AECOM

SURFACE WATER MANAGEMENT PLAN
WAIMANALO GULCH SANITARY LANDFILL
KAPOLEI, O‘AHU, HAWAI‘I

Waste Management of Hawai‘i
92-460 Farrington Highway
Kapolei, O‘ahu, Hawai‘i 96707

August 2010

EXHIBIT K151

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WAIMANALO GULCH SANITARY LANDFILL
KAPOLEI, O'AHU, HAWAI'I

Prepared for:

Waste Management of Hawai'i
92-460 Farrington Highway
Kapolei, O'ahu, Hawai'i 96707

Prepared by:

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August 2010

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ACRONYMS AND ABBREVIATIONS

%	percent
°F	degree Fahrenheit
BMP	best management practice
CCH	City and County of Honolulu
cfs	cubic feet per second
CMP	corrugated metal pipe
CWA	Clean Water Act
DOH	Department of Health, State of Hawai'i
ft	foot or feet
ft^3	cubic feet
HAR	Hawai'i Administrative Rules
msl	mean sea level
MSW	municipal solid waste
NGPC	Notice of General Permit Coverage
no.	number
NPDES	National Pollutant Discharge Elimination System
SPCC	Spill Prevention, Control, and Countermeasures
SWMP	Surface Water Management Plan
SWPCP	Storm Water Pollution Control Plan
U.S.	United States
WGSL	Waimanalo Gulch Sanitary Landfill
WMH	Waste Management of Hawai'i, Inc.

1.0 INTRODUCTION

This Surface Water Management Plan (SWMP) was prepared for the Waimanalo Gulch Sanitary Landfill (WGSL), located at 92-460 Farrington Highway, in Kapolei, O'ahu, Hawai'i. The WGSL is owned by the City and County of Honolulu (CCH) and operated by Waste Management of Hawai'i, Inc. (WMH), a subsidiary of Waste Management, Inc. This SWMP was prepared in accordance with Hawai'i Administrative Rules (HAR) Title 11, Chapter 58.1, and Special Conditions II.G.4 of the WGSL solid waste permit (Number [no.] LF-0182-09), dated June 4, 2010, issued by the Solid and Hazardous Waste Branch of the State of Hawai'i Department of Health (DOH).

1.1 PURPOSE OF SURFACE WATER MANAGEMENT PLAN

The purpose of the SWMP is to describe and ensure the continued implementation of surface water management practices that prevent run-on and control run-off from a 25-year, 24-hour storm event. The WGSL solid waste permit specifies the following requirements:

- Prevention of run-on and collection and control of run-off from a 25-year, 24-hour storm
- Prevention of soil erosion and exposure of waste due to soil erosion
- Prevention of a discharge of pollutants into waters of the United States (U.S.), or violation of any requirement of the Clean Water Act (CWA) or statewide water quality management plan

The SWMP is updated annually to address any new flow patterns that may have resulted from municipal solid waste (MSW) landfilling operations and verify the adequacy of onsite drainage measures. Construction of a landfill expansion is underway at the project site, and extends beyond the boundaries of the original 2006 study and subsequent updates. For the purposes of this update, and in keeping with the purpose of this document, this study focuses on the areas in use for landfilling operations. Once the construction of the landfill expansion is complete and becomes active, this study will be updated accordingly.

1.2 REGULATORY BACKGROUND

1.2.1 Solid Waste Regulations

Solid waste regulation HAR 11-58.1-15(g) provides requirements to ensure adequate control of storm water events at landfills. The regulation requirements for run-on or run-off control systems and surface water management are listed below.

Requirements for Run-on or Run-off Control Systems

- Owners/operators of MSW landfill units must design, construct, and maintain the following:
  - A run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm
  - A run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm
- Run-off from the active portion of the landfill unit must be handled in accordance with surface water requirements.

Requirements for Surface Water Management

- MSW landfill units will not:
  - Cause a discharge of pollutants into waters of the U.S., including wetlands, that violates any requirement of the CWA, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to Section 402 of the CWA.
  - Cause the discharge of a non-point source of pollution to waters of the U.S., including wetlands, that violates any requirement of an area-wide or statewide water quality management plan that has been approved under Sections 208 or 319 of the CWA, as amended.

1.2.2 National Pollutant Discharge Elimination System

The CCH was issued a Notice of General Permit Coverage (NGPC) for the WGSL under NPDES on March 2, 2005, which was assigned File No. HI R50A533. A renewal application was submitted in 2007, and permit coverage continues under an administrative extension (granted October 2007) of the 2005 NGPC while DOH conducts its review of the renewal application. Under the WGSL's 2005 NGPC, the CCH's Department of Environmental Services is authorized to discharge storm water run-off associated with industrial activity at the WGSL to the receiving state water named the Pacific Ocean, a Class A Marine Water, at coordinates 2'0'40'0N and 158°07'35"W. The activities associated with the WGSL NGPC are described in the WGSL Storm Water Pollution Control Plan (SWPCP), which was written to comply with this regulation and was originally submitted to the Clean Water Branch of the DOH in 2005. The SWPCP is evaluated as often as needed to comply with the condition of the NGPC and is included in the Site Operations Manual (WMH 2010) that was previously approved by the DOH.

The SWPCP was last updated in 2009 to reflect onsite changes (AECOM 2009) and resubmitted to DOH.

1.2.3 Spill Prevention, Control, and Countermeasures Plan

A Spill Prevention, Control, and Countermeasures (SPCC) Plan was developed for the WGSL and is included in the Site Operations Manual (WMH 2010) that was previously approved by the DOH. The SPCC Plan complies with Title 40 Code of Federal Regulations Part 112 and addresses measures for prevention and control of fuel and oil related spills.

2.0 SITE BACKGROUND

This section presents a summary description of the WGSL including its location, size, elevation, limits, and surrounding area.

2.1 SITE DESCRIPTION

The WGSL is located at 92-460 Farrington Highway in Kapolei, on the southwest side of the island of O'ahu, Hawai'i. The site is approximately 15 miles northwest of Honolulu International Airport and 2 miles southeast of Nanakuli, as shown on Figure 2-1. The facility occupies a portion of a rugged, southwest-sloping coastal canyon (Waimanalo Gulch) and extends approximately 1.2 miles up-canyon (northeast) from Farrington Highway. The landfill office and scale house are located at the southern end of the facility, near Farrington Highway. The site location is shown on Figure 2-2.

The WGSL property encompasses a total of 198.6 acres. The site is long and narrow, approximately 7,000 feet (ft) in length, with a width ranging from 820 ft on the Farrington Highway frontage to about 1,900 ft at the widest point. The landfill entrance at Farrington Highway is approximately 60 ft above mean sea level (msl), and the extreme northeast corner of the property is at an elevation of 990 ft above msl. The natural terrain of the WGSL slopes upward from approximately 8 percent (%) at the lower end, to approximately 18% at the upper end of the property.

Currently, 78.9 acres of the property are permitted for landfill activities, of which, approximately 58.9 acres are designated for nonhazardous MSW disposal and 20 acres are designated and developed as a monofill for the disposal of nonhazardous MSW incinerator ash (combustion residue) from the Honolulu Program of Waste to Energy Recovery (H-Power) plant. The ash monofill occupies the topographically lower (southern) portion of the WGSL, while the MSW unit occupies the topographically higher (northern) portion of the site.

2.2 CLIMATE AND TOPOGRAPHY

The WGSL is located in a region of O'ahu that is relatively arid, when compared to the rest of the island, due to the "rain-shadow" effect of the Waianae Mountain Range. Average annual rainfall in the area is approximately 20 inches, while stations in nearby mountains experience significantly higher rainfall averages (Hokuloa gauge, elevation 2,200 msl, average annual rainfall 42 inches).

