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Naval Facilities Engineering Systems Command

Naval Facilities Engineering Systems Command Hawaii

Red Hill Shaft Flow Optimization Work Plan Red Hill Bulk Fuel Storage Facility

JBPHH, O‘ahu, Hawai‘i

January 13, 2022

[redacted]

NAVFAC
Naval Facilities Engineering Systems Command

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Prepared for NAVFAC Hawaii by

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Table of Contents

Appendices

Figures

Tables

Acronyms and Abbreviations

AOC	Administrative Order on Consent
BWS	Board of Water Supply, City and County of Honolulu
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	chemical of potential concern
CTO	contract task order
CWRM	Commission on Water Resource Management
DOH	Department of Health, State of Hawaiʻi
DON	Department of the Navy, United States
EAL	Environmental Action Level
EDMS	Electronic Database Management System
EPA	Environmental Protection Agency, United States
ER	emergency response
ER, N	Environmental Restoration, Navy
GAC	granular activated carbon
HCF	Hālawa Correctional Facility
JBPHH	Joint Base Pearl Harbor-Hickam
JP-5	Jet Propellant-5
LNAPL	light nonaqueous-phase liquid
LTM	long-term monitoring
mgd	million gallons per day
N/A	not applicable
NWIS	National Water Information System
NOI	Notice of Interest
OWDF	Oily Waste Disposal Facility
RA	Regulator Agency
RH	Red Hill
RHBFSF	Red Hill Bulk Fuel Storage Facility
RHS	Red Hill Shaft
RHSRMP	Red Hill Shaft Recovery and Monitoring Plan
TBD	to be determined
TCZ	target capture zone
TFN	transfer function-noise
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons – diesel range organics
TPH-o	total petroleum hydrocarbons – residual range organics (i.e., TPH-oil)
USGS	United States Geological Survey
WP	work plan

[redacted]

1.0 Introduction

This Work Plan (WP) describes a synoptic water level survey that is designed to generate empirical data that can be used to optimize the rate of pumping at Navy Supply Well 2254-01 – Red Hill Shaft (RHS) (Figure 1)[1], while gathering useful data that may add to the understanding of geological, hydrogeological, and geochemical aspects of the Red Hill conceptual site model. Optimizing pumping at RHS can help preserve groundwater resources while maintaining successful prevention of migration of gross contamination away from RHS as defined in the *Red Hill Shaft Recovery and Monitoring Plan* (RHSRMP) (IDWST 2022). The water level survey will be performed as part of the Comprehensive Long-Term Environmental Action Navy (CLEAN) V Program under contract number N62742-17-D-1800, contract task order N6274222F0106.

2.0 Purpose

On November 20, 2021, a release of Jet Propellant-5 (JP-5) fuel originating from the Adit 3 tunnel of the Red Hill Bulk Fuel Storage Facility (the Facility) impacted the groundwater in the vicinity of RHS. For the first time since environmental investigations began at the Facility, light nonaqueous-phase liquid (LNAPL) was measured at the aquifer surface in the RHS water development tunnel.

In response to this specific release, the Navy, State of Hawaiʻi Department of Health (DOH), and United States Environmental Protection Agency (EPA) jointly developed and signed the RHSRMP, which set forth the plan to operate RHS and the associated granular activation (GAC) treatment system. The purpose of pumping water from RHS was to "to remove any fuel contamination" from the RHS and "create a contaminant capture zone in the vicinity of the Red Hill Shaft through pumping operations." As part of this urgent and immediate effort during the emergency response, it was agreed that "The first line of defense against migration of fuel away from the Red Hill Shaft well is to establish a 'capture zone' by pumping the well to create a draw-down in the aquifer in the vicinity of the Red Hill Shaft." Thus, the GAC system was implemented specifically to contain the November 20 Release at RHS but was *not* selected as the overall site remedy.

The RHSRMP was agreed upon without defining the extent of capture required or anticipated, and without any optimization of the flow rate. Rather, all signatories recognized the "imperative to create a capture zone as soon as possible to prevent contamination migration" from RHS. Accordingly, the parties agreed on a deterministic approach wherein:

> "**The measure of success for the capture zone will be efficacy in recovery of fuel in the Red Hill Shaft, and prevention of migration of fuel and related contaminants away from the well.**"

While the originally agreed-upon pumping flow rate was approximately 5 million gallons per day (mgd), the RHSRMP provides that "If groundwater quality and level results indicate that the

[1] Figures and tables are compiled following the References section.

capture zone can be maintained at a lower flow rate, reducing flows may be considered" (IDWST 2022).

After more than a half-year of GAC operations and weekly groundwater sampling and analyses, the rate of recovery of fuel from RHS is very small, and weekly data show that concentrations of chemicals of potential concern (COPCs) in groundwater near RHS have substantially and consistently decreased (see Appendix A). Observations of field data collected to date and evaluations of hydraulic heads and other parameters indicate successful prevention of migration of gross contamination away from RHS as defined in the RHSRMP. This is demonstrated by the overall reduction of chemical concentrations and lack of any measurable LNAPL or other indications of gross contamination in groundwater monitoring points in and around RHS since the GAC operations were established. Based on these conditions, it is appropriate to optimize the rate of pumping RHS to minimize the use of groundwater while still achieving the goals set forth in the RHSRMP. The regional freshwater aquifer system is inherently finite due to its island location, and reducing the quantity of groundwater extracted during remedial activities at RHS reduces waste and makes additional groundwater available for other public and private purposes. The proposed water level survey is the first step in optimization of the pumping rate.

This survey will collect data and observations of groundwater behavior in response to changes in pumping rates at RHS, which will be used to evaluate the aquifer conditions that develop when groundwater is extracted from RHS at various rates. The water level survey will be performed in conjunction with continued groundwater sampling to monitor chemical concentrations during these proposed trial periods to further evaluate containment as described in the RHSRMP.

The data collected by the Navy during this study will be utilized to support any proposed permanent reductions in water usage from RHS. The RAs and the Navy should be given reasonable time to be review the results from this study, before performing GAC treatment at a level less than the current average rate of approximately 4.2 mgd, which represents continuous operation (24 hours a day, 7 days a week).

3.0 Background

3.1 Preliminary Evaluation of Existing Data

3.1.1 CSM 2017/2018 Synoptic Study

From July 2017 through March 2018, depths to water in the wells listed in Table 1 and depicted on Figure 2 were measured during a coordinated synoptic monitoring event conducted by the United States Geological Survey (USGS), the Board of Water Supply (BWS), and the Navy. The *Final Synoptic Water Level Study Work Plan* dated August 10, 2017 from the USGS lays out this program (USGS 2017). All the conventional monitoring wells used in the study except for RHMW01 were monitored with vented (i.e., gauged on differential) In-Situ 700H transducers. The diameter of RHMW01 was too small to accommodate a vented transducer; instead, a smaller-diameter non-vented (i.e., absolute, or total) transducer with an accompanying barometric logger was used in RHMW01.

An attempt was made to coordinate controlled supply wells' withdrawal conditions designed to provide data that can be used to interpret the short-term, aquifer-wide response of the aquifer to withdrawals. However, the USGS could not mandate specific withdrawal conditions because the water-purveyor had certain requirements and constraints that had to be met. The pumping scenarios during the study were as follows:

1) Withdrawing water from BWS Moanalua Wells 1, 2, and 3 at a high rate while both BWS Hālawa Shaft and Navy RHS withdrew water at typical rates.
2) Allowing RHS to recover (no pumping) for approximately 5 days while Hālawa Shaft pumped at a near-constant rate.
3) Withdrawing water from RHS at a near-constant rate for approximately 4.5 days while Hālawa Shaft withdrew water at a typical near-constant rate.
4) Allowing Hālawa Shaft to recover (no pumping) for approximately 10 days while RHS was pumping under normal conditions (which historically involved cycling on and off in response to water system demands, unlike the current relatively steady operation of the RHS GAC system).
5) Withdrawing water from Hālawa Shaft at a high rate for 10 days while RHS was pumping under normal operational conditions.
6) Withdrawing water from Hālawa Shaft at a normal rate while RHS was pumping under normal operational conditions.

Most groundwater-level data collected as part of this effort were made publicly available online through the National Water Information System (NWIS) database. The Navy analysis of the synoptic data included:

- Identification of the effects of barometric pressure, seasonal water level changes, earth tides, ocean tides, precipitation and recharge, and pumping from various wells and shafts using both traditional data analysis techniques and using a transfer function-noise (TFN) analysis
- Evaluation of hydrographs
- Evaluation of drawdown and recovery at select times
- Completion of pump test analyses for RHS and Hālawa Shaft to calculate hydraulic parameters:
  - The Cooper-Jacob Approximation to the Theis Method – drawdown versus time and drawdown versus distance

- The Theis Solution in AQTESOLV – drawdown versus time in AQTESOLV (Duffield 2007)
- Anisotropic Evaluations – distance-drawdown analyses (Mutch, Jr. 2005) (Hantush and Thomas 1966)

A more detailed description of the synoptic data evaluation is presented in the Red Hill *Conceptual Site Model* report (DON 2019).

Notably, significantly fewer wells existed near RHS at the time of the 2017/2018 study than exist now; as shown on Figure 2, the only two wells surveyed in 2017/2018 near RHS were OWDFMW01 to the west and RHMW05 to the east. Moreover, these three surveyed points (RHMW05, RHS, and OWDFMW01) lie nearly on a straight line, rendering evaluation of flow directions around RHS (and even simple triangulation) challenging at best. As a result, the 2017/2018 data provided limited resolution of conditions in the RHS area impacted by the November 20 Release. Given the significant number of new wells now installed near RHS, including areas north, southwest, and closer to the east and west of RHS (see Section 4.2), there is an opportunity to much better characterize aquifer parameters in the vicinity of RHS. This will enable both a far more comprehensive assessment of the metrics agreed upon in the RHSRMP than is now possible, as well as collection of data that will be useful for additional analyses.

3.1.2 2022 RHS Startup Synoptic Survey

From January to March 2022, depths to water in wells listed in Table 2 and depicted on Figure 3 were measured during a synoptic monitoring event conducted by the USGS and the Navy. All conventional wells were monitored with vented (i.e., gauged on differential) In-Situ 700H transducers except for OWDFMW08A and RHMW01, which were monitored with non-vented (i.e., absolute, or total pressure) transducers. None of the plume delineation wells surrounding the RHS had been installed prior to this survey, and several of the other nearby wells were not fitted with transducers, due to resources available at the time and to allow for continued Notice of Interest (NOI) sampling (DOH 2021a; 2021b).

Prior to this 2022 survey, RHS was turned off on November 28, 2021, and disconnected from the JBPHH Water Distribution System in response to the November 20 Release. BWS Hālawa Shaft was turned off on December 2, 2021. The Navy's ʻAiea Hālawa Shaft was turned off on December 3, 2021. On January 29, 2022, RHS was turned back on after installation of the GAC treatment system and has since been pumping continuously at an average rate of approximately 4.2 mgd. Transducers were installed during the week of January 17, 2022, by both the USGS and the Navy to record water levels prior to restarting RHS and through approximately 6 weeks after resumption of pumping.

Groundwater-level data collected by USGS as part of this effort were made publicly available online through the NWIS database. Groundwater-level data collected by the Navy were provided to the Regulators. In general, the Navy analyzed the synoptic data as follows:

- Evaluated hydrographs;
- Evaluated drawdown at selected times;
- Evaluated drawdown in plan view at specific times;
- Prepared 3-point solutions;
- Plotted Specific conductivity results vs. time;
- Performed type-curve analyses of aquifer responses; and
- Completed pump test analyses for RHS to calculate hydraulic parameters using the following method:
  - Cooper-Jacob Approximation to the Theis Method – drawdown versus time and drawdown versus distance.

Appendix B summarizes these analyses, which should be reviewed only as preliminary and subject to the data gap analyses described in Section 3.2.

3.1.3 Establishment of the RHS GAC System in accordance with the RHSRMP

To minimize the migration of LNAPL, the RHSRMP established a GAC system capable of treating 5 mgd, which allowed for operation of RHS to both remove fuel from the RHS and create drawdown in the groundwater table and establish a "capture zone." The pumping was initiated on January 29, 2022 in the vertical shaft (wet well) of RHS at an average rate of 4.2 mgd. Water has since been pumped from RHS and treated through the GAC system; the filtered effluent is discharged to South Hālawa Stream subject to testing, which has consistently confirmed that the discharged water meets all applicable standards.

To minimize the migration of product, the RHSRMP established pumping at RHS at 5 mgd, promoting drawdown and creating a "capture zone." The pumping was established in the vertical shaft (wet well) of RHS at an average rate of 4.2 mgd. The vertical shaft is hydraulically supplied by the 1,171-foot-long RHS water development tunnel. This pumping was established on January 29, 2022 to create a capture zone surrounding the area within the basal aquifer that was directly impacted by the release. Water pumped from RHS is treated using a 5-mgd granular activated carbon (GAC) system. The filtered effluent is discharged to South Hālawa Stream.

While the originally agreed upon pumping flow rate was approximately 5 mgd, per the RHSRMP, "If groundwater quality and level results indicate that the capture zone can be maintained at a lower flow rate, reducing flows may be considered." "The measure of success for the capture zone will be [1] efficacy in recovery of fuel in the Red Hill Shaft, and [2] prevention of migration of fuel and related contaminants away from the well" (IDWST 2022).

This survey will collect observations of groundwater behavior in response to changes in pumping rates at RHS and the continued weekly collection and analyses of groundwater samples, which will be used to evaluate aquifer conditions that develop when groundwater is extracted from

RHS at various rates. Importantly, this survey will leverage new wells that have been installed in the vicinity of RHS, such as the plume delineation wells, enabling far more detailed evaluation of groundwater levels and conditions near RHS than has previously been possible.

3.1.4 Groundwater Sample Analytical Data

Analytical samples are collected during the quarterly long-term monitoring program (LTM) and during weekly NOI sampling (DOH 2021a; 2021b). Weekly NOI samples are analyzed for over 125 analytes. Total petroleum hydrocarbon-diesel (TPH-d) and TPH-oil (TPH-o) are regularly plotted for trend evaluation. In addition, weekly heat maps are generated for TPH-d, TPH-o, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, and xylenes using spherical kriging in Surfer software.

Selected heat maps focusing around RHS for TPH-d are presented on Figure 4. Heat maps from December 2021 and January 2022 show TPH-d concentrations above the DOH Environmental Action Limit (EAL) prior to initiation of the RHS pumping and in-tunnel skimming operations, but there were no wells located north or south of RHS at that time to bound concentrations in those directions. Since RHS resumed pumping, and other remedial response efforts were implemented, TPH-d concentrations at and around RHS have significantly declined on a consistent basis. The last measured TPH-d EAL exceedance at RHS was collected the week of January 17, 2022. Most recently, no COPCs were detected in the first two delineation wells, RHP01 and RHP02, located north of RHS.

The analytical data are summarized in detail in Appendix A, which presents selected TPH-d and TPH-o trend plots, a table displaying the initial delineation well (i.e., ‘P-well’) data (all COPCs were non-detect in all samples for which final data are available), and the full set of weekly heat maps for TPH-d, TPH-o, 1-methylnaphthlane, 2-methylnaphthalene, naphthalene, and xylenes. Cumulatively, the vast environmental data set shows significant decreases in concentrations of all COPCs in all wells near RHS since the RHS GAC system came into operation. The data indicates that the RHS GAC system is achieving the goal set forth in the RHSRMP to prevent migration away from RHS.

3.1.5 Fuel Recovery

Records of fuel recovered from the RHS since late December are summarized on Figure 5. Fuel recovery has included a skimmer system, use of sorbents, and operation of the RHS GAC system for more than half a year. Prior to operation of the RHS GAC system, fuel was being recovered at an appreciable rate, which in recent months has decreased to less than a gallon per week. This corresponds to the lack of measurable LNAPL present in RHS since the GAC system operations began. The data indicate that the RHS GAC system is achieving the goal set forth in the RHSRMP to recover fuel from RHS.

3.1.6 Hydraulic Control

The extent of the aquifer that is hydraulically controlled by pumping at RHS has not been delineated yet, but based on the metrics identified in the RHSRMP, it likely includes the area around RHS and the water development tunnel where impacts were previously confirmed. The field observations collected during execution of this work plan will be used to improve aquifer property estimates, better estimate capture under various pumping scenarios, and thereby improve the evaluation of the degree of hydraulic control established by the pumping of RHS at current and other constant flow rates.

Per the RHSRMP, the Navy and the Regulators agreed to attempt to pump RHS at 5 mgd to prevent the migration of product, without any analyses of the target or anticipated capture zones. Although the metrics agreed upon in the RHSRMP govern operation of the RHS GAC system, to evaluate the degree of hydraulic control over potentially impacted groundwater that pumping at RHS provides, a conservative preliminary Target Capture Zone has been developed to represent the portion of the aquifer where hydraulic and contaminant control may be desirable (see EPA 2008). The preliminary Target Capture Zone shown on Figure 6 was developed in consideration of: the heat maps generated from weekly sampling of the monitoring well network; the lack of measurable LNAPL in the RHS after more than a half-year of GAC operations; the extent of soil vapor impacts detected below Adit 3; and the preliminary lack of impacts in the first four plume delineation wells (RHP01 through RHP04A, of which the first two had no COPCs detected by the laboratory and the latter two had no noticeable impacts during drilling) (see Appendix A). Pending results from the rest of the plume delineation wells, this Target Capture Zone is so far both conservative—because it lies beyond the impacted area evidenced by available groundwater and soil vapor data—and will be verifiable over time once all delineation wells are completed, in accordance with the performance metrics set forth in the RHSRMP. This preliminary Target Capture Zone will be re-evaluated and refined based on new data and analyses from this survey and subsequent evaluations.

3.2 Data Gaps

3.2.1 Wells Near RHS

At the time of the 2017/2018 study, relatively few wells existed near RHS (Figure 2); therefore, the data collected at that time did not provide much empirical resolution in the area surrounding the November 20 Release. Several other monitoring wells also had not been installed. By the time the 2022 RHS Startup Synoptic Water Level Survey was conducted, a number of wells west of RHS at the Oily Waste Disposal Facility (OWDF) had been installed, and several other wells had been installed at OWDF and closer to the tank farm since the 2017/2018 study (RHMW12A, RHMW13, RHMW14, RHMW15, RHMW16, RHMW19, OWDFMW02A, OWDFMW03A, OWDFMW04A, OWDFMW05A, OWDFMW06A, OWDFMW07A, and OWDFMW08A; see Figure 3). However, the number of wells close to RHS remained limited north, east, and south of RHS. These areas include areas between RHS and potential offsite receptors.

[redacted]

More recently, four plume delineation wells have been installed north, northeast, and west of RHS and the Adit 3 area (RHP01, RHP02, RHP03, and RHP04A). Six additional plume delineation wells are scoped and at the time of this WP's development, one of which (RHP04B) is currently under construction (Figure 7). RHMW17 has also been installed since the 2022 RHS Startup Synoptic Water Level Survey. These new locations surrounding RHS will allow collection of data near RHS and the November 20 Release, which is required to analyze effects within the Target Capture Zone and optimize the RHS pumping rate for the first time.

3.2.2 Wells Outside the Facility

During the 2022 RHS Startup Synoptic Water Level Survey, monitoring locations were limited to locations within the Red Hill Facility. The proposed synoptic survey will include additional monitoring locations outside the Red Hill Facility, similar to the 2017/2018 Synoptic Study, including key locations in South Hālawa Valley between Red Hill and Hālawa Shaft, as well as other area supply and monitoring wells. However, unlike during the 2017/2018 Synoptic Study, BWS Hālawa Shaft will not be pumping. This should provide a better understanding of the impact pumping at RHS has on the surrounding region under various conditions.

3.2.3 Water Quality Parameters

Another potential data gap was the use of transducers in previous studies that did not measure certain water quality parameters that may allow for evaluation of RHS source water and flow patterns, as recommended by the Regulatory Agency subject matter experts. Specific conductivity and other parameters are measured during weekly NOI sampling. However, a continuous water quality data set that includes all new wells that have been installed, as well as parameters in addition to temperature, is not available. To address this gap, all the transducers proposed to be deployed by the Navy at the Facility will record specific conductivity, actual conductivity, salinity, total dissolved solids, and resistivity every 10 minutes (along with pressure readings). This will allow for a continuous water quality data set at the Facility, compared to less frequent "snapshot" parameter readings collected during weekly sampling. Additional parameters, such as dissolved oxygen, will continue to be measured during weekly sampling. Subsequent analyses can evaluate these data sets along with the pumping data from RHS.

4.0 Synoptic Survey Scope

During meetings held on August 10 and September 7, 2022, the Navy, the Regulatory Agencies, and their experts and consultants discussed the scope and technical details of this WP. Based on those discussions and related communications, changes were made to this WP and the proposed approach, as summarized in Table 5.

4.1 Proposed Trial Periods

Three trial periods will be evaluated during the proposed survey:

- <u>Trial Period #1</u>: RHS pumping 24 hours per day/7 days per week (24/7) at a continuous rate of approximately 4.2 mgd. This is the current pumping condition at RHS that has been maintained since installation of the GAC system, which differs from the pump cycling conditions that occurred during previous studies.

- Trial Period #2: Reduce RHS pumping to weekdays only (Monday through Friday) for an average rate of 3.0 mgd. This would be a roughly 29% reduction from the current pumping condition.
- Trial Period #3: Reduce RHS pumping to three days per week (Monday, Wednesday, and Friday) for an average pumping rate of 1.8 mgd. This would be a roughly 57% reduction from the current pumping condition.

Between trial periods, it is recommended to let the aquifer recover. However, to keep the GAC system functioning properly, the pumps cannot be turned off for more than 3 days between trial periods, as reflected in the proposed schedule in Table 4. If indications suggest that impacts are spreading, such as observations of LNAPL or petroleum at RHS or in the vicinity of RHS, the Regulatory Agencies will be informed and RHS will be returned to full-time pumping conditions, in accordance with the RSHRMP. The RHS will return to normal operation after Trial Period #3.

4.2 Monitoring Locations

Proposed locations for monitoring and details on the modeling entities and other specifics are listed in Table 2. By the time this survey starts, the USGS will have installed transducers in some wells outside of the Facility boundary as part of their ongoing monitoring program since 2017. These wells are also depicted on Figure 8.

The Environmental Restoration, Navy (ER, N) program is currently conducting a separate environmental investigation of historical sources at the Red Hill OWDF site. This ER, N-funded investigation is being executed under another CTO separate from the Red Hill Administrative Order on Consent (AOC) and emergency response (ER) CTOs associated with environmental investigations of the main Red Hill Bulk Fuel Storage Facility. Transducers installed as part of that investigation are identical to and therefore compatible with those proposed in this survey.

4.3 Navy Transducer Deployment

Aside from the multilevel wells (RHMW11, RHMW13, RHMW14, and RHMW15), which have designated MOSDAX transducers, other locations to be monitored by the Navy will have In-Situ AquaTROLL 200 transducers. The AquaTROLL 200 vented transducers record pressure, actual conductivity, specific conductivity, salinity, total dissolved solids, resistivity, and density. Transducers will be set to record readings every 10 minutes over the course of 1 year. When deploying and retrieving transducers (including as required during groundwater analytical sampling events), the field team will take three depth-to-water measurements before and after deployment from a surveyed elevation with a calibrated water level meter capable of measuring to 0.01-foot accuracy. Water levels may also be corrected for barometric response based on a barometric logger.

4.4 RHS Pumping Data

RHS pumping rates will be recorded by the Navy at 10-minute intervals for the entirety of the synoptic survey. During the 2022 RHS Startup Synoptic Survey, these data were provided by the Navy's subcontractor Vectrus as part of operating the GAC system outside Adit 3. It is anticipated that Vectrus will record these data during the proposed synoptic survey.

4.5 NOI and LTM Sampling

Regularly scheduled NOI and LTM sampling will be uninterrupted by this survey and will continue to take place in all wells as scheduled. Transducer data will be downloaded during each week during NOI sampling. When sampling a well, the field team will remove the transducers, download the data, collect the sample, and then re-deploy the transducers after sampling. Similar deployment procedures will be followed each time, with the field team collecting three depth-to-water measurements from a surveyed elevation with a water level meter calibrated by USGS and capable of measuring to 0.01-foot accuracy.

4.6 Isotope Samples

Isotope samples will be collected from wells with Navy transducers at the start of the survey and then roughly each month after until the survey ends to evaluate source zones. Exact sample dates will correspond with already scheduled NOI or LTM sampling. Further details related to isotope sample collection are provided in Table 3.

4.7 Sample Collection Upon RHS Pump Start-Up

During each trial period, samples will be collected from between the discharge pipeline and the GAC system after each scheduled outage of the GAC system, i.e., every time RHS turns off and on. Samples will be collected within approximately the first 5–10 minutes after RHS restarts and will be analyzed for the same list of analytes performed during NOI sampling.

4.8 Proposed Schedule

A proposed schedule is presented in Table 4. Weekly NOI sampling and quarterly LTM will continue uninterrupted.

5.0 Deliverables

The Navy will upload into the Electronic Database Management System (EDMS) data and deliverables as soon as practical for viewing by the RAs. A *Synoptic Survey Report of Findings* will also be submitted. The Synoptic Survey Report will likely include the following analyses; additional analyses may be performed if appropriate:

- Drawdown/Recovery vs. Time (linear-linear and log-linear) plots
- Drawdown/Recovery vs. Distance Plot (log-linear)
- Type-Curve Analyses of Aquifer Responses
- Drawdown/Recovery in plan view at specific times

- 3-point solutions
- Low-complexity analyses including water budget estimation and water-level contour construction to evaluate the extent of plume capture, such as described in EPA's (2008) capture zone guidance (see Appendix B)
- Varied pumping rates will be used to explore the extent and robustness of the estimated hydraulic capture zone generated by RHS (e.g., using isotope data vs. time plots, and isotope concentrations in plan view)
- Specific conductivity results vs. time plots, specific conductivity in plan view

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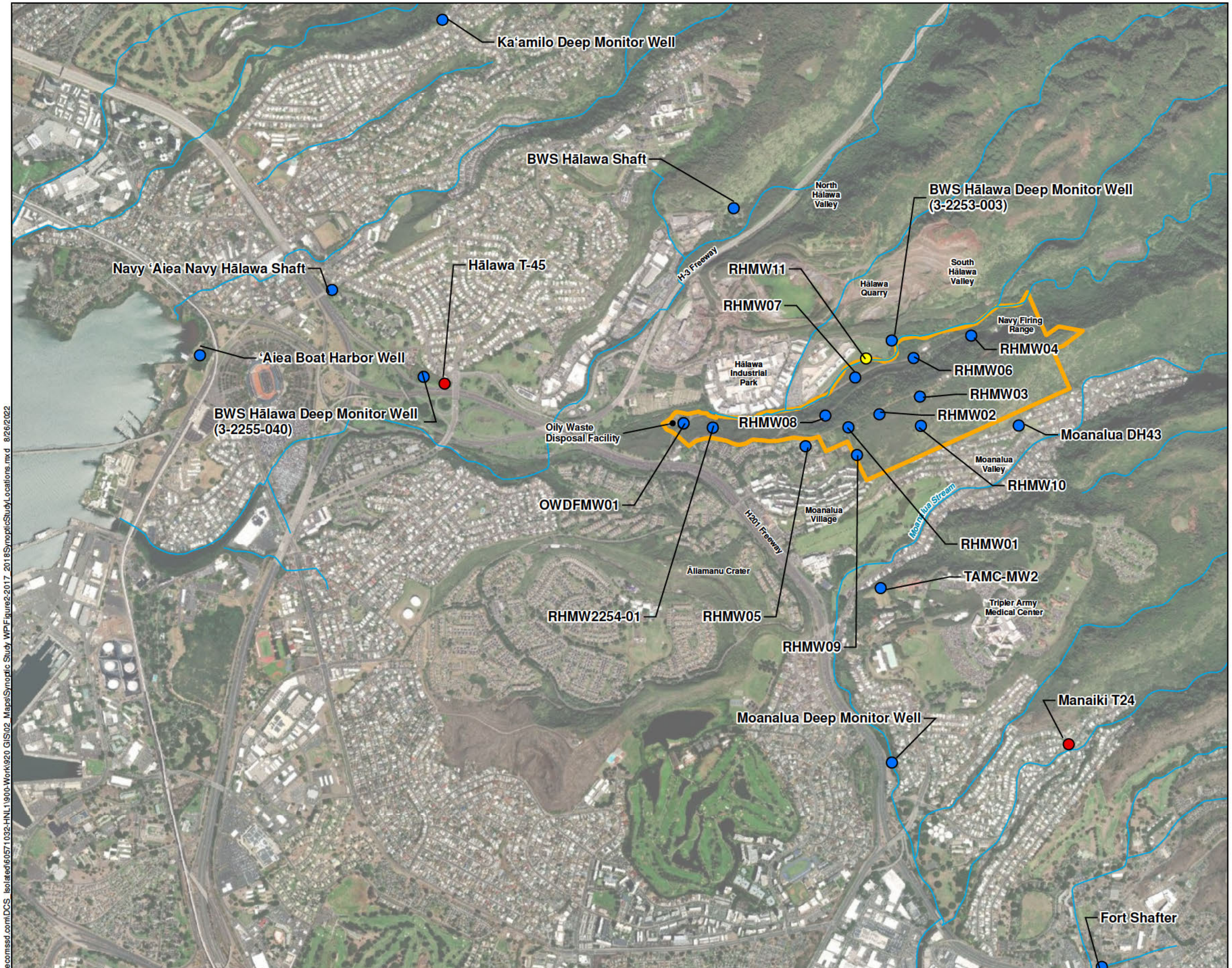
Figure 1
Site Vicinity Map
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map

Legend

- Monitored by BWS
- Navy MOSDAX Transducer
- USGS 700H Transducer
- Stream
- Red Hill Facility Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft

N

0 1,000 2,000
Feet

Figure 2
2017/2018 Synoptic Study Locations
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

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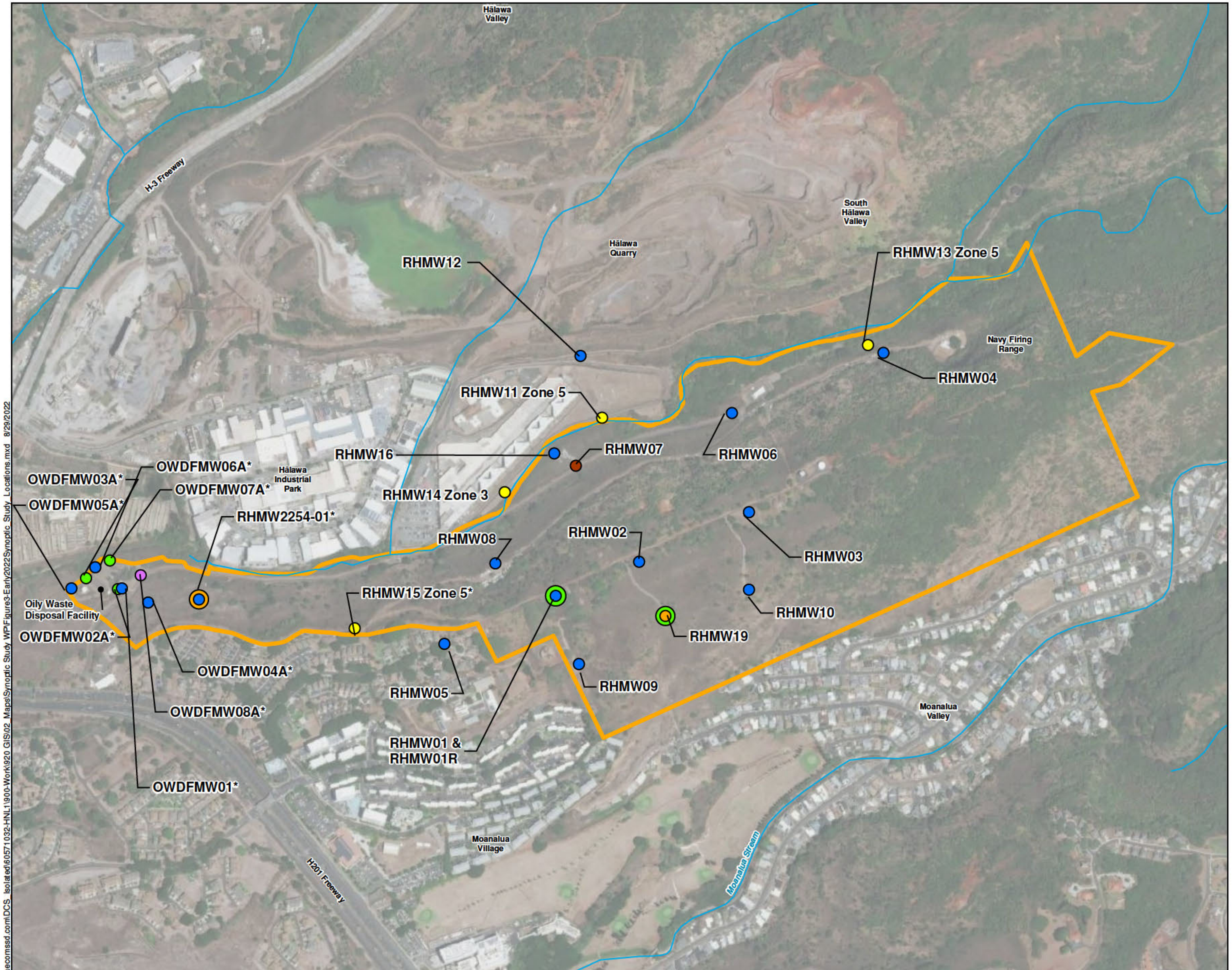

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Location Map

Legend

- Navy Hand Readings and 2 USGS 700H Transducers
- Navy Hand Readings and 2 Navy 700H Transducers
- USGS 700H Transducer
- Navy MOSDAX Transducer
- not currently monitored
- USGS 700H Transducer and Navy 700H Transducer
- Navy Micro Diver Transducer
- Navy 700H Transducer
- Stream
- Red Hill Facility Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. *Funding for these wells comes from the ER, N-funded investigation under a different CTO. These wells are monitored as part of a year-long study.

N

0 1,000 2,000

Feet

Figure 3
2022 RHS Startup Synoptic Survey Locations
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

[redacted]

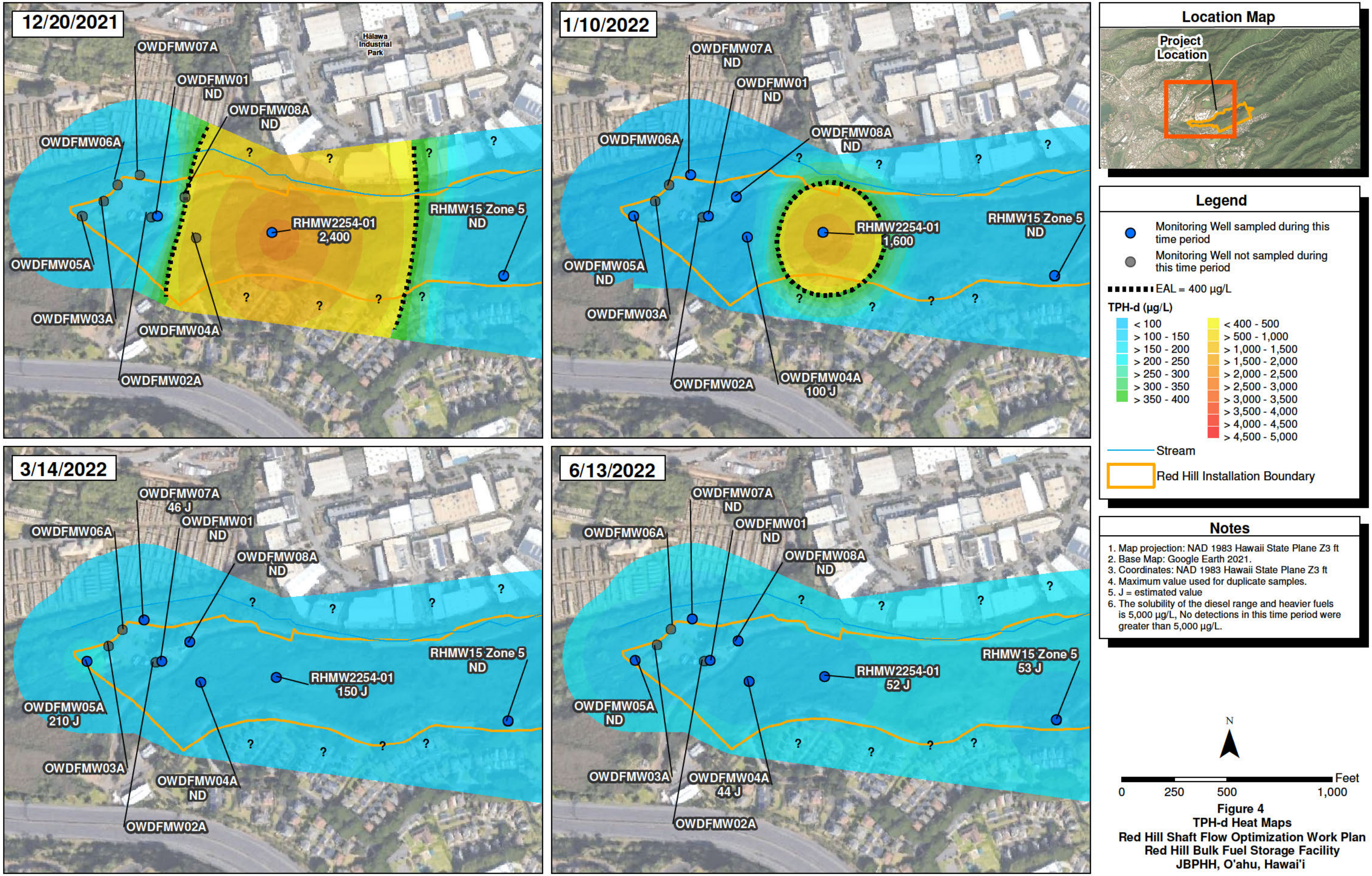

Figure 4
TPH-d Heat Maps
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

[redacted]

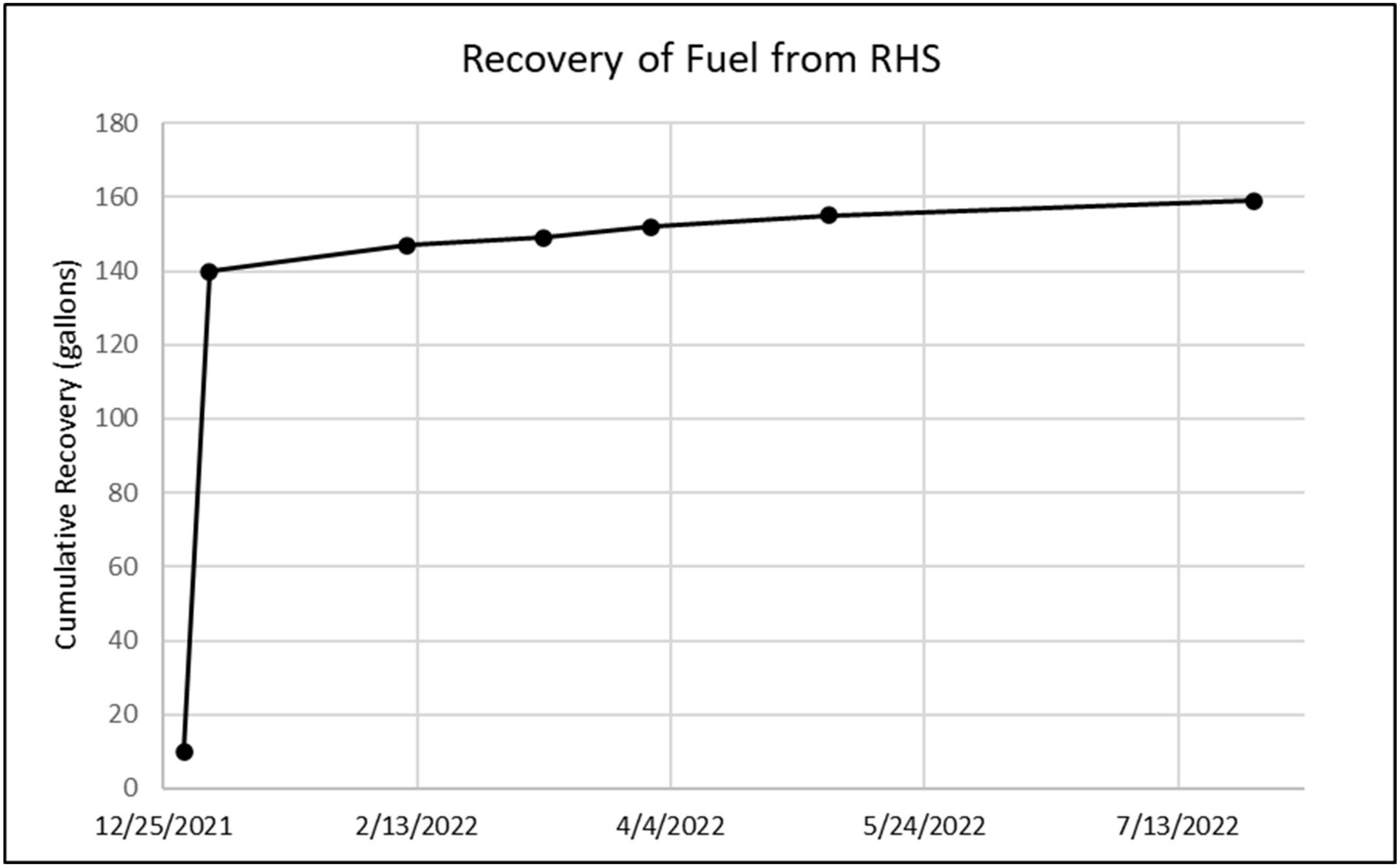

Figure 5
Fuel Recovered from the RHS since Late December, 2021
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O‘ahu, Hawai‘i

[redacted]

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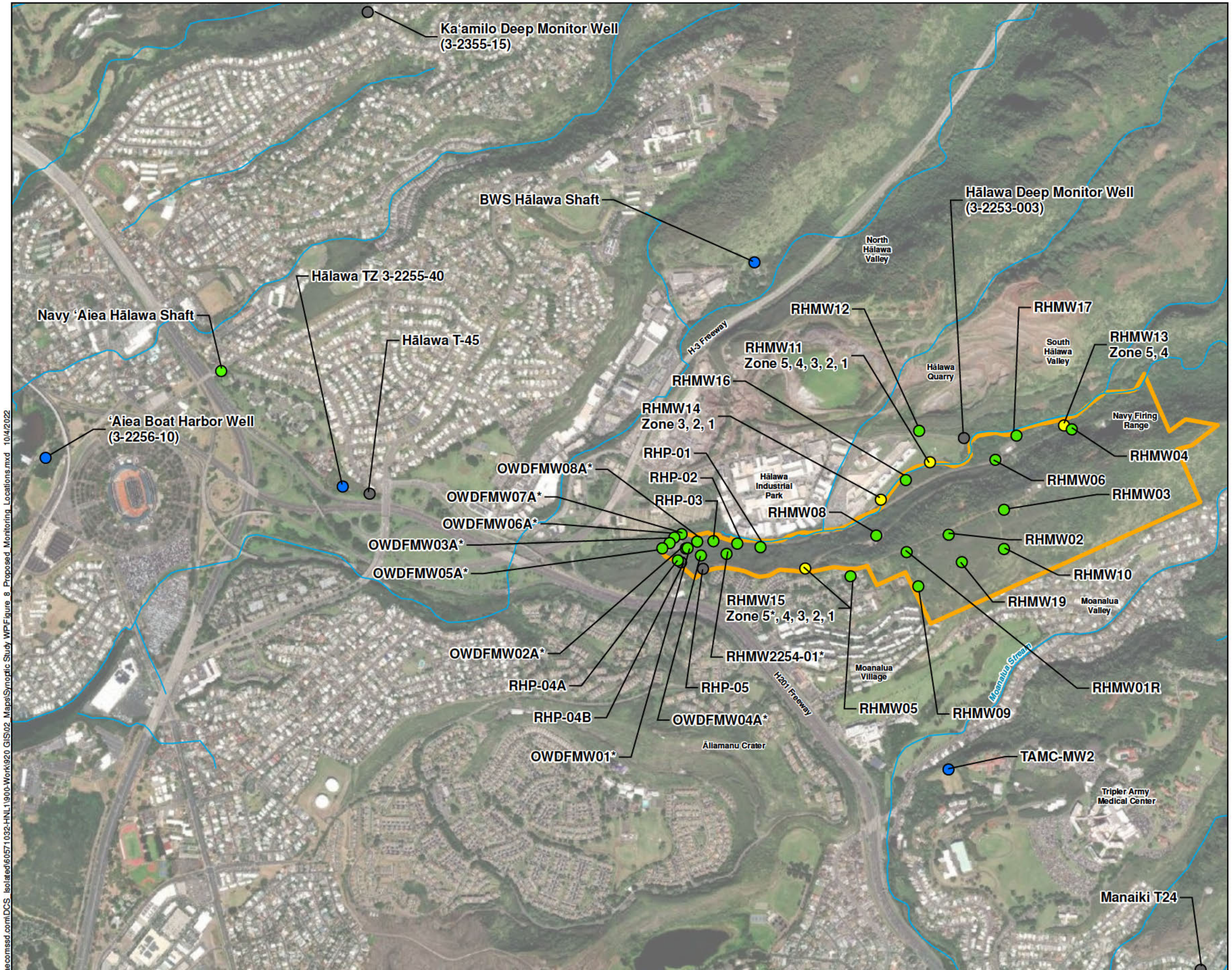


Location Map

Legend

- Wells Considered for Coordination
- Navy AquaTroll 200
- TAMC-MW2
- Navy MOSDAX Transducer
- Stream
- Red Hill Facility Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. * These wells are monitored under a separate ER,N-funded investigation.
5. Additional P-wells are being installed as this WP is being developed. If additional P-Wells are installed when this study takes place, they will be incorporated into this synoptic study.

N

0 1,000 2,000
Feet

Figure 8
Monitoring Locations
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Table 1: 2017/2018 and 2022 RHS Startup Synoptic Water Level Survey Monitoring Locations

Well	General Classification	Well Owner	Monitoring Year:	Monitoring Entity
RHMW2254-01	RHBFSF – In-tunnel Well	Navy	2017/2018	USGS
			2022	USGS
RHMW01	RHBFSF – In-tunnel Well	Navy	2017/2018	USGS
			2022	USGS
RHMW01R	RHBFSF – In-tunnel Well	Navy	2022	Navy
RHMW02	RHBFSF – In-tunnel Well	Navy	2017/2018	USGS
			2022	USGS
RHMW03	RHBFSF – In-tunnel Well	Navy	2017/2018	USGS
			2022	USGS
RHMW04	RHBFSF – Outlying Well	Navy	2017/2018	USGS
			2022	USGS
RHMW05	RHBFSF – In-tunnel Well	Navy	2017/2018	USGS
			2022	USGS
RHMW06	RHBFSF – Outlying Well	Navy	2017/2018	USGS
			2022	USGS
RHMW07	RHBFSF – Outlying Well	Navy	2017/2018	USGS
RHMW08	RHBFSF – Outlying Well	Navy	2017/2018	USGS
			2022	USGS
RHMW09	RHBFSF – Outlying Well	Navy	2017/2018	USGS
			2022	USGS
RHMW10	RHBFSF – Outlying Well	Navy	2017/2018	USGS
			2022	USGS
RHMW11 Zone 5	RHBFSF – Outlying Well	Navy	2017/2018	Navy
			2022	Navy
RHMW12A	HCF	Navy	2022	USGS
RHMW13 Zone 5	RHBFSF – Outlying Well	Navy	2022	Navy
RHMW14 Zone 3	RHBFSF – Outlying Well	Navy	2022	Navy
RHMW15 Zone 5	RHBFSF – Outlying Well	Navy	2022	Navy
RHMW16	RHBFSF – Outlying Well	Navy	2022	USGS
RHMW17	RHBFSF – Outlying Well	Navy	2022	Navy

Well	**General Classification**	**Well Owner**	**Monitoring Year:**	**Monitoring Entity**
RHMW19	RHBFSF – Outlying Well	Navy	2022	Navy
OWDFMW01	OWDF	Navy	2017/2018	Navy
			2022	Navy
OWDFMW02A	OWDF	Navy	2022	Navy
OWDFMW03A	OWDF	Navy	2022	Navy
OWDFMW04A	OWDF	Navy	2022	USGS
OWDFMW05A	OWDF	Navy	2022	USGS
OWDFMW06A	OWDF	Navy	2022	USGS
OWDFMW07A	OWDF	Navy	2022	Navy
OWDFMW08A	OWDF	Navy	2022	Navy
Hālawa Deep Monitor Well (3-2253-003)	Hālawa Valley, HCF	CWRM	2017/2018	USGS
BWS Hālawa Shaft	Hālawa Valley	BWS	2017/2018	USGS
3-2253-006	RHBFSF Border	BWS	Never monitored	Never monitored
Moanalua DH43	Moanalua Valley	BWS	2017/2018	USGS
Hālawa T-45	‘Aiea	BWS	2017/2018	BWS
BWS Hālawa Deep Monitor Well (3-2255-040)	‘Aiea	BWS	2017/2018	USGS
Navy ‘Aiea Navy Hālawa Shaft	‘Aiea	Navy	2017/2018	USGS
Manaiki T24	Moanalua Valley	BWS	2017/2018	BWS
‘Aiea Boat Harbor Well	‘Aiea	Navy	2017/2018	USGS
TAMC-MW2	Moanalua Valley	Army	2017/2018	USGS
Ka‘amilo Deep Monitor Well	Pearl City	BWS	2017/2018	USGS

Notes:

BWS Board of Water Supply
CWRM Commission on Water Resource Management
HCF Hālawa Correctional Facility
OWDF Oily Waste Disposal Facility
RH Red Hill
RHBFSF Red Hill Bulk Fuel Storage Facility
USGS United States Geological Survey

Table 2: Monitoring Locations

Well	Location	Monitoring Entity	Well Owner	Transducer Type	Sampling Requirements
RHMW2254-01 [a]	RHBFSF	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW01	RHBFSF	USGS	Navy	AquaTroll 200	None
RHMW01R	RHBFSF – In-tunnel Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW02	RHBFSF – In-tunnel Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW03	RHBFSF – In-tunnel Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW04	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW05	RHBFSF – In-tunnel Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW06	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW08	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW09	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW10	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW11 Zone 5	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	Weekly NOI RH Quarterly GW LTM

Well	Location	Monitoring Entity	Well Owner	Transducer Type	Sampling Requirements
RHMW11 Zone 4	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW11 Zone 3	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW11 Zone 2	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW11 Zone 1	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW12A	HCF	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW13 Zone 5	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	Weekly NOI RH Quarterly GW LTM
RHMW13 Zone 4	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW14 Zone 3	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	Weekly NOI RH Quarterly GW LTM
RHMW14 Zone 2	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW14 Zone 1	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW15 Zone 5 [a]	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	Weekly NOI RH Quarterly GW LTM
RHMW15 Zone 4	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW15 Zone 3	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW15 Zone 2	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None
RHMW15 Zone 1	RHBFSF – Outlying Well	Navy	Navy	MOSDAX	None

[redacted]

Well	**Location**	**Monitoring Entity**	**Well Owner**	**Transducer Type**	**Sampling Requirements**
RHMW16	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW17	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHMW19	RHBFSF – Outlying Well	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM
RHP01	RHBFSF – Delineation well [b]	Navy	Navy	AquaTroll 200	Delineation Well Sampling Program
RHP02	RHBFSF – Delineation well [b]	Navy	Navy	AquaTroll 200	Delineation Well Sampling Program
RHP03	RHBFSF – Delineation well [b]	Navy	Navy	AquaTroll 200	Delineation Well Sampling Program
RHP04A	RHBFSF – Delineation well [b]	Navy	Navy	AquaTroll 200	Delineation Well Sampling Program
OWDFMW01 [a]	OWDF	Navy	Navy	AquaTroll 200	Weekly NOI RH Quarterly GW LTM OWDF Quarterly GW LTM
OWDFMW02A [a]	OWDF	Navy	Navy	AquaTroll 200	OWDF Quarterly GW LTM
OWDFMW03A [a]	OWDF	Navy	Navy	AquaTroll 200	OWDF Quarterly GW LTM

[redacted]

Well	**Location**	**Monitoring Entity**	**Well Owner**	**Transducer Type**	**Sampling Requirements**
OWDFMW04A [a]	OWDF	Navy	Navy	AquaTroll 200	Weekly NOI OWDF Quarterly GW LTM
OWDFMW05A [a]	OWDF	Navy	Navy	AquaTroll 200	Weekly NOI OWDF Quarterly GW LTM
OWDFMW06A [a]	OWDF	Navy	Navy	AquaTroll 200	OWDF Quarterly GW LTM
OWDFMW07A [a]	OWDF	Navy	Navy	AquaTroll 200	Weekly NOI OWDF Quarterly GW LTM
OWDFMW08A [a]	OWDF	Navy	Navy	AquaTroll 200	Weekly NOI OWDF Quarterly GW LTM
Hālawa Deep Monitor Well (3-2253-003) [c]	Hālawa Valley, HCF	USGS	CWRM	Level Troll 700H	RH Quarterly GW LTM
BWS Hālawa Shaft	Hālawa Valley	USGS	BWS	Level Troll 700H	None
Hālawa T-45 [c]	‘Aiea	USGS	BWS	Level Troll 700H	None
BWS Hālawa Deep Monitor Well (3-2255-040)	‘Aiea	USGS	BWS	Level Troll 700H	None
Navy ‘Aiea Hālawa Shaft	‘Aiea	USGS	Navy	Level Troll 700H	None
Manaiki T24 [c]	Moanalua Valley	USGS	BWS	Level Troll 700H	None
‘Aiea boat harbor well	‘Aiea	USGS	Navy	Level Troll 700H	None

Well	Location	Monitoring Entity	Well Owner	Transducer Type	Sampling Requirements
TAMC-MW2	Moanalua Valley	USGS	Army	Level Troll 700H	None
Kaʻamilo Deep Monitor Well [c]	Pearl City	USGS	BWS	Level Troll 700H	None

Notes:
BWS Board of Water Supply
CWRM Commission on Water Resource Management
GW groundwater
LTM long-term monitoring
NOI Notice of Interest
OWDF Oily Waste Disposal Facility
RH Red Hill
RHBFSF Red Hill Bulk Fuel Storage Facility
USGS United States Geological Survey

[a] ER, N-funded investigation is being executed under another contract task order (CTO) separate from the Red Hill AOC and emergency response CTOs associated with environmental investigations of the main Red Hill Bulk Fuel Storage Facility.

[b] Additional plume delineation wells are being installed as this WP is being developed. If additional delineation wells have been installed by the time this transducer survey takes place, they will be incorporated into this survey.

[c] Wells considered pending coordination with multiple agencies.

[redacted]

Table 3: Isotope Samples

Parameter	Containers (per sample)	Laboratory
δ2H of water (‰ vs. V-SMOW)	125 cc (min 40 mL vol.)	Isotech
δ18O of water (‰ vs. V-SMOW)		
δ15N of nitrate (‰ vs. AIR)	60 mL plastic unpreserved (field filtered)	University of Hawai‘i at Manoa
δ18O of nitrate (‰ vs. V-SMOW)		

cc cubic centimeter
mL milliliter

Table 4: Proposed Schedule

Activities	Organization	Anticipated Date of Initiation	Anticipated Date of Completion	Duration of Each Action (Days)	Action	Action Due Date [b]
Special Purpose Meeting with RAs	AECOM Navy DOH/EPA	8/10/2022	8/10/2022	1	Presentation Slides Meeting Summary	8/10/2022 8/15/2022
Prepare and submit IP Draft WP	AECOM	8/10/2022	8/29/2022	19	IP Draft WP	8/29/2022
Navy review of IP Draft WP	Navy	8/29/2022	8/31/2022	2	Comments on IP Draft WP	8/31/2022
Prepare and submit WP	AECOM	8/31/2022	9/2/2022	2	Draft WP	9/2/2022
RA review and comment on WP	DOH/EPA	9/2/2022	9/7/2022	5	Comments on IP Draft WP	9/7/2022
Special Purpose Meeting with RAs	AECOM Navy DOH/EPA	9/7/2022	9/7/2022	1	Presentation Slides Meeting Summary	9/7/2022 9/12/2022
Prepare and submit Final WP (if nec.)	AECOM	9/7/2022	10/5/2022	7	Final WP (if nec.)	9/30/2022
Transducer Procurement/ Mobilization	AECOM	9/14/2022	10/5/2022	21	N/A	N/A

Activities	Organization	Anticipated Date of Initiation	Anticipated Date of Completion	Duration of Each Action (Days)	Action	Action Due Date [b]
Transducer Deployment	AECOM	10/5/2022	10/12/2022	7	N/A	N/A
RHS Off	AECOM Navy	Fri, Feb 24, 2023, 09:00	Mon, Feb 27, 2023, 09:00	3	N/A	N/A
Trial Period #1: RHS On 24/7	AECOM Navy	Mon, Feb 27, 2023, 09:00	Fri, Mar 17, 2023, 09:00	18	N/A	N/A
RHS Off	AECOM Navy	Fri, Mar 17, 2023, 09:00	Mon, Mar 20, 2023, 09:00	3	N/A	N/A
Trial Period #2: RHS On M-F (Week #1)	AECOM Navy	Mon, Mar 20, 2023, 09:00	Sat, Mar 25, 2023, 09:00	5	N/A	N/A
RHS Off	AECOM Navy	Sat, Mar 25, 2023, 09:00	Mon, Mar 27, 2023, 09:00	2	N/A	N/A
Trial Period #2: RHS On M-F (Week #2)	AECOM Navy	Mon, Mar 27, 2023, 09:00	Sat, Apr 01, 2023, 09:00	5	N/A	N/A
RHS Off	AECOM Navy	Sat, Apr 01, 2023, 09:00	Mon, Apr 03, 2023, 09:00	2	N/A	N/A
Trial Period #2: RHS On M-F (Week #3)	AECOM Navy	Mon, Apr 03, 2023, 09:00	Sat, Apr 08, 2023, 09:00	5	N/A	N/A
RHS Off	AECOM Navy	Sat, Apr 08, 2023, 09:00	Tue, Apr 11, 2023, 09:00	3	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Tue, Apr 11, 2023, 09:00	Thu, Apr 13, 2023, 09:00	2	N/A	N/A
RHS Off	AECOM Navy	Thu, Apr 13, 2023, 09:00	Sat, Apr 15, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Sat, Apr 15, 2023, 09:00	Sun, Apr 16, 2023, 09:00	1	N/A	N/A
RHS Off	AECOM Navy	Sun, Apr 16, 2023, 09:00	Tue, Apr 18, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Tue, Apr 18, 2023, 09:00	Thu, Apr 20, 2023, 09:00	2	N/A	N/A

Activities	**Organization**	**Anticipated Date of Initiation**	**Anticipated Date of Completion**	**Duration of Each Action (Days)**	**Action**	**Action Due Date** [b]
RHS Off	AECOM Navy	Thu, Apr 20, 2023, 09:00	Sat, Apr 22, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Sat, Apr 22, 2023, 09:00	Sun, Apr 23, 2023, 09:00	1	N/A	N/A
RHS Off	AECOM Navy	Sun, Apr 23, 2023, 09:00	Tue, Apr 25, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Tue, Apr 25, 2023, 09:00	Thu, Apr 27, 2023, 09:00	2	N/A	N/A
RHS Off	AECOM Navy	Thu, Apr 27, 2023, 09:00	Sat, Apr 29, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Sat, Apr 29, 2023, 09:00	Sun, Apr 30, 2023, 09:00	1	N/A	N/A
RHS Off	AECOM Navy	Sun, Apr 30, 2023, 09:00	Tue, May 02, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Tue, May 02, 2023, 09:00	Thu, May 04, 2023, 09:00	2	N/A	N/A
RHS Off	AECOM Navy	Thu, May 04, 2023, 09:00	Sat, May 06, 2023, 09:00	2	N/A	N/A
Trial Period #3: RHS On: M-Tu, F	AECOM Navy	Sat, May 06, 2023, 09:00	Sun, May 07, 2023, 09:00	1	N/A	N/A
RHS Off	AECOM Navy	Sun, May 07, 2023, 09:00	Tue, May 09, 2023, 09:00	2	N/A	N/A
RHS Returns to Full-time Operation RHS On	AECOM Navy	Tue, May 09, 2023, 09:00	TBD	TBD	N/A	N/A
Remove Transducers	AECOM	Tue, May 09, 2023, 09:00	Tue, May 16, 2023, 09:00	7	N/A	N/A
Perform data validation and evaluation	AECOM	Tue, May 09, 2023, 09:00	Tue, Jun 13, 2023	35	N/A	N/A

[redacted]

Activities	Organization	Anticipated Date of Initiation	Anticipated Date of Completion	Duration of Each Action (Days)	Action	Action Due Date [b]
Prepare and submit in-progress (IP) Draft Report of Findings	AECOM	Tue, Jun 13, 2023	Fri, Jun 30, 2023	17	IP Draft Report of Findings	2/13/2023
Navy review of IP Draft Report of Findings	Navy	Fri, Jun 30, 2023	Sun, Jul 02, 2023	2	Comments on Report of Findings	2/15/2023
Prepare and submit Draft Report of Findings	AECOM	Sun, Jul 02, 2023	Tue, Jul 04, 2023	2	Draft Report of Findings	2/17/2023
RA review and comment of Draft Report of Findings	DOH/EPA	Wed, Jul 05, 2023	Fri, Jul 14, 2023	5	Comments on Report of Findings	2/22/2023
Special Purpose Meeting with RAs	AECOM Navy DOH/EPA	Fri, Jul 14, 2023	Fri, Jul 14, 2023	1	Presentation Slides Meeting Summary	2/22/2023 2/27/2023
Prepare and submit Final Report of Findings	AECOM	Fri, Jul 14, 2023	Fri, Jul 21, 2023	7	Final Report of Findings	3/1/2023

Notes:

Indicates completed activity

AECOM AECOM Technical Services, Inc.
DOH Department of Health, State of Hawaiʻi
EPA Environmental Protection Agency, United States
IP in-progress
N/A not applicable
RA Regulatory Agency
TBD to be determined
WP work plan

Table 5: Regulatory Agency Comments Received on Draft Work Plan and Changes Made

Regulator Comment	**Navy Response**
Prepare a work plan for review, identifying anticipated analyses and deliverables.	This work plan has been prepared to describe the anticipated procedures, analyses, and deliverables.
Provide a proposed schedule.	Section 4.7 of this work plan presents the anticipated schedule.
Clarify proposed impacts to NOI and LTM sampling.	In response to regulator concerns and requests, the Navy agreed to deploy its own transducers (instead of USGS deploying transducers) in all site wells that undergo LTM or NOI sampling. As a result, this survey will not interfere with any of that sampling.
Clearly identify wells to be monitored and entities performing monitoring.	Table 2 and Figure 8 of this work plan identify the wells to be monitored and entities performing monitoring.
Prepare a work plan for review, identifying anticipated analyses and deliverables.	This work plan has been prepared to describe the anticipated procedures, analyses, and deliverables.
Evaluate relation between water quality parameters and pumping.	This work plan has been revised to incorporate use of AquaTROLL 200 vented transducers in each Navy-controlled conventional monitoring or supply well, in order to record pressure, actual conductivity, specific conductivity, salinity, total dissolved solids, resistivity, and density.
Provide capture zone analyses.	This work plan was modified to clarify the metrics defining the “measure of success for the capture zone” as set forth in the approved Red Hill Shaft Recovery and Monitoring Plan (IDWST 2022). In addition, Figure 6 displays the Target Capture Zone, based on groundwater analytical results and the ability to monitor aquifer condition; and Section 5.0 of this report identifies the minimum analyses that will be performed to estimate or characterize capture.
Recommended adding transducer monitoring to an additional zone in three of the each of the WestBay wells: RHMW11 (zone 3), RHMW13 (zone 4), and RHMW15 (zone 2), in order to evaluate potential changes in vertical gradient that may be induced by pumping stress changes.	The Navy agreed to monitor the requested zones and more, including: all basal zones for RHMW11 (5 zones); all basal zones for RHMW15 (5 zones); basal zones 1, 2, and 3 in RHMW14; and basal zones 4 and 5 in RHMW13.

