0.000	Channel #12
Null	#36	==>	#37	0.000	0.000	Flume F Discharge
Pond	#37	==>	End	0.000	0.000	Infiltration Ditch
Null	#38	==>	#3	0.000	0.000	Top Berm TB-A-1
Null	#39	==>	#3	0.000	0.000	Top Berm TB-A-2
Null	#40	==>	#9	0.000	0.000	Top Berm TB-B-1

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#41	==>	#9	0.000	0.000	Top Berm TB-B-2
Null	#42	==>	#21	0.000	0.000	Top Berm TB-D-1
Null	#43	==>	#21	0.000	0.000	Top Berm TB-D-2
Null	#44	==>	#27	0.000	0.000	Top Berm TB-E-1
Null	#45	==>	#27	0.000	0.000	Top Berm TB-E-2




#20
Null
#19
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#16
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#14
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#13
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#38
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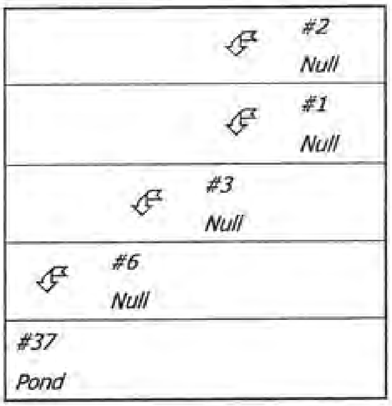

#2
Null
#1
Null
#3
Null
#6
Null
#37
Pond

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#35	2.140	2.140	5.13	0.21
#34	1.660	1.660	4.67	0.16
#32	0.710	0.710	2.00	0.07
#31	0.860	0.860	2.42	0.09
#33	0.000	1.570	4.42	0.16
#36	0.000	5.370	13.22	0.53
#29	2.630	2.630	6.30	0.26
#28	0.690	0.690	1.94	0.07
#45	1.950	1.950	5.49	0.19
#44	1.280	1.280	3.60	0.13
#26	1.720	1.720	4.84	0.17
#25	0.800	0.800	2.25	0.08
#27	0.000	5.750	16.19	0.57
#30	0.000	9.070	23.21	0.90
#23	0.680	0.680	1.91	0.07
#22	0.950	0.950	2.68	0.09
#43	1.410	1.410	3.97	0.14
#42	1.380	1.380	3.89	0.14
#20	0.780	0.780	2.20	0.08
#19	1.140	1.140	3.21	0.11
#21	0.000	4.710	13.26	0.47
#24	0.000	6.340	17.85	0.63
#17	1.220	1.220	3.44	0.12
#16	1.600	1.600	4.51	0.16
#14	0.750	0.750	2.11	0.07
#13	1.150	1.150	3.24	0.11
#15	0.000	1.900	5.35	0.19
#18	0.000	4.720	13.29	0.47
#11	1.560	1.560	4.05	0.15
#10	0.830	0.830	2.34	0.08
#41	0.460	0.460	1.30	0.05
#40	0.650	0.650	1.83	0.06
#8	0.650	0.650	1.83	0.06
#7	0.980	0.980	2.76	0.10
#9	0.000	2.740	7.72	0.27
#12	0.000	5.130	14.10	0.51
#5	0.740	0.740	2.08	0.07

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4		2.020	2.020	4.84	0.20
#39		1.500	1.500	4.22	0.15
#38		2.850	2.850	6.83	0.28
#2		0.720	0.720	2.03	0.07
#1		2.480	2.480	6.98	0.25
#3		0.000	7.550	18.73	0.75
#6		0.000	10.310	24.71	1.02
#37	In	12.500	53.440	141.58	5.29
	Out			30.00	5.30

Structure Detail:

- *Structure #35 (Null)*
  - *Channel #12*
- *Structure #34 (Null)*
  - *Channel # 11*
- *Structure #32 (Null)*
  - *DB-F-2*
- *Structure #31 (Null)*
  - *DB-F-1*
- *Structure #33 (Null)*
  - *Flume F*
- *Structure #36 (Null)*
  - *Flume F Discharge*
- *Structure #29 (Null)*
  - *Channel #10*
- *Structure #28 (Null)*
  - *Channel #9*
- *Structure #45 (Null)*
  - *Top Berm TB-E-2*
- *Structure #44 (Null)*
  - *Top Berm TB-E-1*
- *Structure #26 (Null)*
  - *DB-E-2*
- *Structure #25 (Null)*
  - *DB-E-1*
- *Structure #27 (Null)*
  - *Flume E*

Structure #30 (Null)

Flume E Discharge

Structure #23 (Null)

Channel #8

Structure #22 (Null)

Channel #7

Structure #43 (Null)

Top Berm TB-D-2

Structure #42 (Null)

Top Berm TB-D-1

Structure #20 (Null)

DB-D-2

Structure #19 (Null)

DB-D-1

Structure #21 (Null)

Flume D

Structure #24 (Null)

Flume D Discharge

Structure #17 (Null)

Channel #6

Structure #16 (Null)

Channel #5

Structure #14 (Null)

DB-C-2

Structure #13 (Null)

DB-C-1

Structure #15 (Null)

Flume C

Structure #18 (Null)

Flume C Discharge

Structure #11 (Null)

Channel #4

Structure #10 (Null)

Channel #3

Structure #41 (Null)

Top Berm TB-B-2

Structure #40 (Null)

Top Berm TB-B-1

Structure #8 (Null)

DB-B-2

Structure #7 (Null)

DB-B-1

Structure #9 (Null)

Flume B

Structure #12 (Null)

Flume B Discharge

Structure #5 (Null)

Channel #2

Structure #4 (Null)

Channel #1

Structure #39 (Null)

Top Berm TB-A-2

Structure #38 (Null)

Top Berm TB-A-1

Structure #2 (Null)

DB-A-2

Structure #1 (Null)

DB-A-1

Structure #3 (Null)

Flume A

Structure #6 (Null)

Flume A Discharge

Structure #37 (Pond)

Infiltration Ditch

Pond Inputs:

Initial Pool Elev:	7.51
Initial Pool:	0.02 ac-ft

Pond Results:

Peak Elevation:	8.80
Dewater Time:	0.07 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7.50	1.900	0.000	0.000	
7.51	1.900	0.019	0.000	
7.52	1.916	0.038	19.324	
7.60	1.980	0.194	19.983	0.10
7.70	2.061	0.396	20.822	0.15
7.80	2.143	0.606	21.654	0.10
7.90	2.227	0.825	22.486	0.10
8.00	2.313	1.052	23.318	0.15
8.10	2.392	1.287	24.150	0.10
8.20	2.474	1.530	24.982	0.15
8.30	2.556	1.782	25.814	0.10
8.40	2.640	2.041	26.646	0.10
8.50	2.725	2.310	27.477	0.15
8.60	2.805	2.586	28.309	0.10
8.70	2.887	2.871	29.141	0.15
8.80	2.969	3.163	29.973	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
8.80	2.973	3.175	30.004	0.15	Peak Stage
8.90	3.053	3.465	30.805		
9.00	3.138	3.774	31.637		
9.10	3.218	4.092	32.469		
9.20	3.300	4.418	33.301		
9.30	3.382	4.752	34.133		
9.40	3.466	5.094	34.965		
9.50	3.550	5.445	35.797		
9.60	3.631	5.804	36.629		
9.70	3.713	6.171	37.461		
9.80	3.795	6.547	38.293		
9.90	3.879	6.930	39.125		
10.00	3.963	7.322	39.957		

Detailed Discharge Table

Elevation	User-Input discharge (cfs)	Combined Total Discharge (cfs)
7.50	0.000	0.000
7.51	0.000	0.000
7.52	19.324	19.324
7.60	19.983	19.983
7.70	20.822	20.822
7.80	21.654	21.654
7.90	22.486	22.486
8.00	23.318	23.318
8.10	24.150	24.150
8.20	24.982	24.982
8.30	25.814	25.814
8.40	26.646	26.646
8.50	27.477	27.477
8.60	28.309	28.309
8.70	29.141	29.141
8.80	29.973	29.973
8.90	30.805	30.805
9.00	31.637	31.637
9.10	32.469	32.469
9.20	33.301	33.301
9.30	34.133	34.133

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
9.40	34.965	34.965
9.50	35.797	35.797
9.60	36.629	36.629
9.70	37.461	37.461
9.80	38.293	38.293
9.90	39.125	39.125
10.00	39.957	39.957

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#35	1	2.140	0.166	0.000	0.000	79.000	TR55	5.13	0.212
	Σ	**2.140**						**5.13**	**0.212**
#34	1	1.660	0.119	0.000	0.000	79.000	TR55	4.67	0.164
	Σ	**1.660**						**4.67**	**0.164**
#32	1	0.710	0.106	0.000	0.000	79.000	TR55	2.00	0.070
	Σ	**0.710**						**2.00**	**0.070**
#31	1	0.860	0.043	0.000	0.000	79.000	TR55	2.42	0.085
	Σ	**0.860**						**2.42**	**0.085**
#33	Σ	**1.570**						**4.42**	**0.155**
#36	Σ	**5.370**						**13.22**	**0.532**
#29	1	2.630	0.145	0.000	0.000	79.000	TR55	6.30	0.260
	Σ	**2.630**						**6.30**	**0.260**
#28	1	0.690	0.068	0.000	0.000	79.000	TR55	1.94	0.068
	Σ	**0.690**						**1.94**	**0.068**
#45	1	1.950	0.102	0.000	0.000	79.000	TR55	5.49	0.193
	Σ	**1.950**						**5.49**	**0.193**
#44	1	1.280	0.080	0.000	0.000	79.000	TR55	3.60	0.127
	Σ	**1.280**						**3.60**	**0.127**
#26	1	1.720	0.065	0.000	0.000	79.000	TR55	4.84	0.170
	Σ	**1.720**						**4.84**	**0.170**
#25	1	0.800	0.054	0.000	0.000	79.000	TR55	2.25	0.079
	Σ	**0.800**						**2.25**	**0.079**
#27	Σ	**5.750**						**16.19**	**0.569**
#30	Σ	**9.070**						**23.21**	**0.898**
#23	1	0.680	0.067	0.000	0.000	79.000	TR55	1.91	0.067
	Σ	**0.680**						**1.91**	**0.067**
#22	1	0.950	0.092	0.000	0.000	79.000	TR55	2.68	0.094
	Σ	**0.950**						**2.68**	**0.094**
#43	1	1.410	0.081	0.000	0.000	79.000	TR55	3.97	0.140

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**1.410**						**3.97**	**0.140**
#42	1	1.380	0.082	0.000	0.000	79.000	TR55	3.89	0.137
	Σ	**1.380**						**3.89**	**0.137**
#20	1	0.780	0.054	0.000	0.000	79.000	TR55	2.20	0.077
	Σ	**0.780**						**2.20**	**0.077**
#19	1	1.140	0.088	0.000	0.000	79.000	TR55	3.21	0.113
	Σ	**1.140**						**3.21**	**0.113**
#21	**Σ**	**4.710**						**13.26**	**0.466**
#24	**Σ**	**6.340**						**17.85**	**0.628**
#17	1	1.220	0.123	0.000	0.000	79.000	TR55	3.44	0.121
	Σ	**1.220**						**3.44**	**0.121**
#16	1	1.600	0.072	0.000	0.000	79.000	TR55	4.51	0.158
	Σ	**1.600**						**4.51**	**0.158**
#14	1	0.750	0.054	0.000	0.000	79.000	TR55	2.11	0.074
	Σ	**0.750**						**2.11**	**0.074**
#13	1	1.150	0.037	0.000	0.000	79.000	TR55	3.24	0.114
	Σ	**1.150**						**3.24**	**0.114**
#15	**Σ**	**1.900**						**5.35**	**0.188**
#18	**Σ**	**4.720**						**13.29**	**0.467**
#11	1	1.560	0.038	0.051	0.192	79.000	TR55	4.39	0.155
	Σ	**1.560**						**4.05**	**0.155**
#10	1	0.830	0.008	0.000	0.000	79.000	TR55	2.34	0.082
	Σ	**0.830**						**2.34**	**0.082**
#41	1	0.460	0.051	0.000	0.000	79.000	TR55	1.30	0.046
	Σ	**0.460**						**1.30**	**0.046**
#40	1	0.650	0.051	0.000	0.000	79.000	TR55	1.83	0.064
	Σ	**0.650**						**1.83**	**0.064**
#8	1	0.650	0.040	0.000	0.000	79.000	TR55	1.83	0.064
	Σ	**0.650**						**1.83**	**0.064**
#7	1	0.980	0.054	0.000	0.000	79.000	TR55	2.76	0.097
	Σ	**0.980**						**2.76**	**0.097**
#9	1	0.000	0.000	0.051	0.192	1.000	TR55	0.00	0.000

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**2.740**						**7.72**	**0.271**
#12	Σ	**5.130**						**14.10**	**0.508**
#5	1	0.740	0.073	0.000	0.000	79.000	TR55	2.08	0.073
	Σ	**0.740**						**2.08**	**0.073**
#4	1	2.020	0.158	0.000	0.000	79.000	TR55	4.84	0.200
	Σ	**2.020**						**4.84**	**0.200**
#39	1	1.500	0.075	0.000	0.000	79.000	TR55	4.22	0.149
	Σ	**1.500**						**4.22**	**0.149**
#38	1	2.850	0.137	0.000	0.000	79.000	TR55	6.83	0.282
	Σ	**2.850**						**6.83**	**0.282**
#2	1	0.720	0.050	0.000	0.000	79.000	TR55	2.03	0.071
	Σ	**0.720**						**2.03**	**0.071**
#1	1	2.480	0.117	0.000	0.000	79.000	TR55	6.98	0.246
	Σ	**2.480**						**6.98**	**0.246**
#3	1	0.000	0.000	0.000	0.000	1.000	TR55	0.00	0.000
	Σ	**7.550**						**18.73**	**0.748**
#6	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**10.310**						**24.71**	**1.021**
#37	1	12.500	0.000	0.000	0.000	79.000	TR55	35.20	1.238
	Σ	**53.440**						**141.58**	**5.293**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	3.00	5.55	185.00	1.380	0.037
		3. Short grass pasture	21.40	12.00	56.07	3.700	0.004
		6. Grassed waterway	1.93	11.00	570.00	2.080	0.076
#1	**1**	**Time of Concentration:**					**0.117**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	22.50	18.00	80.00	3.790	0.005
		6. Grassed waterway	2.38	5.00	210.00	2.310	0.025
#2	**1**	**Time of Concentration:**					**0.050**
#4	1	3. Short grass pasture	29.33	44.00	150.00	4.330	0.009
		6. Grassed waterway	0.50	2.85	570.00	1.060	0.149
#4	**1**	**Time of Concentration:**					**0.158**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	1	3. Short grass pasture	27.41	37.00	135.00	4.180	0.008
		6. Grassed waterway	0.50	1.25	250.00	1.060	0.065
#5	**1**	**Time of Concentration:**					**0.073**
#7	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	22.50	18.00	80.00	3.790	0.005
		6. Grassed waterway	2.13	5.00	235.00	2.180	0.029
#7	**1**	**Time of Concentration:**					**0.054**
#8	1	3. Short grass pasture	20.00	5.00	25.00	3.570	0.001
		3. Short grass pasture	27.27	18.00	66.00	4.170	0.004
		6. Grassed waterway	1.89	5.00	265.01	2.060	0.035
#8	**1**	**Time of Concentration:**					**0.040**
#10	1	3. Short grass pasture	27.41	37.00	135.00	4.180	0.008
#10	**1**	**Time of Concentration:**					**0.008**
#11	1	3. Short grass pasture	25.00	25.00	100.00	4.000	0.006
		6. Grassed waterway	6.67	30.00	450.00	3.870	0.032
#11	**1**	**Time of Concentration:**					**0.038**
#13	1	3. Short grass pasture	5.56	5.00	90.00	1.880	0.013
		3. Short grass pasture	20.80	26.00	125.00	3.640	0.009
		6. Grassed waterway	2.86	4.00	140.00	2.530	0.015
#13	**1**	**Time of Concentration:**					**0.037**
#14	1	3. Short grass pasture	5.88	5.00	85.00	1.940	0.012
		3. Short grass pasture	28.57	18.00	63.00	4.270	0.004
		6. Grassed waterway	2.03	6.00	295.00	2.130	0.038
#14	**1**	**Time of Concentration:**					**0.054**
#16	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.27	255.00	1.060	0.066
#16	**1**	**Time of Concentration:**					**0.072**
#17	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	2.25	450.00	1.060	0.117
#17	**1**	**Time of Concentration:**					**0.123**
#19	1	3. Short grass pasture	4.00	10.00	250.00	1.600	0.043
		3. Short grass pasture	27.69	18.00	65.00	4.200	0.004
		6. Grassed waterway	1.94	6.00	310.00	2.080	0.041
#19	**1**	**Time of Concentration:**					**0.088**
#20	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	10.42	5.00	48.00	2.580	0.005
		3. Short grass pasture	21.67	13.00	60.00	3.720	0.004
		6. Grassed waterway	2.69	6.00	223.00	2.460	0.025
#20	**1**	**Time of Concentration:**					**0.054**
#22	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.65	330.00	1.060	0.086
#22	**1**	**Time of Concentration:**					**0.092**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#23	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.17	235.00	1.060	0.061
#23	**1**	**Time of Concentration:**					**0.067**
#25	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	10.42	5.00	48.00	2.580	0.005
		3. Short grass pasture	21.67	13.00	60.00	3.720	0.004
		6. Grassed waterway	2.65	6.00	226.00	2.440	0.025
#25	**1**	**Time of Concentration:**					**0.054**
#26	1	3. Short grass pasture	3.16	6.00	190.00	1.420	0.037
		3. Short grass pasture	20.00	12.00	60.00	3.570	0.004
		6. Grassed waterway	5.00	15.00	300.00	3.350	0.024
#26	**1**	**Time of Concentration:**					**0.065**
#28	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.19	240.00	1.060	0.062
#28	**1**	**Time of Concentration:**					**0.068**
#29	1	3. Short grass pasture	22.56	44.00	195.00	3.800	0.014
		6. Grassed waterway	0.50	2.50	500.00	1.060	0.131
#29	**1**	**Time of Concentration:**					**0.145**
#31	1	3. Short grass pasture	30.23	13.00	43.00	4.390	0.002
		6. Grassed waterway	3.25	13.00	400.00	2.700	0.041
#31	**1**	**Time of Concentration:**					**0.043**
#32	1	3. Short grass pasture	3.03	10.00	330.00	1.390	0.065
		3. Short grass pasture	21.82	12.00	55.00	3.730	0.004
		6. Grassed waterway	2.07	6.00	290.00	2.150	0.037
#32	**1**	**Time of Concentration:**					**0.106**
#34	1	3. Short grass pasture	27.33	41.00	150.00	4.180	0.009
		6. Grassed waterway	0.50	2.09	420.00	1.060	0.110
#34	**1**	**Time of Concentration:**					**0.119**
#35	1	3. Short grass pasture	29.33	44.00	150.00	4.330	0.009
		6. Grassed waterway	0.50	3.00	600.00	1.060	0.157
#35	**1**	**Time of Concentration:**					**0.166**
#38	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.00	6.00	600.00	1.500	0.111
#38	**1**	**Time of Concentration:**					**0.137**
#39	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.50	4.87	325.00	1.830	0.049
#39	**1**	**Time of Concentration:**					**0.075**
#40	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.50	2.55	170.00	1.830	0.025
#40	**1**	**Time of Concentration:**					**0.051**
#41	1	3. Short grass pasture	3.00	4.94	165.00	1.380	0.033
		6. Grassed waterway	1.50	1.80	120.00	1.830	0.018

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#41	**1**	**Time of Concentration:**					**0.051**
#42	1	3. Short grass pasture	3.00	6.89	229.66	1.380	0.046
		6. Grassed waterway	1.50	3.60	240.00	1.830	0.036
#42	**1**	**Time of Concentration:**					**0.082**
#43	1	3. Short grass pasture	3.00	6.60	220.00	1.380	0.044
		6. Grassed waterway	1.50	3.75	250.00	1.830	0.037
#43	**1**	**Time of Concentration:**					**0.081**
#44	1	3. Short grass pasture	3.00	6.60	220.00	1.380	0.044
		6. Grassed waterway	1.50	3.60	240.00	1.830	0.036
#44	**1**	**Time of Concentration:**					**0.080**
#45	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.00	4.15	415.00	1.500	0.076
#45	**1**	**Time of Concentration:**					**0.102**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	1	6. Grassed waterway	0.50	0.97	195.00	1.060	0.051
#9	**1**	**Muskingum K:**					**0.051**
#11	1	6. Grassed waterway	0.50	0.97	195.00	1.060	0.051
#11	**1**	**Muskingum K:**					**0.051**

ATTACHMENT 2B

INFILTRATION BASIN DESIGN
SEDCAD+ OUTPUT
2-YEAR, 24-HOUR STORM EVENT

Perimeter Infiltration Ditch and Pond Engineering Report

Kekaha Landfill

Phase II Lateral Expansion

2-Year, 24-Hour Storm Event

Nancy K. Wright

AECOM
4135 Technology Parkway
Sheboygan, WI 53083

Phone: 920-458-8711

General Information

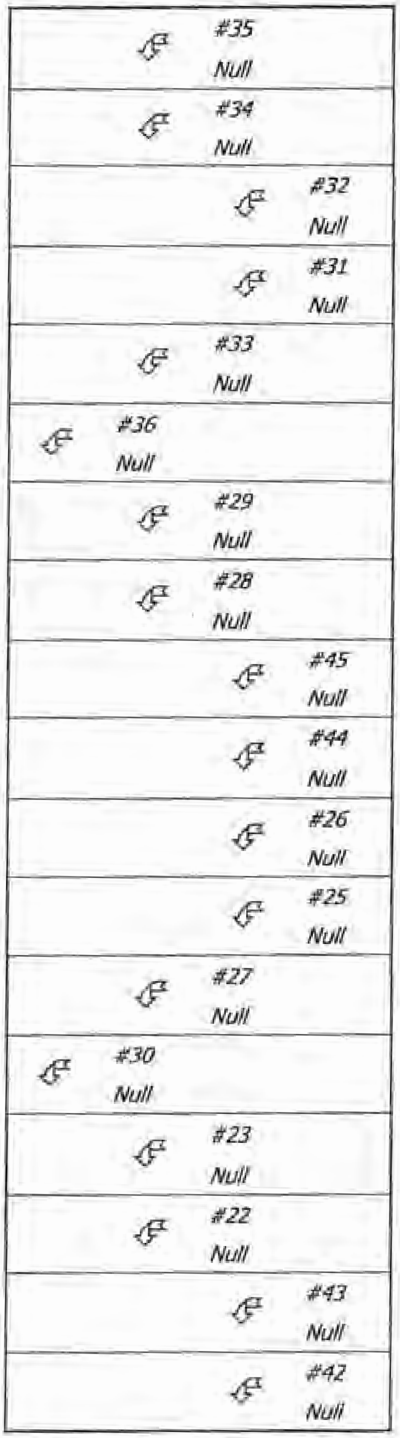
Storm Information:

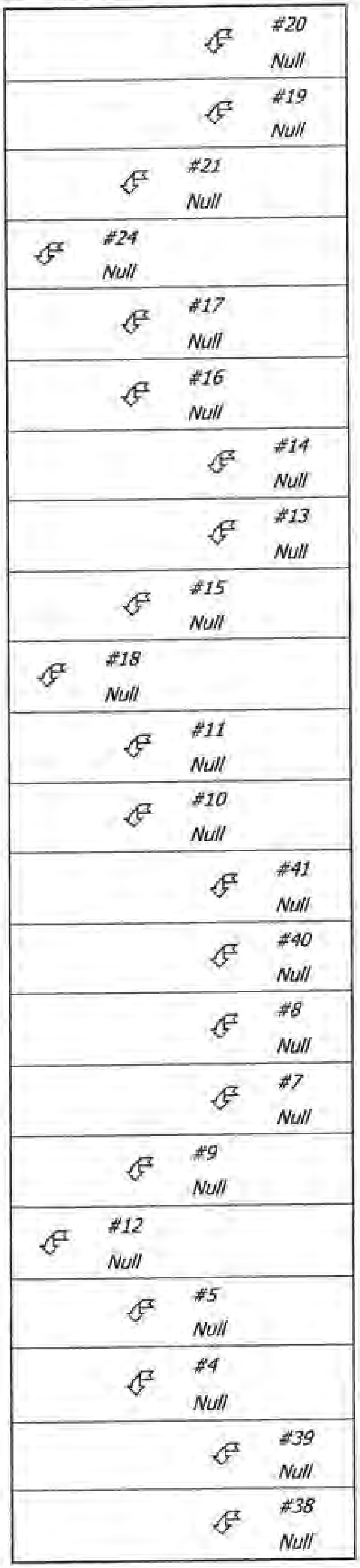
Storm Type:	NRCS Type I
Design Storm:	2 yr - 24 hr
Rainfall Depth:	4.500 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.000	0.000	DB-A-1
Null	#2	==>	#3	0.000	0.000	DB-A-2
Null	#3	==>	#6	0.000	0.000	Flume A
Null	#4	==>	#6	0.000	0.000	Channel #1
Null	#5	==>	#6	0.000	0.000	Channel #2
Null	#6	==>	#37	0.000	0.000	Flume A Discharge
Null	#7	==>	#9	0.000	0.000	DB-B-1
Null	#8	==>	#9	0.000	0.000	DB-B-2
Null	#9	==>	#12	0.000	0.000	Flume B
Null	#10	==>	#12	0.000	0.000	Channel #3
Null	#11	==>	#12	0.000	0.000	Channel #4
Null	#12	==>	#37	0.000	0.000	Flume B Discharge
Null	#13	==>	#15	0.000	0.000	DB-C-1
Null	#14	==>	#15	0.000	0.000	DB-C-2
Null	#15	==>	#18	0.000	0.000	Flume C
Null	#16	==>	#18	0.000	0.000	Channel #5
Null	#17	==>	#18	0.000	0.000	Channel #6
Null	#18	==>	#37	0.000	0.000	Flume C Discharge
Null	#19	==>	#21	0.000	0.000	DB-D-1
Null	#20	==>	#21	0.000	0.000	DB-D-2
Null	#21	==>	#24	0.000	0.000	Flume D
Null	#22	==>	#24	0.000	0.000	Channel #7
Null	#23	==>	#24	0.000	0.000	Channel #8
Null	#24	==>	#37	0.000	0.000	Flume D Discharge
Null	#25	==>	#27	0.000	0.000	DB-E-1
Null	#26	==>	#27	0.000	0.000	DB-E-2
Null	#27	==>	#30	0.000	0.000	Flume E
Null	#28	==>	#30	0.000	0.000	Channel #9
Null	#29	==>	#30	0.000	0.000	Channel #10
Null	#30	==>	#37	0.000	0.000	Flume E Discharge
Null	#31	==>	#33	0.000	0.000	DB-F-1
Null	#32	==>	#33	0.000	0.000	DB-F-2
Null	#33	==>	#36	0.000	0.000	Flume F
Null	#34	==>	#36	0.000	0.000	Channel # 11
Null	#35	==>	#36	0.000	0.000	Channel #12
Null	#36	==>	#37	0.000	0.000	Flume F Discharge
Pond	#37	==>	End	0.000	0.000	Infiltration Ditch
Null	#38	==>	#3	0.000	0.000	Top Berm TB-A-1
Null	#39	==>	#3	0.000	0.000	Top Berm TB-A-2
Null	#40	==>	#9	0.000	0.000	Top Berm TB-B-1

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#41	==>	#9	0.000	0.000	Top Berm TB-B-2
Null	#42	==>	#21	0.000	0.000	Top Berm TB-D-1
Null	#43	==>	#21	0.000	0.000	Top Berm TB-D-2
Null	#44	==>	#27	0.000	0.000	Top Berm TB-E-1
Null	#45	==>	#27	0.000	0.000	Top Berm TB-E-2

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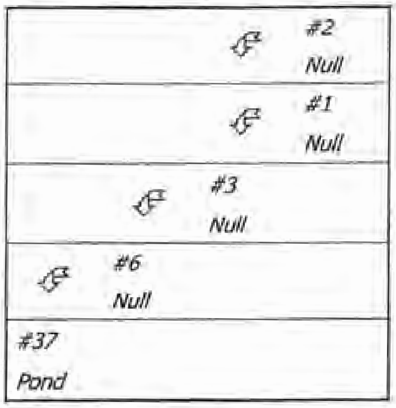
#2
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#1
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#3
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#6
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#37
Pond

