

The 92.5 acre area is proposed for uses that include construction of landfill cells; earthwork to support construction of an access roadway, drainage controls, berms and stability slopes; and excavation and stockpiling of cover material. The proposed expansion project will be subject to a minimum 100 foot buffer inside of the perimeter of the property boundary to reduce the potential for impacts to neighboring properties. The buffer is intended to remain in an undeveloped condition.

### 3.2. Purpose of the ~~Draft~~ Final Environmental Impact Statement

This ~~Draft~~ Final Environmental Impact Statement (~~DEIS~~) (FEIS) is prepared pursuant to the content requirements of Chapter 343, Hawai'i Revised Statutes (HRS), and Chapter 11-200, Hawai'i Administrative Rules (HAR), and in compliance with actions that require the preparation of an EIS document. These specific actions involve: (1) the use of state or county lands or funds; and (2) the proposed action involving the construction and operation of a landfill.

According to the regulations:

Chapter 343, HRS, Environmental Impact Statements:

"§343-5 Applicability and requirements.

(a)(1) Propose the use of state or county lands or the use of state or county funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property; provided that the agency shall consider environmental factors and available alternatives in its feasibility or planning studies; provided further that an environmental assessment for proposed uses under section [205-2(d)(10)] or [205-4.5(a)(13)] shall only be required pursuant to section 205-5(b);"

"(a)(4) Propose any use within any historic site as designated in the National Register or Hawaii Register, as provided for in the Historic Preservation Act of 1966, Public Law 89-665, or chapter 6E;"

"(a)(9) Propose any: (C) Landfill;"

Chapter 11-200, Environmental Impact Statement Rules:

"Subchapter 5, Applicability

§11-200-5 Agency Actions:"

"B. The applicability of chapter 343, HRS, to specific agency proposed actions is conditioned by the agency's proposed use of state or county lands or funds. Therefore, when an agency proposes to implement an action to use state or county lands or funds, it shall be subject to the provisions of chapter 343, HRS, and this chapter."

"C. Use of state or county funds shall include any form of funding assistance flowing from the State or county, and use of state or county lands includes any use (title, lease, permit, easement, licenses, etc.) or entitlement to those lands."

The Environmental Impact Statement Preparation Notice (EISPN) for this project was published by the State Office of Environmental Quality Control (OEQC) on November 23, 2006. The DEIS was published by OEQC on May 23, 2008.

~~This DEIS and the forthcoming Final Environmental Impact Statement (FEIS) will provide information and evaluation of the potential for environmental impacts on the natural and built environment associated with the planned 92.5 acre lateral expansion of the WGSL. This DEIS will also inform interested parties of the proposed project and seek public comment on subject areas that should be addressed during the EIS process.~~

### 3.3. Need for the Proposed Project

The proposed project is required to address the municipal waste disposal needs of the island of O'ahu. A condition of the approved State Special Use Permit (SUP), Docket

No. SP87-362, had required closure of the site from the acceptance of refuse on or before May 1, 2008. In March 2008, this period of time was extended by the State Land Use Commission for a period of 18 months or November 1, 2009, to allow for use of the remaining capacity within the approved 107.5 acres, contingent on no unexpected events that would prematurely exhaust this capacity<sup>1</sup>. Although the extension of time will allow for more efficient use of the space remaining within the existing area, it will eventually reach capacity.

WGSL receives solid waste from all of O'ahu. As an annual ~~acreage~~ average, approximately 800 tons<sup>2</sup> per day from municipal solid waste (MSW) and recycling residue, and approximately 600 tons per day from ash and residue, from the Honolulu Program of Waste Energy Recovery (H-POWER), for a total of approximately 1,400 tons daily, is accepted or delivered<sup>3</sup>. Actual annual tonnages can ~~very~~ vary significantly depending on whether H-POWER is operating. The closure of the landfill upon the exhaustion of the existing area of use without a means of disposal of municipal, recycling, and H-POWER refuse is not practical because it would fail to provide for the islandwide sanitary treatment of municipal generated waste essential to the maintenance of public health and safety.

