DRAFT
RESPONSE ACTION MEMORANDUM

DOH VRP No. V336-24
Waialua Sugar Mill, Voluntary Response Program
Waialua, Oahu, Hawaii
TMK (1) 6-7-001: Parcel 62 (portion)

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1.0 INTRODUCTION

This Voluntary Response Program (VRP) Draft Response Action Memorandum (Draft RAM) presents the proposed (preferred) remedial alternatives selected by the site environmental consultant (ETC) for the former Waialua Sugar Mill (WSM) site. The WSM site consists of 25-acre land parcel owned by the Castle & Cooke Waialua, LLC and identified as TMK (1) 6-7-001: Parcel 062 (portion), Waialua, Oahu, Hawaii.

This Draft RAM summarizes pertinent site information, provides a concise summary of environmental investigation data and the associated environmental hazards, documents the basis for remediation, and describes the rationale for selection of the preferred remedial alternative. The Draft RAM is based on the information presented in the *Task 4: Site Investigation Report and Environmental Hazard Evaluation* dated February 2018; and the *Task 5: Remedial Alternatives Analysis Report* dated February 2018.

1.1 Assessment of the Property

Site investigation data indicate the presence of elevated total petroleum hydrocarbon (TPH) as diesel (TPH-D), TPH as oil (TPH-O), arsenic, lead, dioxins/furans (expressed as 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD] Toxic Equivalents [TEQ]), pentachlorophenol, 1- and 2- methylnaphthalene, anthracene, naphthalene, benzo(a)pyrene, and methylene chloride in soils within select areas of the WSM site. The EHE identified direct exposure, leaching to groundwater, or vapor emission hazards associated with contaminant concentrations in site soils. Receptors of concern included future site construction workers, future site users, future residents in surrounding areas, and aquatic ecological receptors.

The data indicate that hazardous substances existing on the WSM site should be appropriately addressed through implementation of the proposed response action.

1.2 Description of the Preferred Remedy

The overall preferred remedial alternatives for the WSM site combine engineering controls (e.g. soil cap, asphalt/concrete cap, etc.) with institutional controls to address contaminated soils within the WSM site. Contaminated soil will be effectively isolated from direct human contact. In addition to the area specific selected remedies described in the Table 1 below, a site-wide remedy will be implemented for the entire WSM site. The site-wide EHMP will include appropriate cap maintenance/reporting requirements, prohibit activities that may compromise the integrity of the engineering controls, specify appropriate soil handling and worker/area protection requirements should disturbance of the contaminated soils be unavoidable, and also specify appropriate mitigation measures if a portion of the cap(s) are breached. Institutional controls limiting the current and future use of the WSM site to commercial/industrial land use will be included in a Uniform Environmental Covenant. In addition to the area-specific groundwater monitoring described in Table 1, a site-wide groundwater monitoring program of wells MW1, MW2, MW3, MW5, MW6, MW9, MW10, MW11, MW12 (new), MW13 (new), and MW14 (new) will be implemented. Note that several of these wells are part of area-specific monitoring described in Table 1. At a minimum, the following Contaminants of Concern (COCs) will be included in the site-wide groundwater

monitoring program: TPH-D, TPH-O, and polynuclear aromatic hydrocarbons (PAHs). The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring. A summary of the preferred area-specific selected remedies for the WSM site is provided in Table 1 below.

Table 1: Summary of Selected Remedial Alternatives

Source Area	**Selected Remedial Alternative**
Pesticide Mixing / Storage Area (DU1/DU28, DU2, DU35)	Installation of an asphalt cap and groundwater monitoring of existing and newly installed groundwater monitoring wells.
Tank Farm Area (DU3/DU4)	Maintenance of the existing soil cap/cover and erosion control measures.
Arsenic Impacted Area (DU24F.2, DU24F.3, DU24F.3A to F, DU24F.4, DU24F.4A, DU24F.5, DU24F.10 to 12)	Installation of an asphalt cap or 1.5-2 ft. clean soil cap and low groundcover atop Category D arsenic soils.
Diesel Fueling Area (DU11)	Installation of one additional groundwater monitoring well and groundwater monitoring.
Lumber Rack / Transformer Storage (DU13)	Groundwater monitoring.
Service Station Area (DU15)	Groundwater monitoring.
Fertilizer AST Area (DU 22)	Groundwater monitoring of nearest existing groundwater monitoring well.
Mill Area – Petroleum (DU 36/37)	Installation of one additional groundwater monitoring well and groundwater monitoring.
Solid Waste Removal Area (DU 41)	Groundwater monitoring.
Site-wide (see Section 5.0)	• Groundwater monitoring • Environmental Hazard Management Plan (EHMP) and Institutional Controls • Land Use limited to Commercial/Industrial use through Covenant

2.0 SITE LOCATION AND DESCRIPTION

2.1 Site Description

The project site is the former Waialua Sugar Mill (WSM located along Kealohanui Street west of Goodale Avenue). The WSM site is also accessible via cane haul roads from the surrounding area streets (e.g. Puuki Road, Kuemanu Street, etc.). A map illustrating the site location is included as Figure 1 in Appendix I. The WSM site consists of a 25-acre parcel owned by Castle & Cooke Waialua, LLC and identified as TMK (1) 6-7-001: Parcel 062, Waialua, Oahu, Hawaii (see Appendix I, Figure 2). The property is zoned by the City and County of Honolulu for industrial use.

Topography suggests a slight surface slope from south to north. The Property is situated at elevations of 10 feet above mean sea level (msl) in the north and 40 feet above msl in the south. The nearest drinking water wells are located greater than 0.5 miles from the Property. Specifically, the Kemoo Camp I Batt well (Pump No. 7), listed as a sealed well is located approximately 0.80 miles southeast of the Property and the Waialua P2 Batt well (Pump No. 2) is located approximately 0.85 miles south of the Property. The nearest surface water body is the Kiikii Stream, located approximately 0.28 miles east of the Property. There is also an inactive lined ditch/pipeline which was previously used to carry cooling water effluent from the mill to Kiikii Stream. This inlet to this ditch is reportedly defunct and no longer functional (i.e. inlet/outfall blocked).

Currently, there are tenants operating various businesses in the former sugar mill buildings. These businesses include surf board shaping and glassing operations, woodworking, soap making, coffee processing, boat repair, retail, community kitchen, a home building contractor, vehicle and heavy equipment maintenance, farming operations, and a plumbing contractor. Existing uses in the vicinity of the WSM site include the residential homes to the east and west, fallow or unused agricultural fields and former settling ponds to the north, and current agricultural fields to the south.

2.2 Site Background

The WSM site was used as a sugar mill from 1904 through 1996. Approximately 10,000 and 12,000 acres in the areas surrounding the mill were historically in sugarcane cultivation. Pesticide storage and mixing operations were centralized on the western end of the WSM site. Pesticides were stored, mixed, and loaded onto trucks for distribution and dispersal in the plantation fields. Maintenance operations and various shops (welding, electrical, carpentry, vehicle maintenance, etc.) were located at designated buildings on the WSM site. The mill also operated boilers to run the operations and the boilers used bagasse (sugar cane pulp), fuel oil and waste oil as fuel sources. DOH suspects that soil and groundwater at the site became contaminated as a result of the historic sugar mill operations.

2.3 Investigation History

A number of environmental investigations have been conducted on the WSM site. Findings from these investigations indicated the presence of various petroleum, pesticides and pesticide-related chemicals in site soils at elevated concentrations.

In general, data from these previous investigations have indicated that the WSM site has been impacted by TPH-D, TPH-O, arsenic, lead, dioxins/furans (expressed as 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD] Toxic Equivalents [TEQ]), pentachlorophenol, 1- and 2- methylnaphthalene, anthracene, naphthalene, polynuclear aromatic hydrocarbons (PAHs), and methylene chloride. Investigation findings were presented in the *Task 4: Site Investigation Report and Environmental Hazard Evaluation* dated February 2018.

2.4 Magnitude and Extent of Contamination

Based on review of current and historic data, the extent of contaminants of concern (COC) impacts to soils at concentrations exceeding default (lowest) DOH Environmental Action Levels (EALs) within the WSM site were evaluated.

Previous investigations established the following source areas and Decision Units (DUs): Pesticide Mixing/Storage Area (DU1, 2, 28 and 35); Tank Farm Area (DU3 and 4); Electrical Shop Area (DU5); Vehicle Maintenance Area (DU6 to 10); Former Diesel Fueling Area (DU11); Wood Shop Area (DU12); Former Lumber Rack/Transformer Storage Area (DU13 and 14); Former Service Station (DU15); Bagasse Bin/Storage Area (DU16); Suspect Ash Pit Area (DU17); Stack Area (DU18); Pump House Area (DU19); Hydroseparator (DU20); Fertilizer Tank Area (DU21 and 22); Arsenic Impacted Area (DU24), Glenn's Towing (DU27); Mill Area-Petroleum (DU17-B22 only, DU36 and DU37), Former Solid Waste Removal Area (DU41), and all other areas of the Property (DU23, DU25, and DU26). Except for the Suspect Ash Pit Area (DU17) and Pump House Area (DU19), one or more COCs exceeded their corresponding default DOH EAL in all areas of the WSM site for both soil and/or groundwater.

In general, the highest dioxin/furans TEQ concentrations were identified within the surface soils within the Pesticide Mixing/Storage Area (DU1), with decreasing concentrations in the other DUs associated with the Pesticide Mixing/Storage Area (DU2 and DU35). While dioxin/furans concentrations are assumed to decrease with depth, vertical delineation of the dioxins/furans contamination was not completed. However, a subsurface soil sample collected on the WSM site at 26 feet bgs did not contain elevated dioxin/furans TEQ concentrations.

The highest arsenic concentrations were identified within the Arsenic Impacted Area (DU24F.2, DU24F.3, DU24F.3A to F, DU24F.4, DU24F.4A, DU24F.5, DU24F.10 to 12) and the Pesticide Mixing/Storage Area (DU1 and DU2). Other source areas within the WSM site were limited to Arsenic – Category A and B soils. Arsenic and PAHs were also detected in the groundwater within the Pesticide Mixing/Storage Area (DU1) at concentrations exceeding default DOH EALs.