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#35	2.140	2.140	2.48	0.42
#34	1.660	1.660	2.03	0.33
#32	0.710	0.710	0.87	0.14
#31	0.860	0.860	1.05	0.17
#33	0.000	1.570	1.92	0.31
#36	0.000	5.370	6.34	1.06
#29	2.630	2.630	3.04	0.52
#28	0.690	0.690	0.84	0.14
#45	1.950	1.950	2.38	0.39
#44	1.280	1.280	1.56	0.25
#26	1.720	1.720	2.10	0.34
#25	0.800	0.800	0.98	0.16
#27	0.000	5.750	7.02	1.14
#30	0.000	9.070	10.80	1.80
#23	0.680	0.680	0.83	0.13
#22	0.950	0.950	1.16	0.19
#43	1.410	1.410	1.72	0.28
#42	1.380	1.380	1.68	0.27
#20	0.780	0.780	0.95	0.15
#19	1.140	1.140	1.39	0.23
#21	0.000	4.710	5.75	0.93
#24	0.000	6.340	7.74	1.26
#17	1.220	1.220	1.49	0.24
#16	1.600	1.600	1.95	0.32
#14	0.750	0.750	0.92	0.15
#13	1.150	1.150	1.40	0.23
#15	0.000	1.900	2.32	0.38
#18	0.000	4.720	5.76	0.93
#11	1.560	1.560	1.85	0.31
#10	0.830	0.830	1.01	0.16
#41	0.460	0.460	0.56	0.09
#40	0.650	0.650	0.79	0.13
#8	0.650	0.650	0.79	0.13
#7	0.980	0.980	1.20	0.19
#9	0.000	2.740	3.34	0.54
#12	0.000	5.130	6.21	1.02
#5	0.740	0.740	0.90	0.15

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4		2.020	2.020	2.34	0.40
#39		1.500	1.500	1.83	0.30
#38		2.850	2.850	3.30	0.56
#2		0.720	0.720	0.88	0.14
#1		2.480	2.480	3.03	0.49
#3		0.000	7.550	8.92	1.50
#6		0.000	10.310	12.09	2.04
#37	In	12.500	53.440	64.18	10.58
	Out			24.43	10.58

Structure Detail:

Structure #35 (Null)

Channel #12

Structure #34 (Null)

Channel # 11

Structure #32 (Null)

DB-F-2

Structure #31 (Null)

DB-F-1

Structure #33 (Null)

Flume F

Structure #36 (Null)

Flume F Discharge

Structure #29 (Null)

Channel #10

Structure #28 (Null)

Channel #9

Structure #45 (Null)

Top Berm TB-E-2

Structure #44 (Null)

Top Berm TB-E-1

Structure #26 (Null)

DB-E-2

Structure #25 (Null)

DB-E-1

Structure #27 (Null)

Flume E

Structure #30 (Null)

Flume E Discharge

Structure #23 (Null)

Channel #8

Structure #22 (Null)

Channel #7

Structure #43 (Null)

Top Berm TB-D-2

Structure #42 (Null)

Top Berm TB-D-1

Structure #20 (Null)

DB-D-2

Structure #19 (Null)

DB-D-1

Structure #21 (Null)

Flume D

Structure #24 (Null)

Flume D Discharge

Structure #17 (Null)

Channel #6

Structure #16 (Null)

Channel #5

Structure #14 (Null)

DB-C-2

Structure #13 (Null)

DB-C-1

Structure #15 (Null)

Flume C

- *Structure #18 (Null)*
    - *Flume C Discharge*
- *Structure #11 (Null)*
    - *Channel #4*
- *Structure #10 (Null)*
    - *Channel #3*
- *Structure #41 (Null)*
    - *Top Berm TB-B-2*
- *Structure #40 (Null)*
    - *Top Berm TB-B-1*
- *Structure #8 (Null)*
    - *DB-B-2*
- *Structure #7 (Null)*
    - *DB-B-1*
- *Structure #9 (Null)*
    - *Flume B*
- *Structure #12 (Null)*
    - *Flume B Discharge*
- *Structure #5 (Null)*
    - *Channel #2*
- *Structure #4 (Null)*
    - *Channel #1*
- *Structure #39 (Null)*
    - *Top Berm TB-A-2*
- *Structure #38 (Null)*
    - *Top Berm TB-A-1*
- *Structure #2 (Null)*
    - *DB-A-2*

Structure #1 (Null)

DB-A-1

Structure #3 (Null)

Flume A

Structure #6 (Null)

Flume A Discharge

Structure #37 (Pond)

Infiltration Ditch

Pond Inputs:

Initial Pool Elev:	7.51
Initial Pool:	0.02 ac-ft

Pond Results:

Peak Elevation:	8.13
Dewater Time:	0.59 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7.50	1.900	0.000	0.000		
7.51	1.900	0.019	0.000		
7.52	1.916	0.038	19.324	12.35	
7.60	1.980	0.194	19.983	0.15	
7.70	2.061	0.396	20.822	0.25	
7.80	2.143	0.606	21.654	0.25	
7.90	2.227	0.825	22.486	0.20	
8.00	2.313	1.052	23.318	0.30	
8.10	2.392	1.287	24.150	0.30	
8.13	2.420	1.369	24.429	0.35	Peak Stage
8.20	2.474	1.530	24.982		
8.30	2.556	1.782	25.814		
8.40	2.640	2.041	26.646		
8.50	2.725	2.310	27.477		
8.60	2.805	2.586	28.309		
8.70	2.887	2.871	29.141		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
8.80	2.969	3.163	29.973	
8.90	3.053	3.465	30.805	
9.00	3.138	3.774	31.637	
9.10	3.218	4.092	32.469	
9.20	3.300	4.418	33.301	
9.30	3.382	4.752	34.133	
9.40	3.466	5.094	34.965	
9.50	3.550	5.445	35.797	
9.60	3.631	5.804	36.629	
9.70	3.713	6.171	37.461	
9.80	3.795	6.547	38.293	
9.90	3.879	6.930	39.125	
10.00	3.963	7.322	39.957	

Detailed Discharge Table

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
7.50	0.000	0.000
7.51	0.000	0.000
7.52	19.324	19.324
7.60	19.983	19.983
7.70	20.822	20.822
7.80	21.654	21.654
7.90	22.486	22.486
8.00	23.318	23.318
8.10	24.150	24.150
8.20	24.982	24.982
8.30	25.814	25.814
8.40	26.646	26.646
8.50	27.477	27.477
8.60	28.309	28.309
8.70	29.141	29.141
8.80	29.973	29.973
8.90	30.805	30.805
9.00	31.637	31.637
9.10	32.469	32.469
9.20	33.301	33.301
9.30	34.133	34.133

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
9.40	34.965	34.965
9.50	35.797	35.797
9.60	36.629	36.629
9.70	37.461	37.461
9.80	38.293	38.293
9.90	39.125	39.125
10.00	39.957	39.957

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#35	1	2.140	0.166	0.000	0.000	79.000	TR55	2.48	0.424
	Σ	**2.140**						**2.48**	**0.424**
#34	1	1.660	0.119	0.000	0.000	79.000	TR55	2.03	0.329
	Σ	**1.660**						**2.03**	**0.329**
#32	1	0.710	0.106	0.000	0.000	79.000	TR55	0.87	0.141
	Σ	**0.710**						**0.87**	**0.141**
#31	1	0.860	0.043	0.000	0.000	79.000	TR55	1.05	0.170
	Σ	**0.860**						**1.05**	**0.170**
#33	Σ	**1.570**						**1.92**	**0.311**
#36	Σ	**5.370**						**6.34**	**1.063**
#29	1	2.630	0.145	0.000	0.000	79.000	TR55	3.04	0.521
	Σ	**2.630**						**3.04**	**0.521**
#28	1	0.690	0.068	0.000	0.000	79.000	TR55	0.84	0.137
	Σ	**0.690**						**0.84**	**0.137**
#45	1	1.950	0.102	0.000	0.000	79.000	TR55	2.38	0.386
	Σ	**1.950**						**2.38**	**0.386**
#44	1	1.280	0.080	0.000	0.000	79.000	TR55	1.56	0.253
	Σ	**1.280**						**1.56**	**0.253**
#26	1	1.720	0.065	0.000	0.000	79.000	TR55	2.10	0.341
	Σ	**1.720**						**2.10**	**0.341**
#25	1	0.800	0.054	0.000	0.000	79.000	TR55	0.98	0.158
	Σ	**0.800**						**0.98**	**0.158**
#27	Σ	**5.750**						**7.02**	**1.139**
#30	Σ	**9.070**						**10.80**	**1.796**
#23	1	0.680	0.067	0.000	0.000	79.000	TR55	0.83	0.135
	Σ	**0.680**						**0.83**	**0.135**
#22	1	0.950	0.092	0.000	0.000	79.000	TR55	1.16	0.188
	Σ	**0.950**						**1.16**	**0.188**
#43	1	1.410	0.081	0.000	0.000	79.000	TR55	1.72	0.279

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**1.410**						**1.72**	**0.279**
#42	1	1.380	0.082	0.000	0.000	79.000	TR55	1.68	0.273
	Σ	**1.380**						**1.68**	**0.273**
#20	1	0.780	0.054	0.000	0.000	79.000	TR55	0.95	0.154
	Σ	**0.780**						**0.95**	**0.154**
#19	1	1.140	0.088	0.000	0.000	79.000	TR55	1.39	0.226
	Σ	**1.140**						**1.39**	**0.226**
#21	**Σ**	**4.710**						**5.75**	**0.933**
#24	**Σ**	**6.340**						**7.74**	**1.256**
#17	1	1.220	0.123	0.000	0.000	79.000	TR55	1.49	0.242
	Σ	**1.220**						**1.49**	**0.242**
#16	1	1.600	0.072	0.000	0.000	79.000	TR55	1.95	0.317
	Σ	**1.600**						**1.95**	**0.317**
#14	1	0.750	0.054	0.000	0.000	79.000	TR55	0.92	0.149
	Σ	**0.750**						**0.92**	**0.149**
#13	1	1.150	0.037	0.000	0.000	79.000	TR55	1.40	0.228
	Σ	**1.150**						**1.40**	**0.228**
#15	**Σ**	**1.900**						**2.32**	**0.376**
#18	**Σ**	**4.720**						**5.76**	**0.935**
#11	1	1.560	0.038	0.051	0.192	79.000	TR55	1.90	0.309
	Σ	**1.560**						**1.85**	**0.309**
#10	1	0.830	0.008	0.000	0.000	79.000	TR55	1.01	0.164
	Σ	**0.830**						**1.01**	**0.164**
#41	1	0.460	0.051	0.000	0.000	79.000	TR55	0.56	0.091
	Σ	**0.460**						**0.56**	**0.091**
#40	1	0.650	0.051	0.000	0.000	79.000	TR55	0.79	0.129
	Σ	**0.650**						**0.79**	**0.129**
#8	1	0.650	0.040	0.000	0.000	79.000	TR55	0.79	0.129
	Σ	**0.650**						**0.79**	**0.129**
#7	1	0.980	0.054	0.000	0.000	79.000	TR55	1.20	0.194
	Σ	**0.980**						**1.20**	**0.194**
#9	1	0.000	0.000	0.051	0.192	1.000	TR55	0.00	0.000

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**2.740**						**3.34**	**0.543**
#12	**Σ**	**5.130**						**6.21**	**1.016**
#5	1	0.740	0.073	0.000	0.000	79.000	TR55	0.90	0.147
	Σ	**0.740**						**0.90**	**0.147**
#4	1	2.020	0.158	0.000	0.000	79.000	TR55	2.34	0.400
	Σ	**2.020**						**2.34**	**0.400**
#39	1	1.500	0.075	0.000	0.000	79.000	TR55	1.83	0.297
	Σ	**1.500**						**1.83**	**0.297**
#38	1	2.850	0.137	0.000	0.000	79.000	TR55	3.30	0.564
	Σ	**2.850**						**3.30**	**0.564**
#2	1	0.720	0.050	0.000	0.000	79.000	TR55	0.88	0.143
	Σ	**0.720**						**0.88**	**0.143**
#1	1	2.480	0.117	0.000	0.000	79.000	TR55	3.03	0.491
	Σ	**2.480**						**3.03**	**0.491**
#3	1	0.000	0.000	0.000	0.000	1.000	TR55	0.00	0.000
	Σ	**7.550**						**8.92**	**1.495**
#6	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**10.310**						**12.09**	**2.042**
#37	1	12.500	0.000	0.000	0.000	79.000	TR55	15.25	2.475
	Σ	**53.440**						**64.18**	**10.583**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	3.00	5.55	185.00	1.380	0.037
		3. Short grass pasture	21.40	12.00	56.07	3.700	0.004
		6. Grassed waterway	1.93	11.00	570.00	2.080	0.076
#1	**1**	**Time of Concentration:**					**0.117**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	22.50	18.00	80.00	3.790	0.005
		6. Grassed waterway	2.38	5.00	210.00	2.310	0.025
#2	**1**	**Time of Concentration:**					**0.050**
#4	1	3. Short grass pasture	29.33	44.00	150.00	4.330	0.009
		6. Grassed waterway	0.50	2.85	570.00	1.060	0.149
#4	**1**	**Time of Concentration:**					**0.158**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	1	3. Short grass pasture	27.41	37.00	135.00	4.180	0.008
		6. Grassed waterway	0.50	1.25	250.00	1.060	0.065
#5	**1**	**Time of Concentration:**					**0.073**
#7	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	22.50	18.00	80.00	3.790	0.005
		6. Grassed waterway	2.13	5.00	235.00	2.180	0.029
#7	**1**	**Time of Concentration:**					**0.054**
#8	1	3. Short grass pasture	20.00	5.00	25.00	3.570	0.001
		3. Short grass pasture	27.27	18.00	66.00	4.170	0.004
		6. Grassed waterway	1.89	5.00	265.01	2.060	0.035
#8	**1**	**Time of Concentration:**					**0.040**
#10	1	3. Short grass pasture	27.41	37.00	135.00	4.180	0.008
#10	**1**	**Time of Concentration:**					**0.008**
#11	1	3. Short grass pasture	25.00	25.00	100.00	4.000	0.006
		6. Grassed waterway	6.67	30.00	450.00	3.870	0.032
#11	**1**	**Time of Concentration:**					**0.038**
#13	1	3. Short grass pasture	5.56	5.00	90.00	1.880	0.013
		3. Short grass pasture	20.80	26.00	125.00	3.640	0.009
		6. Grassed waterway	2.86	4.00	140.00	2.530	0.015
#13	**1**	**Time of Concentration:**					**0.037**
#14	1	3. Short grass pasture	5.88	5.00	85.00	1.940	0.012
		3. Short grass pasture	28.57	18.00	63.00	4.270	0.004
		6. Grassed waterway	2.03	6.00	295.00	2.130	0.038
#14	**1**	**Time of Concentration:**					**0.054**
#16	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.27	255.00	1.060	0.066
#16	**1**	**Time of Concentration:**					**0.072**
#17	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	2.25	450.00	1.060	0.117
#17	**1**	**Time of Concentration:**					**0.123**
#19	1	3. Short grass pasture	4.00	10.00	250.00	1.600	0.043
		3. Short grass pasture	27.69	18.00	65.00	4.200	0.004
		6. Grassed waterway	1.94	6.00	310.00	2.080	0.041
#19	**1**	**Time of Concentration:**					**0.088**
#20	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	10.42	5.00	48.00	2.580	0.005
		3. Short grass pasture	21.67	13.00	60.00	3.720	0.004
		6. Grassed waterway	2.69	6.00	223.00	2.460	0.025
#20	**1**	**Time of Concentration:**					**0.054**
#22	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.65	330.00	1.060	0.086
#22	**1**	**Time of Concentration:**					**0.092**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#23	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.17	235.00	1.060	0.061
#23	**1**	**Time of Concentration:**					**0.067**
#25	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	10.42	5.00	48.00	2.580	0.005
		3. Short grass pasture	21.67	13.00	60.00	3.720	0.004
		6. Grassed waterway	2.65	6.00	226.00	2.440	0.025
#25	**1**	**Time of Concentration:**					**0.054**
#26	1	3. Short grass pasture	3.16	6.00	190.00	1.420	0.037
		3. Short grass pasture	20.00	12.00	60.00	3.570	0.004
		6. Grassed waterway	5.00	15.00	300.00	3.350	0.024
#26	**1**	**Time of Concentration:**					**0.065**
#28	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.19	240.00	1.060	0.062
#28	**1**	**Time of Concentration:**					**0.068**
#29	1	3. Short grass pasture	22.56	44.00	195.00	3.800	0.014
		6. Grassed waterway	0.50	2.50	500.00	1.060	0.131
#29	**1**	**Time of Concentration:**					**0.145**
#31	1	3. Short grass pasture	30.23	13.00	43.00	4.390	0.002
		6. Grassed waterway	3.25	13.00	400.00	2.700	0.041
#31	**1**	**Time of Concentration:**					**0.043**
#32	1	3. Short grass pasture	3.03	10.00	330.00	1.390	0.065
		3. Short grass pasture	21.82	12.00	55.00	3.730	0.004
		6. Grassed waterway	2.07	6.00	290.00	2.150	0.037
#32	**1**	**Time of Concentration:**					**0.106**
#34	1	3. Short grass pasture	27.33	41.00	150.00	4.180	0.009
		6. Grassed waterway	0.50	2.09	420.00	1.060	0.110
#34	**1**	**Time of Concentration:**					**0.119**
#35	1	3. Short grass pasture	29.33	44.00	150.00	4.330	0.009
		6. Grassed waterway	0.50	3.00	600.00	1.060	0.157
#35	**1**	**Time of Concentration:**					**0.166**
#38	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.00	6.00	600.00	1.500	0.111
#38	**1**	**Time of Concentration:**					**0.137**
#39	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.50	4.87	325.00	1.830	0.049
#39	**1**	**Time of Concentration:**					**0.075**
#40	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.50	2.55	170.00	1.830	0.025
#40	**1**	**Time of Concentration:**					**0.051**
#41	1	3. Short grass pasture	3.00	4.94	165.00	1.380	0.033
		6. Grassed waterway	1.50	1.80	120.00	1.830	0.018

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#41	**1**	**Time of Concentration:**					**0.051**
#42	1	3. Short grass pasture	3.00	6.89	229.66	1.380	0.046
		6. Grassed waterway	1.50	3.60	240.00	1.830	0.036
#42	**1**	**Time of Concentration:**					**0.082**
#43	1	3. Short grass pasture	3.00	6.60	220.00	1.380	0.044
		6. Grassed waterway	1.50	3.75	250.00	1.830	0.037
#43	**1**	**Time of Concentration:**					**0.081**
#44	1	3. Short grass pasture	3.00	6.60	220.00	1.380	0.044
		6. Grassed waterway	1.50	3.60	240.00	1.830	0.036
#44	**1**	**Time of Concentration:**					**0.080**
#45	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.00	4.15	415.00	1.500	0.076
#45	**1**	**Time of Concentration:**					**0.102**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	1	6. Grassed waterway	0.50	0.97	195.00	1.060	0.051
#9	**1**	**Muskingum K:**					**0.051**
#11	1	6. Grassed waterway	0.50	0.97	195.00	1.060	0.051
#11	**1**	**Muskingum K:**					**0.051**

ATTACHMENT 2C

INFILTRATION BASIN DESIGN
SEDCAD+ OUTPUT
25-YEAR, 24-HOUR STORM EVENT

Perimeter Infiltration Ditch and Pond Engineering Report
Kekaha Landfill
Phase II Lateral Expansion
25-Year, 24-Hour Storm Event

Nancy K. Wright

AECOM
4135 Technology Parkway
Sheboygan, WI 53083

Phone: 920-458-8711

General Information

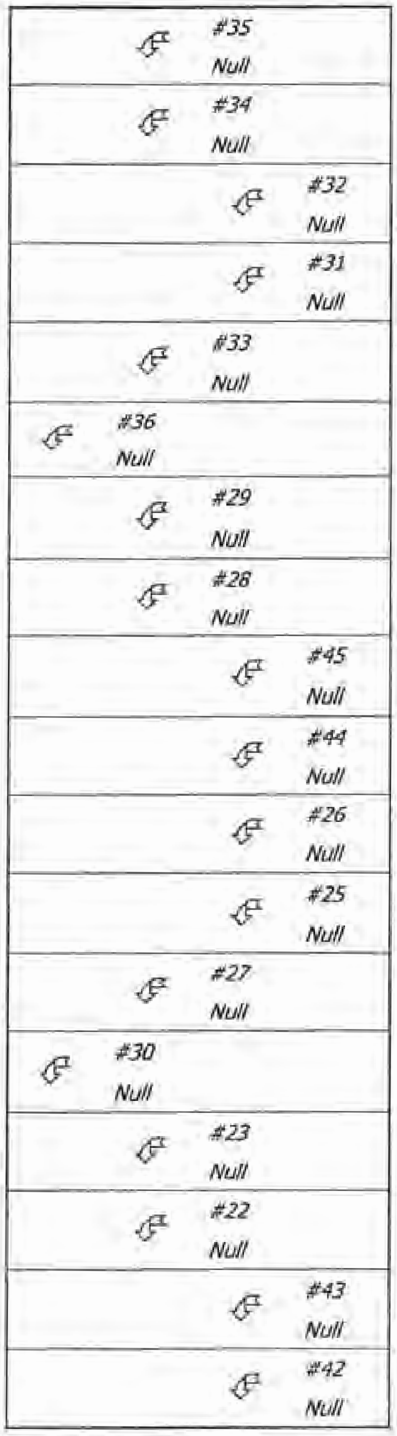
Storm Information:

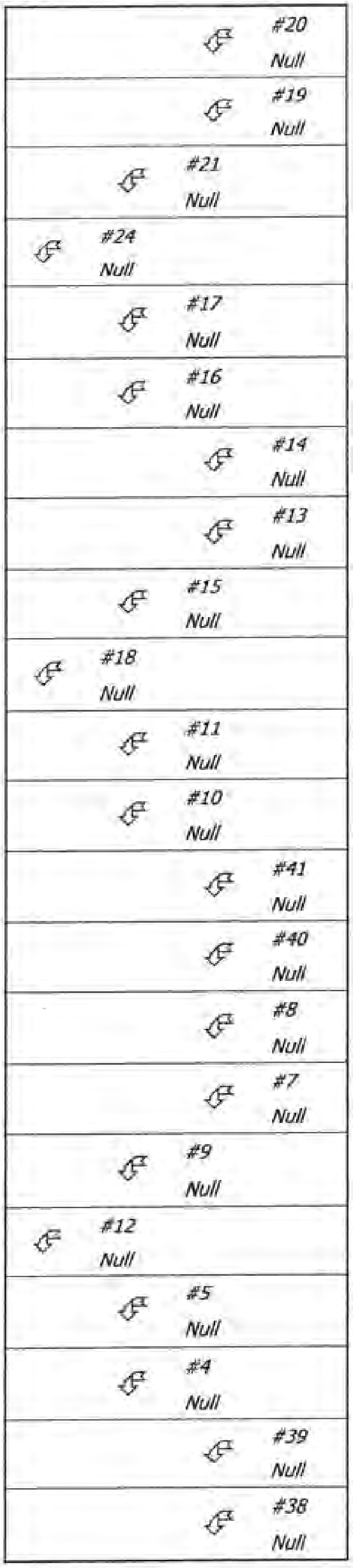
Storm Type:	NRCS Type I
Design Storm:	25 yr - 24 hr
Rainfall Depth:	8.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.000	0.000	DB-A-1
Null	#2	==>	#3	0.000	0.000	DB-A-2
Null	#3	==>	#6	0.000	0.000	Flume A
Null	#4	==>	#6	0.000	0.000	Channel #1
Null	#5	==>	#6	0.000	0.000	Channel #2
Null	#6	==>	#37	0.000	0.000	Flume A Discharge
Null	#7	==>	#9	0.000	0.000	DB-B-1
Null	#8	==>	#9	0.000	0.000	DB-B-2
Null	#9	==>	#12	0.000	0.000	Flume B
Null	#10	==>	#12	0.000	0.000	Channel #3
Null	#11	==>	#12	0.000	0.000	Channel #4
Null	#12	==>	#37	0.000	0.000	Flume B Discharge
Null	#13	==>	#15	0.000	0.000	DB-C-1
Null	#14	==>	#15	0.000	0.000	DB-C-2
Null	#15	==>	#18	0.000	0.000	Flume C
Null	#16	==>	#18	0.000	0.000	Channel #5
Null	#17	==>	#18	0.000	0.000	Channel #6
Null	#18	==>	#37	0.000	0.000	Flume C Discharge
Null	#19	==>	#21	0.000	0.000	DB-D-1
Null	#20	==>	#21	0.000	0.000	DB-D-2
Null	#21	==>	#24	0.000	0.000	Flume D
Null	#22	==>	#24	0.000	0.000	Channel #7
Null	#23	==>	#24	0.000	0.000	Channel #8
Null	#24	==>	#37	0.000	0.000	Flume D Discharge
Null	#25	==>	#27	0.000	0.000	DB-E-1
Null	#26	==>	#27	0.000	0.000	DB-E-2
Null	#27	==>	#30	0.000	0.000	Flume E
Null	#28	==>	#30	0.000	0.000	Channel #9
Null	#29	==>	#30	0.000	0.000	Channel #10
Null	#30	==>	#37	0.000	0.000	Flume E Discharge
Null	#31	==>	#33	0.000	0.000	DB-F-1
Null	#32	==>	#33	0.000	0.000	DB-F-2
Null	#33	==>	#36	0.000	0.000	Flume F
Null	#34	==>	#36	0.000	0.000	Channel # 11
Null	#35	==>	#36	0.000	0.000	Channel #12
Null	#36	==>	#37	0.000	0.000	Flume F Discharge
Pond	#37	==>	End	0.000	0.000	Infiltration Ditch
Null	#38	==>	#3	0.000	0.000	Top Berm TB-A-1
Null	#39	==>	#3	0.000	0.000	Top Berm TB-A-2
Null	#40	==>	#9	0.000	0.000	Top Berm TB-B-1

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#41	==>	#9	0.000	0.000	Top Berm TB-B-2
Null	#42	==>	#21	0.000	0.000	Top Berm TB-D-1
Null	#43	==>	#21	0.000	0.000	Top Berm TB-D-2
Null	#44	==>	#27	0.000	0.000	Top Berm TB-E-1
Null	#45	==>	#27	0.000	0.000	Top Berm TB-E-2

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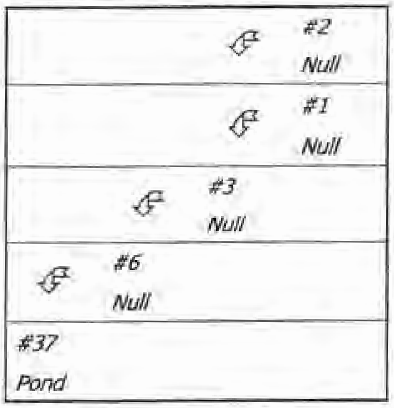
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#6
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#37
Pond

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#35	2.140	2.140	5.84	0.98
#34	1.660	1.660	4.62	0.76
#32	0.710	0.710	1.98	0.33
#31	0.860	0.860	2.39	0.39
#33	0.000	1.570	4.37	0.72
#36	0.000	5.370	14.73	2.46
#29	2.630	2.630	7.18	1.21
#28	0.690	0.690	1.92	0.32
#45	1.950	1.950	5.43	0.90
#44	1.280	1.280	3.56	0.59
#26	1.720	1.720	4.79	0.79
#25	0.800	0.800	2.23	0.37
#27	0.000	5.750	16.00	2.64
#30	0.000	9.070	24.98	4.16
#23	0.680	0.680	1.89	0.31
#22	0.950	0.950	2.64	0.44
#43	1.410	1.410	3.92	0.65
#42	1.380	1.380	3.84	0.63
#20	0.780	0.780	2.17	0.36
#19	1.140	1.140	3.17	0.52
#21	0.000	4.710	13.11	2.16
#24	0.000	6.340	17.64	2.91
#17	1.220	1.220	3.40	0.56
#16	1.600	1.600	4.45	0.73
#14	0.750	0.750	2.09	0.34
#13	1.150	1.150	3.20	0.53
#15	0.000	1.900	5.29	0.87
#18	0.000	4.720	13.14	2.17
#11	1.560	1.560	4.28	0.72
#10	0.830	0.830	2.31	0.38
#41	0.460	0.460	1.28	0.21
#40	0.650	0.650	1.81	0.30
#8	0.650	0.650	1.81	0.30
#7	0.980	0.980	2.73	0.45
#9	0.000	2.740	7.63	1.26
#12	0.000	5.130	14.22	2.35
#5	0.740	0.740	2.06	0.34

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4		2.020	2.020	5.51	0.93
#39		1.500	1.500	4.17	0.69
#38		2.850	2.850	7.78	1.31
#2		0.720	0.720	2.00	0.33
#1		2.480	2.480	6.90	1.14
#3		0.000	7.550	20.73	3.47
#6		0.000	10.310	28.20	4.73
#37	In	12.500	53.440	147.69	24.53
	Out			35.64	24.53

Structure Detail:

Structure #35 (Null)

Channel #12

Structure #34 (Null)

Channel # 11

Structure #32 (Null)

DB-F-2

Structure #31 (Null)

DB-F-1

Structure #33 (Null)

Flume F

Structure #36 (Null)

Flume F Discharge

Structure #29 (Null)

Channel #10

Structure #28 (Null)

Channel #9

Structure #45 (Null)

Top Berm TB-E-2

Structure #44 (Null)

Top Berm TB-E-1

Structure #26 (Null)

DB-E-2

Structure #25 (Null)

DB-E-1

Structure #27 (Null)

Flume E

Structure #30 (Null)