Regulator Comment	Navy Response
Sample Collection Upon Red Hill Shaft (RHS) Pump Start Up. A water sample from the pump discharge within the first five to ten minutes after restarting the pumping after each non-pumping interval should be collected. This is intended to evaluate what impact periods of non-pumping/"stagnation" will have on the dissolved contaminant levels for water in the infiltration gallery (and surrounding saturated rock). The ultimate purpose of the data will be to indicate how much impact residual fuel in the formation will likely have on "normal"/intermittent pumping of RHS when it comes back online. The sample should be collected from the discharge pipeline between the well pump and the granular activated carbon (GAC) treatment system and analyzed for the same list of analytes required by the November 2021 Notice of Interest (NOI) groundwater sampling. This sample is in addition to any sampling required under the Red Hill Bulk Fuel Storage Facility's (the Facility's) National Pollutant Discharge Elimination System permit.	This comment is incorporated in the revised Flow Optimization Work Plan. Sampling will be conducted from between the discharge pipeline and the GAC system after each scheduled outage of the GAC system during the flow optimization trial periods. The sample will be analyzed for the same list of analytes performed during NOI sampling at the time of the sample's collection.
Data Management. To support near real-time interpretation and optimization of collaboratively collected data, the Navy shall immediately upload the draft field data as downloaded from data loggers into the Environmental Data Management System (EDMS). Immediate or near real-time distribution of the data to the Regulatory Agencies shall be done in electronic format consistent with the NOI submittals. Electronic data shall be uploaded along with the field notes documenting transducer disturbance and water level corrections with respective times and dates.	Agreed; incorporated into the work plan. The Navy will provide data as soon as practical after its collection, and upload into EDMS for viewing by the Regulatory Agencies.

Regulator Comment	Navy Response
Return to RHSRMP Pumping Rate. Unless the Regulatory Agencies indicate otherwise in writing, after completion of the Work Plan study, pumping and GAC treatment at RHS should resume at approximately the current average rate of 4.2 million gallons per day.	Agreed; incorporated into the work plan. The data collected by the Navy during this flow optimization trial period will be utilized to support any proposed permanent reductions in water usage from Red Hill Shaft. This work plan's data, which will be provided to the Regulatory Agencies, should be given reasonable time to be reviewed before performing GAC treatment at a level less than the current average rate of 4.2 million gallons per day, which represents "always on" operation.

[redacted]

Appendix A: Summary of Relevant Groundwater Analytical Data

- Table 1: Summary of Validated Plume Delineation Well Data
- TPH-d and TPH-o Time Series Analytical Data
- Heat Maps:
  - Interpolation Details
  - TPH-d
  - TPH-o
  - 1-methylnaphthalene
  - 2-methylnaphthalene
  - Naphthalene
  - Xylenes

[redacted]

Table 1
JBPHH Site Characterization
P-Well Sampling -- Validated Data (available to regulators)
Joint Base Pearl Harbor Hickam

			Location	RHP01				RHP02					
			Sample ID	RHP01-WGN01LF-2206WK3	RHP01-WGN01LF-2207WK1	RHP01-WGN01LF-220718	RHP01-WGN01LF-2208WK1	RHP02-WGN03LF-220608	RHP02-WGFD03LF-220608 (FD)	RHP02-WGN01LF-2206WK3	RHP02-WGN01LF-2207WK1	RHP02-WGN01LF-220718	RHP02-WGN01B-2208WK1
			Sampling Date	20-Jun-22	06-Jul-22	18-Jul-22	01-Aug-22	08-Jun-22	08-Jun-22	20-Jun-22	06-Jul-22	18-Jul-22	04-Aug-22
DISSOLVED GAS (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
Methane	Aqueous			5.90 U				5.90 U	5.90 U	5 90 U			
GENCHEM (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
Alkalinity, Bicarbonate (as CaCO3)	Aqueous			**150000**	**130000**			**190000**	**180000**	**160000**			
Alkalinity, Carbonate (as CaCO3)	Aqueous			7000 U	7000 U			7000 U	7000 U	7000 U			
Alkalinity, Total (as CaCO3)	Aqueous			**150000**	**130000**			**190000**	**180000**	**160000**			
Chloride	Aqueous			**82000 J**	**77000 J**			**78000 J**	**78000 J**	**82000 J**			
Nitrate (as N)	Aqueous			**980 J**	**1000 J**			**770 J**	**770 J**	**850 J**			
Nitrate-Nitrite (as N)	Aqueous			**840 J**	**1100**			**690**	**720**	**810**			
Sulfate	Aqueous			**67000 J**	**65000 J**			**68000 J**	**68000 J**	**87000 J**			
GENCHEM (Diss) (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
Iron, Ferrous, Dissolved	Aqueous			50 0 U	**68.0 J**			**49.0 J**	**54.0 J**	50.0 UJ			
SVOC (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
1-Methylnaphthalene	Aqueous	DOH EAL	10	0.0810 U	0.0810 U	0 0820 U	0.0810 UJ	0.0870 U	0.0810 U	0.0810 U	0 0890 U	0.0800 U	0.0810 U
2-Methylnaphthalene	Aqueous	DOH EAL	10	0.0810 U	0.0810 U	0 0820 U	0.0810 UJ	0.0870 U	0.0810 U	0.0810 U	0 0890 U	0.0800 U	0.0810 U
Naphthalene	Aqueous	DOH EAL	17	0.400 U	0.410 U	0.410 U	0.400 UJ	0.430 U	0.410 U	0.410 U	0.440 U	0.400 U	0.400 U
TOC (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
Total Organic Carbon	Aqueous			**1300 J**	**760 J**			**980 J**	**840 J**	900 UJ			
HC (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
C6-C10 Gasoline Range Organics	Aqueous		300	80 0 U	80.0 U	80.0 U	80.0 UJ	80 0 UJ	80.0 UJ	80.0 U	80.0 UJ	80.0 U	80.0 U
TPH (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
C10-C24 Petroleum Hydrocarbons	Aqueous	DOH EAL	400	110 U	110 U	100 U	100 UJ	100 U	100 U	100 U	110 U	100 U	100 U
C24-C40 Petroleum Hydrocarbons	Aqueous	DOH EAL	500	320 U	320 U	300 U	300 UJ	310 U	300 U	310 U	330 U	300 U	310 U
VOC (UG/L)	**Matrix**	**Screening Limit Type**	**Limit**										
Benzene	Aqueous	DOH EAL	5	0.500 U	0.500 UJ	0.500 U	0.500 UJ	0.500 U	0.500 U	0.500 U	0 500 UJ	0 500 U	0.500 U
Ethylbenzene	Aqueous	DOH EAL	30	0.800 U	0.800 UJ	0.800 U	0.800 UJ	0.800 U	0.800 U	0.800 U	0 800 UJ	0 800 U	0.800 U

			Location	RHP01				RHP02					
			Sample ID	**RHP01-WGN01LF-2206WK3**	**RHP01-WGN01LF-2207WK1**	**RHP01-WGN01LF-220718**	**RHP01-WGN01LF-2208WK1**	**RHP02-WGN03LF-220608**	**RHP02-WGFD03LF-220608 (FD)**	**RHP02-WGN01LF-2206WK3**	**RHP02-WGN01LF-2207WK1**	**RHP02-WGN01LF-220718**	**RHP02-WGN01B-2208WK1**
			Sampling Date	**20-Jun-22**	**06-Jul-22**	**18-Jul-22**	**01-Aug-22**	**08-Jun-22**	**08-Jun-22**	**20-Jun-22**	**06-Jul-22**	**18-Jul-22**	**04-Aug-22**
m,p-Xylene	Aqueous			0.800 U	0.800 UJ	0.800 U	0.800 UJ	0.800 U	0.800 U	0.800 U	0 800 UJ	0 800 U	0.800 U
o-Xylene	Aqueous			0.800 U	0.800 UJ	0.800 U	0.800 UJ	0.800 U	0.800 U	0.800 U	0 800 UJ	0 800 U	0.800 U
Toluene	Aqueous	DOH EAL	40	0.800 U	0.800 UJ	0.800 U	0.800 UJ	0.800 U	0.800 U	0.800 U	0 800 UJ	0 800 U	0.800 U
Xylenes, Total	Aqueous	DOH EAL	20	0.800 U	0.800 UJ	0.800 U	0.800 UJ	0.800 U	0.800 U	0.800 U	0 800 UJ	0 800 U	0.800 U

Notes:

Detected results appear in **bold** font.

Highlighted cells indicate detections that exceed the selected screening levels. In cases in which multiple screening limit types appear on the report, the most conservative available limit is used for data comparison.

DOH EAL - State of Hawaii, Department of Health Environmental Action Levels >150m

µg/L - micrograms per liter

mg/L - milligrams per liter

µg/Kg - micrograms per kilogram

mg/Kg - milligrams per kilogram

FD - Field Duplicate

J - The reported result is an estimated value.

U - Not detected; the compound/analyte was analyzed for, but not detected above the Limit of Detection (LOD) unless otherwise noted.

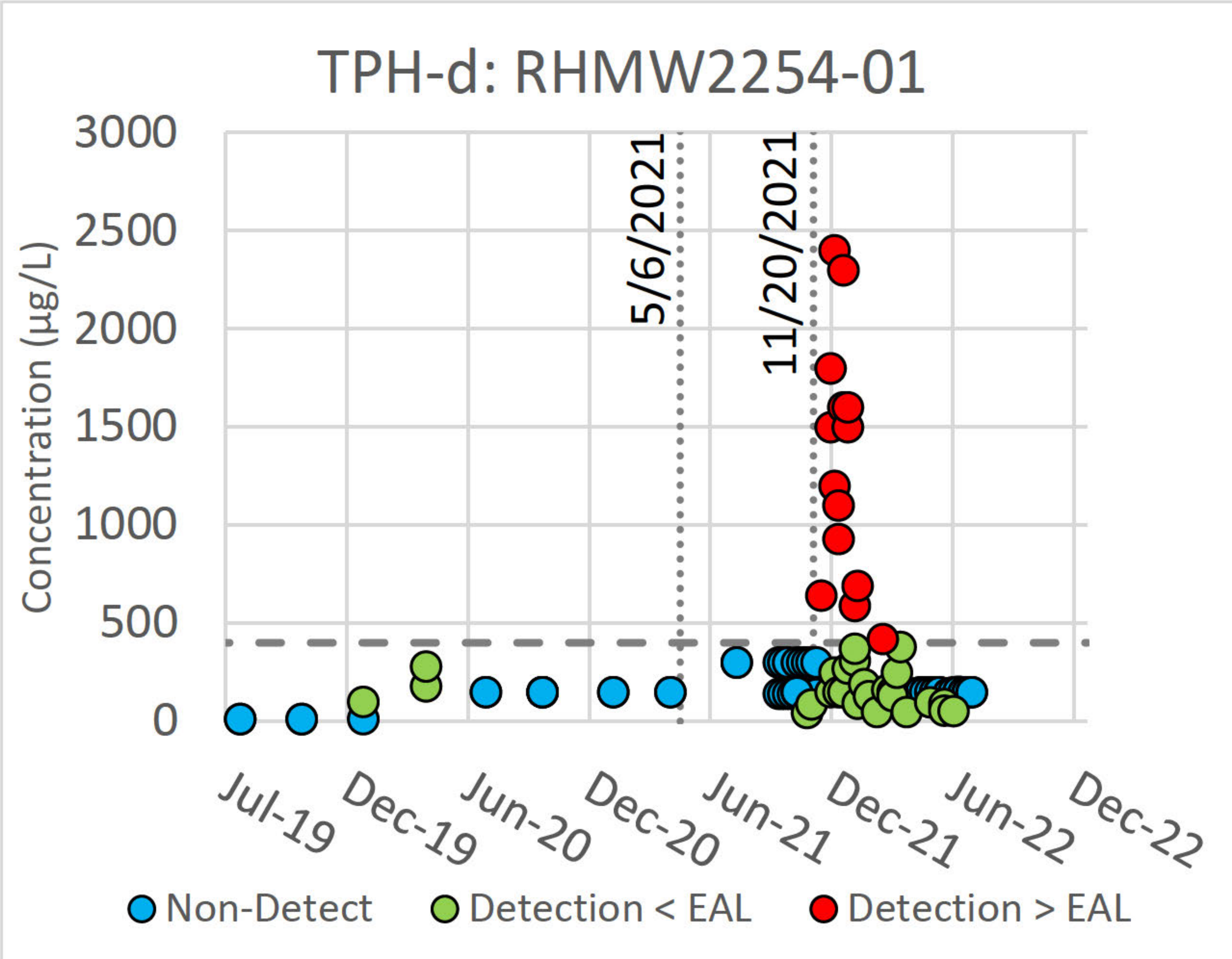
UJ - Qualifier indicates that the target analyte was not detected above the method detection limit. However, the reported detection limit is approximate and may or may not represent the actual limit of detection.

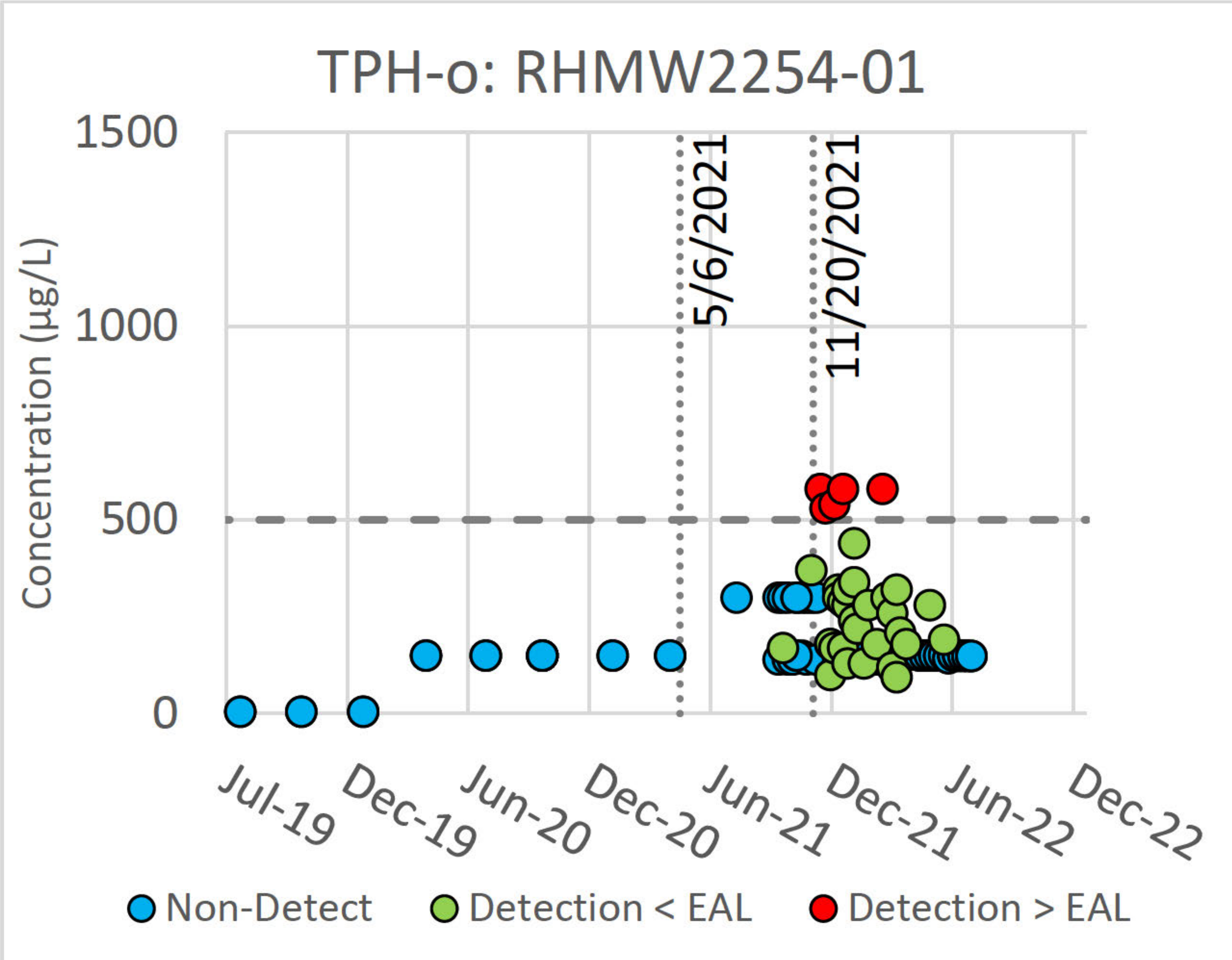
X - The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria.

The presence or absence of the analyte cannot be substantiated by the data provided.

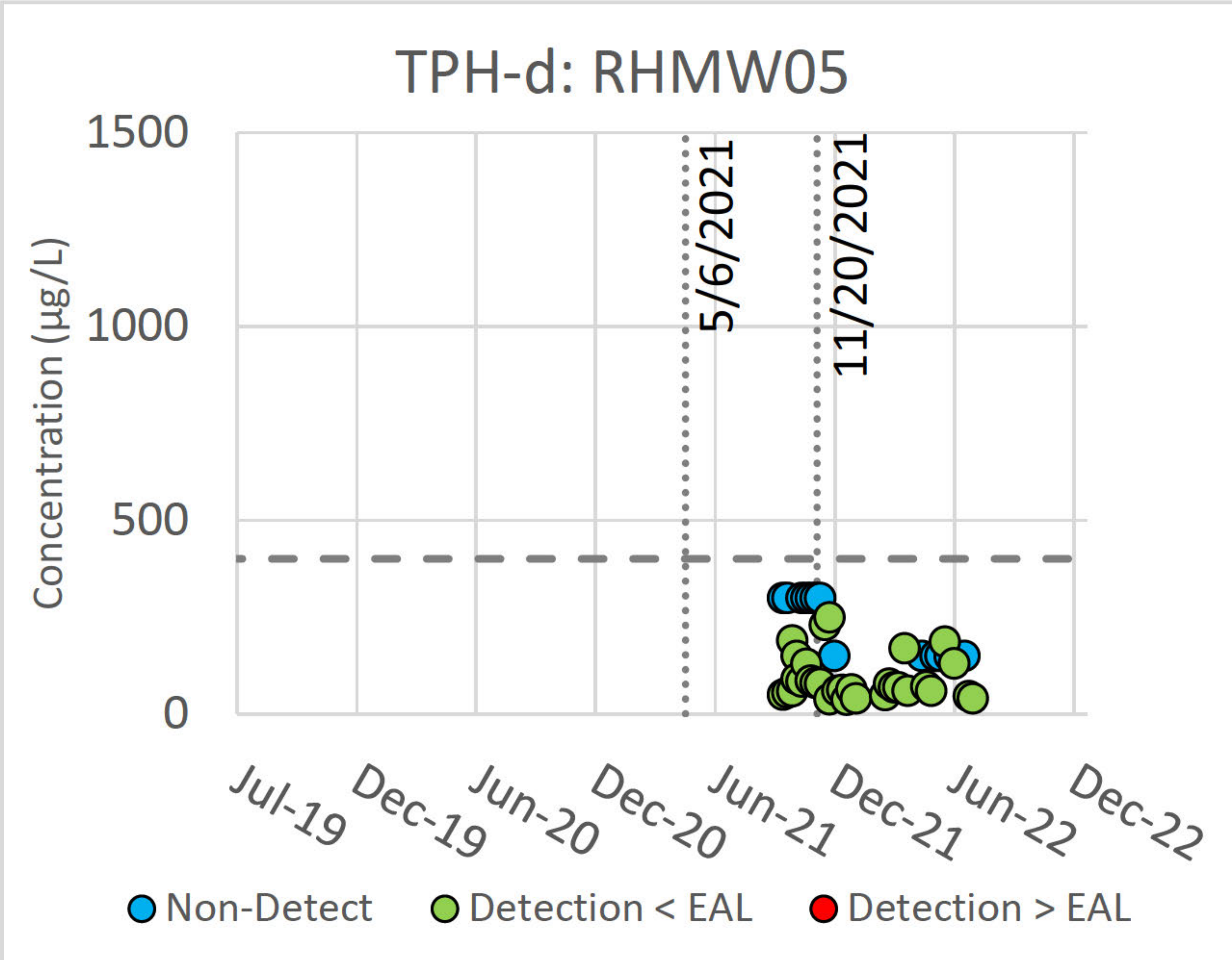
Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

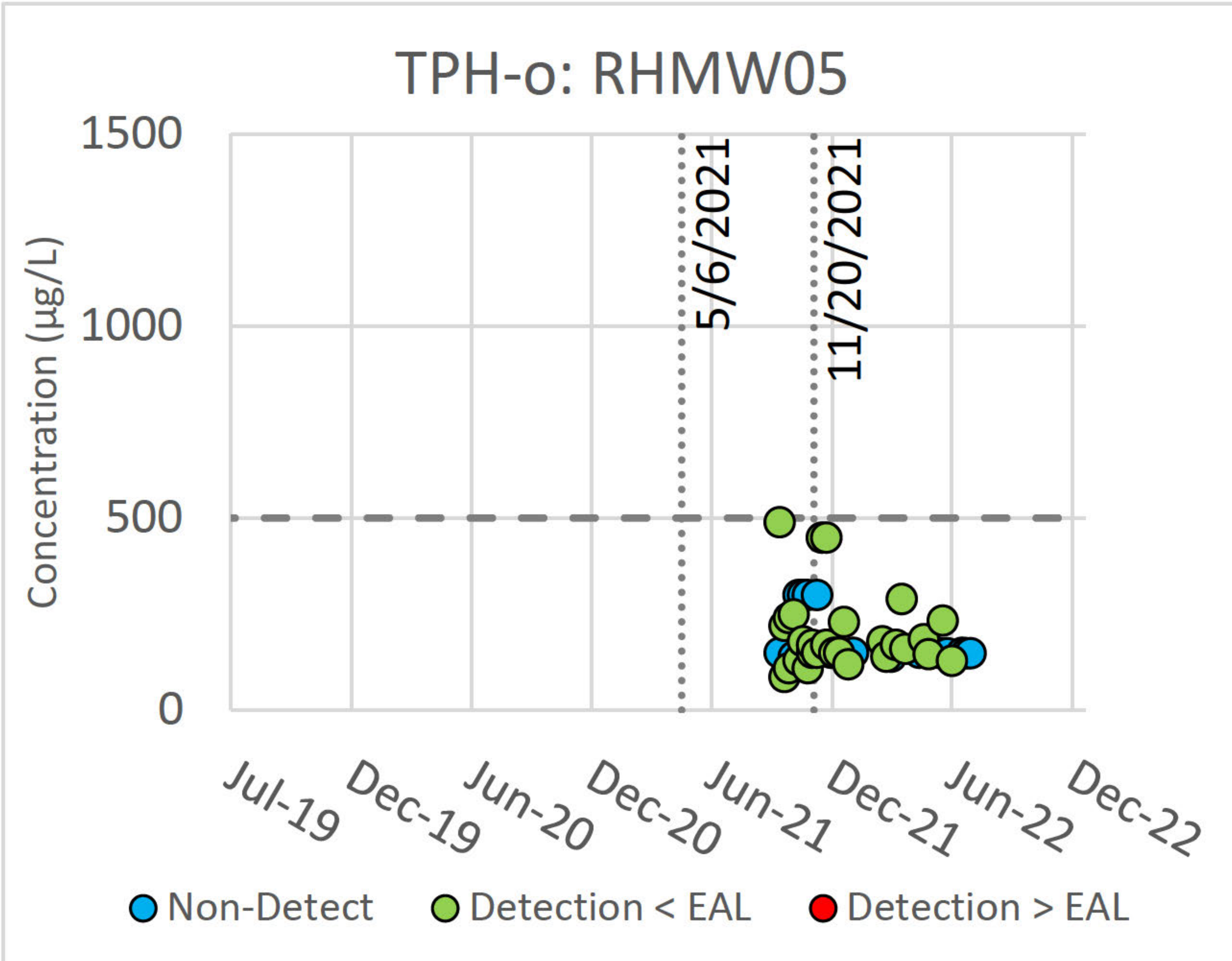
R - Rejected - The data is unusable.

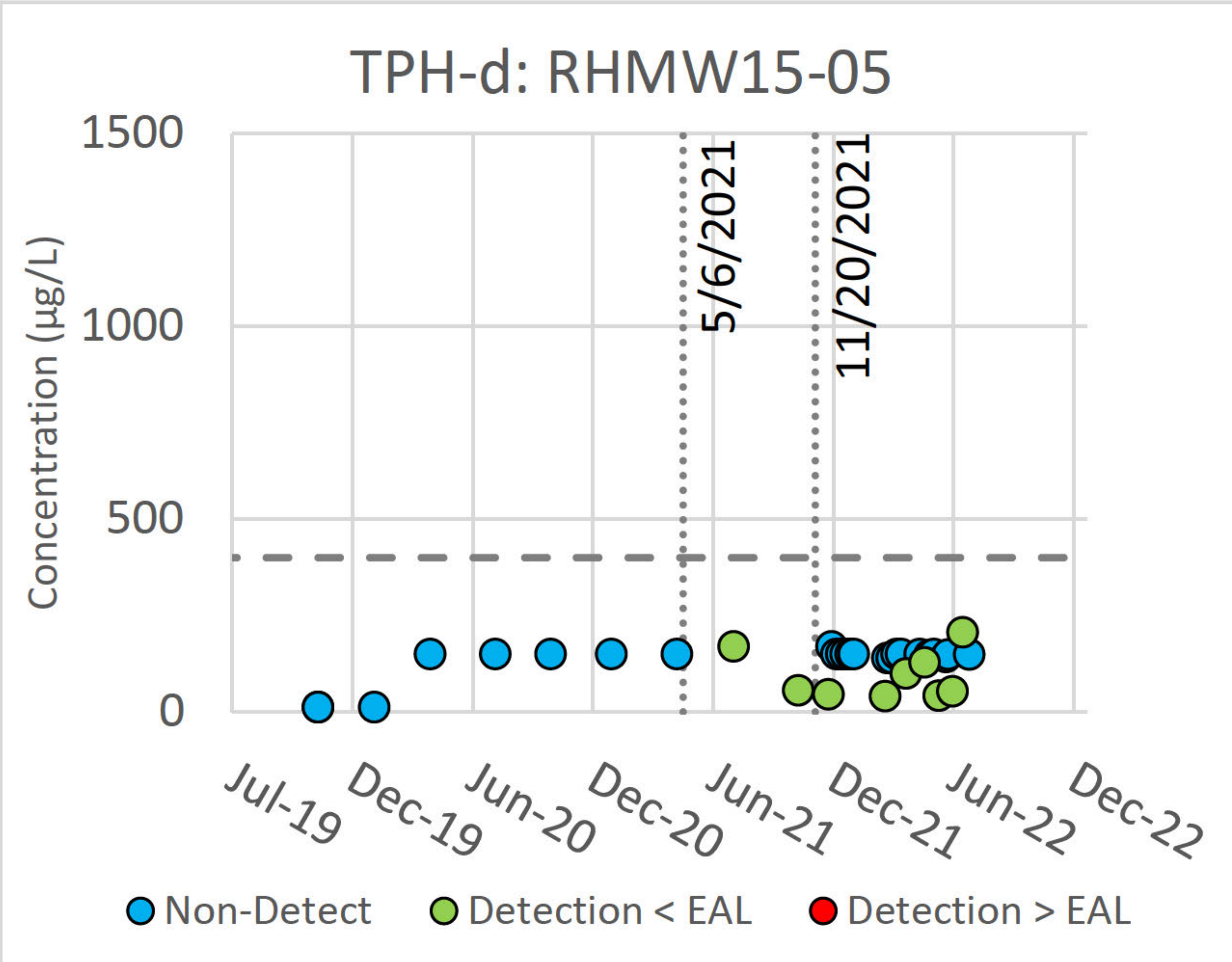

TPH-d: RHMW2254-01
Concentration (µg/L)
3000
2500
2000
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

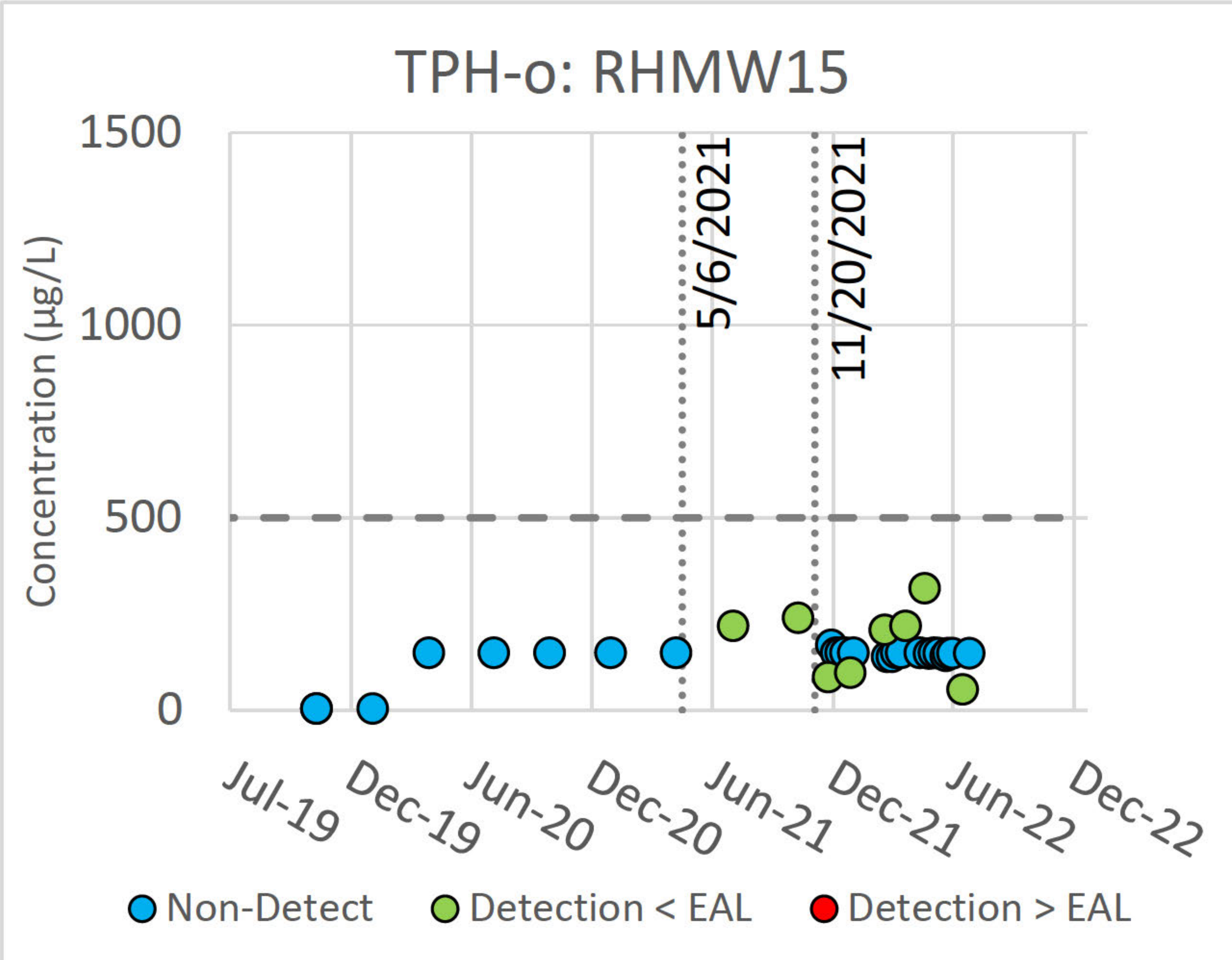


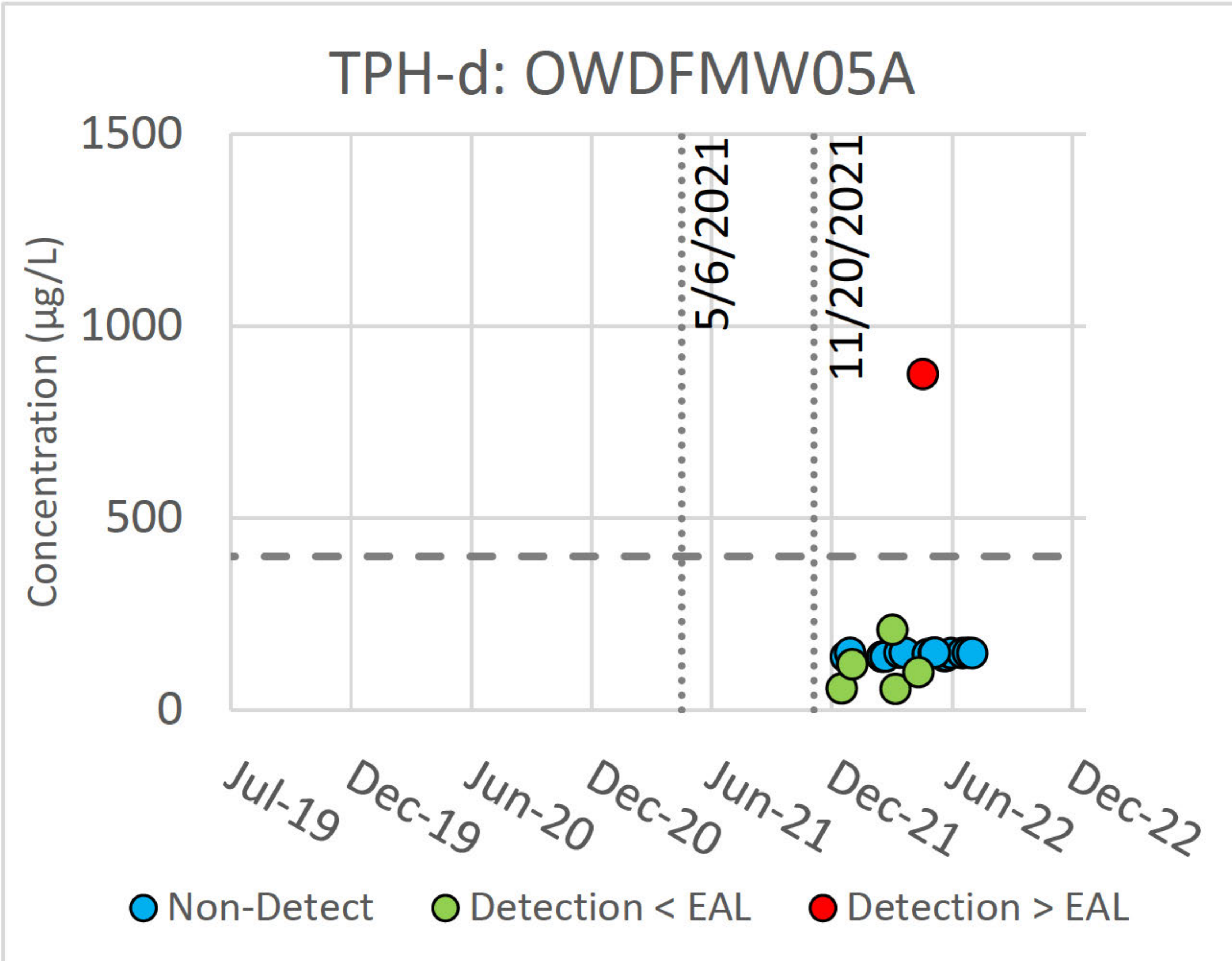
TPH-o: RHMW2254-01
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

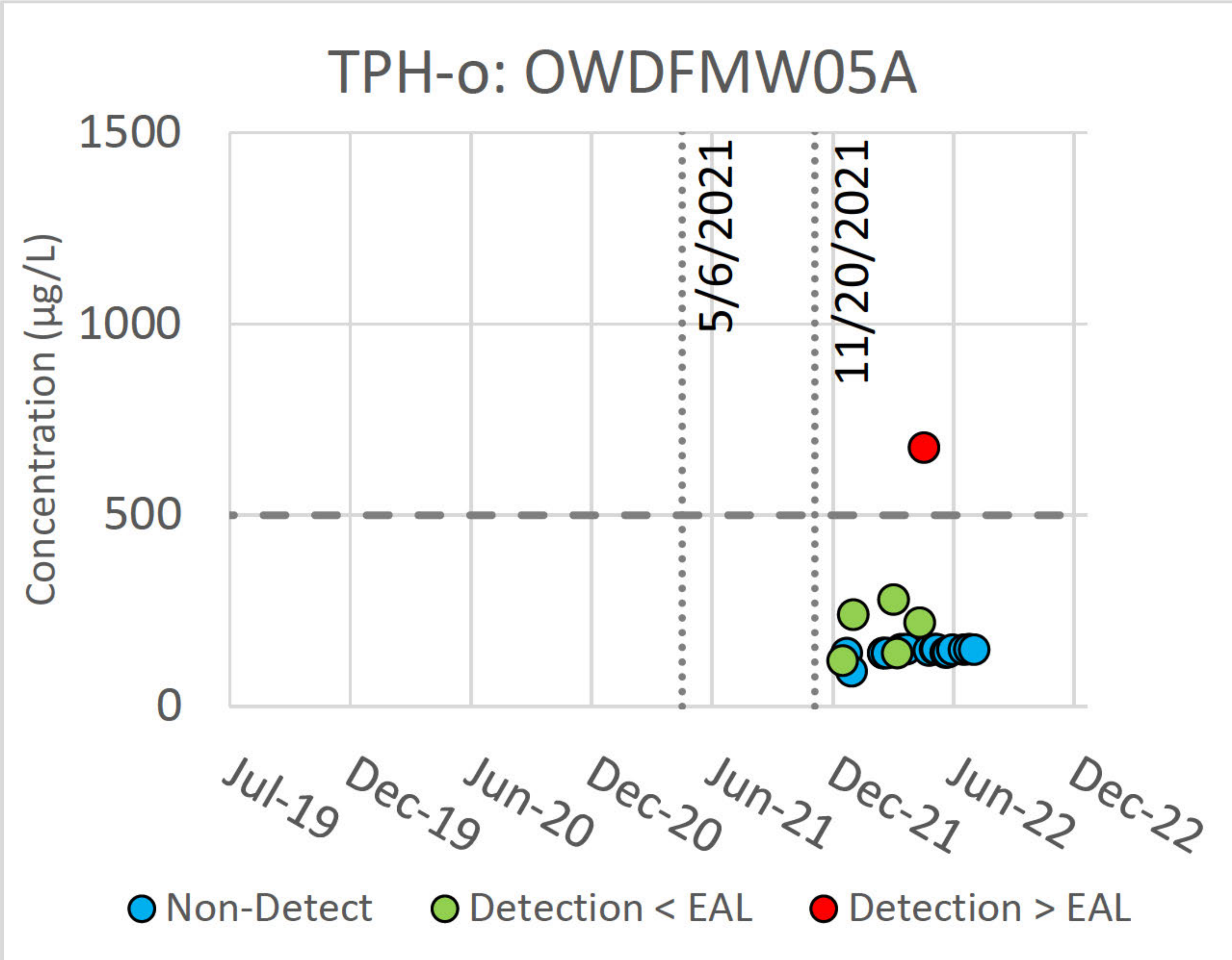

TPH-d: RHMW05
1500
1000
500
0
Concentration (µg/L)
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

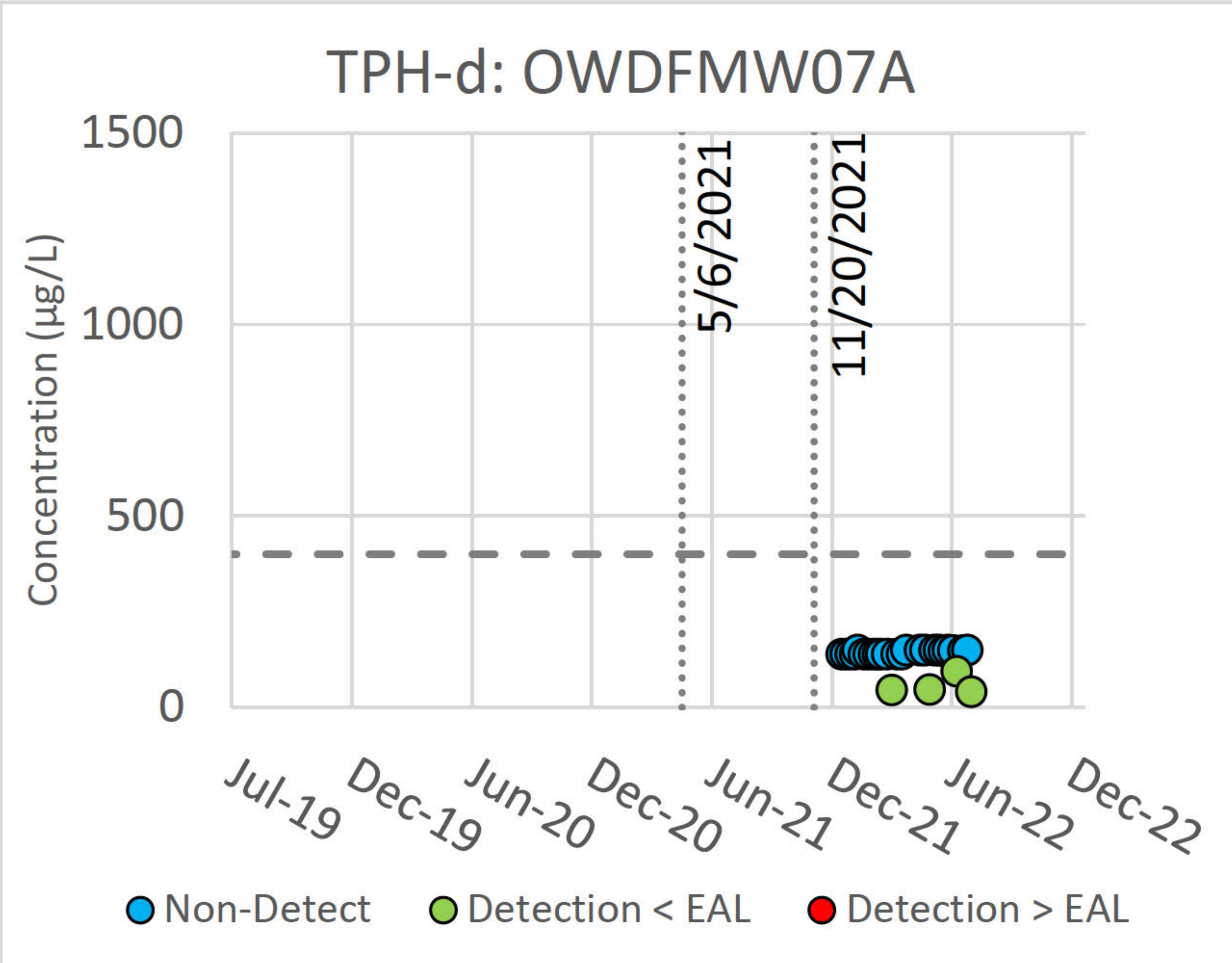

TPH-o: RHMW05
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL


TPH-d: RHMW15-05
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

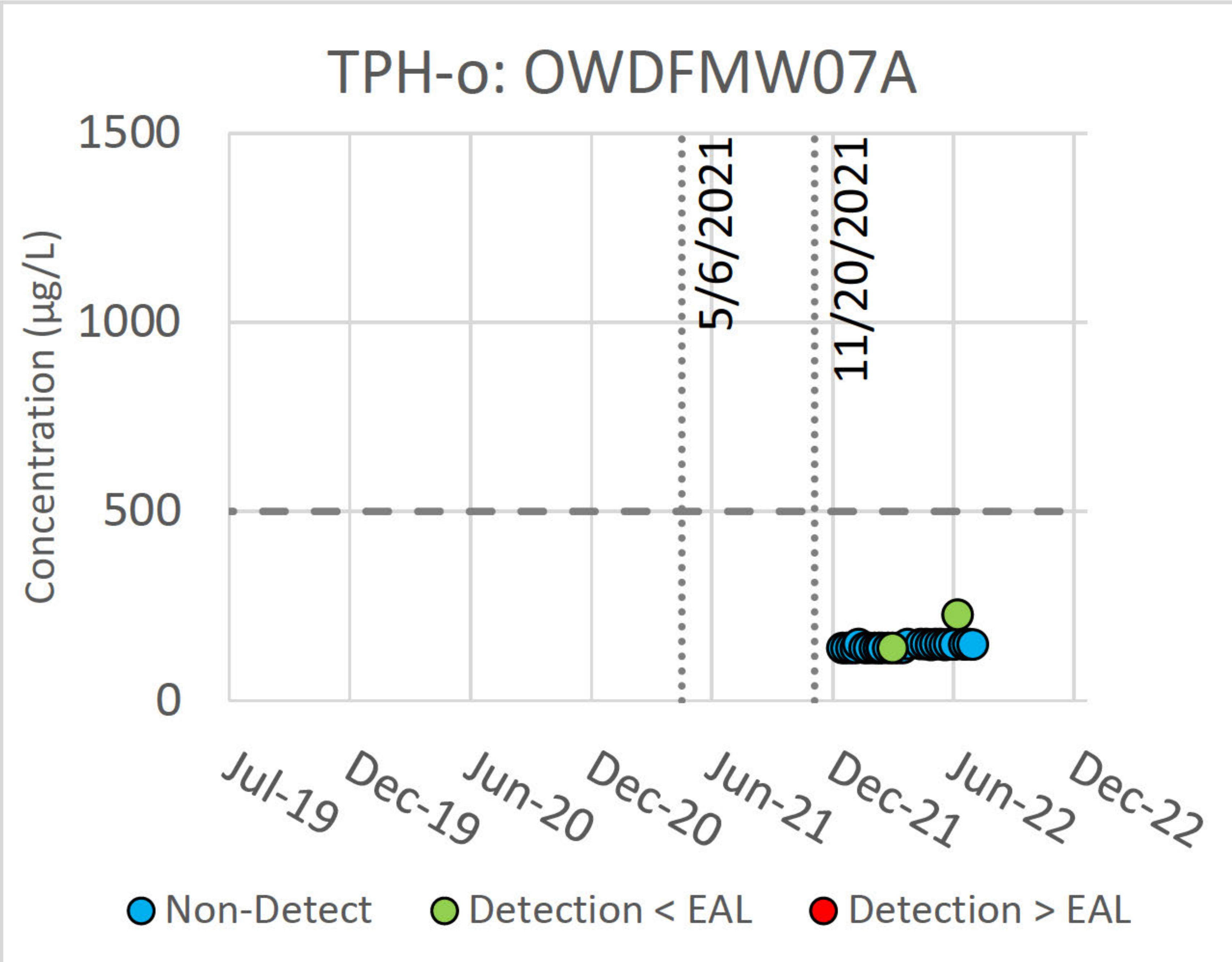

TPH-o: RHMW15
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

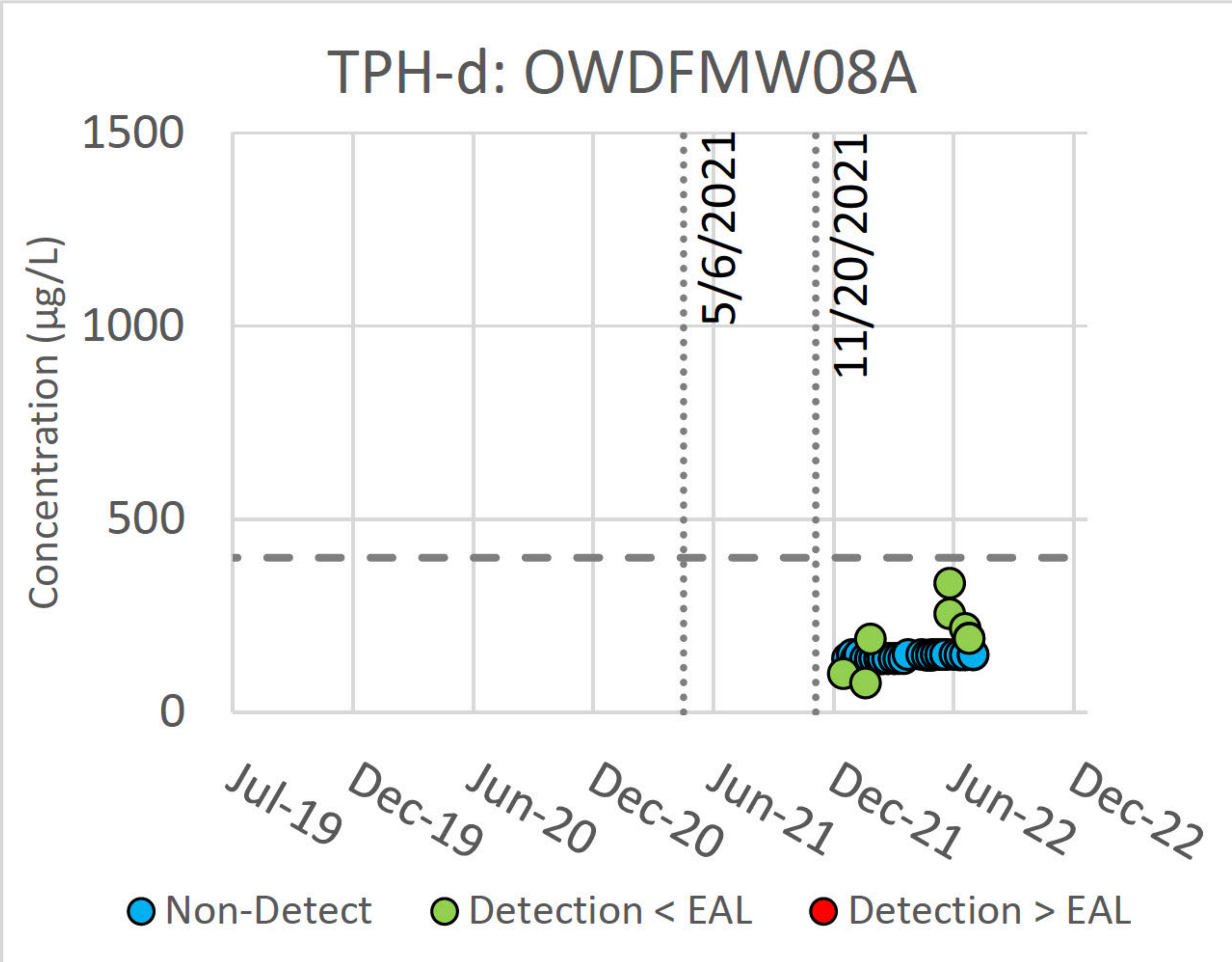

TPH-d: OWDFMW05A
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL


TPH-o: OWDFMW05A
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

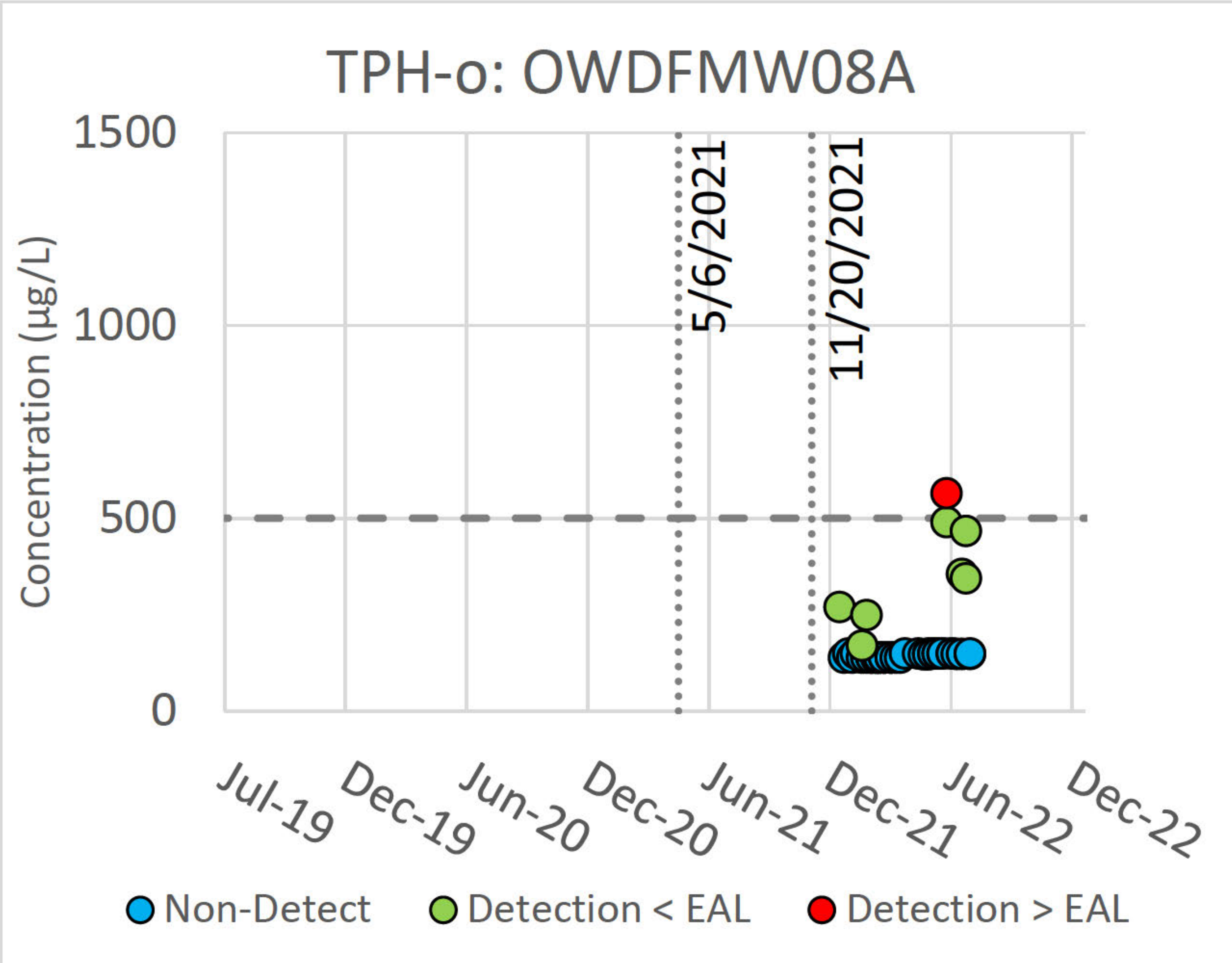


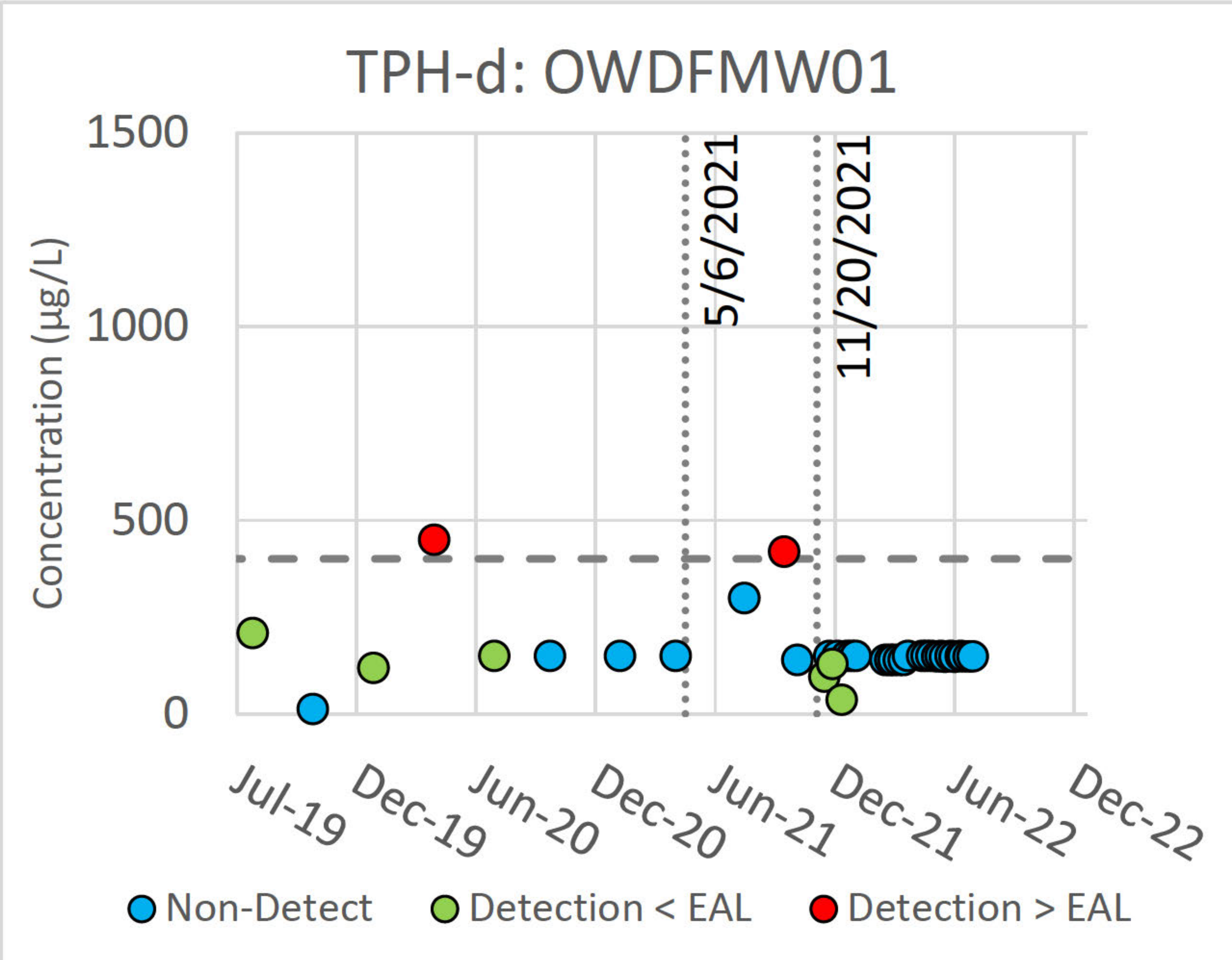
TPH-d: OWDFMW07A
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

