FINAL
RESPONSE ACTION MEMORANDUM

Hakalau Beach Park
Hakalau, Hawaii
TMK (3) 2-9-002:080

Prepared For:
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List of Acronyms and Abbreviations

bgs	below ground surface
c-EHMP	Project specific construction Environmental Hazard Management Plan
COC	Contaminant of Concern
COPC	Contaminants of Potential Concern
CSM	Conceptual site model
CY	Cubic yard(s)
DU	Decision Unit
HDOT	State of Hawaii Department of Transportation
EAL	Environmental Action Level
EHMP	Environmental Hazard Management Plan
EHE	Environmental Hazard Evaluation
EPA	United States Environmental Protection Agency
ESI	Environmental Science International
Final RAM	Final Response Action Memorandum
HAR	Hawaii Administrative Rules
HDOH	State of Hawaii Department of Health
HDOH TGM	State of Hawaii Department of Health Technical Guidance Manual
HEER	Hazardous Evaluation and Emergency Response
ISM	Incremental Sampling Methodology
KPC	Kealamahi Pacific Consulting LLC
LBP	Lead-Based Paint

mg/kg	Milligram per kilogram
PPE	Personal Protective Equipment
RAA	Remedial Alternatives Analysis
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SPLP	Synthetic Precipitation Leaching Procedure
sq. ft.	Square Feet
TCLP	Toxicity Characteristic Leaching Procedure
TSP	Triple Superphosphate
TMK	Tax Map Key
XRF	X-Ray Fluorescence

1 Introduction

This Final Response Action Memorandum (Final RAM) has been prepared by Kealamahi Pacific Consultants (KPC) and presents the proposed (preferred) remedial alternative selected for Hakalau Beach Park (“the site”). The site is located at Hakalau Beach Park, Hakalau, Hawaii on the Hamakua Coast approximately 14 miles north of Hilo HI (Figure 1-1). The site is used a public park for general recreation, swimming, surfing, and fishing. The site includes the Hawaii County Tax Map Key (TMK) (3) 2-9-002 Parcel 080.

This Final RAM describes the proposed remedial alternatives and the selected final alternative. It also summarizes site information, environmental investigation data, and provides the basis for remediation as well as the rationale for the selected remedial alternative. This Final RAM was developed based on the Remedial Alternative Analysis (RAA) Report from July 2023 and the Draft RAM from February 2023. The preferred remedial alternative selected is 5b: Removal of all soil which exceeds 200 mg/kg for lead and replacement with clean fill.

1.1 Assessment of the Property

The area of concern is located in the park and surrounding area, which is below the Hakalau Stream Bridge (Figure 1-1). Lead-impacted soil has been documented at Hakalau Beach Park and potential impacts on human health, several site investigations were conducted in 2016, 2020, and 2022 to identify and delineate the extent of lead-impacted soil within Decision Units (DUs) at the site. The site is a public County of Hawaii managed park which is used for general recreation, surfing, and fishing and the site is anticipated to remain a public park. Therefore, based on the current plans for future site use, a response action must be implemented to protect human and ecological health and the environment.

1.2 Description of Preferred Remedy

The overall preferred remedial alternatives for the site were recommended by the environmental consultant in coordination with the Hawaii Department of Health (HDOH) Hazard Evaluation and Emergency Response Office (HEER Office) and the Hawaii Department of Transportation (HDOT) after investigating the environmental contamination of the site. Six (6) potential remedies were selected:

1. Recycle or Reuse,
2. Destruction or Detoxification,
3. Separation, Concentration, or Volume Reduction,
4. Immobilization of Hazardous Substances,
5. On-site of Off-site Disposal, Isolation, or Containment, and
6. Institutional Controls or Long-Term Monitoring

The fifth remedial option, specifically 5b, was selected as the preferred remedy based on recommendations from the site environmental consultant, as well as a review of the site investigation and RAA report. On-site or Off-site Disposal, Isolation, or Containment is a long-term solution where all soil within the open park and surrounding area that exceeds HDOH Tier 1 Unrestricted Land Use Environmental Action Level of 200 milligram per kilogram (mg/kg) for lead will be removed offsite for disposal and will be replaced with clean fill. This will achieve substantial risk reduction, remove the source of contamination, eliminate the need for an environmental hazard management plan (EHMP), and remove the possibility of lead-impacted soil or sediment becoming exposed during future flooding or erosion events.

Figure 1-1: Site Location Hakalau

2 Site Location and Description

Hakalau Beach Park is located in Hakalau, Hawaii, approximately 14 miles north of Hilo. The TMK is (3) 2-9-002 Parcel 080. The HDOT owns an easement under the Hakalau Bridge that extends out ten feet on either side of the bridge which is TMK (3) 2-9-002 Parcel 999. The access road transits across two privately owned triangular parcels which straddle the stream. The site is located in a steep gulch and is bisected by the wide and rocky Hakalau Stream which opens to the Pacific Ocean (Figure 2-1). A paved road descends into Hakalau Gulch and crosses Hakalau Stream via a stabilized channel crossing and becomes gravel/dirt/rock. The southern embankment includes the County of Hawaii Park parcel. This parcel is open and grassy, with a concrete-floor pavilion, and the partial walls from the former Hakalau Sugar Mill. Another dirt/rock road serves the northern embankment. The area under the Bridge is rocky with tall grasses. The site is a public park used for general recreation, surfing, and fishing.

Figure 2-1: Site Location Hakalau Beach Park

2.1 Site Background

In the past, the site had been used for agricultural purposes. Like the other Hamakua bridges, Hakalau Stream Bridge was originally constructed for a railway in the 1900s. The original footings remain, but it was rebuilt after the 1946 tsunami as a highway bridge. The lead-based paint used on the metal support structure flaked and dispersed into the soil below causing the contamination. The lead paint on the bridge was removed in 2000.

2.2 Investigation History

Lead was found in soils at concentrations exceeding the 200 mg/kg Environmental Action Level for level established by HDOH for unrestricted land use. Soil exceedances were identified in the County Park parcel, HDOT ROW, and between 70 to 200 ft west and east from the ROW within privately owned parcels.

The County of Hawaii Beach Park Parcel had sample results which exceeded 200 mg/kg for lead, however, sample results in this parcel did not exceed the 800 mg/kg Construction/Trench Worker EAL for lead. The concentrations of lead in the soil within the County Park parcel are comparable to results found at some schools along the Hamakua Coast.

Lead results within and adjacent to the HDOT ROW exceeded the HDOH Construction/Trench Worker Scenario EALs.

Six DUs also exceeded the gross contamination EAL of 1,000 mg/kg for lead. All of the DUs which exceeded gross contamination levels were located within the HDOT ROW. Several DUs in the area also failed Toxicity Characteristic Leaching Procedure (TCLP) which assesses leaching in a landfill. Soil from these DUs requires out-of-state disposal.

2.3 Magnitude and Extent of Contamination

The potential for harmful health effects from swallowing the lead-impacted soil or lead-containing paint chips depends upon the levels of lead in the soil and paint, how much soil and paint were ingested, and how often. Previous site investigations on bridges along the Hamakua Coast identified that lead-based paint flakes and arsenic could be a concern in the HDOT Highways right of way below the bridges.

Multi-increment soil sample investigations in 2016 identified lead-impacted soils in 15 of the 19 DUs at the site. One DU was paved and not sampled. Only four DUs met the HDOH-HEER Unrestricted Land Use (residential land use) Environmental Action Levels (EALs) for total lead (HDOH revised Fall 2017). Follow-up sampling in 2020 and 2022 expanded the DU areas and included additional depth profiles.

The sampling confirmed that the southern embankment HDOT ROW contained the highest lead concentration sample results. The area under the Hakalau bridge had lead concentrations that exceeded the gross contamination levels (<1,000 mg/kg) in soil beginning from surface soil to a depth of 12-inches below ground surface (bgs). The highest results in the ROW were 25,000 mg/kg of total lead.

Ultimately every DU in the HDOT ROW exceeded the construction/trench worker action level of 800 mg/kg of total lead. The area was not confined to the ROW. Lead-impacted soil was found in the adjacent properties (Figures 2-2 and 2-3), primarily upstream on the southern embankment.

In total approximately 6,000 sq. feet on the Northern Embankment and approximately 43,000 sq. feet on the southern embankment exceeded the 800 mg/kg lead EAL for Construction/Trench Workers. Concentrations decreased at greater distances from the bridge. Total lead remained between 200 mg/kg and 800 mg/kg even 80 to 100 feet from the bridge in the northern embankment. Lead-impacted soils were found approximately 225 ft from the bridge on the southern embankment.

The County of Hawaii park area DUs were between 200 mg/kg and 800 mg/kg within the primary park area. No DUs exceeded 800 mg/kg. Lead-impacted soils covered an area approximately 43,000 sq ft of the parcel (the majority of the park space). Some DU depth profiles in the County of Hawaii parcel met the HDOH Tier I EALs for unrestricted land use.

Soil containing lead could pose a health risk to young children who play in the park. Lead can be harmful to children who accidentally eat small amounts of lead-impacted soil or lead-containing paint chips. Lead is more harmful to children than adults because it can accumulate and persist in their bodies. Lead is particularly toxic to the developing brains and neurologic systems of young children.

The screening levels used by the HDOH, and the United States Environmental Protection Agency (EPA) are designed to protect people using the area. The screening levels assume that areas, where children play, will be barren and the soil exposed. Fortunately, the impacted soil at the park is covered with thick grass. This helps to minimize contact with the soil and reduces concerns about health risks from the periodic use of the park by young children. It is important to continue efforts to make sure that the contact with the soil is minimized.

2.3.1 X-Ray Fluorescence: HDOH 2016

In 2016, the HDOH HEER performed a surface soil site investigation to evaluate the impacts of Lead-based paint (LBP) and sugar plantation activities at the site. HDOH used an X-ray Fluorescence (XRF) analyzer to screen for lead, arsenic, and mercury in a single composite soil sample. This single-exposure DU was located directly below Hakalau Bridge and represented the most probable location of the lead-impacted soil. Thirty (30) increments of soil were collected from the top 2 to 3-inches of soil within this DU. The DU was approximately 120-feet long by 30- feet wide.

Sixteen (16) XRF measurements were taken from the combined incremental soil samples and averaged. The average lead concentration was 196 milligrams per kilogram (mg/kg) and the average arsenic concentration was less than 8.7 mg/kg. Mercury was not detected in any of the XRF measurements (HDOH 2016).

2.3.2 Paint and Soil Sampling: ESI 2016

Due to high levels of LBP found at other locations on the Hamakua Coast, ESI tested paint chips that were found on the bridge footings and steel girders (ESI 2016).

