

SECTION VII
LANDFILL GAS

SECTION VII – PART A

PERIMETER GAS MONITORING PLAN

**PERIMETER GAS MONITORING PLAN
WEST HAWAI'I SANITARY LANDFILL
WAIKOLOA, HAWAI'I**



**PREPARED BY
WASTE MANAGEMENT OF HAWAII, INC.
SEPTEMBER 2015**

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1 PERIMETER GAS MONITORING PLAN DESCRIPTION

1.1 Introduction

Waste Management of Hawaii, Inc. (WMH) has prepared this Perimeter Gas Monitoring Plan (PGMP) for the West Hawai'i Sanitary Landfill (WHSL), located in Waikoloa, Hawai'i (Figure 1).

This PGMP presents procedures for the installation of permanent perimeter gas monitoring probes and for monitoring methane gas within the probe network at the WHSL. This PGMP complies with the landfill gas monitoring requirements of the Federal Resource Conservation and Recovery Act (RCRA) Subtitle D regulations, Hawai'i Administrative Rules (HAR), and the WHSL Solid Waste Permit (No.LF-0001-08) that was issued by the State of Hawai'i Department of Health (DOH) Solid Waste Section (SWS).

1.2 Objectives

The objectives of this PGMP are:

- To summarize applicable landfill gas migration monitoring and regulatory requirements;
- To outline the existing perimeter gas monitoring network and current site conditions at the WHSL;
- To specify upcoming modifications to the existing WHSL perimeter gas monitoring network.

1.3 Regulatory Requirements

Pursuant to RCRA Subtitle D regulations 40 CFR §258.23, and HAR Title 11, Chapter 58.1-15(d) municipal solid waste (MSW) landfills must monitor methane gas in facility structures and around the landfill perimeter. Owners or operators of all MSW landfills must ensure that:

- §258.23 (a)(1) & §11-58.1-15(d)(1)(A) "*The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit (LEL) for methane in facility structures (excluding gas control or recovery system components)*" and,
- §258.23 (a)(2) & §11-58.1-15(d)(1)(B) "*The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary.*"
- §258.23 (b)(1) & §11-58.1-15 (d)(2)(A) "The type and frequency of monitoring must be determined based on the following factors:
 - (i) *Soil conditions;*
 - (ii) *The hydrogeologic conditions surrounding the facility;*
 - (iii) *The hydraulic conditions surrounding the facility; and*
 - (iv) *The location of facility structures and property boundaries.*"

These criteria were considered in developing the PGMP for the WHSL.

2 GENERAL SITE INFORMATION

2.1 Site Description

The WHSL covers a total area of approximately 300 acres. The permitted waste footprint, which covers approximately 150 acres, is roughly square and is divided into a series of smaller waste disposal cells (see Figure 2). Waste disposal began in the northern portion of the permitted waste footprint (Cell No. 1) and has since extended toward the east and south.

2.2 Landfill Structures and Surroundings

The administration building and scale house are located on the northwest portion of the site, just south of the entrance to the site. A maintenance shop and fueling area are located south of the administration building. Due to the lack of county or private water systems in the vicinity of the WHSL, a pumping station and water tank located in the northeast portion of the site provide non-potable water for fire protection, dust control, and other operating requirements (Figure 2).

The WHSL is surrounded on all sides by rugged, open terrain characteristic of recent lava flows. The Queen Kaahumanu Highway is approximately 0.6 miles west of the WHSL, near the 79-mile marker. The nearest residential area is located approximately 1.25 miles west of the WHSL adjacent to Keawaiki Bay. The Waikoloa Beach Resort and Mauna Lani Resort are located approximately 1.5 miles northwest of the WHSL.

2.3 Site Geology

The site is situated on the historic basaltic lava flow of 1859 from Mauna Loa and is deposited with little ash cover. Basaltic boulders, cobbles, and gravel (clinker) cover the ground with localized exposures of very hard basaltic rock formation. There are sparse areas of vegetation (grasses and kiawe trees), however, the site is generally barren and rocky.

The geology beneath the landfill consists largely of hard, gray vesicular basalt (fractured bluerock). Thin intermittent layers of reddish gray basalt fragments (clinker) lie widely spaced between the dense bluerock layers. Lava tubes, holes, and large cracks are known to exist in the region.

Previous geotechnical field explorations encountered a surface layer, 1.5 to 6.5 feet in thickness, of loose to medium-dense gravel and cobble-sized basalt fragments (clinker). Dense to very dense volcanic basalt were encountered below the clinker layer to maximum depths explored (approximately 40 feet) (Geolabs-Hawai'i, 1992).

2.4 Site Hydrogeology

The northern portion of the WHSL is underlain by the Anaehoomalu Aquifer System, which is part of the Northwest Mauna Loa Aquifer Sector. The southern portion of the WHSL is underlain by the Kiholo Aquifer System, which is part of the Hualalai Aquifer Sector. Both aquifer systems are described as being basal water, unconfined in volcanic flanks. The

status of the groundwater under the WHSL is described as being currently and/or potentially used for drinking water with a low salinity (250-1,000 mg/L CL-), irreplaceable and highly vulnerable to contamination (Mink and Lau, 1993).

Groundwater beneath the WHSL site is encountered at depths ranging from approximately 150 feet to 230 feet below ground surface (bgs) (0.5 to 2.5 ft above mean sea level [msl]), and occurs within fractured basalt and clinker. Historical water level data indicate that groundwater flow has generally been directed toward the west-southwest, indicating that the groundwater discharges to the ocean in the vicinity of Pueo and Keawaiki Bays. The hydraulic gradient is very gentle (generally less than 0.0005 feet per foot), and estimated groundwater flow velocities are on the order of 2 to 3 feet per day (RUST, 1997). A groundwater elevation contour map is included as Figure 3 and is based on water levels measured on March 30, 2015 (AECOM 2015). Water levels observed in the monitoring wells at the WHSL fluctuate moderately due to tidal effects, however, the predominate groundwater flow at the site is to the southwest (WMI, 2002).

Table 1 presents a well construction summary (including TOC elevations) of the WHSL monitoring wells. Table 2 presents the calculated groundwater elevations (relative to msl) and depth-to-groundwater measurements made at the WHSL in September 2014 and March 2015. As shown in Table 2, groundwater elevations at the WHSL monitoring wells ranged from 2.06 ft-msl (WHW-03) to 2.70 ft-msl (WHW-04) on March 30, 2015.