Flume E Discharge

Structure #23 (Null)

Channel #8

Structure #22 (Null)

Channel #7

Structure #43 (Null)

Top Berm TB-D-2

Structure #42 (Null)

Top Berm TB-D-1

Structure #20 (Null)

DB-D-2

Structure #19 (Null)

DB-D-1

Structure #21 (Null)

Flume D

Structure #24 (Null)

Flume D Discharge

Structure #17 (Null)

Channel #6

Structure #16 (Null)

Channel #5

Structure #14 (Null)

DB-C-2

Structure #13 (Null)

DB-C-1

Structure #15 (Null)

Flume C

- *Structure #18 (Null)*
    - *Flume C Discharge*
- *Structure #11 (Null)*
    - *Channel #4*
- *Structure #10 (Null)*
    - *Channel #3*
- *Structure #41 (Null)*
    - *Top Berm TB-B-2*
- *Structure #40 (Null)*
    - *Top Berm TB-B-1*
- *Structure #8 (Null)*
    - *DB-B-2*
- *Structure #7 (Null)*
    - *DB-B-1*
- *Structure #9 (Null)*
    - *Flume B*
- *Structure #12 (Null)*
    - *Flume B Discharge*
- *Structure #5 (Null)*
    - *Channel #2*
- *Structure #4 (Null)*
    - *Channel #1*
- *Structure #39 (Null)*
    - *Top Berm TB-A-2*
- *Structure #38 (Null)*
    - *Top Berm TB-A-1*
- *Structure #2 (Null)*
    - *DB-A-2*

Structure #1 (Null)

DB-A-1

Structure #3 (Null)

Flume A

Structure #6 (Null)

Flume A Discharge

Structure #37 (Pond)

Infiltration Ditch

Pond Inputs:

Initial Pool Elev:	7.51
Initial Pool:	0.02 ac-ft

Pond Results:

Peak Elevation:	9.48
Dewater Time:	0.58 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7.50	1.900	0.000	0.000	
7.51	1.900	0.019	0.000	
7.52	1.916	0.038	19.324	8.15
7.60	1.980	0.194	19.983	0.20
7.70	2.061	0.396	20.822	0.25
7.80	2.143	0.606	21.654	0.25
7.90	2.227	0.825	22.486	0.25
8.00	2.313	1.052	23.318	0.25
8.10	2.392	1.287	24.150	0.25
8.20	2.474	1.530	24.982	0.25
8.30	2.556	1.782	25.814	0.25
8.40	2.640	2.041	26.646	0.25
8.50	2.725	2.310	27.477	0.30
8.60	2.805	2.586	28.309	0.25
8.70	2.887	2.871	29.141	0.25
8.80	2.969	3.163	29.973	0.30

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
8.90	3.053	3.465	30.805	0.25
9.00	3.138	3.774	31.637	0.25
9.10	3.218	4.092	32.469	0.30
9.20	3.300	4.418	33.301	0.30
9.30	3.382	4.752	34.133	0.30
9.40	3.466	5.094	34.965	0.35
9.48	3.534	5.377	35.637	0.60 Peak Stage
9.50	3.550	5.445	35.797	
9.60	3.631	5.804	36.629	
9.70	3.713	6.171	37.461	
9.80	3.795	6.547	38.293	
9.90	3.879	6.930	39.125	
10.00	3.963	7.322	39.957	

Detailed Discharge Table

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
7.50	0.000	0.000
7.51	0.000	0.000
7.52	19.324	19.324
7.60	19.983	19.983
7.70	20.822	20.822
7.80	21.654	21.654
7.90	22.486	22.486
8.00	23.318	23.318
8.10	24.150	24.150
8.20	24.982	24.982
8.30	25.814	25.814
8.40	26.646	26.646
8.50	27.477	27.477
8.60	28.309	28.309
8.70	29.141	29.141
8.80	29.973	29.973
8.90	30.805	30.805
9.00	31.637	31.637
9.10	32.469	32.469
9.20	33.301	33.301
9.30	34.133	34.133

Elevation	User-input discharge (cfs)	Combined Total Discharge (cfs)
9.40	34.965	34.965
9.50	35.797	35.797
9.60	36.629	36.629
9.70	37.461	37.461
9.80	38.293	38.293
9.90	39.125	39.125
10.00	39.957	39.957

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#35	1	2.140	0.166	0.000	0.000	79.000	TR55	5.84	0.982
	Σ	**2.140**						**5.84**	**0.982**
#34	1	1.660	0.119	0.000	0.000	79.000	TR55	4.62	0.762
	Σ	**1.660**						**4.62**	**0.762**
#32	1	0.710	0.106	0.000	0.000	79.000	TR55	1.98	0.326
	Σ	**0.710**						**1.98**	**0.326**
#31	1	0.860	0.043	0.000	0.000	79.000	TR55	2.39	0.395
	Σ	**0.860**						**2.39**	**0.395**
#33	Σ	**1.570**						**4.37**	**0.721**
#36	Σ	**5.370**						**14.73**	**2.465**
#29	1	2.630	0.145	0.000	0.000	79.000	TR55	7.18	1.207
	Σ	**2.630**						**7.18**	**1.207**
#28	1	0.690	0.068	0.000	0.000	79.000	TR55	1.92	0.317
	Σ	**0.690**						**1.92**	**0.317**
#45	1	1.950	0.102	0.000	0.000	79.000	TR55	5.43	0.895
	Σ	**1.950**						**5.43**	**0.895**
#44	1	1.280	0.080	0.000	0.000	79.000	TR55	3.56	0.588
	Σ	**1.280**						**3.56**	**0.588**
#26	1	1.720	0.065	0.000	0.000	79.000	TR55	4.79	0.789
	Σ	**1.720**						**4.79**	**0.789**
#25	1	0.800	0.054	0.000	0.000	79.000	TR55	2.23	0.367
	Σ	**0.800**						**2.23**	**0.367**
#27	Σ	**5.750**						**16.00**	**2.639**
#30	Σ	**9.070**						**24.98**	**4.163**
#23	1	0.680	0.067	0.000	0.000	79.000	TR55	1.89	0.312
	Σ	**0.680**						**1.89**	**0.312**
#22	1	0.950	0.092	0.000	0.000	79.000	TR55	2.64	0.436
	Σ	**0.950**						**2.64**	**0.436**
#43	1	1.410	0.081	0.000	0.000	79.000	TR55	3.92	0.647

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**1.410**						**3.92**	**0.647**
#42	1	1.380	0.082	0.000	0.000	79.000	TR55	3.84	0.633
	Σ	**1.380**						**3.84**	**0.633**
#20	1	0.780	0.054	0.000	0.000	79.000	TR55	2.17	0.358
	Σ	**0.780**						**2.17**	**0.358**
#19	1	1.140	0.088	0.000	0.000	79.000	TR55	3.17	0.523
	Σ	**1.140**						**3.17**	**0.523**
#21	Σ	**4.710**						**13.11**	**2.162**
#24	Σ	**6.340**						**17.64**	**2.910**
#17	1	1.220	0.123	0.000	0.000	79.000	TR55	3.40	0.560
	Σ	**1.220**						**3.40**	**0.560**
#16	1	1.600	0.072	0.000	0.000	79.000	TR55	4.45	0.734
	Σ	**1.600**						**4.45**	**0.734**
#14	1	0.750	0.054	0.000	0.000	79.000	TR55	2.09	0.344
	Σ	**0.750**						**2.09**	**0.344**
#13	1	1.150	0.037	0.000	0.000	79.000	TR55	3.20	0.528
	Σ	**1.150**						**3.20**	**0.528**
#15	Σ	**1.900**						**5.29**	**0.872**
#18	Σ	**4.720**						**13.14**	**2.166**
#11	1	1.560	0.038	0.051	0.192	79.000	TR55	4.34	0.716
	Σ	**1.560**						**4.28**	**0.716**
#10	1	0.830	0.008	0.000	0.000	79.000	TR55	2.31	0.381
	Σ	**0.830**						**2.31**	**0.381**
#41	1	0.460	0.051	0.000	0.000	79.000	TR55	1.28	0.211
	Σ	**0.460**						**1.28**	**0.211**
#40	1	0.650	0.051	0.000	0.000	79.000	TR55	1.81	0.298
	Σ	**0.650**						**1.81**	**0.298**
#8	1	0.650	0.040	0.000	0.000	79.000	TR55	1.81	0.298
	Σ	**0.650**						**1.81**	**0.298**
#7	1	0.980	0.054	0.000	0.000	79.000	TR55	2.73	0.450
	Σ	**0.980**						**2.73**	**0.450**
#9	1	0.000	0.000	0.051	0.192	1.000	TR55	0.00	0.000

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**2.740**						**7.63**	**1.258**
#12	**Σ**	**5.130**						**14.22**	**2.355**
#5	1	0.740	0.073	0.000	0.000	79.000	TR55	2.06	0.340
	Σ	**0.740**						**2.06**	**0.340**
#4	1	2.020	0.158	0.000	0.000	79.000	TR55	5.51	0.927
	Σ	**2.020**						**5.51**	**0.927**
#39	1	1.500	0.075	0.000	0.000	79.000	TR55	4.17	0.688
	Σ	**1.500**						**4.17**	**0.688**
#38	1	2.850	0.137	0.000	0.000	79.000	TR55	7.78	1.308
	Σ	**2.850**						**7.78**	**1.308**
#2	1	0.720	0.050	0.000	0.000	79.000	TR55	2.00	0.330
	Σ	**0.720**						**2.00**	**0.330**
#1	1	2.480	0.117	0.000	0.000	79.000	TR55	6.90	1.138
	Σ	**2.480**						**6.90**	**1.138**
#3	1	0.000	0.000	0.000	0.000	1.000	TR55	0.00	0.000
	Σ	**7.550**						**20.73**	**3.465**
#6	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**10.310**						**28.20**	**4.732**
#37	1	12.500	0.000	0.000	0.000	79.000	TR55	34.79	5.737
	Σ	**53.440**						**147.69**	**24.529**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	3.00	5.55	185.00	1.380	0.037
		3. Short grass pasture	21.40	12.00	56.07	3.700	0.004
		6. Grassed waterway	1.93	11.00	570.00	2.080	0.076
#1	**1**	**Time of Concentration:**					**0.117**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	22.50	18.00	80.00	3.790	0.005
		6. Grassed waterway	2.38	5.00	210.00	2.310	0.025
#2	**1**	**Time of Concentration:**					**0.050**
#4	1	3. Short grass pasture	29.33	44.00	150.00	4.330	0.009
		6. Grassed waterway	0.50	2.85	570.00	1.060	0.149
#4	**1**	**Time of Concentration:**					**0.158**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	1	3. Short grass pasture	27.41	37.00	135.00	4.180	0.008
		6. Grassed waterway	0.50	1.25	250.00	1.060	0.065
#5	**1**	**Time of Concentration:**					**0.073**
#7	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	22.50	18.00	80.00	3.790	0.005
		6. Grassed waterway	2.13	5.00	235.00	2.180	0.029
#7	**1**	**Time of Concentration:**					**0.054**
#8	1	3. Short grass pasture	20.00	5.00	25.00	3.570	0.001
		3. Short grass pasture	27.27	18.00	66.00	4.170	0.004
		6. Grassed waterway	1.89	5.00	265.01	2.060	0.035
#8	**1**	**Time of Concentration:**					**0.040**
#10	1	3. Short grass pasture	27.41	37.00	135.00	4.180	0.008
#10	**1**	**Time of Concentration:**					**0.008**
#11	1	3. Short grass pasture	25.00	25.00	100.00	4.000	0.006
		6. Grassed waterway	6.67	30.00	450.00	3.870	0.032
#11	**1**	**Time of Concentration:**					**0.038**
#13	1	3. Short grass pasture	5.56	5.00	90.00	1.880	0.013
		3. Short grass pasture	20.80	26.00	125.00	3.640	0.009
		6. Grassed waterway	2.86	4.00	140.00	2.530	0.015
#13	**1**	**Time of Concentration:**					**0.037**
#14	1	3. Short grass pasture	5.88	5.00	85.00	1.940	0.012
		3. Short grass pasture	28.57	18.00	63.00	4.270	0.004
		6. Grassed waterway	2.03	6.00	295.00	2.130	0.038
#14	**1**	**Time of Concentration:**					**0.054**
#16	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.27	255.00	1.060	0.066
#16	**1**	**Time of Concentration:**					**0.072**
#17	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	2.25	450.00	1.060	0.117
#17	**1**	**Time of Concentration:**					**0.123**
#19	1	3. Short grass pasture	4.00	10.00	250.00	1.600	0.043
		3. Short grass pasture	27.69	18.00	65.00	4.200	0.004
		6. Grassed waterway	1.94	6.00	310.00	2.080	0.041
#19	**1**	**Time of Concentration:**					**0.088**
#20	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	10.42	5.00	48.00	2.580	0.005
		3. Short grass pasture	21.67	13.00	60.00	3.720	0.004
		6. Grassed waterway	2.69	6.00	223.00	2.460	0.025
#20	**1**	**Time of Concentration:**					**0.054**
#22	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.65	330.00	1.060	0.086
#22	**1**	**Time of Concentration:**					**0.092**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#23	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.17	235.00	1.060	0.061
#23	**1**	**Time of Concentration:**					**0.067**
#25	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
		3. Short grass pasture	10.42	5.00	48.00	2.580	0.005
		3. Short grass pasture	21.67	13.00	60.00	3.720	0.004
		6. Grassed waterway	2.65	6.00	226.00	2.440	0.025
#25	**1**	**Time of Concentration:**					**0.054**
#26	1	3. Short grass pasture	3.16	6.00	190.00	1.420	0.037
		3. Short grass pasture	20.00	12.00	60.00	3.570	0.004
		6. Grassed waterway	5.00	15.00	300.00	3.350	0.024
#26	**1**	**Time of Concentration:**					**0.065**
#28	1	3. Short grass pasture	28.57	30.00	105.00	4.270	0.006
		6. Grassed waterway	0.50	1.19	240.00	1.060	0.062
#28	**1**	**Time of Concentration:**					**0.068**
#29	1	3. Short grass pasture	22.56	44.00	195.00	3.800	0.014
		6. Grassed waterway	0.50	2.50	500.00	1.060	0.131
#29	**1**	**Time of Concentration:**					**0.145**
#31	1	3. Short grass pasture	30.23	13.00	43.00	4.390	0.002
		6. Grassed waterway	3.25	13.00	400.00	2.700	0.041
#31	**1**	**Time of Concentration:**					**0.043**
#32	1	3. Short grass pasture	3.03	10.00	330.00	1.390	0.065
		3. Short grass pasture	21.82	12.00	55.00	3.730	0.004
		6. Grassed waterway	2.07	6.00	290.00	2.150	0.037
#32	**1**	**Time of Concentration:**					**0.106**
#34	1	3. Short grass pasture	27.33	41.00	150.00	4.180	0.009
		6. Grassed waterway	0.50	2.09	420.00	1.060	0.110
#34	**1**	**Time of Concentration:**					**0.119**
#35	1	3. Short grass pasture	29.33	44.00	150.00	4.330	0.009
		6. Grassed waterway	0.50	3.00	600.00	1.060	0.157
#35	**1**	**Time of Concentration:**					**0.166**
#38	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.00	6.00	600.00	1.500	0.111
#38	**1**	**Time of Concentration:**					**0.137**
#39	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.50	4.87	325.00	1.830	0.049
#39	**1**	**Time of Concentration:**					**0.075**
#40	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.50	2.55	170.00	1.830	0.025
#40	**1**	**Time of Concentration:**					**0.051**
#41	1	3. Short grass pasture	3.00	4.94	165.00	1.380	0.033
		6. Grassed waterway	1.50	1.80	120.00	1.830	0.018

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#41	**1**	**Time of Concentration:**					**0.051**
#42	1	3. Short grass pasture	3.00	6.89	229.66	1.380	0.046
		6. Grassed waterway	1.50	3.60	240.00	1.830	0.036
#42	**1**	**Time of Concentration:**					**0.082**
#43	1	3. Short grass pasture	3.00	6.60	220.00	1.380	0.044
		6. Grassed waterway	1.50	3.75	250.00	1.830	0.037
#43	**1**	**Time of Concentration:**					**0.081**
#44	1	3. Short grass pasture	3.00	6.60	220.00	1.380	0.044
		6. Grassed waterway	1.50	3.60	240.00	1.830	0.036
#44	**1**	**Time of Concentration:**					**0.080**
#45	1	3. Short grass pasture	3.00	3.90	130.00	1.380	0.026
		6. Grassed waterway	1.00	4.15	415.00	1.500	0.076
#45	**1**	**Time of Concentration:**					**0.102**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	1	6. Grassed waterway	0.50	0.97	195.00	1.060	0.051
#9	**1**	**Muskingum K:**					**0.051**
#11	1	6. Grassed waterway	0.50	0.97	195.00	1.060	0.051
#11	**1**	**Muskingum K:**					**0.051**

Appendix C-3
Surface Water Downdrain Analysis

AECOM

CALCULATION SHEET

			Page 1	**Of** 13		
			Project No.	95561		
Client	County of Kaua'i	**Subject** Surface Water	**Prepared By**	NKW	**Date**	12/23/08
Project	Kekaha Landfill	Downdrain Analysis	**Reviewed By**	TCR	**Date**	12/30/08
Phase II Lateral Expansion			**Approved By**	KJB	**Date**	12/30/08

SURFACE WATER DOWNDRAIN ANALYSIS

Objective

Design a downslope channel to convey surface water runoff from the diversion berms to the perimeter channels.

Design Criteria and Assumptions

1. Downslope channels will be able to convey runoff from a 25-year, 24-hour storm event, without overflow.
2. Each downslope channel will be designed based on actual estimated flow condition.
3. Downslope channels will be sloped from 25 to approximately 29 percent toward the perimeter channels. Downslope channels will be designed for worst case slope and flow. Channel depth will depend on the shallowest slope condition. Riprap design will depend upon the steepest slope condition.
4. Downslope channels will be trapezoidal in shape. The channels will cut into the landfill, final cover installed, then riprap installed.
5. Downslope channel sideslopes will be 2:1 (horizontal:vertical).
6. Downslope channel bottom width will be either 1 foot or 2 feet.
7. Downslope channels will be lined with riprap for erosion protection.

Calculations

Each of the six downslope channels will be analyzed. The peak flow rate associated with each downslope channel is shown on the SEDCAD+ output files presented in Appendix C-2. Downslope channel locations are shown on Figure No. 1, provided in Appendix C-2.

The SEDCAD+ Channel Design Utility was used to evaluate the downslope channels. The results of these analyses are presented on pages 3 through 13.

Conclusions

The typical cross-section of the downslope channels was developed as shown on the Design Detail Drawing in the drawing set to meet the requirements of the SEDCAD+ analyses. The depths and widths of the channels vary according to the location and peak flow. Dimensions identified by the SEDCAD+ analyses were rounded up to the nearest 0.5 foot to obtain the typical cross-section. Each peak flow rate and specific slope was input into the SEDCAD+ Channel Design Utility. The results are presented on pages 3 through 13. The following schedule was developed to summarize the downslope channel designs.

AECOM

CALCULATION SHEET

Page 2 **Of** 13
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Surface Water
Downdrain Analysis

Prepared By NKW **Date** 12/23/08
Reviewed By TCR **Date** 12/30/08
Approved By KJB **Date** 12/30/08

Downslope Channel Schedule

	25-Year	Slope (Percent)			Depth (ft)		Rip-Rap Size (in)		
Channel	Peak Flow (cfs)	Min.	Max.	Width (ft)	SEDCAD+	Design	D_{min}	D_{50}	D_{max}
A	20.73	25	29	2	0.83	1.0	3	6	9
B	7.63	25	29	2	0.51	1.0	3	6	9
C	5.29	25	29	1	0.53	1.0	3	6	9
D	13.11	25	29	2	0.70	1.0	3	6	9
E	16.00	25	29	2	0.75	1.0	3	6	9
F	4.37	29	29	1	0.48	0.5	3	6	9

Downdrain Channel A -- Shallow Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	25.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.73 cfs	
Depth:	0.73 ft	0.83 ft
Top Width:	4.90 ft	5.30 ft
Velocity:	8.28 fps	
X-Section Area:	2.50 sq ft	
Hydraulic Radius:	0.478	
Froude Number:	2.04	
Manning's n:	0.0550	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel A -- Steep Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	29.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.73 cfs	
Depth:	0.71 ft	0.81 ft
Top Width:	4.82 ft	5.22 ft
Velocity:	8.62 fps	
X-Section Area:	2.40 sq ft	
Hydraulic Radius:	0.467	
Froude Number:	2.15	
Manning's n:	0.0560	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel B -- Shallow Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	25.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	7.63 cfs	
Depth:	0.41 ft	0.51 ft
Top Width:	3.64 ft	4.04 ft
Velocity:	6.58 fps	
X-Section Area:	1.16 sq ft	
Hydraulic Radius:	0.302	
Froude Number:	2.05	
Manning's n:	0.0510	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel B -- Steep Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	29.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	7.63 cfs	
Depth:	0.41 ft	0.51 ft
Top Width:	3.65 ft	4.05 ft
Velocity:	6.57 fps	
X-Section Area:	1.16 sq ft	
Hydraulic Radius:	0.302	
Froude Number:	2.05	
Manning's n:	0.0550	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

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Downdrain Channel C -- Shallow Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
1.00	2.0:1	2.0:1	25.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	5.29 cfs	
Depth:	0.43 ft	0.53 ft
Top Width:	2.73 ft	3.13 ft
Velocity:	6.56 fps	
X-Section Area:	0.81 sq ft	
Hydraulic Radius:	0.275	
Froude Number:	2.13	
Manning's n:	0.0480	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

8/13

Downdrain Channel C -- Steep Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
1.00	2.0:1	2.0:1	29.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	5.29 cfs	
Depth:	0.43 ft	0.53 ft
Top Width:	2.73 ft	3.13 ft
Velocity:	6.53 fps	
X-Section Area:	0.81 sq ft	
Hydraulic Radius:	0.275	
Froude Number:	2.12	
Manning's n:	0.0520	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel D -- Shallow Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	25.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.11 cfs	
Depth:	0.60 ft	0.70 ft
Top Width:	4.39 ft	4.79 ft
Velocity:	6.84 fps	
X-Section Area:	1.91 sq ft	
Hydraulic Radius:	0.409	
Froude Number:	1.83	
Manning's n:	0.0600	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel D -- Steep Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	29.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.11 cfs	
Depth:	0.58 ft	0.68 ft
Top Width:	4.30 ft	4.70 ft
Velocity:	7.22 fps	
X-Section Area:	1.81 sq ft	
Hydraulic Radius:	0.397	
Froude Number:	1.96	
Manning's n:	0.0600	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel E -- Shallow Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	25.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.00 cfs	
Depth:	0.65 ft	0.75 ft
Top Width:	4.59 ft	4.99 ft
Velocity:	7.51 fps	
X-Section Area:	2.13 sq ft	
Hydraulic Radius:	0.435	
Froude Number:	1.94	
Manning's n:	0.0570	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel E -- Steep Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.00	2.0:1	2.0:1	29.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.00 cfs	
Depth:	0.63 ft	0.73 ft
Top Width:	4.51 ft	4.91 ft
Velocity:	7.82 fps	
X-Section Area:	2.04 sq ft	
Hydraulic Radius:	0.425	
Froude Number:	2.05	
Manning's n:	0.0580	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Downdrain Channel F -- Steep Slope

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
1.00	2.0:1	2.0:1	29.0	0.10		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	4.37 cfs	
Depth:	0.38 ft	0.48 ft
Top Width:	2.51 ft	2.91 ft
Velocity:	6.57 fps	
X-Section Area:	0.66 sq ft	
Hydraulic Radius:	0.247	
Froude Number:	2.25	
Manning's n:	0.0480	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Appendix C-4
Surface Water Diversion Berm Analysis

AECOM

CALCULATION SHEET

Page 1 Of 6
Project No. 95561

Client County of Kaua'i	**Subject** Surface Water	**Prepared By**	NKW	**Date**	12/23/08
Project Kekaha Landfill	Diversion Berm Analysis	**Reviewed By**	TCR	**Date**	12/30/08
Phase II Lateral Expansion		**Approved By**	KJB	**Date**	12/30/08

SURFACE WATER DIVERSION BERM ANALYSIS

Objective

Design a diversion berm to intercept surface water runoff from the final cover and divert surface water runoff to the downdrain channels.

Design Criteria and Assumptions

1. Two types of diversion berms being designed for Kekaha Landfill are:
    a. Top deck drainage diversion berm.
    b. Bench (terrace) drainage channel.
2. Diversion berms will be conservatively designed to convey runoff from a 100-year, 1-hour storm event and runoff from a 25-year, 24-hour storm event both with 0.1 foot of freeboard.
3. Diversion berm designs will be based on worst case flow conditions. Peak flows are derived from SEDCAD+ output included in attachments of Appendix C-2.

Calculations

One analysis was performed to design each type of diversion berm for the Expansion. The design was performed using the peak flow rates obtained from both the 100-year, 1-hour storm event and the 25-year, 24-hour storm event. SEDCAD+ results are contained in Appendix C-2. Diversion berms are labeled as shown on Figure No. 1 in Appendix C-2.

1. Top Deck Drainage Diversion Berm

The largest flow is estimated to occur in the top deck diversion berm designated as TB-A-1, which contributes to Downdrain A. The flow in this diversion berm is estimated to be 6.83 cfs for the 100-year, 1-hour storm and 7.78 cfs for the 25-year, 24-hour storm, as shown on the SEDCAD+ output files presented in Appendix C-2. The SEDCAD+ Channel Design Utility was used to evaluate the diversion berm. The results of this analysis are presented herein on pages 3 and 4.

2. Bench/Terrace Diversion Berm

The largest flow is estimated to occur in the bench/terrace diversion berm designated as DB-A-1, contributing to Downdrain A. The flow in this diversion berm is estimated to be 6.98 cfs for the 100-year, 1-hour storm and 6.90 cfs for the 25-year, 24-hour storm, as shown on the SEDCAD+ output files presented in Appendix C-2. The SEDCAD+ Channel Design Utility was used to evaluate the diversion berm. The results of this analysis are presented herein on pages 5 and 6.

AECOM

CALCULATION SHEET

Page 2 **Of** 6

Project No. 95561

Client County of Kaua'i **Subject** Surface Water **Prepared By** NKW **Date** 12/23/08

Project Kekaha Landfill Diversion Berm Analysis **Reviewed By** TCR **Date** 12/30/08

Phase II Lateral Expansion **Approved By** KJB **Date** 12/30/08

Conclusions

Berm details resulting from this calculation are included on the design detail drawing in the plan set. Following are descriptions of the channels:

1. The top deck drainage diversion berm conservatively forms a 2.0-foot deep, v-notch, grass channel with a 2:1 sideslope. The v-notch channel is formed by the 3 percent top deck slope on one side and the 2:1 berm sideslope on the other side.

2. The bench/terrace diversion berm forms a 1.5-foot deep, trapezoidal, grass channel with a 2-foot flat bottom and 2:1 sideslopes on both sides.

Top Deck Diversion Berm A-1 -- 100-Year, 1-Hour Storm

Material: Grass mixture

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
33.0:1	2.0:1	1.0	D, B	0.10			5.0

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	6.83 cfs		6.83 cfs	
Depth:	0.68 ft	0.78 ft	1.21 ft	1.31 ft
Top Width:	23.76 ft	27.26 ft	42.18 ft	45.68 ft
Velocity:	0.85 fps		0.27 fps	
X-Section Area:	8.07 sq ft		25.41 sq ft	
Hydraulic Radius:	0.339		0.602	
Froude Number:	0.26		0.06	
Roughness Coefficient:	0.0854		0.3944	

Top Deck Diversion Berm A-1 -- 25-Year, 24-Hour Storm

Material: Grass mixture

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
33.0:1	2.0:1	1.0	D, B	0.10			5.0

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	7.78 cfs		7.78 cfs	
Depth:	0.70 ft	0.80 ft	1.24 ft	1.34 ft
Top Width:	24.67 ft	28.17 ft	43.40 ft	46.90 ft
Velocity:	0.89 fps		0.29 fps	
X-Section Area:	8.70 sq ft		26.91 sq ft	
Hydraulic Radius:	0.352		0.619	
Froude Number:	0.27		0.06	
Roughness Coefficient:	0.0830		0.3739	

Bench/Terrace Diversion Berm A-1 -- 100-Year, 1-Hour Storm

Material: Grass mixture

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	2.0	D, B	0.10			5.0

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	6.98 cfs		6.98 cfs	
Depth:	0.79 ft	0.89 ft	1.35 ft	1.45 ft
Top Width:	5.15 ft	5.55 ft	7.39 ft	7.79 ft
Velocity:	2.48 fps		1.10 fps	
X-Section Area:	2.82 sq ft		6.32 sq ft	
Hydraulic Radius:	0.510		0.788	
Froude Number:	0.59		0.21	
Roughness Coefficient:	0.0543		0.1627	

6/6

Bench/Terrace Diversion Berm A-1 -- 25-Year, 24-Hour Storm

Material: Grass mixture

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	2.0	D, B	0.10			5.0

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	6.90 cfs		6.90 cfs	
Depth:	0.78 ft	0.88 ft	1.34 ft	1.44 ft
Top Width:	5.14 ft	5.54 ft	7.37 ft	7.77 ft
Velocity:	2.46 fps		1.10 fps	
X-Section Area:	2.80 sq ft		6.29 sq ft	
Hydraulic Radius:	0.509		0.786	
Froude Number:	0.59		0.21	
Roughness Coefficient:	0.0544		0.1635	

Appendix D
Leachate Collection System Calculations

Appendix D-1
Leachate Generation Analysis

AECOM

CALCULATION SHEET

Page 1 **Of** 4
Project No. 95561

Client County of Kaua'i	**Subject** Leachate	**Prepared By** TCR	**Date** 12/24/08
Project Kekaha Landfill	Generation Analysis	**Reviewed By** NKW	**Date** 12/30/08
Phase II Lateral Expansion		**Approved By** KJB	**Date** 12/30/08

LEACHATE GENERATION ANALYSIS

Objective

Estimate the quantity of leachate generated for the Kekaha Landfill, using the USEPA Hydraulic Evaluation of Landfill Performance Version 3.07 (HELP) computer modeling program and site data.