Greyish-black paint chips were collected from the base of four (4) of the steel girders. Lead concentrations ranging from 89 to 510 mg/kg and arsenic concentrations ranging from 61 to 110 mg/kg were found. Red and black paint chips on the rocks beneath the bridge were also tested, and lead was detected in the red paint at 11,000 mg/kg, and in the black paint at 2,700 mg/kg. Arsenic was detected in the red paint at 130 mg/kg and was not detected in the black paint (ESI 2017a).

Additional multi-incremental soil samples were collected from nine DUs in Spring 2016 and twelve more DUs in Fall 2016 (Table 2-1 and Table 2-2) at depths of 0 to 3 inches bgs and 3 to 6 inches bgs. The 2016 soil sample results found exceedances for lead, with results as high as 25,000 mg/kg directly below the bridge. Nine DUs exceeded the HDOH Construction/Trench Worker Direct Exposure EAL of 800 mg/kg for lead, and eight exceeded the HDOH Gross Contamination EAL of 1000 mg/kg for lead (ESI 2017b).

As a result of the high lead exceedances, Toxicity Characteristic Leaching Procedure (TCLP) was performed on soil from seven DUs (KPC 2022). TCLP is a soil sample extraction method for the assessment of the toxicity of heavy metals or other compounds in contaminated soil media. The method incorporates an extraction fluid with a pH that simulates the acidic conditions that soil if it were disposed of in a permitted landfill.

If TCLP is detected at concentrations which exceed the Resource Conservation and Recovery Act (RCRA) hazardous waste criteria (in the case of lead it is 5 mg/L), the material is classified as hazardous waste and must be disposed of in the continental United States as there are currently not any landfills in Hawaii that can accept this type of waste.

TCLP analysis results for three of the DUs exceeded the RCRA listed hazardous waste criterium of 5 mg/L (DU-1B, 11A, and 21A), see Figure 2-1. All of these are located on the southern embankment, under the middle girder (KPC 2022). However, it is estimated that DU2 could also fail TCLP based on the high total lead concentrations.

2.3.3 Soil Sampling: KPC Spring 2022 (April 18-20 and May 10-12)

Concerns about the extent of impacts along both banks of the stream valley floor, shoreline, and the leachability of lead-impacted areas transferring to groundwater and surface water were addressed in the 2022 sampling.

Sampling had been planned for 2021, however, it was delayed due to COVID and right of entry documentation to access private land areas in the vicinity of the project area. Surface and subsurface soil samples were collected along the northern bank as well as upstream at the southern embankment. As shown in Figure 2-3 the vertical and horizontal extent of the lead-impacted soil had not been established on the mauka and makai sides of the bridge on the northern stream bank and in the mauka direction of the southern stream bank. The purpose of the

2022 sampling events was to identify the limits of the contamination “hot zone” to the point where concentrations of total lead in soil fall below the HDOH Tier 1 EAL for unrestricted land use (200 mg/kg) (EnviroQuest 2020).

Sediment Sampling from Stream Bank

During this mobilization, sediment sampling had been proposed along both sides of the stream bank (KPC 2022). When KPC arrived to perform the first of two sampling events in April 2022 extensive scouring, associated with a heavy rain event days preceding the sampling had removed all fine sediment associated with the planned sediment DUs and only large cobble and boulder-sized material remained on the banks. As a result of the high stream discharge rate following the rain event, the vast majority of the sediment formerly along the banks of either side of the stream mouth had been transported out into Hakalau Bay. KPC discussed this event with Mr. Thomas Gilmore (HDOH HEER Remedial Project Manager) who visited the site on April 18, 2022, while KPC was conducting sampling on the northern bank of the Hakalau Stream. Mr. Gilmore concurred that sampling for sediment was not practicable since there was longer fine sediment available to sample in the four planned DU locations on either side of the stream.

KPC returned approximately one month later on May 10, 2022, to complete the sampling activities and observed that the sediment in the planned sediment sampling DUs still had not fully returned to its former position. Coarse cobble and boulder-sized sediment made up the bulk of the stream shoreline in these areas, while the gravel-sized sediment was still in the littoral region of the bay and was only beginning the regress into the mouth of the stream. Based on the April and May 2022 observations it was apparent that the fine sediment is displaced from the mouth of the stream into Hakalau Bay following high rainfall events, then constant wave action winnows out the fine sediment particles out of the slug of new sediment entering the bay and slowly pushes the remaining courser sediment back in the mouth of the stream over days/weeks. The rate that sediment returns into the mouth of the stream depends on the wave conditions and a large portion of the fine sediment formerly in the estuary likely remains offshore and the vast majority of the material originally transported into the bay is redeposited is medium to coarse gravel and cobble-sized material. This cyclical process is repeated perhaps a couple of times per year on the scale that we observed, and several times per year on a smaller scale that acts to continuously winnow out the fine sediment (including fine lead particles in the sediment) from the mouth of the stream. Based on these observations it is unlikely that there is a complete exposure pathway to human receptors (beachgoers, fishermen) posed by lead in the beach and river sediments.

Delineation Sampling North and South Stream Bank Benches Results

As shown in Figure 2-3 the vertical and horizontal extent of the lead-impacted soil had not been established on the mauka and makai sides of the bridge on the northern stream bank and in the mauka direction of the southern stream bank. The purpose of the 2022 sampling events was to identify the limits of the contamination “hot zone” to the point where concentrations of total lead in soil fall below the HDOH Tier 1 EAL for unrestricted land use (200 mg/kg).

The results showed a drop-off in total lead concentrations approximately 225 feet upstream along the southern stream bench and 125 feet along the northern stream bench. The goal was to identify the limits of contamination, where soil met HDOH Tier 1 EALs for unrestricted land use. In the 2022 sampling event, no DU exceeded 800 mg/kg of total lead. Three DUs exceeded the HDOH Tier 1 EALs for unrestricted land use (Figure 2-3).

Groundwater Sampling Results

The plans to collect a groundwater sample from within the highly contaminated zone represented by DUs 32 and 33 using an auger and a gas-powered direct push rig were abandoned based on the observation of the sub-surface cross-section of the southern stream bank adjacent to these DUs. On May 10, 2022, a steep stream bank resulted from high volumes of water scouring the southern bank exposed a 4-foot cross-section that exhibited that a thin veneer of a coarse gravel layer mixed with sand and silt extend from the surface to about 8-12 inches below the upper surface layer. This unit was underlain by rounded large cobble to small boulder-sized rock unit from the base of the described upper layer to the base of the stream bank cross-section where it was covered by other course sediments that made up the rest of the stream bank sediment. This type of geologic unit would not allow a boring to be installed using the available drilling methods and in lieu of the temporary monitoring well, an additional surface water sample collected from the slow meandering stream that passes through the southern side of the steam where the DUs with the highest lead concentrations were found this portion of the stream bench was conducted as a proxy to evaluate the potential soil groundwater leaching effects. This is described in greater detail below.

Surface Water Sampling Results

In accordance with the Final SAP, Addendum samples were collected from surface water at two locations from the small stream flowing along the base of the southern embankment that supports the access road down the side of Hakalau valley (KPC 2022). An additional location was added at the approximate midpoint where the stream passes through the highly contaminated zone (DUs 32 and 33). DU sample from the stream was conducted following the HDOH TGM and the Hawaii Administrative Rules (HAR) Chapter 11-54.

This tributary stream has a width of approximately 6 feet and a depth of approximately 3 feet and runs parallel to the southern wall of the valley, then cuts north and discharges into the Hakalau stream, close to the public beach area. Because this stream passes through the most contaminated areas identified, a sample was planned to be collected in the SAP where the stream turns north and discharged into the main course of Hakalau stream just before where an open concrete dip stream crossing is present in the access roadway connecting to the park, As described above, this point was selected to assess the potential that lead in the soil may be leaching into the surface water as it passes through this highly contaminated zone as described above. These surface water DUs and presented as 202249, 202250, and 202251 in Figure 2-3.

A total of three (3) surface water samples were collected and tested for total lead concentration (mg/L). Concentrations of lead in the water samples were all below the laboratory method reporting limit. Results indicate that there is likely no impact on the surface water body via lead mobilizing from soil to groundwater and groundwater then discharging to surface water.

This is supported by the results of the Batch Test Leaching Model (HDOH 2007), which concluded that the mobility of lead in the soil was very low based on the result of the Synthetic Precipitation Leaching Procedure (SPLP) results of the Incremental Sampling Methodology (ISM) samples collected from the DUs with the highest concentration of lead (DUs 32 and 33).

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Table 2-1: 2016, 2020, and 2022 Combined Soil Sample Results at Hakalau Beach Park

Green	Lead results below HDOH Tier 1 EAL Unrestricted Land Use (200 mg/kg)
Yellow	Lead results above HDOH Tier 1 EAL Unrestricted Land Use (200 mg/kg), but below Construction/Trench Worker Scenario (800 mg/kg)
Red	Lead results above HDOH Tier 1 EAL above Construction/Trench Worker Scenario (800 mg/kg), but below gross contamination (1,000 mg/kg)
Dark red	Lead results above gross contamination (1,000 mg/kg)

2020/2022 DU	2016 DU	Previous Sample ID	Sample Date	Depth (in)	Previous Lead Results (mg/kg)	Current Use Description	Owner
	1	DU-1	2016	0-3	25,000	Area around the bents 4 and 5 under the bridge on the south side stream.	HDOT
	1	DU-1D	2016	0-3	23,700		
	1	DU-1T	2016	0-3	23,600		
	1	DU-1B	2016	3-6	7,880		
32/33	1	DU-1B	2020	6-12	3,250*; 3,360*; 2,960*		
	2	DU-2	2016	0-3	10,200	Between the road and stream around bent 6	HDOT
	2	DU-2B	2016	3-6	9,480		
32/33	2	DU-2B	2020	6-12	3,250*; 3,360*; 2,960*		
	3	DU-3a	2016	0-6	69.4	Southern stream bank	HDOT
	4a	DU-4a	2016	0-6	3.81	Northern stream bank.	HDOT
Observed scour in Feb. 2020	4a	DU-9+	2016	0-6	2.8		
	4a	DU-10+	2016	0-6	2.52		
	4b	DU-4b	2016	6-18	2.99		
	5	DU-5	2016	0-3	3,730	Northern stream bank. Areas around the bridge bents.	HDOT
34	5	DU-5	2020	0-6	221*		
34	5	DU-5	2020	6-12	918*		
34	6	DU-6	2016	0-3	282	Northern bank: Access road between Bents 9-10	HDOT
	7	DU-7	2016	0-3	2,530	Road on S. Embankment, between Bents 5 and 6.	HDOT
	7	DU-7B	2016	3-6	Refusal		
33	7	DU-7B	2020	6-12	3,538*		
	8	DU-8	2016	0-3	1,850	Vegetated area on S. embankment south of the access road to park area.	Wolf Property
32	8	DU-8	2020	3-6	13,500*		
8B	8	DU-8	2020	3-6	2,680**		
32	8	DU-8	2020	6-12	7,510*		
8B				12+	Refusal		