The highest lead concentrations were identified in the Pesticide Mixing/Storage Area (DU35) and Tank Farm (DU3 and DU4). While the source of heavy metals is not known, the concentrations are anticipated to decrease with depth. Based on the subsurface soil data collected within the Tank Farm area, the lead impacts appear to be limited to depths of 2 to 5 feet bgs.

Lead, Thallium, and Zinc were also detected in several other DUs (i.e. DU1, DU3, DU12, DU13, DU25 and/or DU27) at concentrations exceeding their respective default DOH EALs. Note that the default commercial/industrial land use EALs were not exceeded in these DUs.

Data indicated an elevated concentration of pentachlorophenol exceeding the soil leaching EAL within the Pesticide Mixing/Storage Area (DU1) likely present in connection with the dioxin/furans. Pentachlorophenol impacts were limited to DU1 only. While pentachlorophenol is assumed to decrease with depth, vertical delineation of the pentachlorophenol was not completed. However, subsurface soil samples collected in the Pesticide Mixing/Storage Area indicated no detectable concentrations of pentachlorophenol at 26 feet bgs.

TPH-D, TPH-O, PAHs, and select pesticides/herbicides were detected in the surface soils at concentrations exceeding the default DOH EALs. In general, subsurface petroleum related impacts were limited to select source areas within the Former Diesel Fueling Area (DU11); Former Service Station (DU15); Fertilizer Tank Area (DU21 and 22); Mill Area-Petroleum (DU36/DU37); and Former Solid Waste Removal Area (DU41). Specifically, TPH-D and PAHs were detected in the subsurface soils within the Former Diesel Fueling Area (DU11) and Former Service Station (DU15). TPH-D, TPH-O, and PAHs were detected in the subsurface soils within the Mill Area-Petroleum (DU36/DU37). TPH-D and TPH-O were detected in the subsurface soils within the Former Solid Waste Removal Area (DU41). Analytical results indicate that the impacts to subsurface soils within these DUs appear to be limited. In addition, based on the groundwater monitoring sampling conducted in 2009, the Former Diesel Fueling Area (DU11) was the only area in which petroleum impacts were documented. Specifically, TPH-D, VOCs, and PAHs were detected in MW9. While not attributable to a specific point source, Arsenic, Thallium, and select PAHs were detected in several wells (i.e. MW2, MW7, and MW11).

Based on an overall evaluation of all available data compared to default DOH EALs, one or more COCs exceeded their corresponding default DOH EALs in the soil or groundwater throughout the WSM site.

2.5 Current and Future Land Use

The future use and/or redevelopment of the project site is unknown; however, no residential units or similar residential usage is planned for the site. Therefore, the remedy limits the future land use of the project site to commercial/industrial land uses.

3.0 ENVIRONMENTAL HAZARD EVALUATION

The Environmental Hazard Evaluation (EHE) process was developed by the DOH to serve as a link between site investigation activities and the proposed response activities to be undertaken and evaluated in a Remedial Alternatives Analysis (RAA). The EHE is intended to identify potential environmental hazards associated with contaminant concentrations in site media through comparison with DOH EALs established for common environmental hazards. The February 2018 *Task 4: Site Investigation Report and Environmental Hazard Evaluation* included a comparison of site data to DOH EALs for common environmental hazards associated with soil. These potential exposures include:

- Direct Exposure: exposure to contaminants via incidental ingestion, dermal absorption, and inhalation of vapors or dust in outdoor air
- Vapor Intrusion: emission of volatile contaminants from soil into overlying buildings
- Leaching: leaching of contamination from soil by infiltration of surface water (rainfall, irrigation, etc.) and downward migration of leachate into underlying groundwater
- Gross contamination: potentially mobile free product, odors, aesthetics, explosive hazards, and general resource degradation

The remedy selected by the DOH addresses these potential exposures.

3.1 Contaminants of Concern

The contaminants of concern (COC) for the WSM site investigated as part of this Voluntary Response Project. The specific COCs included:

Table 2: COC List

Constituent
Metals
Arsenic (Total and Bioaccessible)
Thallium
Vanadium
Zinc
Cadmium
Lead
Mercury
Herbicides/Pesticides
Chlorinated Herbicides
Dicamba
2,4,5-T
2,4,5-TP
Dalapon
2,4-D
Pentachlorophenol
Organochlorine Pesticides
DDT
DDD (component/breakdown product of DDT)
DDE (component/breakdown product of DDT)
Technical Chlordane

Constituent
Triazine Pesticides
Atrazine
Ametryn
Triazine/Simazine
Fungicide
Propiconazole (Tilt)
Misc. Herbicides
Diuron
Hexazinone (groundwater only)
Glyphosate (groundwater only)
Misc. Insecticide/Pesticide
Dimethylphthalate
Total Petroleum Hydrocarbons
TPH as gasoline
TPH as oil
TPH as diesel
Volatile Organic Compounds (VOCs)
BTEX
Benzene
Toluene
Ethylbenzene
Xylenes
Methyl tertiary-butyl ether (MtBE)
Halogenated Volatile Organic Compounds (HVOCs)
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
DBCP
1,2-Dibromoethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dichlorodifluoromethane
Methylene chloride
Tetrachloroethene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichlorofluoromethane
Trichloroethene
Vinyl chloride
Polynuclear Aromatic Hydrocarbons (PAHs)
1-Methylnaphthalene

Constituent
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
Pyrene
Polychlorinated Biphenyls (PCBs)
Total PCDDs/PCDFs (Dioxins/Furans)

3.2 Exposure Setting

Data collected for the WSM site during the site investigation activities confirmed the presence of one or more environmental hazards and generally identified the lateral extents of impact.

3.3 Receptors of Concern

When identifying potential receptors, DOH evaluated plausible exposure under both current and future land-use was evaluated. Accordingly, potential receptors were identified for both current and future use scenarios. For the purposes of this project, DOH identified the following potential receptors: future site users; current and future residents in surrounding area; site construction workers; and aquatic ecological receptors.

3.4 Exposure Pathway Analysis

The potential exposure pathways present at the property include: soil exposure, air exposure, sediment exposure, and groundwater exposure.

3.5 Environmental Hazard Evaluation Summary

Investigation data presented in February 2018 *Task 4: Site Investigation Report and Environmental Hazard Evaluation* was used by the DOH to identify the extent and magnitude of existing environmental hazards within the WSM site.

A summary of the existing environmental hazards within the WSM site is presented by decision unit in Table 3 below. These environmental hazards are shown in Appendix I.

Table 3: Summary of Environmental Hazards in Soil for Commercial/Industrial Use Only

Decision Unit	Depth	Layer Vol. (cy)	Direct Exposure	Gross Contamination	Leaching to Groundwater	Vapor Emissions to Indoor Air
Pesticide Mixing/Storage Area						
DU1/ DU28*	0-0.5’	~120	Dioxins, Bioaccessible Arsenic, TPH-D	TPH-D	TPH-O, TPH-D Pentachlorophenol	
DU35	0.-0.5’	~55	Bioaccessible Arsenic, Lead		TPH-D	
Tank Farm Area						
DU4	2’-5’	~1300	Lead			
Diesel Fueling Area						
DU11	12’-30’	~600	TPH-D	TPH-D	TPH-D, 2-methylnaphthalene	
Lumber Rack/Transformer Storage						
DU13	0’-0.5’	~400			Diuron	
Service Station Area						
DU15	13’-30’	~1,000	TPH-D	TPH-D	TPH-D, naphthalene, 2-methylnaphthalene	
Fertilizer AST						
DU22	12'-21'	~830			Methylene Chloride	
Mill Area - Petroleum						
DU36	10’-16’	~450	TPH-D	TPH-D, TPH-O	TPH-D, TPH-O, 1-Methyl naphthalene, 2-Methyl naphthalene, Anthracene, Naphthalene	Anthracene
Soild Waste Removal Area						
DU41	7’-9’	~13	TPH-D	TPH-D, TPH-O	TPH-D, TPH-O	
Arsenic Impacted Area						
DU24F.3 DU24F.3A-D DU24F.4 DU24F.10 DU24F.11	0-0.5’	~100	Bioaccessible Arsenic			

*DU28 is the subsurface DU within DU1.

Table 3: Summary of Environmental Hazards in Groundwater

Monitoring Well	Impacts to Aquatic Habitats	Gross Contamination	Drinking Water Toxicity	Vapor Emissions to Indoor Air
MW2 (DU23/DU25-North Central)			Thallium, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene	
MW6 (DU1-Pesticide Mixing/Storage Area)			Arsenic, Thallium, Benzo(a)anthracene, Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene	
MW7 (DU19-Northeast Border)			Indeno(1,2,3-cd)pyrene	
MW9 (DU11-Diesel Fueling Area)		TPH-D	TPH-D, 1,1,2,2-Tetrachloroethane, 1,2,-Dibromo-3-Chloropropane, Benzo(b)fluoranthene	
MW11 (DU22-North Border)			Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene	

Note: Low-flow sampling was used for all sample collection; and the groundwater data evaluation is based on data collected from a single monitoring event in 2008.
*Includes primary and replicate sample results.

4.0 REMEDIAL STRATEGY

The February 2018 *Task 5: Remedial Alternatives Analysis Report* details the process used to determine the preferred remedial alternative.

4.1 Remedial Action Objectives

Remedial action objectives are specific goals to be achieved by the selected remedy. These objectives are specific to the anticipated exposure scenarios (based on current and future use of the site), site characteristics, COC, and potential outcomes. The following remedial action objectives were identified for this site:

- Reduce contaminant concentrations
- Remove direct exposure pathways between contaminants and receptors.
- Prevent migration of contaminants. Minimize potential adverse impacts to the surrounding communities and the environment during implementation of the remedy.
- Meet applicable federal, state and local regulations pertaining to the site and the specific remedial action.