Design Criteria and Assumptions

1. This analysis was performed to estimate leachate generation rates in Cell 1 of the Phase II lateral expansion on a per acre basis based on conditions that yield the greatest leachate quantities.
2. Active conditions are to be modeled as a conservative analysis. Active conditions refers to the situation of active waste placement (without final cover).
3. The average leachate generation rate from the existing landfill from September 2004 through June 2007, approximately 733,300 gallons per year, is used to estimate leachate generation from the existing landfill. This quantity conservatively includes leachate generated from the active area of the existing landfill. The leachate quantities also include leachate generated during 2005 and 2006, two years of above average rainfall.

HELP Model Version 3.07 Input:

1. Solar radiation data can be default data, user input or synthetically generated by the HELP model. Synthetically generated solar radiation data for Honolulu, Hawaii was used to simulate site weather conditions.
2. Temperature, precipitation, and average wind speed data was obtained from site records from January 2001 through December 2006. Missing data is viewed by the model as a "0". Therefore, to avoid skewing the data, missing temperature data for 2001 and 2002 was filled in using temperatures from days adjacent to the missing data. Data is missing for a total of 5 days in April of 2001 and 2002. Data from 2004 is missing from April 9 through May 3, and May 26 through June 19. To avoid skewing the data, these blocks of missing data from 2004 were filled in using data from the same dates in 2003. There is no missing data from 2003, 2005, and 2006.
3. Geomembrane liner pinhole density and size were assumed to account for possible manufacturing defects during geomembrane production. The HELP Model User's Guide for Version 3.07 states that the pinhole density for a typical geomembrane is 0.5 to 1 pinhole per acre. One pinhole per acre was assumed to be present.
4. The placement quality for the geomembrane liner was assumed to be "good". A placement quality of "good" according to the HELP Model User's Guide "assumes good field installation with well prepared, smooth soil surface and geomembrane wrinkle control". The HELP Model User's Guide suggests 1 to 4 installation defects for an installation quality of "good". To be conservative, 2 installation defects per acre were assumed for the geomembrane liner.
5. It is assumed that 50 percent of the area will allow rainwater runoff. This assumption is based on anticipated areas of intermediate cover that will route surface water off the landfill.

6. The HELP model was used to calculate the curve number for the cell based on the intermediate cover soil type, a slope of 28.5% (3.5:1) and a typical slope length of 200.
7. The initial moisture content of the waste layer was conservatively assumed to be at field capacity.
8. Soil layers were generally modeled using HELP model default soil characteristics (porosity, field capacity, wilting point, saturated hydraulic conductivity). The exception is the operations layer. The operations layer is assumed to have a hydraulic conductivity of 6.0×10^{-3} cm/sec.
9. The longest flow path and shallowest slope along the base liner was input, resulting in the highest potential leachate head estimate. For the liner, the longest flow path is 260 feet and the minimum slope is approximately 2.8 percent. The longest slope occurs in Cell 1a.
10. A 1-acre design area was used for modeling purposes to compute unit quantities.
11. The area of the Cell 1 Phase II lateral expansion is approximately 6.4 acres.
12. Active Condition Inputs (see also Table 1):

    - 50 feet of waste (approximate waste depth in area of first bench)
    - Bare ground conditions
    - Evaporative zone depth = 10 in. (recommended by HELP Model for bare ground for Honolulu, Hawaii)
    - Maximum leaf area index = 0 (recommended by HELP Model for bare ground)
    - Fraction of area allowing runoff = 50 percent (assumes no runoff)
    - Runoff curve number = 95.5 (calculated by HELP model)
    - Length of model run = 6 years

Help Model General Layout

Table 1: Active Condition – HELP Model Layout

(Layer Number) Layer Description	Flow	Thickness	Saturated Hydraulic Conductivity	Soil Type/ Texture Number
(1)vertical percolation	↓	12 inches	4.2×10^{-5} cm/sec	Intermediate cover/#12
(2)vertical percolation	↓	600 inches	1.0×10^{-3} cm/sec	waste/#18
(3)vertical percolation	↓	24 inches	6.0×10^{-3} cm/sec	operations layer/ #61
(4)lateral drainage	→	12 inches	3.0×10^{-1} cm/sec	gravel/ #21
(5)60-mil geomembrane Liner	↓	0.06 inch	2.0×10^{-13} cm/sec	geomembrane/#35
(6)Geosynthetic Clay Layer	↓	0.24 inches	5.0×10^{-9} cm/sec	Bentonite mat/#62

Table 2: Soil Texture Properties

Soil Texture	Soil Classification		Comments, Properties, and Uses
	USDA	USCS	
62	---	---	Based on HELP model default parameter for a bentonite mat (0.6 cm or 0.24 inches thick) with the hydraulic conductivity changed from 3 x 10^{-9} cm/sec to 5 x 10^{-9} cm/sec.
61	S	SW	Operations layer. Based on HELP model default soil parameter no. 2 with the hydraulic conductivity changed from 5.8 x 10^{-3} cm/sec to 6 x 10^{-3} cm/sec.
35	---	---	HELP model default parameters for High Density Polyethylene (HDPE) geomembrane.
21	---	---	Gravel drainage layer. HELP model default soil parameter for gravel, hydraulic conductivity of 3.0 x 10^{-1} cm/sec
18	---	---	HELP model default parameter for municipal solid waste.
12	SiCL	CL	HELP model default soil used to model intermediate cover.

Note: All soil properties are defaults of the HELP Model, Version 3.07 unless otherwise designated.

Calculations

Calculations performed by the HELP Model are included in the output located in the following pages. See Table 3 for the modeling results based on peak daily, average monthly, and peak average annual values. The HELP Model presents peak daily results in inches per day and cubic feet per day. Results for average monthly values are based on the average values for the month with the highest leachate quantity (May). The HELP Model presents the average annual results in inches per year and cubic feet per year. See the conversions below.

Peak daily lateral drainage collected from layer 4 (leachate quantity) for the 1-acre design area:

$$\left(\frac{493.55\,\text{cf}}{\text{day xacre}}\right)\left(\frac{7.48\,\text{gallons}}{1\,\text{cf}}\right) = 3{,}691.8\ \text{gal/acre/day}$$

Average monthly lateral drainage collected from layer 4 (leachate quantity) for the 1-acre design area:

$$\left(\frac{0.8271\,\text{inches}}{\text{month}}\right)\left(\frac{1\,\text{foot}}{12\,\text{inches}}\right)\left(\frac{43{,}560\,\text{sf}}{\text{acre}}\right)\left(\frac{7.48\,\text{gallons}}{1\,\text{cf}}\right)\left(\frac{\text{month}}{31\,\text{days (for May)}}\right) = 724.4\ \text{gal/acre/day}$$

Average annual lateral drainage collected from layer 4 (leachate quantity) for the 1-acre design area:

$$\left(\frac{14{,}351.9\,\text{cf}}{\text{year x acre}}\right)\left(\frac{7.48\,\text{gallons}}{1\,\text{cf}}\right)\left(\frac{\text{year}}{365\,\text{days}}\right) = 294.1\ \text{gal/acre/day}$$

AECOM

CALCULATION SHEET

Page 4 **Of** 4
Project No. 95561
Client County of Kaua'i **Subject** Leachate Generation Analysis
Project Kekaha Landfill Phase II Lateral Expansion
Prepared By TCR **Date** 12/24/08
Reviewed By NKW **Date** 12/30/08
Approved By KJB **Date** 12/30/08

Table 3: Active Condition Calculated Results From HELP Analysis Output

Parameter	Peak Daily Value	Average Monthly Value	Peak Average Annual Value
Leachate Head on Base	1.406 inches	0.1458 inches	0.059 inches
Leachate Quantity	3,691.8 gallons/acre/day	724.4 gallons/acre/day	294.1 gallons/acre/day

NOTE: Refer to pages 4 and 5 of the attached HELP Model output (filename: LATEXP2A.OUT).

Daily Lateral Expansion Leachate Estimation:

Based on peak daily leachate generation:
6.4 acres x ~~3,619.8~~ 3,691.8 gal/acre/day = ***23,627.5 gal/day***

Based on average monthly leachate generation:
6.4 acres x 724.4 gal/acre/day = ***4,636.2 gal/day***

Based on peak average annual leachate generation:
6.4 acres x 294.1 gal/acre/day = ***1,882.2 gal/day***

Existing Landfill Leachate Generation
733,300 gallons/yr or 2,009 gallons/day

Estimated Maximum Total Leachate Generation:
23,627.5 gal/day + 2,009 gal/day = 25,637.5 gal/day

Conclusions

During the active conditions when the Phase II Lateral Expansion is actively receiving waste the leachate generated in the Phase II Lateral Expansion based on peak daily values is approximately 3,619.8 gal/acre/day.

During the active conditions when the Phase II Lateral Expansion is actively receiving waste the leachate generated in the Phase II Lateral Expansion based on average monthly values is approximately 724 gal/acre/day.

During the active conditions when the Phase II Lateral Expansion is actively receiving waste the leachate generated in the Phase II Lateral Expansion based on peak average annual values is approximately 294 gal/acre/day.

These values are estimated using a waste with an initial water content at field capacity. The HELP Model was used to calculate leachate volumes and should be considered only an estimate of potential field conditions.

ATTACHMENT 1

HELP MODEL OUTPUT
(FILENAME: LATEXP2A.OUT)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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:\temp\KEK6YR.D4
TEMPERATURE DATA FILE:       C:\temp\KEK6YR.D7
SOLAR RADIATION DATA FILE:   c:\temp\KEK6YR.D13
EVAPOTRANSPIRATION DATA:     c:\temp\KEK6YR.D11
SOIL AND DESIGN DATA FILE:   c:\temp\LATEXP2A.D10
OUTPUT DATA FILE:            c:\temp\LATEXP2A.OUT


TIME:  16:43     DATE:  12/12/2008


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

     TITLE:  Kekaha Landfill Phase II- Cell 1 Lateral Exp., Open Cond.