ENV, which is responsible for the disposal and management of refuse in the City & County of Honolulu, proposes to address this requirement by utilizing the remaining 92.5 acres of the existing Waimānalo Gulch for future landfilling. This area of expansion will extend the life of the site for an estimated minimum period of 15 additional years.

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<sup>1</sup> These unexpected events primarily include a hurricane, tsunami, or earthquake induced event where the landfill would be utilized in an emergency to serve in the cleanup and recovery effort for the disposal of storm and disaster generated debris.

<sup>2</sup> This includes a small amount of recycling residue associated with waste generated from the recycling effort. Department of Environmental Services, August 2006.

<sup>3</sup> Figure is approximate. In FY 2006, WGSL averaged 930 tons per day of MSW and 460 tons per day of ash and residue.

### 3.4. Community EIS Scoping Meetings

#### 3.4.1. Background

ENV convened a series of four EIS Community Scoping Meetings between July 10 and August 10, 2006 to obtain community input on environmental issues that the public feels should be addressed in preparation of the EIS for the expansion of the Waimānalo Gulch Sanitary Landfill. Waimānalo Gulch is located in proximity to the boundaries of the Nānākuli and 'Ewa regions of O'ahu, but is used islandwide by all O'ahu communities for the disposal of municipal refuse. The public scoping meetings were held to obtain input from the communities closest to the landfill, as well as other communities that are important users of the facility. The meetings were held on the following dates and at the following locations:

Mtg. No. 1	July 10, 2006	Nānākuli High and Intermediate School 98-980 Nānākuli Avenue Wai'anae, Hawai'i 96792
Mtg. No. 2	July 11, 2006	Benjamin Parker Elementary School 45-259 Waikalua Road Kāne'ohe, Hawai'i 96744
Mtg. No. 3	July 27, 2006	Mission Memorial Auditorium 550 South King Street Honolulu, Hawai'i 96813
Mtg. No. 4	August 10, 2006 <sup>4</sup>	Kapolei Hale 1000 Uluohia Street Kapolei, Hawai'i 96707

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<sup>4</sup> The date for this meeting was changed from July 26, 2006 which conflicted with the Neighborhood Board No. 34, Makakilo/Kapolei scheduled meeting.



### 3.4.2. EIS Public Scoping Meeting Agenda

Each of the four scoping meetings was conducted by a meeting facilitator who explained that the purpose of the meetings is to obtain community input on environmental issues the public feels should be addressed in preparation of the project EIS. The same agenda was used for all meetings and included:

- A. A statement of purpose for the meeting;
- B. A statement by ENV concerning the need for the project and the events that have transpired since 2003 when the last EIS for the expansion of Waimanalo Gulch was approved;
- C. Time was allotted during the meeting to hear community concerns on issues or subject areas that they felt should be addressed in the EIS;
- D. The facilitator summarized the input provided by the community during the last 15-30 minutes of the meeting; and
- E. The facilitator and ENV thanked the community for its attendance and the meeting adjourned.

### 3.4.3. List of Participants

Participants who signed the attendance sheets for this series of meetings are provided in **Appendix C - EIS Public Scoping Conducted for the Proposed Expansion of the Waimānalo Gulch Sanitary Landfill**.

### 3.4.4 Summary of Issues and Concerns Raised

A number of issues and concerns were raised by the community during the series of scoping meetings. The following list is a consolidation of all issues and comments received when the comment period ended on August 30, 2006. The comments have been taken into consideration, as appropriate, in the preparation of the subject document and the requirements of Chapter 343, HRS, and Chapter 11-200, HAR.

Note: Issues that are in **bold** are those that were received in writing by August 30, 2006, and are not duplicative of what was already stated by the community during the course of the meetings.