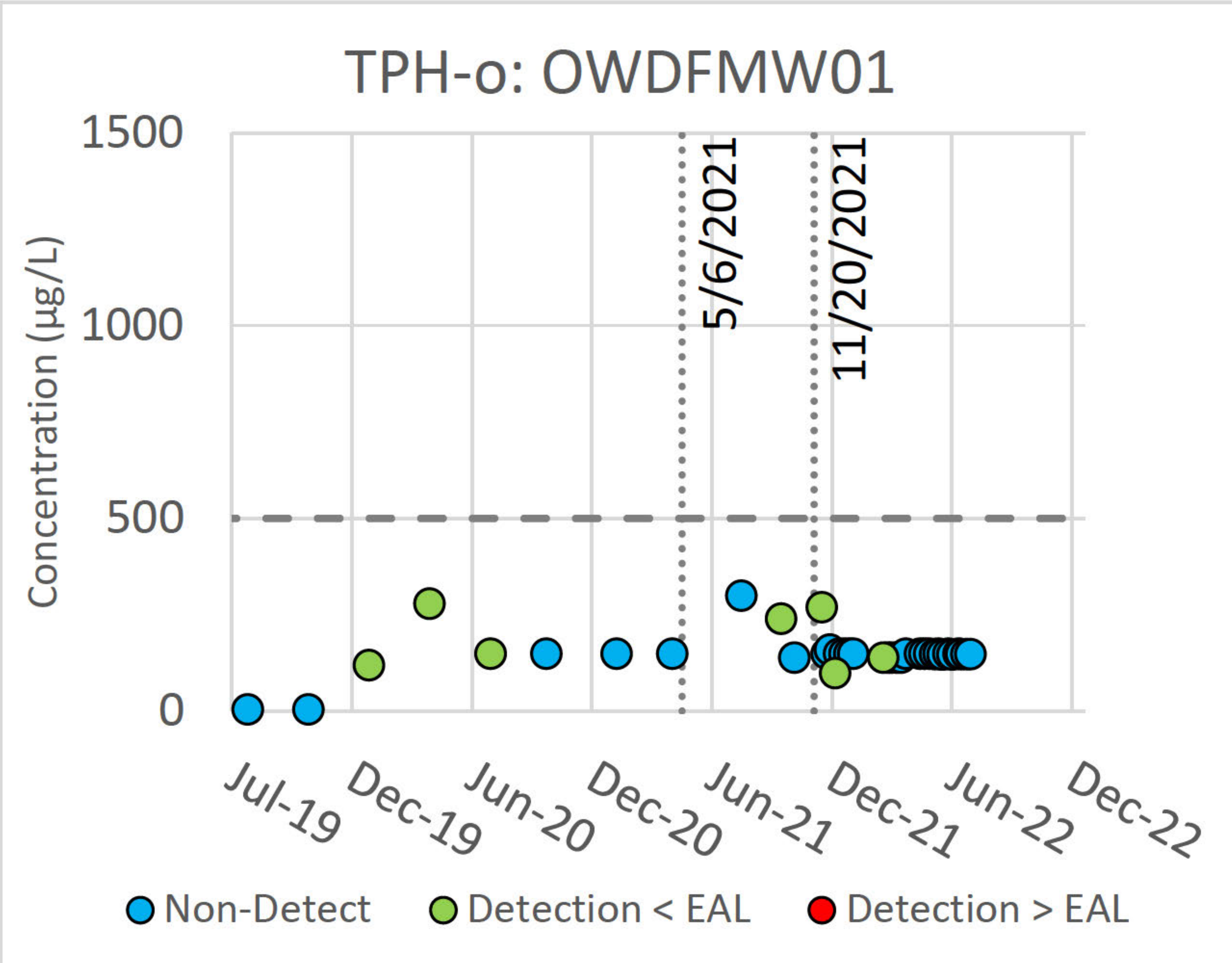

TPH-o: OWDFMW07A
1500
1000
500
0
Concentration (µg/L)
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

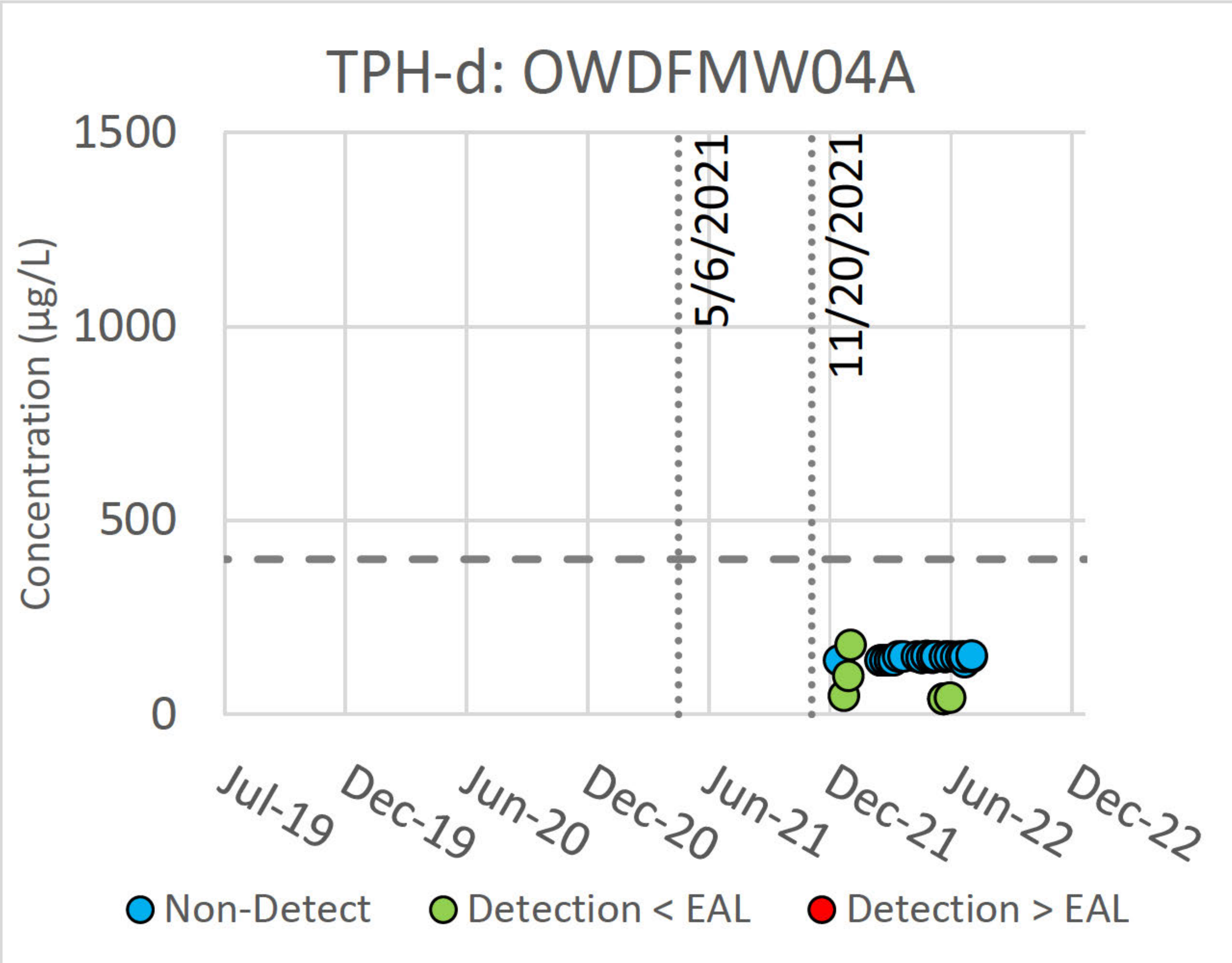


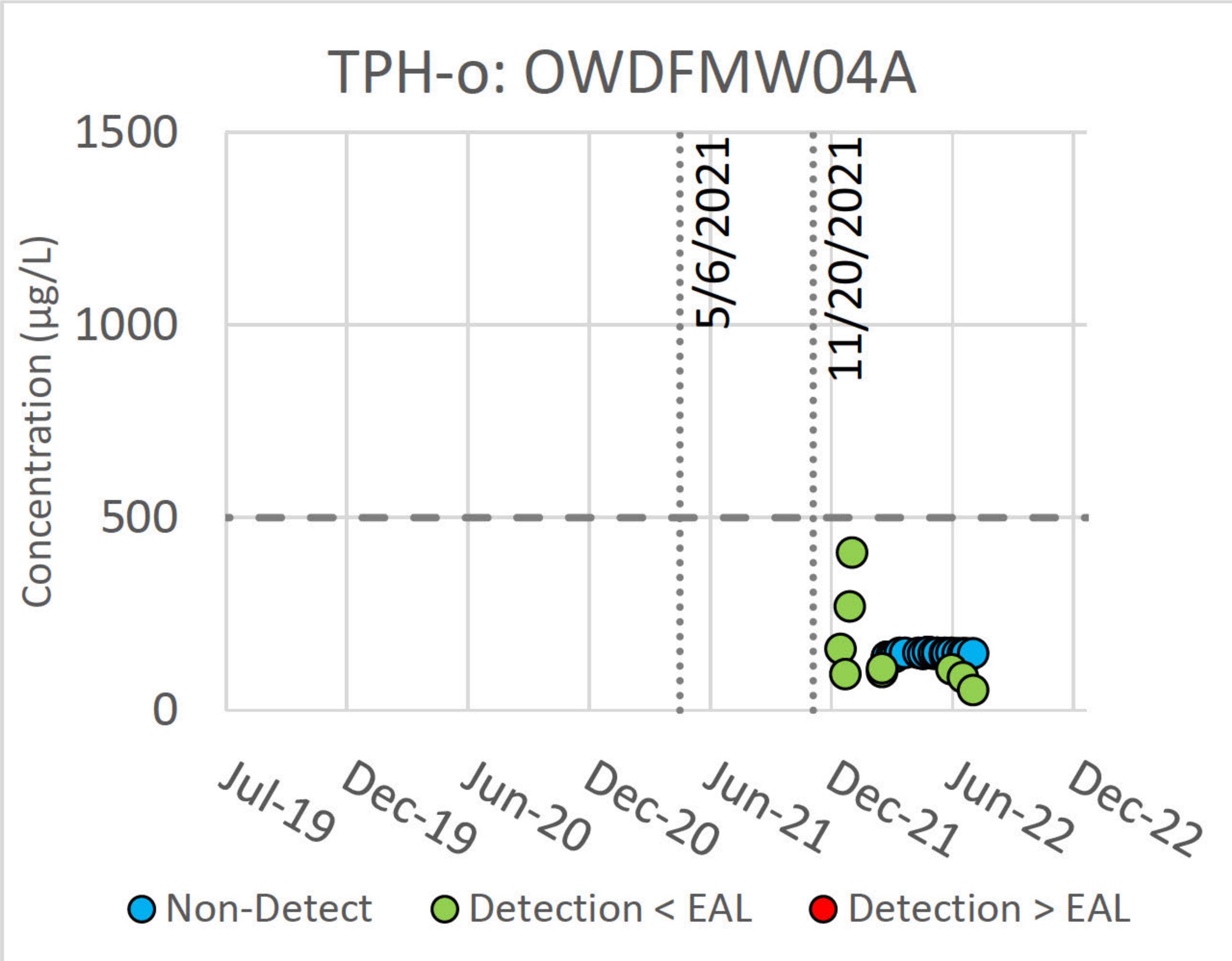
TPH-d: OWDFMW08A
1500
1000
500
0
Concentration (µg/L)
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

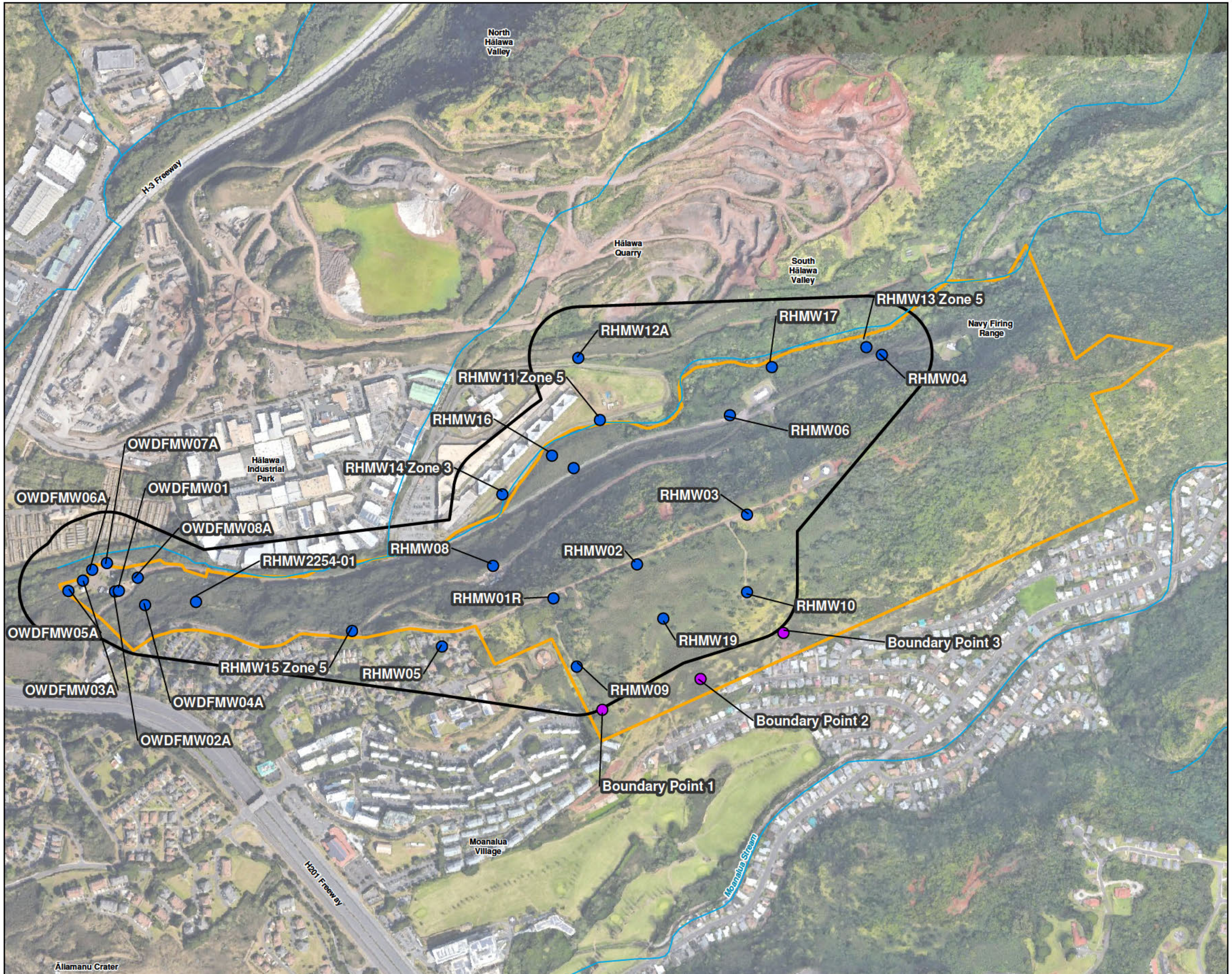

TPH-o: OWDFMW08A
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL


TPH-d: OWDFMW01
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL

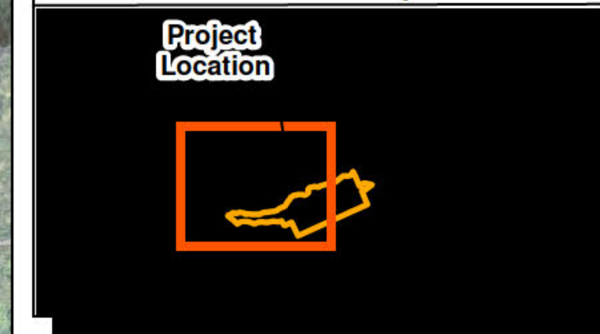

TPH-o: OWDFMW01
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL


TPH-d: OWDFMW04A
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL


TPH-o: OWDFMW04A
Concentration (µg/L)
1500
1000
500
0
5/6/2021
11/20/2021
Jul-19
Dec-19
Jun-20
Dec-20
Jun-21
Dec-21
Jun-22
Dec-22
Non-Detect
Detection < EAL
Detection > EAL



Location Map



Legend

- Monitoring Wells
- Boundary Points
- Interpolation Boundary
- Red Hill Installation Boundary
- Stream

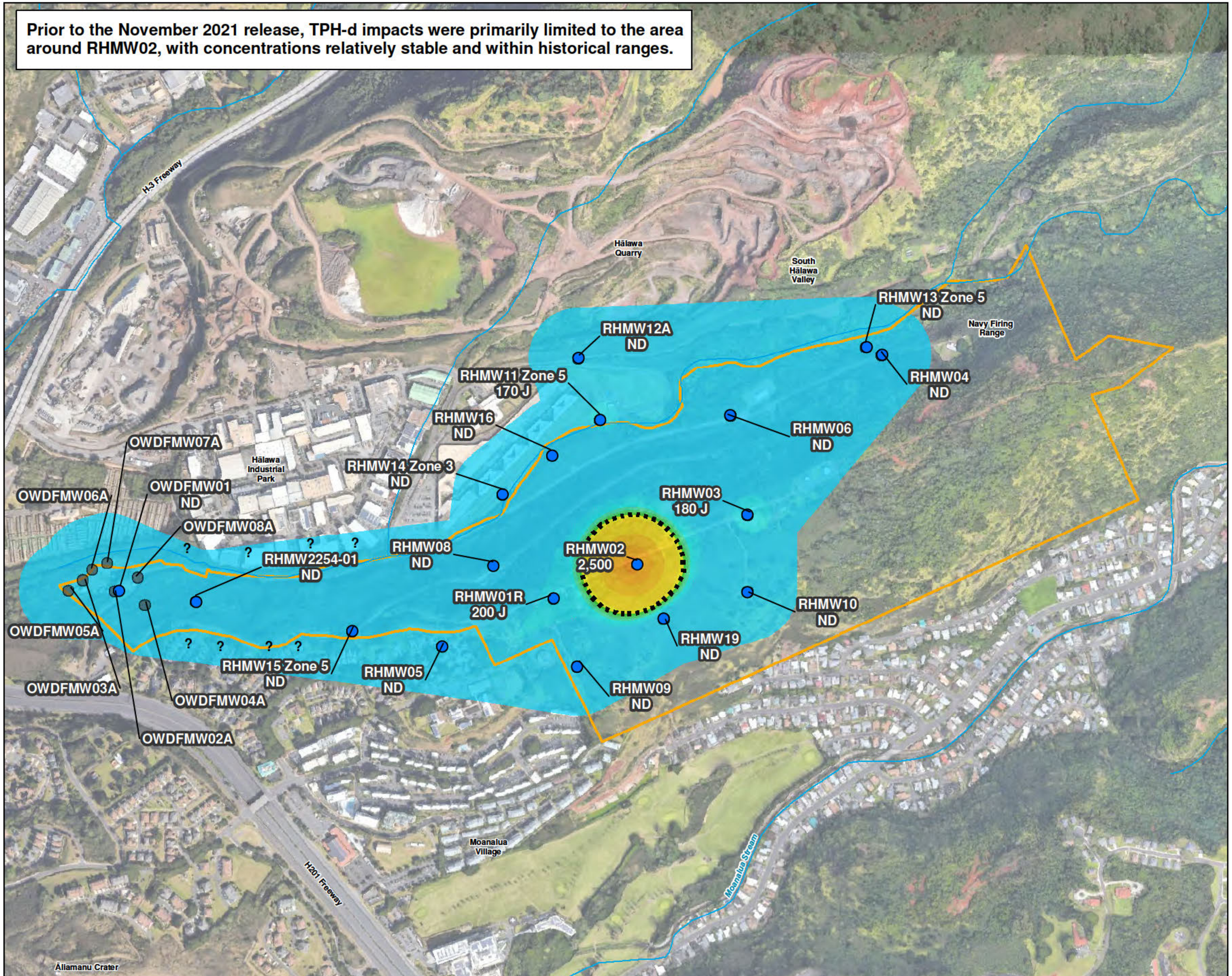
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

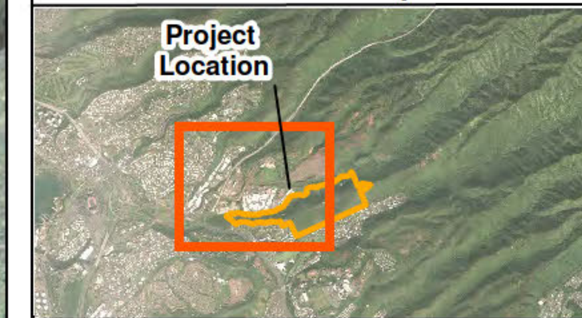
N

Feet
0 250 500 1,000

Interpolation Details
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Wells sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

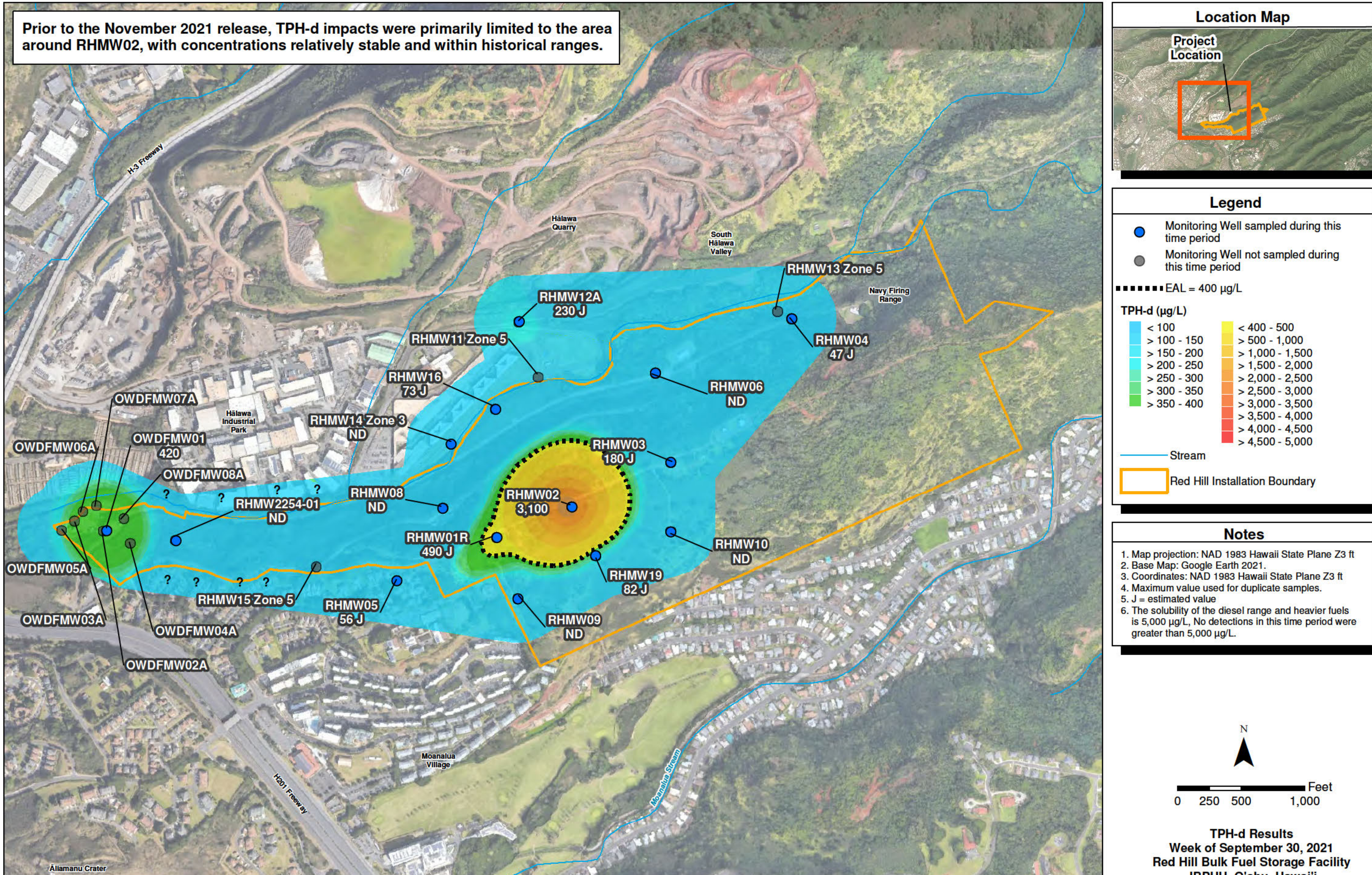
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L. No detections in this time period were greater than 5,000 µg/L.

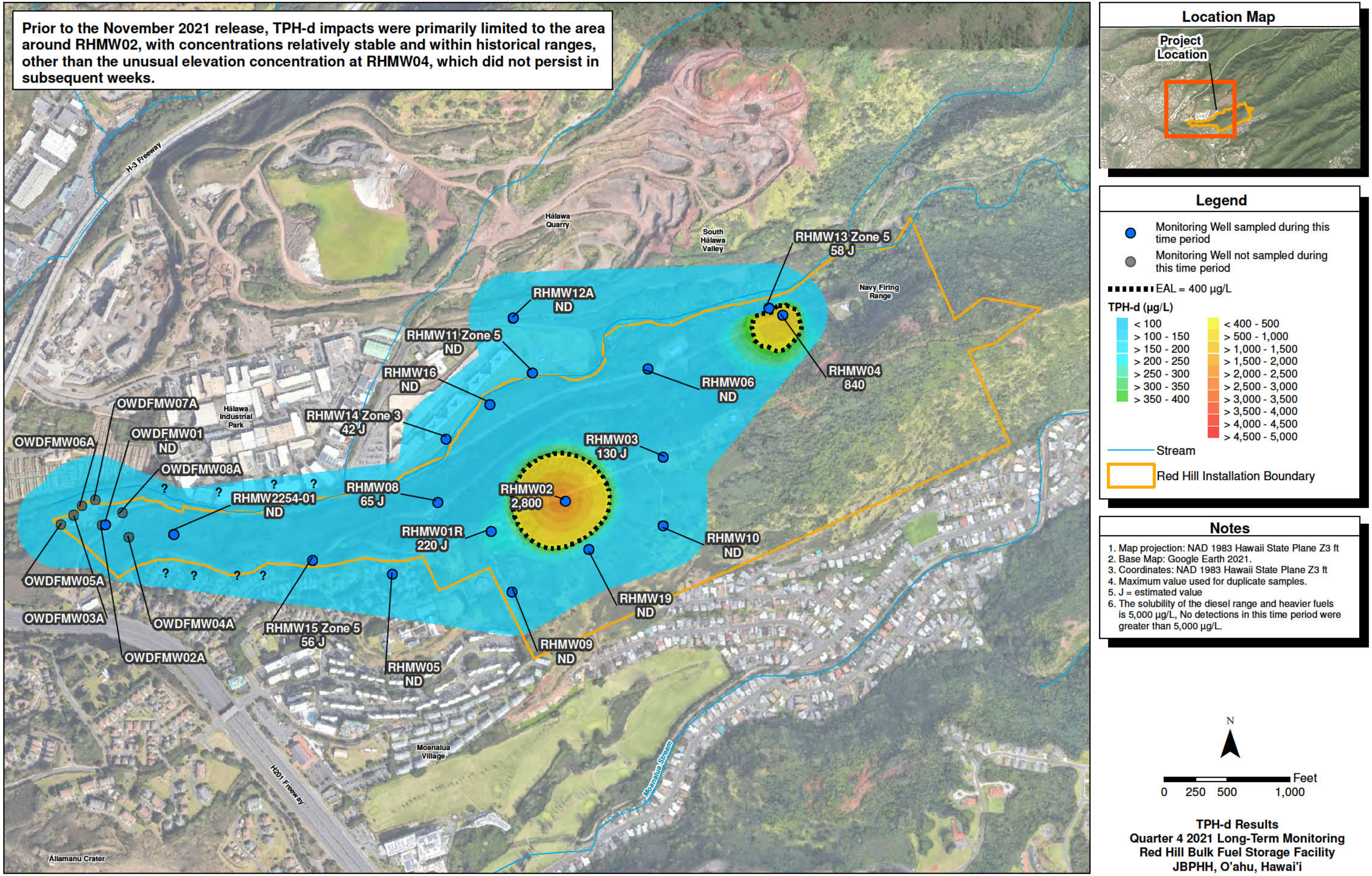
N

Feet 0 250 500 1,000

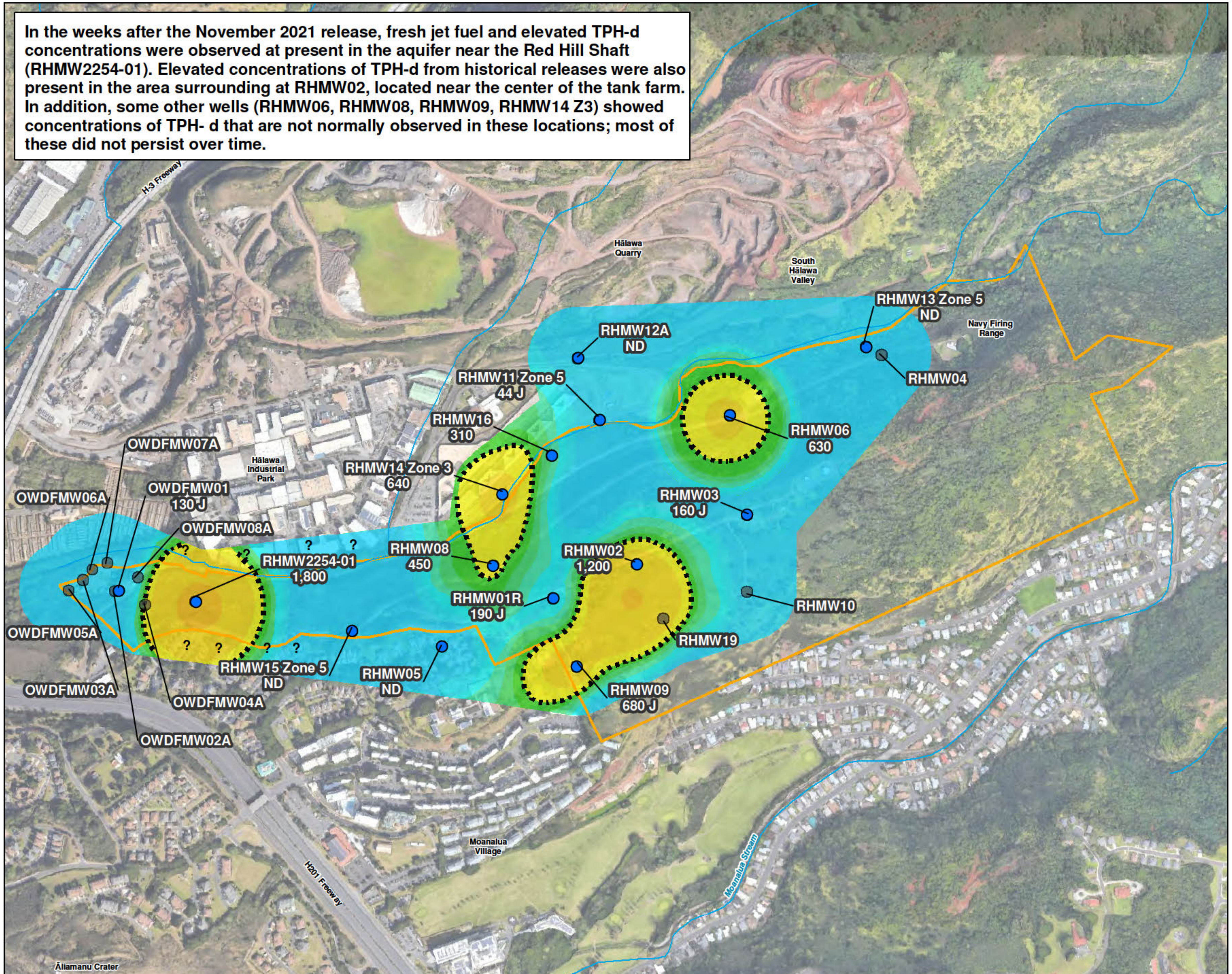
TPH-d Results
Quarter 3 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



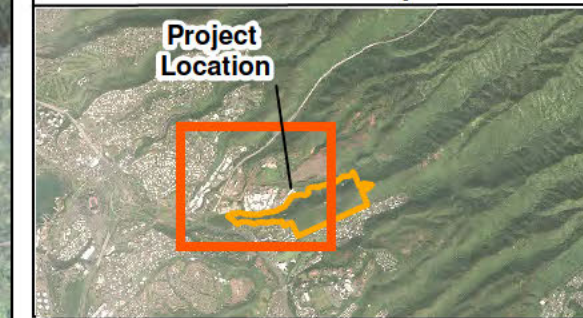
TPH-d Results
Week of September 30, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-d Results
Quarter 4 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

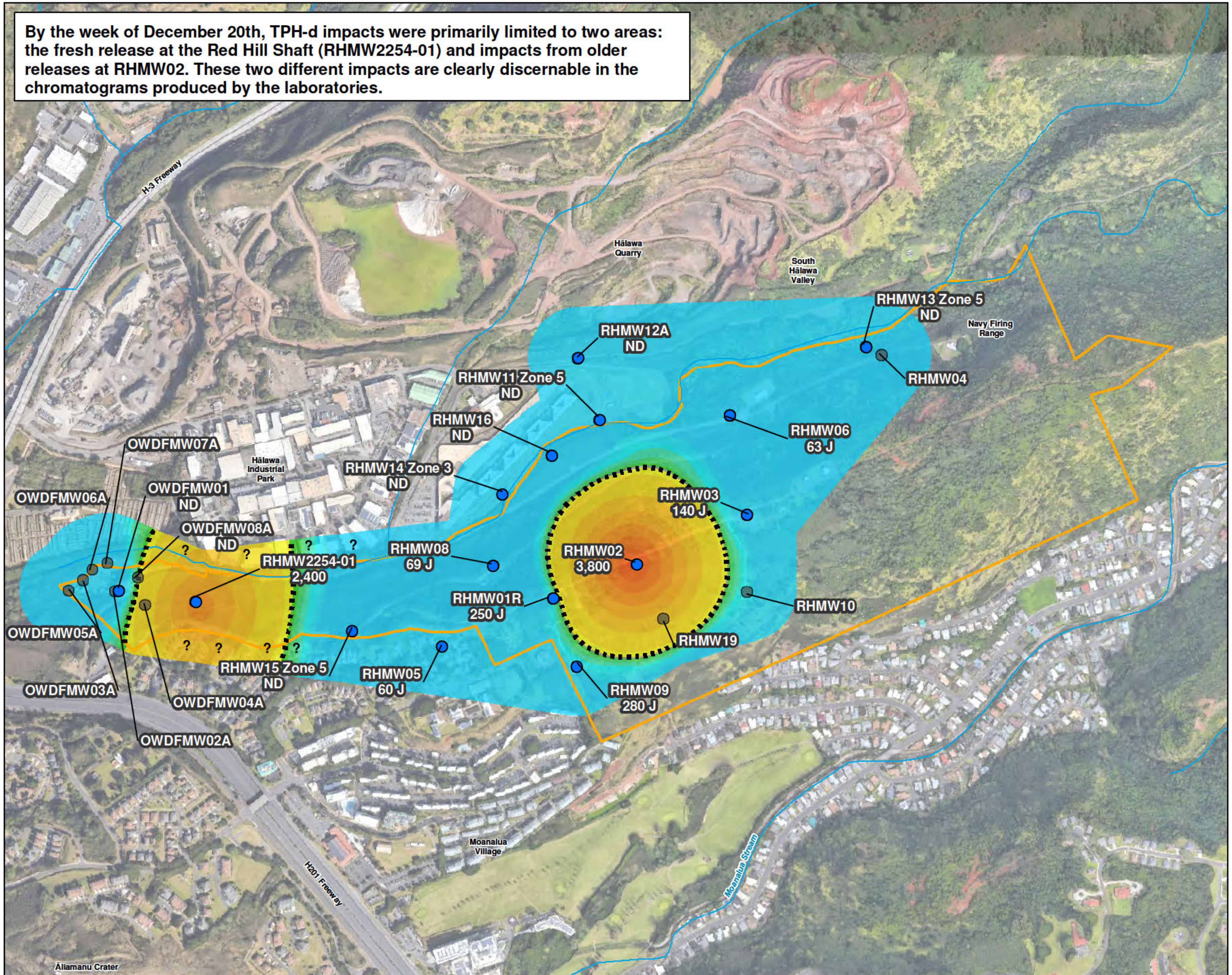
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

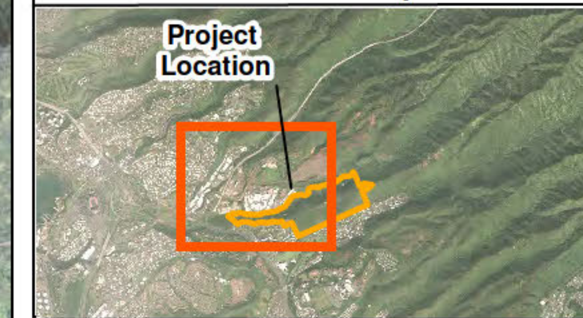
N

0 250 500 1,000 Feet

TPH-d Results
Week of December 13, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

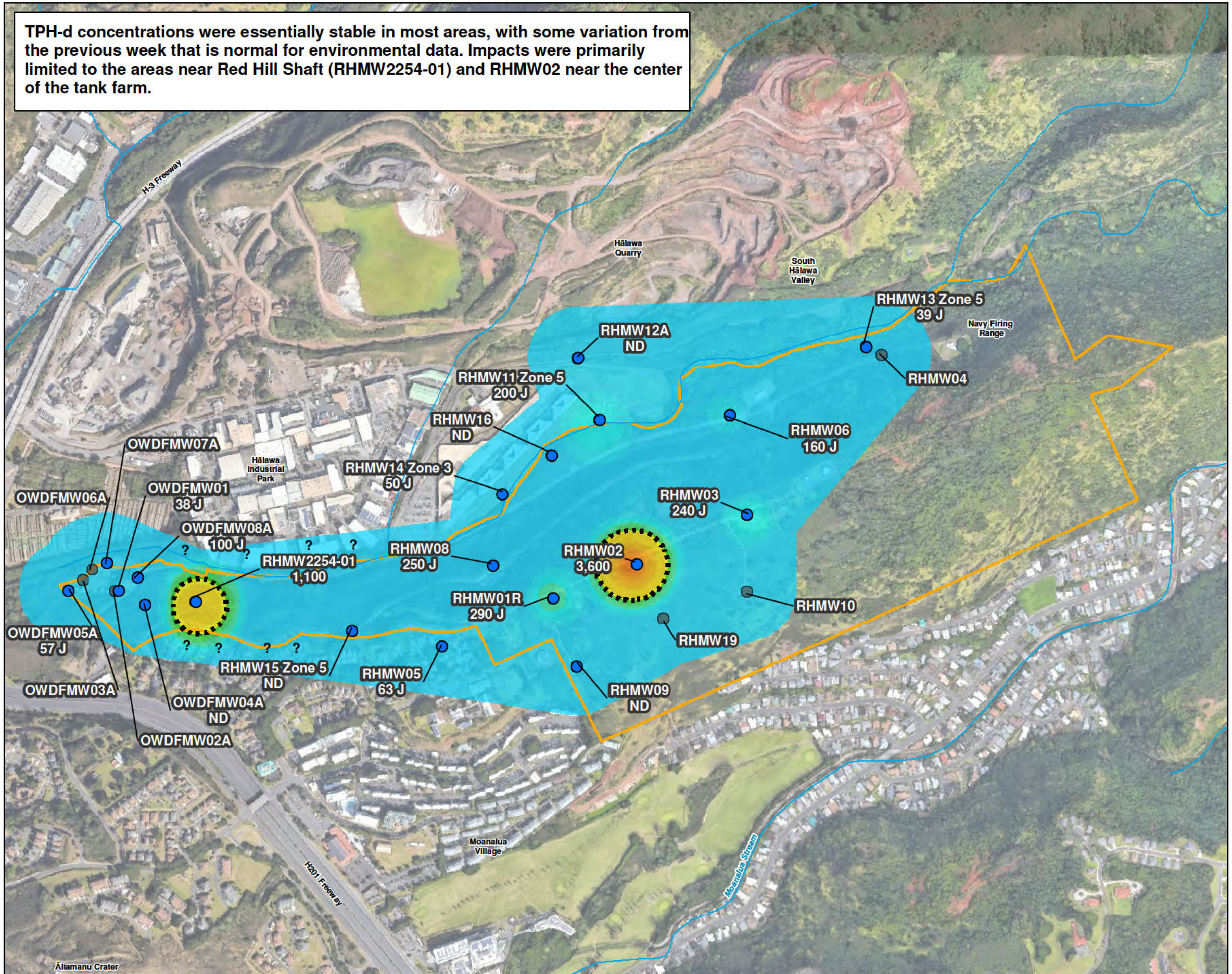
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

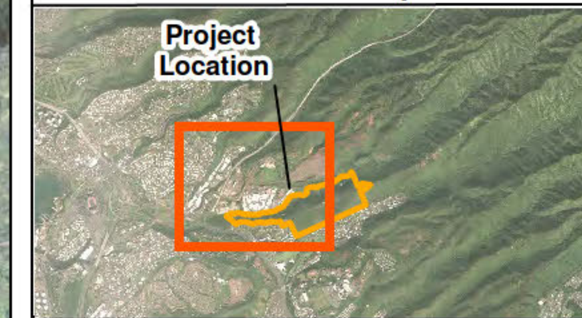
N

Feet
0 250 500 1,000

TPH-d Results
Week of December 20, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- < 400 - 500
- > 500 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

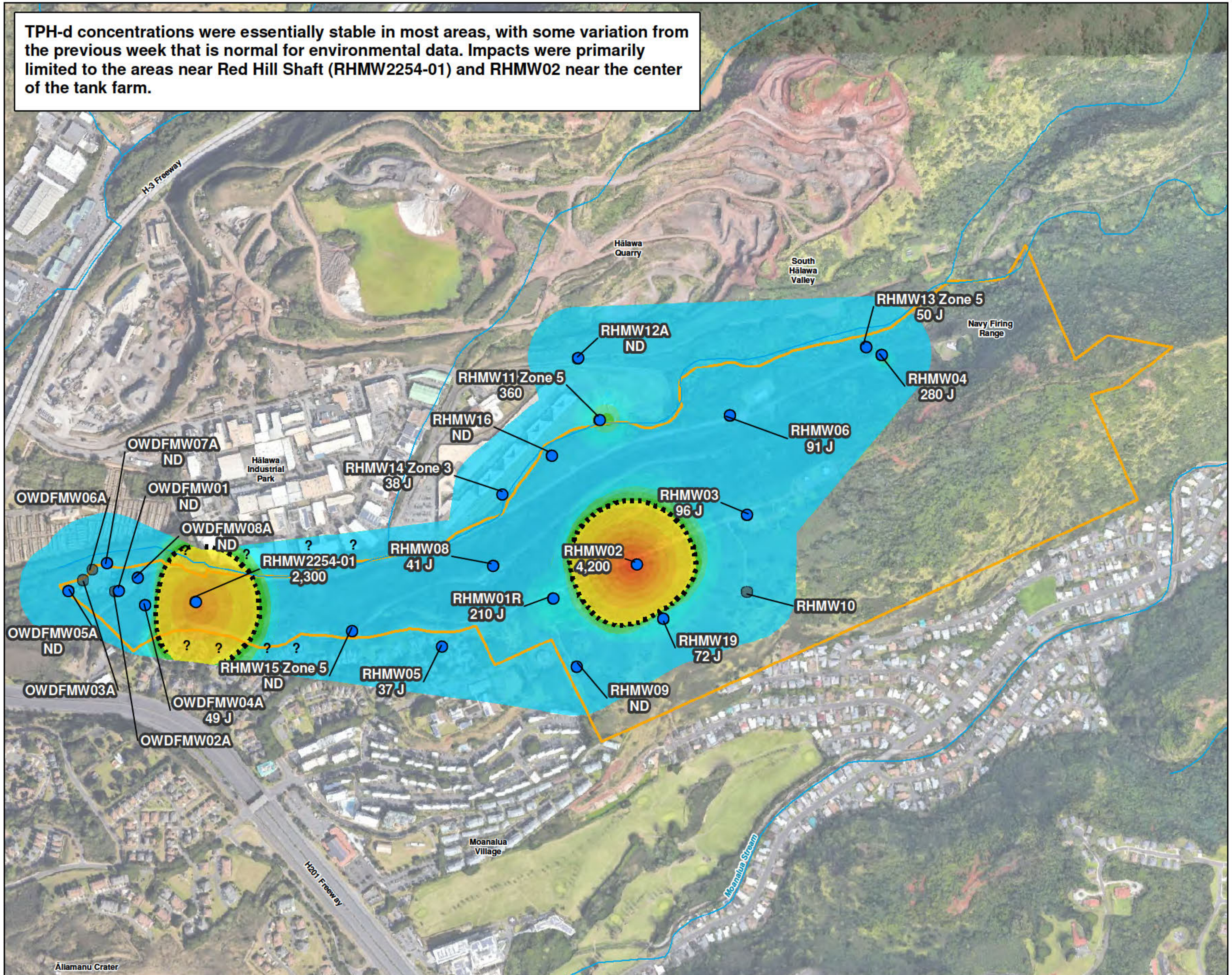
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

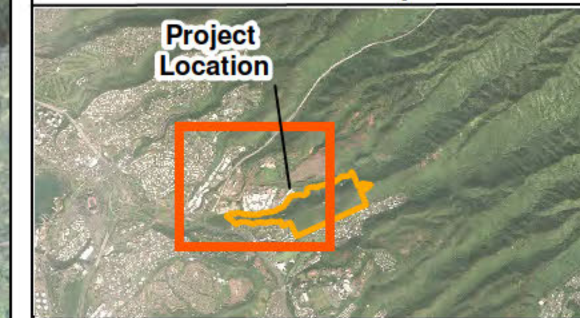
N

Feet
0 250 500 1,000

TPH-d Results
Week of December 27, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- < 400 - 500
- > 500 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

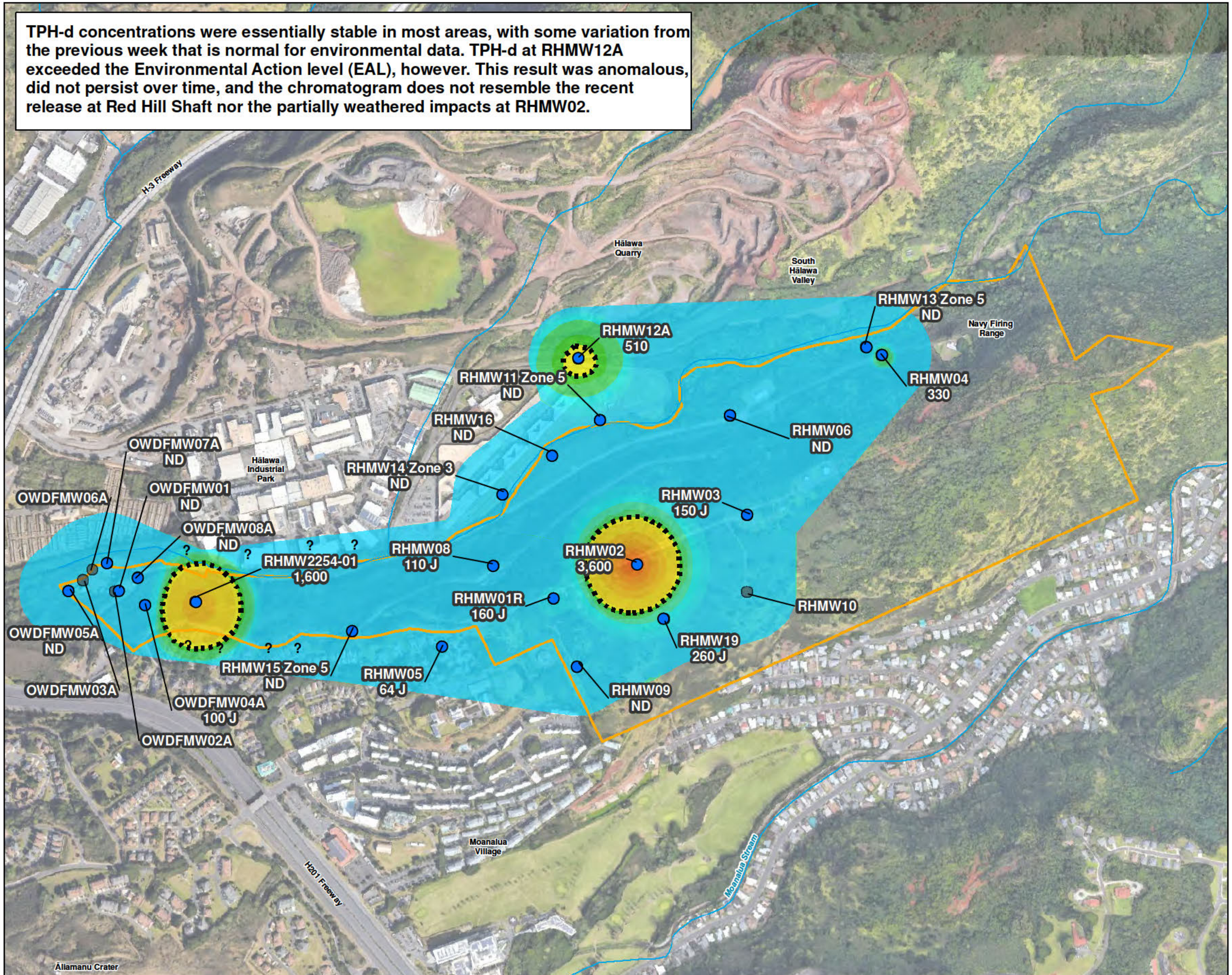
Stream

Red Hill Installation Boundary

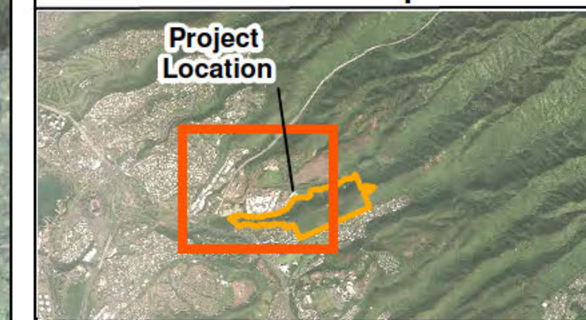
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

TPH-d Results
Week of January 3, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- < 400 - 500
- > 500 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

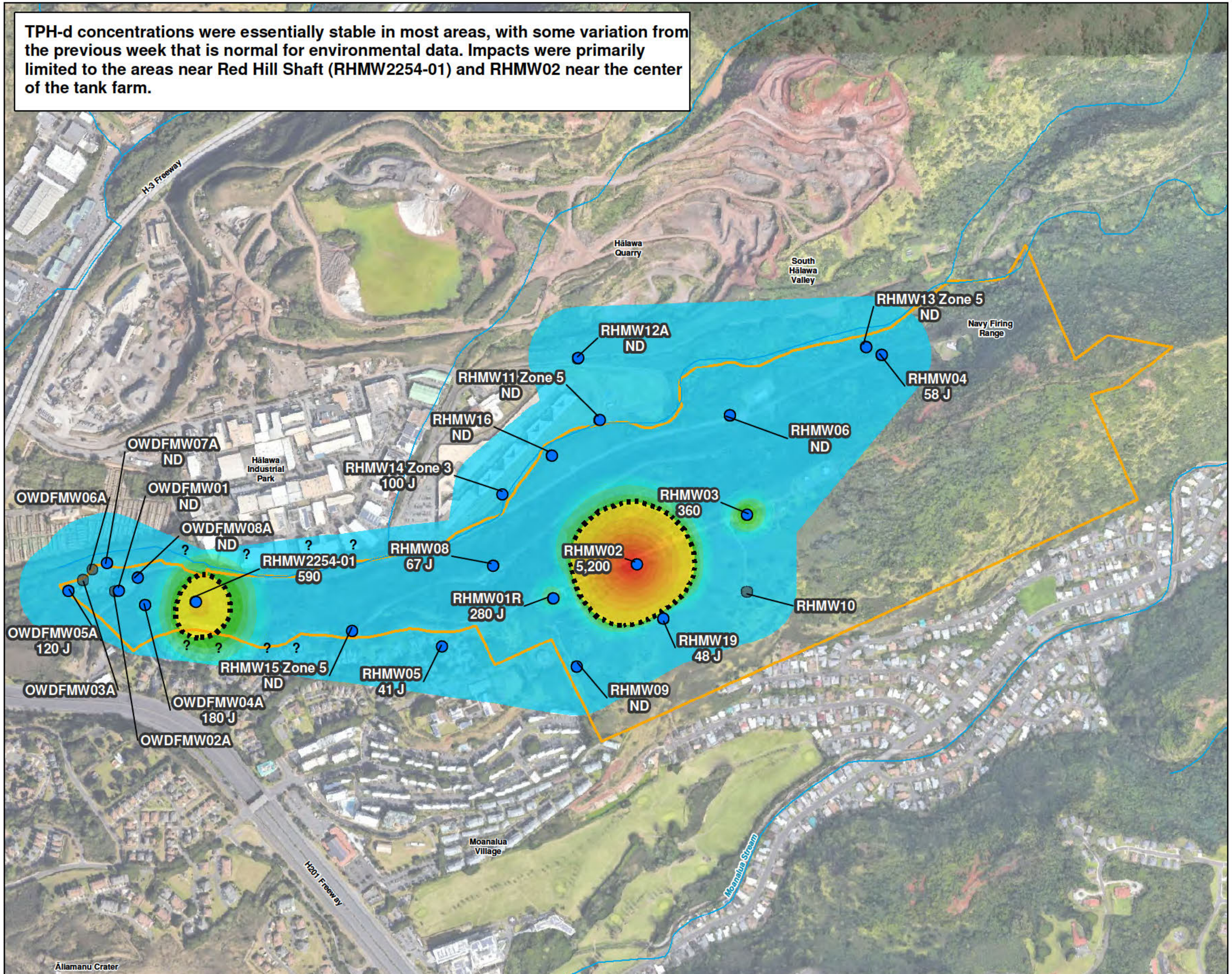
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

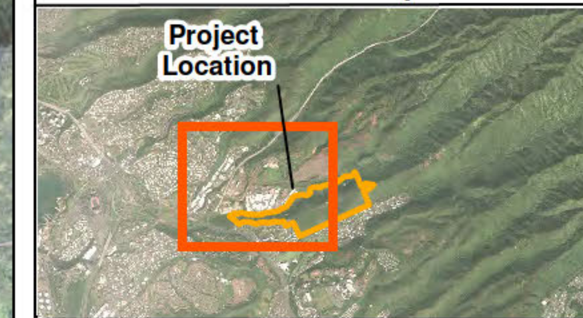
N

Feet
0 250 500 1,000

TPH-d Results
Week of January 10, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

Notes

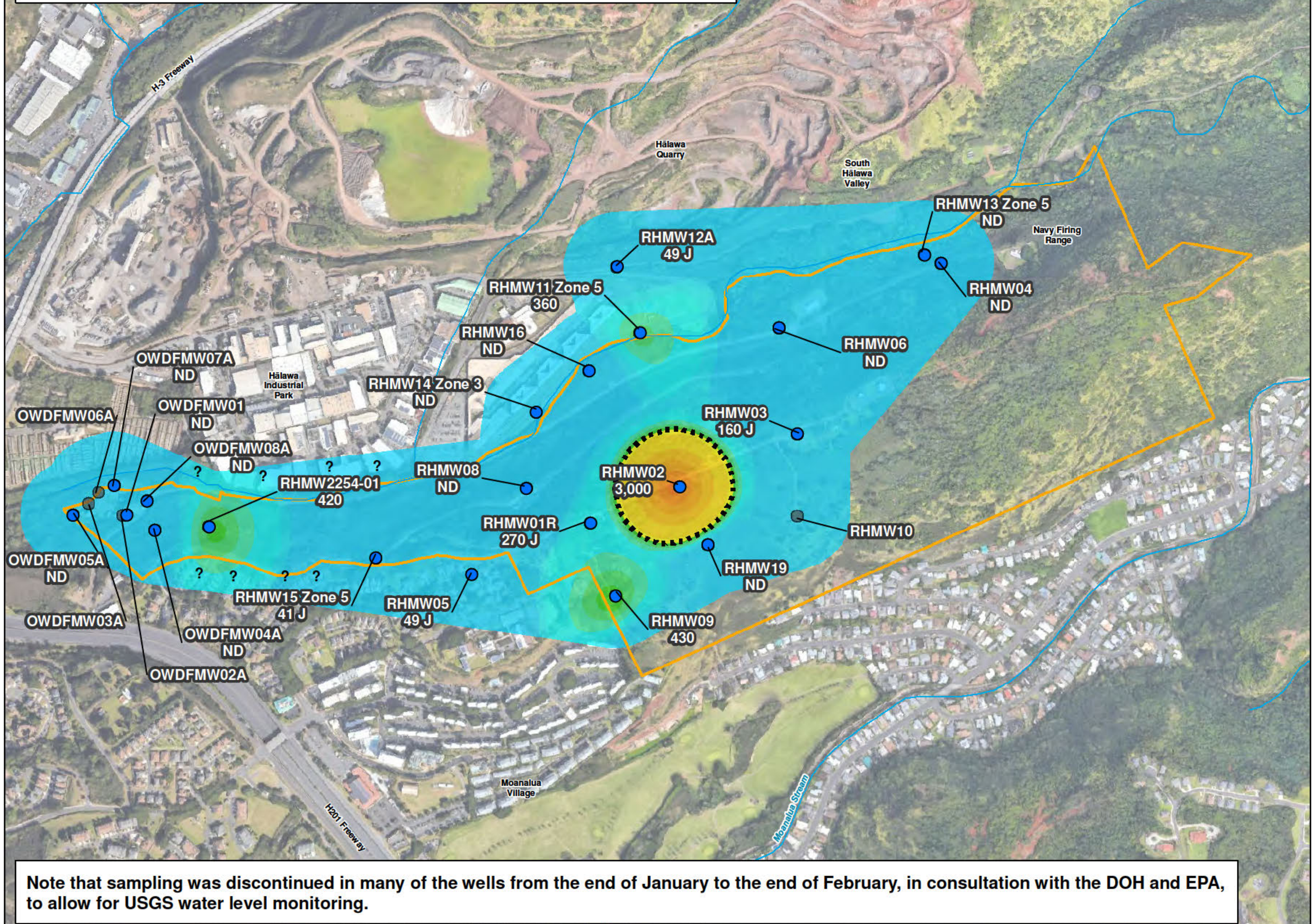
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

N

Feet: 0 250 500 1,000

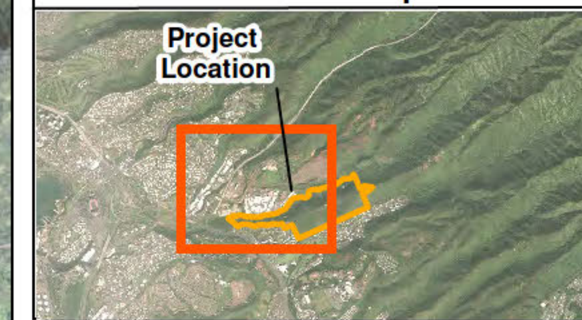
TPH-d Results
Week of January 17, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

TPH-d concentrations were essentially stable, with impacts primarily limited to the areas near Red Hill Shaft (RHMW2254-01) and RHMW02. Note that after more than a month of pumping and treatment at Red Hill Shaft, which began on January 29, 2022. TPH-d concentrations dropped significantly.