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


     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  12
           THICKNESS                 =     12.00    INCHES
           POROSITY                  =      0.4710 VOL/VOL
           FIELD CAPACITY            =      0.3420 VOL/VOL
           WILTING POINT             =      0.2100 VOL/VOL
           INITIAL SOIL WATER CONTENT =     0.2482 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  = 0.419999997000E-04 CM/SEC
```

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

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    600.00    INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  61
THICKNESS                   =     24.00    INCHES
POROSITY                    =      0.4370 VOL/VOL
FIELD CAPACITY              =      0.0620 VOL/VOL
WILTING POINT               =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0902 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.600000005000E-02 CM/SEC


                         LAYER  4
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
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.   =  0.300000012000     CM/SEC
SLOPE                       =      2.80    PERCENT
DRAINAGE LENGTH             =    260.0     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         =      1.00    HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00    HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

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

                       TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  62
    THICKNESS                     =        0.24    INCHES
    POROSITY                      =        0.7500 VOL/VOL
    FIELD CAPACITY                =        0.7470 VOL/VOL
    WILTING POINT                 =        0.4000 VOL/VOL
    INITIAL SOIL WATER CONTENT    =        0.7500 VOL/VOL
    EFFECTIVE SAT. HYD. COND.     =    0.499999997000E-08 CM/SEC


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

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE
           GROUND CONDITIONS, A SURFACE SLOPE OF 28.% AND
           A SLOPE LENGTH OF  200. FEET.

  SCS RUNOFF CURVE NUMBER            =       95.50
  FRACTION OF AREA ALLOWING RUNOFF   =       50.0     PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE =        1.000   ACRES
  EVAPORATIVE ZONE DEPTH             =       10.0     INCHES
  INITIAL WATER IN EVAPORATIVE ZONE  =        2.294   INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE =        4.710   INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE =        2.100   INCHES
  INITIAL SNOW WATER                 =        0.000   INCHES
  INITIAL WATER IN LAYER MATERIALS   =      180.907   INCHES
  TOTAL INITIAL WATER                =      180.907   INCHES
  TOTAL SUBSURFACE INFLOW            =        0.00    INCHES/YEAR


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

  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           HONOLULU              HAWAII

       STATION LATITUDE                         =  21.33 DEGREES
       MAXIMUM LEAF AREA INDEX                  =   0.00
       START OF GROWING SEASON (JULIAN DATE)    =      0
       END OF GROWING SEASON (JULIAN DATE)      =    367
       EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
       AVERAGE ANNUAL WIND SPEED                =   3.78 MPH
       AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  72.00 %
       AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  66.00 %
       AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  66.00 %
       AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  70.00 %
```

```
     NOTE:  PRECIPITATION DATA FOR      KEKAHA/SITE          HAWAII
              WAS ENTERED FROM AN ASCII DATA FILE.


     NOTE:  TEMPERATURE DATA FOR      KEKAHA/SITE          HAWAII
              WAS ENTERED FROM AN ASCII DATA FILE.


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR    HONOLULU              HAWAII
                AND STATION LATITUDE  =  21.33 DEGREES


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

     AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                   2.47     2.13     4.33     0.69     0.48     0.77
                            0.19     0.45     1.04     1.67     1.29     1.61

   STD. DEVIATIONS          3.62     2.09     8.41     0.76     0.37     0.41
                            0.16     0.47     0.81     1.90     0.57     2.92

 RUNOFF
 ------
   TOTALS                  0.548    0.537    1.219    0.057    0.007    0.060
                           0.001    0.049    0.060    0.258    0.146    0.332

   STD. DEVIATIONS         1.239    0.809    2.910    0.115    0.014    0.092
                           0.004    0.091    0.092    0.536    0.143    0.771

 EVAPOTRANSPIRATION
 ------------------
   TOTALS                  1.328    0.898    1.489    1.009    0.515    0.306
                           0.247    0.472    0.746    0.992    1.119    0.714

   STD. DEVIATIONS         1.433    0.602    1.433    1.009    0.627    0.162
                           0.113    0.496    0.745    1.065    0.717    0.510

 LATERAL DRAINAGE COLLECTED FROM LAYER  4
 ----------------------------------------
   TOTALS                 0.0509   0.4311   0.6832   0.6150   0.8271   0.6306
                          0.2034   0.0933   0.0891   0.1076   0.1431   0.0792

   STD. DEVIATIONS        0.0627   0.9788   1.2211   0.6643   1.4656   1.2682
                          0.3075   0.0879   0.1099   0.1664   0.2804   0.1022
```

```
 PERCOLATION/LEAKAGE THROUGH LAYER  6
 ------------------------------------
   TOTALS                 0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                          0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

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


-------------------------------------------------------------------------------
             AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  5
 -------------------------------------
   AVERAGES               0.0090    0.0840    0.1204    0.1120    0.1458    0.1149
                          0.0359    0.0164    0.0162    0.0190    0.0261    0.0140

   STD. DEVIATIONS        0.0111    0.1910    0.2152    0.1210    0.2583    0.2310
                          0.0542    0.0155    0.0200    0.0293    0.0511    0.0180

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


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

   AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2006
-------------------------------------------------------------------------------
                                   INCHES           CU. FEET        PERCENT
                             -------------------  -------------    ---------
PRECIPITATION                17.12     (  10.514)    62151.7       100.00

RUNOFF                        3.275    (  3.3743)    11889.56       19.130

EVAPOTRANSPIRATION            9.836    (  3.5984)    35703.66       57.446

LATERAL DRAINAGE COLLECTED    3.95368 (  4.54080)   14351.870      23.09169
  FROM LAYER  4

PERCOLATION/LEAKAGE THROUGH   0.00001 (  0.00001)        0.032      0.00005
  LAYER  6

AVERAGE HEAD ON TOP           0.059 (     0.068)
  OF LAYER  5

CHANGE IN WATER STORAGE       0.057    (  2.5640)      206.53        0.332
*******************************************************************************
```

```
******************************************************************************

                PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2006
------------------------------------------------------------------------
                                                 (INCHES)      (CU. FT.)
                                                ----------   -------------
     PRECIPITATION                                 4.04       14665.200

     RUNOFF                                        2.118       7686.8984

     DRAINAGE COLLECTED FROM LAYER  4              0.13596      493.55292

     PERCOLATION/LEAKAGE THROUGH LAYER  6          0.000000       0.00090

     AVERAGE HEAD ON TOP OF LAYER  5               0.743

     MAXIMUM HEAD ON TOP OF LAYER  5               1.406

     LOCATION OF MAXIMUM HEAD IN LAYER  4
           (DISTANCE FROM DRAIN)                  13.7 FEET

     SNOW WATER                                    0.00           0.0000


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                     0.4154

     MINIMUM VEG. SOIL WATER (VOL/VOL)                     0.2100

      ***  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 2006
    ----------------------------------------------------------------------

               LAYER          (INCHES)        (VOL/VOL)
               -----          --------        ---------

                 1             2.7839          0.2320

                 2           175.2000          0.2920

                 3             2.6884          0.1120

                 4             0.3957          0.0330

                 5             0.0000          0.0000

                 6             0.1800          0.7500

              SNOW WATER       0.000

******************************************************************************
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Appendix D-2

Leachate Collection Pipe Flow Capacity Analysis and Perforation Sizing

AECOM

CALCULATION SHEET

Page 1 **Of** 3
Project No. 95561
Client County of Kaua'i **Subject** Leachate Pipe Flow Capacity Analysis
Project Kekaha Landfill Phase II Lateral Expansion
Prepared By TCR **Date** 12/24/08
Reviewed By MZ **Date** 12/30/08
Approved By KJB **Date** 12/30/08

LEACHATE PIPE FLOW CAPACITY ANALYSIS

Objective

To evaluate the leachate collection and transfer pipe flow capacity of the proposed leachate management system and determine the maximum allowable area draining to the leachate collection and transfer pipes based on pipe capacity.

Design Criteria and Assumptions

1. Use Manning's equation to calculate the allowable leachate collection pipe flow.
2. The existing leachate collection and transfer pipe is 8-inch HDPE SDR 9.3 pipe. The outside diameter (OD) of the pipe is about 8.625 inches, the wall thickness is about 0.927 inches and the inside diameter (ID) is about 6.771 inches (see Attachment 1).
3. The Manning's "n" for gravity flow in HDPE pipe is approximately 0.011.
4. The 8-inch diameter pipes will be evaluated for two scenarios, at 1 percent slope and 2 percent slope.
5. The maximum leachate generation rate is 3,691.8 gpad under active conditions based upon the leachate generation calculation.

Calculations

Allowable Flow:

Determine the maximum allowable flow, assuming the pipe is flowing full. (Note: Gravity pipes carry more liquid when running 85 percent to 95 percent full than when 100 percent full):

Manning's Equation:

$$Q_{allow} = \frac{1.49}{n} A R_h^{2/3} S^{1/2}$$

Where Q_{allow} = allowable flow rate, ft^3/sec
n = Manning's roughness coefficient ≈ 0.011 for HDPE pipe
A = cross-sectional area of the pipe, ft^2
R_h = hydraulic radius, ft
= ID/4 for full flow
S = slope of pipe

AECOM

CALCULATION SHEET

Page 2 **Of** 3
Project No. 95561
Client County of Kaua'i **Subject** Leachate Pipe **Prepared By** TCR **Date** 12/24/08
Project Kekaha Landfill Flow Capacity Analysis **Reviewed By** MZ **Date** 12/30/08
Phase II Lateral Expansion **Approved By** KJB **Date** 12/30/08

For 1 Percent Slope.

Determine the values for each factor:

$$A = \frac{(6.771)^2 \pi}{4} = 36.0 \text{ in}^2 = 0.25 \text{ ft}^2$$

R_h = ID/4 = (6.771)/4 inches= 1.69 inches = 0.14 f

S = 0.010

$$Q_{allow} = \frac{1.49}{n} AR_h^{\frac{2}{3}} S^{0.5}$$

$$Q_{allow} = \frac{1.49}{0.011}(0.25)(0.14)^{\frac{2}{3}}(0.010)^{0.5} = 0.91 \text{ cfs} = 408 \text{ gpm} = 587{,}520 \text{ gpd}$$

Allowable Drainage Area for One Leachate Collection Pipe at 1 Percent Slope:

$$= \frac{\text{Allowable Flow}}{\text{Leachate Generated per acre}} = \frac{587{,}520 \text{ gpd}}{3{,}691.8 \text{ gpad}} = 159 \text{ acres}$$

For 2 Percent Slope:

Determine the values for each factor:

$$A = \frac{(6.771)^2 \pi}{4} = 36.0 \text{ in}^2 = 0.25 \text{ ft}^2$$

R_h= ID/4 = (6.771)/4 inches= 1.67 inches = 0.14 f

S = 0.020

$$Q_{allow} = \frac{1.49}{n} AR_h^{\frac{2}{3}} S^{0.5}$$

$$Q_{allow} = \frac{1.49}{0.011}(0.25)(0.14)^{\frac{2}{3}}(0.020)^{0.5} = 1.29 \text{ cfs} = 579 \text{ gpm} = 833{,}760 \text{ gpd}$$

Allowable Drainage Area for One Leachate Collection Pipe at 2 Percent Slope:

$$= \frac{\text{Allowable Flow}}{\text{Leachate Generated per acre}} = \frac{833{,}760 \text{ gpd}}{3{,}691.8 \text{ gpad}} = 225 \text{ acres}$$

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CALCULATION SHEET

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		Project No. 95561			
Client County of Kaua'i	**Subject** Leachate Pipe	**Prepared By**	TCR	**Date**	12/24/08
Project Kekaha Landfill	Flow Capacity Analysis	**Reviewed By**	MZ	**Date**	12/30/08
Phase II Lateral Expansion		**Approved By**	KJB	**Date**	12/30/08

Conclusion

Based on the above calculations, the 8-inch diameter HDPE SDR 9.3 leachate collection or transfer pipe will provide sufficient flow capacity to convey the anticipated amount of leachate generated under active conditions in approximately 159 acres for a pipe at a 1 percent slope and approximately 225 acres for a pipe at a 2 percent slope. Therefore, the leachate pipe has sufficient capacity to collect and transmit leachate flows in the Phase II Lateral Expansion at Kekaha Landfill.

Attachment 1

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		7	3.88	0.795	5.172
		7.3	3.95	0.762	4.996
		9	4.25	0.618	4.182
		9.3	4.29	0.598	4.065
		11	4.49	0.506	3.505
5	5.563	11.5	4.54	0.484	3.368
		13.5	4.69	0.412	2.912
		15.5	4.80	0.359	2.564
		17	4.87	0.327	2.353
		21	5.00	0.265	1.929
		26	5.11	0.214	1.574
		32.5	5.20	0.171	1.270
		7	4.62	0.946	7.336
		7.3	4.70	0.908	7.086
		9	5.06	0.736	5.932
		9.3	5.11	0.712	5.765
		11	5.35	0.602	4.971
6	6.625	11.5	5.40	0.576	4.777
		13.5	5.58	0.491	4.130
		15.5	5.72	0.427	3.637
		17	5.80	0.390	3.338
		21	5.96	0.315	2.736
		26	6.08	0.255	2.233
		32.5	6.19	0.204	1.801
		7	6.01	1.232	12.433
		7.3	6.12	1.182	12.010
		9	6.59	0.958	10.054
		9.3	6.66	0.927	9.771
		11	6.96	0.784	8.425
8	8.625	11.5	7.04	0.750	8.096
		13.5	7.27	0.639	7.001
		15.5	7.45	0.556	6.164
		17	7.55	0.507	5.657
		21	7.75	0.411	4.637
		26	7.92	0.332	3.784

AECOM

CALCULATION SHEET

Page 1 **Of** 4
Project No. 95561

Client County of Kaua'i	**Subject** Leachate	**Prepared By**	TCR	**Date**	12/24/08
Project Kekaha Landfill	Collection Pipe Perforation	**Reviewed By**	MZ	**Date**	12/30/08
Phase II Lateral Expansion	Sizing	**Approved By**	KJB	**Date**	12/30/08

LEACHATE COLLECTION PIPE PERFORATION SIZING

Objective

Determine if the proposed pipe perforations in the leachate collection pipe of Cell 1 will be able to maintain leachate flow into the pipe for the estimated leachate quantity and verify proposed granular drainage layer particle sizing verses perforation sizing.

Design Criteria and Assumptions

1. The length of proposed leachate collection pipe is as follows:

    a. 185 ft in Cell 1A
    b. 192 ft in Cell 1B
    c. 200 ft in Cell 1C
    d. 264 ft in Cell 1D

2. Proposed pipe perforations are located in two rows along the bottom of the pipe and alternately spaced 5 inches center-to-center. The diameter of the pipe perforation is 0.5 inches.

3. For conservatism, the average monthly leachate generation rate is used in verifying the flow through the perforations. From the leachate generation analysis calculation (Appendix D-1), the leachate generation rate is 724.4 gallons/acre/day.

4. The area of each subcell in Cell 1 is as follows:

    a. Cell 1A – 1.79 acres
    b. Cell 1B – 1.45 acres
    c. Cell 1C – 1.58 acres
    d. Cell 1D – 1.36 acres

5. The average particle size (D_{50}) of the granular drainage layer is 1.0 inch.

Calculations

Leachate Flow

Cell 1A: 1.79 ac x 3,691.8 gal/ac/day = 6,608.3 gal/day
Cell 1B: 1.45 ac x 3,691.8 gal/ac/day = 5,353.1 gal/day
Cell 1C: 1.58 ac x 3,691.8 gal/ac/day = 5,833.0 gal/day
Cell 1D: 1.36 ac x 3,691.8 gal/ac/day = 5,020.8 gal/day

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CALCULATION SHEET

Page 2 **Of** 4
Project No. 95561

Client	County of Kaua'i	**Subject** Leachate	**Prepared By**	TCR	**Date** 12/24/08
Project	Kekaha Landfill	Collection Pipe Perforation	**Reviewed By**	MZ	**Date** 12/30/08
Phase II Lateral Expansion		Sizing	**Approved By**	KJB	**Date** 12/30/08

Total Pipe Perforations

Determine the total number of perforation available on the proposed leachate collection pipe.

Where: L = Length of perforated pipe.
S = Spacing center-to-center of perforations
H = Number of perforation per side

Solving:

$$P_{total} = L * \left(\frac{1}{S}\right) * \left(\frac{12''}{1ft}\right) * (H)$$

For Cell 1A:

$$P_{1A} = 185\,ft * \left(\frac{1}{5''}\right) * \left(\frac{12''}{1ft}\right) * (2) = 888$$

The proposed pipe in Cell 1A will have 888 perforations.

For Cell 1B:

$$P_{1B} = 192\,ft * \left(\frac{1}{5''}\right) * \left(\frac{12''}{1ft}\right) * (2) = 921$$

The proposed pipe in Cell 1B will have 921 perforations.

For Cell 1C:

$$P_{1C} = 200\,ft * \left(\frac{1}{5''}\right) * \left(\frac{12''}{1ft}\right) * (2) = 960$$

The proposed pipe in Cell 1C will have 960 perforations

For Cell 1D:

$$P_{1D} = 264\,ft * \left(\frac{1}{5''}\right) * \left(\frac{12''}{1ft}\right) * (2) = 1{,}267$$

The proposed pipe in Cell 1D will have 1,267 perforations

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CALCULATION SHEET

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		Project No. 95561			
Client County of Kaua'i	**Subject** Leachate	**Prepared By**	TCR	**Date**	12/24/08
Project Kekaha Landfill	Collection Pipe Perforation	**Reviewed By**	MZ	**Date**	12/30/08
Phase II Lateral Expansion	Sizing	**Approved By**	KJB	**Date**	12/30/08

Flow Per Perforation

The flow per though each perforation can be determined by applying Q=VA, where:

Q = flow rate
A = area of perforation, or $(D^2/4)^*\pi = 0.00137$ sft.
V = flow velocity, 1 foot per second (conservative)

Solving:

$$Q=(A)*(V)$$
$$Q=(0.00137sf)*(1fps)$$
$$Q=0.00137cfs*\left(\frac{1gal}{7.48cf}\right)*\left(\frac{60\sec}{1\min}\right)*\left(\frac{60\min}{1hr}\right)\left(\frac{24hr}{1day}\right)$$
$$Q=15.8gal/day$$

Each perforation will handle 15.8 gal/day of leachate.

Required Total Number of Perforations

The required total number of perforations needed to accommodate the Average Monthly Flow of leachate is:

Cell 1A:

$$P_{required}=(6{,}608.3\,gal/day)*\left(\frac{day-perforation}{15.8gal}\right)=419$$

The total number of perforations required is 419 < 888 perforations available on the leachate collection pipe, or 47.2 percent of the available perforations.

Cell 1B:

$$P_{required}=(5{,}353.1\,gal/day)*\left(\frac{day-perforation}{15.8gal}\right)=339$$

The total number of perforations required is 339 < 921 perforations available on the leachate collection pipe, or 36.8 percent of the available perforations.

Cell 1C:

$$P_{required}=(5{,}833.0\,gal/day)*\left(\frac{day-perforatio\ n}{15.8gal}\right)=370$$

The total number of perforations required is 370 < 960 perforations available on the leachate collection pipe, or 38.5 percent of the available perforations.

Cell 1D:

$$P_{required} = (5{,}020.8\, gal/day)*\left(\frac{day - perforation}{15.8 gal}\right) = 318$$

The total number of perforations required is 318 < 1,267 perforations available on the leachate collection pipe, or 25.1 percent of the available perforations.

Grain Size Criteria of Filter Materials in Relation to Pipe Perforations

To verify specified granular drainage layer particle sizing verse perforations in the leachate collection piping and sideslope riser pipes, the U.S. Bureau of Reclamation formula for grain size criteria of filter materials next to perforations in pipes (Reference 1) is applied. The formula is:

(D_{85} of the filter nearest the pipe) / (Maximum pipe opening) = 2 or greater

Solving the equation based upon a pipe perforation of 0.5 inches we obtain:

$$\frac{D_{85}}{0.5''} = 2, solving : D_{85} = 1.0''$$

The required granular drainage layer against the pipe perforations at D_{85} (or the particle size at which 85 percent of the sample is smaller) should be 1 inch. The specified average particle size for the granular drainage layer, or D_{50}, is 1 inch. Therefore the D_{85} of the granular drainage layer will be larger than 1 inch and meets the requirements for particle size versus pipe perforations.

Conclusions

The leachate collection pipe as proposed contains more than enough perforations to handle the Average Monthly Flow of leachate. The excess perforations are anticipated to be more than adequate to handle peak conditions or plugged perforations.

The specified granular drainage layer with an average particle size of 1 inch will meet the requirements for placement along piping perforated with 0.5 inch holes.

References

1. Qian, Xuede; Koerner, Robert M.; Gray, Donald H., "Geotechnical Aspects of Landfill Design and Construction", page 302.

Appendix D-3
Leachate Collection and Extraction Riser Pipe Strength Analysis

AECOM

CALCULATION SHEET

Page 1 **Of** 9
Project No. 95561
Client County of Kaua'i **Subject** Pipe Strength Analysis **Prepared By** TCR **Date** 12/23/08
Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** MZ **Date** 12/23/08
Approved By KJB **Date** 12/30/08

PIPE STRENGTH ANALYSIS

Objective

Leachate collection pipes will be located at the low points on the base liner. The pipes will be subjected to increased overburden pressures as waste filling progresses. The pipes will be evaluated for compressive ring thrust (wall crushing), ring deflection, and wall buckling.

Design Criteria and Assumptions

1. Leachate collection pipe will be 8-inch diameter, SDR 9.3, HDPE pipe I.D. = 6.66 inches, minimum wall thickness = t = 0.927, from reference 1 (refer to page 9 in Attachment 1).
2. Largest waste height at closure over the leachate collection pipe will be approximately 62 feet (final grade of 85.0 feet MSL and a base grade of 17.0 feet MSL less 3 feet of final cover soils and 3 feet of granular and operations layers above base grade). Note that the largest waste height over the leachate collection pipe is conservatively set equal to the maximum waste depth.
3. The unit weight of cover soil, granular layer, and operations layer material was assumed to be 100 lbs/ft^3. The unit weight of waste was assumed to be 55 lbs/ft^3.
4. The leachate collection pipes will be perforated in the lower quarters. Research (Reference 2) indicates that inclusion of perforations in the lower quarters of the pipe has no significant changes on pipe deflection versus load performance. Thus, the perforated pipe stiffness is assumed the same as that of the solid pipe.
5. An approximately 120,000-pound compactor as the live load (Caterpillar 836).
6. To be conservative, calculate the live load as a concentrated load.
7. Conservatively assume the temperature of the leachate drainage layer is equal to the temperature of the pipes and is 100°F (37.8°C) (see Attachment 2). The apparent modulus of elasticity for HDPE pipe is 23,000 psi (see Table 3-1 in Attachment 1).

Methodology Reference:

1. Evaluation of buried pipes will follow procedure outlined in the "PPI Handbook of Polyethylene Pipe", downloaded May 2006 www.plasticpipe.org/general/ppihandbook.php.
2. Daniel P. Dietzler, "Structural Design of Landfill Leachate Collection System." Sixth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 14-15, 1983.

Methodology

(1) Calculate the total external pressure, P_T, at the top of the pipe. P_T is composed of three components: pressure due to static loads, pressure due to live loads, and apparent pressure due to internal vacuum. The total external pressure is determined for two cases, one with shallow soil height over the pipe, one with maximum soil height over pipe:

$$P_T = P_s + P_L + P_i \qquad <1a>$$

Where:
P_s = total "static load" pressure, soil dead load
P_L = total "live load" pressure
P_i = total effective external pressure due to internal vacuum

The total "static load" pressure, soil dead load, P_s, at the top of the pipe for the two cases is conservatively calculated using a prism load.

$$P_s = \Sigma(w * H) \qquad <1b>$$

Where:
w = unit weight of waste or soil above the pipe
H = height of waste or soil above the pipe

The total "live load" pressure, vehicle traffic load, P_L, at the top of the pipe for the two cases is calculated using Boussinesq's Equation.

$$P_L = \frac{3 \times I_F \times W_L \times H^3}{2 \times \pi \times r^5} \qquad <2>$$

Where:
P_L = live load, psf
I_F = impact factor
W_L = wheel load, lb
H = depth of cover, ft.
r = distance from the point of load application to pipe crown, ft.

(2) Examine compressive ring thrust (wall crushing) by calculating the compressive stress, S_A:

$$S_A = \frac{(P_{RD}) \times DR}{288} \qquad <3>$$

Where:
S_A = compressive stress, psi
P_{RD} = radial directed earth pressure, psf
DR = dimension Ration, D_O/t
D_O = pipe outside diameter, in.
t = pipe wall thickness, in.

$P_{RD} = (VAF) \times w \times H = (VAF) \times P_T$ < 4 >

Where:
P_{RD} = radial directed earth pressure, psf
VAF = Vertical Arching Factor
w = unit weight of soil, pcf
H = depth of cover, ft.
P_T = total external pressure, psf

$VAF = 0.88 - 0.71 \times \dfrac{S_R - 1}{S_R + 2.5}$ < 5 >

Where:
VAF = Vertical Arching Factor
S_R = hoop thrust stiffness ratio

$S_R = \dfrac{1.43 \times M_S \times r_{CENT}}{E \times t}$ < 6 >

Where:
S_R = hoop thrust stiffness ratio
M_S = one-dimensional modulus of soil, psi
r_{CENT} = radius to centroidal axis of pipe, in.
E = apparent modulus of elasticity of pipe material, psi
t = pipe wall thickness

The recommended long-term compressive strength design value is 780 psi for PE 3408 pipe at 100° F (1,000 psi x 0.78, see Tables 1-3 and 2-12 in Attachment 1)

$S_A \leq 780$ psi

(3) Examine ring deflection of the pipe by calculating the deflection, $\Delta X/D_M$:

$\Delta X/D_M = D_F \times \varepsilon$ < 7 >

Where:
$\Delta X/D_M$ = deflection
D_F = deformation factor
ε = soil strain

$\varepsilon = \dfrac{w \times H}{144 \times E_S} = \dfrac{P_T}{144 \times E_S}$ < 8 >

Where:
P_T = total external pressure, psf
w = unit weight of soil, pcf
H = depth of soil cover, ft.
E_S = secant modulus of the soil, psi