2020/2022 DU	2016 DU	Previous Sample ID	Sample Date	Depth (in)	Previous Lead Results (mg/kg)	Current Use Description	Owner
	11	DU-11A	2016	0-3	8,820	Narrow DU south of DU1	HDOT
	11	DU-11B	2016	3-6	Refusal		
32/33	11	DU-11B		6-12	3,538*; 7510*		
	12	DU-12A	2016	0-3	1,410	Grassy area, likely used by public.	Marian Land Co.
	12	DU-23A	2016	0-3	1,040		
	12	DU-24A	2016	0-3	897		
12	12	DU-12A/B, 24A/B	2016	4-6	738**		
	12	DU-12B	2016	3-6	773		
	13	DU-13A	2016	0-3	357	Grassy area, likely used by public.	Marian Land Co.
	13	DU-13B	2016	3-6	372		
	14	DU-14A	2016	0-3	57	Driveway area, acceptable for public use	Marian Land Co.
	14	DU-14B	2016	3-6	93.4		
	15	DU-15A	2016	N/A	Paved	Paved drainage swale.	Marian Land Co.
	15	DU-15B	2016	N/A	Paved		
	16	DU-16A	2016	0-3	339	Park area. Heavy use by public.	County of Hawaii
	16	DU-16B	2016	3-6	348		
37	16	DU-16B		6-12	368*		
	17	DU-17A	2016	0-3	232	Grassy area south of park.	County of Hawaii
	17	DU-17B	2016	3-6	161		
37	17	DU-17B	2020	6-12	368*		
	18	DU-18A	2016	0-3	104	Grassy Park area at mouth of Hakalau stream.	County of Hawaii
	18	DU-18B	2016	3-6	226		
38	18	DU-18B	2020	6-12	764*		
	19	DU-19A	2016	0-3	28.4	Grassy strip west of DU 18. Acceptable for public.	County of Hawaii
	19	DU-19B	2016	3-6	14.1		
	20	DU-20A	2016	0-3	760	Vegetated area west of DU-8.	Wolf Property
	20	DU-20B	2016	3-6	570		
20	20	DU-20A and DU20B	2020	3-6	1,640**		
20				6+	Refusal		
	21	DU-21A	2016	0-3	5,080	Directly below bridge south bank.	HDOT ROW
	21	DU-21B	2016	3-6	2,720		
32	21	DU-21B	2020	6-12	3,538*; 7510*		

2020/2022 DU	2016 DU	Previous Sample ID	Sample Date	Depth (in)	Previous Lead Results (mg/kg)	Current Use Description	Owner
	22	DU-22A	2016	0-3	3,830	Wolf Property: Area between driveway and stream. Potential high use.	HDOT/ Wolf Property
32	22	DU-22B	2016/2020	3-6	2,870; 13,500*		
32	22	DU-22B		6-12	7,510*		
26			2020	0-3	1,320**	Southern bank upstream of DU22	Wolf Property
				3+	Refusal		
				6-18			
27			2020	0-3	1,680**	Southern bank upstream of DU26	Wolf Property
27				3+	Refusal		
34			2020	0-6	221*	Northern bank: renumbered from DU35 in 2020 SAP	HDOT
34			2020	6-12	918*		
39			2022	0-6	490	Northern bank: adjacent to bridge downstream	Marian Land Co.
39			2022	6-12	737		
40			2022	0-6	131	Northern bank: downstream from DU 39	Marian Land Co.
41			2022	0-6	386	Northern bank: adjacent to ROW upstream	Majority Wolf Property
41			2022	6-12	360		
42a			2022	0-6	99	Northern bank: upstream of 41.	Wolf Property
42b			2022	0-6	76.8 (arithmetic mean)	Northern bank: upstream of 42A.	Wolf Property
43			2022	0-6	146	Southern bank: streambank	Wolf Property
44			2022	0-6	402	Southern bank: across from 43.	Wolf Property
44			2022	6-12	339		
45			2022	0-6	83.7 (arithmetic mean)	Southern bank: upstream of 44	Wolf Property

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Figure 2-2: 2016 and 2020 DU and Sample Results Hakalau

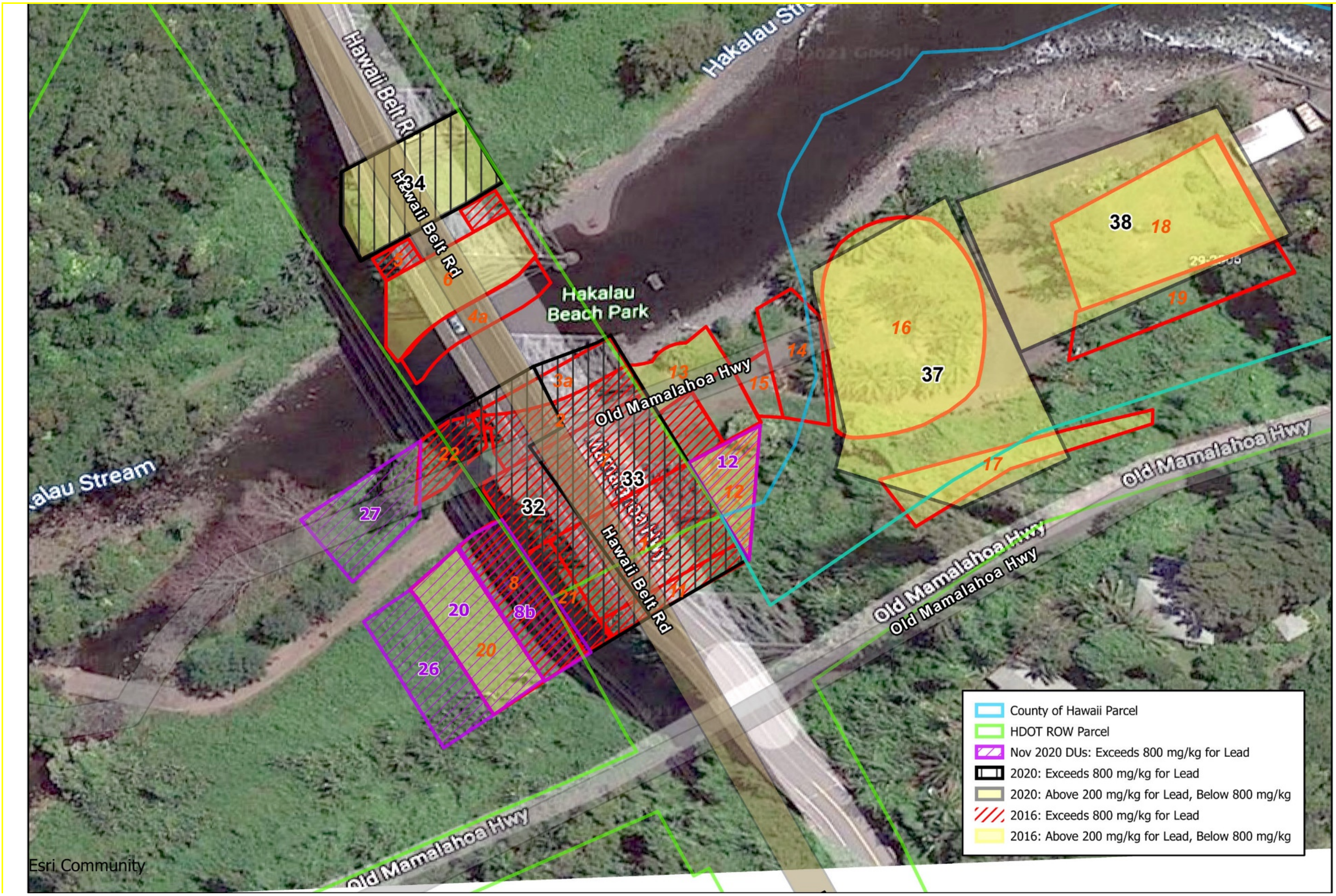

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Figure 2-3: 2022 DU and Sample Results