Note that sampling was discontinued in many of the wells from the end of January to the end of February, in consultation with the DOH and EPA, to allow for USGS water level monitoring.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

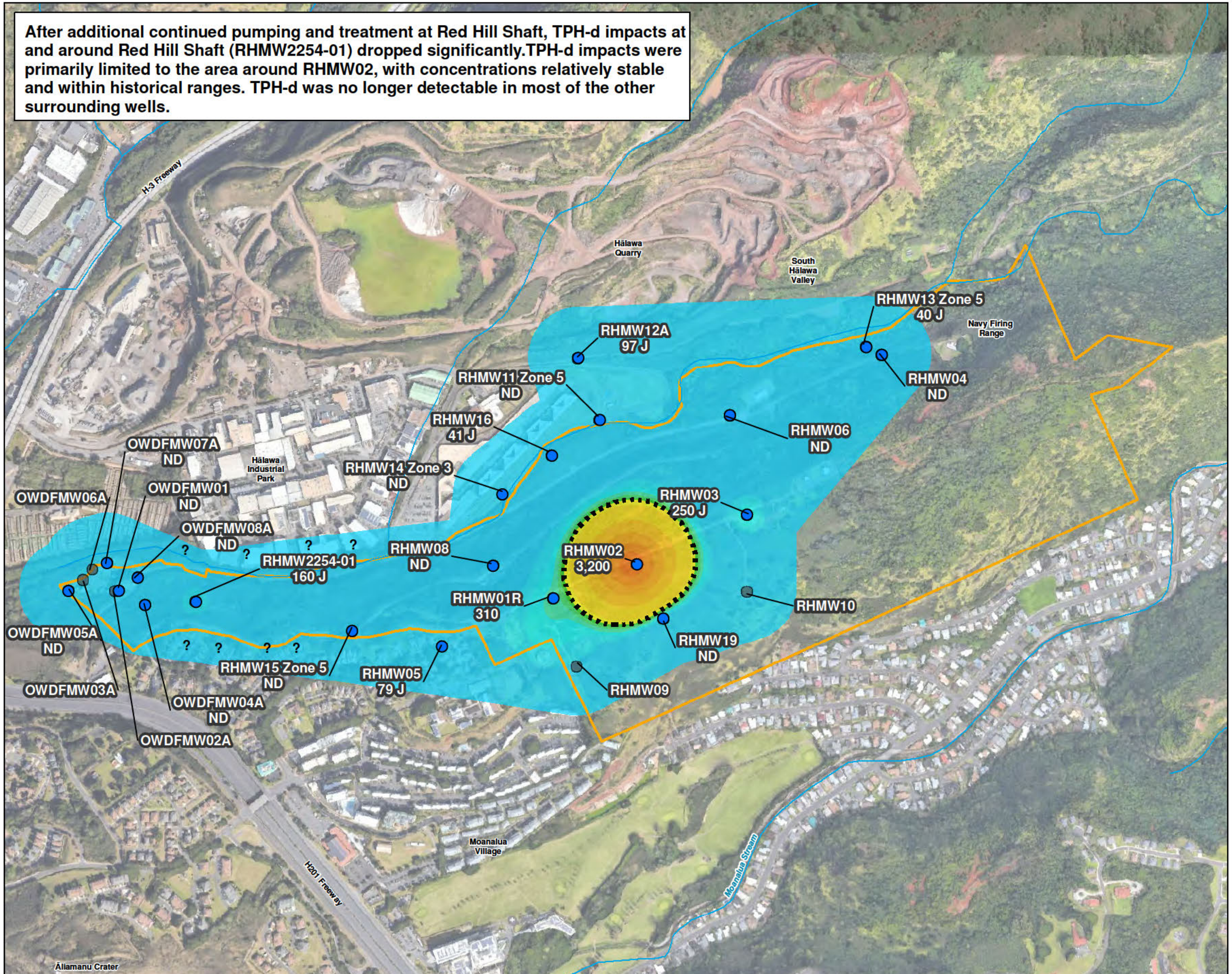
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

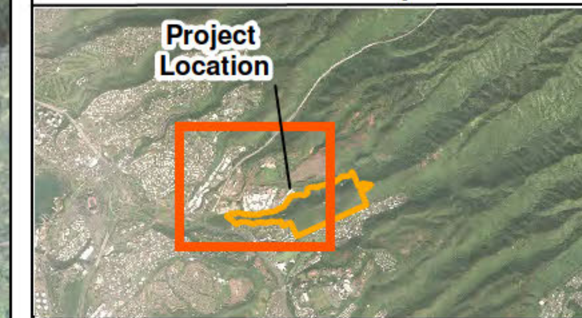
N

Feet
0 250 500 1,000

TPH-d Results
Week of February 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

Stream

Red Hill Installation Boundary

Notes

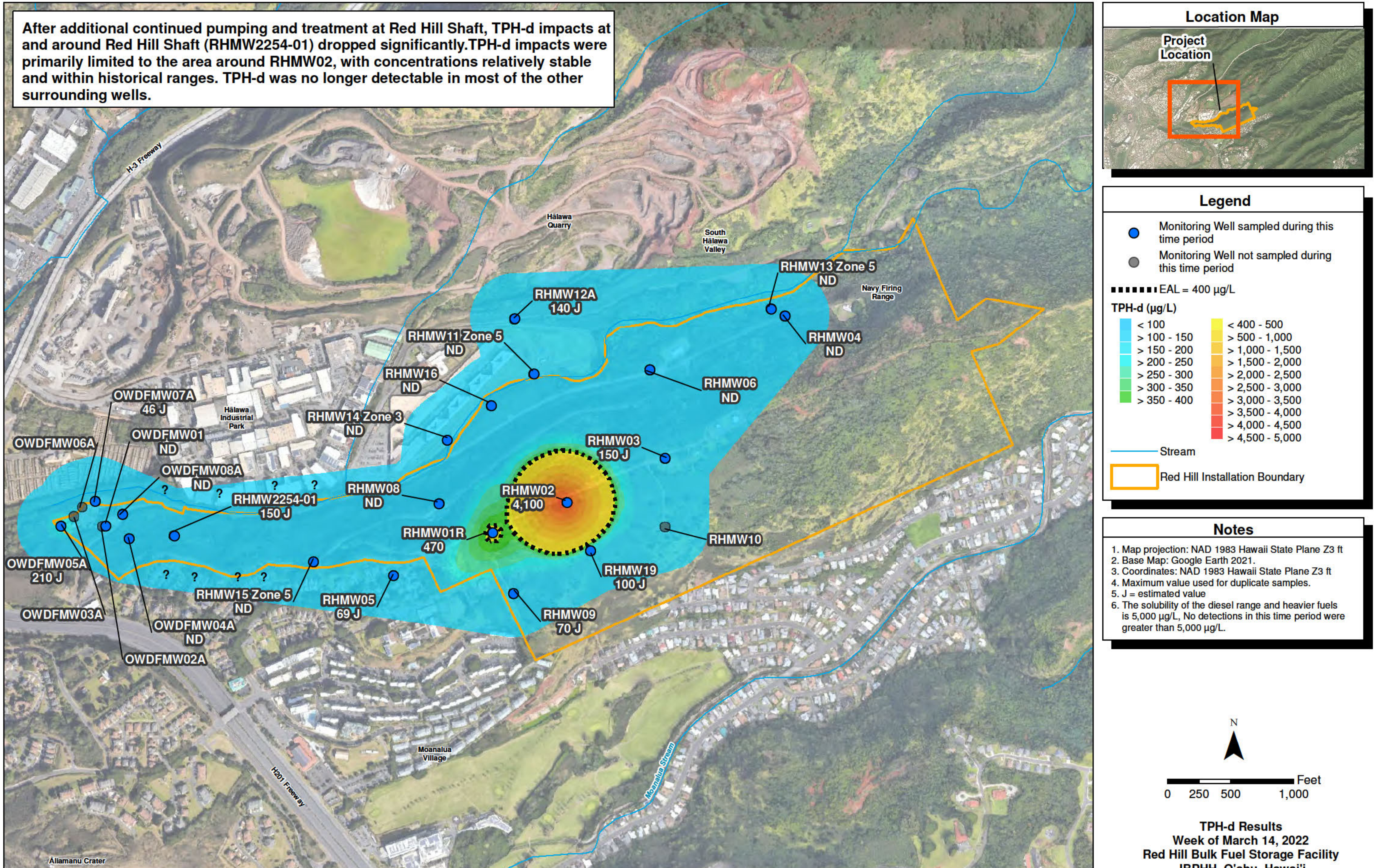
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

N

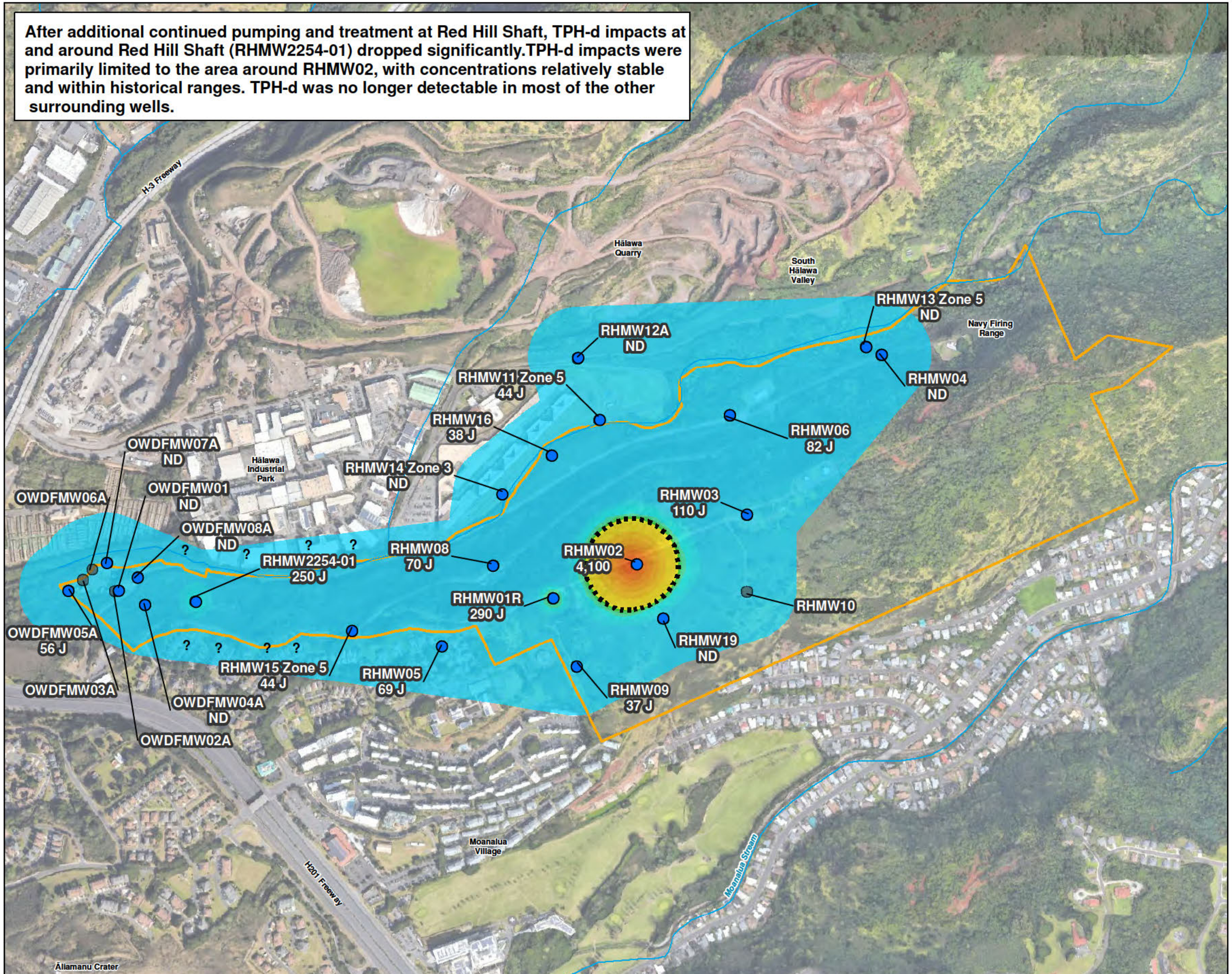
Feet

0 250 500 1,000

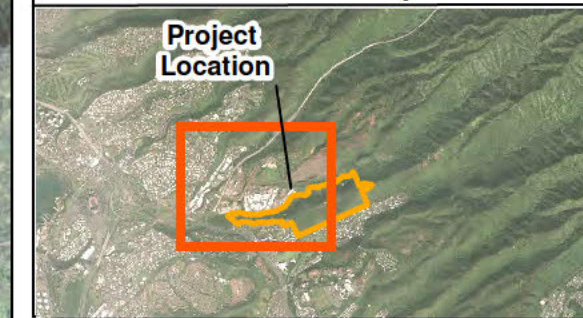
TPH-d Results
Week of March 7, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-d Results
Week of March 14, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- < 400 - 500
- > 500 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

Stream

Red Hill Installation Boundary

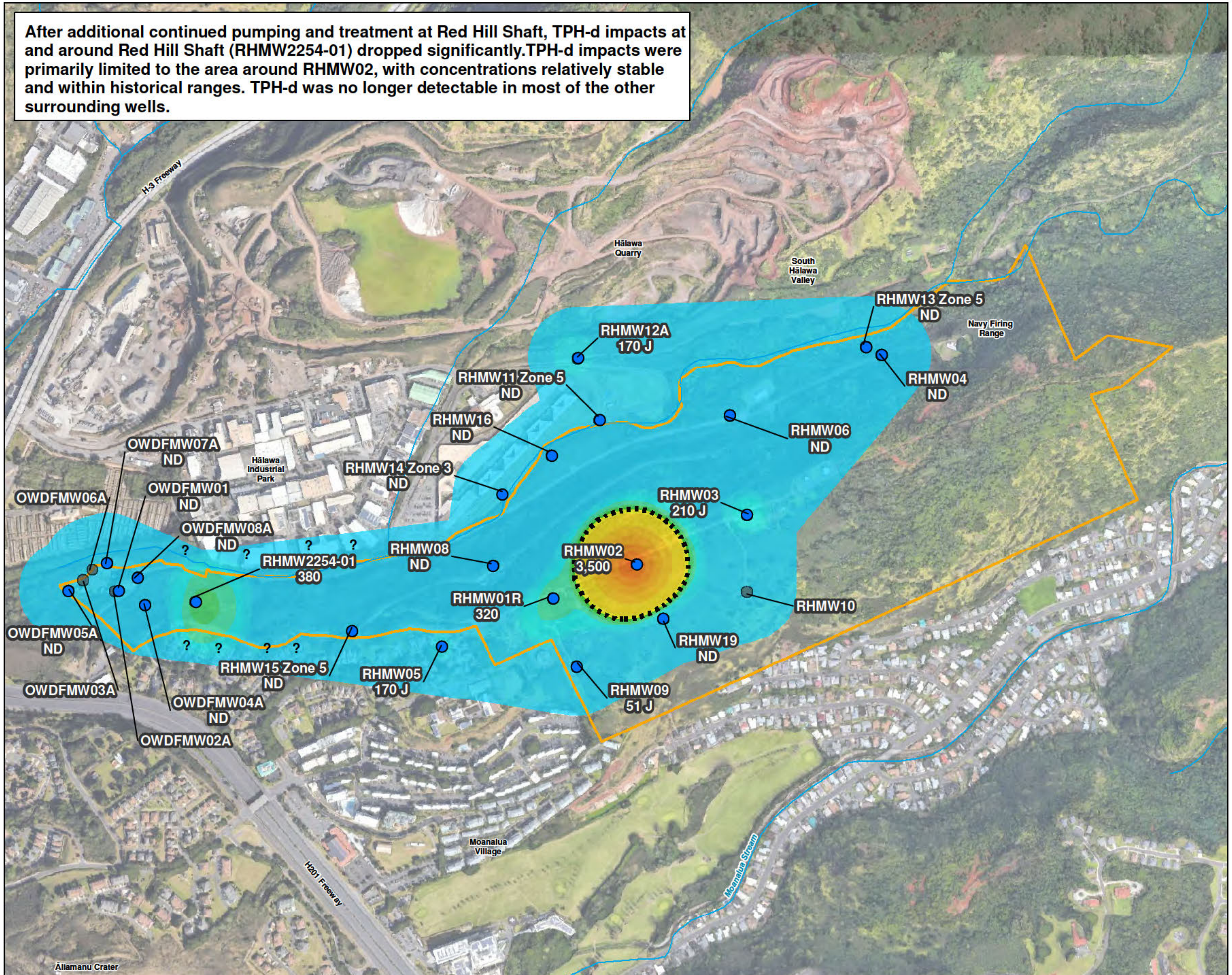
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

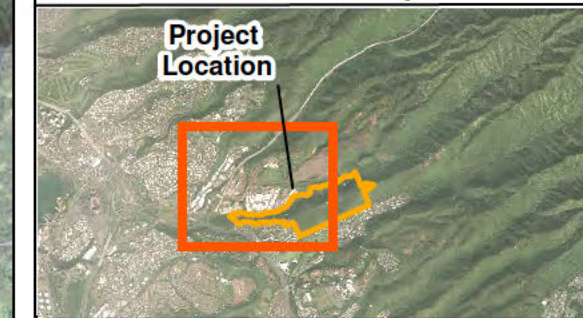
N

Feet
0 250 500 1,000

TPH-d Results
Week of March 21, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

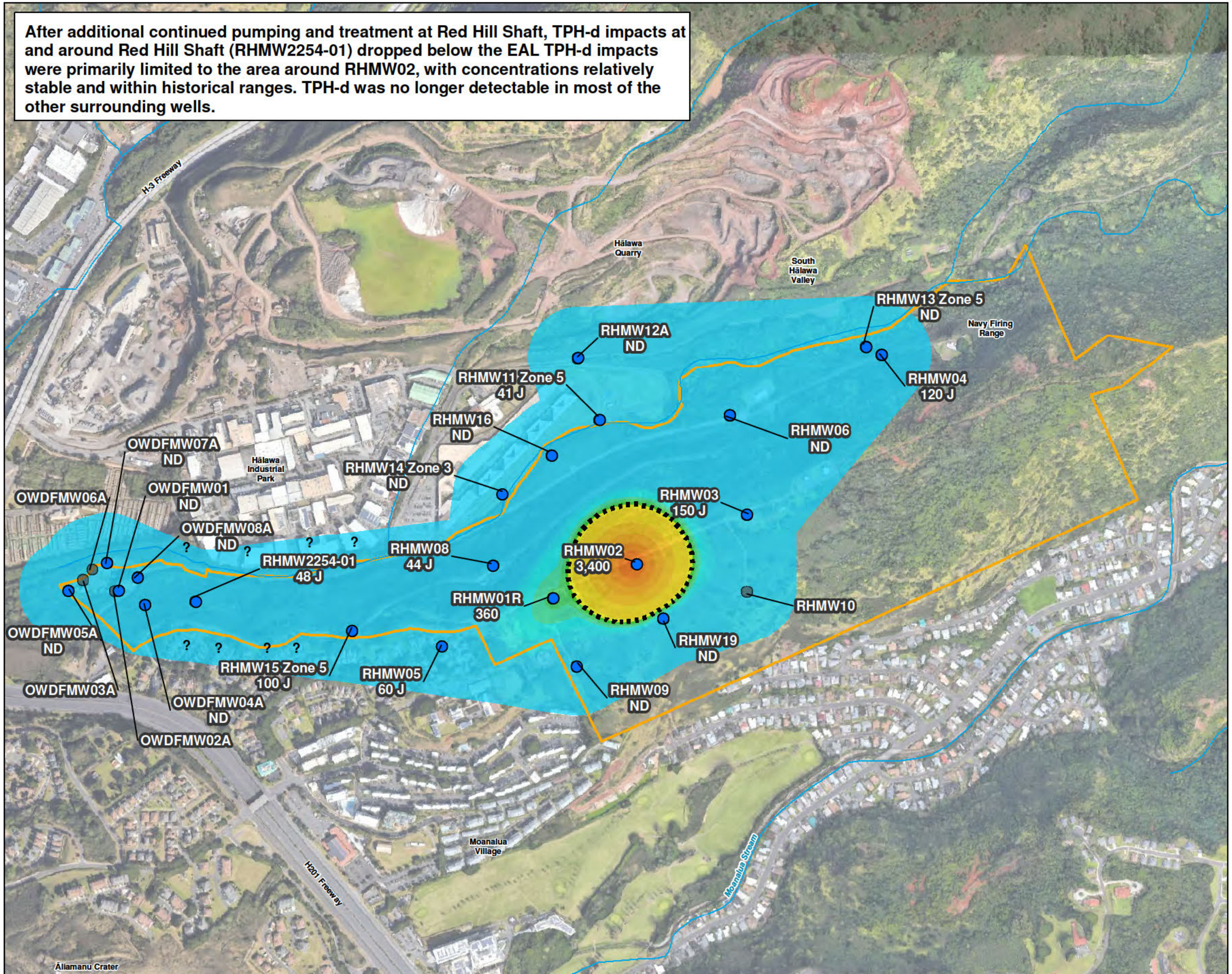
< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

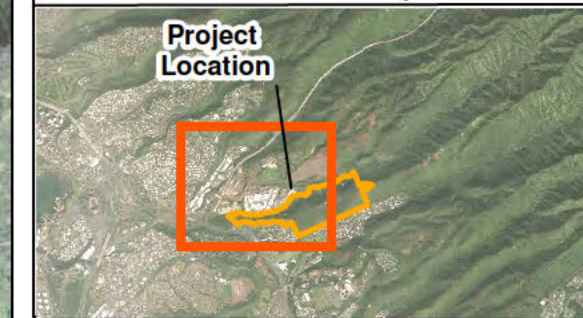
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

TPH-d Results
Week of March 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

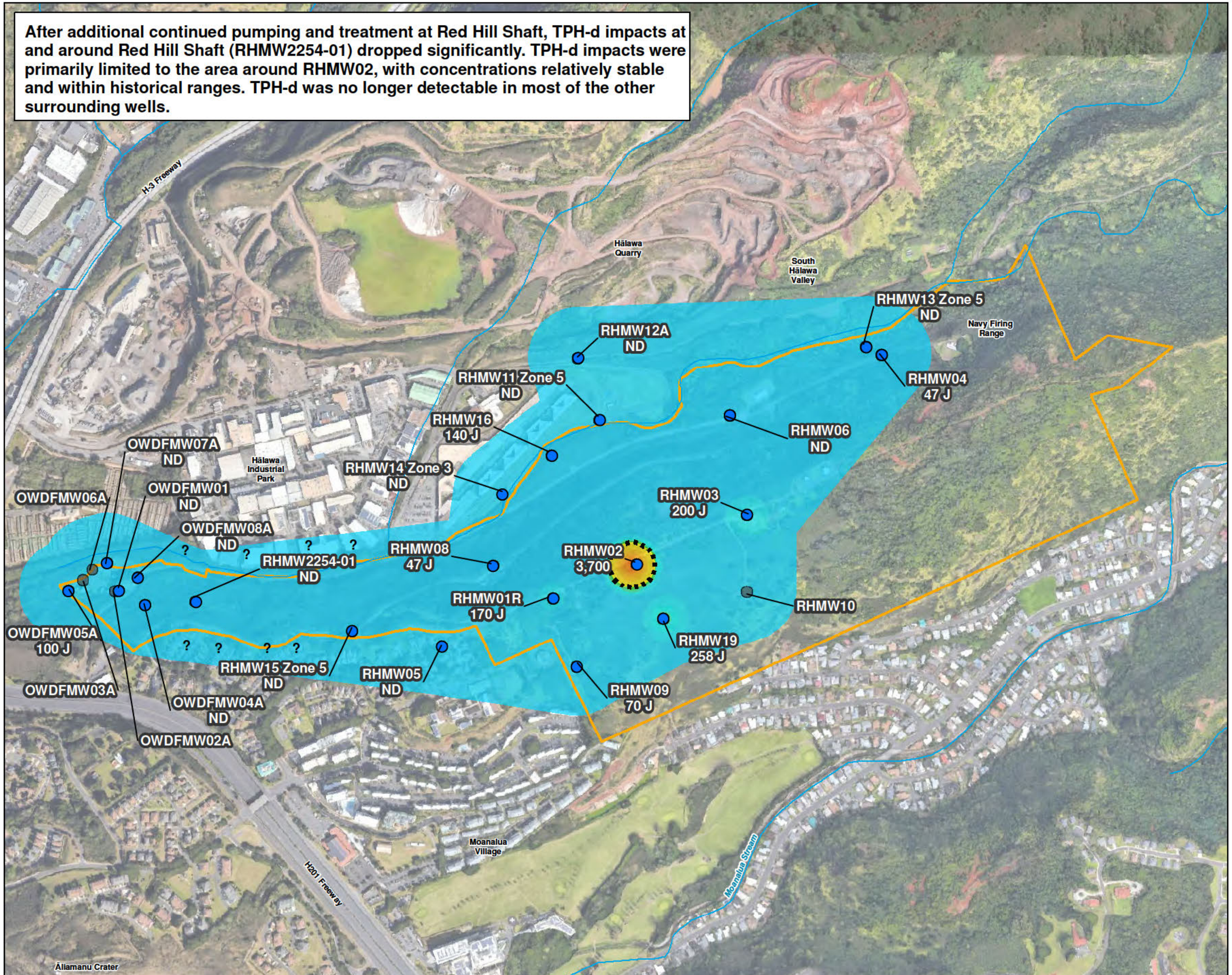
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

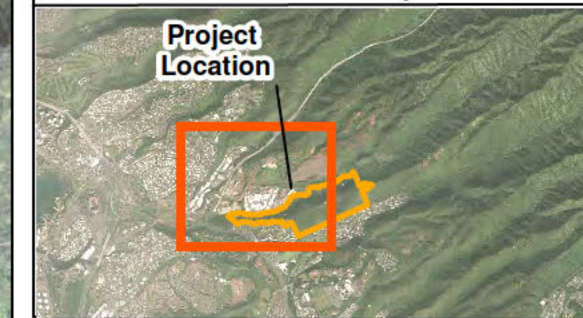
N

0 250 500 1,000 Feet

TPH-d Results
Week of April 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

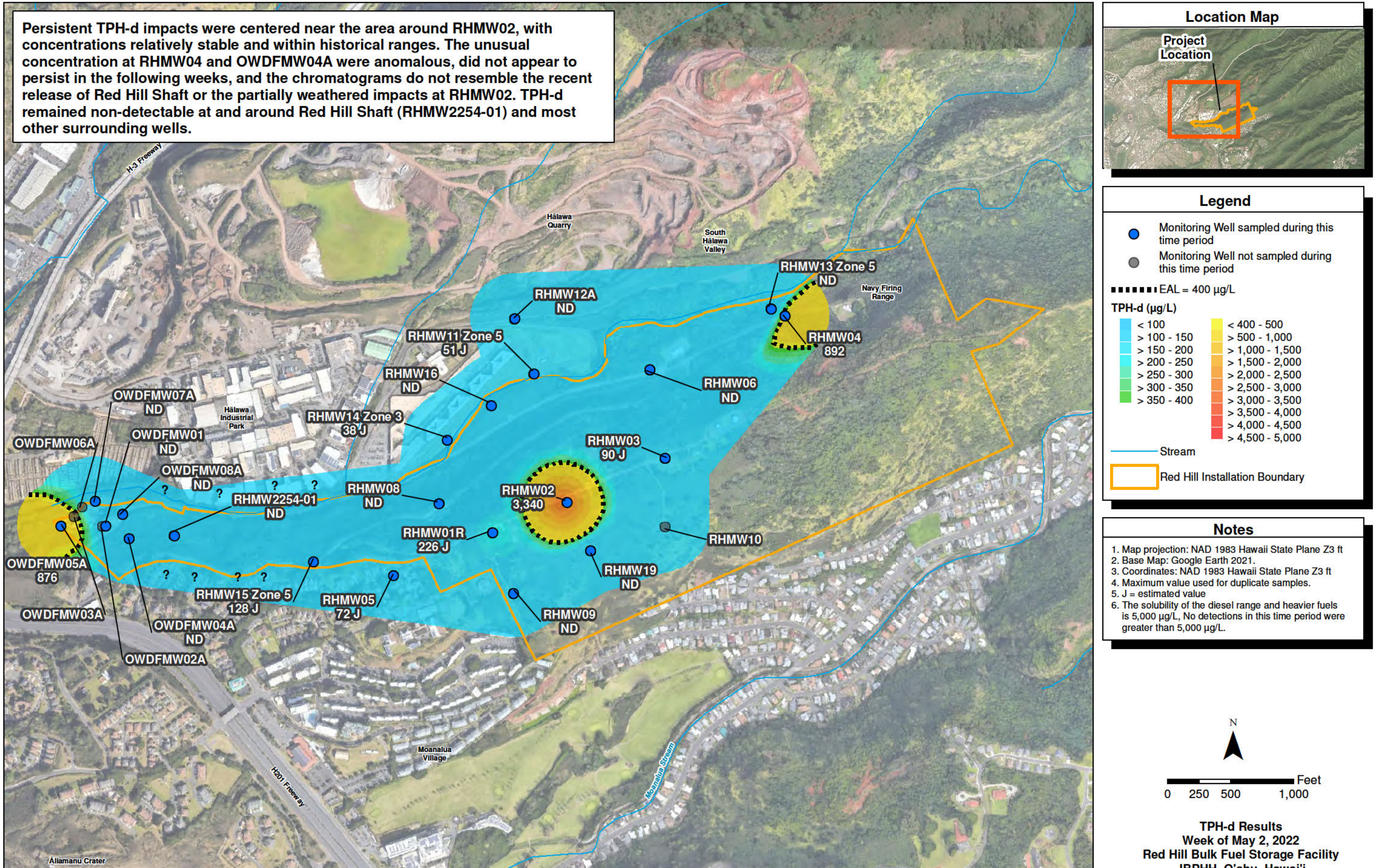
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

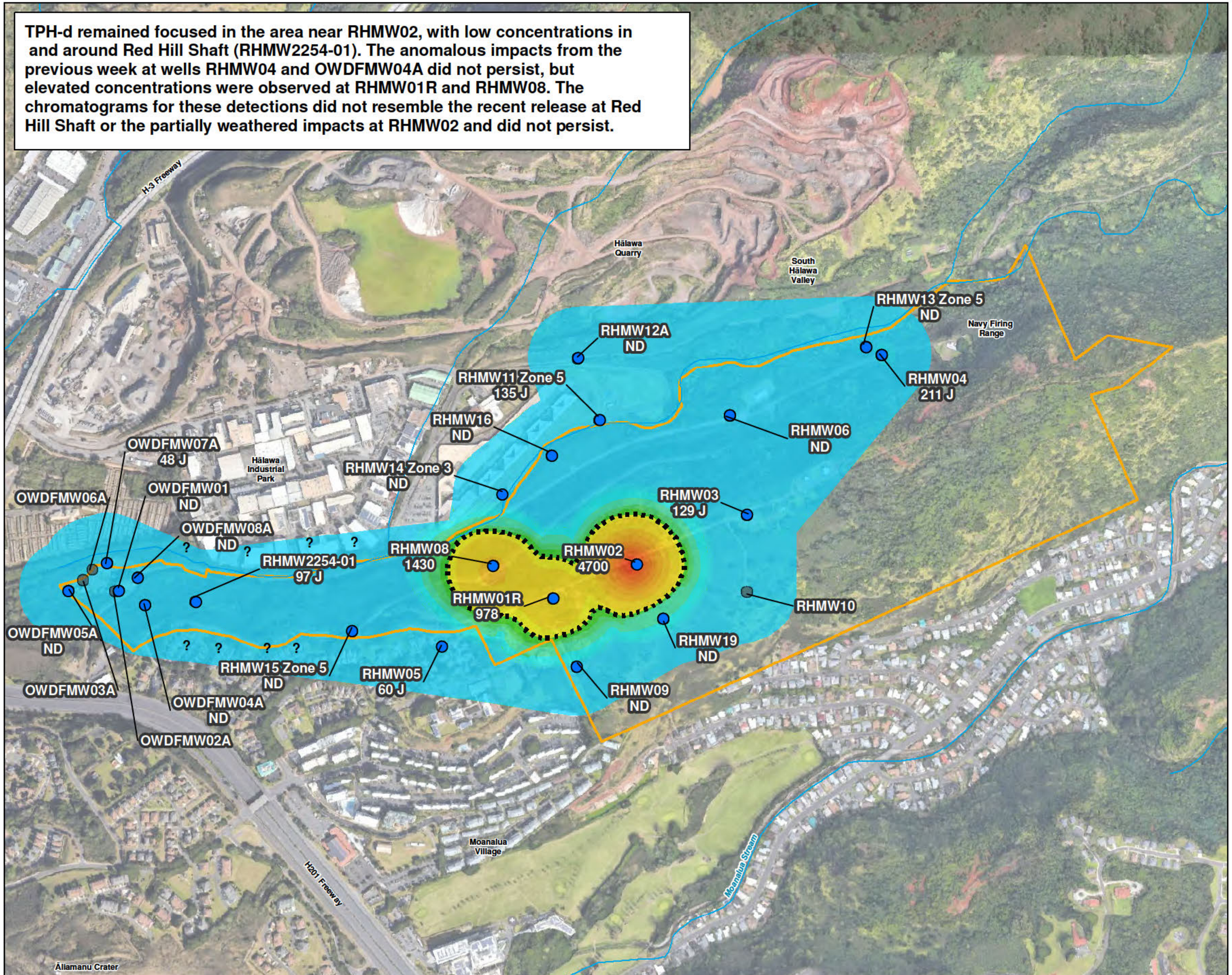
N

0 250 500 1,000 Feet

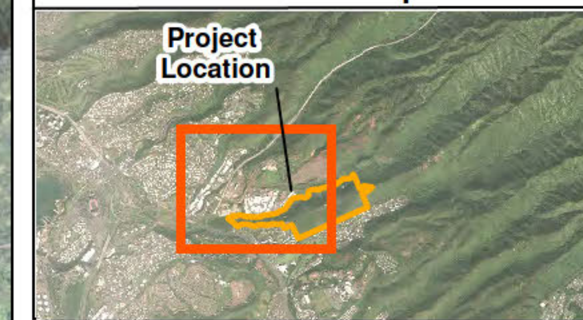
TPH-d Results
Week of April 24, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-d Results
Week of May 2, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- < 400 - 500
- > 500 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

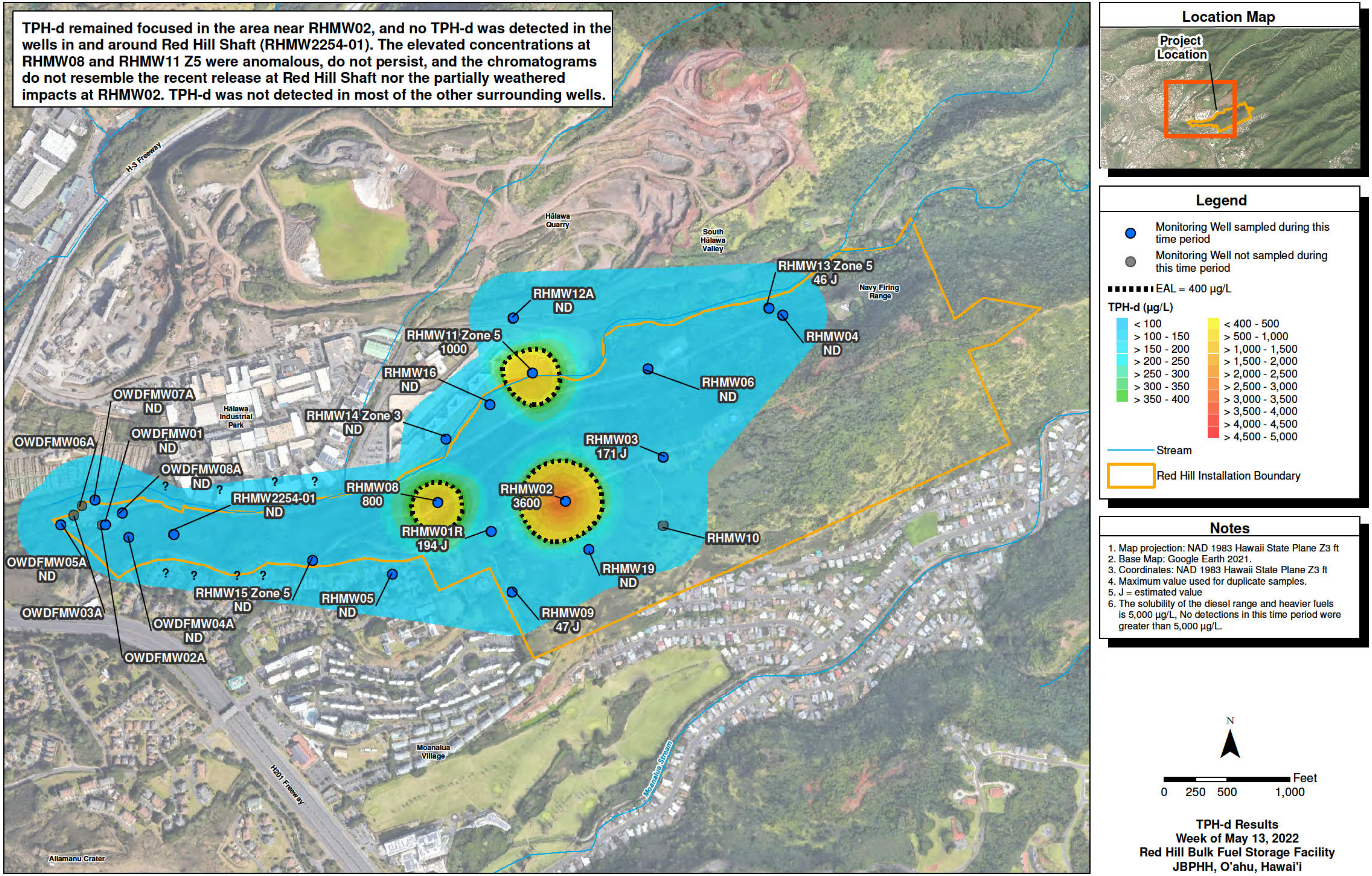
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

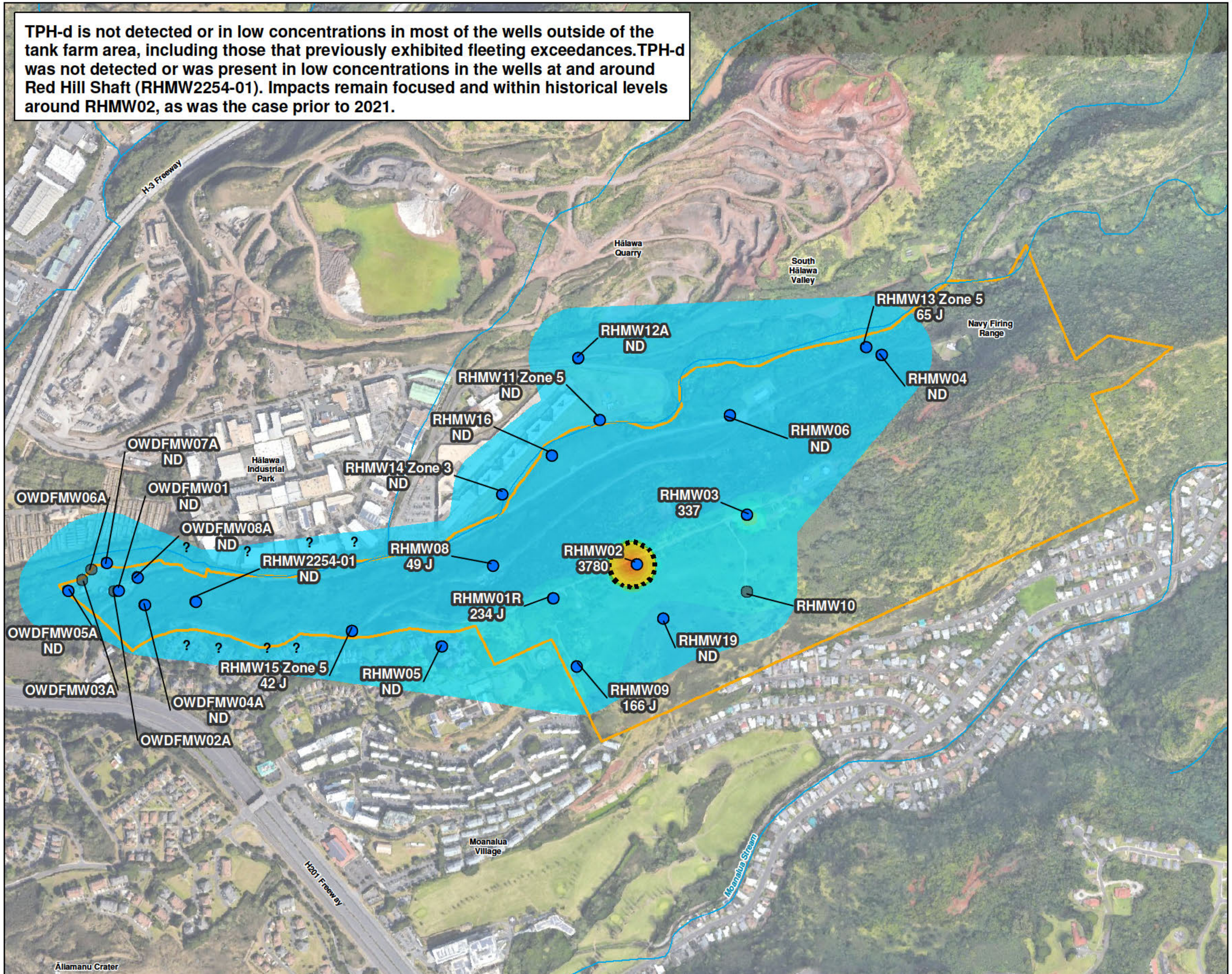
N

Feet
0 250 500 1,000

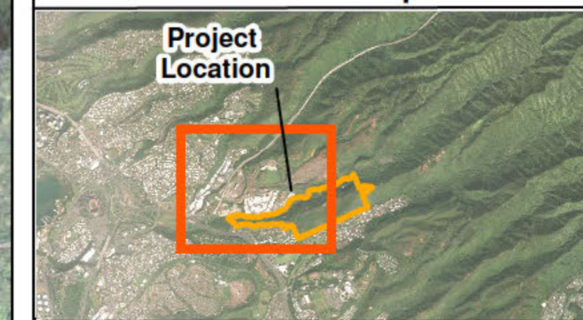
TPH-d Results
Week of May 9, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-d remained focused in the area near RHMW02, and no TPH-d was detected in the wells in and around Red Hill Shaft (RHMW2254-01). The elevated concentrations at RHMW08 and RHMW11 Z5 were anomalous, do not persist, and the chromatograms do not resemble the recent release at Red Hill Shaft nor the partially weathered impacts at RHMW02. TPH-d was not detected in most of the other surrounding wells.
H-3 Freeway
Hālawa Quarry
South Hālawa Valley
Navy Firing Range
Hālawa Industrial Park
RHMW13 Zone 5 46 J
RHMW12A ND
RHMW04 ND
RHMW11 Zone 5 1000
RHMW16 ND
RHMW06 ND
OWDFMW07A ND
RHMW14 Zone 3 ND
OWDFMW06A
OWDFMW01 ND
RHMW03 171 J
OWDFMW08A ND
RHMW2254-01 ND
RHMW08 800
RHMW02 3600
RHMW01R 194 J
RHMW10
OWDFMW05A ND
RHMW19 ND
RHMW15 Zone 5 ND
RHMW05 ND
OWDFMW03A
RHMW09 47 J
OWDFMW04A ND
OWDFMW02A
Moanalua Village
H201 Freeway
Moanalua Stream
Āliamanu Crater
Location Map
Project Location
Legend
Monitoring Well sampled during this time period
Monitoring Well not sampled during this time period
EAL = 400 µg/L
TPH-d (µg/L)
< 100
> 100 - 150
> 150 - 200
> 200 - 250
> 250 - 300
> 300 - 350
> 350 - 400
< 400 - 500
> 500 - 1,000
> 1,000 - 1,500
> 1,500 - 2,000
> 2,000 - 2,500
> 2,500 - 3,000
> 3,000 - 3,500
> 3,500 - 4,000
> 4,000 - 4,500
> 4,500 - 5,000
Stream
Red Hill Installation Boundary
Notes
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.
N
Feet
0 250 500 1,000
TPH-d Results
Week of May 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

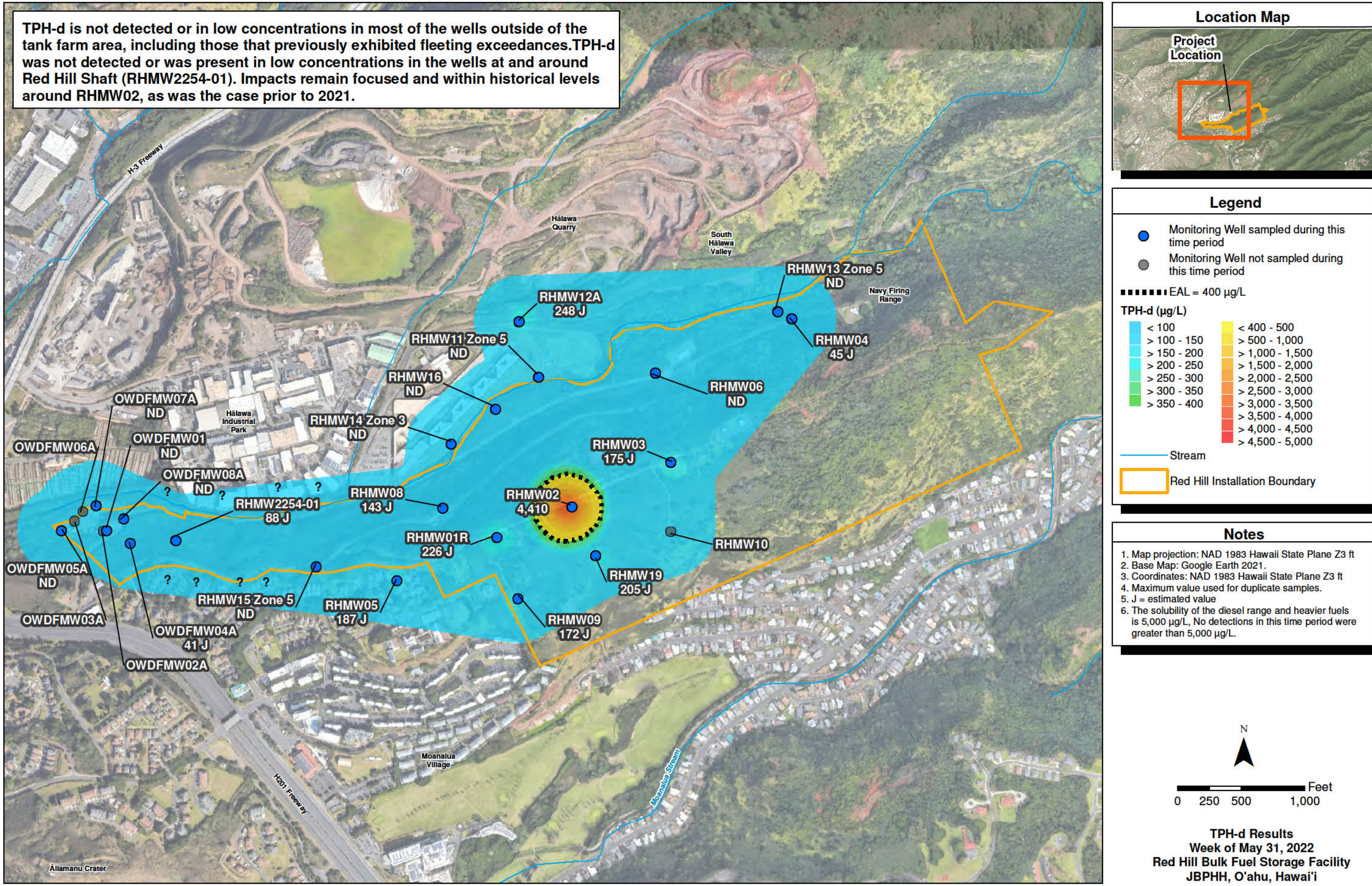
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

N

Feet
0 250 500 1,000

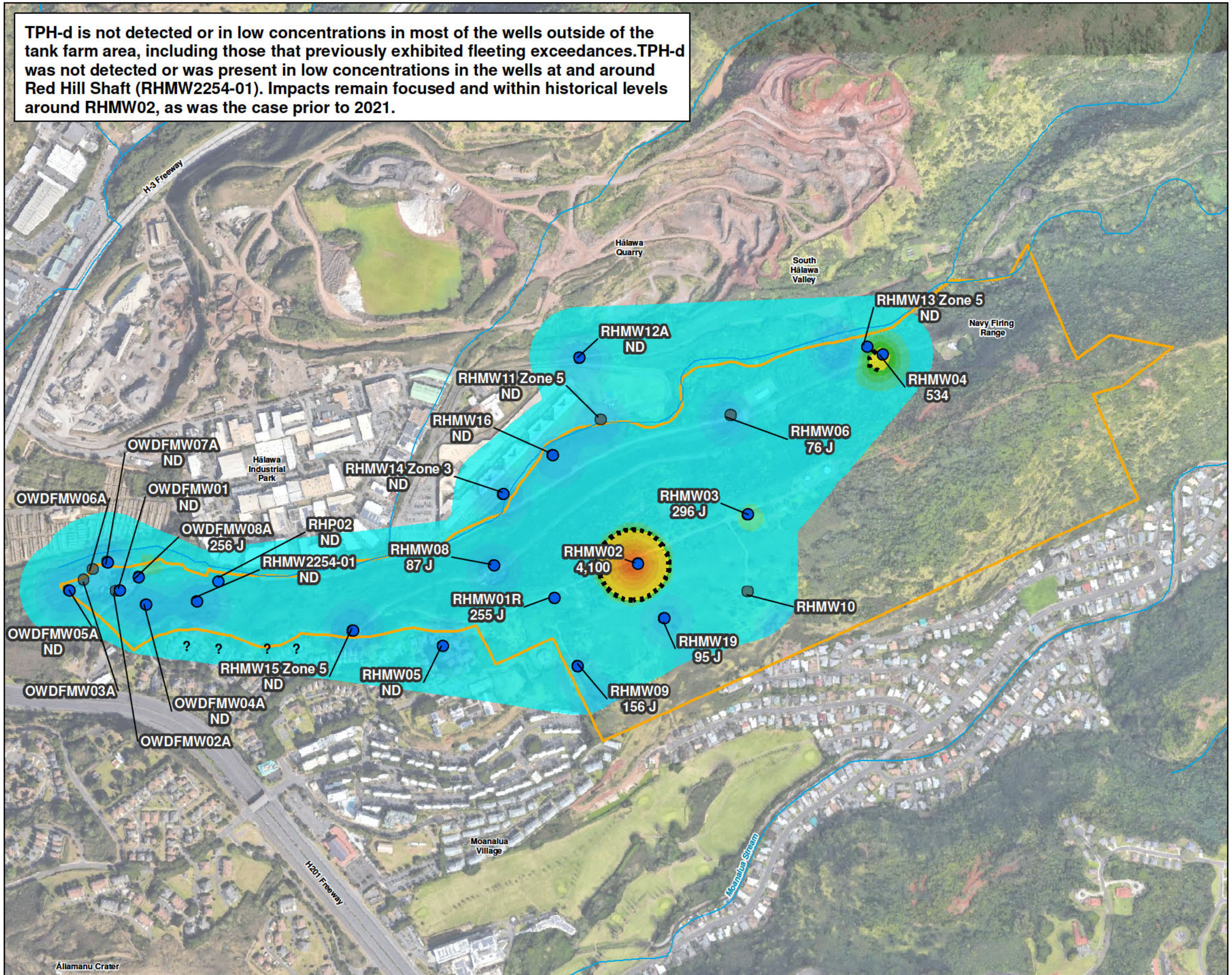
TPH-d Results
Week of May 23, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



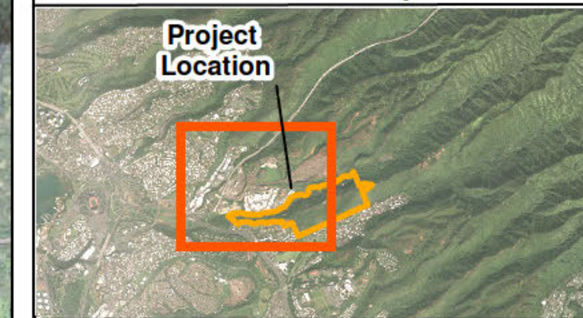
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

TPH-d Results
Week of May 31, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- < 400 - 500
- > 500 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

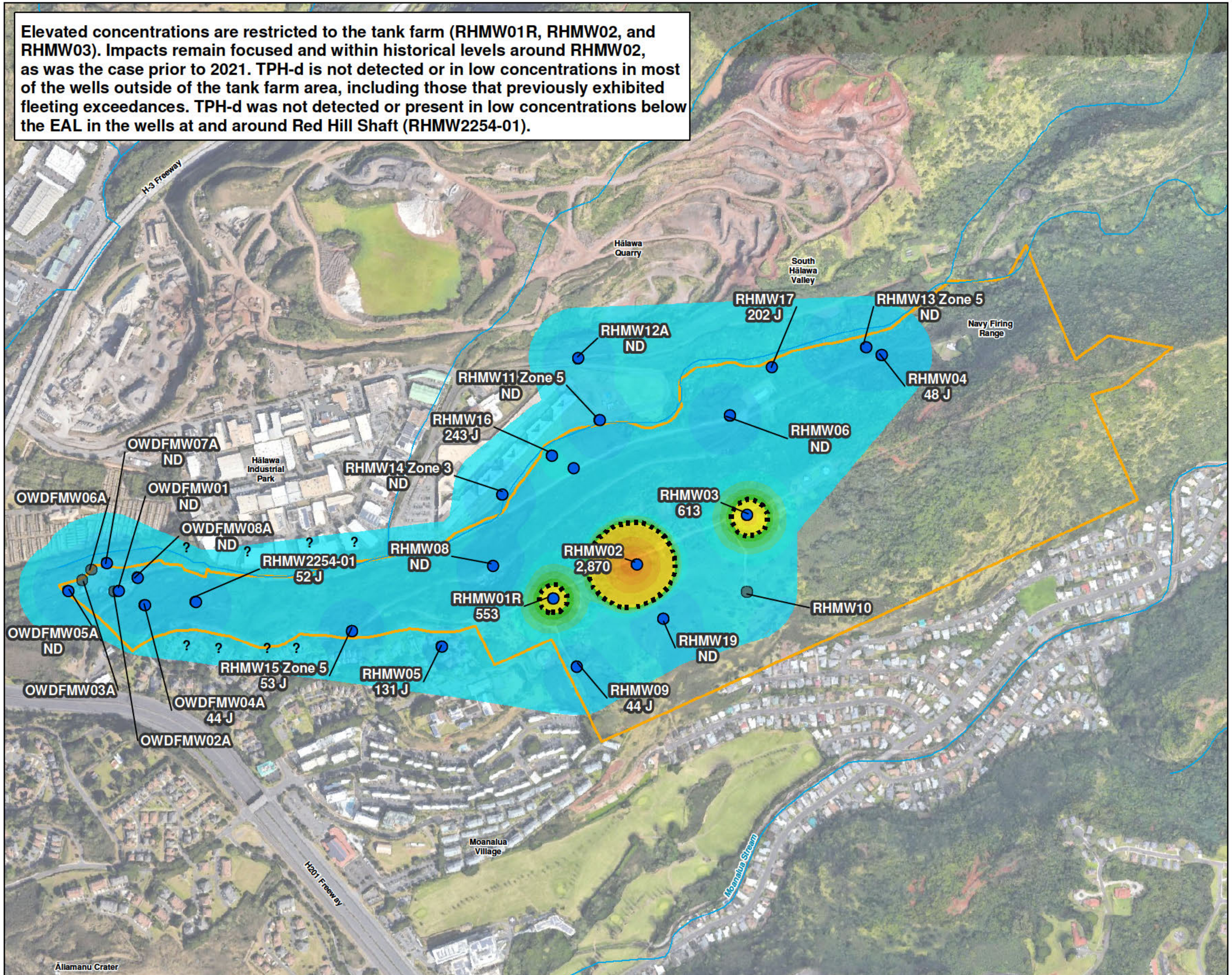
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

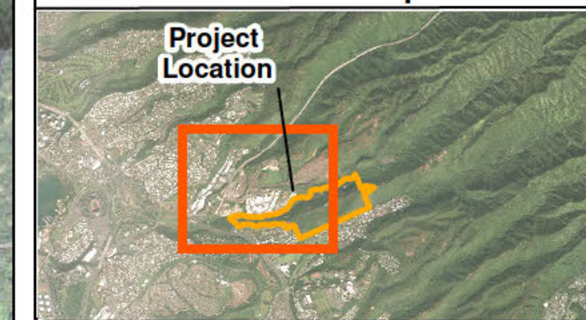
N

0 250 500 1,000 Feet

TPH-d Results
Week of June 6, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period; RHMW17
- Monitoring Well not sampled during this time period
- EAL = 400 µg/L

TPH-d (µg/L)

< 100	< 400 - 500
> 100 - 150	> 500 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
	> 3,500 - 4,000
	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

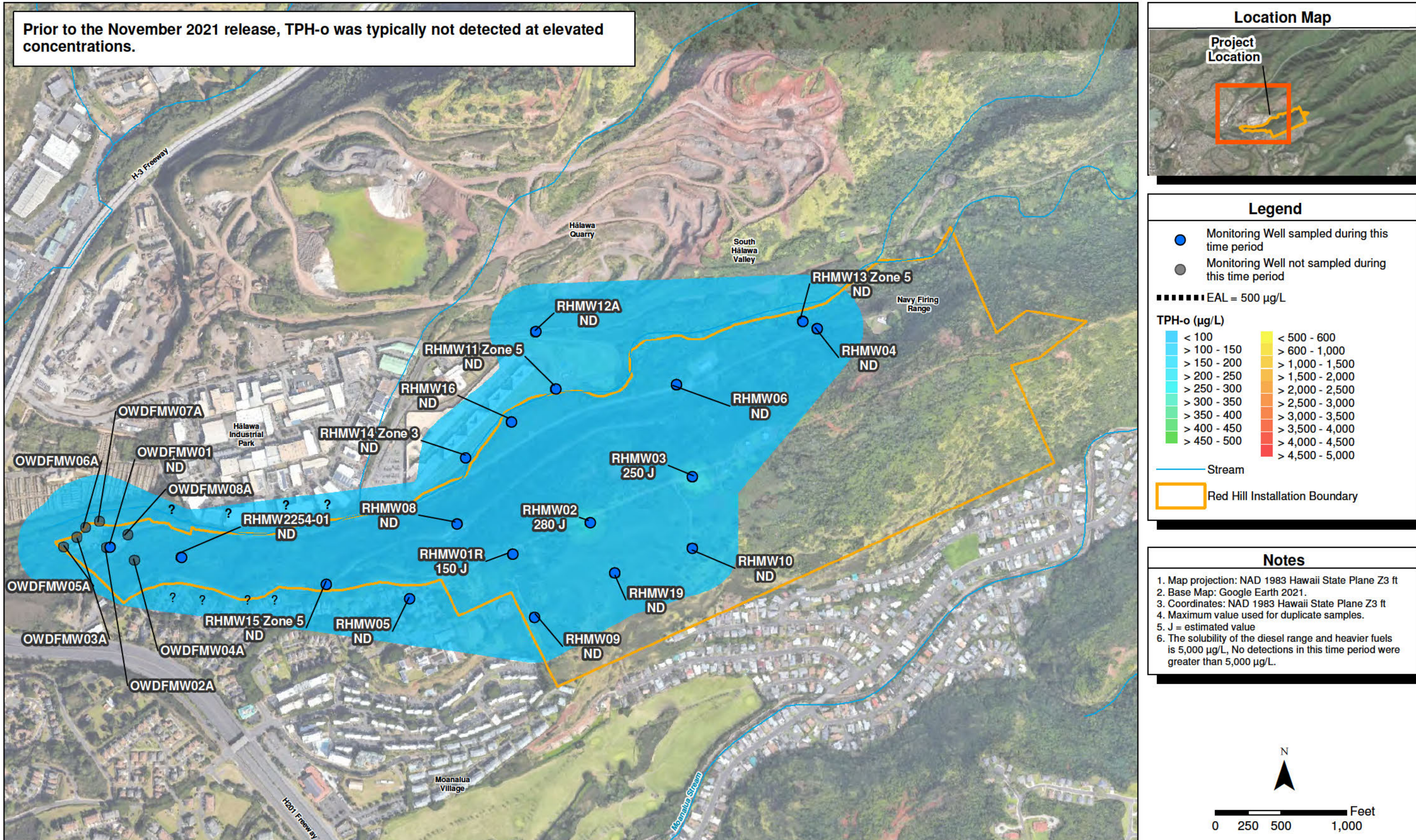
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