4.2 General Response Actions

Based on guidance in the DOH Hazard Evaluation and Emergency Response (HEER) Office Interim Final T*echnical Guidance Manual for Implementation of the Hawaii State Contingency Plan* (referred to as the "TGM") and to comply with Hawaii Administrative Rules §11-451-8, DOH considers the following hierarchy of general response action alternatives in order of descending preference:

- Reuse or recycling
- Destruction or detoxification of contaminants through alteration of their molecular structures and/or through neutralization
- Separation, concentration, or volume reduction
- Immobilization of hazardous substances through changing the physical state of the contaminant or contaminated media
- On-site or off-site disposal, isolation, or containment at an engineered facility designed to minimize the future release of hazardous substances, pollutants, or contaminants and in accordance with applicable regulations
- Institutional controls to restrict access and/or long-term monitoring to assess changes in contaminant distribution over time

Feasible response actions considered appropriate for addressing the contaminants at the site (sometimes referred to as presumptive remedies) were reviewed by the DOH. These actions included destruction/detoxification of contaminants, chemical/physical fixation of contaminants, partial removal/relocation of contaminated soils, placement of a soil cover, implementation of engineering controls, and implementation of institutional controls.

5.0 EVALUATION OF REMEDIAL ACTION ALTERNATIVES

As required by the Hawaii State Contingency Plan, Hawaii Administrative Rules Title 22, Chapter 451, DOH remedial alternatives for each area was based on the following screening criteria:

- Overall Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Reduction of Toxicity, Mobility, and Volume
- Effectiveness
- Feasibility
- Costs

In addition to the selected remedies described in area-specific remedial alternatives below, a site-wide remedy will be implemented for the entire WSM site. This site-wide program will include the following:

- A groundwater monitoring program which will include wells MW1, MW2, MW3, MW5, MW6, MW9, MW10, MW11, MW12 (new), MW13 (new), and MW14 (new). Note that several of these wells are part of DU specific monitoring. At a minimum, the following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, and PAHs. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.
- A site-wide EHMP and institutional controls will be developed and implemented for the entire WSM site. The site-wide EHMP will include appropriate cap maintenance/reporting requirements, prohibit activities that may compromise the integrity of the engineering controls, specify appropriate soil handling and worker/area protection requirements should disturbance of the contaminated soils be unavoidable, and also specify appropriate mitigation measures if a portion of the cap(s) are breached.
- Institutional controls limiting the current and future use of the WSM site to commercial/industrial land use will be included in the form of a Uniform Environmental Covenant or similar.

The comparative analysis of remedial alternatives with respect to the screening criteria is summarized using numerical values in the tables below for each area. The alternative with the highest ranking for a specific criterion was given a score of 2 to 5 based on the number of alternatives; and the alternative with the lowest ranking for a specific criterion was given a score of 1. Therefore, the alternative with the highest composite numerical value would rank the highest in this scoring system. It should be noted that sub-categories were individually ranked; the overall rankings were based on an "equal-weight" scoring system, where the three main criteria (i.e. effectiveness, implementability, and cost) were considered to be of equal importance. Oftentimes, this is not the case, particularly in situations where funding is limited or in the presence of other constraints.

5.1 Pesticide Mixing/Storage Area (DU1/DU28, DU2, and DU35)

A total of four remedial alternatives were developed following screening of remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- Alternative 1: Installation of a 1.5-2 ft. clean soil cap and erosion/bare soil control measures with groundwater monitoring of existing groundwater monitoring wells (MW6, MW10, MW14).
- ***Alternative 2: Installation of an asphalt cap with groundwater monitoring of existing and newly installed groundwater monitoring wells (MW6, MW10, MW14).***
- Alternative 3: Limited excavation and disposal of the DU1/DU28, installation of a cap/cover and/or erosion control measures with groundwater monitoring.
- Alternative 4: Complete excavation, removal, and disposal of contaminated soils with groundwater monitoring.

Table 4: Ranking of Remedial Alternatives for the Pesticide Mixing/Storage Area (DU1/DU28, DU2, and DU35)

Criteria	Alternative			
	1	**2**	**3**	**4**
Effectiveness: Overall protection of human health & the environment	*2*	*3*	*3*	*4*
Effectiveness: Compliance with ARARs	*3*	*4*	*2*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*1*	*2*	*3*	*4*
Effectiveness: Long-term effectiveness	*2*	*3*	*3*	*4*
Effectiveness: Short-term effects	*4*	*4*	*2*	*1*
Overall Effectiveness	2.4	3.2	2.6	3
Implementability: Technical feasibility	*4*	*4*	*2*	*2*
Implementability: Administrative feasibility	*1*	*2*	*3*	*4*
Overall Implementability	2.5	3	2.5	3
Overall Costs*	4	4	2	1
Composite Score	8.9	10.2	7.1	7

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report

5.1.1 Proposed Remedy – Alternative 2: Placement of an Asphalt Cap with Groundwater Monitoring

Alternative 2 ranked first in comparison to the other three alternatives with a composite score of 10.2. This alternative adequately complies with ARARs and was considered by the DOH to be sufficiently protective of human health and the environment since it would isolate the environmental hazards associated with the dioxin, arsenic, lead, TPH, and PCP contaminants beneath a high strength, low permeability asphalt cap. This alternative is a proven and reliable long-term solution that has been implemented in many applications, including use in isolating waste from surface water infiltration and from direct contact with surface receptors. The short-term effects of this alternative would be minimal and primarily due to grubbing and site

preparation (a common activity between all four alternatives). Furthermore, since this alternative has been implemented before in the State of Hawaii, DOH considered it to be both technically and administratively feasible. Finally, the estimated cost to implement this remedial alternative was significantly lower than Alternatives 3 and 4.

5.2 Tank Farm Area (DU3/DU4)

A total of two remedial alternatives were developed following screening of remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- ***Alternative 1: Maintenance of existing soil cap/cover and erosion controls measures***.
- Alternative 2: Excavation, removal, and disposal of contaminated soils.

Table 5: Ranking of Remedial Alternatives for the Arsenic Impacted Area (DU24)

Criteria	Alternative	
	1	**2**
Effectiveness: Overall protection of human health & the environment	*2*	*1*
Effectiveness: Compliance with ARARs	*2*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*1*	*2*
Effectiveness: Long-term effectiveness	*2*	*2*
Effectiveness: Short-term effects	*2*	*1*
Overall Effectiveness	1.8	1.6
Implementability: Technical feasibility	*2*	*1*
Implementability: Administrative feasibility	*2*	*1*
Overall Implementability	2	1
Overall Costs*	2	1
Composite Score	5.8	3.6

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report

5.2.1 Proposed Remedy – Alternative 1: Maintain Existing Soil Cap and Erosion Control Measures

Alternative 1 ranked first out of the two alternatives under consideration with a composite score of 5.8. This alternative adequately complies with ARARs and was considered by the DOH to be sufficiently protective of human health and the environment since the soil cap is already present; and isolates the environmental hazards associated with the existing contaminants beneath the existing cap. This alternative also provides a barrier between direct exposure hazards to lead in the soil and surface receptors. The short-term effects of this alternative would be minimal since the cap is already in place. Furthermore, since this alternative is already in-place, DOH considered it to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was significantly lower than Alternative 2.

5.3 Arsenic Impacted Area (DU24)

A total of three remedial alternatives were developed following screening of remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- ***Alternative 1: Installation of an asphalt cap or 1.5-2 ft. soil cap and low groundcover over Category D soils***.
- Alternative 2: Excavated Category C soils to be relocated and installed as the cap/cover over Category D soils with erosion control measures.
- Alternative 3: Excavation, removal, and disposal of contaminated soils.

Table 6: Ranking of Remedial Alternatives for the Arsenic Impacted Area (DU24)

Criteria	Alternative		
	1	**2**	**3**
Effectiveness: Overall protection of human health & the environment	*1*	*2*	*3*
Effectiveness: Compliance with ARARs	*3*	*2*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*2*	*2*	*3*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*
Effectiveness: Short-term effects	*3*	*2*	*1*
Overall Effectiveness	2.2	2	2.4
Implementability: Technical feasibility	*3*	*2*	*1*
Implementability: Administrative feasibility	*2*	*2*	*3*
Overall Implementability	2.5	2	2
Overall Costs*	3	2	1
Composite Score	7.7	6	5.4

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.3.1 Proposed Remedy – Alternative 1: Installation of an Asphalt Cap or 1.5-2 ft. Clean Soil Cap and low groundcover over Category D soils

Alternative 1 ranked first in comparison to the other two alternatives with a composite score of 7.7. This alternative adequately complies with ARARs and was considered by DOH to be sufficiently protective of human health and the environment since it would isolate the environmental hazards associated with the arsenic contamination beneath an asphalt cap or 1.5-2 ft. clean soil cap with low groundcover on top. This alternative would also provide a barrier between direct exposure hazards in the soil and surface receptors. The short-term effects of this alternative would be minimal and primarily due to grubbing and site preparation (a common activity between all four alternatives). Furthermore, since this alternative has been implemented before in the State of Hawaii, DOH considered it to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was significantly lower than Alternatives 3 and 4.

5.4 Diesel Fueling Area (DU11)

A total of four remedial alternatives were developed for the Diesel Fueling Area following screening of the remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- Alternative 1: Groundwater monitoring of existing groundwater monitoring well (MW9).
- ***Alternative 2: Installation of an additional groundwater monitoring well (MW12) and groundwater monitoring (MW3, MW9, and MW12).***
- Alternative 3: Accelerated Natural Attenuation/Bioremediation with groundwater monitoring.
- Alternative 4: Excavation, removal and disposal of contaminated soils and groundwater monitoring.

Table 7: Ranking of Remedial Alternatives for the Diesel Fueling Area (DU11)

Criteria	Alternative			
	1	**2**	**3**	**4**
Effectiveness: Overall protection of human health & the environment	*2*	*2*	*3*	*4*
Effectiveness: Compliance with ARARs	*4*	*4*	*3*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*2*	*2*	*3*	*4*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*	*4*
Effectiveness: Short-term effects	*4*	*4*	*3*	*1*
Overall Effectiveness	2.8	2.8	3	3
Implementability: Technical feasibility	*4*	*4*	*1*	*3*
Implementability: Administrative feasibility	*2*	*2*	*3*	*4*
Overall Implementability	3	3	2	3.5
Overall Costs*	4	4	2	1
Composite Score	9.8	9.8	7	7.5

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.4.1 Proposed Remedy – Alternative 2: Installation of an Additional Groundwater Monitoring Well and Groundwater Monitoring

Alternative 1 and 2 both had composite scores of 9.8, which were higher ranking in comparison to the other two alternatives. The proposed Alternative 2 requires an additional groundwater monitoring well because data suggests that groundwater may be impacted in the vicinity of the Diesel Fueling Area. The additional well in this area would sufficiently monitor the impacts to the groundwater. This alternative would adequately comply with ARARs and was considered to be sufficiently protective of human health and the environment since the contaminants are already isolated at least 10 feet bgs. The short-term effects of this alternative would be minimal. Furthermore, since this alternative has been implemented before in the State of Hawaii, DOH considered it to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was also significantly lower than Alternatives 3 and 4.