#### General

- The 2001 EIS should not be used as the basis for this EIS
- EIS needs to clearly illustrate what expansion is taking place
- Need to provide number of years of continuing operation as well as the number of acres the expansion will take
- Need to clarify the location, size of the area and what the current zoning is. Documents need to be very clear and specify the boundaries
- Need to look at mainland sewage sludge studies
- New ash area that is covered in EIS needs to be specified where and size
- Impact of other new proposed private sites such as Nānākuli B – do not need both
- Need to identify impacts to RFP process
- Need to consider federal draft rules for shipping of waste
- Need to look seriously at all sites available around the island
- Need to discuss worst case scenario contingencies including earthquake etc.
- Need to determine how the DEIS will tie-in to the City's comprehensive, Solid Waste Integrated Management Plan (SWIMP) update that the city is supposed to prepare
- There is a need to be aware that other areas of the island have hosted landfill sites in the past until their capacity was reached i.e. Aikahi, Kawaianui Marsh, Kapa`a Quarry etc. – they have not all been on the Leeward side
- The EIS needs to reflect the current status at the landfill not the preferred status
- There was a concern expressed about the ability of a local planning firm to be neutral on this issue with all the political pressure
- Need to include all Federal, state and local laws that affect landfill operations
- Need to address Waste Management's 1999 contract with Mayor Harris
- Need clarity between airspace and landfill
- Need to explain why the community should believe the City at this point and why promises have not been kept
- HPOWER has never failed an EPA test on its ash – need to know why DOH has not approved reuse for concrete etc.

- Need to deal with the reality that because of our tourist economy or per person generation of waste is 7 pounds per day instead of the national average of 4 pounds
- Need to consult the County of Hawai'i who has just completed review of 61 alternatives and chosen 3 proven technologies to address this same issue
- **EIS needs to comply with all EIS rules and statutes – including those that require “good faith”**
- **Must not just address expansion but cumulative impacts since the 1980s**

#### Closure of Landfill

- EIS needs to focus on closing of Waimānalo Gulch now or as soon as possible – should not just go for life of area but should have a plan to reduce waste stream as quickly as possible to provide for closing sooner rather than later
- Review all alternatives available to reduce the waste stream with the intent of closing the landfill as soon as possible
- Need to consider the fact that many landowners and developers were fully aware of the landfill's existence pre-development of their current homes and projects and moved in anyway
- Landowners in the area maintain that they were told the landfill would close in '08 when they bought and had depended on these representations in making their decisions
- Need for active recycling program that would cut down the need for a landfill; need for a sensible plan that would allow for the earliest possible closure of the landfill
- Need for finite planning – Hawai'i should be at the cutting edge and shouldn't worry about costs to keep it a paradise
- City must explain why we are here – other meetings have been held in the past which promised closure of the landfill by 08 and it is still open
- EIS needs to provide factual/historic information for the issue of the promised closure in 2008 and the issuance of an operating permit that required closure in '08
- **Need a comprehensive closure plan for the existing Waimānalo Gulch landfill site irrespective of the proposed closure date**
- **Need to address the State Land Use Commission Decision and Order calling for closure in 2008**
- **Need to address the conflicting position of the 1984/1985 EIS which stated that only 57+/- of the 200 or so acres owned were feasible for utilization as a landfill due to the slope angles of the hillsides.**
- **Close it and put it somewhere else on the island**