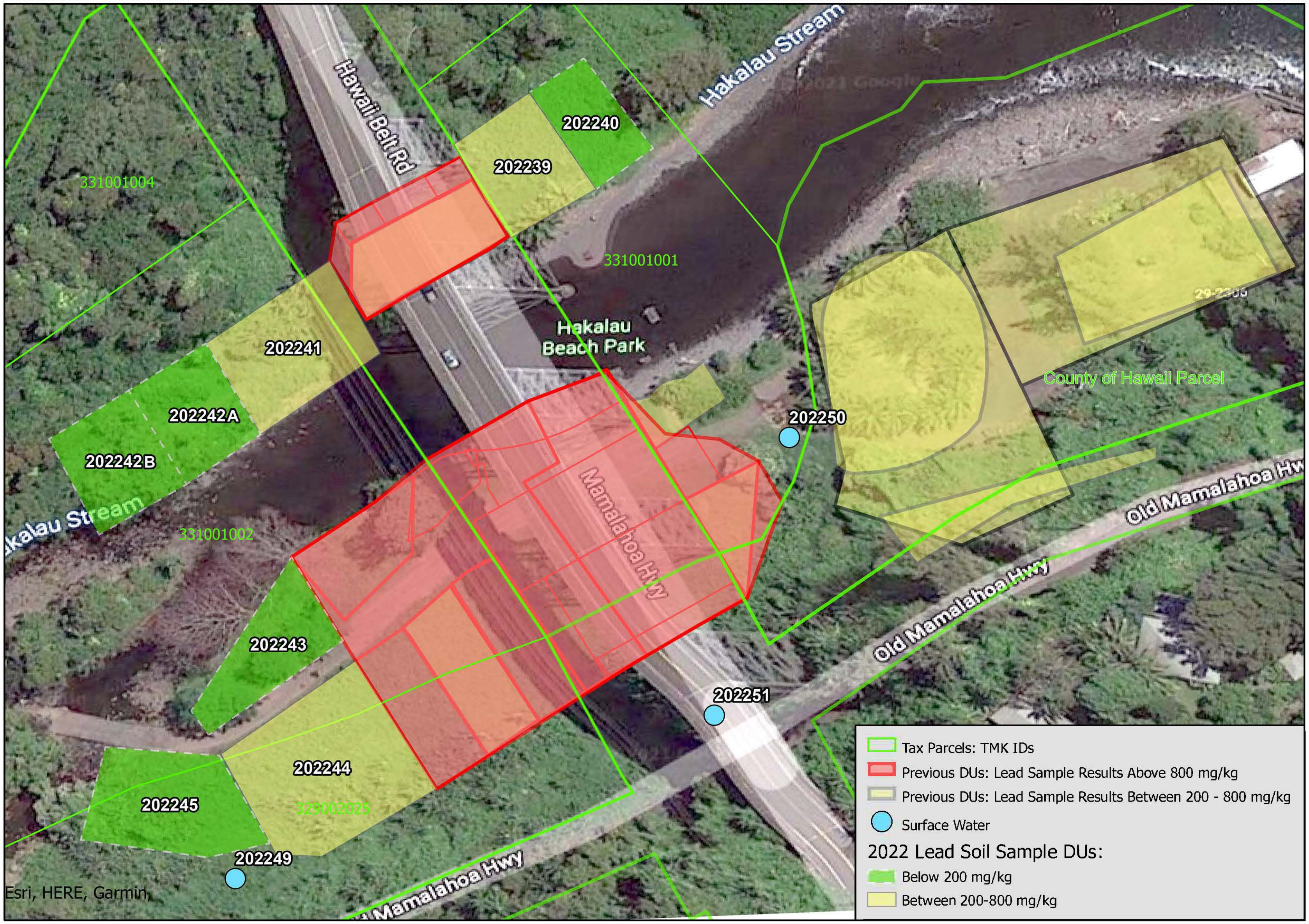

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Table 2-2: Hakalau Beach Park Southern Bank Results above 800 mg/kg for Lead

Exceeds Commercial/Industrial Scenario	Above HDOH Tier 1 EALs for construction/trench worker direct exposure (800 mg/kg)
Gross Contamination	Exceeds HDOH EALs for Gross Contamination (1000 mg/kg)
NA	Not sampled

2020/2022 DU	2016 DU		Depth (in)	Previous Lead Results (mg/kg)	Current Use Description	Owner
HDOT ROW DUs						
	1	DU-1	0-3	25,000	Area around the bents 4 and 5	HDOT
		DU-1D	0-3	23,700		
		DU-1T	0-3	23,600		
		DU-1B	3-6	7,880		
32/33		DU-1B	6-12	3,250*; 3,360*; 2,960*		
	2	DU-2	0-3	10,200	Between the road and stream around bent 6	HDOT
		DU-2B	3-6	9,480		
32/33		DU-2B	6-12	3,250*; 3,360*; 2,960*		
	7	DU-7	0-3	2,530	Road on South stream bank, between Bents 5 and 6.	HDOT
		DU-7B	3-6	Refusal		
33		DU-7B	6-12	3,538*		
	11	DU-11A	0-3	8,820	Narrow DU south of DU1	HDOT
		DU-11B	3-6	Refusal		
32/33		DU-11B	6-12	3,538*; 7510*		
	21	DU-21A	0-3	5,080	Directly below bridge south bank.	HDOT ROW
		DU-21B	3-6	2,720		
32		DU-21B	6-12	3,538*; 7510*		
	22	DU-22A	0-3	3,830	Wolf Property: Area between driveway and stream. Potential high use.	HDOT/ Wolf Property
32		DU-22B	3-6	2,870; 13,500*		
32		DU-22B	6-12	7,510*		
PRIVATELY OWNED PARCELS DUs						
	8	DU-8	0-3	1,850	Vegetated area On southern stream bank south of the access road to park area.	Wolf Property
32		DU-8	3-6	13,500*		
8B		DU-8	3-6	2,680**		
32		DU-8	6-12	7,510*		
8B			12+	Refusal		

2020/2022 DU	2016 DU		Depth (in)	Previous Lead Results (mg/kg)	Current Use Description	Owner
	12	DU-12A	0-3	1,410	Grassy area, likely used by public.	Marian Land Co.
		DU-23A	0-3	1,040		
		DU-24A	0-3	897		
	20	DU-20A	0-3	760	Vegetated area west of DU-8.	Wolf Property
		DU-20B	3-6	570		
20		DU-20A and DU20B	3-6	1,640**		
20			6+	Refusal		
	22	DU-22A	0-3	3,830	Wolf Property: Area between driveway and stream. Potential high use.	HDOT/ Wolf Property
32		DU-22B	3-6	2,870; 13,500*		
32		DU-22B	6-12	7,510*		
26			0-3	1,320**	Southern stream bank upstream of DU22	Wolf Property
			3+	Refusal		
			6-18			
27			0-3	1,680**	Southern bank upstream of DU26	Wolf Property
27			3+	Refusal		

**DU10 consists of a sample, duplicate and triplicate. For the purposes of this table, the highest total lead sample result is identified.*

2016/2017/2019: Year Sampled

mg/kg: Total Lead Results

3 Environmental Hazard Evaluation

The Environmental Hazard Evaluation (EHE) process was developed by DOH to respond to site investigation activities in an RAA. The objective of the EHE was to evaluate the existing soil on the site in relation to HDOH current criteria. A Conceptual Site Model (CSM) was developed (Table 2) to examine the potential exposure of human and ecological receptors to lead-contaminated soil at the site.

3.1 Chemicals of Potential Concern

Lead paint was used for decades on the Hakalau Bridge and may have been used on the Hakalau Plantation Flume (destroyed in 1946). Other bridges along the Hamakua Coast have also been identified as contributing sources for lead paint.

Initial studies performed at Hakalau Beach Park assessed lead, arsenic, and mercury as chemicals of potential concern (COPC). Sampling identified lead as the chemical of concern (COC). Lead-based paints were used as a corrosion-inhibiting coating on the Hakalau Bridge for decades until removed in 2000.

During previous analyses, lead was found to exceed the HDOH Tier 1 EALs for construction/trench worker direct exposure scenario of 800 mg/kg for lead within multiple DUs (Table 1b) for a total area of approximately 46,550 square feet (sq. ft.) Approximately 103,390 sq. ft. were found to be above the HDOH Tier 1 EALs for unrestricted land use (200 mg/kg).

Lead is persistent in the environment and accumulates in soils and sediments through deposition. Once absorbed into the body, lead may be stored for long periods in mineralizing tissue (e.g., teeth, bones, etc.). The stored lead may be released again into the bloodstream, especially in times of calcium stress (e.g., pregnancy, lactation, osteoporosis, etc.) or calcium deficiency.

Depending on the level of exposure, lead can adversely affect the nervous system, kidney function, immune system, reproduction and developmental systems, and the cardiovascular system. Lead exposure also affects the oxygen-carrying capacity of the blood.

The lead effects most commonly encountered in current populations are neurological effects in children and cardiovascular effects (e.g., high blood pressure, heart disease, etc.) in adults. Infants and young children are especially sensitive to even low levels of lead, which may contribute to behavioral problems, learning deficits, and lowered IQ.

Ecosystems near point sources of lead demonstrate a wide range of adverse effects including losses in biodiversity, changes in community composition, decreased growth and reproductive rates in plants and animals, and neurological effects in vertebrates.

3.2 Exposure Setting

Hakalau Beach Park is a public, County of Hawaii Park. However, some portions of private parcels (TMKs) adjacent to the County and HDOT-owned parcels have been used as de facto extensions of the parking area as they are readily accessible to park users but are not owned by the County of Hawaii.

The park was closed in 2017 due to concerns about lead-impacted soil and previously served as a park, fishing area, and general recreation site.

3.3 Potential Human/Ecological Receptors

A conceptual site model (CSM) provides a framework regarding potential sources of contamination, types of contaminants, contaminated media, exposure and migration pathways, and receptors. The CSM (Table 2) was used in the preparation of the Remedial Alternatives Analysis (RAA). Based on the results of the document review, the following are identified as potential human receptors:

- On-site construction workers – including personnel involved in repair or construction/trenching during future site activities; and
- On-site landscapers/site workers – personnel who may maintain landscaped areas and may mow, weed whack, and perform general site maintenance (trash pickup, re-seeding, shrub trimming).
- General Public/Site Users – Including individuals of all ages, who may camp, recreate, or otherwise use the park setting and may potentially dig, touch, drive, lie, or be exposed to lead-impacted soil or dust.
- Ecological Receptors – including native and non-native birds, and mammals that may nest, loaf, hunt, or transit across the site (AECOS 2019).

3.4 Exposure Pathway Analysis

Direct exposure to lead-impacted soil is a potential exposure pathway to human receptors at the site via the following pathways:

- Direct Contact: Incidental ingestion or dermal contact with soil;
- Air: Inhalation of fugitive dust;
- Surface Runoff and Sediment Exposure: Contaminants bourn by water or revealed by erosion; and
- Groundwater Exposure: Contaminants leaching from soil or impacting flowing groundwater.

3.5 Environmental Hazard Evaluation Summary

The exposure pathway analysis described in the previous section identifies various exposure pathways (direct and indirect) where lead-impacted soil may pose risk to human and ecological receptors. The conceptual site exposure model provides a graphical comparison release mechanism, pathways, and exposure routes to potential current and future receptors at the Site (See Table 3-1).

COPC Sources and Release Mechanisms
The primary source of the Contaminants of Potential Concern (COPC) at Hakalau Beach Park is lead-impacted surface and subsurface soil from lead released into the environment from lead-based paint used in historical bridge maintenance activities.

Lead-impacted soil present at the site has been shown to exist at concentrations above the HDOH Tier EALs for gross contamination (1000 mg/kg). Total concentrations vary across the site and include portions that are at or below HDOH Tier 1 EALs for unrestricted land use. The secondary release mechanism, besides direct contact with soil, includes dust, surface water runoff, and leaching.

Pathways and Exposure Routes
Lead poses a hazard to potential receptors through direct exposure to contaminated media through pathways including surface soil, subsurface soil, ambient air, surface water and sediments, and groundwater. These pathways potentially expose receptors to lead via inhalation, ingestion, or dermal absorption.

Potential Receptors Current and Future Land Use
The main human exposure scenarios identified under current land use as a County of Hawaii beach park are the general public, maintenance workers, and construction works. Since the park is owned by the county and land use is not likely to change, future land use includes these same human exposure scenarios. This is also true for avian and aquatic receptors.

Complete Exposure Pathways
Complete exposure pathways exist for all receptor scenarios exposed to surface and subsurface soil at this site under current and future conditions. Exposure to dust is a complete pathway to on-site maintenance and construction workers when the current grass cover is disturbed and there is a potential for inhalation of dust under dry windy conditions when activities such as land mowing and excavation occur.

