A-MEHR, INC.
Memorandum

June 18, 2019

TO: Sage Kiyonaga, County of Maui

FROM: Ali Mehrazarin

RE: Molokai Landfill Airspace Use and Capacity as of April 17, 2019

<u>Airspace Use</u>

As requested, we have calculated the landfill airspace used between the topographic (topo) surveys of May 31, 2018 and April 17, 2019. Based on comparing digital terrain models of the topographic surfaces defined by the aerial survey data we calculated the net airspace use in the active landfill area to be 12,323 cubic yards (cy) in two specific areas of the landfill where refuse was disposed of during the May 31, 2018 and April 17, 2019. Attached drawings Figure 1 and Figure 2 show the topographic surfaces and limits used in the calculations.

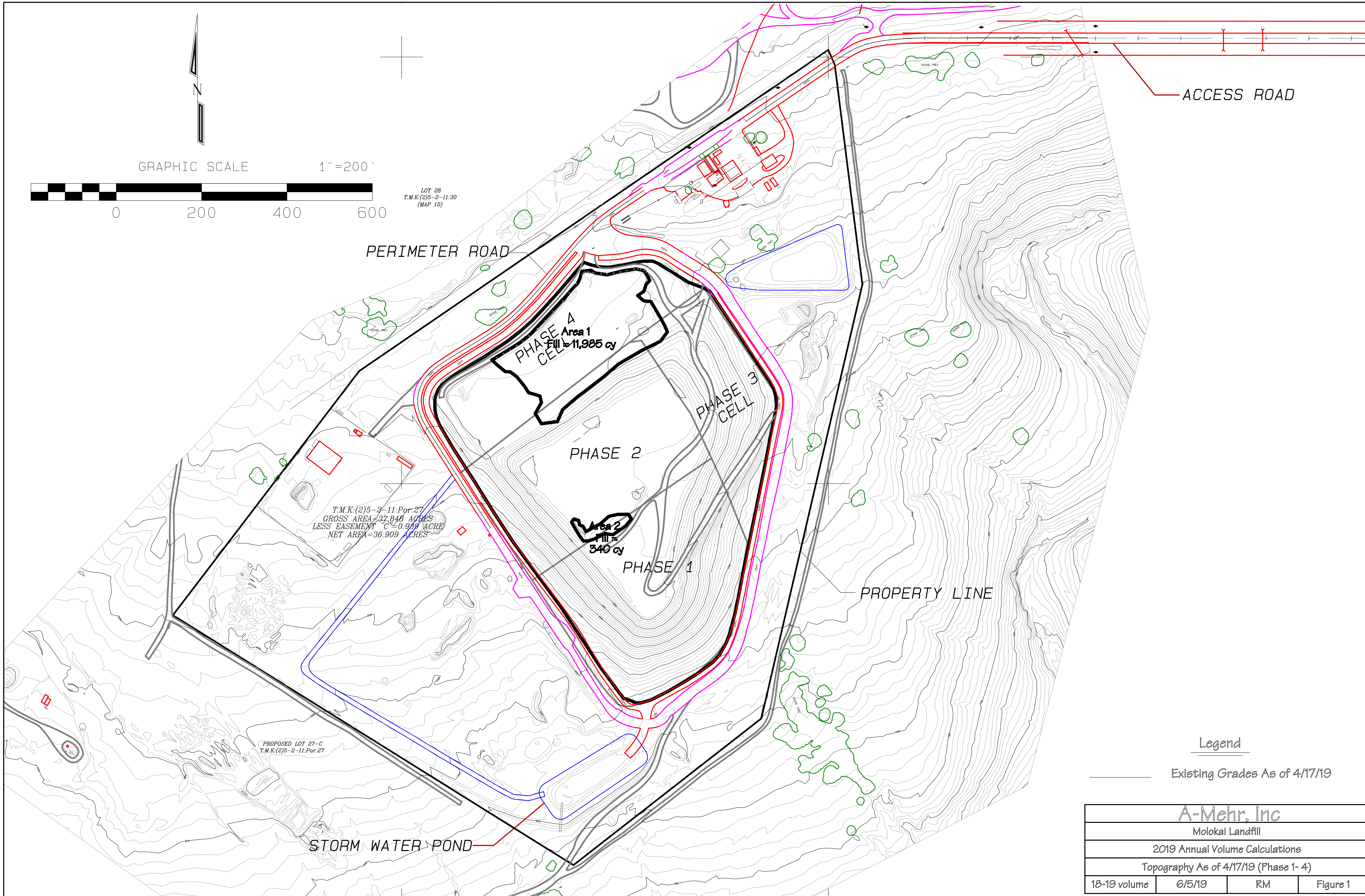
We estimated approximately 2,616 cy of settlement in Phase 3 area between May 31, 2018 and April 17, 2019.

Based on data provided by the County, a total of 5,009 tons of solid waste disposed at the landfill between May 31, 2018 and April 17, 2019. Using this disposed tonnage and the airspace use of 12,323 cy we calculate the airspace utilization factor for the period between surveys to be 813 pounds per cubic yard (lb/cy). Using the 2,616 cy of calculated settlement in the Phase 3 area the airspace utilization factor is estimated to be 1032 lb/cy.

<u>Remaining Capacity in Phases 1, 2, 3 and 4</u>

We calculated the remaining gross airspace in the Phases 1, 2, 3 and 4 to be approximately 112,745 cubic yards, based on the difference between the 2019 topography (Figure 1) and interim final grades that can be achieved within the existing disposal area footprint (Figure 3) within the existing landfill footprint. After subtracting for required final cover, we estimate the net remaining capacity of the existing constructed airspace to be approximately 53,987 cubic yards. Using the monthly average airspace use of 1,168 cy/month, we estimate the remaining useful life of Phases 1-4 to be 46 months from April 17, 2019, or until approximately February 21, 2023. Considering the calculated settlement of top deck in Phase 3 area between May 31, 2018 and April 17, 2019 the life of Phases 1-4 is estimated to be 59 months or until March 6, 2024. Based on this, it appears that construction of Phase 5 should be completed no later than February 2022 in order to maintain efficient operations in the existing permitted waste footprint.

If there are any questions regarding our estimates of airspace use and capacity, please call us at (949) 206-0157. Thank you.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200
400
600
LOT 28
T.M.K:(2)5-2-11:30
(MAP 10)
ACCESS ROAD
PERIMETER ROAD
PHASE 4 CELL
Area 1
Fill = 11,985 cy
PHASE 3 CELL
PHASE 2
Area 2
Fill = 340 cy
PHASE 1
PROPERTY LINE
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NET AREA=36.909 ACRES
PROPOSED LOT 27-C
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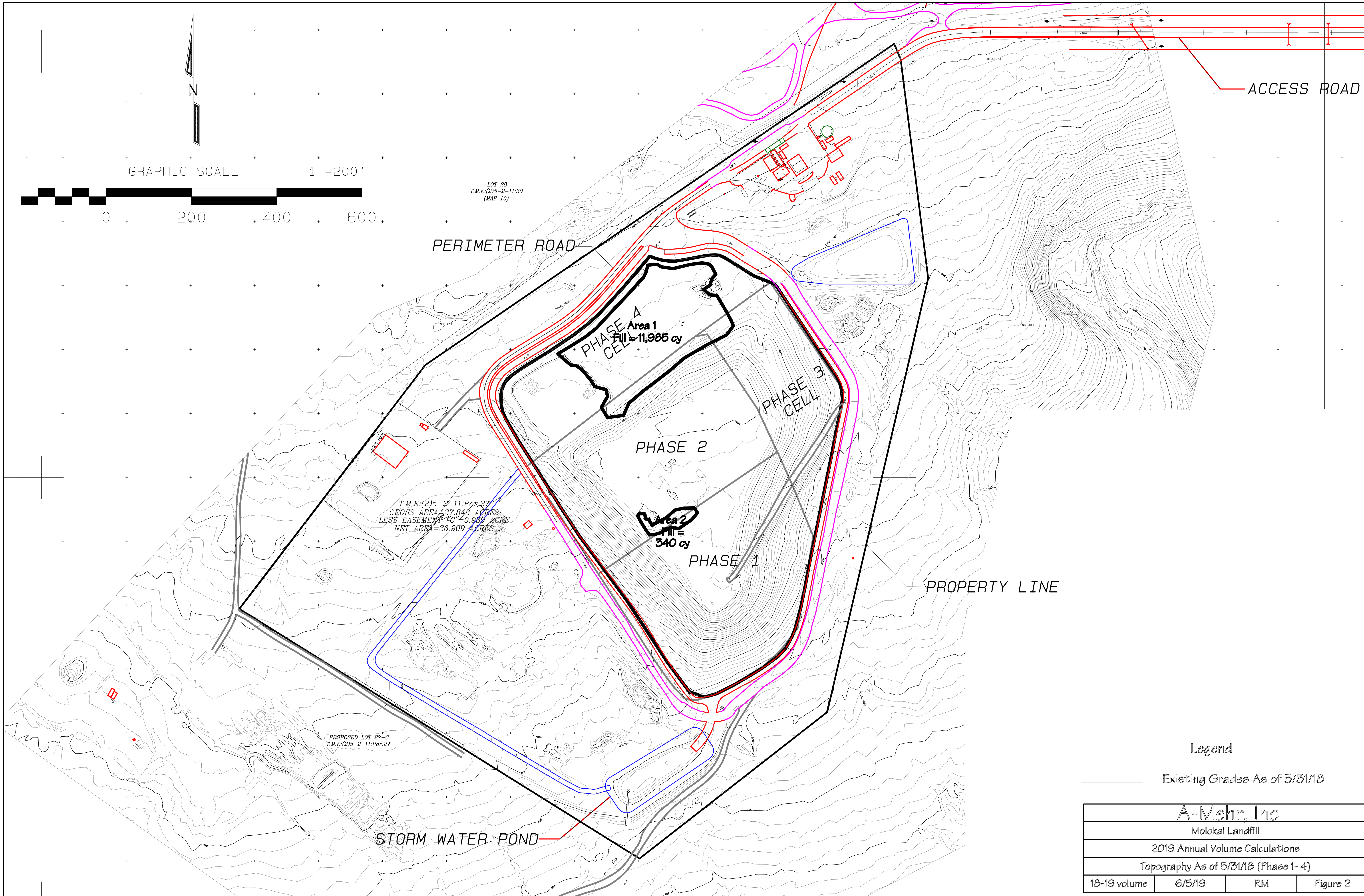
STORM WATER POND
Legend
Existing Grades As of 4/17/19
A-Mehr, Inc
Molokai Landfill
2019 Annual Volume Calculations
Topography As of 4/17/19 (Phase 1- 4)
18-19 volume
6/5/19
RM
Figure 1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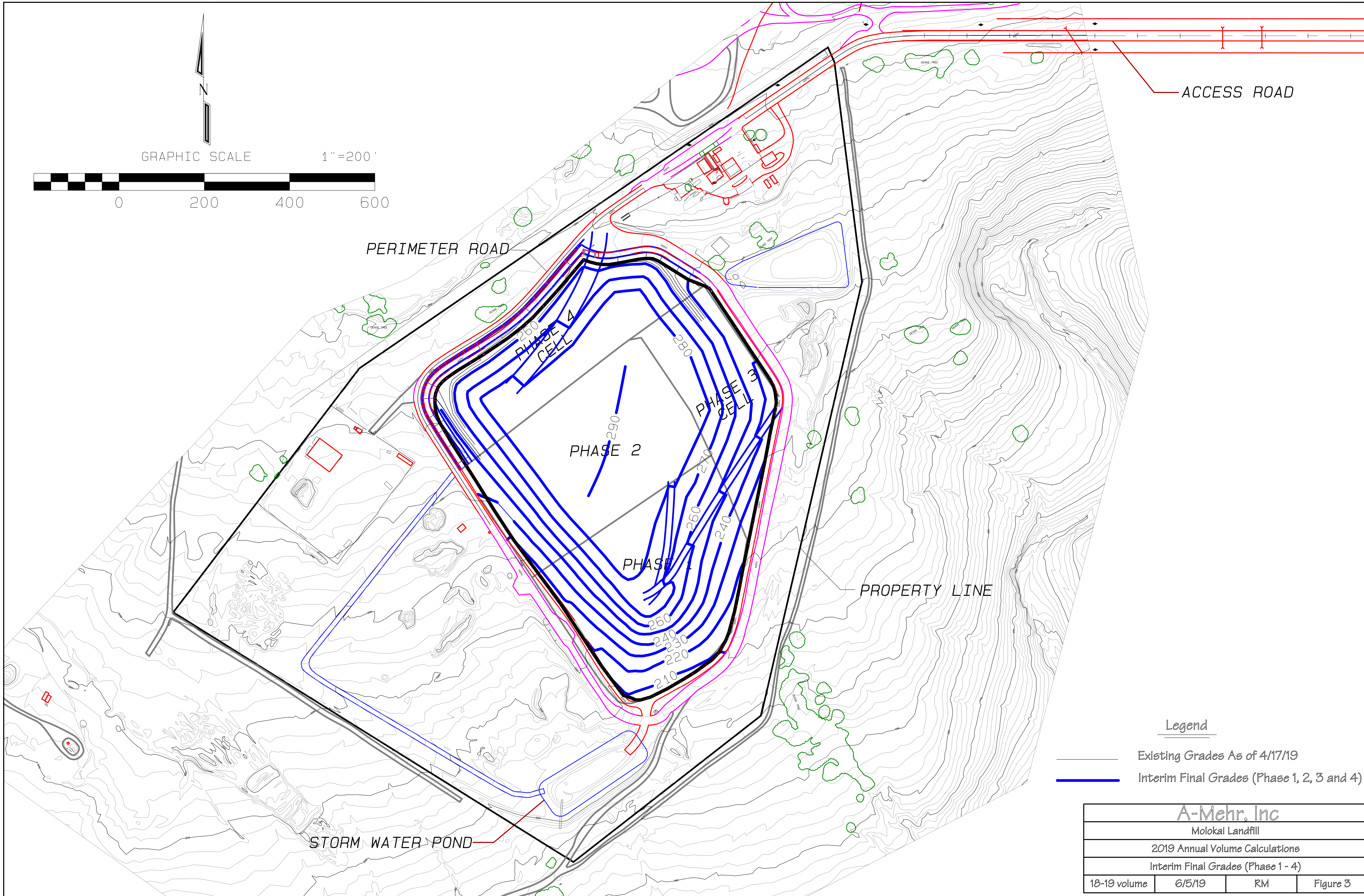
T.M.K:(2)5-2-11:Por.27
STORM WATER POND
Legend
Existing Grades As of 5/31/18
A-Mehr, Inc
Molokai Landfill
2019 Annual Volume Calculations
Topography As of 5/31/18 (Phase 1- 4)
18-19 volume
6/5/19
RM
Figure 2



A-Mehr, Inc			
Molokai Landfill			
2019 Annual Volume Calculations			
Interim Final Grades (Phase 1 - 4)			
18-19 volume	6/5/19	RM	Figure 3

N
GRAPHIC SCALE 1"=200'
0
200
400
600
LOT 28
T.M.K:(2)5-2-11:30
(MAP 10)
ACCESS ROAD
PERIMETER ROAD
PHASE 4 CELL
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STORM WATER POND
Legend
Existing Grades As of 4/17/19
Isopatch between 4/17/19 Topography and Interim Final Grades (Phase 1,2,3 and 4)
A-Mehr, Inc
Molokai Landfill
2019 Annual Volume Calculations
Isopach between 4/17/19 Topography and Interim Final Grades
18-19 volume
6/5/19
RM
Figure 4

APPENDIX D

SITE-SPECIFIC GROUNDWATER AND LEACHATE MONITORIN PLAN

SITE-SPECIFIC GROUNDWATER AND LEACHATE MONITORING PLAN

for

MOLOKAI INTEGRATED SOLID WASTE FACILITY

Prepared for:

County of Maui
Department of Environmental Management
Solid Waste Division
2200 Main Street, Suite 225
Wailuku, Maui, Hawaii 96793

Prepared by:

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Laguna Hills, California 92653
(949) 206-0157

April 2008
Revised December 2009

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MOLOKAI INTEGRATED SOLID WASTE FACILITY
GROUNDWATER AND LEACHATE MONITORING PLAN

1. INTRODUCTION

The Molokai Integrated Solid Waste Facility (MISWF) is a municipal solid waste (MSW) disposal facility owned by the County of Maui and operated by the Maui County Department of Environmental Management, Solid Waste Division. This document describes a groundwater and leachate monitoring plan (monitoring plan) for the MISWF which is consistent with State and Federal regulations applicable to the monitoring of MSW landfills in the State of Hawaii. The document was prepared by A-Mehr, Inc. for Maui County.

1.1 Location

The MISWF is located near the southern coast of the island of Molokai approximately 3 miles northwest of Kaunakakai (Figure 1-1). The Tax Key map identification number for the facility is TMK (2) 5-2-11:27 (portion).

1.2 Regulatory Setting

State of Hawaii regulations governing the monitoring of MSW landfills are contained in Hawaii Administrative Rules (HAR), Chapter 11-58.1, Sections 11-58.1-11 and 11-58.1-16. Contained within HAR 58.1-16(b) are requirements for the design of groundwater monitoring systems and subsequent certification of the design by a qualified groundwater scientist.[1]

HAR 11-58.1-11(f) provides an exemption from requirements of sections 11-58.1-14 (design requirements) and 11-58.1-16 (groundwater monitoring requirements) for small landfills "*that dispose of less than twenty tons of municipal solid waste daily, based on an annual average*", provided:

> *(1) There is no evidence of existing ground-water contamination from the MSWLF unit;*

[1] According to HAR 58.1-03 "Qualified Groundwater Scientist" means a scientist or engineer who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and who has sufficient training and experience in ground-water hydrology and related fields as may be demonstrated by state registration, professional certifications, or completion of accredited university programs that enable that individual to make sound professional judgments regarding ground-water monitoring, contaminant fate and transport and corrective action.

(2) The MSWLF unit serves either:

(A) A community that experiences an annual interruption of at least three consecutive months of surface transportation that prevents access to a regional waste management facility; or

(B) A community that has no practicable waste management alternative and is located in an area that annually receives less than or equal to twenty-five inches of precipitation; and

(3) The owners or operators place in the operating record information demonstrating that the requirements of this subsection are met.

The MISWF has previously been designated as a small landfill with less than 20 tons per day of MSW (A-Mehr, Inc, April 2007). The island of Molokai is clearly an isolated community with no practicable alternative to the MISWF as a waste management alternative, and the average annual rainfall is estimated to be approximately 16 inches per year (see Section 3.1 below). The facility would therefore be exempt from the groundwater monitoring requirements of HAR 11-58.1-16 if it is determined that "there is no evidence of existing ground-water contamination from the MSWLF unit". This matter is addressed in Section 7.1, which concludes that there is no such evidence, and that therefore the site is exempt from the groundwater monitoring requirements of HAR 11-58.1-16.

If future growth of population or other factors causes the daily intake of municipal solid waste at the MISWF to exceed the 20 ton per day threshold for exemption from groundwater monitoring requirements based on HAR 11-58.1-11(f), the site would be required to install groundwater monitoring wells unless it can be shown to meet the criteria for the exemption provided in HAR 11-58.1-16(a)(2), which states:

(2) Ground water monitoring requirements under subsections (b) through (e) may be suspended by the director for a MSWLF unit if the owner or operator can demonstrate that there is no potential for migration of hazardous constituents from that MSWLF unit to the uppermost aquifer (as defined in section 11-58.1-03) during the active life of the unit and the post-closure care period. This demonstration must be certified by a qualified ground water scientist and approved by the director, and must be based upon:

(A) Site-specific field collected measurements, sampling, and analysis of physical, chemical, and biological processes affecting contaminant fate and transport; and

(B) Contaminant fate and transport predictions that maximize contaminant migration and consider impacts on human health and environment.

A no-migration demonstration (Dames & Moore, 1998) was previously submitted by Maui County to the State of Hawaii Department of Health, pursuant to HAR 58.1-16(a)(2). Updated information related to that demonstration is included in Section 7 of this monitoring plan. The analysis concludes, like the 1998 study, that although migration of leachate constituents is theoretically possible, the character of the underlying groundwater is such that hazards to human health and environment are highly unlikely. The analysis of Section 7 also demonstrates that, even considering the highly conservative projections of leachate volume resulting for modeling using the USEPA HELP model, the potential for exceeding prescribed maximum contaminant levels (MCLs) for any leachate constituent at off-site receptors is insignificant. This is due in part to the absence of any volatile organic compounds and most other hazardous constituents in the leachate as determined from samples collected in 2007 and 2008.

1.3 Scope of the Monitoring Plan

Based on the analyses summarized in the foregoing Section 2.2, monitoring of groundwater at the MISWF is not required. Accordingly, this monitoring plan is based on monitoring of leachate. Sections 6 and 8 describe the recommended procedures and rationale for monitoring leachate in each existing and future phase of the MISWF.

1.4 Revisions to the Monitoring Plan

This monitoring plan was prepared by a qualified groundwater scientist based on existing and anticipated site conditions at, and in the vicinity of, the MISWF. It is expected that the monitoring plan will be reviewed at least every two years with respect to changing site conditions at, or in the vicinity of, the MISWF, and updated accordingly. Any substantial changes to the monitoring plan should be accompanied by a re-certification of the document by a qualified groundwater scientist.

1.5 Organization of the Monitoring Plan

The remainder of the monitoring plan is organized in seven parts, as follows:

- Monitoring Plan Summary
- Facility Description,
- Geology,
- Hydrogeology,

- Landfill Liquid Monitoring,
- Groundwater Monitoring, and
- Procedures for Sample Collection.

Tables are presented at the end of the section in which they are first referenced. Figures and Appendices are included at the end of the document.

2. LEACHATE MONITORING PLAN SUMMARY

As developed in Section 1.3 above, the monitoring plan for Molokai Integrated Solid Waste Facility is based on monitoring leachate level, quantity and quality. This section summarizes the major components of the plan, including:

- Monitoring Facilities Preparation,
- Personnel Training,
- Leachate Level and Quantity Monitoring,
- Leachate Sampling, and
- Reporting

2.1 Monitoring Facilities Preparation

At present there is no way of monitoring the depth of leachate above the liner systems in Phases 1 and 2. In order to enable accurate monitoring the following activities will be performed:

2.1.1 Phase 1 Preparation

A riser pipe will be installed in the leachate header line near the leachate wet well, on the upstream side of the shutoff valve. The riser pipe will be used to measure the elevation of the liquid surface before the valve is opened to drain liquid into the wet well for removal. The liquid level elevation will be used to calculate the liquid head above the liner based on available design information.

After the riser pipe is installed, the elevation of its top will be accurately surveyed in order to establish the datum for liquid level measurements. The invert elevation of the leachate line where it discharges into the wet well will also be surveyed and documented.

2.1.2 Phase 2 Preparation

Phase 2 is equipped with a test lysimeter that collects leachate from a limited area on the floor of the unit and drains it to a standpipe located outside the waste footprint. The standpipe can be used to measure liquid head in the test lysimeter, provided its location and elevation is accurately surveyed. The County will engage a qualified surveyor to establish the elevation of the bottom of the standpipe, and a datum elevation for measurements of liquid elevations in the Phase 2 leachate standpipe.

2.1.3 Phases 3 and 4 Preparation

Accurate as-built surveys will be conducted and documented during the construction of the Phase 3 liner and leachate collection system during 2008. This information will be used to establish the basis for determining compliance levels in Phases 3 and 4. In addition, as-built survey information will be used to compute a chart or table of values for the volume of leachate contained in the sump as a function of liquid depth.

In order to implement required monitoring of the Phase 3 test lysimeter, the site must acquire an electric sounding tape that will detect liquid when pushed to the bottom of the lysimeter riser pipe. The sounder will be attached to a pole or sectioned rod at least 15 feet long in order to be pushed to the bottom of the riser, which is buried below the sideslope liner system at a 2:1 (horizontal:vertical) grade. The sounder may also be used to measure leachate depth in the Phase 1 wet well and Phase 2 monitoring standpipe.

2.2 Personnel Training

MISWF operating personnel will be responsible for monitoring leachate levels and removing leachate from the collection points. Collection of samples for laboratory analysis will be performed by engineering or other qualified technical personnel of the County Solid Waste Division.

All County personnel will receive training from the Hawaii Department of Health in proper procedures for monitoring leachate levels, quantity and composition. Additional technical assistance may be provided by outside third-party consultants.

2.3 Leachate Level and Quantity Monitoring

As required by the site's solid waste facility permit, leachate level monitoring in each measurement point will be performed on a monthly basis. In addition, leachate levels will be checked after each significant rain event with more than 0.1 inch of rain in 24 hours. Procedures for each sampling point are summarized below.

2.3.1 Phase 1 Leachate Monitoring

At each monthly monitoring event, site personnel will perform the following procedures:

1. Determine the liquid level in the riser pipe that will be installed in the leachate line near the sump. If an electric sounding tape is available, level will be determined by measuring distance from the top of the riser to the liquid surface; otherwise the depth of liquid in the riser will be measured using a dipstick.

2. Calculate the elevation of the liquid surface using the surveyed elevation of the top of the riser.

3. Calculate the liquid head above the liner in the Phase 1 area based on an assumed liner elevation of 204.0 feet above mean sea level (determined from Phase 1 construction drawings as discussed in Section 3.5.1 of this Plan).

4. Open the valve in the leachate line and drain leachate into the wet well until it is full.

5. Re-measure the elevation of the liquid level in the riser pipe. If it is at elevation 203.0 feet or higher, arrange for liquid to be pumped from the wet well at the next monthly monitoring event.

6. At any time when the liquid elevation in the riser is 204.0 feet or higher, arrange for liquid removal at the earliest possible time. At that time, drain all liquid from the cell into the sump until the incoming flow is reduced to a trickle.

7. If the liquid elevation at any time exceeds the compliance level of 205.0 feet, initiate reporting procedures as directed in Section 2.5 below.

8. Document all leachate removals based on the capacity of the truck-mounted tank used to haul it from the wet well to the wastewater treatment facility or for use on-site if allowed by the Department of Health.

2.3.2 Phase 2 Leachate Monitoring

At each monthly monitoring event, site personnel will perform the following procedures:

1. Measure the liquid level in the Phase 2 leachate monitoring standpipe. If an electric sounding tape is available, level will be determined by measuring distance from the top of the standpipe to the liquid surface; otherwise the depth of liquid will be measured using a dipstick.

2. Calculate the elevation of the liquid surface using the surveyed elevation of the top of the standpipe.

3. Calculate the liquid level in the Phase 2 test lysimeter based on an assumed lysimeter base elevation of 224.5 feet above mean sea level (determined from Phase 2 construction drawings as discussed in Section 3.5.2 of this Plan).

4. Record all measurements.

5. If the elevation of the liquid surface in the Phase 2 standpipe equals or exceeds 224.5 feet above mean sea level, use a portable pump or suction hose to remove as much liquid as possible from the standpipe. The removed liquid may be discharged to the Phase 1 wet well or hauled directly to the wastewater treatment plant. Document the volume and disposition of all liquid withdrawn from the Phase 2 standpipe.

6. If the liquid elevation at any time exceeds the compliance level of 225.5 feet, initiate reporting procedures as directed in Section 2.5 below.

2.3.3 Phases 3 and 4 Leachate Monitoring

Future Phase 4 will be constructed such that leachate from it flows by gravity into the Phase 3 sump. Each monthly monitoring event of leachate in the Phase 3 sump will include the following procedures:

1. Measure distance to the liquid surface in the sump using an electric sounder, if available. Alternatively, measure the depth of liquid in the sump using a long dipstick (Note: the designed distance from the top of riser pipe to the sump bottom is 15 feet).

2. Calculate the liquid head above the liner, if any, using the as-built survey information for the elevation of the liner adjacent to the sump.

3. Estimate the volume of liquid contained in the sump using the chart or table supplied by the site engineer. If the estimated volume exceeds 5,000 gallons, arrange for leachate to be pumped from the sump and either be transported to the wastewater treatment plant or (if permitted by the Department of Health and documented in the site's Operations Plan) spread at the active disposal face in Phase 3 as an aid to litter control and compaction.

4. Check the Phase 3 test lysimeter for the presence of liquid, using an electric sounding tape attached to a pole approximately 15 feet long. If any liquid is detected, notify the County Solid Waste Division designated compliance officer, who will initiate the notification and investigation activities detailed in Section 6.3.4 of this Plan.

5. Record all data regarding leachate levels, volumes, withdrawals and disposition of leachate, using forms provided by the County Solid Waste Division.

6. If the liquid elevation at any time exceeds the compliance level, initiate reporting procedures as directed in Section 2.5 below.

2.4 Leachate Sampling

By permit, a sample of leachate must be collected from each leachate collection point on a semi-annual basis. Collection points to be sampled are the Phase 1 wet well, the Phase 2 standpipe and the Phase 3 sump. Sampling will be conducted by trained personnel using procedures outlined in Section 8 of this Plan.

2.5 Reporting

MISWF personnel will forward all monitoring data to the County Solid Waste Division and maintain copies on site. County Solid Waste Division staff will compile the data and supply reports to the Hawaii Department of Health (DOH) in conformance with the facility solid waste permit and Operations Plan requirements. Reports will include, at a minimum:

- Any measurement of a leachate level above the designated compliance level in any phase will be reported to DOH within 24 hours using a Noncompliance Notification form provided by the County Solid Waste Division.
- Notification of any leachate detection in the Phase 3 lysimeter will be made to DOH within 10 days after detection.
- Laboratory analyses of leachate samples will be submitted to DOH within 45 days after the results are received from the analytical laboratory.
- A summary of data on leachate withdrawals, including at a minimum the total volume and disposition of leachate from each monitoring point, will be included in the site's Annual Operating Repot due by July 31 of each year.

3. FACILITY DESCRIPTION

This section of the monitoring plan describes some of the physical characteristics of the site vicinity, as well as the facility location, layout, operational history, and containment unit characteristics. The remainder of the section is organized in five parts, as follows:

- Climate,
- Topography,
- Facility Layout,
- Operational History, and
- Landfill Liner and Leachate Collection Systems

3.1 Climate

The climate on Molokai is characterized by mild temperatures, cool and persistent trade winds, and a rainy season which extends from October through April (Oki, 2006). Maximum mean annual rainfall is more than 150 inches near the summit of the East Molokai Volcano in the northeastern part of the island (Figure 2-1). Over the West Molokai Volcano, the mean annual rainfall is about 25 inches. Along the southern and western coastal areas of the island mean annual precipitation is less than 16 inches. The MISWF is located in the southern coastal area of Molokai, where mean annual rainfall is less than 16 inches.

According to the USGS (Oki, 2006), pan evaporation records for Molokai are available at only three sites, two in the Hoolehua Plain, and one near the town of Maunaloa in the western part of the island. Mean annual evaporation at the three sites ranges from 81 inches at Maunaloa to 118 inches near the Hoolehua Plain (Oki, 2006). The mean annual evaporation rate for the area of the MISWF is expected to be within this range of values (81 to 118 inches).

3.2 Topography

Figure 2-2 illustrates the major geomorphic areas on the island of Molokai. The island topography is dominated by the eroded remnants of two large shield volcanoes, designated as the West Molokai Dome and the East Molokai Dome. These volcanic highlands are separated by a broad area of generally low-relief known as the Hoolehua Plain. The MISWF is located near the southeastern corner of the Hoolehua Plain approximately 0.7 miles from the Pacific Ocean.

The natural topography in the vicinity of the MISWF slopes gently to the south and southwest, with ground surface elevations at the facility ranging from approximately

185 to 275 feet above mean sea level (Figure 2-3). The southwest-trending Manawainui Gulch is located approximately 1,500 feet north and northwest of the facility. A shallower, unnamed gulch trends north-south in the area east of the MISWF.

3.3 Facility Layout

Figure 2-4 shows the general facility layout for the MISWF. The major functional areas of the MISWF include:

- The entrance area consisting of the scale house and administration building, maintenance facility, and recycling drop-off areas;
- The currently permitted MSW landfill areas (Phases 1 and 2) consisting of approximately 12 acres;
- Receiving and storage area consisting of approximately 2 acres;
- A storm water retention basin, and
- Future landfill expansion areas for Phase 3 and 4.

3.4 Operational History

The MISWF began accepting waste in October of 1993 and is permitted to receive all types of non-hazardous MSW from residential, commercial, and industrial sources. Disposal operations involve the use of the area fill method of disposal, whereby waste is discharged to a limited area each day. The waste is subsequently compacted using earth moving equipment and covered prior to the start of the following day's operations.

The current waste footprint at the MISWF extends throughout Phases 1 and 2 of the facility (Figure 2-4). Maui County estimates that the total volume disposed during the 2006 calendar year was 6,421 tons or 17.6 tons per day on a 365 day per year basis (A-Mehr, 2007). Phase 3 of the MISWF is tentatively scheduled to begin receiving waste during the 2008 calendar year.

3.5 Landfill Liner and Leachate Collection Systems

3.5.1 Phase 1

Phase 1 of the MISWF is located in the topographically lowest (southeast) part of the currently permitted waste footprint (Figure 2-4). The Phase 1 cell floor is lined with a 30 mil PVC geomembrane overlying a compacted soil base. The Phase 1 liner system slopes towards the south to facilitate lateral flow of leachate toward the southern corner of the disposal unit. Perforated leachate collection pipes in a gravel-filled trench run along the south and west sides of the cell, conducting leachate to the southern corner of the cell. The pipes are connected at the southern corner, from which a 6-inch pipe leaves the lined area through a welded "boot" penetration of the liner and conducts leachate to a concrete wet well located outside the waste limits.

Although there is some uncertainty due to internal conflicts in the available design drawings for Phase 1, it is believed that the elevation of the liner at the southern corner of Phase 1 is approximately 204 feet above mean sea level (amsl). The leachate header pipe leaves the lined area at an elevation of approximately 203 ft. amsl, and discharges to the wet well at elevation 198 ft. amsl. The wet well is 6 feet in inside diameter and can hold leachate to a depth of approximately 6 feet, storing a maximum of approximately 1,200 gallons of leachate before overflowing to the surrounding ground at an elevation of approximately 202 amsl. Overflowing is prevented by a valve installed in the leachate header pipe above the wet well, which keeps leachate from entering the wet well until it is manually opened for sampling and withdrawing leachate from the cell.

3.5.2 Phase 2

Phase 2 of the MISWF was constructed with a minimum six-inch thick compacted soil liner which slopes to the south, generally merging with the Phase 1 base grades. A test lysimeter is installed above the disposal unit's compacted soil liner to aid in the assessment of site leachate generation rates. The test lysimeter consists of a 20-foot wide by 40-foot long geomembrane-liner, which is surrounded by a compacted soil berm. It is constructed such that leachate migrating to the bermed test area drains by gravity through conveyance piping to a standpipe collection and removal system located outside the Phase 2 unit boundary (the Phase 2 standpipe). The approximate location of the Phase 2 standpipe and its general construction details are shown in Figure 2-5.

The elevation of the Phase 2 test lysimeter is approximately 224.5 ft. amsl. The elevation at which the test pipe discharges to the Phase 2 standpipe outside the disposal area is estimated to be approximately 222 ft. amsl.

3.5.3 Phases 3 and 4

Phase 3 of the MISWF is expected to be completed during the 2008 calendar year and will cover an area of approximately 2 acres east of the Phase 1 and Phase 2 disposal areas (Figure 2-4). Future Phase 4 will be constructed to the north of Phase 2 and Phase 3, completing the presently permitted disposal area footprint. Phases 3 and 4 will be constructed with a complete geomembrane liner and leachate collection and removal system. Both areas will be graded, and contain leachate collection pipes and trenches, to drain leachate to a common internal sump located in the southeast corner of the Phase 3 area. The double-lined sump is designed to have a bottom elevation of 216 ft. amsl, which is four feet below the cell floor adjacent to the sump.

4. GEOLOGY

This section of the monitoring plan describes the geologic setting of the MISWF. The remainder of this section is organized in two parts, as follows:

- Regional Geology, and
- Site Geology.

4.1 Regional Geology

A generalized geologic map of Molokai is presented in Figure 3-1. As shown in Figure 3-1, the island of Molokai consists of volcanic flows derived from two coalescing volcanoes, designated as the East Molokai Volcano and the West Molokai Volcano, respectively. In the central portion of the island, westerly flowing lavas from the East Molokai Volcano ponded against older, previously formed lavas of the West Molokai Volcano, forming a relatively gently sloping lowland known as the Hoolehua Plain (Stearns and Macdonald, 1947).

Stearns and Macdonald (1947) divided the volcanic rocks of Molokai into two main lithologic series, which they designated as the East Molokai Volcanic Series (EMVS) and the West Molokai Volcanic Series (WMVS). The EMVS was further subdivided by Stearn and Macdonald (1947) into a lower basalt member and an overlying andesite member. The basalt member comprises the vast majority of the EMVS and consists predominantly of thin-bedded aa and pahoehoe basalt flows. Thin lenticular beds of vitric tuff and volcanic ash are common between individual flows of the basalt member.

The overlying andesite member of the EMVS is much thinner than the basalt member and consists predominantly of andesitic lavas erupted primarily from large cinder cones and bulbous domes. Many of these cinder cones and domes are relatively resistant to erosion and stand out as prominent topographic features. Examples of large andesitic cinder cones near the MISWF include those at Kualapuu and Puu Luahine (Stearns and Macdonald, 1947).