## Environmental

- Need to explain what the relationship will be between the newly created topography of the expanded landfill, and the prevailing wind patterns of the area including any impact on ocean currents and near shore water temperatures as well as any impacts the new topography may have on adjacent landowners (including the slope integrity along shared property lines, and heights and distances along these lines)
- Need to review Hawaiian Electric Company's wind study and explain the logic of the increase in height of the landfill in light of the wind energy study
- Need an assessment of the static stability of the landfill both ash and solid waste areas including consideration of past history as well as the dynamic stability of the landfill recognizing the fact that we live in a seismically active area
- Need to address how much of the mountain land space is being shaved for the landfill and discuss blasting or grading setbacks that are necessary
- Need to address environmental impacts of potential hazards
- Need to understand how 20 years of further capacity will be provided without excavation as previously stated – if there is excavation need to address where the soil will go
- Need to review recent State of Hawai'i Supreme Court case (Hōkūli'a) regarding State DOH responsibility for water quality in relation to how it is being affected by the landfill e.g. ocean run off
- If expansion moves forward, storm water retention basins, leachate and gas monitoring systems are needed
- Address future ash monofills
- Need to know chemical composition of ash
- The location of potential hazards such as asbestos within the landfill need to be identified
- **Address unknown effects to the land, water, and air**
- **Need to address odor issues – will the expansion take sludge and if so for how long**
- **How is the liner tested and how secure is it needs to be addressed**
- **The ability of the rock berm to handle the expansion needs to be discussed**
- **Needs to address the need for a surface water management plan**
- **Need fugitive trash plan designed to end this problem**

## Infrastructure

- Impact to landfill when H-POWER is down is an issue
- Impact on highway; road blockages, etc.
- Maintenance issues along Farrington Highway with heavy truck use – standards for adequate maintenance of this highway
- Any new access points and their impacts on adjacent property owners

### Economic Issues

- Economic impacts
- Costs of closing landfill
- Need a solution to address lost revenues to the city should the solid waste go to a private landfill – tipping fees

### Explore Alternatives

- Need to look at all alternatives that are appearing (i.e., Plasma ARC gasification, etc.) and determine how these alternatives fit in with everything else that the City is doing – including how they can reduce the waste stream to allow for the earliest closing possible of the landfill
- Need to explore all viable alternatives
- Need to look at other places, especially Europe, and how they dispose of their waste, the kinds of incentives/taxes/sanctions they use to reshape people's attitudes at the curbside
- Expansion should be limited to a specific time and coupled with a plan to reduce the waste stream
- Need to address things that can be done to reduce the amount of waste that goes to the landfill – curbside recycling, alternative technologies, partnerships with the business community to promote recycling and reuse, etc. Need to get innovative and creative.
- Need to increase HPOWER and explore reuse of ash – HPOWER type facilities could be decentralized and built anywhere
- Need to address trans-shipping of waste
- Need to address providing a funding stream to address alternatives
- Need to speed up action on alternatives
- **Plasma Arc Gasification – Jacoby Inc.**
- **Need to address the implementation of the comprehensive and mandatory island-wide recycling program (proposed to be done by December 2006)**
- **Alternatives looked at must be explained including why they are rejected – the exploration must be rigorous**

### Facilities Management

- Need to look at as a facilities management problem and apply technologies correctly (especially as pertains to smells and debris)
- The EIS should address the status of all violations and what has been done regarding violations – need to close violations prior to new EIS and permit
- Hours of operation need to be clear and adhered to – the community recently expressed concerns about night operations taking place and the impact of the lighting on houses and neighborhoods

- Need to address overfilling of landfill site
- Need to look at rubbish control and sludge issues
- Need a specific operational plan for soil cover
- **Explain the contracts between the city and Waste Management Inc and the timing of these contracts.**
- **There should be a clearly identified, separate (physically divided) MSW and ash monofill cells for the expansion**
- **A separate area should be identified for asbestos disposal**
- **A full discussion of all management techniques must be included**
- **Impact of expanded operations on adjacent property owners including line of sight issues**