2.5 Landfill Gas Collection and Control System

The U.S. EPA enforces rules limiting the ambient emissions of non-methane volatile organic compounds (NMOCs) from solid waste landfills (40 CFR §51, 52, and 60, Standards of Performance for New Stationary Sources and Guidelines for Control of Existing Sources: Municipal Solid Waste Landfills). Under this rule, landfills having a design capacity in excess of 2.5 million metric tons (2.76 million tons) are limited to 50 metric tons (55.1 tons) per year of NMOC emissions. The WHSL installed a Gas Collection and Control System in 2013. The GCCS operates under covered source permit number 0497-01-C issued by the State of Hawaii in accordance with the Hawaii Administrative Rules (HAR), Title 11, Chapter 60.1. The permit was issued on June 19, 2013 and expires on June 18, 2018.

3 PERIMETER GAS MONITORING NETWORK

3.1 Perimeter Gas Monitoring Network

A perimeter gas monitoring network consisting of permanent gas probes has been installed at the WHSL to detect any landfill gas migration from the WHSL. The design of the permanent gas monitoring probes was consistent with the USEPA requirements for a perimeter gas monitoring network, as detailed in the *Solid Waste Disposal Facility Criteria, Technical Manual*, which was prepared by the USEPA to assist in the implementation of Subtitle D requirements. Specifically, the permanent gas probe design meets the following criteria:

- a. *Location*: Permanent gas probe locations were selected with consideration of site-specific characteristics, potential migration pathways, adjacent land use, and inhabitable structures in the vicinity of property boundary. The probe locations also were selected to provide installation and sampling access, and to minimize impacts from site operations and future landfill construction.
- b. *Spacing*: The maximum distance between probes is 1,000 feet.
- c. *Depth*: The design depths of the permanent gas probes were based on the depth of waste adjacent to the probe, the depth to bedrock, and transmissive zones. The construction depths vary from proposed depths depending on actual conditions encountered during drilling.

3.2 Current Perimeter Gas Monitoring Network

Currently nine permanent gas probes (GP-01 through GP-09) have been installed at the WHSL. These probes are located along the western, northern, and eastern property boundaries of the WHSL (see Figure 4).

Borings for the gas probes were drilled using a 6-inch-diameter air-rotary or percussion hammer drilling equipment. A geologist supervised the drilling and observed drill cuttings for lithologic logging. The borings were converted to permanent gas monitoring probes by installing a 1-inch diameter Schedule 80 PVC casing into each borehole. Because the volcanic lithology is vertically heterogeneous (i.e. composed of varying thicknesses of individual flows and clinker zones), the casings were provided with full-length screened intervals below the 5-foot top-seal depth. A 3-foot bentonite separation layer was placed above the pea-gravel filter pack. A 2-foot thick bentonite cement seal was placed from the top of the bentonite separation layer to the ground surface. A 6-inch thick concrete sanitary seal was cast-in-place at the ground surface. Each probe was completed to approximately 3 feet above surface grade and fitted with a monitoring port, a locking cap, and a steel "stovepipe" monument.

The borehole logs and gas probe construction summaries are included in Table 3 and Appendix A. The details of a typical gas monitoring probe are presented in Figure 5.

3.3 Proposed Perimeter Gas Monitoring Probe Construction

To complete the perimeter gas monitoring network, 5 additional permanent gas probes (GP-10 through GP-14) are proposed at the WHSL (see Figure 4). The depth of each probe will be roughly targeted to the lowest permitted excavation grade within the MSW cell nearest to each proposed probe (see Table 3).

It is expected that the borings for the proposed gas probes will be drilled using a 6-inch-diameter air-rotary or percussion hammer drilling equipment. The feasible depth of each boring will be determined in the field, based on geologic conditions or first encountered groundwater, although groundwater is not anticipated to be encountered, as it occurs at elevations well below the landfill design base grade elevations. A geologist will supervise the drilling and observe drill cuttings for lithologic logging.

The borings will be converted to permanent gas monitoring probes by installing a 1-inch diameter Schedule 80 PVC casing into each borehole. Because the volcanic lithology is vertically heterogeneous (i.e. composed of varying thicknesses of individual flows and clinker zones), the casing will be provided with a full-length screened interval below the 5-foot top-seal depth. A 3-foot bentonite separation layer will be placed above the pea-gravel filter pack. A 2-foot thick bentonite cement seal will be placed from the top of the bentonite separation layer to the ground surface. A 6-inch thick concrete sanitary seal will be cast-in-place at the ground surface. Each probe will be completed to approximately 3 feet above surface grade and fitted with a monitoring port, a locking cap, and a steel "stovepipe" monument. A general detail of the proposed gas monitoring probe is presented in Figure 5.

4 GAS MONITORING PROGRAM

4.1 Perimeter Gas Probe Monitoring

The perimeter gas network is monitored quarterly, as required by RCRA Subtitle D regulations, HAR Chapter 11-58.1-15(d), and the WHSL Solid Waste Permit. The following subsections describe the monitoring equipment and procedures, the compliance threshold level for methane, documentation and recording procedures, the response to be conducted in an event of an exceedance of compliance threshold level, and inspection and maintenance procedures to be followed by WHSL.

4.1.1 Monitoring Equipment

A portable gas-monitoring instrument (*Land Tec GEM 2000* or equivalent) calibrated to detect methane at concentrations of 5% or less is used to monitor the perimeter gas probes. The gas-monitoring instrument is calibrated before and after each monitoring day, using an appropriate standard calibration gas. Calibration information for the meter is entered into the *Landfill Gas Meter Calibration Certificate* (Appendix B). Maintenance and calibration of all monitoring instruments are in accordance with manufacturer instructions.

4.1.2 Monitoring Procedures

On a quarterly basis, a qualified gas technician monitors the perimeter gas probes using a calibrated portable gas-monitoring instrument (as described in above in Section 4.1.1).

Methane

The gas probes contain a capped ¼-inch NPT barbed fitting installed at the top of the probe casing. The technician connects tygon tubing that is attached to the inlet valve of the LandTec GEM over the top of the barbed fitting. Once the connection between the instrument and the casing space has been established, the technician allows the instrument to pump gas through the instrument for a period of at least 2 minutes until readings have stabilized. The technician then records probe pressure and the methane concentration in percent LEL and percent by volume. These results, in addition to ambient temperature and barometric pressure readings are recorded electronically directly into the memory of the LandTec GEM 2000 instrument or transcribed on to a *Perimeter Gas Monitoring Field Report Form* (see Appendix C), which are retained on-site in the WHSL Operating Files.