5.5 Lumber Rack / Transformer Storage (DU13)

A total of three remedial alternatives were developed for the Fertilizer AST following screening of the remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- Alternative 1: Groundwater monitoring of the nearest existing groundwater monitoring well (MW11).
- ***Alternative 2: Groundwater monitoring of the existing monitoring well (MW10) and nearest downgradient monitoring well (MW6)***
- Alternative 3: Excavation, removal and disposal of contaminated soils and groundwater monitoring.

Table 10: Ranking of Remedial Alternatives for the Fertilizer AST (DU22)

Criteria	Alternative		
	1	**2**	**3**
Effectiveness: Overall protection of human health & the environment	*2*	*2*	*3*
Effectiveness: Compliance with ARARs	*3*	*3*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*2*	*2*	*3*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*
Effectiveness: Short-term effects	*3*	*3*	*1*
Overall Effectiveness	2.4	2.4	2.4
Implementability: Technical feasibility	*3*	*2*	*1*
Implementability: Administrative feasibility	*2*	*2*	*3*
Overall Implementability	2	2	2
Overall Costs*	3	3	1
Composite Score	7.4	7.4	5.4

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.5.1 Proposed Remedy – Alternative 2: Groundwater Monitoring of Existing Monitoring Well and Nearest Downgradient Monitoring Well

Alternative 1 and 2 both had composite scores of 7.4, which were higher ranking in comparison to Alternative 3. The proposed Alternative 2, would require the well within the DU as well as a downgradient well to be monitored. The additional downgradient well would sufficiently monitor the potential groundwater migration concerns. This alternative adequately complies with ARARs and was considered by the DOH to be sufficiently protective of human health. The short-term effects of this alternative would be minimal. Furthermore, since this alternative has been implemented before in the State of Hawaii, it was considered to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was also significantly lower than Alternative 3.

5.6 Service Station Area (DU15)

A total of four remedial alternatives were developed for the Service Station Area following screening of the remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- ***Alternative 1: Groundwater monitoring of existing groundwater monitoring well (MW1).***
- Alternative 2: Installation of an additional groundwater monitoring well and groundwater monitoring.
- Alternative 3: Accelerated Natural Attenuation/Bioremediation with groundwater monitoring.
- Alternative 4: Excavation, removal and disposal of contaminated soils and groundwater monitoring.

Table 8: Ranking of Remedial Alternatives for the Service Station Area (DU15)

Criteria	Alternative			
	1	**2**	**3**	**4**
Effectiveness: Overall protection of human health & the environment	*2*	*2*	*3*	*4*
Effectiveness: Compliance with ARARs	*4*	*4*	*3*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*2*	*2*	*3*	*4*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*	*4*
Effectiveness: Short-term effects	*4*	*4*	*3*	*1*
Overall Effectiveness	2.8	2.8	3	3
Implementability: Technical feasibility	*4*	*4*	*1*	*2*
Implementability: Administrative feasibility	*2*	*2*	*3*	*4*
Overall Implementability	3	3	2	3
Overall Costs*	4	4	2	1
Composite Score	9.8	9.8	7	7

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.6.1 Proposed Remedy – Alternative 1: Groundwater Monitoring

Alternative 1 and 2 both had composite scores of 9.8 which were higher ranking in comparison to the other two alternatives. The proposed Alternative 1, does not require an additional groundwater monitoring well because initial limited groundwater data within the Service Station Area indicated that the groundwater had not been significantly impacted. This alternative adequately complies with ARARs and was considered to be sufficiently protective of human health and the environment since the TPH-D and PAH contaminants are already isolated at least 10 feet bgs. The short-term effects of this alternative would be minimal. Furthermore, since this alternative has been implemented before in the State of Hawaii, it was considered to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was also significantly lower than Alternatives 3 and 4.

5.7 Mill-Area Petroleum (DU36/DU37)

A total of four remedial alternatives were developed for the Mill-Area Petroleum following screening of the remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- Alternative 1: Groundwater monitoring of the nearest existing groundwater monitoring well (MW7).
- ***Alternative 2: Installation of one additional groundwater monitoring well (MW13) and groundwater monitoring (MW13).***
- Alternative 3: Accelerated Natural Attenuation/Bioremediation with groundwater monitoring.
- Alternative 4: Excavation, removal and disposal of contaminated soils and groundwater monitoring.

Table 9: Ranking of Remedial Alternatives for the Mill Area - Petroleum (DU36/DU37)

Criteria	Alternative			
	1	**2**	**3**	**4**
Effectiveness: Overall protection of human health & the environment	*2*	*2*	*3*	*4*
Effectiveness: Compliance with ARARs	*4*	*4*	*3*	*3*
Effectiveness: Reduction of toxicity, mobility, and volume	*2*	*2*	*3*	*4*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*	*4*
Effectiveness: Short-term effects	*4*	*4*	*3*	*1*
Overall Effectiveness	2.8	2.8	3	3.2
Implementability: Technical feasibility	*4*	*4*	*1*	*2*
Implementability: Administrative feasibility	*2*	*2*	*3*	*4*
Overall Implementability	3	3	2	3
Overall Costs*	4	4	2	1
Composite Score	9.8	9.8	7	7.2

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.7.1 Proposed Remedy – Alternative 2: Installation of an Additional Groundwater Monitoring Well and Groundwater Monitoring

Alternative 1 and 2 both had composite scores of 9.8, which were higher ranking in comparison to the other two alternatives. The proposed Alternative 2, requires an additional groundwater monitoring well since data suggests that groundwater may be impacted in the vicinity of the Mill-Area Petroleum. The additional well in this area would sufficiently monitor the impacts to the groundwater. This alternative adequately complies with ARARs and was considered by the DOH to be sufficiently protective of human health and the environment since the TPH and PAH contaminants are already isolated at least 10 feet bgs. The short-term effects of this alternative would be minimal. Furthermore, since this alternative has been implemented before in the State of Hawaii, it was considered to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was also significantly lower

than Alternatives 3 and 4.

5.8 Fertilizer AST (DU22)

A total of three remedial alternatives were developed for the Fertilizer AST following screening of the remedial actions. The remedial alternatives are listed below, with the proposed remedy indicated in bold italics:

- ***Alternative 1: Groundwater monitoring of the nearest existing groundwater monitoring well (MW11).***
- Alternative 2: Installation of one additional groundwater monitoring well and groundwater monitoring.
- Alternative 3: Excavation, removal and disposal of contaminated soils and groundwater monitoring.

Table 10: Ranking of Remedial Alternatives for the Fertilizer AST (DU22)

Criteria	Alternative		
	1	**2**	**3**
Effectiveness: Overall protection of human health & the environment	*2*	*2*	*3*
Effectiveness: Compliance with ARARs	*3*	*3*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*2*	*2*	*3*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*
Effectiveness: Short-term effects	*3*	*3*	*1*
Overall Effectiveness	2.4	2.4	2.4
Implementability: Technical feasibility	*3*	*2*	*1*
Implementability: Administrative feasibility	*2*	*2*	*3*
Overall Implementability	2.5	2	2
Overall Costs*	3	3	1
Composite Score	7.9	7.4	5.4

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.8.1 Proposed Remedy – Alternative 1: Groundwater Monitoring

Alternative 1 had a composite score of 7.9. This score is the highest ranking in comparison to the other two alternatives. This alternative adequately complies with ARARs and was considered by DOH to be sufficiently protective of human health and the environment since the contaminants are already isolated at least 10 feet bgs. The soil impacts have been delineated and initial limited groundwater data in the vicinity indicated that the groundwater had not been significantly impacted. The short-term effects of this alternative would be minimal. Furthermore, since this alternative has been implemented before in the State of Hawaii, it was considered by DOH to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was also significantly lower than Alternatives 2 and 3.

5.9 Solid Waste Petroleum Area (DU41))

A total of three remedial alternatives were developed for the Solid Waste Petroleum Area following screening of the remedial actions. The remedial alternatives are listed below with proposed remedy indicated in bod talics:

- ***Alternative 1: Groundwater monitoring of a newly installed downgradient groundwater monitoring well (MW13).***
- Alternative 2: Accelerated Natural Attenuation/Bioremediation with groundwater monitoring.
- Alternative 3: Excavation, removal and disposal of contaminated soils and groundwater monitoring.

Table 11: Ranking of Remedial Alternatives for the Solid Waste Petroleum Area (DU41)

Criteria	Alternative		
	1	**2**	**3**
Effectiveness: Overall protection of human health & the environment	*1*	*2*	*3*
Effectiveness: Compliance with ARARs	*3*	*2*	*2*
Effectiveness: Reduction of toxicity, mobility, and volume	*1*	*2*	*3*
Effectiveness: Long-term effectiveness	*2*	*2*	*3*
Effectiveness: Short-term effects	*3*	*2*	*1*
Overall Effectiveness	2	2	2.4
Implementability: Technical feasibility	*3*	*2*	*1*
Implementability: Administrative feasibility	*2*	*2*	*3*
Overall Implementability	2.5	2	2
Overall Costs*	3	2	1
Composite Score	7.5	6	5.4

* For detailed analysis and cost estimates, see ETC's 2018 Task 5 report.

5.9.1 Alternative 1: Groundwater Monitoring

Alternative 1 had a composite score of 7.5. This score is the highest ranking in comparison to the other two alternatives. This alternative adequately complies with ARARs and was considered to be sufficiently protective of human health and the environment since the contaminants are already isolated at least 10 feet bgs. The soil impacts have been delineated. Due to the lack of groundwater data in the immediate vicinity, the additional well (MW13) will be installed as part of Alternative 1 within the Solid Waste Petroleum Area to sufficiently monitor the TPH impacts to the groundwater, if any. The short-term effects of this alternative would be minimal. Furthermore, since this alternative has been implemented before in the State of Hawaii, DOH considered it to be both technically and administratively feasible. The estimated cost to implement this remedial alternative was also significantly lower than Alternatives 2 and 3.