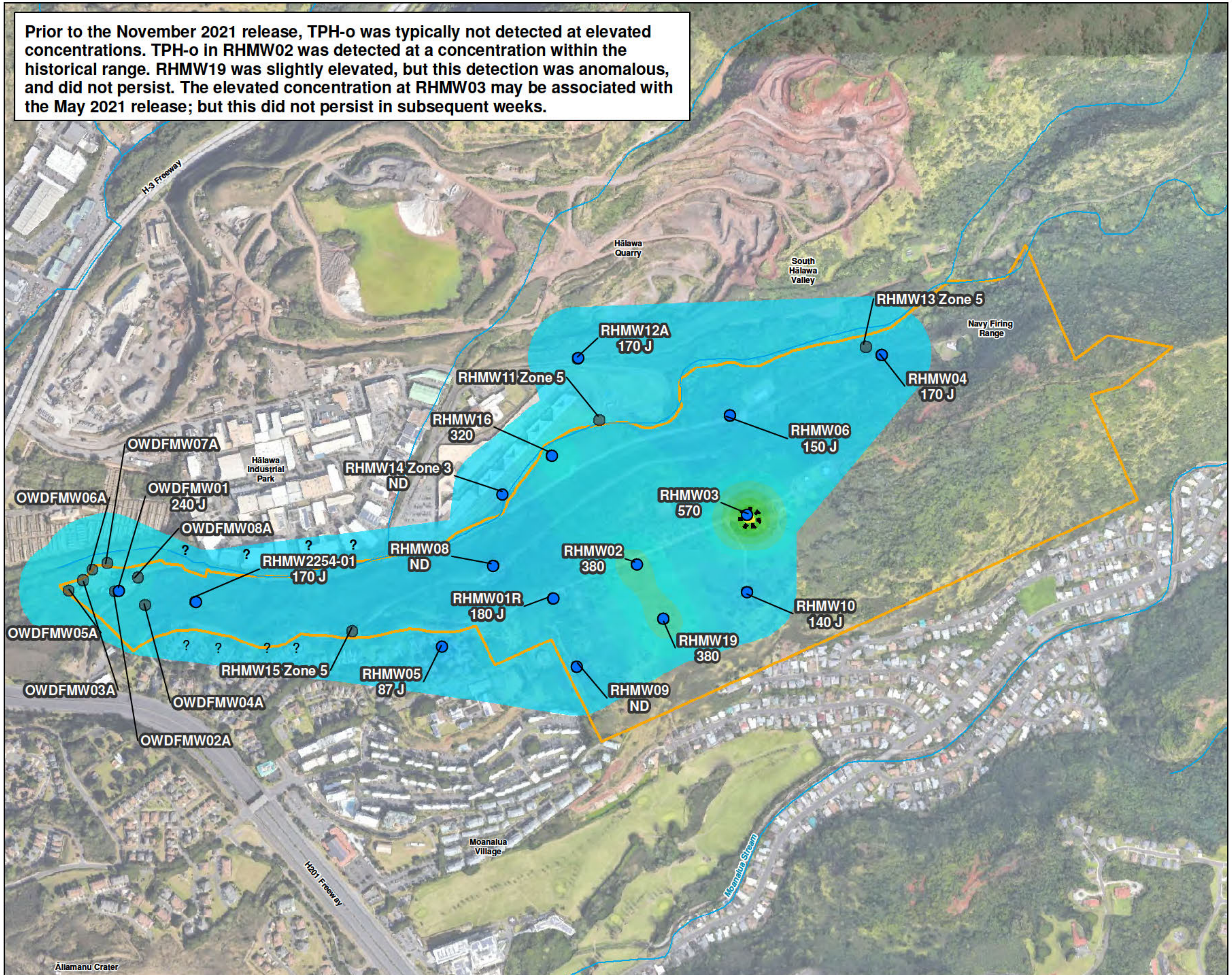
N

0 250 500 1,000 Feet

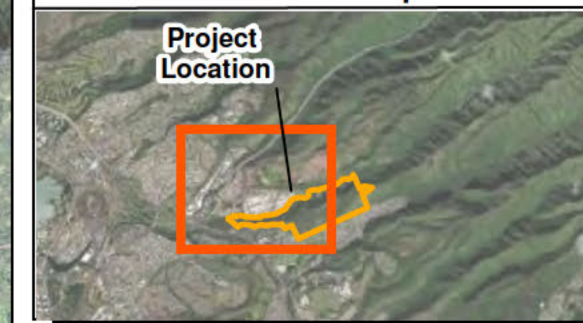
TPH-d Results
Week of June 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-o Results
Quarter 3 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

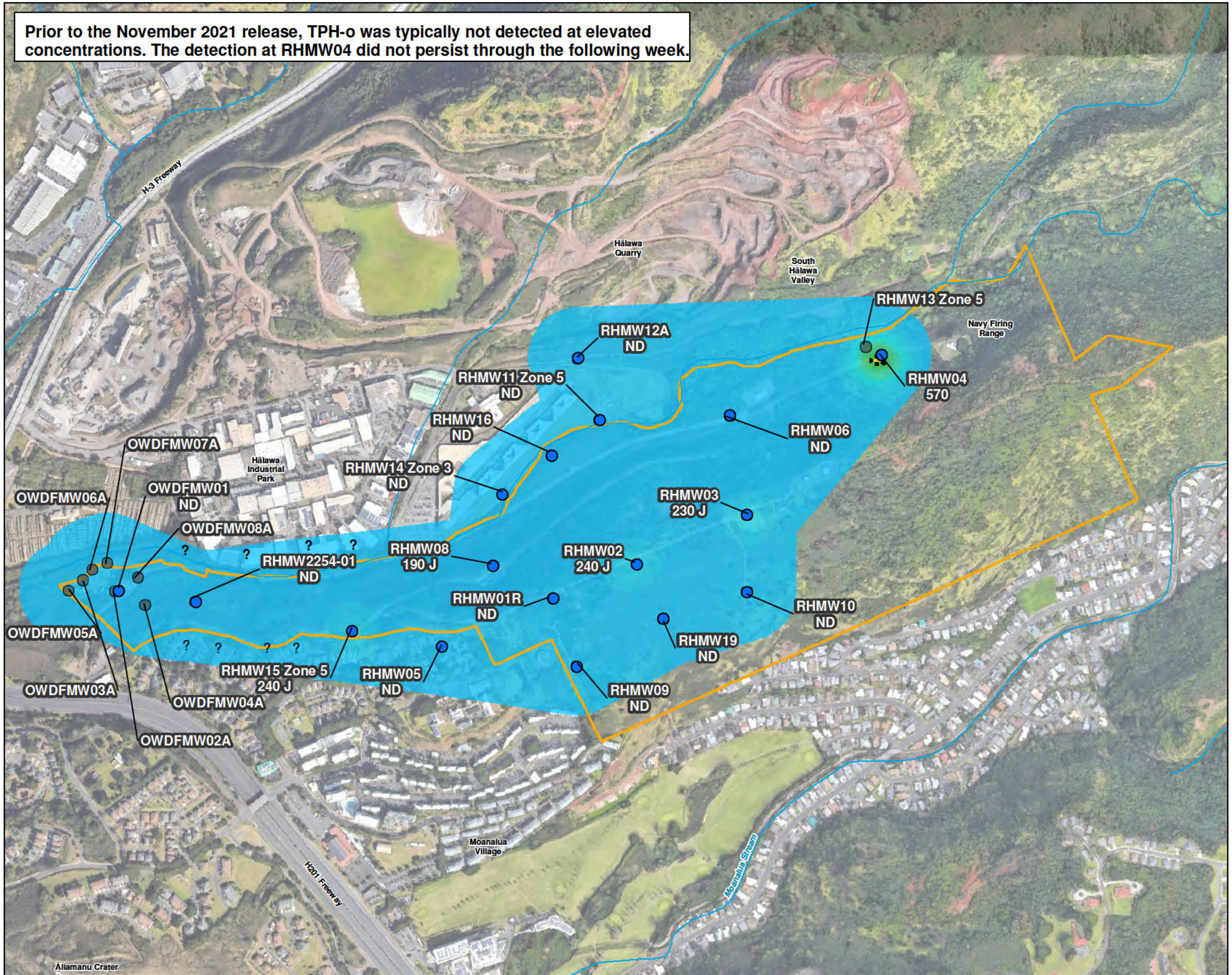
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

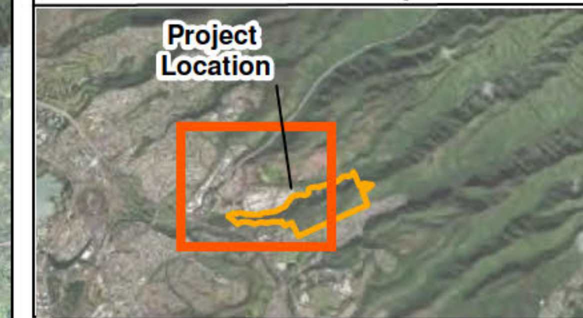
N

Feet
0 250 500 1,000

TPH-o Results
Week of September 30, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

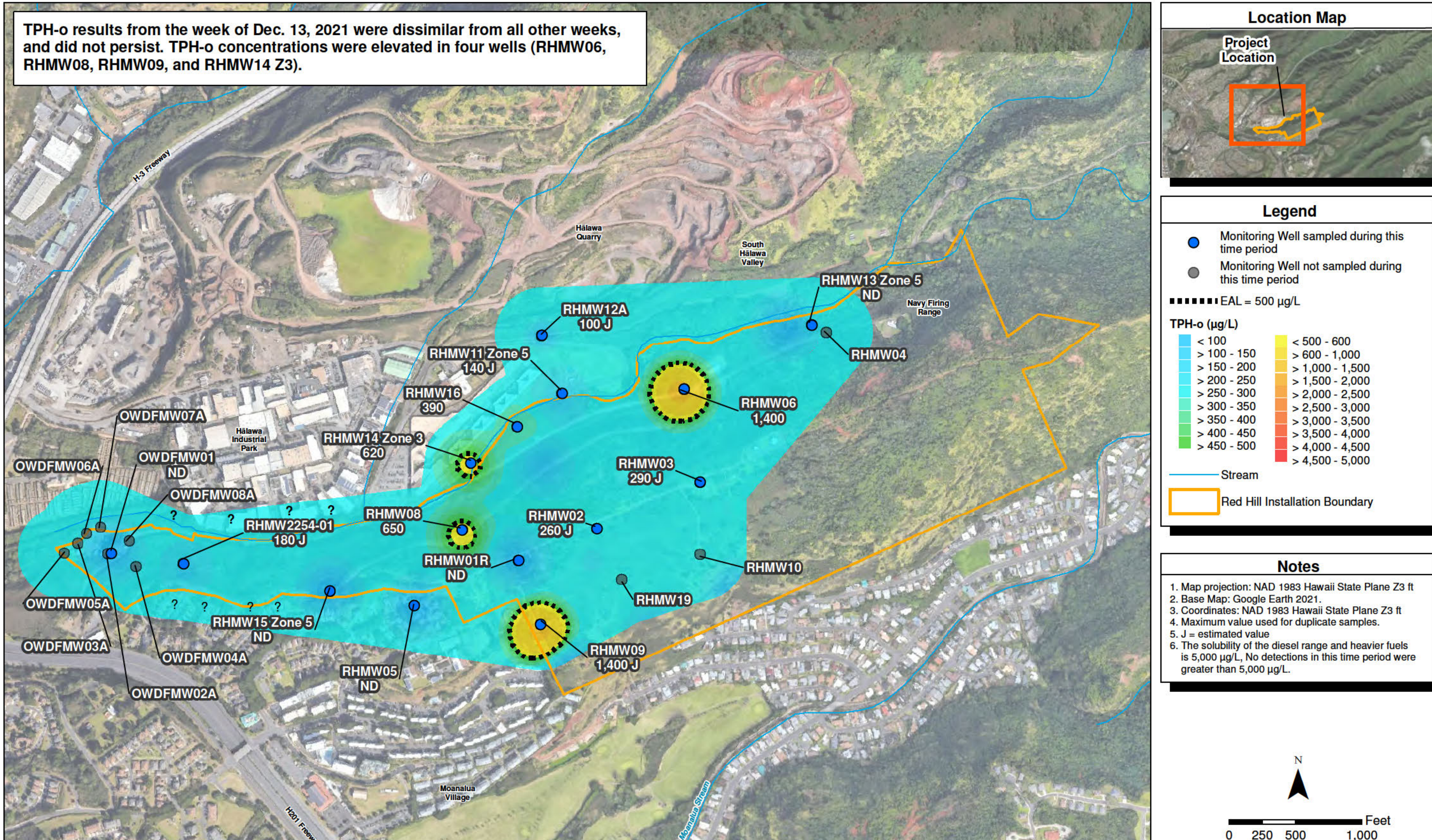
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

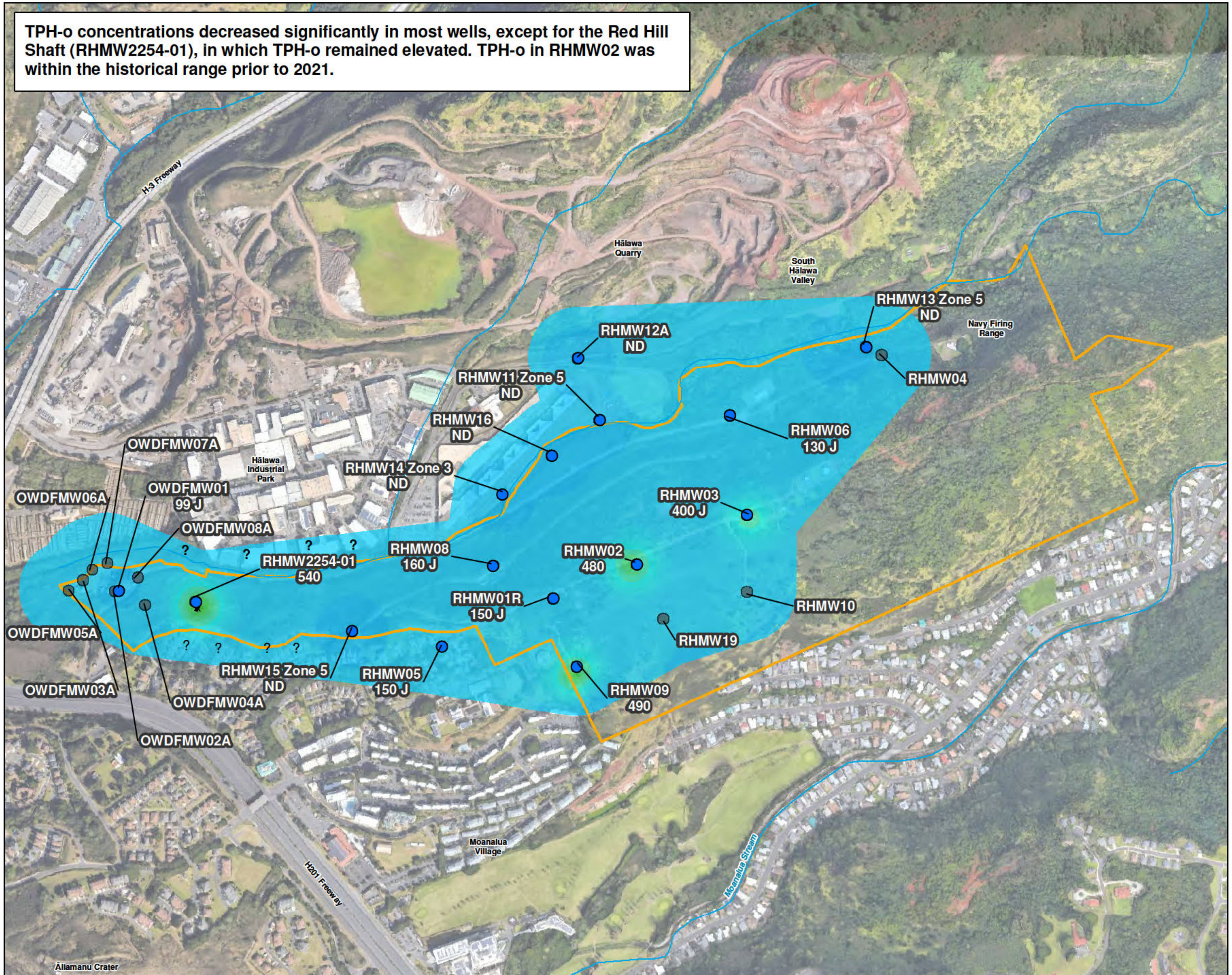
N

Feet
0 250 500 1,000

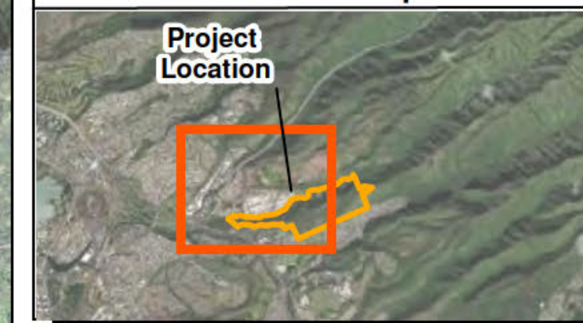
TPH-o Results
Quarter 4 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-o Results
Week of December 13, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

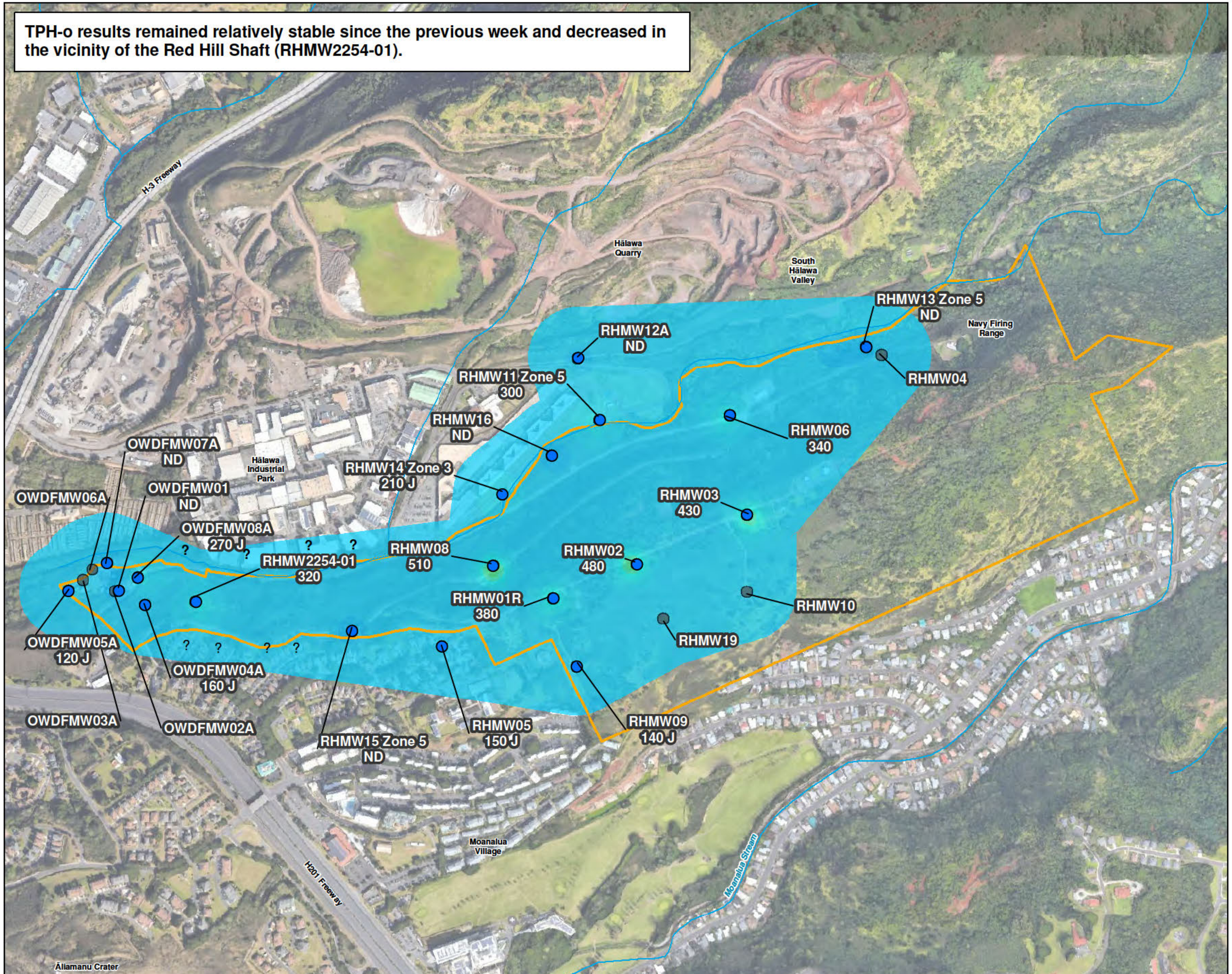
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

N

Feet
0 250 500 1,000

TPH-o Results
Week of December 20, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map

Project Location

Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- > 400 - 450
- > 450 - 500
- < 500 - 600
- > 600 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

Stream

Red Hill Installation Boundary

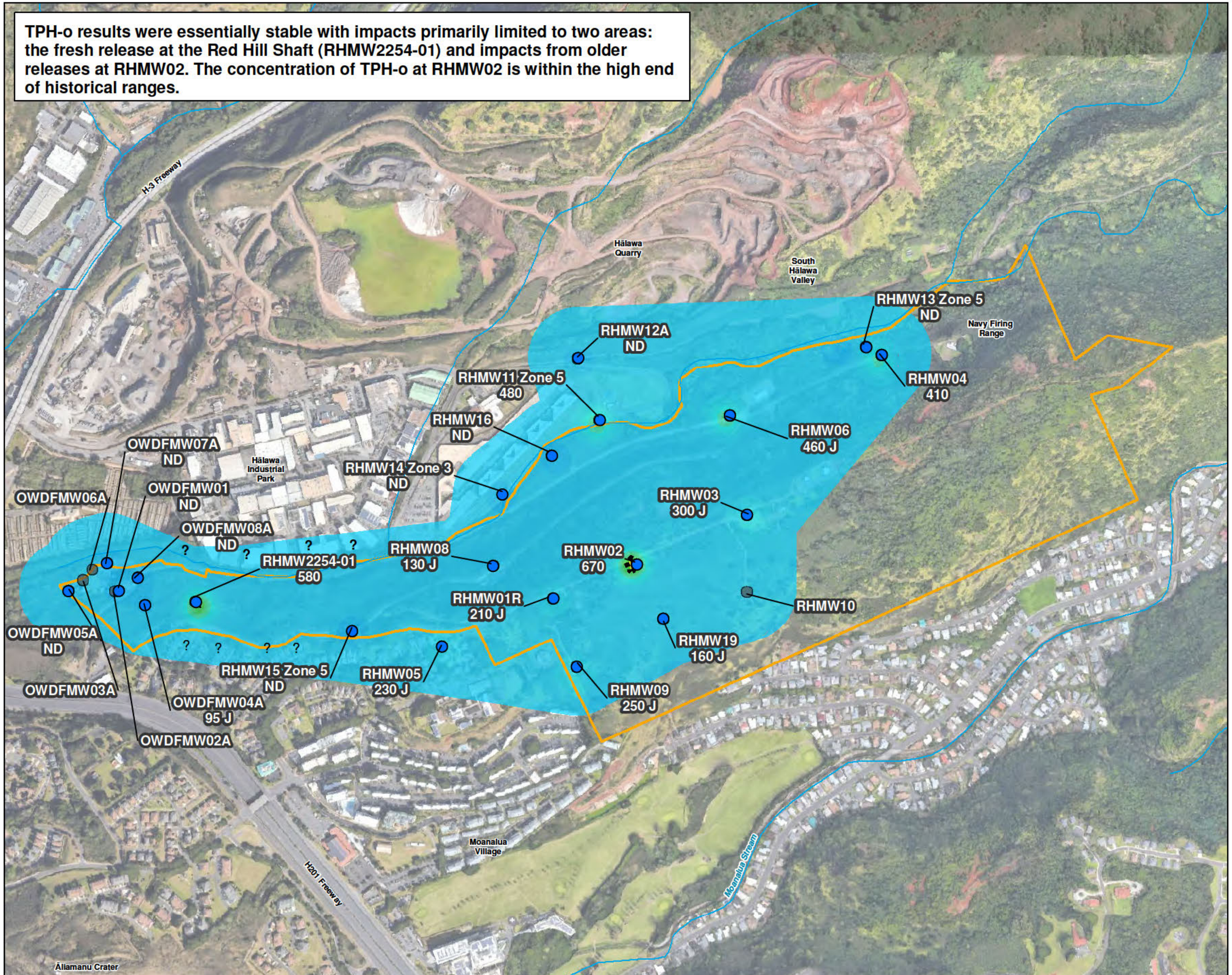
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

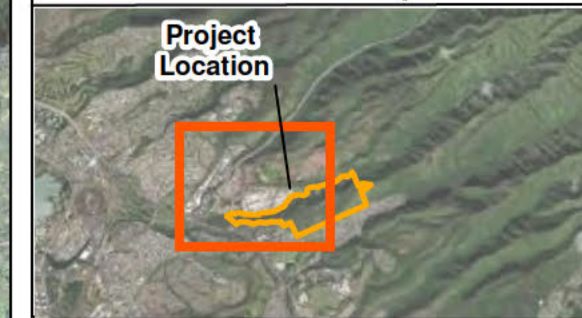
N

Feet
0 250 500 1,000

TPH-o Results
Week of December 27, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	> 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

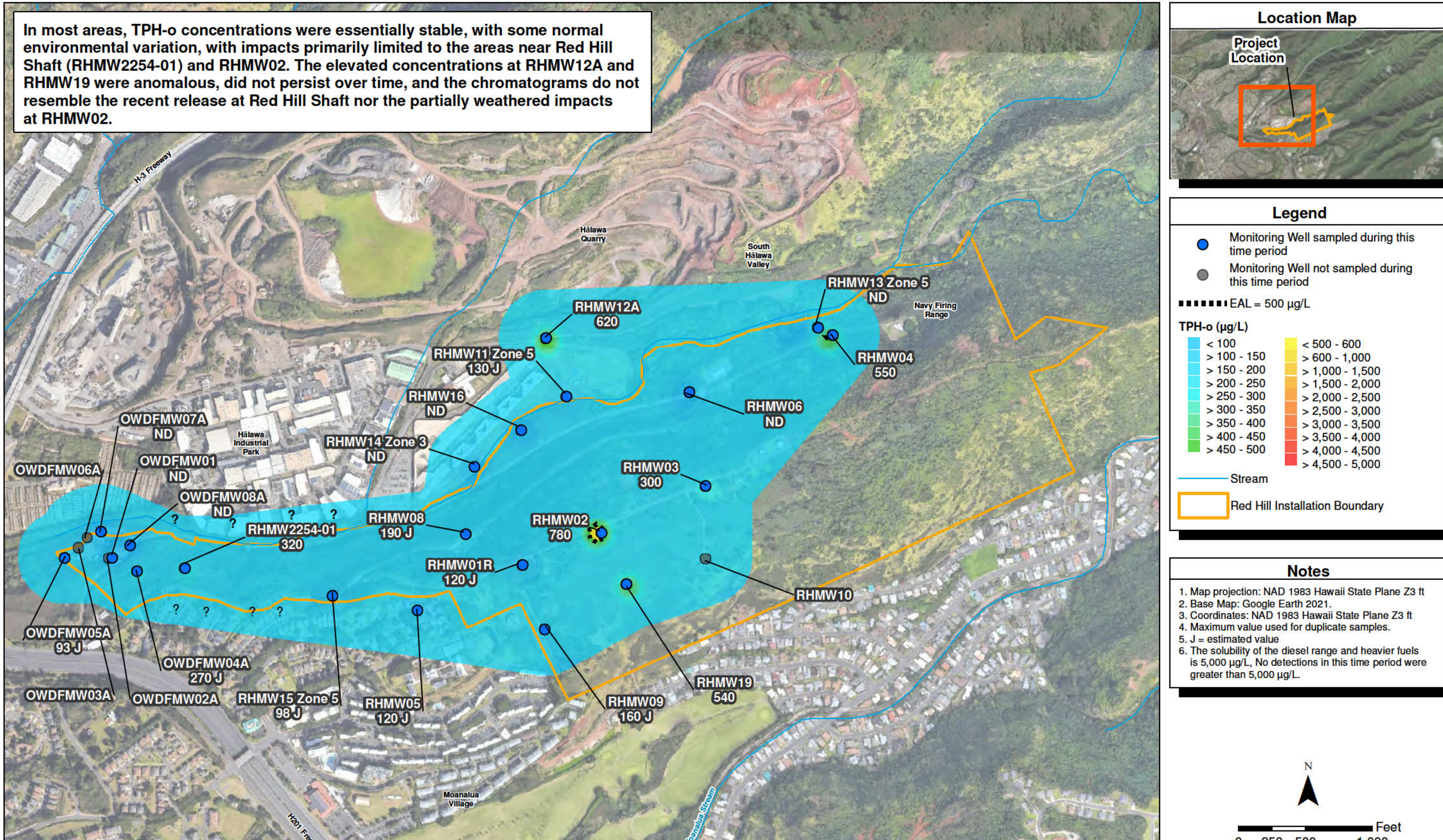
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

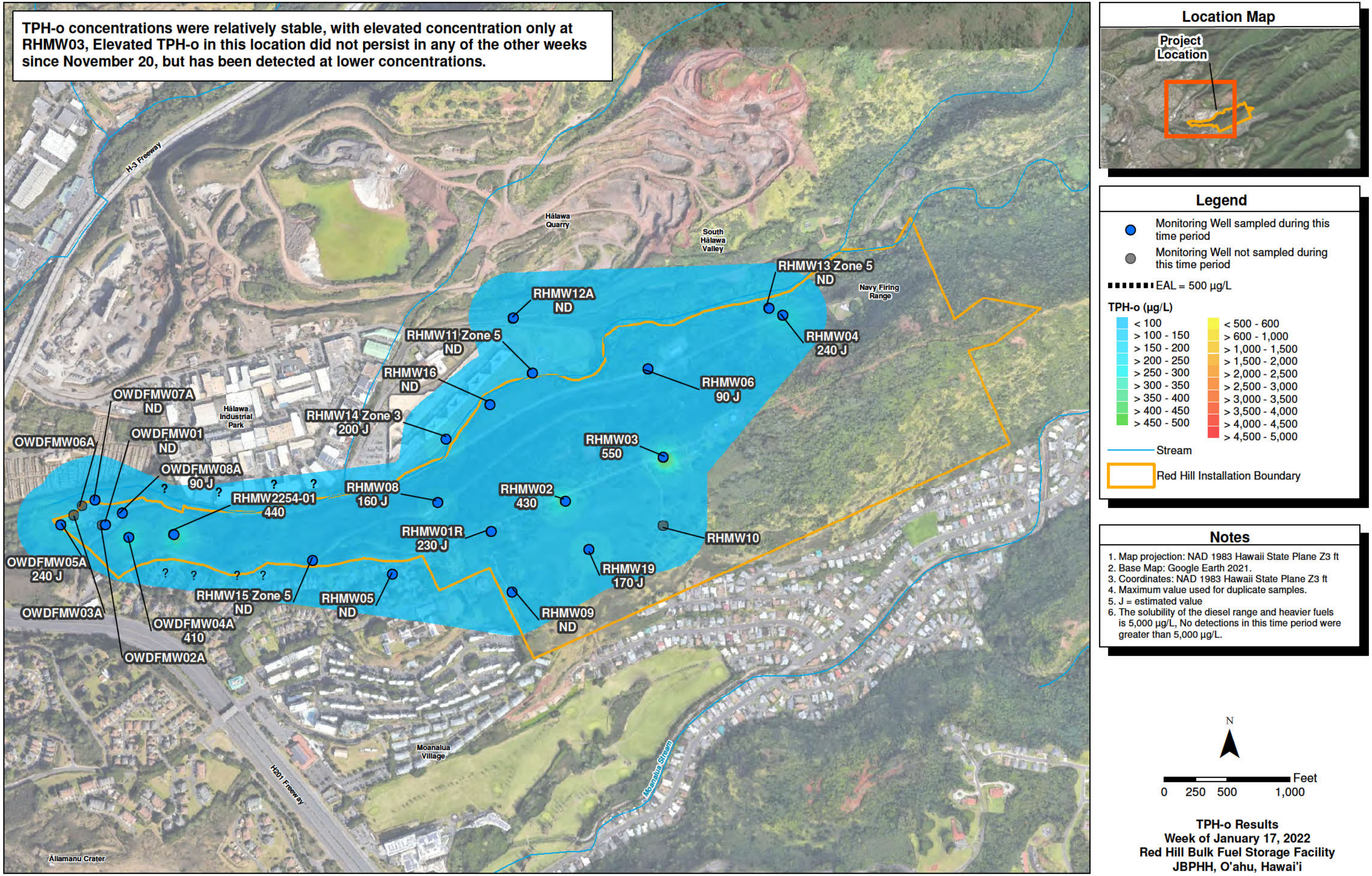
N

0 250 500 1,000 Feet

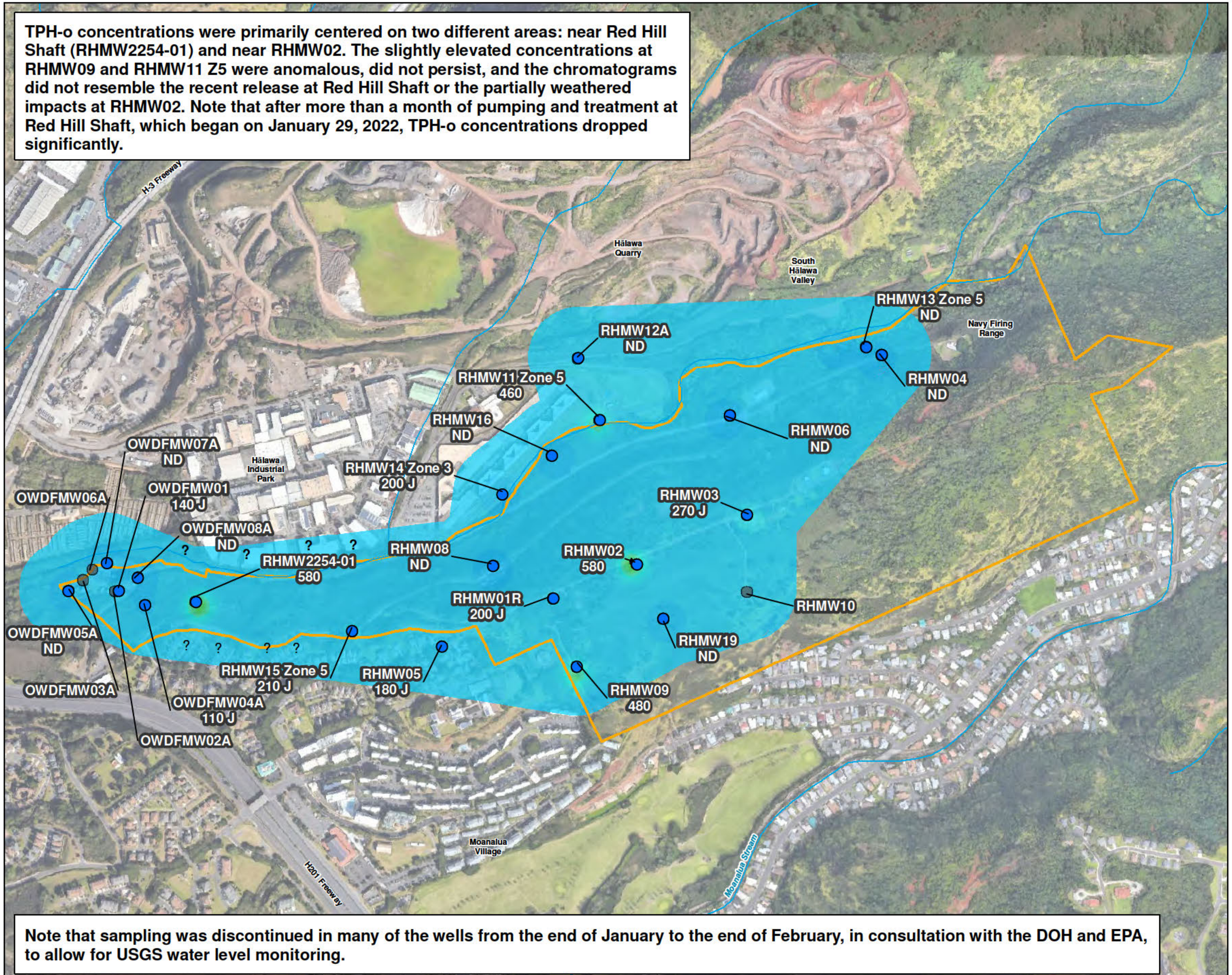
TPH-o Results
Week of January 3, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



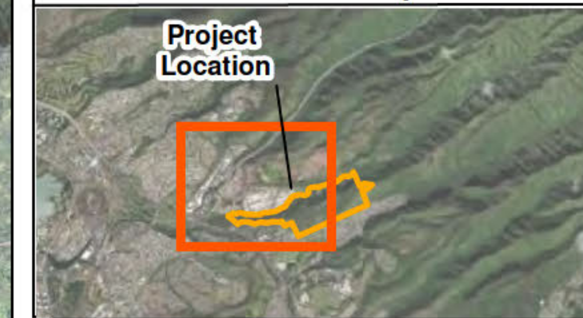
TPH-o Results
Week of January 10, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-o Results
Week of January 17, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

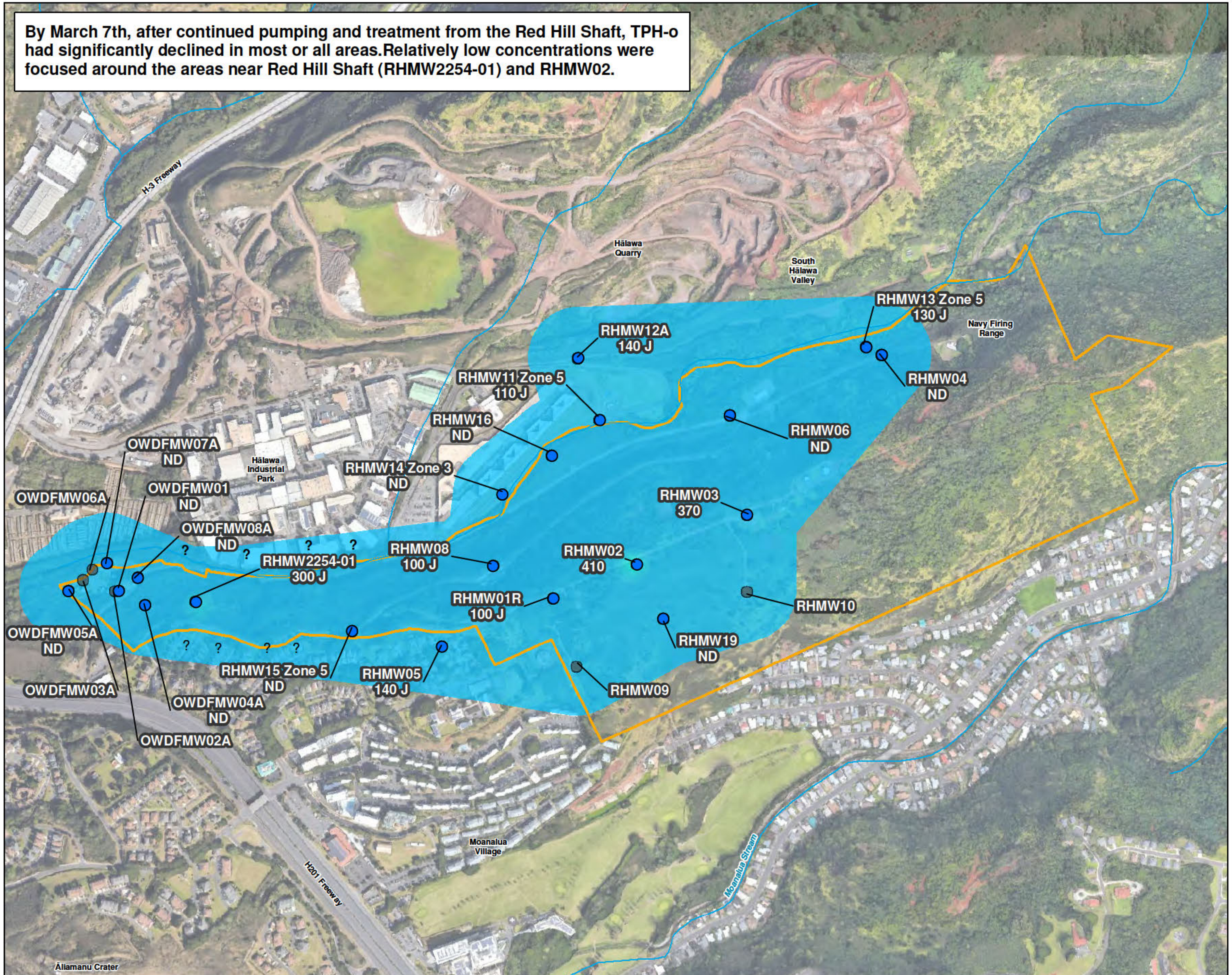
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

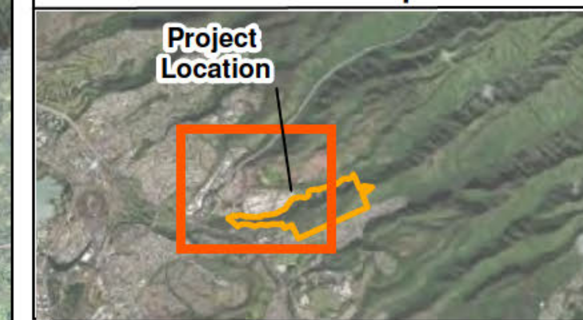
N

Feet
0 250 500 1,000

TPH-o Results
Week of February 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

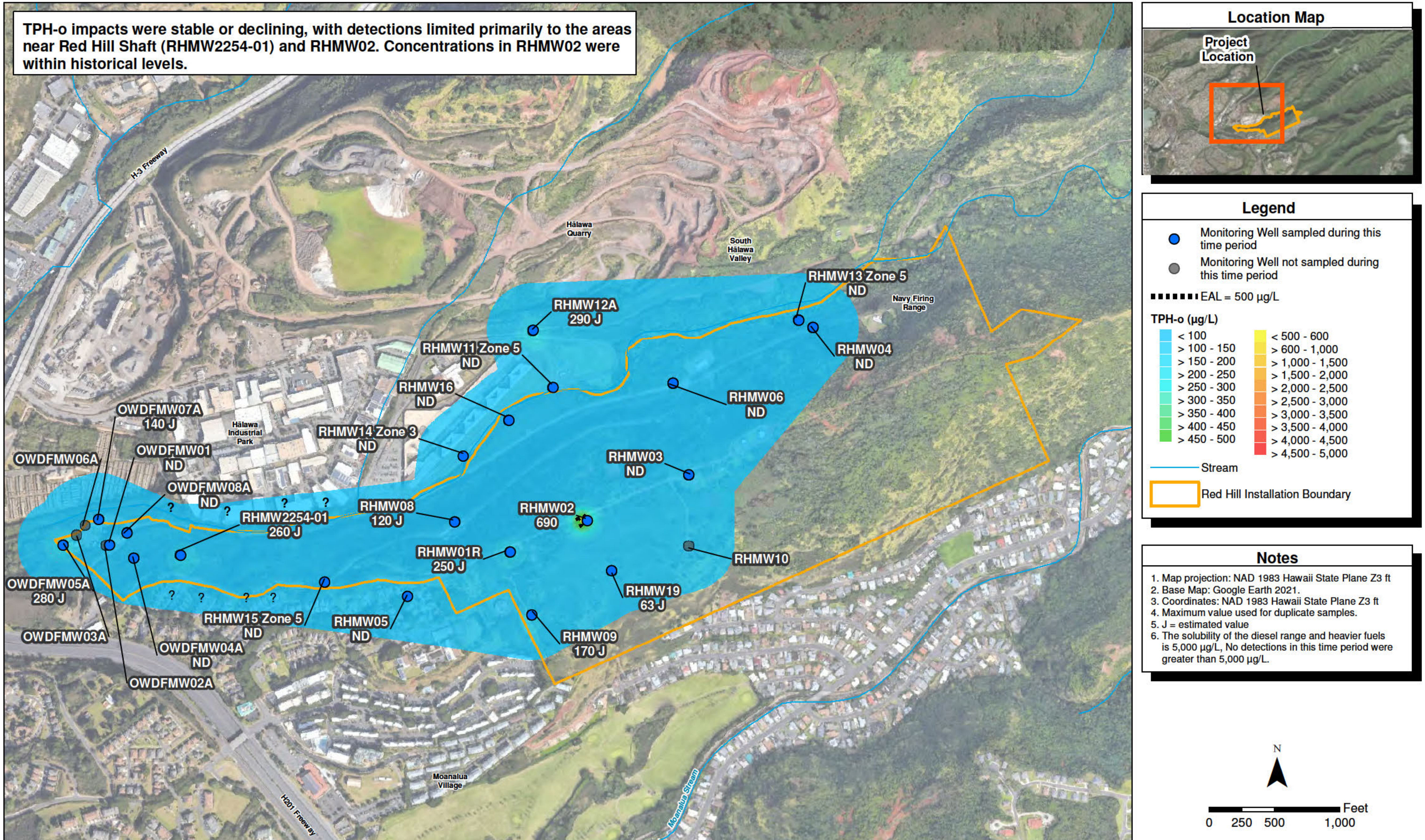
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

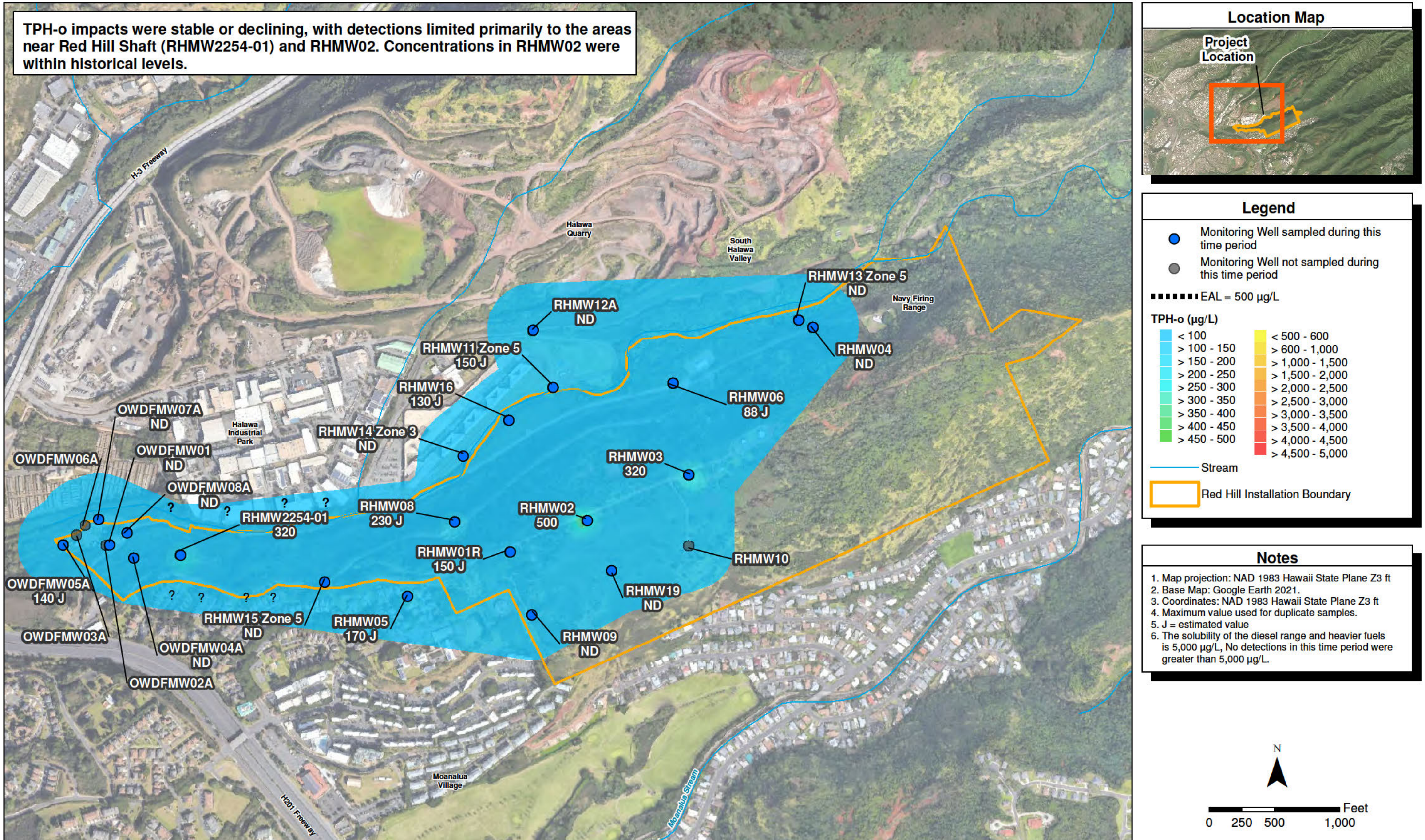
N

Feet
0 250 500 1,000

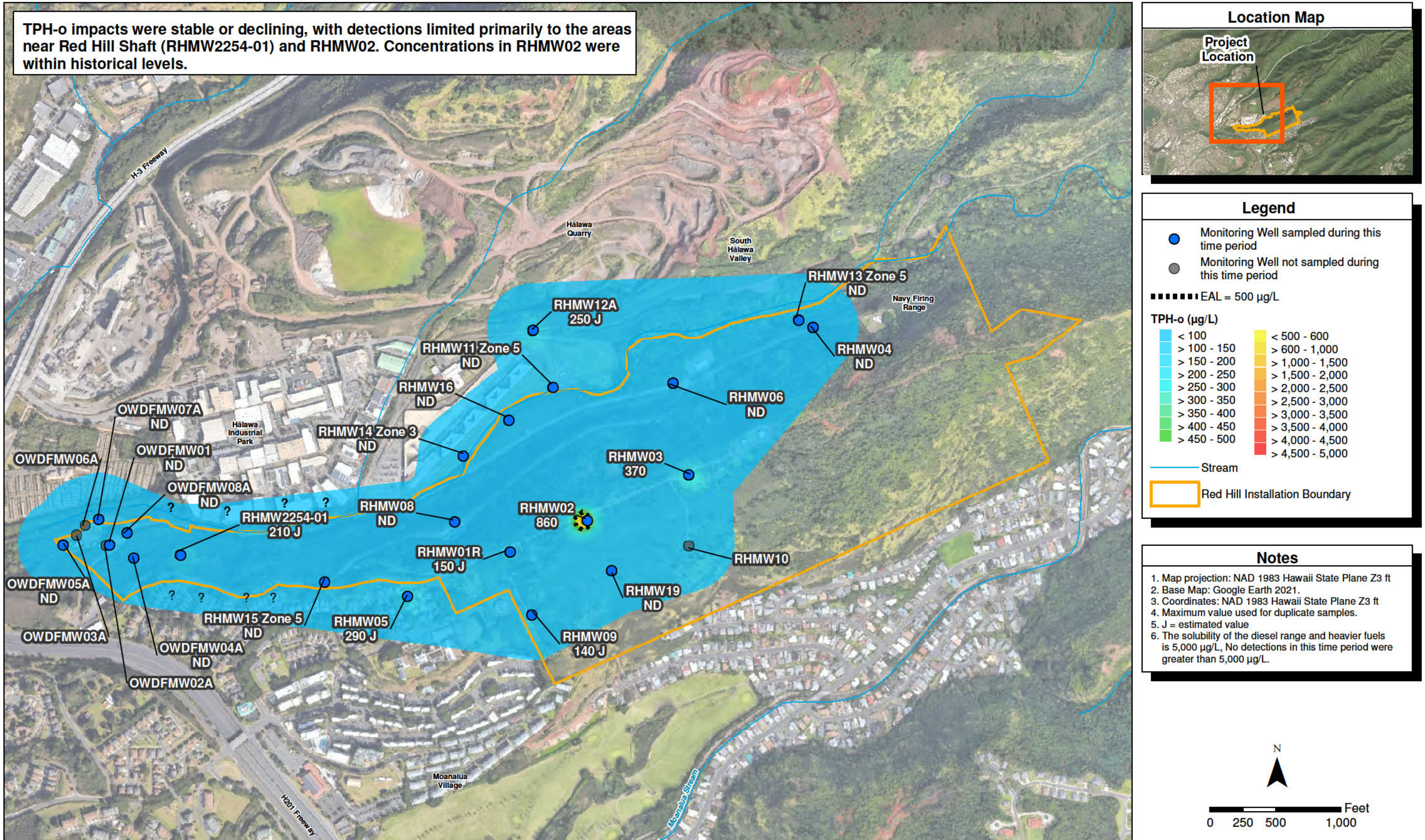
TPH-o Results
Week of March 7, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



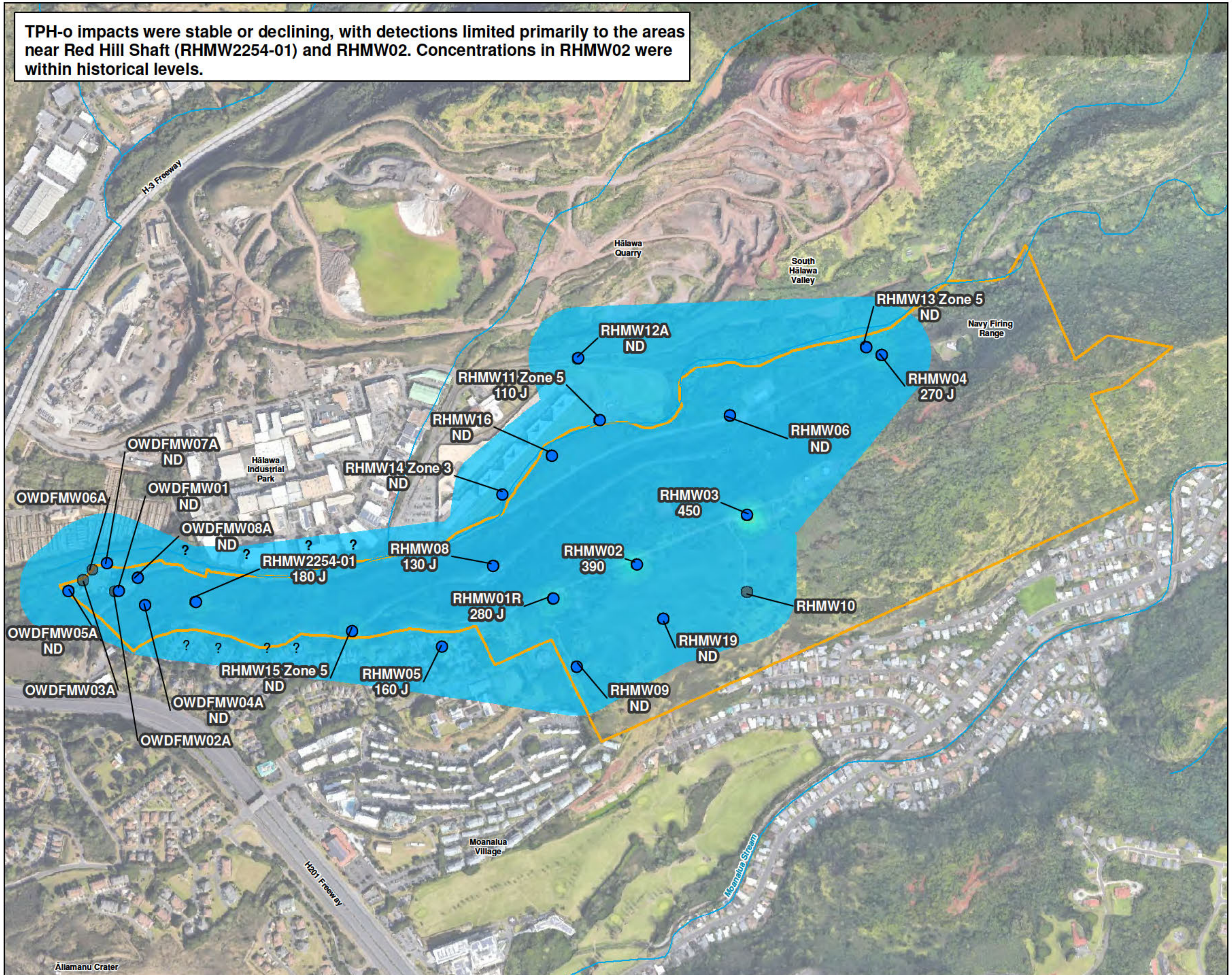
TPH-o Results
Week of March 14, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



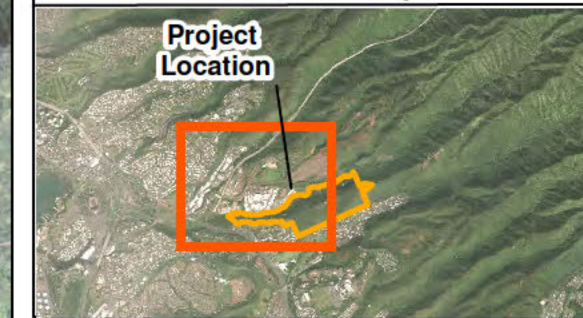
TPH-o Results
Week of March 21, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-o Results
Week of March 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

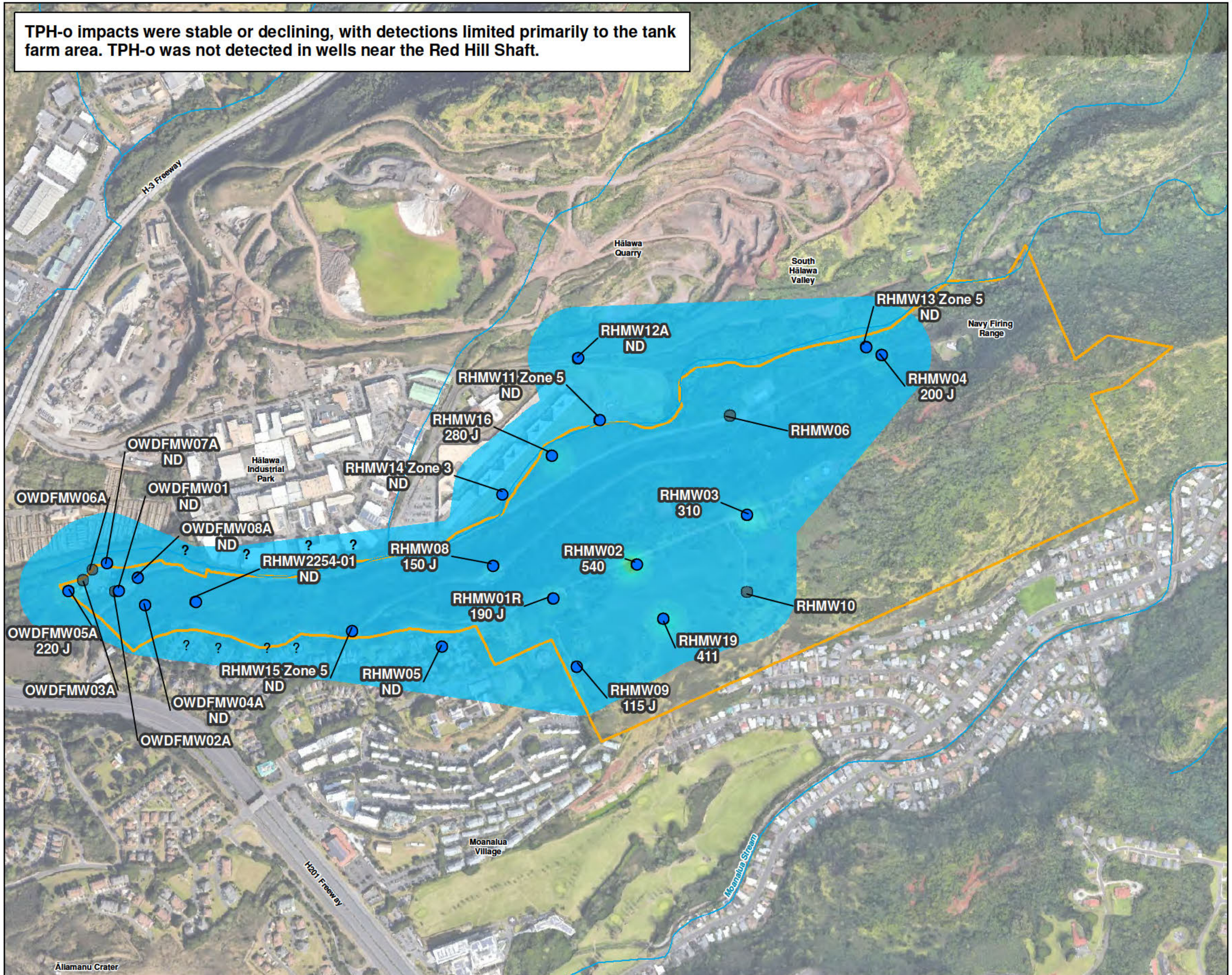
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

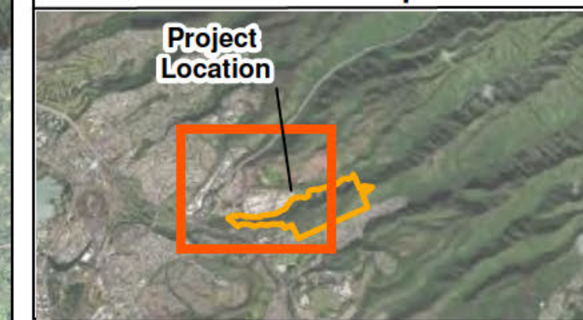
N

Feet
0 250 500 1,000

TPH-o Results
Week of April 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