4.2 Perimeter Probe Methane Compliance Monitoring

If methane levels within any probe are detected at or above 5 percent by volume, the WHSL will act in accordance with Subtitle D regulations, HAR standards, and the WHSL solid waste permit. These actions are outlined in procedures listed in Section 4.5 of this document.

4.3 Structure Compliance Monitoring System

Building structures at the WHSL are continuously monitored using automatic combustible gas monitors. The *Sierra Model 2001* Combustible Gas Monitor is calibrated to sound an alarm when combustible gas concentrations reach or exceed 1.25 percent methane by

volume. The monitors are installed where combustible gas is most likely to accumulate within a structure (e.g., corners, baseboards, crawlspaces, or any location where air movement is restricted and in areas of potential leaks). Combustible gas meters are located in the office, scale house, lunch room, and mechanic's office.

Combustible gas monitor locations are shown on Figure 6. The gas monitors are calibrated in accordance with manufacturer instructions (every 90 days or after a sensor failure occurs) and documentation is recorded on the *Combustible Gas Monitor Log/Calibration Log* (Appendix D). On-site structures may be manually monitored periodically using an infrared gas detector, flame ionization detector, or equivalent, with minimum detection level of 0.1 percent methane by volume or less.

If methane levels are detected at or above 1.25 percent by volume, WHSL will take steps to ensure worker safety. In addition, WHSL will institute controls to bring the level of methane below the 1.25 percent in the structure.

4.4 Documentation and Reporting

In accordance with Subtitle D regulations, HAR standards, and the WHSL solid waste permit, perimeter gas probe monitoring results are recorded electronically within the memory of the portable gas-monitoring instrument and/or transcribed on to the *Perimeter Gas Monitoring Field Report Form* (Appendix C) and retained onsite in the WHSL Operating Record. The monitoring reports include:

- Methane concentrations and pressure at each probe;
- Incidents of methane exceedances detected by continuous automatic combustible gas monitors;
- Documentation of site conditions at the time of monitoring, including date, time, barometric pressure, atmospheric temperatures, and general weather conditions; and
- Personnel names, instrumentation, and a brief description of methods used in the monitoring.

All monitoring data will be maintained through the closure and post-closure periods. A monitoring report with the above mentioned information will be submitted to DOH SWS within forty-five (45) days of each monitoring event.

4.5 Responses for Exceedances

If methane is detected at levels exceeding 1.25 % by volume in facility structures or 5% by volume in perimeter gas monitoring probes, then the owner or operator may conduct a verification monitoring event, provided that the event be conducted within one (1) hour of measuring the initial exceedance. The exceedance limits specified above correspond to explosive gas (methane) control limits specified in RCRA Subtitle D regulations 40 CFR §258.23, HAR Title 11, Chapter 58.1-15(d) (Section 1.3 above), or the WHSL Solid Waste Permit (No.LF-0001-08).

If verification monitoring indicates that gas concentrations are below the regulatory limits, the owner or operator shall place the results in the operating record and send written notification of the exceedance and verification monitoring event to the DOH within seven (7) days.

If verification sampling is not performed within one (1) hour of measuring the initial exceedance, and/or the verification sampling confirms an exceedance, the owner or operator shall perform the following:

- Immediately take all necessary steps to ensure protection of human health;
- Immediately notify DOH of the exceedance;
- Within three (3) days of detection, place in the operating record and submit to DOH, the type of gas detected, gas levels detected, and a description of the steps taken to protect human health;
- Within sixty (60) days of detection, implement a remediation plan for the combustible gas releases, place a copy of the plan in the operating record, provide a copy of the plan to DOH, and notify DOH that the plan has been implemented. The plan shall describe the nature and extent of the problem and the proposed remedy.
- Within thirty (30) days after the remediation plan has been completed, submit a report to the DOH documenting the actions taken, additional monitoring results, and plans to prevent future recurrences

The DOH may modify the reporting and implementation schedule, as necessary to protect human health and the environment.

4.6 Inspection and Maintenance

WHSL shall inspect and maintain the gas monitoring probes. In the event that a probe is unusable, WHSL shall repair the probe or install a new probe prior to the next monitoring event.

If a probe is repaired, WHSL will submit documentation to the DOH SWS indicating the reason for the repair, type of repairs completed, and evaluations performed to ensure the probe is acceptable for use.

If a probe is replaced, then WHSL will comply with the following requirements:

- a) WHSL will update the Perimeter Gas Monitoring Plan to show the new probe location and identification number within thirty (30) days. The update shall also document the reason for replacing the probe.
- b) WHSL will submit an installation report for the new probe within sixty (60) days to the DOH SWS. The documentation shall include, but is not limited to, geologic logs of each probe location, surveyed locations and elevations of probes, and as-built drawings of each monitoring probe.

- c) WHSL will properly abandon the unusable probe and submit associated documentation to DOH SWS.

5 REFERENCES

- AECOM. 2015. *First Semi-Annual Monitoring Report For 2015, West Hawai'i Sanitary Landfill, North Kona, Hawai'i*. June.
- Geolabs-Hawai'i. 1992. *Geotechnical Engineering Exploration, West Hawai'i Sanitary Landfill, Puuanahulu, North Kona, Hawai'i*. W.O. 2818-00, June.
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- . 2002. *Tidal Influence Study for Evaluation of Potential Additional Downgradient Well, West Hawai'i Landfill*. February.
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TABLES

Table 1
Monitoring Well Construction Summary
West Hawaii Sanitary Landfill
Waikoloa, Hawaii

Well No. ^{a, b}	Northing (ft)	Easting (ft)	TOC Elevation ^c (ft-msl)	Casing stickup (ft-ags)	Screen Interval (ft-bgs)		Screen Length
					Top	Bottom	
WHW-01	384,452.12	370,107.95	231.31	2.09	215.4	245.4	30
WHW-02	383,403.39	369,651.04	213.10	2.09	196.9	226.9	30
WHW-03	385,174.09	366,975.39	153.51	1.92	136.1	166.1	30
WHW-04 ^b	384,559.00	366,656.40	163.31	~2.0	155	175	20

Notes:

ft-ags feet above ground surface
ft-bgs feet below ground surface
ft-msl feet above mean sea level
TOC top of casing

^a Well construction details for WHW-01, WHW-02, and WHW-03 are from the *Monitoring Plan* (RUST 1997).