Potentially Complete Exposure Pathways
Potentially complete pathways to the general public, terrestrial and aquatic ecological receptors exist via direct exposure to fugitive dust if the grass cover was not maintained or a construction excavation project was conducted at the park and dust controls were not implemented correctly. This potential exposure route could be controlled using proper materials management practices and could limit this exposure pathway. Currently, there is no complete pathway to any receptors via surface water runoff, but again, future construction activities could potentially complete this pathway if not conducted with care. Additionally, if there were a natural disaster such as a tsunami that could scour away the current stream bank and redistribute lead-impacted soils in the current park in the Kolekole valley floor sediment and runoff could be a completed exposure pathway.

Exposure to Lead Leaching
There has not been an identified complete pathway to current and future receptors via leaching

in subsurface soil or groundwater. A batch test leachability model based on SPLP analyses from soil collected from the DUs with the highest documented throughout the aggregated sampling events demonstrated that the absorption coefficient is high enough to prevent contaminant mobilization from the soil to groundwater. This is also in part supported by the results of surface water sampling conducted in May of 2022 from a small slow-flowing stream that borders the southern valley escarpment that meanders through and around the most heavily lead-impacted areas. Three surface water DUs were sampled from this stream (DUs 202249, 202250, and 202251, See Figure 2-3) from locations; 1) prior to passing through most impacted areas (DU 202249), 2) at the point which was adjacent to the areas where highest soil concentrations have been identified (DU 202251), and the final point just downstream of the areas of greatest lead concentrations (just before draining into the mouth of Hakalau stream and Hakalau Bay) (DU 202250).

Table 3-1: Conceptual Site Model (CSM) for Human and Ecological Receptors

Primary Sources	Primary Release Mechanism	Secondary Sources	Secondary Release Mechanism	Pathway	Exposure Route	Potential Receptors							
						Current Land Use				Future Land Use*			
						On-site Landscape or Construction Workers	General Public	Terrestrial Ecological	Aquatic Ecological	On-site Landscape or Construction Workers	General Public/	Terrestrial Ecological	Aquatic Ecological
Lead Impacted Soil	Lead-Based Paint from Bridge	Lead Impacted Soil	None	Surface Soil	Ingestion	X	X	X	X	X	X	X	X
					Dermal	X	X	X	X	X	X	X	X
			None	Sub-Surface Soil	Ingestion	X	X	X	X	X	X	X	X
					Dermal	X	X	X	X	X	X	X	X
			Dust	Ambient Air	Inhalation	X	O	O	O	X	O	O	O
			Surface Water Runoff	Surface Water and Sediments	Ingestion	O	O	O	O	O	O	O	O
					Dermal	O	O	O	O	O	O	O	O
			Leaching	Subsurface Soil	Ingestion	I	I	I	I	I	I	I	I
					Dermal	I	I	I	I	I	I	I	I
				Groundwater	Ingestion	I	I	I	I	I	I	I	I
					Dermal	I	I	I	I	I	I	I	I
					Inhalation	I	I	I	I	I	I	I	I

Notes: X - Complete exposure pathway O – Potentially Complete I - Incomplete
* - No significant change to the land use is planned in the near future

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4 Remedial Strategy

4.1 Development of Remedial Action Objectives

The Remedial Action Objectives for Hakalau Beach Park were based on the multiple rounds of soil sample analysis described above to identify the nature and extent of contamination. The objective of the remedial action is to meet the requirements of HDOH and protect the health of users, site workers, and ecological receptors.

4.1.1 Applicable Remedial Action Levels

The HDOT has chosen to implement soil removal and offsite disposal (Option 5b) for soil in the areas which exceed the HDOH Tier 1 Unrestricted Land Use Environmental Action Level of 200 mg/kg for lead, and replacement of impacted soil with clean fill.

4.1.2 Remedial Action Objectives

The Remedial Action Objectives for Hakalau Beach Park as identified by the site owners and as recommended by the state guidance is to remove the lead-impacted soil which exceeds 200 mg/kg for lead from direct contact with site users, site workers, and potential ecological receptors (Option 5b). This option will achieve substantial risk reduction, remove the source of contamination, eliminate the need for an environmental hazard management plan (EHMP), and remove the possibility of lead-impacted soil or sediment from becoming exposed during flooding or erosion in the future.

4.2 Estimation of Soil Volumes Needing Remedial Action

A total of 1,265 Cubic Yards (CY) of soils that exceeded the 200 mg/kg lead criteria for soil removal will be removed and disposed of off-site at a permitted waste disposal facility. The total volume includes approximately 1,150 CY of soil exceeding 200mg/kg and approximately 115 CY of soil exceeding 800 mg/kg. Soil which exceed 800 mg/kg will require off-island disposal.

4.3 General Response Actions

Actions may include restricting access, fencing, administrative/institutional controls, reducing contact with lead-impacted soil through physical barriers, or removing the source of contamination. The option to remove the source of contamination had an open public comment period. Notices were placed in the Hawaii Tribune-Herald on June 30, 2023. The public Fact Sheet and Draft RAM was available to the public through the HDOH HEER Office website (http://hawaii.gov/doh/heer) during the public comment period Comments from eight people were received. All supported a clean-up activity, and 6 supported option 5b. One person identified 5c as their preferred alternative, and one person identified 6a as their top choice. Option 5 b was ultimately chosen as the final remedial action.

4.4 Development of Remedial Alternatives

HDOT operates Hakalau Beach Park and is responsible for the cleanup. HDOT has coordinated to investigate the environmental contamination at the site and has evaluated six (6) potential remedies. The State of Hawaii Department of Health Technical Guidance Manual (HDOH TGM)

(Section 16.2.2.2) and the Hawaii State Contingency Plan [HAR 11-451-8(c)] (HAR, 1995) identifies a hierarchy of remedial response actions in the following descending order:

1. Recycle or Reuse,
2. Destruction or Detoxification,
3. Separation, Concentration, or Volume Reduction,
4. Immobilization of Hazardous Substances,
5. On-site or Off-site Disposal, Isolation, or Containment, and
6. Institutional Controls or Long-Term Monitoring.

5 Evaluation of Remedial Action Alternatives

Alternative 1: Recycle or Reuse
The COC is dispersed lead-paint flakes. The lead paint material is not dense enough to be separated from the soil to be recycled or reused. This alternative is not suitable to remove the contaminant from the site or reduce potential exposure pathways.

Alternative 2: Destruction or Detoxification
The lead at the site is also not organic, corrosive, or explosive and is relatively immobile. This alternative is not suitable to remove the contaminant from the site or reduce potential exposure pathways.

Alternative 3: Separation, Concentration, or Volume Reduction
Under this alternative, contaminated material may be completely or partially separated from material that is not contaminated, or contamination may be reduced in a large volume of material by concentrating the contaminant in a smaller volume. Soil particle size separation is conducted to reduce contaminated soil volume, soils at Hakalau and lead paint flakes are not suitable for volume reduction in this form and contamination would not be reduced significantly.

Alternative 4: Immobilization of Hazardous Substances
Portions of the site exceed gross contamination and fail TCLP. Soil in some DUs would be classified as hazardous waste if removed for disposal (areas of 8390 sq ft). This soil cannot be disposed of in Hawaii as there are no facilities that are permitted to accept hazardous waste. Reducing bioavailability by stabilizing the lead with a strong buffering agent application was tested to reduce the concentration which could allow for disposal in the state (e.g., through the application of triple superphosphate (TSP) as an amendment to the soil). This would be in conjunction with soil excavation and removal and would not be used for in-situ stabilization. Treated soil would be hauled to RCRA subpart D permitted landfill (e.g., West Hawaii Sanitary Landfill).

TSP is a commercially available soil fertilizer than can also be used to reduce the mobility of lead in the soil. Phosphate is a compound made up of phosphorous (P) and oxygen (O) and phosphorous atoms that act as an anion that binds readily to lead cations. TSP can also be combined with different ions to impact solubility under acidic conditions. It is most commonly used as fertilizer produced from phosphate rock and phosphoric acid and is technically known as calcium dihydrogen phosphate and as monocalcium phosphate, [$Ca\ (H_2PO_4)_2.H_2O$]. Treatability studies for in situ lead stabilization that used phosphate-based binders found a significant reduction in the bioavailable lead in soil when it was amended with TSP (Hettiarachchi et al. 2001 and Gene 2008). TSP can also be combined with different ions to impact solubility under acidic conditions. Based on the high concentrations of lead in soil at the Hakalau site, TSP was not considered as a potential in situ stabilization remedial alternative approach. Instead, TSP is evaluated in this alternative and was considered as an amendment to be added to the contaminated soil after it is excavated in an effort to reduce the toxicity through immobilization/stabilization of the soil to allow it to be disposed of on island. This is a variation of the scenarios that are evaluated under Alternative 5.

As part of the remedial alternative evaluation, in May of 2022, KPC collected a bulk sample using ISM from the most heavily impacted areas below the bridge on the southern side of the Hakalau stream from DUs 32 and 33 which had been documented in previous investigations as having the highest total lead concentrations in the project area (DUs 32 and 33 were composed of the consolidated DUs 1, 2, 11, and 21).

The study concluded that TSP was effective at reducing the toxicity of lead in the areas where the highest total lead was present. The total lead concentrations from ISM soil samples collected from DU32 and DU33 were 11,400 mg/kg and had a respective TCLP result of 25.6 mg/l, which is well above the RCRA toxicity characteristic for lead of 5.0 mg/L. However, if TSP is added to an aliquot from this same ISM from DU32 and DU33 at a concentration of just 5% of the total soil mass, the TCLP results were shown to reduce concentrations below the laboratories method reporting limit (or in other words non-detectable dissolved lead). This was achieved without any additional pH buffering additives and demonstrated that immobilization/ stabilization using TSP is highly effective and ratios that are economically feasible.

As a component of the bench test treatability study in addition to evaluation of the effectiveness of immobilizing lead by adding TSP as an amendment, KPC also evaluated the effectiveness of adding Portland Cement as a way to stabilize the lead. The concept was that if Portland Cement could both buffer the soil to reduce the mobility of the lead and create a material that is could consolidate the lead soil as long-term management to reduce disposal costs (e.g., construct an onsite encapsulation cell). Portland Cement was added to the impacted soil at a typical mass ratio for making concrete (1:3). Samples of the soil were weighed, and Portland Cement was mixed with the soil, no other sand or gravel was added and because the soil already had a high moisture content, water was not added to the mix. After the mix was cured, samples were pulverized and submitted to Eurofins for analysis. TCLP analysis on this final material also showed that Portland cement is able to reduce the TCLP result to below the laboratory reporting limit without the addition of TSP Appendix D.