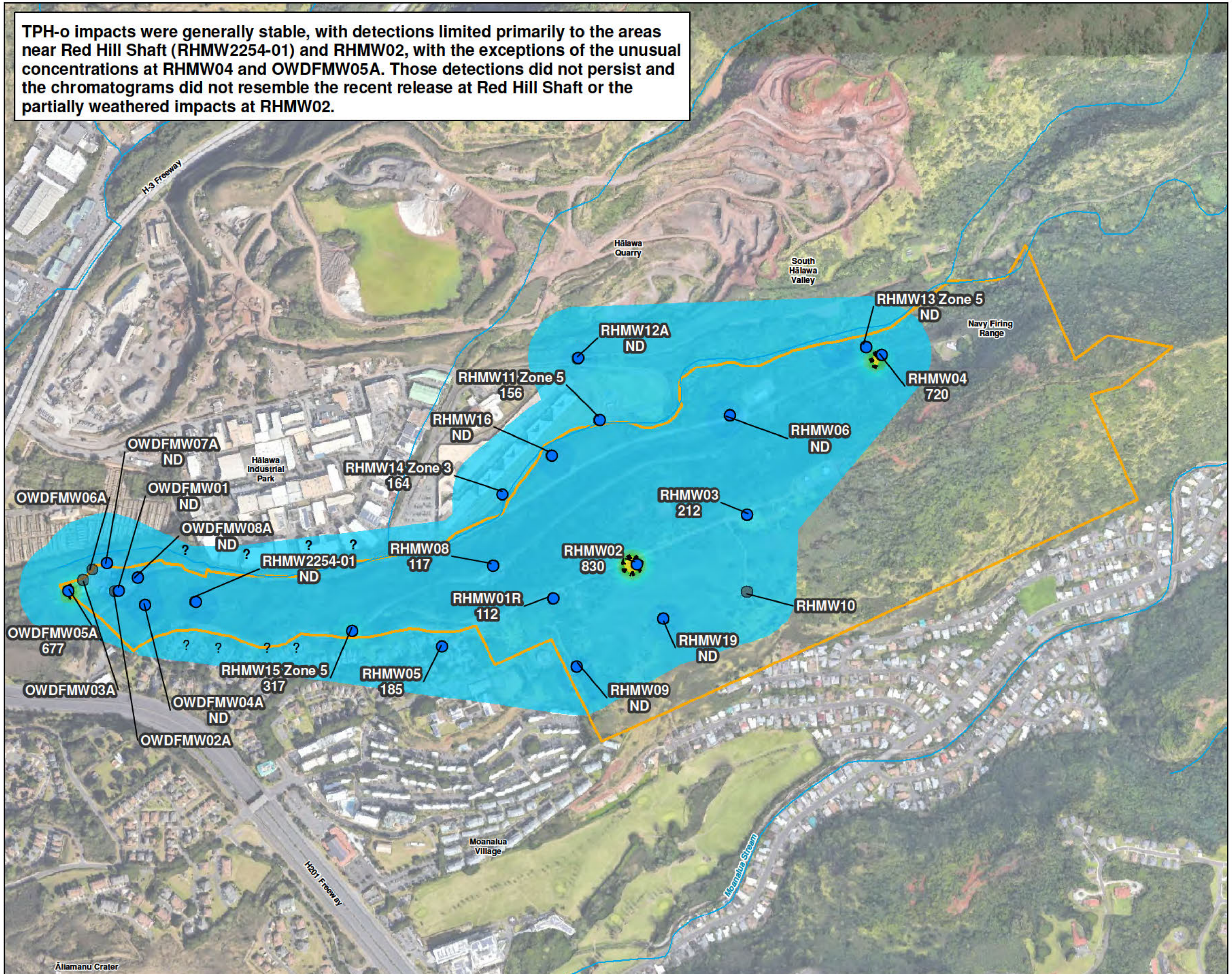
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

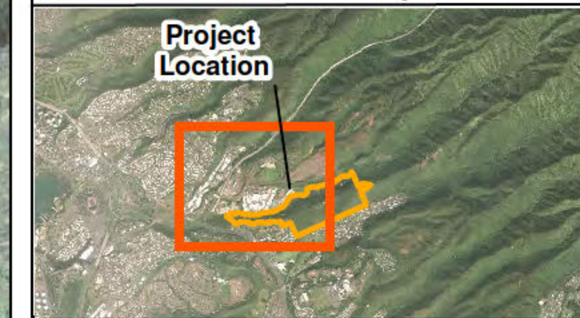
N

Feet
0 250 500 1,000

TPH-o Results
Week of April 24, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	> 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

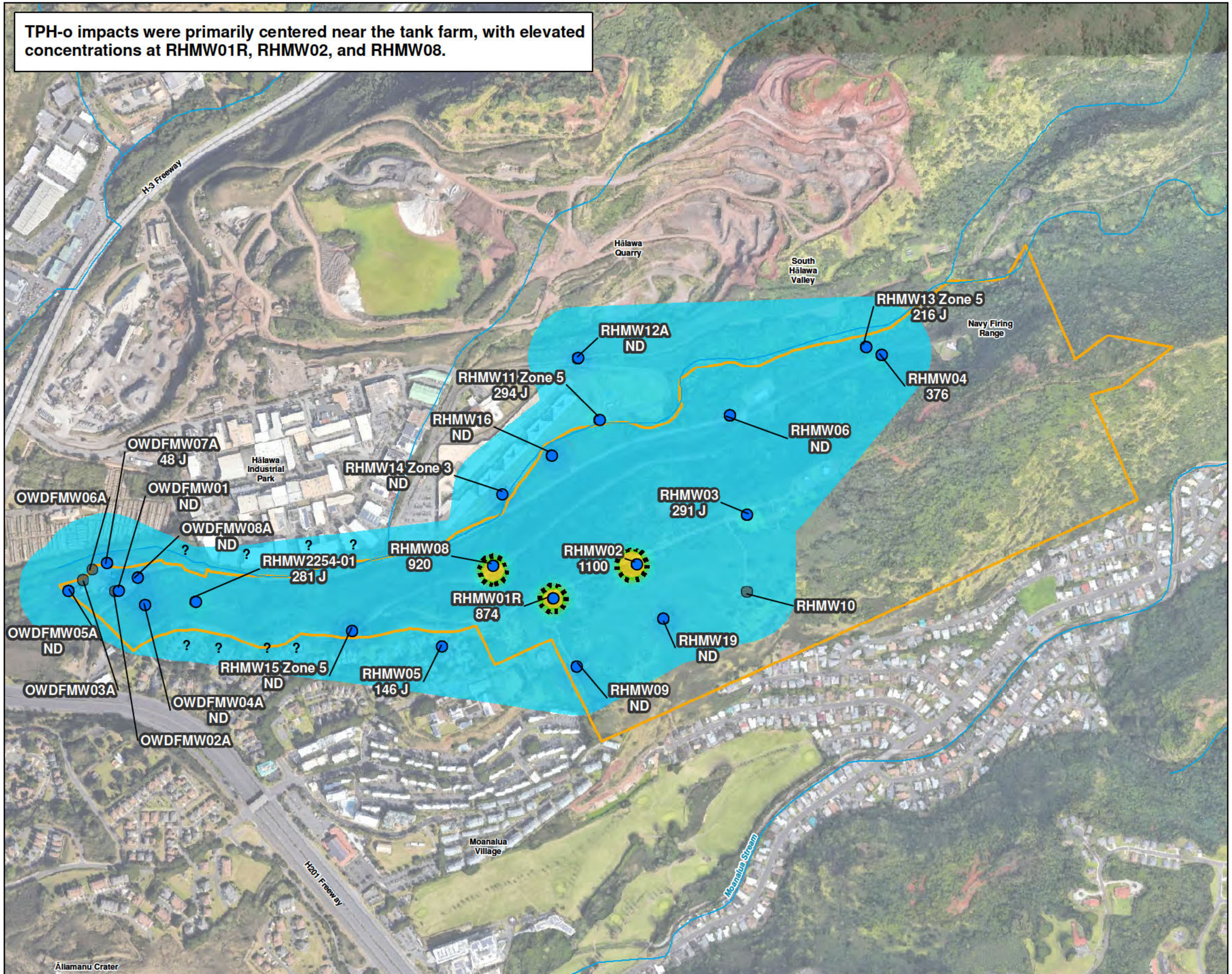
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

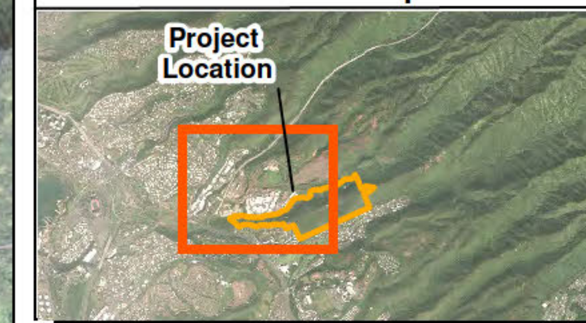
N

Feet
0 250 500 1,000

TPH-o Results
Week of May 2, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

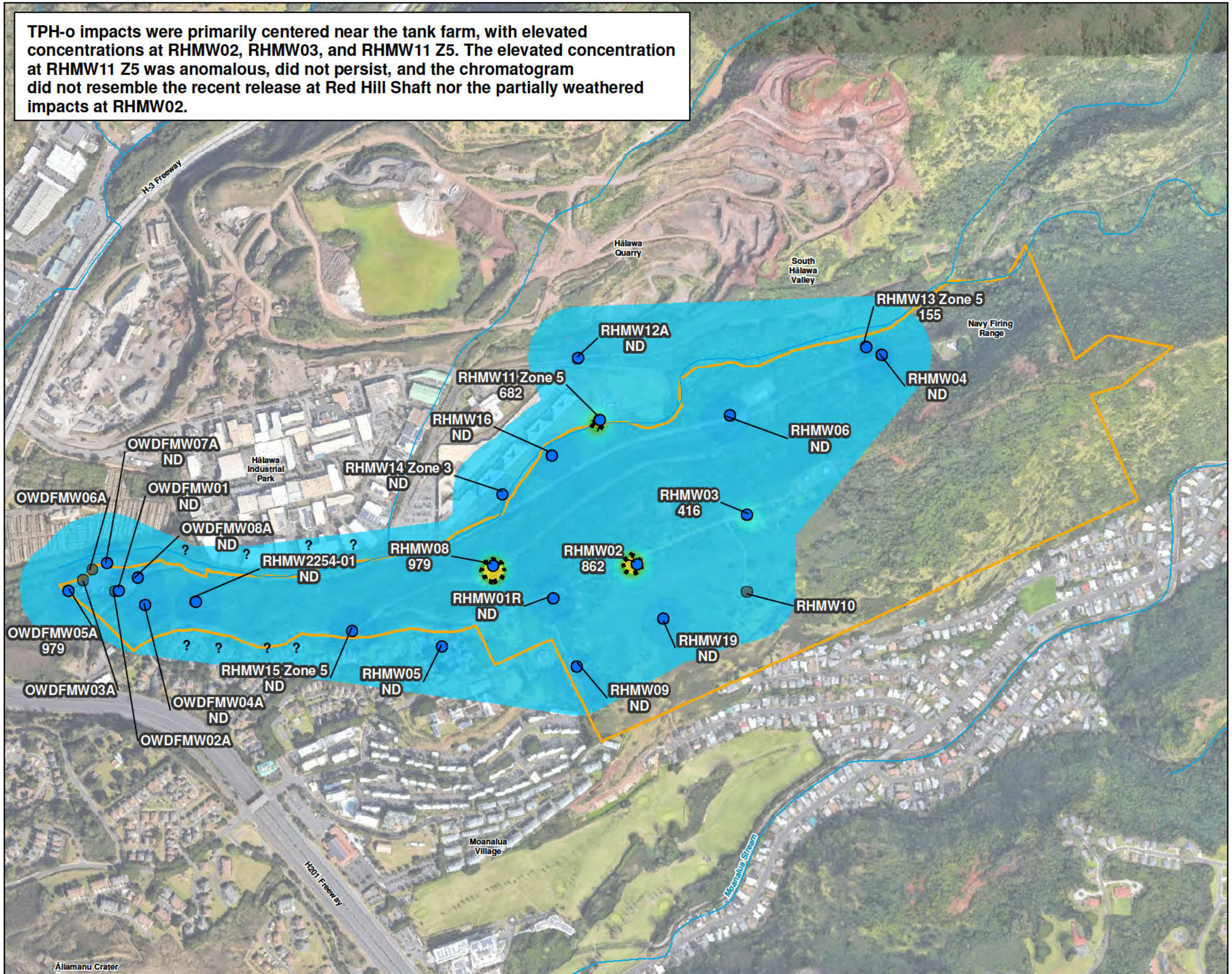
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L. No detections in this time period were greater than 5,000 µg/L.

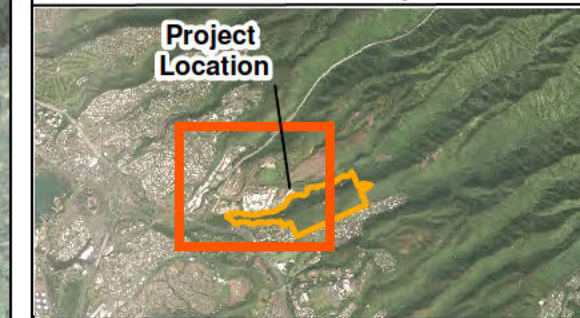
N

0 250 500 1,000 Feet

TPH-o Results
Week of May 9, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

Notes

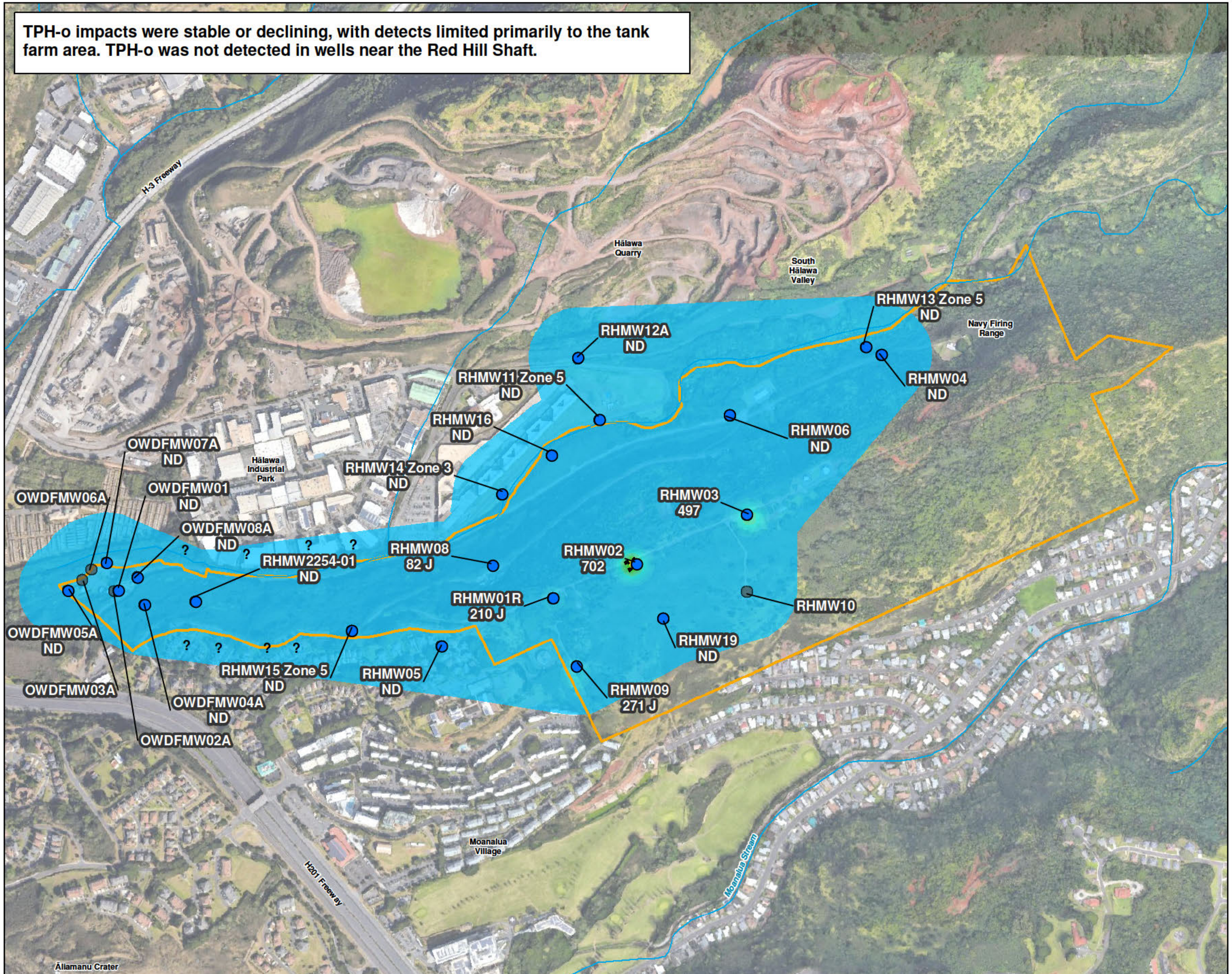
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

N

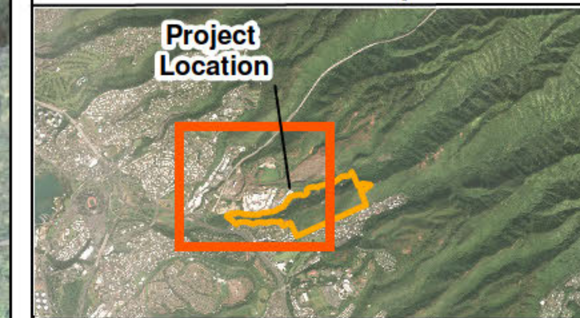
Feet
0 250 500 1,000

TPH-o Results
Week of May 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

TPH-o impacts were stable or declining, with detects limited primarily to the tank farm area. TPH-o was not detected in wells near the Red Hill Shaft.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

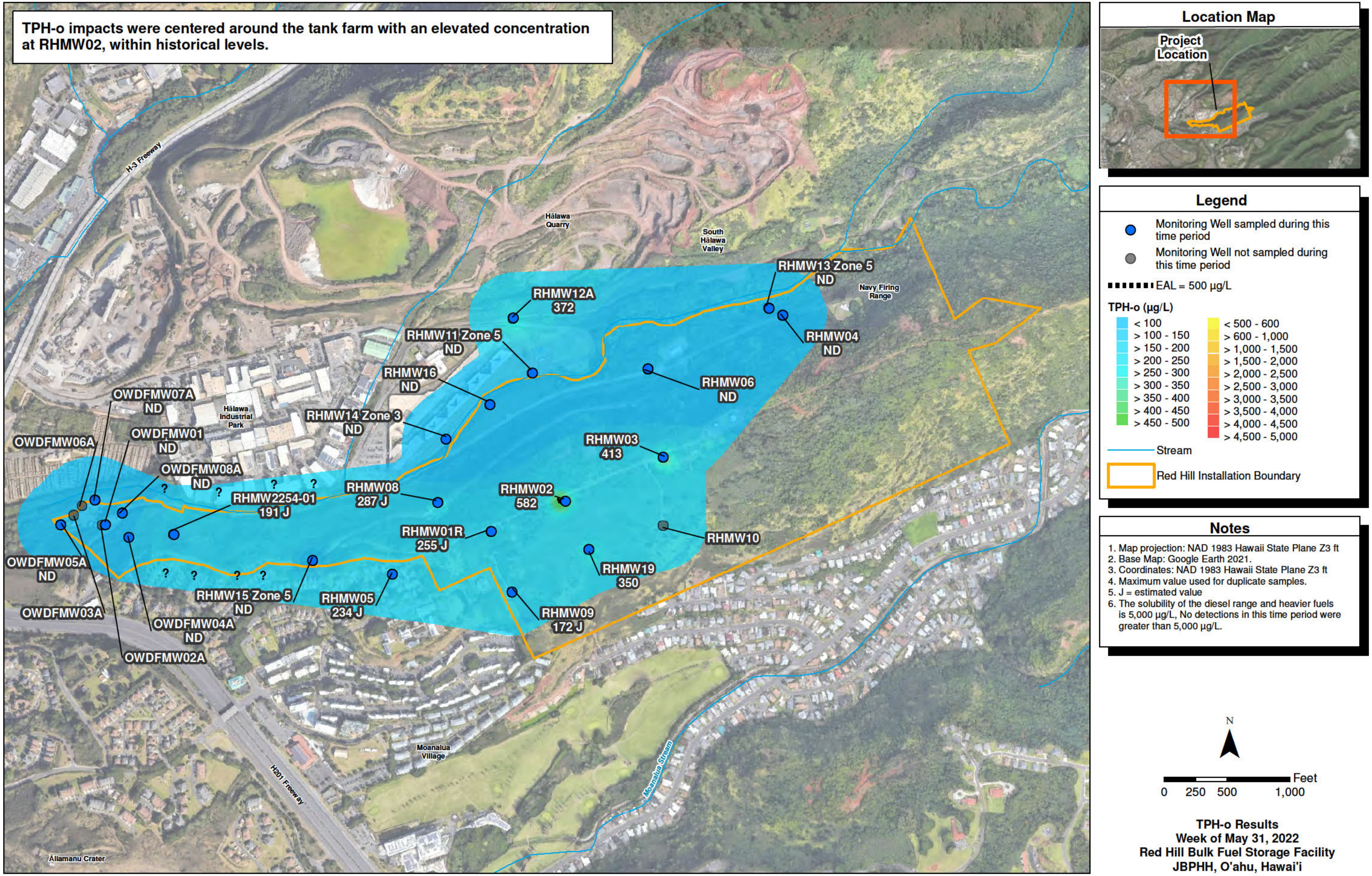
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

N

Feet
0 250 500 1,000

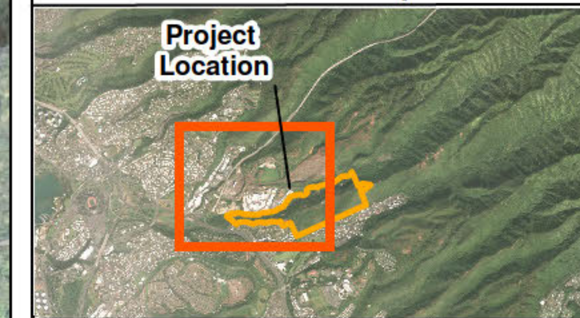
TPH-o Results
Week of May 23, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



TPH-o Results
Week of May 31, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

TPH-o impacts were centered around the tank farm with an elevated concentration at RHMW02, within historical levels.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

- < 100
- > 100 - 150
- > 150 - 200
- > 200 - 250
- > 250 - 300
- > 300 - 350
- > 350 - 400
- > 400 - 450
- > 450 - 500
- < 500 - 600
- > 600 - 1,000
- > 1,000 - 1,500
- > 1,500 - 2,000
- > 2,000 - 2,500
- > 2,500 - 3,000
- > 3,000 - 3,500
- > 3,500 - 4,000
- > 4,000 - 4,500
- > 4,500 - 5,000

Stream

Red Hill Installation Boundary

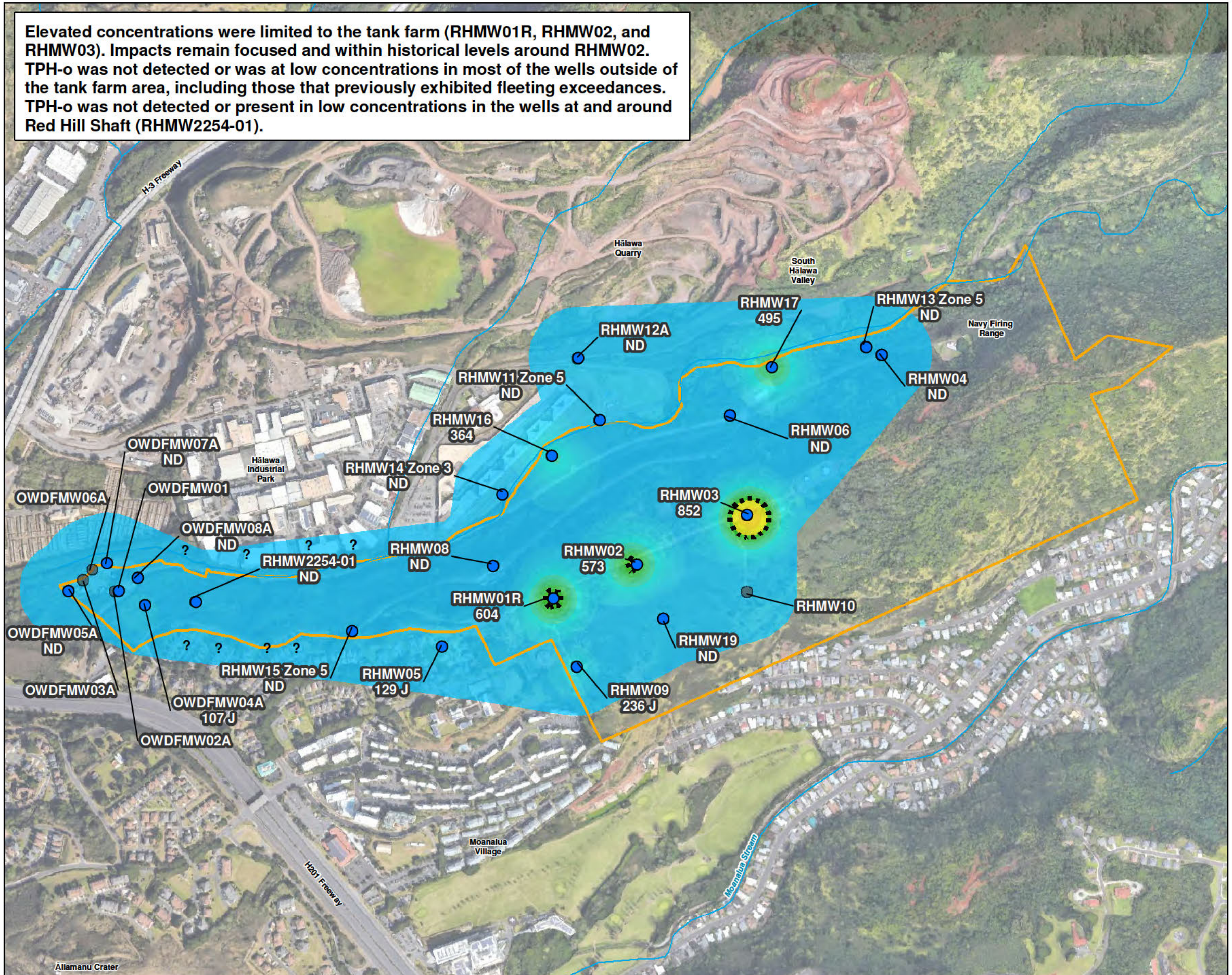
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

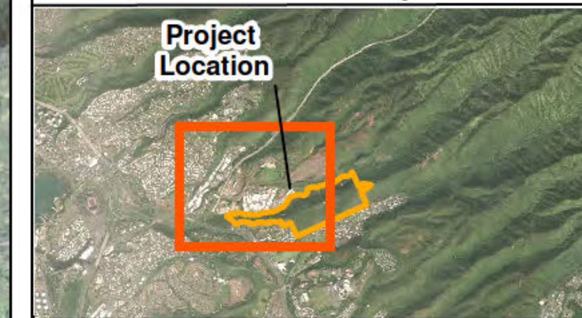
N

0 250 500 1,000 Feet

TPH-o Results
Week of June 6, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during the time period
- Monitoring Well not sampled during this time period
- EAL = 500 µg/L

TPH-o (µg/L)

< 100	< 500 - 600
> 100 - 150	> 600 - 1,000
> 150 - 200	> 1,000 - 1,500
> 200 - 250	> 1,500 - 2,000
> 250 - 300	> 2,000 - 2,500
> 300 - 350	> 2,500 - 3,000
> 350 - 400	> 3,000 - 3,500
> 400 - 450	> 3,500 - 4,000
> 450 - 500	> 4,000 - 4,500
	> 4,500 - 5,000

- Stream
- Red Hill Installation Boundary

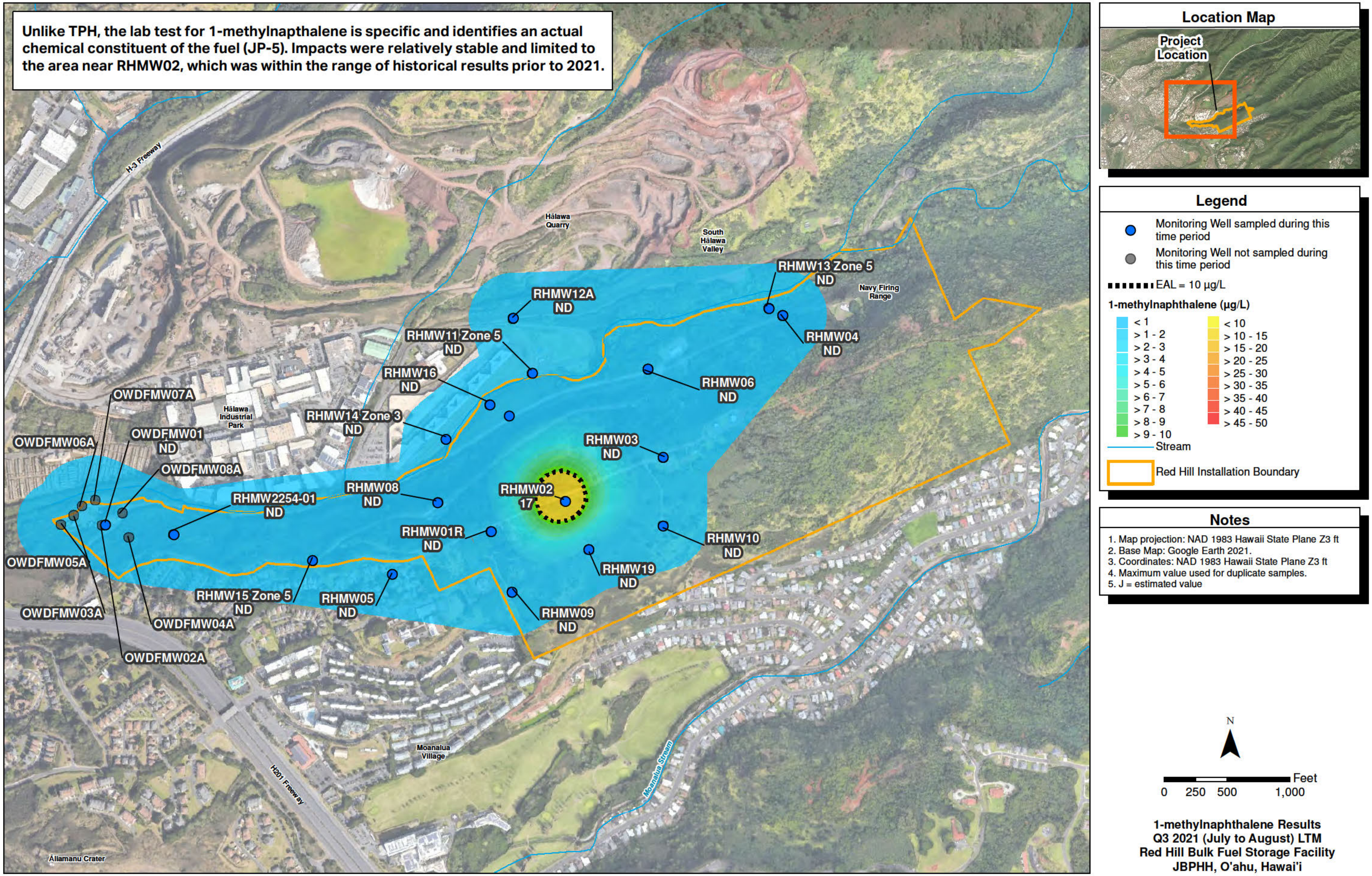
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
6. The solubility of the diesel range and heavier fuels is 5,000 µg/L, No detections in this time period were greater than 5,000 µg/L.

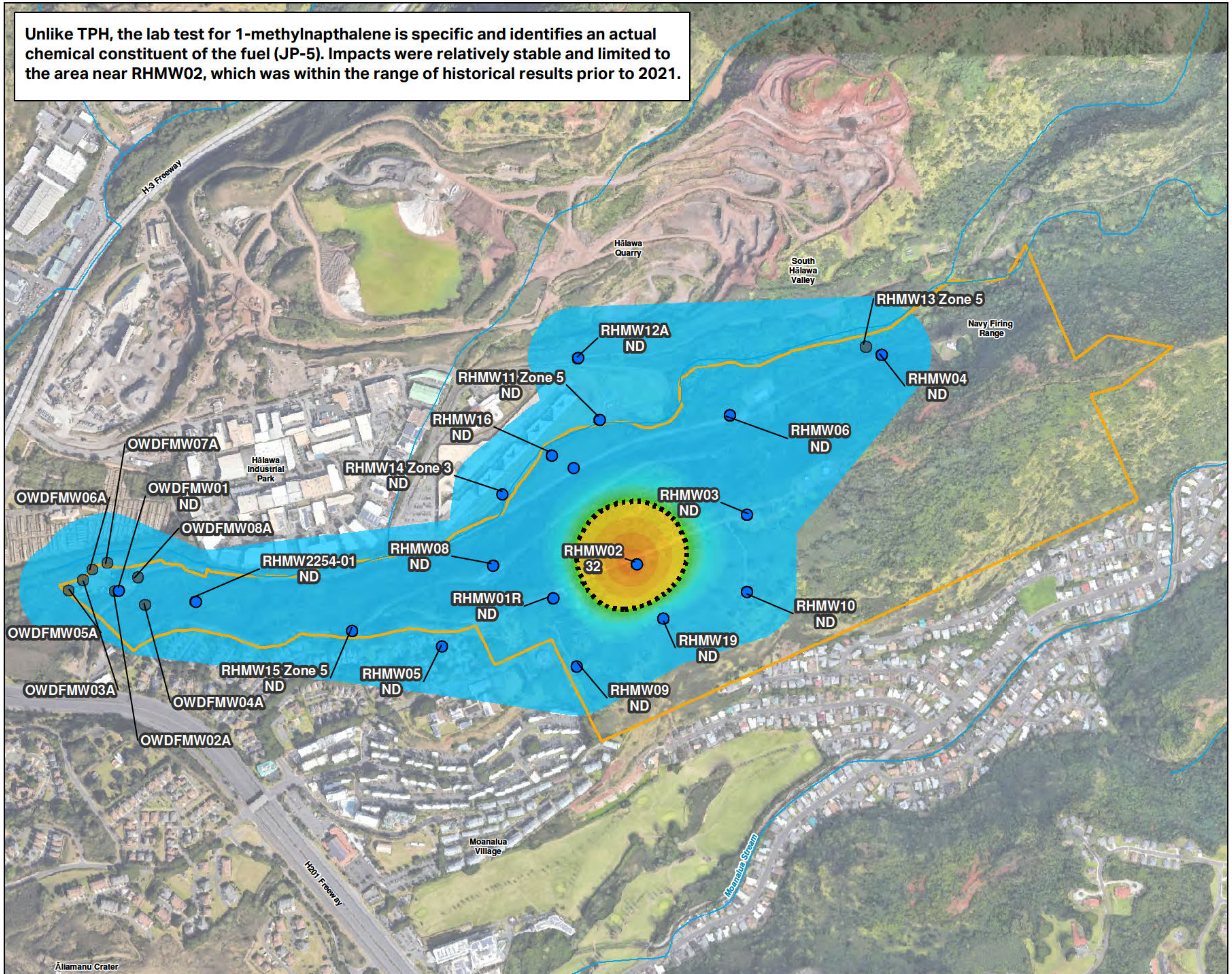
N

Feet
0 250 500 1,000

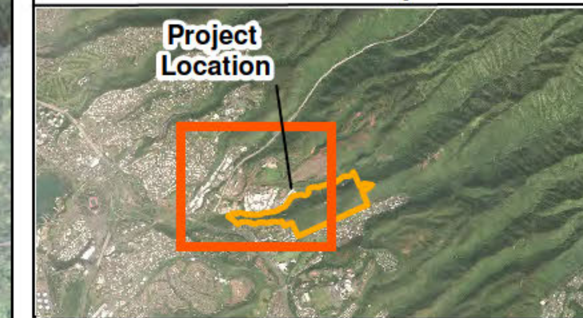
TPH-o Results
Week of June 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Unlike TPH, the lab test for 1-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were relatively stable and limited to the area near RHMW02, which was within the range of historical results prior to 2021.
H-3 Freeway
Hālawa Quarry
South Hālawa Valley
Navy Firing Range
Hālawa Industrial Park
RHMW13 Zone 5
ND
RHMW12A
ND
RHMW04
ND
RHMW11 Zone 5
ND
RHMW16
ND
RHMW06
ND
OWDFMW07A
RHMW14 Zone 3
ND
OWDFMW06A
OWDFMW01
ND
RHMW03
ND
OWDFMW08A
RHMW08
ND
RHMW02
17
RHMW2254-01
ND
RHMW01R
ND
RHMW10
ND
OWDFMW05A
RHMW19
ND
RHMW15 Zone 5
ND
RHMW05
ND
RHMW09
ND
OWDFMW03A
OWDFMW04A
OWDFMW02A
Moanalua Village
H201 Freeway
Moanalua Stream
Āliamanu Crater
Location Map
Project Location
Legend
Monitoring Well sampled during this time period
Monitoring Well not sampled during this time period
EAL = 10 µg/L
1-methylnaphthalene (µg/L)
< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
< 10
> 10 - 15
> 15 - 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50
Stream
Red Hill Installation Boundary
Notes
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
N
Feet
0 250 500 1,000
1-methylnaphthalene Results
Q3 2021 (July to August) LTM
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

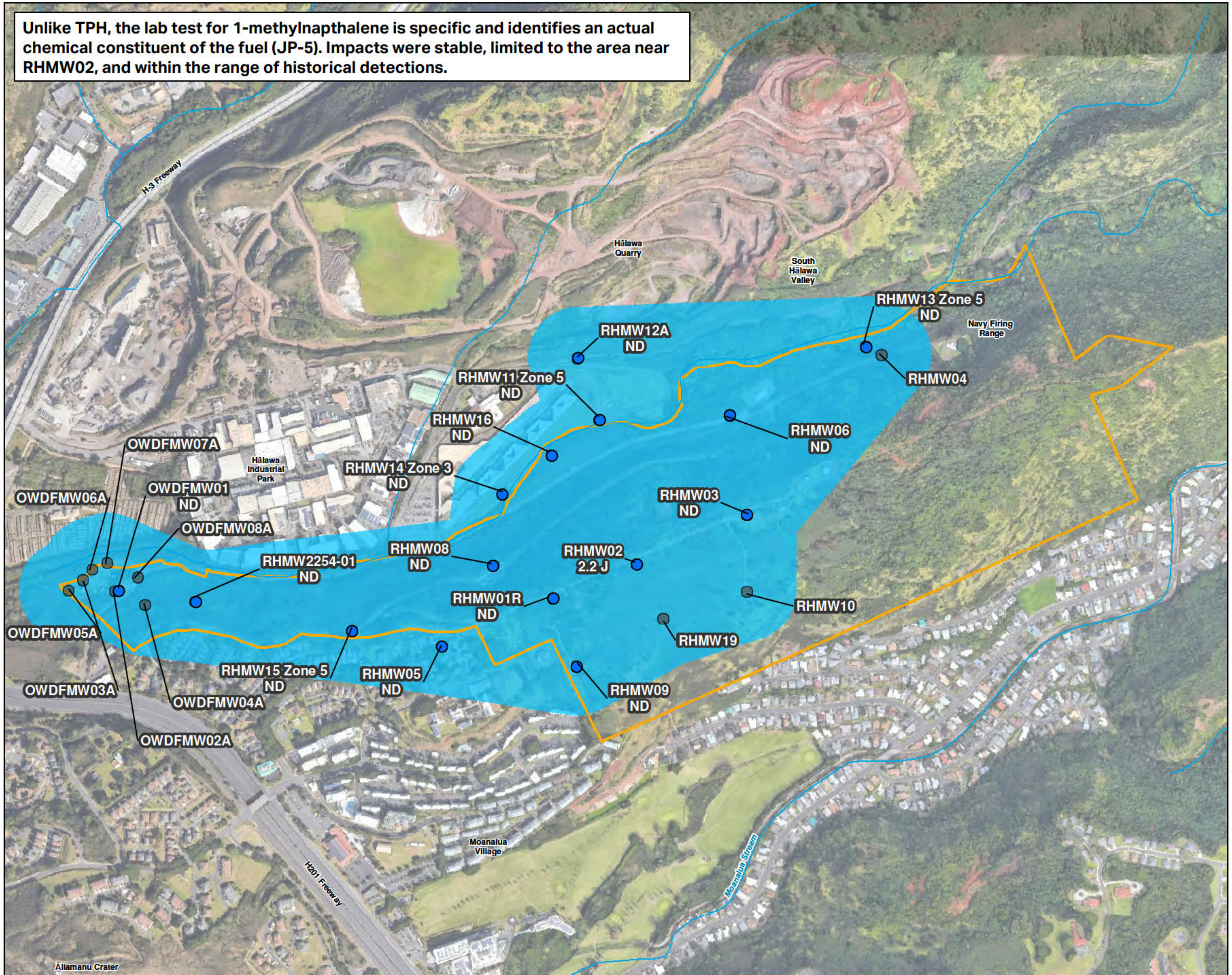
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

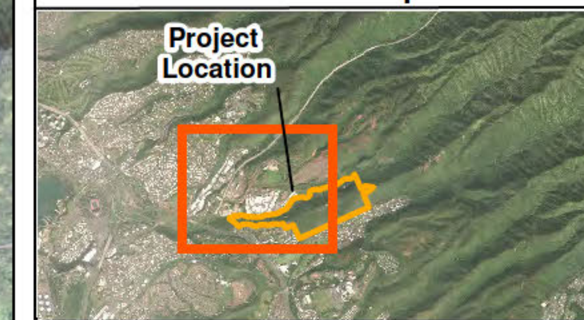
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Q4 2021 (October to November) LTM
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

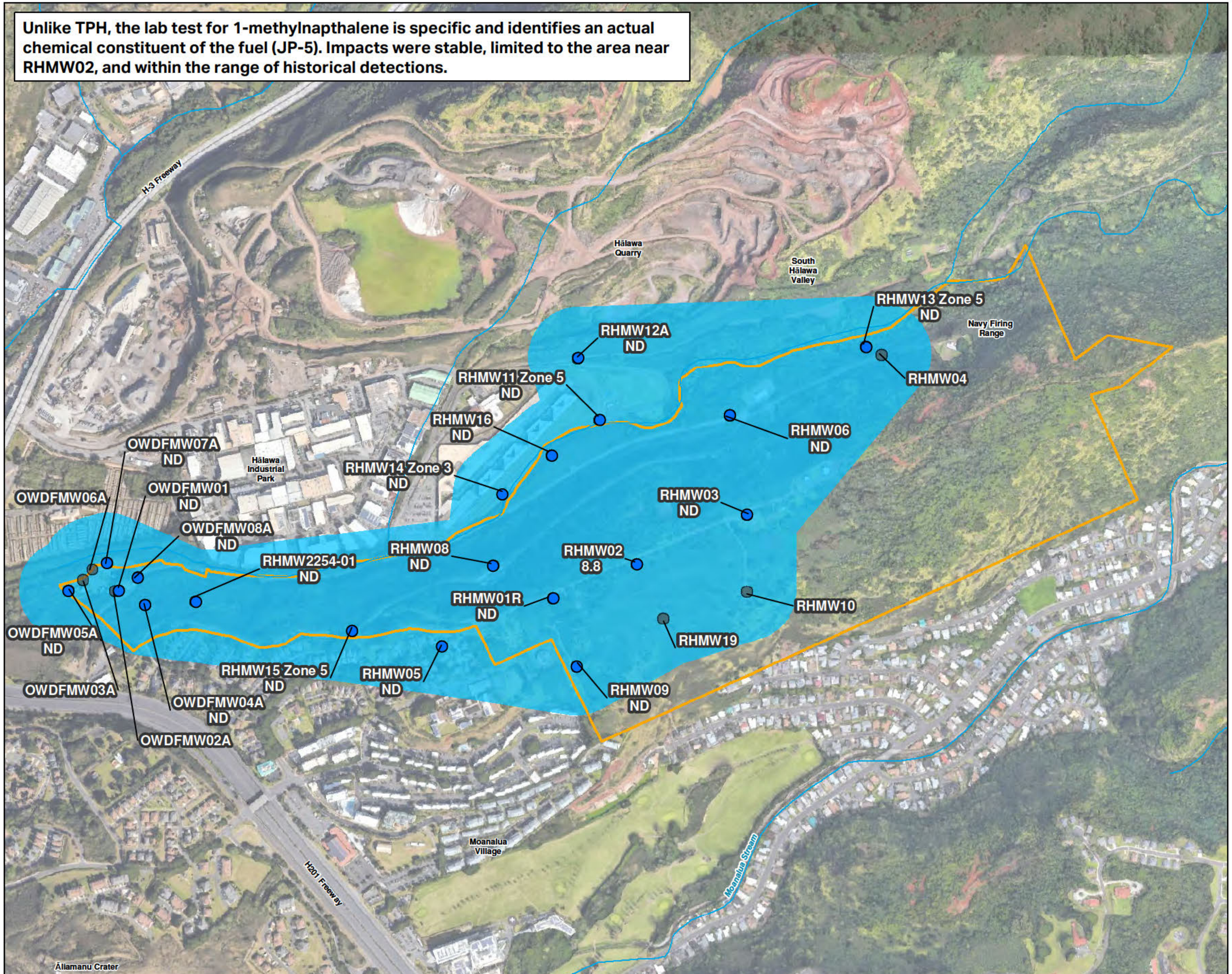
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

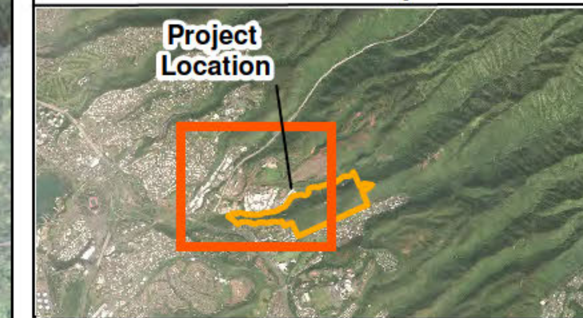
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of December 13, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

Notes

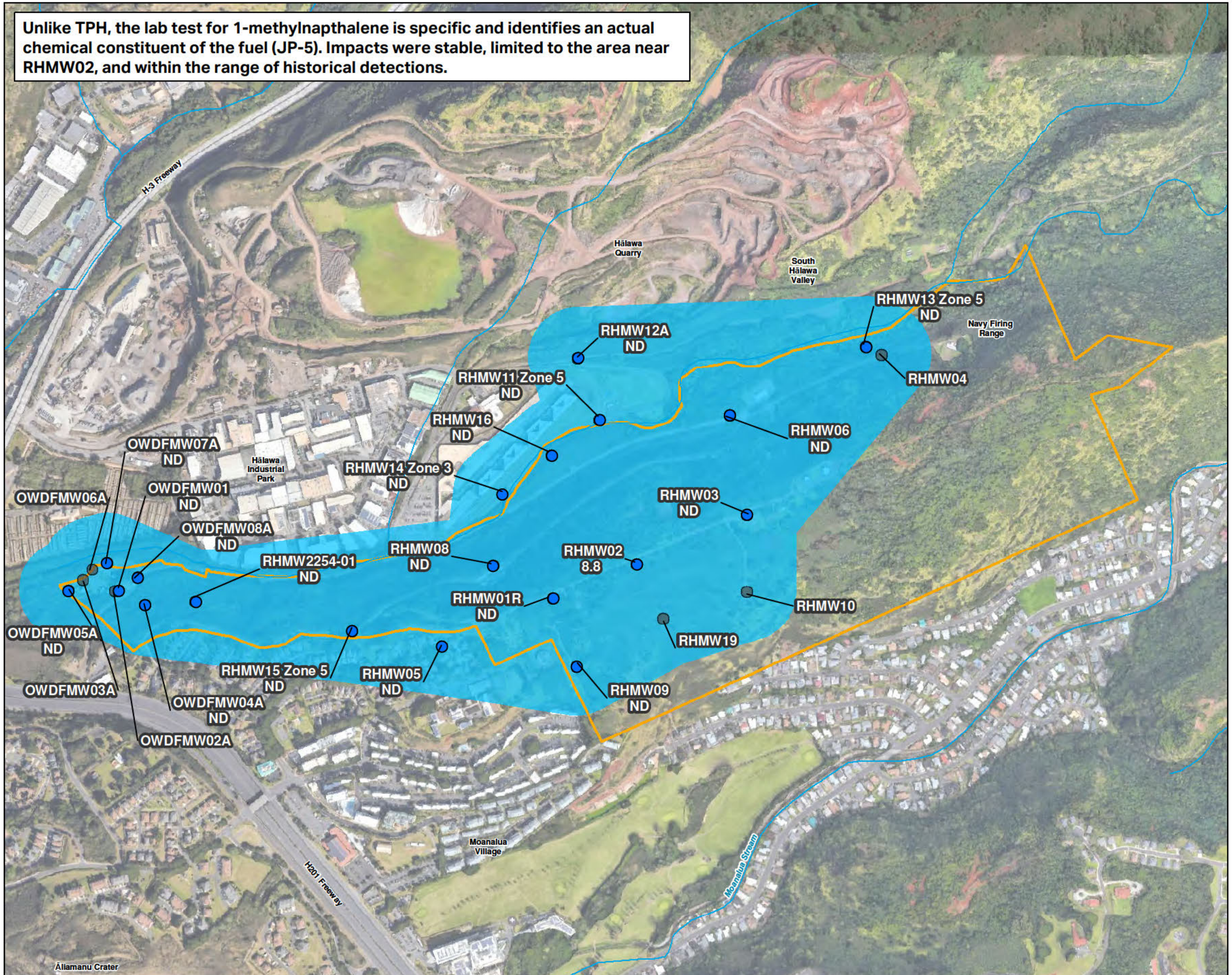
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

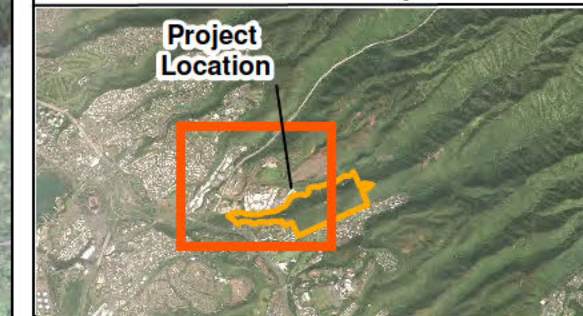
Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of December 20, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 1-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were stable, limited to the area near RHMW02, and within the range of historical detections.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

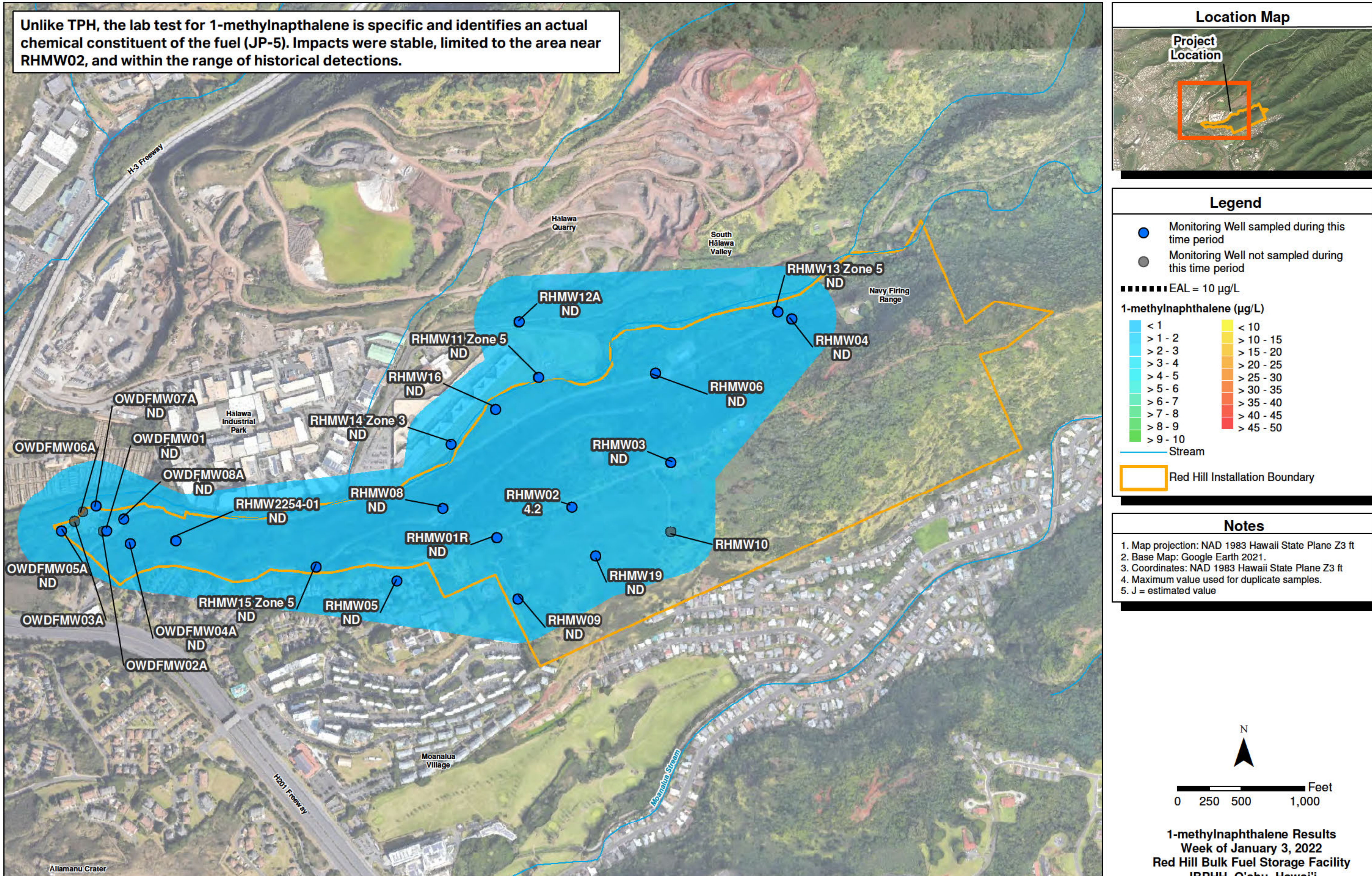
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

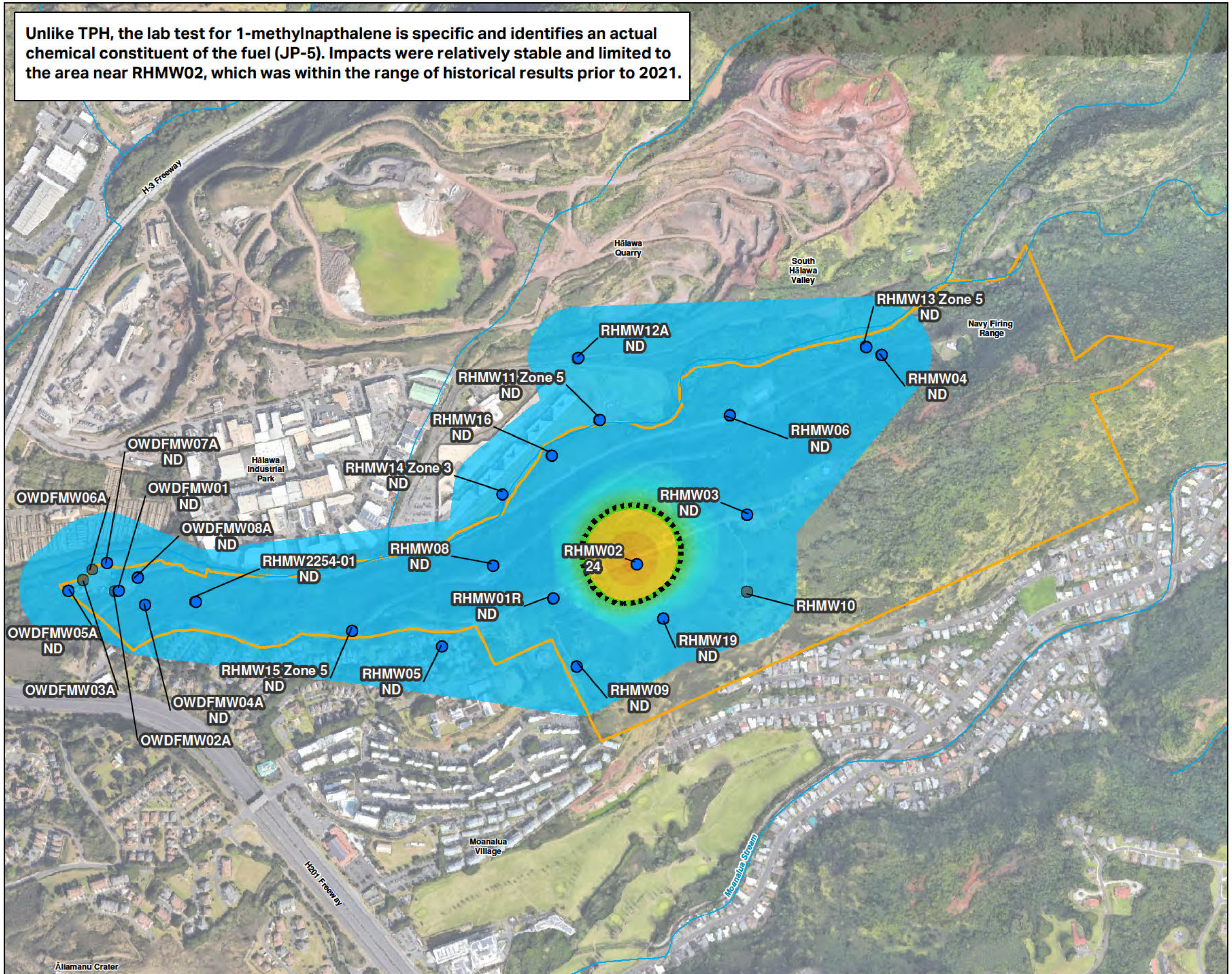
N

Feet
0 250 500 1,000

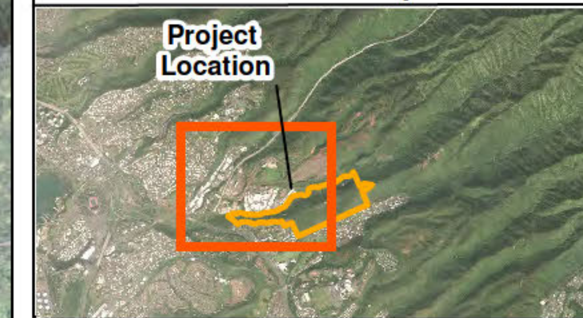
1-methylnaphthalene Results
Week of December 27, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



1-methylnaphthalene Results
Week of January 3, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

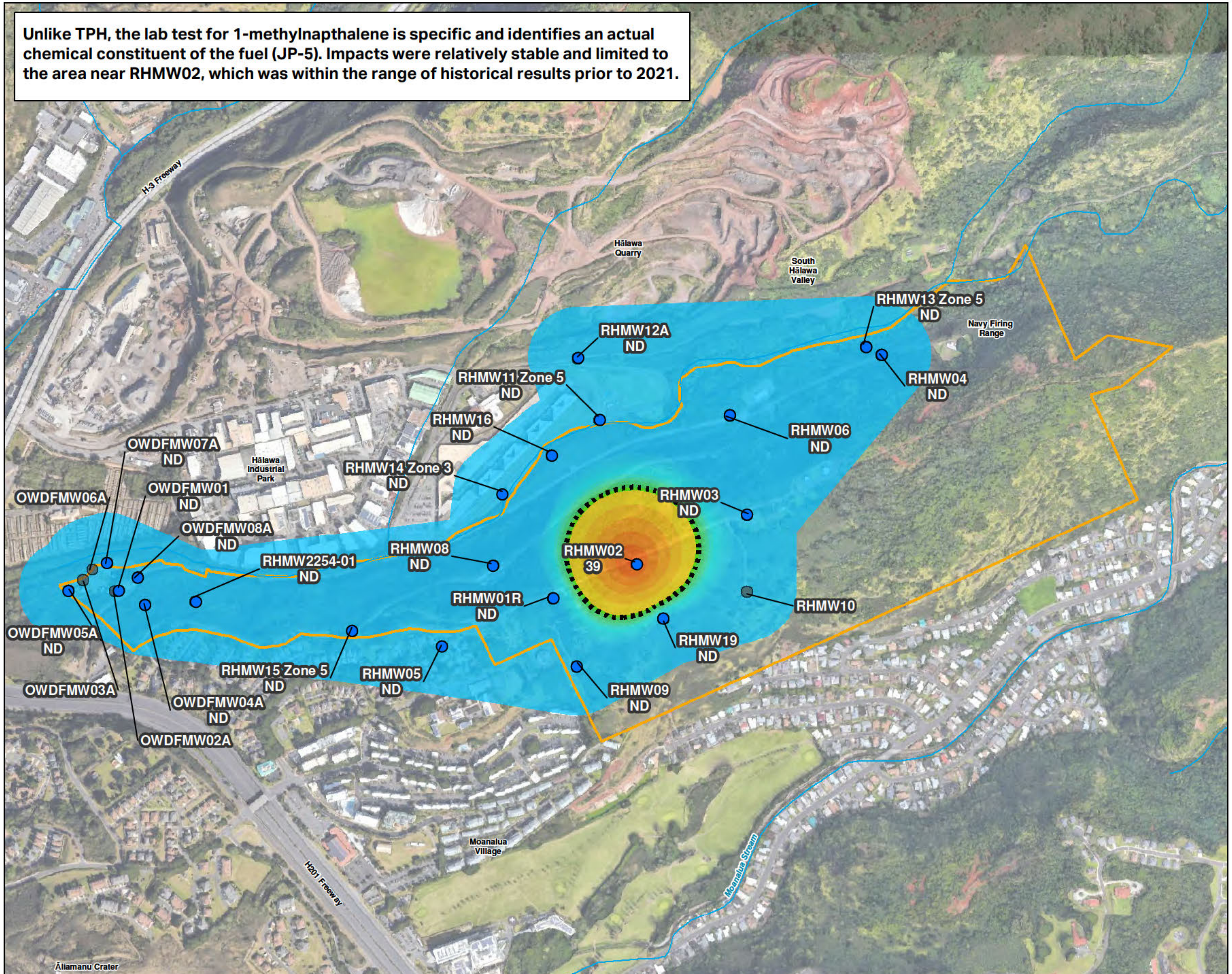
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

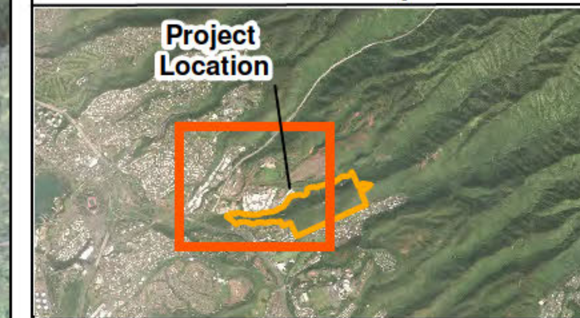
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of January 10, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

Notes

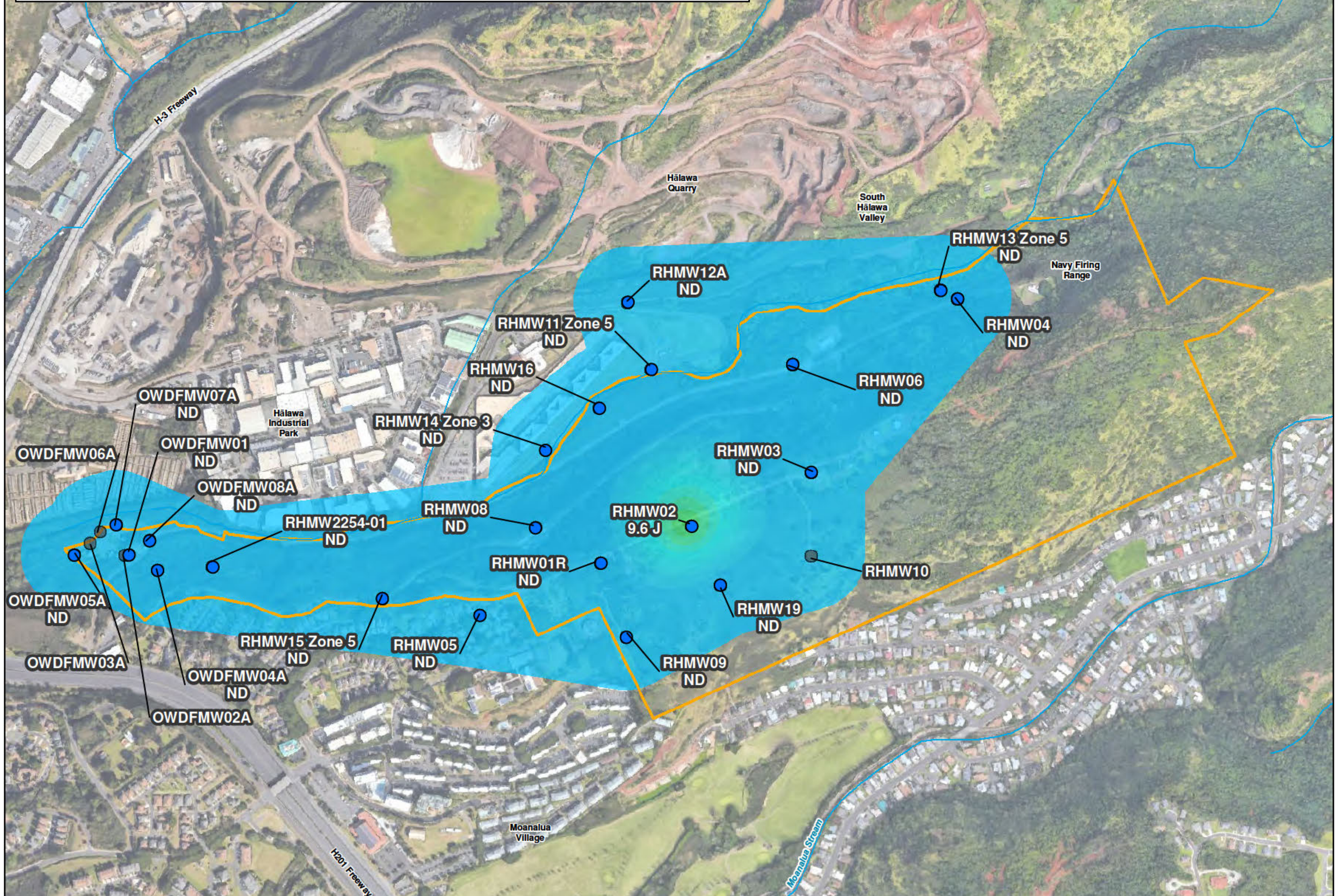
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

Feet
0 250 500 1,000

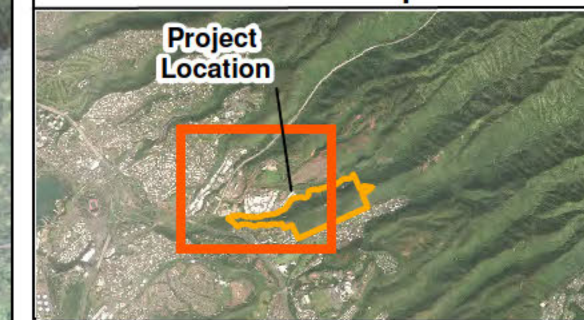
1-methylnaphthalene Results
Week of January 17, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 1-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were stable, limited to the area near RHMW02, and within the range of historical detections.