^b Well construction details for WHW-04 are estimated based on *Groundwater Well Completion Report for WHW-04* (WMI 2003).

^c TOC elevations are from the well surveys conducted by Wes Thomas Associates on May 23, 2007 and September 16, 2007.

Table 2
Recent Groundwater Level Summary
West Hawaii Sanitary Landfill
Waikoloa, Hawaii

Well No.	TOC Elevation ^a (ft-msl)	Measurement Date	Depth To Groundwater (ft-below TOC)	Groundwater Elevation (ft-msl)
WHW-01	231.31	06/19/2007 09/25/2007	229.37 229.25	1.94 2.06
WHW-02	213.10	06/19/2007 09/25/2007	211.22 211.09	1.88 2.01
WHW-03	153.51	06/19/2007 09/25/2007	151.69 151.62	1.82 1.89
WHW-04	163.31	06/19/2007 09/25/2007	161.58 161.52	1.73 1.79

Notes:

ft-msl feet above mean sea level

TOC top of casing

^a TOC elevations are from the well surveys conducted by Wes Thomas Associates on May 23, 2007 and September 16, 2007.

**Table 3
Gas Probe Schedule
West Hawaii Sanitary Landfill
Waikoloa, Hawaii**

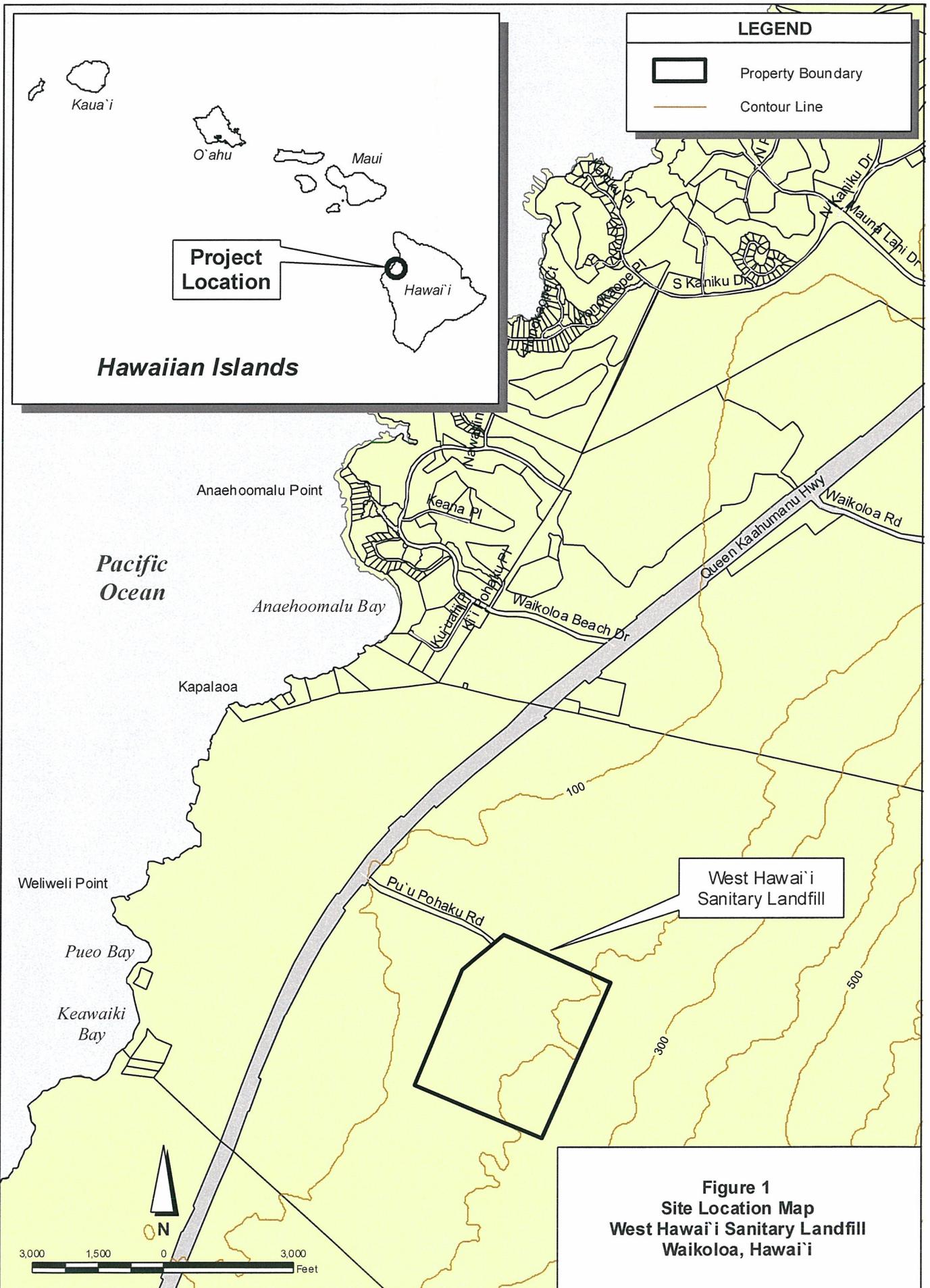
Probe No.	Coordinates		Approx. Ground Surface Elev. (ft. msl) ¹	Approx. Lowest Elev. of MSW Cell Nearest to Probe (ft-msl) ²	Depth to Lowest Elev. of MSW Cell (ft-bgs)	Approx. Groundwater Elevation (ft-msl) ³	Approx. Depth to Water (ft-bgs)	Total Borehole Depth (ft-bgs) ⁴	Pipe Length	
	North	East							Perforated (ft-bgs)	Solid (ft-bgs)
GP-01	385222.075	366977.945	152	130	22	2	150	30.5	20	8
GP-02	386024302	367504.787	156	136	20	2	154	20	14	6
GP-03	386533.989	368314.193	164	136	28	2	162	28	22	6
GP-04	386164.332	369169.456	176	147	29	2	174	29	23	6
GP-05	385781.603	370052.510	184	164	20	2	182	20	14	6
GP-06	384893.484	370334.547	208	170	38	2	206	38	32	6
GP-07	384042.432	369964.351	218	170	48	2	216	48	42	6
GP-08	383129.101	369569.365	218	170	48	2	216	48	42	6
GP-09	384358.083	366583.917	158	130	28	2	156	28	22	6
GP-10	383486.834	366204.663	156	130	26	2	154	26	20	6
GP-11	382835.456	366627.112	156	130	26	2	154	26	20	6
GP-12	382457.081	367497.989	204	147	57	2	202	57	51	6
GP-13	382079.057	368370.358	214	164	50	2	212	50	44	6
GP-14	382274.260	369193.571	214	170	44	2	212	44	38	6