Alternative 5: On-site or off-site disposal, isolation, or containment

This method offers a good option to prevent the general public from coming into contact with lead-impacted soils. There are three scenarios evaluated in the RAA that are considered effective presumptive remedies for addressing lead-impacted sites by the EPA. Generally, if lead-impacted soil remains on-site it will be encapsulated and direct exposure to park users is prevented, however, site maintenance workers/construction workers may come into contact with it in the future. An Environmental Hazard Management Plan (EHMP) will need to be maintained and updated when future work activities are planned in areas where encapsulated contaminated soil is present. A project-specific construction EHMP (C-EHMP) will need to be prepared for each future repair and construction activities need to plan for managing lead-impacted soil to be protective of all potentially exposed receptors for the duration of the project. Alternatively, if lead-impacted soil is removed in its entirety from the site as a remedial approach then all potential exposure risk is removed and no EHMP is required for the long term.

This alternative presents the remedial alternatives that reduce or remove contamination from direct contact with receptors at the site.

Due to the overlapping rounds of sampling and DUs that have occurred between the period 2016 and 2022, Tables 5-1 and 5-2 identify the total area of the exceedances broken down by landowner, location, and DU.

Table 5-1: HDOT and Privately Owned Parcels which exceed 800 mg/kg

Stream Side	Owner (Description)	Lead	Area (sq ft)	Perimeter (ft)	DUs	Total (sq ft)
North	HDOT (ROW)	800+ mg/kg	5885	313	5,6,34	
South	HDOT (ROW Streamside)	800+ mg/kg	5510	331	1,2,7,33, 22 (partial)	
South	HDOT (ROW Roadway)	800+ mg/kg	3026	285	7,32,33,	
South	HDOT (ROW Upslope)	800+ mg/kg	10805	421	1,7,11, 21,32,33	
South	Wolf Property (Streamside)	800+ mg/kg	5219	308	22,27	
South	Wolf Property (Roadway)	800+ mg/kg	1817	248	Not sampled, likely 800 mg/kg +	
South	Wolf Property (Upslope)	800+ mg/kg	10382	404	8,20,26	
South	Marian Land Co (makai of bridge)	800+ mg/kg	3907	345	12, portion 13	
		Total HDOT Area 800 + mg/kg				***25,226***
		Total Privately Owned Parcel				***21,325***
		Total Area 800+ mg/kg				***46,551***

Table 5-2: Hawaii County and Privately Owned Parcels which exceed 200 mg/kg and are below 800 mg/kg *

Stream Side	Owner	Lead	Area (sq ft)	Perimeter (ft)	DUs	Total (sq ft)
North	Wolf Property (mauka)	200+ mg/kg	5847	310	202241	
North	Marian Land Co (makai)	200+ mg/kg	4100	267	202239	
			North Side: Between 200-800 mg/kg			***9947***
South	County of Hawaii	200+ mg/kg	36017	875	16, 17,18,37,38	***36017***
South	Wolf Property upslope	200+ mg/kg	9035	374	202244	***9035***
South	Marian Land Co	200+ mg/kg	1355	161	13	***1355***
			South Side: Between 200-800 mg/kg			***46407***
				Total Area 200- 800 mg/kg		***56354***
**All HDOT DUs exceed 800 mg/kg*						

5a: On-site isolation and containment
HDOH and EPA-acceptable mitigation measures include soil encapsulation. During soil encapsulation, DUs which exceed HDOH unrestricted land use EALs (200 mg/kg) (Figure 5-1) for lead would first be covered with orange mirafi (geotextile) or black geotextile material with caution tape laid at intervals to produce a visible barrier between the clean and impacted soils (Table 5-2). Confirmation visual confirmation will be conducted to ensure that all targeted soil is covered.

- Clean fill would be brought in and overlaid across the impacted site at a depth of either 18 or 24 inches and grass would be maintained to prevent potential exposure (Table 5-3). Additional cubic yards of clean soil would also be needed for drainage and grading.

An exposure assessment conducted at nearby Kolekole Beach Park in 2017 for park maintenance workers demonstrated the grass cover on the impacted soil areas effectively prevented a complete exposure pathway while performing maintenance activities (e.g., lawn mowing). The results of this assessment also demonstrated that grass cover was protective of park user exposure scenarios as long as there were restrictions on activities that could render the grass cover ineffective (e.g., digging, driving fence posts, etc.). This may be suitable for the County of Hawaii Park Parcels but may not be adequate for the HDOT ROW due to high COPC levels.

This option leaves the lead-impacted soil on site (including areas of Gross Contamination) and an EHMP would still be needed. Batch Test Leachability analysis demonstrated that lead is immobile and unlikely to affect groundwater and surface water. Workers within the DOT ROW would need respirators when performing maintenance tasks where they are digging/trenching in soil.

Table 5-3: Alternative 5a: No Removal, Cap Only, Cubic Yards

		Cubic Yards	
Ownership	**Sq Ft**	**Clean fill 18" Grass Cap**	**Clean fill (24") Grass Cap**
County of Hawaii 200-800 mg/kg	36017	2001	2667
HDOT ROW (North) 800+ mg/kg	5885	327	436
HDOT ROW (South) 800+ mg/kg	19341	1075	1433
Private Parcels (North) 200 - 800 mg/kg	9947	553	737
Private Parcels (South) 200 – 800 mg/kg	10390	577	770
Private Parcels (South) 800+ mg/kg	21325	1185	1580
Total	**102905**	**5718**	**7623**

Annual operation and maintenance costs are not typically high for this alternative; however, the location could be impacted by erosion due to heavy rains and storms. The hard cap and soil cover option may be undermined during large storms. If this occurs, additional soil or hard cap repairs may be needed. If evidence of erosion impacts the mirafi layer, there is a potential that impacted soil may be spread over areas currently identified as "lower risk" and additional sampling could be required. It is vital that this cap is maintained to protect park users.

Areas where this would be impracticable (steep slopes, areas of intense vegetation/trees on the southern embankment) would be fenced and signs would be maintained to restrict access.

5b: Removal of all soil which exceeds 200 mg/kg for lead and replacement with clean fill
DUs which pass TCLP and exceed HDOH Tier I unrestricted land use EALs for lead (200 mg/kg) (Figure 5-1) will be excavated, hauled to West Hawaii Sanitary Landfill, and replaced with clean fill at a design fill depth of 24 inches. DUs in the County of Hawaii parcel meet this standard. Other locations, particularly the DOT ROW area and some private parcels, do not meet this standard and may require disposal off-island (Table 5-4).

Table 5-4: Alternative 5b – Soil Removal 200+ mg/kg, Clean Fill, Cubic yards

Ownership	Sq Ft	DU ID	Remove soil (12" estimate) that exceeds 200 mg/kg (CY)	Clean fill 18" (CY)	Clean fill 24" (CY)
County of Hawaii 200-800 mg/kg	36017	16, 17,18,37,38	1334	2001	2667
HDOT ROW (North) 800+ mg/kg	5885	5,6,34	218	327	436
HDOT ROW (South) 800+ mg/kg	19341	1,2,7, 11, 21, 22, 32, 33	716	1075	1433
Private Parcels (North) 200 - 800 mg/kg	9947	202241, 202239	368	553	737
Private Parcels (South) 200 - 800 mg/kg	10390	13, 202244	385	577	770
Private Parcels (South) 800+ mg/kg	21325	8, 12, 13, 22,27, 26	790	1185	1580
Total	**102905**		**3811**	**5718**	**7623**

Initial costs would be high as soil which is classified as hazardous waste could not be disposed of at facilities in Hawaii. DU1, DU2, DU11, and DU21 failed TCLP at different depth profiles, (0 to 3-inches bgs), and near-surface soil (3 to 6-inches bgs) (Table 5-5). This is approximately 8,390 sq ft. It is possible that DU2, which was not tested at the time, could also fail TCLP due to its high total lead concentrations. DU2 is approximately 2,444 sq ft but both 0.25-inch depth layers are likely to fail TCLP so at least 0.5 feet would be removed and would require off-island disposal.

Table 5-5: DUs which Failed TCLP (2016) and Require Mainland Disposal

DU	Owner	sq. ft	Depth*	CY	Total Lead mg/kg	TCLP
DU-1B	HDOT	5847	3 - 6 inches	54.14	7880	26.2
DU-11	HDOT	1228	0 - 3 inches	11.37	8820	31.8
DU-21	HDOT	1315	0 - 3 inches	12.18	5080	14.2
DU-2A	HDOT	2444	0 - 3 inches	22.63	10200	Fails TCLP*
DU-2B	HDOT	2444	3 - 6 inches	22.63	9480	Fails TCLP*
Total		13278		122.94		

Soil Excavation, and Off-Site Disposal of all soil which exceeds the HDOH Tier 1 EAL for unrestricted land use for lead (200 mg/kg) Replace contaminated soil with clean fill.
Note = DUs 2A and 2B are assumed to fail TCCP based on total lead concentrations
* As a conservative measure assume that an entire 0.5 will be removed from each of these DUs total of 246 cubic yards (123 CY x 2=226 CY).