D_F is determined from Figure 2-6 of Attachment 1 using the rigidity factor, R_F

$R_F = \dfrac{12 \times E_S \times (DR - 1)^3}{E}$ < 9 >

Where: E_S = secant modulus of the soil (soil strain), psi
DR = dimension ratio
E = apparent modulus of elasticity of pipe material, psi

$$E_S = M_S \times \frac{(1+\mu) \times (1 - 2 \times \mu)}{(1-\mu)} \qquad <10>$$

Where: M_S = one-dimensional modulus
μ = poisson's ratio of soil

The recommended allowable ring deflection for non-pressure HDPE pipe and accounting for a large safety factor is 7.5% (see page 2 in Attachment 1).

(4) Calculate the allowable pipe wall buckling pressure, P_{CR}.

$$P_{CR} = \frac{2.4 \times \varphi \times R_H}{D_M} \times (E \times I)^{1/3} \times (E_S{}^*)^{2/3} \qquad <11>$$

Where: P_{CR} = allowable buckling pressure, psi
φ = calibration factor, 0.55 for granular soils (see page 7 in Attachment 1)
R_H = geometry factor, 1 (for deep burial, see page 7 in Attachment 1)
D_M = mean diameter ($D_O - t$), in.
D_O = pipe outside diameter, in.
t = pipe wall thickness, in.
E = apparent modulus of elasticity of pipe material, psi
I = pipe wall moment of inertia, in^4/in (t^3/12, if solid wall construction)
$E_S{}^*$ = $E_S/(1-\mu)$
E_S = secant modulus of the soil, psi
μ = poisson's ratio of soil

The allowable buckling pressure should be compared to the total "static load" pressure, P_T, on the pipe.

$$P_{CR} \geq P_T$$

AECOM

CALCULATION SHEET

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				Project No.	95561		
Client	County of Kaua'i	**Subject**	Pipe Strength	**Prepared By**	TCR	**Date**	12/23/08
Project	Kekaha Landfill	Analysis		**Reviewed By**	MZ	**Date**	12/23/08
Phase II Lateral Expansion				**Approved By**	KJB	**Date**	12/30/08

Calculations

I. 8-inch HDPE Leachate Collection Pipe

A. Compressive Ring Thrust (Wall Crushing) Analysis

The compressive stress, S_A, by equation 3:

$$S_A = \frac{(P_{RD}) \times DR}{288} \qquad < 3 >$$

Where:
S_A = compressive stress, psi
P_{RD} = radial directed earth pressure, psf
DR = dimension Ratio, D_O/t
D_O = pipe outside diameter, in.

$$P_T = P_s + P_L + P_i \qquad < 1a >$$

Where:
P_T = total external pressure, psf
P_s = total "static load" pressure, soil dead load
P_L = total "live load" pressure
P_i = total effective external pressure due to internal vacuum

The leachate collection pipe will have no internal pressure. Therefore, $P_i = 0.0$ psi for both shallow and largest soil height cases.

Total "static load" pressure on pipe, equation < 1b >

$$P_s = \Sigma(w * H) \qquad < 1b >$$

Where:
w_{soil} = 100 pcf, unit weight of soil above pipe
w_{waste} = 55 pcf, unit weight of waste

Shallow waste height (during waste filling):

H_{soil} = 3 ft (granular drainage and operation layers)
H_{waste} = 5 ft
$P_s = [(100 \text{ pcf} \times 3 \text{ ft}) + (55 \text{ pcf} \times 5 \text{ ft})] \times 1 \text{ ft}^2/144 \text{ in}^2$
$P_s = 3.99$ psi

Largest waste height:

H_{soil} = 3 ft cover + 3 ft granular drainage layer
H_{waste} = 62 ft, largest height of waste over pipe
$P_s = [(100 \text{ pcf} \times 6 \text{ ft}) + (55 \text{ pcf} \times 62 \text{ ft})] \times 1 \text{ ft}^2/144 \text{ in}^2$
$P_s = 27.85$ psi

The total "live load" pressure, vehicle traffic load, P_L, at the top of the pipe for the two cases is calculated using Boussinesq's Equation.

$$P_L = \frac{3 \times I_F \times W_L \times H^3}{2 \times \pi \times r^5} \qquad <2>$$

Where
P_L = total "live load" pressure, psf
I_F = impact factor = 1.5, assumed for slow vehicle velocity see Attachment 3
W_L = wheel load = 60,000 lbs (approximately 120,000 lbs for Caterpillar 836 compactor divided by 2 drums)
H = depth of cover, ft.
r = distance from the point of load application to pipe crown (same as H), ft.

For the Shallow Waste Height Case:

Where
$H = r$ = depth of cover; 8 ft (5 ft of waste + 3 ft drainage and operational layers)

$$P_L = \frac{3 \times 1.5 \times 60{,}000 \times (8)^3}{2 \times \pi \times (8)^5} = 671.4 \text{ psf} \times 1 \text{ ft}^2/144 \text{ in}^2 = 4.66 \text{ psi}$$

For the Largest Waste Height Case:

The "live load" pressure, P_L, applied at the top of the final cover will be negligible due to the distance (over 40 feet) from the top of the pipe. Therefore, $P_L = 0$. At the burial depths greater than 5 feet, loads from an AASHTO Standard H-20 truck are "not usually significant because the load is attenuated significantly compared (with) loads under 1 or 2 feet of cover." The H-20 loading represents a 40,000-lb. dual axle truck.

Shallow waste height:
Total external pressure, $P_T = P_s + P_L + P_i = 3.99 \text{ psi} + 4.66 \text{ psi} + 0 = 8.65 \text{ psi}$

Largest waste height:
Total external pressure, $P_T = P_s + P_L + P_i = 27.85 \text{ psi} + 0 + 0 \text{ psi} = 27.85 \text{ psi}$
$27.85 \text{ psi} \times 144 \text{ in}^2/\text{ft}^2 = 4{,}010 \text{ psf}$

The worst case situation is the largest waste height case and will therefore be used in this analysis.

Calculate the hoop stiffness ratio, S_R, using equation < 6 > to determine the vertical arching factor, VAF, using equation < 5 >. The radial directed earth pressure, P_{RD}, can then be calculated using equation < 4 >:

$$S_R = \frac{1.43 \times M_S \times r_{CENT}}{E \times t} \qquad <6>$$

Where:
S_R = hoop thrust stiffness ratio
M_S = one-dimensional modulus of soil, 1,920 psi (for 90% standard proctor and 28 psi vertical soil stress, see Table 2-14 included in Attachment 1)
r_{CENT} = radius to centroidal axis of pipe, 3.849 in. ($r_{cent} = r_{pipe} - t/2 = 8.625/2 - 0.927$)
E = apparent modulus of elasticity of pipe material, 23,000 psi
t = pipe wall thickness, 0.927 in.

$$S_R = \frac{1.43 \times M_S \times r_{CENT}}{E \times t} = \frac{1.43 \times 1{,}920 \text{ psi} \times 3.849 \text{ in}}{23{,}000 \text{ psi} \times 0.927 \text{ in}} = 0.496$$

$$VAF = 0.88 - 0.71 \times \frac{S_R - 1}{S_R + 2.5} = 0.88 - 0.71 \times \frac{0.496 - 1}{0.496 + 2.5} = 0.999$$

Where:
VAF = Vertical Arching Factor
S_R = hoop thrust stiffness ratio

$$P_{RD} = (VAF) \times w \times H = (VAF) \times P_T = 0.999 \times 4{,}010 \text{ psf} = 4{,}006 \text{ psf}$$

Where:
P_{RD} = radial directed earth pressure, psf
VAF = Vertical Arching Factor
w = unit weight of soil, pcf
H = depth of cover, ft.
P_T = total external pressure, psf

$$S_A = \frac{(P_{RD}) \times DR}{288} = \frac{4{,}006 \text{ psf} \times (8.625 \text{ in} / 0.927 \text{ in})}{288} = 129.42 \text{ psi}$$

The recommended long-term compressive strength design value is 780 psi at 100°F for PE 3408 pipe, (see Tables 1-3 and 2-12 in Attachment 1).

$P_{RD} = 129.42 \text{ psi} \leq 780 \text{ psi}$

The factor of safety for wall crushing is defined by:

F.S. = Allowable / Actual = 780 / 129.42 = 6.0

A factor of safety of 6.0 demonstrates that the pipe will perform without wall crushing.

B. Calculate the secant modulus of the soil, E_S, using equation 10, determine the rigidity factor, R_F, using equation 9 and the soil strain using equation 8. The rigidity factor is used to determine the deformation factor which is used to calculate the percent deflection, $\Delta X/D_M \times 100$, of the pipe using equation 7.

$$E_S = M_S \times \frac{(1 + \mu) \times (1 - 2 \times \mu)}{(1 - \mu)} \qquad < 10 >$$

Where: E_S = secant modulus of the soil, psi
M_S = one-dimensional modulus, 1,920 psi (for 90% standard proctor and 28 psi vertical soil stress, see Table 2-14 included in Attachment 1)
μ = poisson's ratio of soil, 0.15 (used to be conservative, value for coarse sand from Table 2-15 included in Attachment 1).

$$E_S = 1{,}920 \text{ psi} \times \frac{(1 + 0.15) \times (1 - 2 \times 0.15)}{(1 - 0.15)} = 1{,}818.4 \text{ psi}$$

$$R_F = \frac{12 \times E_S \times (DR - 1)^3}{E} \qquad <9>$$

Where: R_F =rigidity factor
E_S = secant modulus of the soil, psi (see calculated value above)
DR = dimension ratio, D_O/t, 9.3, (8.625/0.927)
E = apparent modulus of elasticity of pipe material, 23,000 psi

$$R_F = \frac{12 \times E_S \times (DR - 1)^3}{E} = \frac{12 \times 1{,}818.4 \text{ psi} \times (9.3 - 1)^3}{23{,}000 \text{ psi}} = 542.5$$

$$\varepsilon = \frac{P_T}{144 \times E_S} \qquad <8>$$

Where: P_T = total external pressure, 4,010 psf
E_S = secant modulus of the soil, psi (see calculated value above)

$$\varepsilon = \frac{P_T}{144 \times E_S} = \frac{4{,}010 \text{ psf}}{144 \times 1{,}818.4 \text{ psi}} = 0.0153$$

$$\Delta X/D_M = D_F \times \varepsilon \qquad <7>$$

Where: $\Delta X/D_M$ = deflection
D_F = deformation factor, 1.55 (from Figure 2-6 included in Attachment 1 for R_F as calculated above).
ε = soil strain

$$\Delta X/D_M = D_F \times \varepsilon = 1.55 \times 0.0153 = 0.0237$$

Percent Deflection = 0.0237 x 100 = 2.37%

The recommended allowable ring deflection for non-pressure pipe and accounting for a large safety factor is 7.5% (see page 2 in Attachment 1). Therefore, the pipe will not deflect beyond the allowable limit.

C. Calculate the allowable pipe wall buckling pressure, P_{CR}.

$$P_{CR} = \frac{2.4 \times \varphi \times R_H}{D_M} \times (E \times I)^{1/3} \times (E_S{}^*)^{2/3} \qquad < 11 >$$

Where: P_{CR} = allowable buckling pressure, psi

φ = calibration factor, 0.55 for granular soils (see page 7 in Attachment 1)

R_H = geometry factor, 1 (for deep burial, see page 7 in Attachment 1)

D_M = mean diameter ($D_O - t$), 7.698 in. (8.625 – 0.927)

D_O = pipe outside diameter, 8.625 in.

t = pipe wall thickness, 0.927 in.

E = Apparent modulus of elasticity of pipe material, 23,000 psi

I = Pipe wall moment of inertia, 0.066 in^4/in ($t^3/12 = 0.927^3/12$)

$E_S^* = E_S/(1-\mu)$ = 1,818.4 psi/(1 – 0.15) = 2,139.3 psi

E_S = secant modulus of the soil, 1,818.4 psi (see calculation above)

μ = poisson's ratio of soil, 0.15 (used to be conservative, value for coarse sand from Table 2-15 included in Attachment 1).

$$P_{CR} = \frac{2.4 \times 0.55 \times 1}{7.698} \times (23{,}000 \times 0.066)^{1/3} \times (2{,}139.3)^{2/3} = 327.19 \text{ psi}$$

The allowable buckling pressure should be compared to the total external pressure, P_T, on the pipe.

$$327.19 \text{ psi} = P_{CR} \geq 27.85 \text{ psi} = P_T$$

Factor of safety for wall buckling is:

$$\text{F.S.} = P_{CR} / P_T = 327.19 \text{ psi} / 27.85 \text{ psi} = 11.7$$

A factor of safety of 11.7 demonstrates that the pipe will perform without wall buckling.

Conclusions

The results of the above calculations are summarized below for the 8-inch SDR 9.3 HDPE leachate collection pipe. The proposed leachate collection pipes will perform as designed without strength failure.

	8" Pipe
Compressive Ring Thrust (Wall Crushing)	F.S. = 6.0
Ring Deflection (7.5% allowable, see Attachment 1)	2.37%
Wall Buckling	F.S. = 11.7

Attachment 1

Source: "PPI Handbook of Polyethylene Pipe",
downloaded May, 2006
www.plasticpipe.org/general/ppi_handbook.php

As indicated in Table 1-2, polyethylene pipe which meets the requirements of ASTM D2513 may be used for the transport of liquefied petroleum gas (LPG). NFPA 58 recommends a maximum operating pressure of 30 psig for LPG gas applications involving polyethylene pipe. This design limit is established in recognition of the higher condensation temperature for LPG as compared to that of natural gas and, thus, the maximum operating pressure is recommended to ensure that plastic pipe is not subjected to excessive exposure to LPG condensates. For further information the reader is referred to PPI's TR-22, Polyethylene Piping Distribution Systems for Components of Liquid Petroleum Gases.(14)

TABLE 1-3
Service Temperature Design Factors, F_T

Maximum Continuously Applied Service Temp., °F(°C)	Temperature Compensation Factor, FT, for PE3408
≤ 80 (26)	1.00
≤ 90 (32)	0.90
≤ 100 (38)	0.78
≤ 110 (43)	0.75
≤ 120 (49)	0.63
≤ 130 (54)	0.60
≤ 140 (60)	0.50

Fluid Flow in Polyethylene Piping

Head Loss in Pipes – Darcy-Weisbach/Fanning/Colebrook/Moody

Viscous shear stresses within the liquid and friction along the pipe walls create resistance to flow within a pipe. This resistance within a pipe results in a pressure drop, or loss of head in the piping system.

The Darcy-Weisbach or Fanning formula, Equation 1-7, and the Colebrook formula, Equation 1-10, are generally accepted methods for calculating friction losses due to liquids flowing in full pipes.(15,16) These formulas recognize dependence on pipe bore and pipe surface characteristics, liquid viscosity and flow velocity.

The Darcy-Weisbach formula is:

(1-7)

$$h_f = f \frac{L V^2}{d' 2g}$$

Attachment 1 cont.

Bending strain occurs in the pipe wall as a result of ring deflection — outer-fiber tensile strain at the pipe springline and outer-fiber compressive strain at the crown and invert. While strain limits of 5% have been proposed, Jansen (12) reported that, on tests of PE pipe manufactured from pressure-rated resins and subjected to soil pressure only, "no upper limit from a practical design point of view seems to exist for the bending strain." In other words, as deflection increases, the pipe's performance limit will not be overstraining but reverse curvature collapse.

Thus, for non-pressure applications, a 7.5 percent deflection limit provides a large safety factor against instability and strain and is considered a safe design deflection. Some engineers will design profile wall pipe and other non-pressure pipe applications to a 5% deflection limit, but allow spot deflections up to 7.5% during field inspection.

The deflection limits for pressurized pipe are generally lower than for non-pressurized pipe. This is primarily due to strain considerations. Hoop strain from pressurization adds to the outer-fiber tensile strain. But the internal pressure acts to reround the pipe and, therefore, Eq. 2-10 overpredicts the actual long-term deflection for pressurized pipe. Safe allowable deflections for pressurized pipe are given in Table 2-11. Spangler and Handy (13) give equations for correcting deflection to account for rerounding.

TABLE 2-11
Safe Deflection Limits for Pressurized Pipe

DR or SDR	Safe Deflection as % of Diameter
32.5	7.5
26	7.5
21	7.5
17	6.0
13.5	6.0
11	5.0
9	4.0
7.3	3.0

*Based on Long-Term Design Deflection of Buried Pressurized Pipe given in ASTM F1962

Compressive Ring Thrust

Earth pressure exerts a radial-directed force around the circumference of a pipe that results in a compressive ring thrust in the pipe wall. (This thrust is exactly opposite to the tensile hoop thrust induced when a pipe is pressurized.) See Figure 2-1b. Excessive ring compressive thrust may lead to two different performance limits:

Attachment 1 cont.

The compressive stress in the pipe wall can be compared to the pipe material allowable compressive stress. If the calculated compressive stress exceeds the allowable stress, then a lower DR (heavier wall thickness) or heavier profile wall is required.

Allowable Compressive Stress

Table 2-12 gives allowable long-term compressive stress values for PE 3408 and PE 2406 material.

TABLE 2-12
Long-Term Compressive Stress at 73°F (23°C)

Material	Long-Term Compressive Stress, lb/in^2
PE 3408	1000
PE 2406	800

The long-term compressive stress value should be reduced for elevated temperature pipeline operation. Temperature design factors used for hydrostatic pressure may be used, i.e. 0.5 @ 140°F. Additional temperature design factors may be obtained by reference to Table 1-11 in Section 1 of this chapter.

Ring Compression Example

Find the pipe wall compressive ring stress in a DR 32.5 HDPE pipe buried under 46 ft of cover. The ground water level is at the surface, the saturated weight of the insitu silty-clay soil is 120 lbs/ft^3.

SOLUTION: Find the vertical earth pressure acting on the pipe. Use Equation 2-1.

Although the net soil pressure is equal to the buoyant weight of the soil, the water pressure is also acting on the pipe. Therefore the total pressure (water and earth load) can be found using the saturated unit weight of the soil.

Next, solve for the compressive stress.

$$P_E = (120\ pcf)(46\ ft) = 5520\ psf$$

$$S = \frac{(5520\ lb / ft^2)(32.5)}{288} = 623\ lb / inch^2$$

The compressive stress is within the 1000 lb/in^2 allowable stress for HDPE given in Table 2-12.

Attachment 1 cont.

(2-21)

$$VAF = 0.88 - 0.71\frac{S_A - 1}{S_A + 2.5}$$

WHERE

VAF = Vertical Arching Factor

S_A = Hoop Thrust Stiffness Ratio

(2-22)

$$S_A = \frac{1.43\, M_S\, r_{CENT}}{EA}$$

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

A= profile wall average cross-sectional area, in^2/in, or wall thickness (in) for DR pipe

One-dimensional modulus values for soil can be obtained from soil testing, geotechnical texts, or Table 2-14 which gives typical values. The typical values in Table 2-14 were obtained by converting values from McGrath(20).

TABLE 2-14

Typical Values of M_s, One-Dimensional Modulus of Soil

Vertical Soil Stress[1] (psi)	Gravelly Sand/Gravels 95% Std. Proctor (psi)	Gravelly Sand/Gravels 90% Std. Proctor (psi)	Gravelly Sand/Gravels 85% Std. Proctor (psi)
10	3000	1600	550
20	3500	1800	650
40	4200	2100	800
60	5000	2500	1000
80	6000	2900	1300
100	6500	3200	1450

* Adapted and extended from values given by McGrath(20). For depths not shown in McGrath(20), the MS values were approximated using the hyperbolic soil model with appropriate values for K and n where n=0.4 and K=200, K=100, and K=45 for 95% Proctor, 90% Proctor, and 85% Proctor, respectively.

[1] Vertical Soil Stress (psi) = [soil depth (ft) x soil density (pcf)]/144

The radial directed earth pressure can be found by multiplying the prism load (pressure) by the vertical arching factor as shown in Eq. 2-23.

(2-23)

$$P_{RD} = (VAF)wH$$

Attachment 1 cont.

TABLE 2-15

Typical range of Poisson's Ratio for Soil (Bowles [21])

Soil Type	Poisson 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

Next, the designer determines the Deformation Factor, D_F, by entering the Watkins-Gaube Graph with the Rigidity Factor. See Fig. 2-6. The Deformation Factor is the proportionality constant between vertical deflection (compression) of the soil layer containing the pipe and the deflection of the pipe. Thus, pipe deflection can be obtained by multiplying the proportionality constant D_F times the soil settlement. If D_F is less than 1.0 in Fig. 2-6, use 1.0.

The soil layer surrounding the pipe bears the entire load of the overburden above it without arching. Therefore, settlement (compression) of the soil layer is proportional to the prism load and not the radial directed earth pressure. Soil strain, ε_S, may be determined from geotechnical analysis or from the following equation:

(2-27)

$$\varepsilon_S = \frac{wH}{144E_S}$$

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:

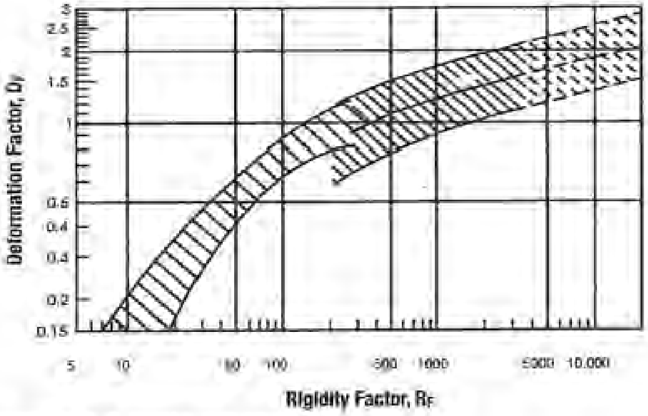


Figure 2-6 Watkins-Gaube Graph

(2-28)
$$\frac{\Delta X}{D_M}(100) = D_F \varepsilon_S$$

WHERE

$\Delta X/D_M$ multiplied by 100 gives percent deflection.

Watkins – Gaube Calculation Technique

Find the deflection of a 6" SDR 11 pipe under 140 ft of fill with granular embedment containing 12% or less fines, compacted at 90% of standard proctor. The fill weighs 75 pcf.

SOLUTION: First, calculate the vertical soil pressure equation, Eq. 2-1.

Eq. 2-1: $P_E = wH$

$P_E = (75 lb/ft^3)(140\ ft)$

$P_E = 10{,}500\ lb/ft^2$ or 72.9 psi

The M_S is obtained by interpolation from Table 2-14 and equals 2700. The secant modulus can be found assuming a Poisson Ratio of 0.30

$$E_S = \frac{2700\,psi\,(1+0.30)(1-2(0.30))}{(1-0.30)} = 2005\,psi$$

The rigidity factor is obtained from Equation 2-24.

$$R_F = \frac{12\,(2005)\,(11-1)^3}{28250} = 852$$

Attachment 1 cont.

Using Figure 2-6, the deformation factor is found to be 1.2. The soil strain is calculated by Equation 2-27.

$$\varepsilon_S = \frac{75pcf * 140ft}{144 * 2005\dfrac{lbs}{inch^2}} \bullet 100 = 3.6\%$$

The deflection is found by multiplying the soil strain by the deformation factor:

$$\frac{\Delta X}{D_M}(100) = 1.2 * 3.6 = 4.4\%$$

Moore-Selig Equation for Constrained Buckling in Dry Ground

As discussed previously, a compressive thrust stress exists in buried pipe. When this thrust stress approaches a critical value, the pipe can experience a local instability or large deformation and collapse. In an earlier section of this chapter, Luscher's equation was given for constrained buckling under ground water. Moore and Selig(17) have used an alternate approach called the continuum theory to develop design equations for contrained buckling due to soil pressure (buckling of embedded pipes). The particular version of their equations given below is more appropriate for dry applications than Luscher's equation. Where ground water is present, Luscher's equation should be used.

The Moore-Selig Equation for critical buckling pressure follows: (Critical buckling pressure is the pressure at which buckling will occur. A safety factor should be provided.)

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

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, in^4/in ($t^3/12$, if solid wall construction)

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

E_S = Secant modulus of the soil, psi

μ_s = Poisson's Ratio of Soil

The geometry factor is dependent on the depth of burial and the relative stiffness between the embedment soil and the insitu soil. Moore has shown that for deep burials in uniform fills, R_H equals 1.0.

change cannot occur, so a longitudinal tensile stress is created along the pipe. The magnitude of this stress can be determined using Equation 3-2.

$$\text{(3-2)}\quad \sigma = E\,\alpha\,\Delta T$$

Where terms are as defined above, and
σ = longitudinal stress in pipe, psi
E = apparent modulus elasticity of pipe material, psi

The value of the apparent modulus of elasticity of the pipe material has a large impact on the calculated stress. As with all thermoplastic materials, polyethylene's modulus, and therefore its stiffness, is dependent on temperature and the duration of the applied load. Therefore, the appropriate elastic modulus should be selected based on these two variables. When determining the appropriate time interval, it is important to consider that heat transfer occurs at relatively slow rates through the wall of polyethylene pipe; therefore temperature changes do not occur rapidly. Because the temperature change does not happen rapidly, the average temperature is often chosen for the modulus selection.

TABLE 3-1
Apparent Modulus Elasticity for HDPE Pipe Material at Various Temperatures

	PE 3408 Apparent Elastic Modulus†, 1000 psi (MPa), at Temperature, °F (°C)							
Load Duration	**-20 (-29)**	**0 (-18)**	**40 (4)**	**60 (16)**	**73 (23)**	**100 (38)**	**120 (49)**	**140 (60)**
Short-Term	300.0 (2069)	260.0 (1793)	170.0 (1172)	130.0 (896)	110.0 (758)	100.0 (690)	65.0 (448)	50.0 (345)
10 h	140.8 (971)	122.0 (841)	79.8 (550)	61.0 (421)	57.5 (396)	46.9 (323)	30.5 (210)	23.5 (162)
100 h	125.4 (865)	108.7 (749)	71.0 (490)	54.3 (374)	51.2 (353)	41.8 (288)	27.2 (188)	20.9 (144)
1000 h	107.0 (738)	92.8 (640)	60.7 (419)	46.4 (320)	43.7 (301)	35.7 (246)	23.2 (160)	17.8 (123)
1 y	93.0 (641)	80.6 (556)	52.7 (363)	40.3 (278)	38.0 (262)	31.0 (214)	20.2 (139)	15.5 (107)
10 y	77.4 (534)	67.1 (463)	43.9 (303)	33.5 (231)	31.6 (218)	25.8 (178)	16.8 (116)	12.9 (89)
50 y	69.1 (476)	59.9 (413)	39.1 (270)	29.9 (206)	28.2 (194)	23.0 (159)	15.0 (103)	11.5 (79)

† Typical values based on ASTM D 638 testing of molded plaque material specimens. An elastic modulus for PE 2406 may be estimated by multiplying the PE 3408 modulus value by 0.875.

Attachment 1 cont.

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		7	3.88	0.795	5.172
		7.3	3.95	0.762	4.996
		9	4.25	0.618	4.182
		9.3	4.29	0.598	4.065
		11	4.49	0.506	3.505
5	5.563	11.5	4.54	0.484	3.368
		13.5	4.69	0.412	2.912
		15.5	4.80	0.359	2.564
		17	4.87	0.327	2.353
		21	5.00	0.265	1.929
		26	5.11	0.214	1.574
		32.5	5.20	0.171	1.270
		7	4.62	0.946	7.336
		7.3	4.70	0.908	7.086
		9	5.06	0.736	5.932
		9.3	5.11	0.712	5.765
		11	5.35	0.602	4.971
6	6.625	11.5	5.40	0.576	4.777
		13.5	5.58	0.491	4.130
		15.5	5.72	0.427	3.637
		17	5.80	0.390	3.338
		21	5.96	0.315	2.736
		26	6.08	0.255	2.233
		32.5	6.19	0.204	1.801
		7	6.01	1.232	12.433
		7.3	6.12	1.182	12.010
		9	6.59	0.958	10.054
		9.3	6.66	0.927	9.771
		11	6.96	0.784	8.425
8	8.625	11.5	7.04	0.750	8.096
		13.5	7.27	0.639	7.001
		15.5	7.45	0.556	6.164
		17	7.55	0.507	5.657
		21	7.75	0.411	4.637
		26	7.92	0.332	3.784

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	**Actual in.**	**SDR**	**in.**	**in.**	**lb. per foot**
		7	7.49	1.536	19.314
		7.3	7.63	1.473	18.656
		9	8.22	1.194	15.618
		9.3	8.30	1.156	15.179
		11	8.68	0.977	13.089
10	10.750	11.5	8.77	0.935	12.578
		13.5	9.06	0.796	10.875
		15.5	9.28	0.694	9.576
		17	9.41	0.632	8.788
		21	9.66	0.512	7.204
		26	9.87	0.413	5.878
		32.5	10.05	0.331	4.742
		7	8.89	1.821	27.170
		7.3	9.05	1.747	26.244
		9	9.75	1.417	21.970
		9.3	9.84	1.371	21.353
		11	10.29	1.159	18.412
12	12.750	11.5	10.40	1.109	17.693
		13.5	10.75	0.944	15.298
		15.5	11.01	0.823	13.471
		17	11.16	0.750	12.362
		21	11.46	0.607	10.134
		26	11.71	0.490	8.269
		32.5	11.92	0.392	6.671
		7	9.76	2.000	32.758
		7.3	9.93	1.918	31.642
		9	10.70	1.556	26.489
		9.3	10.81	1.505	25.745
		11	11.30	1.273	22.199
14	14.000	11.5	11.42	1.217	21.332
		13.5	11.80	1.037	18.445
		15.5	12.09	0.903	16.242
		17	12.25	0.824	14.905
		21	12.59	0.667	12.218
		26	12.86	0.538	9.970
		32.5	13.09	0.431	8.044

Attachment 1 cont.

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		7	11.15	2.286	42.786
		7.3	11.35	2.192	41.329
		9	12.23	1.778	34.598
		9.3	12.35	1.720	33.626
		11	12.92	1.455	28.994
16	16.000	11.5	13.05	1.391	27.862
		13.5	13.49	1.185	24.092
		15.5	13.81	1.032	21.214
		17	14.00	0.941	19.467
		21	14.38	0.762	15.959
		26	14.70	0.615	13.022
		7	12.55	2.571	54.151
		7.3	12.77	2.466	52.307
		9	13.76	2.000	43.788
		9.3	13.90	1.935	42.558
		11	14.53	1.636	36.696
18	18.000	11.5	14.68	1.565	35.263
		13.5	15.17	1.333	30.491
		15.5	15.54	1.161	26.849
		17	15.76	1.059	24.638
		21	16.18	0.857	20.198
		26	16.53	0.692	16.480
		32.5	16.83	0.554	13.296
		7	13.94	2.857	66.853
		7.3	14.19	2.740	64.576
		9	15.29	2.222	54.059
		9.3	15.44	2.151	52.541
		11	16.15	1.818	45.304
20	20.000	11.5	16.31	1.739	43.535
		13.5	16.86	1.481	37.643
		15.5	17.26	1.290	33.146
		17	17.51	1.176	30.418
		21	17.98	0.952	24.936
		26	18.37	0.769	20.346
		32.5	18.70	0.615	16.415

Attachment 1 cont.

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		9	16.82	2.444	65.412
		9.3	16.98	2.366	63.574
		11	17.76	2.000	54.818
		11.5	17.94	1.913	52.677