Notes:

- ¹ Approximate ground surface elevation base on aerial photogrammetric mapping dated 5-18-08 topographical fly over. Ground surface elevations at the time of probe construction will likely change due gaining access to the probe location including: roads, gravel pads, and/or alterations to the landscape (i.e. the visual barrier berm) to permit placement of the probe.
- ² Lowest elevation within the MSW Cell nearest to each probe obtained from the permitted excavation grades for the site (Rust E&I 8/93).
- ³ Groundwater elevation is estimated from historical groundwater contour maps for the site.
- ⁴ Total borehole depths are equal to the depth to lowest elevation of MSW Cell nearest to each probe, except for GP-01 which is already constructed to a depth below the adjacent MWS Cell.

ft-bgs feet below ground surface
ft-msl feet above mean sea level

FIGURES



LEGEND	
	Property Boundary
	Contour Line

Project Location

Hawaiian Islands

West Hawai'i Sanitary Landfill

Figure 1
Site Location Map
West Hawai'i Sanitary Landfill
Waikoloa, Hawai'i

L:\work\Infra\Hawaii_Recycle\Drawings\Gas Monitoring Report\QMR_Fig2.dwg 02/13/08 1:21 PM lisa.namoc

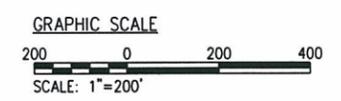
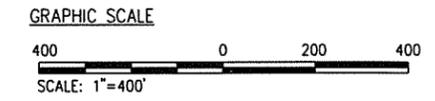
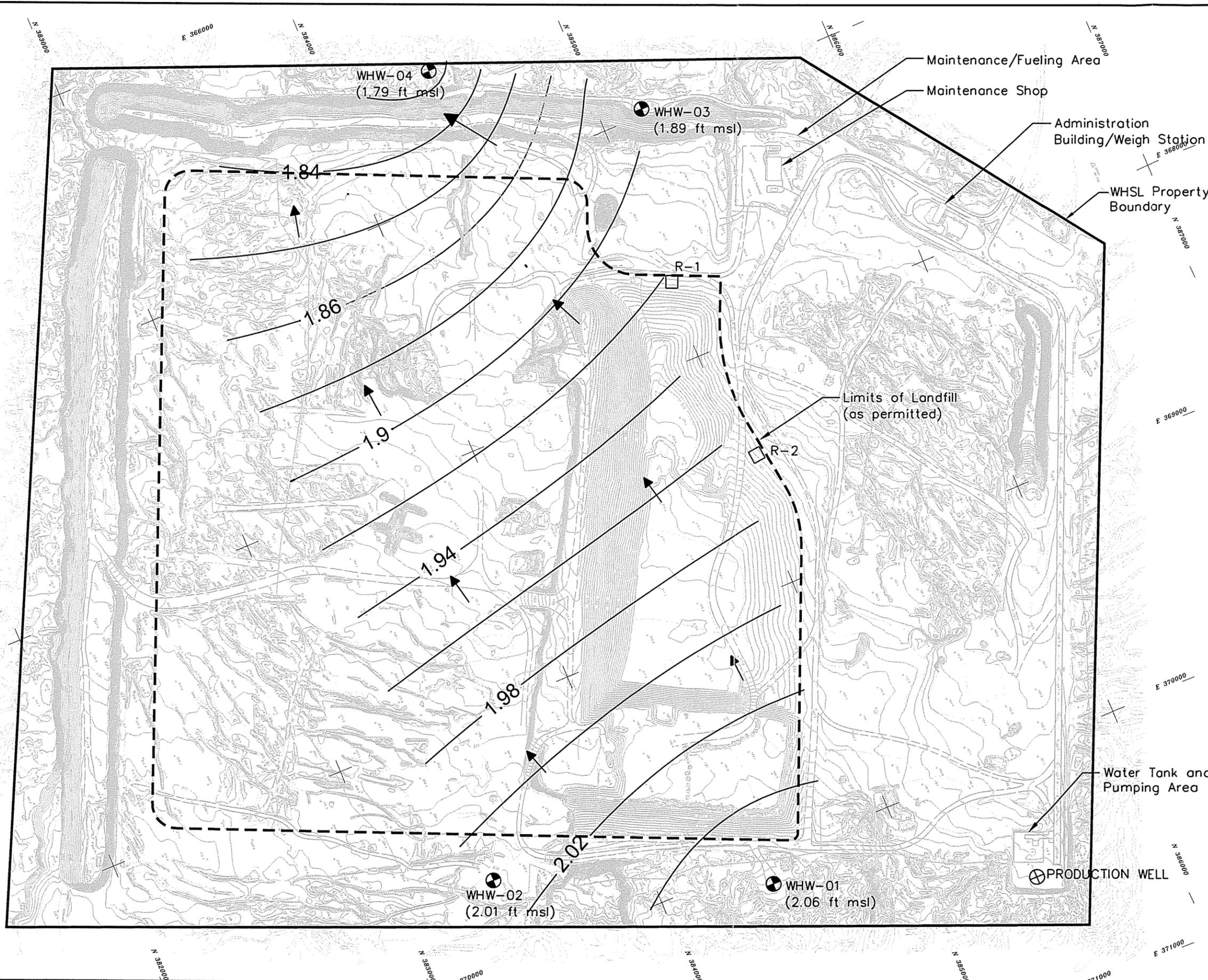