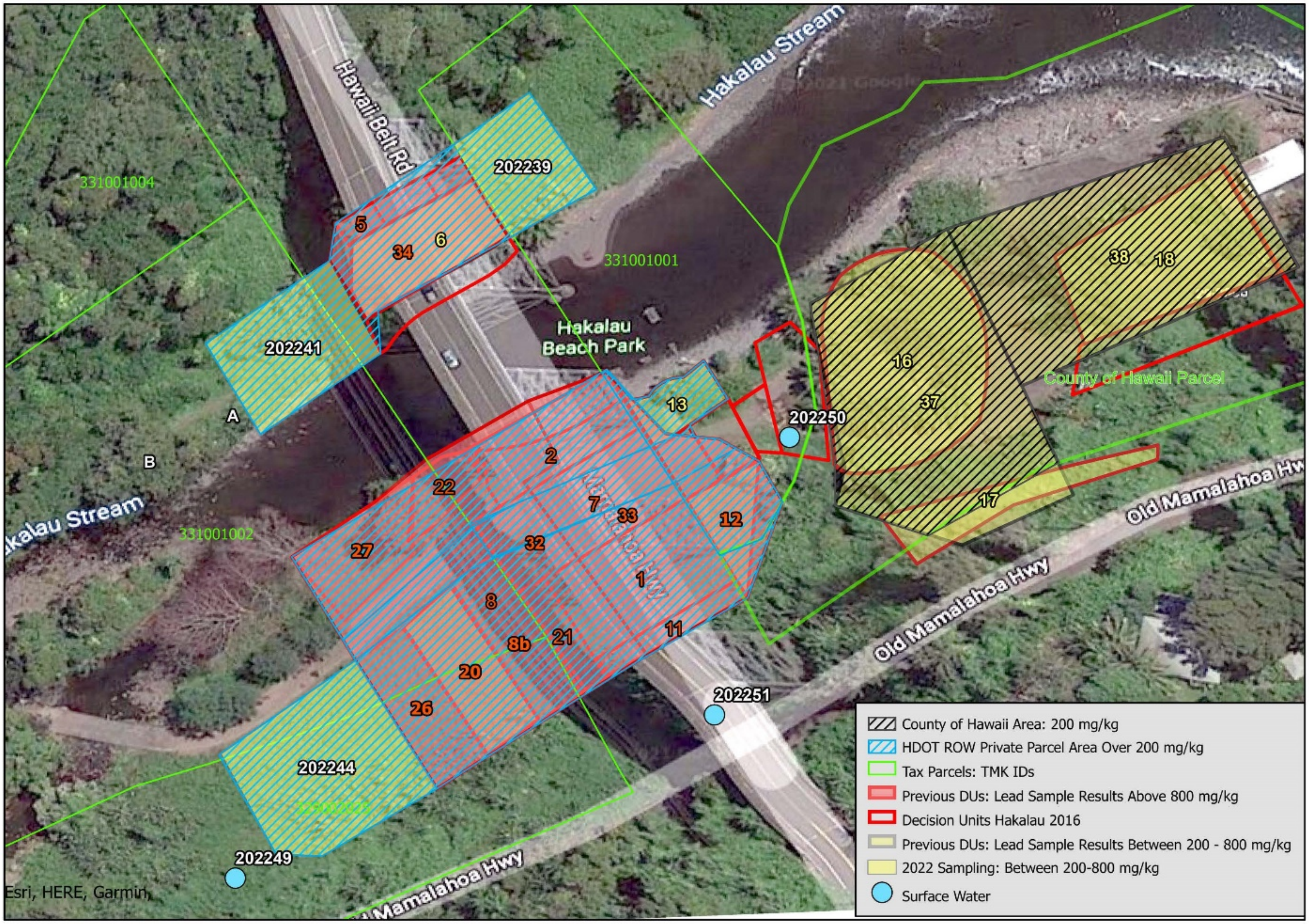
Confirmation sampling will be conducted to ensure that all targeted soil is removed from each DU. All DUs would be excavated in 6-inch lifts until confirmation samples indicated that soil concentrations were below the HDOH EAL for unrestricted land use (200 mg/kg). Approximately 103,000 sq ft of soil would need to be removed to various depths. For this alternative, we used an estimated depth of 12". The depth may be less on a site-wide average (Table 5-3).

Clean fill would then be brought in and overlaid across the impacted site at a depth of 24 inches and grass would be maintained to prevent potential exposure. Additional clean soil for drainage grading would be needed.

An archaeological consultation and monitoring would be required during the excavation. The lead-impacted soil would be removed, therefore an EHMP will not be needed.

Once removal is completed, soil onsite would not require an EHMP. The primary maintenance item would be cutting grass and addressing any erosional issues to the grass cover over the new layer of imported soil.

Figure 5-1: Alternative 5a or 5b, Removal 200+ mg/kg and Capped Soil Areas



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5c: Removal of soil that exceeds 800 mg/kg for lead, containment, and replacement with clean fill.

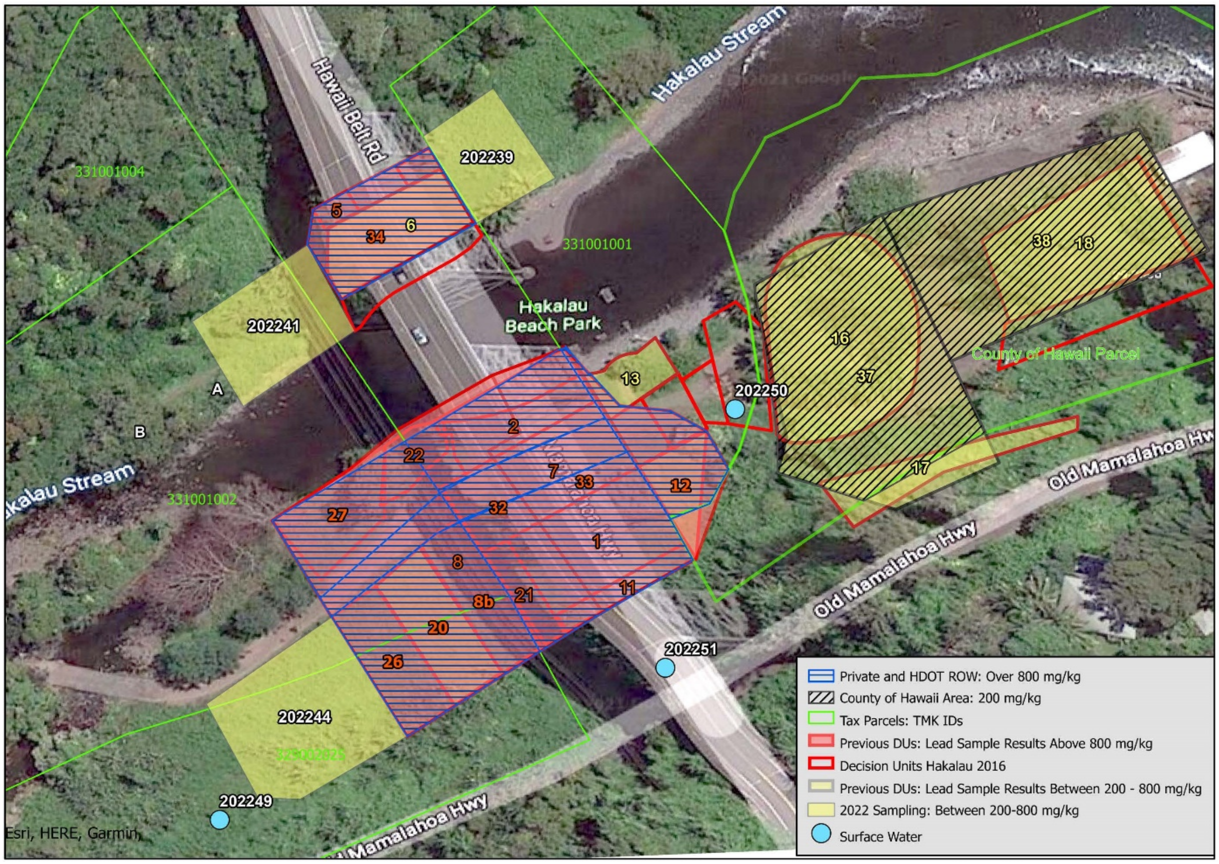
DUs within the HDOT ROW and privately owned parcel exceed the HDOH EALs for the construction/trench worker exposure for lead (800 mg/kg) (Figure 5-2). This is approximately 46,551 sq ft. (See Table 5-1). Soil from these DUs will be removed. Confirmation sampling will be conducted to ensure that all targeted soil is removed. The soil will be replaced with clean fill at an estimated fill depth of 24 inches (Table 5-6).

DUs which exceed the HDOH EALs for unrestricted land use for lead (200 mg/kg) would first be covered with orange mirafi (geotextile) or black geotextile with caution tape laid at intervals to produce a visible barrier between the clean and impacted soils. Clean fill would then be brought in and overlaid across these DUs at a depth of 18- 24 inches and grass will be maintained to prevent potential exposure. Additional cubic yards of clean soil may also be needed for drainage and grading.

Table 5-6: Alternative 5c – Soil Removal 800+ mg/kg, Clean Fill Cubic Yards

		Cubic Yards		
Ownership	**Sq Ft**	**Remove soil (12" estimate) that exceeds 800 mg/kg**	**Clean fill 18"**	**Clean fill (24")**
County of Hawaii 200-800 mg/kg	36017		2001	2667
HDOT ROW (North) 800+ mg/kg	5885	218	327	436
HDOT ROW (South) 800+ mg/kg	19341	716	1075	1433
Private Parcels (North) 200 – 800 mg/kg	9947		553	737
Private Parcels (South) 200 – 800 mg/kg	10390		577	770
Private Parcels (South) 800+ mg/kg	21325	790	1185	1580
Total	**102905**	**1724**	**5718**	**7623**

Figure 5-2: Removal of Soil Over 800 mg/kg, Cap 200 mg/kg



Alternative 6: Institutional Controls or Long-term Monitoring
This option removes harm to the public but does not remove or reduce the impacts from the site. This option also removes the use-value from the site.

Archaeological consultation and monitoring would be required during the excavation period (approximately five weeks). A portion of the lead-impacted soil would remain on-site, therefore an EHMP will be needed.

Initial costs would be high as soil which is classified as hazardous waste could not be disposed of at facilities in Hawaii and be required to be disposed of in the mainland United States. DU1, DU11, and DU21 failed TCLP at different depth profiles, (0 to 3-inches bgs), and near-surface soil (3 to 6-inches bgs). This is approximately 8,390 sq ft. DU 2 is also likely to fail the TCLP threshold and has been included for removal as lead concentrations in this DU range between 9480 – 10,200 mg/kg. DU2 is approximately 2,444 sq ft. (See Table 5-5).

Annual operation and maintenance costs are not expected to be high for this alternative and would fit in with the park's current budget. The primary maintenance item would be cutting grass and addressing any erosional issues to the grass cover over the new layer of imported soil.

6 Proposed Remedy

Based on recommendations from the site environmental consultant, as well as a review of the site investigation and remedial alternatives reports (Table 4), and public comments, HDOT has selected Option 5b as the long-term solution.

Specifically, the HDOT has chosen to implement soil removal and offsite disposal of all soil in the areas which exceeds HDOH Tier 1 Unrestricted Land Use Environmental Action Level of 200 mg/kg for lead, and replacement with clean fill. This option will achieve substantial risk reduction, remove the source of contamination, eliminate the need for an environmental hazard management plan, and remove the possibility of lead-impacted soil or sediment from becoming exposed during flooding/erosion in the future (Table 6-1).