Note that sampling was discontinued in many of the wells from the end of January to the end of February, in consultation with the DOH and EPA, to allow for USGS water level monitoring.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

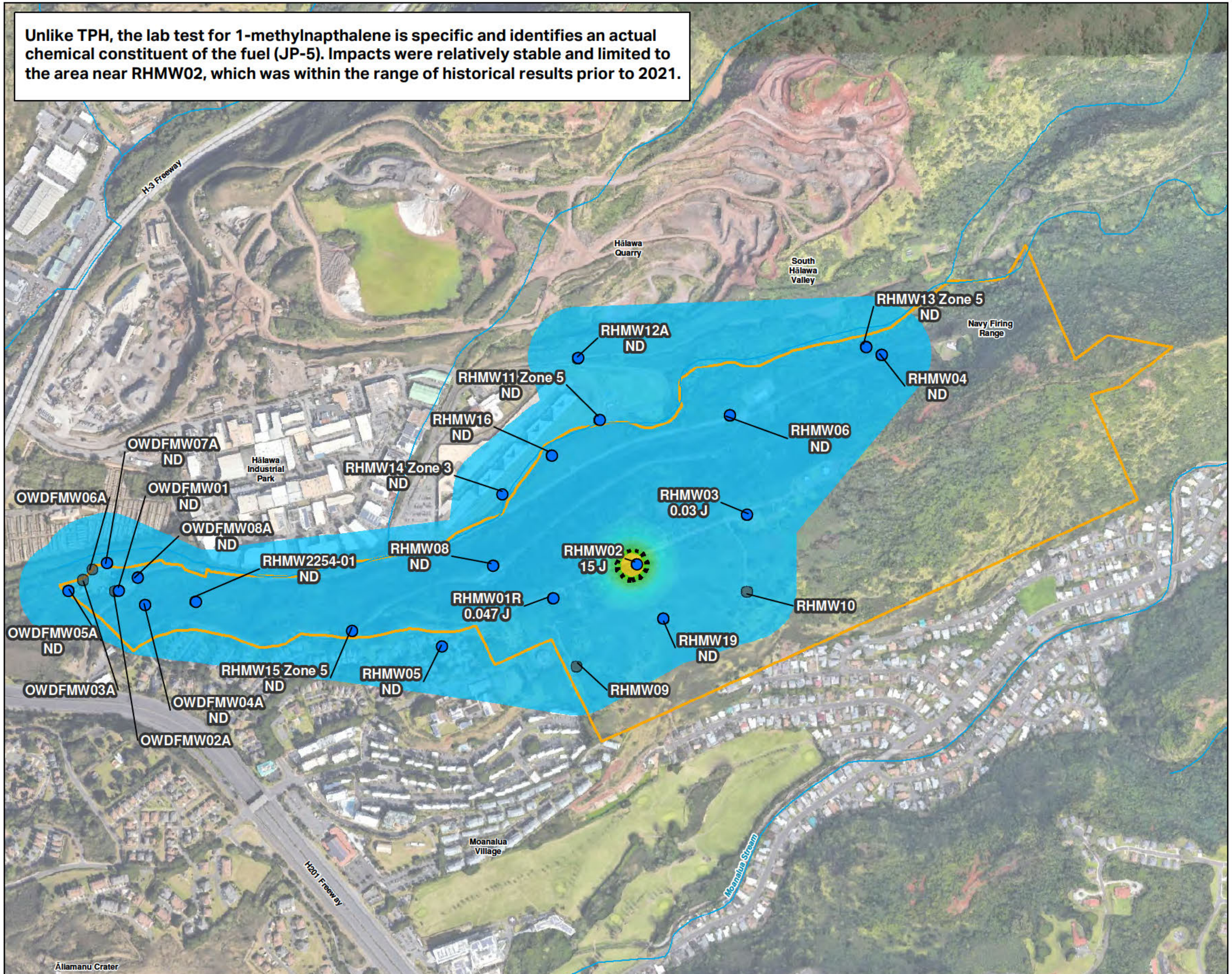
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

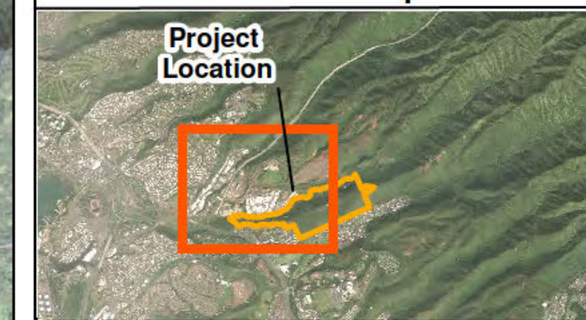
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of February 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

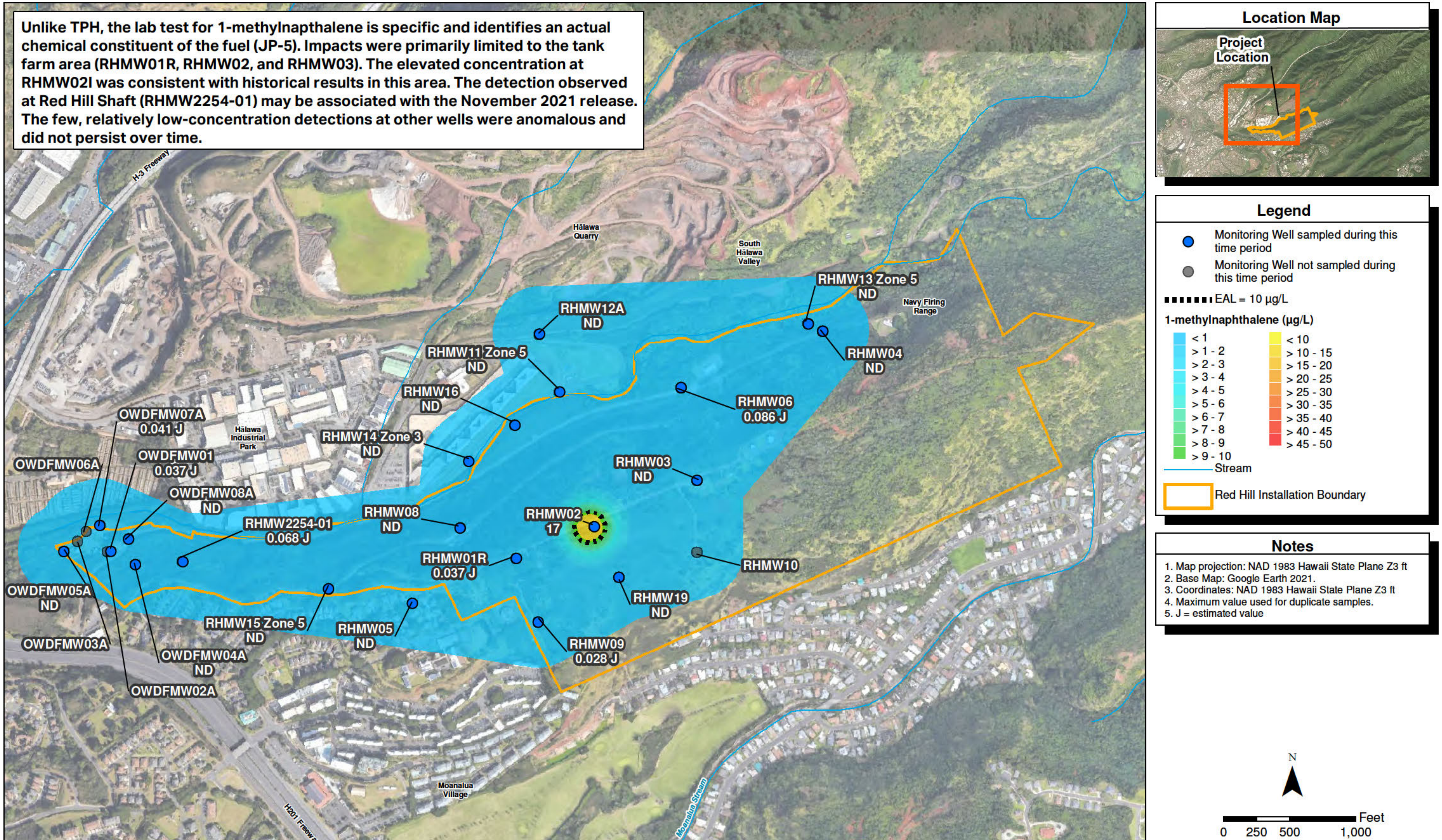
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

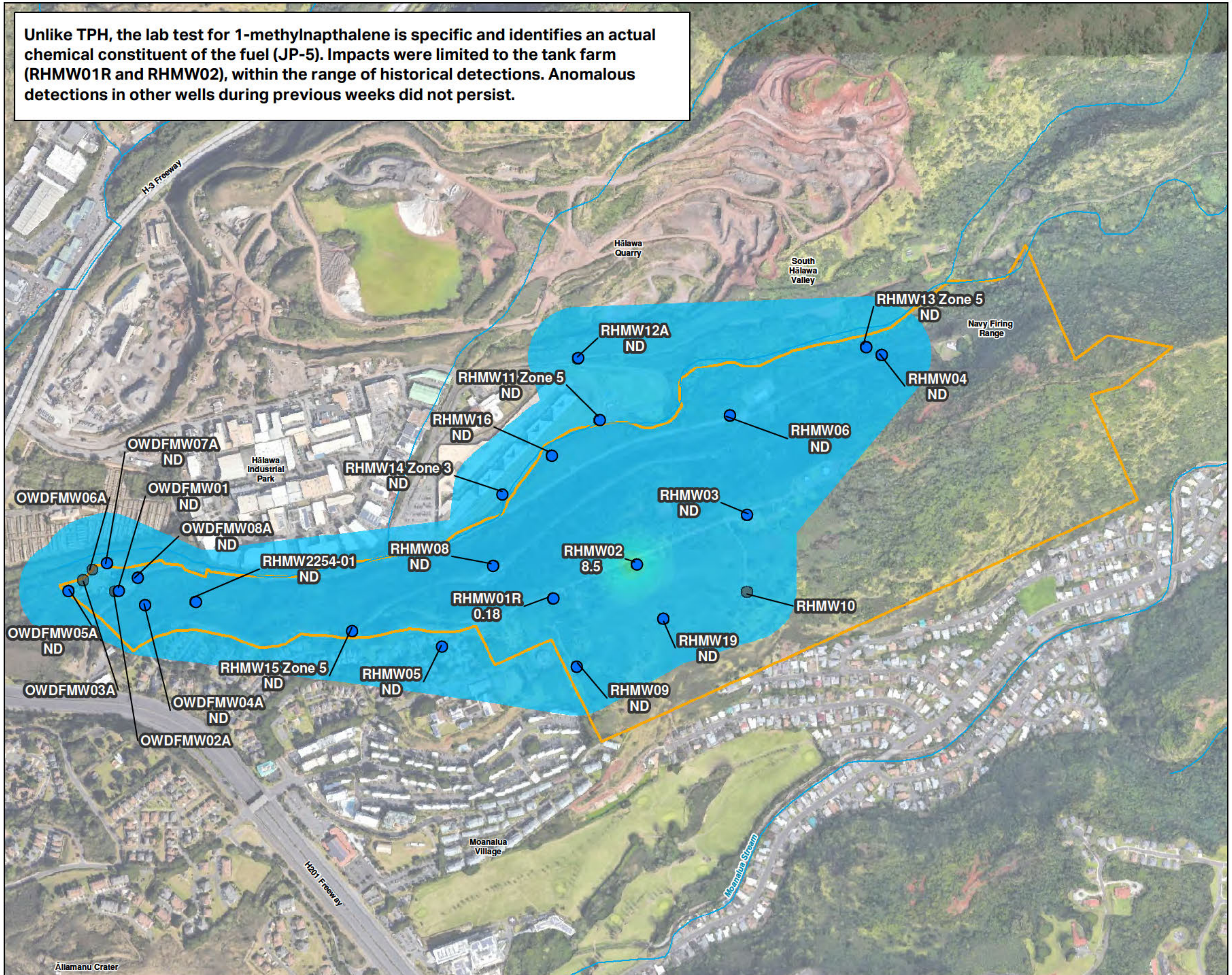
Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of March 7, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

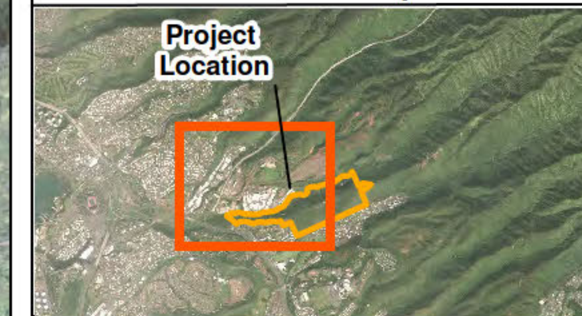


1-methylnaphthalene Results
Week of March 14, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 1-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the tank farm (RHMW01R and RHMW02), within the range of historical detections. Anomalous detections in other wells during previous weeks did not persist.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

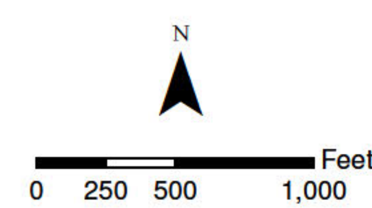
1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

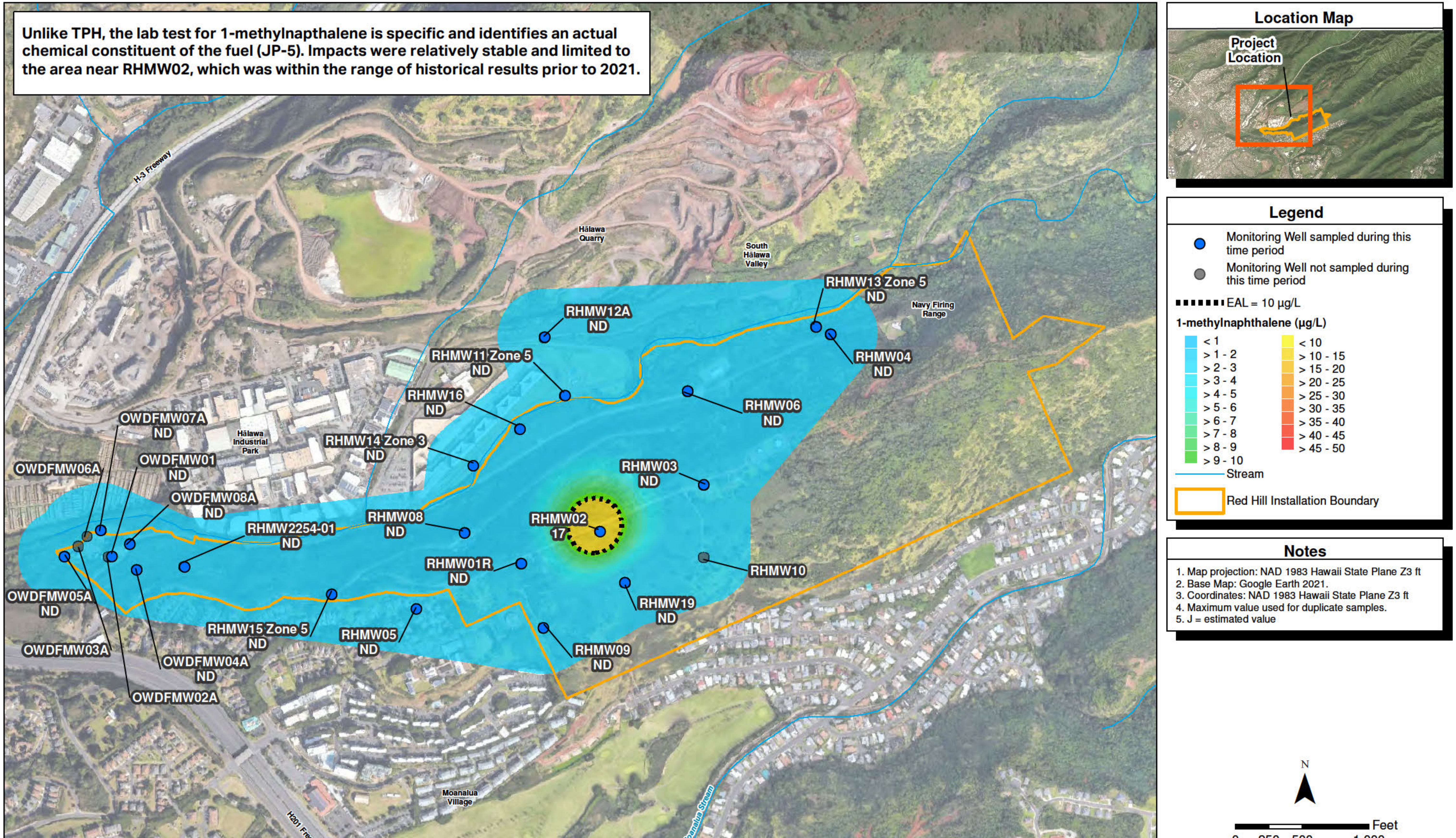
- Stream
- Red Hill Installation Boundary

Notes

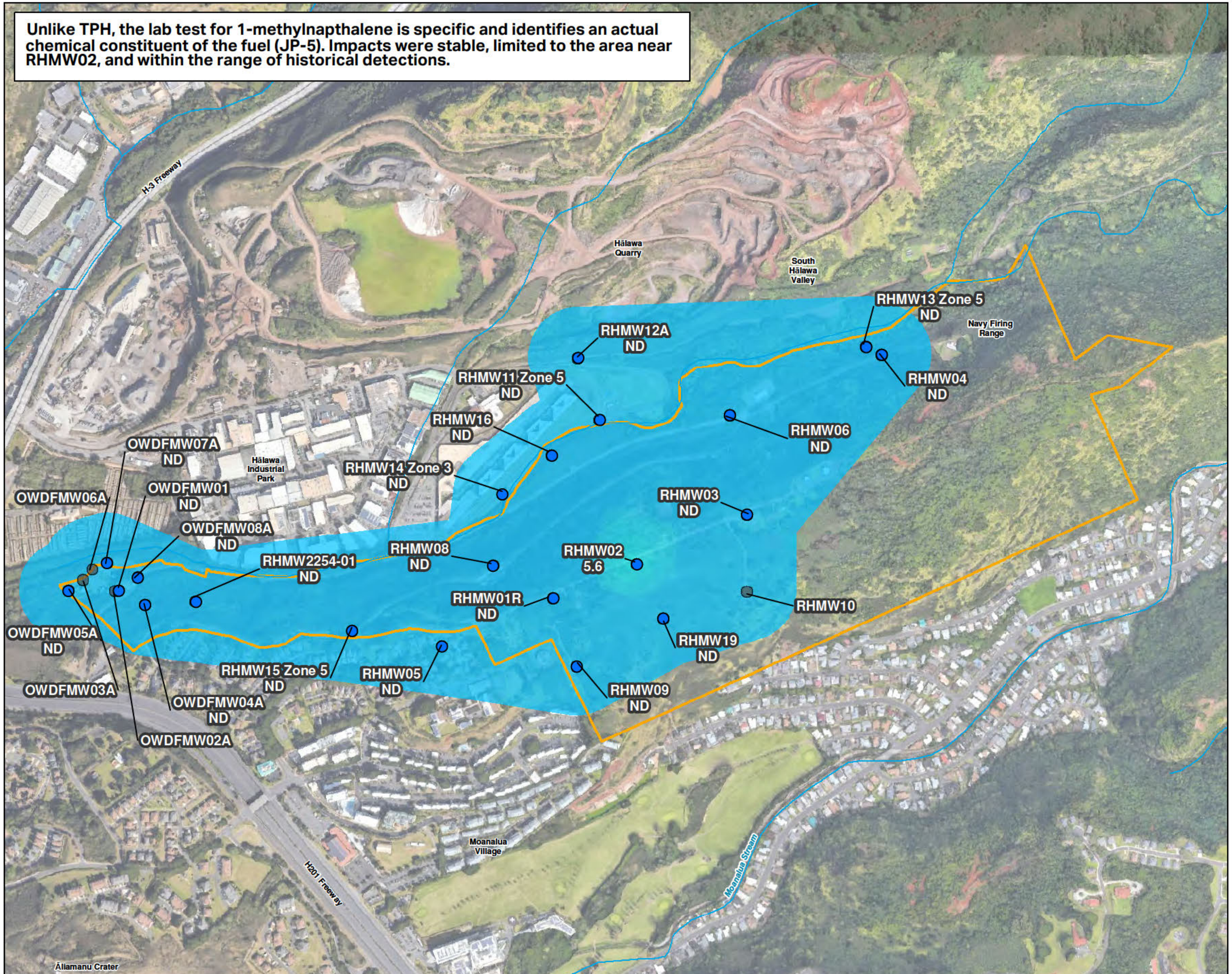
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value



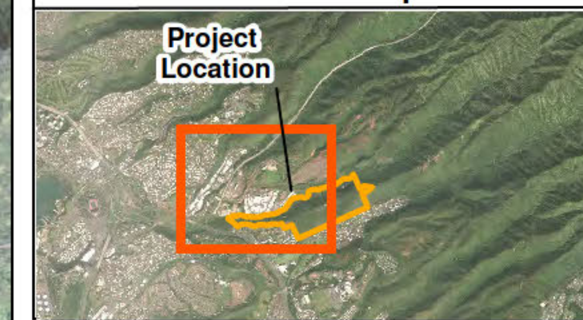
1-methylnaphthalene Results
Week of March 21, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



1-methylnaphthalene Results
Week of March 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1, > 1 - 2, > 2 - 3, > 3 - 4, > 4 - 5, > 5 - 6, > 6 - 7, > 7 - 8, > 8 - 9, > 9 - 10

< 10, > 10 - 15, > 15 - 20, > 20 - 25, > 25 - 30, > 30 - 35, > 35 - 40, > 40 - 45, > 45 - 50

- Stream
- Red Hill Installation Boundary

Notes

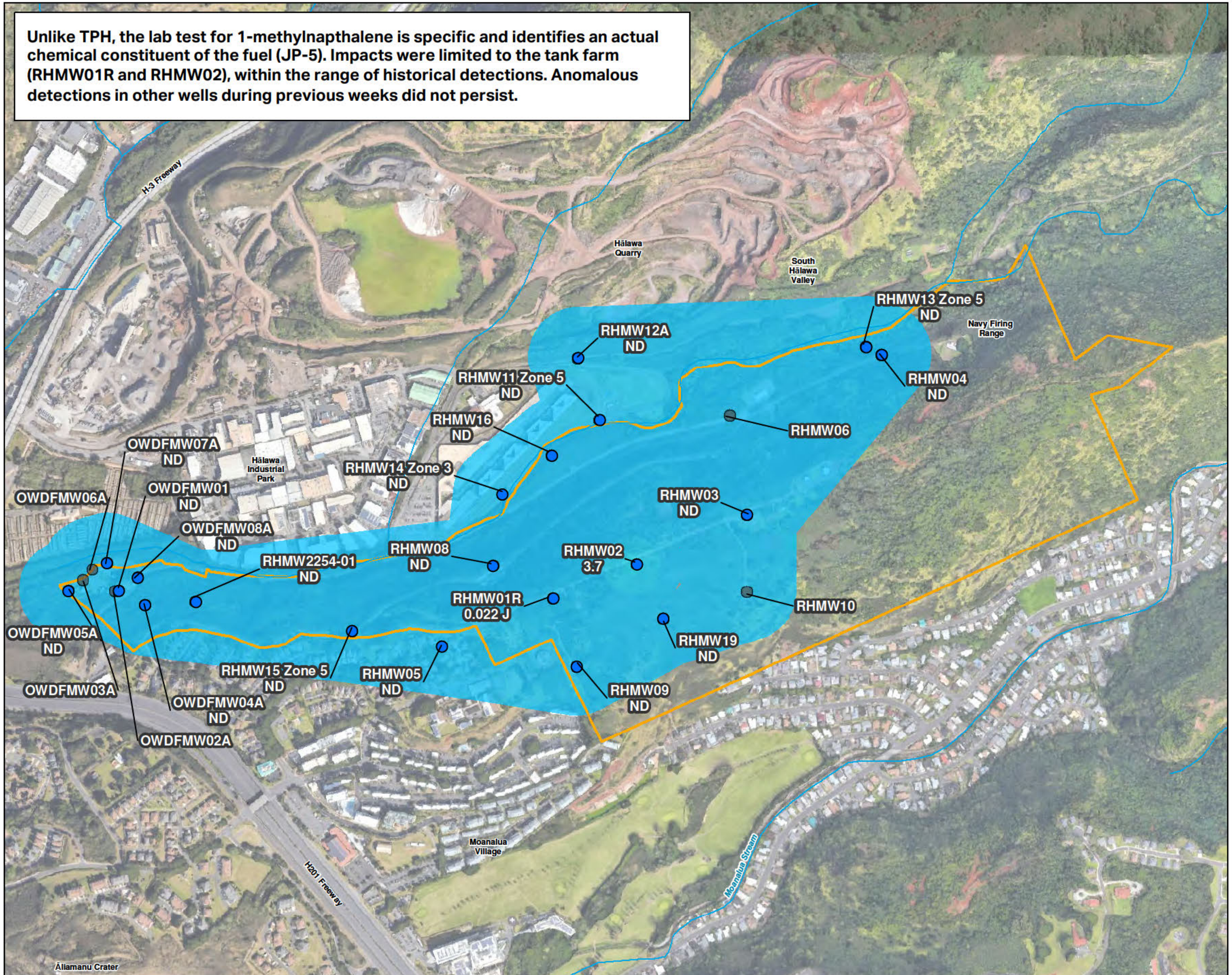
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

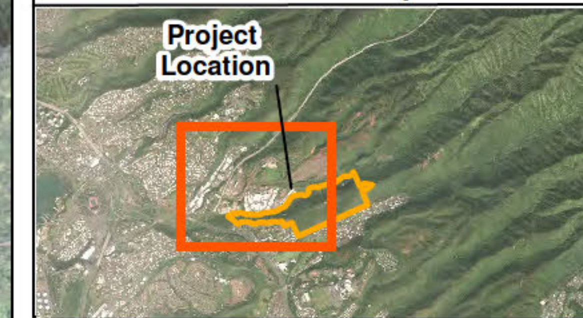
Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of April 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 1-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the tank farm (RHMW01R and RHMW02), within the range of historical detections. Anomalous detections in other wells during previous weeks did not persist.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

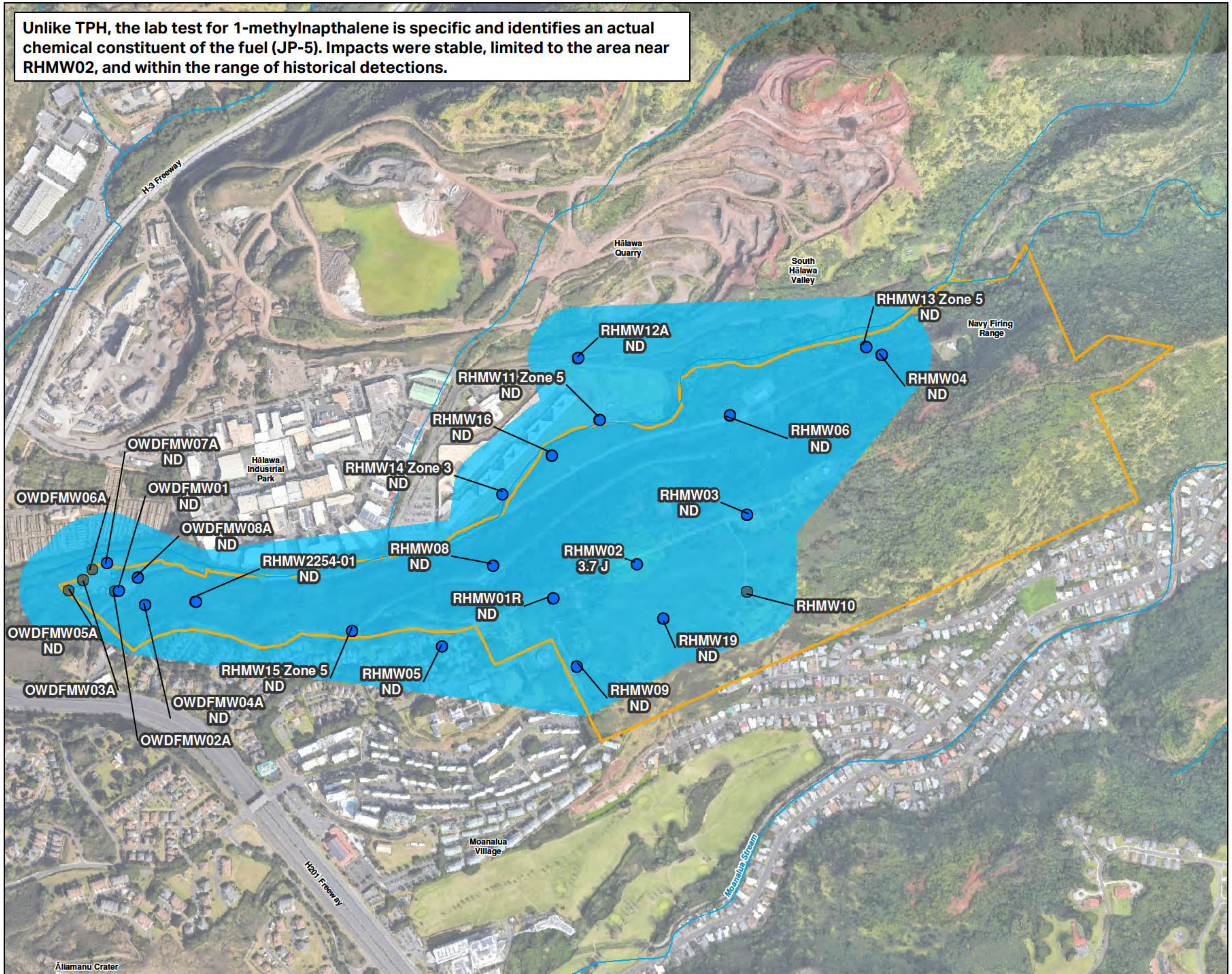
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

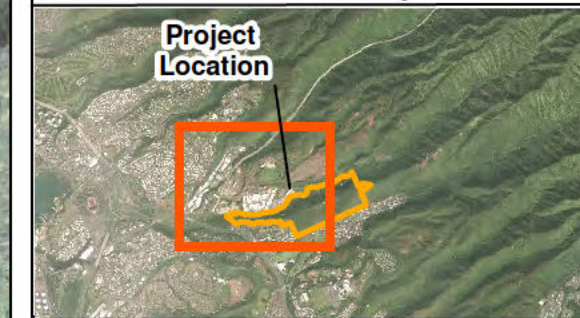
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of April 24, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- < 10
- > 10 - 15
- > 15 - 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50
- Stream
- Red Hill Installation Boundary

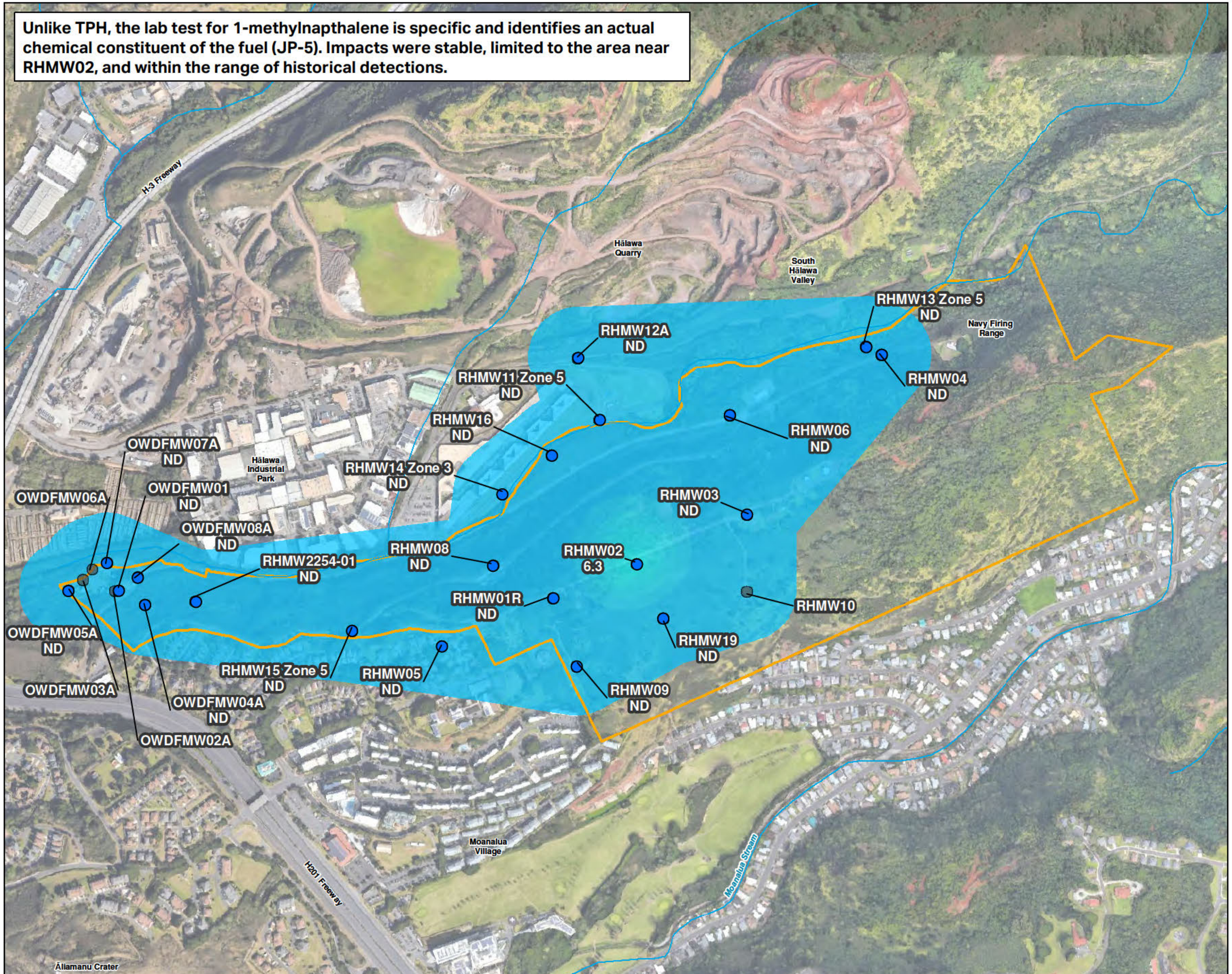
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

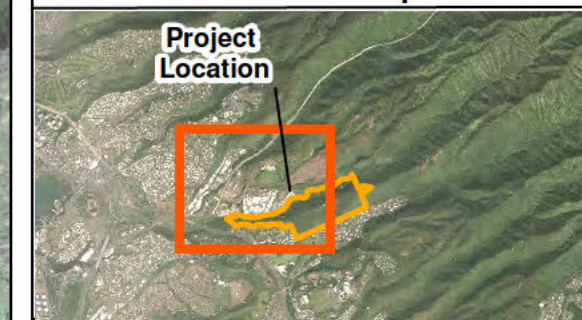
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of May 2, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

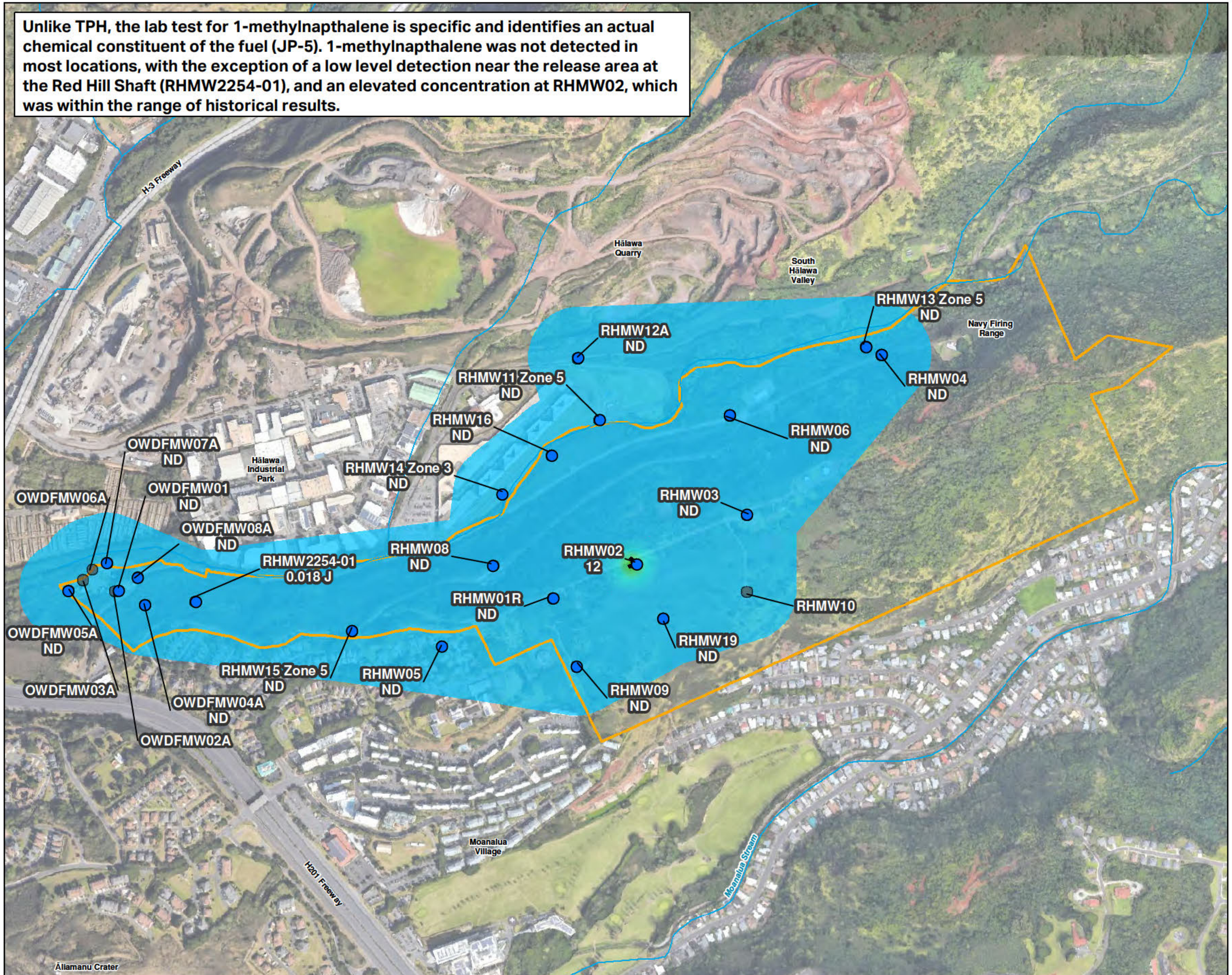
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

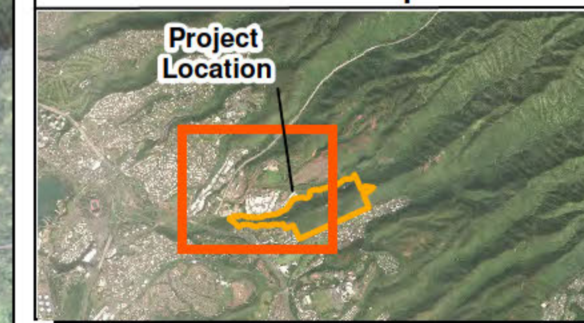
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of May 9, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

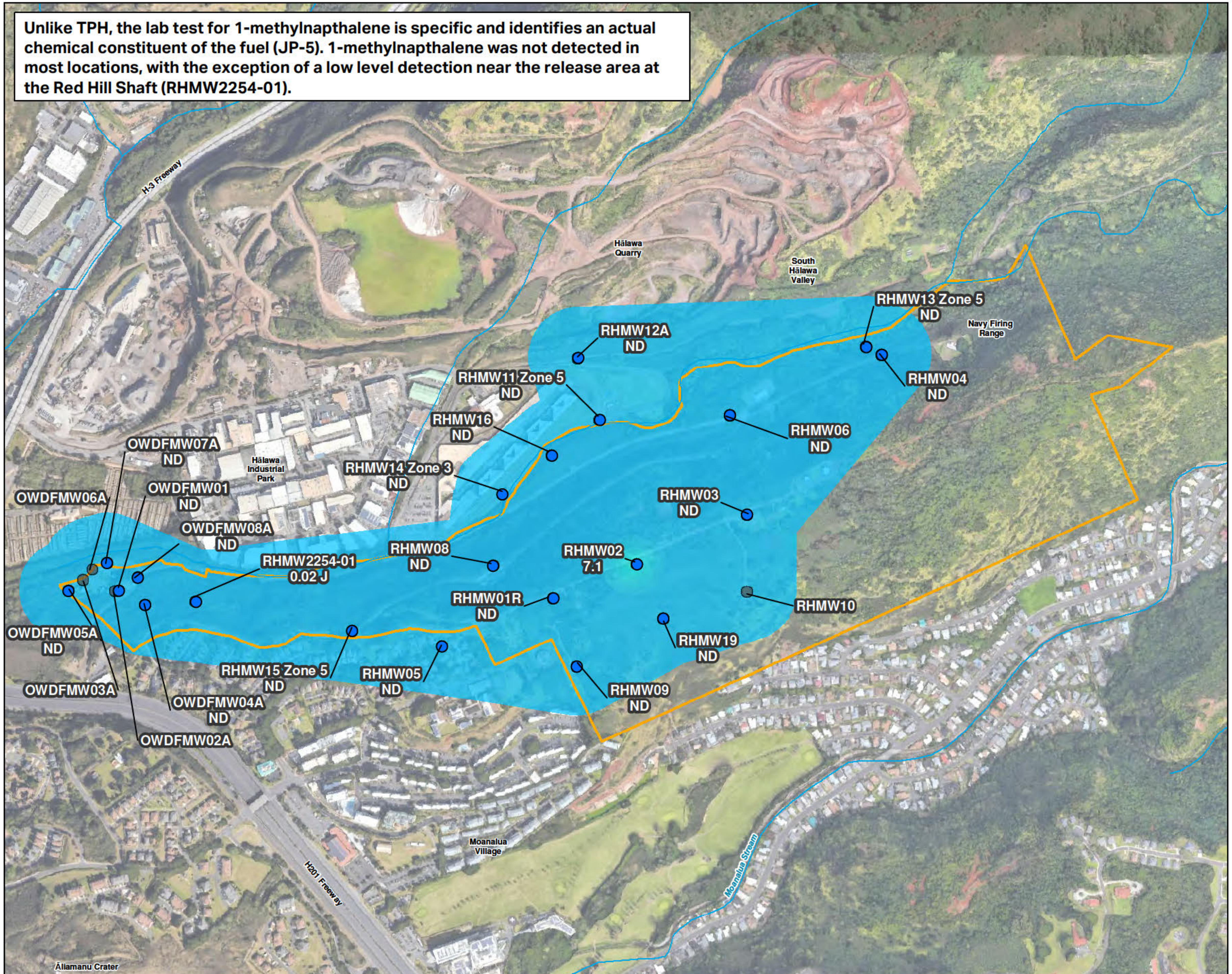
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

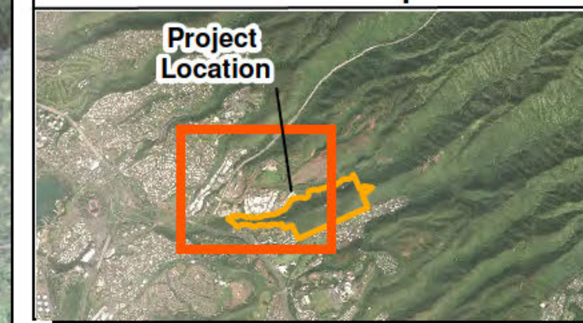
N

0 250 500 1,000 Feet

1-methylnaphthalene Results
Week of May 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

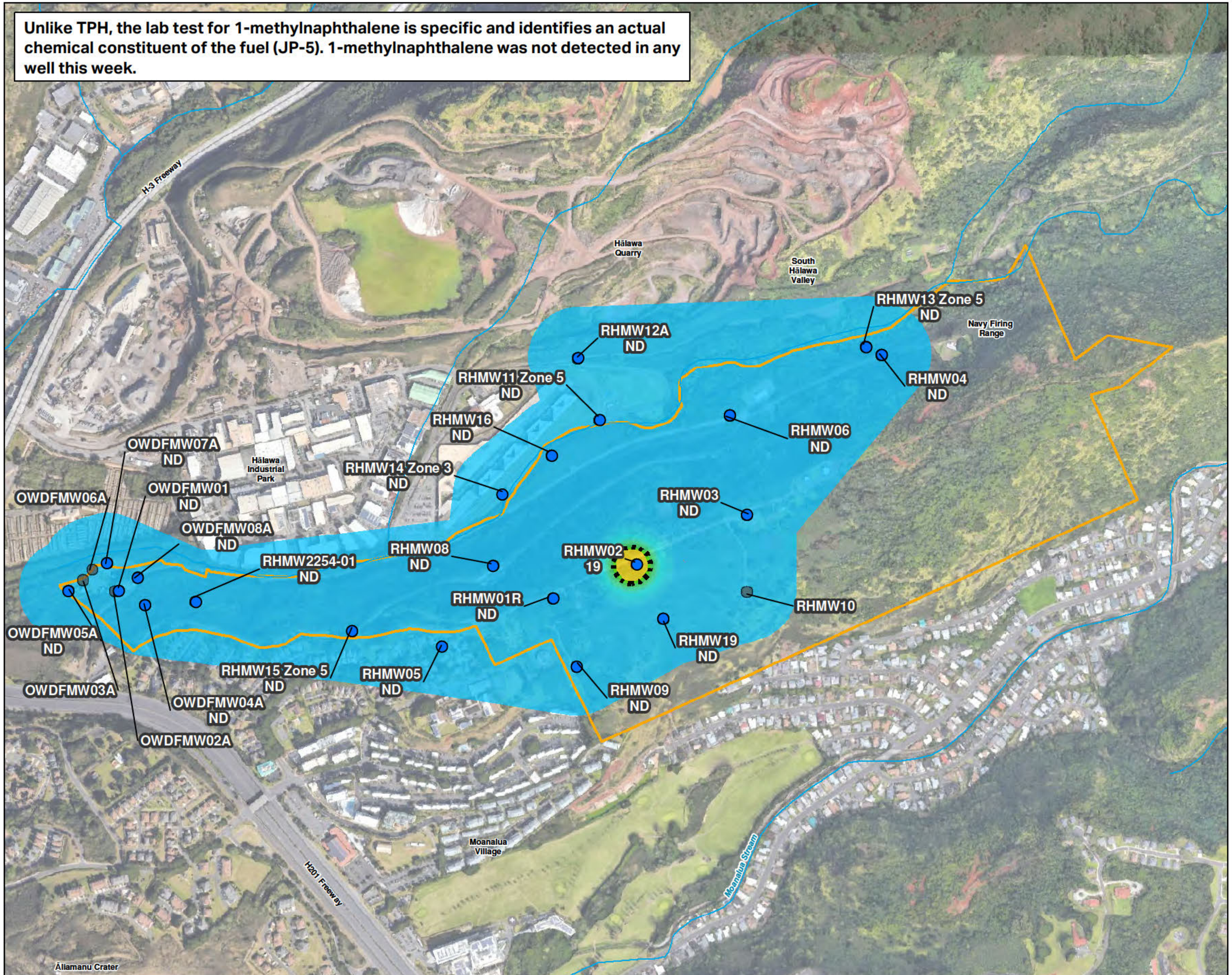
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

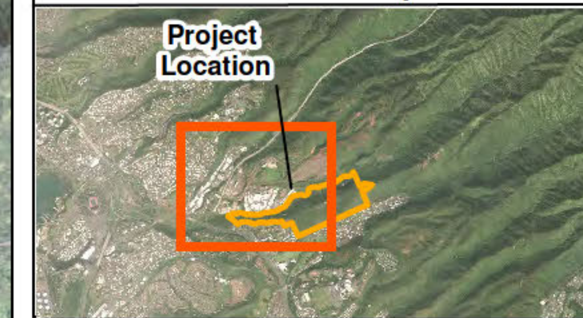
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of May 23, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

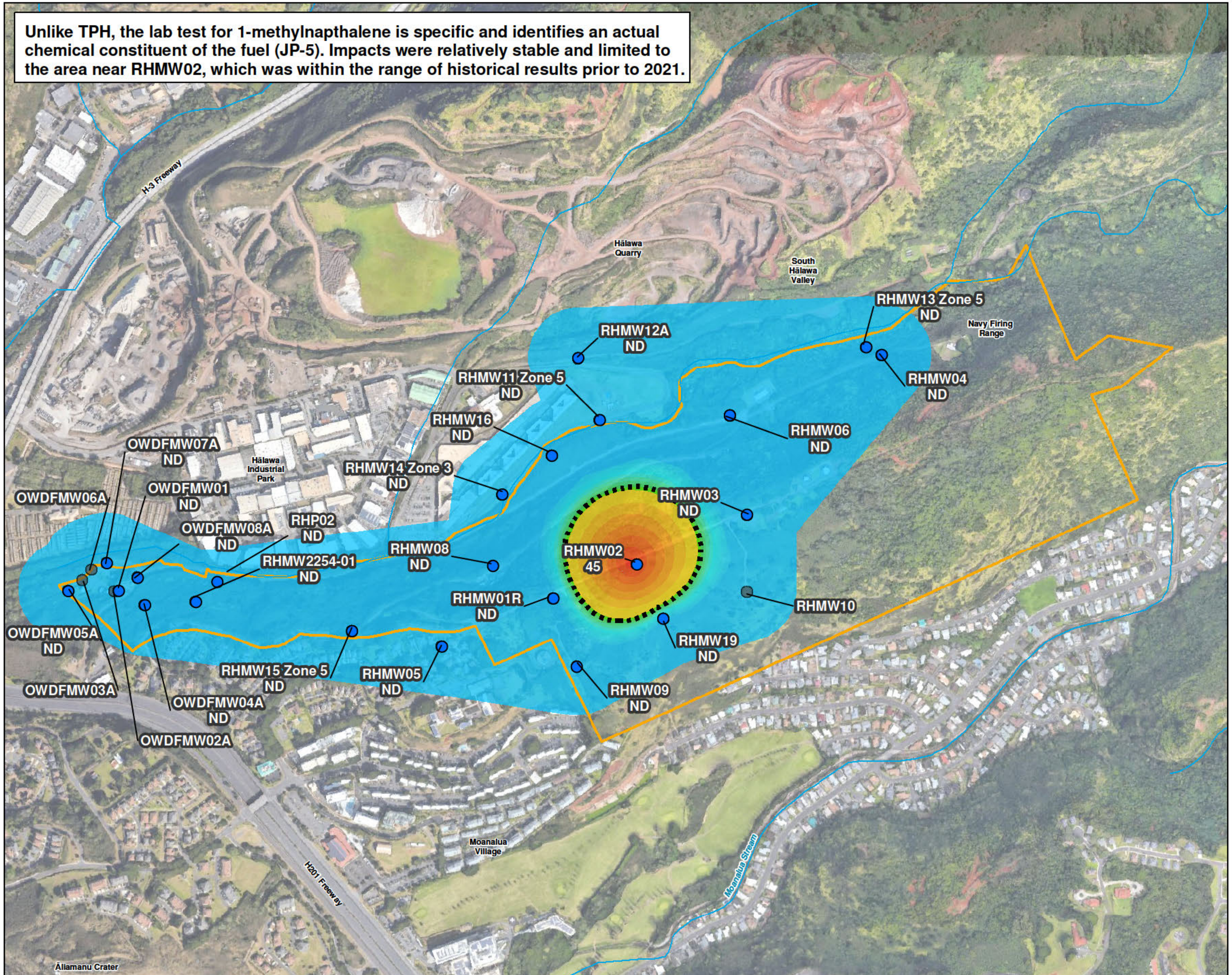
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

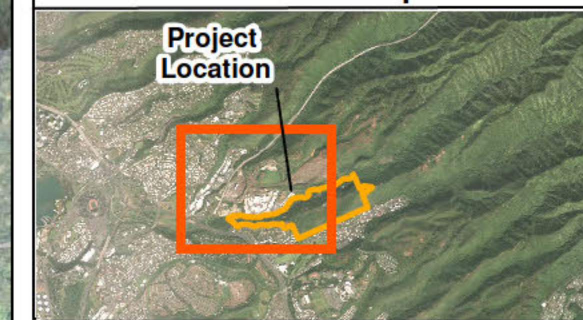
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of May 31, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

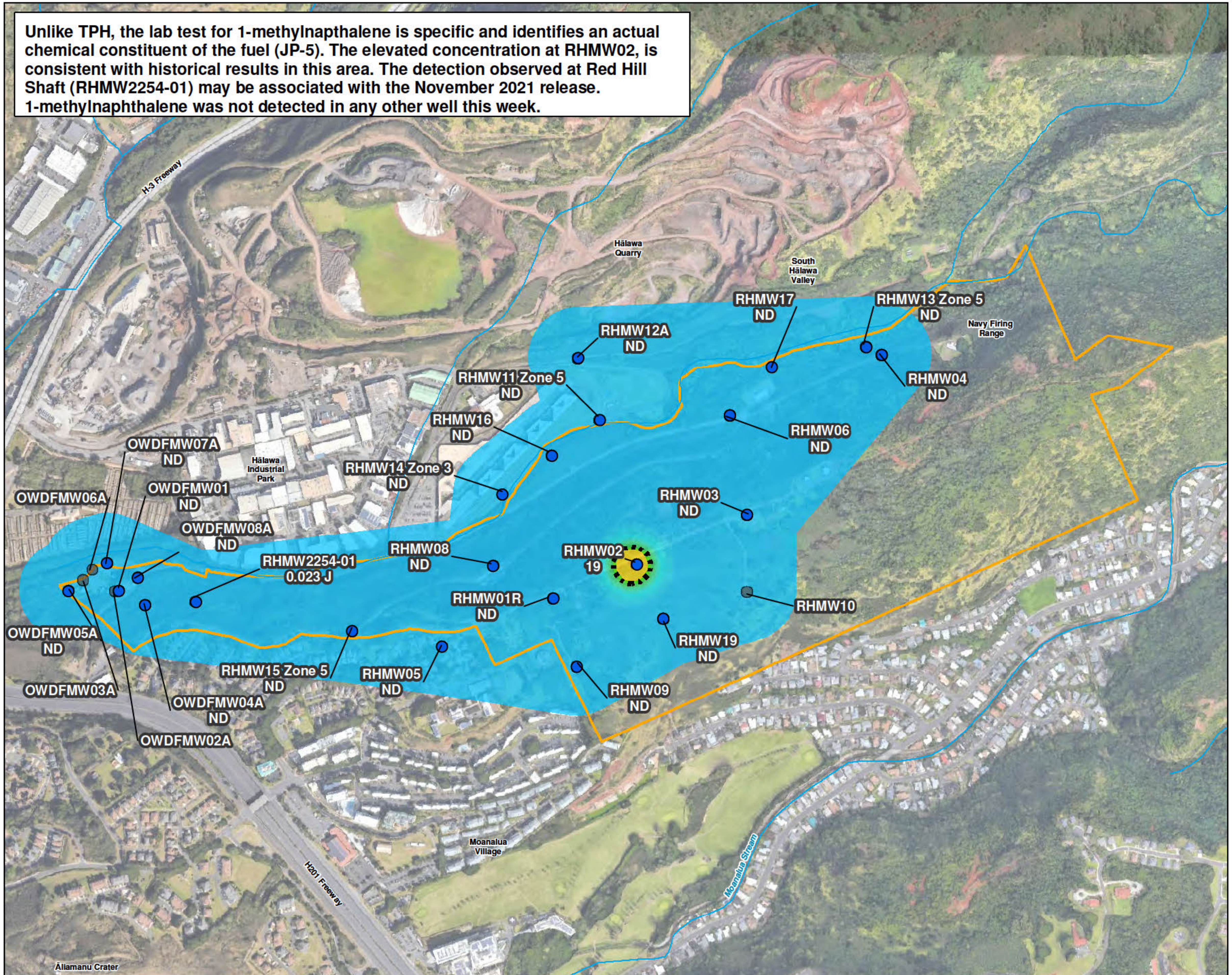
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