Prevailing winds in the area of the landfill are the Hawaiian trade winds, which are channeled along the Nanakuli coastline by the Waianae and Ko'olau Mountains, in a roughly northeast to southwest to direction, at an average annual speed of approximately 10 knots. Between the months of October and April, the WGSL occasionally comes under the influence of southerly winds associated with Kona storms or approaching storm fronts.

The typical daily temperature ranges from low 60s (degrees Fahrenheit [°F]) to high 70s (°F) during the winter and from low 70s (°F) to high 80s (°F) during the summer.

The regional topography near the WGSL is dominated by the moderate to steep Waianae Range, a northerly trending volcanic mountain range that is characterized by narrow valleys, separated by steeply sloping hills and ridges. The range extends northward from the site approximately 20 miles and is up to approximately 4 miles in width. The WGSL is located near the southern toe of this range in a steep and narrow valley (gulch). Elevations along the main mountain ridgeline range from approximately 1,000 to 3,600 ft msl. Elevations drop dramatically away from the main ridgeline. Lateral slopes along the Waianae Range are asymmetrical, with steeper slopes to the west. Typical slopes on the sides of the range drop some 2,600 ft over distances of two miles or less. Near the WGSL, the mountains of the Waianae Range transition to the low-lying coastal plains. Elevations abruptly diminish from 2,300 ft msl (Pu'u Manawahua) to sea level in a lateral distance of two miles in the WGSL vicinity (RUST 1993).

2.3 SURROUNDING AREA

The WGSL is surrounded by rugged terrain and open space to the north and west. The Hawaiian Electric Kahe Power Generating Station is located west of the WGSL's boundary, with the nearest structure being over 900 ft distant. The Ko 'Olina Resort is south of the landfill, across Farrington Highway from the main entrance of the facility. Thirteen residential land parcels are located southwest of the WGSL, approximately 500 ft from the southernmost edge of the landfill footprint.

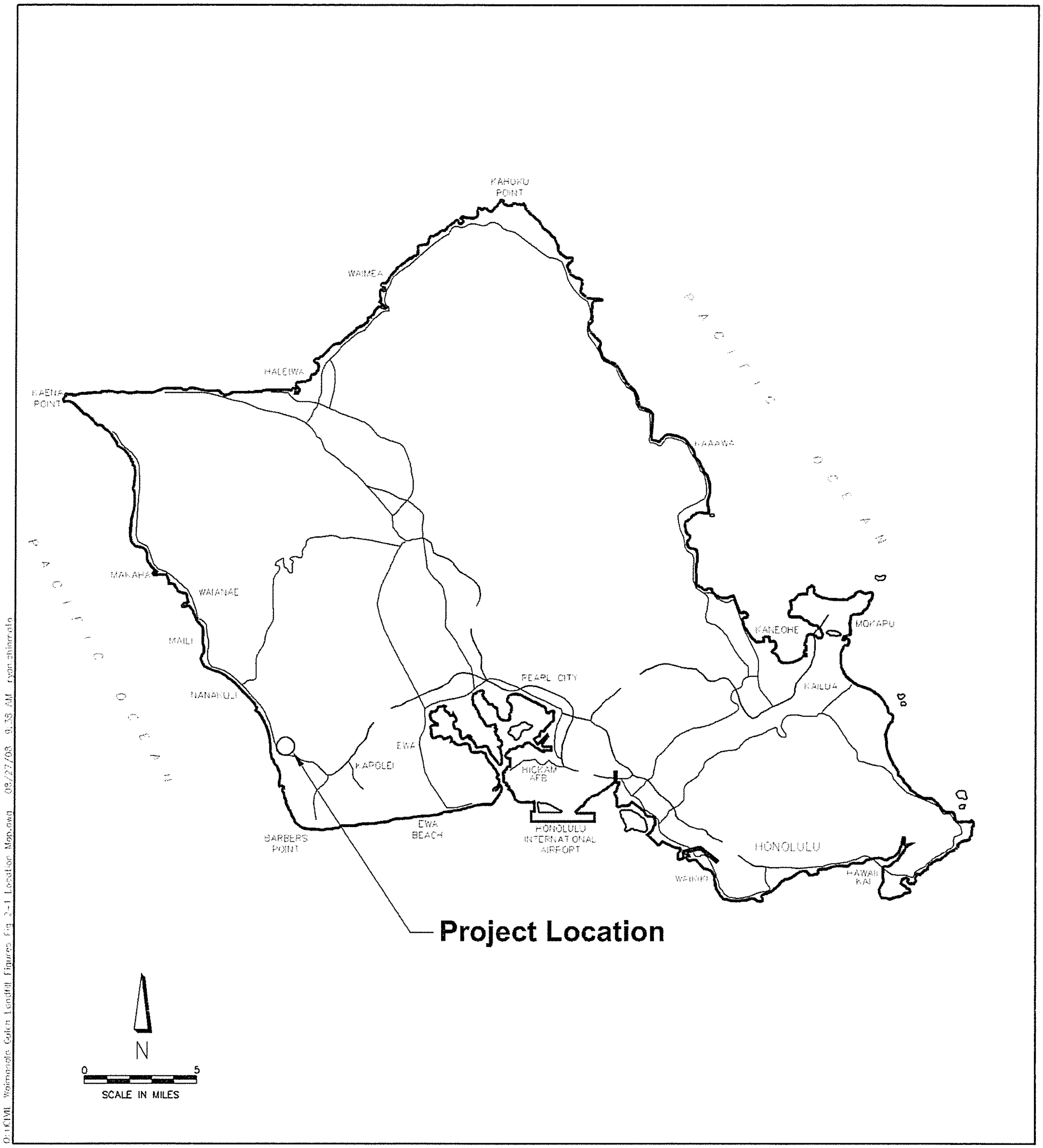

Figure 2-1
Project Location Map
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

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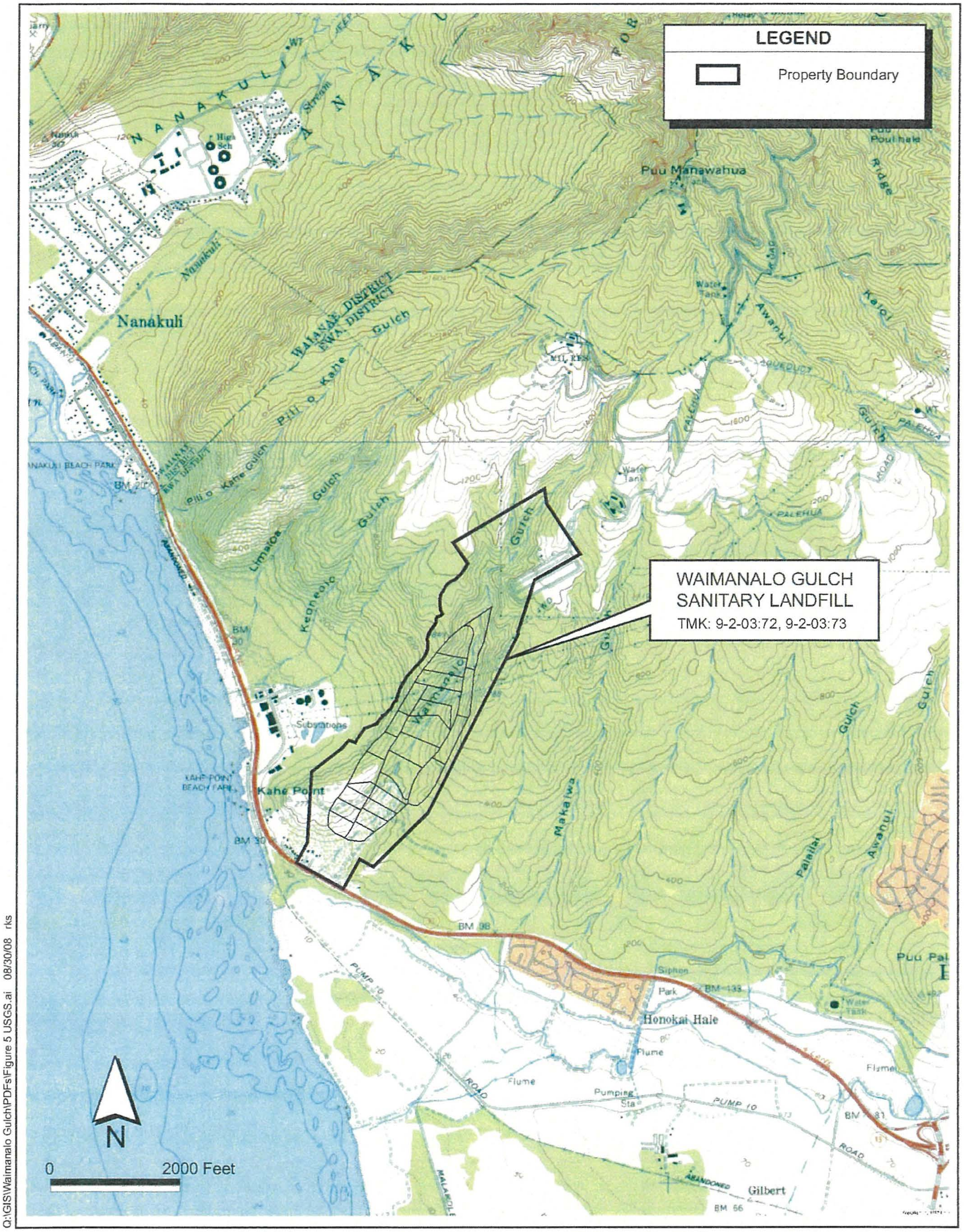