The older WMVS consists predominantly of thin bedded aa and pahoehoe flows of tholeiitic basalt. Thin layers of vitric tuff, up to one-foot thick are common between flows of the WMVS. The contact between lava flows of WMVS and overlying EMVS is exposed in Waiahewahewa Gulch, approximately 5 miles west of the MISWF. At this location, the contact between the two volcanic series is well exposed, and strikes approximately north 50 degrees west, with a structural dip of approximately 10 degrees to the northeast (Stearns and Macdonald, 1947).

Along the southern coast of Molokai, a coral reef complex extends from the coast to about 1 mile offshore (Oki, 2007). Along this portion of the coast, an apron of alluvium has also formed by deposition of eroded volcanic sediment. The resulting interbedded sedimentary sequence along this southern coastal zone includes lithologies ranging from compact alluvium to cavernous limestone (Oki, 2006).

4.2 Site Geology

Pre-landfill soils mapping by the US Soil Conservation Service (1972) indicates the presence of two primary soil types originally beneath the MISWF. Soils underlying the northwest part of the facility are designated by the Soil Conservation Service as "Holomua Silt Loam, Severely Eroded" and consist predominantly of well-drained silty loam or silty clay loam soils. Soils beneath the southeastern part of the facility are designated by the US Soil Conservation Service as "Very Stony Land, Eroded". In 1992, Pacific Geotechnical Engineers (PGE, 1993) conducted an investigation of shallow soil characteristics and depth to bedrock which included the completion of 21 shallow exploratory trenches. The results of PGE's investigation indicate site soils consisting primarily of weathered andesite, with relatively competent andesitic bedrock occurring at depths of 1.5 to 8 feet below the original ground surface.

The previous geotechnical investigation by PGE (1993) indicates the presence of andesitic bedrock at shallow depths at the MISWF. This is consistent with geologic mapping by Stearns and Macdonald's (1947) which indicates that the site area is underlain directly by the andesite member of the EMVS. As no additional subsurface investigation has been conducted at the MISWF, site-specific information regarding the thickness of the andesite member and the character of the underlying basalt member are currently not available.

As noted previously, the Manawainui Gulch is located approximately 1,500 feet north and north-northwest of the MISWF. Quarrying activities within adjacent portions of the Manawainui Gulch have created good exposures of the upper approximately 60 to 70 feet of the EMVS which include the contact between the andesite member and the underlying basalt member (Parametrix, 1992). A field log prepared by Parametrix (1992) describing a portion of these quarry exposures is presented in Figure 3-2. As shown in Figure 3-2, the andesite member within the quarry sequence is between 10 and 15 feet thick and overlies a repetitious sequence of thin-bedded aa-type basaltic flows with local lavers of volcanic cinders and lenticular deposits of volcanic ash. Based on the Parametrix log (Figure 3-2), the basalt member is at least 60 feet thick in the quarry sequence.

The volcanic flows beneath the MISWF are expected to have south to southwest structural dips of about 1 to 3 degrees. Given this structural dip, and the fact that no significant faults are known in the site vicinity, it is considered likely that the

Manawainui Gulch quarry exposures (Figure 3-2) are relatively representative of lithologies beneath the MISWF to a depth of at least 50 to 60 feet. Although no site-specific information is available regarding deeper site lithologies, the structural dip of the EMVS-WMVS contact noted west of the site in Waiahewahewa Gulch suggests that the basalt member likely extends to a depth of between 700 to 1,200 feet below ground surface at the MISWF.

5. HYDROGEOLOGY

This section of the monitoring plan describes the hydrologeologic setting of the MISWF. The remainder of this section is organized in five parts, as follows:

- Regional Hydrogeology,
- Local Hydrogeology,
- Groundwater Use,
- Groundwater Quality, and
- Surface Water Hydrology.

5.1 Regional Hydrogeology

Like most volcanic islands, Molokai is underlain, at or slightly above mean sea level (msl), by a laterally extensive zone of unconfined groundwater. This basal groundwater ranges from fresh to brackish and forms a roughly lens-shaped body which floats upon the underlying salt water (see Figure 4-1). According to the USGS (Oki, 2006), this basal groundwater zone is normally first encountered at elevations ranging from about 15 feet above msl (beneath interior highlands) to near sea level (beneath coastal areas). Important groundwater resources also occur on Molokai where subsurface waters are impounded by low-permeability volcanic dikes. These dike-impounded waters can generate large amounts of fresh groundwater, but are generally limited to highland areas in the northeastern portion of the island. Small amounts of groundwater can occur locally above low permeability layers within the volcanic sequences (e.g., ash layers or weathering horizons) and within the islands coastal sedimentary deposits.

The volcanic rocks on the island of Molokai are expected to have average hydraulic conductivities on the order of 1,000 ft per day (Oki, 2006). Where not affected by dikes or perching layers, groundwater flow is roughly radial, with subsurface flow directed from recharge areas in eastern and western volcanic highlands to discharge points along the coast (Figure 4-2). Groundwater originating from the eastern and western volcanic highlands also flows towards the central Hoolehua Plain, from where it flows to either the north or south coast.

5.2 Local Hydrogeology

No site-specific data exists regarding the depth and quality of groundwater immediately beneath the MISWF. Based on the facility's regional setting and limited data from local wells (Figure 4-2), it is considered likely that first groundwater beneath the MISWF occurs within basaltic lithologies as part of the island's laterally extensive basal groundwater lens. Given that the site vicinity lacks the large volcanic dike complexes of the northeastern highlands, no significant dike-impacted groundwater resources are expected to occur beneath the MISWF. Similarly, the lack of reported surface water springs at the facility suggests that perched groundwater conditions are not significant, at least within the upper portions of the basalt member. Given these assumption, the elevation of first groundwater beneath the MISWF is likely to be encountered at elevations of no more than about 10 feet above sea level (175 to 265 feet below ground surface).

Given the high evaporation rates and low annual rainfall at the MISWF, direct vertical recharge to the underlying water table from the vicinity of the site is expected to be minimal. Rather, the majority of the groundwater beneath the MISWF is expected to have migrated from recharge areas located in topographically higher areas to the north and northeast. Although no site-specific data exists, the hydraulic conductivities estimated by the USGS (Oki, 2006) for the basalt lithologies of Molokai (1,000 feet per day) are considered reasonable for the basalt materials beneath the MISWF. Given the relatively high expected hydraulic conductivities of subsurface materials and the apparent lack of significant dikes or perching layers beneath the MISWF, groundwater beneath the facility would be expected to flow south or southwest towards the southern coast of Molokai.

The flow of groundwater towards the southern coast may be impeded to some extent as it encounters sedimentary units along the coast. Previous investigators (Stearns and Macdonald, 1947; Oki, 2006 & 2007) have noted higher than expected water levels in groundwater wells located along the southern coast of Molokai and have attributed these to the “backup” of subsurface flow as groundwater migrates from the more permeable basalt lithologies to the less permeable coastal sedimentary units. The coastal springs noted by Stearns and Macdonald (1947) along the southern coast of Molokai may result from these higher than expected groundwater elevations.

5.3 Groundwater Use

Most of the groundwater withdrawals on the island of Molokai are from the Kaulapuu area and from dike-impounded zones in the northeastern part of the island (Oki, 2007). Both of these production areas are located well upgradient of the MISWF. The vast majority of water supply for communities along the southern coast of Molokai is transported by aqueduct or tunnels systems from these production areas. According to the USGS (Oki, 2007), groundwater withdrawals along the south coast of Molokai are predominantly from two Maui-type wells, located near Kawela and near Ualapue. These wells are located approximately 7 miles and 16 miles east of the MISWF, respectively.

Figure 4-3 shows the location of the MISWF with respect to the Underground Injection Control (UIC) Areas established for the island of Molokai by the State of Hawaii. As shown in Figure 4-3, the MISWF, and those areas downgradient of the MISWF, are located seaward (makai) of the UIC line. As such, the underlying aquifer beneath these areas is not considered a drinking water source. In response to concerns about water resources on the island of Molokai, the State of Hawaii Commission on Water Resources Management (CWRM), in 1992, designated the entire island as a Groundwater Management Area (Oki, 2007). The CWRM has divided the island into 16 aquifer systems, based primarily on geologic conditions and topographic divides. As shown in Figure 4-4, the MISWF lies within the southeastern part of the Manawainui Aquifer System.

As part of its aquifer management responsibilities, the CWRM has implemented a water use permit process by which water well owners are required to supply information regarding their water wells. Figure 4-5 shows the approximate location of wells for which permit information has been provided by well owners. The map also indicates the locations of known wells for which permit information has not yet been received. A review of Figure 4-5 indicates the presence of at least 9 wells within about 2 miles of the MISWF (Table 5-2). According to the USGS (Oki, 2007), none of the permitted wells drilled within the Manawainui Aquifer System were utilized for water supply during the 2007 calendar year. The presence of additional groundwater wells, not noted by Oki (2007), is indicated in documents prepared by Parametrix (1992) and Brown and Caldwell (2002). Although not expected to be substantial, no information was available regarding potential groundwater withdrawals from non-permitted wells in the vicinity of the MISWF.

5.4 Groundwater Quality

The quality of groundwater varies greatly across the island of Molokai. In areas of high precipitation and recharge, the thickness of the basal groundwater zone is better maintained, mixing with underlying sea water is minimal, and the quality of the groundwater lens remains high. Where precipitation and recharge rates are low, mixing and diffusion between the basal groundwater lens and the underlying salt water is common, and the basal groundwater zone tends to be brackish.

The MISWF is located in a portion of the Hoolehau plain characterized by low annual precipitation and high annual evaporation. Given these conditions, freshwater recharge to the underlying basal groundwater lens is low and the quality of the groundwater lens is typically poor. Stearns and Macdonald (1947) reported brackish groundwater conditions beneath the entire Hoolehua Plain, including the area of the MISWF. Figure 4-1 lists historical water quality data from wells in the site vicinity. As shown in Table 5-1, groundwater wells in the vicinity of the MISWF are expected to be brackish, with chloride concentrations in most wells ranging between about 500 and 1,100 mg/liter.

5.5 Surface Water Hydrology

5.5.1 Coastal Waters

Saline coastal waters of the Pacific Ocean are located approximately 3,500 feet due south of the MISWF. A series of coastal ponds, including the Ooia and Kaluaapuhi Fishponds and the Ohipili pond, are located between the facility and the Pacific Ocean (Figure 2-3).

5.5.2 Streams

No perennial streams exist in the vicinity of the MISWF. The nearest ephemeral water course, within Manawainui Gulch, is located approximately 1,500 feet north-northwest of the MISWF (Figure 2-3). A small unnamed gulch which may locally show surface flow during precipitation events is located approximately 500 feet east of the MISWF.

5.5.3 Springs

Several natural springs have been identified downgradient of the MISWF in the area between Umipaa and Kahanui (Figure 2-3). Most of these natural springs occur slightly above sea level and are interpreted by Oki (2006) as the result of groundwater ponding as subsurface waters migrate from the more permeable volcanic lithologies to the less permeable coastal sedimentary units.

TABLE 5-1

SUMMARY OF CHLORIDE CONCENTRATIONS IN GROUNDWATER WELLS MANAWAINUE AND KAMILOLOA AQUIFER SYSTEMS, MOLOKAI, HAWAII

Aquifer System(1)	Well Name(2)	Well Type & Number (3)	Chloride (mg/L)(2)	Approximate Distance from MISWF(3) (miles)	Direction from MISWF(3)
Manawainui	Puu Pili Well	Dug Well 11	799	3	W
	Palaau Well	Dug Well 12	610	2	W
	Ooia Well	Dug Well 13	932	1	S-SW
	Oliwai Well	Dug Well 14	639	1	SE
	Conant Kaunakakai	Maui-Type 1	520	3	SE
	John Kupa	Maui-Type 2	630	3.5	SE
	Canefield Well	Drilled Well 10A	893-997	3	SE
	Settlement Well	Drilled Well 10C	520-893	3	SE
	Donkey Engine Well	Drilled Well 11	119	3	SE
Kamiloloa(4)	Kalamaula Well	Dug Well 15	570	3	SE
	Kalamaula Well	Dug Well 16	769	3	SE
	Hotel Well	Dug Well 17	1190	3	SE
	None Listed	Drilled Well 2	1060	2.5	W-SW
	None Listed	Drilled Well 3	893	2	W-SW
	None Listed	Drilled Well 4	893	2	W-SW
	None Listed	Drilled Well 7	935	1	S-SE
	None Listed	Drilled Well 8	1060	2	SE

Notes:

(1) The aquifer system for each well was estimated from Figure 4-4.

(2) From Tables on Pages 58 through 64 of Stearns and Macdonald (1947).

(3) Approximate values, estimated from Plate 1 of Stearns and Macdonald (1947).

(4) Only wells within the northern portion of the Kamiloloa Aquifer System (nearest the site) are shown..

TABLE 5-2
LIST OF GROUNDWATER WELLS REPORTED IN THE SITE VICINITY
MOLOKAI INTEGRATED SOLID WASTE FACILITY

Well Number	Well Name or Location	Approximate Distance from the MISWF (miles)[3]	General Direction from the MISWF[3]
0602-03[1]	Kalaiakamanu	2	SE
0603-01[1]	Umipaa	0.6	SE
0603-07[1]	Not Listed	0.7	S
0604-03[1]	Not Listed	0.7	S-SW
0605-01[1]	Orca Shaft No. 1	1.2	SW
0605-02[1]	Orca Shaft No. 2	1.2	SW
0605-03[1]	Orca Shaft No. 3	1.2	SW
0705-04[1]	Not Listed	1.9	W
0705-05[1]	Naiwa	1.7	NW
0602-01[2]	Kalamaula	1.5	SE
0602-02[2]	Kalamaula	1.6	SE
0603-02[2]	Umipaa	0.8	SE
0603-03[2]	Naiwa-South	0.35	S-SE
0604-01[2]	Ooia Dug Well	0.7	SW
0704-01[2]	Manawainui Gulch	0.6	SW
KMW-1[3]	Kalamaula LF	1.1	SW
KMW-2[3]	Kalamaula LF	1.3	SW
KMW-3[3]	Kalamaula LF	1.3	SW
KMW-4[3]	Kalamaula LF	1.2	SW

Notes:

(1) Wells from Figure 4-5 which are estimated to be located within 2 miles of the MISWF.

(2) Additional wells identified in Figure 10 and Table 1 of Parametrix (1992)

(3) From Brown and Caldwell (2002).

(2) From Table 1 of Oki (2007).

(3) These are approximate values estimated from Figure 4-5.

6. LANDFILL LIQUID MONITORING

As described in Section 3, the MISWF currently includes three distinct disposal units, designated as Phases 1, 2, and 3. This section of the monitoring plan, describes the monitoring facilities and procedures for each disposal unit. The remainder of this section is organized in three parts, as follows.

- Phase 1 Monitoring Activities,
- Phase 2 Monitoring Activities, and
- Phase 3 and Phase 4 Monitoring Activities.

6.1 Phase 1 Monitoring Activities

As discussed in Section 3, the Phase 1 disposal unit is underlain by a geomembrane liner and leachate collection and removal system. Leachate collected in the southern corner of Phase 1 flows by gravity through conveyance piping to a wet well collection and removal system located outside the Phase 1 unit boundary (the Phase 1 wet well). A shutoff valve in the pipe isolates the cell from the wet well except when leachate is actively being drained to the wet well, which holds approximately 1,200 gallons of liquid, for sampling and removal. The leachate is pumped from the wet well and disposed of in accordance with applicable Maui County requirements. The approximate location of the Phase I wet well and its general construction details are shown in Figure 2-5.

6.1.1 Phase 1 Head Levels

Based on information contained in the available design drawings for Phase 1 construction (Parametrix, 1997), the elevation of the liner at the southern corner of Phase 1 where the leachate collection header pipe exits the lined area is believed to be approximately 204 feet above mean sea level (amsl). Based on this assumption, the compliance level for leachate in Phase 1 is 205 feet amsl (12 inches above the liner).

At present there is no means for measuring the depth of leachate (hydraulic head) above the Phase 1 liner, because the ground elevation of the top of the Phase 1 wet well is approximately 202 feet amsl, which is below the liner elevation. In order to monitor leachate head, it will be necessary to install a measurement device in the leachate header piping above the shutoff valve. This will entail excavating approximately 4 feet to expose the pipe and installing a tee and a riser pipe to an elevation of at least 205 ft. amsl (the compliance level). The riser pipe will be extended to a surveyed elevation several feet above the compliance level and capped, with leachate elevation to be determined by measuring the distance from the liquid level to the top of pipe.

Leachate level monitoring and leachate removal will be conducted as follows:

- Leachate level will be measured and recorded on a monthly basis using the riser pipe installed in the leachate header pipe. Additional monitoring will be done after any significant rain event of 0.1 inch or more in a 24 hour period.

- If the level of leachate is measured at elevation 204 ft. amsl (the elevation of liner at the lowest point of the cell) or higher, the valve will be opened and leachate drained to the wet well. The header pipe from the edge of the cell to the wet well is estimated to hold approximately 140 gallons when full.

- Leachate will be removed from the wet well whenever it is full and additional leachate is present in the header pipe or cell.

- If measured leachate levels exceed the compliance level (elevation 205 feet amsl), leachate level monitoring shall be performed before and after leachate pumping on a daily basis until the level has remained within the allowable limit for a period of one week.

6.1.2 Phase 1 Liquid Volumes

Appendix A presents an analysis of estimate leachate generation rates for each Phase of the MISWF, using the USEPA model HELP (Hydrologic Evaluation of Landfill Performance). The estimated average annual volume of leachate predicted for a 30-year simulation by the model, using assumptions documented in Appendix A, is 10,800 cubic feet, or 60,400 gallons per year.

Actual volumes of leachate produced in Phase 1 are somewhat uncertain. Annual reports indicate that 3,000 gallons of leachate was collected during the 12 months ending on June 30, 1996, the first full year of disposal operations in Phase 1. Records for 1997 through 2003 are not presently available. Annual reports for fiscal years 2004 and 2005 state that no leachate was pumped from the wet well, but do not indicate whether the valve allowing liquid to enter the wet well was opened during the year. In March 2006 approximately 300 gallons of leachate was pumped from the wet well, but it is not clear whether the valve was opened at that time to drain leachate from the cell. In September 2007 the valve was opened and a total of approximately 10,000 gallons of leachate was drained from the cell to the wet well and removed to a wastewater treatment plant. An additional 50,400 gallons of leachate was drained from the cell between February 28, 2008 and March 7, 2008, reducing leachate flow from the cell to a trickle. On March 19, 2008 the valve was opened and approximately 1,200 gallons was drained to the wet well, with additional leachate remaining in the pipe or in the cell.

In summary, a total of approximately 61,600 gallons of leachate was drained from Phase 1 from September 2007 through March 19, 2008. It is not clear how much of this volume was generated during this period, and how much was in storage in the cell at the time. The improved monitoring and recording program outlined in Section 6.1.1 above will provide more definitive information on the actual rate of leachate generation in the lined Phase 1 disposal cell.

6.1.3 Phase 1 Leachate Quality

Samples of leachate from the Phase 1 wet well were collected on June 6, 2007 and February 28, 2008. Table 7-1 summarizes the results of the laboratory analyses for these samples. Continued periodic laboratory analysis of Phase 1 leachate samples are to be conducted for two purposes. First, select laboratory analyses are necessary to facilitate proper disposal of the collected liquids. Second, laboratory analyses will support continuing assessment of the potential for landfill impacts to groundwater. Contaminant modeling and assessments made to date for the MISWF have been made on the basis of current leachate analyses. Continued periodic monitoring of leachate concentrations from Phase 1 is needed to ensure that modeling results and the associated assessment of potential impacts are current and accurate.

Phase 1 leachate samples will be collected directly from the Phase 1 wet well, in accordance with sampling procedures described in Section 8 of this monitoring plan. The Phase 1 leachate samples will be collected and submitted for laboratory analysis on at least a semi-annual basis. At a minimum, the Phase 1 liquid samples will be analyzed by the laboratory for the parameters listed in Table 8-1. More frequent sample collection and/or additional laboratory analyses will be conducted as necessary to facilitate proper disposal of the collected Phase 1 liquids.

6.2 Phase 2 Monitoring Activities

As noted in Section 3, the Phase 2 base grades slope towards the south and generally merge with those of topographically lower Phase I. During construction of Phase 2, a test lysimeter was constructed above the disposal unit's compacted soil liner to aid in the future assessment of site leachate generation rates. The test lysimeter consists of a 20-foot wide by 40-foot long geomembrane-liner, which is surrounded by a compacted soil berm. The test lysimeter is constructed such that leachate migrating to the bermed test area will subsequently drain by gravity through conveyance piping to a standpipe collection and removal system located outside the Phase 2 unit boundary (the Phase 2 standpipe). The approximate location of the Phase 2 standpipe and its general construction details are shown in Figure 2-5.

The design elevation of the soil liner within the Phase 2 test lysimeter is approximately 224.5 ft. amsl. Therefore, the compliance level in Phase 2 would be indicated by a liquid level in the standpipe at elevation 225.5 ft. amsl.

Future monitoring and removal of liquid in the Phase 2 test lysimeter and standpipe will be conducted as follows:

- The elevation of the top of the standpipe will be accurately surveyed.
- The elevation of liquid level, if any, in the standpipe will be determined by measuring the distance from the top of standpipe to the liquid surface.
- Leachate level will be measured and recorded on a monthly basis. Additional monitoring will be done after any significant rain event of 0.1 inch or more in a 24 hour period.
- If measured leachate levels exceed the compliance level (elevation 225.5 feet amsl), leachate level monitoring shall be performed before and after leachate pumping on a daily basis until the level has remained within the allowable limit for a period of one week.

6.2.1 Phase 2 Liquid Generation

The Phase 2 test lysimeter and standpipe system was designed to provide information regarding the amount of leachate, if any, being generated from wastes immediately above the test lysimeter. This information may then be utilized in the evaluation of unit-wide leachate generation rates.

The HELP modeling presented in Appendix A predicts an average annual leachate generation rate in Phase 2 of approximately 0.73 inches per year. Applied to the 800 square feet (20 ft. x 40 ft.) area of the test lysimeter, this volume would produce approximately 360 gallons of leachate per year in the lysimeter.

Based on the design drawings for the test lysimeter and its associated piping, the liquid storage capacity of the system at the compliance level of 225.5 feet amsl is calculated to be approximately 800 gallons with one foot of liquid in the lysimeter.

There is no documentation of monitoring of liquid levels in the Phase 2 standpipe prior to April 2008, when it was inspected and approximately 10 gallons of liquid was withdrawn. Based on this result, it appears there is a substantial unexplained difference between HELP model predictions and field experience.

In the future, the Phase 2 wet well will be monitored for the presence of leachate accumulations, and leachate removed, as described in Section 6.2.1 above. The amount of liquid removed from the Phase 2 standpipe is to be accurately measured and documented.

6.2.2 Phase 2 Liquid Quality

No previous leachate analytical data is available for the Phase 2 test lysimeter. Samples will be collected on a semi-annual basis, if significant leachate accumulations are noted in the Phase 2 standpipe. Procedures for sampling and laboratory analyses will be conducted as described for the Phase 1 wet well.

6.3 Phase 3 and Phase 4 Monitoring Activities

As discussed in Section 3, Phase 3 and Phase 4 will be constructed with a geomembrane liner and full leachate collection and removal system. The new Phase 3 and Phase 4 liner systems will be hydraulically isolated from the Phases 1 and 2 collection systems, and will slope to an internal leachate collection sump at the southern corner of Phase 3. Figure 2-5 shows the anticipated design for the Phase 3 leachate collection and removal system.

6.3.1 Phase 3 Leachate Head Levels

The design elevation of the leachate sump in Phase 3 is 216 feet amsl. The sump bottom is 4 feet below the adjacent floor liner system at elevation 220 feet amsl. Therefore, the compliance level for Phases 3 and 4 is at elevation 221 ft. amsl, or 5.0 feet above the bottom of the sump.

Monitoring of leachate head on the liner will be made using soundings taken from an accurately surveyed reference point on the riser. The following procedures will be used.

- The elevation of liquid level, if any, in the sump will be determined by measuring the distance from the reference point on the riser to the liquid surface.

- Leachate level will be measured and recorded on a monthly basis. Additional monitoring will be done after any significant rain event of 0.1 inch or more in a 24 hour period.

- Leachate will be pumped and removed from the sump whenever the depth of liquid in the sump exceeds three (3) feet (elevation 219 feet amsl).

- If measured leachate levels exceed the compliance level (elevation 221 feet amsl), leachate level monitoring shall be performed before and after leachate pumping on a daily basis until the level has remained within the allowable limit for a period of one week.

6.3.2 Phase 3 Leachate Volumes

The HELP modeling summarized in Appendix A predicts an annual average rate of leachate production in Phase 3 of approximately 5,240 cubic feet, or approximately 39,200 gallons per year.

Leachate accumulating in the Phase 3 leachate sump will be periodically removed by pumping through the structure's associated riser pipe. The volume of leachate removed from the Phase 3 leachate collection system is to be accurately measured and documented for future comparison with the predicted quantity.

6.3.3 Phase 3 Leachate Quality

Leachate samples from the Phase 3 leachate sump will be collected on a semi-annual basis, according to the sampling procedures described in Section 8 of this monitoring plan. At a minimum, the Phase 3 liquid samples will be analyzed by the laboratory for the parameters listed in Table 8-1. More frequent sample collection and/or additional laboratory analyses will be conducted as necessary to facilitate proper disposal of the collected Phase 3 liquids.

6.3.4 Phase 3 Lysimeter Monitoring

Phase 3 will be constructed with a lysimeter located immediately below the leachate sump area. In the absence of residual construction waters or surface water percolation, there should be no significant liquid accumulations within the Phase 3 lysimeter. Detection monitoring for the Phase 3 lysimeter will be performed on a semi-annual basis, with monitoring to consist of soundings to determine the presence or absence of accumulated liquids. Should significant liquids be detected in the Phase 3 lysimeter, MISWF will implement the following procedures specified in the site's solid waste facility permit:

- The County will notify the Hawaii Department of Health (DOH) within 10 days after any liquid in the lysimeter is detected.

- A sample of the lysimeter liquid will be collected and analyzed for major cations and anions (Mg, Na, Ca, K, Cl, CO3, SO4, HCO3), and major leachate indicators (TDS, TOC, total alkalinity, nitrogen-ammonia, Cl, Fe) to assist in the determination on whether the liquid is leachate.

- The County will engage a registered engineer or geologist to prepare a technical study report, to be submitted to the DOH within 120 days after the liquid detection, containing at least the following information:

  - Results of the liquid sampling;
  - Evaluation of liquid levels or other data to determine the likely source of liquid/leachate (i.e. leakage from the sump or from the liner system);
  - Estimates of the volume of liquid being released from the liner system or sump; and
  - Recommended measures to eliminate or mitigate additional releases, if the liquid in the lysimeter is determined to be leachate.

Following its review of the technical report, the DOH may direct the County to implement either or both of the following measures if it determines that the detection in the lysimeter is the result of a leachate release:

- Manage leachate to a specified maximum hydraulic head, less than 12-inches, above the liner, with a corresponding reduction of allowable leachate depth in the sump; and/or

- Prepare a groundwater monitoring plan based on detection monitoring wells.

7. GROUNDWATER MONITORING

As noted in Section 1.2 of the plan, the MISWF has previously been designated as a small landfill with respect to HAR Section 58.1-11(f) and is therefore considered exempt from the groundwater monitoring requirements of HAR Section 58.1-16. Given its small landfill status and the physical setting of the facility, landfill monitoring has been limited to measurement and analysis of site leachate, with no direct monitoring of groundwater (i.e., no groundwater monitoring wells have been installed).

It is not clear at this time whether or not the facility will increase disposal volumes to the point that the small landfill exemption remains in effect. Given this uncertainty, it is considered prudent to clarify and evaluate the potential for facility impacts to groundwater, in the event that the small landfill exemption does not remain in effect. The remainder of this section discusses facility characteristics which are considered important in determining the ultimate extent of monitoring activities required for the MISWF and is organized in 8 parts, as follows:

- Evidence of Existing Groundwater Contamination
- Leachate Generation,
- Containment Unit Characteristics,
- Depth to Groundwater,
- Leachate Composition,
- Local Water Quality and Use,
- Other Potential Receptors and
- Migration Potential

7.1 Evidence of Existing Groundwater Contamination

As described in Section 4 above, groundwater below the MISWF is limited to a brackish lens of water at elevations less than 10 feet above sea level. Although wells have been constructed downgradient of the landfill, none of the well owners have reported any pumping or use of the water. There has been no reported testing of water from these wells, and therefore there is no testing evidence of contamination from the landfill or any other source. The poor quality of the groundwater makes it unlikely any future utilization of the water will occur.

Absent any data or reports relative to contamination of groundwater in nearby wells, the only other potential evidence of an existing release of leachate from the MISWF would be expressions of a surface seep causing discoloration of soil or rock, or signs of distressed vegetation. Maui County personnel have surveyed the landfill site and surrounding area and found no evidence of a surface seep. The survey also produced no evidence of distressed vegetation or other signs of a leachate at or near the surface.

Based on the available information, it is reasonable to conclude there is no evidence of existing groundwater contamination at the MISWF and that the site meets all requirements of HAR 11-58.1-11(f) for exemption from the groundwater monitoring requirements of HAR 11-58.1-16.

7.2 Leachate Generation

As detailed in Section 6 above and in Appendix A, simulation of landfill performance using the HELP model indicates the potential for substantial leachate production from the facility. A significant volume of leachate, estimated at more than 60,000 gallons, was withdrawn from Phase 1 from September 2007 through April 2008, although the length of time during which that leachate was produced is not known. On the other hand, the HELP model projected volume of leachate in Phase 2 has not been realized in practice. To be conservative it is assumed substantial volumes of leachate will continue to be produced, including in the new Phase 3 and Phase 4 cells.

7.3 Containment Unit Characteristics

As described in Section 3 above, each phase of the landfill has been designed differently with respect to waste containment and leachate collection systems. To summarize:

- Phase 1 has a thin geomembrane liner and a leachate collection system that drains by gravity to an external wet well, with a valve normally closed to keep leachate from draining to the wet well except when leachate sampling and removal is being done.

- Phase 2 has a compacted soil liner graded to drain to the Phase 1 geomembrane liner. Phase 2 has no leachate collection and removal system except for an 800-square foot test lysimeter that drains by gravity to an external standpipe for monitoring and removal.

- Phases 3 and 4 will be constructed with a composite liner system, leachate collection piping, and an internal sump from which leachate will be pumped.

7.4 Depth to Groundwater

As detailed in Section 5.2 above, the elevation of first groundwater beneath the MISWF is estimated to be no more than about 10 feet above sea level. Any potential contaminants from the facility would migrate vertically through approximately 175 to 265 feet of fractured basalt and associated ash layers before reaching groundwater.

7.5 Leachate Composition

Table 7-1 summarizes the results of site-specific leachate quality data collected at the MISWF. As noted in Table 7-1, two leachate samples have been collected at the facility. These leachate samples were collected during June of 2007 and February of 2008 from the Phase 1 wet well and analyzed by Food Quality Lab, in Honolulu, Hawaii. No analytical results are currently available for Phase 2 as significant leachate has not yet been noted in the Phase 2 wet well. The following subsections discuss the character of the Phase 1 leachate.

7.5.1 Volatile Organic Compounds

As shown in Table 7-1, chloromethane (at 1.18 ug/L) was the only volatile organic compound (VOC) detected in the Phase 1 leachate samples. VOCs, as a group, are typically the most common, most abundant, and most diagnostic organic constituents detected in leachate from MSW landfills. Based on the lack of significant VOC detections in the Phase 1 leachate sample (Table 7-1), the Phase 1 leachate is somewhat atypical in this respect. The reason for the lack of significant VOCs is unknown, however, given the inorganic character of the leachate samples (see next subsection) this lack of VOCs is considered likely to be representative of actual site characteristics (e.g., site-specific waste stream characteristics), rather than sample dilution by rainwater or analytical error. The leachate samples contained no VOC detections which exceed applicable USEPA Primary Maximum Contaminant Levels (MCLs).

7.5.2 Other Trace Organic Compounds

The Phase 1 leachate samples were also analyzed for semi-volatile organic compounds (SVOCs) and select pesticides and herbicides. No SVOCs, pesticides, or herbicides were noted in either sample. Although not typical, this lack of SVOCs, pesticide, and herbicide detections is not uncommon for MSW leachate.

7.5.3 Major Cations and Anions

The results of analyses for major cations and anions are indicative of a relatively mature Phase 1 leachate. Typical leachate constituents such as chloride, sodium, and potassium are present at high concentrations in the Phase 1 samples. Bicarbonate, a constituent typically present at high concentrations, is present in the Phase 1 leachate samples but at relatively low concentrations. The concentrations of chloride detected in the leachate sample (Table 7-1) are well above the Secondary MCL established for this constituent in drinking water (250 mg/L). The concentrations of sulfate detected are slightly above the Secondary MCL, but below the Primary MCL (500 mg/L) established for this parameter.

7.5.4 Trace Metals

Barium and nickel were the only trace metals detected in the leachate sample (Table 7-1). The concentration of barium detected in the February 2008 leachate sample is slightly above the Secondary MCL established for this parameter in drinking water. No Federal MCL has been established for nickel.

7.5.5 Other Conventional Parameters

Concentrations reported for other conventional parameters (Table 7-1) are also generally consistent with a mature Phase 1 leachate, suggesting significant contact time between leachate and waste. The total dissolved solids (TDS) concentrations reported for the Phase 1 leachate are relatively high and exceed the Secondary MCL established for this parameter in drinking water. Results of the chemical oxygen demand (COD), biological oxygen demand (BOD), and dissolved oxygen analyses are consistent with the expected overall reducing environment within the landfill. The presence of primarily reduced nitrogen forms (ammonia and total kjeldahl nitrogen) at the expense of its oxidized form (nitrate) is also consistent with such a reducing environment. A comparison of the “nitrate” and “nitrate+nitrite” concentrations reported by the laboratory for the Phase 1 leachate suggests that nitrite concentrations in the leachate may exceed the Primary MCL established for this constituent.

7.6 Local Water Quality and Use

As discussed in Section 5, groundwaters of the Manawainui and Kamiloloa Aquifer Systems in the vicinity of the MISWF are expected to exhibit naturally poor water quality (Stearns and Macdonald, 1947; Oki, 2006, Oki, 2007). As indicated in Table 5-1, groundwater wells located in the vicinity of the facility are expected to be brackish (TDS concentrations greater than 1,000 mg/L), with chloride levels in most wells ranging from about 500 and 1,100 mg/L.

A recent report by the USGS (Oki, 2007) indicates that there are at least 9 groundwater wells located within about 2 miles of the MISWF. The presence of additional wells in the vicinity of the MISWF is indicated in documents prepared by Parametrix (1992) and Brown and Caldwell (2002). Oki (2007) also indicates that there is currently no significant water supply derived from groundwater wells located downgradient of the MISWF. In addition, the facility’s location relative to the UIC line (Figure 4-3) indicates that the Manawainui Aquifer System and northern coastal portions of the Kamiloloa Aquifer System are not considered potential sources of drinking water.

7.7 Other Potential Receptors

There are no known perennial streams in the vicinity of the MISWF. Manawainui Gulch, located approximately 500 feet north of the MISWF, is an ephemeral stream which flows generally southwest and ultimately discharges to the Pacific Ocean near Kahanui. A number of coastal surface water bodies are located in the area downgradient of the MISWF. The Pacific Ocean, along with two hydraulically connected fish ponds, at Kaluaapuhi and Ooia, are located approximately 0.7 miles south of the MISWF. The Ohiapili pond and associated wetlands area are located approximately 0.7 miles southeast of the MISWF. Several natural springs were previously identified by Stearns and Macdonald (1947) along the coast between Umipaa and Kahaunui. Each of the above-mentioned potential receptors is located more than one half mile from the MISWF.

7.8 Migration Potential

7.8.1 General Assessment

Assuming that site leachate is consistently free of significant levels of VOCs, SVOCs, pesticides and herbicides, there is little potential for impacts to groundwater from these trace organic compounds. Similarly, concentrations of analyzed trace metals and most conventional parameters are below established MCLs, and are therefore considered to be of limited risk to groundwater. Concentrations of TDS, chloride, sodium, sulfate, and possibly nitrite are above Federal MCLs. Based on the reported ammonia-nitrogen concentration, nitrate concentrations in the migrating leachate could exceed the Federal MCL if the majority of the reduced nitrogen forms convert to nitrate.

For the most part, concentration reductions would be expected for most of the elevated leachate parameters during migration through the underlying unsaturated zone. Subsurface processes likely to attenuate parameter concentrations include redox reactions, absorption, adsorption, biologic activities, dilution, and dispersion. The affects of dilution and dispersion would be particularly strong within the saturated zone beneath the facility. Slight increases in nitrate concentrations could occur within the unsaturated or saturated zones as reduced nitrogen forms migrate through more oxygenated portions of the subsurface and are transformed to oxidized forms. Nitrite is relatively unstable within most subsurface environments and its conversion to a more stable nitrogen form (e.g., nitrate) would be expected to occur fairly rapidly once within the unsaturated zone (Lamond, 1999).