6.0 FINAL PREFERRED REMEDIES

Based on the comparative analysis of remedial alternatives using the specified screening criteria, the preferred remedial alternatives to address environmental hazards at the WSM site are summarized in Table 12 below.

Table 12: Summary of Preferred Remedial Alternatives

Source Area	Selected Remedial Alternative	Estimated Capital Costs
All Areas of the WSM site	A site-wide EHMP which would include a soil management plan, inspection and maintenance plan, and long-term groundwater monitoring plan. The site-wide groundwater monitoring program (MW1, MW2, MW3, MW5, MW6, MW7, MW9, MW10, MW11, MW12, MW13, and MW14) will initially include the following COCs program: TPH-D, TPH-O, PAHs, and Thallium (MW2 and MW6 only). In addition, DU specific COCs will be included in the groundwater monitoring program. The groundwater monitoring COCs for the site are detailed in the Groundwater Monitoring Summary in Appendix I. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring. A covenant will limit land use on the site to Commercial/Industrial uses.	~$10,000 (Well Evaluation) ~$40,000 (annually)
Pesticide Mixing / Storage Area (DU1/DU28, DU2, DU35)	Installation of an asphalt cap and groundwater monitoring of existing and newly installed groundwater monitoring wells (MW6, MW10, and MW14). The following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, PAHs, pentachlorophenol, arsenic, lead, and dioxins/furans. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.	~$382,000
Tank Farm Area (DU3/DU4)	Maintenance of the existing soil cap/cover and erosion control measures.	$0
Arsenic Impacted Area (DU24F.2, DU24F.3, DU24F.3A to F, DU24F.4, DU24F.4A, DU24F.5, DU24F.10 to 12)	Installation of an asphalt cap or a 1.5-2 ft. clean soil cap with erosion control measures atop Category D arsenic soils (DU DU24F.3, DU24F.3A to D, DU24F.4, DU24F.10, DU24F.11)	~$206,000
Diesel Fueling Area (DU11)	Installation of one additional groundwater monitoring well (MW12) and groundwater monitoring of MW9, MW3 and MW12. The following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, VOCs and PAHs. The groundwater monitoring program will be evaluated annually to determine	~$31,000

Source Area	Selected Remedial Alternative	Estimated Capital Costs
	whether COCs and/or well(s) require continued monitoring.	
Lumber Rack / Transformer Storage (DU13)	Groundwater monitoring of nearest existing groundwater monitoring well (MW10) and the nearest downgradient monitoring well (MW6). The following COCs will be included in the groundwater monitoring program: diuron. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.	~$21,500
Service Station Area (DU15)	Groundwater monitoring of nearest existing groundwater monitoring well (MW1). The following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, and PAHs. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.	~$20,500
Fertilizer AST Area (DU 22)	Groundwater monitoring of nearest existing groundwater monitoring well (MW11). The following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, PAHs, and VOCs. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.	~$20,500
Mill Area – Petroleum (DU 36/37)	Installation of one additional groundwater monitoring well (MW13) and groundwater monitoring of MW7 and MW13. The following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, VOCs, and PAHs. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.	~$30,500
Solid Waste Removal Area (DU 41)	Groundwater monitoring of the nearest downgradient groundwater monitoring well (MW13). The following COCs will be included in the groundwater monitoring program: TPH-D, TPH-O, and PAHs. The groundwater monitoring program will be evaluated annually to determine whether COCs and/or well(s) require continued monitoring.	~$20,100

Total Remediation Costs = $742,100
Annual GW Monitoring and Maintenance Costs = $40,000

6.1 Selection Process for Final Remedial Alternatives

The HDOH HEER Office will carefully consider all public comments received on this Draft RAM, as well as comments from HEER Office staff and management. Once the public comment period is over, the HEER Office will make the final determination on remedies selected for the site and include this determination and a response to public comments received in the Final RAM.

7.0 REFERENCES

- Baker and LaChance. 2003. Performance Relative to Dioxins of the In-Situ Thermal Destruction (ISTD) Soil Remediation Technology. TerraTherm Inc. August.
- EnviroServices & Training Center, LLC. 2007. Revision 2, Task 1: Summary Analysis of Environmental Work To Date, Waialua Sugar Mill Voluntary Response Project. Prepared for the Castle & Cooke Waialua, LLC. February.
- EnviroServices & Training Center, LLC. 2007. Task 2: General Work Plan, Determine the Scope of the Remedial Investigation and the Voluntary Response Action, Waialua Sugar Mill Voluntary Response Project. Prepared for the Castle & Cooke Waialua, LLC. February.
- EnviroServices & Training Center, LLC. 2008. Revised Former Mill Area, Task 3: Detailed Site Investigation Work Plan. Prepared for the Castle & Cooke Waialua, LLC. March.
- EnviroServices & Training Center, LLC. 2018. Former Mill Area, Task 4: Site Investigation Report and Environmental Hazard Evaluation, DOH VRP No. V336-24, Waialua Sugar Mill, Voluntary Response Program, Waialua, Oahu, Hawaii, TMK (1) 6-7-001: Parcel 62 (portion). Prepared for the Castle & Cooke Waialua, LLC. February.
- EnviroServices & Training Center, LLC. 2018. Former Mill Area, Task 5: Remedial Alternatives Analysis Report, DOH VRP No. V336-24, Waialua Sugar Mill, Voluntary Response Program, Waialua, Oahu, Hawaii, TMK (1) 6-7-001: Parcel 62 (portion). Prepared for the Castle & Cooke Waialua, LLC. February.
- DOH, Environmental Management Division. 2016. (updated January 2017). Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater. Summer.
- DOH, Environmental Management Division. 2017. Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater. Fall (November).
- DOH, Hazard Evaluation and Emergency Response (HEER) Office. 2009. *Technical Guidance Manual for the Implementation of the State Contingency Plan*. November.
- Macdonald, G.A., Abbot, A.T. and Peterson, F.L. 1983. *Volcanoes and the Sea*. University of Hawaii Press.
- Mink, John F. and Stephen L. Lau. 1990. *Aquifer Identification and Classification for Oahu: Groundwater Protection Strategy for Hawaii*. Technical Report No. 179. Water Resources Research Center, University of Hawaii at Manoa. February.
- Naval Facilities Engineering Command. 1998. *Application Guide for Thermal Desorption Systems*. Technical Report TR-2090-ENV. April.

- U.S. Department of Agriculture Soil Conservation Service. 1972. Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.
- U.S. Department of Energy. Case Study: In Situ Vitrification, U.S. Department of Energy, Hanford Site, Richland, Washington; Oak Ridge National Laboratory WAG 7, Oak Ridge , Tennessee; and Various Commercial Sites.
- U.S. EPA. 1989. Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual, Part A, Interim Final. EPA/540/1-89/002. December.
- U.S. EPA. 1997. Innovative Site Remediation Technology, Volume 4, Stabilization / Solidification. September.
- U.S. EPA. 2000. Data Quality Objectives Process for Hazardous Waste Site Investigations (EPA QA/G-4) Final. EPA/600/R-00/007. January.
- U.S. EPA. SW-846 On-line Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.
- U.S. EPA. 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples (EPA 600/R-03/027). November.

APPENDIX I
Groundwater Monitoring Summary

Groundwater Monitoring Summary

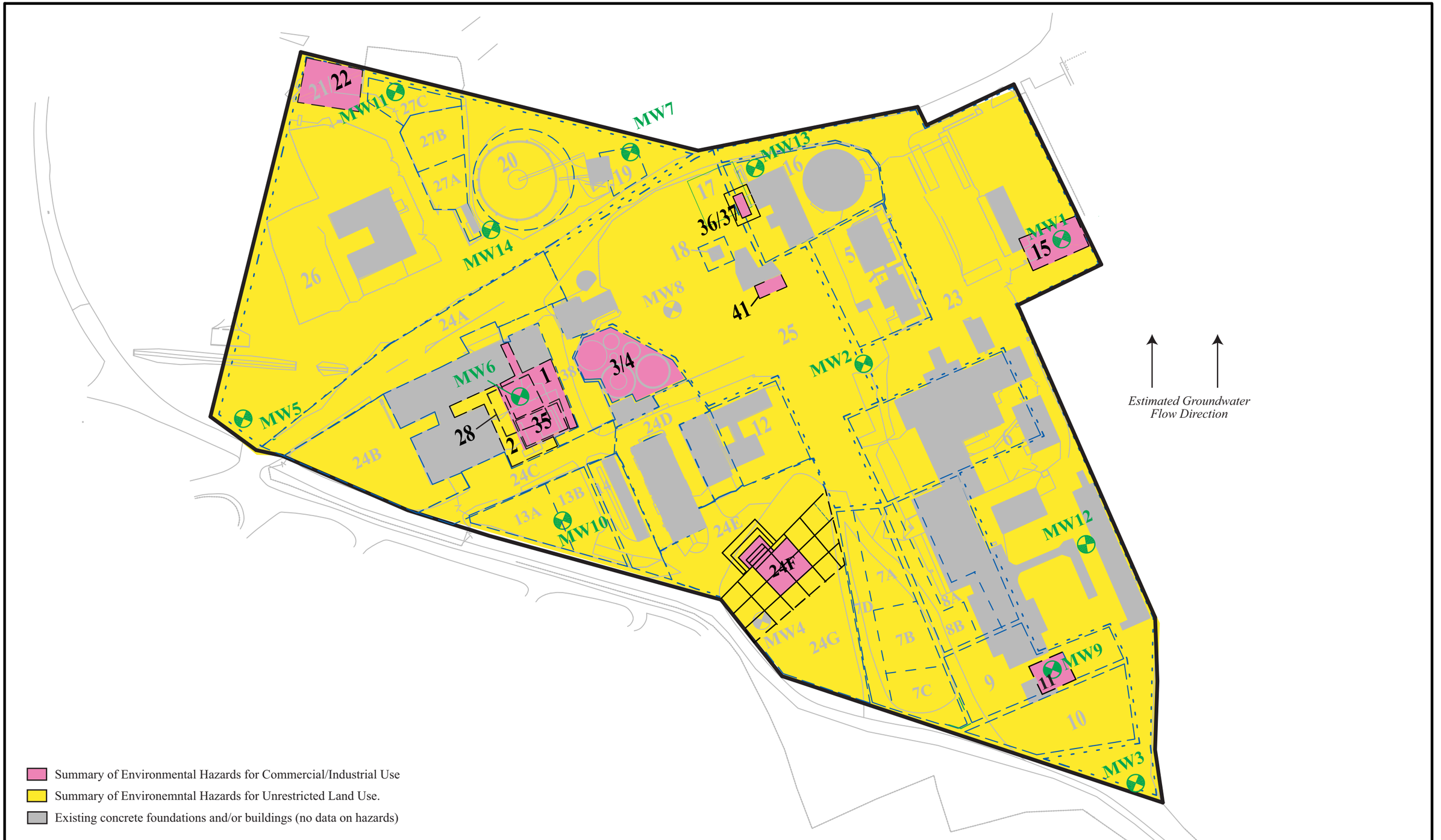
Well No.	TPH-D	TPH-O	PCP	Arsenic	Lead	Thallium	Dioxins	PAHs	VOCs	Diuron
MW1	X	X						X		
MW2	X	X				X		X		
MW3	X	X						X	X	
MW5	X	X						X		
MW6	X	X	X	X	X	X	X	X		X
MW7	X	X						X		
MW9	X	X						X	X	
MW10	X	X	X	X	X		X	X		X
MW11	X	X						X	X	
MW12*	X	X						X	X	
MW13*	X	X						X	X	
MW14*	X	X	X	X	X		X	X		