Figure 2-2
Site Location Map
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

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3.0 SURFACE WATER MANAGEMENT PLAN INSPECTION AND MEASURES

This section describes the existing surface water management features at the WGSL, presents the results of the annual inspection, evaluates the effectiveness of the surface-water drainage system by reviewing and updating supporting hydrology/hydraulics calculations, and provides recommendations for additional measures necessary to provide adequate drainage control.

Extensive improvements to storm-water management features are currently underway at the site as part of a landfill expansion project. This includes constructing a permanent bypass that will divert run-on water from up-gradient watersheds around the landfill to discharge below the detention pond. The onsite runoff will continue to be directed to the detention basin. Because of the transient nature of construction features in the northern and western portion of the landfill, this study does not perform a detailed analysis on the hydraulics of the new construction areas. The current runoff and run-on water from the site are being managed based on construction best management practices (BMPs) being implemented by WMH.

A new and detailed hydraulic analysis of the entire landfill should be performed once the landfill expansion project is complete, and preferably before the next management plan update is due, in order to reassess the adequacy of the new construction features for storm-water management and ensure compliance with the permit conditions.

3.1 EXISTING DRAINAGE AND EROSION CONTROL FEATURES

In 2006, WMH constructed a comprehensive on-site storm drainage system to convey the landfill run-off flows from a 25-year, 24-hour storm. From 2006 to present, site drainage features have been updated. Figure 3-1A and Figure 3-1B illustrate the current site-drainage features based on the most recent topographic map for the site (May 2010).

3.1.1 Main Haul Road Swale and Downdrains

The mid-section of the main haul road was realigned since the last inspection. A new drainage swale, running the length of the realignment, was constructed to collect haul road run-off and convey it to the detention basin. The drainage swales are rock-lined to reduce surface run-off velocities and increase sediment control. The drainage swales convey surface water run-off from the upper areas of the landfill adequately. Down-drain pipes are installed at appropriate intervals to convey swale flows down to the western concrete-lined drainage channel. Gravel check dams remain in place at the drainage inlet locations to reduce flow velocities and potential over-flow along the length of the drainage swale.

3.1.2 Slopes

A silt fence was installed along the eastern edge of the landfill. Sediment accumulation observed behind the silt fences suggests proper installation, which prevents sediment entry into the lined portions of the drainage system. The silt fences consist of woven geotextile held in-place with steel rebar posts and backfilled with coarse gravel along the up-slope side of the fence. Wattles, intended to decelerate water flowing down exposed slopes, are installed on a steep slope on a portion of sub-watershed L2E. Erosion control matting is installed on slopes that are prone to gullying during rainfall events. The matting is in place beneath the hydroseeded areas in sub-watersheds L2C, L2D, L2E, and L2A2/L2B.

3.1.3 Swales and Detention Pond

For the remainder of the site, concentrated onsite flows are conveyed via a series of rock-lined swales and pipes, which ultimately drain into the western concrete-lined drainage channel and then into the detention pond, located near the facility entrance. The detention pond is separated into two parts divided by a rock separation berm consisting of 18-inch to 24-inch rocks. A rip-rap berm is also located within the detention pond and detains initial storm water run-off entering the pond in a preholding area, thus reducing the amount of sediment and particulates that will reach the 48-inch reinforced concrete pipe subdrains and inlet risers. Subdrains are located within the pond to minimize standing water conditions during periods of low flow.

3.1.4 West Berm

The expansion plans for the landfill required the construction of a soil stabilization berm (west berm) along the northwestern perimeter of the landfill, which consequently covered (filled in) a portion of the existing western drainage channel. In 2006, two temporary 48-inch corrugated metal pipes (CMPs) were installed in the western drainage channel to accommodate up-canyon surface water, which flows down the drainage channel. The pipes conveyed run-off generated from the canyon area above the landfill but have since been replaced with 78 inch diameter fiberglass reinforced pipe.

3.1.5 Detention Pond Discharge

Storm water, discharging from the two 42-inch discharge pipes from the detention pond, flows for approximately 200 ft through a well-vegetated grassy area prior to leaving the site. Multiple geosynthetic bags approximately 4 ft in length and 6 inches in diameter, filled with gravel and cobbles, as well as groupings of large rocks were installed below the discharge pipes to allow storm water to spread throughout the grassy area prior to discharging off-site. This additional dispersion provides passive storm-water treatment through additional sediment removal, resulting in improved discharge water quality.

3.2 EVALUATION OF DRAINAGE MEASURES

A site inspection was performed by AECOM Technical Services, Inc. on August 4, 2010 to verify the condition of the existing drainage system features, and erosion and sediment controls. The annual site inspection log is presented in Appendix A.

Extensive ongoing construction to expand and improve the western and northern drainage structures were observed during the site visit. These construction features mostly affect the run-on water from upper watershed areas. A large depression has been excavated as part of the ongoing construction of the landfill expansion and will, in the future, be referred to as Sump E6. This area acts as an additional temporary detention basin during construction, because it is not connected by pipes or channels to the lower sub-watersheds. Pumps are in place to convey water from the future Sump E6 to prevent uncontrolled overtopping. This detention basin is temporarily acting as a sink for runoff water flowing from the northernmost sub-watershed from the site and for run-on water from up-gradient watersheds.

A conservative calculation of the detention potential of the future Sump E6 (based on the contours shown) results in an estimate of 478,000 cubic feet (ft^3) of water potentially detained. This volume is greater than the entire upgradient watershed runoff estimate from a 25-year storm event (i.e. 383,000 ft^3) based on the 2006 hydrology report by Geosyntec Consultants (Geosyntec 2006). Future Sump E6 receives additional input from the 38 acres of northernmost portion of the active landfill. Including this portion and using the parameters from Table 8 of the Geosyntec report (i.e. C = 0.5, i = 1 inch, and area = 38 acres) results in an additional volume of 69,000 ft^3. The total capacity of the future Sump E6 (478,000 ft^3) is more than the combined input of flow into the future Sump (452,000 ft^3).