7.8.2 Contaminant Fate and Transport Modeling

General. Contaminant fate and transport modeling was performed for the MISWF to provide insight regarding the potential for leachate impacts to groundwater from the MISWF and to guide future decision with regard to the facility's monitoring programs. The modeling work was completed using Version 1.51 of the commercially-available software package MULTIMED for Windows (Allison Geosciences, Inc., 2005). The modeling activities for the MISWF integrated MULTIMED's Subtitle D restrictions and setting in order to facilitate subsequent evaluation of the modeling results.

Modeling Inputs, Setting, and Assumptions. Appendix B contains a modeling report for the MISWF which describes the MULTIMED model inputs, settings, and assumptions. Key inputs and assumptions used in the modeling effort include the following:

- The modeling efforts focused on Phase 2 of the MISWF as this unit was considered to represent a worst-case scenario with respect to landfill impacts to groundwater.

- The infiltration rate used for Phase 2 in the modeling effort was derived using the USEPA's HELP model (see Appendix A).

- Site-specific leachate data from Phase 1 of the MISWF were used to establish initial leachate concentrations. The highest values from the two available sets of analytical data were used in the model.

- Given that no significant VOCs, SVOCs, pesticides or herbicides have been detected in the Phase 1 leachate, no impact to downgradient receptors is expected from these organic constituents. VOCs, SVOCs, pesticides and herbicides therefore were not included in the modeling effort.

- The potential inorganic contaminants modeled included those constituents that exceeded applicable MCLs in the Phase 1 leachate samples (i.e., total dissolved solids, chloride, sulfate, and barium). Three additional inorganic constituents were also modeled based on anticipated conversions within the vadose zone (ammonia-nitrogen and total kjeldahl nitrogen) or questions regarding actual sample concentrations (nitrite).

- For purposes of this modeling effort, two theoretical receptor well scenarios were modeled. The first, designated here as the "POC well scenario", assumed a receptor well located at the facility's point of compliance, considered here to be 10 meters from the waste footprint. The second, designated here as the "nearest offsite well" scenario, assumed an offsite receptor well located approximately 560 meters downgradient of the Phase 2 waste footprint.

Modeling Results. Table 7-2 summarizes the results of the MULTIMED modeling activities conducted for the MISWF. For the POC well scenario the dilution attenuation factor (DAF) was 74, and the calculated concentrations for the modeled parameters were less than their MCLs. For the “nearest offsite well” simulation, the DAF was 3,179, and calculated concentrations for the modeled parameters were less than their MCLs.

Based on these results it is concluded that the potential for significant impacts on groundwater due to migration of leachate from the MISWF is extremely low. Future improved monitoring of leachate volume and quality will provide additional site-specific information on the volume and composition of potential releases from the site. This data will be useful in updating the modeling of contaminant transport and fate in the event future development on Molokai causes waste volumes to increase above the 20 ton per day threshold for the small landfill exemption from full groundwater monitoring requirements of HAR 11-58.1-16.

TABLE 7-1
SUMMARY OF PHASE 1 LEACHATE ANALYTICAL RESULTS
MOLOKAI INTEGRATED SOLID WASTE FACILITY

MONITORING PARAMETERS		Molokai - Phase 1		Primary MCL	Secondary MCL	Typical Seawater
	Units	6/6/07	2/8/08			
Trace Organics						
Chloromethane (EPA 8260B)	ug/L	1.18	All ND	--	--	
Other VOCs (EPA 8260B)	ug/L	All ND	All ND	--	--	--
SVOCS (EPA 8270C)	ug/L	All ND	All ND	--	--	--
Pesticides (EPA 8081A)	ug/L	All ND	All ND	--	--	--
Miscellaneous Conventionals						
Total Organic Carbon	mg/L	88	93	--	--	--
Chemical Oxygen Demand	mg/L	570	812	--	--	--
Biochemical Oxygen Demand	mg/L	30.2	61.5	--	--	--
Dissolved Oxygen	mg/L	< 1.0	3.0	--	--	--
Total Hardness	mg/L	3,120	2,970	--	--	--
Total Dissolved Solids	mg/L	11,200	10,550	--	500	35,000
Total Alkalinity	mg/L	210	200	--	--	--
pH, laboratory	SU	7.4	7.73	--	6.5-8.5	--
Turbidity	NTU	5.5	2.1	--	--	--
Cyanide	mg/L	< 0.0100	< 0.0100	0.2	--	--
Sulfide	mg/L	< 0.020	< 0.020	--	--	--
Organic Nitrogen	mg/L	0.45	< 0.1	--	--	--
Ammonia Nitrogen	mg/L	34.1	16.4	--	--	--
Total Kjeldahl Nitrogen	mg/L	34.6	16.4	--	--	--
Nitrate-Nitrogen	mg/L	< 0.05	--	10	--	--
Nitrate+Nitrite	mg/L	3.03	2.03	1[(2)]	--	--
Total Phosphorus	mg/L	0.63	--	--	--	--
Ortho Phosphate	mg/L	0.22	0.02	--	--	--
Major Cations and Anions						
Chloride	mg/L	5490	4,490	--	250	19,000
Sodium	mg/L	2050	1,900	--	--	10,500
Sulfate	mg/L	275	200	500	250	2,700
Magnesium	mg/L	816	588	--	--	1,350
Calcium	mg/L	234	218	--	--	410
Potassium	mg/L	296	163	--	--	390
Bicarbonate	mg/L	210 [(1)]	200[(1)]	--	--	142

TABLE 7-1 (Continued)

MONITORING PARAMETERS	Units	Molokai - Phase 1		Primary MCL	Secondary MCL	Typical Seawater
		6/6/07	2/28/08			
Trace Metals						
Arsenic	mg/L	< 0.0100	< 0.500	0.010	--	--
Barium	mg/L	1.16	2.04	2	--	--
Cadmium	mg/L	< 0.0100	< 0.500	0.005	--	--
Chromium	mg/L	< 0.0100	< 0.500	0.1	--	--
Copper	mg/L	< 0.0100	< 0.0100	1.3	1	--
Iron	mg/L	< 0.2	0.127	--	0.3	--
Lead	mg/L	< 0.0050	< 0.250	0.015	--	--
Mercury	mg/L	< 0.0100	< 0.0100	0.002	--	--
Selenium	mg/L	< 0.0100	< 0.500	0.050	--	--
Silver	mg/L	< 0.0100	< 0.500	--	0.1	--
Molybdenum	mg/L	< 0.0100	< 0.0100	--	--	--
Nickel	mg/L	0.0165	0.0178	--	--	--
Zinc	mg/L	< 0.0200	< 0.0200	--	5	--

Notes:
(1) Bicarbonate values are estimated based on reported total alkalinity and pH values.
(2) The MCL shown is for nitrite alone.

TABLE 7-2
SUMMARY OF RESULTS FOR MULTIMED MODELING
MOLOKAI INTEGRATED SOLID WASTE FACILITY

PARAMETER	Maximum Concentration in Phase 2 Leachate Samples (mg/L)	Applicable MCLs	Point of Compliance Well Simulation (Well 10 m from MISWF)		Nearest Offsite Receptor Simulation (Well 560 m from MISWF)	
			DAF[3] (unitless)	Calculated Concentration at Theoretical POC Well (mg/L)	DAF[3] (unitless)	Calculated Concentration at Theoretical Offsite Well (mg/L)
Total Dissolved Solids	11,200	500 (s)	74	151[4]	3,179	4 [4]
Ammonia-Nitrogen[1]	34.1	10 (p)(1)		0.46		< 0.1
Total Kjeldahl Nitrogen[1]	34.6	10 (p)(1)		0.47		< 0.1
Nitrite+Nitrate[2]	3.03	1 (p)(2)		0.04		< 0.1
Chloride	5,490	250 (s)		74 [4]		2 [4]
Sulfate	275	250 (s)		4 [4]		< 1 [4]
Barium	2.02	2 (s)		< 0.1		< 0.1

Notes:

(s) = Secondary MCL, based on aesthetic considerations (taste, odor, etc.); (p) = primary MCL, based on health considerations.

(1) No Federal MCLs have been established for these parameters. However, given the possibility that these reduced nitrogen forms can convert to nitrate within an oxidized subsurface environment, a comparison to the nitrate MCL has been included.

(2) The relative proportions of nitrate and nitrite in the leachate samples is unknown. As a conservative step, all reported nitrogen in the sample has been assumed to be nitrite.

(3) = Dilution Attenuation Factor (USEPA, 1995).

(4) = These are calculated values and, given the brackish quality of local groundwater, would likely not be realized.

8. SAMPLING PROCEDURES

This section of the monitoring plan addresses procedures for the collection of liquid samples from liquid (leachate and lysimeter) monitoring points at the MISWF. The remainder of this section is organized in five parts, as follows:

- Procedures Prior to Sampling,
- Sample Collection,
- Sample Preservation,
- Sample Shipment and Holding Times; and
- Chain-of-Custody Control.

8.1 Procedures Prior to Sampling

Upon arrival at the liquid monitoring point location, the sampling personnel should observe and record the condition of the monitoring point. Information to be recorded includes:

- Is the monitoring point clearly labeled?
- Was the monitoring point secured upon arrival?
- Is there structural or other damage to the monitoring point?
- Are there potential contaminants in the vicinity of the monitoring point that could negatively affect the monitoring results?
- What are the weather conditions at the time of sample collection?

8.2 Sample Collection

The liquid samples should be collected in sample containers obtained from the analytical laboratory. Ideally, sample containers should be filled directly from an outfall or pump discharge port. The VOC sample containers should be filled such that there is no enclosed air within the containers. All other containers should be filled as close to the top of the container as possible without overflowing the container. Sample containers and caps should not contact the ground or any portions of the monitoring point during the sample collection activities. If filling directly from an outfall is not feasible, the liquid should be transferred to the laboratory-supplied sample containers using a clean glass, stainless steel, or polyethylene container. Given that several of the laboratory-supplied containers will contain chemical preservatives, lowering the sample containers into the liquid to be sampled should be avoided. Any equipment or containers used in the sample collection activities should be described in detail on an appropriate field sample collection log.

8.3 Sample Preservation

Required chemical preservatives should already be placed by the laboratory in the sample containers. Once a sample container is filled, it should immediately be placed in a ice-filled cooler. All samples must be maintained at a temperature of 4 degrees Celsius (+/- 2 degrees) at all times during transport to the analytical laboratory.

8.4 Sample Shipment and Holding Times

Each analysis to be performed will have a specific holding time, indicating the maximum time that may elapse between sample collection and sample analysis by the laboratory. Holding times for some laboratory analyses may be a short as 24 hours. Prior to each liquid sampling event, the sampling personnel should coordinate sample collection and sample shipping activities such that all required holding times can be met.

8.5 Chain-of-Custody Control

A chain-of-custody form must be completed during each liquid sampling event. The chain-of-custody form should accompany the sample(s) at all times during transport to the analytical laboratory.

TABLE 8-1

MINIMUM MONITORING PARAMETERS FOR LEACHATE AND LYSIMETER LIQUID SAMPLES MOLOKAI INTEGRATED SOLID WASTE FACILITY[1]

Volatile Organic Compounds
Semi-volatile Organic Compounds
Chemical Oxygen Demand
Total Organic Carbon
Ammonia Nitrogen
Total Phosphorus
Nitrate
Total Alkalinity
Bicarbonate Alkalinity
Sulfate
Chloride
Bromide
pH
Total Dissolved Solids
Specific Conductance
Calcium
Magnesium
Potassium
Sodium
Iron
Manganese

Notes:

(1) These are the minimum analyses considered necessary for characterization of site liquid samples. Additional laboratory analyses should be conducted as necessary to facilitate liquid disposal activities.

9. REFERENCES

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USGS, 1993b, "Kaunakakai Quadrangle, Hawaii-Maui Co., 7.5-Minute Series Topographic Map"; 1:24,000 scale map.

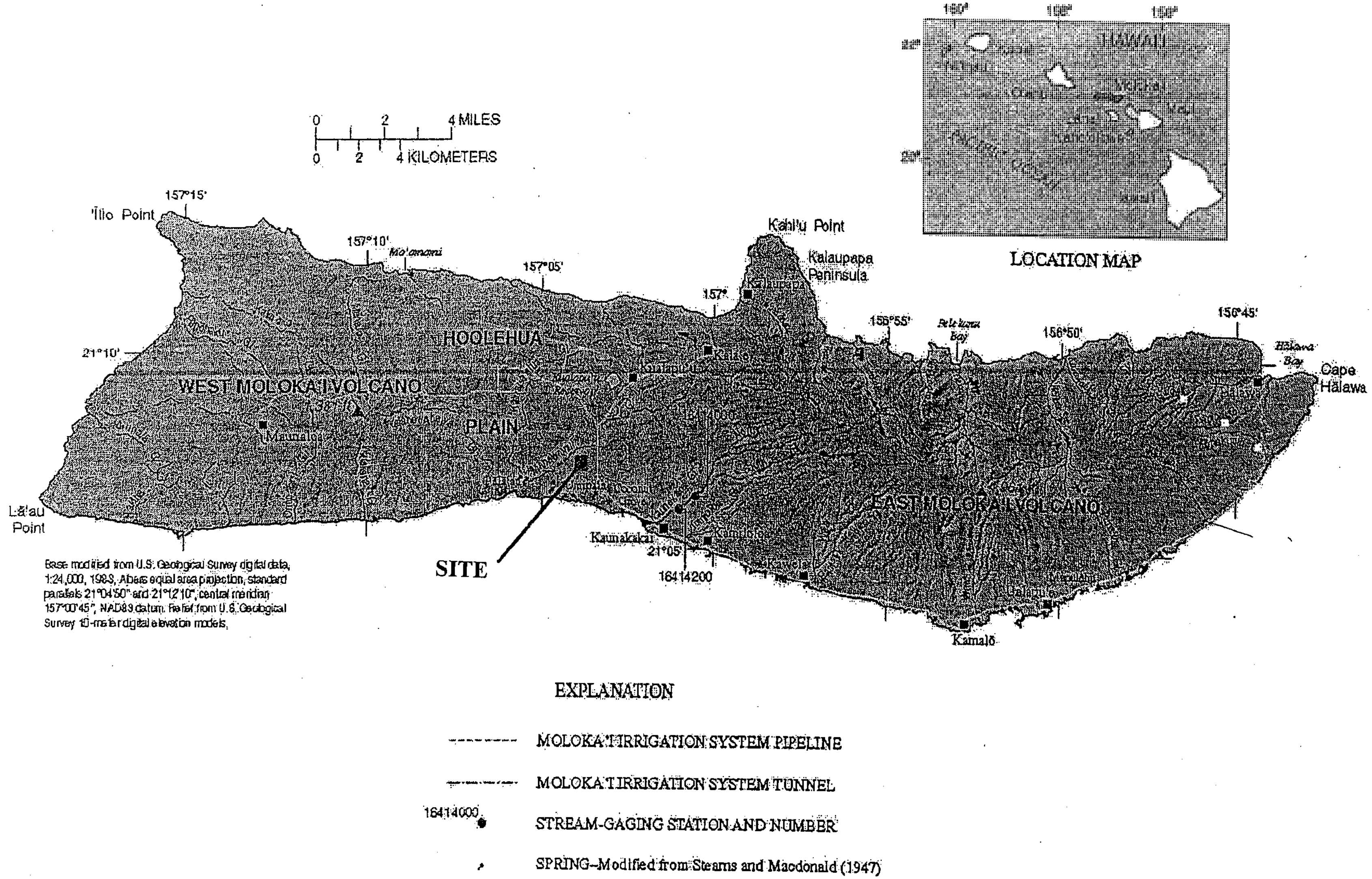


Figure 1-1: Site Location Map (Modified from Oki, 2007)

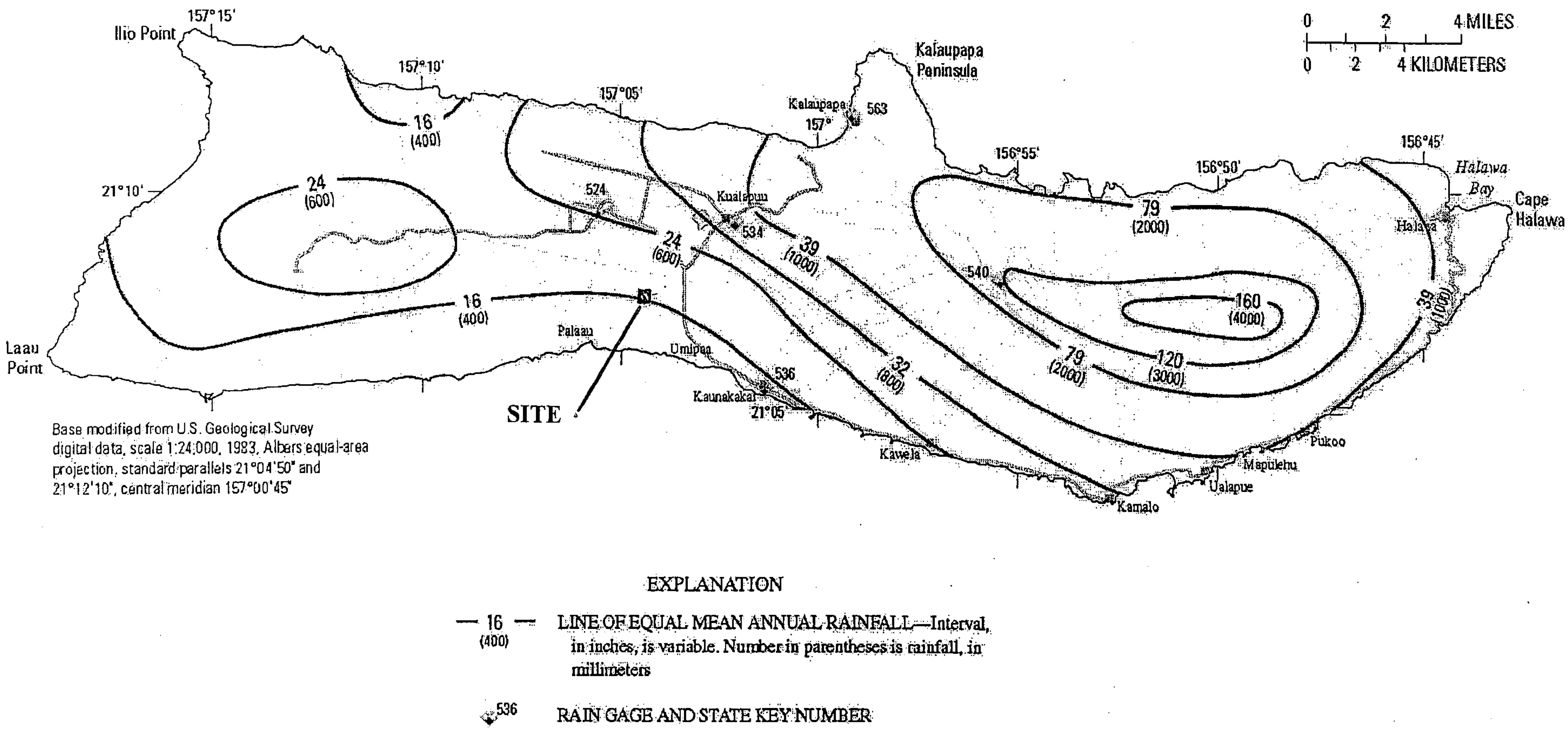


Figure 2-1: Contour Map Showing Mean Annual Rainfall for Molokai (Modified from Oki, 2007)

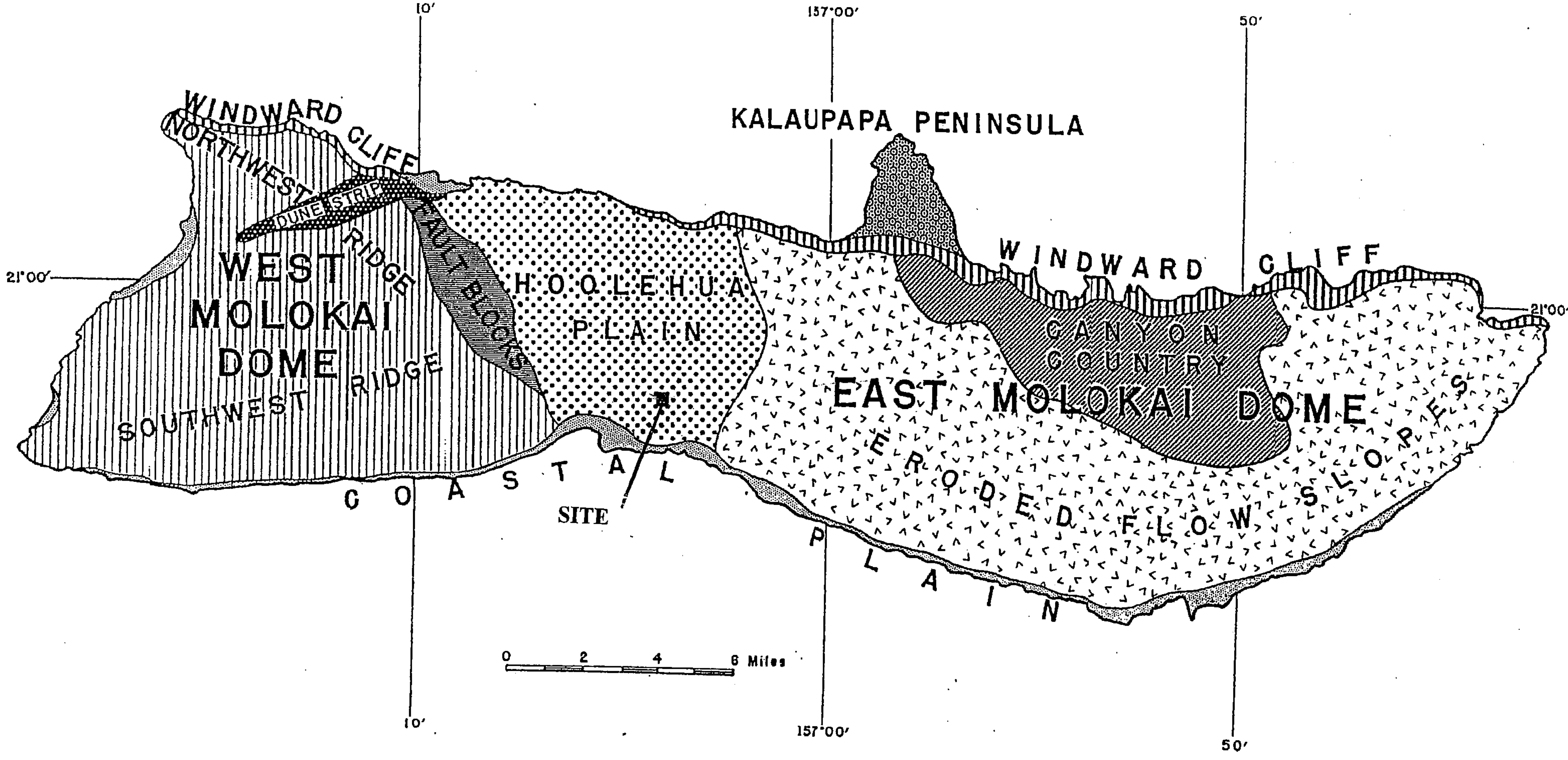


Figure 2-2: Map Showing Major Geomorphic Areas of Molokai (Reproduced from Stearns and Macdonald, 1947)

A-Mehr, Inc.

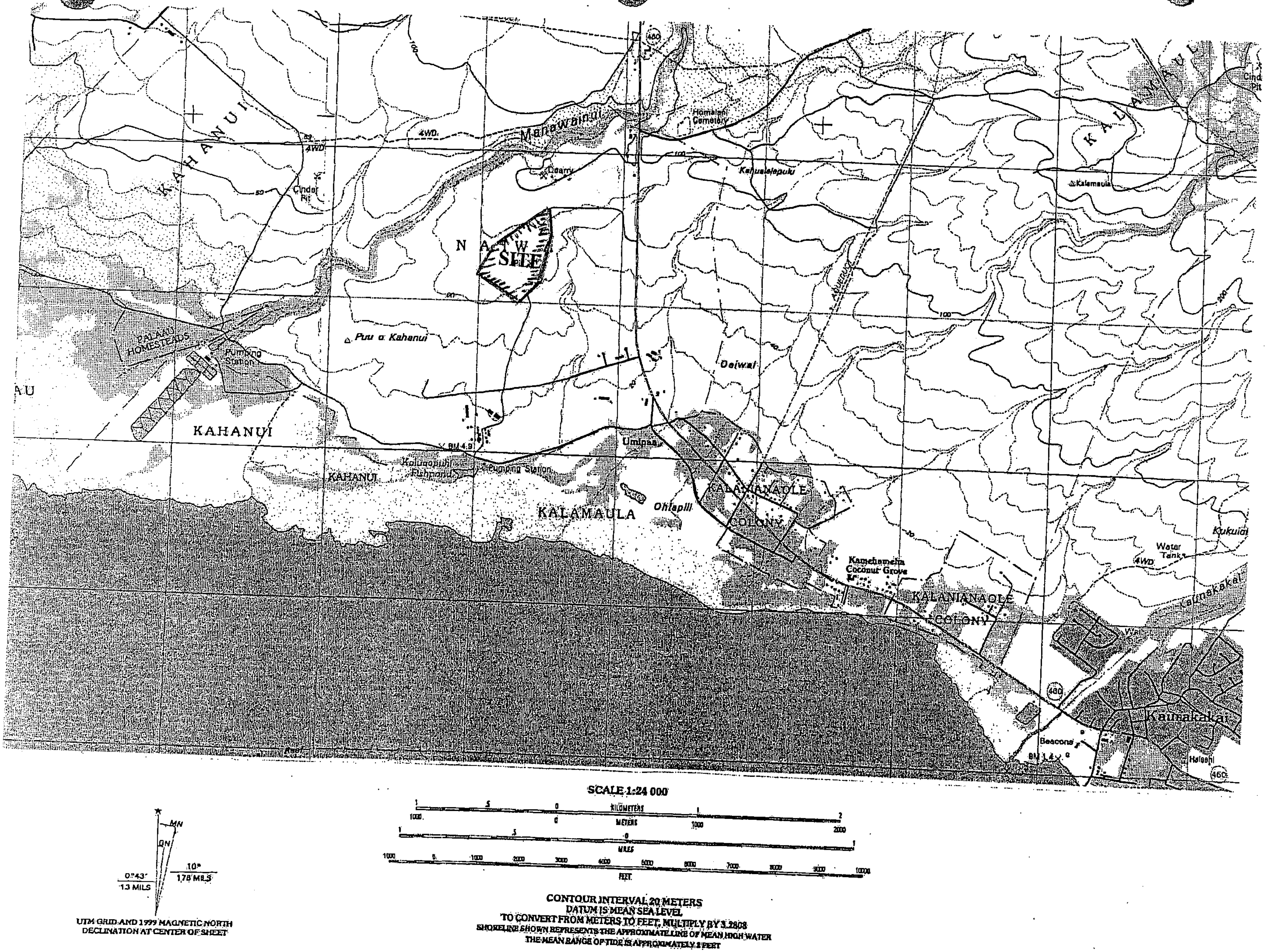
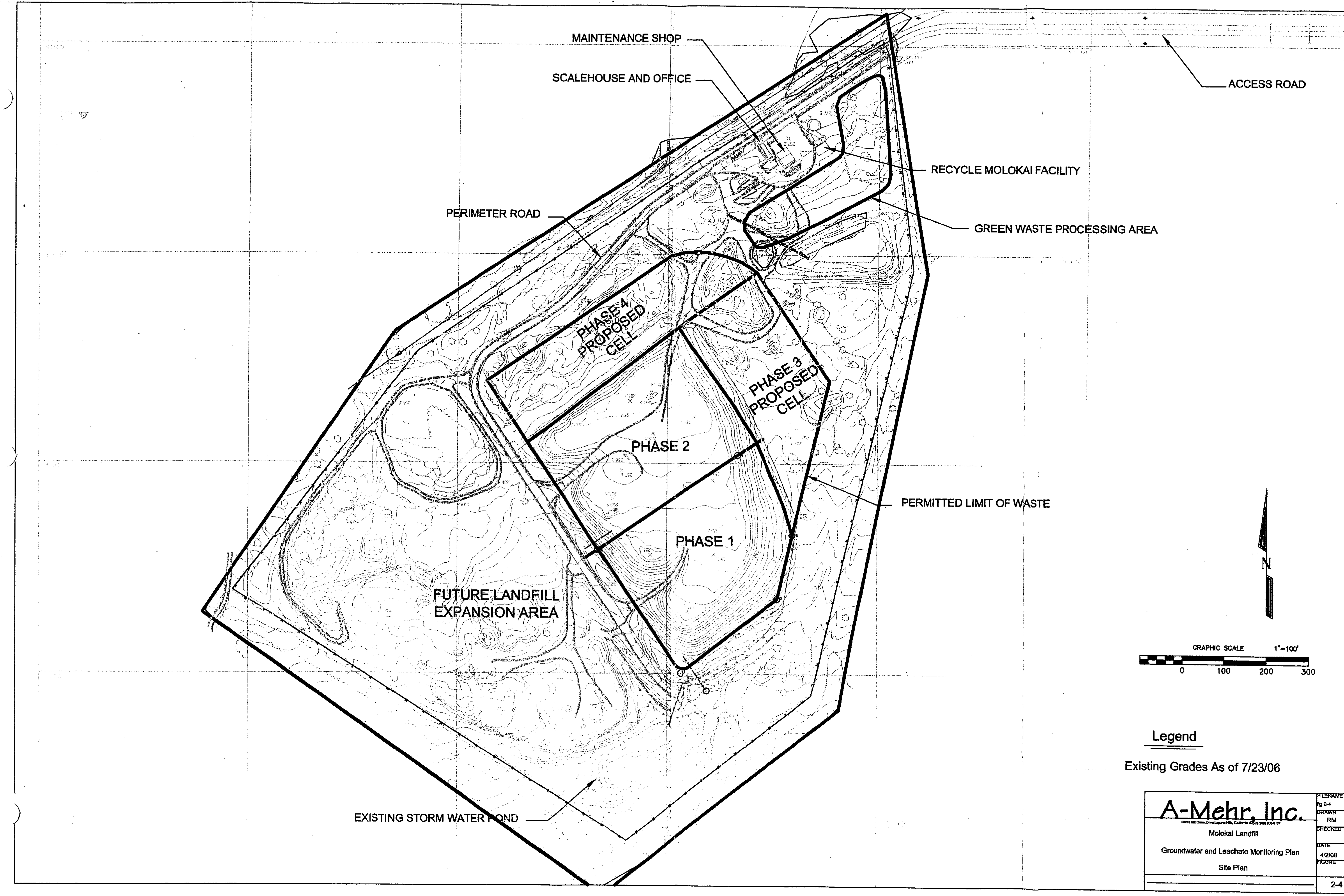
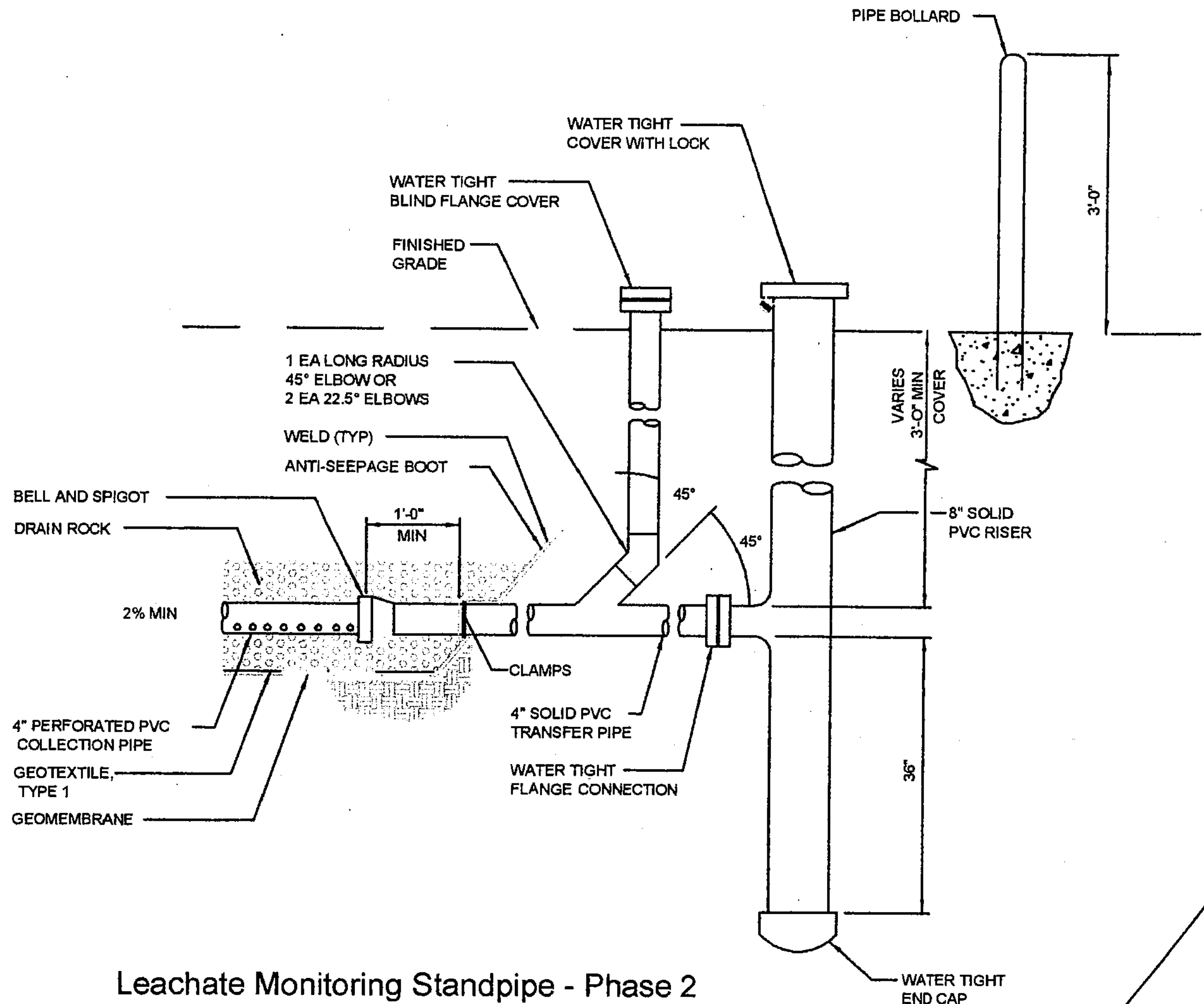


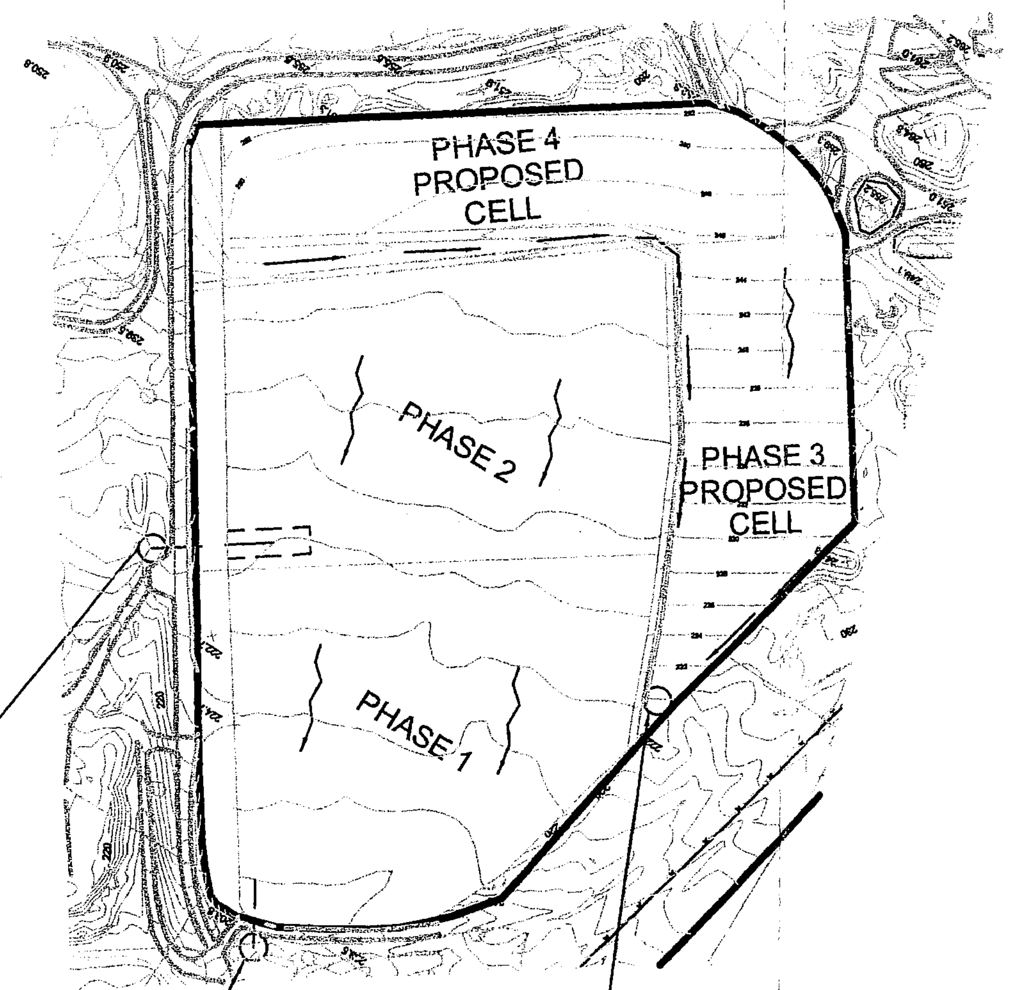
Figure 2-3: Site Topographic Map (USGS, 1993a&b)