Table 6-1: Alternatives Analysis - Protectiveness

	5a/6. On-site isolation and containment. Soil cap entire site.	5a/6. On-site isolation and containment. Hard cap on areas of 800 mg/kg exceedances	5b. Removal of all soil which exceeds 200 mg/kg for lead and replace with clean fill	5c. Removal of all soil which exceeds 800 mg/kg for lead, containment, and replacement with clean fill.	6a. Institutional and Engineering Controls: Fencing, No Action	6b. Institutional and Engineering Controls: Fencing to Limit Access
Is Lead-Impacted Soil Still Present?	Yes	Yes	No	Yes	Yes	Yes
Direct Contact Does the site have a complete exposure pathway for the following users under the scenario?						
Public	No	Potential (if breached)	No	Potential	No	No
Construction/ Trench Workers	Potential	Potential	No	No: Lead is below direct exposure for construction/trench worker scenario	Yes	Yes
Site Workers (Landscapers)	Potential	Potential (if breached)	No	No	Yes	Yes
Ecological Receptors	Potential	Potential (if breached)	No	Potential: Unlikely	Yes	Yes
Air Exposure Does the site have a complete exposure pathway for the following users under the scenario?						
Public	Potential	No	No	No	Potential	Potential
Construction/ Trench Workers	Potential	Potential	No	Potential	Yes	Yes
Site Workers (Landscapers)	Potential	No	No	No	Yes	Yes
Ecological Receptors	Potential	No	No	No	Yes	Yes

	5a/6. On-site isolation and containment. Soil cap entire site.	5a/6. On-site isolation and containment. Hard cap on areas of 800 mg/kg exceedances	5b. Removal of all soil which exceeds 200 mg/kg for lead and replace with clean fill	5c. Removal of all soil which exceeds 800 mg/kg for lead, containment, and replacement with clean fill.	6a. Institutional and Engineering Controls: Fencing, No Action	6b. Institutional and Engineering Controls: Fencing to Limit Access
Surface Water Runoff (Sediment) in River Does the site have a complete exposure pathway for the following users under the scenario?						
Public	Potential	No	No	No	Potential	Potential
Construction/ Trench Workers	No	No	No	No	No	No
Site Workers (Landscapers)	Potential	No	No	No	No	No
Ecological Receptors	Potential	No	No	No	Potential	Potential

Table 6-2: Reduction of Toxicity, Mobility, and Volume through Treatment Comparison

5a/6. On-site isolation and containment. Grass cap on Park area. Hard cap on areas of 800 mg/kg exceedances.	**5b.** Removal of all soil which exceeds 200 mg/kg for lead and replacement with clean fill.	**5c.** Removal of all soil which exceeds 800 mg/kg for lead, containment, and replacement with clean fill.	**6a.** Institutional and Engineering Controls: Entire Site Restricted, No Action.	**6b.** Institutional and Engineering Controls: Partial Reopening and Restricted Access to Areas of Highest Contamination.
Toxicity No change - contaminants are still present for construction/site workers. Impacts are reduced for maintenance crews, the public and ecological receptors.	**Toxicity**: Eliminated	**Toxicity**: Reduced.	**Toxicity:** No Change - contaminants are still present for ecological receptors, maintenance crews and any potential construction/site workers. Reduced for the public.	**Toxicity:** No Change - contaminants are still present for ecological receptors, maintenance crews and any potential construction/site workers. Reduced for the public.
Mobility: Contaminant is potentially mobile during extensive erosion and damaging storms.	**Mobility**: Eliminated Contamination is no longer present.	**Mobility**: Reduced but potentially mobile during extensive erosion.	**Mobility:** No change - contaminant is potentially mobile through erosion and surface runoff.	**Mobility:** No change - contaminant is potentially mobile through erosion and surface runoff.
Volume: No reduction in volume of contaminant	**Volume**: Eliminated: all contaminant removed.	**Volume**: Reduced – all soil above 800 mg/kg removed	**Volume:** No reduction in volume of contaminant	**Volume:** No reduction in volume of contaminant

6.1 Long-Term and Short-Term Effectiveness

Alternative 5a: Offers short-term effectiveness. The Hakalau Beach Park reopens without soil removal disposal costs. Site work is still needed in terms of applying mirafi, soil, and re-vegetation/stabilization of the site. The park is located in an area that can experience torrential rains and associated flooding, increasing the potential for long-term exposure risks. The site will need to be maintained to ensure that the containment soil cap is not breached. If breached, the park will likely require closure, repairs, and extended period of time out of use for the public. Costs associated with future repairs will need to be considered due to the frequent flooding and scouring in the valley and stream mouth. See Table 6-2 for Treatment Comparison.

Alternative 5b: Repairs to the site will take longer, and the park will not open as quickly as under scenario 5a. This alternative has long-term effectiveness. Sitework will include scraping soil, disposing of soils (off-island), laying clean soil, and stabilization. All work will be completed, and additional work is not anticipated. The source should be removed from direct contact for all users. An EHMP will not be needed for the affected area of the park under this alternative. Construction and Landscaping crews would not require additional Personal Protective Equipment (PPE) while working in these DUs after soil removal. Other sources of lead may be present in the park, and areas outside of the DUs may need soil testing. See Table 6-2 for Treatment Comparison.

Alternative 5c: Repairs to the site will offer long-term effectiveness. Site work will take as long as alternative 5a but less than 5b and will require additional materials (mirafi). Soil disposal costs and soil disposal work will remain high. Sitework will include scraping soil, disposing of soils (off-island), applying mirafi, laying clean fill, and stabilization. An EHMP will also be required as lead-impacted soil will remain on-site in the park area. The removal of soils with total lead greater than 800 mg/kg will mean that construction/trench workers will not require additional PPE while working on the site. Lead-impacted soil may be present in the upper steep gulch slopes and could migrate to the park space below. See Table 6-2 for Treatment Comparison.

6.2 Implementability

Alternative 5a is implementable using equipment and supplies from Hawaii County or shipped to Hawaii County. This alternative will require excavators, work crews, clean fill (from Hawaii County), and EHMP document production. See Table 6-2 for Treatment Comparison.

Alternatives 5b and 5c are implementable using equipment and supplies from Hawaii County or shipped to Hawaii County. However, both alternatives require off-island disposal costs and shipping. Immobilization using TSP or Portland Cement could be used to eliminate the need for offsite disposal but the uncertainty in the time need to gain regulatory and public acceptance pose a risk to using this approach. These alternatives will require excavators, work crews, topsoil, and clean fill (from Hawaii County), and alternative 5c will require EHMP document production. The source of the topsoil and clean fill will need to be documented that the source is free of chemical and biological contamination (e.g., chlordane, little fire ants, etc.). See Table 6-2 for Treatment Comparison.

Alternative 6a will be the easiest to implement. This alternative requires fencing installation and EHMP document production. This alternative will require the County of Hawaii to maintain an EHMP and conduct periodic inspections of the engineering controls (e.g., monthly inspections) reports documenting the results of the inspection (e.g., annual reports). See Table 6-2 for Treatment Comparison.

6.3 Estimated Costs

A summary cost table of the alternatives is found below in Table 6-3. All alternatives are assumed to have the same costs for the planning component including project management, permitting, and public meeting support. The planning component is estimated at $44,818 and is included in all alternative costs.

For alternatives that consider a soil cap, the thickness of the soil cap can vary from 18 to 24 inches depending on HDOH requirements. This can have an impact on total costs which are summarized in the table below.

Table 6-3: Cost Summary Table

	5a. On-site isolation and containment. Grass cap on Park area.	**5b**. Removal of all soil which exceeds 200 mg/kg for lead and replace with clean fill.	**5c.** Removal of all soil which exceeds 800 mg/kg for lead, containment, and replace with clean fill. Grass cap on Park area.	**6a.** Institutional and Engineering Controls: Entire Site Restricted, No Action.	**6b.** Institutional and Engineering Controls: Partial Reopening and Restricted Access to Areas of Highest Contamination.
Planning Costs	Yes	Yes	Yes	Yes	Yes
EHMP Needed	Yes	No	Yes	Yes	Yes
Soil Removal	No	Yes	Yes	No	No
300 additional CY clean soil for drainage grading.	Yes	Yes	Yes	No	No
Archeological consultation and monitoring	Yes	Yes	Yes	No	No
Mirafi/ Geotextile defined boundary	Yes	No	Yes	No	No
Total Cost including 24 inches soil cover	$1,807,166	8,100,000	$3,812,916	$102,171	$252,997
O&M Cost -30 years	$120,000	$0	$120,00	55,000	55,000

Notes:
1) A standard three (3) percent (%) escalation factor per year should be considered when estimating the cost. Current rates present remedial alternative cost in 2022 dollars.
2) These are rough order of magnitude budgetary estimates (+50%/-30 % level of accuracy).
3) There is no cost difference between 18-inch and 24-inch soil cover cost for Alternative 5b. This remedy does not require any additional soil cover beyond the soil needed to replace the volume removed.

7 Final Remedy Selected

The final remedy selected is the proposed remedy: alternative 5b which is the removal of all soil which exceeds 200 mg/kg for lead and replacement with clean fill. This is the final remedy selected because it will achieve substantial risk reduction, removes the source of contamination, eliminates the need for an EHMP, and removes lead-impacted soil or sediment from becoming exposed during flooding/erosion in the future.

This remedy costs more than capping or selective removal due to the requirement for off-island disposal of soil that exceeds 800 mg/kg. Costs are estimated at $8.1 Million due to the need for off-island disposal. However, Option 5b offers a permanent reduction of toxicity, mobility, and completely reduces the volume of contamination at the site. It provides the most long-term effectiveness, and the park will not need additional controls. Moreover, the park can be opened for use by the public, site workers, and construction/trench workers with no additional monitoring or maintenance stipulations.

8 Responsiveness Summary

The public comment period on the proposed remedial action described in the Draft RAM was accepted during the 30-day public comment period from June 30, 2023, to July 29, 2023. Eight individuals identified their preferences via email sent to the HDOH HEER office project manager, Mr. Thomas Gilmore, which are included in Table 6 below. Six of the eight supported Option 5b. One supported Option 6a, and one supported 5c.

A public notice including the accessibility of the Draft RAM, contact information, and commenting period was published in the Hilo Tribune-Herald on June 30, 2023. The public Factsheet and Draft RAM was available to the public through the HDOH HEER Office website (http://hawaii.gov/doh/heer) during the public comment period.

Table 8-1: Public Comments Submitted During Public Comment Phase

Public Comment	Individual
Supports Option 5b	Jeff Pereboom
Supports Option 5b	John Kocol
Supports Option 5b	Susan Melow
Supports Option 6a	Randy Simpson
Supports Option 5c	Paul Landau
Supports Full Cleanup (this is Option 5b)	Michael Stolp
Supports Option 5b	Cortney Okumura
Supports Option 5b	Susan Forbes

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