To confirm that the existing drainage measures are adequate, a review of last year's hydrology and hydraulic calculations was performed. Onsite hydrology calculations (see Appendix B) were performed for the 25-year, 24-hour storm to ensure the adequacy of the drainage swales and piping. The 25-year, 24-hour rainfall interpolation of O'ahu (Giambelluca et al. 1984) was used to determine rainfall intensity. The Technical Release-55 method (USDA 1986) was used to determine the 25-year, 24-hour storm run-off peak flow rates.

New hydrologic calculations performed for areas that have significant changes in drainage pattern compared to last year are presented in Appendix B. Conservatively, this report calculates flow from the northernmost sub-watershed (i.e. sub-watershed C1, excluding the 2.65 acres of area occupied by the future Sump E6 proper) in the active landfill area, even though the entire flow from sub-watershed is being intercepted in the future Sump E6.

The sizing analysis for the current drainage features was completed in the 2006 SWMP (Earth Tech 2006). The majority of the drainage basins that are not on the northernmost area of the active landfill have not significantly changed. Therefore, estimated peak discharges and sizing of hydraulic features from last year's report remain valid (see Appendix B). A large area (basin L1A1-A in previous report) is now draining into the future Sump E6 (as part of new sub-watershed delineation C1) and not south into the eastern swales. Therefore, the water input to the active landfill storm water features on the eastern side have decreased this year.

Overall, the peak flow computations indicate a slight increase in flow from previous year for the changed subbasins (an increase of 23.6 cubic feet per second [cfs] or 7.5% increase in peak flow from previous year). The increased computed flow is related to steeper slopes because of the construction/landfill filling and reduced surface cover because of grading activities (increases in curve numbers). However, as mentioned before the entire flow from sub-watershed C1 (i.e. 201.9 cfs) flows into the future Sump E6 and is captured there. Removing this flow from calculations will result in total flow from changed areas this year at 139.2 cfs in comparison to total previous flow of 317.43 cfs. Realistically there is no additional flow at the site to be managed.

Although the storm-water features in place are sufficient for the time being, a detailed analysis of storm water hydraulics will be required upon completion of the ongoing construction phase, which will ultimately result in significant changes to the site hydrology.

3.3 RECOMMENDED MEASURES

The following measures are recommended for surface water management at the WGSL.

3.3.1 A Detailed Hydraulics Study

The significant construction changes at the landfill warrant a complete reevaluation/reassessment of the hydrology and hydraulics for run-on and runoff storm water flow at the landfill. This evaluation should be completed as soon as new post-construction data (aerial photographs, new contours, channel and pipe dimensions) are available.

3.3.2 Detention Pond

WMH is currently improving the western perimeter channel to route run-on flows from the watershed above the landfill via a lined channel that will bypass the lower detention pond. Therefore, only surface water from the landfill property will flow into the detention pond. With construction of the new western perimeter channel and minor modifications to the outlet risers that have already been implemented, the pond will likely be able to achieve flood control and water quality design criteria for a 25-year, 24-hour storm. The bypass channel and pond performance are discussed further in a technical memorandum by Geosyntec Consultants, Inc., presented in Appendix C.

3.3.3 Maintenance Measures

The following maintenance measures are to be implemented:

- As necessary, fiber rolls or silt fences will be placed along the top of banks along exposed active work areas to reduce erosion and sediment loss due to storm water sheet flow.
- Installation of wattles or similar BMPs along larger slope faces (greater than 15 ft in height) to reduce surface runoff velocities, downstream sediment activity and to promote vegetative establishment.

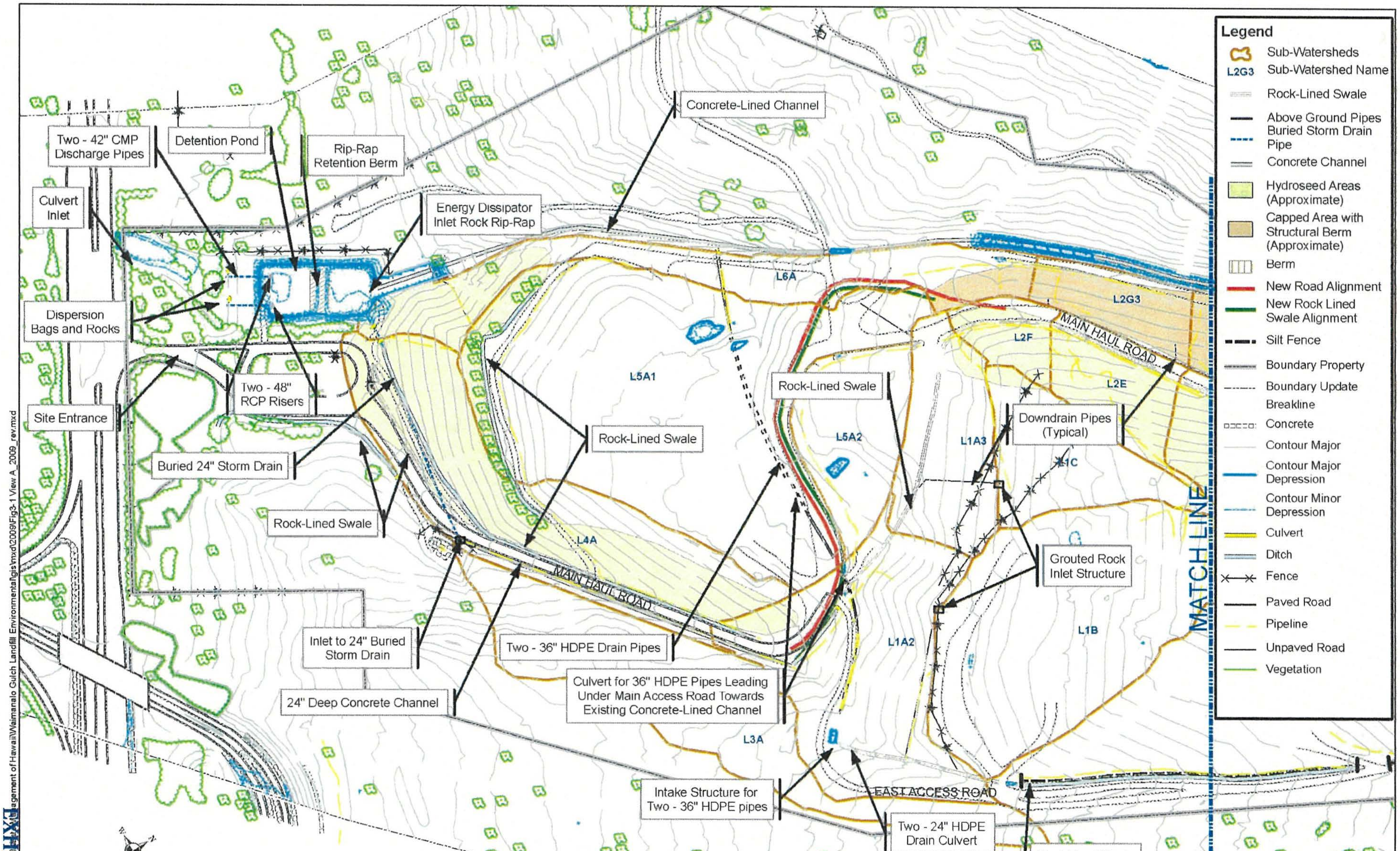

Figure 3-1A
Site Drainage Features
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