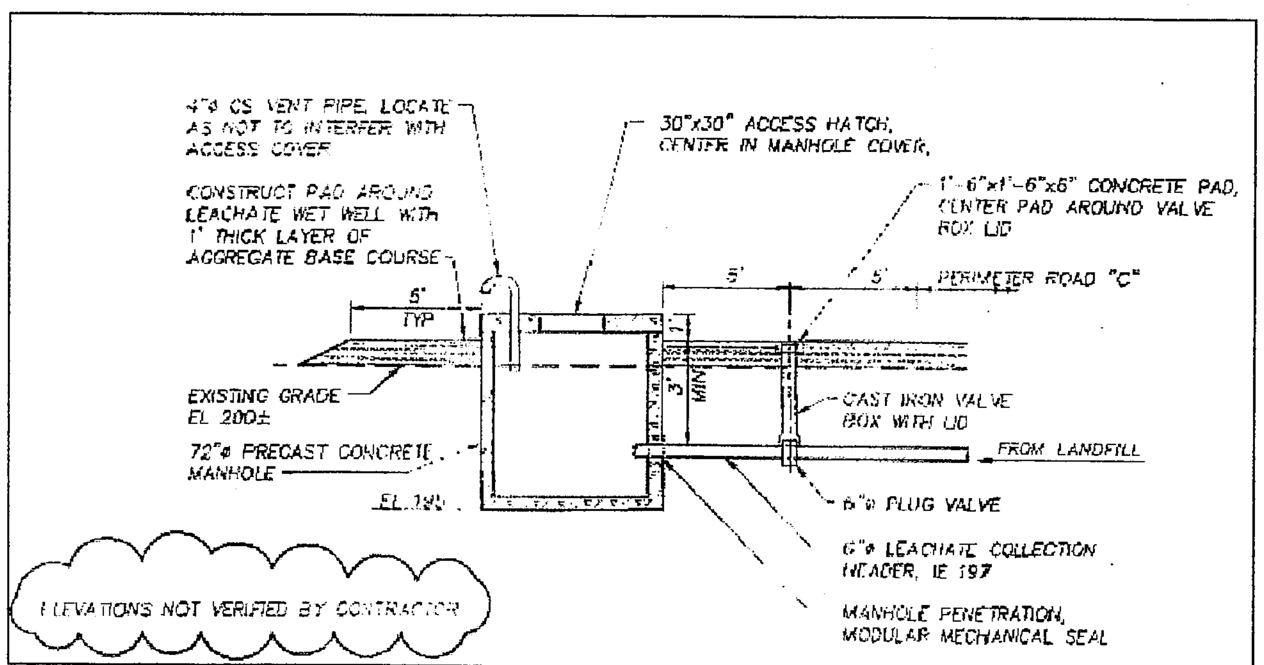


MAINTENANCE SHOP
SCALEHOUSE AND OFFICE
ACCESS ROAD
RECYCLE MOLOKAI FACILITY
PERIMETER ROAD
GREEN WASTE PROCESSING AREA
PHASE 4 PROPOSED CELL
PHASE 3 PROPOSED CELL
PHASE 2
PHASE 1
PERMITTED LIMIT OF WASTE
N
FUTURE LANDFILL EXPANSION AREA
GRAPHIC SCALE 1"=100'
0
100
200
300
Legend
Existing Grades As of 7/23/06
EXISTING STORM WATER POND
A-Mehr, Inc.
Molokai Landfill
Groundwater and Leachate Monitoring Plan
Site Plan
FILENAME
fig 2-4
DRAWN
RM
CHECKED
DATE
4/2/08
FIGURE
2-4

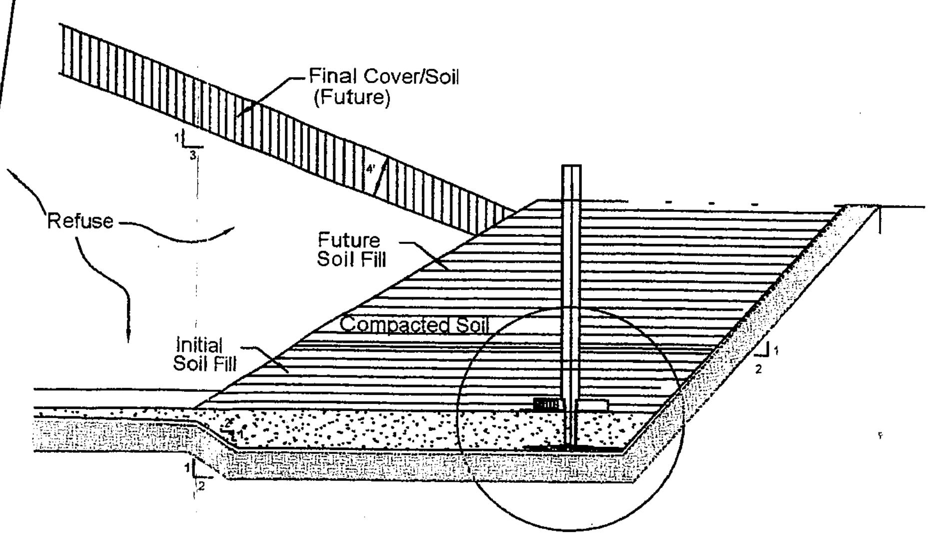


Leachate Monitoring Standpipe - Phase 2





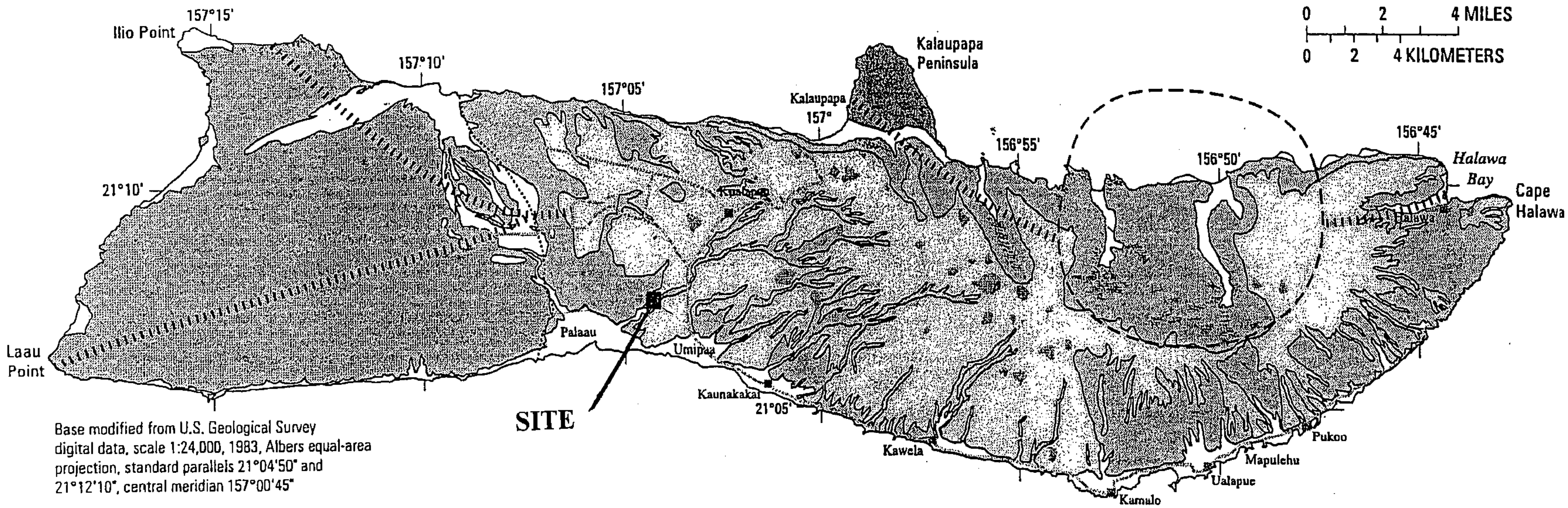
Leachate Wet Well - Phase 1



Proposed Leachate Collection Sump - Phase 3 &4

Note: Phase 1 and 2 facilities based on design drawings - Field locate and verify.

A-Mehr, Inc. 23016 Mill Creek Drive, Laguna Hills, California 92653 (949) 206-0157	FILENAME fig 2-5
Molokai Landfill	DRAWN RM
Groundwater and Leachate Monitoring Plan	CHECKED
Leachate Collection and Monitoring Points	DATE 4/2/08
	FIGURE 2-5



EXPLANATION

- SEDIMENTARY DEPOSITS (Holocene and Pleistocene)
- EAST MOLOKAI VOLCANO
  - Kalaupapa Volcanics (Pleistocene)
  - East Molokai Volcanics (Pleistocene and Pliocene)
    - Upper member
    - Lower member
- WEST MOLOKAI VOLCANO
  - West Molokai Volcanics (Pleistocene and Pliocene)
- VOLCANIC VENT
- DIKE
- CONTACT
- CALDERA BOUNDARY
- AXIS OF RIFT ZONE—Approximately located
- SEA-LEVEL LOCATION OF WEST MOLOKAI CONFINING UNIT

Figure 3-1: Regional Geology Map (Reproduced from Oki, 2007)

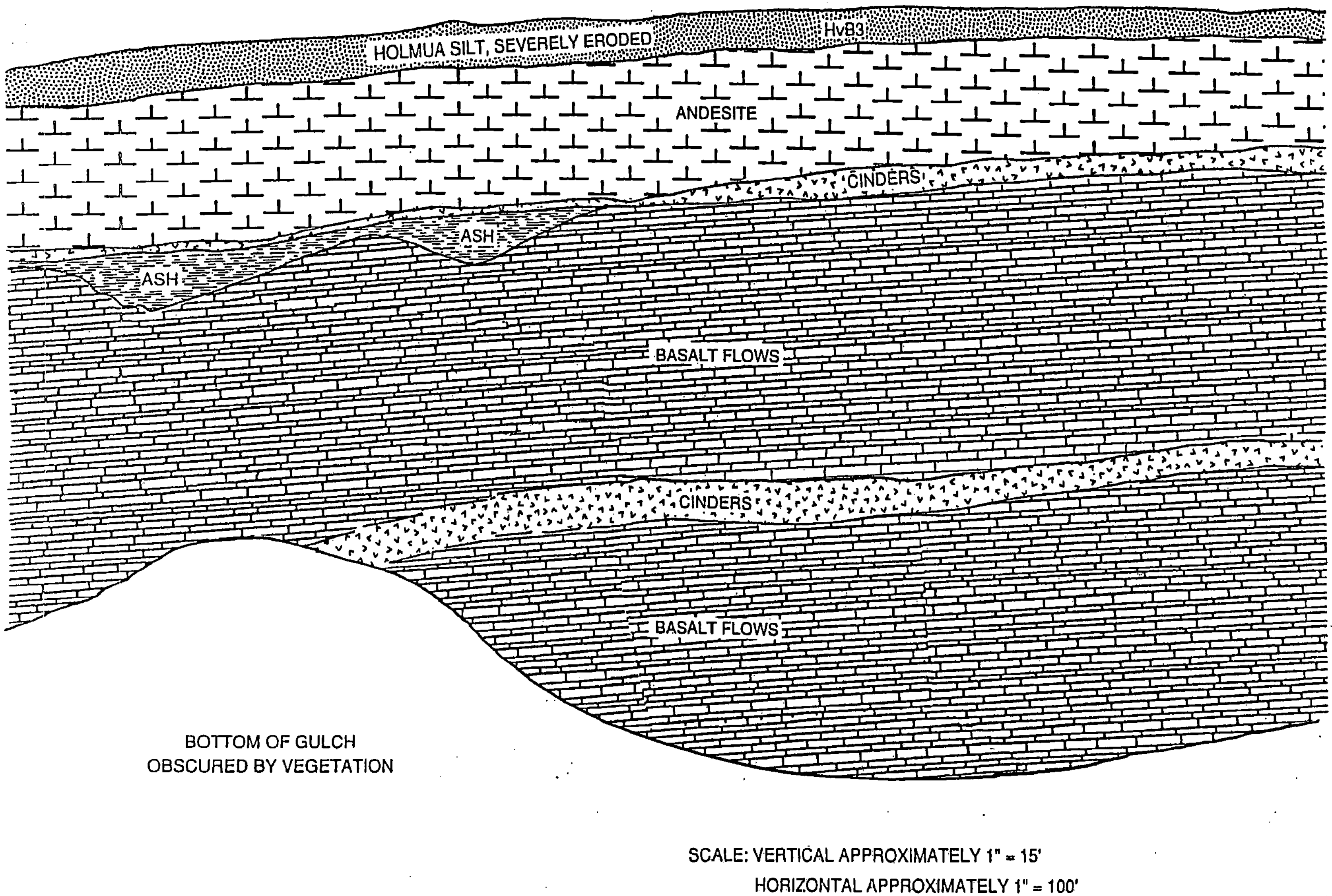
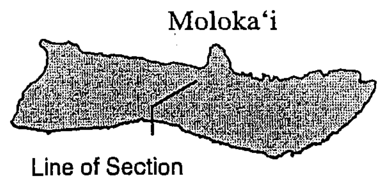


Figure 3-2: Quarry Cross-Section (Reproduced from Parametrix, 1992)



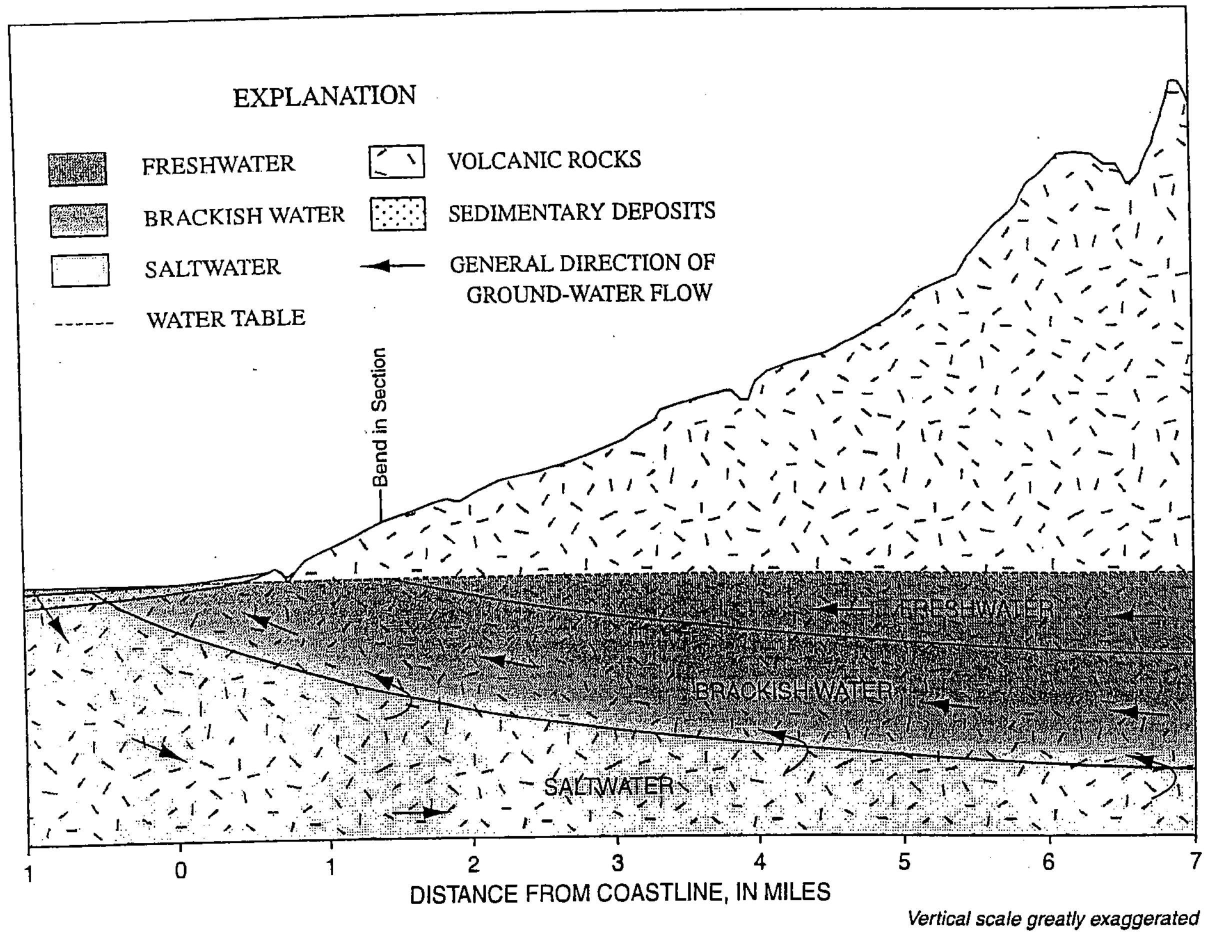
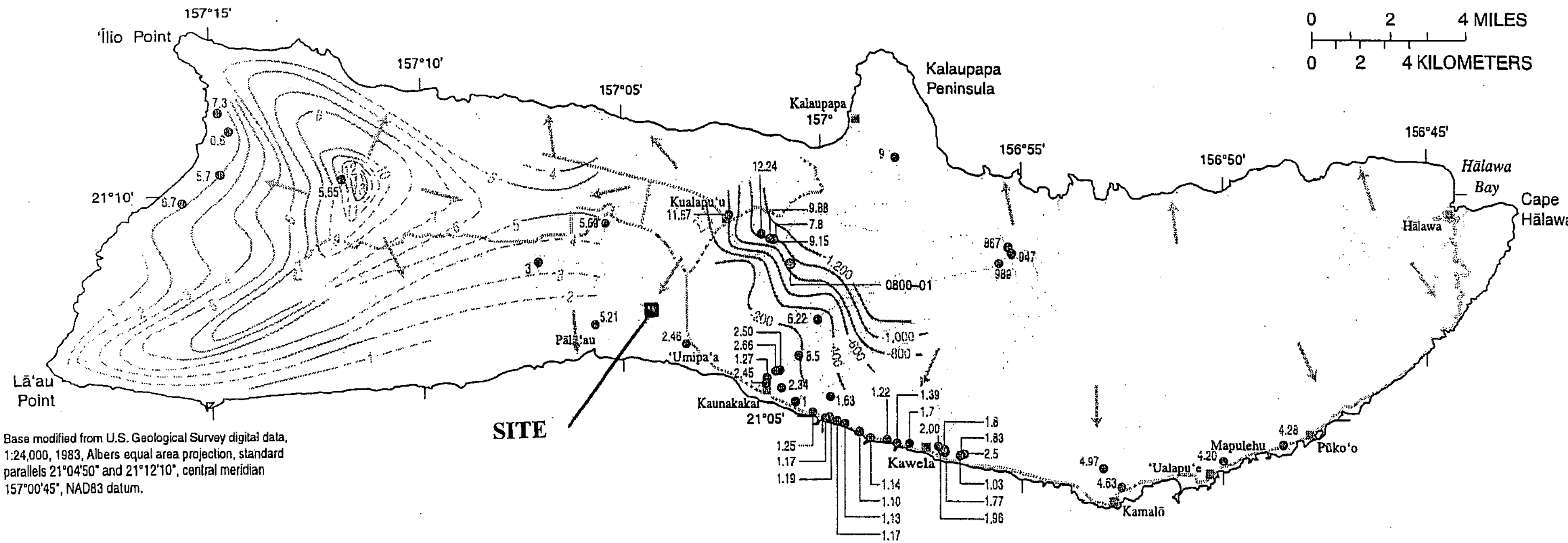


Figure 4-1: Generalized Cross-section Showing Basal Groundwater Lens (Modified from Oki, 2007)



EXPLANATION

LINE OF EQUAL WATER LEVEL AS DETERMINED BY RESISTIVITY MEASUREMENTS (MacCarthy, 1941) Interval, 1 foot. Datum is mean sea level. Dashed where inferred

LINE OF EQUAL DEPTH TO SALINE WATER BODY AS DETERMINED BY TIME-DOMAIN ELECTROMAGNETIC SURVEY (HAWAI'I COMMISSION ON WATER RESOURCE MANAGEMENT, 1997) Interval, 200 feet. Datum is mean sea level.

APPROXIMATE DIRECTION OF GROUND-WATER FLOW

WELL AND AVERAGE MEASURED WATER LEVEL, IN FEET ABOVE MEAN SEA LEVEL

Figure 4-2: Generalized Groundwater Contour Map (Modified from Oki, 2007)

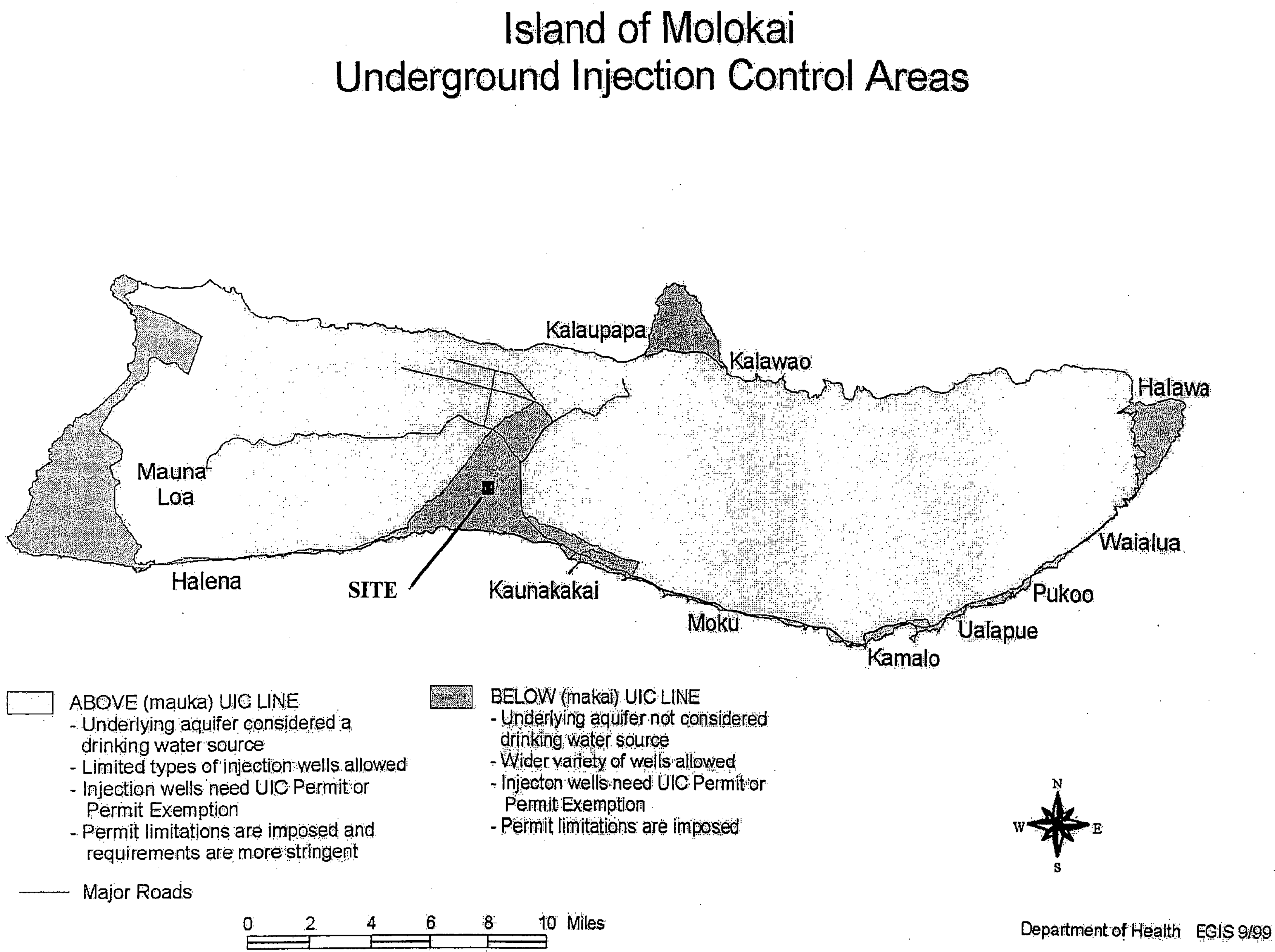


Figure 4-3: Map Showing Underground Injection Control Areas

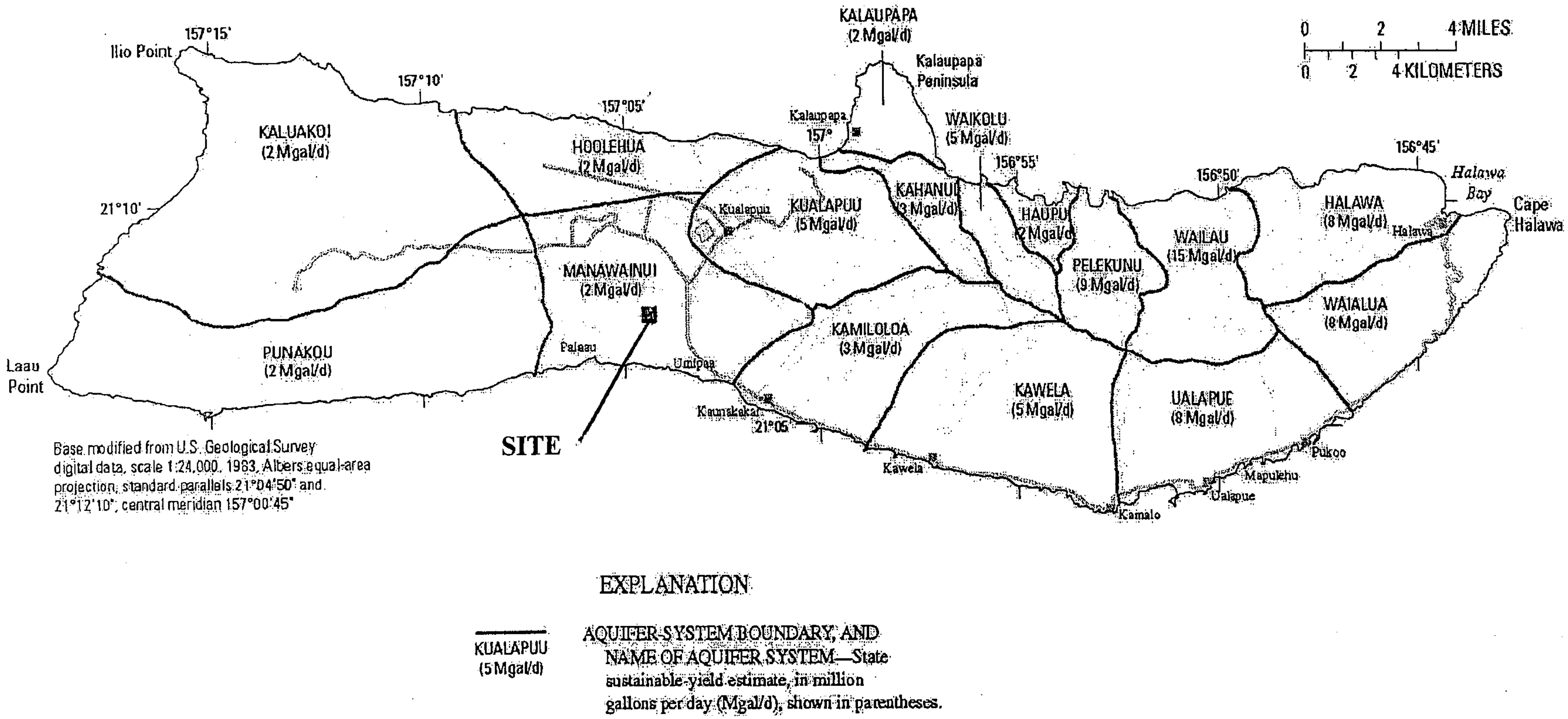


Figure 4-4: Map Showing Aquifer Systems on Molokai

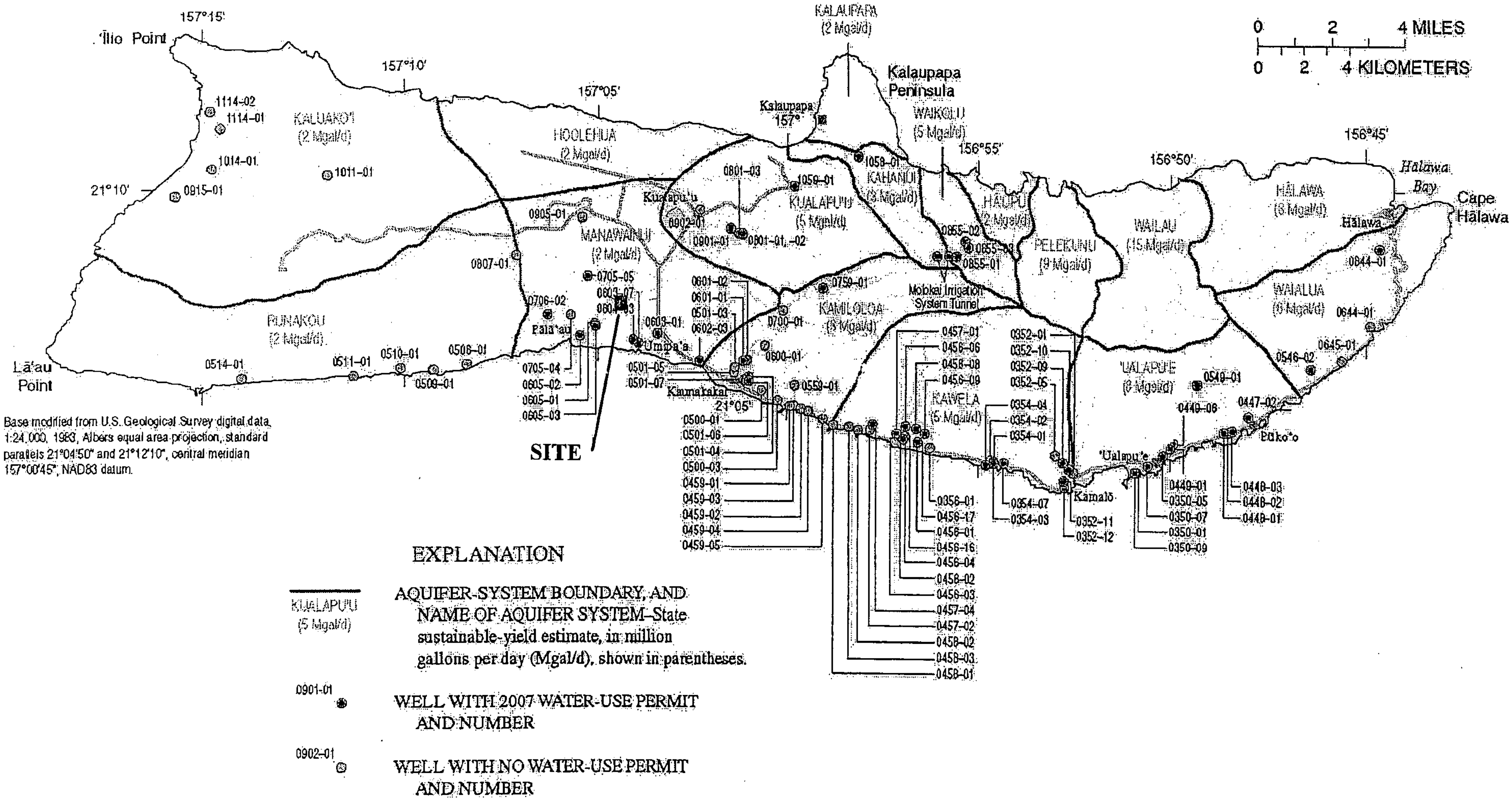


Figure 4-5: Map Showing Groundwater Well Locations (From Oki, 2007)

APPENDIX A
HELP MODEL ANALYSIS

MOLOKAI INTEGRATED
WASTE FACILITY
GROUNDWATER AND LEACHATE MONITORING PLAN

APPENDIX A
HELP MODEL ANALYSIS

Prepared for

County of Maui
Department of Environmental Management
Solid Waste Division
2200 Main Street, Suite 225
Wailuku, Hawaii 96793

Prepared by

A-Mehr, Inc.
23016 Mill Creek Drive
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March 2008

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APPENDIX A
HELP MODEL ANALYSIS
MOLOKAI INTEGRATED WASTE MANAGEMENT FACILITY
GROUNDWATER AND LEACHATE MONITORING PLAN

1. INTRODUCTION

A long-term simulation of leachate generation and potential migration from the Molokai Landfill to groundwater was conducted using the USEPA HELP (Hydrologic Evaluation of Landfill Performance) computer model. The existing permitted landfill footprint was divided into five separate subareas defined by type of containment system and final grades. The simulation was based on a landfill configuration believed to represent the most extreme case for leachate production.

2. MODEL INPUTS

2.1 Area Definitions and Characteristics

The landfill configuration assumed for the modeling consists of Phases 1, 2 and 3 at interim final grades, and Phase 4 (the final permitted area to be constructed in the future), with a minimal waste layer of five feet. This is believed to represent a reasonable "worst case" in terms of leachate production.

Among the important inputs to the HELP model are the design of containment system, which largely determines the proportion of leachate which is collected and which migrates from the landfill, and the grading of the top layer (final or interim cover), which influences the fraction of incident precipitation that runs off. In order to provide a reasonable accounting for these factors, the overall site was divided into five areas, defined as follows and shown on Figure 1:

Area	Size (acres)	Upper Layer Type and Slope	Containment System
Phase 1	4.2	Slope – 25%	Geomembrane
Phase 2A	1.4	Deck – 3%	Soil Liner
Phase 2B	2.0	Slope – 25%	Soil Liner
Phase 3	2.0	Slope – 25%	Composite - Geomembrane
Phase 4	2.4	Deck – 3%	Composite - Geomembrane

2.2 Layer Properties

The HELP Model is based on computing water balances and transport through a series of layers defined to represent a vertical cross-section through the area being modeled. Each area was modeled as a series of layers based on its known or design configuration, as discussed below. The detailed properties assigned to each layer are presented in Table 1.

2.2.1 Phase 1

Phase 1 was modeled as a sloped area with a geomembrane liner. Because the Phase 2 subgrade is graded to drain to the Phase 1 lined area, the model was configured to assume lateral flow into Cell 1 from Phase 2. The layers assumed for Phase 2 were as follows, from top to bottom:

- Layer 1 – Intermediate cover consisting of one foot of silty loam soil
- Layer 2 – Municipal solid waste, 50 feet thick
- Layer 3 – Operations layer consisting of one foot of loamy sand soil
- Layer 4 – Lateral drainage layer (leachate collection) consisting of one foot of gravel
- Layer 5 – Geomembrane liner
- Layer 6 – Soil liner consisting of 2 feet of silty loam soil

2.2.2 Phase 2A (Deck) and 2B (Slope)

The southerly portion of Phase 2 is primarily top deck area, with a minimum slope of 3%. It was modeled with layers and properties summarized as follows:

- Layer 1 – Intermediate cover consisting of one foot of silty loam soil
- Layer 2 – Municipal solid waste, 55 feet thick 2A) or 40 feet thick (2B)
- Layer 3 – Lateral drainage layer, consisting of 0.5 feet of loamy sand with a hydraulic conductivity of 1.7×10^{-3} cm/sec. Phase 2 was not constructed with a geomembrane liner. The compacted native soil liner (subgrade) is assumed to have a hydraulic conductivity ranging from 1×10^{-4} to 5×10^{-4} cm/sec based on available information. In order to simulate the potential drainage of leachate into Phase 1, the upper 0.5 foot of the compacted soil subgrade was arbitrarily assigned a hydraulic conductivity of 1.7×10^{-3} cm/sec, and the lower 2 feet assigned a hydraulic conductivity of 1.9×10^{-4} cm/sec.
- Layer 4 – Soil liner consisting of 2 feet of silty loam soil with a hydraulic conductivity of 1.9×10^{-4} cm/sec.