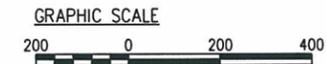
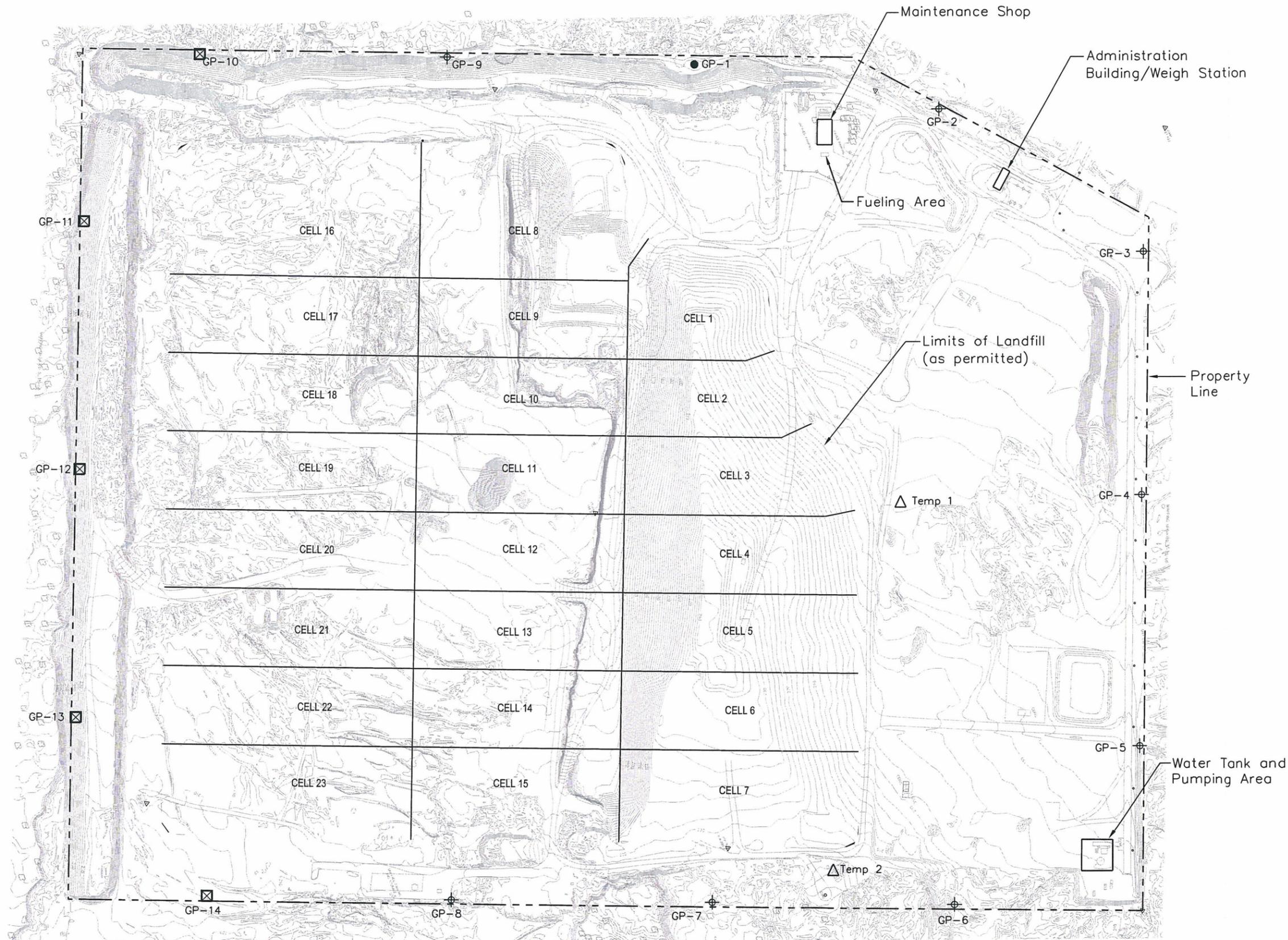
Figure 2
Site Layout Map
West Hawai'i Sanitary Landfill
Waikoloa, Hawai'i



NOTES:
Monitoring well locations are from May 07 and Sep 07 (WHW-03) surveys conducted by Wes Thomas Associates.

- LEGEND:
- Ground water monitoring well with water table elevation. (1.89 ft msl)
 - Ground water elevation contour lines. (September 25, 2007)
 - Leachate sump.

Figure 3
Groundwater Elevation Contour Map
September 25, 2007
West Hawai'i Sanitary Landfill
Waikoloa, Hawai'i



LEGEND:

- Existing Permanent Gas Probe
- ⊕ Proposed Permanent Gas Probe
- ⊗ Future Proposed Permanent Gas Probe
- △ Temporary Gas Probe (Approximate Location)

Figure 4
Gas Monitoring Probe Locations
West Hawai'i Sanitary Landfill
Waikoloa, Hawai'i