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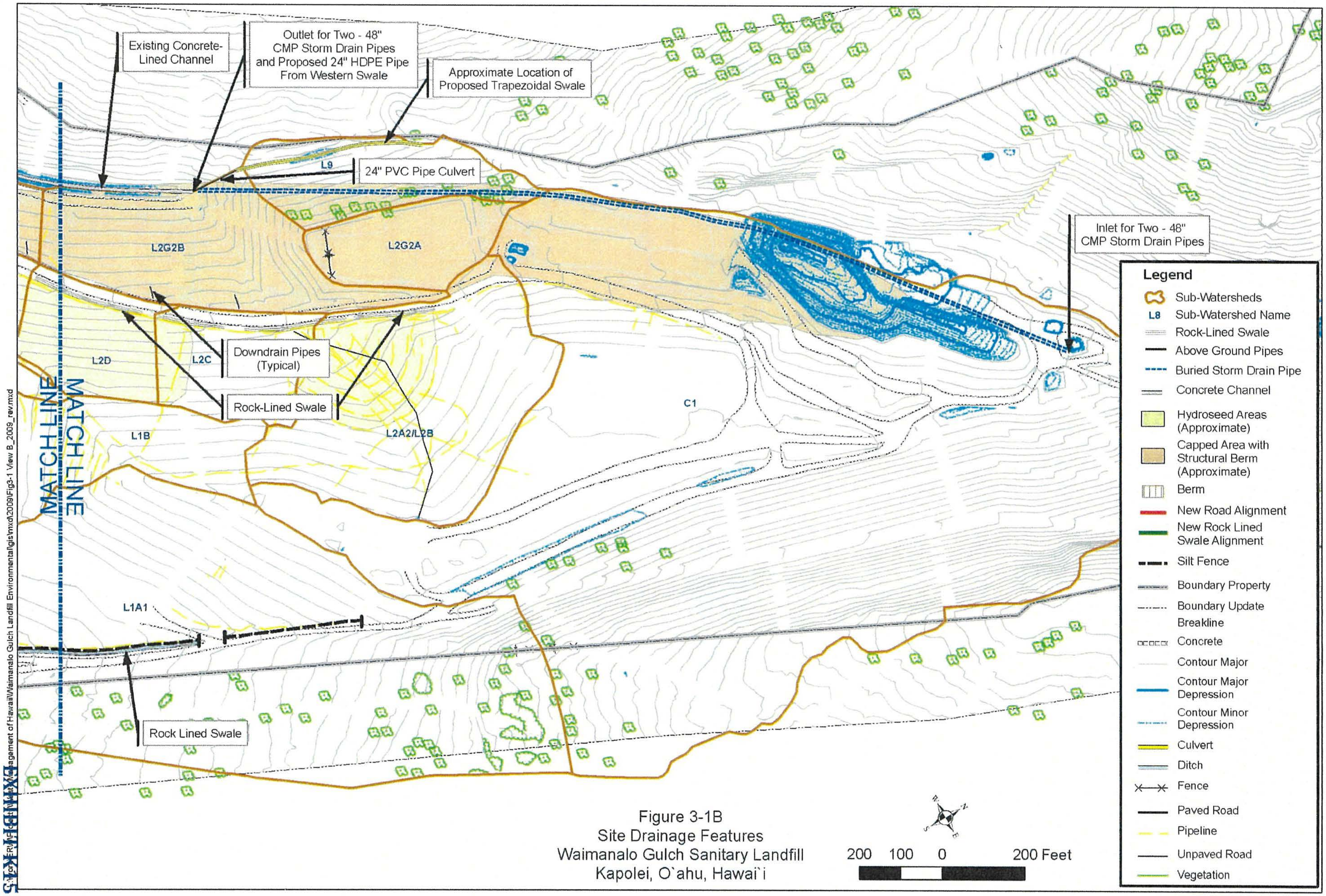

Figure 3-1B
Site Drainage Features
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

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EXHIBIT K51

4.0 SWMP IMPLEMENTATION AND EVALUATION

This section describes the mechanisms and procedures through which the SWMP will be implemented and evaluated. It identifies the required inspections and follow-up actions and record keeping procedures.

4.1 SWMP Implementation

4.1.1 Inspections

Annual inspections of the landfill area, the drainage system, and the detention pond are performed by WMH personnel. An inspection log sheet is used to document the results of the inspection. The current annual inspection log sheet is presented in Appendix A. After all major rainstorm events, inspections of the drainage system, detention pond, and erosion and sediment measures are performed to identify failures, breaches, or sediment deposition requiring repair.

4.1.2 Record Keeping

Records of the inspections and follow-up actions are maintained in the WGSL Operating Record/Files.

4.2 SWMP Evaluation

The effectiveness of the WGSL storm water run-on and run-off drainage systems is reviewed on an annual basis. The review assesses the drainage pond, new flow patterns due to changes in grades, the effectiveness of the employed erosion and sediment control BMPs, and compliance with the procedural requirements of the SWMP (inspection, reporting, record keeping, and SWMP updates).

The effectiveness of individual BMPs is assessed using visual observations made during the annual inspections. The inspection log form is used to document the effectiveness and appropriateness of the existing erosion and sediment control measures and drainage system features for current site conditions. Maintenance of the detention pond is scheduled on an as-needed basis and includes removal of any sediment deposits within the detention pond bottom. Two to three feet of freeboard is maintained at all times.

4.2.1 Documentation of Revisions

Changes to the SWMP are incorporated through updates of plans and the SWMP. Revisions are reflected within the update log located in Appendix D including the revision date and a brief description of changes.

5.0 REFERENCES

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Appendix A
Annual Site Inspection Log Sheet

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ANNUAL INSPECTION LOG
WAIMANALO GULCH SANITARY LANDFILL
SURFACE WATER MANAGEMENT PLAN

GENERAL INFORMATION

Date: 8/4/2010

Personnel: Frank Cioffi (ATS), Sushant Dhal (ATS), Tobias Koehler (ATS), Justin Lottig (WMH)

Weather:

Raining Yes ☐ No ☒

Time Since Last Rainfall Event: No measureable rainfall since June 2010

Runoff:

Flow observed? Yes ☐ No ☒

Type of Flow Sheet ☐ Rill ☐ Concentrated ☐

VISUAL OBSERVATIONS

Inspection List	Yes/No/NA	If Yes, Describe Location and Required Follow-up Action (if any)
Active Face / Landfill Cover		
Bare or sparsely vegetated areas	No	Active landfill areas do not have vegetative cover.
Settlement or depressions	No	
Slope Instability	No	
Gullies caused by erosion	No	.
Illicitly-dumped material	No	
Stressed or dead vegetation	No	Vegetation is dry due to extended dry period.
Other indicators of leachate seepage	None	
Drainage swales		
Evidence of erosion	Yes	Roadside grouted rock swales show evidence of undercutting. Landfill operator indicates that the responsible contractor has been notified by email and that corrective action will be taken.
Sediment deposition	No	

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Inspection List	Yes/No/NA	If Yes, Describe Location and Required Follow-up Action (if any)
Detention Pond		
Structure blocked or has obstructions	No	
Outfall areas eroded	No	
Security Measures		
Landfill access road gate damaged	No	
Access Roads		
Roads inaccessible	No	
Roads damaged by erosion or settlement	No	
Leachate Sumps		
Depth from top of sump less than 3 feet?	No	Levels are in compliance. Compared leachate level logs with leachate compliance levels (as of 7/30/10).
Side Slopes Covered with Geosynthetic Tarps		
Evidence of erosion?	No	
Geosynthetic tarps intact on lower slopes?	Yes	
Geosynthetic tarp condition on lower slopes?	Good	
Side Slopes hydroseeded?		
Upper slopes hydroseeded?	NA	Slopes on inactive, capped portions of landfill are hydroseeded.

Appendix B
SWMP Onsite Hydrology & Hydraulic Calculations

ONSITE HYDROLOGY CALCULATION

The analysis follows the Technical Release-55 (TR-55) Urban Hydrology for Small Watersheds method (USDA 1986) to determine the 25-year, 24-hour storm run-off peak flow rates. Where applicable in the drainage sub-watersheds, weighted run-off coefficients were calculated for composite drainage areas. Time of concentration or time of travel for each sub-watershed and reach was determined using run-off coefficients as given in TR-55 for the various existing site surface conditions. Surface run-off peak flows were determined from the 25-year, 24-hour rainfall map of O'ahu (USDC 1962).