#### Monitoring and Enforcement

- Need to provide for air quality monitoring, testing as it corresponds to traffic at the site, and along the route to/from the site
- Need to examine enforcement capability and capacity of DOH – including the lack of resources required for monitoring, enforcement, reporting, and accountability
- Major dirt and dust issues; monitoring doesn't work – need for more data collection
- Need to consider past problems with the landfill (i.e., EPA violations, leachate collection system) and be sure the DEIS identifies ways to assure that they do not happen again
- Need to address and explain the \$2.8 million fine that has been imposed on the landfill by the Department of Health and assure that these types of practices/violations do not continue in the expansion
- Need to assure that a system is in place to hold the operator accountable
- Monitoring should be adequate so that after the fact permit modification should not happen – example the permit modification needed for the leachate sump pump system
- Need to monitor methane gas levels
- Need to have rigid standards and adequate monitoring to ensure the health and safety of the community
- Need regular monitoring by the Department of Environmental Services
- Need to address who will be responsible for enforcement of things in the EIS and what guarantees will be made in the EIS
- Need to include status of compliance with current permit – by modifying the permit, are we negating prior violations which should not be allowed
- **Need to assure timely reporting by the operator and public access to these reports – consider webcam on site for monitoring purposes**

### Leachate

- Need to also address leachate and its impact to groundwater, runoff to ocean, subsidence and slippage resulting from seismic activity, methane fires, and EPA violations relating to gas collection systems
- Need to look back and forward – what has been/will be done to take care of leachate problems and make sure these do not reoccur in the future
- Need to address leachate pumped out to the sewer treatment plant and what happens to it and what is its effect on the final outflow water quality from the sewer treatment plant
- Need to discuss comprehensively the leachate management system – including possible failure of the geomembrane lining system and how it will be taken care of

### Environmental Justice

- Need to address “environmental justice” along the Leeward Coast and as it pertains to this landfill, including the multitude of existing private and proposed sites in the area

### Health Impacts

- Need to include discussion of potential health hazards
- Who is liable for the health costs to residents should the landfill cause health problems
- When considering expansion, need to discuss EPA finding regarding gas collection system issues
- Compensation to neighbors for health impacts
- Impact of multiple landfills, both public and private, on air quality needs to be addressed
- Higher standards are needed for dust and debris and possible impacts to health

### Community Issues

- The DEIS needs to deal with the lack of sensitivity to cultural sites and issues
- What communities will benefit - who will be selected and how will the compensation benefits committees be set up also needs to be addressed
- Need to include impact of non-closure of Waimānalo Gulch on for-profit businesses in the area or planning to locate in the area
- Smells, trash escape, floating dust, truck traffic and speeding, trash on road, visual blight all need to be addressed
- Landfill should not be going above the ridge lines, which can be seen from Waiʻanae

- One of the conditions of the permit was to allow for ridgeline and site views being maintained
- No trucks should be parked on Farrington Highway waiting for entrance to the facility
- Trucks should be cleaned when leaving facility so there is no mud or dirt dropped on the highway
- Route along Farrington Highway should be kept clean of rubbish or dirt generated by the facility
- There should be identification of how the Waimānalo Gulch Sanitary Landfill will be maintained facing Farrington Highway, landscaped to reflect surrounding areas, park-like upkeep, greenbelt, setbacks, etc.



## **Section 4**

### **Project Description**

#### **4.1. Construction Activities**

##### **4.1.1. Project Location**

Waimānalo Gulch Sanitary Landfill is located in Waimānalo Gulch, O‘ahu. The property is owned by the City & County of Honolulu, and is under the jurisdiction of the Department of Environmental Services (ENV). The landfill is operated for ENV by Waste Management of Hawaii, Inc. (WMH). The operations of the landfill are consistent with or exceed the requirements of EPA Subtitle D, Resource Conservation and Recovery Act (RCRA) and the State of Hawai‘i regulations.

The Waimānalo Gulch Sanitary Landfill (WGSL) is located near the community of Kapolei; approximately 15 miles northwest of Honolulu International Airport; and two miles southeast of Nānākuli. The WGSL property begins at the north side of Farrington Highway just southeast of Kahe Point and extends approximately 1.2 miles inland up Waimānalo Gulch. The site location is identified on **Figure 3-1, Waimānalo Gulch Landfill Property**.