*New wells to be installed as part of the remedial alternative.

APPENDIX II
Figures

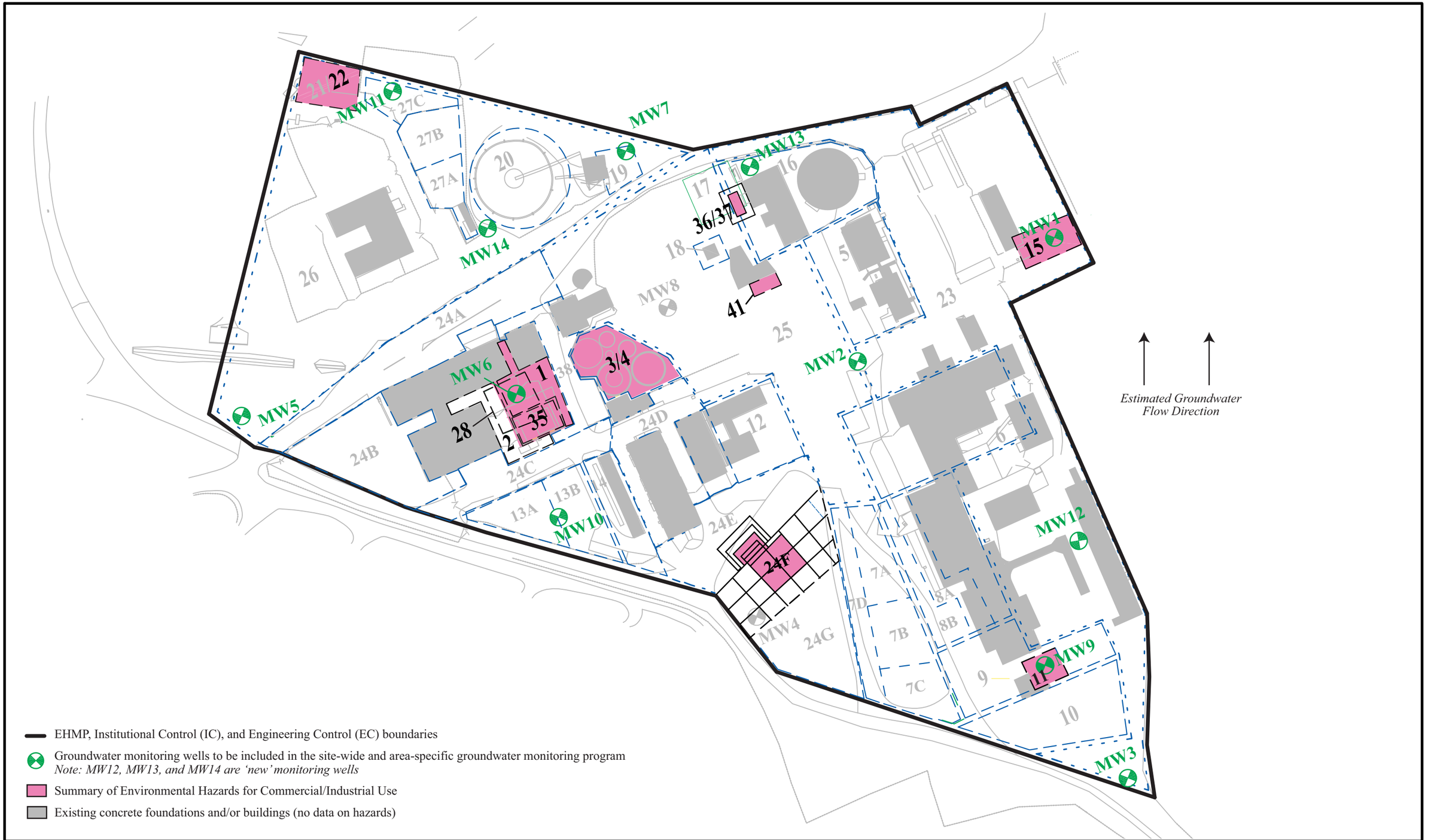
Source:
U.S. Department Of Geological Services
Haleiwa Quadrangle
Island of Oahu, 7.5 Minute Series
1999

N	enviro SERVICES & TRAINING CENTER, LLC	Project No. 05-2003 February 2018	**Figure 1: Site Location Map** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii



Project 05-2003	
1 in. = 200 ft.	
February 2018	

Figure 2: Summary of Environmental Hazards
Draft Remedial Action Memorandum
Waialua Sugar Mill VRP-Former Mill Area
Waialua, Oahu, Hawaii



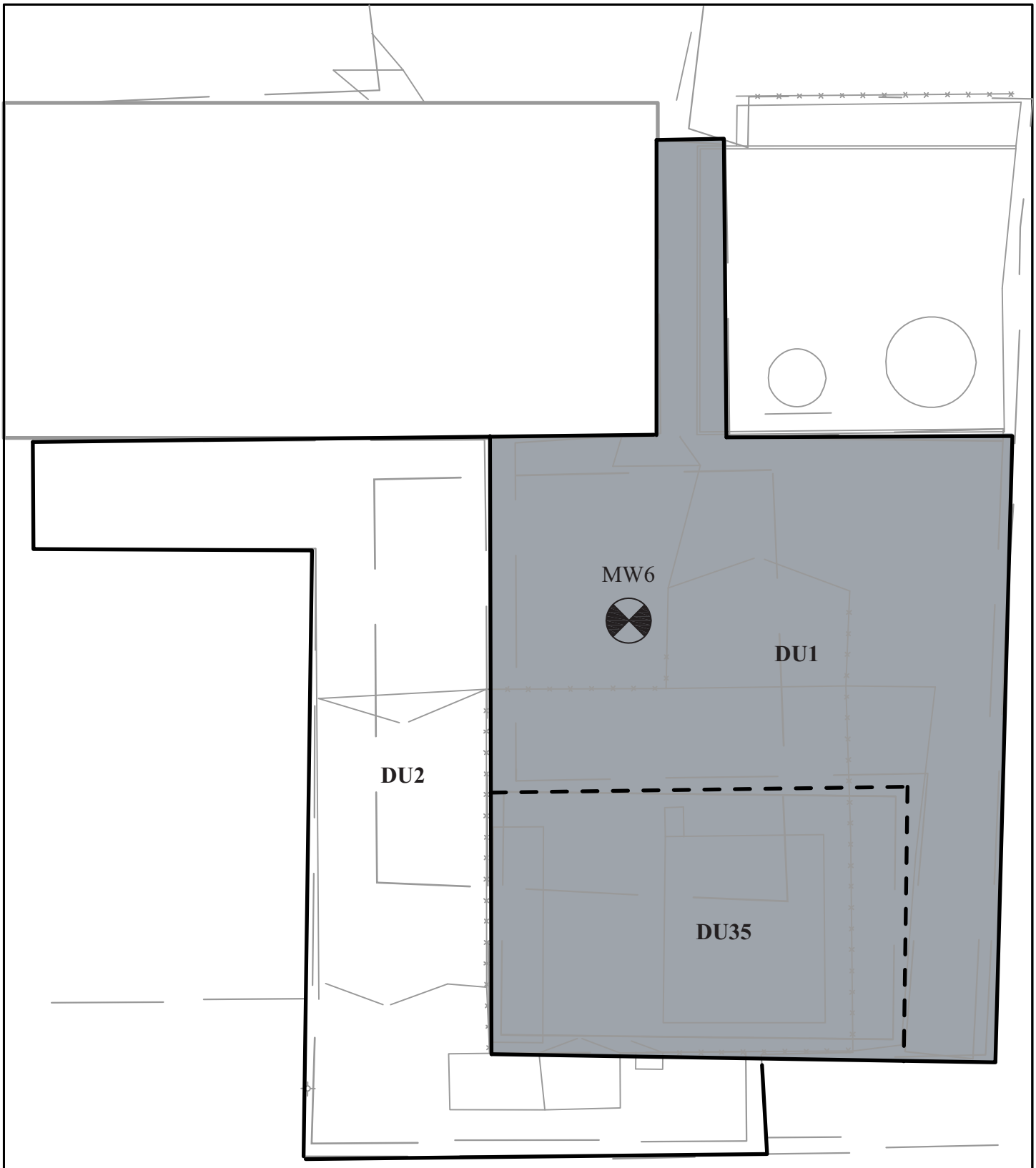
enviro SERVICES & TRAINING CENTER, LLC

Project 05-2003

1 in. = 200 ft.