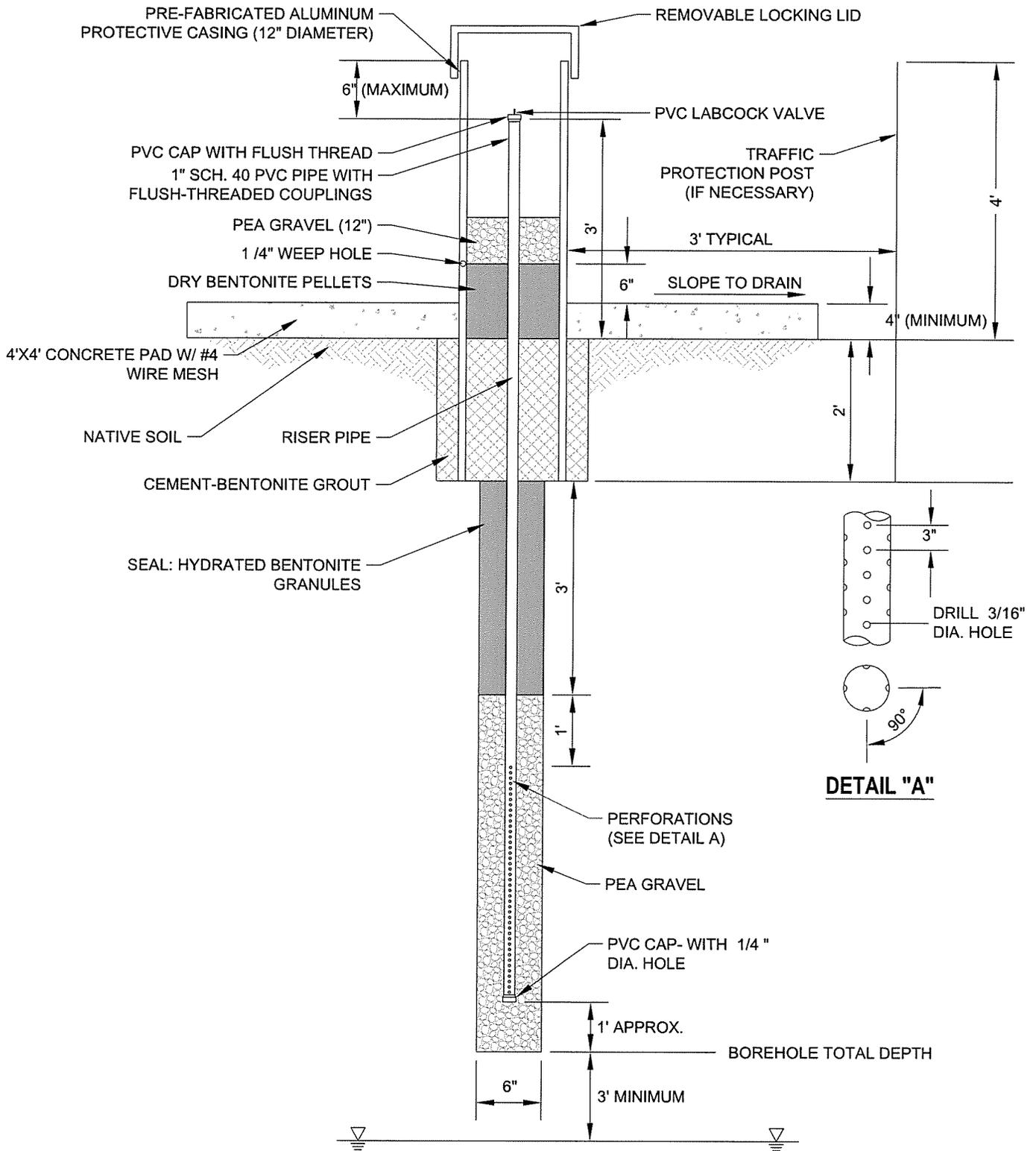
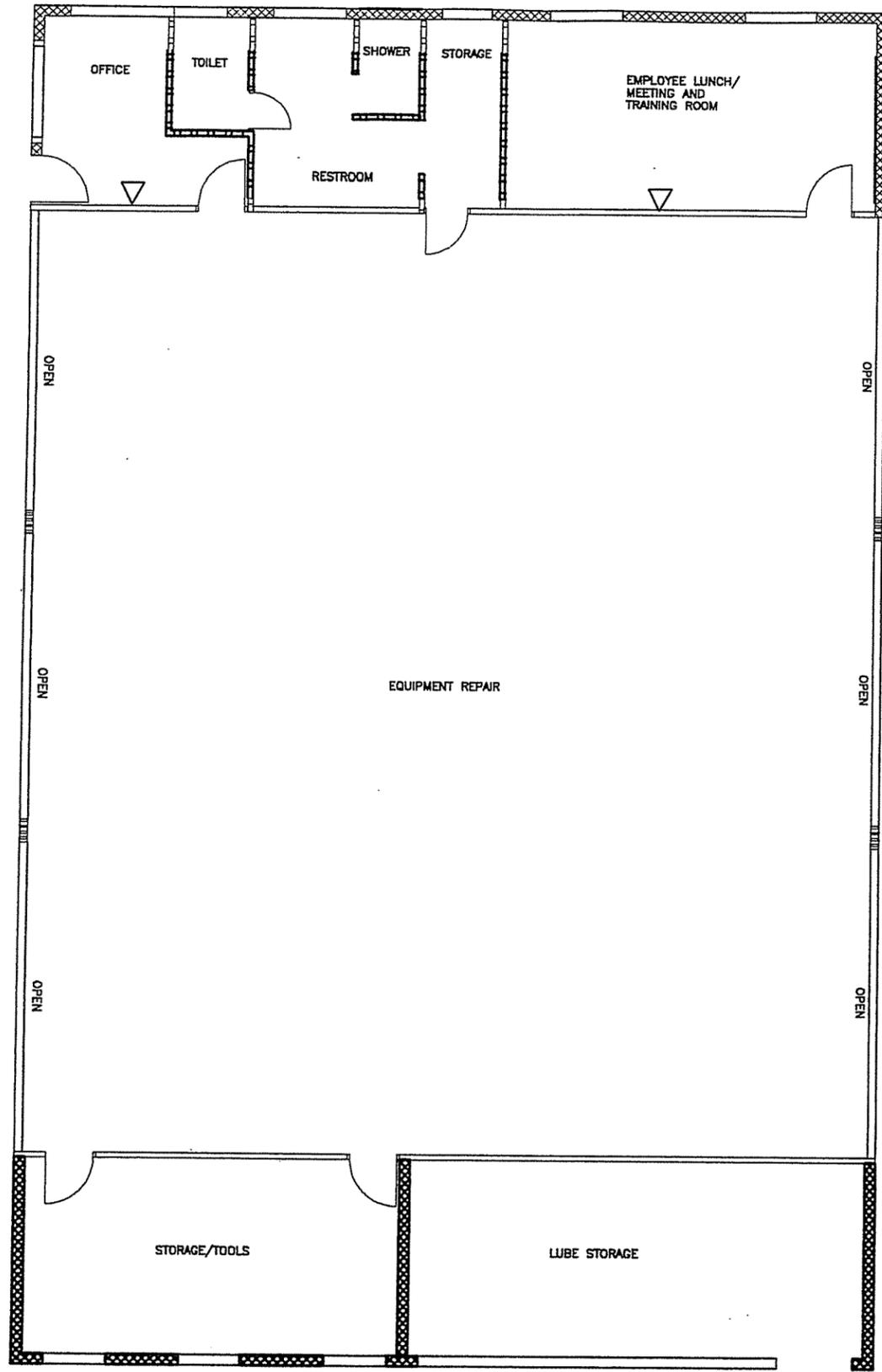
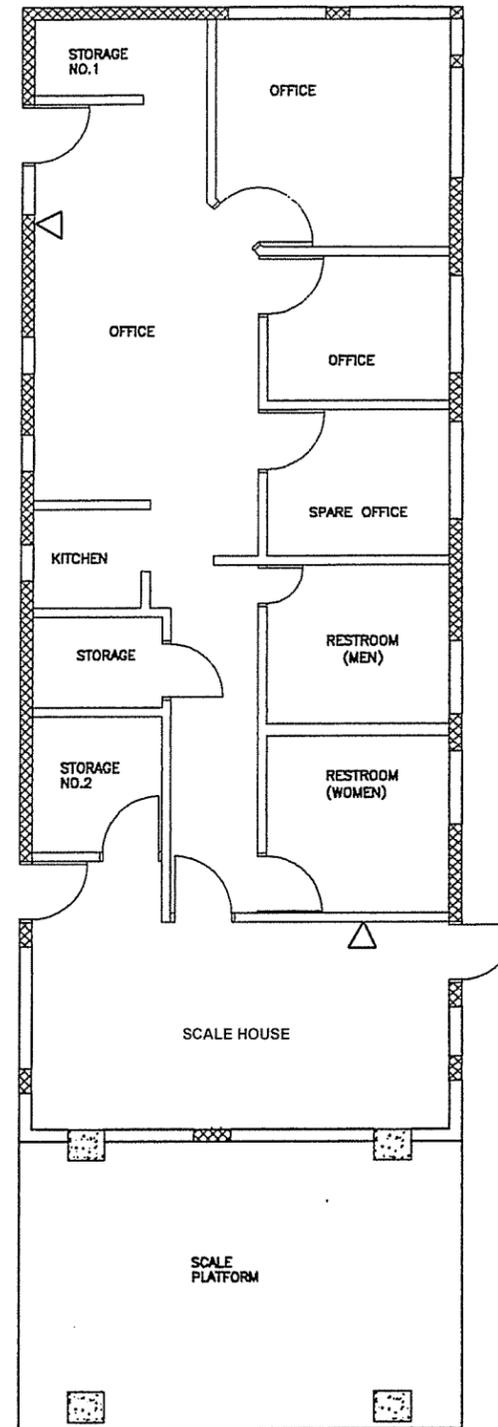