The WGSL property encompasses approximately 200 acres with a dimension of approximately 7,000 feet in length and 820 feet in width along the Farrington Highway frontage widening to approximately 1,900 feet at its widest point. Farrington Highway (FASP No. S-900(4)), is under jurisdiction and management of the State Department of Transportation (DOT), Highways Division. Approximately 92.5 acres of the 200 acre property are proposed for landfill expansion and accessory uses (**Figure 3-2, Waimānalo Gulch Sanitary Landfill Lateral Expansion Site**).

Elevation of the site at the access road off of Farrington Highway is approximately 60 feet above mean sea level (msl). At the northeastern corner of the property the elevation rises to 990 feet above msl. Terrain on the lower end of the site slopes upward

at about 8 percent, increasing to approximately 18 percent on the upper end. The current maximum fill elevation is 513 feet above msl. A depiction of the general site topography is provided on **Figure 3-2**.

A small area within the proposed expansion area was graded during the construction of Cell E-4 to maintain slope stability and to allow safe filling of Cell E-4. No waste has been placed in this area nor will further work take place until completion of the EIS process and the State Special Use Permit boundaries are modified or a State Land Use District Boundary Amendment is obtained. This work was performed over a period of approximately 3 months starting in October 2006.

#### 4.1.2. Features of Construction of Lateral Expansion

The proposed project is intended to provide for the future development of landfill cells at WGS. According to the Engineering Report for Landfill Expansion, Draft, prepared by GeoSyntec Consultants in February 2008, the proposed lateral expansion was designed to: (1) accommodate the expected waste stream; (2) provide a landfill base lining and leachate collection and recovery system to meet the regulatory requirements of RCRA Subtitle D (40 CFR Part 258); (3) meet typical slope stability design criteria at final build out conditions based on industry accepted MSW, ash, and base and side slope line interface shear strength properties; and (4) meet the vertical separation requirement for the overhead power lines used by the Hawaiian Electric Company (HECO) (GeoSyntec Consultants, 2008).

In addition to expanding the active landfill area, the proposed project will involve the development of support infrastructure including drainage, access roadways, landfill gas and leachate collection systems, perimeter monitoring systems, and other related features.

Also proposed are:

- A part of the landfill expansion, a community Drop-Off Center, will be constructed at the landfill. This location may be moved during detailed

engineering design but will remain between the front face of the landfill and Farrington Highway. The purpose of the Drop-Off Center will be to allow members of the public to conveniently and safely deliver solid waste and/or recyclables to the Landfill for disposal and/or recycling without entering areas of the landfill where active filling is taking place. The facility will likely consist of 4 or more roll off containers set below grade for easy access and screened from view from Farrington Highway.

Drivers delivering drop off center refuse would go to the scale house for visual inspection to verify that the loads qualify for disposal at the drop off center. The bins containing refuse will be transferred and discharged at the working face of the landfill when they are full. Operational procedures in place for the inspection of loads prior to landfilling will be applied to the drop off center refuse. Loads containing recyclables will be transported to third party recyclers.

- A landfill gas to energy (LFGTE) system may be installed to convert landfill gases to electricity. As with the proposed drop off center, specific details are under development by WMH and ENV. The electricity generated from landfill gas will help to reduce dependency on imported oil used to generate electricity.

#### 4.1.3. Waste Stream, Soil Excavation, and Soil Usage

Preliminary volume estimates for the preferred expansion master plan have been prepared indicating the amount of soils usage and airspace provided by the project (**Table 4-1, Preliminary Estimate of Expansion Quantities (Cells E-5 through E-11)**).

#### 4.1.4. Geologic Considerations

WGSL contains an ephemeral stream, which remains dry except during heavy rainfall. According to GeoSyntec Consultants, the subgrade consists of alternating layers of relatively dense lava flow followed by more fractured and porous clinker seams. The layers dip gradually down toward the coastline. The rock materials appear to be variably

weathered throughout the height of the exposed hill slopes. Very little alluvial/colluvial soil deposits were observed. However, a 3- to 5-ft thick dark brown clayey soil deposit was noted at the ground surface along the top of the exposed hill slopes. No significantly-sized lava tubes or cave features at the site were observed by consultant Geolabs Hawai'i, during a seismic refraction survey in 2000. (GeoSyntec, 2008).

**Table 4-1**  
**Preliminary Estimate of Expansion Quantities**  
**Cells E-5 through E-11**

Expansion Footprint (Cells)	~37 acres
Footprint of Landfill After Expansion	115.8 acres
Total Expansion Airspace Increase <sup>1</sup>	7,923,980 cubic yards
<b>Soil Usage<sup>2,3</sup></b>	
Cell Excavation	3,103,165 cubic yards
Fill <sup>4</sup>	147,830 cubic yards
Soil Buttress	518,315 cubic yards
Used as part of Liner System (4' thick on floor & 3' thick on side slopes)	263,545 cubic yards
Final Cover Material (3.5 feet over 36.2 acres)	204,410 cubic yards
Estimated Daily Cover Soil	1,567,923 cubic yards
Excess Excavation Material <sup>5</sup>	401,142 cubic yards

Source: Eng. Rpt. for Landfill Expansion, Waimānalo Gulch, Geosyntec Consult., 2008.

Table Notes:

- <sup>1</sup> Available gross volume above currently-permitted grading plan for expansion area only.
- <sup>2</sup> A positive number means soil available on-site. A negative number means soils required.
- <sup>3</sup> Shrinkage and swell factors not included in soil usage calculations.
- <sup>4</sup> To meet grade at certain locations; exclude the soil buttress.
- <sup>5</sup> As indicated, a soil surplus results. The soil surplus may be influenced with future changes to the landfill slopes that are excavated. Surplus materials may be left in place in stockpile sites or used for other purposes.

The regional groundwater level for this portion of the island is lower than the elevations of the project site. However, some groundwater seepage may be anticipated following rainfall due to percolating groundwater. For the previous landfill cells E1 through E4, a subdrain system was constructed along the base of the cells to intercept and convey any seeping water. The subdrain system consisted of a High Density Polyethylene (HDPE) perforated pipe encapsulated in a gravel-filled trench. A similar system will be constructed for the expansion cells, if seeps are encountered during construction. (GeoSyntec, 2008).

#### 4.1.5. Liner and Final Cover Systems

The existing liner system design for the existing area is provided in **Figure 4-1** and **4-2**. The liner system for the proposed lateral expansion area is provided in **Figure 4-3**.

The lateral expansion liner system for both ash and MSW cells will consist of the following as indicated from bottom to top (GeoSyntec, 2008):

- Prepared subgrade
- Soil cushion layer
- 40-mil-thick backing HDPE geomembrane (textured on both sides)
- Geosynthetic clay liner (GCL)
- 60-mil-thick primary HDPE geomembrane (textured on both sides)
- Cushion geotextile
- 1 foot of gravel (maximum size of 1 inch)
- Filter geotextile
- 2 feet of Operations layer.

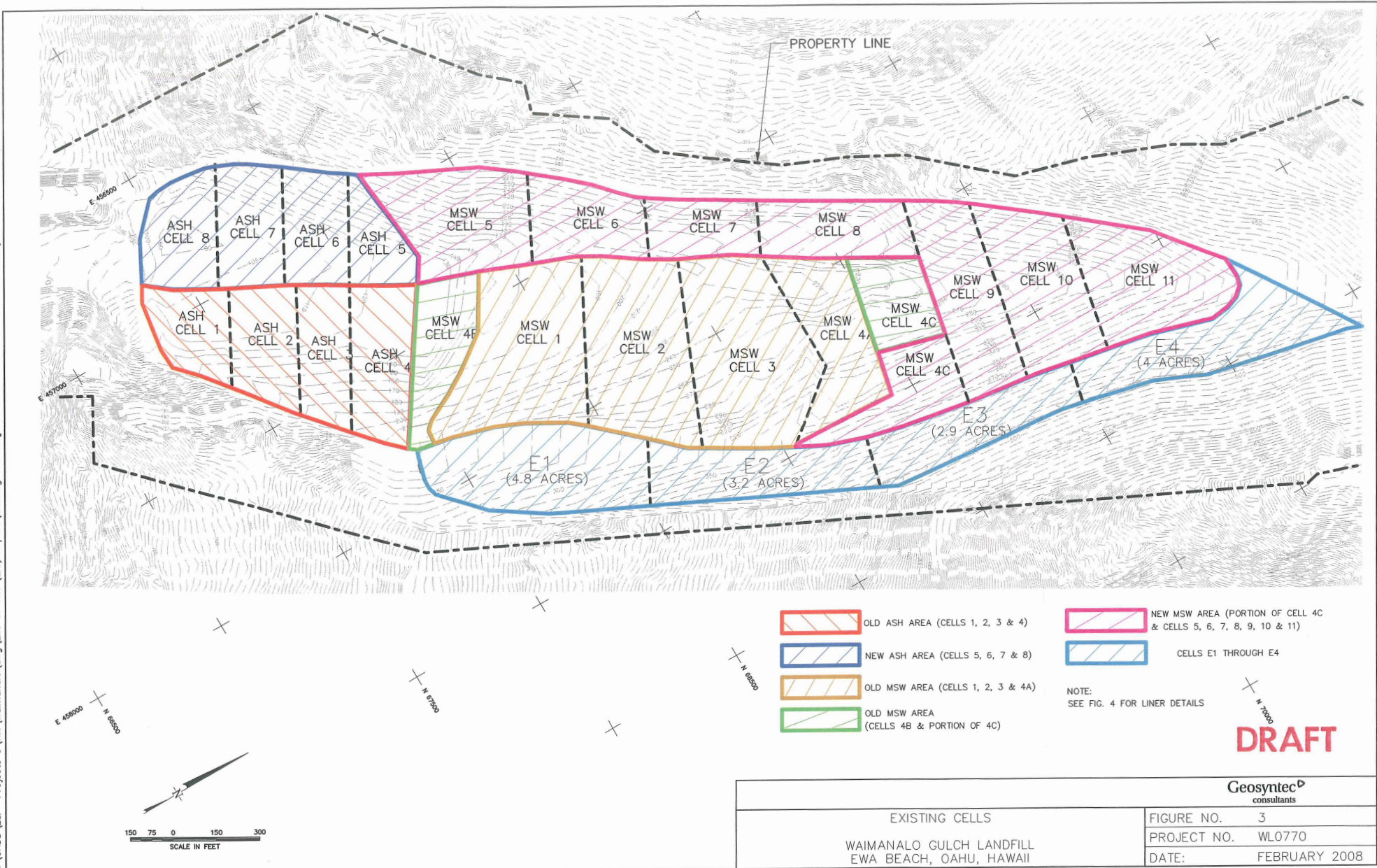
To collect leachate on the landfill base, a perforated, HDPE collection pipe will be placed within the drainage layer. The leachate will drain down the cells toward one or more lined sumps furnished with a riser pipe (WMH, 2008).

**Figure 4-4**, shows potential locations for the Leachate Collection and Removal System (LCRS) collection pipe and sump for the expansion. These locations may be changed during final design.

#### 4.1.6. Final Cover

**Figure 4-5** shows the final cover system currently proposed for the existing and expansion areas, this section may be modified during final design as approved by the Department of Health. As can be observed, the proposed final cover above ash or MSW consists of (from bottom to top) (GeoSyntec, 2008):





Source: Engineering Report for Landfill Expansion, Draft,  
Waimanalo Gulch Landfill, Geosyntec Consultants,  
12 February 2008

**Figure 4-1**  
**Existing Cells**  
Waimanalo Gulch Sanitary Landfill Expansion  
Department of Environmental Services