February 2018

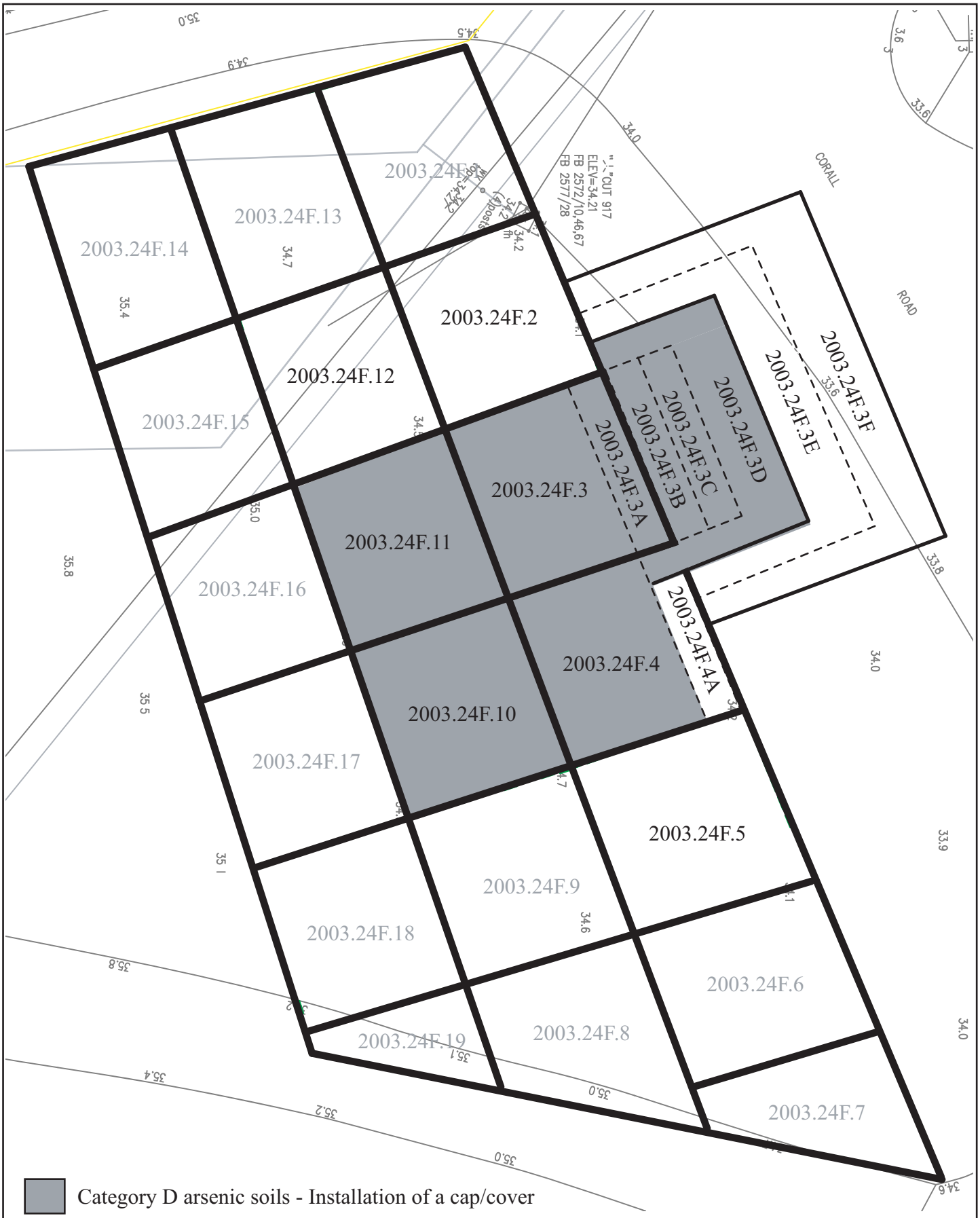
Figure 3: Site-Wide EHMP, ECs, ICs, and Monitroing
Draft Remedial Action Memorandum
Waialua Sugar Mill VRP-Former Mill Area
Waialua, Oahu, Hawaii



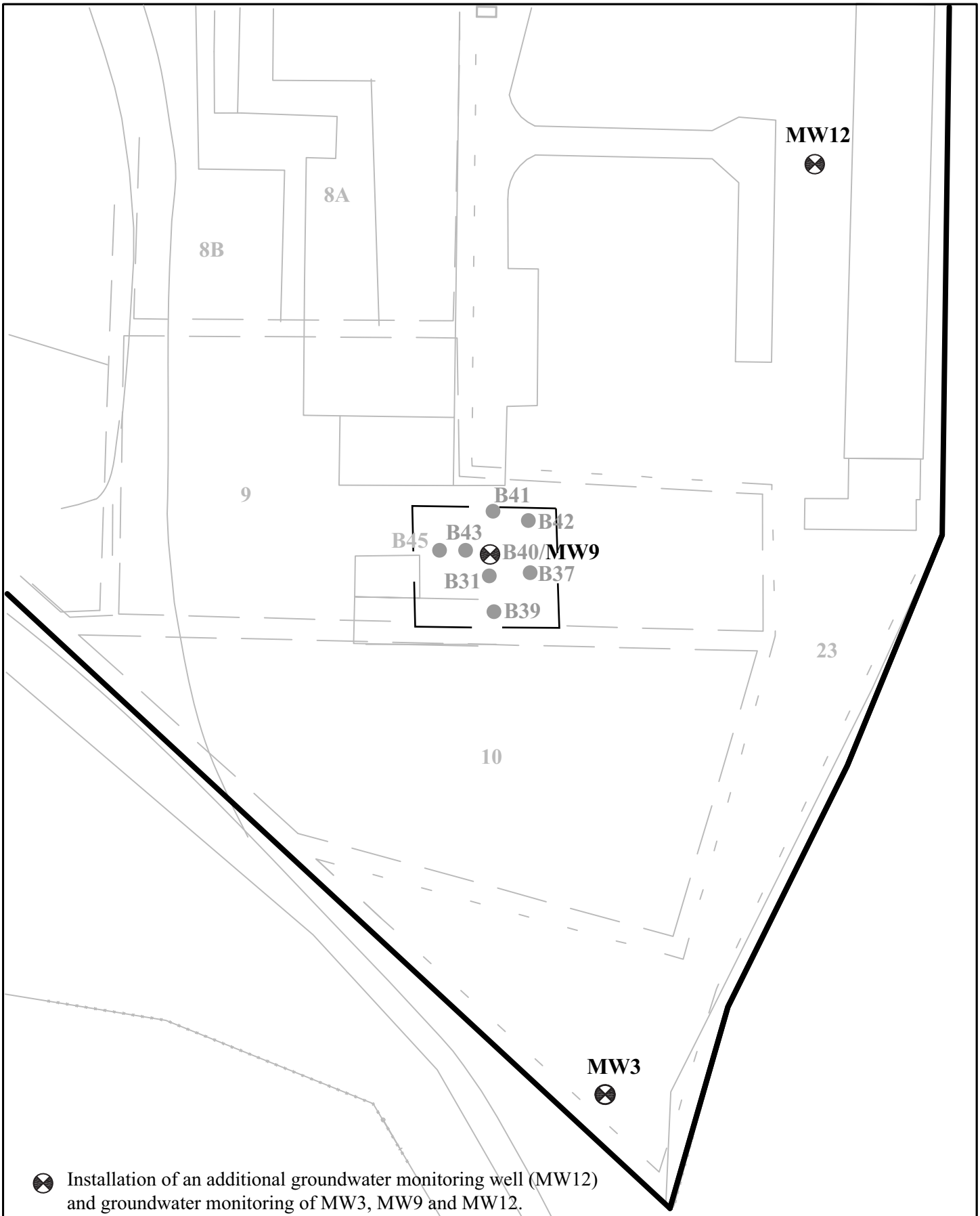
DU1 and DU35 - Installation of a cap/cover

Groundwater monitoring of MW6

N	enviro SERVICES & TRAINING CENTER, LLC	Project No. 05-2003 1 in. = 25 ft. February 2018	**Figure 4: Pesticide Mixing / Storage Area** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii

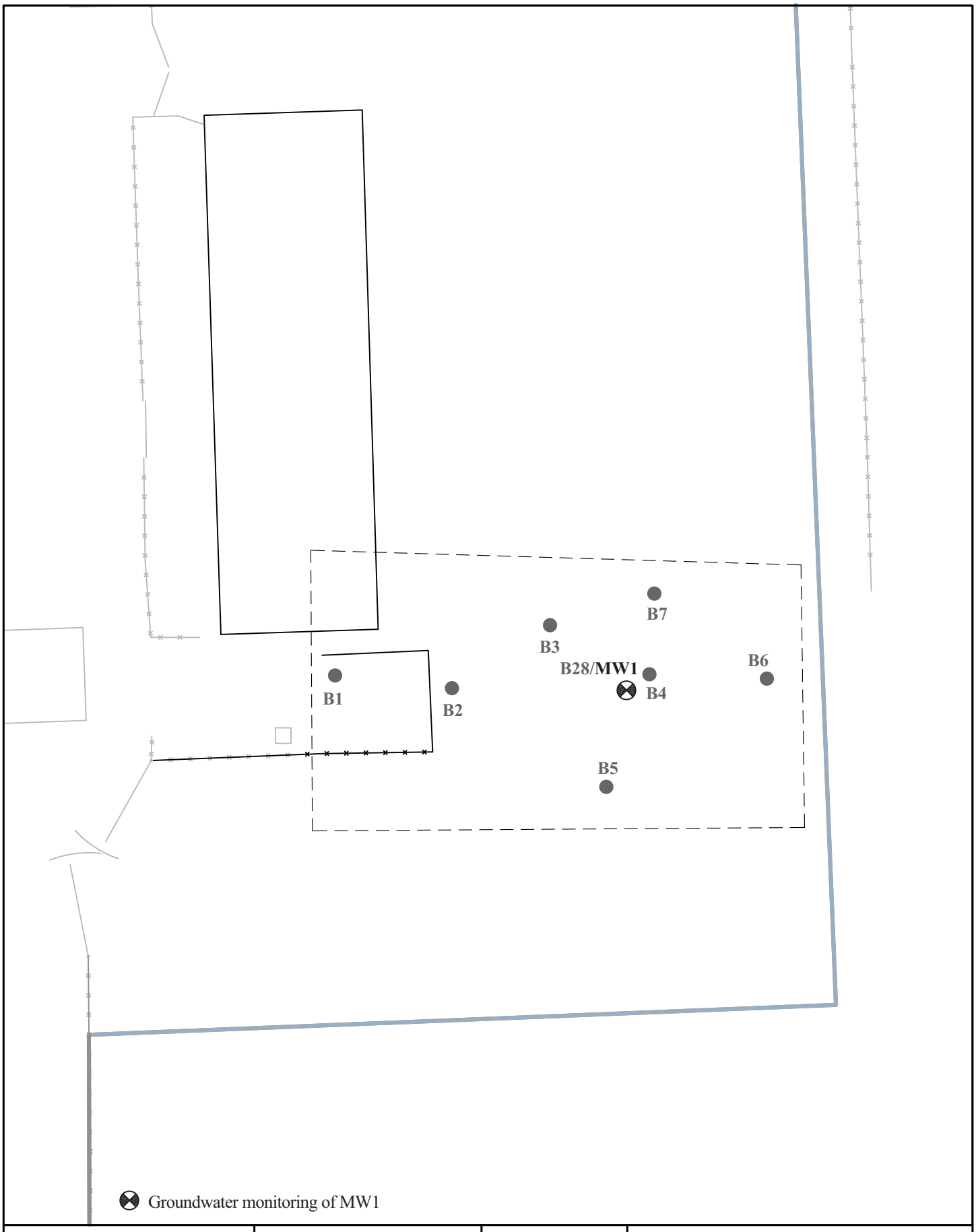


	enviro SERVICES & TRAINING CENTER, LLC	Project No. 05-2003 1 in. = 25 ft. February 2018	**Figure 5: Arsenic Impacted Area** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii

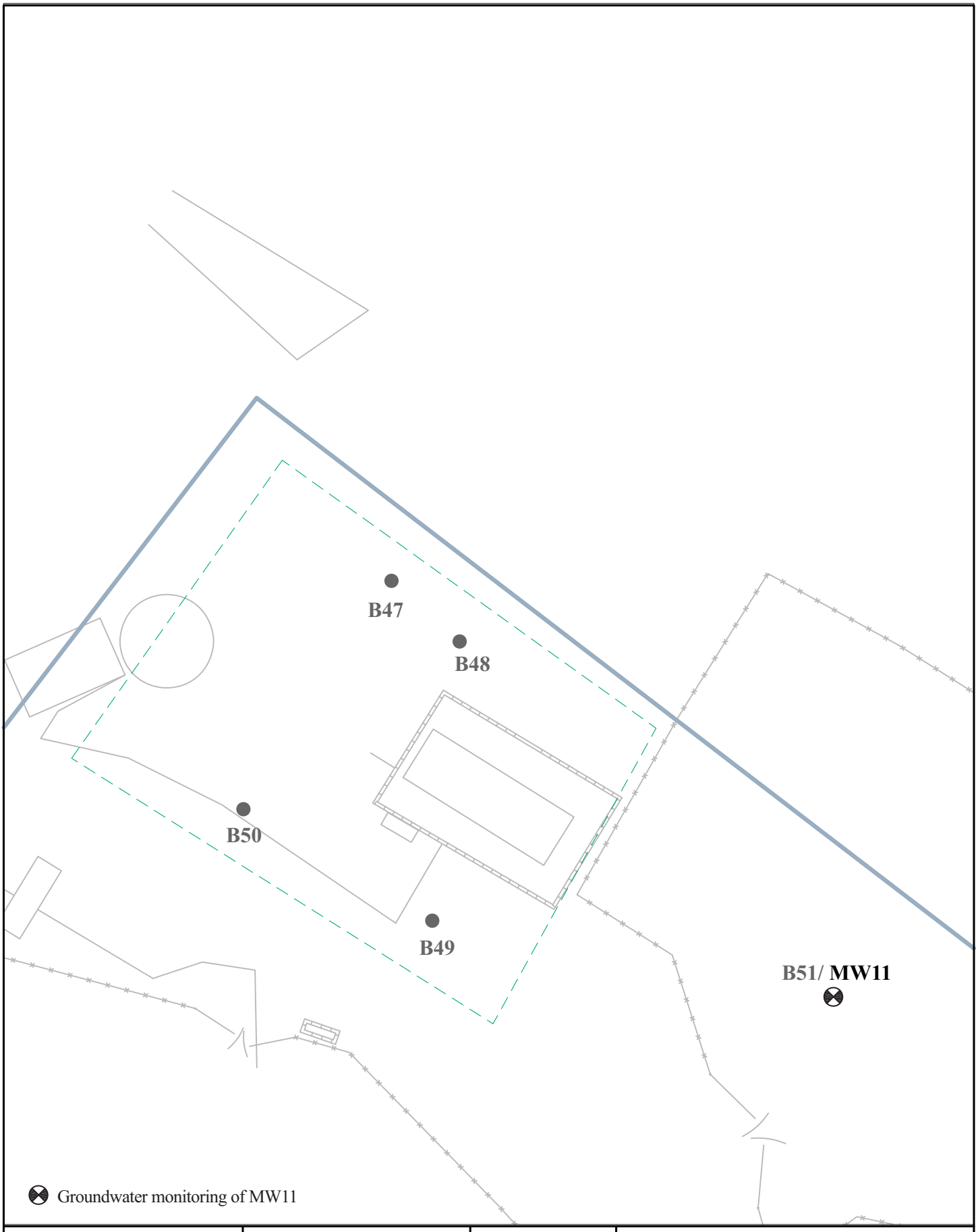


⊗ Installation of an additional groundwater monitoring well (MW12) and groundwater monitoring of MW3, MW9 and MW12.

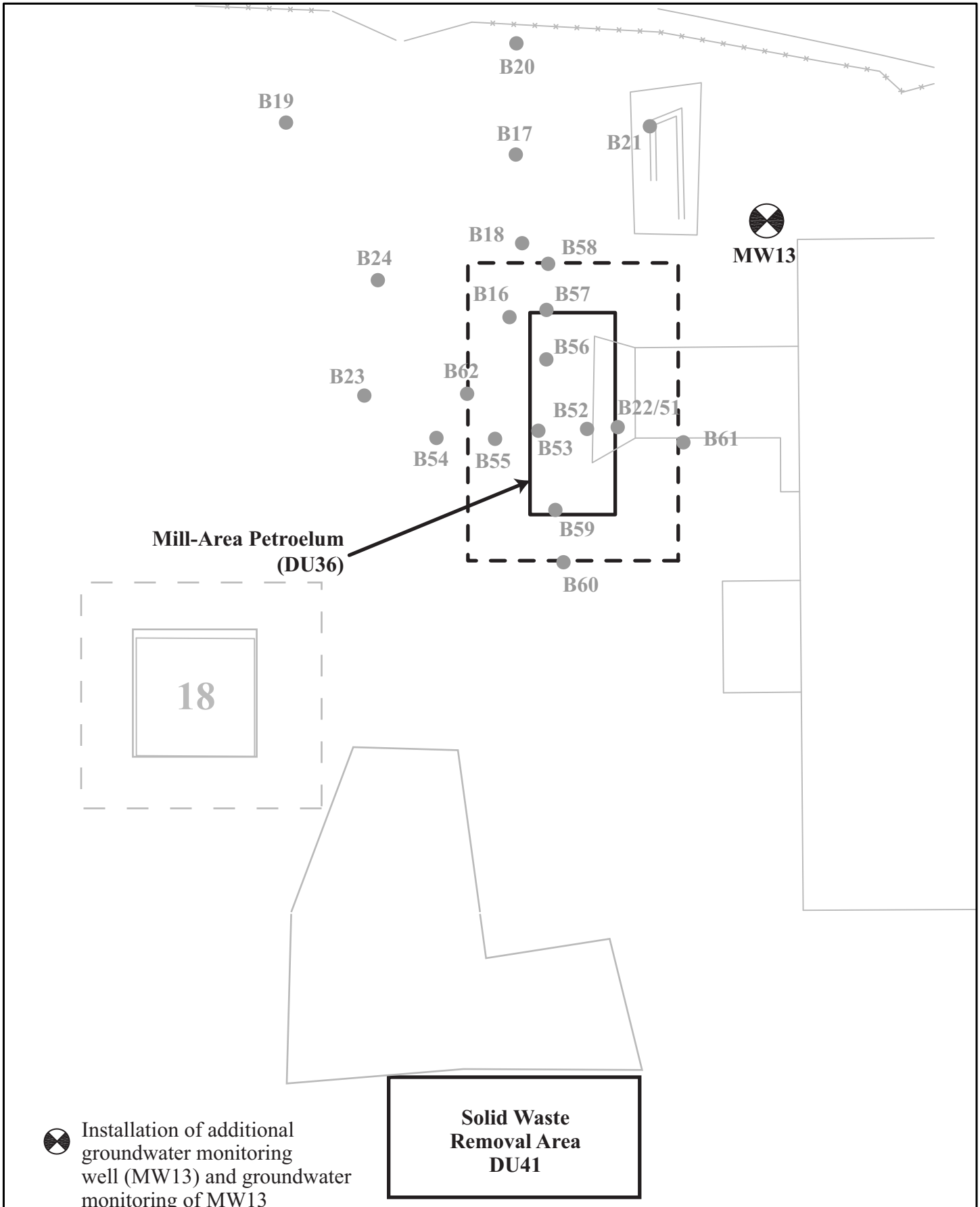
N	enviro SERVICES & TRAINING CENTER, LLC	Project No. 05-2003 1 in. = 25 ft. February 2018	**Figure 6: Diesel Fueling Area** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii



N	enviro SERVICES & TRAINING CENTER, LLC	Project No. 05-2003 1 in. = 25 ft. February 2018	**Figure 7: Service Station Area** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii



N	enviro SERVICES & TRAINING CENTER, LLC	Project No. 05-2003 1 in. = 25 ft. February 2018	**Figure 8: Fertilizer AST Area** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii



		Project No. 05-2003	**Figure 9: Mill-Area Petreoleum and Solid Waste Removal Area** Draft Response Action Memorandum Waialua Sugar Mill VRP-Former Mill Area Waialua, Oahu, Hawaii
		1 in. = 25 ft.	
		February 2018	