2.2.3 Phase 3

The composite-lined Phase 3 cell was modeled as follows:

- Layer 1 – Intermediate cover consisting of one foot of silty loam soil
- Layer 2 – Municipal solid waste, 45 feet thick
- Layer 3 – Operations layer consisting of two feet of loamy sand soil
- Layer 4 – Lateral drainage layer (leachate collection) consisting of one foot of gravel

- Layer 5 – Geomembrane liner
- Layer 6 – Soil liner consisting of one foot of soil with a hydraulic conductivity of 1.0×10^{-6} cm/sec

2.2.4 Phase 4

Phase 4 was modeled with daily cover soil and 5 feet of waste, with layers defined as follows:

- Layer 1 – Intermediate cover consisting of 0.5 foot of silty loam soil
- Layer 2 – Municipal solid waste, 5 feet thick
- Layer 3 – Operations layer consisting of two feet of loamy sand soil
- Layer 4 – Lateral drainage layer (leachate collection) consisting of one foot of gravel
- Layer 5 – Geomembrane liner
- Layer 6 – Soil liner consisting of one foot of soil with a hydraulic conductivity of 1.0×10^{-6} cm/sec

2.3 Climate Data

Climate data for the analysis was based on built-in HELP model default data for Honolulu, with the following site-specific adjustments:

- Precipitation was based on the mean value of monthly averages for National Weather Service sites at Molokai Airport (annual total rainfall 26 inches) and Kaunakakai (14.1 inches per year). The resulting values are believed conservatively high, based on the nearer proximity of the site to Kaunakakai.
- Temperature was based on monthly averages from Molokai Airport (no data is available for Kaunakakai)

Table 2 presents the monthly averages input to the analysis. The built-in HELP model software generates a synthetic record using the monthly averages for temperature and precipitation.

3. RESULTS

Table 3 lists the key outputs of the HELP Model analysis. The most critical results, leachate volume generated or collected, and infiltration through the bottom layer of each area, are summarized and discussed in the following sections.

3.1 Leachate Quantity

The model output for the annual average volumes of leachate in each area is given in the table below. Values listed for Phases 1, 3 and 4 are the leachate collected in the lateral drainage layer; values for Phase 2 are the sum of lateral drainage and infiltration through the bottom layer.

HELP Model Predicted Leachate Generation

Area	Annual Average Total		Peak Day	
	Inches	Cubic feet	Inches	Cubic Feet
Phase 1	0.708	10,801	0.168	2,562
Phase 2A	0.734	3,728	0.189	959
Phase 2B	0.726	5,273	0.185	1,346
Phase 3	0.721	5,238	0.157	1,144
Phase 4	0.950	827	0.00088	7.6

Based on these results, the average annual total leachate expected to be collected from the Phase 1 wet well would be approximately 80,000 gallons per year, a value likely to be unrealistically high. Although approximately 60,000 gallons was drained from Phase 1 from September 2007 through March 2008, it is believed a substantial portion of this volume was generated and held in storage within the landfill for an undetermined period of years when monitoring of the leachate collection system was not performed. The HELP model is generally recognized as producing conservatively high estimates of leachate production, and that is most likely the case with the results of the present analysis.

A stronger indication of over-prediction of leachate production by the model is evident from a comparison of the Phase 2 projection with monitoring results from the Phase 2 test lysimeter. The average annual generation of 0.73 inches per year for the Phase 2A and 2B areas is equivalent to 350 gallons per year in the 800 square-feet area of the Phase 2 floor covered by the lysimeter. However, available records indicate that over the 10-year life of the Phase 2 area, only 10 gallons of liquid has been withdrawn from the Phase 2 standpipe to which the test lysimeter area drains.

3.2 Infiltration of Leachate

As expected, the geomembrane-lined areas of Phases 1, 3 and 4 are projected by the HELP model to experience low levels of leakage or infiltration from the liner system. On the other hand, nearly all the leachate in Phase 2 is predicted to infiltrate through the bottom soil liner. Although the upper layer of the soil liner was modeled as a lateral drainage layer with a higher permeability than the lower layer, only a negligible fraction of the generated leachate was projected by the model to be drained into the Phase 1 lined area where it could be collected. As a result, virtually all the generated leachate in Phase 2 is projected to infiltrate through the landfill bottom. The resulting values for infiltration from each area are given in the following table.

HELP Model Predicted Leachate Infiltration from Bottom of Landfill

Area	Annual Average Total		Peak Day	
	Inches	Cubic feet	Inches	Cubic Feet
Phase 1	6×10^{-5}	0.839	1.2×10^{-5}	0.190
Phase 2A	0.734	3,728	0.189	959
Phase 2B	0.726	5,273	0.185	1,346
Phase 3	5×10^{-5}	0.354	1.0×10^{-5}	0.074
Phase 4	$< 1 \times 10^{-5}$	0.038	$< 1.0 \times 10^{-5}$	2.5×10^{-4}

4. DISCUSSION

4.1 Leachate Quantity

The HELP Model results presented above indicate that significant leachate is generated in all phases of Molokai Landfill. The presence of significant collected leachate from the lined area of Phase 1 supports this finding, but does not confirm the volume due to the following circumstances:

- The leachate collected from Phase 1 during the period September 2007-March 2008, representing the only significant volumes collected since the landfill opened in 1995, may have been generated and stored in the landfill over a period of years; and
- Although the modeling effort presented herein indicates negligible lateral flow of drainage from Phase 1 into Phase 2, such flow cannot be ruled out; thus the leachate being collected from Phase 1 may include leachate generated in Phase 2. This possibility is supported in part by the relative absence of leachate in the Phase 2 test lysimeter (10 gallons since 1997 compared with a HELP model projected 350 gallons per year)

Based on our experience, A-Mehr, Inc. believes the leachate volumes projected by the HELP model are conservatively high. Improved monitoring of leachate volumes and quality in Phase 1 and the future Phase 3 sump will enable a refinement of the projected quantities.

4.2 Leachate Infiltration

The model results indicate that potential infiltration from the Phase 2 area, which has no geomembrane liner, would exceed the total from Phases 1, 3 and 4 by a factor of approximately 8,000. The predicted volume of infiltration, however, would be proportionately reduced if future measurements of actual leachate volumes result in downward adjustments of the HELP model estimates of leachate generation.

TABLE 1
LAYER DEFINITIONS AND PROPERTIES

Phase and Inputs		Phase 1	Phase 2A - Deck	Phase 2B - Slope	Phase 3	Phase 4
	Area (acres)	4.2	1.4	2.0	2.0	2.4
Layer 1	Type	Vertical Percolation. Layer	Vertical Percolation. Layer	Vertical Percolation. Layer	Vertical Percolation. Layer	Vertical Percolation. Layer
	Material Name	Silty Loam #99 (custom material)	Silty Loam #99 (custom material)	Silty Loam #99 (custom material)	Silty Loam #99 (custom material)	Silty Loam #99 (custom material)
	Thickness (ft)	1	1	1	1	0.5
	Top slope length	260	100	165	220	165
	Bottom slope length	0	0	0	0	0
	Top slope grade	25%	3%	25%	25%	3%
	Bottom slope grade	0	0	0	0	0
	Porosity	0.501	0.501	0.501	0.501	0.501
	Field capacity	0.284	0.284	0.284	0.284	0.284
	Wilting point	0.135	0.135	0.135	0.135	0.135
	Sat. hyd. Conductivity	0.001	0.001	0.001	0.001	0.001
	Subsurface inflow	0	0	0	0	0
Layer 2	Type	Vertical Percolation. Layer	Vertical Percolation. Layer	Vertical Percolation. Layer	Vertical Percolation. Layer	Vertical Percolation. Layer
	Material	Waste (#18)	Waste (#18)	Waste (#18)	Waste (#18)	Waste (#18)
	Thickness (ft)	50	55	40	45	5
	Top slope length	0	0	0	0	0
	Bottom slope length	0	0	0	0	0
	Top slope grade	0	0	0	0	0
	Bottom slope grade	0	0	0	0	0
	Porosity	Default	Default	Default	Default	Default
	Field capacity	Default	Default	Default	Default	Default
	Wilting point	Default	Default	Default	Default	Default
	Sat. hyd. Conductivity	Default	Default	Default	Default	Default
	Subsurface inflow	0	0	0	0	0

Phase and Inputs		Phase 1	Phase 2A - Deck	Phase 2B - Slope	Phase 3	Phase 4
Layer 3	Type	Vertical Percolation. Layer (Operations Layer)	Lateral Drainage	Lateral Drainage	Vertical Percolation. Layer (Operations Layer)	Vertical Percolation Layer (Operations Layer)
	Material	Loamy Sand (HELP Texture #4)	Loamy Sand #53 (custom material)	Loamy Sand #53 (custom material)	Loamy Sand (HELP Texture #4)	Loamy Sand (HELP Texture #4)
	Thickness (ft)	1	0.5	0.5	2	2
	Top slope length	0	0	0	0	0
	Bottom slope length	0	150	200	0	0
	Top slope grade	0	5%	5%	0	0
	Bottom slope grade	0	0	0	0	0
	Porosity	0.437	0.437	0.437	0.437	0.437
	Field capacity	0.105	0.105	0.105	0.105	0.105
	Wilting point	0.047	0.047	0.047	0.047	0.047
	Sat. hyd. Conductivity	0.0017	0.0017	0.0017	0.0017	0.0017
	Subsurface inflow (mm/yr)	0.00056 (in-flow from Layer 3 of Phase 2A)	0.000437 (in-flow from Layer 3 of Phase 2B)	0	0	0
Layer 4	Type	Lateral Drainage	Barrier Soil	Barrier Soil	Lateral Drainage	Lateral Drainage
	Material	Gravel #50 (custom material)	Silty Loam Barrier Soil #51 (custom material)	Silty Loam Barrier Soil #51 (custom material)	Gravel #50 (custom material)	Gravel #50 (custom material)
	Thickness (ft)	1	2	2	1	1
	Top slope length	0	0	0	0	0
	Bottom slope length	260	360	200	450	175
	Top slope grade	0	0	0	0	0
	Bottom slope grade	5%	5%	5%	5%	5%
	Porosity	0.397	0.501	0.501	0.397	0.397
	Field capacity	0.032	0.284	0.284	0.032	0.032
	Wilting point	0.013	0.135	0.135	0.013	0.013
	Sat. hyd. Conductivity	1	1.90E-04	1.90E-04	1	1
	Subsurface inflow	Drainage from 2A & 2B	Drainage from 2A	0	0	0

Phase and Inputs		Phase 1	Phase 2A - Deck	Phase 2B - Slope	Phase 3	Phase 4
Layer 5	Type	FML	--	--	FML	FML
	Material	HDPE	--	--	HDPE	HDPE
	Thickness (ft)	60 mil	--	--	80 mil	80 mil
	Top slope length	350	--	--	450	175
	Bottom slope length	350	--	--	450	175
	Top slope grade	5%	--	--	5%	4%
	Bottom slope grade	5%	--	--	5%	4%
	Sat. hyd. Conductivity	2.0E-13	--	--	2.0E-13	2.0E-13
	Pinhole density (#/hectare)	2	--	--	1	1
	Placement quality	2	--	--	2	2
	Geotextile transmissivity	0	--	--	0	0
Layer 6	Type	Barrier Soil	--	--	Barrier Soil	Barrier Soil
	Material	Silty Loam Barrier Soil #51 (custom material)	--	--	Barrier Soil #16	Barrier Soil #16
	Thickness (ft)	2	--	--	1	1
	Top slope length	0	--	--	0	0
	Bottom slope length	360	--	--	360	360
	Top slope grade	0	--	--	0	0
	Bottom slope grade	5%	--	--	5%	5%
	Porosity	0.501	--	--	0.427	0.427
	Field capacity	0.284	--	--	0.418	0.418
	Wilting point	0.135	--	--	0.367	0.367
	Sat. hyd. Conductivity	1.90E-04	--	--	1.00E-06	1.00E-06
	Subsurface inflow	0	--	--	0	0

TABLE 2
HELP MODEL CLIMATE INPUTS

	Precipitation Data			Temperature Data
	Kaunakakai 536	Molokai Airport 524	Average	Molokai Airport 524
Month	Average Total Precipitation (inches)	Average Total Precipitation (inches)	Average Total Precipitation (inches)	Monthly Mean Temperature (°F)
Jan	3.33	4.61	3.97	70.5
Feb	1.66	3.09	2.38	70.2
Mar	2.04	3.06	2.55	71.5
Apr	0.57	2.09	1.33	72.9
May	0.59	1.39	0.99	74.5
Jun	0.14	0.54	0.34	76.5
Jul	0.08	0.66	0.37	77.5
Aug	0.10	0.66	0.38	78.3
Sep	0.16	0.72	0.44	78.2
Oct	0.75	1.97	1.36	77.1
Nov	1.84	3.20	2.52	74.8
Dec	2.82	4.00	3.41	72.2
Total	14.08	25.99	20.04	74.5

data source: Western Regional Climate Center, wrcc@dri.edu

TABLE 3
HELP MODEL SUMMARY OF RESULTS
ANNUAL AVERAGE VALUES

Area	Units	Phase 1	Phase 2A - Deck	Phase 2A - Slope	Phase 3	Phase 4
Precipitation	inch	19.21	19.21	19.21	19.2	18.72[1]
Runoff	inch	0.069	0.067	0.079	0.072	0.007
Evapotranspiration	inch	18.51	18.49	18.48	18.49	18.67
Total Leachate	inch	0.708			0.722	0.095
	cubic feet	10,802			5,238	827
Leachate Collected in Drainage Layer	inch	0.708			0.722	0.095
	cubic feet	10,801			5,238	827
Infiltration from Bottom Layer	inch	6×10^{-5}			5×10^{-5}	$<1 \times 10^{-5}$
	cubic feet	0.839			0.354	0.038

Note: 1 - Phase 4 was modeled for a 5-year period to simulate a shorter period for a cell with minimum waste, resulting is different average precipitation relative to longer term (30-year) period used for Phases 1-3.

ATTACHMENT 1

HELP MODEL COMPUTER 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:\WHI\VHELP22\data\P8785.VHP_weather1.dat
TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather2.dat
SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather3.dat
EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P8785.VHP_weather4.dat
SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\I_395215.inp
OUTPUT DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\O_395215.prt

TIME: 21:50 DATE: 3/22/2008

****

TITLE: Phase 1 - 30yr V3

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
WERE SPECIFIED BY THE USER. INITIAL MOISTURE CONTENT FOR LAYERS 1 THRU 4 TAKEN FROM OUTPUT OF PHASE 1 – 5 YR MODEL RUN.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 99
THICKNESS = 30.48 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2466 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18
THICKNESS = 1524.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2907 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000224000E-02 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4
THICKNESS = 30.48 CM
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.1050 VOL/VOL
WILTING POINT = 0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1107 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.170000000000E-02 CM/SEC
SUBSURFACE INFLOW = 0.0 MM/YR (value of 0.00056 mm/yr was input for this layer. Program output truncating the value)

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 50
THICKNESS = 30.48 CM
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. = 1.00000000000 CM/SEC
SLOPE = 5.00 PERCENT
DRAINAGE LENGTH = 79.2 METERS

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 83
THICKNESS = 0.15 CM
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. = 0.200000000000E-12 CM/SEC
FML PINHOLE DENSITY = 2.00 HOLES/HECTARE
FML INSTALLATION DEFECTS = 2.00 HOLES/HECTARE
FML PLACEMENT QUALITY = 2 - EXCELLENT

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 51
THICKNESS = 60.96 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.5010 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 75.0, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 79. METERS.

SCS RUNOFF CURVE NUMBER = 77.27
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 1.6997 HECTARES
EVAPORATIVE ZONE DEPTH = 55.9 CM
INITIAL WATER IN EVAPORATIVE ZONE = 14.900 CM
UPPER LIMIT OF EVAPORATIVE STORAGE = 32.314 CM
LOWER LIMIT OF EVAPORATIVE STORAGE = 6.071 CM
INITIAL SNOW WATER = 0.000 CM
INITIAL WATER IN LAYER MATERIALS = 485.434 CM
TOTAL INITIAL WATER = 485.434 CM
TOTAL SUBSURFACE INFLOW = 0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Honolulu HI

STATION LATITUDE = 21.09 DEGREES
MAXIMUM LEAF AREA INDEX = 5.00
START OF GROWING SEASON (JULIAN DATE) = 0
END OF GROWING SEASON (JULIAN DATE) = 366
EVAPORATIVE ZONE DEPTH = 22.0 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 WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.97	2.38	2.55	1.33	0.99	0.34
0.37	0.38	0.44	1.36	2.52	3.41

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
70.50	70.20	71.50	72.90	74.50	76.50
77.50	78.30	78.20	77.10	74.80	72.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI
AND STATION LATITUDE = 20.77 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.62	1.97	2.31	1.15	1.08	0.39
	0.41	0.29	0.48	1.40	2.67	3.43
STD. DEVIATIONS	1.89	1.38	1.00	0.66	0.74	0.29
	0.20	0.19	0.23	0.65	1.22	1.81
RUNOFF						
TOTALS	0.052	0.000	0.004	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.001	0.012
STD. DEVIATIONS	0.134	0.000	0.017	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.004	0.033
EVAPOTRANSPIRATION						
TOTALS	1.898	4.046	2.542	1.370	1.050	0.476
	0.418	0.293	0.485	1.324	2.368	2.239
STD. DEVIATIONS	0.389	1.076	1.260	0.818	0.645	0.311
	0.184	0.190	0.227	0.626	0.963	0.821
SUBSURFACE INFLOW INTO LAYER 3						
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
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0198	0.3316	0.2022	0.0411	0.0264	0.0190
	0.0159	0.0134	0.0113	0.0103	0.0090	0.0086
STD. DEVIATIONS	0.0530	0.5944	0.4621	0.0547	0.0293	0.0188
	0.0143	0.0112	0.0088	0.0076	0.0062	0.0057
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)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 5						
AVERAGES	0.0006	0.0108	0.0060	0.0013	0.0008	0.0006
	0.0005	0.0004	0.0003	0.0003	0.0003	0.0003
STD. DEVIATIONS	0.0016	0.0195	0.0137	0.0017	0.0009	0.0006
	0.0004	0.0003	0.0003	0.0002	0.0002	0.0002

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	19.21	(3.202)	292838.8	100.00
RUNOFF	0.069	(0.1358)	1051.30	0.359
EVAPOTRANSPIRATION	18.508	(2.8813)	282161.41	96.354
SUBSURFACE INFLOW INTO LAYER 3	0.00002		0.360	0.00012
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.70845	(1.13978)	10800.783	3.68830
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00006	(0.00008)	0.839	0.00029
AVERAGE HEAD ON TOP OF LAYER 5	0.002	(0.003)		
CHANGE IN WATER STORAGE	-0.077	(1.4604)	-1175.17	-0.401

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	3.47	52902.46692	130015
RUNOFF	0.564	8605.46775	130015
DRAINAGE COLLECTED FROM LAYER 4	0.16804	2561.89921	730020
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000012	0.19038	730020
AVERAGE HEAD ON TOP OF LAYER 5	0.155		
MAXIMUM HEAD ON TOP OF LAYER 5	0.306		
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	2.0 FEET		
SNOW WATER	0.00	0.0000	0
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3668		
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1086		

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

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

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.9964	0.1664
2	173.0938	0.2885
3	1.3048	0.1087
4	0.3840	0.0320
5	0.0000	0.0000
6	12.0240	0.5010

SNOW WATER 0.000

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


PRECIPITATION DATA FILE:   C:\WHI\VHELP22\data\P8785.VHP\_weather1.dat
TEMPERATURE DATA FILE:     C:\WHI\VHELP22\data\P8785.VHP\_weather2.dat
SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\_weather3.dat
EVAPOTRANSPIRATION DATA:   C:\WHI\VHELP22\data\P8785.VHP\_weather4.dat
SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\I_395196.inp
OUTPUT DATA FILE:          C:\WHI\VHELP22\data\P8785.VHP\O_395196.prt


TIME: 18:26    DATE:  3/22/2008


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

   TITLE: Phase 2A Deck    V3

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


                LAYER 1
                --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
            MATERIAL TEXTURE NUMBER 99
   THICKNESS                =   30.48  CM
   POROSITY                 =   0.5010 VOL/VOL
   FIELD CAPACITY           =   0.2840 VOL/VOL
   WILTING POINT            =   0.1350 VOL/VOL
   INITIAL SOIL WATER CONTENT =   0.2725 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.100000000000E-02 CM/SEC


                LAYER 2
                --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
            MATERIAL TEXTURE NUMBER 18
   THICKNESS                =  1676.40  CM
   POROSITY                 =   0.6710 VOL/VOL
   FIELD CAPACITY           =   0.2920 VOL/VOL
   WILTING POINT            =   0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT =   0.2906 VOL/VOL
   EFFECTIVE SAT. HYD. COND.  = 0.100000224000E-02 CM/SEC
```

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 53
THICKNESS = 15.24 CM
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.1050 VOL/VOL
WILTING POINT = 0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1050 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.170000000000E-02 CM/SEC
SLOPE = 5.00 PERCENT
DRAINAGE LENGTH = 45.7 METERS

This model run (Phase 2A Deck) was run with subsurface flow from Phase 2B Slope Layer 3 at a rate of 0.000437 mm/yr.

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 51
THICKNESS = 60.96 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.5010 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 75.0, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 30. METERS.

SCS RUNOFF CURVE NUMBER = 77.12
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 0.5666 HECTARES
EVAPORATIVE ZONE DEPTH = 55.9 CM
INITIAL WATER IN EVAPORATIVE ZONE = 13.311 CM
UPPER LIMIT OF EVAPORATIVE STORAGE = 32.314 CM
LOWER LIMIT OF EVAPORATIVE STORAGE = 6.071 CM
INITIAL SNOW WATER = 0.000 CM
INITIAL WATER IN LAYER MATERIALS = 527.544 CM
TOTAL INITIAL WATER = 527.544 CM
TOTAL SUBSURFACE INFLOW = 0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Honolulu HI

STATION LATITUDE = 21.09 DEGREES
MAXIMUM LEAF AREA INDEX = 5.00
START OF GROWING SEASON (JULIAN DATE) = 0
END OF GROWING SEASON (JULIAN DATE) = 366
EVAPORATIVE ZONE DEPTH = 22.0 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 WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.97	2.38	2.55	1.33	0.99	0.34
0.37	0.38	0.44	1.36	2.52	3.41

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
70.50	70.20	71.50	72.90	74.50	76.50
77.50	78.30	78.20	77.10	74.80	72.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Honolulu HI
AND STATION LATITUDE = 20.77 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.62	1.97	2.31	1.15	1.08	0.39
	0.41	0.29	0.48	1.40	2.67	3.43
STD. DEVIATIONS	1.89	1.38	1.00	0.66	0.74	0.29
	0.20	0.19	0.23	0.65	1.22	1.81
RUNOFF						
TOTALS	0.051	0.000	0.004	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.001	0.012
STD. DEVIATIONS	0.132	0.000	0.017	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.003	0.032
EVAPOTRANSPIRATION						
TOTALS	1.899	4.029	2.539	1.370	1.050	0.476
	0.418	0.293	0.485	1.324	2.368	2.239
STD. DEVIATIONS	0.390	1.094	1.257	0.818	0.645	0.311
	0.184	0.190	0.227	0.626	0.965	0.821
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.2270	0.4203	0.0852	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0004	0.0004
STD. DEVIATIONS	0.3708	0.7688	0.2751	0.0005	0.0002	0.0001
	0.0001	0.0000	0.0000	0.0001	0.0010	0.0013

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0025	0.0054	0.0010	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0041	0.0096	0.0033	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	19.21	(3.202)	97612.9	100.00
RUNOFF	0.067	(0.1332)	339.72	0.348
EVAPOTRANSPIRATION	18.489	(2.8956)	93956.55	96.254
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00002	(0.00004)	0.112	0.00011

Lateral Drainage from Layer 3 of this model run (Phase 2B Deck) is used as subsurface inflow into Layer 3 of Phase 1 model runs.

Value of 0.00056 mm/year input into Layer 3 for Phase 1 model runs.

	INCHES		CU. FEET	PERCENT
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.73363	(1.17842)	3728.234	3.81941
AVERAGE HEAD ON TOP OF LAYER 4	0.001	(0.001)		
CHANGE IN WATER STORAGE	-0.081	(1.5402)	-411.69	-0.422

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	3.47	17634.15564	130015
RUNOFF	0.556	2825.71802	130015
DRAINAGE COLLECTED FROM LAYER 3	0.00001	0.04433	350023
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.188713	959.01908	710020
AVERAGE HEAD ON TOP OF LAYER 4	0.059		
MAXIMUM HEAD ON TOP OF LAYER 4	0.005		
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET		
SNOW WATER	0.00	0.0000	0
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3669		
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1086		

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

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

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.9964	0.1664
2	190.6138	0.2888
3	0.6300	0.1050
4	12.0240	0.5010
SNOW WATER	0.000	

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

PRECIPITATION DATA FILE:   C:\WHI\VHELP22\data\P8785.VHP\_weather1.dat
TEMPERATURE DATA FILE:     C:\WHI\VHELP22\data\P8785.VHP\_weather2.dat
SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\_weather3.dat
EVAPOTRANSPIRATION DATA:   C:\WHI\VHELP22\data\P8785.VHP\_weather4.dat
SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\I_393373.inp
OUTPUT DATA FILE:          C:\WHI\VHELP22\data\P8785.VHP\O_393373.prt

TIME: 16:14    DATE:  3/22/2008

******************************************************************************
   TITLE: Phase 2B Slope    30 years V3
******************************************************************************

   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  99
      THICKNESS                =   30.48   CM
      POROSITY                 =   0.5010 VOL/VOL
      FIELD CAPACITY           =   0.2840 VOL/VOL
      WILTING POINT            =   0.1350 VOL/VOL
      INITIAL SOIL WATER CONTENT =   0.2725 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  = 0.100000000000E-02 CM/SEC

                         LAYER  2
                         --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  18
      THICKNESS                =  1219.20   CM
      POROSITY                 =   0.6710 VOL/VOL
      FIELD CAPACITY           =   0.2920 VOL/VOL
      WILTING POINT            =   0.0770 VOL/VOL
      INITIAL SOIL WATER CONTENT =   0.2900 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  = 0.100000224000E-02 CM/SEC

                         LAYER  3
                         --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER  53
      THICKNESS                =   15.24   CM
      POROSITY                 =   0.4370 VOL/VOL
      FIELD CAPACITY           =   0.1050 VOL/VOL
      WILTING POINT            =   0.0470 VOL/VOL
      INITIAL SOIL WATER CONTENT =   0.1050 VOL/VOL
      EFFECTIVE SAT. HYD. COND.  = 0.170000000000E-02 CM/SEC
      SLOPE                    =    5.00  PERCENT
      DRAINAGE LENGTH          =   61.0    METERS
```

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 51
THICKNESS = 60.96 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.5010 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 75.0, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 50. METERS.

SCS RUNOFF CURVE NUMBER = 77.89
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 0.8094 HECTARES
EVAPORATIVE ZONE DEPTH = 55.9 CM
INITIAL WATER IN EVAPORATIVE ZONE = 13.311 CM
UPPER LIMIT OF EVAPORATIVE STORAGE = 32.314 CM
LOWER LIMIT OF EVAPORATIVE STORAGE = 6.071 CM
INITIAL SNOW WATER = 0.000 CM
INITIAL WATER IN LAYER MATERIALS = 394.042 CM
TOTAL INITIAL WATER = 394.042 CM
TOTAL SUBSURFACE INFLOW = 0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Honolulu HI

STATION LATITUDE = 21.09 DEGREES
MAXIMUM LEAF AREA INDEX = 5.00
START OF GROWING SEASON (JULIAN DATE) = 0
END OF GROWING SEASON (JULIAN DATE) = 366
EVAPORATIVE ZONE DEPTH = 22.0 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 WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.97	2.38	2.55	1.33	0.99	0.34
0.37	0.38	0.44	1.36	2.52	3.41

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
70.50	70.20	71.50	72.90	74.50	76.50
77.50	78.30	78.20	77.10	74.80	72.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Honolulu HI
AND STATION LATITUDE = 20.77 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.62	1.97	2.31	1.15	1.08	0.39
	0.41	0.29	0.48	1.40	2.67	3.43
STD. DEVIATIONS	1.89	1.38	1.00	0.66	0.74	0.29
	0.20	0.19	0.23	0.65	1.22	1.81
RUNOFF						
TOTALS	0.058	0.000	0.005	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.002	0.015
STD. DEVIATIONS	0.145	0.000	0.020	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.005	0.037
EVAPOTRANSPIRATION						
TOTALS	1.899	4.025	2.539	1.369	1.050	0.476
	0.418	0.293	0.485	1.324	2.368	2.238
STD. DEVIATIONS	0.390	1.092	1.259	0.817	0.645	0.311
	0.184	0.190	0.227	0.626	0.964	0.821
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.2299	0.4290	0.0664	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0003	0.0004
STD. DEVIATIONS	0.3756	0.7897	0.2431	0.0005	0.0002	0.0001
	0.0001	0.0000	0.0000	0.0001	0.0009	0.0016

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0027	0.0056	0.0008	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0042	0.0102	0.0030	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	19.21	(3.202)	139447.0	100.00
RUNOFF	0.079	(0.1474)	571.31	0.410
EVAPOTRANSPIRATION	18.484	(2.8945)	134190.65	96.231
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00002	(0.00003)	0.125	0.00009

Lateral Drainage from Layer 3 of this model run (Phase 2B Slope) is used as subsurface inflow into Layer 3 of Phase 2A Deck model runs.

Value of 0.000437 mm/year input into Layer 3 for Phase 2A Deck model runs.

PERCOLATION/LEAKAGE THROUGH LAYER 4	0.72634	(1.16219)	5273.085	3.78142
AVERAGE HEAD ON TOP OF LAYER 4	0.001	(0.001)		
CHANGE IN WATER STORAGE	-0.081	(1.5359)	-588.13	-0.422

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	3.47	25191.65091	130015
RUNOFF	0.601	4365.51708	130015
DRAINAGE COLLECTED FROM LAYER 3	0.00001	0.05215	380002
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.185478	1346.54312	580026
AVERAGE HEAD ON TOP OF LAYER 4	0.062		
MAXIMUM HEAD ON TOP OF LAYER 4	0.006		
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET		
SNOW WATER	0.00	0.0000	0
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3649		
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1086		

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

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

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.9964	0.1664
2	138.0538	0.2876
3	0.6300	0.1050
4	12.0240	0.5010

SNOW WATER 0.000

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**              HELP MODEL VERSION 3.07 (1 November 1997)                   **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**              USAE WATERWAYS EXPERIMENT STATION                           **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather1.dat
TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather2.dat
SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather3.dat
EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P8785.VHP_weather4.dat
SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\I_395234.inp
OUTPUT DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\O_395234.prt

TIME: 22: 5 DATE: 3/22/2008

****

TITLE: re-do Phase 3 - 30yr V3

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 99
THICKNESS = 30.48 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2725 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18
THICKNESS = 1371.60 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2902 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000224000E-02 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4
THICKNESS = 60.96 CM
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.1050 VOL/VOL
WILTING POINT = 0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1077 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.170000000000E-02 CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 50
THICKNESS = 30.48 CM
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. = 1.00000000000 CM/SEC
SLOPE = 5.00 PERCENT
DRAINAGE LENGTH = 137.2 METERS

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 83
THICKNESS = 0.15 CM
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. = 0.200000000000E-12 CM/SEC
FML PINHOLE DENSITY = 1.00 HOLES/HECTARE
FML INSTALLATION DEFECTS = 1.00 HOLES/HECTARE
FML PLACEMENT QUALITY = 2 - EXCELLENT

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 51
THICKNESS = 60.96 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.5010 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 75.0, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 67. METERS.

SCS RUNOFF CURVE NUMBER = 77.50
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 0.8094 HECTARES
EVAPORATIVE ZONE DEPTH = 55.9 CM
INITIAL WATER IN EVAPORATIVE ZONE = 13.311 CM
UPPER LIMIT OF EVAPORATIVE STORAGE = 32.314 CM
LOWER LIMIT OF EVAPORATIVE STORAGE = 6.071 CM
INITIAL SNOW WATER = 0.000 CM
INITIAL WATER IN LAYER MATERIALS = 444.481 CM
TOTAL INITIAL WATER = 444.481 CM
TOTAL SUBSURFACE INFLOW = 0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Honolulu HI

STATION LATITUDE = 21.09 DEGREES
MAXIMUM LEAF AREA INDEX = 5.00
START OF GROWING SEASON (JULIAN DATE) = 0
END OF GROWING SEASON (JULIAN DATE) = 366
EVAPORATIVE ZONE DEPTH = 22.0 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 WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.97	2.38	2.55	1.33	0.99	0.34
0.37	0.38	0.44	1.36	2.52	3.41

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
70.50	70.20	71.50	72.90	74.50	76.50
77.50	78.30	78.20	77.10	74.80	72.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI
AND STATION LATITUDE = 20.77 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.62	1.97	2.31	1.15	1.08	0.39
	0.41	0.29	0.48	1.40	2.67	3.43
STD. DEVIATIONS	1.89	1.38	1.00	0.66	0.74	0.29
	0.20	0.19	0.23	0.65	1.22	1.81
RUNOFF						
TOTALS	0.054	0.000	0.004	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.001	0.013
STD. DEVIATIONS	0.138	0.000	0.019	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.004	0.034
EVAPOTRANSPIRATION						
TOTALS	1.899	4.030	2.541	1.369	1.050	0.476
	0.418	0.293	0.485	1.324	2.368	2.238
STD. DEVIATIONS	0.390	1.096	1.259	0.818	0.645	0.311
	0.184	0.190	0.227	0.626	0.963	0.821
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0166	0.1068	0.2868	0.0809	0.0530	0.0385
	0.0322	0.0272	0.0229	0.0211	0.0184	0.0173
STD. DEVIATIONS	0.0124	0.2467	0.6032	0.1187	0.0648	0.0423
	0.0326	0.0256	0.0202	0.0175	0.0145	0.0129
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	0.0008	0.0061	0.0147	0.0043	0.0027	0.0020
	0.0017	0.0014	0.0012	0.0011	0.0010	0.0009
STD. DEVIATIONS	0.0006	0.0140	0.0310	0.0063	0.0033	0.0022
	0.0017	0.0013	0.0011	0.0009	0.0008	0.0007

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	19.21	(3.202)	139447.0	100.00
RUNOFF	0.072	(0.1401)	526.07	0.377
EVAPOTRANSPIRATION	18.489	(2.8950)	134230.82	96.259
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.72150	(1.08773)	5238.009	3.75627
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00005	(0.00007)	0.354	0.00025
AVERAGE HEAD ON TOP OF LAYER 5	0.003	(0.005)		
CHANGE IN WATER STORAGE	-0.076	(1.4574)	-548.20	-0.393

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	3.47	25191.65091	130015
RUNOFF	0.578	4195.78948	130015
DRAINAGE COLLECTED FROM LAYER 4	0.15753	1143.66026	670015
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000010	0.07369	670015
AVERAGE HEAD ON TOP OF LAYER 5	0.251		
MAXIMUM HEAD ON TOP OF LAYER 5	0.497		
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	3.3 FEET		
SNOW WATER	0.00	0.0000	0
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3666		
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1086		

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

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

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	1.9964	0.1664
2	155.5738	0.2881
3	2.7489	0.1145
4	0.3841	0.0320
5	0.0000	0.0000
6	12.0240	0.5010

SNOW WATER 0.000

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**                                                                          **
**                                                                          **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**            HELP MODEL VERSION 3.07 (1 November 1997)                     **
**             DEVELOPED BY ENVIRONMENTAL LABORATORY                        **
**              USAE WATERWAYS EXPERIMENT STATION                           **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather1.dat
TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather2.dat
SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P8785.VHP_weather3.dat
EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P8785.VHP_weather4.dat
SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\I_395253.inp
OUTPUT DATA FILE: C:\WHI\VHELP22\data\P8785.VHP\O_395253.prt

TIME: 22: 9 DATE: 3/22/2008

****

TITLE: re-do Phase 4 - 5yr V3

****

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 99

```
THICKNESS                  =    15.24   CM
POROSITY                   =    0.5010 VOL/VOL
FIELD CAPACITY             =    0.2840 VOL/VOL
WILTING POINT              =    0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT =    0.2727 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =    0.100000000000E-02 CM/SEC
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

```
THICKNESS                  =   152.40   CM
POROSITY                   =    0.6710 VOL/VOL
FIELD CAPACITY             =    0.2920 VOL/VOL
WILTING POINT              =    0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT =    0.2694 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =    0.100000224000E-02 CM/SEC
```

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4
THICKNESS = 60.96 CM
POROSITY = 0.4370 VOL/VOL
FIELD CAPACITY = 0.1050 VOL/VOL
WILTING POINT = 0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1110 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.170000000000E-02 CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 50
THICKNESS = 30.48 CM
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. = 1.00000000000 CM/SEC
SLOPE = 5.00 PERCENT
DRAINAGE LENGTH = 53.3 METERS

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 83
THICKNESS = 0.15 CM
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. = 0.200000000000E-12 CM/SEC
FML PINHOLE DENSITY = 1.00 HOLES/HECTARE
FML INSTALLATION DEFECTS = 1.00 HOLES/HECTARE
FML PLACEMENT QUALITY = 2 - EXCELLENT

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 51
THICKNESS = 30.48 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.5010 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM A USER-SPECIFIED CURVE NUMBER OF 75.0, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 50. METERS.

SCS RUNOFF CURVE NUMBER = 76.42
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 0.9712 HECTARES
EVAPORATIVE ZONE DEPTH = 55.9 CM
INITIAL WATER IN EVAPORATIVE ZONE = 12.572 CM
UPPER LIMIT OF EVAPORATIVE STORAGE = 34.905 CM
LOWER LIMIT OF EVAPORATIVE STORAGE = 5.187 CM
INITIAL SNOW WATER = 0.000 CM
INITIAL WATER IN LAYER MATERIALS = 68.220 CM
TOTAL INITIAL WATER = 68.220 CM
TOTAL SUBSURFACE INFLOW = 0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Honolulu HI

STATION LATITUDE = 21.09 DEGREES
MAXIMUM LEAF AREA INDEX = 6.00
START OF GROWING SEASON (JULIAN DATE) = 0
END OF GROWING SEASON (JULIAN DATE) = 366
EVAPORATIVE ZONE DEPTH = 22.0 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 WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.97	2.38	2.55	1.33	0.99	0.34
0.37	0.38	0.44	1.36	2.52	3.41

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
70.50	70.20	71.50	72.90	74.50	76.50
77.50	78.30	78.20	77.10	74.80	72.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Honolulu HI
AND STATION LATITUDE = 20.77 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.56	2.27	2.01	0.85	1.31	0.28
	0.56	0.29	0.57	1.29	2.96	3.78
STD. DEVIATIONS	0.91	2.40	0.76	0.65	1.01	0.15
	0.26	0.16	0.23	0.68	0.82	1.91
RUNOFF						
TOTALS	0.002	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.002	0.003
STD. DEVIATIONS	0.005	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.005	0.007
EVAPOTRANSPIRATION						
TOTALS	1.787	3.519	2.937	0.860	1.155	0.453
	0.565	0.294	0.570	1.216	2.876	2.439
STD. DEVIATIONS	0.527	1.256	1.569	0.601	0.765	0.429
	0.257	0.166	0.227	0.619	0.794	0.522
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0081	0.0072	0.0071	0.0064	0.0067	0.0064
	0.0076	0.0086	0.0088	0.0095	0.0093	0.0094
STD. DEVIATIONS	0.0075	0.0071	0.0071	0.0063	0.0066	0.0063
	0.0055	0.0056	0.0059	0.0065	0.0065	0.0066
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	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
STD. DEVIATIONS	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.72 (1.893)	163119.9	100.00
RUNOFF	0.007 (0.0071)	64.50	0.040
EVAPOTRANSPIRATION	18.671 (2.4024)	162660.28	99.718
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.09498 (0.06389)	827.437	0.50726
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00000)	0.038	0.00002
AVERAGE HEAD ON TOP OF LAYER 5	0.000 (0.000)		
CHANGE IN WATER STORAGE	-0.050 (1.5986)	-432.32	-0.265

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	1.93	16813.79352	3080003
RUNOFF	0.016	137.60721	3490005
DRAINAGE COLLECTED FROM LAYER 4	0.00088	7.63550	590003
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00025	590003
AVERAGE HEAD ON TOP OF LAYER 5	0.001		
MAXIMUM HEAD ON TOP OF LAYER 5	0.001		
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET		
SNOW WATER	0.00	0.0000	0
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3142		
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0928		

*** 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 5

LAYER	(INCHES)	(VOL/VOL)
1	1.4084	0.2347
2	16.0510	0.2675
3	2.7547	0.1148
4	0.3840	0.0320
5	0.0000	0.0000
6	6.0120	0.5010

SNOW WATER 0.000

APPENDIX B
MULTIMED MODEL ANALYSIS

APPENDIX B

MULTIMED EVALUATION
MOLOKAI INTEGRATED SOLID WASTE FACILITY
MOLOKAI, HAWAII

1. INTRODUCTION

This document presents the results of contaminant fate and transport modeling performed by A-Mehr, Inc. (A-Mehr) for the Molokai Integrated Solid Waste Facility (MISWF). The modeling activities were conducted to support the development of the MISWF's facility-specific groundwater and leachate monitoring plan (the monitoring plan) and draw extensively from information presented in the monitoring plan. The remainder of the document is organized in four parts, as follows:

- Purpose and Scope,
- Model General Approach
- Model Inputs
- Model Results, and
- References.

2. PURPOSE AND SCOPE

Contaminant fate and transport modeling was performed for the MISWF to provide insight regarding the potential for leachate impacts to groundwater from the MISWF and to guide future decisions with regard to the facility's monitoring programs.

3. GENERAL APPROACH

The contaminant fate and transport simulations for the project were completed using Version 1.51 of the commercially-available software package MULTIMED for Windows (Allison Geosciences, Inc., 2005). The modeling activities for the MISWF incorporated MULTIMED's Subtitle D restrictions and setting. This was done to facilitate subsequent evaluation of the modeling results by allowing general comparison of modeling procedures and results to other landfill facilities. The following model settings and restrictions were therefore utilized:

- Only the saturated and unsaturated modules were used;

- Only steady-state transport simulations were used, no decay of the landfill leachate concentrations entering the aquifer system were allowed, and the contaminant pulse was assumed to be continuous and constant for the duration of the simulation;

- The receptor wells were assumed to lie directly downgradient of the facility;
- The contaminant concentrations were calculated at the top of the aquifer; and
- A Gaussian source geometry was utilized;

As with all modeling efforts, the work performed for the MISWF involved the use of several assumptions regarding site conditions and processes affecting contaminant fate and transport in subsurface environments. Any use of the modeling results should be tempered with an understanding of the assumptions involved.

4. MODEL INPUTS

Table B-1 lists the facility-specific settings and values utilized in the modeling effort. It also includes a brief description or reference describing how the value or setting was selected. The remainder of this section provides additional information regarding several of the model inputs and settings.

4.1 Landfill Characteristics

As noted in Section 2 of the monitoring plan, the MISWF includes two existing disposal units (Phases 1 and 2) and one soon-to-be-constructed disposal unit (Phase 3), each of which have, or will have, a different landfill containment design. Given that Phase 2 is considered to have the least protective landfill containment design, its unit characteristics were utilized in the modeling effort. This approach is considered to provide a conservative, worst case scenario.

4.2 Infiltration Rates

The infiltration rate used for Phase 2 in the modeling effort was derived using the HELP model. Appendix A discusses the results of the HELP modeling performed for the MISWF.

4.3 Initial Leachate Concentrations

No site-specific leachate analytical data exists for Phase 2 of the MIWSF. Two sets of leachate analytical results are available for Phase 1 of the MISWF (see Table 6-1 of the Monitoring Plan). Based on their similar geographic location, age, and waste characteristics, the character of Phase 1 and Phase 2 leachate are also expected to be similar. Given this, the two sets of Phase 1 leachate analytical data were used in the modeling effort. As a conservative step, the highest concentration of each parameter from the two sets of data was used.

4.4 Potential Contaminants

The potential contaminants included in the MULTIMED modeling effort are listed in Table B-2. As noted in the monitoring plan, the two sets of Phase 1 leachate analytical data indicate no significant detections of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides or herbicides. Given that no impact to downgradient receptors would be expected from these organic parameters, they were therefore not considered in the modeling effort.

With a few exceptions, inorganic and other conventional leachate constituents which occur at concentrations below the USEPA maximum contaminant level (MCL) for drinking water, were not considered in the modeling efforts. Although the results of the ammonia-nitrogen, total kjeldahl nitrogen (TKN), and nitrite+nitrate analyses did not directly exceed MCLs, each was included in the modeling effort. Although no MCLs have been established for ammonia-nitrogen and TKN, these reduced nitrogen forms were included in the modeling effort given that they can, to some extent, be expected to convert to nitrate during migration through oxidized portions of the unsaturated zone. The actual concentration of nitrite in the leachate samples can not be directly determined from the results of the nitrate+nitrite analyses and therefore a direct comparison to the nitrite MCL cannot be made with certainty. However, as a conservative step, all of the nitrogen reported for the "nitrite+nitrate" was assumed to be nitrite for purposes of the modeling effort. Given that these "assumed" nitrite concentrations exceeded the MCL for nitrite, this parameter was included in the modeling effort.

4.5 Receptor Wells

For purposes of this modeling effort, two groundwater well scenarios were modeled. The first included a theoretical receptor well located at the facility's assumed point of compliance, estimated to be approximately 10 meters from the waste footprint. The second scenario assumed a theoretical offsite receptor well located approximately 560 meters downgradient of the Phase 2 waste footprint. This distance reflects the distance to the nearest offsite well noted during preparation of the monitoring plan, regardless of the well's current status or direction from the facility.

4.6 Hydraulic Conductivity

No site-specific information exists regarding the hydraulic conductivity of the volcanic rocks beneath the MISWF. The hydraulic conductivity used in both modeling scenarios was that estimated by the USGS as part of their large scale modeling effort for the island of Molokai. (Oki, 2007) The USGS's modeling effort included a large portion of central Molokai, including the area of the MISWF, and their estimated hydraulic conductivity value is considered reasonable for the volcanic lithologies beneath the MISWF. As a conservative approach, no modification of the USGS's (2007) value was made to account for possible vertical anisotrophy within the volcanic lithologies.

4.7 Groundwater Gradient

No site-specific information exists regarding the groundwater gradient beneath the MISWF. A groundwater contour map by Oki (2007) shows inferred gradients in the area just west of the MISWF (also see Figure 4-2 of the monitoring plan). For purposes of the current modeling efforts the groundwater gradient beneath the MISWF was calculated by projecting Oki's (2007) contours into the area of the MISWF. The calculated gradients are considered reasonable for this portion of the basal groundwater zone.

4.8 Contaminant Fate and Transport Processes

There is considerable level of uncertainty regarding site-specific values for several of the processes affecting subsurface contaminant migration, for both the saturated and unsaturated zones. Much of the required input with regard to subsurface flow and transport modules were therefore estimated from information presented in the USEPA's (1995) MULTIMED guidance manual.

5. MODEL RESULTS

Table B-2 summarizes the results of the MULTIMED modeling activities conducted for the MISWF. Complete MULTIMED output for both scenarios is presented following Table B-2. For the POC well scenario (receptor well located 10 meters from the waste footprint) the dilution attenuation factor (DAF) was 74 and the calculated concentrations for the modeled parameters were less than their MCLs. For the "nearest offsite well" simulation, the DAF was 3,179, and calculated concentrations for the modeled parameters were less than their MCLs.

6. REFERENCES

Allison Geosciences, Inc., 2005, "MULTIMED for Windows, Groundwater Fate and Transport Model", version no. 1.51.

Oki, D.S., 2006, "Numerical Simulation of the Hydrologic Effects of Redistributed and Additional Ground-Water Withdrawal, Island of Molokai, Hawaii"; USGS Scientific Investigations Report 2006-5177, 49 p.

Oki, D.S., 2007, "Effects of Ground-Water Withdrawal On Kaunakakai Stream Environmental Restoration Plan, Moloka'i, Hawai'i"; USGS Scientific Investigations Report 2007-5128, 25 p.

United States Environmental Protection Agency (USEPA), 1995, "A Subtitle D Landfill Application Manual for the Multimedia Exposure Assessment Model (Multimed 2.0)".

Waterloo Environmental, Inc., 2003, "Visual HELP", version 2.2.

TABLE B-1
MULTIMED INPUT PARAMETERS
MOLOKAI INTEGRATED SOLID WASTE FACILITY
(MARCH 2008)

PARAMETER	UNIT	VALUE	EXPLANATION
General			
Application Type	--	Subtitle D	MULTIMED for Windows, Version 1.51 software was used. The model settings shown for application type, run type, source type, and aquifer source plane geometry are consistent with Subtitle D requirements outlined in EPA (1995).
Run type	--	Deterministic	
Source Type	--	Steady State	
Aquifer Source Plane Geometry	--	Gaussian	
Active Models	--	Saturated and Unsaturated Zones	Consistent with assumed depth to groundwater at the MISWF.
Number of MC Interations	--	--	Not required for Subtitle D applications.
MC Confidence Interval	%	--	
Source			
Source Length	m	137.2	Approximate values measured from facility site map. Values are based on Phase 2 landfill footprint.
Source Width	m	94.5	
Source Area	m^2	12,946	
Source Infiltration Rate	m/yr	0.0185	Phase 2 value generated using HELP Model.
Outside Recharge Rate	m/yr	0	Conservative Assumption - Model results do not account for potential concentration decrease associated with recharge by surface precipitation along transport path.
Initial Concentration	mg/L	1	The initial source concentration was set at 1.0 to allow calculation of the dilution-attenuation factor (DAF).
Source Duration	yr	--	Not Applicable - Subtitle D applications requires a steady state source (i.e., no decay of the source concentration over time) .
Source Decay Coefficient	1/yr	--	
Initial Spread of Source	m	Derived	Calculated by software.

TABLE B-1 (continued)

Chemical				
	Chemical Name	--	Generic	Not required for calculation of dilution-attenuation factor (DAF)
	Normalized Distribution Coefficient	mL/g	0	Conservative Assumption - Model results do not account for potential concentration decreases associated with sorption to, or reaction with, solid phase materials during saturated flow.
	Dissolved Decay Coefficient	1/yr	0	
	Sorbed Decay Coefficient	1/yr	0	
	Overall Aquifer Decay Coefficient	1/yr	0	
	Acid Hydrolysis Rate	L/mole-yr	0	
	Neutral Hydrolysis Rate	1/yr	0	
	Base Hydrolysis Rate	L/mole-yr	0	
	Aquifer Distribution Coefficient	mL/g	0	
	Hydrolysis Reference Temperature	degrees C	--	
Unsaturated Zone				
	Flow Layer Thickness	m	68.5	Phase 2 low point to estimated groundwater table near msl.
	Saturated Hydraulic Conductivity	cm/hr	1,270	From Oki (2007).
	Effective Porosity	unitless	0.2	Estimated.
	Air Entry Pressure head	m	0	Estimated from values provided in USEPA (1995).
	Residual Water Content	unitless	0.4	Estimated.
	van Genuchten Alpha	1/cm	0.145	Estimated from values provided in USEPA (1995).
	van Genuchten Beta	unitless	2.68	Estimated from values provided in USEPA (1995).
	Transport Layer Thickness	m	68.5	Same as flow layer thickness (above).
	Longitudinal Dispersivity	M	1.0	Maximum default value in model for deep unsaturated zones.
	Percent Organic Matter	%	0	Conservative assumption – no sorption of chemicals to solids.
	Bulk Density	g/cc	2.65	Estimated.
	Bilogical Decay Coefficient	1/yr	--	Conservative assumption – no decay.

TABLE B-1 (continued)

Saturated Zone Flow and Transport				
	Aquifer Thickness	m	200	Estimate of basal freshwater lens based on water levels shown in Figure 7 of Oki (2006).
	Mixing Zone Thickness	m	--	Derived by software.
	Effective Porosity	unitless	0.2	Estimated.
	Particle Diameter	cm/hr	--	Not required for Subtitle D application.
	Bulk Density	g/cc	2.5	Estimated.
	Saturated Hydraulic Conductivity	m/yr	1.11E+05	Estimated from Figure 6 of Oki (2006).
	Hydraulic Gradient	unitless	0.00002	Estimated.
	Seepage Velocity	m/yr	--	Derived by software.
	Longitudinal Dispersivity	m	--	Derived by software.
	Transverse Dispersitivity	m	--	Derived by software.
	Vertical Dispersivity	m	--	Derived by software.
	Aquifer Temperature	degrees C	25.0	Estimated.
	Aquifer pH	std units	7.0	Estimated.
	Fraction of Organic Carbon	unitless	--	Not required for Subtitle D application.
	Retardation Factor	unitless	1	Conservative assumptions - Model results assume no retardation or decay of contaminant concentrations during transport.
	Aquifer Biological Decay Coefficient	1/yr	0	

TABLE B-1 (continued)

Well Location and Time				
	Radial Distance to Well	m	560	Based on closest groundwater well noted during research, regardless of current well status or direction relative to site.
	Angle Off Plume Axis	degree	0	For Subtitle D applications, the MULTIMED software automatically assumes that well is directly downgradient from center line of landfill source and calculates contaminant concentrations at top of water table.
	Well Screen Depth Factor	unitless	0	
	Time Step Option	--	--	Not required for Subtitle D applications.
	Start Time	--	--	
	End Time	--	--	

TABLE B-2
SUMMARY OF RESULTS FOR MULTIMED MODELING
MOLOKAI INTEGRATED SOLID WASTE FACILITY

PARAMETER	Maximum Concentration in Phase 2 Leachate Samples (mg/L)	Applicable MCLs	Point of Compliance Well Simulation (Well 10 m from MISWF)		Nearest Offsite Receptor Simulation (Well 560 m from MISWF)	
			DAF[3] (unitless)	Calculated Concentration at Theoretical POC Well (mg/L)	DAF[3] (unitless)	Calculated Concentration at Theoretical Offsite Well (mg/L)
Total Dissolved Solids	11,200	500 (s)	74	151[4]	3,179	4[4]
Ammonia-Nitrogen[1]	34.1	10 (p)(1)		0.46		< 0.1
Total Kjeldahl Nitrogen[1]	34.6	10 (p)(1)		0.47		< 0.1
Nitrite+Nitrate[2]	3.03	1 (p)(2)		0.04		< 0.1
Chloride	5,490	250 (s)		74[4]		2[4]
Sulfate	275	250 (s)		4[4]		< 1[4]
Barium	2.02	2 (s)		< 0.1		< 0.1

Notes:

(s) = Secondary MCL, based on aesthetic considerations (taste, odor, etc.); (p) = primary MCL, based on health considerations.

(1) No Federal MCLs have been established for these parameters. However, given the possibility that these reduced nitrogen forms can convert to nitrate within an oxidized subsurface environment, a comparison to the nitrate MCL has been included.

(2) The relative proportions of nitrate and nitrite in the leachate samples is unknown. As a conservative step, all reported nitrogen in the sample has been assumed to be nitrite.

(3) = Dilution Attenuation Factor (USEPA, 1995).

(4) = These are calculated values and, given the brackish quality of local groundwater, would likely not be realized.

COMPUTER INPUT AND OUTPUT DETAILS

```
MULTIMED V1.01   DATE OF CALCULATIONS:  1-APR-2008  TIME: [illegible]6:36:26

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

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

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

                           MULTIMED  (Version 1.50, 2005)
```

POC WELL SCENARIO

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



 Chemical simulated is Chemical Name


 Option Chosen                          Saturated and unsaturated zone models
 Run was                                DETERMIN
 Infiltration Specified By User: 1.850E-02 m/yr
 Run was steady-state
 Reject runs if Y coordinate outside plume
 Reject runs if Z coordinate outside plume
 Gaussian source used in saturated zone model
1
1
 UNSATURATED ZONE FLOW MODEL PARAMETERS
 (input parameter description and value)
 NP      - Total number of nodal points              240
 NMAT    - Number of different porous materials        1
 KPROP   - Van Genuchten or Brooks and Corey           1
 IMSHGN  - Spatial discretization option               1
 NVFLAYR - Number of layers in flow model              1


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

 Layer information
 -----------------
 LAYER NO.    LAYER THICKNESS    MATERIAL PROPERTY
 ---------    ---------------    -----------------
     1             67.70                 1
```

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.127E+04	-999.	-999.	-999.
Unsaturated zone porosity	--	CONSTANT	0.200	-999.	-999.	-999.
Air entry pressure head	m	CONSTANT	0.000	-999.	-999.	-999.
Depth of the unsaturated zone	m	CONSTANT	67.7	0.000	0.000	0.000

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.400	-999.	-999.	-999.
Brook and Corey exponent,EN	--	CONSTANT	-999.	-999.	-999.	-999.
ALFA coefficient	1/cm	CONSTANT	0.145	-999.	-999.	-999.
Van Genuchten exponent, ENN	--	CONSTANT	2.68	-999.	-999.	-999.

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	- Number of different layers used		1
NTSTPS	- Number of time values concentration calc		40
DUMMY	- Not presently used		1
ISOL	- Type of scheme used in unsaturated zone		2
N	- Stehfest terms or number of increments		18
NTEL	- Points in Lagrangian interpolation		3
NGPTS	- Number of Gauss points		104
NIT	- Convolution integral segments		2
IBOUND	- Type of boundary condition		1
ITSGEN	- Time values generated or input		1
TMAX	- Max simulation time	--	0.0
WTFUN	- Weighting factor	--	1.2

OPTIONS CHOSEN

Convolution integral approach
Nondecaying continuous source

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	67.7	-999.	-999.	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	-999.	-999.
Percent organic matter	--	CONSTANT	0.000	-999.	-999.	-999.
Bulk density of soil for layer	g/cc	CONSTANT	2.53	-999.	-999.	-999.
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.

1

CHEMICAL SPECIFIC VARIABLES

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

1

SOURCE SPECIFIC VARIABLES

Infiltration rate	m/yr	CONSTANT	0.185E-01	-999.	-999.	-999.
Area of waste disposal unit	m^2	DERIVED	0.138E+05	-999.	-999.	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	-999.	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	-999.	-999.
Recharge rate	m/yr	CONSTANT	0.000	-999.	-999.	-999.
Source decay constant	1/yr	CONSTANT	0.000	0.000	0.000	0.000
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	-999.	-999.
Length scale of facility	m	CONSTANT	137.	-999.	-999.	-999.
Width scale of facility	m	CONSTANT	94.5	-999.	-999.	-999.
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	-999.	-999.	-999.	-999.
Aquifer porosity	--	CONSTANT	0.200	-999.	-999.	-999.
Bulk density	g/cc	CONSTANT	2.53	-999.	-999.	-999.
Aquifer thickness	m	CONSTANT	123.	-999.	-999.	-999.
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	-999.	-999.
Conductivity (hydraulic)	m/yr	CONSTANT	0.111E+06	-999.	-999.	-999.
Gradient (hydraulic)		CONSTANT	0.300E-03	-999.	-999.	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	-999.	-999.
Retardation coefficient	--	CONSTANT	1.00	-999.	-999.	-999.
Longitudinal dispersivity	m	FUNCTION OF X	3.00	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	1.00	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	0.200	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	-999.	-999.
pH	--	CONSTANT	7.00	-999.	-999.	-999.
Organic carbon content (fraction)		CONSTANT	-999.	-999.	-999.	-999.
Well distance from site	m	CONSTANT	10.0	-999.	-999.	-999.
Angle off center	degree	CONSTANT	0.000	0.000	0.000	0.000
Well vertical distance	m	CONSTANT	0.000	0.000	0.000	0.000

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1351E-01

MULTIM[illegible] V1.01 DATE OF CALCULATIONS: 1-APR-2008 TIME: [illegible]:36:26

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.50, 2005)

POC WELL SCENARIO

1

Run options

Chemical simulated is Chemical Name

```
Option Chosen                              Saturated and unsaturated zone models
Run was                                    DETERMIN
Infiltration Specified By User: 1.850E-02 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
1
1
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)
NP      - Total number of nodal points              240
NMAT    - Number of different porous materials        1
KPROP   - Van Genuchten or Brooks and Corey           1
IMSHGN  - Spatial discretization option               1
NVFLAYR - Number of layers in flow model              1
```

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	67.70	1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.127E+04	-999.	-999.	-999.
Unsaturated zone porosity	--	CONSTANT	0.200	-999.	-999.	-999.
Air entry pressure head	m	CONSTANT	0.000	-999.	-999.	-999.
Depth of the unsaturated zone	m	CONSTANT	67.7	0.000	0.000	0.000

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.400	-999.	-999.	-999.
Brook and Corey exponent,EN	--	CONSTANT	-999.	-999.	-999.	-999.
ALFA coefficient	1/cm	CONSTANT	0.145	-999.	-999.	-999.
Van Genuchten exponent, ENN	--	CONSTANT	2.68	-999.	-999.	-999.

1

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	- Number of different layers used		1
NTSTPS	- Number of time values concentration calc		40
DUMMY	- Not presently used		1
ISOL	- Type of scheme used in unsaturated zone		2
N	- Stehfest terms or number of increments		18
NTEL	- Points in Lagrangian interpolation		3
NGPTS	- Number of Gauss points		104
NIT	- Convolution integral segments		2
IBOUND	- Type of boundary condition		1
ITSGEN	- Time values generated or input		1
TMAX	- Max simulation time	--	0.0
WTFUN	- Weighting factor	--	1.2

OPTIONS CHOSEN

Convolution integral approach

Nondecaying continuous source

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Thickness of layer	m	CONSTANT	67.7	-999.	-999.	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	-999.	-999.
Percent organic matter	--	CONSTANT	0.000	-999.	-999.	-999.
Bulk density of soil for layer	g/cc	CONSTANT	2.53	-999.	-999.	-999.
Biological decay coefficient	1/yr	CONSTANT	0.000	-999.	-999.	-999.

1

CHEMICAL SPECIFIC VARIABLES

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

1

SOURCE SPECIFIC VARIABLES

Infiltration rate	m/yr	CONSTANT	0.185E-01	-999.	-999.	-999.
Area of waste disposal unit	m^2	DERIVED	0.138E+05	-999.	-999.	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	-999.	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	-999.	-999.
Recharge rate	m/yr	CONSTANT	0.000	-999.	-999.	-999.
Source decay constant	1/yr	CONSTANT	0.000	-999.	-999.	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.000	0.000	0.000	0.000
Length scale of facility	m	CONSTANT	1.00	-999.	-999.	-999.
Width scale of facility	m	CONSTANT	137.	-999.	-999.	-999.
Near field dilution	m	CONSTANT	94.5	-999.	-999.	-999.
		DERIVED	1.00	0.000	0.000	1.00

1

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	-999.	-999.	-999.	-999.
Aquifer porosity	--	CONSTANT	0.200	-999.	-999.	-999.
Bulk density	g/cc	CONSTANT	2.53	-999.	-999.	-999.
Aquifer thickness	m	CONSTANT	123.	-999.	-999.	-999.
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	-999.	-999.
Conductivity (hydraulic)	m/yr	CONSTANT	0.111E+06	-999.	-999.	-999.
Gradient (hydraulic)		CONSTANT	0.300E-03	-999.	-999.	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	-999.	-999.
Retardation coefficient	--	CONSTANT	1.00	-999.	-999.	-999.
Longitudinal dispersivity	m	FUNCTION OF X	3.00	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	1.00	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	0.200	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	-999.	-999.
pH	--	CONSTANT	7.00	-999.	-999.	-999.
Organic carbon content (fraction)		CONSTANT	-999.	-999.	-999.	-999.
Well distance from site	m	CONSTANT	10.0	-999.	-999.	-999.
Angle off center	degree	CONSTANT	0.000	0.000	0.000	0.000
Well vertical distance	m	CONSTANT	0.000	0.000	0.000	0.000

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1351E-01

$DAF = \frac{1}{0.1351 \times 10^{-1}} = 74$

MULTIMED V1.01 DATE OF CALCULATIONS: 1-APR-2008 TIME: 44:20

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.50, 2005)

OFFSITE WELL SCENARIO

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

Chemical simulated is Chemical Name

```
Option Chosen                          Saturated and unsaturated zone models
Run was                                DETERMIN
Infiltration Specified By User: 1.850E-02 m/yr
Run was steady-state
Reject runs if Y coordinate outside plume
Reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model
```

1
1

```
UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)
NP      - Total number of nodal points            240
NMAT    - Number of different porous materials      1
KPROP   - Van Genuchten or Brooks and Corey         1
IMSHGN  - Spatial discretization option             1
NVFLAYR - Number of layers in flow model            1
```

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

1

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	67.70	1

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

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX

Saturated hydraulic conductivity	cm/hr	CONSTANT	0.127E+04	-999.	-999.	-999.
Unsaturated zone porosity	--	CONSTANT	0.200	-999.	-999.	-999.
Air entry pressure head	m	CONSTANT	0.000	-999.	-999.	-999.
Depth of the unsaturated zone	m	CONSTANT	67.7	0.000	0.000	0.000

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

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Residual water content	--	CONSTANT	0.400	-999.	-999.	-999.
Brook and Corey exponent,EN	--	CONSTANT	-999.	-999.	-999.	-999.
ALFA coefficient	1/cm	CONSTANT	0.145	-999.	-999.	-999.
Van Genuchten exponent, ENN	--	CONSTANT	2.68	-999.	-999.	-999.

1
UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	- Number of different layers used		1
NTSTPS	- Number of time values concentration calc		40
DUMMY	- Not presently used		1
ISOL	- Type of scheme used in unsaturated zone		2
N	- Stehfest terms or number of increments		18
NTEL	- Points in Lagrangian interpolation		3
NGPTS	- Number of Gauss points		104
NIT	- Convolution integral segments		2
IBOUND	- Type of boundary condition		1
ITSGEN	- Time values generated or input		1
TMAX	- Max simulation time	--	0.0
WTFUN	- Weighting factor	--	1.2

OPTIONS CHOSEN
------- ------
Convolution integral approach
Nondecaying continuous source
Computer generated times for computing concentrations
1

DATA FOR LAYER 1
---- --- -----
VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Thickness of layer	m	CONSTANT	67.7	-999.	-999.	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	-999.	-999.
Percent organic matter	--	CONSTANT	0.000	-999.	-999.	-999.
Bulk density of soil for layer	g/cc	CONSTANT	2.53	-999.	-999.	-999.

CHEMICAL SPECIFIC VARIABLES

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

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Infiltration rate	m/yr	CONSTANT	0.185E-01	-999.	-999.	-999.
Area of waste disposal unit	m^2	DERIVED	0.138E+05	-999.	-999.	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	-999.	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	-999.	-999.
Recharge rate	m/yr	CONSTANT	0.000	-999.	-999.	-999.
Source decay constant	1/yr	CONSTANT	0.000	0.000	0.000	0.000
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	-999.	-999.
Length scale of facility	m	CONSTANT	137.	-999.	-999.	-999.
Width scale of facility	m	CONSTANT	94.5	-999.	-999.	-999.
Near field dilution		DERIVED	1.00	0.000	0.000	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	STD DEV	LIMITS MIN	MAX
Particle diameter	cm	CONSTANT	-999.	-999.	-999.	-999.
Aquifer porosity	--	CONSTANT	0.200	-999.	-999.	-999.
Bulk density	g/cc	CONSTANT	2.53	-999.	-999.	-999.
Aquifer thickness	m	CONSTANT	123.	-999.	-999.	-999.
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	-999.	-999.
Conductivity (hydraulic)	m/yr	CONSTANT	0.111E+06	-999.	-999.	-999.
Gradient (hydraulic)		CONSTANT	0.300E-03	-999.	-999.	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	-999.	-999.
Retardation coefficient	--	CONSTANT	1.00	-999.	-999.	-999.
Longitudinal dispersivity	m	FUNCTION OF X	3.00	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION OF X	1.00	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION OF X	0.200	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	25.0	-999.	-999.	-999.
pH	--	CONSTANT	7.00	-999.	-999.	-999.
Organic carbon content (fraction)		CONSTANT	-999.	-999.	-999.	-999.
Well distance from site	m	CONSTANT	560.	-999.	-999.	-999.
Angle off center	degree	CONSTANT	0.000	0.000	0.000	0.000
Well vertical distance	m	CONSTANT	0.000	0.000	0.000	0.000

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3146E-03

$$DAF = \frac{1}{0.3146 \times 10^{-3}} = 3179$$

APPENDIX E

STORMWATER POLLUTION PREVENTION PLAN

MOLOKAI INTEGRATED SOLID WASTE FACILITY

STORM WATER POLLUTION CONTROL PLAN

Prepared for

COUNTY OF MAUI
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
SOLID WASTE DIVISION
2200 Main Street, Suite 225
Wailuku, Hawaii 96793

Prepared by

A-Mehr, Inc.
23016 Mill Creek Drive
Laguna Hills, CA 92653

December 2013

TABLE OF CONTENTS

<u>FIGURES</u>

<u>TABLES</u>

MOLOKAI INTEGRATED SOLID WASTE FACILITY
STORM WATER POLLUTION CONTROL PLAN

1. INTRODUCTION

1.1 Purpose

This Plan has been prepared in accordance with requirements of Hawaii Administrative Rules Chapter 11-55 and corresponding federal regulations contained in the Code of Federal Regulations, Title 40, Section 122. It describes the facilities, means and methods by which the County of Maui will operate Molokai Integrated Solid Waste Facility in compliance with state and federal requirements to prevent pollution of surface waters of the State of Hawaii.

1.2 Responsible Personnel

Implementation of this Storm Water Pollution Control Plan (SWPCP) is the responsibility of the individuals filling the following key positions within the County of Maui Department of Environmental Management, Waste Management Division:

- Chief, Waste Management Division
- General Manager, Molokai Integrated Solid Waste Facility
- Environmental Compliance Officer, Molokai Integrated Solid Waste Facility

Each of these individuals is authorized to prepare and submit reports and other documents referenced in the SWPCP.

1.3 Related Plans and Programs

The SWPCP has been prepared in consideration of other regulatory plans and documents associated with Molokai Integrated Solid Waste Facility, and will be implemented in coordination with them. Related plans and programs include, but are not limited to, the following:

- Solid Waste Management Permit No. LF-0076-93 for Molokai Integrated Solid Waste Facility, issued by the Hawaii Department of Health on October 1, 1993 or as it may subsequently be revised and reissued; and

- Operations Plan, Molokai Integrated Solid Waste Facility, November 2006 and as subsequently amended.

2. SITE AND FACILITY DESCRIPTION

2.1 Site Location and General Description

The MISWF is a municipal solid waste (MSW) disposal facility owned by Maui County and operated by the Department of Environmental Management, Solid Waste Division. The facility provides the following services to residents and businesses of Molokai:

- Solid waste disposal
- Recycling of containers, green waste and other designated materials
- Recycling of major appliances (white goods)
- Recycling of automobiles and related materials including tires, batteries, and motor oil

Solid waste disposal is provided for public and commercial customers, subject to acceptance screening upon delivery, weighing of each load, and payment of the posted gate fees. The disposal fees are set by the Maui County Council to support operation of the landfill and associated waste management programs.

MISWF is located near the southern coast of the island of Molokai, on the dry leeward side of the island, approximately three miles northwest of Kaunakakai and approximately 1.25 miles inland with elevations spanning between approximately 200 to 250 feet mean sea level (MSL), and the topography gently slopes toward the south-southwest.

The site area is bounded to the north-northwest by Manawainui Gulch and to the south-southeast by a smaller unnamed gulch. Manawainui Gulch lies approximately 500 feet north-northwest of the site. Canyon walls of the gulch are over 50 feet high. Rock has been quarried from the southeast canyon wall of the gulch. The quarry is operated by Patterson Construction and Trucking Company, Inc. The Tax Key Map identification for the site is TMK (2) 5-2-11:27 (portion). Figure 1 is a vicinity map showing the site location.

2.2 Site Map

Figure 2 is a detailed map of the facility showing drainage structures and facilities, major materials handling areas and other features referenced in this SWPCP.

2.3 Storm Drainage System

This section describes the facilities installed and planned for management of storm drainage at MISWF, as shown in Figure 2. Major elements of the stormwater management system include the following:

- Temporary diversion and containment berms to prevent rainfall that has contacted waste in the active disposal area from being discharged to the stormwater management system. Site operators are responsible for constructing and maintaining soil berms to divert runoff from inactive areas away from the active area, and berms to contain any stormwater incident on refuse that has not been covered with daily cover soil. Any stormwater that has contacted waste must be allowed to percolate into the refuse and be treated as leachate if it reaches the leachate management system.

- Temporary ditches or channels on the landfill to direct runoff to the perimeter drainage channels. They must be frequently inspected and maintained to minimize erosion of intermediate soil cover.

- Perimeter drainage ditches and channels conveying stormwater to the sedimentation basin.

- The landfill sedimentation basin, covering an area of approximately 0.6 acres, receives all runoff from the landfill area. The primary discharge is from a perforated riser pipe and discharge pipe, with an emergency overflow weir as a secondary discharge. The stormwater released from the basin flows offsite to historical drainage areas to the west and south.

- The entrance area stormwater basin, located to the east of the landfill, receives runoff from the scalehouse and recycling areas. This basin is covered with tall grass and functions as a retention basin with no designed outfall. The basin discharges by overflow to a natural drainage path along the easterly property limits.

Stormwater leaving the site drains by overland flow southeasterly to the unnamed gulch outside the site boundaries.

3. POLLUTION CONTROL STRATEGY

This section describes the potential sources and types of pollutants that may occur in various areas of the facility, and outlines the control measures that will prevent the release of pollutants to surface water.

3.1 Sources and Types of Pollutants

3.1.1 Landfill Areas

This section discusses potential sources and types of pollutants in two categories of landfill areas:

- Active landfill areas, consisting of areas where waste has been placed, additional filling is expected, and no permanent closure has occurred; and

- Working face, the area within the active landfill area where waste is actively being placed on a daily basis. The working face moves daily as the waste fill advances across the active landfill.

Runoff from the active landfill contains primarily suspended solids consisting of small soil particles entrained while running across daily and intermediate cover soil. It may also contain paper or plastic litter. Landfill equipment is generally fueled and lubricated on the active landfill, resulting in the need for spill prevention and control measures, described in Section 4 below, to prevent spills of fuel or lubricant from adding oil and grease pollutants to runoff.

Control of stormwater on the landfill top deck and sideslopes is an important responsibility of site operating staff. This includes:

- Diversion berms must be constructed and maintained upslope from the current active disposal face to prevent surface water from running onto refuse that has not received daily cover. The berms must be frequently moved and rebuilt as the active face changes location on the landfill top deck.

- Containment berms must be constructed and maintained to prevent runoff from leaving the active disposal area after it has contacted waste. Rainfall or surface water that has run onto uncovered refuse must be retained and allowed to infiltrate into the landfill, where it will either be absorbed in the waste mass or percolate to the leachate collection system and be treated accordingly. This is accomplished in part by grading the immediate area near the toe of the active face toward the exposed refuse on any day when rain is anticipated, so that rainwater running off the exposed refuse is contained and absorbed into the refuse and cover soil. At the end of the day, the working area is covered and the adjacent area re-graded to convey storm water to intermediate slopes or the perimeter drainage system.

- Runoff from the landfill top deck and sideslopes must be directed to the perimeter drainage channels without eroding the landfill intermediate cover. This is accomplished by proper preparation and maintenance of temporary or permanent ditches and channels along the access roads to the top deck, installation of sandbag or rock check dams to reduce velocity and trap sediment in runoff, and other measures spelled out in the annual drainage plan.

3.1.2 Residential Recycling Area

Runoff from the scalehouse, administration and residential recycling areas potentially contains paper, plastic or other litter. Stormwater runoff from these areas is collected???

3.1.3 Green Waste Receiving and Processing Area

Green waste is received from residential and commercial customers, and stored temporarily in areas north and east of Phase 3, for a period of up to several months before it is shredded and removed from the site. Runoff from the green waste storage and processing area may contain soil sediments, particles of vegetation, and leached organic constituents contributing to biological and chemical oxygen demand.

3.1.4 Paved Roads and Parking Areas

Paved roads and parking areas throughout the site are a potential source of suspended solids, litter, and oil and grease.

3.2 Pollution Control Strategies

3.2.1 Structural Control Measures

This section describes permanent engineered facilities constructed specifically for management of surface water in a manner that prevents pollution of surface water discharged from the site. They include two major categories of facilities: drainage channels and storm water basins.

<u>Drainage Channels</u>

Improved drainage channels enclose the entire perimeter the landfill area. Two basic types of channels are provided, all designed to carry runoff from a design 24-hour, 25-year storm event as required under HAR 11-58.1-15(g). The original site construction included rock-lined V-ditch channels along the perimeter road on the north and west sides of the landfill. Construction of Phase 3 and Phase 4 disposal areas included drainage improvements to complete the perimeter drainage system with 14-foot wide asphalt-paved curbed roadways serving as the stormwater conveyance.

<u>Stormwater Basins</u>

Two stormwater basins receive and retain stormwater from all areas of the facility:

- A grass-lined basin located east of the landfill area receives runoff from the entrance area and green waste storage and processing area. This basin covers approximately 0.3 acre and will store approximately 1.2 acre-feet of water with a maximum depth of approximately 4 feet. The basin discharges by overflow to a natural drainage path along the easterly property limits.

- The landfill sedimentation basin, covering an area of approximately 0.6 acres, receives all runoff from the landfill perimeter drainage channels. The primary discharge is from a perforated riser pipe and discharge pipe, with an emergency overflow weir as a secondary discharge. The stormwater released from the basin flows offsite to historical drainage areas to the west and south.

3.2.2 Non-Structural Control Measures

This section describes the operational practices implemented at MISWF to prevent surface water contamination. They include temporary or seasonal physical barriers as well as maintenance and housekeeping activities.

<u>Runoff Controls at the Active Disposal Working Face</u>

Among the most critical responsibilities of site operations for storm water control is to prevent run-on and run-off of surface water from the active working face. All precipitation incidents on exposed refuse must be contained within the immediate area and be allowed to infiltrate into the refuse for subsequent management as leachate. This is accomplished primarily by construction and maintenance of temporary earthen berms around the active area during periods of rain. Berms upgradient of the active working face prevent run-on from contacting refuse, and divert it to soil-covered areas. Downgradient berms retain any runoff from the working face until it is absorbed into the refuse and cover soil.

Installation and maintenance of diversion and retention berms are responsibilities of landfill operations supervisors. Planning and installation must occur prior to the first seasonal rains or at any time when rain is forecast. Berms must be maintained, relocated or reconstructed on a daily or weekly basis as the location of the active disposal working face changes.

<u>Preventive and Scheduled Maintenance</u>

Preventive maintenance of landfill operating equipment is important not only to ensure equipment availability for operations, but also to minimize the potential for leaks or spills of fuel or other fluids that could contribute to pollution of stormwater.

Stormwater management facilities must be maintained consistently to ensure their proper functioning. At a minimum the following measures should be implemented:

- Asphalt paved and concrete channels and all storm drain pipes and culverts will be inspected annually, and any significant accumulations of sediment will be removed prior to the onset of the winter rainy season;

- Grass and other vegetation growing in storm water basins should be cut and removed annually or as necessary during the dry season to maintain it at a height of 12 inches or less at the onset of the winter rainy season; and

- At not less than 5 year intervals, all sediment and vegetation should be removed from storm water basins in order to maintain their storage capacity at design levels.

Good Housekeeping

MISWF is required by state regulations and its solid waste management permit to keep the site clear of litter, and to control dust and mud. Measures for these controls are specified in the site's Operations Plan and are implemented on a daily basis, including:

- Placement and maintenance of litter screens to minimize the amount of litter leaving the active disposal area;
- Daily litter pickup throughout the site by County employees and/or contract laborers;
- Periodic sweeping or cleaning of paved roads and parking areas.

Sediment and Erosion Control

The following measures will be implemented to minimize soil erosion and sediment transport in surface water being managed at the site:

- Landfill exterior sideslopes in the Phase I and II area that are substantially at final grade will be covered green waste mulch, and/or planted with grass to prevent erosion to the extent possible, and eroded areas will be repaired as needed prior to the onset of winter rains each year;

- Unpaved access roads on the surface of the landfill will be surfaced with rock, asphalt rubble or other materials, to the extent possible consistent with the availability of suitable materials; and

- Sandbag check dams, diversion berms, silt fencing and similar devices will be installed and maintained during the rainy season to minimize erosion and sediment transport in unpaved areas of the site.

4. SPILL PREVENTION AND RESPONSE PLAN

This section describes facilities and procedures implemented at MISWF to prevent the release to the environment of liquids used or stored at the facility. Spill prevention is an important element of storm water pollution prevention not only for events that may occur during rain events, but also in relation to events that may result in contaminated surface soil that would subsequently contribute pollutants to surface runoff from the affected area.

4.1 Potential Spill Sources

The sources of potential liquid spills at MISWF include the following:

- Landfill Equipment Servicing Operations – Landfill operating equipment is fueled by an off-site County mobile service truck. Potential spills of diesel fuel may occur during transfers of fuel from the County mobile service truck to landfill equipment. Other fluids, primarily motor oil, hydraulic fluid and coolant, could potentially be spilled during transfers from 55-gallon drums to landfill operating equipment.

  Lubricants are stored in 55-gallon drums located on spill containment pallets inside a locked 20' or 40' container. Most servicing involving changing of oil and coolant occurs off-site; however, if on-site servicing is done, used oil and coolant are removed from the site in the County mobile service truck.

4.2 Spill Prevention Procedures

4.2.1 Fuel Handling

This section outlines procedures to be followed at MISWF to prevent spills of diesel fuel associated with fueling of landfill operating equipment.

<u>Fuel Transfers to Equipment</u>

The following procedures shall be followed when transferring diesel fuel to vehicles or landfill operating equipment from the mobile service truck.

- The following spill cleanup equipment shall be on hand at the location of fueling:

  a) A drip bucket/pan.
  b) A shovel.

- The fueling operation shall observe the following precautions and procedures:

  a) The operator must hold the nozzle while filling the vehicle.
  b) The operator must not overfill the tank.
  c) The operator must not keep the nozzle open using a device or method other than his/her hand.
  d) The operator must place the drip pan/bucket on the ground beneath the vehicle fill opening to catch any overfill. Any overfill must be cleaned and absorbent material disposed of in properly marked containers.

- The following procedures apply to fueling operations on the landfill surface:

    a) Provide breakaway couplings on the mobile fuel truck dispenser hose(s).
    b) Provide automatic shut-off on the mobile tank dispenser nozzles.
    c) If a spill of less than 25 gallon occurs, the operator must immediately shovel soil onto the spill to absorb the fuel, then remove all contaminated soil to a pile. Prior to the end of the working day, site operations shall test a sample of the fuel-contaminated soil to determine if it is flammable by removing it from the landfill area and attempting to cause it to burn with a propane torch. If the soil is determined to be non-flammable, it should be picked up and disposed at the active landfill face. Any cover soil removed from the spill location should be replaced. If the soil sample tested is found to be flammable, mix additional soil with the contaminated soil until it is determined to be non-flammable.
    d) If a spill of 25 gallons or more occurs, take immediate steps to contain the spill, get help, and report the incident to the site Environmental Compliance Officer.

- The following procedures apply to any fueling of equipment outside the lined landfill area:

    a) The following equipment must be on hand at the site of fueling:
        - Two watertight covered containers, one labeled 'Clean Absorbent' and the other 'Used Absorbent'
        - A supply of clean, dry absorbent.
        - A yard brush
    b) If a spill of less than 25 gallon occurs, the operator must immediately place absorbent on the spilled fuel, and immediately pick up the absorbed material with a sweeping brush and shovel, and place it in the 'Used Absorbent' receptacle.
    c) The 'Clean Absorbent' and 'Used Absorbent' storage containers must be protected from rain at all times.
    d) Used absorbent must be disposed of in accordance with State and Federal regulations.
    e) The fueling area must be dry cleaned (sweep and shovel - absolutely no water) at the end of every workday.
    f) The shovel, yard brush, and drip pan/bucket must always be kept in the vicinity during fueling activities.
    g) The drip pan/bucket must be stored up-side down when not in use.
    h) If a spill of 25 gallons or more occurs, take immediate steps to contain the spill, get help, and report the incident to the site Environmental Compliance Officer.

4.2.2 Handling of Lubricants and Coolants

Any oil, hydraulic fluid, coolant and other equipment operating fluids, as well as waste oil and coolant, must be stored in drums located on containment pallets in the materials storage container. In the event the container becomes full or otherwise is unable to hold more drums, drums may be stored temporarily on containment pallets, provided they are located on a paved area and covered securely with a tarpaulin or other cover.

A supply of clean absorbent and other materials and equipment needed for cleanup of spills must be maintained at the storage location.

4.3 Spill Response

4.3.1 General

The following sections describe procedures to be followed in the event of a spill or release of a petroleum product or other liquid addressed in this plan.

An important aspect of an effective response procedure during a spill incident is to keep the material separated from water to minimize migration and the resulting potential increase in human and environmental exposure. Every effort should be made to prevent spills and emphasize containment at the source rather than resort to separation of the material from expanded portions of the environment or downstream waters.

4.3.2 Discovery of a Release

The person discovering a release of material from a container, tank, or operating equipment should initiate certain actions immediately.

a) Extinguish any sources of ignition. Until the material is identified as nonflammable and noncombustible, all potential sources of ignition in the area should be removed. Vehicles should be turned off. If the ignition source is stationary, attempt to move spilled material away from the ignition source. Avoid sparks and movement creating static electricity.

b) Attempt to stop the release at its source. **Assure that no danger to human health exists first**. Simple procedures (turning valves, plugging leaks, etc.) may be attempted by the discoverer if there is no health or safety hazard and there is a reasonable certainty of the origin of the leak. All efforts to control leaks must be under the supervision of the Environmental Compliance Officer (ECO).

c) Initiate spill notification and reporting procedures. Report the incident immediately to the Supervisor and the ECO. If there is an immediate threat to human life (e.g. a fire in progress or fumes overcoming workers), an immediate alarm should be sounded to evacuate the building, and the fire department should be called. Request the assistance of the fire department's hazardous materials response team if an uncontrollable spill has occurred and/or if the spill has migrated beyond the site boundaries.

4.3.3 Containment of a Release

The following procedures shall be implemented in the event of a significant release (greater than 25 gallons) outside a secondary containment area:

a) Stop the release at the source. Close valves or apply temporary patches to leaks in tanks. Personnel must wear appropriate safety equipment to prevent direct contact with liquids or vapors. Consult applicable material safety data sheets for material compatibility, safety, and environmental precautions.

b) Contain the material released into the environment. Following proper safety procedures, the spill should be contained by absorbent materials and dikes using shovels and brooms. Consult applicable material safety data sheets for material compatibility, safety, and environmental precautions.

c) Continue the notification procedure. Inform the Environmental Compliance Officer of the release (the ECO shall notify outside authorities as required). Obtain outside contractors to clean up the spill, if necessary.

4.4 Spill Cleanup

Appropriate personal protective equipment and clean-up procedures can be found on material safety data sheets. Care must be taken when cleaning up spills in order to minimize the generation of waste. The Environmental Compliance Officer can provide assistance for the issues discussed below.

a) Recover or cleanup the material spilled - As much material as possible should be recovered and reused where appropriate. Material that cannot be reused must be declared waste. Disposal methods shall be as follows:

- Diesel fuel shall be blended with soil until the mixture is determined to be non-flammable, then disposed at the active landfill working face. It may be used as daily cover provided it is covered with additional waste or refuse within 24 hours.

- Other materials, including coolant, lubricants or other fluids must be absorbed in solid material and shoveled into open top, 55-gallon drums. When drums are filled after a cleanup, the drum lids shall be secured and the drums shall be appropriately labeled (or re-labeled) identifying the substance(s), the date of the spill/cleanup, and the facility name and location. Combining non-compatible materials can cause potentially dangerous chemical and/or physical reactions or may severely limit disposal options. Compatibility information can be found on material safety data sheets. These materials must be managed in accordance with MISWF's Special Waste Screening Program.

b) Cleanup of the spill area - Surfaces that are contaminated by the release shall be cleaned by the use of an appropriate substance or water. Cleanup water must be minimized, contained and properly disposed. Occasionally, porous materials (such as wood, soil, or oil-dry) may be contaminated; such materials will require special handling for disposal.

c) Decontaminate tools and equipment used in cleanup - Even if dedicated to cleanup efforts, tools and equipment that have been used must be decontaminated before replacing them in the spill control kit.

4.5 Post-Cleanup Procedures

a. Notification and reports to outside agencies. - The Environmental Compliance Officer shall file the following reports for any spill of 25 gallons or more:

- For any spill of 25 gallons or more, notify the Solid Waste Branch of the the Hawaii Department of Health by phone or fax within 8 hours if possible, but not more than 24 hours; and file an Incident Report according to Solid Waste Management Permit requirements within three days following the spill or release.

- For any spill of 25 gallons or more of diesel fuel, other petroleum products or any hazardous material, also notify the Department of Health, Hazard Evaluation & Emergency Response Office at (808) 586-4249 during normal business hours, or (808) 247-2191 after normal business hours.

b. Arrange for proper disposal of any waste materials. - The waste material from the cleanup must be characterized according to State and Federal Regulations. Representative sampling and analysis may be necessary to make this determination. In any case, the Environmental Compliance Officer shall assure that the waste is transported and disposed of in compliance with applicable laws, regulations and the site's Solid Waste Management Permit.

c. Review the contingency and spill plans. - Management and operating personnel shall review spill response efforts, notification procedures, and cleanup equipment usage to evaluate their adequacy during the episode. Where deficiencies are found, the plan shall be revised and amended.

5. SIGNIFICANT LEAKS, SPILLS OR DISCHARGES

There have been no recorded incidents of significant leaks or spills of toxic or hazardous pollutants at Molokai Integrated Solid Waste Facility.

There have been no discharges of storm water to the un-named gulch from any part of the facility of stormwater causing the discharge of a reportable quantity for which notification is or was required under 40 CFR §110.6.

6. STORM WATER MONITORING PLAN

This section describes methods to be used by MISWF personnel to monitor storm water in conformance with the General Permit for storm water discharges from industrial facilities under the National Pollutant Discharge Elimination System (NPDES) as specified in HAR 11-55, Appendix B.

6.1 Location and Frequency of Sampling

6.1.1 Visual Observations

During significant rain events, the Environmental Compliance Officer or designee for MISWF will visually check both stormwater basins at the facility, as identified in Section 3.2.1 above, on a daily basis. Data to be recorded for each observation include:

- Date and time
- Approximate depth of water and elevation below the discharge structure
- Approximate rate of water inflow to basin
- Presence or absence of flow from the basin

6.1.2 Sampling Events and Locations

Regulations require sampling to be conducted during a “representative storm”, defined as one in which at least 0.1 inches of rainfall accumulates and follows at least 72 hours after a previous storm with greater than 0.1 inch of rain. In response to this requirement, surface water sampling will be conducted during the first event in which a discharge occurs from a storm water basin each year, unless the discharge occurs during the first rain event of the winter rainy season. If the first rain event of the year results in a discharge from a basin, the next discharge event will be sampled. Because all basins are designed to retain stormwater and discharge only by overflow, no sampling may occur in dry years, while from one to three basins may have flow and require sampling in wetter years. Samples will be collected from the outfall or point of discharge from the basin.

6.2 Sample Collection Methods

For each sample event, from one to four grab samples will be collected from the outfall and consolidated into a composite sample. Each sample will be collected in a clean container that has been washed, triple rinsed and sealed prior to being taken into the field. The first grab sample will be taken during the first 15 minutes of the discharge.

Subsequent samples will be taken at 15 minute intervals for up to one hour, or as long as the discharge continues.

The grab samples must be combined into a composite sample for analysis on a flow-proportional basis. In order to do this, each sample must be associated with a flow measurement obtained using the method described in Section 6.4 below. The flow measurements should be made before each sample is collected. One aliquot from each grab sample is then combined into a composite sample for testing, as follows:

Let Q_i = the measured discharge flow associated with sample *i*;
V_i = the volume of a sample aliquot *i* to be added to make a composite sample;
V_{tot} = the total volume needed for laboratory analysis; and
n = the number of grab samples to be combined into a composite (n = 2, 3 or 4)

Then V_1 is set at a value of approximately V_{tot} / n;
$V_2 = V_1 (Q_2/Q_1)$
$V_3 = V_1 (Q_3/Q_1)$
$V_4 = V_1 (Q_4/Q_1)$

The calculated total volume of all aliquots should not exceed the capacity of the mixing vessel, or be less than the volume needed to fill the laboratory sample bottles. If it is outside these limits, a new value of V_1 must be selected and the calculations repeated.

An appropriate measuring device (measuring cup, graduated cylinder, etc.) is used to measure the calculated volume from each sample and pour it into a clean container, which is stirred or shaken to thoroughly mix the aliquots from the grab samples. The combined sample is then used to fill the prepared sample bottles supplied by the analytical laboratory.

Each sample bottle will be identified by location, date, and time. Samples will be sealed and shipped to the analytical laboratory using procedures specified by the laboratory.

6.3 Test Parameters, Methods and Detection Limits

Surface water samples will be tested for the parameters listed in Table 1, using the USEPA test methods and detection limits as specified. Parameters and methods may be revised from time to time if and as directed by the Hawaii Department of Health.

6.4 Storm Water Flow Measurement

During periods when storm water is being discharged from a basin, the following procedures will implemented during sample events and at least twice each day to estimate the total rate of discharge during the storm event:

- Measure or estimate the average width and depth of the flow across a length of reasonably uniform channel or flow path below the spillway or other discharge point from the basin.

- Estimate the surface velocity of the flow by timing the flow of a floating object, such as a leaf or wood chip, across a measured length of flow. Repeat this measurement 3 to 5 times until a reasonable average is obtained.
- Compute the volumetric flow rate in cubic feet per second by multiplying the average surface velocity by the cross-sectional area of the flow path.

At the conclusion of the period of discharge, compute a time-averaged rate of discharge for the period.

6.5 Storm Event Information

The following data will be collected and recorded for the storm event during which sampling occurred:

- Date the event began
- Duration (days and hours)
- Starting and ending times
- Total inches of rain during event
- Elapsed time from end of previous storm event with rainfall greater than 0.1 inches and the beginning of the sampled event.

6.6 Report

A report will be prepared for each sampling event, including the following information:

- Date and time of sampling
- Sampling methods
- Results
- Storm event information
- Flow measurement results
- Log of visual observations during storm event

TABLE 1
STORM WATER MONITORING PARAMETERS

Constituent	Units	Test Method[1]	Detection Limits[2]
Biochemical Oxygen Demand	mg/l	EPA 405.1	10 mg/l
Chemical Oxygen Demand	mg/l	EPA 410.4	30 mg/l
Total Suspended Solids	mg/l	EPA 160.2	1.0 mg/l
Total Phosphorus	mg/l	EPA 8190	0.15 mg/l
Total Nitrogen	mg/l	EPA 300.0	0.1 mg/l
Nitrate + Nitrite Nitrogen	mg/l	EPA 352.1	0.25 mg/l
Oil and Grease	mg/l	EPA 413.1	1.0 mg/l
pH Range	Std. units	EPA150.1	0.1 unit
Total Recoverable Iron	mg/l	EPA 236.1	0.2 mg/l
Total Recoverable Aluminum	µg/l	EPA 202.1	0.1 mg/l
Total Recoverable Copper	µg/l	EPA 220.1	0.2 mg/l
Total Recoverable Lead	µg/l	EPA 239.1	0.1 mg/l
Ammonia	mg/l	EPA 6010B	0.05 mg/l
Alpha Terpineol	µg/l	EPA 8270C	5.0 µg/l
Benzoic Acid	µg/l	EPA 8270C	4.0 µg/l
p-Cresol	µg/l	EPA 8270C	5.0 µg/l
Phenol	µg/l	EPA 8270C	5.0 µg/l
Total Recoverable Zinc	mg/l	EPA 6010B	0.02 mg/l

Note:
1. Equivalent EPA test methods may be substituted.
2. Detection limits may vary based on specific method and laboratory. Methods and detection limits will be included in monitoring reports.

7. IMPLEMENTATION PROCEDURES

This section describes the procedures to be followed at MISWF to implement this SWPCP and ensure that any storm water discharges meet state water quality standards. The principal elements of implementation are training, inspections, documentation and maintaining the plan in a current state.

7.1 Employee Training

The Environmental Compliance Officer for MISWF will prepare and present an annual training session for all site operations staff to inform them of the SWPCP plan and requirements. The training will include information on regulatory requirements, facilities and procedures for preventing storm water pollution, and spill prevention and control measures. Documentation of the training will include an outline of the contents and an attendance list of staff participants.

7.2 Inspections

7.2.1 Frequency of Inspections

Inspections of the storm water management system at MISWF must be made at least twice each year at the following times:

- During the month of August prior to preparing the annual Surface Water Management Plan required to be submitted to the DOH Solid Waste Division by September 1 of each year, according to the site's Solid Waste Management Permit; and
- During the first major rain event of the season

7.2.2 Scope of Inspections

Each inspection will be conducted by the MISWF Environmental Compliance Officer or designee and will include the following elements:

- Condition of landfill cover and the presence of eroded areas or areas susceptible to erosion during storm events;
- Condition of drainage channels and pipes, including damage or presence of excessive sediment, litter or debris;
- Condition of storm water basins including presence of excessive sediment, vegetation or debris;
- Need for temporary drainage and erosion control measures on landfill access roads and inactive areas;
- Condition of diversion and retention berms at the active landfill working face;
- Condition of spill prevention and control facilities relative to handling and storage of fuel, leachate and landfill gas condensate; and
- Detailed description of deficiencies and recommendations for maintenance or repairs to correct them.

7.2.3 Documentation

Inspections will be documented on a form prepared by the Environmental Compliance Officer. All inspection reports must be retained on site for a minimum of three (3) years.

7.2.4 Correction of Deficiencies

Any deficient conditions identified in an inspection should be corrected within 14 days if possible. Conditions requiring construction or repairs that are not capable of being implemented within 14 days should be completed as soon as possible according to a schedule established and documented within 14 days after the inspection. In no event should items identified in the August inspection be completed later than October 15.

Corrective actions must be documented in the relevant inspection report or an addendum to the inspection report.

7.3 Storm Water Pollution Control Plan Maintenance

7.3.1 Location of the SWPCP

A current copy of the SWPCP must be maintained at the administration building on-site at MISWF, where it is readily available for inspection by DOH personnel.

7.3.2 Procedures for Updating the Pollution Control Plan

The SWPCP may be amended from time to time, either at the request of the Hawaii Department of Health or at the County's initiative. The Plan must be amended whenever a change in the facility occurs that may significantly affect the discharge of pollutants to surface water, or when there is a change in regulatory requirements. Revisions in the SWPCP should also be made when stormwater management systems or practices are made. The site Environmental Compliance Officer has primary responsibility for determining when the SWPCP requires updating, and facilitating the revisions in consultation with other responsible parties.

7.3.3 SWPCP Submittals

Copies of the revised SWPCP or revisions to it are required to be submitted to the Hawaii Department of Health within thirty days after revisions are made. Copies of the revised plan or of revised sections should be submitted to both the Clean Water Branch and Solid Waste Branch of HDOH.

APPENDIX F

LANDFILL GAS MONITORING PLAN

LANDFILL GAS MONITORING PLAN

for

MOLOKAI INTEGRATED SOLID WASTE FACILITY

Prepared for:

County of Maui
Department of Environmental Management
Solid Waste Division
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Prepared by:

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November 2008
Revised: November 2017

Molokai Landfill
Landfill Gas Monitoring Plan
November 2017

Introduction

This Plan describes the regulatory requirements, facilities, and operational procedures for monitoring potential migration of landfill gas from the Molokai Landfill. It has been prepared for submittal to the Hawaii Department of Health (DOH) and, after approval by DOH, to guide implementation of landfill gas monitoring by the County of Maui.

This document was prepared by A-Mehr, Inc. on behalf of the Solid Waste Division of the Maui County Department of Environmental Management.

Regulatory Requirements

Hawaii Administrative Rules, Title 11, Section 11-58.1-15(d) requires operators of municipal solid waste landfills to implement a routine methane monitoring program to ensure that

(1) Concentrations of landfill gas do not exceed 25 percent of the lower explosive limit for methane in facility structures, and;

(2) The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary. Monitoring is required no less frequently than quarterly, and is to be based on site-specific factors including:

- Soil conditions;
- Hydrogeologic conditions surrounding the facility;
- Hydraulic conditions surrounding the facility; and
- The location of facility structures and property boundaries

Molokai Landfill Site Conditions

Site Geology

Pre-landfill soils mapping by the US Soil Conservation Service (1972) indicates the presence of two primary soil types originally beneath the landfill. Soils underlying the northwest part of the facility are designated by the Soil Conservation Service as "Holomua Silt Loam, Severely Eroded" and consist predominantly of well-drained silty loam or silty clay loam soils. Soils beneath the southeastern part of the facility are designated by the US Soil Conservation Service as "Very Stony Land, Eroded". In 1992, Pacific Geotechnical Engineers (PGE, 1993) conducted an investigation of shallow soil characteristics and depth to bedrock which included the completion of 21 shallow exploratory trenches. The results of PGE's investigation indicate site soils consisting primarily of weathered andesite, with relatively competent andesitic bedrock occurring at depths of 1.5 to 8 feet below the original ground surface.

The previous geotechnical investigation by PGE (1993) indicates the presence of andesitic bedrock at shallow depths at the Molokai Landfill site. This is consistent with geologic mapping by Stearns and Macdonald's (1947) which indicates that the site area is underlain directly by the andesite member of the East Molokai Volcanic Series (EMVS) lithologic series. Inferred information regarding the thickness of the andesite member and the character of the underlying basalt member is available from observations of conditions in the Manawainui Gulch, which is located approximately 1,500 feet north and north-northwest of the landfill. Quarrying activities within adjacent portions of the Manawainui Gulch have created good exposures of the upper approximately 60 to 70 feet of the EMVS which include the contact between the andesite member and the underlying basalt member (Parametrix, 1992). Field investigations by Parametrix (1992) indicate that the andesite member in the quarry sequence is between 10 and 15 feet thick and overlies a repetitious sequence of thin-bedded aa-type basaltic flows with local layers of volcanic cinders and lenticular deposits of volcanic ash. Based on the Parametrix data, the basalt member is at least 60 feet thick in the quarry sequence.

Hydrogeology

No site-specific data exists regarding the depth and quality of groundwater immediately beneath the Molokai Landfill. Based on the facility's regional setting and limited data from local wells, it is likely that first groundwater beneath the MISWF occurs within basaltic lithologies as part of the island's laterally extensive basal groundwater lens. Given that the site vicinity lacks the large volcanic dike complexes of the northeastern highlands, no significant dike-impacted groundwater resources are expected to occur beneath the site. Similarly, the lack of reported surface water springs at the facility suggests that perched groundwater conditions are not significant, at least within the upper portions of the basalt member. Given these assumption, the elevation of first groundwater beneath the MISWF is likely to be encountered at elevations of no more than about 10 feet above sea level (175 to 265 feet below ground surface).

Gas Migration Potential

Phases 1 and 2 of the landfill were constructed prior to passage of federal and state requirements for installation of liners and leachate collection systems in solid waste landfills, and are not equipped with continuous bottom liners that would impede the potential migration of landfill gas. Phases 3, and 4, and all future expansions of the landfill, have and will have a composite liner system and therefore will have a very low potential for subsurface gas migration. In general, the site is expected to produce relatively low volumes of landfill gas due to the low volume of waste disposed and the dry climate which creates conditions for low rates of waste decomposition and resultant generation of methane gas.

Gas Monitoring Network Design

A total of five (5) landfill gas compliance wells are installed at the landfill. The wells are installed within the permitted boundary of the landfill, installed in native soil, and to the depth of waste at the deepest part of the landfill and at a maximum spacing between the wells of approximately 1,000 feet.

Well construction included the following activities:

1. Boring of five (5) perimeter monitoring wells within the permitted boundary of the landfill and outside of the waste fill in native soil material, at locations designed to reduce the maximum lateral spacing between adjacent wells to less than 1,000 feet.

2. Installation of a total of eleven probes (3 each in LFG wells GP-1 and GP-5, 2 each in LFG wells GP-2 and GP-4, and 1 in well GP-3) to the lowest elevation of waste.

All perimeter monitoring probe are completed with ¼-inch labcock valves, and identification tags. All landfill gas perimeter wells are enclosed in a locking steel monument, and protected by three (3) traffic bollards installed in a rectangular concrete pad. All well casings and traffic bollards are painted for high visibility.

TABLE 1
MOLOKAI LANDFILL GAS MONITORING WELL DATA

Well No.	Ground Elevation[1]	Total Depth (FT)	Number of Screens	Shallow Screen Interval	Intermediate Screen Interval	Deep Screen Interval
GP-1	254	56	3	5'-15'	25'-35'	45'-55'
GP-2	218	33	2	6'-11'	-	19'-29'
GP-3	191	13	1	6'-11'	-	-
GP-4	227	30	2	6'-11'	-	19'-29'
GP-5	259	63	3	9'-19'	29'-39'	49'-63'

The locations of the gas probes are shown on Figure 1.

Monitoring Program

In conformance with DOH regulations, each probe will be monitored on a quarterly basis. Trained County personnel will monitor the probes using a GEM-2000 infrared landfill gas monitoring instrument. Typical field procedures for monitoring gas probes are as follows:

- Check each probe's condition and structural integrity and suitability for monitoring. Be sure each inspected probe is not subject to excessive negative pressure generated by nearby vacuum sources. A simple way to check for negative pressure is to hold a sheet of paper just above the opening of the probe and see if the paper is sucked to the opening. If the paper is sucked to the probe opening, the probe is more than likely influenced by negative pressure. Probes should also be checked for presence of water prior to monitoring. Probes that are damaged or are under negative pressure are considered inadequate for use.

- Use a gas monitoring instrument that is properly calibrated and warmed up for at least 5 minutes. Open the labcock or otherwise ready the probe for sampling, and connect the flexible intake tube assembly to the probe, making sure that there is a tight seal.

- Direct connect the instrument to the probe. Monitor until a steady state reading is achieved for 30 seconds and record the reading. It is not necessary to purge one probe volume of gas.

Readings will also be taken during each monitoring event of methane concentrations, if any, in site structures including the scalehouse and administration building.

Data from each quarterly monitoring event will be recorded and maintained at the Molokai Landfill and at the office(s) of designated Environmental Management Department personnel in Maui. The Department will summarize and report all data to DOH within 45 days after each monitoring event. In addition, any measurement of a methane concentration in excess of DOH regulations (lower explosive limit (LEL), or 5 percent by volume) in a perimeter gas probe, or 25% of the LEL (1.25 percent by volume) in structures, will be reported to DOH as a non-compliance event within 24 hours as required by the facility’s Solid Waste Permit.

References

California Code of Regulations, Title 27, Environmental Protection; Division 2, Solid Waste; Chapter 3 Criteria for All Waste Management Units, Facilities, and Disposal Sites; Subchapter 4. Criteria for Landfills and Disposal Sites; Article 6. Gas Monitoring and Control at Active and Closed Disposal Sites, Sections 20920 - 20925

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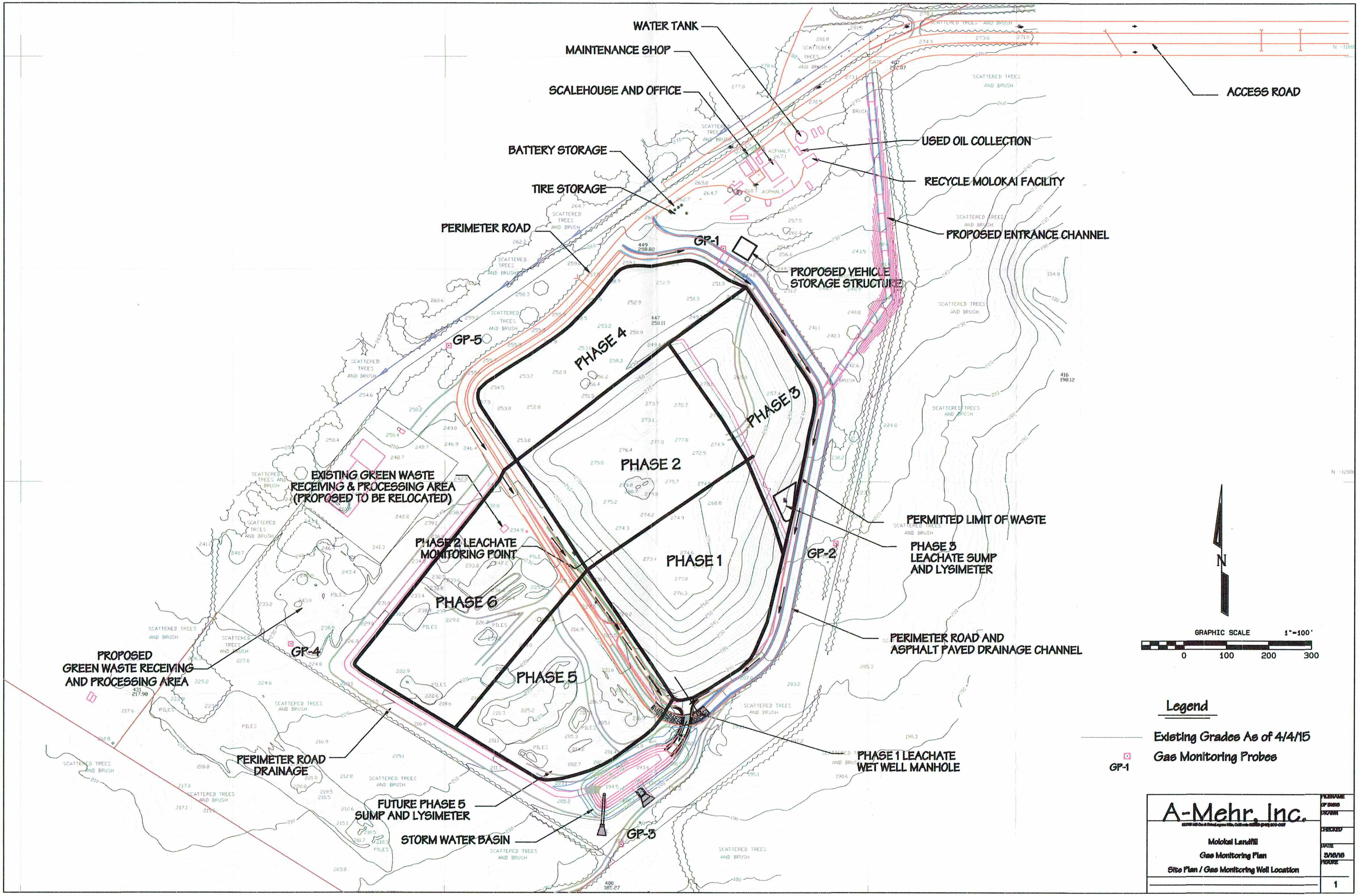

WATER TANK
MAINTENANCE SHOP
SCALEHOUSE AND OFFICE
BATTERY STORAGE
TIRE STORAGE
PERIMETER ROAD
ACCESS ROAD
USED OIL COLLECTION
RECYCLE MOLOKAI FACILITY
PROPOSED ENTRANCE CHANNEL
PROPOSED VEHICLE STORAGE STRUCTURE
GP-1
GP-2
GP-3
GP-4
GP-5
PHASE 1
PHASE 2
PHASE 3
PHASE 4
PHASE 5
PHASE 6
EXISTING GREEN WASTE RECEIVING & PROCESSING AREA (PROPOSED TO BE RELOCATED)
PHASE 2 LEACHATE MONITORING POINT
PROPOSED GREEN WASTE RECEIVING AND PROCESSING AREA
PERMITTED LIMIT OF WASTE
PHASE 3 LEACHATE SUMP AND LYSIMETER
PERIMETER ROAD AND ASPHALT PAVED DRAINAGE CHANNEL
PHASE 1 LEACHATE WET WELL MANHOLE
PERIMETER ROAD DRAINAGE
FUTURE PHASE 5 SUMP AND LYSIMETER
STORM WATER BASIN
SCATTERED TREES AND BRUSH
PILES
N
GRAPHIC SCALE 1"=100'
0 100 200 300
Legend
Existing Grades As of 4/4/15
Gas Monitoring Probes
GP-1
A-Mehr, Inc.
Molokai Landfill
Gas Monitoring Plan
Site Plan / Gas Monitoring Well Location
FILENAME
DRAWN
CHECKED
DATE
FIGURE
1

APPENDIX G

HAZARDOUS WASTE EXCLUSION PROGRAM

HAZARDOUS WASTE EXCLUSION PROGRAM

Molokai Integrated Solid Waste Facility
Naiwa, Hawaii

April 2008

Revised December 2013

Prepared by

County of Maui
Wailuku, Hawaii

Hazardous Waste Exclusion Program
Molokai Integrated Solid Waste Facility

Table of Contents

1 INTRODUCTION

This Hazardous Waste Exclusion Program (Program) was prepared at the request of the County of Maui (County) for the Molokai Integrated Solid Waste Facility (MISWF) in accordance with 40 CFR, Section 258.20, "Procedures for excluding the receipt of hazardous waste". Section 258.20 states that "Owners or operators of all Municipal Solid Waste Landfill (MSWLF) units must implement a program at the facility for detecting and preventing the disposal of regulated hazardous wastes as defined in part 261 of this chapter (40 CFR Ch.1) and polychlorinated biphenyls (PCB) wastes as defined in part 761 of this chapter (40 CFR Ch.1)". This program must include, at a minimum:

- Random inspections of incoming loads unless the owner or operator takes other steps to ensure that incoming loads do not contain regulated hazardous wastes or PCB wastes.
- Records of any inspections.
- Training of facility personnel to recognize regulated hazardous waste and PCB wastes.
- Notification of State Director of authorized States under Subtitle C of RCRA or the EPA Regional Administration if in an unauthorized State if a regulated hazardous waste or PCB waste is discovered at the facility.

For purposes of this discussion, regulated hazardous waste means "a solid waste that is a hazardous waste, as defined in 40 CFR 261.3, that is not excluded from regulation as a hazardous waste under 40 CFR 261.4(b) or was not generated by a conditionally exempt small quantity generator as defined in subsection 261.5 of this chapter (40 CFR Ch. 1)".

This Program was developed to discover and discourage attempts to place hazardous or other unacceptable wastes, including PCBs, in the MISWF.

The hazards posed by the intentional and unintentional disposal of hazardous wastes in landfills designed for nonhazardous solid wastes are a concern. The repercussions of careless disposal practices include landfill worker injuries and illness, fires and explosions in collection vehicles and in the landfill, and contamination of air and groundwater.

The intent of this Program is to address the need for implementing a random load-checking program at the MISWF, which is located near the southern coast of the island of Molokai, approximately three miles northwest of Kaunakakai. The site currently accepts an average of 16.2 tons of refuse daily based on a five-day work week.

The Program has been designed to prevent, to the extent possible, the acceptance of prohibited wastes into the MISWF's waste stream. Specific elements of the program include:

- Descriptions of acceptable and prohibited wastes.
- Provisions for a random load-checking program for incoming wastes.

- Specifying methods for determining the acceptability of wastes.
- Descriptions of other measures to discourage the disposal of prohibited wastes.

The details of the Program are presented in Sections 2.0 through 5.0.

2 DESCRIPTION OF ACCEPTABLE AND PROHIBITED WASTES

This section describes the types of waste that can be accepted at the MISWF and those that are prohibited. In addition, the characteristics of hazardous and designated wastes are described.

2.1 Acceptable Wastes

The MISWF can accept the following wastes:

- Residential and commercial refuse, municipal solid waste.
- Nonhazardous solid waste from industrial sources.
- Construction and demolition waste.
- Other nonhazardous solid wastes not prohibited from being accepted at the MISWF under its operating permits or under applicable law.

2.2 Prohibited Wastes

The MISWF is prohibited from accepting the following wastes:

- Hazardous or PCB contaminated wastes
- Untreated infectious and pathological waste from hospitals, veterinary facilities, and other similar facilities
- Liquids
- Agricultural waste unless approved by landfill personnel
- Green waste (Commercial loads containing greater that 25% green waste and residential containing greater than 50% green waste)
- White goods (accepted for recycling at the CML entrance facility)
- Vehicles
- Tires
- Unflattened cardboard boxes
- Tree trunks, roots, telephone poles, piling, cables, wire fences, and similar types of materials (longer than 4-feet)
- Drums unless one end is completely open
- Sewage sludge
- Fats, oils and greases
- Automobile batteries
- Radioactive wastes
- Electronic waste

Common examples of prohibited wastes include: oil-based paint, paint thinner, glues and solvents, flammable liquids, household cleaners and polishes, arsenic, pesticides, asbestos, acid and alkaline solutions, PCBs, inks, photographic and pool chemicals, oxidizers, gasoline, automotive products, poisons, explosives, pyrophorics, cyanides, sulfides, sulfuric and hydrochloric acid, and water reactives. Compressed gas cylinders, pharmaceuticals, and radioactive wastes also are prohibited.

3 LOAD-CHECKING PROGRAM

3.1 Objective

A key element in the hazardous waste exclusion program for the MISWF is a random load-checking program which is designed to detect and discourage attempts to dispose of prohibited wastes. The load-checking program for the landfill will entail the checking of one random load each week. The schedule will be random to make the load-checks unpredictable to facility users and therefore deter attempts to conceal prohibited wastes in their loads.

The County of Maui will designate and train members of the landfill staff who will be responsible for conducting the periodic load-checking program at the site. Back-up personnel will also be trained. The training program will consist of both classroom and hands on field training.

The procedures for the load-checking program are described below.

3.2 Initial Screening

The initial step in the load-checking program is to visually inspect all incoming vehicles at the scalehouse upon entrance to the facility. The trained inspector will observe incoming loads for any indication of prohibited wastes (e.g., unusual odors or leaks, smoke, suspicious behavior, etc.). If the inspector encounters suspicious looking loads; he will summon the Working Supervisor to determine if the waste is acceptable, and if necessary conduct a load-check. If prohibited wastes are identified during inspection of a load, the driver will be notified that the wastes must be removed from the facility premises and arrangements made for their proper disposal. If possible, the scalehouse attendant will provide information on how to properly dispose of the rejected waste.

3.3 Load-Checking

In addition to the initial screening, an inspector at the landfill, on a random basis, will select a load for inspection. The driver will be asked to unload the wastes at a designated location. The location shall be above the lined portion of the landfill, but away from the active area. If liquid wastes are suspected, special precautions shall be taken in the construction of berms and channels to contain possible spills. The driver will be instructed to pull forward while discharging the waste, resulting in the formation of a long, narrow windrow no taller than 4-feet. The inspector will then tear down the windrow, using a rake or shovel.

The discharged material will be carefully observed for the presence of any prohibited wastes in the load. The methods by which the acceptability of waste will be determined are described in Section 4.0. Information and observations will be recorded on the Load Check Data Sheet for the load. If necessary, photographs and samples will be taken.

The load-checking inspector will record as much of the following information as needed to identify the responsible party: (1) date, (2) time, (3) the hauling firm or vehicle owner's name, (4) the driver's name and driver's license number, (5) telephone number for contacting the company, (6) vehicle's license plate number, and (7) the source of the waste as stated by the vehicle driver. This information will be recorded on the Load Check Data Sheet (Form 1). The form will be signed by both the driver and the load-checking inspector.

A copy of the Load Check Data Sheet and any associated documents will be placed on file onsite at the MISWF. A duplicate copy will be sent to the Central Maui Landfill for retention by that office.

If hazardous or other unacceptable wastes are identified, the responsible party for transporting the wastes to the landfill will be notified that the wastes must be removed from the facility premises and arrangements made for their proper disposal. Incidents will be reported to the State of Hawaii Department of Health.

4 METHODS FOR DETERMINING WASTE ACCEPTABILITY

4.1 Physical Assessment

One means for determining the acceptability of a suspect waste is to examine a product label. Warning labels such as "harmful if inhaled", or "use only in a well ventilated area" are often useful in identifying the waste type. In some cases, physical signs (i.e., odor, color) of the presence of a prohibited waste are detected. This observation, coupled with a customer's response to questions, often provides sufficient data to prohibit the wastes.

In physically assessing a waste load, the inspector may note an incompatibility in waste type that draws attention to a part of the load that seems out of place. An example would be one or more 55 gallon drums within a load of residential refuse. Once noted, the customer would be questioned, and if needed, additional assessment undertaken.

4.2 Additional Assessment

In some cases, the steps outlined above may be insufficient to identify whether the waste can be accepted at the facility. Since it is the customer's responsibility to ensure that a waste is permissible, the load-checking inspector may require that additional measures be undertaken by the customer at the customer's expense prior to accepting the waste. When this occurs, the customer will be advised to exercise one or more of the following options in order to dispose of waste at the facility:

- Written clarification by regulatory agencies.
- Material Safety Data Sheets (MSDS)
- Written clearance from the County of Maui, operator of the MISWF.
- Analysis by a state-certified hazardous waste laboratory.

Ultimately, the responsibility for obtaining the laboratory analysis and incurring costs lies with the customer.

4.3 Disposition of Prohibited Wastes

If prohibited wastes are discovered as a result of any of the waste identification activities listed above, the customer is informed that such wastes cannot be accepted by the facility. In addition, the customer is informed that these prohibited wastes must be removed from the facility premises and arrangements must be made for their proper disposal. If possible, landfill personnel shall advise the customer on how to dispose of prohibited wastes.

5 Procedures for Handing Identified Prohibited Wastes

5.1 Procedures for Handling and Removing Prohibited Wastes

Upon identifying suspected hazardous wastes, the area will be isolated and people shall be moved upwind. The Maui County Fire Department (911) shall then be notified as well as the Working Supervisor, and First Aid administered if necessary. To maintain the necessary level of safety training, all personnel involved with the identification, handling, and storage of prohibited waste should be trained in the procedures outlined in this program as well as basic Occupational Safety and Health Administration (OSHA) hazardous waste training.

A. Protective Clothing

All personnel involved in the handling and/or removal of hazardous waste must wear, at a minimum, the following protective clothing:

- Chemical resistant gloves (heavy industrial or nitrile with cotton liner)
- Steel toe boots
- Dust mask
- Goggles
- Hard hat
- High-visibility safety vest

Other Protective Clothing/Equipment (optional):

- Tyvek suit: Required when used oil or other recyclable materials are bulked. A tyvek suit may also be worn at the discretion of personnel handling household hazardous waste in their routine duties.

- Half-facepiece respirator: All personnel handling household hazardous waste should be fit-tested for and should have accessible a half-facepiece air purification respirator. Each respirator shall be equipped with cartridges designed to remove dusts, acid gases, organic vapors, and radionuclide (Such cartridges are typically color-coded yellow and magenta).

5.2 Household Hazardous Waste Handling Procedures

Household hazardous wastes are generally those unwanted chemical products found in homes such as pesticides, household cleaners, automotive products, paints, solvents, etc. These wastes may be detected through the random load checking program or by site personnel in the working face. These materials should be removed and set aside for proper disposal. Handling and storage procedures are discussed in Section 6.0.

5.3 Prohibited Waste Handling Procedures

If hazardous or other unacceptable wastes are detected by site personnel, the area will be immediately cordoned off from the general public and site personnel not involved in the incident. The Maui County Fire Department shall be contacted along with the Working Supervisor. Upon approval from the Fire Department Hazmat Team, the unacceptable waste shall be safely separated and moved away from the active face and either:

- Notify the response unit of the Department of Health which will conduct the cleanup, transport, and disposal of the wastes. The wastes will be disposed of at an approved facility. The incident and response will be recorded in the site records; or
- If the producer of the waste is known, the producer will be contacted and notified of the incident and the operations' action. The producer will be billed for all costs incurred in the proper cleanup, transport, and disposal of waste.

6 ADDITIONAL WASTE ACCEPTANCE CONTROL PROCEDURES

6.1 Signs

Signs will be posted at the site entrance that clearly state the types of wastes not accepted at the site. In addition to stating that hazardous wastes are not accepted at the site, the signs will cite examples of such materials in non-technical language. In addition, a sign will be posted at the site entrance stating that a random load-checking program is in effect.

6.2 Source Control

In order to further prevent the disposal of known hazardous wastes, franchised commercial haulers, as well as businesses with commercial/industrial accounts at the MISWF, will receive notices by mail, through advertisements, or by handouts given out at the landfill by the scalehouse attendant alerting them to the Hazardous Waste Exclusion Program. An example of a customer notice that could be given out is attached. This should discourage to deliberate disposal of hazardous material.

6.3 Observation by Operation Personnel

In addition to observations for hazardous wastes that are conducted in the load checking program, the landfill operator will be trained and directed to identify potentially prohibited wastes that may be delivered to the site. Equipment operators will also be trained to identify prohibited wastes as they are spread and exposed on the working face of the site. The following describes the procedures to be followed at the working face:

Visual Inspection of the Working Face

- AS REFUSE IS DUMPED AND COMPACTED;

  Bulldozer operators and other trained personnel shall observe the working face for suspicious objects and record findings on a daily log sheet. Objects to beware of are:

  - Red bags (infectious waste).
  - Containers which are 5 gallons or larger.
  - Other hazardous type material.

- IF ANY SUSPICIOUS MATERIAL IS SPOTTED;

  - Stop compacting operations in the immediate vicinity of the suspicious material.
  - Notify the Designated Supervisor.

- PROCEDURE FOR HANDLING, REMOVAL AND STORAGE;

  Hazardous waste personnel will follow procedures described in Sections 5.0 and 7.0 of this report for handling and removing hazardous waste and hazardous waste storage.

- LOAD CHECK DATA SHEET;

  A Load Check Data Sheet (Form 1) must be completed by hazardous waste personnel, for any dangerous or significant quantity of hazardous waste discovered.

6.4 Known Offenders

Special caution will be taken when accepting wastes from sources that have previously attempted to deliver hazardous wastes to the site. Precautionary measures will include: (1) questioning of the vehicle driver by the scalehouse attendant concerning the contents of the load, (2) visually inspecting the load prior to discharging, when feasible, (3) additional recordkeeping at the scalehouse regarding the delivery of wastes from such sources, and (4) additional efforts by site personnel at the working face to observe the wastes discharged from such sources. Repeat offenders will be banned from the site.

7 HAZARDOUS WASTE STORAGE AND REMOVAL

The County of Maui currently stores hazardous waste in a twenty foot container and will be evaluating permanent hazardous waste storage alternatives for the MISWF. Upon siting of a permanent hazardous waste storage area, this area will store only hazardous waste generated from the MISWF's Hazardous Waste Exclusion Program and wastes illegally disposed of immediately outside the landfill.

This storage area will be inspected regularly by trained personnel for signs of leaking or spilled hazardous waste. The inspector will immediately notify the designated supervisor of any incident and will fill out a Load Check Data Sheet (Form 1).

7.1 Onsite Storage Time Limitation

Onsite hazardous waste storage will be limited to 90 days or as required by the State Health Department prior to offsite disposal. Waste may be transported to a permitted treatment, storage and disposal facility (TSDF) any time prior to that.

7.2 Accumulation Start Date

The "Accumulation Start Date" on the EPA label of each drum containing hazardous waste should be monitored on a regular basis. At 60 days from the earliest "Accumulation Start Date", arrangements should be made to transport and properly dispose of the waste to allow time for the disposal site operator to review the inventory sheets for the drum shipment and accept the waste. If the "Accumulation Start Date" has a worn off label, information on the start date from the inventory sheets should be transferred to a new label.

7.3 Storage Area Inspections

The designated hazardous waste storage area shall be subject to a monthly inspection. The monthly inspection will be documented on the Storage Area Monthly Inspection Report (Form 2). This report addresses proper labeling of the containers, the integrity of containers and storage area and the presence and condition of safety equipment. The completed monthly report form will be retained on file at the MISWF office.

If it is found through the monthly inspection that problems exist with the drum labeling, container or storage area integrity or that necessary safety or spill containment equipment is absent or non-functional, the designated supervisor shall be notified immediately so that corrective measures can be taken.

7.4 Hazardous Waste Removal/Disposal

Unsuitable wastes identified through the MISWF's hazardous waste exclusion program are handled as follows:

- If the wastes pose an immediate risk to heath, safety and/or the environment, a hazardous material spill contractor will be contacted for immediate clean-up, packaging, transportation and disposal;
- Wastes which are in adequate containers and can be safely handled are either returned to the hauler if possible, or stored onsite in a designated area (e.g., the storage container, the waste oil tank, etc.) to await proper disposition/ recycling within 90 days by a licensed hazardous waste hauler/recycler.

8 REPORTING

The reporting requirements for the Hazardous Waste Exclusion Program will consist of recording information and observations during the load-check inspection and storage area inspection. The Load Check Data Sheet (Form 1) will be completed by the load checking inspector and signed by the vehicle driver. A copy of the Load Check Data Sheet and any associated documents will be placed on file at the landfill and a duplicate copy will be sent to the State of Hawaii, Department of Health.

A report will be prepared on a monthly basis for inspection of the hazardous waste storage area (Form 2). These reports will document proper labeling of the containers, the integrity of the containers and storage area, and the presence and condition of safety equipment. Completed report forms will be retained onsite and at the Central Maui Landfill office.

FORMS

FORM 1

LOAD CHECK DATA SHEET

Hazardous Waste Exclusion Program
Molokai Integrated Solid Waste Facility

1. Date:_______________ Time:______a.m.
p.m.

Location:

___Scalehouse
___Visual Inspection of Working Face
___Other_________________________________
___Random Load Check
___Storage Area

2. Information on vehicle that is responsible for bringing waste to the landfill.

Driver's Name:____
Last First Middle Initial

Driver's License No.:_________________

Vehicle License Plate No.:________________

Vehicle Owner / Agency:

___City (Specify)____
___Other (Specify)____

Owner Telephone No.:___________________________

Vehicle Type:

___Refuse Truck
___Transfer Trailer
___Other___________________________________

3. Prohibited Materials Found (or Suspected) and Approximate Quantity:

____
____
____

Origin of the Waste and Generator:

____
____
____

FORM 1

LOAD CHECK DATA SHEET
(continued)

List of hazards to Human Health or Environment (also list injuries if any):

____

____

____

Quantity of Hazardous Materials Recovered and Unrecovered and their Condition (if any):

____

____

____

Corrective Actions Taken to Prevent Incident Reoccurrence (if any):

____

____

____

Driver's Signature:____

Landfill Employee's Signature________________________________

Reporting to Hawaii Department of Health

If prohibited wastes are found, a copy of this report must be sent to the HDOH within 24 hours of incident. If this is a weekly random load-check, file in the office and send a copy to Central Maui Landfill.

FORM 2

STORAGE AREA
MONTHLY INSPECTION REPORT

Hazardous Waste Exclusion Program
Molokai Integrated Solid Waste Facility

Date: ______________

Inspected by: ______________________

1. Check the storage area for the presence of leakage, liquid or gaseous, from any drum or pail containing waste. Is there any leakage?

   Yes / No (circle and initial) _________

2. Is/are the hazardous waste transport vehicles properly placarded on all four sides?

   Yes / No (circle and initial) _________

3. Is proper signage posted in the hazardous waste storage area?

   Yes / No (circle and initial) _________

4. Are containers properly labeled with the Hawaii Hazardous Waste sticker and is the sticker visible for inspection?

   Yes / No (circle and initial) _________

5. Are containers in good condition and are those containers containing waste closed?

   Yes / No (circle and initial) _________

6. Is the storage area structurally intact (the underlying surface, concrete or asphalt, should be void of cracks)?

   Yes / No (circle and initial) _________

7. Is necessary safety equipment available and operational for use in an emergency?

   Fire Extinguishers: Yes / No (circle and initial) _________

   First Aid Kit: Yes / No (circle and initial) _________

   Absorbent/Spill Containment Materials: Yes / No (circle and initial) _________

Comments:

____

____

____

ATTACHMENT

NOTICE TO SITE USERS
CONCERNING WASTE ACCEPTANCE
CONTROL PROGRAM

- Hazardous wastes are not accepted at the Molokai Integrated Solid Waste Facility and may not be placed in refuse containers.
- Hazardous wastes present a significant danger to both human health and the environment. Hazardous wastes are therefore prohibited by law from disposal at sanitary landfills.
- Typical household wastes that are considered to be hazardous include oil-based paint, paint thinner, glues and solvents, pesticides, household cleaners and poisons, waste chemicals, treated wood, demolition debris, excavated soils, flammable liquids, poisons, and automotive products.
- A load-checking program is in effect at the disposal site for detecting hazardous and other unacceptable wastes.
- If hazardous or other unacceptable wastes are delivered to the Molokai Integrated Solid Waste Facility, the party responsible for transporting the waste will be billed for the removal and disposal of such wastes in state-approved facilities.
- There are Federal and State penalties for the improper disposal of hazardous and certain other types of wastes.

APPENDIX H

CONSTRUCTION AND DEMOLITION WASTE ACCEPTANCE AND REPORTING FORMS

FOR OFFICIAL USE ONLY	
C&D Job No.:______________________________	Date Approved:____________________
Approved By:______________________________	Expires 6 Months from Approval

Declaration of Non-Hazardous Commercial Construction and Demolition Waste
MAUI COUNTY LANDFILLS

For Delivery To: ☐ **Molokai** ☐ **Lanai** ☐ **Central Maui**

Waste Generator / Jobsite

Property Owner:______________________________

Jobsite Address:______________________________

____

Phone No.:______________________________

Contractor

Contractor:______________________________

Address:______________________________

____

Phone No.:______________________________

Email Address:______________________________

Waste Transporter

Transporter:______________________________

Address:______________________________

____

Phone No.:______________________________

Email Address:______________________________

C&D Delivery Period is 6 Months from Date of Approval.

Note: Customers should renew their C&D Job No. prior to expiration.

USE OF SITE	**JOB/PROJECT**	**WASTE MATERIAL**	
☐ Residential	☐ Demolition	☐ Canec	☐ Transite
☐ Commercial	☐ Renovation	☐ Concrete/Asphalt	☐ Asbestos
☐ Industrial	☐ Roofing Only	☐ Grub	☐ Lead Based Paint
☐ Vacant Land	☐ New Construction	☐ Mixed Const. Waste	☐ Paint Chips
☐ State/Federal	☐ Other:__________	☐ Rock/Dirt/Soil	☐ Contaminated Soil
☐ Other:__________		☐ Liquid Waste/Sludge	☐ Other:___________

THE UNDERSIGNED HEREBY CERTIFIES THAT IT HAS REVIEWED AND WILL COMPLY WITH THE ATTACHED TERMS, CONDITIONS AND PROVISIONS AND REPRESENTS THAT THE FOLLOWING PERSONS ARE AUTHORIZED TO EXECUTE THIS AGREEMENT.

____ ______________

Print Name of Property Owner or Authorized Agent / Signature *Date*

____ ______________

Print Name of Contractor Authorized Agent / Signature *Date*

____ ______________

Print Name of Transporter Authorized Agent / Signature *Date*

Only wastes delivered by the Transporter identified above will be accepted. For any additional transporters submit an additional separate copy of this Form.

Terms, Conditions and Provisions:

1. Materials delivered **do not** contain hazardous wastes as defined by Federal, State and local agencies, including but not limited to radioactive, Polychlorinated Biphenyls (PCBs), petroleum, asbestos and lead.
2. Materials delivered under this C&D Number are solely from the above Waste Generator / Jobsite address.
3. Any and all information provided by me herein and as supplement to is true and correct.
4. I will indemnify, defend and hold harmless the County of Maui and authorized agents, from any and all claims, actions, proceedings, expenses, damages and liabilities, including attorney's fees and costs, directly or indirectly arising out of the services received.
5. The County reserves the right to refuse service where the County has cause, for any reason, to believe that incoming materials may contain unacceptable materials, sourced from a location other than specified above, or adversely affects the landfill.
6. The County may require testing results from an independent, certified laboratory (at no expense to the County) to confirm that all materials delivered contains no unacceptable wastes. Samples submitted for testing shall be representative of the wastes to be delivered and collected in accordance with EPA SW-846. Requested tests may include but not limited to TCLP metals, VOCs, Semi-VOCs, and EPA Method 8080.
7. The County of Maui reserves the right to change the terms, conditions and provisions of this contract at any time.

Maui County Landfills

Commercial Construction and Demolition Waste Acceptance General Conditions

Acceptable Material

Maui County Landfills may only accept materials originating from commercial construction and demolition (C&D) sites in accordance with its State Department of Health Permit. By permit Central Maui Landfill cannot accept C&D waste unless there are no other permitted private C&D landfills in operation. C&D waste is defined as solid waste resulting from the construction, repair, demolition, or razing of buildings, of roads, and other structures. It includes the land clearing debris from the clearing of land for construction. Construction and demolition wastes typically consist of concrete, hollow tile, bituminous concrete, asphaltic pavement, wood, glass, masonry, roofing, siding, plaster, alone or in combinations. Land clearing debris typically consists of dirt, rock, stumps, boulders, brush, and other similar material. Demolition and construction waste does not include cleanup materials contaminated with hazardous wastes, asbestos, waste paints, solvents, sealers, adhesives, or similar materials.

Unacceptable Material

The Maui County Landfills will not accept any materials prohibited under Hawaii Revised Statues (HRS) Chapter 342H and Hawaii Administrative Rules (HAR) Section 11-58.1 including but not limited to the following:

Petroleum Contaminated Materials	Green Waste
Tires	Flammable Explosives
Vehicle Parts and Fluids	Toxic and Carcinogenic Materials
Appliances (White Goods)	Flammable Explosives
PCBs	Adhesives
Tanks and Cylinders	Sealers
Liquids	Asbestos (separate receiving procedures apply)
Medical Wastes	Solvents
Batteries and Electronic Wastes	Paints
Sealed Barrels/Drums	Hazardous Waste, as defined in Section 8.04.010 Maui County Code

Waste Size Limitations

Incoming materials shall be no larger than 4-feet in the first and second largest dimensions and 1-foot in the smallest dimension. Concrete, boulders and rubble shall be no greater than 4-feet long in the largest dimension, 2-feet in the second and third largest dimensions and shall be free of protruding materials.

Waste Screening

The County shall assume no responsibility for screening, examining or inspecting any or all loads delivered by the Customer. The County may inspect incoming loads at any time.

C&D Acceptance Hours (unless otherwise arranged at your local landfill office)

The Maui County Landfills will only accept C&D wastes on weekdays from opening through 1PM, or as otherwise directed by your local landfill. C&D will not be accepted on Saturdays and County Holidays.

Loads consisting predominantly (i.e. greater than 50% by volume) of lightweight materials such as styro-foam, shredded paper, and sandblast material will only be accepted on weekdays from opening to 8AM, or as otherwise directed by your local landfill.

Rates

Please contact your local landfill office for rates and charges for C&D waste disposal. Rates and charges are subject to change.

Recycling

Contractors are encouraged to reuse, repurpose, donate or recycle to the greatest extent possible. For more information on recycling in your area, please contact the County Recycling Hotline at 270-7880.

C&D Number

The completed Declaration of Non-Hazardous Construction and Demolition Waste Form shall be emailed or mailed to the Central Maui Landfill Office along with any supporting documentation, i.e.; building assessment/abatement reports or any certified laboratory testing results for C&D wastes suspected to contain hazardous wastes:

Email: *ConDemo@co.maui.hi.us*

Address: *Central Maui Landfill*
PO Box 518
Puunene, Hawaii 96784

Please allow for up to 7 business days for processing. Upon completion, a copy of this form will be emailed or mailed back to the Contractor with the project C&D Job Number unless further information is required. For more information please call (808) 280-3416 or visit our website at: *www.co.maui.hi.us/1739/Commercial-ConstructionDemo-Waste-Accept.*

Revised 12/12/16

County of Maui
Soil Profile Sheet

1. Soil Generator Information
a. Generator Name:______________________________
b. Generator Address:______________________________c. Zip Code:______________
d. Address of Soil Generation: ______________________________
e. Address of Soil Storage (if different from source address)______________________________
f. Type of Facility Soil Has Been Generated From:______________________________
____
g. State DOH Facility ID#:______________________________
h. Contact:______________________________i. Phone: (___) ____________

2. Soil Information
a. Name of Contaminant(s):______________________________
b. Amount of Soil (tons and/or cubic yards)______________________________
c. Type of Soil:______________________________
d. Soil Moisture: Wet:__________ Damp:_________ Dry:__________
e. Soil Color (Munsell Color Chart Code if available)______________________________
f. Strong incidental odor ? No________ Yes________ Describe:______________________
g. pH ____________________________
h. Is the soil ignitable? Yes______________ No______________

i. Describe the circumstances by which the soil has been generated.
____
____

3. Transportation Information
a. Method of Shipment: Bulk Solid____________ Drum/Box______________ Other___________
b. Transportation Company:
____

c. Is this a U. S. Department of Transportation (USDOT) Hazardous Material? Yes____ No ____

4. Chemical Contaminants (Attach supplementary sheets if necessary)

Range (Min-Max)
a. ______________________________ __________-__________ppm.
b. ______________________________ __________-__________ppm.
c. ______________________________ __________-__________ppm.
d. ______________________________ __________-__________ppm.
e. ______________________________ __________-__________ppm.
f. ______________________________ __________-__________ppm.
g. ______________________________ __________-__________ppm.
h. ______________________________ __________-__________ppm.
i. ______________________________ __________-__________ppm.

Attach copies of analytical reports and chain of custody documentation.
Attach a description of the soil sampling procedures.
Attach a site plan showing where the soil originated, and where samples were collected.

Continued

j. Does the soil contain any of the following (provide concentration if known)

PCBs	Yes___________	No___________	_______ppm
Cyanides	Yes___________	No___________	_______ppm
Sulfides	Yes___________	No___________	_______ppm
Asbestos	Yes___________	No___________	_______%

k. Indicate method used to determine the presence or absence of items listed in section j.

____

____

l. Sampling Source(e.g., Drum, Pit, Pile, Insitu, etc.)__________________________________

____

m. Does the waste represented by this profile contain any of the carcinogens that require OSHA notification? Yes____No____
n. Does the waste represented by this profile contain dioxins? Yes____No____(List in Section 4)
o. Does the waste represented by this profile contain asbestos? Yes____No____If yes, friable______non-friable________.
p. Does the waste represented by this profile contain benzene? Yes____No____
q. Is the waste subject to RCRA Subpart CC Controls? Yes____No____
r. Does the waste contain any Class I or Class II ozone-depleting substances? (Freons) Yes____No____
s. Does the waste contain debris? Yes____No____(List, if yes)__________________________________
t. Personal Protective Equipment Requirements: ______________________________________
u. Is this a state hazardous waste? Yes____No____ (List, if yes)________________________________

v. Is the Waste from a CERCLA or state mandated clean-up? Yes____No____ (if yes, provide relevant documentation.)

w. Does the waste represented by this waste profile contain concentrations of PCBs regulated by 40 CFR ? Yes____No____
x. Does the waste represented by waste profile contain radioactive material or disposal regulated by the NRC? Yes____No____
y. Does the waste profile and all attachments contain true and accurate descriptions of the waste material, and has all relevant information within the possession of the Generator regarding known or suspected hazards pertaining to the waste been disclosed to the contractor? Yes____No____

5. Generator’s or Representative’s Certification

a. Print Sampler's Name:________________________________ b. Sample Date:________________
c. Sampler's Title:____
d. Sampler's Employer (if other than Generator):______________________________________

The sampler's signature certifies that any sample submitted is representative of the soil described above pursuant to the DOH Technical Guidance Manual for Underground Storage Tank Closure and Release Response (August 1992) and EPA SW-846.

e. Sampler's Signature:____

Continued

6. Generator Certification

By signing this soil profile sheet, the Generator certifies:

a. This soil is not a "Hazardous Waste" as defined by EPA or the State of Hawaii.

b. This waste does not contain regulated radioactive materials or regulated concentrations of PCBs (Polychlorinated Biphenyls).

c. The statements and attachments contain true and accurate descriptions of the soil. All relevant information regarding known or suspected hazards in the possession of the Generator has been disclosed.

d. The analytical data presented herein or attached hereto were derived from testing representative samples taken in accordance with the DOH Technical Guidance Manual for Underground Storage Tank Closure and Release Response (August 1992 and subsequent amendments/revisions) and EPA SW-846.

e. If any changes occur in the character of the soil, the Generator shall notify a Nanakuli Landfill representative immediately.

f. Signature____________________ g. Company____________________

h. Name and Title____________________ i. Date____________________

---

7. County of Maui Waste Disposal Decision (For Official Use Only)

a. Waste Disposal Decision ______Accepted ______Rejected

b. Disposal Method ______Landfill ______Special Waste Landfill (Asbestos)

c. Precautions, Special Handling Procedures, or Limitations on Approval: ____________________

d. C&D Job No. ____________________ Date:____________________

e. Reviewed by ____________________ Date:____________________

f. Eng. Section Approval: ____________________ Date:____________________

g. Operations Approval:____________________ Date:____________________

h. Forwarded to DOH:____________________ Date:____________________

Additional Information for Contaminated Soil Reviews

1. Is this a hazardous waste (RCRA C)? ___Yes___ No
2. Does this waste contain heavy metals? ___Yes ___ No
   If yes, explain & identify
3. Does the waste contain PCBs? ___ Yes ___ No
   If yes, explain
4. Is the waste a TSCA waste? ___ Yes ___ No
   If yes, explain & identify
5. Is the waste a CERCLA waste? ___ Yes ___ No
   If yes, explain & identify

6. Regulatory agency & Contact____

____

7. Generator____

____

8. Type of Contamination____

9. Consultant Name & Number____

10. Review report attached____

If this certification is made by a broker, the undersigned signs as authorized agent of the generator and has confirmed the information contained in this Sheet and additionally attached sheets from information provided by the generator and additional information as it has determined to be reasonably necessary.

Certification Signature:____________________________Title:________________________

Name (Type or Print):_________________________Company:_____________Date:______

Submittal Instructions

The following are the items that should be in any review report, in the order noted.

1. List of regulatory agencies and regulations applicable to the project. Include Names and contact information (phone numbers) for all agencies involved for follow up.
2. Contact information: generator, type of contamination, and site history in narrative form.
3. Consultant information (i.e. Names, phone numbers) include the consultant that did the original investigation and subsequent investigations.
4. Report format for technical information.
   A. Background information for site and processes.
   B. Summary of investigative action. Including sampling and testing information pertinent to disposal.
   C. Summary of remedial actions and how material being disposed was generated.
   D. Rational for the determination that material is solid waste this should be based on applicable regulations.
   E. Site location maps and site drawings.
   F. Summary table of test data.
   G. Laboratory data.

Actions Taken

Date:____________

Accepted:________ Rejected:________

Reason for Rejection:____

COUNTY OF MAUI LANDFILLS ACCEPTANCE OF CONSTRUCTION & DEMOLITION WASTE

Central Maui (Upon Closure of the Maui Demolition and Construction Landfill Facility), Hana, Molokai and Lanai Landfills are permitted by the Hawaii Department of Health to Accept Commercial Construction and Demolition Waste

ACCEPTED WASTES	
Commercial Construction and Demolition Waste	Materials that originate from commercial construction or demolition sites (excluding resident self-hauled-wastes from residential projects), which include concrete, hollow bituminous concrete, asphalt, pavement, wood, glass, masonry, roofing, siding, plaster, dirt, rock, stumps (upon approval), boulders and brush.
<u>Special Rate Waste Types:</u> - Clean soil, rocks & concrete containing **no protruding** rebar - Clean soil, rocks & concrete **not containing** rebar - Non-HI5 and Non-ADF crushed glass	<u>Associated Tipping Fees at County Landfills:</u> - $75 per ton (no larger than 4' x 2' x 2') - $50 per ton (2 ½ inch minus) - $20 per ton (2 ½ inch minus)
Normal Rates Apply for Mixed Construction &Demolition Waste.	

****A Declaration of Non-Hazardous Waste Form must be completed and approved prior to acceptance of loads after April 1, 2016****

County Landfills will not accept any materials prohibited under Hawaii Revised Statues (HRS) Chapter 342H and Hawaii Administrative Rules (HAR) Section 11-58.1 including but not limited to the following:

- Petroleum Contaminated Materials
- Tires
- Appliances (White Goods)
- PCBs
- Tanks and Cylinders
- Liquids
- Batteries and Electronic Wastes
- Sealed Barrels/Drums
- Green Waste
- Flammable Explosives
- Solvents
- Adhesives
- Sealants
- Asbestos (separate receiving procedures apply)
- Paints
- Hazardous Waste as defined in Section 8.04.010 MCC

Any loads found to be containing unacceptable material will be referred to alternative sites prior to delivery where possible. The County of Maui reserves the right to charge for re-loading, clean-up, and/or disposal of any unacceptable materials that have been delivered to landfill sites in error.

To avoid disruption to your operations please call ahead or advise if you have any concerns about the acceptability of any waste material in your loads.

For more information and facility operating hours, please contact your local landfill or visit www.co.maui.hi.us