22	22.000	13.5	18.55	1.630	45.548
		15.5	18.99	1.419	40.107
		17	19.26	1.294	36.805
		21	19.78	1.048	30.172
		26	20.21	0.846	24.619
		32.5	20.56	0.677	19.863
		9	18.35	2.667	77.845
		9.3	18.53	2.581	75.658
		11	19.37	2.182	65.237
		11.5	19.58	2.087	62.690
24	24.000	13.5	20.23	1.778	54.206
		15.5	20.72	1.548	47.731
		17	21.01	1.412	43.801
		21	21.58	1.143	35.907
		26	22.04	0.923	29.299
		32.5	22.43	0.738	23.638
		11	22.60	2.545	88.795
		11.5	22.84	2.435	85.329
		13.5	23.60	2.074	73.781
		15.5	24.17	1.806	64.967
28	28.000	17	24.51	1.647	59.618
		21	25.17	1.333	48.874
		26	25.72	1.077	39.879
		32.5	26.17	0.862	32.174
		11	24.22	2.727	101.934
		11.5	24.47	2.609	97.954
		13.5	25.29	2.222	84.697
		15.5	25.90	1.935	74.580
30	30.000	17	26.26	1.765	68.439
		21	26.97	1.429	56.105
		26	27.55	1.154	45.779
		32.5	28.04	0.923	36.934

Attachment 2

Source: "Monitoring Approaches for Landfill Bioreactors", Carson, et. al,
December 2004, EPA/600/R-04/301.

4.2 Analytical Monitoring Parameters

4.2.1 Leachate Monitoring

Suggested leachate monitoring parameters for MSW bioreactor landfills to enhance operational control under RCRA and the RD&D (FR 2004) rule are divided into primary (Table 3) and secondary parameters (Table 4). The primary parameters are relatively inexpensive and easy to examine. Parameters presented in the secondary list are more research-oriented, and are more time intensive and as a result are relatively costly. Suggested analysis methods and monitoring frequencies are presented in the tables. It is the responsibility of the owner/operator of a landfill to comply with all existing local, state and federal regulations with regard to existing monitoring parameters in addition to parameters agreed upon under an RD&D project. A few monitoring parameters are evaluated further in the following sections.

Sample duplication is necessary to account for the statistical relevance of monitoring data. Caution must also be taken to hydraulically isolate bioreactor from adjacent conventional landfill cells. The separation would allow for an accurate evaluation of conditions only within the bioreactor. Hydraulic separation may be achieved in an as-built cell; however, such a separation is more difficult in retrofit bioreactor landfill cells. In the case of a retrofit bioreactor landfill, it is suggested that the zone of influence of the liquid application area be examined (see Reinhart and Townsend, 1998 for more details). Leachate samples representing the bioreactor section of the landfill should be collected only from areas directly under the zone of influence.

4.2.1.1 Leachate Temperature

Research suggests that anaerobic processes occur best within either mesophilic (30-38°C) or thermophilic (50 to 60°C) temperature ranges (McCarty 1964; Parkin and Owen 1986). Optimum methane generation from solid wastes, however, occurred

at 41°C (Harts et al. 1982). Regardless of the operational temperatures, the maintenance of a uniform temperature is considered to be fundamental to anaerobic stabilization process efficiencies. Historically, conventional landfills leachate temperature ranged from 7 to 25°C while bioreactor landfills leachate ranged from 6 to 37°C (EPA 2003).

Because landfill temperature is not externally controlled, it reflects a combination of ambient temperature conditions, microbial activities and the extent and effectiveness of insulation provided by the landfill configuration. In cold climates, for example, leachate temperatures could initially be as low as 6°C. Soon after recirculation the leachate temperatures should steadily increase. Leachate temperatures at the Outer Loop landfill in Kentucky were initially around 7°C. The leachate temperatures at the landfill steadily increased to above 30°C within a few months of the bioreactor operation (EPA 2003). While an increase in leachate temperature is reflective of waste degradation in a landfill, it is not solely indicative of biological activity.

4.2.1.2 Leachate pH

The optimum pH range for anaerobic systems ranges between 6.5 and 7.6 (Parkin and Owen 1986). Gas generation and stabilization rates have been reported to be the highest at near neutral pH levels (Pohland et al. 1993). Initially the leachate pH may be neutral, however after the onset of anaerobic conditions there may be a pH drop especially during the acid forming phase (see section 3.2). The pH drop is most likely caused by VFAs production and accumulation in the leachate. The pH, however, will tend to move to neutrality as methanogens consume these acids. Historically there may not be a measured difference between the leachate pH measured in conventional and in bioreactor landfills. The leachate pH ranged between 4.7-8.8 for conventional landfills (EPA 2003; Kjeldsen et al. 2002; Chu et al. 1994; Krung and Ham 1991) and from 5.4-8.6 for bioreactor landfills (EPA 2003; Pohland and Harper 1986).

Attachment 3

Source: "PPI Handbook of Polyethylene Pipe", downloaded May, 2006
www.plasticpipe.org/general/ppi_handbook.php

Off-Highway and Unpaved Road Loads

Off-highway vehicles may be considerably heavier than H20 or HS20 trucks, and these vehicles frequently operate on unpaved roads that may have uneven surfaces. Thus impact factors higher than 1.5 may be reached depending on the vehicle speed. Except for slow traffic, an impact factor of 2.0 to 3.0 should be considered.

During construction, both permanent and temporary underground pipelines may be subjected to heavy vehicle loading from construction equipment. A designated vehicle crossing with special design measures such as temporary pavement or structural sheeting may be prudent, as well as vehicle speed controls to limit impact loading.

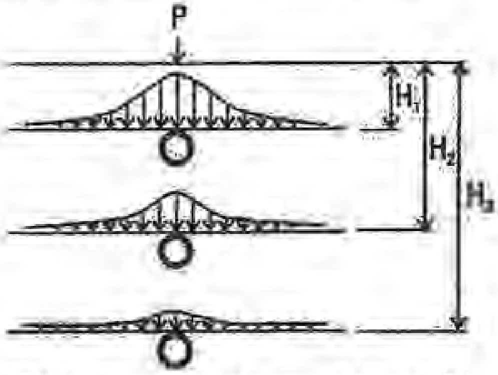
Vehicular Loads As Point Loads

There are generally two approaches for calculating vehicle live load surcharge pressure. The more conservative approach is to treat the wheel load as a concentrated (point) load. The other is to treat it as a distributed load spread over the contact area of the tire with the ground (imprint area). The pressure due to a distributed load and the pressure due to a concentrated load begin to approach the same value at a depth of about twice the square root of the loaded area.

The distributed load method gives more realistic values where the depth equals less than twice the square root of the loaded area, whereas for deeper depths concentrated loads are preferred because the calculations are simpler and typically more conservative.

The pressure distribution under a concentrated load varies with depth as illustrated in Figure 7-9. When the live load is calculated using the point load methods in the following sections, a conservative approach is to assume that the maximum pressure at the pipe crown is distributed across the entire pipe.

Figure 7-9 Concentrated Vehicular Load Pressure Distribution at Various



A key consideration in determining live load pressure on the pipe is the location of vehicle wheels relative to the pipe. A higher pressure may occur below a point between two vehicles passing in adjacent lanes than directly under a single vehicle wheel. This depends on the depth of cover.

When depths are not greater than four or five feet, the combined H20 load for two separate wheels straddling the pipe is greater than that for a single wheel directly over the pipe. Deeper than five feet, H20 loads are not usually significant because the load is attenuated significantly compared loads under one or two feet of cover. However, greater live loads may produce design significant effects at depths greater than five feet. Therefore, the designer should check load conditions for a single wheel directly over the pipe, and for two wheels spaced six feet apart and centered over the pipe.

Single Wheel Load Centered On Pipe

To check a single wheel load centered directly over the pipe, a method based on Holl's integration of Boussinesq's equation assumes that the wheel load is a concentrated (point) load. Holl's integration finds the pressure at the depth of the pipe crown that is distributed over a surface three feet long and the width of the pipe outside diameter.

Appendix D-4
Leachate Evaporation Pond Analysis

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CALCULATION SHEET

Page 1 **Of** 2
Project No. 95561
Client County of Kaua'i **Subject** Leachate Evaporation Lagoon Analysis **Prepared By** TCR **Date** 12/22/08
Project Kekaha Landfill Phase II Lateral Expansion **Reviewed By** MZ **Date** 12/23/08
Approved By KJB **Date** 12/30/08

LEACHATE EVAPORATION LAGOON ANALYSIS

Objective

Evaluate the ability of the proposed leachate evaporation lagoon to properly process the lateral expansion estimated leachate quantities, current leachate quantities, and rainfall.

Design Criteria and Assumptions

1. The proposed evaporation lagoon is evaluated based on a water balance, comparing the liquid entering the evaporation lagoon to anticipated evaporation quantities.

2. It is assumed that the evaporation rates from the evaporation lagoon will be similar to pan evaporation rates due to the confined nature, relatively shallow depth, and black geomembrane lining in the lagoon. No gravel

3. Estimated pan evaporation rates from two sources were reviewed (see Attachment 1). To be conservative, the pan evaporation rate of 64.5 inches annually for the weather station at HILO WSO, Hawaii was used in this calculation. For comparison, the pan evaporation rate at the weather station in Lihue, is 96.5 inches/year.

4. Estimated monthly leachate generation rates based on active conditions for Cell 1 of the Phase II lateral expansion were used in this analysis (see the Leachate Generation Analysis calculation).

5. Average monthly rainfall data based on the 5 years of available site data was used in this analysis. Note that this data includes 2006, a year with extremely above average rainfall quantities.

6. Monthly leachate generation data between September 2004 and June 2007 for Kekaha Landfill was reviewed. To be conservative the year with the greatest leachate generation, 2006, was used in this analysis. Note that the leachate generation in March of 2006 alone was greater than the annual leachate generation for both 2004 and 2005 resulting in a very conservative review of the proposed evaporation lagoon.

7. The area of the evaporation lagoon available for evaporation, 1.63 acres, was determined at the average depth, elevation 12.

8. The planar area of Cell 1 of the Phase II Lateral Expansion is 6.4 acres.

9. The gross capacity of the leachate evaporation lagoon is approximately 21,000 cy or 4,241,000 gallons. The bottom of the lagoon will have 1-foot of gravel and the sideslopes will have 8-inches of drainage material supported in place by a geoweb system. The total volume of base and sideslope material is 2,682 cy or 542,000 gallons. Assuming no porosity of the base and sideslope material (conservative), the net volume of the evaporation lagoon is 3,699,000 gallons. ?

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			Project No. 95561			
Client	County of Kaua'i	**Subject** Leachate	**Prepared By**	TCR	**Date**	12/22/08
Project	Kekaha Landfill	Evaporation Lagoon Analysis	**Reviewed By**	MZ	**Date**	12/23/08
Phase II Lateral Expansion			**Approved By**	KJB	**Date**	12/30/08

Calculations

Calculations are summarized in Table 1, Evaporation Lagoon Water Balance, included as Attachment 2. Sample calculations are provided below.

Expansion leachate (convert HELP model out put from in/ac to gallons) for the month of March:

$$\text{Expansion Leachate} = \left(\frac{0.6832\text{ inches}}{\text{month}}\right)\left(\frac{1\text{ foot}}{12\text{ in.}}\right)\left(\frac{43{,}560\text{ sf}}{\text{acre}}\right)\left(\frac{7.48\text{ gal.}}{1\text{ cf}}\right)\text{x } 6.4\text{ ac.} = 118{,}723\text{ gal/ month}$$

Total leachate generated (in inches of evaporation lagoon) for the month of March:

Total leachate = (existing leachate + expansion leachate) / average lagoon surface area

$$= \left(\frac{\left(670{,}304\text{ gal}/_{\text{month}} + 118{,}723\text{ gal}/_{\text{month}}\right)\text{x } 1\text{ cf}/_{7.48\text{ gal}}}{1.63\text{ acres x } 43{,}560\text{ sf}/_{\text{acre}}}\right)\text{x }\frac{12\text{ in}}{1\text{ ft}} = 17.83\text{ in/month}$$

Monthly water balance (inches) for March:

Monthly water balance = Total leachate + Rainfall – evaporation
= 17.83 inches + 4.33 inches – 5.15 inches = 17.01 inches

Cumulative Required Storage from inches to cubic yards for the month of March:

Cumulative required storage = Cumulative water storage * average lagoon area

$$= 17.01\text{ inches} * \left(\frac{1\text{ ft}}{12\text{ inches}}\right) * \left(\frac{43{,}560\text{ sf}}{1\text{ acre}}\right) * (1.63\text{ acres}) * \left(\frac{1\text{ cy}}{27\text{ cf}}\right) = 3{,}727\text{ cy} = 752{,}700\text{ gallons}$$

Conclusion

Based on estimated monthly leachate flows, evaporation and rainfall, the proposed evaporation lagoon is able to process anticipated leachate and rainfall quantities. The proposed evaporation lagoon has a net volume of 3,699,000 gallons. The estimated maximum leachate and rainfall volume occurs during the month of April, and is just under 1,000,000 gallons providing a factor of safety of over 3.0.

Attachment 1
Hawaii Pan Evaporation Rates

Source 1: GROUND WATER ATLAS of the UNITED STATES
Alaska, Hawaii, Puerto Rico and the U. S. Virgin Islands
HA 730-N
http://capp.water.usgs.gov/gwa/ch_n/N-HItext1.html

Evapotranspiration, which is the loss of water to the atmosphere by the combination of transpiration of plants and direct evaporation from land and water surfaces, is a major component of the hydrologic budget of the islands. In the Honolulu area of Oahu, for example, actual evapotranspiration was estimated to be about 40 percent of the total water (rainfall plus irrigation) falling on or applied to the ground surface during 1946-75. Pan evaporation is the main measurement used in Hawaii to assess the amount of water loss by evapotranspiration. Over the open ocean, the estimated annual pan-evaporation rate is 65 inches. As with precipitation, pan-evaporation rates in Hawaii are related to topography. At altitudes between 2,000 and 4,000 feet, where humidity is high and sunlight intensity is reduced because of clouds, pan-evaporation rates are reduced to as low as 25 percent of the open-ocean rate. In the leeward coastal areas, wind carrying dry, warm air increases annual pan-evaporation rates to as much as 100 inches. At the summits of Mauna Kea and Mauna Loa on the island of Hawaii, annual pan-evaporation rates exceed 70 inches because of clear skies and dry air.

Source 2: Western Regional Climate Center
http://www.wrcc.dri.edu/htmlfiles/westevap.final.html#HAWAII/PACIFIC%20ISLANDS

Evaporation Stations

Standard daily pan evaporation is measured using the four-foot diameter Class A evaporation pan. The pan water level reading is adjusted when precipitation is measure to obtain the actual evaporation. Most Class A pans are installed above ground, allowing effects such as radiation on the side walls and heat exchnges with the pan material. These effects tend to increase the evaporation totals. The amounts can then be adjusted by multiplying the totals b 0.70 or 0.80 to more closely estimate the evaporation from naturally existing urfaces such as a shallow lake, wet soil or other moist natural surfaces.

HAWAII
MONTHLY AVERAGE PAN EVAPORATION (INCHES)

	Period Of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
HILO WSO AP 87	1949-2005	5.06	4.87	5.15	5.40	5.66	6.49	6.44	6.13	5.40	5.37	4.06	4.46	64.49
HONOLULU OBSRVY 702.2	1962-2005	4.72	5.23	7.01	7.84	8.93	9.41	10.10	10.09	8.82	7.68	5.94	5.08	90.85
LIHUE WSO AP 1020.1	1950-2005	5.62	6.22	7.62	8.22	9.21	9.85	10.40	10.21	9.18	8.04	6.27	5.67	96.51

For Lihue, Kaua'i: 96.51 inches (annual pan evaporation) x 0.70 (correction factor from above) = 67.56 inches
96.51 inches (annual pan evaporation) x 0.80 (correction factor from above) = 77.21 inches

Attachment 2

Evaporation Lagoon Monthly Water Balance
Kekaha Landfill
Phase II Lateral Expansion, Cell 1

Month	Rainfall[1] (in)	Existing Leachate[2] (gal)	Expansion Leachate[1] (in/ac)	Expansion Leachate (gal)	Total Leachate[3] (in)	Pan Evaporation[4] (in)	Monthly Water Balance[5] (in)	Cumulative Water Balance[6] (in)	Cumulative Required Storage Volume (cy)	Cumulative Required Storage Volume (gal)
Jan	2.47	12,578	0.0509	8,845.2	0.48	5.06	-2.11	0.00	0	0
Feb	2.13	18,496	0.4311	74,914.6	2.11	4.87	-0.63	0.00	0	0
Mar	4.33	670,304	0.6832	118,723.3	17.83	5.15	17.01	17.01	3,727	752,700
Apr	0.69	284,102	0.6150	106,871.8	8.83	5.40	4.12	21.13	4,631	935,300
May	0.48	48,090	0.8271	143,729.6	4.33	5.66	-0.85	20.29	4,446	897,800
Jun	0.77	36,993	0.6306	109,582.7	3.31	6.49	-2.41	17.88	3,918	791,200
Jul	0.19	19,237	0.2034	35,345.9	1.23	6.44	-5.02	12.86	2,818	569,200
Aug	0.45	36,993	0.0933	16,213.2	1.20	6.13	-4.48	8.38	1,837	371,000
Sept	1.04	27,374	0.0891	15,483.4	0.97	5.40	-3.39	4.99	1,094	220,900
Oct	1.67	68,806	0.1076	18,698.2	1.98	5.37	-1.72	3.27	716	144,700
Nov	1.29	30,334	0.1431	24,867.3	1.25	4.06	-1.52	0.00	0	0
Dec	1.61	19,236	0.0792	13,763.0	0.75	4.46	-2.10	0.00	0	0
TOTAL:	17.12	1,272,543	3.9536	687,038.3	44.28	64.49				

Notes:
1. Rainfall and expansion leachate in inches/acre obtained from HELP Model output included in the "Leachate Generation Analysis" calculation.
2. Existing leachate generation quantities determined from 2006 site data.
3. Total leachate generation is displayed in inches of evaporation pond depth at average pond area.
4. Pan evaporation data from the weather station at HILO WSO as indicated in Attachment 1.
5. Negative monthly water balance indicates evaporation is greater than the liquid entering the basin.
6. Negative water balance quantities can not be accumulated, therefore, the minimum cumulative water balance is 0.

Appendix D-5
Flows For Cell 1 Leachate System Sizing

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Project No. 95561

Client	County of Kaua'i	**Subject**	Leachate	**Prepared By**	NKW	**Date**	12/29/08
Project	Kekaha Landfill		Flows for Cell 1 Leachate	**Reviewed By**	TCR	**Date**	12/30/08
Phase II Lateral Expansion			System Sizing	**Approved By**	KJB	**Date**	12/30/08

LEACHATE FLOWS FOR CELL 1 LEACHATE SYSTEM SIZING

Objective

Determine peak leachate flows for pipe sizing, pump station sizing, and pump selection.

Design Criteria and Assumptions

1. Use peak daily leachate generation per the HELP model included with the leachate generation analysis in Appendix D-1.
2. Estimate leachate generation by subcell in Cell 1.
3. Estimate leachate generation from the future Cell 2 contribution to the leachate extraction system for Cell 1.

Calculations

1. Convert peak daily leachate generation from Leachate Generation Analysis in Appendix D-1 from gal/acre/day to gal/acre/min.

$$3{,}691.8\frac{\text{gal}}{\text{acre}-\text{day}}\ \text{x}\ \frac{1\,\text{day}}{24\,\text{hr}}\ \text{x}\ \frac{1\,\text{hr}}{60\,\text{min}} = 2.6\frac{\text{gpm}}{\text{acre}}$$

2. Leachate flow per subcell in Cell 1.

   a. Subcell 1A:

   1.79 ac x 2.6 gpm/ac = 4.7 gpm

   b. Subcell 1B:

   1.45 ac x 2.6 gpm/ac = 3.8 gpm

   c. Subcell 1C:

   1.58 ac x 2.6 gpm/ac = 4.1 gpm

   d. Subcell 1D:

   1.36 ac x 2.6 gpm/ac = 3.5 gpm

3. Leachate flow from Cell 2, northern portion:

   3.3 ac x 2.6 gpm/ac = 8.6 gpm

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Project No. 95561

Client County of Kaua'i

Project Kekaha Landfill

Phase II Lateral Expansion

Subject Leachate

Flows for Cell 1 Leachate

System Sizing

Prepared By NKW **Date** 12/29/08

Reviewed By TCR **Date** 12/30/08

Approved By KJB **Date** 12/30/08

Conclusions

Following are the peak leachate generation rates contributing to the Cell 1 leachate transfer system:

Subcell 1A	4.7 gpm
Subcell 1B	3.8 gpm
Subcell 1C	4.1 gpm
Subcell 1D	3.5 gpm
Cell 2	8.6 gpm

Appendix D-6
#3 Wet Well and Forcemain Design

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CALCULATION SHEET

			Page 1	**Of** 5		
			Project No.	95561		
Client	County of Kaua'i	**Subject** #3 Wet Well	**Prepared By**	NKW	**Date**	12/29/08
Project	Kekaha Landfill	and Forcemain Design	**Reviewed By**	HAW	**Date**	12/31/08
Phase II Lateral Expansion			**Approved By**	KJB	**Date**	12/31/08

WETWELL #3 AND FORCEMAIN DESIGN

Objective

Evaluate the required wetwell size, pump size, and forcemain size to LCM-14. Determine pump on/off levels based on pump requirements and requirements to maintain separation between landfill gas and air at the "straw drain" manhole, Wetwell #3.

Design Criteria and Assumptions

1. Subcell 1D will drain by gravity to LCM-14.
2. Subcell 1C will drain by gravity and join with flow from Cell 1B to flow by gravity to new Wetwell #3.
3. Future Cell 2 north will drain and join with flow from Cell 1A to flow by gravity to new Wetwell #3.
4. Use the peak daily leachate collection rate from the HELP model. See Appendix D-5.
5. The pump station will be sized for two incoming leachate pipes which will discharge through straw drain down pipes into the pump station. This is to prevent methane migration into the pump station and air intrusion into the future landfill gas collection system. The wetwell will contain alternating duplex pumps discharging to LCM-14. Pump selection is based on the peak daily leachate collection rate and the system head curve, which consists of the static head, friction loss, and minor losses.
6. Use the following design criteria for the analysis:
    a. Assume a 4-inch diameter SDR 11 HDPE inside and 8-inch diameter SDR 17 HDPE outside dual containment forcemain from new Wetwell #3 to LCM-14. The pipe will have a constant downward slope toward LCM-14 of about 0.44 percent.
    b. The pump discharge piping will be 1.25-inch diameter Schedule 80 PVC.
7. Lowest "pump-on" elevation is at least 17 inches off the bottom of the wetwell, based on pump requirements.
8. Bottom of the incoming downdrain leachate gravity drain pipes is 3 inches off the bottom of the wetwell based on leaving room for HDPE welding and a small sump to store any fines that enter the wetwell.
9. Lowest "pump-off" elevation is at least 6 inches above the pressure transducer.

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Page 2 **Of** 5
Project No. 95561
Client County of Kaua'i **Subject** #3 Wet Well and Forcemain Design
Project Kekaha Landfill Phase II Lateral Expansion
Prepared By NKW **Date** 12/29/08
Reviewed By HAW **Date** 12/31/08
Approved By KJB **Date** 12/31/08

Calculations

1. Peak flow from "west" into new Wetwell #3:

Flow in = Cell 2 + Cell 1A
= 8.6 gpm + 4.7 gpm
= 13.3 gpm

2. Peak flow from "east" into new Wetwell #3:

Flow in = Cell 1B + Cell 1C
= 3.8 gpm + 4.1 gpm = 7.9 gpm

3. Peak flow into new Wetwell #3 = 21.2 gpm.

4. Static Head:

High point of system = 17 (3 feet below berm at Wetwell #3)
Low point of system = 4 (conservatively the lowest water level in Wetwell #3)

Static head = 13 feet

5. Minor loss:

The minor loss can be calculated as follows:

$$h_L = K_L \frac{V^2}{2g}$$

Where

h_L = head loss (ft)
K_L = minor loss coefficient
V = velocity (fps)
g = gravitational constant (32.2 ft/s^2)

6. Friction Loss

The Hazen-Williams equation is used to calculate the friction loss in the system:

$$V = 1.318 C_{hw} R^{0.63} S^{0.54}$$

Where,

V = flow velocity (fps)
C_{hw} = Hazen-Williams coefficient

R = Hydraulic radius
S = Slope of the energy grade line (head loss per unit length of pipe) (ft/ft)
= h_f / L
h_f = friction loss (ft)
L = pipe length (ft)

Rearranging the equation to solve for the slope of the energy grade line yields:

$$S = \left(\frac{V}{1.318 C_{hw} R^{0.63}} \right)^{1.85}$$

Solving for the friction loss yields:

$$h_f = \left(\frac{V}{1.318 C_{hw} R^{0.63}} \right)^{1.85} \times L$$

7. System Head

The system head is the summation of the static head, minor losses and friction losses at each flow rate. The calculations are included as Attachment 1.

8. Pump Selection

An EPG SurePump™ Vertical Sump Drainer (VSD) Model 2-2 with 0.5 HP motor was selected as the leachate sump pump. The pump characteristic curve is included as Attachment 2. The intersection of the pump characteristic curve with the system head curve yields the operating point of the system. The plot of the system head curve versus the pump characteristic curves is included in Attachment 1. The pump operates very near the end of its volume (gpm) range under simplex operation. If vibration occurs, the ball valves should be closed enough to end vibration. Closing the ball valves a bit will increase system head. The operating points are summarized in Table 1. Two pumps operating in parallel pump 26 gpm which exceed the target flow rate of 21.2 gpm from Part 1.

Table 1 - Pump Operating Points

Pump	Number of Pumps in Parallel	Operating Point	
		Flow (gpm)	System Head (ft)
EPG VSD 2-2	1	14	16
	2	13 (each) = 26	20 (total)

AECOM

CALCULATION SHEET

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Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion
Subject #3 Wet Well and Forcemain Design
Prepared By NKW **Date** 12/29/08
Reviewed By HAW **Date** 12/31/08
Approved By KJB **Date** 12/31/08

9. Pump Off Level

   a. Straw drains will break the vacuum of the future landfill gas collection system. Pipe size is 8 inches. Vacuum is conservatively assumed to be 48 inches. We will provide at least 50 inches. When the landfill gas blower is turned on, the water will be "drawn up" into the downdrain pipes 50 inches, up from the beginning water level. Find the volume of water needed in the permanent pool of the pump station to maintain the water level above the top of the incoming drain pipes after the water has been "drawn up" into the two pipes.

   8-inch diameter SDR-11 has an inside diameter of 6.994 inches. We will assume 7 inches ID. Volume of water required to have 50 inches in each pipe:

   $V_P = 2 \times \pi \times (3.5 \text{ inches})^2 \times 50 \text{ inches}$
   $= 3{,}848 \text{ in}^3$

   Inside diameter of the SDR 32.5 wetwell is 44.9 inches. Find depth of water needed over the top of the drain pipes to keep them submerged if a 50-inch column of water is pulled up into each drain pipe.

   $$\text{Depth required} = \frac{\text{volume in pipes}}{\text{area of manhole}}$$

   $$\text{Area of manhole} = \pi\left(\frac{44.9}{2}\right)^2 = 1{,}584 \text{ in}^2$$