Figure 5
Gas Monitoring Probe Detail
West Hawai'i Sanitary Landfill
Waikoloa, Hawai'i



Maintenance Shop



**Administration Building/
Weigh Station**

Legend	
▽	Methane Monitor

**Figure 6
Combustible Gas Monitor Location Map
West Hawai'i Sanitary Landfill
Waikoloa, Hawai'i**

APPENDIX A

Harding Lawson Associates



December 8, 1993

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Mr. Joe Hernandez
Waste Management of Hawaii, Inc.
92-460 Farrington Highway
Ewa Beach, Hawaii 96707

**Gas Probe Completion Report—Gas Probe GP-1
West Hawaii Landfill
Puuanahulu, North Kona, Hawaii**

Dear Mr. Hernandez:

On October 18 and 19, 1993, GeoLabs of Hawaii drilled and installed Gas Probe GP-1 at West Hawaii Landfill at the location shown on Figure 1 (enclosed). At the request of Waste Management of Hawaii, Inc. (WMH), Harding Lawson Associates (HLA) observed and documented the first 5 feet of drilling and the installation of the gas probe. Enclosed are the Rock Borehole Log and Monitor Well Construction Summary for Gas Probe GP-1.

The 1-inch-diameter PVC gas probe was completed to an approximate depth of 28 feet below ground and in accordance with WMH specifications, as presented on Figure F-3 of the Gas Migration Monitoring Plan, with a couple of exceptions. The changes made to the specifications were the use of clean 3/4-inch gravel instead of 1/4-inch gravel because of its availability onsite; and a 2.5-foot stickup of the outer protective casing instead of 2 feet at WMH's request. Both changes were approved by WMH prior to installation.

Please feel free to call if you have any questions regarding the installation of Gas Probe GP-1. A copy of this gas probe completion report should be included with the operations plan for West Hawaii Landfill.

Sincerely yours,

HARDING LAWSON ASSOCIATES

Gerald Friesen, P.E.
Associate Engineer

GAF/LKI/rmc

Enclosures: Figure 1 - Gas Probe Location Map
Rock Borehole Log
Monitor Well Construction Summary

APPENDIX B

Landfill Gas Meter Calibration Certificate
WEST HAWAII SANITARY LANDFILL, WAIKOLOA, HAWAII

Calibration Gas	Calibration Gas Concentration	Readings After Calibration	Calibration Verification After Probe Readings
Methane:	%	%	%
CO₂:	%	%	%
Oxygen:	%	%	%

Instrument: LandTec GEM 2000
Serial #

Calibrated by:

Signature:

Date: _____

APPENDIX C

PERIMETER GAS MONITORING FIELD REPORT FORM

WEST HAWAII SANITARY LANDFILL, WAIKOLOA, HAWAII

Monitoring Technician Name: _____ Date: _____

Sampling Time: Start: _____ Finish: _____

Instrument: Landfill Gas Monitor Instrument Calibrated:
 Yes No

Make: LandTec

Model: GEM 2000 Serial #: _____ Battery Condition:
 OK Low

Gas Probe	CH ₄ (% LEL)
GP-1	
Temp-1	
Temp-2	

CH₄ = Methane; O₂ = Oxygen; CO₂ = Carbon Dioxide

Weather Conditions:

Temperature: _____ (°C) Wind Direction/Speed: _____ (miles/hour)

Atmospheric Pressure: _____ (Pa) Precipitation: Yes No

Outlook: _____ General weather conditions: _____

Comments:

1. Site conditions during the monitoring event are documented, including date, time, barometric pressure, atmospheric temperatures, and general weather conditions.
2. Calibration gas used for LandTec GEM 2000 is 50% methane and 35% carbon dioxide.
- 3.
- 4.

Technician's signature: _____

APPENDIX D

WEST HAWAII SANITARY LANDFILL

COMBUSTIBLE METHANE GAS MONITOR

Quarterly Calibration Log



LOCATION	SERIAL NUMBER	1st Qtr. CALIBRATION DATE / BY	2nd Qtr. CALIBRATION DATE / BY	3rd Qtr. CALIBRATION DATE / BY	4th Qtr. CALIBRATION DATE / BY
Office	15643				
Scale House	15703				
Lunch Room	15642				
Mechanic's Office	15702				
Spare	16844				

NOTES: