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DEPARTMENT OF ENVIRONMENTAL SERVICES,
CITY AND COUNTY OF HONOLULU

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DEPT OF PLANNING
AND PERMITTING
CITY & COUNTY OF HONOLU

BEFORE THE PLANNING COMMISSION
OF THE CITY AND COUNTY OF HONOLULU

STATE OF HAWAII

In the Matter of the Application of DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU To delete Condition No. 14 of Special Use Permit No. 2008/SUP-2 (also referred to as Land Use Commission Docket No. SP09-403) which states as follows: "14. Municipal solid waste shall be allowed at the WGSL up to July 31, 2012, provided that only ash and residue from H-POWER shall be allowed at the WGSL after July 31, 2012."	FILE NO. 2008/SUP-2 DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU'S SECOND AMENDED LIST OF EXHIBITS; EXHIBITS A34 THROUGH A50; CERTIFICATE OF SERVICE

P10

DEPARTMENT OF ENVIRONMENTAL SERVICES,
CITY AND COUNTY OF HONOLULU'S SECOND AMENDED LIST OF EXHIBITS

COMES NOW DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU (hereinafter, "Applicant"), by and through its attorneys, DANA VIOLA and ROBERT BRIAN BLACK, Deputies Corporation Counsel, and hereby submits its Second Amended List of Exhibits and Exhibits "A34" through "A50" regarding Applicant's request to delete Condition No. 14 of Special Use Permit No. 2008/SUP-2 (also referred to as Land Use Commission Docket No. SP09-403) which states as follows:

> 14. Municipal solid waste shall be allowed at the WGSL up to July 31, 2012, provided that only ash and residue from H-POWER shall be allowed at the WGSL after July 31, 2012.

The Second Amended List of Exhibits is a list of exhibits that may be used in support of the Applicant's case pursuant to the pre-hearing conference held on October 14, 2011. Applicant reserves the right to amend its Second Amended List of Exhibits and identify any additional exhibits not expressly identified above for rebuttal purposes in response to any pleadings, arguments, exhibits, issues, and witnesses identified by any party pursuant to the Rules of the Planning Commission Section 2-71(c).

DATED: Honolulu, Hawaii, April 16, 2012.

ROBERT CARSON GODBEY
Corporation Counsel

By ______________________________
DANA VIOLA
ROBERT BRIAN BLACK
Deputies Corporation Counsel
Attorneys for Applicant
DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU

EXHIBIT NUMBER	DESCRIPTION	PARTY: OBJECTIONS	ADMIT
A1	Compact Disc containing "Final Environmental Impact Statement; Waimanalo Gulch Sanitary Landfill Lateral Expansion; Waimanalo Gulch, Oahu, Hawaii; TMKs (1) 9-2-003:072 and 073" (the "Final EIS")		
A2	Fly-over photo of Waimanalo Gulch Sanitary Landfill ("WGSL"), dated April 2011		
A3	Table reflecting remaining airspace at WGSL, dated April 2011		
A4	Solid Waste Management Permit No. LF-0182-09, dated June 4, 2010		
A5	Findings of Fact, Conclusions of Law and Decision and Order, Land Use Commission, Docket No. SP87-362, April 20, 1987		
A6	Findings of Fact, Conclusions of Law and Decision and Order, Land Use Commission, Docket No. SP87-362, October 31, 1989		
A7	Findings of Fact, Conclusions and Decision, Planning Commission of the City and County of Honolulu, Docket 2002/SUP-6, March 13, 2003		

Applicant reserves the right to amend its LIST OF EXHIBITS and identify any additional exhibits not expressly identified above for rebuttal purposes in response to any pleadings, arguments, exhibits, issues, and witnesses identified by any party pursuant to the pre-hearing conference held on October 14, 2011 and the Rules of the Planning Commission Section 2-71(c).

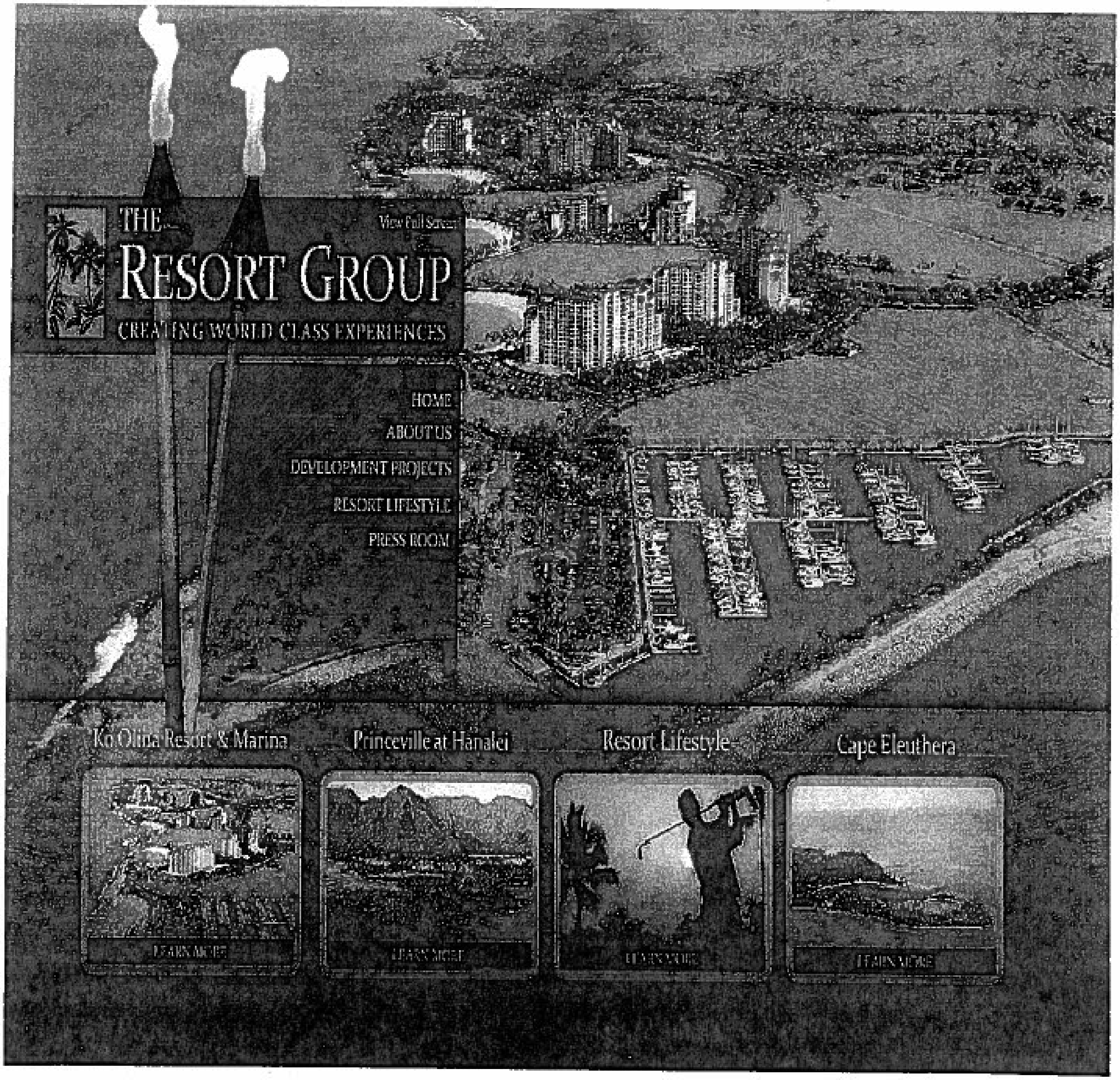
EXHIBIT NUMBER	DESCRIPTION	PARTY: OBJECTIONS	ADMIT
A8	Decision and Order Approving Amendment to Special Use Permit, Land Use Commission, Docket No. SP87-362, June 9, 2003		
A9	Office of Information Practices Opinion Letter No. 04-01, January 13, 2004		
A10	Order Granting In Part and Denying In Part Motion to Amend and/or Stay the Decision and Order Approving Amendment to Special Use Permit Dated June 3, 2003, Land Use Commission, Docket No. SP 87-362, May 10, 2004		
A11	Resolution No. 04-348, CD1, FD1		
A12	Bill 37 (2005), CD2		
A13	Mayor's Message No. 037, February 28, 2006		
A14	State Special Use Permit no. 86/SUP-5, In re Department of Environment al Services, City and County of Honolulu (FKA Department of Public Works, City and County of Honolulu); Application to Modify (1) the Findings of Fact, Conclusions and Decision dated march 13, 2003, and (2) the Decision and Order Approving Amendment to Special Use Permit Issued June 9, 2003, filed with the Department of Planning and Permitting on July 6, 2007, without accompanying exhibits		
A15	Findings of Fact, Conclusions of Law, and Decision and Order, Planning Commission of the City and County of Honolulu, Ewa – State Special Use Permit No. 86/SUP-5 (RY), January 18, 2008		

EXHIBIT NUMBER	DESCRIPTION	PARTY: OBJECTIONS	ADMIT
A16	Findings of Fact, Conclusions of Law, and Decision and Order Adopting with Modifications, the City and County of Honolulu Planning Commission's Recommendation to Approve Amendment to Special Use Permit, Land Use Commission Docket No. SP87-362, March 14, 2008		
A17	Transcript of July 31, 2009, decision-making hearing of Planning Commission of the City and County of Honolulu		
A18	Findings of Fact, Conclusions of Law, and Decision and Order, Planning Commission of the City and County of Honolulu, File Nos. 2008/SUP-2 (RY) and 86/SUP-5, August 4, 2009		
A19	Order Adopting the City and County of Honolulu Planning Commission's Findings of Fact, Conclusions of Law, and Decision and Order With Modifications, Land Use Commission Docket No. SP09-403, October 22, 2009		
A20	Order Granting Defendants Department of Environmental Services, Department of Planning and Permitting, and City and County of Honolulu's Motion for Summary Judgment filed on February 2, 2010, Civil No. 08-1-2562-12 RAT, March 25, 2010		
A21	Order Affirming Land Use Commission's Order Adopting the City and County of Honolulu Planning Commission's Findings of Fact, Conclusions of Law, and Decision and Order Dated October 22, 2009 with Modifications, Civil No. 09-1-2719-11, September 21, 2010		
A22	Executive Summary, Integrated Solid Waste Management Plan		

EXHIBIT NUMBER	DESCRIPTION	PARTY: OBJECTIONS	ADMIT
A23	Letter from United States Department of Agriculture notifying of cancellation of Compliance Agreements No. Oahu RG002 and HMSW001, dated August 11, 2010		
A24	Order Granting Plaintiffs' Motions for Preliminary Injunction Hearing and Motion for Expedited Hearing, Denying Motion to Strike Declaration, and Requiring Setting of Scheduling Conference, Confederated Tribes and Bands of the Yakama Nation, et al., v. United States Department of Agriculture, et al., No. CV-10-3050-EFS, August 30, 2010.		
A25	Testimony submitted by the Chairman of the Confederated Tribes and Bands of the Yakama Nation, October 5, 2011 Public Hearing of the Planning Commission of the City and County of Honolulu		
A26	Chart Depicting Total Waste Stream Flow on Oahu		
A27	Chart Depicting Municipal Solid Waste Stream Flow on Oahu		
A28	Charts Showing Yearly Recycling Rates (1988-2010)		
A29	Chart Depicting The Sustainable Solid Waste Management Ladder for the U.S.		
A30	Curbside Recycling Program Evaluation and Strategic Planning Report		
A31	Agendas, Group Memories, and Documentation Provided to Landfill Advisory Committee for meetings held on January 20, February 10, March 10 and 31, May 12, June 23, and July 21, 2011.		

EXHIBIT NUMBER	DESCRIPTION	PARTY: OBJECTIONS	ADMIT
A32	Letter From the United States Department of Agriculture notifying Hawaiian Waste Systems, LLC of the suspension of operations under Compliance Agreement No. Oahu RG002.		
A33	Supplemental Report for Resolution 11-182: "Alternative Technologies for the Treatment and Minimization of Sewage Sludge," dated November 2011.		
A34	Internet publication entitled "The Resort Group: Creating World Class Experiences"		
A35	Except of Ewa Development Plan, August 1997 (Revised May 2000), Section 4.5, entitled "Solid Waste Handling and Disposal."		
A36	Curriculum Vitae of Janice C. Marsters, PhD., LEED AP		
A37	Curriculum Vitae of Hari D. Sharma, MBA, PhD, ME, BE		
A38	Bibliography: Waimanalo Gulch Landfill		
A39	Listing of GEI Consultants' Reports Issued for the Waimanalo Gulch Sanitary Landfill Project		
A40	GEI Consultants, "Surface Water Management Plan," Waimanalo Gulch Sanitary Landfill, March 2011		
A41	Geosyntec Consultants, "Engineering Report for Landfill Expansion," Waimanalo Gulch Sanitary Landfill, March 12, 2008		
A42	Map depicting locating of cells within the Waimanalo Gulch Sanitary Landfill, November 2009		

A43	Curriculum Vitae of Professor Edward Kavazanjian, Jr., PhD, PE, GE		
A44	Curriculum Vitae of Professor Jonathan Bray, PhD, PE		
A45	Curriculum Vitae of Rudolph Bonaparte, PhD, PE		
A46	Curriculum Vitae of Professor Craig H. Benson, PhD, PE, DGE		
A47	Mayor's Advisory Committee on Landfill Site Selection, Meeting No. 9, Agenda, Group Memory, Oahu Landfill CCE Site Score Sheets		
A48	Letter From State of Hawaii, Department of Land and Natural Resources, State Historic Preservation Division, regarding Application for a Special Use Permit for an Expansion and Time Extension for the Waimanalo Gulch Sanitary Landfill, dated April 2, 2009		
A49	Letter from the State of Hawaii, Office of Hawaiian Affairs, regarding Amendment of Special Use Permit No. 2008/SUP-2 for the Waimanalo Gulch Sanitary Landfill, dated August 16, 2011		
A50	Environment Hawaii, "State Directs County to Fix Flaws in Central Maui Landfill Phase IV," vol. 14, no. 12, June 2004		



Home | Ko Olina Resort & Marina | Princeville at Hanalei | Development Projects | Press Room | About TRG | Community Outreach

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EXHIBIT A34

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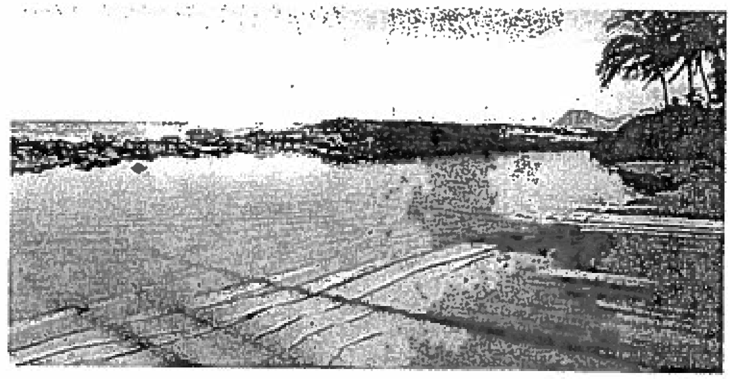
About The Resort Group



HOME

ABOUT US

DEVELOPMENT PROJECTS

RESORT LIFESTYLE

PRESS ROOM

"Creating World-Class Resort Visions, Guiding Development, Investing in the Future"

We acquire, master develop, reposition and market domestic and international mixed use and master-planned resort communities. Our goal is to create resorts that deliver world-class experiences with a powerful sense of place.

World-class resorts are the highly successful blend of many ingredients: spectacular location, luxury accommodations, recreational amenities, convenient services and community kinship.

Led by real estate visionary Jeff Stone, our resort development projects are carefully designed to balance resident, visitor and employee needs with community interests, local cultural values and land use requirements.

We work with hospitality brands and management companies to develop design concepts for luxury resort products and strategies for their ongoing operation in ways that also maximize cash flow and long term asset appreciation.

We take inspiration from many sources. The land itself, with stunning natural settings and vistas, sets the stage, as do the region's history and cultural traditions. Then we weave together a mix of art and science to give the resort community its unique personality and to create quality lifestyles for the people who will live, work and play there.

With our experience in hospitality, hotel, resort real estate and housing, we successfully integrate the most desirable and appropriate components to ensure the highest and best use of the property.

Please visit one or more of our signature projects to see how we bring our resort philosophy to life:

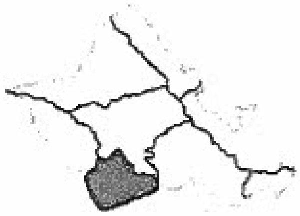
- Ko Olina Resort & Marina, Honolulu, Hawaii
- Princeville at Hanalei, Kauai, Hawaii
- Newport Beach Hotel, Newport Beach, California
- Cape Eleuthera, Bahamas

Jeffrey R. Stone - Founder

One of Hawaii's most dynamic and intrepid developers, Jeffrey Stone is celebrated for his real estate savvy and as a local business entrepreneur who cares deeply about Hawaii and its future generations.

He acquired the stalled Ko Olina Resort project, dormant for more than 10 years, in 1998 and imbued it with innovation, energy and vitality. His vision of creating Oahu's first active family resort destination undoubtedly contributed to the success of businesses in the neighboring West Oahu region and throughout the state. Stone's infusion of attention and vigor into the area has strengthened community and visitor interest in the destination and revitalized the island of Oahu as a multi-resort destination by attracting numerous national and international investors to Ko Olina, including Walt Disney Resorts, Massachusetts Mutual Life Insurance, Marriott International, Brookfield Homes, The Weinberg Foundation and Alexander & Baldwin. He was presented with the "Deal of the Year" award from the Financial Executives Institute (FEI) in 2001 for Ko Olina's turn-around. Stone also spearheaded the development of the state-of-the-art Ko Olina Marina, the first marina to be built in the State of Hawaii in 30 years and the cornerstone of activities at Ko Olina.

In 2005, Stone partnered with Morgan Stanley to purchase the 9,000-acre Princeville Resort on Kauai. Plans for Princeville, considered one of the finest destination resorts in the world, include resort residences and visitor accommodations, shopping complexes, affordable housing and careful but continued growth as it goes through a refreshing new era on the island's North Shore.



EWA
DEVELOPMENT PLAN

CITY AND COUNTY OF HONOLULU
PLANNING DEPARTMENT

AUGUST 1997 (Revised May 2000)

EXHIBIT A35

Cover photo by **Gary Hofheimer Photography**

The Hawaiian Electric Company forecasts that increased demand and the proposed retirement of the Honolulu Power Plant from service will create a need for additional island-wide power generation capacity by 2020. Potential sites in Ewa for additional generating units include Campbell Industrial Park and Kahe Point.

4.4.1 GENERAL POLICIES

Major system improvements -- such as development of a new power generating plant and/or major new transmission lines -- should be analyzed and approved based on islandwide studies and siting evaluations. Strong consideration should be given to placing any new transmission lines underground.

Electrical power plants should generally be located in areas shown as planned for Industrial use and away from Residential areas shown on the Urban Land Use Map in Appendix A. Existing power plants are shown on the Urban Land Use Map and Public Facilities Map in Appendix A. Any proposed major new electrical power plant or proposals for a new above-ground or underground transmission corridor carrying voltages of 138kV or greater shall be considered through a City review and approval process, such as the Plan Review Use process, which provides public review, complete analysis, and approval from the Department of Land Utilization and the City Council.

Other system elements, such as sub-stations and transmission lines, are not shown on the Map and should be reviewed and approved administratively.

4.5 SOLID WASTE HANDLING AND DISPOSAL

Two major solid waste handling and disposal facilities are located in Ewa. The H-Power plant at Campbell Industrial Park is operating at maximum capacity, receiving over 600,000 tons of solid waste each year. The Waimanalo Gulch Sanitary Landfill, located between the proposed Makaiwa Hills residential development and Kahe Valley, is the major active waste disposal site on Oahu. It will run out of capacity within ten to twenty five years.

The Solid Waste Integrated Management (SWIM) Plan prepared by the Department of Public Works and adopted by the City Council in 1995 identified existing landfills which could be expanded and potential sites for developing new landfills to provide new capacity. The Waimanalo Gulch was identified as having potential for expansion. Ewa sites for new landfills identified in the Plan included the mauka part of Kahe Valley, a site within the West Loch Magazine Blast Zone, and a site in East Kapolei.

4.5.1 GENERAL POLICIES

The East Kapolei site identified in the SWIM Plan should not be developed as a landfill. It is in an area planned for residential use and is adjacent to the University of Hawaii West Oahu campus.

Siting and/or expansion of sanitary landfills should be analyzed and approved based on islandwide studies and siting evaluations.

4.6 DRAINAGE SYSTEMS

Low-lying parts of the Ewa Plain are subject to flooding during intense rainstorms. Flood control has typically been provided for urbanized areas through the development of concrete-lined channels to convey stormwaters to the ocean.

Discharge of floodwaters to the ocean, however, is a major source of non-point source pollution of nearshore waters, negatively affecting coral growth, fish populations and use of the shoreline for swimming, surfing, and other types of ocean recreation.

The federal government has initiated a major program to reduce non-point-source pollution, mandating response by the State and the counties. The City requires retention/detention facilities adequate for a two-year frequency/24-hour duration storm to be provided on site, but the required capacity is only for the amount of stormwater generated on site. In many watersheds, however, undeveloped mountain areas generate

CITY COUNCIL
CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII

ORDINANCE 97-49

BILL 67 (1996), CD1

A BILL FOR AN ORDINANCE

TO ADOPT THE DEVELOPMENT PLAN FOR EWA OF THE CITY AND COUNTY OF HONOLULU.

BE IT ORDAINED by the People of the City and County of Honolulu:

SECTION 1. Purpose and Intent. This ordinance is intended to bring the development plan for Ewa into compliance with Section 5-408 of the Revised Charter of the City and County of Honolulu 1973, as amended in 1992, which sets forth the requirement that "Development plans shall consist of conceptual schemes for implementing and accomplishing the development objectives and policies of the general plan within the city . . . . The development plans shall . . . serve as a policy guide for more detailed zoning maps and regulations and public and private sector investment decisions."

This development plan ordinance adopts a revised development plan for Ewa that presents a vision for Ewa's future development consisting of conceptual schemes that will serve as a policy guide for more detailed zoning maps and regulations and for public and private sector investment decisions.

This ordinance is enacted pursuant to the powers vested in the City and County of Honolulu by Chapter 46, Hawaii Revised Statutes.

SECTION 2. Article 3 of Chapter 24, Revised Ordinances of Honolulu 1990, as amended ("Ewa"), is repealed.

SECTION 3. Chapter 24, Revised Ordinances of Honolulu 1990, as amended, is amended by adding a new Article 3 to read as follows:

"Article 3. Ewa

Sec. 24-3.1 Definitions.

Unless the context otherwise requires, the definitions contained in this section shall govern the construction of this article.

"Charter" means the Revised Charter of the City and County of Honolulu 1973, as amended.

"Chief planning officer" means the administrative head of the planning department of the City and County of Honolulu.

"Council" means the city council of the City and County of Honolulu.

"County" means the City and County of Honolulu.

"Department of land utilization" means the department of land utilization of the City and County of Honolulu.

"Development" means any public improvement project, or any public or private project requiring a zoning map amendment.

"Development plan" means a plan document for a given geographic area which consists of conceptual schemes for implementing and accomplishing the development objectives and policies of the general plan for the several parts of the City and County of Honolulu.

"Environmental assessment" and "EA" mean a written evaluation prepared in compliance with the environmental quality commission's procedural rules and regulations implementing Hawaii Revised Statutes Chapter 343 to determine whether an action may have a significant environmental effect.

"Environmental impact statement" and "EIS" mean an informational document prepared in compliance with the environmental quality commission's procedural rules and regulations implementing HRS Chapter 343; and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic and social welfare of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects.

"Finding of no significant impact" and "FONSI" mean a determination based on an environmental assessment that the subject action will not have a significant effect and, therefore, will not require the preparation of an environmental impact statement.

"Functional plan" means the public facility and infrastructure plans to meet the needs created as a result of the developments in the Ewa area.

"General plan" means the general plan of the City and County of Honolulu as defined by Section 5-407 of the charter.

"Planning commission" means the planning commission of the City and County of Honolulu.

"Planning Department" means the planning department of the City and County of Honolulu.

"Project master plan" means a conceptual plan that covers all phases of a development project. The project master plan shall be that portion of an EA or EIS which illustrates and describes how the project conforms to the vision for Ewa, and the relevant policies, principles, and guidelines for the site, the surrounding lands, and the region.

"Significant zone change" means a zone change which involves at least one of the following:

(1) Changes in zoning of 25 or more acres of land to any zoning district or combination of zoning districts, excluding preservation or agricultural zoning districts;

(2) Any change in zoning of more than 10 acres to a residential or country zoning district;

(3) Any change in zoning of more than 5 acres to an apartment, resort, commercial, industrial or mixed use zoning district; or

(4) Any development which would have a major social, environmental, or policy impact, or major cumulative impacts due to a series of applications in the same area.

"Special area" means a designated area within the Ewa development plan area that requires more detailed planning efforts beyond what is contained in the Ewa development plan.

"Special area plan" means a plan for a special area.

"Unilateral agreement" means a conditional zoning agreement made pursuant to Section 21-8.40 that imposes conditions on a landowner's or developer's use of the property at the time of the enactment of an ordinance for a zoning change.

"Vision" means the future outlook for the Ewa region extending out to the year 2020 and beyond that entails creation of an urban growth boundary, an open space network for development of the secondary urban center with its core at Kapolei, master planned communities with pedestrian and transit orientation, protection of historic and community resources, and provision of adequate infrastructure and community facilities to meet Ewa's future needs.

Sec. 24-3.2 Applicability.

(a) The Ewa development plan area encompasses the coral plain which stretches from the northeastern end of Kunia Road down to Waipahu and Pearl Harbor, and around the southwestern corner of Oahu along the shoreline up to Nanakuli where the coral plain meets the moderately steep slopes of the southerly end of the Waianae mountain range, which form Ewa's mauka sector.

(b) It is the intent of the Ewa development plan to provide a guide for orderly and coordinated public and private sector development in a manner that is consistent with applicable general plan provisions, including the designation of Ewa as the secondary urban center for Oahu and the Ewa urban fringe areas as one of the principal areas for residential development.

(c) The provisions of this article are not regulatory. Rather, they are established with the explicit intent of providing a coherent vision to guide all new public and private sector development within Ewa. This article shall guide the phasing of development for Ewa and public investment in infrastructure, zoning and other regulatory procedures, and the preparation of the City's annual capital improvements program budget.

Sec. 24-3.3 Adoption of the Ewa development plan.

(a) This article is adopted pursuant to the Revised Charter Section 5-408 and provides a self-contained development plan document for Ewa. Upon its adoption, all proposed developments will be evaluated against how well they fulfill the vision for Ewa enunciated in the Ewa development plan and how closely they meet the policies, principles, and guidelines selected to implement that vision.

(b) The plan on file with the city clerk entitled "Ewa Development Plan," dated as of the effective date of this ordinance, is hereby adopted by reference and made part of this development plan Ordinance for Ewa.

(c) Ordinance No. 84-54, as amended, entitled, "Chapter 24, Development Plans: Article 1. Development Plans Common Provisions," in its entirety is no longer applicable to the Ewa development plan area. The Ewa development plan, as adopted by reference by this ordinance, supersedes any and all common provisions previously applicable to the Ewa area.

(d) Ordinance No. 81-80, as amended, entitled, "Article 3, Ewa: Part I Development Plan Special Provisions for Ewa," and "Part II Development Plan Maps (Land Use and Public Facilities Maps) for Ewa," is hereby repealed in its entirety.

Sec. 24-3.4 Existing zoning and subdivision ordinances.

(a) All existing subdivisions and zoning already approved for projects, including but not limited to those operating under unilateral agreements, shall continue to remain in effect following the enactment of this ordinance.

(b) Existing subdivision and zoning ordinances applicable to the Ewa development plan area shall continue to regulate the use of land within demarcated zones until such time as the subdivision and zoning ordinances may be amended to be consistent with the revised Ewa development plan.

(c) Notwithstanding adoption of the revised Ewa development plan, subdivision actions and land use permits shall continue to be subject only to applicable ordinances and rules and regulations in effect at the time the application is accepted for processing.

Sec. 24-3.5 Consistency.

(a) The performance of prescribed powers, duties and functions by all city agencies shall conform to and implement the policies and provisions of this ordinance. Pursuant to Section 5-410.3 of the charter, public improvement projects and subdivision and zoning ordinances shall become consistent with the Ewa development plan, as adopted.

(b) Any questions of interpretation regarding the consistency of a proposed development with the provisions of the Ewa development plan and the objectives and policies of the general plan shall ultimately be resolved by the council.

(c) In determining whether a proposed development is consistent with the Ewa development plan, the responsible agency shall primarily take into consideration the extent to which the development is consistent with the vision, policies, principles, and guidelines set forth in the Ewa development plan.

(d) Whenever there is a question regarding consistency between existing subdivision or zoning ordinances, including any unilateral agreement, and the Ewa development plan, the existing subdivision or zoning ordinances shall prevail until such time as they may be amended to be consistent with the Ewa development plan.

Sec. 24-3.6 Implementation.

Implementation of this ordinance relating to the Ewa development plan will be accomplished by the following:

(a) Phasing developments to support the vision for Ewa and to maximize the effect of infrastructure investments;

(b) Guiding development in special areas of critical concern, such as Kalaeloa (Barbers Point Naval Air Station) through the formulation of a special area plan;

(c) Guiding public investment in infrastructure which supports the vision of the Ewa development plan through functional plans;

(d) Promoting the policies and guidelines contained in the Ewa development plan as the basis of assuring consistency with the Ewa development plan of developments and other improvements to land seeking approvals;

(e) Incorporating the Ewa development plan priorities in preparation of the city's annual capital improvement program and budget;

(f) Evaluating progress in achieving the vision of the Ewa development plan periodically and presenting the results of the evaluation in the biennial report which is required by RCH Section 5-409.4; and

(g) Reviewing the vision of the Ewa development plan every three years and revising the policies, guidelines, and capital improvement program investments, as necessary, on the basis of the review.

Sec. 24-3.7 Zoning change applications.

(a) All zone change applications relating to land in the Ewa development plan area will be reviewed by the planning department for consistency with the general plan, the Ewa development plan, and any applicable special area plan provisions.

(1) The chief planning officer will recommend either approval, approval with changes, or denial to the department of land utilization within the prescribed review period as set forth in Section 21-8.30-3. The chief planning officer's written review of the application shall become part of the zone change report which will be sent to the planning commission and the city council.

(2) A project master plan shall be a part of an EA or EIS for any project involving 25 acres or more of land. The chief planning officer shall review the project master plan for its consistency with the Ewa development plan. Project master plans shall be reviewed in accordance with Section 5.4.2 of the Ewa development plan.

(3) Any development or phase of a development already covered by a project master plan which has been fully reviewed under the provisions of this article shall not require a new project master plan, provided the chief planning officer determines that the proposed zone change is generally consistent with the existing project master plan for the affected area.

(4) If a final EIS has already been accepted for a development, then a subsequent project master plan shall not be required.

(b) Projects which involve a significant zone change shall be required to submit an environmental assessment to the department of land utilization prior to an application for a zone change being accepted. Any development or phase of a development which has already been assessed under the

National Environmental Policy Act, HRS Chapter 343, ROH Chapter 25 or the provisions of this article, and for which a FONSI has been filed or a required EIS has been accepted, shall not be subject to further EA or EIS requirements under this chapter.

(c) The environmental assessment will be reviewed by the department of land utilization. Based on review of the environmental assessment, the director of land utilization will determine whether an environmental impact statement will be required or whether a FONSI should be issued.

(d) If an environmental impact statement is required, the environmental impact statement must be accepted by the director of land utilization before a zone change application shall be initiated.

(e) Zone changes shall be processed in accordance with the provisions of this section, Section 5.4 of the Ewa development plan, and all applicable requirements under Chapter 21.

Sec. 24-3.8 **Review of development and other applications.**

The review of applications for zone changes and other development approvals will be guided by the vision of the Ewa development plan. Decisions on all proposed developments should be based on the extent to which the project enabled by the development approval supports the policies, principles, and guidelines of the Ewa development plan.

The chief planning officer may review other applications for improvements to land, as well, to help the responsible agency determine whether a proposed improvement supports the policies, principles, and guidelines of the Ewa development plan.

Sec. 24-3.9 **Annual capital improvement program review.**

Annually, the chief planning officer shall work jointly with the chief budget officer and the city agencies to review all projects in the city's capital improvement program and budget for compliance and consistency with the general plan, the Ewa development plan and other development plans, any applicable special area plan provisions, and the appropriate functional plans. The chief planning officer will prepare a written report of findings to be included in the budget submittal to the council.

Sec. 24-3.10 Public infrastructure map.

The city council shall adopt a public infrastructure map for the Ewa development plan area. The public infrastructure map shall not be deemed a part of this development plan, shall be adopted by resolution, and shall be amended by resolution in accordance with the procedures set forth in subsection (a).

The public infrastructure map shall show general locations of major proposed municipal facilities to be funded in the capital improvement budget and certain public utility facilities in the categories listed in subsection (b) below. For budgeting purposes, the funding of capital improvement projects shall not be approved by the council without the projects appearing on the public infrastructure map.

(a) Procedure.

(1) The planning department shall consult with other governmental and community organizations on amendments to the public infrastructure map.

(2) Amendments to the public infrastructure map shall be by council resolution. The council shall consider the public infrastructure map in review of the city's annual budget. Public infrastructure map symbols may be administratively deleted by the planning department, once the improvement or land acquisition is completed.

(3) The council resolution amending the map shall include, but not be limited to:

(A) The general location of the proposed public infrastructure; and

(B) A description of the project as well as the project's size and function.

(b) Types of Public Infrastructure.

The following types of public improvement projects shall be shown on the public infrastructure map:

(1) Corporation yard;

(2) Desalination plant;

(3) Drainage way (open channel);

(4) Energy generation facility;

(5) Fire station;

(6) Government building;

(7) Golf Course (public and private);

(8) Electrical transmission line and substation;

(9) Park;

(10) Police station;

(11) Parking facility;

(12) Water reservoir;

(13) Sewage treatment plant;

(14) Solid waste facility;

(15) Transit corridor; and

(16) Arterial roadway.

The alignment of linear facilities, and the location of project boundaries, shall be considered approximate and conceptual.

(c) Applicability Criteria.

"Public infrastructure" means any public improvement project funded by the city for land acquisition or construction and certain public utility facilities as listed in subsection (b) and which meets any one of the following criteria:

(1) Establishes a new facility;

(2) Changes the function of an existing facility;

(3) Involves modification (replacement or renovation) of existing facilities which would permit significant new development or redevelopment; or

(4) Costs over $3,000,000.00 for capital improvements.

An amendment to the public infrastructure map shall not be required if the project:

(1) Does not impact the surrounding land uses;

(2) Does not affect the natural environment of the area; or

(3) Does not change the approved use of an existing park facility such as play courts, play equipment, restrooms, swimming pools, gymnasiums, and recreation buildings.

Any questions of interpretation shall be resolved by the city council.

Sec. 24-3.11 **Three year review.**

(a) The planning department shall conduct a comprehensive review of the Ewa development plan, adopted by reference in Section 24-3.3(b), every three years subsequent to the plan's adoption and shall report its findings and recommended revisions to the city council.

(b) The Ewa development plan will be evaluated to assess the appropriateness of the plan's regional vision, policies, design principles and guidelines, and implementing actions, as well as its consistency to the general plan. In addition, the development phasing guidelines shall be reviewed to assess whether their purpose is being achieved and if phasing priorities should be revised.

(c) Nothing herein contained shall be construed as a prohibition against processing a revision to the development plan in accordance with the Revised Charter of the City and County of Honolulu.

Sec. 24-3.12 Biennial report.

In addition to meeting the requirements of the Revised Charter Section 5-409.4, the planning department's biennial report shall also address the City's achievements and progress in fulfilling the vision of the Ewa development plan.

Sec. 24-3.13 Authority.

Nothing in this article shall be construed as an abridgement or delegation of the responsibility of the chief planning officer, or of the inherent legislative power of the city council, to review or revise the Ewa development plan pursuant to the city charter and the above procedures.

Sec. 24-3.14 Severability.

If any provision of this article or the application thereof to any person or property or circumstances is held invalid, such invalidity shall not affect other provisions or applications of this article which can be given effect without the invalid provision or application, and to this end the provisions of this article are declared to be severable.

Sec. 24-3.15 Conflicting provisions.

Any provision contained in this article shall prevail should there be any conflict with the common provisions or any other provisions under Chapter 24."

SECTION 4. Effective Date of Ewa Development Plan. The City Clerk is hereby directed to date the Ewa Development Plan with the effective date of this ordinance.

SECTION 5. This ordinance shall take effect 60 days after its enactment.

INTRODUCED BY:

John Henry Felix (BR)

Councilmembers

DATE OF INTRODUCTION:

July 31, 1996

Honolulu, Hawaii

APPROVED AS TO FORM AND LEGALITY:

Jane H. Howell
Deputy Corporation Counsel

APPROVED this 22 day of August, 1997.

Jeremy Harris
JEREMY HARRIS, Mayor
City and County of Honolulu

Janice C. Marsters, Ph.D., LEED AP™

Senior Environmental Engineer

Education

B Eng, Civil Engineering, Technical University of Nova Scotia – 1983
M Eng, Civil Engineering (Geotechnical), Technical University of Nova Scotia - 1986
PhD, Geology & Geophysics, University of Hawaii - 1995

Professional Summary

Janice Marsters has more than 20 years of experience in environmental and engineering consulting for a wide variety of projects in Hawaii and the Pacific. Prior to joining Kennedy/Jenks Consultants, she was a principal of Masa Fujioka & Associates, a Hawaii geotechnical/environmental consulting firm, for 17 years. For both firms, she has had leading roles in managing the business of the firm, especially in the areas of risk management, business development, quality control, mentoring junior staff, and financial management.

Dr. Marsters has managed hundreds of environmental projects, encompassing a variety of facility types and settings, and including assessment of soil, groundwater, surface water, and/or building materials for contaminants such as petroleum compounds, pesticides, PCBs, furans and dioxins, heavy metals, and asbestos. At her previous firm, she managed many sizable environmental projects under an award-winning contract with NAVFAC Pacific. Prior to her consulting career, Dr. Marsters worked internationally in marine geotechnology and geophysics research.

Dr. Marsters also has extensive experience in environmental permitting and compliance. She facilitates a full range of Federal, State and local permits, including NPDES and Army Corps permits, for many project types. Dr. Marsters has been involved in or managed the preparation of a number of Environmental Impact Statements/Environmental Assessments under NEPA/HEPA. She has performed human-health and ecological risk assessments for a number of contaminated properties, and has published on the risk assessment process. Dr. Marsters is LEED™-accredited and has provided sustainability and LEED™ consultation on several Federal projects. She is a recognized storm water expert and much of her current practice consists of assisting facilities with storm water permit compliance. Representative projects include:

Environmental Planning and Permitting

- *Kalaupapa Emergency Wharf Repair, Phase II, Kalaupapa National Historic Park, Molakai.* Project manager for Phase II of the emergency wharf repairs for this vital supply link for the Kalaupapa community. Provided project administration and quality control, and managed the permit application process for the Army Corps of Engineers (401) and Water Quality (404) and permit applications, as well as State Conservation District Use and Coral Take permits.
- *Guam Naval Hospital, Guam.* Project manager for preparation of environmental plans and permit applications during construction. Prepared the contractor's Environmental Protection Plan, NPDES permit applications and Storm Water Pollution Prevention Plan, biosecurity plan, and Guam EPA permit applications and plans.
- *Visitor Center, Kealia Pond National Wildlife Refuge, Maui.* Project manager for environmental consultation for the design of a visitor center at a wildlife refuge. Project included an Environmental Assessment, preparation of an NPDES permit application, and consultation regarding Shoreline Management Area.

- *NPDES Site Inspections and Reporting, City Industrial Facilities, Oahu.* Project manager for the inspections and reporting required for the City & County of Honolulu's compliance with MS4 permit requirements. Conducted inspections of more than 90 facilities, prepared summary field datasheets, identified areas for operational improvement related to implementation of best management practices, conducted re-inspections to check on compliance, and provided reports to meet permit requirements.

Environmental Assessment

- *NAVMAG Lualualei Waikele Branch, Waikele, Hawaii.* Project manager for the Environmental Baseline Survey and Finding of Suitability for Transfer conducted for the purposes of sale of a decommissioned naval magazine facility. Project included an extensive environmental assessment, including hazardous materials surveys of the existing structures, investigation of subsurface contamination (dioxins/furans, PCBs, petroleum products, heavy metals), investigation of a former landfill, and preparation of a report and Suitability for Transfer documentation.
- *Private Client, Makaha, Hawaii.* Project manager for a Phase I Environmental Site Assessment of a 300-acre property in Makaha, Hawaii. Project included investigation of historical environmental concerns, including underground storage tanks, comprehensive site reconnaissance, and preparation of a report.
- *Kapolei Senior Village, Kapolei, Hawaii.* Project manager for a Phase I Environmental Site Assessment and Phase II pesticide investigation for a proposed senior housing development. Project included investigation of historical environmental concerns, comprehensive site reconnaissance, preparation of a sampling plan for investigation of potential pesticide contamination, soil sampling and analysis, risk evaluation, and preparation of Phase I and Phase II reports.
- *Kauai Island Utility Cooperative Phase I Environmental Site Assessment.* Project manager for environmental assessment of all of Kauai Electric's facilities, including the Port Allen Power Plant, two hydroelectric facilities, numerous substations and distribution systems, for the purchase of the utility by a local cooperative. Project included extensive investigation of the facilities, preparation of a Phase I report, and consultation during Public Utility Commission hearings.

Sustainability

- *Sustainability Manual, Lake Mead Recreation Area, Californ*ia. Project manager for the preparation of a sustainability manual for National Park Service use at Lake Mead Recreation Area. Project included extensive research into laws and mandates governing the Park in a variety of sustainability areas, such as energy reduction, alternative energy use, purchasing, fleets, etc.; evaluating the Park's current status; and developing a report with a "gap analysis" highlighting areas that need to be improved for the park to meet sustainability-related mandates.
- *NOAA Ford Island Campus, Buildings 175/176, Ford Island, Hawaii.* Sustainability consultant for the civil design of two buildings as part of the NOAA campus development, which renovated existing historical military hangars.

Affiliations

- American Council of Engineering Companies:
  - Risk Management Committee Chair (2012-2013); RMC Member (2007-present)
  - National Director (2005-2007)
- American Council of Engineering Companies of Hawaii:
  - President (2004-2005)
  - Legislative Committee Co-Chair (2008-present)
- American Society of Civil Engineers
- Society of American Military Engineers
- Engineers without Borders
- National Association of Environmental Professionals
- Society of Women Engineers
- Community Involvement:
  - Member of the State's Complete Streets Task Force (2010)
  - Member of the Oahu Metropolitan Planning Organization's Citizen Advisory Council (2008-2010)
  - Sierra Club, Hawaii Chapter EXCOM member (2010-2012)

Publications (partial list)

- Marsters, J., Zelenka, A., and Graydon, J., 2012. *Energy Master Planning*. The Military Engineer, Volume 104, Number 676, Society of American Military Engineers, March-April 2012.

- Marsters, J. C., and Del Percio, S., 2010. *Green Blues: Assessing Potential Legal Risks from Green Building*, Proc., 2010 Annual Convention and Legislative Summit, American Council of Engineering Companies, April 2010.

- Marsters, J.C., 2008. *Managing Risk and Client Expectations of Perfection*. Proc., LTAP Conference on Risk Management, ACECH, May 2008.

- Marsters, J. C., 1997. *Selecting Successful Remediation Technologies for Petroleum-Contaminated Sites in Hawaii.* Proc., 19th Annual Conference, Hawaii Water Environment Association, HWEA, February 1997.

- Marsters, J. C., 1995. *The Influence of Microfossil Content on the Physical Properties of Calcareous Sediments from the Ontong Java Plateau,* Ph.D. Dissertation, University of Hawaii, Honolulu, Hawaii, May 1995.

- Marsters, J. C. and Kleveno, J. J., 1994. *Standards for Screening-Level Risk Assessments.* Proc., 1st ASCE Symposium on Soil Clean-up in the Pacific Islands, Honolulu.

Hari D. Sharma, Ph.D., P.E., G.E. is a principal geotechnical engineer at Geosyntec Consultants, inc. with 40 years of geotechnical design experience. For the past 25 years, Dr. Sharma has specialized in the permitting, design, and construction of solid waste containment facilities. Dr. Sharma earned his Ph.D. from Purdue University and his Master's Degree from IIT Roorkee University and is currently a Registered Professional Civil Engineer in Hawaii, California and other states. Dr. Sharma has published numerous technical papers and two textbooks related to the design of solid waste facilities. Dr. Sharma's textbooks, Geoenvironmental Engineering: Site Remediation, Waste Containment & Emerging Waste Management Technologies and Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, were published by John Wiley & Sons and have been used by universities to teach future solid waste engineers and educate the industry's design practitioners.

Dr. Sharma has been the design engineer for the permitting and detailed design at more than 50 municipal solid waste facilities throughout California, Oregon, Hawaii, Washington, Alaska and Arizona.

Dr Sharma recently served on the National Research Council committee to assess the Performance of Engineered Barriers and is active geoenvironmental engineering research and practice.

EXHIBIT A37

Geosyntec consultants

HARI D. SHARMA

solid and hazardous waste facility design and closure
geotechnical investigation and design
litigation support

EDUCATION

M.B.A., Business Administration, University of Alberta, Alberta, Canada, 1979
Ph.D., Geotechnical Engineering, Purdue University, Indiana, 1972
M.E., Soil Mechanics and Foundation Engineering, IIT Roorkee (University), India, 1966
B.E., Civil Engineering, IIT Roorkee (University), India, 1964

PROFESSIONAL REGISTRATION

California Civil Engineer, P.E. Number C47839
California Geotechnical Engineer, G.E. Number GE2372
Oregon Civil Engineer, P.E. Number 19601PE
Arizona Civil Engineer, P.E. Number 35667
Hawaii Civil Engineer, P.E. Number 10694

REPRESENTATIVE EXPERIENCE

Dr. Sharma, a principal geotechnical engineer based in California, focuses on the design and construction of waste containment facilities and earthen structures in seismically active areas. Specializing in providing the engineering expertise for the permitting and operation of Class I, II, and III landfills for more than 30 years, Dr. Sharma has developed site-specific geotechnical engineering applications utilizing geotextile, flexible membrane liner (FML) and clay and admixed liner technologies to create secure structures for waste containment. He also specializes in the design of earthen structures such as surface impoundments (cooling ponds, wastewater ponds, chemical storage ponds) for electric utilities, petrochemical manufacturers, mining and ore processors, and waste disposal industries.

Dr. Sharma directs geotechnical investigations and design activities for infrastructure and water resources projects. He has been involved in feasibility studies, site selection, and cost-benefit evaluations of large earthen dam projects, and has performed testing and monitoring during dam design and construction. He has also performed feasibility studies, final design, and construction coordination of technical issues for other water resources projects, such as flood control levees, canals for irrigation districts, and water diversion and control systems. Dr. Sharma has conducted and supervised field investigations, laboratory testing programs, and design of flexible and rigid pavements and foundations for bridges, roads, and highways.

Dr. Sharma continues to advance the state of the practice through the authorship of major works on geoenvironmental engineering, including Geoenvironmental Engineering: Site Remediation, Waste Containment & Emerging Waste Management Technologies (John Wiley & Sons), and membership on the American Society of Civil Engineers' Environmental Geotechnics Committee.

Dr Sharma has supervised, reviewed, and performed designs at more than 50 landfills including: Altamont Landfill, Anderson Landfill, Ben Lomond Landfill, BKK Landfill, Buena Vista Landfill, Butterfield Station Facility, Capitol Disposal Facility, Chiquita Canyon Landfill, Colton Landfill Cummings Road Landfill, Copper Mountain Landfill, Graham Road Landfill, Gray Wolf Regional Landfill, Hillsboro Landfill, Keller Canyon Landfill, Kettleman Hills Landfill, Kirby Canyon Landfill, Imperial Landfill, Marina Landfill, McKittrick Waste Treatment Site, Neal Road Landfill, Newby Island Landfill, Northern Wasco Landfill, Northwest Regional Landfill, Ostrom Road Landfill, Ox Mountain Landfill, Pacheco Pass Landfill, Potrero Hills Landfill, Redwood Landfill, Riverbend Landfill, Shafter-Wasco Landfill, Sunshine Canyon Landfill, Tri-Cities Landfill, Vasco Road Sanitary Landfill, Waimanalo Gulch Landfill, West Contra Costa Landfill, West Hawaii Landfill, Yolo County Landfill, and Zanker Road Landfill.

A few examples of his geoenvironmental work are summarized below:

Solid and Hazardous Waste Facility Design and Closure

- ***Stability Berm, Waimanalo Gulch Sanitary Landfill, Waste Management, Inc.**, Ewa Beach, Oahu, HI.* Project Manager for the design and construction of an approximately 100,000 cubic yard stability berm at the Waimanalo Gulch Sanitary Landfill in Ewa Beach, Oahu Hawaii. The project also involved training a local CQA consultant to conduct additional monitoring.

- ***Waimanalo Gulch Sanitary Landfill**, Ewa Beach, Oahu, HI.* Principal in charge for permit and construction for expansion area cells. Work included seismic design and design of landfill liner system using geosynthetics (geomembranes, GCLs, and geotextiles) and leachate collection systems and filters. Prepared plans and specifications for these elements. Other tasks included evaluation and retrofit of existing ash cells, surface water construction plans and specifications, and cost estimates for various alternatives based on site life scenarios for landfill development.

- ***Multi-year, Multi-Solid Waste Services Contract, County of Santa Cruz, Ben Lomond, Buena Vista Landfills**, Santa Cruz County, CA.* Principal-in-Charge for a multi-year, multi-services agreement with the County of Santa Cruz for services at the County's solid waste landfill facilities. Projects have included development and design of solid and household hazardous waste recycling centers, entrance and exit facilities, expansion design and closure plan development for the Buena Vista Landfill, and environmental compliance and regulatory updates for both the Buena Vista and Ben Lomond landfills.

- ***Static and Seismic Slope Stability Analyses, Gray Wolf Regional Landfill, Waste Management, Inc., Yavapai County, AZ.*** Served as Project Manager for an independent evaluation of static and seismic slope stability of the final landfill grades for a proposed expansion of the Gray Wolf Regional Landfill. The evaluation, submitted to the Arizona Department of Environmental Quality, demonstrated stability of the expansion area with landfill side slopes increased from 10H:1V to 3.5H:1V.

- ***Expansion Design and Construction, Kirby Canyon Landfill, Waste Management, Inc., San Jose, CA.*** Project Manager for the preparation of permit-level design documents for an expansion cell and construction documents for Phase I of the permitted cell. Technical issues associated with the project included design of a 200-foot high excavation slope in serpentinite rock, and design and evaluation of the leachate collection system. Successfully incorporated the existing leachate collection system with the new system, and designed optimal landfill slopes in the seismically active, steep canyon environment.

- ***Closure Design and Preparation of Joint Technical Document, McKittrick Waste Treatment Facility, Waste Management, Inc., Bakersfield, CA.*** Managed preparation of permit and construction-level documents for a Class II landfill cell and Class II waste pile closure at the McKittrick Waste Treatment Facility near Bakersfield, California. Responsible for review and technical direction of the site's surface water management plan, design of the leachate collection system with a high groundwater table, and preparation of the Joint Technical Document.

- ***Various Expansions, Vasco Road Sanitary Landfill, Allied Waste Systems, Livermore, CA.*** Directed and supervised field investigations; liner design (including alternative liners); borrow evaluations; sedimentation basin design; and evaluations of landfill stability for various expansions (lateral and vertical) at the Vasco Road Sanitary Landfill. Assignments included preparation of permitting, design, and construction documents, and extensive interaction with regulatory agencies.

- ***Lateral Expansion, Tri Cities Landfill, Waste Management, Inc., Fremont, CA.*** Managed preparation of permit-level documents for a lateral expansion of the Tri Cities Landfill. Technical challenges addressed in the project included design on soft bay mud foundation soils, high groundwater levels and related leachate collection system design, high seismicity, and optimization of air space while minimizing subgrade fill over settling foundations (up to 7 feet).

- ***Lateral Expansion, Hillsboro Landfill, Waste Management, Inc.,*** *Hillsboro, OR.* Managed permit level design and construction documents for a lateral expansion that included a borrow source evaluation and design on liquefiable peat soils. Led efforts to balance soils at the site, optimize air space, and address the public's concern about the expansion's effect on adjoining wetlands.

- ***Subtitle D Liner System Design in Landslide Prone Areas, Multiple Landfills,*** *northern CA and OR.* Supervised, managed, and reviewed Subtitle D liner system design in landslide prone areas in California (Ox Mountain Sanitary Landfill, Half Moon Bay, Vasco Road Sanitary Landfill, Livermore; Keller Canyon Landfill, Pittsburg) and Oregon (Northern Wasco Landfill, Portland). These and other projects included conducting extensive static and seismic slope stability evaluations to address the impact of potential landslides on landfill expansion and closure design, and construction.

- ***Expansion Design, Graham Road Landfill, Waste Management, Inc.,*** *Medical Lake, WA.* Technical manager and reviewer for the expansion design, which included an evaluation of the liner and leachate collection and removal systems and MULTIMED modeling.

- ***West Contra Costa County Landfill,*** *Richmond, CA.* Performed and managed the geotechnical design of a 45,000 yd^3 sludge solidification program during remediation of a Class I landfill in Richmond, California. In addition, designed and evaluated final closure and the cap for the Class I- and Class II-designated waste facilities.

- ***RCRA Facility Investigation,*** *northern CA.* Conducted the field investigation and evaluated static and seismic (including liquefaction) stability and settlement analyses for a closure of a Resource Conservation and Recovery Act (RCRA)-permitted facility.

- ***Slurry Wall, Hazardous Waste Facility*** *northern CA.* Managed evaluation, testing, design, construction monitoring, and CQA of a slurry wall used in the containment remedy at a hazardous waste facility.

PROFESSIONAL HISTORY

Geosyntec Consultants, Principal, 1997 to present
EMCON Associates, Senior Project Engineer to Director, San Jose, CA, 1988 - 1997

Fluor Daniel Corp., Principal Engineer, 1981 - 1988
Alberta Environment, Alberta, Canada, Senior Engineer, 1976 - 1981
Bechtel Corporation, Alberta, Canada, Senior Civil Engineer, 1973 - 1976

AFFILIATIONS

American Society of Civil Engineers
Canadian Geotechnical Society

PUBLICATIONS

12-1 Sharma, H.D., Lin, J., Settepani, F., and Bernardini, J., "Settlement Monitoring for a Proposed Multipurose Site Development" in *Proceedings, 2012 Geo-Congress: State of the Art and Practice in Geotechnical Engineering*, Oakland, California, March.

07-1 Sharma, H.D. and De, A., "*Municipal Solid Waste Landfill Settlement: Postclosure Perspectives,*" Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Volume 133, Number 6, June 2007.*

04-1 Sharma, H.D. and Reddy, K.R., GEOENVIRONMENTAL ENGINEERING: Site Remediation, Waste Containment & Emerging Waste Management Technologies. John Wiley and Sons, New York, NY, May, 992 pages.*

03-1 Sharma, H.D., Settepani, F.W., and Burns, P.F., "Design and Construction of a Foundation System for an Industrial Building above a Closed Sanitary Landfill," In: *Proceedings, Ninth International Waste Management and Landfill Symposium*, Sardinia, Italy.

00-1 Sharma, H.D., "Solid Waste Landfills: Settlement and Post-closure Perspectives," In: *Proceedings of the ASCE National Convergence on Environmental and Pipeline Engineering*, July.*

99-1 Sharma, H.D., Fowler, W.L., and Cochrane, D.A., "Evaluation and Remediation of Ground Cracking Associated with Refuse Settlements," In: *Proceedings, Seventh International Waste Management and Landfill Symposium,* Cagliari, Italy, October.*

98-1 Sharma, H.D., Hullings, D.E., and Greguras, F.R., "Site Parameters Influencing Liner Strengths and Impacts on Landfill Stability," In: *Proceedings, Sixth International Conference on Geosynthetics*, Atlanta, GA, March.*

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* Refereed Publication

98-2 Sharma, H.D., Walter, R.W., and Settepani, F.W., "Evaluation of Lined and Unlined Landfills under Seismic Loading," In: *Proceedings, Sixth U.S. National Conference on Earthquake Engineering*, Seattle, WA, June.*

97-1 Sharma, H.D., and Vargas, J.C., "Alternative Liners: Equivalency, Testing and Design, and Construction Case Histories," In: *Presentation and Proceedings, Waste Tech '97*, Tempe, AZ, February.

97-2 Sharma, H.D., Hullings, D.E., and Greguras F.R. "Interface Strength Tests and Applications to Landfill Design," In: *Proceedings, Geosynthetics '97*, Long Beach, California, March.*

94-1 Sharma, H.D. and Lewis, S.P., Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation. John Wiley and Sons, New York, NY, 588 pages.*

94-2 Sharma, H.D., "Solid Waste Settlement: Operation and Postclosure Perspectives," Presented at *Eleventh Annual HAZMACON Conference*, San Jose, CA, March.

93-1 Sharma, H.D., and Hullings D.E., "Direct Shear Testing for HDPE/Amended Soil Composites," In: *Proceedings, Geosynthetics Conference*, Vancouver, Canada, March-April.*

92-1 Sharma, H.D., "Field Performance of Vertical Cutoff (Slurry) Wall, " Presented at *ASCE Convention*, New York, NY, September.

91-1 Sharma, H.D., "Contaminant Transport Evaluation through a Natural Low-Permeability Deposit," *Presentation and Proceedings, National Research and Development Conference on the Control of Hazardous Materials*, Anaheim, CA, February.*

91-2 Sharma, H.D. and Goyal, H.K., "Performance of a Hazardous Waste and Sanitary Landfill Subjected to Loma Prieta Earthquake of October 17, 1989," *Presentation and Proceedings, 2nd International Conference on Geotechnical Earthquake Engineering and Soil Dynamics*, St. Louis, MO, March.*

91-3 Sharma, H.D., Olsen, D.M. and Sinderson, L.K., "Contaminant Migration Evaluation at a Hazardous Waste Management Facility." In: *Proceedings, ASCE Geotechnical Engineering Congress*, Boulder, CO, June.*

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* Refereed Publication

90-1 Prakash, S. and Sharma, H.D., Pile Foundations in Engineering Practice. John Wiley and Sons, New York, NY, 734 pages.*

90-2 Sharma, H.D., Dukes, M.T. and Olsen, D.M., "Field Measurements of Dynamic Module and Poison's Ratios of Refuse and Underlying Soils at a Landfill Site." *Geotechnics of Waste-Fills - Theory and Practice, ASTM, STP 1070*, pp. 57-70.*

90-3 Sharma, H.D. and Dukes, M.T., "Sludge Solidification/Stabilization Testing for a Hazardous Waste Management Facility Surface Impoundment," *presented at 2nd International Symposium on Stabilization/Solidification of Hazardous, Radioactive, and Mixed Wastes*, ASTM, Williamsburg, VA, May.

89-1 Joshi, R.C., Sharma, H.D. and Sparrow, D., "Skin Friction Distribution along Driven Piles," In: *Proceedings, XII International Conference on Soil Mechanics and Foundation Engineering*, Rio de Janeiro, Brazil, August.*

89-2 Sharma, H.D., Dukes, M.T. and Olsen, D.M., "Evaluation of Infiltration through Final Cover Systems: Analytical Methods," *Presentation and Proceedings, National Solid Wastes Management Association, Waste Tech '89*, Washington, D.C., October.

88-1 Sharma, H.D., "Static Pile Capacity Based on Penetrometer Tests in Cohesionless Soils," In: *Proceedings, First International Symposium on Penetration Testing*, Orlando, FL, March.*

88-2 Sharma, H.D. and Joshi, R.C., "Drilled Pile Behavior in Granular Deposits," *Canadian Geotechnical Journal*, Volume 25, Number 2, May, pp. 222-232.*

88-3 Sharma, H.D. and Kozieki, P., "Use of Synthetic Liner and/or Soil Bentonite Liner for Groundwater Protection," In: *Proceedings, 2nd International Conference on Case Histories in Geotechnical Engineering*, St. Louis, MO, June.*

87-1 Joshi, R.C. and Sharma, H.D., "Prediction of Ultimate Pile Capacity from Load Tests on Bored and Belled, Expanded Based Compacted and Driven Piles," In: *Proceedings, International Symposium on Prediction and Performance in Geotechnical Engineering*, Calgary, Canada, June.

86-1 Sharma, H.D. and Joshi, R.C., "Comparison of In-Situ and Laboratory Soil Parameters for Pile Design in Granular Deposits," In: *Proceedings, 39th Canadian Geotechnical Conference*, Ottawa, Canada, August.

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* Refereed Publication

86-2 Sharma, H.D., Harris, M.D., Scott, J.D. and McAllister, K.W., "Bearing Capacity of Bored Cast-In-Place Concrete Piles on Oil Sands," *American Society of Civil Engineers Journal of Geotechnical Engineering,* Volume 112, Number 12, December 1986, pp. 1101-116.*

85-1 Sharma, H.D., Luk, W.Y. and Crawford, A., "Metal and Plastic Pipelines: Design and Construction Aspects," In: *Proceedings, International Conference on Advances in Underground Pipeline Engineering,* American Society of Civil Engineers, Madison, Wisconsin, August.*

84-1 Pritchard, R.B., Sharma, H.D. and Kollmeyer, M.J., "Three-Component Monitoring System Guards Canadian Petro Chemical Plants Ground Water," *Oil and Gas Journal,* Volume 82, Number 18, April, pp. 53-56.

84-2 Sharma, H.D., Sengupta, S. and Harron, G., "Design and Construction of a Railway Yard, Embankment and Foundations under Difficult Ground-Water Conditions." In: *Proceedings, International Conference on Case Histories in Geotechnical Engineering,* St. Louis, MO, May.*

84-3 Pritchard, R.B., Kollmeyer, M.J. and Sharma, H.D., "Protect and Monitor Ground Water," *Hydrocarbon Processing*, Volume 63, Number 10, October, pp. 39-41.*

84-2 Sharma, H.D., Sengupta, S. and Harron, G., "Cast-In-Place Bored Piles on Soft Rock under Artisan Pressures," *Canadian Geotechnical Journal*, Volume 21, Number 4, November, pp. 684-698.*

83-1 Sharma, H.D., Sengupta, S. and Harron, G., "Design and Construction of Pile Foundations Bearing on Top of Soft Weathered Rock Surface," In: *Proceedings, 36th Canadian Geotechnical Conference*, Vancouver, Canada, June.

83-2 Pritchard, R.B., Sharma, H.D., and Kollmeyer, M.J., "Ground Water Protection and Monitoring Petrochemical Plan," In: *Proceedings, 33rd Chemical Engineering Conference,* Toronto, Canada, October.

81-1 Sharma, H.D., Koppula, S.D., Campbell, J.W. and Brittain, R.S., "Strength Considerations for an Undisturbed Soft Fissured Clay," In: *Proceedings, 34th Canadian Geotechnical Conference,* Fredericton, New Brunswick, September.

79-1 Sharma, H.D., "Cost Forecasting: Time Series Analysis Approach," In: *Proceedings, International Conference on Mathematical Modeling*, St. Louis, MO, July.

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* Refereed Publication

73-1 Sharma, H.D., "Effect of Acceleration on Material Properties," *Joint Highway Research Report* Number 24, September, pp. 116.

69-1 Prakash, S. and Sharma, H.D., "Analysis of Pile Foundations Against Earthquakes," *The Indian Concrete Journal*, Volume 43, Number 6, pp. 205-221.*

67-1 Singh, B. and Sharma, H.D., "A Tilting Mould for Anisotropic Studies of Compacted Soil," *Journal Indian National Society, Soil Mechanics and Foundation Engineering,* Volume 5, pp. 461-470.*

* Refereed Publication

Bibliography: Waimanalo Gulch Landfill

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Geosyntec Consultants, 2003b. Project Manual: Cells E1 and E2 Construction, Waimanalo Gulch Landfill, Ewa Beach, Oahu, Hawaii. February.

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GEI Reports Issued for the Waimanalo Gulch Sanitary Landfill Project

1. Design Report- Western Surface Water Drainage Project, Waimanalo Gulch Sanitary Landfill Ewa, Oahu, Hawaii, December 2008. Report includes an attachment with permit level submittal drawings C-400 through C-416.

2. Design Report- Eastern Surface Water Drainage Project, Waimanalo Gulch Sanitary Landfill, Ewa, Oahu, Hawaii, October 2009. Report includes an attachment with permit level drawings 001 through 016

3. Design Report- Western Surface Water Drainage Project, Waimanalo Gulch Sanitary Landfill Ewa, Oahu, Hawaii, June 2009. Report includes an attachment with permit level submittal drawings C-401 through C-516

4. Design Report- Western Surface Water Drainage Project, Waimanalo Gulch Sanitary Landfill Ewa, Oahu, Hawaii, November 2009. Report includes an attachment with permit level submittal drawings C-0 through C-22.

5. Letter Correspondence to WM- Certification of Seismic Impact Adequacy of Landfill Containment System, Waimanalo Gulch Sanitary Landfill, April 13, 2010

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List of Permit Level Drawings Associated with Design Reports

Western Surface Water Drainage Project, December 2008

C-400 Vicinity/ Project Area Map and List of Drawings

C-401 Project Notes

C-402 Plan of Existing Conditions

C-403 Plan of Modifications

C-404 Plan and Profile Sheet 1

C-405 Plan and Profile Sheet 2

C-406 Plan and Profile Sheet 3

C-407 Diversion Structure Plan and Sections (Sheet 1 of 2)

C-408 Diversion Structure Plan and Sections (Sheet 2 of 2)

C-409 Transition Structure Plan and Sections

C-410 Thrust Block Plan and Sections

C-411 Typical Sections (Sheet 1 of 2)

C-412 Typical Sections (Sheet 2 of 2)

C-413 Miscellaneous Details (Sheet 1 of 2)

C-414 Miscellaneous Details (Sheet 2 of 2)

C-415 Trashrack Sections and Details

C-416 North Channel Plan and Profile

Western Surface Water Drainage Project, June 2009

C-500 Vicinity/ Project Area Map and List of Drawings

C-401 Project Notes

C-402 Plan of Existing Conditions and Survey Control

C-403 Plan and Profile of Modifications

C-404 Plan and Profiles Sheet 1

C-405 Plan and Profiles Sheet 2

C-506 Plan and Profiles Sheet 3

C-507 Diversion Structure Plan and Sections

C-509 Transition Structure Plan and Sections

C-410 Concrete Pipe Encasement Details and Structural Notes

C-511 Typical Sections (Sheet 1 of 2)

C-512 Typical Sections (Sheet 2 of 2)

C-413 Miscellaneous Details (Sheet 1 of 2)

C-414 Miscellaneous Details (Sheet 2 of 2)

C-415 Trashrack Plan, Sections and Details

C-516 North Channel Plan, Profile and Section

Eastern Surface Water Drainage Project, October 2009

No. 001	Cover Sheet, Vicinity/ Project Area Map
No. 002	Project Notes, Legend and Abbreviations
No. 003	Plan- Existing Conditions and Proposed Eastern Pipe Alignment
No. 004	Final Landfill Expansion
No. 005 to No. 009	Plan and Profile- Eastern Surface Drainage (5 Sheets)
No. 010	Truck Scale Area
No. 011	Plan and Profile- Auxiliary Pipe Conveyance
No. 012	Inlet Structure- Plan, Sections and Details
No. 013	Outlet Structure- Plan, Sections and Details
No. 014	Miscellaneous Details (Sheet 1)
No. 015	Miscellaneous Details (Sheet 2)
No. 016	Miscellaneous Details (Sheet 3), Phase II

Western Surface Water Drainage Project, November 2009

C-00: Vicinity/ Project Area Map and List of Drawings

C-01: Project Notes

C-02: Plan and Profile of Modifications

C-03: Plan and Profile of Permanent Drainage Sta. 0+00 to Sta. 12+00

C-04: Plan and Profile of Permanent Drainage Sta. 12+00 to Sta. 27+00

C-05: Plan and Profile of Permanent Drainage Sta. 27+00 to Sta. 42+00

C-06: Plan and Profile of Permanent Drainage Sta. 42+00 to Sta. 57+00

C-07: Plan and Profile of Permanent Drainage Sta. 57+00 to Sta. 66+50

C-08: Diversion Structure Plan and Sections

C-09: Transition Structure Plan and Sections

C-10: Concrete Pipe Encasement Details and Structural Notes

C-11: Typical Sections (Sheet 1 of 2)

C-12: Typical Sections (Sheet 2 of 2)

C-13: Miscellaneous Details (Sheet 1 of2)

C-14: Miscellaneous Detail (Sheet 2 of 2) and Construction Notes

C-15: Trash Rack Plan, Sections and Details

C-20: 84-inch HOBAS and 36-Inch HDPE Details in Concrete Lined Channel

C-21: Downstream Stilling Facilities Plan

C-22: Flip Bucket Structure Plan and Sections

(Note Drawings C-16 through C-19 pertained to the 36" HDPE temporary storm water diversion and were not issued as part of the permit drawings for the November 2009 design report).

GEI CONSTRUCITON ISSUE DRAWINGS FOR WGSL

Western Surface Water Drainage Project – Issued January 2010- Rev 1 Drawings (Issued April 2010)

C-00: Vicinity/ Project Area Map and List of Drawings

C-01: Project Notes

C-02: Plan and Profile of Modifications

C-03: Plan and Profile of Permanent Drainage Sta. 0+00 to Sta. 12+00

C-04: Plan and Profile of Permanent Drainage Sta. 12+00 to Sta. 27+00

C-05: Plan and Profile of Permanent Drainage Sta. 27+00 to Sta. 42+00

C-06: Plan and Profile of Permanent Drainage Sta. 42+00 to Sta. 57+00

C-07: Plan and Profile of Permanent Drainage Sta. 57+00 to Sta. 67+00

C-08: Diversion Structure Plan and Sections

C-09: Transition Structure Plan and Sections

C-10: Transition Structure Plan and Sections Sta. 52+44

C-11: Typical Sections (Sheet 1 of 2)

C-12: Typical Sections (Sheet 2 of 2)

C-13: Miscellaneous Details (Sheet 1 of2)

C-14: Miscellaneous Detail (Sheet 2 of 2) and Construction Notes

C-15: Trash Rack Plan, Sections and Details

C-16: Plan and Profile – Temporary Drainage Sta. 0+00 to Sta. 15+00 (Rev 1)

C-17: Plan and Profile – Temporary Drainage Sta. 15+00 to Sta. 30+00

C-18: Plan and Profile – Temporary Drainage Sta. 30+00 to Sta. 45+00

C-19: Plan and Details- Surface Drainage of Excavation Benches

C-20: 84-inch HOBAS and 36-Inch HDPE Details in Concrete Lined Channel

C-21: Downstream Stilling Facilities Plan and Sections

C-22: Flip Bucket Structure Plan and Sections

C-23: Temporary Drainage Diversion Berm and Inlet Installation (Rev 1)

C-24: Inlet Abandonment (Issued April 2010)

Addendum to Western Surface Water Drainage Project Drawings to Reflect the Design Modification from Open Channel to Buried Box Culvert from Approx. Station 52+44 to 64+35 – Issued September – October 2010

C-06-1: Plan and Profile- Permanent Drainage- Sta. 42+00 to 57+00

C-07-1: Plan and Profile- Permanent Drainage- Sta. 57+00 to 67+00

C-09-1: Transition and Inspection Manhole and Sections

C-10-1: Transition Plan and Sections – Sta. 52+44

C-11-1: Box Culvert- Sta. 52+17 to Sta. 64+05

C-12-1: Typical Sections- Diversion Structure and Lined Channel

C-14-1: Inspection Manhole Details

C-15-1: Trashrack Plan, Sections and Details

Lower Western Bypass Project – Issued June 2011

C-0: Vicinity/ Project Area Map and List of Drawings

C-1: Project Notes

C-2: Site Plan and Existing Topography

C-3: Plan and Profile of Lower Western Bypass Project

C-4: Plan and Profile- 84" HOBAS Pipe Alignment- Sta. 0+00 to 9+00

C-5: Plan and Profile- 84" HOBAS Pipe Alignment- Sta. 9+00 to 18+00

C-6: Plan and Profile- 36" HDPE Pipe Alignment

C-7: Typical 84-Inch HOBAS and 36-Inch HDPE Sections

C-8: Headwall Details- 36" HDPE Alignment

C-9: Miscellaneous Details, Construction Notes and HOBAS Manhole Sections

C-10: HOBAS Concrete Inspection Manhole Details

C-11: Downstream Stilling Facilities Plan and Details (Drawing Revised /Reissued in Dec. 2011)

C-12: Downstream Stilling Facilities Sections and Details (Drawing Revised /Reissued in Dec. 2011)

C-13: Flip Bucket Structure Plan and Sections

C-14: Stair Ramp Profile and Details

C-15: Stilling Basin Outlet Pipes- Raising of Walkway Pavement (Drawing Issued December 2011)

Northern Drainage Diversion- Construction Issue December 2011

CN-0: Vicinity / Project Area Map and List of Drawings

CN-1: Northern Drainage Diversion Plan and Profile

CN-2: Northern Drainage Diversion Pipe Inlet Structure Plan, Section and Details

CN-3: Northern Drainage Diversion Outlet Plan and Miscellaneous Sections

CN-4: Northern Drainage Diversion Pipe Outlet Sections and Details

Eastern Drainage System, Phase 1- Construction Issue March 2012

CE-1: Vicinity/ Project Area Map and List of Drawings

CE-2: Project notes

CE-3: Site Plan and Existing Topography

CE-4: Plan and Profile- Eastern Surface Drainage (Sheet 1 of 3)

CE-5: Plan and Profile- Eastern Surface Drainage (Sheet 2 of 3)

CE-6: Plan and Profile- Eastern Surface Drainage (Sheet 3 of 3)

CE-7: Auxiliary Pipe Conveyance

CE-8: Truck Scale Area Drainage

CE-8A: Truck Scale Area Drainage Details

CE-9: Miscellaneous Details for Eastern Surface Drainage and Auxiliary Pipe Conveyance

CE-10: Miscellaneous Details 2- Eastern Surface Drainage

CE-11: Miscellaneous Details 3- Eastern Surface Drainage

CE-12: Eastern Surface Drainage Pipe Inlet Structure

CE-13: Typical Cross- Sections Type A, B and C

CE-14: Main Access Road Culvert- Plan, Section and Detail

GEI Consultants

Geotechnical
Water Resources
Environmental and
Ecological Services

Surface Water Management Plan

Waimanalo Gulch Sanitary Landfill

Submitted to:
Waste Management of Hawaii, Inc.
92-460 Farrington Highway
Kapolei, Hawaii 96707

Submitted by:
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180 Grand Ave, Suite 1410
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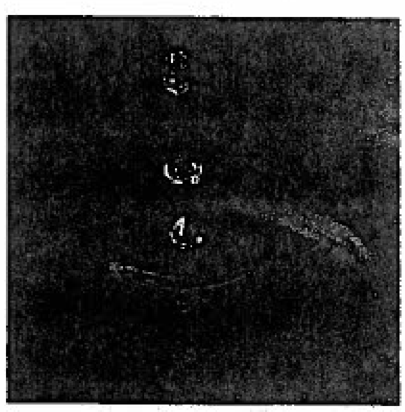
March 2011

Project 07018-1



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List of Appendices

1.0 Introduction

This Surface Water Management Plan (SWMP) was prepared for the Waimanalo Gulch Sanitary Landfill (Landfill) which is located at 92-460 Farrington Highway in Kapolei, Oahu, Hawaii. The document is an update of the SWMP prepared by AECOM [2009].

The Landfill is owned by the City and County of Honolulu (CCH) and operated by Waste Management of Hawaii, Inc. (WMH). This SWMP was prepared in accordance with Hawaii Administrative Rules (HAR) Title 11, Chapter 58.1, and Special Condition G of the Landfill solid waste permit (No. LF-0182-09), dated 4 June 2010, issued by the Solid and Hazardous Waste Branch of the Hawaii Department of Health (HDOH).

1.1 Purpose of Surface Water Management Plan

The purposes of the SWMP are:

a. To describe the design basis and storm used to estimate surface water run-on and run-off at the Landfill.
b. To describe the surface water management features, including permanent and interim, to direct and manage surface water run-on and run-off at the Landfill.

Other requirements in the solid waste facility permit[1] are:

<u>General</u>

- Bypass site run-on and collection and control of site run-off from a 24-hour storm, 25-year;
- Minimize soil erosion and exposure of waste due to soil erosion; and
- Prevent 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.

<u>Specific</u>

- A western bypass channel or offsite surface water conveyance for the upper Waimanalo Gulch and western area flows, in accordance with construction drawings titled *Western Surface Water Drainage Project*, dated January 2010 and prepared by GEI Consultants, Inc. This conveyance is designed to handle the 24-hour, 25-year storm flows, and will

[1] Refer to Solid Waste Management Permit No. LF-0182-09 dated 4 June 2010 for the complete details.

bypass the landfill and terminate in a stilling basin to be constructed below (i.e., to the South) the existing sedimentation basin.

- An on-site surface water management system designed for the 24-hour, 25-year storm that includes: (i) temporary berms, swales, and pipes as necessary to prevent ponding and minimize infiltration of stormwater into the landfill, and (ii) construction of the Eastern Surface Water drainage system.

This SWMP will be updated to address changes in the flow patterns resulting from landfilling operations and to verify the adequacy of the on-site drainage measures.

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 or operators of all 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.

Furthermore, the surface water run-on conveyances at the Landfill have been evaluated to reduce potential impacts to the Landfill area during peak flow resulting from the 24-hour, 100-year storm.

For reference, the 24-hour, 25-year storm at the landfill is about 9.0 inches and the 24-hour, 100-year storm is about 11.5 inches as determined by point precipitation frequency estimates from the NOAA Atlas No. 14 precipitation frequency data server (http://hdsc.nws.noaa.gov)

Requirements for surface water management

MSW landfill units shall 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 state-wide 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 Landfill under NPDES on August 30, 2010, which was assigned File No. HI R50A533. Under the Landfill's NGPC, the CCH, Department of Environmental Services is authorized to discharge storm water run-off associated with industrial activity at the Landfill to the receiving State water named the Waimanalo Gulch stream. The activities associated with the Landfill NGPC are described in the Landfill 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 HDOH 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 2009] that was previously submitted to HDOH.

The SWPCP was updated in 2009 to reflect on-site changes [Earth Tech 2009a] and re-submitted to HDOH.

1.2.3 Spill Prevention, Control, and Countermeasures Plan.

A Spill Prevention, Control, and Countermeasures (SPCC) Plan was developed for the Landfill by Earth Tech [2009b] and is included in the Site Operations Manual [WMH 2009] that was previously submitted to HDOH. 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 Landfill including its location, size, elevation, and limits, and surrounding area.

2.1 Site Description

The Landfill is located at 92-460 Farrington Highway in Kapolei, on the southwest side of the island of O`ahu, Hawaii. The site is approximately 15 miles northwest of Honolulu International Airport and two miles southeast of Nanakuli, as shown on Figure 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 as shown on Figure 2. The landfill office and scale house are located at the southern end of the facility, near Farrington Highway.

The Landfill property encompasses a total of 200 acres, of which approximately 116 acres is the landfill footprint. The site is long and narrow, approximately 7,000 feet in length, with a width ranging from 820 feet on Farrington Highway frontage to about 1,900 feet at the widest point. The landfill entrance at Farrington Highway is approximately 60 feet above mean sea level (msl), and the extreme northeast corner of the property is at an elevation of 990 feet above msl.

2.2 Climate and Topography

The Landfill is located in a region of Oahu 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 19 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 direction, at an average annual speed of approximately 10 knots. Between the months of October and April, the Landfill occasionally comes under the influence of southerly winds associated with Kona storms or approaching storm fronts.

Typical daily temperatures range from the low 60s (degrees Fahrenheit [°F]) to the upper 70s °F during the winter and from the lower 70s °F to the upper 80s °F during the summer.

The regional topography near the landfill 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. The Landfill is located at the southern toe of this range in a typically narrow valley (gulch). Elevations along the main mountain ridgeline range from about 1,000 to 4,000 feet 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 feet over distances of two miles or less. Near the Landfill, the mountains of the Waianae Range transition to the low-lying coastal plains.

2.3 Surrounding Area

The Landfill is surrounded by open space to the north and west. The Hawaiian Electric Company (HECO) Kahe Power Generating Station is located west of the Landfill's boundary. The Ko`Olina Resort is south of the Landfill.

3.0 Surface Water Management Plan

The Landfill consists of 8 original cells where ash is disposed (Ash Cells 1 through 8), one future cell where ash will be disposed (Cell E8), and 15 cells where municipal solid waste (MSW) is/was disposed (MSW Cells 1 through 3; MSW Cells 4A, 4B, and 4C; MSW Cells 5 through 11; and MSW Cells E1 through E4), and 5 cells (E5 through E9-under development) which constitute the recent expansion approved by Solid Waste Management Permit No. LF-0182-09. The fill slopes are equal to or flatter than 3:1 (horizontal to vertical) and the maximum elevation reached will be approximately 810 feet msl. Figure 3 shows the main surface water management systems that will be used to control surface water run-on and run-off:

a. Western Bypass to control stormwater run-on from the upper Waimanalo Gulch and western areas adjacent to the Landfill that do not come in contact with the Landfill. This system will also convey run-on water flowing from the Northern Drainage System.

b. Western Drainage System. This system will convey flows from the western side of the landfill and will be collected in a down drain and pipe conveyance system which discharges to the site's sedimentation basin.

c. Eastern Drainage System to convey flows from the eastern and south sides (both onsite run-off and offsite run-on).

Figure 3 also shows a schematic of the major temporary and permanent drainage features associated with each system. Temporary and permanent drainage features are presented in more detail on Figures 5 and 6. The temporary features will be in service as MSW and ash placement proceeds in the Cell E5 through E9 area. These features will be modified or taken out of service as fill grades are raised in the landfill and areas of the landfill are closed as illustrated in Figure 4. Temporary landfill drainage flows conveyed through these features will report to the on-site sedimentation basin.

Permanent surface water management features will control site run-on and landfill run-off as the Cell E6- E8 area is expanded and will also be in place after the landfill is closed. The perimeter run-on controls (i.e. the Western and Eastern Drainage Systems) are permanent surface water management features. The Eastern Drainage system will be extended to the north into the Cell E6-E9 area. There will also be permanent drainage ditches and drop inlets to covey landfill run-off flows and perimeter run-on flows into permanent on-site management systems. Permanent drainage ditches will also convey flows directly into a concrete lined channel immediately upstream of the sedimentation basin.

The remainder of this section describes in more detail the various temporary and permanent surface water management features at the Landfill.

3.1 Temporary Surface Water Management Features

As the Landfill is further developed (i.e., filled), the stormwater run-off will be directed toward the South and West. Figure 5 shows the initial fill sequencing plan.

A majority of the storm water flows will be diverted around the periphery of the landfill by the Western Bypass described previously; however, run-off will also be generated downstream of these systems during the period of active landfilling.

3.1.1 Western Drainage System

The Western Drainage System will convey run-on flows from the western perimeter access road and run-on flows from landfill grades in the Cell E6 though E8 area. Figure 5 shows the key components of the Western Drainage System. The run-on flows from western perimeter access road will be directed towards the permanent inlet located in the West Berm area. Run-off flows from the landfill will either be directed into an 18-inch down drain system or surface water ditches described below.

The western drainage system includes a 36-inch-diameter HDPE temporary diversion pipe that will convey storm water flows from areas to the north of cells E6 through E9. The 36-inch pipe conveys flows to the existing concrete channel and sedimentation basin located at the south end of the landfill. Some of the interior drainage pipes and inlets will be decommissioned as the landfill is developed.

Figure 3 shows a schematic of how the ditches and pipes convey surface water run-on and run-off flows from the northern part of the landfill to the existing sedimentation basin located to the south of the landfill. Key features of the interior drainage system are as follows:

- Surface water run-off from the Landfill will be collected by temporary lined ditches along the western side of the Landfill which will flow to 18-inch drainage pipe drop inlets.

- Surface water run-off the unlined slopes will be collected on the benches by ditches which will also flow into the drop inlets.

- The drop inlets flow into an 18-inch-diameter HDPE buried pipe which discharges into a 36-inch-diameter HDPE buried pipe which in turn discharges to the sedimentation basin at the south end of the landfill. For reference, portions of the top surface of the West Berm will be graded as needed to direct flow to the drop inlets; the drop inlets will be extended or decommissioned depending on the field conditions.

- If the flow capacity of an individual inlet is exceeded, the surface water will be conveyed to the sedimentation basin by open rock-lined ditches. Refer to Figure 5 showing the downstream conveyance routes of the landfill surface water (i.e., through the 36-inch HDPE pipe or the rock-lined ditches). The open ditches will run alongside the landfill access road and convey flows downstream to the existing concrete channel and sedimentation basin.

Surface water run-off from the currently unlined slopes located to the North of Cell E8 will flow into an inlet that enters a 36-inch-diameter HDPE buried pipe below the liner (i.e., the temporary E8/E9 inlet shown on Figure 5). This inlet will remain active as the Landfill is developed; furthermore, as Cell E9 is developed, the 36-inch HDPE pipe may be extended to the north and up the slope and the inlet would be relocated. The pipe and the inlet will be properly abandoned when the landfill reaches the perimeter road/bench.

If needed, operations will also deploy pumps that would pump any accumulated water that has not been in contact with MSW or ash to the ditches that flow to the sedimentation basin. Water that has been in contact with MSW or ash will be pumped and transported to the publicly-operated water treatment works (POTW).

3.1.2 Eastern Drainage Phase 1 Inlet

The Eastern Drainage System will intercept eastern storm water runoff and run-on and convey it in a primary and an auxiliary pipe system. Collected water will be discharged to the existing sedimentation basin located near Farrington Highway. The Eastern Drainage System will be constructed in two phases: Phase I and Phase II as shown on Figures 5 and 6.

The Phase I pipe conveyance extends approximately 3,500 feet upstream from the existing sedimentation basin. The inlet structure at the upstream end of Phase I will be active for a few years until the Phase II extension of the pipe conveyance towards the north is required. Temporary drainage ditches will convey drainage from the eastern portion of the site towards the inlet at the upstream end of Phase I. The Phase I inlet is expected to serve until the elevation of the landfill reaches the same elevation as the Eastern Perimeter Bench. At this time the Phase II portion of the system will be constructed and landfill run-off on the east side will be captured in the permanent ditches and inlets associated with the Eastern Drainage System.

3.1.3 Landfill Ditches

The ditches on the landfill will be moved as landfilling activities progress and subsequent cells are constructed. Generally, as shown on Figures 3, 4 and 5, the objective for the landfill areas and the future landfill is to drain the areas to the west and to the south so that the flows report to the sedimentation basin. The runoff from areas of the landfill that have not been fully-developed (e.g., the slopes that have been excavated but not lined to receive waste) will be captured by ditches on the benches on the rock cut-slopes that will also flow to drop inlets of the interior drainage system or to other ditches that will convey flow to the sedimentation basin. The above components are described in Section 3.2, Permanent Drainage Features

The open ditches along the western side of the landfill will be lined with sacrificial geomembrane to minimize erosion and minimize water seeping into the landfill. Figure 3 presents the proposed configuration of the temporary ditches as MSW grades are raised. Open ditches in non-active landfilling areas, and the landfill access road will be rock lined. Inlets and down drains will consist of HDPE basins and pipes with typical diameters ranging from 18-inches to 36-inches. The location of key conveyance ditches, inlets and down drains is presented on Figure 5.

3.1.4 Landfill Stockpile Drainage

The landfill stockpile will be used to store excavation spoils from the excavations for the landfill, and will have the approximate footprint shown on Figure 5. The stockpile will be depleted and expanded (to the maximum configuration shown), depending on future landfill and construction operations. As part of the interim surface run-on and run-off measures, the stockpile will be graded so that surface water runoff flows to the south towards the Sedimentation Basin. Best management practices such as hydroseeding and wattle/erosion control mat installation will be used to control erosion as needed.

3.2 Permanent Surface Water Management Features

This section describes the various surface water management components that will be permanent features. Many of the perimeter run-on control features will be in-place while the landfill is active but may also remain in-place after the landfill is closed.

3.2.1 Western Bypass System

The system is designed to divert the 24-hour, 25-year storm event run-on collected from the upper part of the Waimanalo Gulch, located north of the permitted landfill footprint, and convey the stormwater flow under gravity flow conditions around the western perimeter of the landfill. There are also contingency measures in place to control a 24-hour, 100-year event and prevent water entry into the landfill area. These control measures will be installed along the upper perimeter access road and include a 2-foot high berm along the eastern (landfill side) and a drainage ditch on the rock cut slope side to direct flows southward. The upper perimeter access road steepens to a 20 to 30 percent grade near the southern end of the landfill expansion area. In order to minimize the potential for erosion and scour along the access road in this steep area, water will be conveyed downstream to the west berm inlet via a 36-inch diameter HDPE pipe along the perimeter access road. (Refer to Figures 5 and 6). Intercepted runoff along the steep portion of the bench will enter the pipe via grated catch basins.

The system will also receive diverted run-on flows from the abandoned Nike site conveyed through the Northern Channel Diversion system as described in Section 3.2.2. The main conveyance components of the Western Bypass System are (from north to south):

- A concrete diversion and concrete channel transition structure to intercept flows from Waimanalo Gulch;
- A 1,200 feet long concrete box culvert structure, having a cross section dimension of 10-feet by 10-feet;
- A buried, fiberglass mortar pipe (HOBAS pipe) conveyance with diameters varying from 104 inches to 78 inches with a total length approximately 5,200 feet; and
- A stilling basin (flip bucket and plunge pool) at the downstream end of the pipe that discharges to the existing channel and Farrington Highway culverts.

Diversion Structure. The diversion structure consists of a 100-foot-long reinforced concrete, side-channel weir structure having minimal submergence. The weir structure will trap some coarse sediment upstream of the HOBAS pipe especially during storms; the structure will be cleaned out as needed. Low flows from the upper Waimanalo Gulch will be discharged at a slow rate through the 12-inch-diameter pipe outlet installed across the weir at side channel invert level to minimize ponding and convey the flows to the box culvert.

Box Culvert and Pipe Conveyance. The 10-foot by 10-foot buried box culvert segment of the Western Surface Water Drainage conveyance begins at the downstream end of the diversion structure and extends southeast (see Figures 5 and 6). The box culvert is approximately 1,200 feet long, and has a relatively flat grade of approximately 0.6%. A coarse sediment trash rack is installed at the upstream end of the box culvert structure. The box culvert has an average burial depth of approximately 3 feet below the final landfill bench grade. The downstream end of the box culvert connects from the rectangular cross section to the circular HOBAS pipe section through a concrete transition structure. The pipe conveyance system will bypass the sedimentation basin and discharge to the stilling basin.

Flip Bucket Structure and Plunge Pool. The pipe alignment makes an eastward turn to direct the flow towards a plunge pool with a flip bucket structure (stilling basin). The stilling basin provides gravity flow downstream to the existing drainage culverts beneath Farrington Highway. The bottom of the stilling basin will be lined with large size rock riprap to limit erosion. Low flow outlets from the plunge pool are provided by two 48-inch diameter pipes crossing the dike forming the southwest end of the plunge pool. The discharge capacity of the two 48-inch pipes will only be adequate to discharge low flows and at high flow, the water depth in the pool will rise to flow over the dike crest.

3.2.2 Northern Drainage Diversion

This system will be constructed along the northern property boundary above the future Landfill area to divert and convey flows up to the 24-hour, 100-year storm run-on collected from a drainage swale at the northern property boundary of the site. The diverted storm water will be conveyed to the southwest beneath the future Cell E9 cut slope boundary, and discharge into the Western Drainage diversion structure.

The total elevation drop is about 150 feet. The main components are:

- A diversion structure consisting of a concrete inlet with sloping trash rack and a rock fill diversion berm to direct flows from the upstream swale area.
- A 36-inch diameter, 750 foot-long HDPE pipe to convey flows southwest in a steep gradient area above the diversion weir for the Western Drainage System. The 36-inch HDPE pipe will discharge directly into the side channel invert of the diversion structure.

3.2.3 Permanent Portion of the Western Drainage System

The downstream segment of the 36" HDPE pipe (i.e. the portion in the existing concrete channel) will remain active to receive drainage from the western perimeter access road and landfill areas. A 36-inch stubbed- out "Y" connection was added to the drainage alignment in the West Berm area to convey future surface water flows from landfill areas on the north and west side of the landfill downstream to the sedimentation basin. A drainage inlet will be installed at the northern end of the west berm buttress to collect upstream surface water from landfill areas. The system is sized to convey flows resulting from the 24-hour, 25-year event.

When the final stockpile configuration is achieved, permanent down drains and ditches may be installed prior to landfill closure. Preliminary configurations of drainage control features in the stockpile area are shown on Figure 6.

3.2.4 Eastern Drainage System

Phase I of the Eastern Drainage System will function to receive upstream flows from temporary drainage benches and a temporary upstream inlet as the eastern side of the landfill is developed. However, the Phase I system will also receive run-on and run-off including drainage from landfill areas and the eastern cut slopes above the perimeter access road. Phase II will include 2,900 feet of pipe to collect and convey runoff from the landfill (Figure 6). The combined drainage area for the Phase I and II systems will be approximately 50 acres. Phase II will be installed as the landfill is developed.

At the southeast end of the landfill, runoff from a catchment area of about 11 acres will be collected in an auxiliary drainage system as shown on Figures 5 and 6.

The temporary inlet for the Phase I portion of the system is described in Section 3.1. The permanent features of the Eastern Drainage System will include the following:

Upstream Inlet Structure- The Phase II inlet will be designed as a permanent structure. Each inlet structure have an approach channel, debris barrier, coarse trash rack, and transition from open ditch to pipe section.

Pipe Conveyance- A 36-inch-outer-diameter HDPE pipe will be used for the main conveyance pipe in the Phase I and II systems. The pipe will be buried along the eastern perimeter of the landfill. The pipe conveyance will follow along the alignment of the final landfill closure cap, except for the downstream 1,300 feet that will be located along the existing landfill access road.

Structures along Pipe Conveyance- Along the pipe alignment a V ditch on the landfill side of the bench serve to intercept runoff from the landfill slopes facing east and from the narrow drainage area along the other west-facing, side of the bench. Intercepted runoff along the bench enters the pipe via grated catch basins connected to the main conveyance pipe. Depending on the elevation, catch basins will be placed at 100- to 300-ft horizontal (N-S) intervals. The catch basins in Phase I will also collect surface run-on from drainage bench areas above active areas of the landfill, and surface runoff from the existing landfill Manholes, air vents, and pipe anchors will also be included as needed.

Outlet Structure- The outlet structure is planned to be an energy dissipater structure. Considering that the sedimentation basin may not always contain water to cushion and to dissipate the energy of the outflow, an impact type energy dissipater which does not require tail water was selected.

Auxiliary Drainage System- At the southeast area of the landfill, run-off from the landfill access road and ash berm areas will be collected and conveyed in a separate 18-inch HDPE pipe, about 1,400 feet long that collects surface water by gravity and discharges it to the sedimentation basin. The pipe will be routed along the existing access road. Runoff from the up gulch side of the perimeter access road and the nearby landfill slope is diverted to the inlets along the auxiliary pipe conveyance.

Truck Scale, Parking Lot, and Flare Station Drainage- The truck scale area is located at the lower end of the existing landfill disposal area, to the east of the sedimentation basin. Currently the runoff from the paved truck scale area drains into a ditch formed along the east side of the truck scale area. The ditch conveys drainage flow from the truck scale area to a natural flow line further southeast. At this time, the configuration envisioned for diverting drainage runoff from the truck scale area into the sedimentation basin involves: capturing of the southern ditch flow in a drop inlet and conveying water beneath the Landfill office parking lot into the sedimentation basin with an HDPE cross drain. Surface ditches will also intercept runoff from the Flare Station and entrance road areas as shown on Figures 5 and 6. An inlet will also be constructed in the parking lot area, to convey surface water collected in the parking lot to the HDPE cross drain. An oil-water separator will be installed at the downstream end of the cross drain before it enters the sedimentation basin to remove any oils or fuels that enter into the system from the parking lot, access road flare station or truck scale areas.

3.2.5 Sedimentation Basin

The sedimentation basin is located by the landfill's entrance facilities (Figures 3, 5 and 6) and receives the run off flows from the landfill to allow for sedimentation and gradual release of storm water up to the 1 inch design storm (per the City and County of Honolulu's Storm Drainage Standards). The outlets and spillway of the sedimentation basin can also pass the 100-year peak flow.

A vegetated drainage corridor will be located downstream of the spillway apron for the sedimentation basin. The vegetated area flows to three existing large diameter culverts beneath Farrington Highway. The vegetated drainage corridor will be modified to construct the stilling basin outlet for the Drainage System. Longer term erosion control measures for the vegetated drainage corridor will be considered during construction of the stilling basin structure.

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 sedimentation basin are performed by WMH personnel. An inspection log is used to document the results of the inspection. The current annual inspection log sheet is presented in Appendix A. After all major rain storm events, inspections of the drainage system, sedimentation basin, 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 Landfill Operating Record/Files.

4.2 SWMP Evaluation

The effectiveness of the Landfill storm water run-on and run-off drainage systems is reviewed on an annual basis. The review assesses the sedimentation basin, 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 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 sedimentation basin is scheduled on an annual basis and includes removal of any sediment deposits within the sedimentation basin bottom.

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 B including the revision date and a brief description of changes.

5.0 References

AECOM. 2010. *Surface Water Management Plan, Waimanalo Gulch Sanitary Landfill, Kapolei, Oahu, Hawaii.* August.

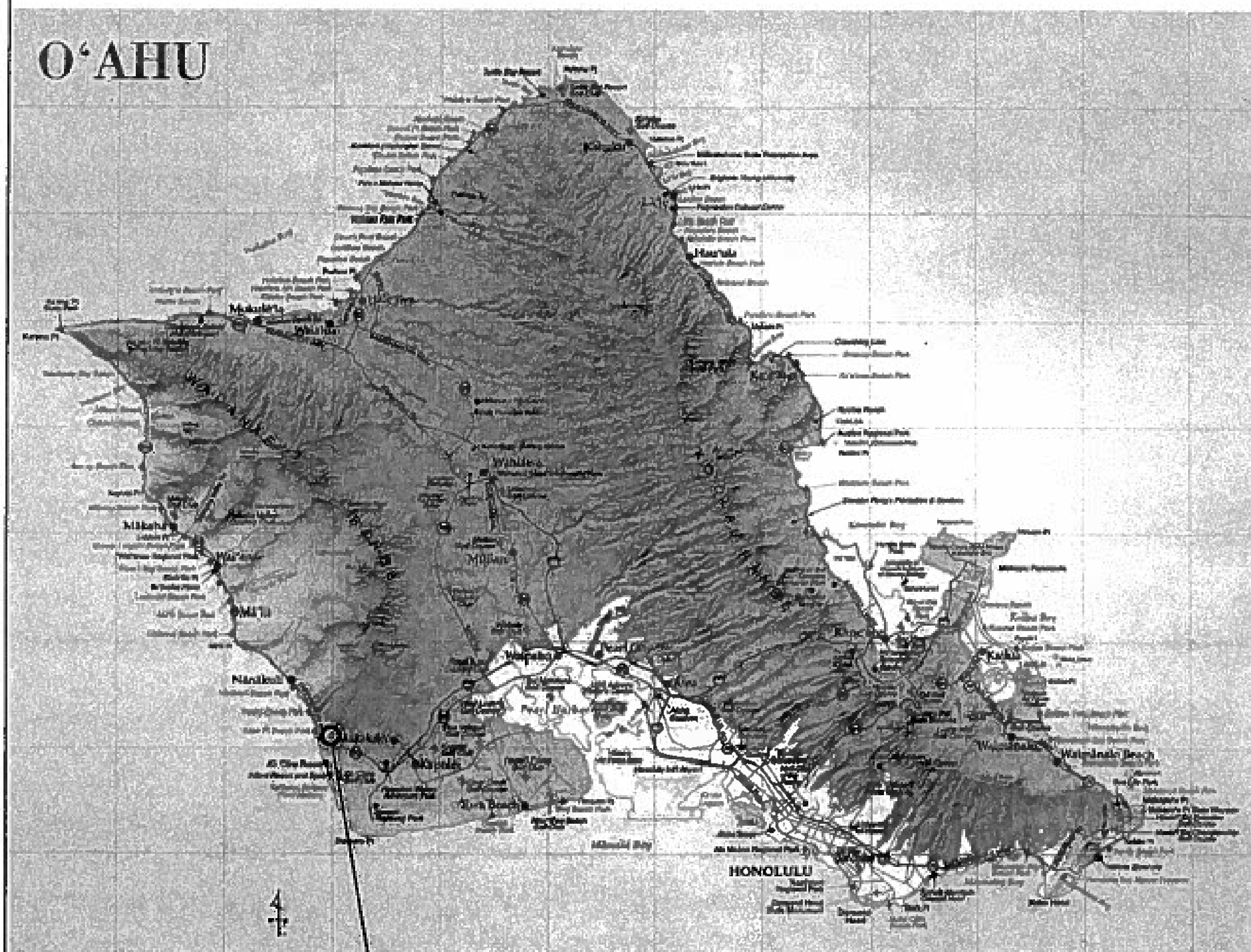
Autodesk, Civil Design 2005, Version 2005.0.0, Service Pack 1.

Earth Tech, Inc. 2009a. *Storm Water Pollution Control Plan, Revision 3; Waimanalo Gulch Sanitary Landfill, Oahu, Hawaii.* January.

Earth Tech, Inc. 2009b. *Spill Prevention Control and Countermeasures Plan, Revision 3; Waimanalo Gulch Sanitary Landfill, Oahu, Hawaii.* January.

Waste Management of Hawaii, Inc. (WMH). 2009. *Site Operations Manual*, Waimanalo Gulch Sanitary Landfill, Kapolei, Hawaii. Volumes I and II. November.

Figures



PROJECT LOCATION

WASTE MANAGEMENT

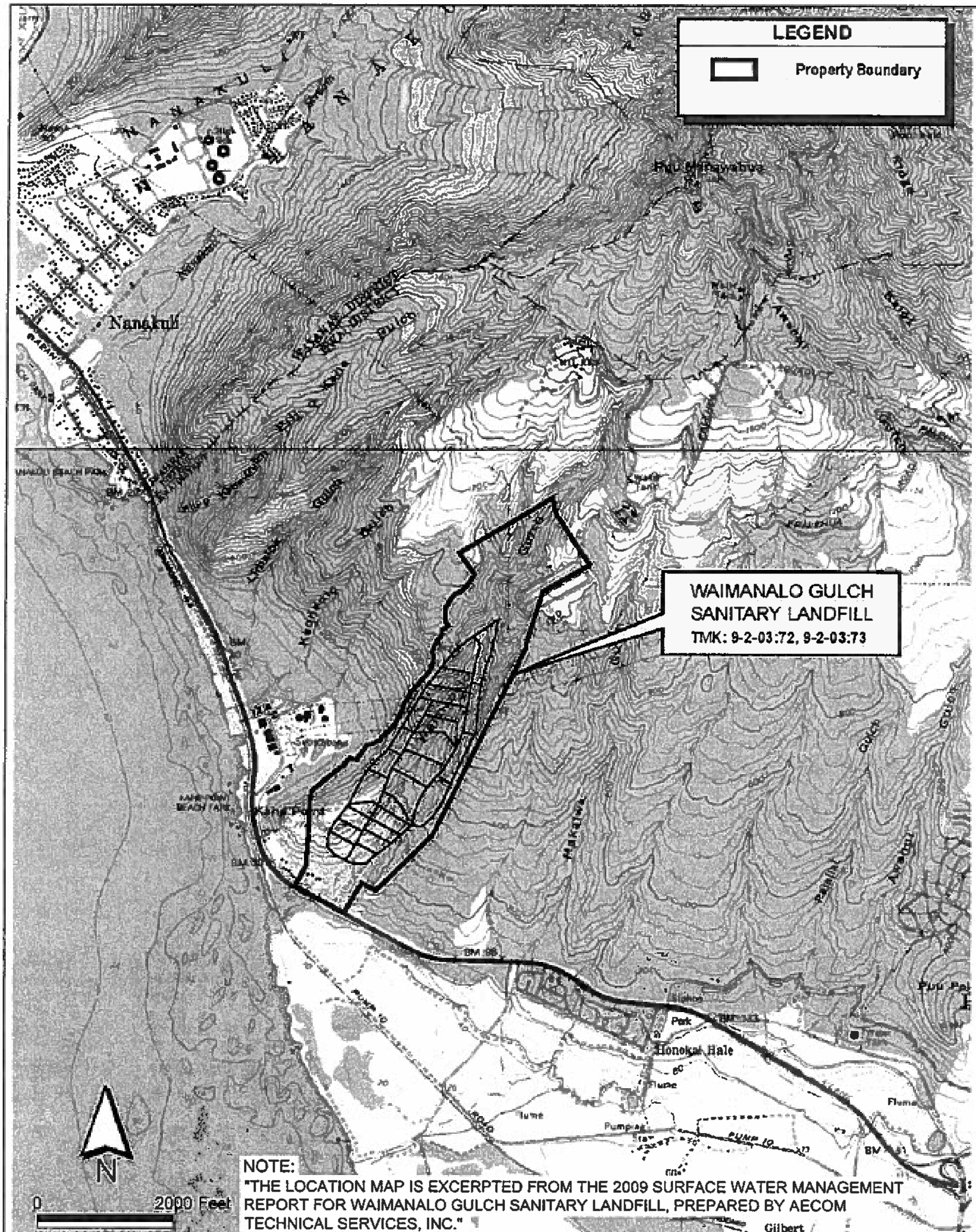
Oakland
California
GEI Consultants

WAIMANALO GULCH LANDFILL
WESTERN SURFACE WATER DRAINAGE PROJECT
EWA BEACH, OAHU, HAWAII

PROJECT LOCATION MAP

FIGURE 1

WM SWMP Figure 1B 03-08-11 PYM

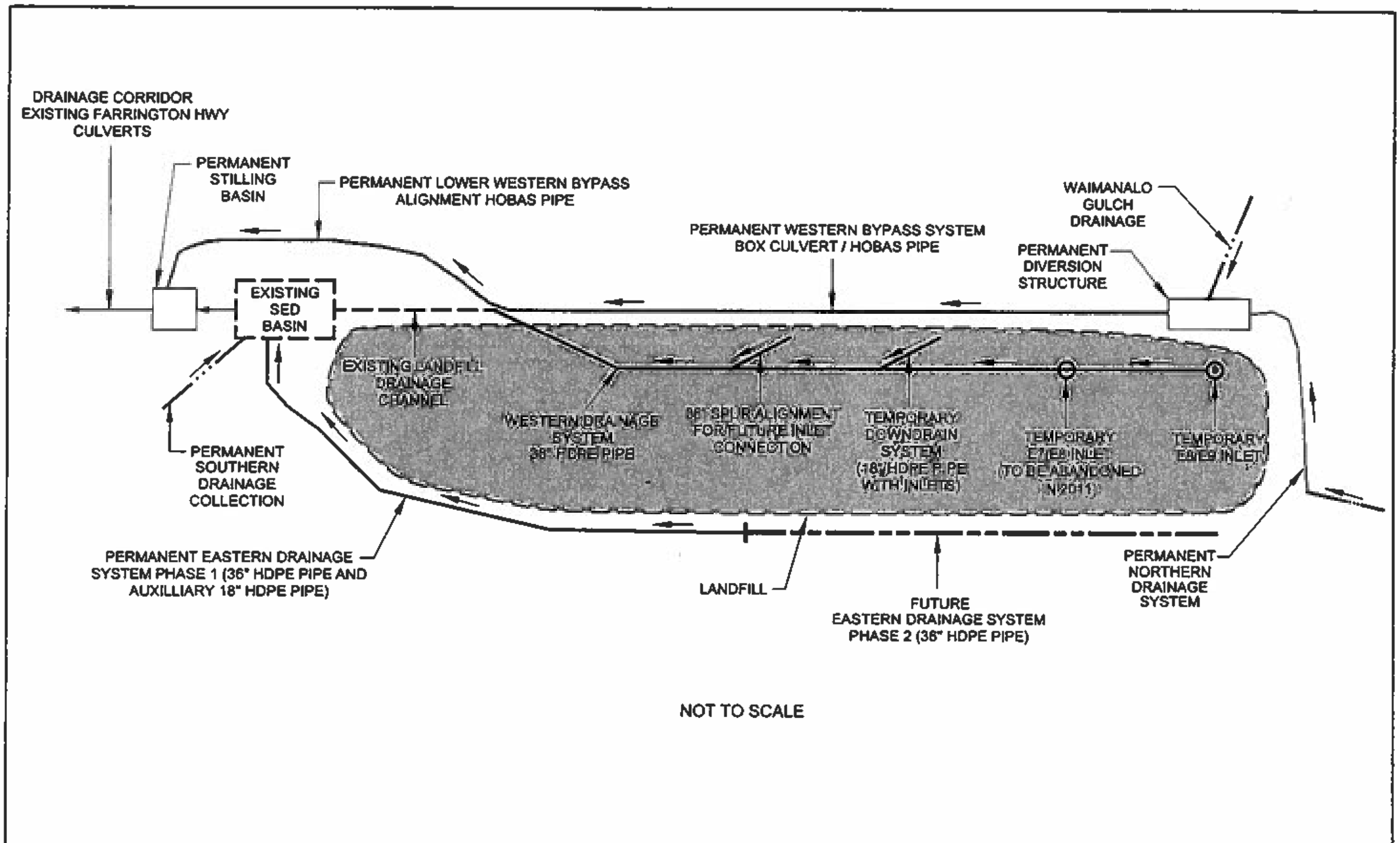


NOTE:
"THE LOCATION MAP IS EXCERPTED FROM THE 2009 SURFACE WATER MANAGEMENT REPORT FOR WAIMANALO GULCH SANITARY LANDFILL, PREPARED BY AECOM TECHNICAL SERVICES, INC."

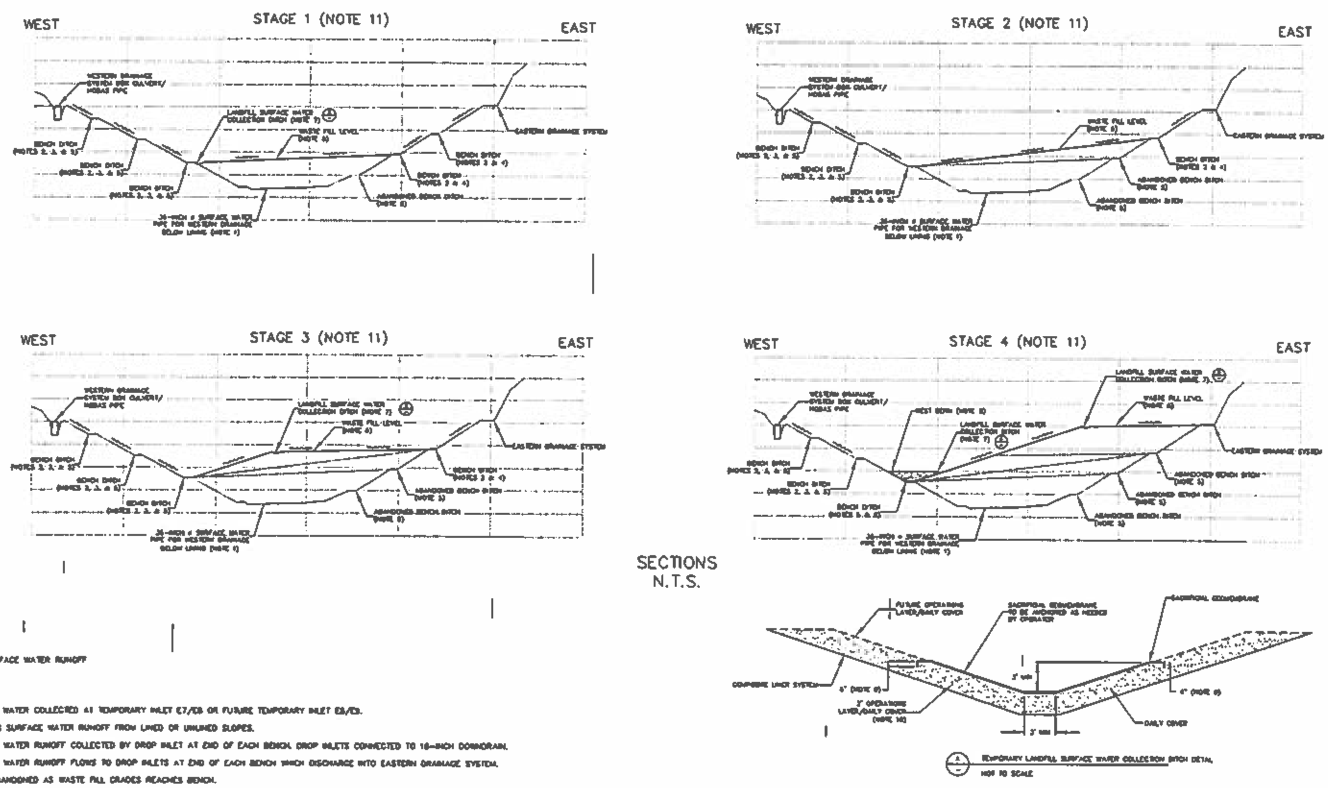
WM WASTE MANAGEMENT	Oakland California GEI Consultants	WAIMANALO GULCH LANDFILL WESTERN SURFACE WATER DRAINAGE PROJECT EWA BEACH, OAHU, HAWAII SITE LOCATION MAP	FIGURE 2

WM SWMP Figure 2 03-07-11 PYM

WM SWMP Figure 3 03-11-11 PYM



WM WASTE MANAGEMENT	Oakland • California GEI Consultants	DESIGNED BY: L. SANSONE CHECKED BY: C. ANDERSON DRAWN BY: P. MORRISON CAD FILE NAME: Figure 3.dwg PROJECT NO. 07018-1 SCALE: AS SHOWN	WAIMANALO GULCH LANDFILL SURFACE WATER MANAGEMENT PLAN KAPOLEI, OAHU, HAWAII SCHEMATIC OVERVIEW OF SURFACE WATER MANAGEMENT AND CONVEYANCE SYSTEMS	FIGURE 3



LEGEND

—— SURFACE WATER RUNOFF

NOTES:

1. CONVEYS WATER COLLECTED AT TEMPORARY INLET E7/E8 OR FUTURE TEMPORARY INLET E8/E9.
2. COLLECTS SURFACE WATER RUNOFF FROM LINED OR UNLINED SLOPES.
3. SURFACE WATER RUNOFF COLLECTED BY DROP INLET AT END OF EACH BENCH. DROP INLETS CONNECTED TO 18-INCH DOWNDRAIN.
4. SURFACE WATER RUNOFF FLOWS TO DROP INLETS AT END OF EACH BENCH WHICH DISCHARGE INTO EASTERN DRAINAGE SYSTEM.
5. DITCH ABANDONED AS WASTE FILL GRADES REACHES BENCH.
6. WASTE FILL LEVEL TO BE BASED ON FILL SEQUENCING PLAN AND SLOPE STABILITY.
7. DITCH FLOWS ON LANDFILL AND WOULD BE MOVED AS NEEDED DURING OPERATIONS
8. DROP INLETS CONNECTED TO 18-INCH DOWNDRAIN MAY NEED TO BE EXTENDED/ABANDONED AS WEST BERM IS CONSTRUCTED.
9. OPERATOR TO DEPLOY SACRIFICIAL GEOMEMBRANE AND DITCH LINING WITHOUT DAMAGING COMPOSITE LINER SYSTEM OR EXISTING FACILITIES.
10. DITCH MAY EXTEND ONTO WEST BERM.
11. STAGES REPRESENT TEMPORAL SNAPSHOTS OF LANDFILL OPERATIONS FOR ILLUSTRATIVE PURPOSES.

GENERAL NOTE:
SURFACE WATER SCHEMATIC SEQUENCING PREPARED BY GEOSYNTEC CONSULTANTS.

WASTE MANAGEMENT

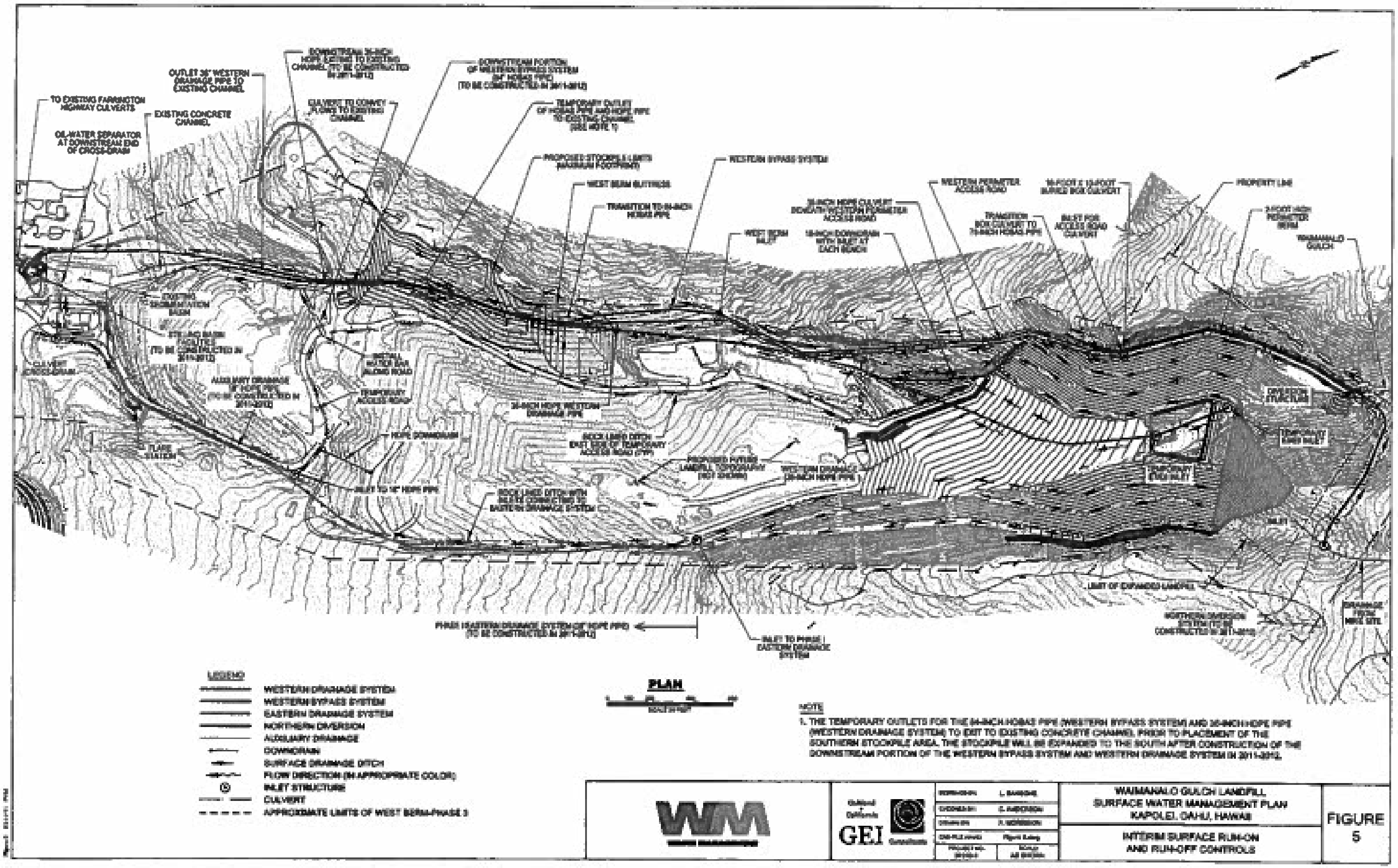
GEI Consultants, Oakland, California

DESIGNED BY:	Geosyntec Consultants
CHECKED BY:	Geosyntec Consultants
DRAWN BY:	Geosyntec Consultants
CAD FILE NAME:	Figure 4.dwg
PROJECT NO.	SCALE: NOT TO SCALE

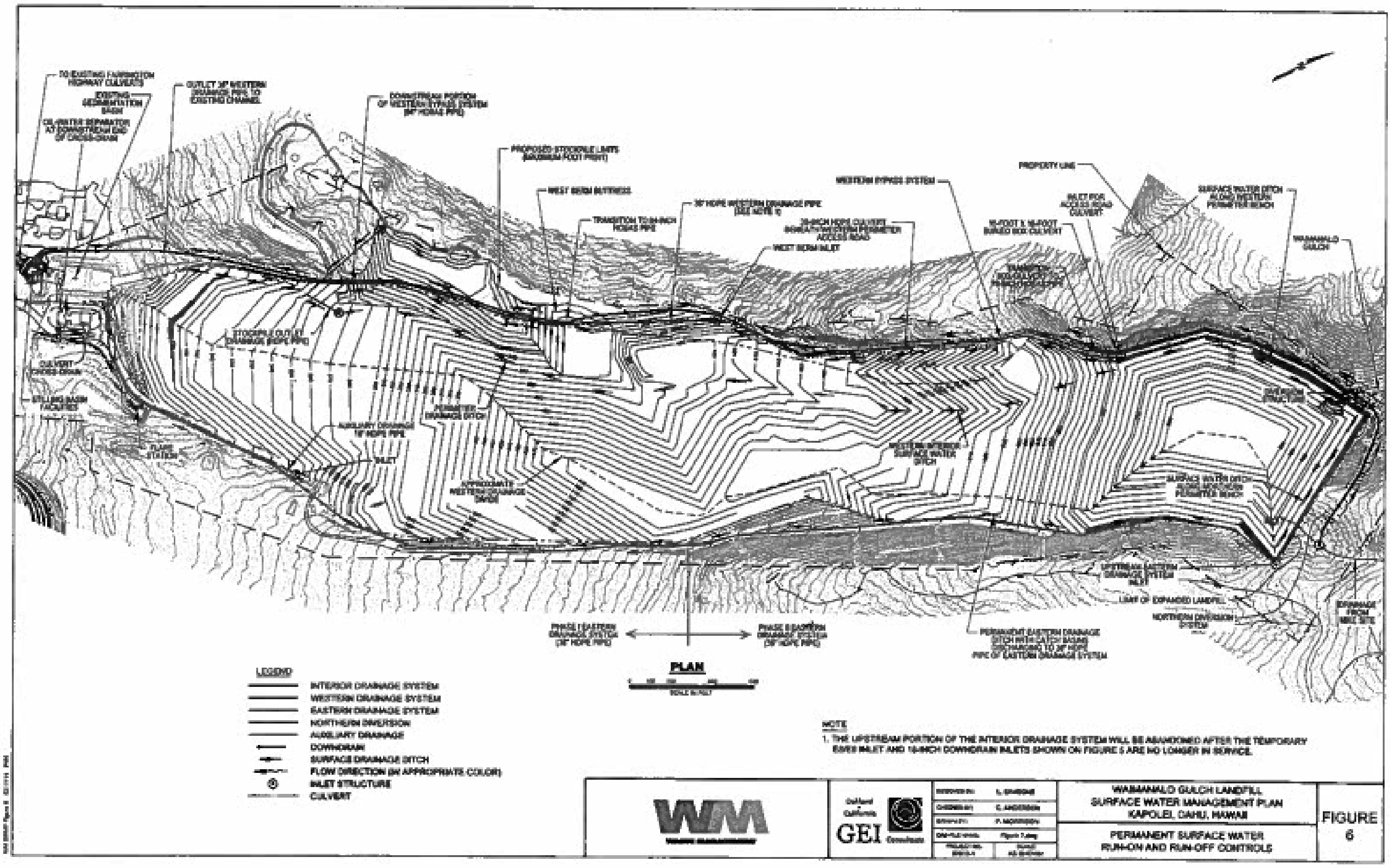
WAIMANALO GULCH LANDFILL
SURFACE WATER MANAGEMENT PLAN
KAPOLEI, OAHU, HAWAII

LANDFILL INTERIM SURFACE WATER SCHEMATIC SEQUENCING

FIGURE 4



LEGEND
WESTERN DRAINAGE SYSTEM
WESTERN BYPASS SYSTEM
EASTERN DRAINAGE SYSTEM
NORTHERN DIVERSION
AUXILIARY DRAINAGE
DOWNDRAIN
SURFACE DRAINAGE DITCH
FLOW DIRECTION (IN APPROPRIATE COLOR)
INLET STRUCTURE
CULVERT
APPROXIMATE LIMITS OF WEST BERM-PHASE 3
PLAN
NOTE
1. THE TEMPORARY OUTLETS FOR THE 84-INCH HOBAS PIPE (WESTERN BYPASS SYSTEM) AND 36-INCH HDPE PIPE (WESTERN DRAINAGE SYSTEM) TO EXIT TO EXISTING CONCRETE CHANNEL PRIOR TO PLACEMENT OF THE SOUTHERN STOCKPILE AREA. THE STOCKPILE WILL BE EXPANDED TO THE SOUTH AFTER CONSTRUCTION OF THE DOWNSTREAM PORTION OF THE WESTERN BYPASS SYSTEM AND WESTERN DRAINAGE SYSTEM IN 2011-2012.
GEI Consultants
WAIMANALO GULCH LANDFILL
SURFACE WATER MANAGEMENT PLAN
KAPOLEI, OAHU, HAWAII
INTERIM SURFACE RUN-ON
AND RUN-OFF CONTROLS
FIGURE
5


WESTERN BYPASS SYSTEM
PROPERTY LINE
WEST BERM BUTTRESS
WEST BERM INLET
WAIMANALO GULCH
PLAN
LEGEND
INTERIOR DRAINAGE SYSTEM
WESTERN DRAINAGE SYSTEM
EASTERN DRAINAGE SYSTEM
NORTHERN DIVERSION
AUXILIARY DRAINAGE
DOWNDRAIN
SURFACE DRAINAGE DITCH
FLOW DIRECTION (IN APPROPRIATE COLOR)
INLET STRUCTURE
CULVERT
NOTE
1. THE UPSTREAM PORTION OF THE INTERIOR DRAINAGE SYSTEM WILL BE ABANDONED AFTER THE TEMPORARY E8/E9 INLET AND 18-INCH DOWNDRAIN INLETS SHOWN ON FIGURE 5 ARE NO LONGER IN SERVICE.
GEI Consultants
WAIMANALO GULCH LANDFILL
SURFACE WATER MANAGEMENT PLAN
KAPOLEI, OAHU, HAWAII
PERMANENT SURFACE WATER
RUN-ON AND RUN-OFF CONTROLS
FIGURE
6

Appendix A

Annual Site Inspection Log

ANNUAL INSPECTION LOG
WAIMANALO GULCH SANITARY LANDFILL
SURFACE WATER MANAGEMENT PLAN

GENERAL INFORMATION

Date:

Personnel:

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		
Settlement or depressions		
Slope Instability		
Gullies caused by erosion		
Illicitly-dumped material		
Stressed or dead vegetation		
Other indicators of leachate seepage		
Drainage swales		
Evidence of erosion		
Sediment deposition		

Inspection List	Yes/No/NA	If Yes, Describe Location and Required Follow-up Action (if any)
Detention Pond		
Structure blocked or has obstructions		
Outfall areas eroded		
Security Measures		
Landfill access road gate damaged		
Access Roads		
Roads inaccessible		
Roads damaged by erosion or settlement		
Leachate Sumps		
Depth from top of sump less than 3 feet?		
Side Slopes Covered with Geosynthetic Tarps		
Evidence of erosion?		
Geosynthetic tarps intact on lower slopes?		
Geosynthetic tarp condition on lower slopes?		
Side Slopes hydroseeded?		
Upper slopes hydroseeded?		

Appendix B

Update Log

UPDATE LOG
WAIMANALO GULCH SANITARY LANDFILL
SURFACE WATER MANAGAMENT 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 3-1 B 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 3-1 B 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 3-1 B 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 3-1 B 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.	
March 2011	THE SWMP has been updated to reflect current and proposed site drainage features to control site run-on and run-off at the landfill. Both interim and permanent surface water management features were described in the update along with figures showing the locations of these features.	

Prepared for:

Waste Management of Hawaii, Inc.
92-460 Farrington Highway
Kapolei, Hawaii 96707

ENGINEERING REPORT FOR LANDFILL EXPANSION

WAIMANALO GULCH LANDFILL
Ewa Beach, Oahu, Hawaii

Prepared by:

Geosyntec consultants

475 14th Street, Suite 400
Oakland, California 94612
(510) 836-3034

Project Number: WL0770
12 March 2008

EXHIBIT A41

1.4 Expansion Plan

Figure 5 shows the preferred expansion fill plan, which expands the landfill to the north in cells E5 through E11. The expansion (E5 through E11) adds approximately 36.9 acres to the overall currently permitted footprint for MSW disposal. Fill slopes are equal to or flatter than 3:1 (horizontal to vertical) and the maximum elevation reached is approximately 800 ft- msl.

The limits of each expansion cell (i.e., E5 through E11) shown on Figure 5 are approximate at this time; the actual cell limits will be developed based on waste flows and may be modified based on the actual waste stream[1] (i.e., ash versus MSW). If ash cells are added, the sump arrangement may be changed, if required by the HDOH to separate leachate from the ash and MSW cells. The overall expansion limit will not change.

The expansion area will be accessed using the existing access road that runs over the ash cells and along the west side of the currently permitted landfill. The access road over the filled areas E5 through E11 will be moved as operations progress and the road alignment adjusted accordingly. The access road will be paved with an all-weather surface such as crushed concrete, crushed asphalt or rock.

Surface water design of the west side drainage features was performed by GEI Consultants (GEI) for the preferred expansion; Geosyntec performed surface water design for flows originating from the landfill and for run on from areas adjacent to the east side of the landfill.

Figure 6 shows the alternative expansion plan. The main differences between the preferred expansion and alternative expansion are: (i) a new ash cell (AE-1) adjacent to existing ash cells 1 through 4; and (ii) a new access road that shifts the traffic from the western portion of the site to the eastern portion of the site. The alternative expansion plan would require a significant re-routing of current traffic flow patterns at the site and very specific timing for development of the ash cell. It would also potentially increase visual impacts and therefore, it a less preferred alternative at this time.

---

[1] Depending on the ratio of MSW to ash received at the landfill, an ash cell may need to be constructed later in the northern portion of the Expansion area. A change to the operating permit will be submitted for approval by the HDOH.

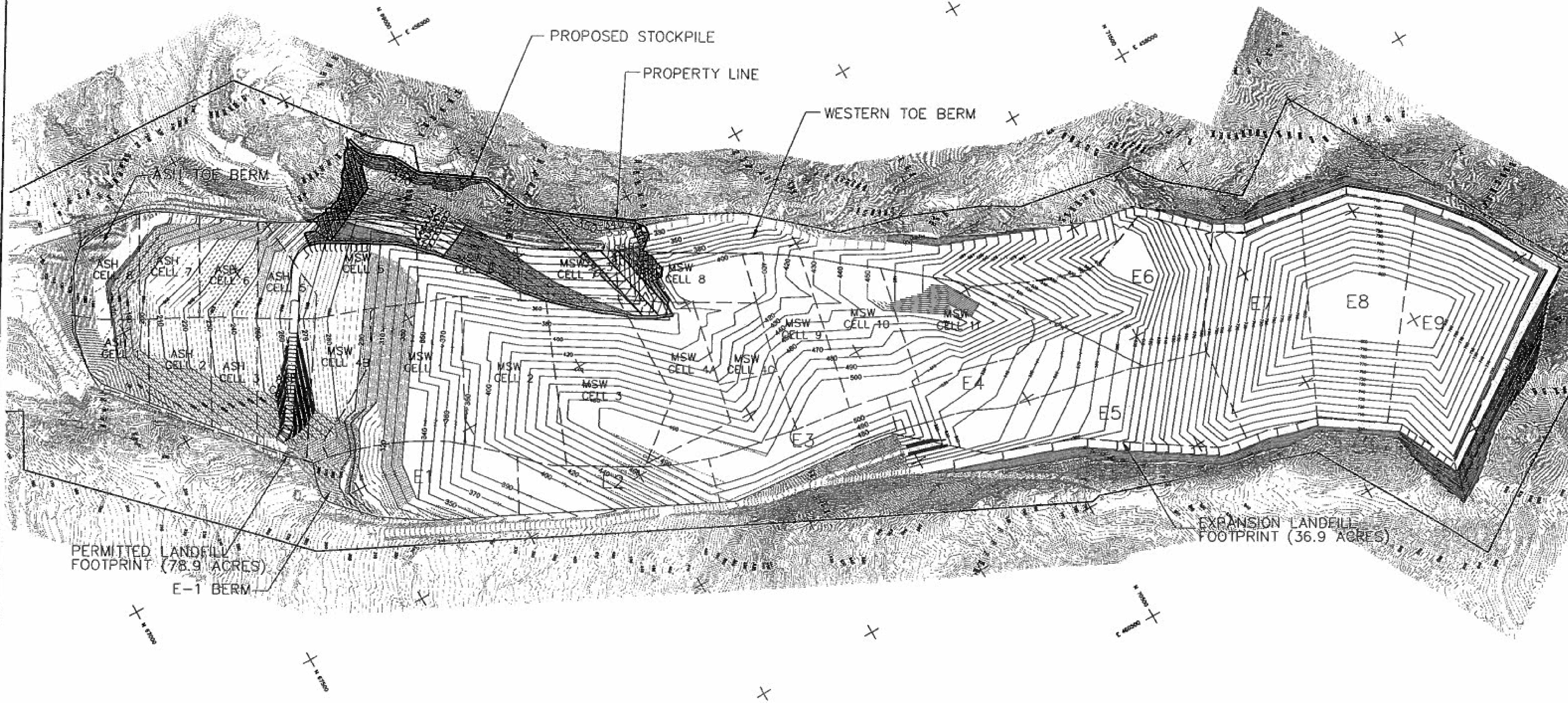
This Expansion Design Report presents information for the development of future cells at the landfill. The Report discusses the following:

- The landfill base lining and LCRS meets the regulatory requirements of RCRA Subtitle D (40 CFR Part 258);
- The design meets state of practice slope stability criteria at final build-out conditions and is based on industry-accepted MSW, ash, and base and side slope liner interface shear strength properties;
- The design meets the vertical separation requirements for the overhead power lines over the site.
- Details on the final cover system for expansion cells[2]; and
- Details on the overall surface water control design for the site.

[2] If approved by the HDOH, the final cover system may include compacted ash in its configuration.

7.4 Surface Water during Operations

During operations, surface water will be controlled by temporary pipes and ditches that will be moved as necessary to address stockpiles, active fill areas, the extent of each cell, and fill sequencing. Since the size of each cell may vary depending on the waste stream at the time, surface water details will be designed as part of preparing the construction drawing package for each cell.



NOTE: EXPANSION CELL LIMITS WILL BE ADJUSTED BASED ON ACTUAL WASTE STREAM.

200 100 0 200 400
SCALE IN FEET

	Geosyntec consultants	
STOCKPILE AND CELLS LOCATION PLAN	FIGURE NO.	6
WAIMANALO GULCH LANDFILL EWA BEACH, OAHU, HAWAII	PROJECT NO.	WL0770
	DATE:	NOVEMBER 2009

EXHIBIT A42

P:\CADD\Land Projects 3\WM\Waimanalo\dwg\Life of Site (EIS) Report\NEW FIGURES NOV 2009\LOS Report-Figure 5-6 Expansion Fill Plan.dwg 11-23-09 03:10:37 PM CWon

Professor Edward Kavazanjian, Jr., Ph.D., P.E., G.E. earned his Master's Degree at the Massachusetts Institute of Technology and Ph.D. from the University of California, Berkeley. Over his 34 year career, Dr. Kavazanjian was an Associate Professor of Civil Engineering at Stanford University, worked for 20 years as a practicing engineer extensively involved in the design, permitting, and closure of landfills, returned to academia in 2004, and is currently a Professor of Civil Engineering at the Ira A. Fulton School of Engineering at Arizona State University. Dr. Kavazanjian is nationally and internationally recognized for his work on evaluation and design of waste containment systems, in particular, for his expertise on seismic design of landfills, the properties of municipal solid waste, and post-closure development of landfills. He is a Registered Professional Civil Engineer in four states and has worked on the design, permitting, construction, and closure of landfills throughout California, Arizona, Washington, Virginia, New York, Tennessee, and South Carolina.

Dr. Kavazanjian co-authored the USEPA's MSW landfill seismic design guidance manual for Subtitle D compliance, and was principal investigator for the National Science Foundation-sponsored joint Geosyntec/University of California investigation of the performance of solid waste landfills during the 1994 Northridge Earthquake. He served as principal investigator for National Science Foundation-sponsored research projects on measurement of shear wave velocity at municipal solid waste landfills and the mechanical properties of municipal solid waste. Dr. Kavazanjian has extensively published on the topics of alternative landfill liner and cover design and performance, engineering properties of solid wastes, and seismic design and performance of landfill systems.

EXHIBIT A43

EDWARD KAVAZANJIAN, JR., Ph.D., P.E.
Associate Professor of Civil Engineering
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Arizona State University, Tempe, AZ 85287-5306
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Email: edkavy@asu.edu

EDUCATION

University of California, Berkeley: Ph.D., Geotechnical Engineering, 1978
Massachusetts Institute of Technology: SM, Geotechnical Engineering, 1975
Massachusetts Institute of Technology: SB, Civil Engineering, 1973

PROFESSIONAL REGISTRATION

Registered Civil Engineer, Arizona, No. 28043
Registered Professional Engineer, California, No. C031834
Registered Geotechnical Engineer, California, No. GE002103
Registered Professional Engineer, Washington, No. 34612

PROFESSIONAL HISTORY

Department of Civil Engineering, Arizona State University, Tempe, Arizona
Associate Professor, 2004 - present
Consulting Engineer, Huntington Beach, California
Independent Consultant, 2002 - 2004
GeoSyntec Consultants, Huntington Beach, California
Principal, 1995 – 2002; Associate, 1992-1995
MAA Engineering Consultants, Inc., Los Angeles, California
Executive Vice President, 1990-1992
The Earth Technology Corporation, Long Beach, California
Associate, 1988-1990
Parsons, Brinckerhoff Quade and Douglas, Inc., New York, New York.
Supervising Engineer, 1987-1988; Lead Engineer, 1985-1987
Department of Civil Engineering, Stanford University, Stanford, California
Assistant Professor, 1978-1985

EDWARD KAVAZANJIAN, JR., Ph.D., P.E.

REPRESENTATIVE EXPERIENCE

Dr. Kavazanjian is nationally and internationally recognized for his work on evaluation and design of waste containment systems. He has been responsible for containment system analysis and design for numerous municipal solid waste (MSW) and hazardous waste landfills. His design experience includes liquid and gas containment for lined and unlined waste units at active and closed sites. Dr. Kavazanjian is particularly well-recognized for his expertise on seismic design of landfills, the properties of municipal solid waste, and post-closure development of landfills. Dr. Kavazanjian is co-author of the USEPA MSW landfill seismic design guidance manual for Subtitle D compliance, was a co-principal investigator for Tasks 1-4, 6, and 7 of the California Integrated Waste Management Board Statewide Assessment of MSW Landfill performance, and was principal investigator for the National Science Foundation-sponsored joint GeoSyntec-University of California at Berkeley investigation of the performance of solid waste landfills in the Northridge earthquake of 17 January 1994. He also co-chaired a 1993 National Science Foundation workshop on seismic design of solid waste landfills and served as principal investigator for National Science Foundation-sponsored research projects on measurement of shear wave velocity at municipal solid waste landfills and the mechanical properties of municipal solid waste. Dr. Kavazanjian has authored invited state-of-the-art, state-of-the-practice, and keynote papers on *Field Measurement of MSW Properties* at the 17th Geosynthetics Research Institute Conference (Las Vegas, Nevada, December 2003), *Construction on Old Landfills* at the 2nd Australian/New Zealand Conference on Environmental Geotechnics (Newcastle, Australia, November 2001), *Seismic Design of Mixed and Hazardous Waste Landfills* at the Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics (San Diego, March 2001), *Design and Construction of Evapotranspirative Cover Systems for Arid Region Landfills* at the 36th Annual Western States Geotechnical Symposium (University of Nevada, Las Vegas, March 2001) and *Seismic Design of Solid Waste Landfills* at the 8th Canadian Conference of Earthquake Engineering in June 1999.

Over the past 12 years, Dr. Kavazanjian has been extensively involved in the design, permitting, and closure of landfills. He has been responsible for static and seismic analysis of numerous municipal solid waste landfills for compliance with state and federal regulations, including landfills in California, Arizona, Washington, Virginia, New York, Tennessee, and South Carolina. His landfill closure experience includes landfills with geosynthetic, low permeability soil, and evapotranspirative soil covers. His experience at southern California MSW landfills includes closure design, permitting, and construction at the Lopez Canyon, Bishops Canyon, and Gaffey Street Landfills for the City of Los Angeles, at the Bradley, Simi Valley, and Azusa Landfills for Waste Management, at the Sunshine Canyon Landfill for Browning Ferris Industries, at the Bena and Lebec Landfills for Kern County, at the Puente Hills and Spadra Landfills for the County Sanitation Districts of Los Angeles County, and at the Newberry, Lucerne, and Yucaipa Landfills for San Bernardino County. His southern California hazardous waste landfill experience includes closure activities for the Operating Industries, Inc. (OII) Landfill in Monterey Park in Los Angeles County (pre-design analysis, final design, and construction quality assurance), the McColl Superfund Site in Fullerton in Orange County (permitting, design, construction, community relations, regulatory interface), the Casmalia site in Santa Maria (seismic hazard and final cover stability assessment), the Thomas Ranch Site in Corona, Riverside County (design, regulatory interface), the ASCON site in Huntington Beach in Orange County (design), the El Toro Marine Base Landfills in Orange County (third party review for the County of Orange), and the Lokern Hazardous Waste Facility in Buttonwillow in Kern County (permitting, design, and construction quality assurance).

Dr. Kavazanjian served as project manager for over $8 million of engineering support services at the City of Los Angeles Lopez Canyon Landfill from 1993 to 1998, including permitting, design, construction management, and quality assurance services for closure of Disposal Areas A and B, including permitting, construction, and monitoring of an evapotranspirative soil cover for the unlined areas, community relations, landfill gas migration control, noise and groundwater monitoring, and support for preparation of California Environmental Quality Act (CEQA) documents. For the Gaffey Street Landfill, Dr. Kavazanjian directed geotechnical stability analysis and infiltration analysis for design of an evapotranspirative cover and "smart" irrigation system that enabled construction of a soccer field on top of the closed landfill. At the Sunshine Canyon Landfill, Dr. Kavazanjian has been involved in design of an evapotranspirative cover for the City Landfill, and preparation of the Closure and Post-Closure Plans for the County Landfill. Dr. Kavazanjian was project manager for the final cover alternatives study, include geosynthetic, low permeability soil, and evapotranspirative soil coves, and project director for preparation of the closure plan and closure design drawings and for quality assurance service during construction for Kern County's Lebec Landfill. Dr. Kavazanjian directed preparation of closure plans, design, and performance evaluations of alternative final covers for the Sunshine Canyon, Simi Valley, Bradley, and Azusa Landfills in southern California.

Dr. Kavazanjian was project manager for preliminary design, including the geotechnical investigation, conceptual design of the containment system, and chemical compatibility testing, and provided senior technical oversight for closure design and construction at McColl Superfund site in Fullerton, California. Dr. Kavazanjian was project manager for pre-design seismic studies under Consent Decree Number 3 (CD-3) for the OII Landfill Superfund site in Monterey Park, California. The pre-design studies at OII included a geophysical investigation, large diameter bucket auger borings, design and construction of an on-site laboratory for static and dynamic soil testing, large test trench, in-situ density evaluation, seismic hazard assessment, and static and dynamic finite element analyses of the waste mass. Dr. Kavazanjian directed seismic analysis for the five landfills at the Casmalia site near Santa Maria, California, including field measurement of shear wave velocity, seismic response analyses, and seismic deformation analyses. Dr. Kavazanjian was engineer in responsible charge for stabilization of the final cover for a Cement Kiln Dust pile, restoration of the borrow area, and the Department of Transportation Deck Extension in Metalline Falls, Washington. Dr. Kavazanjian's Superfund experience includes static and seismic stability analysis of fine, compressible tailings and design of bank stabilization measures for closure of the Big River Mine Tailings site in Desloge, Missouri, and design review of the geosynthetic cover system for closure of the Hardage site in Criner, Oklahoma. Dr. Kavazanjian's hazardous waste landfill experience also includes geotechnical analyses for a proposed low-level radioactive waste disposal facility in Martinsville, Illinois, and he was responsible for seismic analyses for the mixed waste on-site landfill at the Fernald site in Ohio. He also consulted on disposition of spent nuclear fuel sludge at the Hanford site in Eastern Washington.

EDWARD KAVAZANJIAN, JR., Ph.D., P.E.

PROFESSIONAL AFFILIATIONS

- American Society of Civil Engineers (ASCE)
- International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE)
- Solid Waste Association of North America (SWANA)
- Unites States Society on Dams (USSD)
- Earthquake Engineering Research Institute (EERI)

SELECTED PUBLICATIONS

Merry, S.M., Kavazanjian, E., Jr., and Fritz, W. (2004) "Reconnaissance of the July 10, 2000 Payatas Landfill Failure," *Journal of Constructed Facilities,* ASCE (accepted for publication)

Kavazanjian, E. Jr. (2003) "Field Measurement of MSW Properties," Proceedings, *17th GSI/GRI Conference: Hot Topics in Geosynthetics, IV,* Geosynthetics Research Institute, Philadelphia, Pennsylvania, December 2003

Hadj-Hamou, T. and Kavazanjian, E., Jr. (2003) "Monitoring and Evaluation of Evapotranspirative Cover Performance," Proc. Sardinia '03 - 9th International Waste Management and Landfill Symposium, Cagliari, Italy, October (on CD ROM)

Kavazanjian, E., Jr. and Dobrowolski, J.G. (2003) "Cost and Performance Evaluation of Alternative Final Covers," Proc. Sardinia '03 - 9th International Waste Management and Landfill Symposium, Cagliari, Italy, October (on CD ROM)

Dobrowolski, J.G. and Kavazanjian, E., Jr. (2003) "Performance Demonstration for Alternative Liner Systems at Municipal Solid Waste Landfills," Proc. Sardinia '03 - 9th International Waste Management and Landfill Symposium, Cagliari, Italy, October (on CD ROM)

Bouazza, A., Kavazanjian, E., Jr., Avsar, S., and Kodikara, J. (2003) "Application of Geostatistical Model to Map Spatial Distribution of Shear Wave Velocities of Solid

Wastes ," Proc. Sardinia '03 - 9th International Waste Management and Landfill Symposium, Cagliari, Italy, October (on CD ROM)

Kavazanjian, E. Jr. and Corcoran, G.T. (2002) "Combined Leachate Collection / Operations Layer for Landfill Sideslopes," Proceeding, *Wastecon 2002,* Solid Waste Association of North America, Long Beach, California, October (In Press)

Walters, D., Goldfield, T., Luccioni, L., Hadj-Hamou, T., and Kavazanjian, E. Jr. (2002) "Design, Performance, Monitoring, and Evaluation of an Evapotranspirative Cover at a Municipal Solid Waste Landfill", Proceedings, 7[th] *Annual Landfill Symposium*, Solid Waste Association of North America, Lexington, Kentucky, June

Arteaga, K.E. and Kavazanjian, E. Jr. (2002) "Household Hazardous Waste Content in MSW", Proceedings, 7[th] *Annual Landfill Symposium*, Solid Waste Association of North America, Lexington, Kentucky, June

Bouazza, M., and Kavazanjian, E. Jr. (2001) "Construction on Old Landfills," Proc. *Australian ' New Zealand Conference on Environmental Geotechnics (in print)*

Zornberg, J.G., and Kavazanjian, E., Kr. (2001). "Prediction of the Performance of a Geogrid-Reinforced Slope Founded on Solid Waste." *Soils and Foundations*, Vol. 41, No. 6, December

Menq, F-Y, Stokoe, K.H., II, and Kavazanjian, E., Jr. (2001) "Dynamic Properties of Municipal Waste from Large-Scale Resonant Testing," Proc. *Sardinia '99 - 8th International Waste Management and Landfill Symposium*, Cagliari, Italy, Vol. 111, PP. 435-444

Kavazanjian, E., Jr. (2001) "Mechanical Properties of Municipal Solid Waste," Proc. *Sardinia '01 - 8th International Waste Management and Landfill Symposium*, Cagliari, Italy, October, Vol. 111, pp. 415-424.

EDWARD KAVAZANJIAN, JR., Ph.D., P.E.

Kavazanjian, E. Jr., Hendron, D. and Corocran, G.T. (2001) "Strength and Stability of Bioreactor Landfills," Proceedings, *6th Annual Landfill Symposium*, Solid Waste Association of North America, 18-20 June, San Diego, pp. 63-72

Kavazanjian, E. Jr., and Matasovic, N. (2001) "Seismic Design of Mixed and Hazardous Waste Landfills," State of the Art Paper No. 11, Proceedings, *Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering*, University of Missouri, Rolla, 27-31 March, San Diego, California, on CD ROM

Kavazanjian, E., Jr. (2001), "Design and Performance of Evapotranspirative Cover Systems For Arid Region Landfills," Proceedings, *36th Annual Engineering Geology and Geotechnical Engineering Symposium*, 28-30 March 2001, University of Nevada, Las Vegas, Nevada, pp. 11-26

Evans, T.M., Meyers, D.K., Gharios, K.M., Hadj-Hamou, T., and Kavazanjian, E., Jr. (2000) "The Use of a Capillary Barrier Final Cover for Reclamation of a Closed Municipal Solid Waste Landfill," Proc. *3rd Arid Climate Symposium*, Albuquerque, New Mexico, 12-14 April.

Hendricker, A.T., Fredianelli, K.H., Kavazanjian, E., Jr., and McKelvey, J.A., III (1998), "Reinforcement Requirements at a Hazardous Waste Site," Proc. *Sixth International Conference on Geosynthetics*, Atlanta, Georgia, Vol. I, pp. 465-468.

Kavazanjian, E., Jr. (1998), "Current Issues in Design of Geosynthetic Cover Systems," Proc. *Sixth International Conference on Geosynthetics*, Atlanta, Georgia, Vol. I, pp. 219-226.

Kavazanjian, E., Jr., and Tanaka, M. (1997), "Geotechnics of Waste Landfill," General report, Proc. *2nd International Congress Environmental Geotechnics*, Osaka, Japan, Balkema, Vol. 3, pp. 1565-1569

Matasovic, N., Kavazanjian, E., J., Augello, A.J., Bray, J.D. and Seed, R.B. (1995), "Solid Waste Landfill Damage Caused by 17 January 1994 Northridge Earthquake," In:

Woods, Mary C. and Seiple, Ray W., Eds., *The Northridge, California, Earthquake of 17 January 1994: California Department of Conservation, Division of Mines and Geology Special Publication 116*, Sacramento, California, pp. 221-229.

Richardson, G.N., Kavazanjian, E., Jr. and Matasovic, N. (1995), "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities," EPA/600/R-95/051, United States Environmental Protection Agency, Cincinnati, Ohio, 143 p.

Kavazanjian, E., Jr., Matasovic, N. Bonaparte, R. and Schmertmann, G.R. (1995), "Evaluation of MSW Properties for Seismic Analysis," In: *Geoenvironment 2000,* ASCE Geotechnical Special Publication No. 46, Vol. 2, pp. 1126-1141.

Kavazanjian, E., Jr. and Matasovic, N. (1995), "Seismic Analysis of Solid Waste Landfills," In: *Geoenvironment 2000,* ASCE Geotechnical Special Publication No. 46, Vol. 2, pp. 1066-1080.

Snow, M.S., Bonaparte, R., and Kavazanjian, E. Jr. (1994), "Geosynthetic Composite Liner System for Subtitle D," Proc. *Waste Tech '94 Landfill Technology Conference*, National Solid Waste Management Association, Charleston, South Carolina.

Derian, L., Gharios, K.M., Kavazanjian, E., Jr., and Snow, M.S. (1993), "Geosynthetics Conquer the Landfill Law," *Civil Engineering*, ASCE, Vol. 63, No. 12.

Kavazanjian, E., Jr. (1993), "SASW Testing at Solid Waste Landfill Facilities," Proc. *National Science Foundation Workshop on Seismic Design of Solid Waste Landfills*, University of Southern California.

Professor Jonathan Bray, Ph.D., P.E. is a national leader in the field of seismic design and evaluation of solid waste landfills and has lectured throughout the country for the National Science Foundation, American Society of Civil Engineers, Earthquake Engineering Research Center, and Association of Engineering Geologists. Dr. Bray has published over 225 research papers. His publications related to estimating earthquake-induced slope displacements and seismic design of solid waste landfills are used in practice throughout the solid waste industry.

Dr. Bray earned his Master's Degree from Stanford University and Ph.D. from the University of California, Berkeley in Geotechnical Engineering. Dr. Bray is a Registered Professional Civil Engineer in California and Virginia, is a Fellow of the American Society of Civil Engineer, and was the recipient of the Shamsher Prakash Research Award, the Walter L. Huber Civil Research Prize in Civil Engineering, and the David and Lucile Packard Foundation Fellowship for Science and Engineering. Dr. Bray has been consulting and teaching geotechnical engineering for 22 years and is currently a Professor of Geotechnical Engineering at the University of California, Berkeley. Dr. Bray is the Editor-In-Chief of the International Journal of GeoEngineering Case Histories and is on the Editorial Boards of both the ASCE Journal of Geotechnical Engineering and the Geosynthetics International Journal.

Over the last 20 years, Dr. Bray has been directly involved in the seismic design of solid waste landfills throughout the West, and particularly California where high seismicity can create significant design challenges.

JONATHAN DONALD BRAY
Professor of Civil and Environmental Engineering
University of California at Berkeley

EDUCATION

UNIVERSITY OF CALIFORNIA, Berkeley, CA; Ph.D. in Geotechnical Engineering, 1990

STANFORD UNIVERSITY, Palo Alto, CA; M.S. in Structural Engineering, 1981

UNITED STATES MILITARY ACADEMY, West Point, NY; B.S., 1980

AWARDS AND HONORS

Shamsher Prakash Research Award, Shamsher Prakash Foundation, 1999
Walter L. Huber Civil Engineering Research Prize, American Society of Civil Engineers, 1997
David and Lucile Packard Foundation Fellowship for Science and Engineering, 1992-1997
Presidential Young Investigator Award, National Science Foundation, 1991-1996
American Society of Civil Engineers Technical Council on Forensic Engineering Outstanding Paper Award, 1995
North American Geosynthetics Society - State of the Practice Award of Excellence, 1995
North American Geosynthetics Society - Geotechnical Engineering Technology Award of Excellence, 1993
American Society of Civil Engineers Trent R. Dames and William W. Moore Award, 1992
National Science Foundation Fellowship in Engineering, 1980-81, 1986-88
Commandant's Award (Highest rating in U.S. Army Engineer Officer Advanced Course), 1985
Italian Veterans of Foreign Wars Award (Outstanding United States Military Academy graduate), 1980
The Robert E. Lee Memorial Award (Highest rating in Mathematics), 1980
West Point Fund Award (Highest rating in Advanced Engineering Fundamentals), 1980
National Society of the Veterans of Foreign Wars of the United States Award (Highest rating in Physics), 1980
General Terry de la Mesa Allen Award (Highest rating in Military Science), 1980
The Association of Graduates Award (Cadet with the 3rd highest overall class standing), 1980
Distinguished Cadet (Honor roll of cadets with academic standing within top 5%), 1976-1980
The Ancient and Honorable Artillery Company of Massachusetts Award (Outstanding Company Commander), 1979
Phi Kappa Phi Honor Society, 1978

PROFESSIONAL QUALIFICATIONS AND EMPLOYMENT RECORD

Registered Professional Civil Engineer in California , No. C 45519, since 1990
Registered Professional Engineer in Virginia , No. 015644, since 1985

PROFESSOR, University of California, Berkeley, CA (JUL 99 - Present)
ASSOCIATE PROFESSOR, University of California, Berkeley, CA (JUL 96 – JUN 99)
ASSISTANT PROFESSOR, University of California, Berkeley, CA (JAN 93 - JUN 96)
ASSISTANT PROFESSOR, Purdue University, West Lafayette, IN (AUG 90 - JAN 93)
CORPS OF ENGINEERS OFFICER, Captain to Major, USAR, 416th Engineer Command (FEB 87 - SEP 91)
PROJECT ENGINEER, Dames & Moore, CA (FEB 90 - JUL 90)
Seismic design study for wharves damaged at Oakland Army Base during the 1989 Loma Prieta Earthquake.
SENIOR PROJECT ENGINEER, Baltimore Dist., Corps of Engineers, VA (APR 85 - AUG 86)
Managed a field office staff of 5 engineers/inspectors. Responsible for 5 construction contracts valued at over $28M.
COMPANY COMMANDER, Lieutenant to Captain, Construction Engineer Company, South Korea (JUL 83 - AUG 84)
Commanded a 218 person/106 equipment engineer company composed of Americans and Koreans. Designed and managed 8 construction projects valued at over $1 million. Attained highest company rating in yearly field evaluation.
PLATOON LEADER, Lieutenant, Construction Engineer Company, South Korea (FEB 82 - JUN 83)
Leader of 4 of the company's 5 platoons. Project Engineer for 6 construction projects valued at over $1 million.

CONSULTING EXPERIENCE (selected)

BART Peer Review Panel: Serving as a member of the panel that reviews seismic aspects of the BART Earthquake Safety Program retrofit design strategies, including those for the Transbay Tube system, 2005.
RMC Pacific Materials, Inc.: Providing guidance regarding the static and seismic stability of a deep quarry excavation near a housing development, Livermore, Calif., 2004-2005.
Alternative Resolution Centers: Served as neutral geotechnical engineer in an arbitration case concerning potential damage to a home from static or seismic settlement, Studio City, Calif., 2004.
Earth Consultants International: Evaluated the geotechnical earthquake hazards at a large area to be developed in Southern California and provided expert witness services for primary client, 2003.
IT Corp.: Developed earthquake ground motions for seismic analyses of a solid-waste landfill in Burbank, Calif., 2002.
IT Corp: Evaluated the seismic performance of a solid-waste landfill situated atop soft clay in Richmond, Calif., 2002.
Fugro: Reviewed and provided guidance regarding the liquefaction and ground shaking hazards evaluation for the Western Expansion of the Children's Hospital, Oakland, 2002.
EMCON: Developed earthquake ground motions for seismic analyses of a solid-waste landfill near Holliser, CA, 2001.
Morgenstein & Jubelirer, LLP.: Evaluated the potential seismic performance of a soft clay site in Foster City, CA, 2000.
Zemin Technology Company: Provided guidance and recommendation for the Izmit Bay Crossing Project, Izmit Bay, Turkey, 2000.
Treadwell & Rollo: Reviewed seismic considerations regarding a proposed development atop a solid-waste landfill located in San Jose, California, 1999.
Morgenstein & Jubelirer, LLP.: Provided advice regarding a facility constructed atop a solid-waste landfill, 1998.
Mr. J. R. C. Mello: Participated in the seismicity evaluation, soil liquefaction, and seismic slope stability studies for the proposed Tech Ion Bunker Site in Manaus, Brazil, 1998.
Pacific Materials Laboratory, Inc.: Performed finite element study to evaluate and to mitigate the surficial effects due to minor bedrock fault displacements at the Moorpark site in Southern California, 1997.
EBA Wastechnologies: Assessed static and seismic stability procedures used for Toland Road Landfill, 1997.
Superior Court of the State of California, County of Orange: Appointed as the neutral geotechnical expert to assist the Court in evaluating slope-related issues in the Canyon Estates v. Mission Viejo mediation proceeding, 1997.
Bacalski, Byrne & Koska: Evaluated the seismic performance of structural fills constructed in a housing development that was strongly shaken by the 1994 Northridge earthquake, 1996.
Golder Associates: Developed seismic coefficient used in heap leach pad stability analyses at Cripple Creek, CO, 1994.
Indianapolis Water Company: Evaluated the seismic stability of the High Banks canal, 1992.
Boult, Cummings, Conners & Berry: Investigated the failure of a reinforced soil retaining wall in Glasgow, KT, 1992.
Leighton and Associates, Inc.: Performed finite element study to develop fill placement procedures to mitigate the surficial effects due to minor bedrock fault displacements at the Spanish Hills site in Southern California, 1992.
Staal, Gardner & Dunne, Inc.: Investigated the long-term stability of a closed sanitary landfill which is experiencing excessive lateral deformations, 1992.
Leighton and Associates, Inc.: Performed finite element study of a 100-ft high reinforced soil fill slope subjected to excessive foundation deformation, 1991.

INVITED LECTURE PRESENTATIONS (selected)

"Performance of Solid-Waste Landfills," "Earthquake Ground Motions Characteristics and Selection," and "Dynamic Analyses of Waste Fills," Static and Seismic Stability of Solid-Waste Landfills, ASCE short course, GeoFrontiers, Austin, Jan. 25, 2005.
"Advancements in Seismic Slope Stability Evaluation Procedures," and "Earthquake Surface Fault Ruptura," Pontificia Universidad Catolica Del Ecuador, Quito, Ecuador, July 16, 2004.
"Lessons Learned from Recent Earthquakes in Turkey and Taiwan," "Evaluation and Modeling of Dynamic Soil Properties," "Seismic Site Response," and "Seismic Slope Stability and Deformation Analyses," Seismic Hazards Mapping Act Practicing Engineers' Short Course, California Division of Mines and Geology, Berkeley, CA, August 8-10, 2002.
"Seismic Slope Stability Evaluation Procedures," Recent Advances in Geotechnical Earthquake Engineering, ASCE Seattle Section Geotechnical Spring Seminar, Seattle, WA, April 20, 2002.
"Lessons Learned from Recent Earthquakes in Turkey and Taiwan," "Evaluation and Modeling of Dynamic Soil Properties," "Seismic Site Response," and "Seismic Slope Stability and Deformation Analyses," Seismic Hazards Mapping Act Practicing Engineers' Short Course, California Division of Mines and Geology, Berkeley, CA, August 17-19, 2000.
"Seismic Performance of Solid-Waste Landfills," American Society of Civil Engineers, Atlanta Geotechnical Engineering Section, Atlanta, GA, March 16, 1999.
"Seismic Design of Solid-Waste Landfills," several hours of lecture in American Society of Civil Engineers – sponsored short course, part of *Geotechnical Earthquake Engineering and Soil Dynamics III, ASCE,* ,Seattle, WA, August 7, 1998.

"Evaluation and Modeling of Dynamic Soil Properties," "Seismic Site Response," and "Seismic Slope Stability and Deformation Analyses," Seismic Hazards Mapping Act Practicing Engineers' Short Course, California Division of Mines and Geology, Los Angeles, CA, July 30 – August 1, 1998.

"Landfill Seismic Response Issues," and "Back-Analysis of Landfill Performance," California Sanitary Landfill Static and Dynamic Slope Stability Conference, ASCE/AEG/Calif. IWMB, Whittier, CA, March 27-28, 1997.

"Seismic Stability Considerations for Solid Waste Fills," Geotechnical Group, San Francisco Section, ASCE, April 16, 1996.

"Observations of the Seismic Performance of Waste Fills," and "Dynamic Analyses of Waste Fills," Advances in Earthquake Engineering Practice, EERC, Berkeley, June 4, 1994.

"Seismic Analysis of Solid Waste Landfills", NSF Workshop on Research Priorities for Seismic Design of Solid Waste Landfills, Los Angeles, CA, August 29, 1993.

RESEARCH GRANTS (selected)

"Collaborative Proposal: Static and Dynamic Properties of Municipal Solid Waste," National Science Foundation, 9/02-08/05, $198,611, Principal Investigator.

"Ground Failure of Adapazari's Fine Grain Soils and Its Interaction with Building Response," National Science Foundation, 10/01-03/04, $238,037, Principal Investigator.

"Reconnaissance of the Geotechnical Aspects of the February 28, 2001, Nisqually Earthquake," National Science Foundation, 09//01-08/02, $20,000, Principal Investigator.

"Seismic Performance of Ground and Buildings in Adapazari, Turkey," National Science Foundation, 9/00-8/01, $75,000, Principal Investigator.

"Liquefaction and Ground Failure Deformation Data in Turkey," Pacific Earthquake Engineering Research Center, 6/00-5/01, $150,000; Principal Investigator.

"Identification and Prediction of Ground Motion Parameters Relating to Damage," Pacific Earthquake Engineering Research Center, 05/00-03/03, $125,000; Principal Investigator.

"Evaluation of Seismic Slope Stability Procedures Through Shaking Table Testing," U.S. Geological Survey, National Earthquake Hazards Reduction Program, 9/1/00-8/31/03, $140,000; Principal Investigator.

"Near-Source Site Effects," Pacific Earthquake Engineering Research Center, 4/98-4/00, $90,000; PI.

"Coordinated Geotechnical and Earthquake Engineering Program at UC Berkeley", California Department of Transportation, 7/95-6/98, $1,490,655; Co-PI.

"The Response of Earth Structures to Ground Movements and the Seismic Response of Deep Soil Deposits," The David and Lucile Packard Foundation Fellowship for Science and Engineering, 10/92-9/97; $500,000; PI.

"Modelling and Analysis of the Response of Earth Structures to Ground Movements", National Science Foundation - 1991 Presidential Young Investigator Award, 9/91-8/97; $312,500; PI.

"Influence of Soil Conditions on 1994 Northridge Earthquake Recorded Ground Motions", U.S. Geological Survey, National Earthquake Hazards Reduction Program, 1/95-5/96, $44,000; PI.

"Seismic Performance of Solid Waste Landfills" National Earthquake Hazards Reduction Program, National Science Foundation, 9/94-12/95, $53,055; PI.

PUBLICATIONS (Prof. Bray has authored more than 150 research publications; selected works are listed below)

BOOKS

J. D. Bray, "Retaining Structures" and "Geotechnical Earthquake Engineering" Chapters 21 and 24, respectively, in The Civil Engineering Handbook, W. F. Chen, Editor-in-Chief, CRC Press, Inc., Boca Raton, Florida, pp. 803-816 and pp. 868-882, 1995.

JOURNALS

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J. D. Bray, R. B. Seed, L. S. Cluff and H. B. Seed, "Earthquake Fault Rupture Propagation through Soil", Journal of Geotechnical Engineering, American Society of Civil Engineers, Vol. 120, No. 3, pp. 543-561, March, 1994.

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Travasarou, T., Bray, J.D., and Der Kiureghian, A.D. "A Probabilistic Methodology for Assessing Seismic Slope Displacements," 13th World Conference on Earthquake Engineering, Vancouver, Canada, Paper No. 2326, Aug 1-6, 2004.

Rudolph Bonaparte, Ph.D., P.E. is the President and Chairman of the Board of Geosyntec Consultants, Inc. Dr. Bonaparte earned his Master's Degree and Ph.D. from the University of California, Berkeley. For more than 30 years of professional practice, he has focused in the areas of: geotechnical and geoenvironmental engineering; contaminated soil, sediment, and groundwater remediation; and solid, hazardous, and low-level radioactive waste disposal facility permitting and design. Dr. Bonaparte has authored more than 50 technical papers, several book chapters, and six major reports published by the USEPA, Federal Highway Administration, and U.S. Navy, including the USEPA's *"Technical Guidance for RCRA/CERCLA Final Covers."* He has served on the editorial boards of the ASCE *Journal of Geotechnical and Geoenvironmental Engineering*, the journal *Geosynthetics International*, and the *International Journal of Geoengineering Case Histories*. Dr. Bonaparte has been elected to the U.S. National Academy of Engineering and the CAEE Academy of Distinguished Alumni at the University of Texas, Austin. He was named the Engineer of the Year by the Georgia Alliance of Professional Engineering Societies, was appointed to the Board of Governors of the ASCE Geo-Institute, was co-recipient of the 2000 J. James Croes Medal from ASCE and the 1994 IGS award from the International Geosynthetics Society.

Dr. Bonaparte is experienced in the siting, design, permitting, construction, and closure of municipal, industrial, and hazardous waste landfills and liquid impoundments. He has directed, managed, or performed projects at over 100 solid-waste facilities throughout the US and is a Registered Professional Civil Engineer in 18 states.

EXHIBIT A45

Geosyntec consultants

RUDOLPH BONAPARTE

geoenvironmental engineering
waste disposal facility design/permitting
brownfields remediation/engineering
remedial investigation/design
geotechnical engineering

EDUCATION

Ph.D., Geotechnical Engineering, University of California, Berkeley, 1981
M.S., Geotechnical Engineering, University of California, Berkeley, 1978
B.S., Civil Engineering, University of Texas, Austin

PROFESSIONAL REGISTRATION

P.E., Alabama, Number 17793
P.E., Arkansas, Number 9175
P.E., California, Number 047076
P.E., Colorado, Number 27485
P.E., Florida, Number 0052202
P.E., Georgia, Number 17516
P.E., Illinois, Number 054352
P.E., Kansas, Number 17542
P.E., Maryland, Number 18232
P.E., Michigan, Number 47814
P.E., Missouri, Number 298461
P.E., New Jersey, Number GE44827
P.E., New York, Number 067675
P.E., North Carolina, Number 030150
P.E., Ohio, Number 56679
P.E., Pennsylvania, Number 38870
P.E., Texas, Number 64329
P.E., Virginia, Number 020498

PROFESSIONAL HISTORY

Geosyntec Consultants, Atlanta, Georgia, President & CEO, 1996-date; Principal, 1988-date; Senior Engineer, 1986-1987
Tensar Corporation, Morrow, Georgia, Applications Technology Manager, 1984-1986
Woodward-Clyde Consultants, San Francisco, California, Assistant Project Engineer, 1982-1983
University of California, Berkeley, California, National Science Foundation Research Fellow, 1977-1980

REPRESENTATIVE EXPERIENCE

Geoenvironmental Engineering/Waste Disposal Facility Design and Permitting

Dr. Bonaparte was the project manager and design engineer-of-record for a low-level radioactive waste (LLRW) disposal facility being constructed as part of a CERCLA remedial action at the Department of Energy (DOE) Fernald Environmental Management Project (FEMP) in Fernald, Ohio. This project includes Title II and III design of a 2.5 million cubic yard facility for the long-term disposal of a variety of impacted materials from the demolition and restoration of the Fernald Feed Materials Plant. The scope of work has included preparation of design criteria packages (DCPs), plans, specifications, and calculations, soil-liner test pad program, leachate-geomembrane liner compatibility study, soil-geomembrane-GCL interface shear testing program, vegetative cover study, and preparation of support plans including CQA plan, waste placement plan, stormwater management and erosion control plan, O&M plan, and air monitoring plan.

Dr. Bonaparte is also experienced in the siting, design, permitting, construction, and closure of municipal, industrial, and hazardous waste landfills and liquid impoundments. He has directed, managed, or performed solid-waste projects for a variety of public-sector clients, including Anne Arundel County (Maryland), Town of Babylon (New York), Chester County Solid Waste Authority (Pennsylvania), Delaware Solid Waste Authority (Delaware), City of High Point (North Carolina), and the U.S. Army Rocky Mountain Arsenal (Denver). He has also managed or directed design projects for many private-sector clients, including AlliedSignal, Inc., American Electric Power Service Corporation, Browning-Ferris Industries, Ciba-Geigy Corporation, Highway 36 Land Development Company, Mine Reclamation Corporation, and Waste Management of North America, Inc. Other waste disposal facility clients for which he has worked include Forsyth County (Georgia), Gloucester County (New Jersey), King County (Washington), County Sanitation Districts of Los Angeles County (California), Riverside County (California), Arco Chemical Company, City Management Corporation, Dow Chemical Company, Laidlaw, Rollins Environmental Services, Inc., and USA Waste Services, Inc.

Dr. Bonaparte has worked extensively in a contract research capacity for the U.S. Environmental Protection Agency (EPA) in the evaluation of liner and final cover systems for municipal, industrial, and hazardous waste disposal facilities. He has been a primary author of four research reports published by the agency, most recently for a major multi-year research study to investigate the field performance of double-liner systems and final cover systems designed to current regulatory standards. He was also a contributing author to a state-of-the-art review for the U.S. Navy on the application of subsurface barrier technology for contaminant source control at unlined Navy landfills. He has been an invited lecturer on landfill-related design topics at seminars and short courses offered by EPA, New York State Department of Environmental Conservation, Pennsylvania Department of Environmental Protection, and California Integrated Waste Management Board. He is the lead author of the pending EPA document "*Technical Guidance for RCRA/CERCLA Final Covers*."

Remedial Investigation/Design

Dr. Bonaparte has been extensively involved in projects involving remedial investigations and remedial designs for soil and groundwater contamination. His project experience includes:

- Consultant to Port of Houston Authority (PHA) for the design of soil, sediment, and groundwater remediation measures for property along Green's Bayou, Houston Ship Channel, Texas; contaminants of concern included DDT, DDE, BHC isomers, chlorobenzene, and arsenic; served on core technical team that assisted client in negotiating financial settlement with responsible parties;

- Core member of multi-disciplinary client team to develop in-situ and ex-situ treatment technologies for sites containing chromite ore processing residue (COPR) in New Jersey and Maryland; COPR material contains high hexavalent chromium concentrations (>3,000 mg/kg), high alkalinity (pH>12), and it is highly expansive; treatment technologies considered include chemical reduction, stabilization/solidification, and vitrification;

- Principal-in-charge and engineer-of-record for preparation of a focused feasibility study (FFS), ROD amendment, Explanations of Significant Differences and remedial design for the Bailey Dump NPL site, Orange, Texas;

- Member of external technical review team (focus on in-situ containment and sludge solidification) for the Chevron Port Arthur Refinery remediation project, Port Arthur, Texas;

- Consultant to PRP technical committee for negotiation of the Proposed Plan and ROD for the MIG/DeWane Landfill NPL site, Belvidere, Illinois;

- Technical director for work plan and remediation design development, Yeoman Creek Landfill NPL site, Waukegan, Illinois;

- Technical director for remediation design development, sulfate basin closures, Avtex Fibers NPL site, Front Royal, Virginia;

- Principal-in-charge for analysis, conceptual design, and regulatory negotiation for the final cover system for the Operating Industries Inc. (OII) Landfill NPL site in Monterey Park, California;

- Principal-in-charge for work plan development, preliminary design, and design/build contractor procurement and oversight, Wingate Road NPL Site, Fort Lauderdale, Florida;

- Principal-in-charge of site characterization and corrective measures, Eagle No. 2 coal mine site, Shauneetown, Illinois;

- Project manager for investigation of groundwater impacts due to treated spent potliner disposal in bauxite mine pit backfill, Bryant, Arkansas;

- Project engineer for design of removal actions for the LCP Chemicals Superfund site in Brunswick, Georgia;

- Technical team member for geotechnical investigation, landslide stabilization design, and remedial design for the Vandale Junkyard NPL site, Marietta, Ohio;

- Principal-in-charge of soil and groundwater remedial investigations for CERCLA landfills near Baltimore, Maryland and Mt. Holly, New Jersey;

- Project manager for preparation and implementation of a remedial action plan (RAP) for acid-impacted groundwater at a former metal finishing site in Dade County, Florida;

- Principal-in-charge and engineer-of-record for design and preparation of construction bid documents for remediation (final cover, subsurface leachate interceptor, and waste slope toe buttress) for a closed municipal/ industrial landfill in Cuyahoga County, Ohio;

- Project engineer for investigation of organic solvent contamination of groundwater at three semiconductor manufacturing plants in northern California;

- Project engineer for asbestos and asbestos-contaminated soil remediation of a former industrial site in Redwood City, California; and

- Project engineer for remedial investigation of an abandoned leather tannery in south San Francisco, California.

Geotechnical Engineering

Dr. Bonaparte has substantial experience in site investigations for building foundations, embankments, and waste containment facilities. He has extensive experience in laboratory testing of soils and in the use of subsurface exploration techniques such as cone penetrometer testing, pressuremeter testing, rock coring, and borehole geophysics.

Dr. Bonaparte has a nationally-recognized expertise in the design of earth-retaining structures, particularly reinforced-earth structures. His design experience includes several reinforced-soil retaining walls and slopes at the American Electric Power Zimmer Generating Station in Ohio, a 100-ft high reinforced-soil buttress for a hillside in southern California, and large highway embankments for the State of Montana Department of Highways. He has designed unreinforced and reinforced earthen dikes for sludge and industrial waste containment for projects in Alabama, Georgia, and California. He has also provided engineering services to the U.S. Army Corps of Engineers and U.S. Federal Highway Administration (FHWA) on projects involving reinforced soil structures. Currently, he is principal investigator for FHWA for preparation of geotechnical engineering circulars for transportation projects; the first two circulars are entitled *Earth Retaining Systems* and *Geotechnical Design Guidance for Highway Earthquake Engineering*. Dr. Bonaparte is also experienced in earth dam evaluation and design. His experience in this area includes Lake Petit Dam and Martins Landing Dam in Georgia, Park Dam in Colorado, and Tablachaca Dam in Peru.

During the early 1980s, Dr. Bonaparte was a member of an engineering team that evaluated the seismic risk potential of a proposed state office complex in Anchorage, Alaska. This evaluation involved detailed back-analyses of slope failures which occurred in Anchorage during the 1964 Good Friday earthquake, as well as an evaluation of the probability of a slope failure at the office complex site due to future seismic events. He was also the lead engineer on a project for the U.S. Army Corps of Engineers involving the interpretation of pile load tests and the development of recommendations on pile load capacities for a lock and dam structure in Louisiana. Other geotechnical assignments include: (i) performing and interpreting static and cyclic pile load tests in soft clays adjacent to San Francisco Bay; (ii) investigation of the loss of soil support for several cracked, large-diameter underground pressure conduits at the Sacramento Regional Wastewater Treatment Plant in California, and the construction monitoring of a remedial grouting program to re-establish support for the pipes; and (iii) design and construction monitoring of stabilization measures for two landslides.

AWARDS AND HONORS

Georgia Engineering Alliance - Georgia Engineer of the Year (2004)
American Society of Civil Engineers - James R. Croes Medal (2000)
International Geosynthetics Society - IGS Award (1994)
North American Geosynthetics Society - Award of Excellence (1991)
National Science Foundation – Graduate Research Fellow (1977-1980)
University of Texas, Austin, Outstanding Graduate Award (1977)
Academic Honor Societies (Phi Kappa Phi, Tau Beta Pi, Chi Epsilon)

MAJOR INVITED LECTURES, WORKSHOPS, AND COMMITTEES

U.S. Environmental Protection Agency – Workshop on Bioreactor Landfills (2003)
National Research Council – Workshop on Safeguarding the Future: Assessing the Performance of Engineered Containment Systems for Waste Disposal (2001)
American Society of Civil Engineers – Geo-Institute Board of Governors (2002)
American Society of Civil Engineers – Keynote Lecture: "Long-Term Performance of Landfills," Geoenvironment 2000 Conference (1995)
International Geosynthetics Society – Editorial Board, Geosynthetics International Journal (1994 – present)
Foundation – Workshop on Research Priorities for Seismic Design of Solid Waste Landfills (1994)
American Society of Civil Engineers – Editorial Board, Journal of Geotechnical Engineering (1992 – 1994)
National Science Foundation – Workshop on Soil Improvement and Foundation Remediation with Emphasis on Seismic Hazards (1991)
American Society of State Highway and Transportation Officials – AASHTO/AGC/ARTBA Task Force 27 on In-Situ Soil Improvement Techniques

AFFILIATIONS

American Chemical Society
American Society of Civil Engineers
American Society of Civil Engineers: Geo-Institute
American Society of Civil Engineers: Environmental and Water Resources Institute
International Society on Soil Mechanics and Foundation Engineering
International Geosynthetics Society
National Ground Water Association
North American Geosynthetics Society

Professor Craig H. Benson, Ph.D., P.E., DGE is Wisconsin Distinguished Professor and Chair of Geological Engineering at the University of Wisconsin at Madison, with a joint appointment in Geological Engineering and Civil & Environmental Engineering. Dr. Benson has been leading experimental and analytical research teams for more than two decades, with a primary focus on geoengineering, waste containment, and beneficial use of industrial byproducts. His scholarly activities include laboratory studies, large-scale field experiments, and development of computer models. He was co-Director of the USEPA's Alternative Cover Assessment Program, the landmark study on long-term closure of waste containment facilities, and is co-Director of the National Science Foundation Bioreactor Partnership, an academic-industry partnership to advance sustainable solid waste management.

Dr. Benson earned his Master's Degree and Ph.D. at the University of Texas at Austin. Over his 22-year teaching career, he has received several awards for his scholarship, including the Ralph B. Peck Award, the Huber Research Award, the Alfred P. Noble Prize, the Croes Medal (twice), and the Casagrande Award from the American Society of Civil Engineers. Dr. Benson serves on the National Academy of Engineers, is a Fellow of the American Society of Civil Engineers and ASTM International, holds two US patents, and is a Registered Professional Engineer in Wisconsin.

CRAIG H. BENSON, PHD, PE, DGE, NAE

Wisconsin Distinguished Professor
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Chair, Civil & Environmental Engineering, Geological Engineering
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EDUCATION

BSCE, Lehigh University - 1985
MSE, University of Texas at Austin – 1987 (Civil Engineering, Geotechnical/Geoenvironmental)
PhD, University of Texas at Austin – 1989 (Civil Engineering, Geotechnical/Geoenvironmental)

REGISTRATION

Professional Engineer, State of Wisconsin, License No. 34108-006

FACULTY APPOINTMENTS

Wisconsin Distinguished Professor, University of Wisconsin, Madison, Wisconsin, July 2007-present (joint appointment in Geological Engineering, Civil & Environmental Engineering).
Affiliate, Nelson Institute for Environmental Studies, University of Wisconsin, Madison, Wisconsin, 2010-present.
Professor, University of Washington, Seattle, WA, August 2008-July 2009.
Professor, University of Wisconsin, Madison, Wisconsin, February 2000-June 2007 (joint appointment in Geological Engineering, Civil & Environmental Engineering).
Associate Professor, University of Wisconsin, Madison, Wisconsin, May 1995-January 2000 (joint appointment in Geological Engineering, Civil & Environmental Engineering).
Assistant Professor, University of Wisconsin, Madison, Wisconsin, January 1990-May 1995 (joint appointment in Geological Engineering, Civil & Environmental Engineering).

ACADEMIC LEADERSHIP

Director of Sustainability Research and Education and Co-Director of the Office of Sustainability, University of Wisconsin, Madison, Wisconsin, July 2011-present.
Chair, Civil & Environmental Engineering, University of Wisconsin, Madison, Wisconsin, July 2011-present.
Chair, Geological Engineering, University of Wisconsin, Madison, Wisconsin, August 2007-present.
Chair, Civil & Environmental Engineering, University of Washington, Seattle, WA, August 2008-July 2009.
Director, Recycled Materials Resource Center, University of Wisconsin, Madison, Wisconsin, August 2007-present. *For more information* → ➊
Director, Wisconsin Geotechnics Laboratory, University of Wisconsin, Madison, Wisconsin, August 2000-present.

Management Board, Consortium for Risk Evaluation and Stakeholder Participation, US Department of Energy, January 2009-present. *For more information →*

Associate Chair for Environmental Science and Engineering, Dept. of Civil & Environmental Engineering, University of Wisconsin, Madison, Wisconsin, July 2004 to June 2007.

Co-Director, Consortium for Fly Ash Use in Geotechnical Engineering, University of Wisconsin-Madison, Co-Director, December 1999-present.

PROFESSIONAL AND COMMUNITY LEADERSHIP

Advisory Board, Global Waste Research Institute, California Polytechnic Institute at San Louis Obispo, (2010-present)

Board of Governors, Geo Institute of ASCE, Governor 2007-present, Treasurer 2010-11 term, Vice President and President Elect 2011-12 term.

Editor-in-Chief, *Journal of Geotechnical and Geoenvironmental Engineering*, 2004-06, top journal in profession.

Executive Committee, Committee D18 on Soil & Rock, ASTM International, 2006-present, Liaison to Geo Institute Board of Governors, 2007-present, Vice Chairman, 2011-present.

Independent Technical Review Committee for On-Site Disposal Facilities, US Department of Energy, Created by Asst. Secretary J. Rispoli, Chair 2007-2010 (disbanded).

Park Commission, Town of Middleton, Wisconsin, Commissioner, 2010 - present

LEADERSHIP DEVELOPMENT

Fellow, Academic Leadership Program, Committee on Institutional Cooperation, Big10 Universities and University of Chicago, 2010 – 2011. *For more information →*

Manager's Boot Camp, Haas School of Business, University of California-Berkeley.

HONORS AND AWARDS

Professional

National Academy of Engineering, 2012
Fellow, ASTM International, 2011
Fellow, American Society of Civil Engineers, 2009
Academy of Distinguished Alumni, University of Texas at Austin, 2009
Diplomate, Geotechnical Engineering, Academy of Geo-Professionals, 2009

Research

Ralph B. Peck Award, American Society of Civil Engineers, 2012
Outstanding Article on the Practice of Geotechnical Testing, ASTM International, 2011
Croes Medal, American Society of Civil Engineers, 1998 and 2008
Alfred P. Noble Prize, American Society of Civil Engineers, 2008
IJOG Excellent Paper Award, Intl. Assoc. Computer Methods & Advances in Geomechanics, 2008
Second Paper Award, Global Waste Management Symposium, 2008
Kellet Mid-Career Research Award, University of Wisconsin, 2005
Walter L. Huber Civil Engineering Research Award, ASCE, 2000
Casagrande Award, American Society of Civil Engineers, 1995
Middlebrooks Award, American Society of Civil Engineers, 1995
Collingwood Prize, American Society of Civil Engineers, 1994

Distinguished Young Faculty Award, U.S. Department of Energy, 1991
Presidential Young Investigator, National Science Foundation, 1991

Teaching
Polygon Outstanding Instructor Award, College of Engr., Univ. of Wisconsin, 1991, 93, 97
Outstanding Professor Award, ASCE Wisconsin Student Chapter, 1992
Top 100 Educators Award, Wisconsin Students Association, Univ. of Wisconsin, 1991

Service
Order of the Engineer, Geo Institute, 2011
Award of Merit, ASTM International, 2011
Richard S. Ladd Standards Development Award, Committee D18, ASTM International, 2002, 03, 04, 06, 08, 11
Special Service Award, Committee D18, ASTM International, 2007

Academics
John A. Focht Endowed Presidential Scholarship in Civil Engr., Univ. of Texas at Austin, 1988
Dawson Endowed Presidential Scholarship in Civil Engr., Univ. of Texas at Austin, 1986
Engineering Foundation Fellowship, University of Texas at Austin, 1985
John B. Carson Prize in Civil Engineering, Lehigh University, 1985
Phi Beta Kappa, Chi Epsilon, and Tau Beta Pi

CONGRESSIONAL TESTIMONY

Invited Testimony on Proposed USEPA Regulations Related to Coal Combustion Products; House Small Business Committee, Congressman H. Shuler, Chair (D-NC), 22 July 2010.

UNIVERSITY SERVICE

Bollinger Academic Staff Award Committee (2010-11, Chair)
Academic Council, Dept. of Civil and Environmental Engineering (1994-99, Chair 1997-99)
Admissions Chair, Geo Engineering Program (1990-2006)
Becker Award Committee, Civil and Environmental Engineering (Chair 2002-04)
Byron Bird Award Committee, College of Engineering (1995)
Civil and Environmental Engineering Strategic Hiring Committee (Chair, 2010-present)
Civil and Environmental Engineering Merit Committee (1998, 2002, 2004-2006)
College of Engineering Academic Planning and Curriculum Committee (1996-99)
College of Engineering Curriculum Committee (1997-99, 2002-04)
College of Engineering Diversity Committee (2002-04)
Conflict of Interest Oversight Committee, University of Wisconsin (2000-02)
Graduate Committee, Geological Engineering (1999-present, Chair 1999-2001, 2003-2006)
Scholarship Committee, Dept. of Civil and Environmental Engineering (1998-2002)
Search Committees for Geological Engineering (Chair, 1997-98, 2003-04)
Undergraduate Committee, Geological Engineering (Chair, 2002-2008)
University of Wisconsin Information Technology Committee (2010-present)
University of Wisconsin Honors Committee (2010-present)

PROFESSIONAL SERVICE AND AFFILIATIONS

Geo-Institute of the American Society of Civil Engineers (Fellow ASCE)
- Board of Governors (2007-present, Treasurer 2010-11, Vice President, 2011-present)
- Awards Committee (Chair, 1999-01)
- Editor-in-Chief, *JGGE*, 2004-06, Editor *JGGE*, 1996-99
- Geoenvironmental Engineering Committee (1990-Present, chair 1996-99)
- GeoStrata Magazine Task Force (1997-99)
- Technical Publications Committee (1993-99, 2004-2006, BoG Liaison 2010-present)
- TPC Subcommittee on Policies for Specialty Conferences (1997-99)

American Society for Testing and Materials (ASTM)
- D18 Executive Committee (2006-present, Vice Chair 2011-present)
- D18.04 - Hydrologic Properties of Soil & Rock (1991-Present, chair 1996-2006)
- D18.14 – Sustainable Geotechnical Construction (founding member, 2008-present)
- D18.19 - Frozen Soil & Rock (1992-Present)

American Geophysical Union
British Geotechnical Association
Canadian Geotechnical Society
International Geosynthetics Society
National Ground Water Association
North American Geosynthetics Society
Soil Science Society of America

PUBLICATIONS

A 2010 Wisconsin Engineering Merit Evaluation reported that my papers have been cited 1455 times, my average citation rate is 11.02, and my h-index is 23. These metrics are the highest amongst my US peer group.

Refereed Journal Articles: Environmental Containment Systems

Abichou, T., Powelson, D., Aitchison, E., Benson, C., and Albright, W. (2005), Water Balances in Vegetated Lysimeters at a Georgia Landfill, *Soil and Crop Society of Florida Proc.*, 64, 1-8.

Abichou, T., Benson, C., and Edil, T. (2004), Network Model for Hydraulic Conductivity of Sand-Bentonite Mixtures, *Canadian Geotech. J.*, 41(4), 698-712.

Abichou, T., Benson, C., and Edil, T. (2002), Micro-Structure and Hydraulic Conductivity of Simulated Sand-Bentonite Mixtures, *Clays and Clay Minerals*, 50(5), 537-545.

Abichou, T., Benson, C., and Edil, T. (2002), Foundry Green Sands as Hydraulic Barriers: Field Study, *J. Geotech. and Geoenvironmental Eng.*, 128(3), 206-215.

Abichou, T., Benson, C., and Edil, T. (2000), Foundry Green Sands as Hydraulic Barriers: Laboratory Study, *J. Geotech. and Geoenvironmental Eng.*, 126(12), 1174-1183.

Abu-Hassanein, Z., and Benson, C., and Blotz, L. (1996), Electrical Resistivity of Compacted Clays, *J. Geotech. Eng.*, 122(5), 397-407.

Abu-Hassanein, Z. and Benson, C., Wang, X., and Blotz, L. (1995), Determining Bentonite Content in Soil-Bentonite Mixtures Using Electrical Conductivity, *Geotech. Testing J.*, 19(1), 51-57.

Albrecht, B. and Benson, C. (2002), Predicting Airflow Rates in the Coarse Layer of Passive Dry Barriers, *J. Geotech. and Geoenvironmental Eng.*, 128(4), 338-346.

Albrecht, B. and Benson, C. (2001), Effect of Desiccation on Compacted Natural Clays, *J. Geotech. and Geoenvironmental Eng.*, 127(1), 67-76.

Albright, W., Benson, C., Gee, G., Abichou, T., Tyler, S., Rock, S. (2006), Field Performance of Three Compacted Clay Landfill Covers, *Vadose Zone J.*, 5(6), 1157-1171.

Albright, W., Benson, C., Gee, G., Abichou, T., Tyler, S., Rock, S. (2006), Field Performance of A Compacted Clay Landfill Final Cover at A Humid Site, *J. Geotech. and Geoenvironmental Eng.*, 132(11), 1393-1403.

Albright, W., Benson, C., Gee, G., Roesler, A., Abichou, T., Apiwantragoon, P., Lyles, B., and Rock, S. (2004), Field Water Balance of Landfill Final Covers. *J. Environmental Quality*, 33(6), 2317-2332.

Akpinar, M. and Benson, C. (2005), Effect of Temperature on Shear Strength of Two Geomembrane-Geotextile Interfaces, *Geotextiles and Geomembranes*, 23, 443-453.

Bareither, C., Benson, C., Barlaz, M., Edil, T., and Tolaymat, T. (2010), Performance of North American Bioreactor Landfills: I. Leachate Hydrology and Waste Settlement, *J. Environmental Engineering*, 136(8), 824-838.

Bareither, C., Benson, C., and Edil, T. (2012), Effects of Waste Composition and Decomposition on the Shear Strength of Municipal Solid Waste, *J. Geotech. and Geoenvironmental Eng.*, in press

Barlaz, M., Bareither, Hossain, A., Saquing, J., Mezzari, I., C., Benson, C., and Tolaymat, T. (2010), Performance of North American Bioreactor Landfills: . II. Chemical and Biological Characteristics, *J. Environmental Engineering*, 136(8), 838-853.

Benson, C., Oren, A., and Gates, W. (2010), Hydraulic Conductivity of Two Geosynthetic Clay Liners Permeated with a Hyperalkaline Solution, *J. Geotextiles and Geomembranes*, 28(2), 206-218, doi:10.1016/j.geotexmem.2009.10.002.

Benson, C., Kucukkirca, I., and Scalia, J. (2010), Properties of Geosynthetics Exhumed from the Final Cover at a Solid Waste Landfill, *J. Geotextiles and Geomembranes*, 28, 536-546, doi:10.1016/j.geotexmem.2010.03.001.

Benson, C. and Meer, S. (2009), Relative Abundance of Monovalent and Divalent Cations and the Impact of Desiccation on Geosynthetic Clay Liners, *J. Geotech. and Geoenvironmental Eng.*, 135(3), 349-358.

Benson, C., Thorstad, P., Jo, H., and Rock, S. (2007), Hydraulic Performance of Geosynthetic Clay Liners in a Landfill Final Cover, *J. Geotech. and Geoenvironmental Eng.*, 133(7), 814-827.

Benson, C., Barlaz, M., Lane, D., and Rawe, J. (2007), Practice Review of Five Bioreactor/Recirculation Landfills, *Waste Management*, 27(1), 13-29.

Benson, C., Sawangsuriya, A., Trzebiatowski, B., and Albright, W. (2007), Post-Construction Changes in the Hydraulic Properties of Water Balance Cover Soils, *J. Geotech. and Geoenvironmental Eng.*, 133(4), 349-359.

Benson, C., Abichou, T., and Jo, H. (2004), Forensic Analysis of Excessive Leakage from Lagoons Lined with a Composite GCL, *Geosynthetics International*, 11(3), 242-252.

Benson, C. (2001), Waste Containment: Strategies and Performance, *Australian Geomechanics*, 36(4), 1-25.

Benson, C., Abichou, T., Albright, W., Gee, G., and Roesler, A. (2001), Field Evaluation of Alternative Earthen Final Covers, *International J. Phytoremediation*, 3(1), 1-21.

Benson, C., Daniel, D., and Boutwell, G. (1999), Field Performance of Compacted Clay Liners, *J. Geotech. and Geoenvironmental Eng.*, 125(5), 390-403.

Benson, C., Gunter, J., Boutwell, G., Trautwein, S., and Berzanskis, P. (1997), Comparison of Four Methods to Assess Hydraulic Conductivity, *J. Geotech. and Geoenvironmental Eng.*, 123(10), 929-937.

Benson, C., Olson, M., and Bergstrom, W. (1996), Temperatures of Insulated Landfill Liner, *J. Transportation Research Board*, 1534, 24-31.

Benson, C. and Trast, J. (1995), Hydraulic Conductivity of Thirteen Compacted Clays, *Clays and Clay Minerals*, 43(6), 669-681.

Benson, C., Chamberlain, E., Erickson, A., and Wang, X. (1995), Assessing Frost Damage in Compacted Clay Liners, *Geotech. Testing J.*, 18(3), 324-333.

Benson, C., Abichou, T., Olson, M., and Bosscher, P. (1995), Winter Effects on the Hydraulic Conductivity of Compacted Clay, *J. Geotech. Eng.*, 121(1), 69-79.

Benson, C., Zhai, H., and Wang, X. (1994), Estimating Hydraulic Conductivity of Compacted Clay Liners, *J. Geotech. Eng.*, 120(2), 366-387.

Benson, C. and Daniel, D. (1994), Minimum Thickness of Compacted Soil Liners: I-Stochastic Models," *J. Geotech. Eng.*, 120(1), 129-152.

Benson, C. and Daniel, D. (1994), Minimum Thickness of Compacted Soil Liners: II-Analysis and Case Histories, *J. Geotech. Eng.*, 120(1), 153-172.

Benson, C., Bosscher, P., Lane, D., and Pliska, R. (1994), Monitoring System for Hydrologic Evaluation of Landfill Final Covers, *Geotech. Testing J.*, 17(2), 138-149.

Benson, C., Zhai, H. and Rashad, S. (1994), Statistical Sample Size for Construction of Soil Liners, *J. Geotech. Eng.*, 120(10), 1704-1724.

Benson, C. and Othman, M. (1993), Hydraulic and Mechanical Characteristics of Compacted Municipal Solid Waste Compost, *Waste Management and Research*, 11(1), 127-142.

Benson, C. (1993), Probability Distributions for Hydraulic Conductivity of Compacted Soil Liners, *J. Geotech. Eng.*, 119(3), 471-486.

Benson, C. and Othman, M. (1993), Hydraulic Conductivity of Compacted Clay Frozen and Thawed In Situ, *J. Geotech. Eng.*, 119(2), 276-294.

Benson, C. and Daniel, D. (1990), Influence of Clods on Hydraulic Conductivity of Compacted Clay, *J. Geotech. Eng.*, 116(8), 1231-1248.

Blotz, L., Benson, C., and Boutwell, G. (1998), Estimating Optimum Water Content and Maximum Dry Unit Weight for Compacted Clays, *J. Geotech. and Geoenvironmental Eng.*, 124(9), 907-912.

Bohnhoff, G., Ogorzalek, A., Benson, C., Shackelford, C., and Apiwantragoon, P. (2009), Field Data and Water-Balance Predictions for a Monolithic Cover in a Semiarid Climate, *J. Geotech. and Geoenvironmental Eng.*, 135(3), 333-348.

Daniel, D. and Benson, C. (1990), Water Content-Density Criteria for Compacted Soil Liners, *J. Geotech. Eng.*, 116(12), 1811-1830.

Foose, G., Benson, C., and Edil, T. (2002), Comparison of Solute Transport in Three Composite Landfill Liners, *J. Geotech. and Geoenvironmental Eng.*, 128(5), 391-403.

Foose, G., Benson, C., and Edil, T. (2001), Predicting Leakage Through Composite Landfill Liners, *J. Geotech. and Geoenviron. Eng.*, 127(6), 510-520.

Foose, G., Benson, C., and Edil, T. (2001), Analytical Equations for Predicting Concentration and Mass Flux from Composite Landfill Liners, *Geosynthetics International*, 8(6), 551-575.

Gulec, S., Benson, C., and Edil, T. (2005), Effect of Acidic Mine Drainage (AMD) on the Mechanical and Hydraulic Properties of Three Geosynthetics, *J. Geotech. and Geoenvironmental Eng.*, 131(8), 937-950.

Gulec, S., Edil, T., and Benson, C. (2004), Effect of Acidic Mine Drainage (AMD) on the Polymer Properties of an HDPE Geomembrane, *Geosynthetics International*, 11(2), 60-72.

Jacobson, K., Lee, S., Somerville, R., McKenzie, D., Benson, C., and Pedersen, J. (2010), Transport of the Pathogenic Prion Protein Through Soils, *J. Environmental Quality*, 39, 1145–1152.

Jacobson, K., Lee, S., McKenzie, D., Benson, C., and Pedersen, J. (2008), Transport of the Pathogenic Prion Protein Through Landfill Materials, *Environmental Science & Technology*, 43(6), 2022-2028.

Jo, H., Benson, C., and Edil, T. (2006), Rate-Limited Cation Exchange in Thin Bentonitic Barrier Layers, *Canadian Geotech. J.*, 43, 370-391.

Jo, H., Benson, C., Lee, J., Shackelford, C., and Edil, T. (2005), Long-Term Hydraulic Conductivity of a Non-Prehydrated Geosynthetic Clay Liner Permeated with Inorganic Salt Solutions, *J. Geotech. and Geoenvironmental Eng.*, 131(4), 405-417.

Jo, H., Benson, C., and Edil, T. (2004), Hydraulic Conductivity and Cation Exchange in Non-Prehydrated and Prehydrated Bentonite Permeated with Weak Inorganic Salt Solutions, *Clays and Clay Minerals*, 52(6), 661-679.

Jo, H., Katsumi, T., Benson, C., and Edil, T. (2001), Hydraulic Conductivity and Swelling of Non-Prehydrated GCLs Permeated with Single Species Salt Solutions, *J. of Geotech. and Geoenvironmental Eng.*, 127(7), 557-567.

Katsumi, T., Benson, C., Foose, G., and Kamon, M. (2001), Performance-Based Design of Landfill Liners, *Engineering Geology*, 60, 139-148.

Katsumi, T., Benson, C., Foose, G., and Kamon, M. (1999), Evaluation of the Performance of Landfill Liners, *J. Japan Society of Waste Management*, 10(1), 75-85.

Khire, M., Benson, C., and Bosscher, P. (2000), Capillary Barriers: Design Variables and Water Balance, *J. Geotech. and Geoenvironmental Eng.*, 126(8), 695-708.

Khire, M., Benson, C., and Bosscher, P. (1999), Field Data from a Capillary Barrier in Semi-Arid and Model Predictions with UNSAT-H, *J. Geotech. and Geoenvironmental Eng.*, 125(6), 518-528.

Khire, M., Benson, C., and Bosscher, P. (1997), Water Balance of Two Earthen Landfill Caps in a Semi-Arid Climate, *J. Land Contamination and Reclamation*, 5(3), 195-202.

Khire, M., Benson, C., and Bosscher, P. (1997), Water Balance Modeling of Earthen Final Covers, *J. Geotech. and Geoenvironmental Eng.*, 123(8), 744-754.

Kim, H. and Benson, C. (2004), Contributions of Advective and Diffusive Oxygen Transport Through Multilayer Composite Caps Over Mine Waste, *J. Contaminant Hydrology*, 71(1-4), 193-218.

Kolstad, D., Benson, C., and Edil, T. (2004), Hydraulic Conductivity and Swell of Nonprehydrated GCLs Permeated with Multispecies Inorganic Solutions, *J. Geotech. and Geoenvironmental Eng.*, 130(12), 1236-1249.

Kolstad, D., Benson, C., Edil, T., and Jo, H. (2004), Hydraulic Conductivity of a Dense Prehydrated GCL Permeated with Aggressive Inorganic Solutions, *Geosynthetics International*, 11(3), 233-240.

Kraus, J., Benson, C., Erickson, A., and Chamberlain, E. (1997), Freeze-Thaw and Hydraulic Conductivity of Bentonitic Barriers, *J. Geotech. and Geoenvironmental Eng.*, 123(3) 229-238.

Kraus, J., Benson, C., Maltby, V., and Wang, X. (1997), Field and Laboratory Hydraulic Conductivity of Compacted Papermill Sludges, *J. Geotech. and Geoenvironmental Eng.*, 123(7), 654-662.

Lee, J., Shackelford, C., Benson, C., Jo, H., and Edil, T. (2005), Correlating Index Properties and Hydraulic Conductivity of Geosynthetic Clay Liners, *J. Geotech. and Geoenvironmental Eng.*, 131(11), 1319-1329.

Lin, L. and Benson, C. (2000), Effect of Wet-Dry Cycling on Swelling and Hydraulic Conductivity of Geosynthetic Clay Liners, *J. Geotech. and Geoenvironmental Eng.*, 126(1), 40-49.

Ma, X., Benson, C., D. McKenzie, J. Aiken, and J. Pedersen (2007), Adsorption of Pathogenic Prion Protein to Quartz Sand, *Environmental Science and Technology*, 41(7), 2324-2330.

Meer, S. and Benson, C. (2007), Hydraulic Conductivity of Geosynthetic Clay Liners Exhumed from Landfill Final Covers, *J. Geotech. and Geoenvironmental Eng.*, 133(5), 550-563.

Meerdink, J., Benson, C., and Khire, M. (1995), Unsaturated Hydraulic Conductivity of Two Compacted Barrier Soils, *J. Geotech. Eng.*, 122(7), 565-576.

Ogorzalek, A., Bohnhoff, G., Shackelford, C., Benson, C., and Apiwantragoon, P. (2008), Comparison of Field Data and Water-Balance Predictions for a Capillary Barrier Cover." *J. Geotech. and Geoenvironmental Eng.*, 134(4), 470-486.

Othman, M. and Benson, C. (1994), Effect of Freeze-Thaw on the Hydraulic Conductivity and Morphology of Compacted Clay, *Canadian Geotech. J.*, 30(2), 236-246.

Othman, M. and Benson, C. (1993), Effect of Freeze-Thaw on the Hydraulic Conductivity of Three Compacted Clays from Wisconsin, *J. Transportation Research Board*, 1369, 118-125.

Palmer, B., Edil, T. and C. H. Benson (2000), Liners for Waste Containment Constructed with Class F and C Fly Ashes, *J. Hazardous Materials*, 18(2-3), 133-161.

Park, M., Benson, C., and Edil, T. (2012), Comparison of Batch and Double Compartment Tests for Measuring VOC Transport Parameters in Geomembranes, *J. Geotextiles and Geomembranes*, 31, 15-30.

Pedersen, J., Johnson, C., Bell, C., Jacobson, K., Benson, C., McKenzie, D., and Aiken, J. (2009), Soil and the Transmission of Prion Diseases, *Geochimica et Cosmochimica Acta Suppl.*, 73, A1007.

Pedersen, J., McMahon, K., and Benson, C. (2006), Prions: Novel Pathogens of Environmental Concern?, *J. of Environmental Engineering*, 132(9), 967-969.

Scalia, J. and Benson, C. (2011), Hydraulic Conductivity of Geosynthetic Clay Liners Exhumed from Landfill Final Covers with Composite Barriers, *J. Geotech. and Geoenvironmental Eng.*, 137(1), 1-13.

Scalia, J. and Benson, C. (2010), Preferential Flow in Geosynthetic Clay Liners Exhumed from Final Covers with Composite Barriers, *Canadian Geotechnical J.*, 47, 1101-1111.

Scalia, J. and Benson, C. (2010), Effect of Permeant Water on the Hydraulic Conductivity of Exhumed Geosynthetic Clay Liners, *Geotechnical Testing J.*, 33(3), 1-11.

Shackelford, C., Benson, C., Katsumi, T., and Edil, T. (2000), Evaluating the Hydraulic Conductivity of GCLs Permeated with Non-Standard Liquids, *J. Geotextiles and Geomembranes*, 18(2-3), 133-161.

Smesrud, J., Benson, C., Albright, W., Richards, J., Wright, S., Israel, T., and Goodrich, K. (2011), Using Pilot Test Data to Refine an Alternative Cover Design in Northern California, *International J. Phytoremediation*, in press.

Tinjum, J., Benson, C., and Blotz, L. (1997), Soil-Water Characteristic Curves for Compacted Clays, *J. Geotech. and Geoenvironmental Eng.*, 123(11), 1060-1070.

Trast, J. and Benson, C. (1995), Estimating Field Hydraulic Conductivity of Compacted Clay, *J. Geotech. Eng.*, 121(10), 736-740.

Wang, X. and Benson, C. (1999), Hydraulic Conductivity Testing of Geosynthetic Clay Liners Using the Constant Volume Method, *Geotechnical Testing J.*, 22(4), 277-283.

Wang, X. and Benson, C. (1995), Infiltration and Field-Saturated Hydraulic Conductivity of Compacted Clay, *J. Geotech. Eng.*, 121(10), 713-722.

Zhai, H. and Benson, C. (2006), The Log-Normal Distribution for Hydraulic Conductivity of Compacted Clays: Two or Three Parameters?, *Geotechnical and Geological Engineering*, 24(5), 1149-1162.

Refereed Journal Articles: Sustainable Infrastructure

Bareither, C., Benson, C., and Edil, T. (2012), Compression Behavior of Municipal Solid Waste: Immediate Compression, *J. Geotech. and Geoenvironmental Eng.*, in press.

Bareither, C., Benson, C., Edil, T., and Barlaz, M. (2012), Abiotic and Biotic Compression of Municipal Solid Waste, *J. Geotech. and Geoenvironmental Eng.*, in press.

Benson, C. and Khire, M. (1994), Reinforcing Sand with Strips of Reclaimed High Density Polyethylene, *J. Geotech. Eng.*, 120(5), 838-855.

Bin-Shafique, S., Benson, C., Edil, T., and Hwang, K. (2006), Leachate Concentrations from Water Leach and Column Leach Tests on Fly-Ash Stabilized Soil, *Environmental Engineering Science*, 23(1), 51-65.

Bin-Shafique, S., Edil, T., and Benson, C. (2004), Incorporating a Fly Ash Stabilized Layer into Pavement Design: Case Study, *Geotechnical Engineering*, 157(4), 239-249.

Lee, J., Bradshaw, S., Edil, T., and Benson, C (2012) Quantifying the Benefits of Flue Gas Desulfurization Gypsum in Sustainable Wallboard Production, *Coal Combustion and Gasification Products J.*, in press.

Carpenter, A., Gardner, K., Fopiano, J., Benson, C., and Edil, T. (2007), Life Cycle Based Risk Assessment of Recycled Materials in Roadway Construction, *Waste Mgmt.*, 27, 1458-1464.

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SPONSORED RESEARCH

Dr. Benson's research program is supported by a collection of federal, state, and industrial sponsors, with an annual budget of approximately $2M. Contracting details are excluded from this list for brevity, but are available on request.

Environmental Containment Systems

Compatibility of Geosynthetic Clay Liners and Leachate from CCP Containment Facilities, Electric Power Research Institute.

Bench-Scale Comparison of EVOH and HDPE Geomembranes as Barriers to VOC and Methane Emissions, Kuraray America Inc.

Consortium for Risk Evaluation and Stakeholder Participation, US Department of Energy, with Vanderbilt University, Rutgers University, New York University, Oregon State University, University of Pittsburgh, Howard University, University of Arizona, Robert Wood Johnson Medical School

Coupling Effects of Erosion and Hydrology on the Long-Term Performance of Engineered Surface Barriers, US Nuclear Regulatory Commission

Predicting the Long-Term Performance of Surface Barriers for LLRW Containment, US Department of Energy, Consortium for Risk Evaluation with Stakeholder Participation

Effectiveness of Engineered Covers: From Modeling to Performance Monitoring, US Nuclear Regulatory Commission

Bentonite-Polymer Nanocomposites for Geoenvironmental Applications, National Science Foundation, with T. Edil and C. Shackelford

Prion Transport in Porous Media: Influence of Electrostatic and Non-DLVO Interactions, National Science Foundation, with J. Pedersen and J. Aiken

Effect of Stress, Hydration, and Ion Exchange on the Hydraulic Conductivity of Geosynthetic Clay Liners, Colloid Environmental Technologies Corporation

Innovative Methods for Natural Restoration of Final Covers for Mill Tailings, US Dept. of Energy, with W. Albright and J. Waugh

Evaluating Long-Term Impacts on Final Covers - Exhumation of the ACAP Test Sections, National Science Foundation, US Environmental Protection Agency, Environmental Research and Education Foundation, with D. Fratta and W. Albright

Toxin/Pathogen Inactivation and Disposal of Intentionally Contaminated Foods, National Center for Food Protection and Defense, US Dept. of Homeland Security, with D. Noguera

Predictive Tools for Sustainable Solid Waste Management Using Bioreactor Landfills, National Science Foundation, with M. Barlaz (*Bioreactor Partnership, For more information* →◉)

The State of Municipal Solid Waste Bioreactor Landfills-II, US Environmental Protection Agency, with M. Barlaz

VOC Transport Through Composite Landfill Liners, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

VOC Transport in Lined Containment Facilities, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

Hydrology of the Monticello Water Balance Cover, Stoller Corporation and US Dept. of Energy.

Effect of Freeze Thaw on Compacted Soil Liners and Covers, University of Wisconsin Graduate School.

Fate and Transport of Chronic Waste Disease Prions in Municipal Solid Waste Landfills, US Environmental Protection Agency, with J. Pedersen and J. Aiken.

Evaluation of VOC Contamination of Groundwater from Lined Landfills in Wisconsin, Groundwater Research Advisory Council, State of Wisconsin.

Hydrologic Modeling of Covers Used for Mine Waste Containment, US Environmental Protection Agency, with C. Shackelford.

Bioreactor Landfills: State of the Practice, US Environmental Protection Agency, with D. Lane and M. Barlaz.

Field Performance of Alternative Covers, US Environmental Protection Agency.

Integrated Long-Term Stewardship for Low-Level Radioactive Waste, US Department of Energy and Flour Fernald, Fernald, Ohio.

Chemical Interactions Between Mine Waste Liquids and Geosynthetics, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

Long-term Chemical Compatibility of Geosynthetic Clay Liners, National Science Foundation, with C. Shackelford.

Hydraulic Conductivity Testing Protocols for Paper Sludges, National Council of the Pulp and Paper Industry for Air and Stream Improvement.

Dry Barriers for Waste Containment, National Science Foundation, with S. Kung

Alternative Cover Assessment Program, United States Environmental Protection Agency, with W. Albright (Desert Research Institute) and Glendon Gee (Battelle PNNL).

Large-Scale Verification of a VOC Transport Model for Composite Liners, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

Field Assessment of Geosynthetic Clay Liners in Final Covers, United States Environmental Protection Agency.

Unsaturated Hydraulic Properties of Alternative Cover Soils, Waste Management, Waste Connections, Bluestem Solid Waste Authority, and Marina Solid Waste Management District

Alternative Covers for Waste Containment in Southern California, San Bernardino County, CA.

Equivalency of Subtitle D and Alternative Earthen Covers, City of Glendale, Arizona.

Development of *Win*UNSAT-H, a Windows Implementation of UNSAT-H, WMX Technologies, Inc.

Hydraulic Characterization of Mine Rock Backfill for the Flambeau Mine, Flambeau Mining Company, Ladysmith, WI

Hydraulic Characterization of Mine Rock Backfill for the Flambeau Mine: II-In Situ Verification, Flambeau Mining Company, Ladysmith, WI

Field Hydraulic Conductivity Assessment of the NCASI Test Plots, National Council of the Paper Industry for Air and Stream Improvement

Effect of Freeze-Thaw on the Hydraulic Conductivity of Compacted Papermill Sludge, the National Council of the Paper Industry for Air and Stream Improvement.

Engineering Properties of Paper Sludges Used for Hydraulic Barriers in Landfill Covers, Solid Waste Research Program, State of Wisconsin.

Shear Strength of Municipal Solid Waste, WMX Technologies, Inc., with T. Edil.

Evaluating the Effectiveness of Landfill Liners, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

Laboratory and Field Evaluation of the Effects of Freeze-Thaw on Barrier Materials, United States Environmental Protection Agency.

Field-Evaluation of Geoinsulation-A Geosynthetic Insulation Material, Envotech Limited Partnership, with P. Bosscher

Hydraulic Conductivity Assessment of Compacted Soil Liners, Waste Management of North America, Inc.

Rational Construction Quality Control Criteria for Compacted Soil Liners, University of Wisconsin Graduate School.

Final Cover Hydrologic Evaluation, Waste Management of North America, Inc.

Evaluation of Freezing and Thawing on the Hydraulic Conductivity of a Test Pad, Waste Management of Wisconsin, Inc.

Improved Design Methods for Landfill Final Covers, National Science Foundation.

Quality Assurance and Hydraulic Conductivity Assessment of Compacted Soil Liners, Waste Management of North America and Chemical Waste Management, Inc.

Hydrologic Analysis of a Co-Composting Landfill, Solid Waste Research Council, State of Wisconsin.

Sustainable Infrastructure

Recycled Materials Resource Center – Third Generation, Federal Highway Administration Pooled Fund, with T. Edil.

Recycled Materials Resource Center, Federal Highway Administration and United States Environmental Protection Agency, with K. Gardner

Environmental Benefits of Using Coal Combustion Products in Construction, Electric Power Research Institute, with T. Edil

Engineering Behavior of Recycled Unbound Materials, US Dept. of Transportation Pooled Fund, with T. Edil.

Assessing Environmental Impacts Associated with Bases and Subgrades Stabilized with Coal Combustion Products, Center for Freight and Infrastructure Research and Education, US Department of Transportation, with T. Edil.

User Guidelines for Waste and By-Product Materials in Highway Pavements, US Environmental Protection Agency, with A. Graettinger and J. Jambeck

Gravel Equivalency of Fly Ash Stabilized Reclaimed Roads, Minnesota Local Roads Research Board, with T. Edil

In Situ Stabilization of Gravel Roads with CCPs, Combustion Byproducts Recycling Consortium, US Dept. of Energy, with T. Edil

Leaching of Heavy Metals from Gray-Iron Foundry Slags Used in Geo Engineering Applications, Solid Waste Research Council, State of Wisconsin, with T. Edil.

Monitoring and Analysis of Leaching from Subbases Constructed with Industrial Byproducts, FHWA Recycled Materials Research Center, with T. Edil.

Ash Utilization in Low Volume Roads, Minnesota Department of Transportation, with T. Edil

Integrated Approach for Assessing Groundwater Impacts from Fly Ash Stabilized Soils, Alliant Energy, with T. Edil.

Geoenvironmental Assessment of Soft Soils Stabilized with High Carbon Fly Ashes, Solid Waste Research Program, State of Wisconsin, with T. Edil.

Are High Carbon Fly Ashes Effective Stabilizers for Soft Organic Soils?, National Science Foundation, with T. Edil.

Consortium for Beneficial Reuse of Fly Ashes, Alliant Energy, Northern States Power, and Mineral Solutions, Inc., with T. Edil.

Reuse of Fly Ash for Soil Stabilization, US Dept. of Energy, with T. Edil.

Field Demonstration of Earth Structures Constructed with Soil-Tire Chip Mixtures, Solid Waste Research Council, State of Wisconsin, with T. Edil.

Use of Foundry Sands in Hot Mix Asphalt, University Industrial Relations, with H. Bahia

Fly Ash Stabilization of Soft Subgrades, US Dept. of Energy, Mineral Solutions, Inc., and Alliant Power, with T. Edil.

Field Demonstration of Beneficial Reuse of Foundry Byproducts in Highway Subgrade, Wisconsin Department of Transportation, with T. Edil.

Properties of Foundry Sand Relevant to Design of Embankments and Retaining Wall Backfill, State of Wisconsin, Recycling Market Development Board, with T. Edil.

National Practice Survey: Beneficial Re-use of Waste Foundry Sands, State of Wisconsin Recycling Market Development Board, with T. Edil.

Using Waste Foundry Sands as Hydraulic Barriers, Solid Waste Research Council, State of Wisconsin, with T. Edil.

Field Assessment of Barrier Layers Constructed with Foundry Sands, Solid Waste Research Council, State of Wisconsin, with T. Edil.

Use of Shredded Waste Tires in Highway Construction, United States Environmental Protection Agency, with T. Edil.

Sub-base Replacement with Waste Foundry Sands, State of Wisconsin, Recycling Market Development Board, with T. Edil.

Using High Carbon Class F Fly Ash as a Lining Material: I-Laboratory Study, Solid Waste Research Council, State of Wisconsin, with T. Edil.

Using High Carbon Class F Fly Ash as a Lining Material: II-Field Verification, Solid Waste Research Council, State of Wisconsin, with T. Edil.

Reinforcement of Soils with Shredded Waste Tires, Solid Waste Research Council, State of Wisconsin, with P. Bosscher.

Use of Reclaimed Waste HDPE as Soil Reinforcement, Solid Waste Research Council, State of Wisconsin.

Groundwater

Sorption and Transport of Polycyclic Aromatic Hydrocarbons in Organoclays used for Permeable Adsorptive Barriers, CH2M Hill Inc. and Union Pacific Inc.

Environmental Impacts of Engineered Nanomaterials, Nanoscale Science and Engineering Center, National Science Foundation, with J. Pedersen and R. Hammers

Gray-Iron Foundry Slags as a Reactive Medium for Removing Arsenic from Ground Water and Drinking Water, Groundwater Research Advisory Council, State of Wisconsin, with D. Blowes.

Innovative Treatment of COPR Wastes in Coastal Areas, US Dept. of Transportation, with T. Edil.

Development of Large-Scale Application for Remediation of Chromium Ore Processing Residue, University Industrial Relations, University of Wisconsin, with T. Edil.

An Integrated Approach to Evaluating Environmental Impacts from Soils Stabilized with Fly Ashes, State of Wisconsin Recycling Program and Alliant Energy, Inc.

Uncertainty Based Design of Permeable Reactive Barriers, Wisconsin Ground Water Research Advisory Council, with G. Eykholt

Innovative Groundwater Treatment: Reactive Walls Constructed with Excess Foundry Sand, Wisconsin Groundwater Research Advisory Council, with G. Eykholt.

Development of Integrated Decision Support System for Wellhead Protection, Wisconsin Water Resources Council, State of Wisconsin.

Reducing Uncertainty in Subsurface Characterization, U.S. Department of Energy.

Ultrasonic Probe to Evaluate the Integrity of Borehole Seals, Federal Highway Administration, with T. Edil.

Field Assessment of Monitoring Well Seal Integrity, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

A Tool For Evaluating the Integrity of Monitoring Well Seals, Groundwater Research Advisory Council, State of Wisconsin, with T. Edil.

Characterization of Air Plumes and Modeling Mass Removal During In Situ Air Sparging, Groundwater Research Advisory Council, State of Wisconsin, with G. Eykholt.

Other Topics

Wisconsin-Puerto Rico Partnership for Research and Education in Materials [Wi(PR)EM], US National Science Foundation, with J. de Pablo, J. Pedersen, et al.

Fate and Transport of Chronic Waste Disease Prions in Waste Water Treatment Plants, US Environmental Protection Agency

A Modular Geoenvironmental Curriculum, National Science Foundation, with other faculty from Wisconsin, Northwestern, Michigan, and Argonne National Laboratory.

Stiffness and Stress State in Unsaturated Soils, Minnesota Department of Transportation, with T. Edil.

Thermal Conditions Below Highway Pavements During Winter, Wisconsin Department of Transportation, with P. Bosscher.

Design Protocols for Cellular Confinement with Geoweb, University Industrial Relations and Presto Products, Appleton, WI, with T. Edil.

Equivalency of Subgrade Improvement Methods, Wisconsin Department of Transportation, with T. Edil.

Reinforcement of Soft Subgrades with Geosynthetics, Wisconsin Department of Transportation, with T. Edil.

Evaluation of the DCP and SSG for Subgrade Evaluation, Wisconsin Department of Transportation, with T. Edil.

Shear Strength of Granular Backfill Materials, Wisconsin Department of Transportation, with T. Edil.

Correlating Index Properties and Engineering Behavior of Wisconsin Soils, Wisconsin Department of Transportation, with T. Edil.

Incorporating Alternative Subgrade Improvement Methods in Pavement Design, Wisconsin Department of Transportation, with T. Edil.

STEM TEACHER ENGAGEMENT

The following STEM teachers have been engaged in our research and educational programs through NSF's program *Research Experience for Undergraduates*:

Hayden, Matthew, Earth Science Teacher, Glacier Creek Middle School, Middleton-Cross Plains School District, Middleton, Wisconsin.

Kisting, Richard, Science Teacher, Badger Ridge Middle School, Verona Area School District, Verona, Wisconsin.

GRADUATE STUDENTS SUPERVISED

PhD Students

Abichou, T., Hydraulic Properties of Foundry Sands, co-advised with T. Edil, 1999.
Albrecht, B., Passive Dry Barriers: Air Circulation and Mass Transfer, 2001.
Albright, W., Field Performance of Landfill Covers, 2005.
Apiwantragoon, P., Alternative Covers: Field Performance and Modeling Methods, 2007.

Bareither, C., Settlement of Bioreactor Landfills: Compression Mechanisms, co-advised with T. Edil, 2010.

Breitmeyer, R., Unsaturated Hydraulic Properties of Solid Waste and Hydrology of Bioreactor Landfills, co-advised with T. Edil, 2010.

Bin-Shafique, S., Leaching of Heavy Metals from Fly Ash Stabilized Soils, co-advised with T. Edil, 2002.

Chalermyanont, T., Reliability Analysis of Mechanically Stabilized Earth (MSE) Walls, 2002.

Chang, P., Geophysical Characterization of Water and Solute Movement in an Arid Climate, 2003, co-advised with D. Alumbaugh.

Chen, Nicholas, pH Dependent Leaching of Trace Elements from Recycled Concrete Aggregate, expected 2014.

Elder, C., Effect of Heterogeneity on Performance of Permeable Reactive Barriers, 2000.

Foose, G., Leakage Rates and Chemical Transport Through Composite Landfill Liners, co-advised with T. Edil, 1997.

Gulec, S., Compatibility of Geosynthetics and Mine Waste Liquids, co-advised with T. Edil, 2003.

Hunter, E., Sorption of Radionuclides in Engineering Barrier Materials, expected 2014.

Jo, H., Fundamental Factors Affecting Interactions Between Bentonite and Inorganic Liquids, 2003.

Khire, M., Field Hydrology and Water Balance Modeling of Earthen Final Covers for Waste Containment, 1995.

Kim, H., Oxygen Transport Through Multi-layer Caps Over Mine Waste, 2000.

Kim, W., Alternative Subgrades Stabilization with Geosynthetics, co-advised with T. Edil, 2003.

Komonweeraket, K., Mechanisms Controlling Release of Trace Elements from Soils Stabilized with Fly Ash, co-advised with T. Edil, 2010.

Lee, T., Using Waste Foundry Sands as Reactive Media in Permeable Reactive Barriers, 2002.

Li, L., Impacts of Mineralogical Fouling of Permeable Reactive Barriers in Heterogeneous Environments, 2004.

Nokkaew, K., Unsaturated Hydraulic Behavior of Recycled Base Course Materials, co-advised with J. Tinjum, expected 2013

Othman, M., Effect of Freeze/Thaw on the Structure and Hydraulic Conductivity of Compacted Clays, 1992.

Park, M., Transport of VOCs in Composite Landfill Liners, co-advised with T. Edil, 2011.

Scalia, J., Bentonite-Polymer Nanocomposites for Environmental Containment, expected 2012.

Tachavises, C., Flow Rates Past Vertical Groundwater Cut-Off Walls: Influential Factors and Their Impact on Wall Selection, 1998.

Tanyu, B., Equivalency of Alternative Subgrade Stabilization Methods, co-advised with T. Edil, 2003.

Tinjum, J., Innovative Remedial Treatment of Chromium Ore Processing Residues, co-advised with T. Edil, 2006.

Yesiller, N., Ultrasonic Evaluation of Cased Borehole Seals, 1994, co-advised with T. Edil.

MS Students

Abichou, T., Field Evaluation of Geosynthetic Insulation for Protection of Clay Liners, 1993.

Abu Hassanein, Z., Using Electrical Resistivity Measurement as a Quality Control Tool for Compacted Clay Liners, 1994.

Acosta, H., Stabilization of Soft Subgrade Soils Using Fly Ash, with T. Edil, 2002.

Albrecht, B., Effect of Desiccation on Hydraulic Conductivity of Compacted Clays, 1995.

Akpinar, M., Interface Shear Strength of Geomembranes and Geotextiles at Different Temperatures, 1997.

Bahner, E., Soil Nailing Case Histories in Wisconsin, 1993.

Baker, D., Physical Modeling of In Situ Air Sparging, 1996.

Bareither, C., Geological Controls on the Shear Strength of Wisconsin Sands, with T. Edil, 2006.

Bashel, M., Flow Rates in Composite Landfill Liners, 1993.

Baugh, J., Fly Ash Stabilization of Gravelly Soils, with T. Edil, 2008.

Beuermann, S., Dielectric Sensor for Measuring Suction in Dry Soils, 1999.

Bohnhoff, G., Predicting the Water Balance of Alternative Covers Using UNSAT-H, 2005.

Bozyurt, O., Effect of Deleterious Materials on the Mechanical Properties of RAP and RCA, with T. Edil, expected 2011.

Bradshaw, S., Effects of Stress, Hydration, and Ion Exchange on Geosynthetic Clay Liners, 2008.

Camacho, L., Analysis of Landfill Failure Using Three-Dimensional Limit Equilibrium Methods, with T. Edil, 2002.

Camargo, F., Equivalency of Fly-Ash Stabilized RPM and Gravel Base Course, with T. Edil, 2008.

Chen, C., Meteorological Conditions for Design of Monolithic Alternative Earthen Final Covers (AEFCs), 1999.

Chiang, I., Effect of Fines and Gradation on Soil Water Characteristic Curves of Sands, 1998.

Christman, M., Annular Well Seals: A Geophysical Study of Influential Factors and Seal Quality, with T. Edil, 1999.

Cope, D., Treating TCE-Contaminated Groundwater with Gray-Iron Slag, 2007.

Cooper, S., An Evaluation of How Subsurface Characterization Using Soil Classifications Affects Predictions of Containment Transport, 1993.

Dingrando, J., Beneficial Reuse of Foundry Sands in Controlled Low Strength Material, with T. Edil, 1999.

Eberhardt, M., Leaching of Heavy Metals from Gray-Iron Slags with and without Carbonation, 2008.

Elder, C., Modeling Mass Transfer During In Situ Air Sparging, 1996.

Foose, G., Shear Strength of Sand Reinforced with Shredded Waste Tires, 1993.

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IN REPLY REFER TO:

CITY AND COUNTY OF HONOLULU
MAYOR'S ADVISORY COMMITTEE ON LANDFILL SITE SELECTION
WARD WAREHOUSE (1050 ALA MOANA BLVD.)
WARD WAREHOUSE CONFERENCE ROOM - 2ND FLOOR
MEETING NO. 9
FRIDAY, MARCH 16, 2012
9:00 A.M. - 2:00 P.M.

AGENDA

1. Welcome and Introduction

   Purpose: To report to the Committee on the final findings regarding potential sites per the Committee's instructions from the last meeting; and to weight the Community Criteria and apply these weights to the sites.

   Outcome: To have a list of ranked sites for presentation to the City in the final report.

2. Review of Meeting No. 8

3. Public Comments

4. Consultant's Report on Final Site Evaluation

5. Committee's Weighting of Community Criteria

6. Application of Weights to Sites to Achieve Ranking

7. Discussion on the Draft Executive Summary and Final Report

8. Thank You and Adjournment

EXHIBIT A47

Meeting No. 9
Group Memory

Mayor's Advisory Committee on Landfill Site Selection
City and County of Honolulu

March 16, 2012

Attendance:

Committee Members Present: Tom Arizumi, John Goody, Joe Lapilio, Janice Marsters, Chuck Prentiss, David Arakawa, Tesha Malama, George West

Committee Members Absent: Richard Poirier

ENV: Steven Serikaku, Markus Owens, Suzanne Jones

Consultants: Brian Takeda, Mark White, James Dannemiller, Emi Moriuchi

Facilitator: Dee Dee Letts

Public Present: Cynthia K.L. Rezentes, Councilmember Tom Berg, Gina Mangieri, Leila Fujimori, Philmund Lee, Chris Goodin. Other members of the public were also in attendance.

Agenda:

Welcome and Introduction

Review of Mtg. No. 8

Public Comment

Consultant's Report on Final Site Evaluation

Committee's Weighting of Community Criteria

Application of Weights to Sites to Achieve Ranking

Discussion on the Draft Preliminary Executive Summary and Final Report

Thank You and Adjournment

Meeting Notes:

The meeting was held at the Ward Warehouse Kaka'ako Conference Room, starting at 9:00 AM, with a review of the Agenda and Group Memory from Meeting No. 8. The Facilitator next invited comments from any member of the public in attendance.

The following comments were received:

- Ms. Rezentes: The Committee was acknowledged for taking on a difficult task with the following points noted:
    - Consider the impact on the communities that the various trucks would travel through when siting the next landfill. The speaker cited Kikiola as an example

where if the site were to be selected that the landfill truck traffic would pass through the entire Wai'anae Coast.

- o Because the City's instruction to the Committee was to look at sites that would accept all waste, including construction debris, then the likelihood of even more traffic than currently going to the Waimānalo Gulch Landfill is possible. There is presently no quantification of the amount of waste that would be created by rail construction and the City needs to do this analysis.
- o If a 15-year extension is granted to the current site (Waimānalo Gulch Landfill) then the next site should not be on the leeward side.

➢ Councilmember Berg: Regarding Federal lands, they should be taken in to consideration for potential landfill sites. Just because the military says no, it is not a reason to stop evaluating federal sites for a potential landfill. The sites may still be able to be obtained by an Act of Congress or a Presidential Order.

The Consultant next presented the report on the final site evaluation.

First the Consultant reminded the Committee of the constraints on the level of evaluation that can be performed within the permitted timeframe, i.e., that the work was done within the limits of existing City, State, Federal and Real Estate Geographic Information System (GIS) data bases, and information from consulting with various governmental agencies. This is not a substitute for a more formal evaluation such as would be conducted for an Environmental Impact Statement (EIS). Therefore the 464 GIS identified sites were reviewed at a desktop level of analysis. At the direction of the Committee this resulted in the identification of 6 potential sites.

When the consultant reran the sites with the Committee's instruction to relook at parcels that were eliminated only because they had one or more structures as noted on an aerial map, one more potential site was identified. The list of potential sites after this review went from six to seven.

Questions and answers and comments were then discussed:

Q: Why did you remove sites upgradient from existing residential areas due to drainage concerns? These are engineering issues and can be addressed and should not be removed from consideration.
A: If the potential landfill site was above an existing residential area and the drainage would have to go through the area then it was removed.

Q: How many sites were eliminated because they were in capture zones for monitoring wells?
A: When we spoke with the Commission on Water Resource Management (CWRM) they only noted if it was a well and could not further define what its specific use was. As a result they requested that we apply the 1,000 foot buffer to all CWRM well sites.

Q: Did I hear correctly that if a site is in the process, or the City is aware of development potentially moving forward on the site, that the site would not be considered – an example is Makaiwa Hills?
A: We are at present aware of the plans for the Makaiwa Hills subdivision making this site unviable.

Q: Why shouldn't runoff be addressed in the EIS process and those sites that might be impacted identified and passed through that process?
A: It was a judgment decision based on the residential site sharing a border or a highway with the landfill. It was a matter of ensuring that downgradient developed areas would be sufficiently considered in this process.

Q: Why remove these sites now?
A: We know that if it shares a border with a residential area that there might be a runoff issue.

The Committee discussed this matter and requested that the Consultant add back in the sites that were removed because they shared a border with residential developed areas. Some of the reasons for this were to recognize (1) that the exclusion did not necessarily follow the Committee's process; and (2) that a landfill can be properly engineered above such sites. The Consultant agreed to reevaluate and include the sites for consideration and weighting.

C: Waimanalo Gulch Sanitary Landfill was an engineering problem that could have been addressed as was proposed in the design. This means that as an engineering issue a potential landfill site should not be removed for reasons having to do with the presence of downgradient developments.

Q: The problem at Waimānalo Gulch appears to be because it was engineered incorrectly; could proper engineering on a site mitigate runoff problems?
A: Waimānalo Gulch was properly engineered to address runoff, but the combination of delays combined with an extraordinary rainfall event during the construction of the drainage control system created the problem.

C: The cost of development which is one of our criteria would address this issue and therefore potential sites should not be removed from consideration.

C: Should we look at sites that were eliminated just because of [Land Study Bureau] B agricultural lands?

Q: Can you tell us now how many sites were eliminated just because of the runoff question and how many just because they are [LSB] Class B agricultural lands?
A: Give us a minute and we will do the best we can now – the consultant worked with their data base on laptop and came up with 6 sites that were eliminated due to runoff concerns by sharing a common border or street with the proposed sites. The group decided that these should be reconsidered as the community criteria on closeness to residential development would address this in the ranking process. There were no sites identified that were eliminated just because of the [LSB] Class B agricultural lands.

Q: Why are we giving up on federal lands just because we get a letter from the branch of the service that it is not available?
A: If they are not willing to declare it excess then it is difficult and time consuming to pursue with a small chance of success. The current processes available to obtain Federal lands would be a Congressional Act or a Presidential Executive Order. We have been informed that both processes are very difficult to obtain and process, and could add years to the siting process.

C: We should contact someone who knows the process. As it is not impossible, these sites should not be automatically removed.

Q: What do you mean by federal sites?
A: Non active military or other federal sites owned by the U. S. Government.

Q: Parcel 62 is an example of federal lands it is 379 acres and is classed as B agricultural lands – shouldn't we look at these – can you tell us how many there are?
A: There may be 66 or more parcels and it is not possible with our current level of detail to say how many are active military and how many are not as they were eliminated early.

C: You need to look at this and especially check if any of the parcels have been declared excess or surplus federal land.

The group had extensive discussion about adding back in federal lands. Some Committee members felt that they were unlikely to be available and that the complex and long process that would need to be pursued was not viable and that they should not be added back in. One Committee member noted that they had accomplished consulting work for the military and based on their experience it would not be time efficient to pursue these lands due to the length of the process and low likelihood of success.

Others felt that in the interest of doing as thorough a job as possible, and to have a highly defensible product, that the Committee should ask that the Consultant add back in any federal sites that passed all the existing screening factors for further analysis. This action was agreed to by the Committee in part because of the difficulty of finding appropriate land on O'ahu for landfilling and not wanting to miss any alternatives. The request is that only federal lands outside the UIC line be looked at.

The Committee next reviewed the Community Criteria prior to performing the weighting exercise. Jim Dannemiller of SMS reviewed the criteria noting only a few changes:

> Criterion 7 – Wind Direction: Changed to address average wind direction
>
> Criterion 20 – Quality of Agricultural Lands: Removed at the request of the Committee based on the consideration of agricultural land in the Screening Factors.

The Consultants and the City excused themselves from the meeting while the Committee weighted the criteria. The Committee weighted the criteria individually and then as a group. The Committee discussed the results of the group weighting exercise and after much discussion on the pros and cons associated with the weights requested the Consultant's advice on how the weighting would work when there are some remaining equally weighted criteria. Jim Dannemiller advised the Committee that even with tied votes, it is possible to further refine the weighting exercise so that there would be no tied weights between the criteria. The Committee used the guidance offered and reweighted the remaining criteria to establish a separate weight for each of the remaining 19 criteria.

The results of the weighting were not shared with the City or the Consultant at this time as the Consultant still needs to assess and run the criteria in relation to the sites that were added back onto the list due to the day's discussions.

The Committee next discussed the draft report and identified any general recommendations they wanted to add to the report. The following discussions were proposed to be added:

- There needs to be a discussion as to why the Committee felt it was necessary to look for sites inside the UIC line/No Pass Zone.
- The City needs to adopt a philosophy that everything that goes into a landfill may become a resource that can be recovered in the future – they need to take this philosophy into account when they advertise for an operator – to ensure that the operator selected will prepare the use of the landfill for the future recovery of disposed materials via mapping or other techniques.
- Host Community Benefits should be embraced as a concept and details should be negotiated with the affected community.

The meeting ended at about 2:30 PM. The next meeting was set for early April starting at 9:00 AM with a place to be determined.

Criterion 1: Landfill Capacity

Criterion Definition

Landfill capacity is the volume required to fill the landfill site at the future projected fill rates.

Rationale

A landfill site with a longer capacity is preferred over a site with less capacity. A minimum capacity of 15 years was established by the MACLS with input from ENV. It was decided that 15 years was the minimum life needed to justify the cost of acquiring, permitting, and constructing a new landfill. All of the sites evaluated during this project have estimated capacities greater than 15 years.

Measurement

Measurement was carried out in six steps: (1) a temporary site footprint was established at each site; (2) the usable landfill area was calculated as the total area of the footprint minus the area needed for landfill support facilities and other solid-waste related activities; (3) the total volume in cubic yards was estimated from the area of the top and bottom surfaces of the landfill and the distance between the surfaces; (4) the available volume of MSW that can be placed in the site was estimated as total volume minus the volume of soil and other materials needed for the liner, leachate, and gas controls, and for daily, intermediate, and final cover; (5) the available volume was converted to tons of MSW and H–POWER ash using the compacting factors that are being achieved at the WGSL; and (6) the capacity in tons was converted to capacity in years by estimating the amount of ash and MSW to be produced each year until the landfill capacity is reached. Capacity in years for each site (raw data) was then transformed to a ten-point scale with endpoints defined as shown below.

Point Value	Measure Assigned
1	The site with the least capacity needed to fill the landfill site.
10	The site with the greatest capacity needed to fill the landfill site.

Data Source

Honolulu Land Information System

Data and Measurement Issues

The landfill volume estimate is based on desktop review of the site so the volume should be expected to be refined with more detailed engineering.

<table>
<tr><th colspan="7">Calculation Detail</th></tr>
<tr><th rowspan="2">Site Num.</th><th rowspan="2">Site name</th><th rowspan="2">TMK</th><th colspan="4">Landfill Capacity</th></tr>
<tr><th colspan="2">Detail (Census Block)</th><th>Raw Score</th><th>Scaled Score</th></tr>
<tr><td>1</td><td>Site 1</td><td>00000001</td><td colspan="2"></td><td>00000001</td><td>#DIV/0!</td></tr>
<tr><td>2</td><td>Site 2</td><td>00000002</td><td colspan="2"></td><td>00000002</td><td>#DIV/0!</td></tr>
<tr><td>3</td><td>Site 3</td><td>00000003</td><td colspan="2"></td><td>00000003</td><td>#DIV/0!</td></tr>
<tr><td>4</td><td>Site 4</td><td>00000004</td><td colspan="2"></td><td>00000004</td><td>#DIV/0!</td></tr>
<tr><td>5</td><td>Site 5</td><td>00000005</td><td colspan="2"></td><td>00000005</td><td>#DIV/0!</td></tr>
<tr><td>6</td><td>Site 6</td><td>00000006</td><td colspan="2"></td><td>00000006</td><td>#DIV/0!</td></tr>
<tr><td>7</td><td>Site 7</td><td>00000007</td><td colspan="2"></td><td>00000007</td><td>#DIV/0!</td></tr>
<tr><td colspan="3">Raw score data is measured in</td><td>Cubic yards</td><td>Range</td><td>-</td><td rowspan="2"></td></tr>
<tr><td colspan="3">Scale direction: 1 = normal scaled score; 0 = inverted scale score</td><td>0</td><td>Maximum</td><td>-</td></tr>
</table>

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the highest raw score is set at 1 and the lowest raw score is set at 10.

Oahu Landfill CCE Site Score Sheets

Criterion 2: Location Relative to Educational Institutions, Health Care Facilities, or Parks and Recreation Facilities

Criterion Definition

Distance measured between subject facilities and landfill. Entities include schools: any school for children up to age 18, public or private, academic or vocational, and public and private colleges and universities but exclude commercial training institutions for adults covered in Criterion 5; health care facilities: any medical or dental health center or office, hospitals (general, specialized, rehab), skilled nursing facilities, clinics (except school clinics), day care or elderly day care, and outpatient surgery centers; public recreational facilities: national, state, and county parks, sports facilities, playgrounds (except school playgrounds), zoos, and community meeting centers.

Rationale

The closer a potential site is to the subject facilities the greater the potential impact of a landfill at that location. This criterion assigned lower site values to sites located near these facilities

Measurement

Measurement was conducted in three steps. First, identify all facilities defined above near the site. Second, measure the distance from the boundary of each facility to the boundary of the landfill footprint. Third, determine the nearest facility and input its distance to the site footprint as the raw score for the site. The raw distances were then transformed to a ten-point scale defined as shown in the table below.

Point Value	Measure Assigned
1	Shortest distance from the nearest school, health care facility park or recreational facility.
10	Greatest distance from the nearest school, health care facility park or recreational facility.

Data Source

Data taken from Google Earth and C&C HoLIS. Any change to the currently assigned footprints may result in minor changes to the findings shown here.

Data and Measurement Issues

None

Calculation Detail					
Site Num.	Site name	TMK	Location Relative to Educational Institutions, Health Care Facilities, or Parks and Recreation Facilities		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			miles	Range	4.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 3: Location Relative to Residential Concentrations

Criterion Definition

Distance measured between residential concentration to landfill site. A residential concentration is defined as one or more residential housing units. This criterion does not include visitor accommodations covered in Criterion 5.

Rationale

The closer a potential site is to concentrations of residential development the greater the potential impact of a landfill at that location. This criterion assigned lower values to landfill sites located near residential concentrations.

Measurement

All existing residential concentrations near the landfill site were identiifed. The distance from the landfill to footprint the nearest residential unit in each concentration was calcuated from the property line nearest the landfill to the footprint boundary of the site. The shortest distance calculated was entered as the raw score. Raw scores were transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Shortest distance from the nearest residential concentration.
10	Greatest distance to the nearest residential concentration.

Data Source

Residences were identified using Tax Map Key (TMK) maps as well as the HoLIS system and TerraMetrics google satellite maps.

Data and Measurement Issues

Where the nearest building was a single unit it was sometimes difficult to determine whether that unit was a residence or commerical structure.

Calculation Detail					
Site Num.	Site name	TMK	Location Relative to Residential Concentrations		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			miles	Range 5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum 7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 4: Location Relative to Visitor Accommodations

Criterion Definition

Distance measured between visitor accommodations and landfill site. Visitor accommodations include hotels, motels, vacation condominium units, time-share units, and hostels. Bed and breakfast and temporary visitor rentals are covered in Criterion 3.

Rationale

The closer a potential site is to visitor accommodations the greater the potential impact of a landfill at that location. This criterion assigns lower scores to sites located nearer to visitor accommodations

Measurement

All visitor accommodations near the landfill site were identified. The distance between the footprint boundary of the landfill site and the boundary of the visitor accommodations property were measured. The shortest distance from a visitor accommodation and the landfill footprint was entered as the raw score. Distances were transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Shortest distance from the nearest visitor accommodations facility.
10	Farthest distance from the nearest visitor accommodations facility

Data Source

The City and County of Honolulu's HoLIS system was used. Where HoLIS did not locate a visitor accommodation near the suite, Google Earth was used to confirm the finding.

Data and Measurement Issues

Using just the City and County of Honolulu's HoLIS system is insufficient in determining if there is an existing visitor accommodation. Google Earth is required to determine the presence of visitor accommodations. The "hotels/motels" box was checked in order to detect existing visitor accommodations.

Calculation Detail					
Site Num.	Site name	TMK	Location Relative to Visitor Accommodations		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			years / Range	6.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1 / Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 5: Location Relative to Local or Visitor Commercial Facilities

Criterion Definition

The distance measured between commercial facilities and the landfill site. Commercial facilities include stores, shopping centers, and office buildings. Local and visitor commercial facilities include visitor centers, major attractions (public and private), museums, post offices, and fire stations. Medical office buildings are included in Criterion 2.

Rationale

The closer a potential site is to visitor and commercial facilities the less desirable that site is because of the greater potential impact of a landfill at that location. This criterion assigns lower value to sites located close to visitor commercial facilities.

Measurement

All local or visitor commercial facilities near the landfill site were identified. The distance between the footprint boundary of the landfill site and the boundary of the commercial facilities were measured along roadways identified. The shortest distance from a visitor accommodation and the landfill footprint was entered at the raw score. Distances were transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Shortest distance from the nearest local or visitor commercial facility.
10	Greatest distance from the nearest local or visitor commercial facility.

Data Source

State of Hawaii GIS maps (HoLIs), TerraMetrics satellite maps, and City and County of Honolulu map information.

Data and Measurement Issues

None.

Calculation Detail					
Site Num.	Site name	TMK	Commercial Facilities		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			years	Range 5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum 7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 6: Effect on Established Public View Planes

Criterion Definition

A view plane is the unobstructed view from an offsite location to the operating area of a landfill site. View planes have been established by the City and County for many areas, and those determinations were used for this criterion.

Rationale

Visual impact is one of the common impacts of a landfill if the operating area cannot be hidden by a ridge or vegetation. This criterion will provide a measure of the visual impact.

Measurement

Evaluate City-defined scenic viewplanes and applicability to the site. Evaluate "visibility" or level of exposure of the site to public access roads. The nearest public road from the landfill site footprint was used as the basis for measurement. Along the roadway samples of views were taken at 5 points. The first point is nearest to the landfill site on the nearest public road. The 2nd point is 1/4 mi of road in one direction from the 1st point. The 3rd point is 1/4 mi of road in the other direction from the 1st point. The 4th point is 1/2 mi of road in one direction from the 1st point. The 5th point is 1/2 mi of road in the other direction from the first point. However, in some cases it was not appropriate to take sample view points going in certain directions because of obvious obstructions. Sometimes sample view points were taken in one direction that had the most potential for an unobstructed viewplane. This measurement attempted to take the "qualitative" aspect out of the scoring, sites either had a view plane or not.

Point Value	Measure Assigned
1	Any obstruction of established view plans.
10	No obstruction of established public planes.

Data Source

Google Earth, C&C Honolulu HOLIS shape file "Public_Street_Centerline.shp", and Hawaii State GIS shape file "cr

Data and Measurement Issues

Street view images of Google Earth may not be up to date and/or data was not available. Also, a view plane was determined if it was suspected that any portion of the footprint would be visible. Therefore sites that may have raw scores ranked the same in terms of having the same number of sample points having a view plane, sites may be significantly more exposed than others.

Calculation Detail					
Site Num.	Site name	TMK	Effect on Established Public View Planes		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			quarters	Range 5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum 7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 7: Wind Direction Relative to Landfill Site

Criterion Definition

The prevailing wind direction and velocity is measured by data available for a location near each landfill site relative to the location of residential concentrations, visitor accommodation facilities, and commercial land uses.

Rationale

Wind can affect areas near landfill by transmitting dust, litter, and odor from a landfill to a receptor. In general, a site with weaker prevailing wind in a direction other than toward populated areas, is preferred over one with strong prevailing winds blowing toward a populated area for a large percentage of the year.

Measurement

An index of wind impact was developed by multiplying the maximum annual wind speed by the percentage of time wind blows in the direction of the nearest residential concentration. Wind speed and direction were measured at the nearest meteorological station. The receptors (usualy populated areas) are indicated in the calculation details table. The index of wind impact was entered as the raw score for each landfil site. The raw scores were then transfored to a ten point scale with the orientation shown below.

Point Value	Measure Assigned
1	The site with the least appropriate wind pattern (wind impact index)
10	The site with the most appropriate wind pattern (wind impact index)

Data Source

Meteorological stations located nearest to the landfill site was used for the data for that site. The source of the data was DOH weather stations, a study of wind resources done by HECO, and a study of wind resources done for the MCAS Kanehoe Bay.

Data and Measurement Issues

A higher wind speed will reduce the odor impact on closer receptors and increase the impact of litter on receptors further away. Meteorological stations are located in areas that may not represent the conditions at the landfill sites.

Calculation Detail					
Site Num.	Site name	TMK	Wind Direction Relative to Landfill Site		
			Location of Wind Data	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			Index Score / Range	5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1 / Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 8: Effect on Local Roads and Traffic in Residential Neighborhoods

Criterion Definition

The criterion describes the effect of landfill-induced traffic on residential neighborhoods through which MSW trucks must travel to reach the site. The definition of traffic impact is the distance between the residential housing units and the landfill site. This distance measured is between the roadway used by the MSW trucks which travels along existing State highway on a local roadways.

Rationale

A potential landfill site that causes less traffic through residential neighborhoods is prefered over sites that generate larger amounts of traffic longer trips through residential homes (house passed.) This criterion measures the impact of additional traffic in a residential area. The cost of upgrading the roadway (a form of mitigation) is measured by Criterion 9. Road access to the potential landfill site is based on whether there is an access road available regardless of its condition (i.e. improvement needed). Estimated distance of the access road was measured from the entry/exit of the site to the nearest residential concentration.

Measurement

The subject roadway was selected as the shortest route between the point at which MSW trucks would likely leave the highway and the likely entry to the landfill footprint. Maps were used to indentify residential housing units along the identifed path. Both occupied and vacant units were included and multi family units were counted as one unit. The distance between the roadway and the residential concentrations was entered as the raw score. Those distance counts were then transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Greatest distance between the local roadways in the residential neighborhood and LS.
10	Smallest distance between the local roadways in the residential neighborhood and LS.

Data Source

State of Hawaii GIS maps, City and County of Honolulu HoLis System, Google Earth database.

Data and Measurement Issues

The route selected for MSW trucks may change. Distance measured may change if additional residential units are constructed between now and the date of the new landfill opening. The distance between any new housing units in each multi family residential building can be obtained to improve the measurments shown here. The method of observation may have included some commercial establishments which may overestimate the nearest units passed.

Calculation Detail					
Site Num.	Site name	TMK	Effect on Local Roads and Traffic in Residential Neighborhoods		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			Miles	Range	5.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 9: Wear and Tear on Highways and Roadways Caused by Landfill Related Traffic

Criterion Definition

This criterion considers the extent to which developing siting a landfill at a specific site results in deterioration of existing roadways. The deterioration is measured as the cost of upgrading the subject roadways(s) to a level consistent with MSW track traffic.

Rationale

A potential site that produces less roadway deterioration, and thus less cost for roadway upgrading, is preferred over a site that will cause greater deterioration and require greater roadway upgrade expenditures.

Measurement

Roadways between the State highway and the landfill site were identified and roadway type was established. Distance along the path from the highway to the site were measured and determination was made as to the extent of upgrade required to carry heavy truck traffic. The cost of the required upgrades calculated in current dollars. Calculation included construction and maintenance costs for 15 years. Average construction costs per mile were multiplied by the miles of roadway improvement required, and those dollars were entered as raw scores. The raw scores were then transformed to a ten-point scale with orientation as shown below.

Point Value	Measure Assigned
1	Highest upgrading cost which includes construction and maintenance cost for 15 years.
10	Lowest upgrading cost which Includes construction and maintenance cost for 15 years.

Data Source

Sources used: Need maps, construction costs sources, roadway type sources.

Data and Measurement Issues

None

Calculation Detail					
Site Num.	Site name	TMK	Wear and Tear on Highways and Roadways Caused by Landfill Related Traffic		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			Dollars	Range	5.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 10: Location Relative to Identified Community Disamenities

Criterion Definition

This criterion considers the relative number of "disamenities" currently exist in the larger community in which the potential landfill exists. Community disamenities include wastewater treatment plants, slaughterhouses, other landfill sites, public housing, correctional facilities, operating quarry sites, and power plants. The community was defined as the ahupua`a in which the landfill site is located.

Rationale

The MACLS wanted to avoid locating a landfill in an area that already has many community disamenities. Locating a landfill in an area with few existing disamenities was considered to be more just that locating it in a community that already has several disamenities.

Measurement

Maps were used to identify the ahupua`a in which each landfill site was located. Then the number of disamenities within the Ahupua'a for that site were counted. That number of disamenities was entered as the raw score. The raw scores were then transformed to a ten-point sc ale with the orientation noted below.

Point Value	Measure Assigned
1	Highest number of disamenities existing in an LS area.
10	Lowest number of disamenities existing within any LS area.

Data Source

The Ahupua'a maps available from Bishop Museum (circa 1850) were used to describe the communities in which the landfill sites were located. Disamenities were identified using real property data, Google earth map, C&C HoLIS and lists of public projects, including Hawaiian Electric Company website, Oahu correctional facility list, and the C&C mayor's advisory committee on landfill site selection notes (2011).

Data and Measurement Issues

As the ahupua'a map is only available in print, it is sometimes difficult to identify a ahupua'a in which footprint is located. The ahupua'a noted in the table below is the best estimate of the location of the footprint.

Calculation Detail						
Site Num.	Site name	TMK	Ahupua'a	Location Relative to Identified Community Disamenities		
				Detail	Raw Score	Scaled Score
1	Site 1	00000001	Site 1.1	000000000000008	1	1
2	Site 2	00000002	Site 2.2	000000000000009	2	1
3	Site 3	00000003	Site 3.3	000000000000010	3	1
4	Site 4	00000004	Site 4.4	000000000000011	4	1
5	Site 5	00000005	Site 5.5	000000000000012	5	1
6	Site 6	00000006	Site 6.6	000000000000013	6	1
7	Site 7	00000007	Site 7.7	000000000000014	7	1
Raw score data is measured in				number	Range	5.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score				1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 11: Location Relative to H-Power

Criterion Definition

Distance measured between the H-Power facility and the landfill site. The measurement includes the distance along suitable truck accessible roadways from the H-POWER facility to the landfill site. This criterion measures the additional cost of a site that is more than 12 miles from H–POWER.

Rationale

A landfill site with lower transportation costs was preferred. The H-POWER contract provides cost adjustments for distances greater than 12 miles.

Measurement

The distance was measured in miles along suitable truck-accessible roadways from the H-Power facility to each landfill site. The excess distance was calculated by subtracting 12 miles from the total distance. The excess distances were transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Greatest distance along suitable truck-accessible roadways from H-POWER facility to each LS.
10	Shortest distance along suitable truck-accessible roadways from H-POWER facility to each LS.

Data Source

The distance was measured using Google Earth from the point at which the landfill access road intersected the public road.

Data Issues and Measurement Discussion

None.

Calculation Detail					
Site Num.	Site name	TMK	Location Relative to Power House		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			miles	Range	5.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 12: Effect of Precipitation on Landfill Operations

Criterion Definition

Precipitation is the predicted amount of rainfall at a landfill site. The 24-hour duration and the 100-year average recurrence interval (also referred to as peak events) are used to select the rainfall data to be used. The duration and recurrence intervals in the State landfill regulations are 24-hour duration and the 25-year average recurrence interval, so this criterion exceeds state requirements.

Rationale

Precipitation affects landfill operations by reducing the efficiency of earthmoving machinery, generating leachate, and making it more difficult to manage discharge from the site. The MACLS was particularly concerned with problems that might result from unusually severe storms. Peak event rainfall describes the worst-case potential for negative impact of those storms. A landfill site with lower peak event rainfall is preferred over a site with heavier peak event rainfall.

Measurement

For each landfill site, the watershed area above the site was identified on maps. Several points along the ridgeline within the watershed, whether inside or outside the site boundaries, were identified for inspection. The latitude and longitude of each of those points was identified on maps, and the 100-year peak rainfall was identified for that point in NWS records. The greatest 100-year peak rainfall was recorded in inches of precipitation identified per hour and entered as the raw score for the landfill site. The raw peak even rainfall was then transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Greatest rainfall in inches per hour.
10	Least rainfall in inches per hour.

Data Source

Google Earth maps were used to identify watershed areas and identify the latitude and longitude of precipitation measurement locations. The National Weather Service records were used to identify precipitation intensity and duration for those locations.

Data Issues and Measurement Discussion

Peak event precipitation is dependent on past rainfall measurements. It is possible that greater rainfall may occur in the future. The extent of uncertainty is equal for all sites, therefore the relative scores assigned to each site will severe as a reasonable measure of peak event problems at each site.

Calculation Detail					
Site Num.	Site name	TMK	Effect of Precipitation on Landfill Operations		
			Location of Max Rainfall	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			inches/hour Range	5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1 Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 13: Landfill Development, Operation and Closure Cost

Criterion Definition

This criterion is an estimate the cost of landfill operations in 2021 (the first year of operation). The net present value of the cost of acquisition, development, and closure over the number of years the landfill will be in operation is added to get a total estimated annual cost. In addition the cost of purchasing the land, costs include storm water control and treatment, drainage facilities to handle peak rain events, soil suitability for daily cover; and cost to purchase the land.

Rationale

The cost of a new landfill is an important consideration. Site-specific factors can make the cost of one site significantly different than another. This criterion measures that difference.

Measurement

The cost of acquisition, development, operation, and closure divided into the cubic yards of capacity is calculated. The ratio for all the sites are transformed into deciles where 1 is the highest estimated cost/cubic yard of capacity and 10 is the lowest estimated cost.

Point Value	Measure Assigned
1	The highest estimated annual cost per cubic yard of landfill life in 2021 for all sites.
10	The lowest estimated annual cost per cubic yard of landfill life in 2021 for all sites.

Data Source

Comparative cost for Waimanalo Gulch Solid Waste Landfill, property tax records, and current road costs.

Data Issues and Measurement Discussion

None.

Calculation Detail					
Site Num.	Site name	TMK	Landfill Development, Operation and Closure Cost		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			dollars	Range	5.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 14: Displacement Cost

Criterion Definition

This criterion considers the cost of displacing an existing commercial operation on or near a potential landfill site. The cost is considered to be the reduction in economic value to the county due to the loss of business at the site. The loss of revenue and cost of relocation accruing to the owner of the commercial operation are covered in Criterion 13.

Rationale

The MACLS wanted to avoid use of landfill sites that would displace important elements of industry in the City & County of Honolulu. Use of a site that would displace commercial operations in the visitor or agricultural industry, for example, would be contrary to the General Plan. This criterion attempts to measure the economic value of displaced commercial activity.

Measurement

Commercial operations for each site were identified. The economic value of production (gross revenues), total payments to local employees (gross payroll), and number of jobs (FTE employees) were estimated annually for each of the last five years. The direct value of the business was the sum of revenues and payroll. Indirect and induce costs were estimated using IO Model multipliers and the total induced value sales and payroll were entered as the raw score for displacement cost. The raw scores were transformed to a ten-point scale with the orientation shown below.

Point Value	Measure Assigned
1	The site with the highest estimated displacement cost.
10	The site with the lowest estimated displacement cost.

Data Source

HoLIS maps were used to identify existing commercial operations within the TMK boundaries of each landfill site. The value of operations were taken from public financial records. Payroll records for quarry workers were referenced from Hawaiian Cement VP's verbatim reported on 2004 StarBulletin newspaper.Tax base data and multipliers for indirect and induced economic value were taken from the DBEDT READ I-O Model.

Data Issues and Measurement Discussion

Estimating displacement cost is a complex process and one subject to many subjective decisions.

Calculation Detail					
Site Num.	Site name	TMK	Displacement Cost		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			dollars	Range	5.00
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 15: Potential for Solid Waste- Related Land Uses

Criterion Definition

This criterion measures acres of land within the site to accommodate businesses that would benefit from operating close to the landfill (e.g., metal and other material recyclers).

Rationale

If a site has adequate space for solid waste related activities it can be more cost effective for such activities to co-locate with the landfill. This criterion identifies whether a site has space that could be used for other activities and is not needed for landfill-related activities.

Measurement

Estimated the acres of developable land not suited for landfill. Transform the range of acres into deciles where 1 is the least acreage available for solid waste related uses and 10 is the greatest acreage available.

Point Value	Measure Assigned
1	Least acreage available for solid waste related uses.
10	Greatest acreage available for solid waste related uses.

Data Source

The topographic map of the site and the preliminary landfill layout.

Data Issues and Measurement Discussion

Areas that were designated Impaired Waterways or CWRM well offset were considered acceptable for the recycling area (but not for use as landfill space).

Calculation Detail						
Site Num.	Site name	TMK	Potential for Solid Waste-Related Land Uses			
			Detail		Raw Score	Scaled Score
1	Site 1	00000001	000000000000008		1	1
2	Site 2	00000002	000000000000009		2	1
3	Site 3	00000003	000000000000010		3	1
4	Site 4	00000004	000000000000011		4	1
5	Site 5	00000005	000000000000012		5	1
6	Site 6	00000006	000000000000013		6	1
7	Site 7	00000007	000000000000014		7	1
Raw score data is measured in			Acres	Range	5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1	Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criteria 16: Location Relative to Wetlands and Natural Area Reserve Systems (NARS)

Criterion Definition

This criterion measures the distance between the landfill boundary and the nearest boundary of a parcel that contains a wetland or is part of a reserves natural reserve area classified by the Natural Area Reserve Systems (NARS).

Rationale

A landfill site at greater distance from wetlands is preferred over a site that occupies or is near wetland areas.

Measurement

All wetlands and NARS sites near each landfill site were identified. Distances were measured in miles along a point-to-point aerial path from the nearest boundary of the wetlands or NARS site to the nearest point on the footprint of the potential landfill site. The shortest distance for each site was entered as the raw data for each site. The raw data were then transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	The site with the shortest distance between the LS boundary and a parcel classified as containing wetlands or a NARS area .
10	The site with the greatest distance between the LS boundary and a parcel classified as containing wetlands or a NARS area.

Data Source

Hawaii State GIS shape files "NaturalAreaReserve.shp", " wetlnds_ln_n83.shp", "wetlnds_py_n83"

Data Issues and Measurement Discussion

All distances will be rounded to the nearest tenth of a mile. Raw score will be a distance value.

Calculation Detail					
Site Num.	Site name	TMK	Location Relative to Wetlands and Natural Area Reserve Systems Land (NARS)		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	-17
2	Site 2	00000002	000000000000009	2	-13
3	Site 3	00000003	000000000000010	3	-8
4	Site 4	00000004	000000000000011	4	-4
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	6
7	Site 7	00000007	000000000000014	7	10
Raw score data is measured in			miles	Range	2.00
Scale direction: 1 = normal scaled score; 0 = inverted scale			1	Maximum	7.00

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

*Wetland code

Criterion 17: Location Relative to Listed Threatened and Endangered Species

Criterion Definition

This criterion considers the distance from the landfill footprint to parcels classified as a habitat for listed threatened or endangered plants or animals.

Rationale

A landfill site at a greater distance from a habitat for listed threatened or endangered plants or animals is preferred over a site at a lesser distance from these habitats.

Measurement

All habitats for threatened or endangered species of plans and animals near each landfill site were identified. Distances were measured in miles along a point-to-point aerial path from the nearest boundary of the habitat to the nearest point on the footprint of the potential landfill site. The shortest distance for each site was entered as the raw data for each site. The raw data were then transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	The site with the shortest distance between the LS boundary and a parcel classified as containing a habitat for endangered species.
10	The site with the greatest distance between the LS boundary and a parcel classified as containing habitat for endangered species.

Data Source

Plant habitats were identified in DLNR documents and animal habitats were identified in the U. S. Fish & Wildlife Service

Data Issues and Measurement Discussion

None.

Calculation Detail					
Site Num.	Site name	TMK	Location Relative to Listed Threatened and Endangered Species		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in		miles	Range	5.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score		1	Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 18: Surface Water Resources

Criterion Definition

This criterion measures the potential at each landfill site to discharge untreated storm water from the landfill to identified perennial or intermittent streams classified as important streams or into class AA marine waters.

Rationale

In general, a site with none or only a small chance of discharging untreated storm water into streams or the ocean is preferred over one with a greater potential for untreated water discharge. The MACLSS combined stream and ocean criteria to indicate equal concern for discharge into any surface water.

Measurement

All Class 1 perennial or intermittent streams and class AA marine waters (critical surface waters) within or near each potential landfill site were identified. Critical surface waters determined to be up-gradient of a landfill footprint were eliminated from further consideration. Sites that contained critical surface waters within the landfill footprint were assigned a raw score of zero. Then the distance between other critical surface waters and the nearest point on the landfill footprint was measured along a point-to-point aerial path. The shortest distance from each site was entered as the raw data for this criterion. The raw data were then transformed to a ten-point scale with the orientation shown below.

Point Value	Measure Assigned
1	The site with the shortest distance to the nearest Class 1 perennial or intermittent stream of Class AA marine waters.
10	The site with the greatest distance to the nearest Class 1 perennial or intermittent stream of Class AA marine waters.

Data Source

State of Hawai'i, Department of Health, Water Quality Standards Maps; Hawai'i Administrative Rules, Chapter 11-54, Water Quality Standards Map (digitized polygons) and Hawaii State GIS shape file "Class Water"

Data Issues and Measurement Discussion

All distances will be measured to the nearest hundredth of a mile.

Calculation Detail					
Site Num.	Site name	TMK	Surface Water Resources		
			Critical Surface Water Type	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			Binary measure / Range	1.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1 / Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 19: Archeological and Culturally Significant Resources

Criterion Definition

Archaeological and cultural resources include all sites listed or eligible for listing on the State Register of Historic Places or are identified as a culturally significant site by the DLNR, State Historic Preservation Division (SHPD).

Rationale

A better landfill site will not be located close to archaeological and cultural resources.

Measurement

This criterion measures the number of miles along a point-to-point aerial path from the archaeological and cultural resources to the site. The range of measurements is transformed into deciles as shown in the table below.

Point Value	Measure Assigned
1	Known area(s) of significant archaeological and/or historical importance have been listed in areas within 0.25 miles of the site.
5	Known area(s) of significant archaeological and/or historical importance have been listed in areas within 0.25 and 0.5 miles of the site.
10	Known area(s) of significant archaeological and/or historical importance have been listed in areas greater than 0.5 miles of the site.

Data Source

A lengthy list of archaeological studies was used to develop data for this Criterion; see Appendix.

Data Issues and Measurement Discussion

Two problems are suggested. First, the scoring system may not be the most effective one; it does not distinguish between sites with resoruces in the footprint and those with resources within 0.25 miles of the footprint, and it makes an unused distinction between distances from 0.25 and 0.5 mile away, and those 0.5 or more miles from the footprint. Second, it may not be appropriate to assign a point value of zero to a site that has not been studied.

Calculation Detail					
Site Num.	Site name	TMK	Archeaological and Culturally Significant Resources		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			miles Range	4.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale score			1 Maximum	7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Criterion 20: Quality of Agricultural Lands

Criterion Definition

This criterion considers the suitability of the soils for agricultural uses at each landfill site. Note that all qualified sites were previously qualified for consideration as landfill site because there was sufficient non-prime agricultural land on the site in which to locate a landfill footprint. This criterion deals with prime agricultural land nearby the site.

Rationale

The MACLS wanted to avoid using prime agricultural lands or ALISH prime lands as the lanfill site. This criterion evaluates the quality of agricultural lands, if any, near the landfill site.

Measurement

Any ALISH land classified as prime, unique, or other important agricultural land located near the proposed landfill site, was identified. The distance between the nearest boundary of the identified parcel and the landfill footprint boundary was measured in miles along a point-to-point aerial path. The smallest distance for each site was entered as the raw score. Raw scores were transformed to a ten-point scale with the orientation noted below.

Point Value	Measure Assigned
1	Prime agricultural land.
5	Unique agricultural land.
10	All other land.

Data Source

The State of Hawaii Agricultural Land Use of Hawaii maps serve as a basis for evaluation, as located in the Hawaii State GIS shape file "alish_n83.shp"

Data Issues and Measurement Discussion

All distances will be rounded to the nearest 10th of a mile.

Calculation Detail					
Site Num.	Site name	TMK	Quality of Agricultural Lands		
			Detail	Raw Score	Scaled Score
1	Site 1	00000001	000000000000008	1	1
2	Site 2	00000002	000000000000009	2	1
3	Site 3	00000003	000000000000010	3	1
4	Site 4	00000004	000000000000011	4	1
5	Site 5	00000005	000000000000012	5	1
6	Site 6	00000006	000000000000013	6	1
7	Site 7	00000007	000000000000014	7	1
Raw score data is measured in			Miles	Range 3.00	
Scale direction: 1 = normal scaled score; 0 = inverted scale			1	Maximum 7.00	

Note: Normal scaled score is used when the raw data and the scaled score have the same direction, low to high. The higher score is preferred and thus the highest score is set at 10 and lowest score is set at 1. In cases where the lower score is preferred, the scale is inverted, i.e., the lowest raw score is set at to and the highest score is set at one.

Appendix A

Wetland Code Description From USFWS

Description for code PEM1C :

Description for code PEM1C :
P System PALUSTRINE: The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, emergents, mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 ppt. Wetlands lacking such vegetation are also included if they exhibit all of the following characteristics: 1. are less than 8 hectares (20 acres); 2. do not have an active wave-formed or bedrock shoreline feature; 3. have at low water a depth less than 2 meters (6.6 feet) in the deepest part of the basin; 4. have a salinity due to ocean-derived salts of less than 0.5 ppt.
Subsystem :
EM Class EMERGENT: Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.
1 Subclass Persistent: Dominated by species that normally remain standing at least until the beginning of the next growing season. This subclass is found only in the Estuarine and Palustrine systems.

Modifier(s):
C WATER REGIME Seasonally Flooded: Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

Description for code PSS3C :
P System PALUSTRINE: The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, emergents, mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 ppt. Wetlands lacking such vegetation are also included if they exhibit all of the following characteristics: 1. are less than 8 hectares (20 acres); 2. do not have an active wave-formed or bedrock shoreline feature; 3. have at low water a depth less than 2 meters (6.6 feet) in the deepest part of the basin; 4. have a salinity due to ocean-derived salts of less than 0.5 ppt.
Subsystem :
SS Class SCRUB-SHRUB: Includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.
3 Subclass Broad-Leaved Evergreen: Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more; e.g. red mangrove (Rhizophora mangle).

Modifier(s):
C WATER REGIME Seasonally Flooded: Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

Description for code R4SBC :
R System RIVERINE: The Riverine System includes all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water or which forms a connecting link between the two bodies of standing water. Upland islands or Palustrine wetlands may occur in the channel, but they are not part of the Riverine System.
4 Subsystem INTERMITTENT: This Subsystem includes channels that contain flowing water only part of the year, but may contain isolated pools when the flow stops.
SB Class STREAMBED: Includes all wetlands contained within the Intermittent Subsystem of the Riverine System and all channels of the Estuarine System or of the Tidal Subsystem of the Riverine System that are completely dewatered at low tide.
Subclass :

Modifier(s):
C WATER REGIME Seasonally Flooded: Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

Appendix B
Oahu Landfill Road Study
0% Cost Estimate

AMERON QUARRY				
TMK: 4-2-015:001				
DESCRIPTION	**QTY**	**UNIT**	**UNIT PRICE**	**TOTAL**
Proposed driveway connection to Kapaa Quarry Place				
A.C. Pavement 2 1/2" thick, in place complete.	34	TON	$200.00	$6,800.00
Base Course 6" thick, in place complete.	38	CY	$300.00	$11,400.00
Subbase Course, 12" thick, in place complete.	75	CY	$65.00	$4,875.00
			TOTAL	$23,075.00
NOTE: Quantities are based on an approximation of paving ~2000 sf of roadway to add a 24' wide driveway connecting to the main road with a minimum turning radius of 45'.				
LAIE UPLANDS				
TMK: 5-5-007-001				
DESCRIPTION	**QTY**	**UNIT**	**UNIT PRICE**	**TOTAL**
Aakahi Gulch Road				
Demolition and removal of existing A.C. pavement, including base course.	35490	SF	$5.00	$177,450.00
P.C.C. Pavement 9" thick, in place complete.	430	CY	$375.00	$161,250.00
Base Course 6" thick, in place complete.	287	CY	$300.00	$86,100.00
A.C. Pavement 2 1/2" thick, in place complete.	337	TON	$200.00	$67,400.00
Base Course 6" thick, in place complete.	371	CY	$300.00	$111,300.00
			SUBTOTAL	$603,500.00
Undeveloped Road				
P.C.C. Pavement 9" thick, in place complete.	360	CY	$375.00	$135,000.00
Base Course 6" thick, in place complete.	240	CY	$300.00	$72,000.00
Subbase Course 12" thick, in place complete.	480	CY	$65.00	$31,200.00
			SUBTOTAL	$238,200.00
			TOTAL	$841,700.00
WAIMEA UKA 1				
TMK: 6-1-006-001				
DESCRIPTION	**QTY**	**UNIT**	**UNIT PRICE**	**TOTAL**
Ashley Road				
Demolition and removal of existing A.C. pavement, including b	176150	SF	$5.00	$880,750.00
A.C. Pavement 2 1/2" thick, in place complete.	2963	TON	$200.00	$592,603.40
Base Course 6" thick, in place complete.	2180	CY	$300.00	$654,000.00
			TOTAL	$2,127,353.40
WAIMEA UKA 2				
TMK: 6-1-007-001				
DESCRIPTION	**QTY**	**UNIT**	**UNIT PRICE**	**TOTAL**
Kawailoa Road & Kawailoa Drive				
Demolition and removal of existing A.C. pavement, including b	560110	SF	$5.00	$2,800,550.00
A.C. Pavement 2 1/2" thick, in place complete.	9422	TON	$200.00	$1,884,400.00
Base Course 6" thick, in place complete.	10372	CY	$300.00	$3,111,600.00
			TOTAL	$7,796,550.00

KEAAU ROAD/OHIKILOLO				
TMK: 8-3-001-013				
DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL
Proposed driveway connection to Farrington Highway				
A.C. Pavement 2 1/2" thick, in place complete.	34	TON	$200.00	$6,800.00
Base Course 6" thick, in place complete.	38	CY	$300.00	$11,400.00
Subbase Course, 12" thick, in place complete.	75	CY	$65.00	$4,875.00
			TOTAL	$23,075.00
NOTE: Quantities are based on an approximation of paving ~2000 sf of roadway to add a 24' wide driveway connecting to the main road with a minimum turning radius of 45'.				
NANAKULI UKA				
TMK: 8-5-006-004				
Waianae Valley Road				
DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL
Demolition and removal of existing A.C. pavement, including b	19650	SF	$5.00	$98,250.00
A.C. Pavement 2 1/2" thick, in place complete.	331	TON	$200.00	$66,200.00
Base Course 6" thick, in place complete.	364	CY	$300.00	$109,200.00
Subbase Course 12" thick, in place complete.	728	CY	$75.00	$54,600.00
			TOTAL	$328,250.00
NOTE: Existing Waianae Valley Road is assumed to be 12' wide A.C. pavement from Haleahi Road intersection to proposed point of access. Assuming widening of road by 12 feet for two way traffic.				
KULIA I KA				
TMK: 3-9-010-047				
Proposed driveway to				
connect to exist.				
Kalanianaole Hwy				
DESCRIPTION	QTY	UNIT	UNIT PRICE	TOTAL
A.C. Pavement 2 1/2" thick, in place complete.	34	TON	$200.00	$6,800.00
Base Course 6" thick, in place complete.	38	CY	$300.00	$11,400.00
Subbase Course for undeveloped roadway, 12" thick, in place	75	CY	$65.00	$4,875.00
			TOTAL	$23,075.00
NOTE: Quantities are based on an approximation of paving ~2000 sf of roadway to add a 24' wide driveway connecting to the main road with a minimum turning radius of 45'.				

NOTES:

1. Existing roads are assumed to be A.C. pavement and 24' wide unless otherwise specified.
2. Cost estimate does not include any earthwork required to access and develop the site.

GLOSSARY

ahupua`a	
DBEDT	The Hawaii Department of Business, Economic Development and Tourism
DLNR	The Hawaii Department of Land and Natural Resources
DOH	The Hawaii Department of Health
ENV	
HoLIS	Honolulu Land Information System
H-Power	
IO Model	The Input-Output Model maintained by DBEDT
LS	Landfill Site
MACLSS	The Mayor's Advisory Council on Landfill Site Selection
NARS	Natural Area Resource System
NWS	National Weather Service
READ	Research and Economic Analysis Division, DBEDT
WGSL	Waimanalo Gulch Solid Waste Landfill

Notes

This document has been prepared to inform the MACLSS about minor changes to the landfill site selection criteria prior to the weighting exercise. The changes have occurred in the process of implementing and refining the definitions and measurement criteria based on the realities of available data on the sites.

The version shown here does not contain the actual data being collected. Any data shown is facsimile or place-holder data. Raw data and scores will be inserted after weighs have been decided. The document is a work in progress.

Following your lead we have attempted to eliminate correlated criteria where ever we could.

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
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FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

'09 APR -9

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

April 2, 2009

Mr. David Tanoue
Department of Planning and Permitting
Honolulu Municipal Building
650 South King Street
Honolulu, Hawai'i 96813

LOG NO: 2009.1041
DOC NO: 0903WT176
Archaeology

Dear Mr. Tanoue

SUBJECT: **Chapter 6E-8 Historic Preservation Review—**
Application for a Special Use Permit for an Expansion and Time Extension for the Waimānalo Gulch Sanitary Landfill, 92-460 Farrington Highway, Kapolei, Hono'uli'uli Ahupua'a, 'Ewa district, O'ahu Island, Hawai'i
TMK: (1) 9-2-3: 72 and 73

This is an application for an extension on the special use permit for the 92-acre expansion of the Waimānalo gulch Sanitary Landfill, allowing continuing operations for a minimum of fifteen years.

As part of an Environmental Impact Statement, an archaeological inventory survey was performed (*Archaeological Inventory Survey for the Waimānalo Gulch Sanitary Landfill Expansion Project, Hono'uli'uli Ahupua'a, 'Ewa District, Island of O'ahu, Hawai'i)*. A single historic property was recorded consisting of three stones (*pōhaku)* that may mark a trail or an area of cultural practice (SIHP #50-80-12-6903). In a review of this project mitigation measures proposed relocating the stones to Battery Arizona until the landfill closes, and then they are to be returned to their original location (2008.1458/0808LM10).

With this mitigation measure in place we determine that there is **"no effect to historic properties"**.

Please contact Wendy Tolleson at (808) 692-8024 if you have any questions or concerns regarding this letter.

Aloha,

Nancy A. McMahon (Deputy SHPO)
State Historic Preservation Officer

[redacted]

EXHIBIT A48

PHONE (808) 594-1888

FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD11/2765I

August 16, 2011

RECEIVED
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DEPT OF PLANNING AND PERMITTING
CITY & COUNTY OF HONOLU

Raymond Young
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, Hawai'i 96813

Re: Project File Number 2011/GEN-8
Amendment of Special Use Permit No. 2008/SUP-2
Waimanalo Gulch Sanitary Landfill, Island of O'ahu

Aloha e Raymond Young,

The Office of Hawaiian Affairs (OHA) is in receipt of your July 13, 2011 letter seeking comments on a request by the City and County of Honolulu-Department of Environmental Services (DES) to amend Special Use Permit No. 2008/SUP-2 (permit). The requested amendment will delete the existing July 31, 2012 deadline (deadline) to cease disposal of municipal solid waste (waste) at Waimanalo Gulch Sanitary Landfill (WGSL), allowing the disposal of waste to continue until the WGSL reaches capacity. It is believed the recent expansion of the WGSL from 96 acres to nearly 200 acres would allow the disposal of waste to continue for the next fifteen (15) years.

The deadline to close the WGSL for all material (except ash and residue left over from the conversion of trash to energy via the "H-Power" process) was imposed by the State Land Use Commission (LUC) in 2009. If approved by the City and County of Honolulu-Department of Permitting and Planning (DPP), the amended permit will be transmitted to the City and County of Honolulu Planning Commission (planning Commission) for consideration. If approved by the Planning Commission, the amended permit will then be submitted back to the LUC for consideration.

It is our understanding that the original permit which was approved by the Planning Commission and submitted to the LUC in 2009 did not establish a deadline to cease disposal of waste at the WGSL. Following the establishment of the July 31, 2012 deadline and approval of the permit by the LUC, the DES made it clear that they intended to request an amendment to the approved permit because the WGSL is the only permitted municipal solid waste landfill on the Island of O'ahu.

EXHIBIT A49

Long-standing concerns regarding the continued use of the WGSL have been consistently expressed by certain businesses and the Leeward O'ahu community, which includes a large Native Hawaiian population. These concerns were highlighted in September 2010 when a severe storm event (event) caused the release of an unknown amount of trash, including medical waste from the WGSL into near shore waters and onto Leeward O'ahu beaches. This event forced the temporary closure of the WGSL and resulted in a U.S. Environmental Protection order that implemented certain deadlines for the completion of protection measures to prevent the release of trash in the future. The temporary closure of the WGSL caused "backup crises" at wastewater treatment facilities and municipal solid waste transfer stations around the Island of O'ahu.

While OHA recognizes the spectrum of concerns which have been expressed by the Leeward O'ahu community regarding the continued disposal of waste at the WGSL, we also recognize that the closure of the WGSL to waste disposal would affect the entire Island of O'ahu because the WGSL is the only landfill disposal option available to the DES at this time.

A Landfill Site Advisory Committee (committee) has been established to assist the City and County of Honolulu in identifying criteria and ranking alternative landfill sites. The committee met for the first time in January 2011. Once an alternative landfill site is selected, the DES website reports that it will take up to seven years for the permitting and construction process for an alternative landfill site to be completed.

Efforts to reduce the amount of waste disposed of at the WGSL are currently underway. These efforts include but are not necessarily limited to:

-the anticipated completion of a third boiler at the H-Power Facility in mid-2012;
-recycling and "reuse" programs; and
-shipping waste to the continental United States for landfill disposal.

OHA applauds the commitment of committee members and we hope that the DES will continue to support their efforts to identify an alternative landfill site on the Island of O'ahu. The issues and concerns relative to the continued disposal of waste at the WGSL will affect our communities for generations to come and we will continue to monitor the amended permit should it move forward from the DPP to the Planning Commission and LUC for consideration. We have no additional comments at this time.

Thank you for the opportunity to provide comments. Should you have any questions or concerns, please contact Keola Lindsey at 594-0244 or keolal@oha.org.

'O wau iho nō me ka 'oia'i'o,

Clyde W. Nāmu'o
Chief Executive Officer

CWN:kl

Environment Hawai'i

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Volume 14, Number 12 June 2004

STATE DIRECTS COUNTY TO FIX FLAWS IN CENTRAL MAUI LANDFILL PHASE IV

"The DOH cannot give a permit for a landfill, constructed without a permit, if things are already failing.... It's like driving your new car with a spare tire already." - Gary Siu, Department of Health Solid Waste Branch

For years, the state has been a stone wall to Maui County's pleas for a permit to operate Phase IVA of the central Maui landfill, construction of which was finished in 1999. Earlier phases of the landfill had been filled to overflowing even before Phase IVA was built. Since then, the county has begged, argued, and thrown engineering reports at the DOH in an effort to open the new unit.

All to no avail. The $7.2 million facility remains closed.

At a glance, Phase IV looks good. It's a 10-acre pit in the ground, lined with plastic and blanketed with a cushioning layer of dirt. An underground pipe pokes through the pit's bottom to carry leachate from the sump to a plastic holding tank. From there, leachate can be pumped into a nearby lagoon, where evaporation reduces its volume.

To the man on the street, the design might appear sound, and according to DOH solid waste engineer Gary Siu, that's been a major problem: Non-experts making judgments on the fitness of the landfill.

Siu is the lone engineer in the DOH's Solid Waste Branch and is solely responsible for ensuring that all of Hawai'i's landfills comply with state and federal solid waste laws. That lack of staff, too, has contributed to Maui's problems in opening the landfill.

John Harder, once head of the DOH Solid Waste Branch and now Maui County's solid waste director, believes the DOH - that is to say, Siu - should provide technical assistance and guidance to the counties. But with one man to do the job, Harder says, it's difficult.

Arguments over blame aside, the conclusions contained in an independent consultant's report last November suggest that the Department of Health's long-standing reluctance to grant a permit may have been justified.

Garbage In...

Phase IV of the Central Maui Landfill was a mess practically from the start. In 1996, the county first hired local engineering firm Masa Fujioka & Associates to design the new phase, which, according to MFA's final plans, was to span 26 acres and cost $5.7 million. But after the construction contract had been awarded to Rojac Construction, Inc., the county invited in another engineering firm, Parametrix, Inc., which argued that the MFA design didn't adequately provide for leachate, the liquid at the bottom of the landfill that is caused by rain and other fluids in the fill percolating through the tamped down garbage.

In 1998, through a process called "value engineering," Parametix redesigned the landfill to include a large leachate lagoon. But instead of saving the county money, as the project was intended to do, construction costs under the new design ballooned to $7.2 million while the size of the landfill shrank to 10 acres.

EXHIBIT A50

The fact that Rojac was working on the landfill at the same time Parametrix was redesigning it didn't help matters. Impatient with the DOH's review of the new, constantly changing plans, the county allowed Rojac to build the 10-acre landfill cell in 1999 without a DOH permit. Since then, the cell has sat idle while the DOH has fought to correct what it sees as critical flaws in the landfill's design assumptions and construction. (For additional background, see articles on the landfill in the April 1999 and September 2002 editions of *Environment Hawai'i*.)

As Peter Fuller, a geologist with California's Land Disposal Program, wrote in a review of the Parametrix value engineering study and a May 2002 report by county engineer Elaine Baker defending the Parametrix work, "Overall, the two reviewed documents ... do not provide useful information justifying the design and do not show the kind of professional competence that is necessary for a good landfill design. If these documents were submitted to the State of California, they would be returned as incomplete and inaccurate. The level of competence shown by this design is below the minimum qualifications for a review by the state of California."

So in March 2003, Masa Fujioka & Associates met with Maui's solid waste staff to discuss the facility's technical problems. In July 2003, at Maui County's request, MFA submitted a proposal to "develop technical and regulatory solutions to the ongoing issues preventing the Central Maui Landfill from being placed in service." MFA planned to work with A-Mehr, Inc., of Laguna Hills, California, a consultant that specializes in the design and operation of solid waste landfills and has worked on landfills on O'ahu and Hawai'i.

A-Mehr completed its evaluation of Phase IVA in November 2003 and in February 2004, the DOH followed up with a list of 21 recommendations to the county addressing corrective actions, operations and future cell construction.

Isolation Given all the problems found in Phase IVA, A-Mehr issued a harsh recommendation. Although the cell is "generally acceptable for use following additional recommended testing and revisions," its report states, "due to certain aspects of the design, issues related to construction quality and uncertainties in the [quality assurance] documentation, we recommend certain limitations on use and future development of the cell. Specifically, we recommend that Phase IVA be designated an isolated unit with its liners and LCRS [leachate collection system] to operate independent of future additional cells."

Some of the obvious problems A-Mehr identified had already been called out by the Department of Health, including:

An Unstable Berm: Sloping earthen berms surround the Phase IV's boundary. A-Mehr found that the berm separating the landfill cell from the leachate lagoon was never fully compacted and is potentially unstable. Once Phase IVA is opened, trash will pile up, and the weight pressing against the berm may cause it to shift. If it shifts, the landfill's liner could tear in the worst possible place - the sump. To keep the liner from tearing, Siu says the county may one day have to inject cement into the berm to firm it up. In the meantime, the DOH recommended that the county equip the berm with so-called "monuments" that can be used to monitor any settling, and that it provide regular reports on settlement to the DOH for at least five years.

Operations Layer: When a lined landfill is built, before it's put in use, a thick layer of soil must be laid down to prevent the liner from being damaged by the trash or the trucks hauling it in. The industry standard for this layer, called the operations layer, is 36 inches. When Parametrix was redesigning the landfill, it sought to increase the amount of usable volume in the landfill by reducing the operations layer to 18 inches.

Failed Waterproofing: One of the more unusual features of Phase IVA is the leachate manhole, a kind of tank outside the landfill that holds leachate before it's pumped into the lagoon. The DOH and A-Mehr found in their inspections that the manhole's waterproofing had failed. Siu says that the epoxy sealant applied inside the concrete manhole is already cracking. To keep the leachate from penetrating the porous concrete, the DOH recommended installing a thick plastic liner in the manhole.

Run-off: In violation of state and federal laws regarding the design of surface water controls in landfills, A-Mehr found, Phase IV has no barriers or other systems that would prevent storm water run-off from entering the landfill.

Leachate Control

The DOH's biggest concern about the landfill is leachate management. The primary liner in the leachate lagoon leaks. According to A-Mehr, although there appear to be no leaks in the secondary liner, "the absence of a leak cannot be confirmed... The evidence of leakage from the primary liner suggests that some defects may not have been corrected." In addition to repairs and the addition of a third liner, A-Mehr recommends that the lagoon "be used only as a backup storage unit for leachate. Instead of being pumped to the lagoon, A-Mehr recommends the leachate be pumped into large tanks.

According to a model A-Mehr ran to determine the potential leachate from a 24-hour, 25-year storm, Phase IV could generate 17 gallons of leachate per minute. That's far below Parametrix's figure of 1,033 gallons per minute - the estimate that it used to justify substituting the 10,000-gallon holding tank proposed in the MFA design with a multi-million dollar leachate lagoon system.

To allow for overflow capacity in the event of multiple storms, and in light of the fact that it takes time to move leachate from the tanks to a wastewater treatment plant, the DOH recommended the county have enough tanks to contain 100,000 gallons of leachate.

The county originally planned to let leachate pond in the lagoon until it evaporated. "Winter rain will sit there until summer," Siu says. If the lagoon is used, he says, "it better not leak." But because the lagoon's liner is not self-sealing and was found in tests to be leaking, the DOH did not want the lagoon used at all.

The risks are just too high, Siu explains. Water from the aquifer beneath the landfill is used to grow food crops, he says, and as Maui's population grows, it's likely the aquifer will be needed for drinking water. Siu adds that EPA studies that show 80 percent of liner damage occurs after the liner is in use. "No liner is perfect. All liners have some damage. That is why they have to be self-sealing," he says. (A self-sealing liner consists of a plastic liner on top of a clay liner. If the top layer is punctured, moisture will cause the clay beneath to expand and plug the hole.)

Peter Fuller, the California engineering geologist, notes in his 2003 report to the DOH, "Leachate pond liners in California are required to be as, or more protective than landfill liners because of the greater danger presented by the risk of groundwater contamination."

Harder has taken steps in line with the DOH's concerns, but does not seem overly concerned about leachate somehow making its way to the aquifer. Based on climate and hydrology of Central Maui, as well as other dry areas like Waimanalo Gulch on O'ahu's Wai'anae Coast and Kekaha on Kaua'i, he says, "Once you've got 10 to 15 feet of trash, you're not going to see any leachate. The trash acts like a sponge." Waimanalo Gulch, he says, generates only 5,000 gallons of leachate a year. "Even if the liner fails, its not a total catastrophe," he says.

Harder also argues that although the DOH says Phase IVA's double plastic lagoon liner does not meet requirements, "the DOH doesn't have lagoon liner requirements." There are no plans to make the lagoon liner self-sealing, but because of the DOH's concerns, Harder says the lagoon will sit empty, at least until Phase IVB is completed. "It's more of a technical issue than a real issue," Harder says. To allay DOH's concern's about the lagoon, Harder says, "Maybe we'll use it for asbestos or other friable products."

In light of the DOH's February letter spelling out the totality of its concerns over the lagoon, Harder's Plan B might make the most sense. The DOH sets the following conditions on use of the lagoon for leachate: "Quarry spalls and drainage rock" must be removed form the access ramp, leveling soil must be placed above the drain rock on the floor, the plastic liner's side slopes and ramp must be repaired and tested for leaks, a third liner of geosynthetic clay and plastic must be installed on the floor and five feet up the side slopes, and the county must provide a rationale on the "total head and time that leachate may remain in the reconstructed leachate pond. However, the pond shall not be used as an evaporation pond unless the reconstruction consists of a lower composite liner and an upper geosynthetic liner with a drainage layer in between."

A New Leaf

On March 23, the county agreed, with minor modifications, to all of the DOH's recommendations, and had already increased the landfill's operations layer to 36 inches. On April 23, the DOH gave its permission to the county to start remedial construction.

Harder says he thinks he'll be able to start piling trash in Phase IVA this summer. Siu, on the other hand, is more cautious in his predictions. Once the fixes are done, they must be reviewed by a third party for quality assurance, he says. Only when the DOH accepts that review and has made sure all of its conditions have been met will it issue the county a permit to operate.

- Teresa Dawson

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BEFORE THE PLANNING COMMISSION
OF THE CITY AND COUNTY OF HONOLULU

STATE OF HAWAII

In the Matter of the Application of DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU To delete Condition No. 14 of Special Use Permit No. 2008/SUP-2 (also referred to as Land Use Commission Docket No. SP09-403) which states as follows: "14. Municipal solid waste shall be allowed at the WGSL up to July 31, 2012, provided that only ash and residue from H-POWER shall be allowed at the WGSL after July 31, 2012."	FILE NO. 2008/SUP-2 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I HEREBY CERTIFY THAT A COPY OF THE **DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU'S SECOND AMENDED LIST OF EXHIBITS** was duly served by either hand-delivery or U. S. Mail, postage prepaid, to the following on the date below, addressed as follows:

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DATED: Honolulu, Hawai'i, April 16, 2012.

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DEPARTMENT OF ENVIRONMENTAL SERVICES, CITY AND COUNTY OF HONOLULU

11-01661/221737