   $$\text{Depth required} = \frac{3{,}848 \text{ in}^3}{1{,}584 \text{ in}^2} = 2.43 \text{ in}$$

   So, the lowest pump off level (based on preventing air from getting in the gas is 3 inches below the pipe, 8.625 inches for the pipe, and 2.5 inches over the pipe.

   Lowest pump off level = 3 inches + 8.625 + 2.5 = 14.125
   Say, 14.25 inches

   b. The lowest pump off level is 12 inches above the bottom of the wetwell assuming the level sensor is set 6 inches above the bottom of the wetwell.

   c. Preventing air intrusion is the worst case. So, pump off is at 14.25 inches above the bottom of the wetwell.

10. Pump Control Levels

   a. Low level alarm is set at 13.25 inches above the bottom of the wetwell.
   b. Pump Off level is set at 14.25 inches above the bottom of the wetwell.
   c. Pump #1 On level is set at 48 inches above the bottom of the wetwell.

d. Pump #2 On level is set at 60 inches above the bottom of the wetwell.
e. High Level Alarm level is set at 84 inches above the bottom of the wetwell.

Conclusions

The design of the Phase II Lateral Expansion Wetwell #3 leachate pumping system is as follows:

- 4-inch diameter SDR 11 HDPE inside 8-inch diameter SDR 17 HDPE dual containment forcemain sloped at 0.44 percent downward toward Wetwell #3;
- 1.25-inch diameter Schedule 80 PVC piping within the wetwell;
- EPG VSDPT Model 2-2 with a 0.5 HP motor as the leachate Wetwell #3 pump.
- Pump control levels for the alternating duplex pumping system are:

High Level Alarm	84 inches
Pump 2 On	60 inches
Pump 1 On	48 inches
Pump(s) Off	14.25 inches
Low Level Alarm	13.25 inches

ATTACHMENT 1

PROPOSED CELL 1 LEACHATE (#3 WETWELL) PUMP STATION DESIGN

AECOM

CALCULATION SHEET

Page 1 **Of** 3
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Proposed Leachate
Storage Tank Area Pump
Station Design

Prepared By NKW **Date** 12/29/08
Reviewed By HAW **Date** 12/31/08
Approved By KJB **Date** 12/31/08

Pipe Length

Pipe Size	Average Inner Diameter (in)	(ft)	Length (ft)	Description
1.25	1.250	0.1042	14	1.25" dia. SCH 80 PVC pipe inside pump station

STATIC HEAD

High Point of System = EL 17 ft (Estimated top of berm at wet well #3 minus 3')

Low Point of System = EL 4 ft (Conservatively, the lowest water level in wet well #3, Elev. 2.75' + 17")

Static Head = 13 ft

MINOR LOSSES

Minor Losses for 1.25" diameter SCH 80 PVC pipe inside Pump Station

Fitting Type	Loss Coefficient K_L	No. of Fittings	Total Loss Coefficient K_L	
90° Elbow and Threaded Fittings	0.30	7	2.10	
Ball Valve	2.00	1	2.00	
Check Valve	1.00	1	1.00	
Branch Tee	1.00	1	1.00	
Total			6.10	

Minor Losses for 4" diameter SDR 11 force main

Fitting Type	Loss Coefficient K_L	No. of Fittings	Total Loss Coefficient K_L	
45° Elbow	0.20		0.00	
90° Elbow	0.30		0.00	
Butterfly Valve	2.00		0.00	
Branch Tee	1.00		0.00	
Running Tee	0.20		0.00	
Total			0.00	

OPERATING POINTS

Pump	No. of Pumps in Parallel	Operating Point Flow (gpm)	Operating Point Head (ft)
EPG VSD 2-2	1	14	15
	2	13 (each)	20 (total)

AECOM

CALCULATION SHEET

Page 2 **Of** 3
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Proposed Leachate Storage Tank Area Pump Station Design

Prepared By NKW **Date** 12/29/08
Reviewed By HAW **Date** 12/31/08
Approved By KJB **Date** 12/31/08

	1.25-in. Sch 80 PVC	2 pumps; 1.25-in. Sch 80 PVC
Length (ft) =	14	14
Inside Diameter (ft) =	0.1042	0.1042
Flow Area (sf) =	0.00852	0.00852
Hydraulic Radius (ft) =	0.026	0.026
C_{HW} =	130	130
Total Loss Coefficient (K_L) =	6.10	6.10

Static Head = 13 ft

Q (gpm)	1.25 in. Schedule 80 PVC						2 pumps; 1.25-in. Schedule 80 PVC					
	V (ft/sec)	h_L (ft)	S (ft/ft)	h_f (ft)	$h_L + h_f$ (ft)	TDH (ft)	V (ft/sec)	h_L (ft)	S (ft/ft)	h_f (ft)	$h_L + h_f$ (ft)	TDH (ft)
0	0.00	0.00	0.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00	0.00	13.00
2	0.52	0.03	0.00	0.02	0.05	13.05	1.05	0.10	0.01	0.08	0.18	13.18
4	1.05	0.10	0.01	0.08	0.18	13.18	2.09	0.41	0.02	0.28	0.70	13.70
6	1.57	0.23	0.01	0.17	0.40	13.40	3.14	0.93	0.04	0.60	1.54	14.54
8	2.09	0.41	0.02	0.28	0.70	13.70	4.18	1.66	0.07	1.03	2.68	15.68
10	2.62	0.65	0.03	0.43	1.08	14.08	5.23	2.59	0.11	1.55	4.14	17.14
12	3.14	0.93	0.04	0.60	1.54	14.54	6.28	3.73	0.16	2.17	5.90	18.90
14	3.66	1.27	0.06	0.80	2.07	15.07	7.32	5.08	0.21	2.89	7.97	20.97
16	4.18	1.66	0.07	1.03	2.68	15.68	8.37	6.63	0.26	3.70	10.33	23.33
20	5.23	2.59	0.11	1.55	4.13	17.13	10.46	10.37	0.40	5.59	15.95	28.95
24	6.28	3.73	0.16	2.17	5.89	18.89	12.55	14.93	0.56	7.83	22.75	35.75
28	7.32	5.08	0.21	2.89	7.95	20.95	14.65	20.32	0.74	10.41	30.72	43.72
32	8.37	6.63	0.26	3.70	10.31	23.31	16.74	26.53	0.95	13.32	39.86	52.86

AECOM

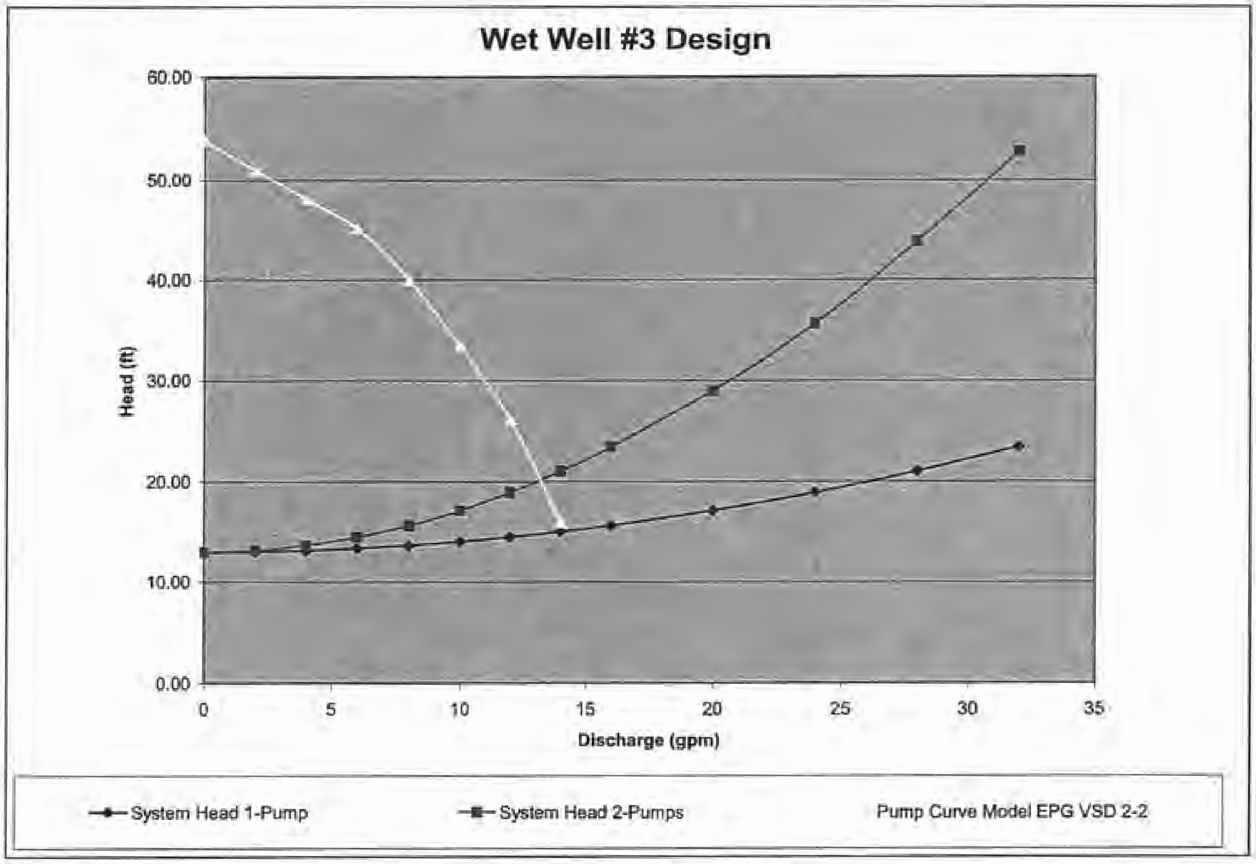
CALCULATION SHEET

Page 3 **Of** 3
Project No. 95561

Client County of Kaua'i
Project Kekaha Landfill
Phase II Lateral Expansion

Subject Proposed Leachate Storage Tank Area Pump Station Design

Prepared By NKW **Date** 12/29/08
Reviewed By HAW **Date** 12/31/08
Approved By KJB **Date** 12/31/08



Flow Rate	System Head 1-Pump	System Head 2-Pumps	Pump Curve Model EPG VSD 2-2
Q	TDH	TDH	TDH
(gpm)	(ft)	(ft)	(ft)
0	13.00	13.00	54
2	13.05	13.18	51
4	13.18	13.70	48
6	13.40	14.54	45
8	13.70	15.68	40
10	14.08	17.14	33.5
12	14.54	18.90	26
14	15.07	20.97	16
16	15.68	23.33	--
20	17.13	28.95	--
24	18.89	35.75	--
28	20.95	43.72	--
32	23.31	52.86	--

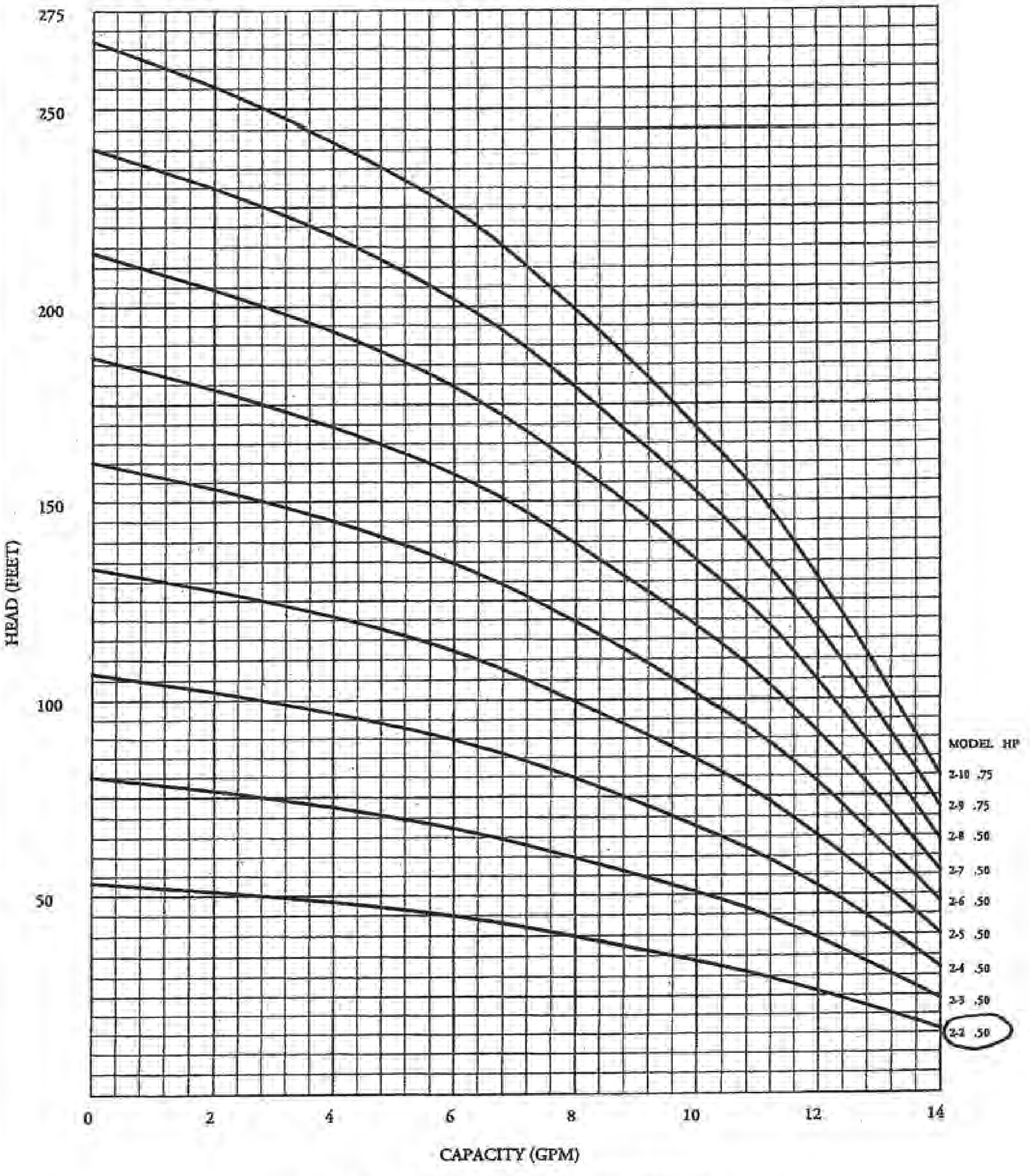
ATTACHMENT 2

PUMP CHACTERISTIC CURVE

^
RA

SERIES 2 SurePump™

Flow Range 4-14 GPM
60 Hz



DATA SUBJECT TO CHANGE WITHOUT NOTICE

SERIES 2 SUMP DRAINER SELECTION GUIDE

To select the appropriate sump drainer:

1. Select SINGLE or THREE PHASE, motor HORSEPOWER, and system supply VOLTAGE.
2. Determine the DISTANCE from the power supply to the pump.
3. Use the sump drainer size from the SUMP DRAINER column to find its respective dimensions on the following pages. MOTOR LEAD column shows minimum motor power cable size.

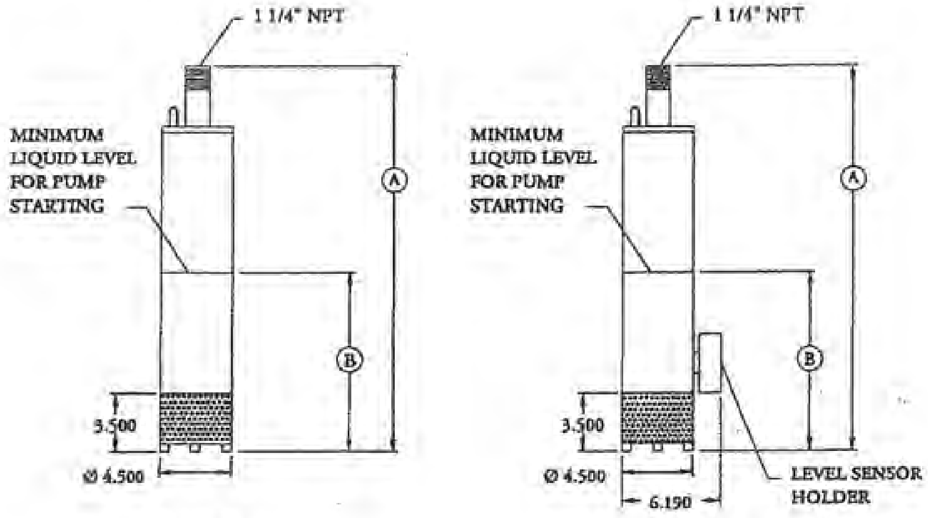
SINGLE PHASE MOTORS

HORSEPOWER	VOLTAGE	DISTANCE FROM SERVICE ENTRANCE TO PUMP IN FEET	SUMP DRAINER	MOTOR LEAD
0.5	230	0 TO 360'	SIZE 4	14 GA
0.5	230	360' TO 585'	SIZE 4	12 GA
0.75	230	0 TO 270'	SIZE 4	14 GA
0.75	230	270' TO 435'	SIZE 4	12 GA

THREE PHASE MOTORS

HORSEPOWER	VOLTAGE	DISTANCE FROM SERVICE ENTRANCE TO PUMP IN FEET	SUMP DRAINER	MOTOR LEAD
0.5	200	0 TO 640'	SIZE 4	14 GA
0.5	200	640' TO 1025'	SIZE 4	12 GA
0.5	230	0 TO 835'	SIZE 4	14 GA
0.5	230	835' TO 1340'	SIZE 4	12 GA
0.5	460	0 TO 3390'	SIZE 4	14 GA
0.5	460	3390' TO 5420'	SIZE 4	12 GA
0.75	200	0 TO 460'	SIZE 4	14 GA
0.75	200	460' TO 730'	SIZE 4	12 GA
0.75	230	0 TO 600'	SIZE 4	14 GA
0.75	230	600' TO 970'	SIZE 4	12 GA
0.75	460	0 TO 2455'	SIZE 4	14 GA
0.75	460	2455' TO 3915'	SIZE 4	12 GA

SERIES 2 SIZE 4 VERTICAL SUMP DRAINER



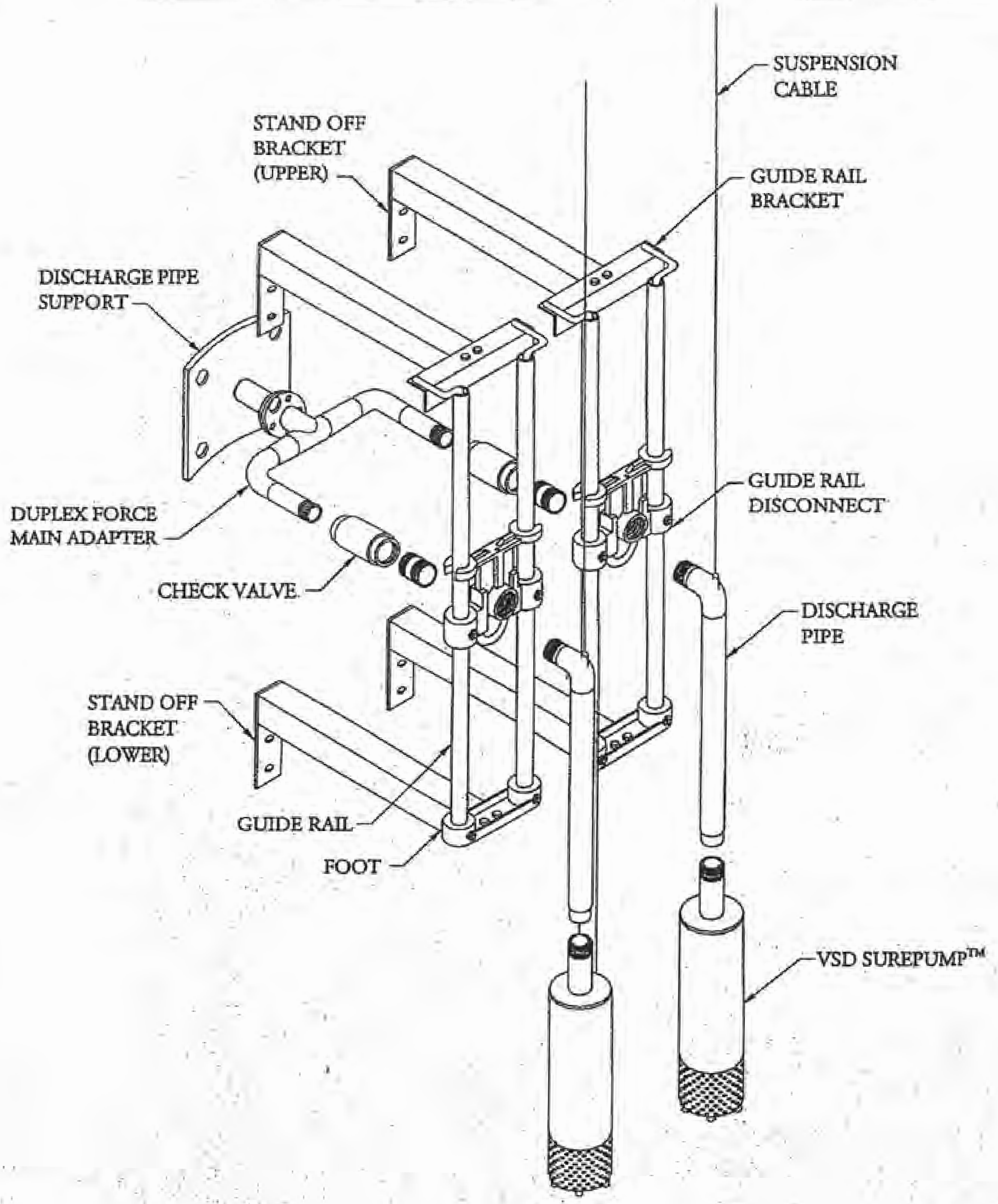
VSD **VSDPT**

MODEL	HP	PHASE	A	B	*APPROX. SHIPPING WEIGHT	
					VSD	VSDPT
2-2	0.50	1	26.28	17	55.01	60.01
2-2	0.50	3	26.28	17	55.01	60.01
2-3	0.50	1	27.11	17	55.91	60.91
2-3	0.50	3	27.11	17	55.91	60.91
2-4	0.50	1	27.94	17	56.80	61.80
2-4	0.50	3	27.94	17	56.80	61.80
2-5	0.50	1	28.77	17	57.69	62.69
2-5	0.50	3	28.77	17	57.69	62.69
2-6	0.50	1	29.60	17	58.59	63.59
2-6	0.50	3	29.60	17	58.59	63.59
2-7	0.50	1	30.43	17	59.48	64.48
2-7	0.50	3	30.43	17	59.48	64.48
2-8	0.50	1	31.26	17	60.38	65.38
2-8	0.50	3	31.26	17	60.38	65.38
2-9	0.75	1	33.22	18	65.15	70.15
2-9	0.75	3	33.22	18	65.15	70.15
2-10	0.75	1	34.05	18	66.04	71.04
2-10	0.75	3	34.05	18	66.04	71.04

NOTE: ALL DIMENSIONS ARE IN INCHES.

*SHIPPING WEIGHT INCLUDES
VSD: CRATE, 50' OF 14-4 MOTOR LEAD, 50' OF 1/8" SS CABLE.
VSDPT: CRATE, 50' OF 14-4 MOTOR LEAD, 50' OF 1/8" SS CABLE,
LEVEL SENSOR AND CABLE.

DUPLEX GUIDE RAIL DISCONNECT SYSTEM (Side Mounted)



Appendix D-7
Hydrostatic Uplift Analysis of Leachate Pump Station

AECOM

CALCULATION SHEET

Page 1 **Of** 2
Project No. 95561

Client	County of Kaua'i	**Subject**	Hydrostatic	**Prepared By**	MZ	**Date**	12/30/08
Project	Kekaha Landfill		Uplift Analysis of Leachate	**Reviewed By**	KJB	**Date**	12/30/08
Phase II Lateral Expansion			Pump Station	**Approved By**	KJB	**Date**	12/30/08

HYDROSTATIC UPLIFT ANALYSIS OF LEACHATE PUMP STATION

Objective

Evaluate the factor of safety against hydrostatic uplift pressures applied to the leachate pump station – No. 3 wet well from groundwater.

Design Criteria and Assumptions

?

1. The groundwater (GW) levels fluctuate from approximately 4.0 to potentially 10.5 feet msl around the No. 3 wet well. To be conservative, the maximum groundwater level of 10.5 feet msl was used in calculating the uplift pressure applied to the bottom of the well.

2. The wet well is a dual containment HDPE manhole assembly as shown in Figure 1. The exterior of the wet well is a 63-inch (O.D.) SDR-32.5 HDPE pipe fusion welded to a 2-inch thick flatstock base and cover. The interior of the wet well is a 48-inch (O.D.) SDR-32.5 HDPE pipe fusion welded to a 1-inch thick flatstock base.

3. A 2-inch thick flatstock ring with a width of 1 ft is installed onto the exterior wall of the wet well at Elevation 12.0 msl to provide resistance against the uplift pressure from groundwater.

4. Per Forrer Supply Co. Inc, typical 2-inch thick flatstock weighs 10 pounds per square foot. Pipe weight is based upon Reference 1 (Attachment 1)

5. Backfill around the wet well and the carrier pipe is compacted sand. The friction force applied to the wet well wall by the surrounding sand backfill, which intently holds the wet well in place, was not considered in the analysis providing additional conservatism.

6. The bottom of the well (2.58 feet msl) was used as the reference elevation to check the factor of safety against hydrostatic uplift failure of the wet well.

7. For conservatism, the weight of proposed pumps, racks, wet well wing and collected leachate will not be considered in determining the overburden pressure.

8. Factor of safety of 1.5 is deemed as an acceptable measuring of resistance to hydrostatic uplift.

Calculations:

The factor of safety (FS) against hydrostatic uplift failure is calculated as follows (Reference 2):

$$\text{FS} = \frac{\text{Overburden pressure against the uplift pressure}}{\text{Driving uplift pressure}} \qquad <1>

CALCULATION SHEET

AECOM

			Page 2	**Of** 2		
			Project No. 95561			
Client County of Kaua'i	**Subject** Hydrostatic		**Prepared By** MZ		**Date** 12/30/08	
Project Kekaha Landfill	Uplift Analysis of Leachate		**Reviewed By** KJB		**Date** 12/30/08	
Phase II Lateral Expansion	Pump Station		**Approved By** KJB		**Date** 12/30/08	

Driving Uplift Pressure:

The driving uplift pressure will be hydrostatic and is defined as:

Driving uplift pressure = (maximum groundwater elevation – reference elevation) x unit weight of groundwater

Overburden Pressure:

Overburden pressure against the uplift pressure is equal to the sum of loads from the wet well placed above the reference elevation and the soil backfill placed above the wet well wing.

A spreadsheet was developed to calculate the factor of safety against the uplift pressure, which is shown in Attachment 2.

Based on the calculation, a factor of safety against the uplift pressure from groundwater of 2.0 is achieved.

Conclusions

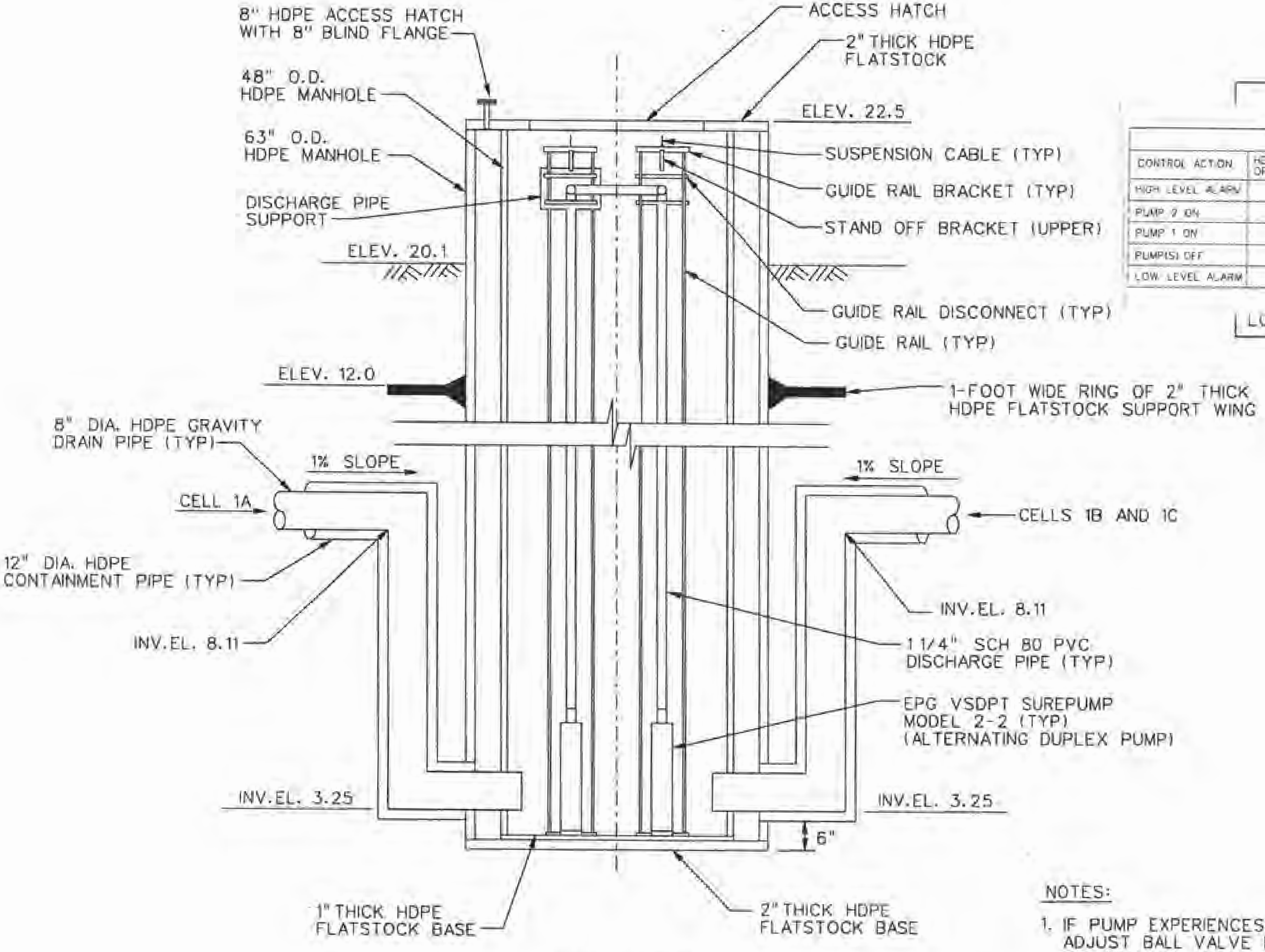
The analysis indicates that the No. 3 wet well will be stable in terms of uplift stability.

References

1. Chart titled "Polypipe EHMW PE3608 Pipe, Pipe Data and Pressure Ratings – IPS," provided by Forrer Supply Co. Inc.

2. Koerner, R. M. 1997, "Designing with Geosynthetics," 4th Edition

FIGURE 1
NO. 3 WET WELL DETAILS



PU

PUMP CONTROLS		
CONTROL ACTION	HEIGHT ABOVE FLOOR OF #3 WET WELL	ELEVATION FEET ABOVE MSL
HIGH LEVEL ALARM	7'-0"	10.0
PUMP 2 ON	5'-0"	8.0
PUMP 1 ON	4'-0"	7.0
PUMP(S) OFF	1'-2.25"	4.19
LOW LEVEL ALARM	1'-1.25'	4.11

LOW LEVEL ALARM

NOTES:

1. IF PUMP EXPERIENCES EXCESSIVE VIBRATION, ADJUST BALL VALVE BY FURTHER CLOSING TO INCREASE PUMP HEAD.

SECTION A-A

LEACHATE FORCEMAIN WET WELL #3 3

NTS

ATTACHMENT 1

PRODUCT INFORMATION OF POLYPIPE

PolyPipe® EHMW PE3608 Pipe
Pipe Data and Pressure Ratings – IPS

Pressure Rating		Class 265 DR7		Class 200 DR9		Class 160 DR11		Class 130 DR13.5		Class 100 DR17		Class 80 DR21		Class 65 DR26		Class 50 DR32.5	
Nominal Pipe Size	OD Size, inches	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft	Min. Wall, inches	Weight, lbs/ft
½"	0.840	0.120	0.12	0.093	0.10	0.076	0.08	---	---	---	---	---	---	---	---	---	---
¾"	1.050	0.150	0.18	0.117	0.15	0.095	0.13	---	---	---	---	---	---	---	---	---	---
1"	1.315	0.188	0.29	0.146	0.23	0.120	0.20	---	---	---	---	---	---	---	---	---	---
1 ¼"	1.660	0.237	0.46	0.184	0.37	0.151	0.31	0.123	0.26	---	---	---	---	---	---	---	---
1 ½"	1.900	0.271	0.60	0.211	0.49	0.173	0.41	0.141	0.34	---	---	---	---	---	---	---	---
2"	2.375	0.339	0.94	0.264	0.76	0.216	0.64	0.176	0.53	0.140	0.43	---	---	---	---	---	---
3"	3.500	0.500	2.05	0.389	1.66	0.318	1.39	0.259	1.15	0.206	0.93	0.167	0.76	0.135	0.62	---	---
4"	4.500	0.643	3.38	0.500	2.74	0.409	2.29	0.333	1.91	0.265	1.54	0.214	1.26	0.173	1.03	0.138	0.83
5"	5.375	0.768	4.83	0.597	3.91	0.489	3.27	0.398	2.72	0.316	2.20	0.256	1.80	0.207	1.47	0.165	1.19
5"	5.563	0.795	5.17	0.618	4.18	0.506	3.51	0.412	2.91	0.327	2.35	0.265	1.93	0.214	1.57	0.171	1.27
6"	6.625	0.946	7.34	0.736	5.93	0.602	4.97	0.491	4.13	0.390	3.34	0.315	2.74	0.255	2.23	0.204	1.80
7"	7.125	1.018	8.49	0.792	6.86	0.648	5.75	0.528	4.78	0.419	3.86	0.339	3.17	0.274	2.58	0.219	2.08
8"	8.625	1.232	12.43	0.958	10.05	0.784	8.43	0.639	7.00	0.507	5.66	0.411	4.64	0.332	3.78	0.265	3.05
10"	10.750	1.536	19.31	1.194	15.62	0.977	13.09	0.796	10.88	0.632	8.79	0.512	7.20	0.413	5.88	0.331	4.74
12"	12.750	1.821	27.17	1.417	21.97	1.159	18.41	0.944	15.30	0.750	12.36	0.607	10.13	0.490	8.27	0.392	6.67
14"	14.00	2.000	32.76	1.556	26.49	1.273	22.20	1.037	18.45	0.824	14.91	0.667	12.22	0.538	9.97	0.431	8.04
16"	16.00	2.286	42.79	1.778	34.60	1.455	28.99	1.185	24.09	0.941	19.47	0.762	15.96	0.615	13.02	0.492	10.51
18"	18.00	2.571	54.15	2.000	43.79	1.636	36.70	1.333	30.49	1.059	24.64	0.857	20.20	0.692	16.48	0.554	13.30
20"	20.00	2.857	66.85	2.222	54.06	1.818	45.30	1.481	37.64	1.176	30.42	0.952	24.94	0.769	20.35	0.615	16.42
22"	22.00	---	---	2.444	65.41	2.000	54.82	1.630	45.55	1.294	36.81	1.048	30.17	0.846	24.62	0.677	19.86
24"	24.00	---	---	2.667	77.85	2.182	65.24	1.778	54.21	1.412	43.80	1.143	35.99	0.923	29.30	0.738	23.64
28"	28.00	---	---	---	---	2.545	88.80	2.074	73.78	0.647	59.62	1.333	48.87	1.077	39.88	0.862	32.17
30"	30.00	---	---	3.333	121.63	2.727	101.93	2.222	84.70	1.765	68.44	1.429	56.11	1.154	45.78	0.923	36.93
32"	32.00	---	---	---	---	---	---	2.370	96.37	1.882	77.87	1.524	63.84	1.231	52.09	0.985	42.02
36"	36.00	---	---	---	---	3.273	146.78	2.667	121.96	2.118	98.55	1.714	80.79	1.385	65.92	1.108	53.19
42"	42.00	---	---	---	---	---	---	---	---	2.471	134.14	2.000	109.97	1.615	89.73	1.292	72.39
48"	48.00	---	---	---	---	---	---	---	---	---	---	2.286	143.63	1.846	117.19	1.477	94.55
54"	54.00	---	---	---	---	---	---	---	---	---	---	2.571	181.78	2.077	148.32	1.662	119.67
63"	63.00	---	---	---	---	---	---	---	---	---	---	3.000	247.42	2.423	201.89	1.938	162.88
65"	65.00	---	---	---	---	---	---	---	---	---	---	3.095	263.38	2.500	214.91	2.000	173.39

**See notes on Page 3 for product information and pressure rating information.*

ATTACHMENT 2

CALCULATION SPREADSHEET FOR FACTOR OF SAGETY AGAINST UPLIFE PRESSURE

Design Elevations/Feature Dimensions

Top of Wet Well	22.50 feet	(top of 2" thick flatstock cover)
Top of Pipe	22.33 feet	(bottom of 2" thick flatstock cover)
Bottom of 48 (OD)	2.83 feet	(top of 1" thick flatstock base)
Bottom of 63 (OD)	2.75 feet	(top of 2" thick flatstock base)
Bottom of Wet Well	2.58 feet	(bottom of 2" thick flatstock base)

Wing width	12 inches
Unit weight of soil	100 pcf
Wing elevation	12 feet
Ground elevation	20 feet

Piping Weight

Pipe Diameter (OD) (inches)	Top Elev (feet)	Bottom Elev (feet)	Length (feet)	Unit Wt. (lb/lf)	lbs-force
48	22.33	2.83	19.50	94.55	1843.73
63	22.33	2.75	19.58	162.88	3189.19
Total					**5032.92**

Flatstock (Cover and Bases)

	Diameter (inches)	Diameter (feet)	Radius (feet)	Area (sf)	Unit Wt. (lb/sf)	lbs-force
2 inch thick (cover)	63	5.25	2.63	21.64	10.00	216.37
2 inch thick (base)	63	5.25	2.63	21.64	10.00	216.37
1 inch thick (base)	48	4.00	2.00	12.56	5.00	62.80
Total						**495.53**

Wet Well Wing Soil Overburden

	Diameter (OD) (inches)	Diameter (OD) (feet)	Radius (feet)	Outside Area (sf)	Inside Area (sf)	Available Area (sf)	Overburden Thickness (feet)	lbs-force
2 inch thick flatstock	87	7.25	3.63	41.26	21.64	19.63	8.00	**15700.00**

Weight of wet well	**21228.45 lbs-force**	(Sum of Piping Weight + Flatstock + Wing Overburden)
Downforce pressure	**981.14 psf**	(Weight of wet well / 2" thick flatstock base)

Driving Uplift Pressure

	Top Elev (feet)	Bottom Elev (feet)	Total Heigl (feet)	Water Wt (pcf)	Uplift Pressure (psf)
Water uplift	10.5	2.58	7.92	62.40	**494.21**

Factor of Safety **2.0** (Downforce Pressure / Water Uplift)

Appendix E
Geosynthetic Material Properties

Appendix E-1

Geosynthetic Clay Liner (GCL)

Property	ASTM Test Method	Value	Test Frequency
Clay (as received prior to manufacturing GCL)			
Swell index (ml/2g)	D5890	24	50 tonnes
Fluid Loss (ml)(1)	D5891	18	50 tonnes
Geotextiles (as received prior to manufacturing GCL)			
Cap fabric (nonwoven), mass per unit area (oz/yd^2)(2)	D5261	5.8	25,000 yd^2
Carrier fabric (woven), mass per unit area (oz/yd^2)(2)	D5261	3	25,000 yd^2
GCL (as manufactured)			
Mass of GCL (lb/ft^2)(3)	D5993	0.82	5,000 yd^2
Mass of bentonite (lb/ft^2)(3)	D5993	0.75	5,000 yd^2
Tensile strength, MD (lb/in.)	D6768	23	25,000 yd^2
Peel strength (lb/in.)	D6496	2.1	5,000 yd^2
Permeability(1) (cm/sec)	D5887	$5x10^{-9}$	30,000 yd^2
Needle-punched reinforcement	—	Required	—

Notes:

(1) These values are maximum (all others are minimum).

(2) Carrier fabric for nonwoven reinforced GCL must contain a scrim component of mass >2.9 oz/yd^2 for dimensional stability.

(3) Mass of GCL and bentonite is measured after oven drying for stated test method.

Material properties based upon Geosynthetic Research Institute GRI –GCL3, Standard Specification for "Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCls)", dated May 16, 2005.

Appendix E-2

60-mil HDPE Geomembrane

Property	ASTM Test Method	Value	Test Frequency
Textured Geomembrane, textured both sides**			
Thickness, min. ave. (mils) Lowest individual for 8 out of 10 values (mils) Lowest individual for any of the 10 values (mils)	D5994	57 54 51	Per roll
Asperity height(5), min. ave. (mils)	GRI GM 12	10	Every 2nd roll(6)
Density, min. (g/cm^3)	D1505/D 792	0.940	200,000 lbs
Tensile Properties(1), min. ave. Yield strength (lb/in.) Break strength (lb/in.) Yield elongation (%) Break elongation (%)	D6693, Type IV	 126 90 12 100	20,000 lbs
Tear resistance, min. ave. (lbs)	D1004	42	45,000 lbs
Puncture Resistance, min. ave. (lbs)	D4833	90	45,000 lbs
Stress crack resistance(2) (hrs)	D5397 (App.)	300	Per GRI-GM 10
Carbon black content (range) (%)	D1603(3)	2.0 to 3.0	20,000 lbs
Carbon black dispersion	D5596	Note 4	45,000 lbs
Oxidative induction time	Per current GRI GM13 at time of manufacture		
Oven aging at 85 degrees			
UV Resistance			

Notes:

(1) Machine direction (MD) and cross machine direction (XMD) average values should be basis of 5 test specimens each direction.

Yield elongation is calculated using gage length of 1.3 inches.
Break elongation is calculated using gage length of 2.0 inches.

(2) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Tests should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(3) Other methods such as D4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.

(5) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest reading must be ≥ 5 mils; also see Note 4.

(6) Alternate the measurement side for double-sided textured sheet.

****Material Note:**

Geomembrane to be installed adjacent to the pipe penetrations for each subcell is to be 80-mil HDPE geomembrane, textured on both sides. This geomembrane must meet the minimum material properties for 60-mil HDPE geomembrane specified above except for an increase in material thickness as defined in the following table.

Property	ASTM Test Method	Value	Test Frequency
Textured Geomembrane, textured both sides			
Thickness, min. ave. (mils) Lowest individual for 8 out of 10 values (mils) Lowest individual for any of the 10 values (mils)	D5994	76 72 68	Per roll

Material properties based upon Geosynthetic Research Institute GRI –GM 13, Standard Specification for "Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes", Revision 8, dated July 10, 2006.

Appendix E-3

Nonwoven Cushion Geotextile

Property	ASTM Test Method	Value
Mass per unit area (oz/yd^2)	D5261	16
Grab tensile strength (lbs)	D4632	370
Grab tensile elongation (%)	D4632	50
Trapezoidal tear strength (lbs)	D4533	145
Puncture (pin) strength (lbs)	D4833	170
UV Resistance	D4355	70

Notes:

(1) All values are minimum average roll value (MARV) except for UV resistance which is a minimum value.

(2) UV Resistance evaluation to be on a 2.0 inch strip tensile specimen after 500 hours exposure.

Material properties based upon Geosynthetic Research Institute GRI –GT12(a), Standard Specification for "Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials", dated February 18, 2002.

Appendix E-4

Nonwoven Separator Geotextile

Property	ASTM Test Method	Value
Mass per unit area (oz/yd^2)	D5261	6
Apparent Opening Size (US Sieve)	D4751	70
Permittivity (sec^{-1})	D4491	1.5
Permeability (cm/sec)	D4491	0.30
Geotextile Structure	Nonwoven, needle-punched	
Notes: (1) All values are minimum average roll value (MARV) except for Apparent Opening Size which is a maximum average roll value.		

Appendix E-5

40-mil LLDPE Geomembrane

Property	ASTM Test Method	Value	Test Frequency
Textured Geomembrane, textured both sides (final cover)			
Thickness, min. ave. (mils)	D5994	38	Per roll
Lowest individual for 8 out of 10 values (mils)		36	
Lowest individual for any of the 10 values (mils)		34	
Asperity height(1), min. ave. (mils)	GRI GM 12	10	Every 2nd roll(2)
Density, min. (g/cm^3)	D1505/D 792	0.939	200,000 lbs
Tensile Properties(3), min. ave.	D6693, Type IV		20,000 lbs
Break strength (lb/in.)		60	
Break elongation (%)		250	
2% modulus, max. (lb/in.)	D5323	2400	Per formulation
Tear resistance, min. ave. (lbs)	D1004	22	45,000 lbs
Puncture Resistance, min. ave. (lbs)	D4833	44	45,000 lbs
Axi-Symmetric break resistance strain, min. (%)	D5617	300	Per GRI-GM 10
Carbon black content (range) (%)	D1603(4)	2.0 to 3.0	20,000 lbs
Carbon black dispersion	D5596	Note 5	45,000 lbs
Oxidative induction time	Per current GRI GM17 at time of manufacture		
Oven aging at 85 degrees			
UV Resistance			

Notes:

(1) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest reading must be ≥ 5 mils; also see Note 6.

(2) Alternate the measurement side for double-sided textured sheet.

(3) Machine direction (MD) and cross machine direction (XMD) average values should be basis of 5 test specimens each direction. Break elongation is calculated using gage length of 2.0 inches at 2.0 in/minute.

(4) Other methods such as D4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.

(6) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

Material properties based upon Geosynthetic Research Institute GRI –GM 17, Standard Specification for "Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes", Revision 5, dated July 10, 2006.

Appendix E-6

Geocomposite Drainage Layer

Property[1]	ASTM Test Method	Value	Test Frequency
HDPE Geonet core (prior to lamination)			
Thickness, min. (mils)	D5199	200	50,000 ft^2
Density, min (g/cm^3)	D1505	0.940	50,000 ft^2
Tensile strength (MD), (lb/in.)	D5035	45	50,000 ft^2
Carbon black content (%)	D1603 (modified) / ASTM D4218	2.0	50,000 ft^2
Nonwoven Geotextile[2] (prior to lamination)			
Mass per unit area (oz/yd^2)	D5621	8	90,000 ft^2
Grab tensile strength (lbs)	D4632	220	90,000 ft^2
Puncture strength (lbs)	D4833	120	90,000 ft^2
AOS, max. ave. (US sieve)	D4751	80	540,000 ft^2
Permittivity (sec^{-1})	D4491	1.5	540,000 ft^2
Flow rate (gpm/ft^2)	D4491	110	540,000 ft^2
UV resistance (% retained)	D4355 (after 500 hrs)	70	Per formulation
Geocomposite (after assembly)			
Transmissivity[3], min. (m^2/sec)	D4716	$1x10^{-4}$	540,000 ft^2
Ply adhesion (lb/in.)	D7005	1.0	50,000 ft^2

Notes:

(1) All values are minimum average roll value (MARV) unless otherwise noted.

(2) Geocomposite to consist of a nonwoven geotextile laminated (heat-bonded) to both sides of the geonet core.

(3) Transmissivity of geocomposite to be used in final cover to be determined by using proposed final cover soils at representative loadings, gradient, and seat time determined by Engineer.

Appendix E-7

Interface Friction Angle Testing

Interface	Test Condition	ASTM Test Method	Minimum Friction Angle[1]
Cell 1 Base Liner System and Leachate Evaporation Pond			
1. Operation Layer to Separation Nonwoven Geotextile	Direct Contact	D5321	25 degrees
2. Separation Nonwoven Geotextile to Drainage Layer	Direct Contact	D5321	25 degrees
3. Drainage Layer to Cushion Nonwoven Geotextile to Textured HDPE Geomembrane	Floating	D5321	25 degrees
4. Textured HDPE Geomembrane to Nonwoven Geotextile of GCL	Direct Contact	D6243	23 degrees
5. Woven geotextile of GCL to Textured HDPE Geomembrane	Direct Contact	D6243	18 degrees
6. Textured HDPE Geomembrane to Nonwoven Geotextile of Geocomposite	Direct Contact	D5321	25 degrees
7. Textured HDPE Geomembrane to Subbase Soils (multiple tests for different subbase material types)	Direct Contact	D5321	25 degrees

Interface	Test Condition	ASTM Test Method	Minimum Friction Angle[1]
Cell 1 Final Cover System			
1. Rooting Zone to Nonwoven Geotextile (geocomposite)	Direct Contact	D5321	23.1 degrees
2. Nonwoven Geotextile (geocomposite) to Textured LLDPE Geomembrane	Direct Contact	D5321	23.1 degrees
3. Textured LLDPE Geomembrane to Grading Layer	Direct Contact	D5321	23.1 degrees

Notes:

1. Minimum friction angles are presented solely as a friction angle without apparent adhesion. Laboratory test results which provide an adhesion factor and a lower resulting friction angle may be approved by the Design Engineer for the specific application.
2. Interface friction angle testing to be completed prior to acceptance of geosynthetic and soil materials. Any changes in material, interface friction angle testing should be retested.
3. Coordinate test loads, seating parameters, shear rates, and wet/dry interface requirements with Design Engineer prior to testing to confirm current test methods, procedures, and practices.