The delineated watershed boundaries are shown on Figure B-1. The boundaries and surface conditions for the 15 sub-watersheds listed in Table B-1 have not changed significantly since the last Surface Water Management Plan update, which was conducted in 2009.

Table B-1: Sub-Watersheds With Insignificant Change From Previous Year Delineation

Sub-Watershed Name	2009 Basin Area (Acres)	2008 Basin Area (Acres)	Difference (2009-2008)
L1A1	19.05	19.05	0.00
L1A2	4.97	4.97	0.00
L1A3	2.31	2.31	0.00
L1B	8.23	8.23	0.00
L1C	2.12	2.12	0.00
L2C	2.11	2.11	0.00
L2D	1.91	1.91	0.00
L2E	1.51	1.51	0.00
L2F	0.77	0.77	0.00
L2G2A	1.84	1.84	0.00
L2G2B	4.22	4.22	0.00
L2G3	1.18	1.18	0.00
L3A	4.78	4.78	0.00
L6A	3.36	3.36	0.00
L9	2.36	2.36	0.00

The outfall peak discharges from all of the sub-watersheds listed in Table B-1 remain in accordance with previous modeling. The sub-watershed time of concentration values, run-off coefficients, and drainage areas have not significantly changed, and therefore the outfall peak discharges have not significantly changed. The onsite drainage features, such as the piped drainage systems, rock-lined and rip-rap swales, and the piped culverts, have been working properly within the past year. These features are designed to convey surface water run-off to the detention pond while minimizing erosion and sediment dispersal, and are functioning properly.

The five sub-watersheds listed in Table B-2 changed from the previous year's conditions, due to active landfill cell filling operations and ongoing construction activities that caused changes in surface topography and drainage pattern. The changes were inferred from latest topographic survey maps and recent site visit assessment of the onsite drainage features. These sub-watersheds were all evaluated using TR-55 to find their 25-year, 24-hour storm run-off peak flow rates. Sub-watershed L1A1-A, which last year was draining towards to the east of the landfill, is now flowing north-west and draining through the west side (as part of new sub-watershed C1). Previous sub-watersheds L2G1, L8, and L2A1/L7 were combined with L1A1-A into sub-watershed C1. All water from these areas drain towards the large excavated depression (the future Sump E6) created during the ongoing construction, which acts as a temporary detention basin (see Figure B-1).

Adjustments to the sub-watershed delineations resulted in increases in areas from previous sub-watershed representation for L5A1, L5A2, and C1. Correspondingly, the areas for L4A, and L2B/L2A2 were reduced, because water from parts of these sub-watersheds are now flowing to adjoining sub-watersheds.

Table B-2: Sub-Watersheds With Significant Changes in Topography

Sub-Watershed Name	Previous Sub-Watersheds in the Area	20010 Basin Area (Acres)	2009 Basin Area (Acres)	Difference (2009-2008)	New Peak flow (ft^3/sec.)	Old Peak flow (ft^3/sec.)	Difference (Old-New)
L4A	L4A	5.5	7.13	1.6	32.2	30.1	-2.1
L5A1	L5A1	10.5	9.14	-1.3	58.2	47.21	-11.0
L5A2	L5A2	2.0	1.75	-0.3	10.0	7.38	-2.6
L2B/L2A2	L2A2/L2B	6.8	7.4	0.6	38.8	35.22	-3.6
C1	L2G1, L8, L2A1/L7, and L1A1-A	38.03 (Active area = 35.37)	36.81	-1.2	201.9	197.52	-4.4

ft^3/sec cubic feet per second

As shown in Table B-2, the new computations for peak flows show a slight increase in the sub-watersheds affected by new construction/ filling operations. The increase in computed peak flow is related to increases in slopes for the basins and decrease in vegetative cover because of recent soil disturbances. There is a computed net peak flow increase of 23.6 cubic feet per second, (approximately 7.4 percent greater) than the peak flow for the same areas in 2009. However, the flow from sub-watershed C1 drains into the future Sump E6 in the northwestern corner of the landfill property. This area acts as an additional detention basin for the time being because it is not hydraulically connected by pipes or channels to the lower sub-watersheds. Additionally, pumps are in place to convey water from the future Sump E6 to prevent uncontrolled overtopping. The future Sump E6 is temporarily acting as a sink for runoff water flowing from sub-watershed C1 and for run-on water from upgradient watersheds. A conservative calculation of the detention potential of the future sump results in an estimate of 478,000 cubic feet (ft^3) of capacity. This volume is greater than the entire up-gradient watershed runoff estimate from a 25 year storm event (i.e. 383,000 ft^3) based on the 2006 hydrology report by Geosyntec Consultants, Inc. (Geosyntec 2006) and the additional input from the 38 acres of subwatershed C1 (69,000 ft^3). The runoff volume from C1 was calculated using the parameters from Table 8 of the Geosyntec report (i.e. C = 0.5, i = 1 inch, and area = 38 acres). The total capacity of the future sump E6 (478,000 ft^3) is more than the combined input of flow into the future sump (452,000 ft^3). Therefore, the actual peak flow from the site is well below the computed peak flow values presented in Table B-2 and the existing storm water management features continue to provide sufficient capacity.

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Geosyntec Consultants, Inc. 2006. *Engineers Design Report, Design and Analysis of Waimanalo Landfill, Oahu, Hydrology and Hydraulics, Waimanalo Gulch Sanitary Landfill, Oahu, Hawai'i.* April.

United States Department of Agriculture (USDA). 1986. *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55).* Natural Resources Conservation Service. Revised June.

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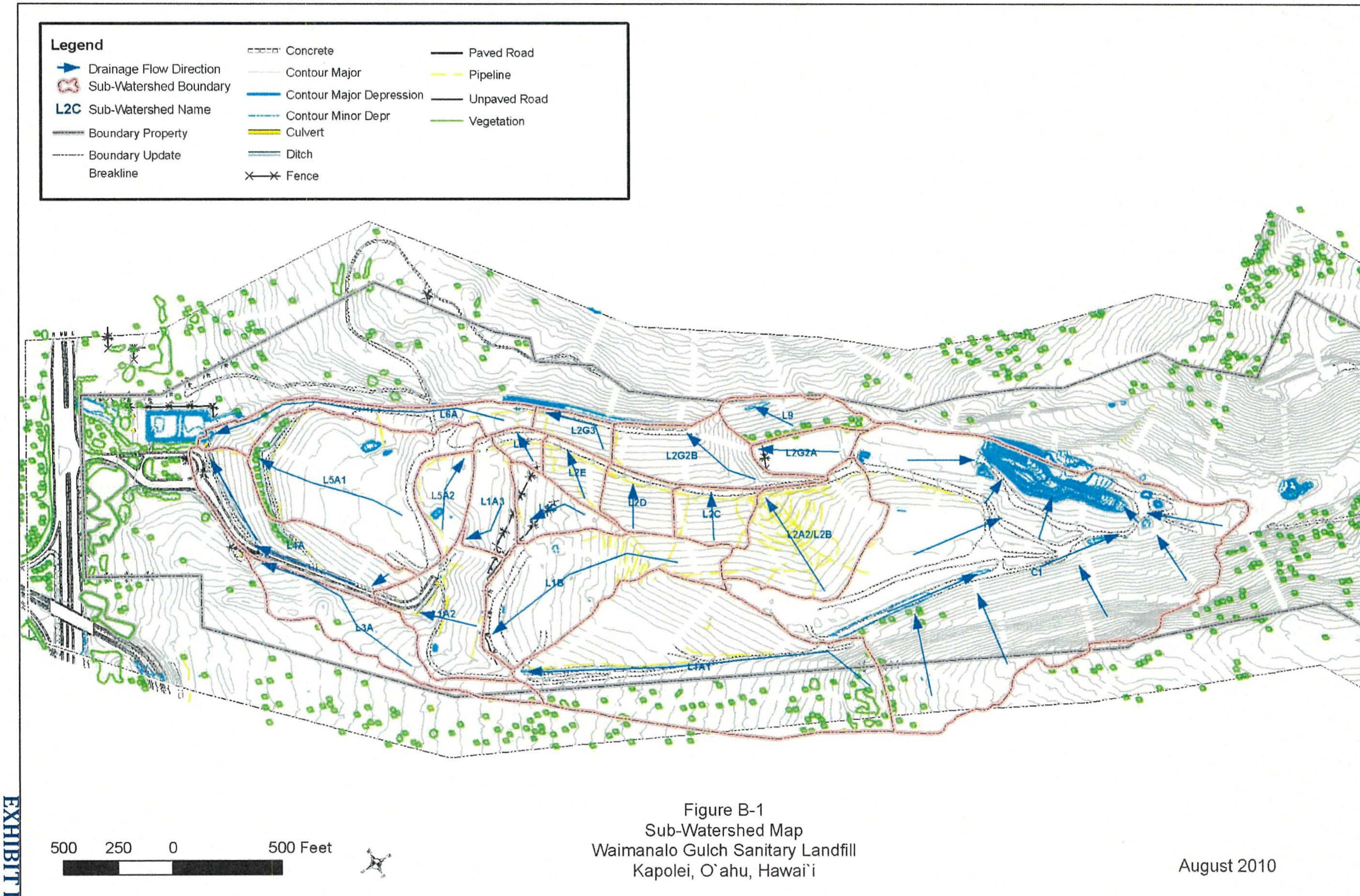

Figure B-1
Sub-Watershed Map
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

August 2010

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Appendix C
Technical Memorandum for Sedimentation Pond

EXHIBIT K151

GEOSYNTEC CONSULTANTS, INC.
TECHNICAL MEMORANDUM

TO: RICK VON PEIN, PE (WASTE MANAGEMENT, INC.)

FROM: HARI SHARMA, GARY PALHEGYI, FABRIZIO SETTEPANI

SUBJECT: **SYNOPSIS OF SEDIMENTION POND PERFORMANCE**

DATE: 14 AUGUST 2007

Question 11 asks about the performance of the existing sedimentation basin; its overall volume, flow through velocities, and particle settling performance. This brief technical memorandum summarizes our response.

The existing sedimentation basin was designed based on flood control criteria; however, current regulations require that the sedimentation basin also be designed based on water quality criteria. The required water quality criteria are specified in the City and County of Honolulu's *Storm Drainage Standards* (2000). The main difference between the criteria is that the design storage volume is computed using a different formula and the holding time increases from about 6 hours to 48 hours to achieve the required settling performance.

Design for Flood Control

The existing sedimentation basin was designed according to flood control criteria (Earth Tech 2005) such that it detained and slowly released the 25-year, 24-hour design storm through the riser pipes; the estimated detention time is 6 hours. The basin can also safely pass the 100-year peak discharge through the spillway without flooding. The basin currently has two 48-inch diameter perforated riser pipes to control stormwater for storms up to the 25-year event, and has a rock weir and spillway to pass storm flows greater than the 25-year design storm.

To provide a frame of reference, Earth Tech (2005) computed the total existing basin storage and back calculated the storm that fits this volume, arriving at the 25-year, 2-hour event. The basin was not originally designed to this criterion.

Water Quality Design Volume

In 2006, Geosyntec evaluated the sedimentation basin design and water quality requirements based on the *Storm Drainage Standards* and determined that the existing

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basin did not meet the water quality design criterion. This is primarily due to capturing Run-On from the upper watershed. To address this issue, Waste Management plans to re-route Run-On from the upper watershed around the landfill via a lined channel (Western Perimeter Channel) and bypass the sedimentation basin. The bypass channel is currently being designed by GEI Consultants, Inc.

Once the Western Perimeter Channel is constructed; only landfill surfaces and minor adjacent side slopes will drain to the sedimentation basin; therefore, only minor modification will be required to meet the water quality design criterion. The criterion requires the volume to be computed as shown below; furthermore, the basin should detain the computed volume for 48 hours to achieve the required settling time and water quality performance.

According to the *Storm Drainage Standards*, the water quality design volume (WQDV) is computed using:

WQDV = C x 1" x A x 3630

where:

C = runoff coefficient
1" = 1 inch of rainfall over the entire catchment
A = Area of catchment
3630 = unit conversion

Table 1 summarizes the estimated water quality design volume as well as the additional excavation volume needed to accommodate the WQDV for the landfill portion of the Run-On after the Western Perimeter Channel has been constructed.

Table 1 – Water Quality Design Volumes

Volume Required	Area	C	Rainfall	Volume
	(acres)		(inches)	(cubic-feet)
Option 1	165	0.5	1	299500
Option 2	162	0.5	1	293300
Existing Basin[1]				309276
Excavation Needed				0

Option 1 includes a small area of off-site run-on from the south-western portion of the watershed that could pass over the proposed pipe section of the western perimeter channel. Option 2 assumes that ALL of the off-site areas west of the perimeter channel is

[1] The existing basin volume was reported by Earth Tech in November 2005 *Surface Water Management Plan, Waimanalo Gulch Sanitary Landfill, Kapolei, Oahu, Hawaii*. In September 2006, Earth Tech again reports an existing volume of 7.1 acre-feet or 309,276 cubic-feet with a new basin configuration and outlet design.

captured as clean water and routed around the sedimentation basin. The difference is actually minor and there is enough volume in the existing basin to satisfy either case.

One of the other changes that will be implemented by WM is to increase the drain time of the basin from 6 hours to 48 hours to meet the water quality requirements. This will require modification of the outlet structure low flow orifice openings to slow the rate of discharge of smaller volumes. The figures attached show examples of outlets designed for a different project with similar goals.

This modification will affect the effectiveness of the basin at managing the 25-year and 100-year, 24-hour storms. WM plans to make the necessary modifications in basin design to satisfy both the water quality and flood control performance.

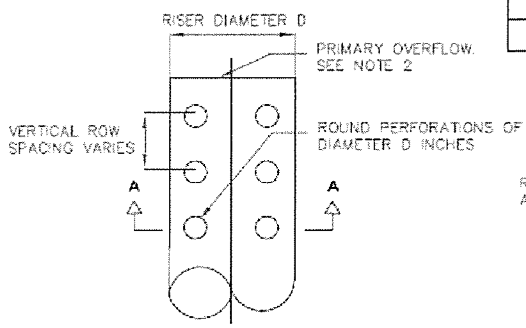
References

City and County of Honolulu. 2000. *Rules Relating to Storm Drainage Standards.*

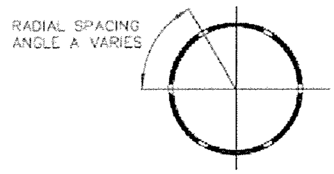
Earth Tech, Inc. 2005. *Surface Water Management Plan, Waimanalo Gulch Sanitary Landfill, Oahu.*

Smooth Plastic Riser Standard Dimensions (Wyoming NRCS)

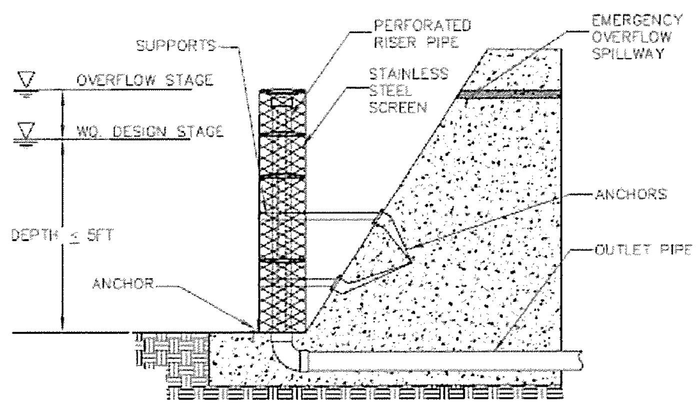
Max Orifice Diameter D (Inches)	Pipe Diameter (Inches)	Min Wall Thickness (Inches)	No. of vertical rows of perforations	Radial Spacing of Vertical Rows A (Degrees)
3½	8	0.15	6	60
5½	10	0.20	8	38
8	12	0.25	10	45



Perforated Riser Detail
(Not to Scale)



Section A-A
(Not to Scale)



Perforated Riser Outlet Structure
(Not to Scale)

NOTES:

1. RISER PIPE SHALL BE SIZED TO PROVIDE 36 TO 48-HOUR FULL BRIM DRAW DOWN TIME.
2. TOTAL OUTLET CAPACITY: CAPITAL DEVELOPED PEAK FLOW FOR ON-LINE BASINS AND WATER QUALITY DESIGN FLOW FOR OFF-LINE BASINS.
3. SCREEN OPENINGS SHALL BE AT LEAST ⅛" AND SHALL NOT EXCEED THE DIAMETER OF THE PERFORATIONS ON THE RISER.
4. MINIMUM NUMBER OF PERFORATIONS SHALL BE 8
5. MINIMUM DIAMETER SHALL BE ½".
6. MAXIMUM PERFORATION DIAMETER SHALL BE 2".

GEOSYNTEC CONSULTANTS

Figure 2-2

PERFORATE RISER OUTLET

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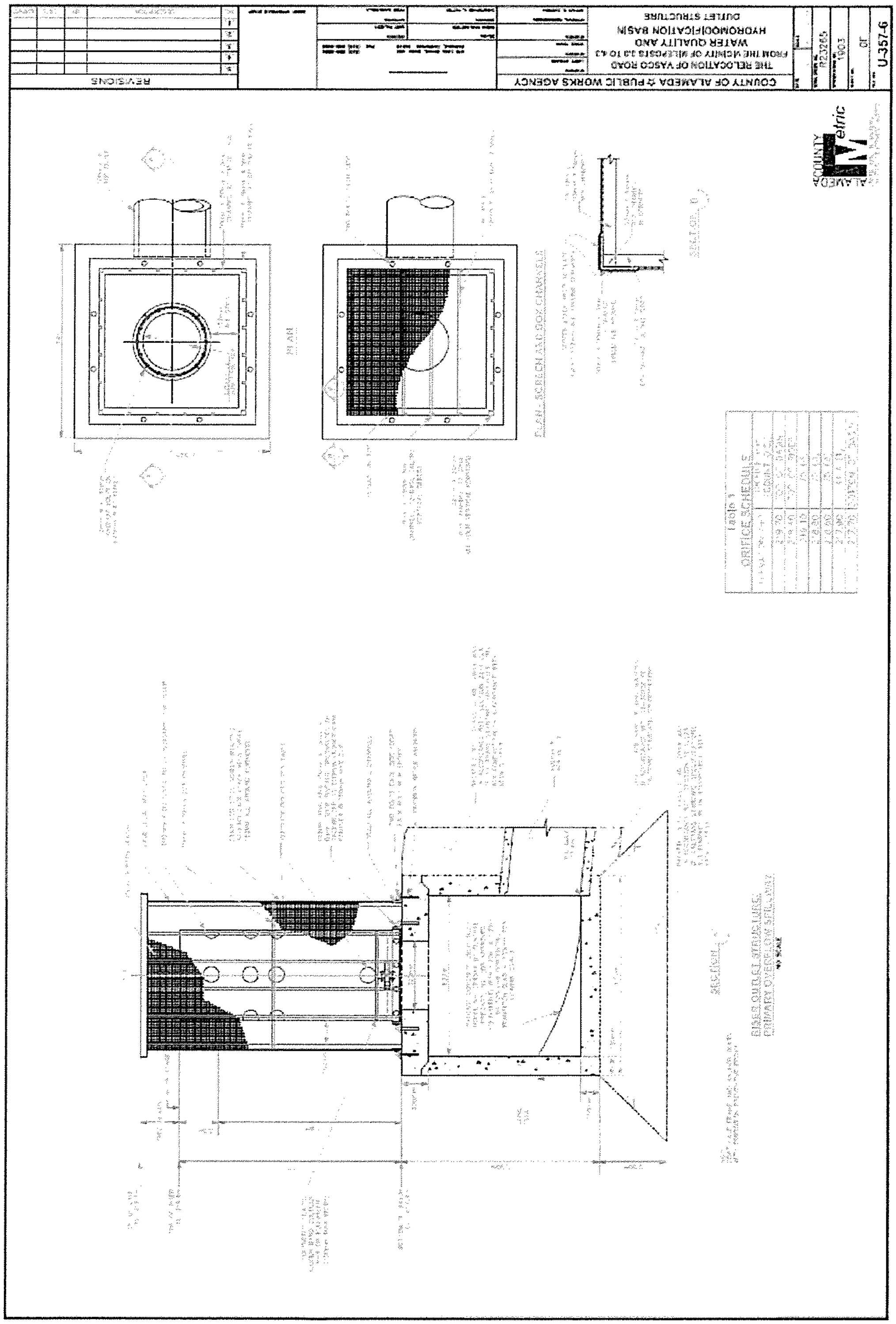

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Appendix D
Update Log

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UPDATE LOG
WAIMANALO GULCH SANITARY LANDFILL
SURFACE WATER MANAGEMENT PLAN

DATE	DESCRIPTION OF UPDATE	NAME/SIGNATURE OF RESPONSIBLE OFFICIAL
September 2006	The original SWMP prepared in November 2005 has been updated to reflect current site conditions including the current aerial view (Figures 2-3 & 2-4), updated on-site drainage measures plans (Appendix A), the updated hydrology and hydraulic calculations (Appendix B), and the overall watershed hydrology calculations (Appendix C). The SWPCP has been excluded from this version of the SWMP and will be submitted to DOH separately. In addition the 2006 Annual Inspection documentation has been included in Appendix E.	
August 2007	The SWMP has been updated from 2006 to reflect all construction of drainage measures completed to date. Figure 3-1A and Figure 3-1B have been updated with the most current topography (March 2007) as well as new drainage features. Surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix C). The SWPCP and SPCC are both included in the Site Operations Manual that was submitted to DOH, so therefore they are not included in this SWMP.	
August 2008	The SWMP has been updated to reflect the most recent topographic conditions (May 2008) and site drainage features updated during 2007. Figure 3-1A and Figure 3-1B have been updated with the most current topography (May 2008). Also surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix B). The SWPCP and SPCC are both included in the Site Operations Manual that was submitted to DOH, so therefore they are not included in this SWMP.	
August 2009	The SWMP has been updated to reflect the most recent topographic conditions (March 2009) and updated site drainage features. Figure 3-1A and Figure 3-1B have been updated with the most current topography (March 2009). Also surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix B). The SWPCP and SPCC are both included in the Site Operations Manual that was submitted to DOH, so therefore they are not included in this SWMP.	
August 2010	The SWMP has been updated to reflect the most recent topographic conditions (May 2010) and updated site drainage features. Figure 3-1A and Figure 3-1B have been updated with the most current topography (May 2010). Surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix B). An update to the SWPCP was submitted with the recent NPDES NOI-B permit application responses to DOH comments (June 2010). The SPCC is excluded from this submittal.	

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