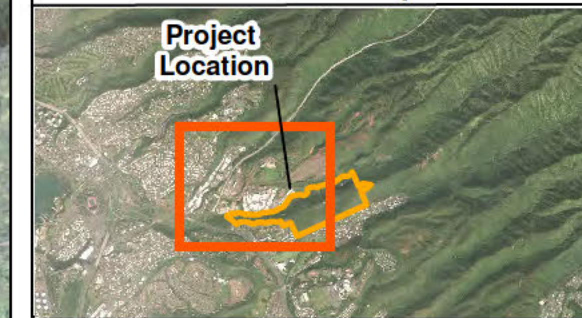
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of June 6, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

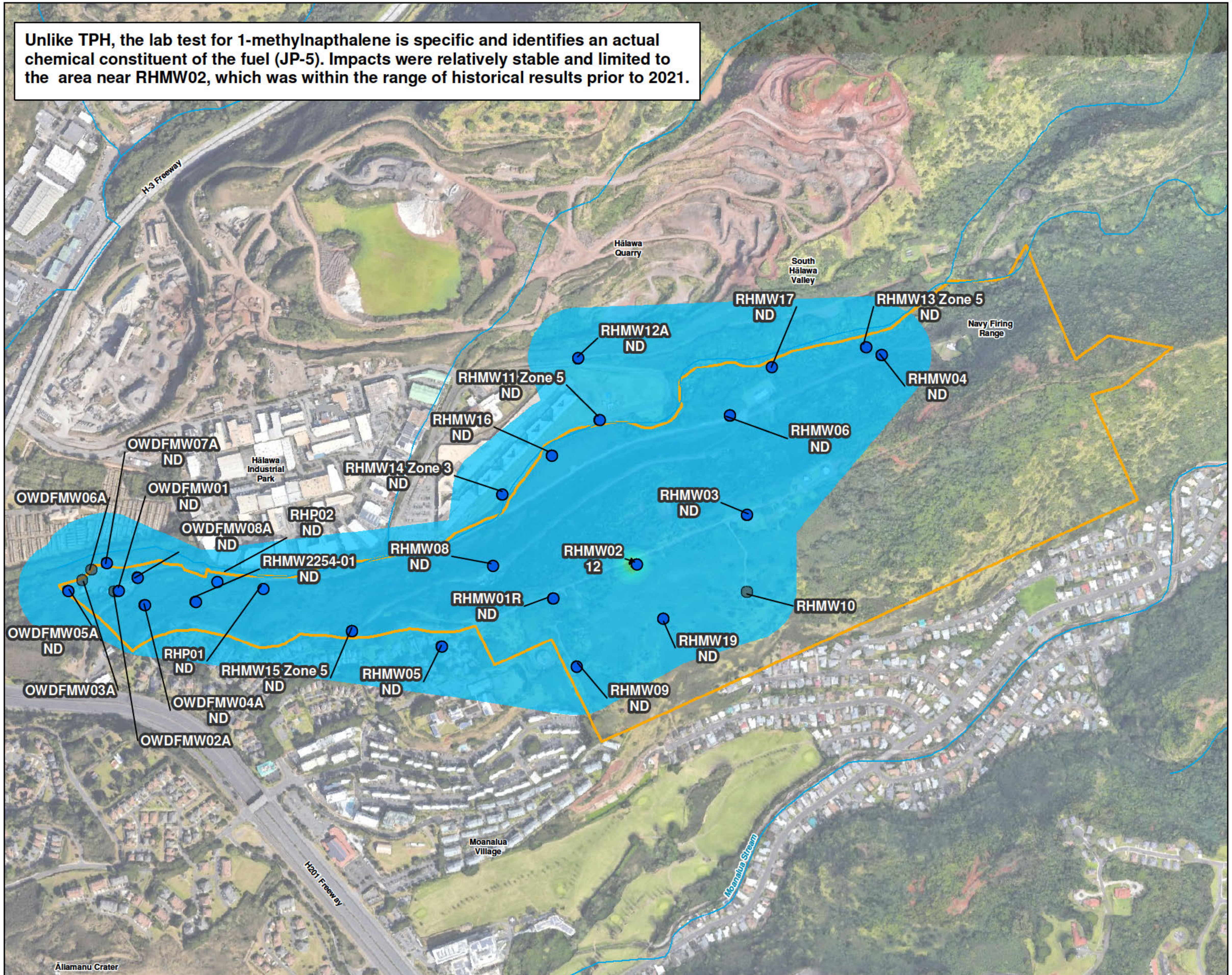
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

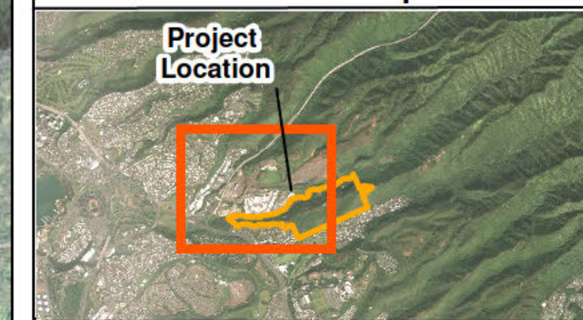
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of June 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation

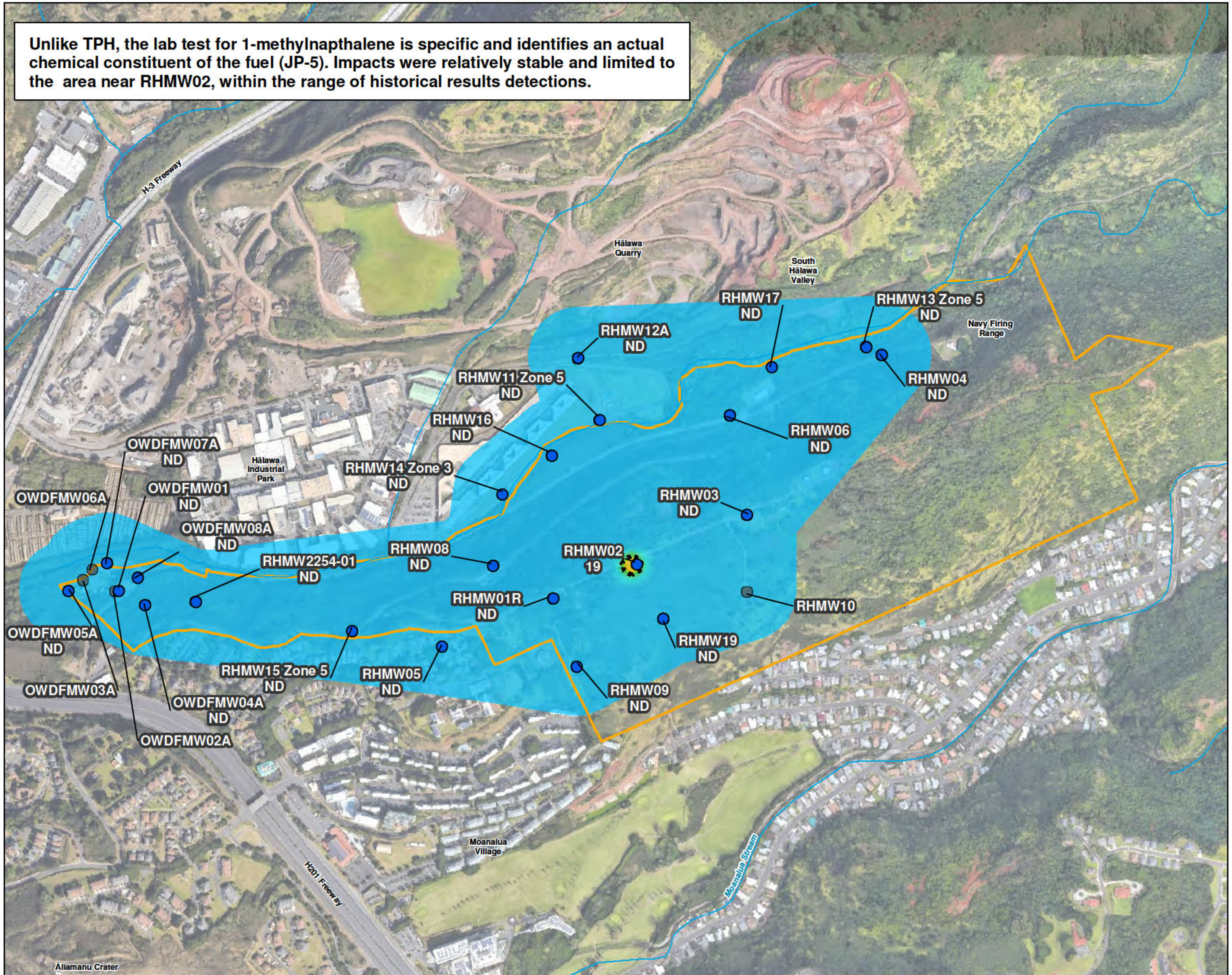
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

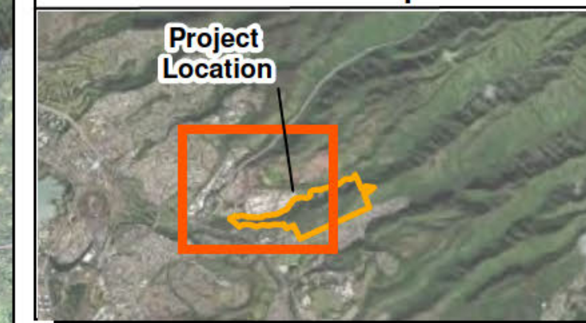
N

Feet
0 250 500 1,000

1-methylnaphthalene Results
Week of June 20, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

1-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

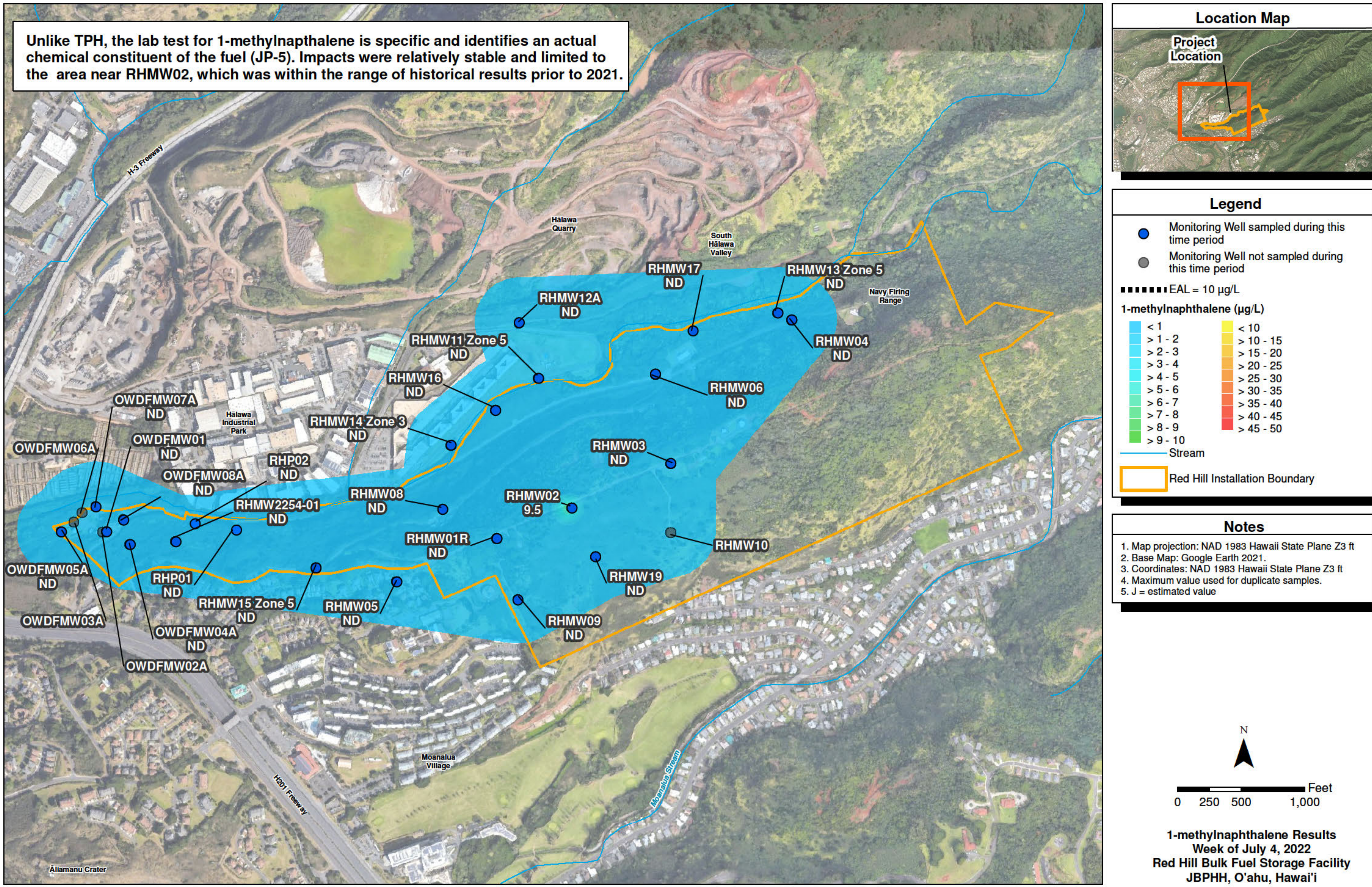
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

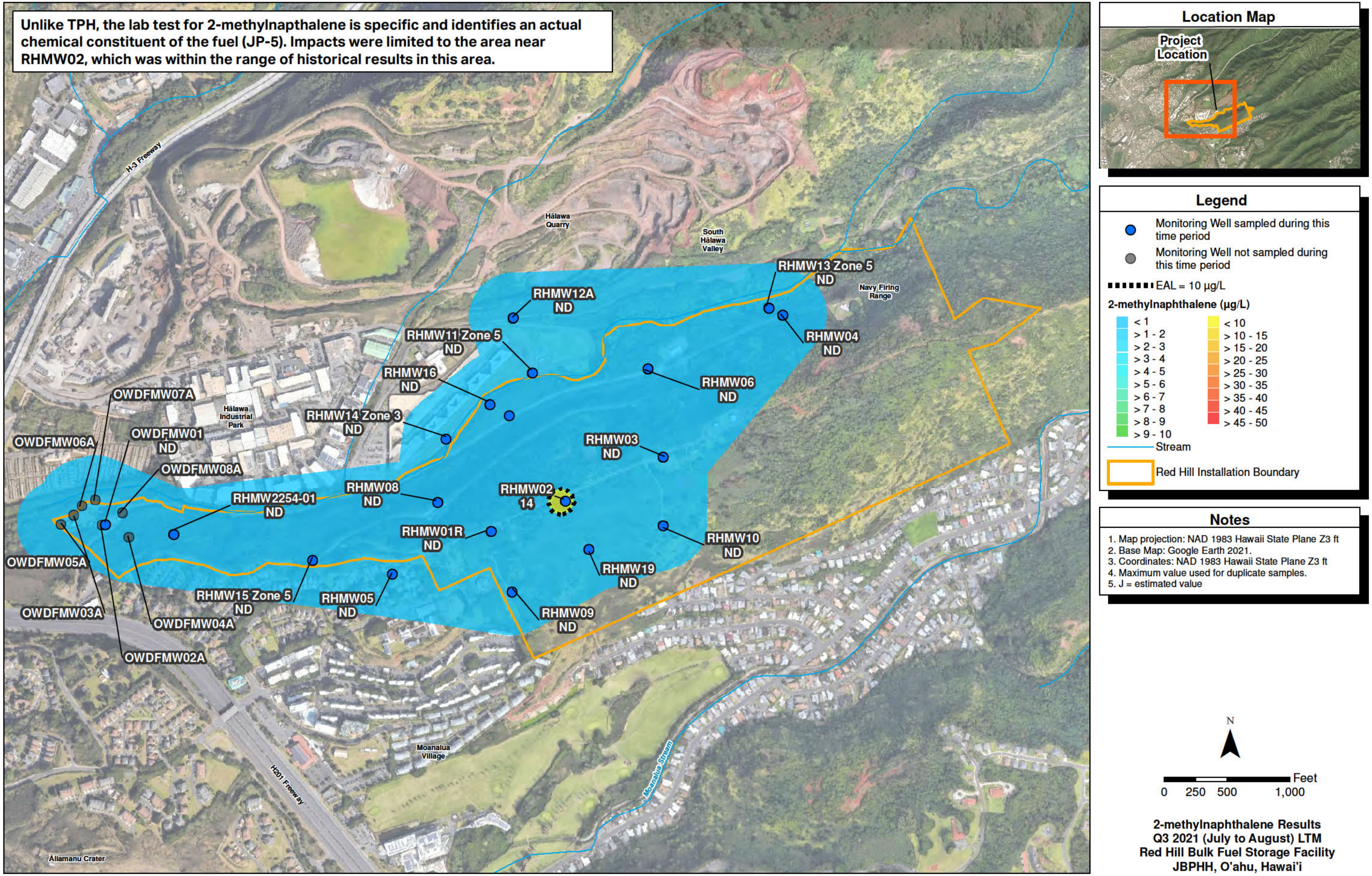
N

Feet
0 250 500 1,000

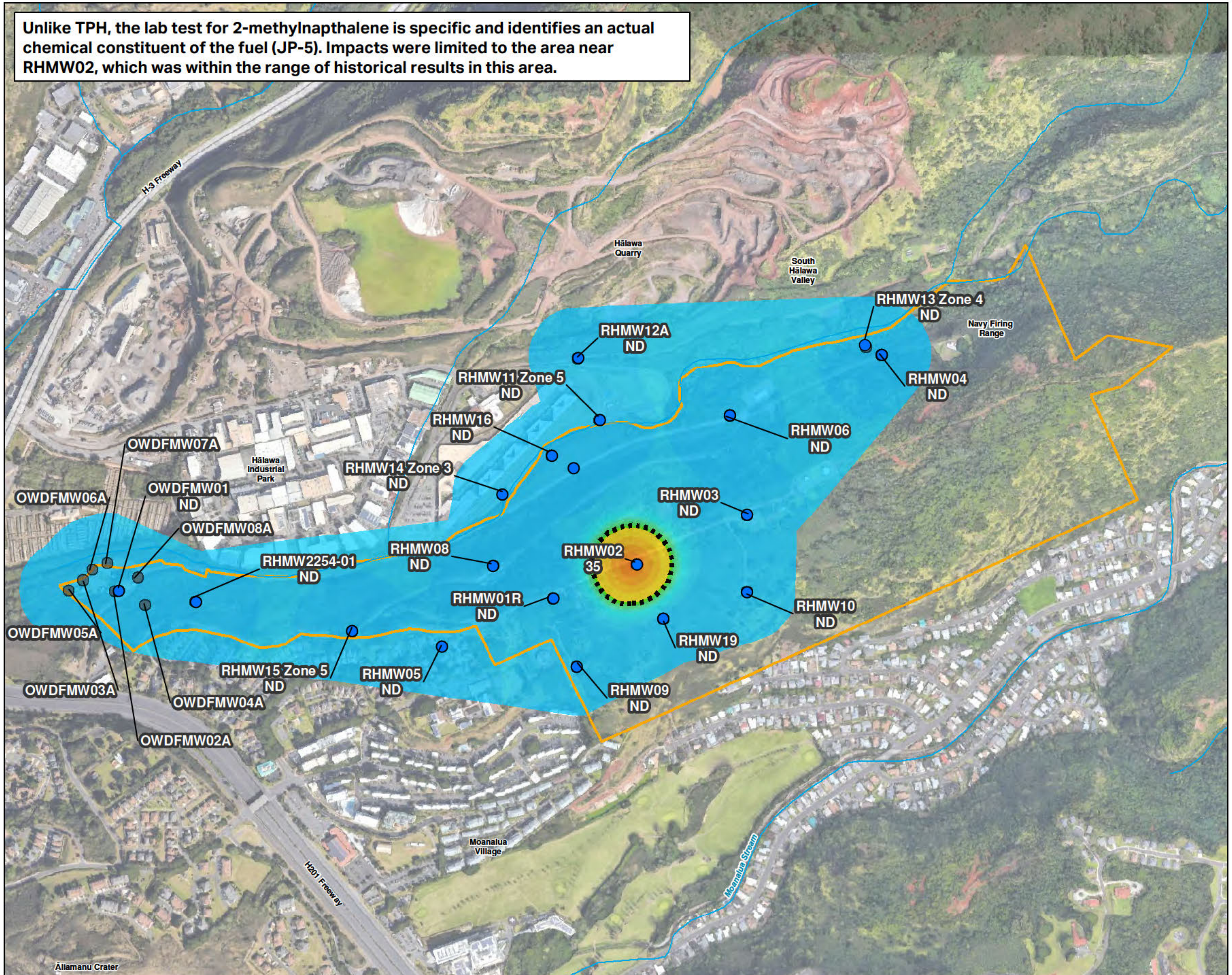
1-methylnaphthalene Results
Week of June 27, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



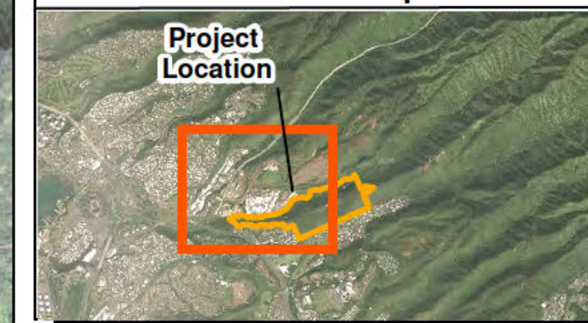
1-methylnaphthalene Results
Week of July 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Unlike TPH, the lab test for 2-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, which was within the range of historical results in this area.
H-3 Freeway
Hālawa Quarry
South Hālawa Valley
Navy Firing Range
Hālawa Industrial Park
Moanalua Village
Moanalua Stream
H201 Freeway
Āliamanu Crater
RHMW12A ND
RHMW13 Zone 5 ND
RHMW04 ND
RHMW11 Zone 5 ND
RHMW16 ND
RHMW06 ND
RHMW14 Zone 3 ND
RHMW03 ND
RHMW08 ND
RHMW02 14
RHMW2254-01 ND
RHMW01R ND
RHMW10 ND
RHMW19 ND
RHMW15 Zone 5 ND
RHMW05 ND
RHMW09 ND
OWDFMW07A
OWDFMW06A
OWDFMW01 ND
OWDFMW08A
OWDFMW05A
OWDFMW03A
OWDFMW04A
OWDFMW02A
Location Map
Project Location
Legend
Monitoring Well sampled during this time period
Monitoring Well not sampled during this time period
EAL = 10 µg/L
2-methylnaphthalene (µg/L)
< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
< 10
> 10 - 15
> 15 - 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50
Stream
Red Hill Installation Boundary
Notes
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
N
Feet
0 250 500 1,000
2-methylnaphthalene Results
Q3 2021 (July to August) LTM
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

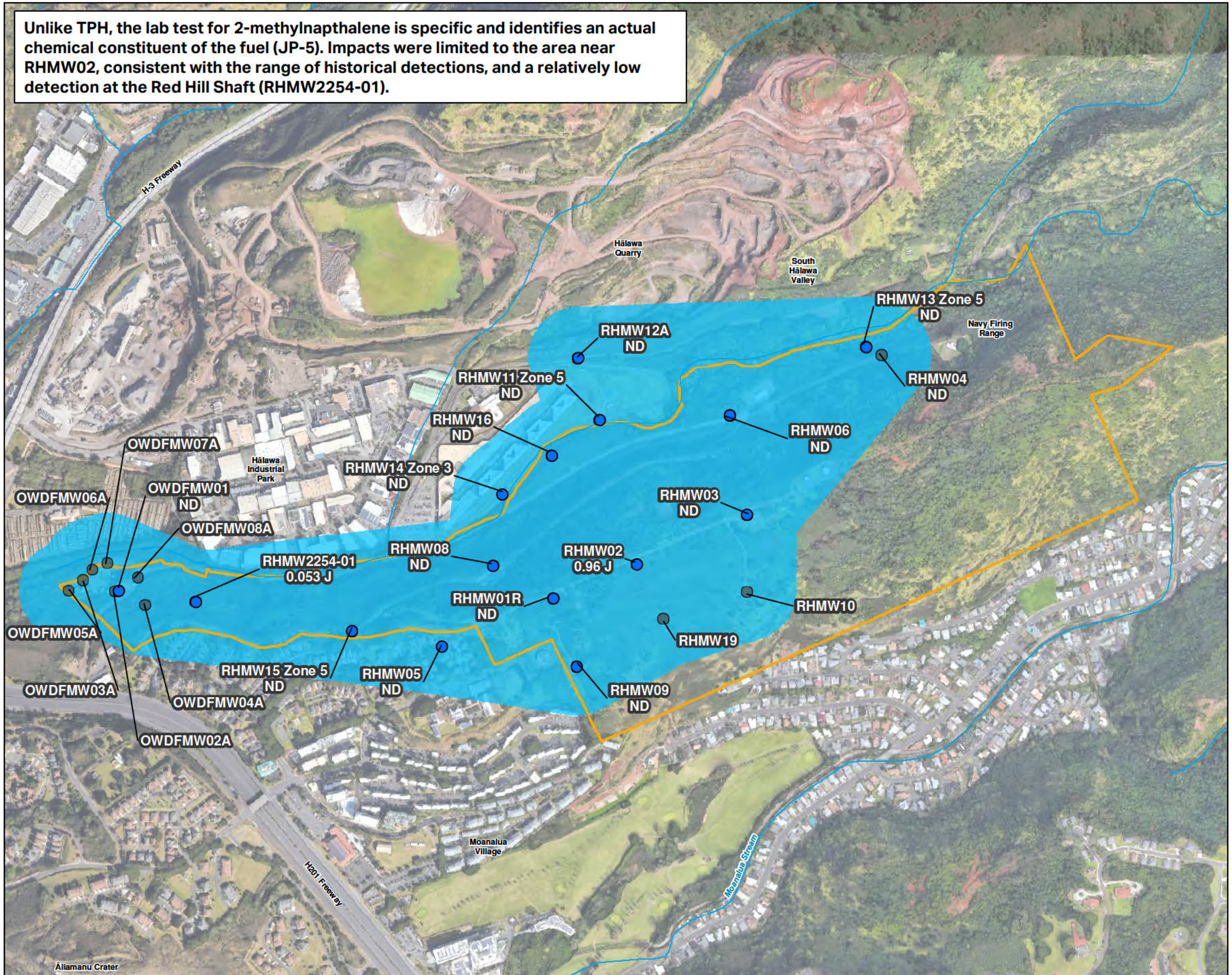
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

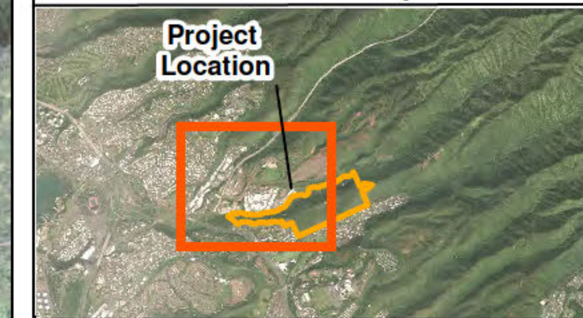
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Q4 2021 (October to November) LTM
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

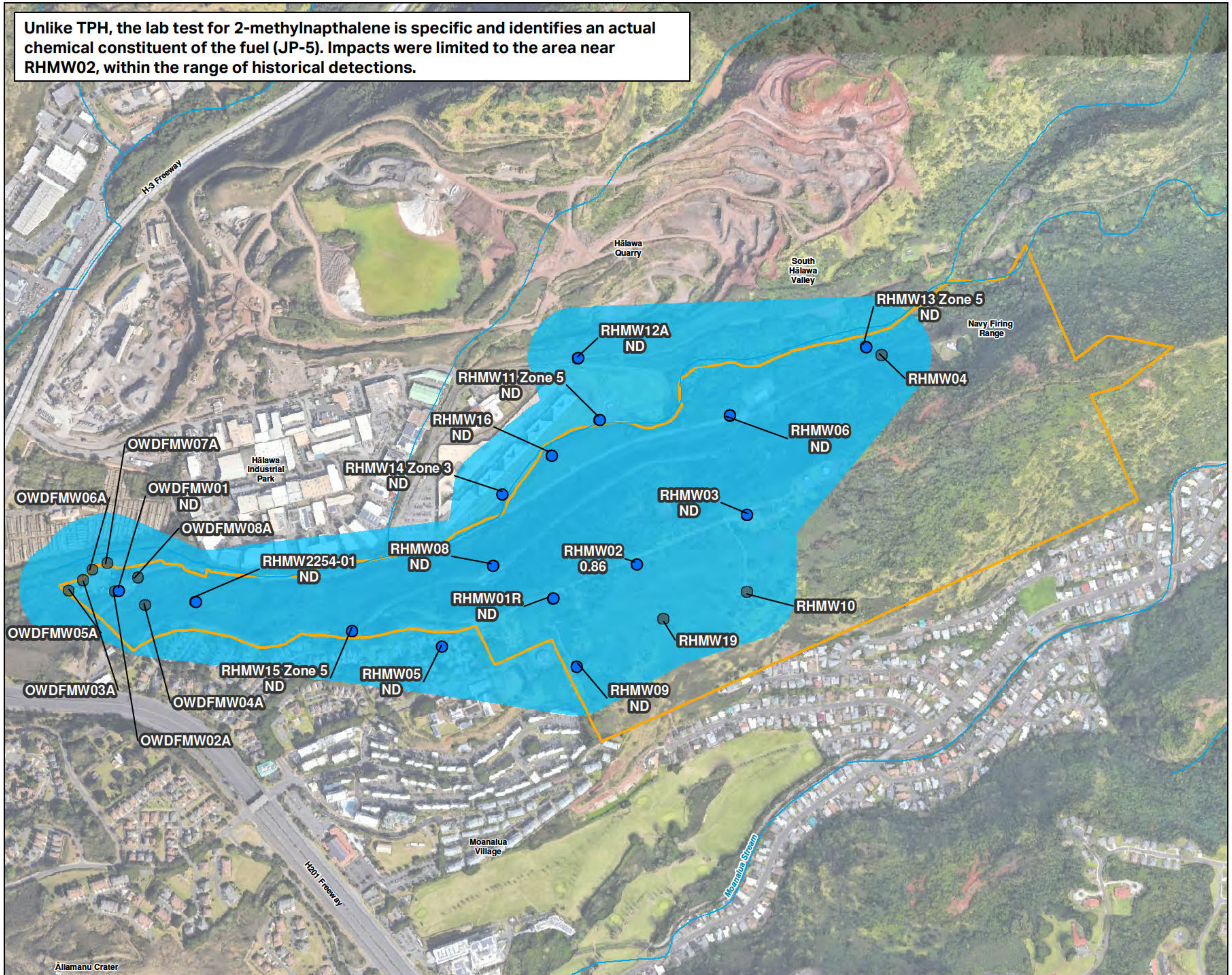
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

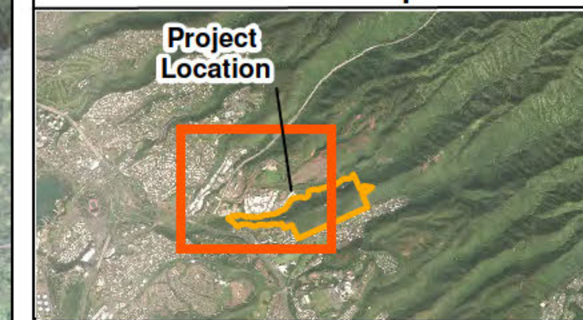
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of December 13, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

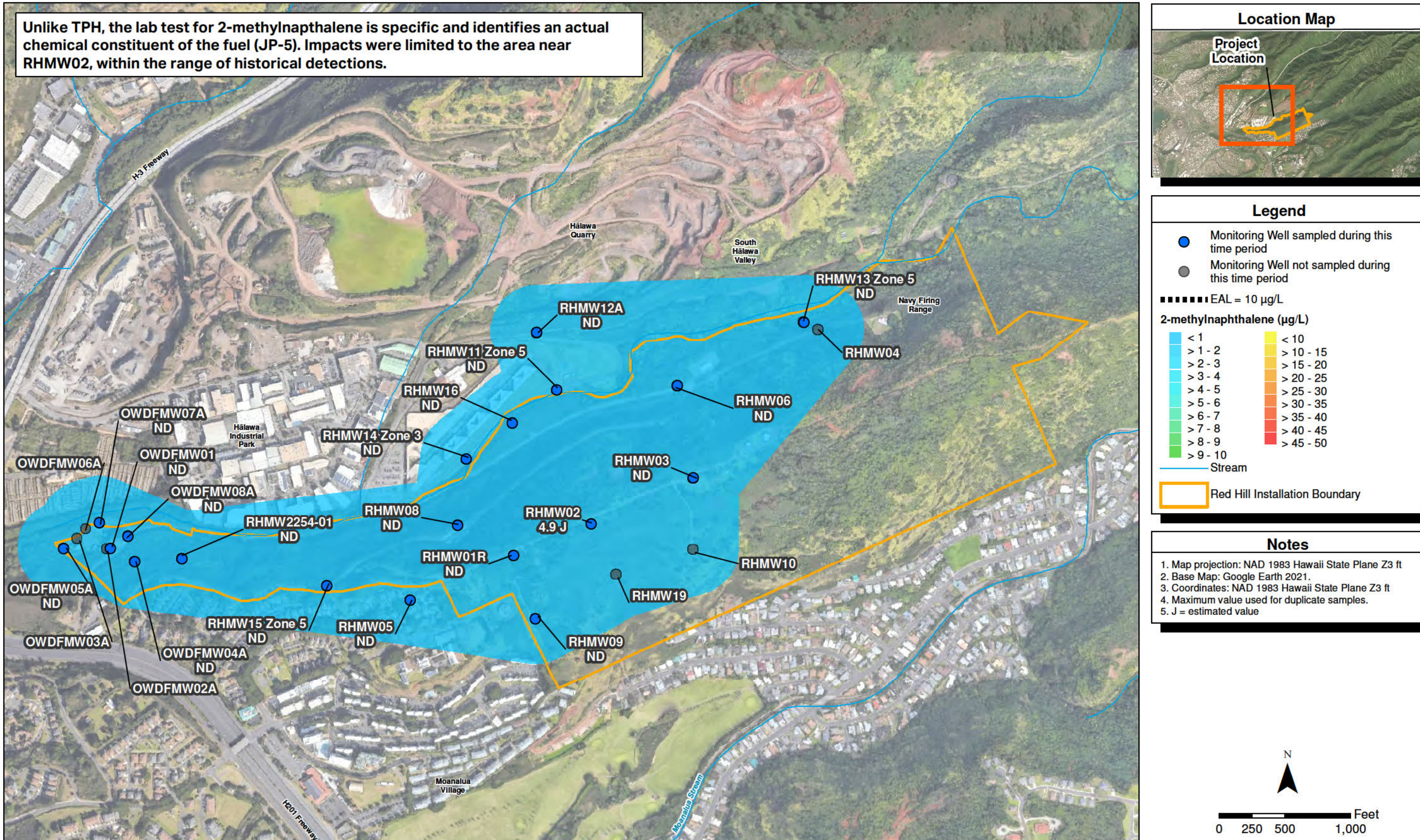
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

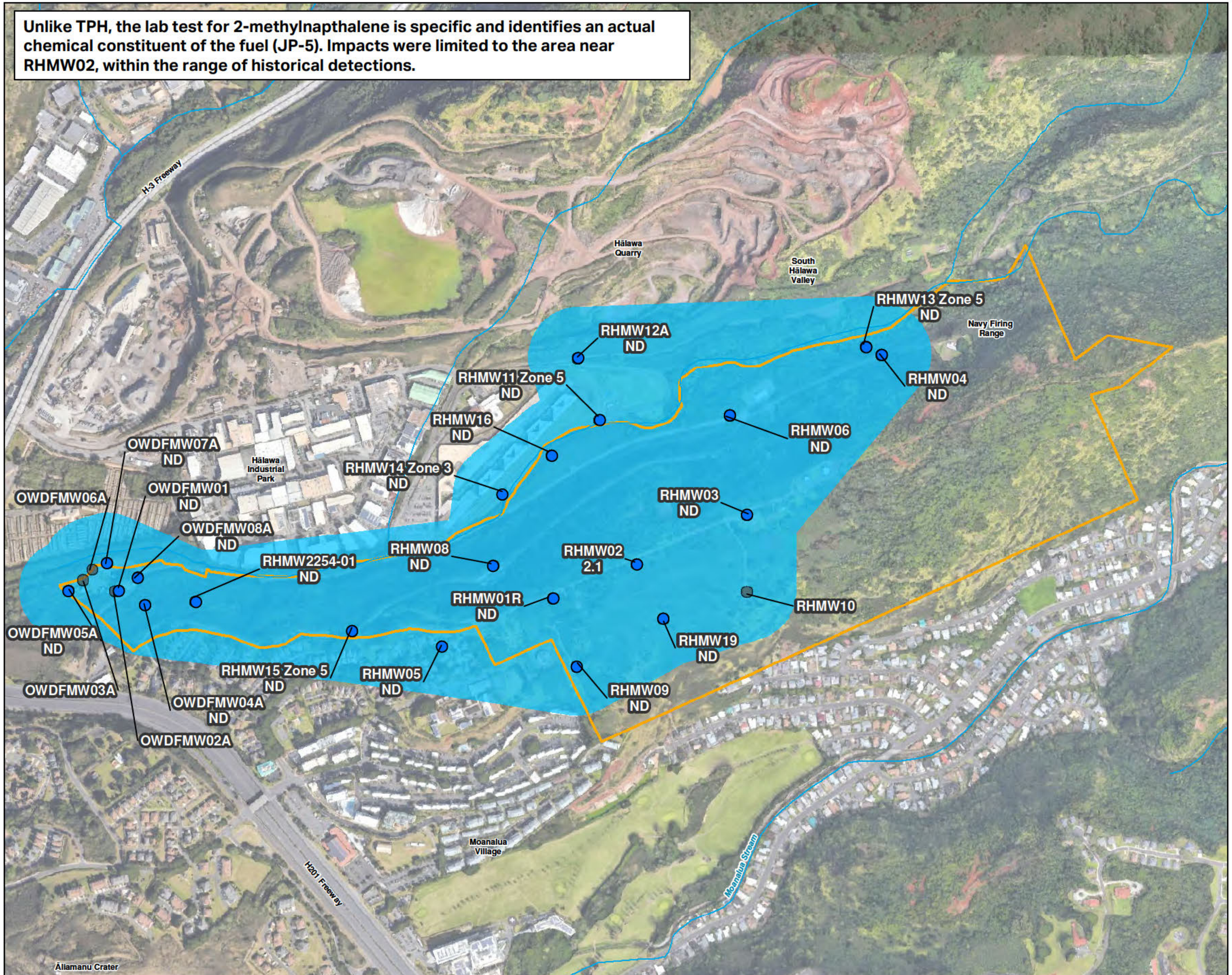
N

Feet
0 250 500 1,000

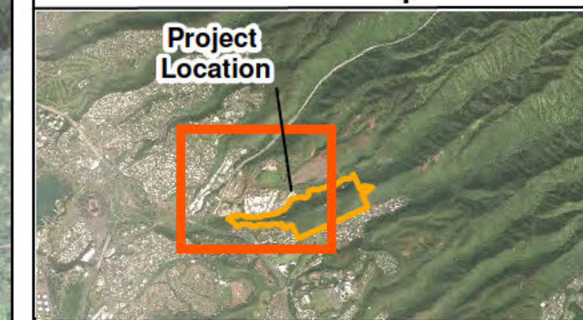
2-methylnaphthalene Results
Week of December 20, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



2-methylnaphthalene Results
Week of December 27, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

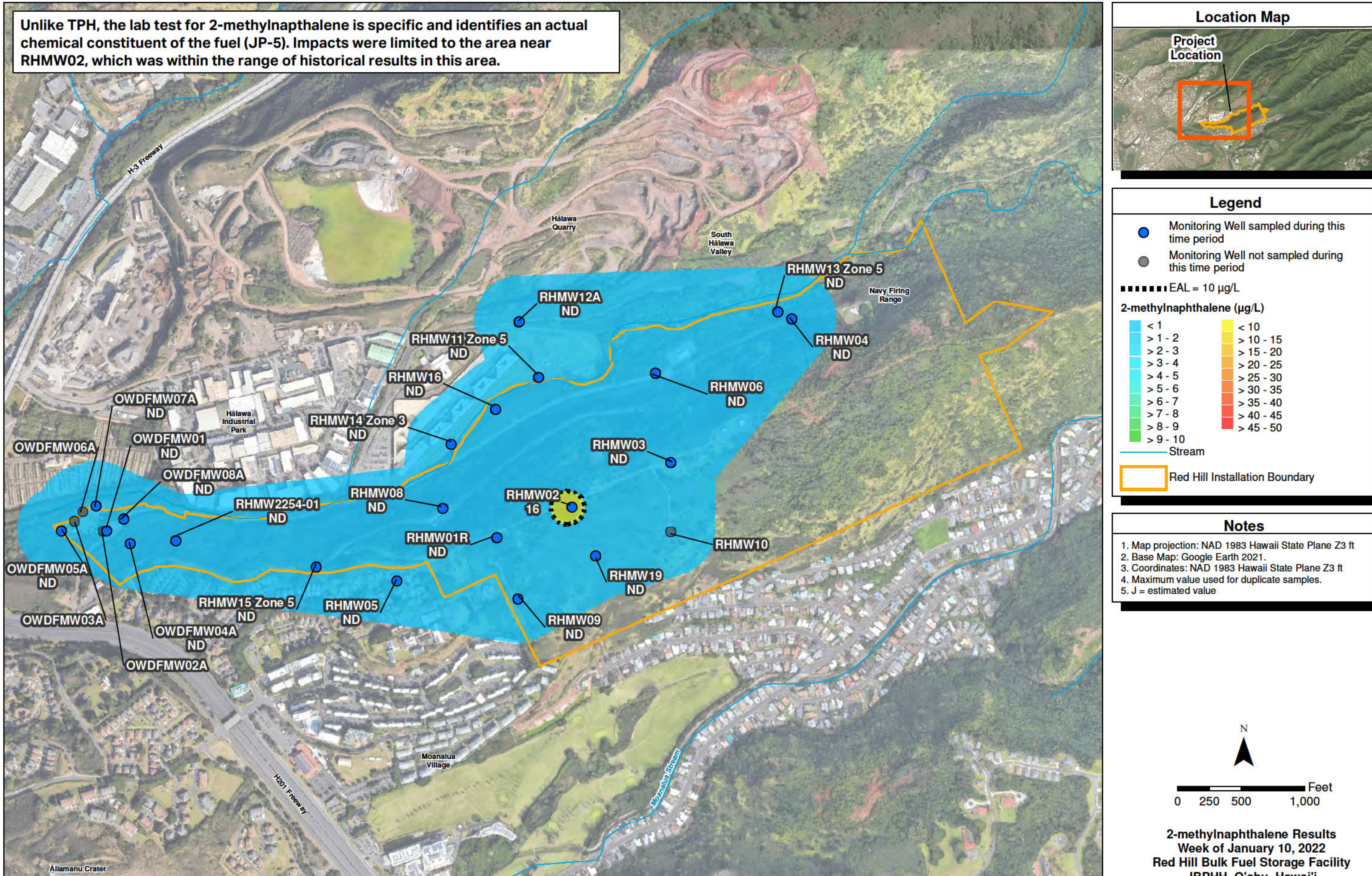
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

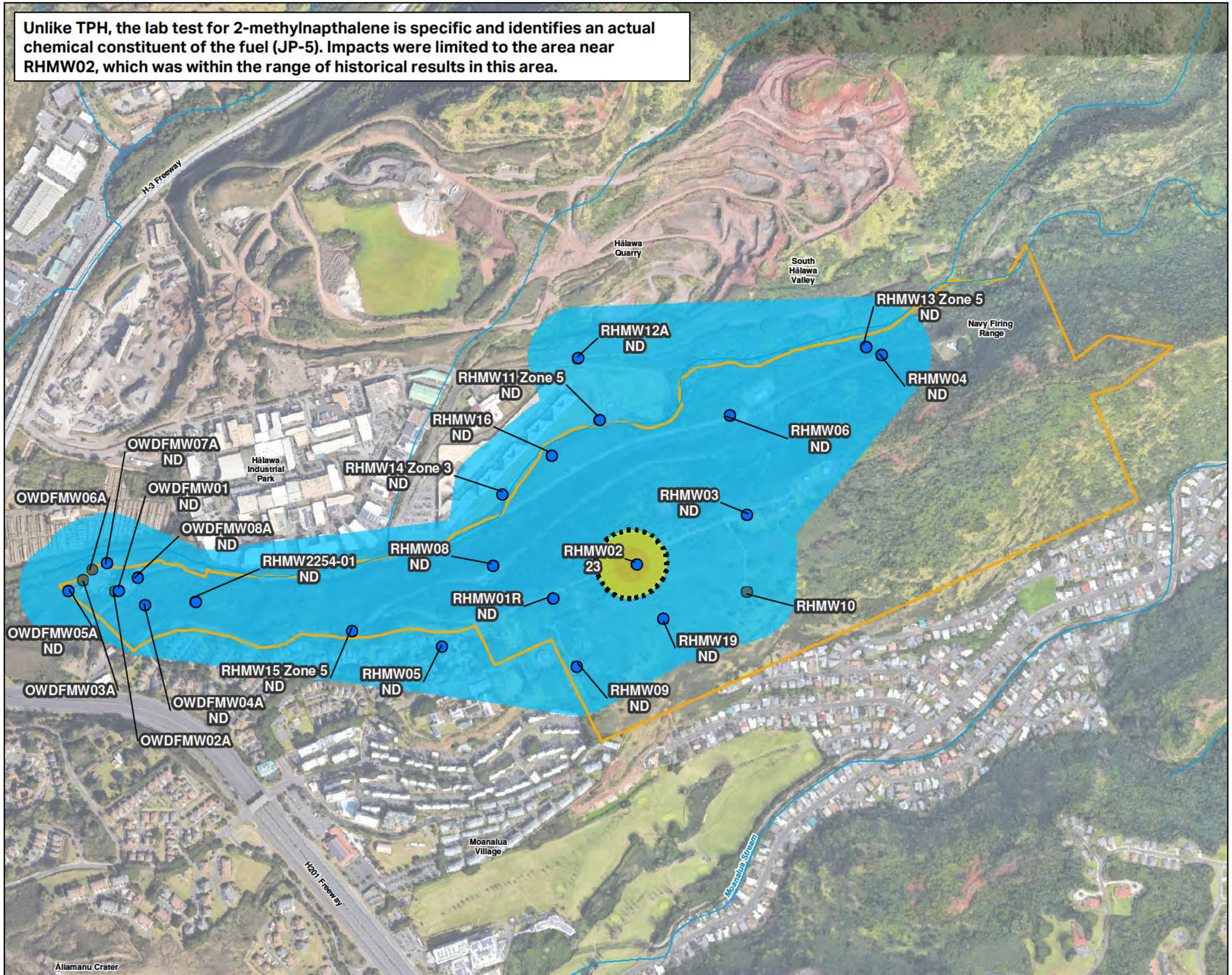
N

Feet
0 250 500 1,000

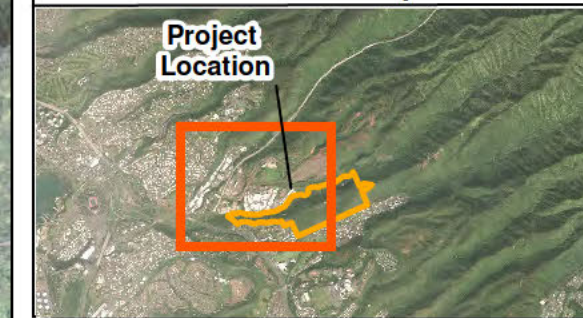
2-methylnaphthalene Results
Week of January 3, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



2-methylnaphthalene Results
Week of January 10, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

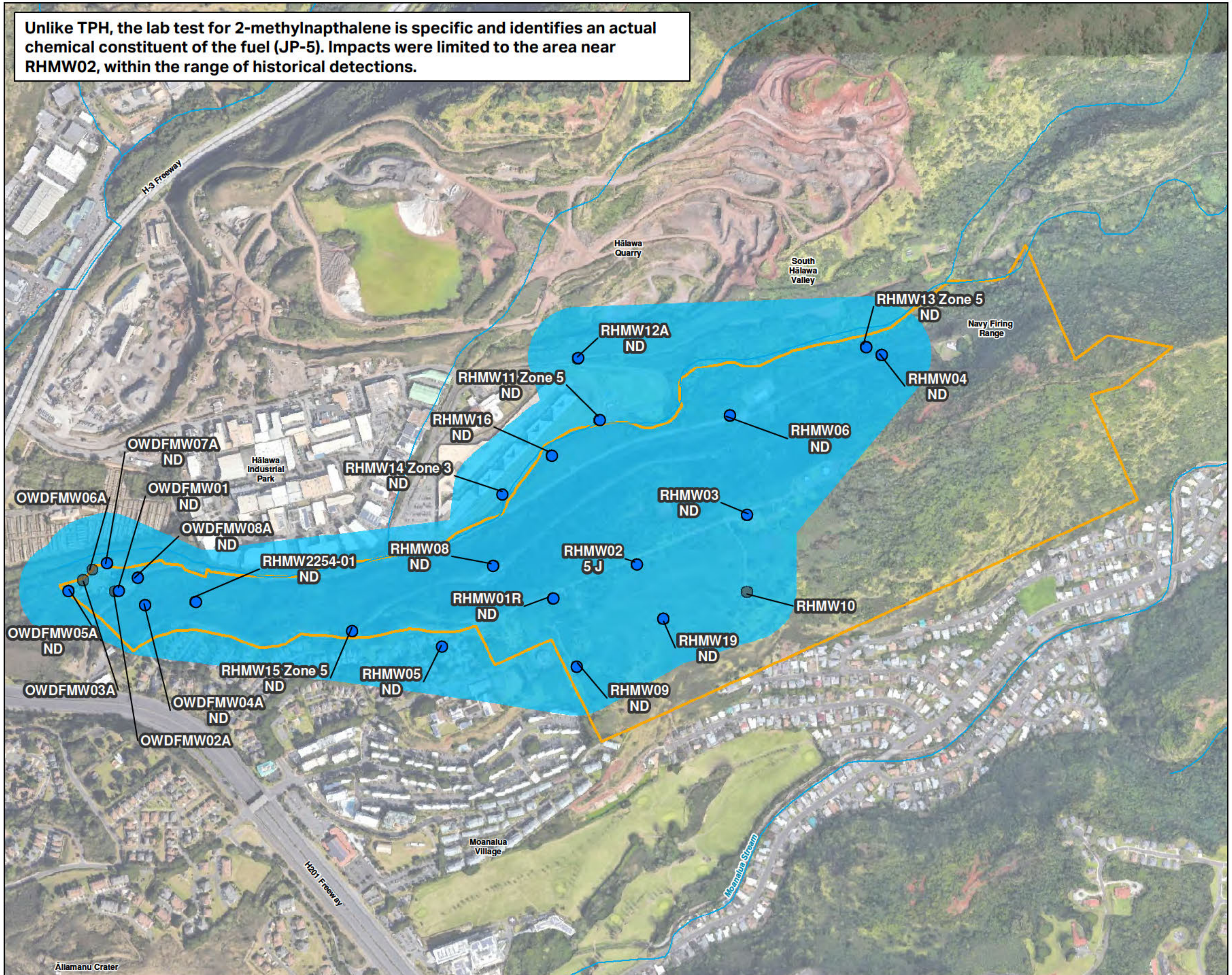
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

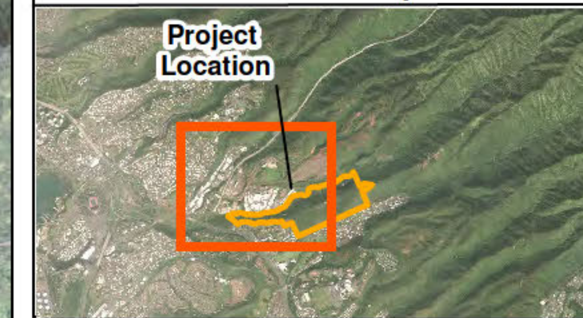
N

Feet 0 250 500 1,000

2-methylnaphthalene Results
Week of January 17, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

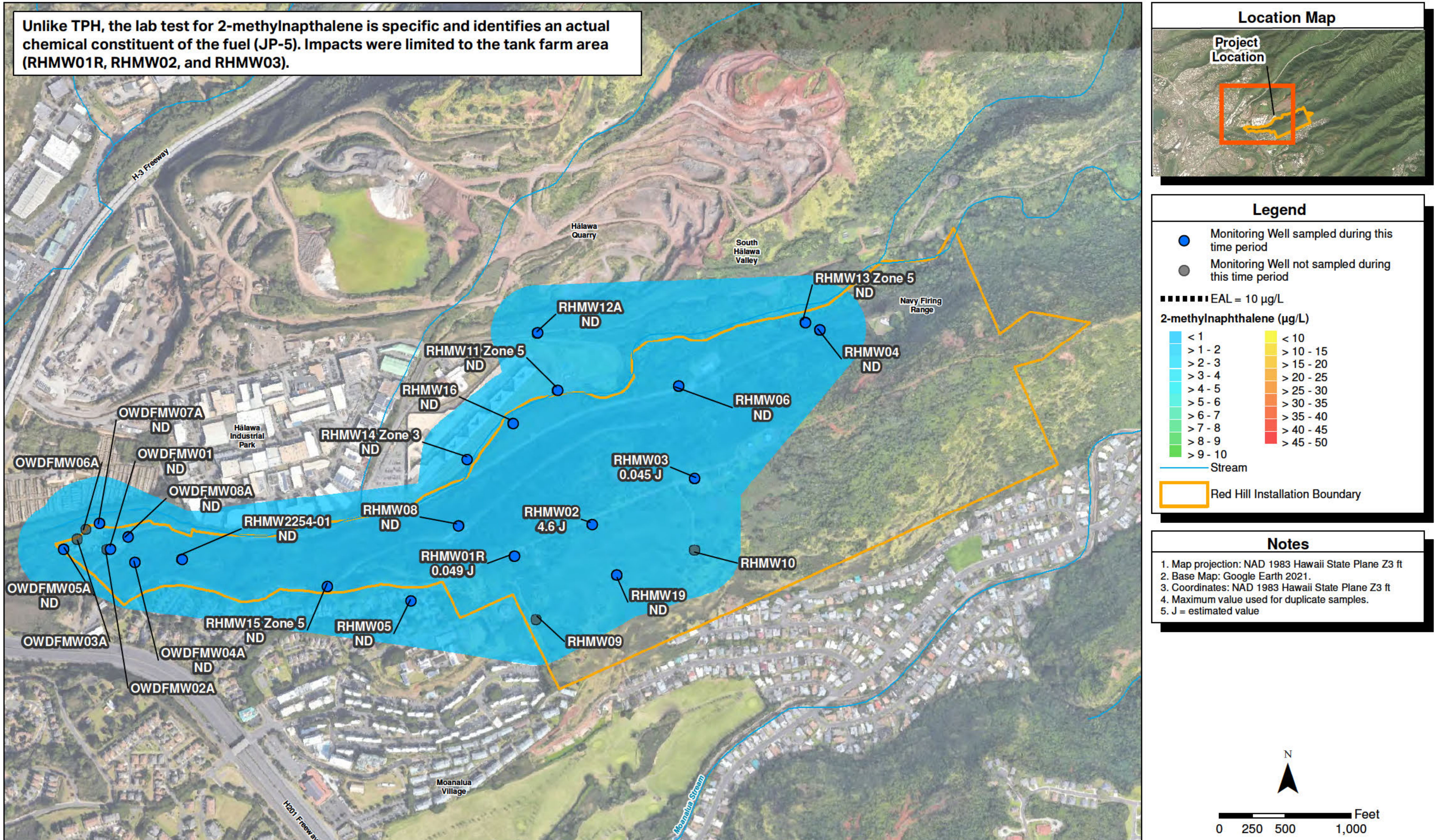
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

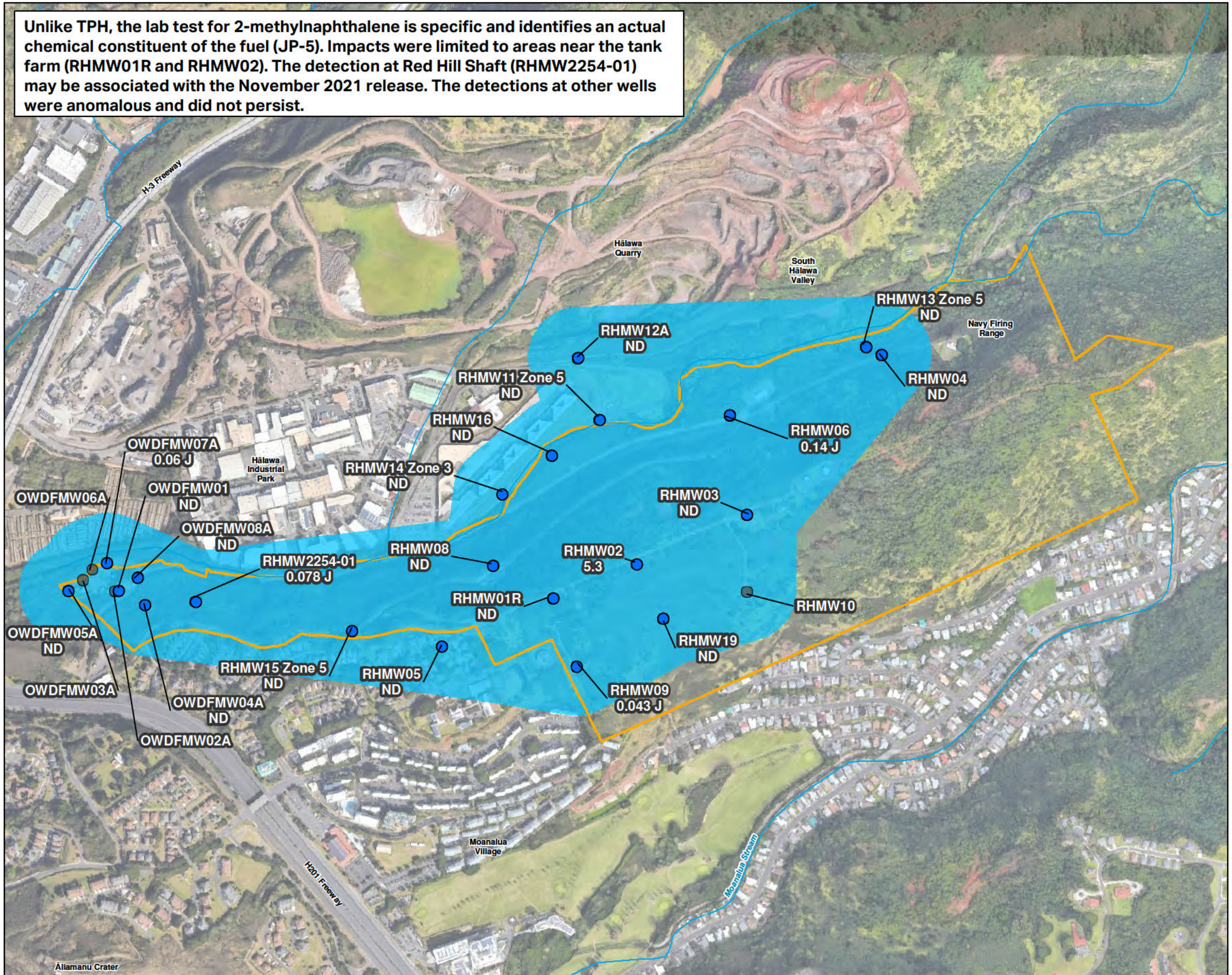
N

Feet
0 250 500 1,000

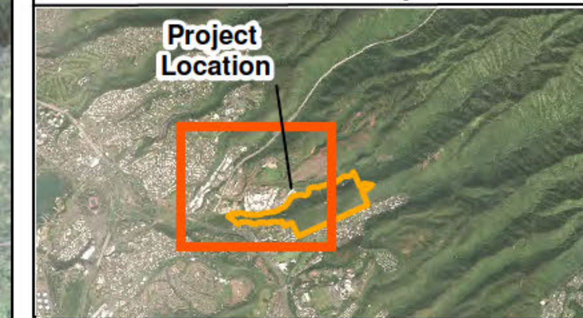
2-methylnaphthalene Results
Week of February 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



2-methylnaphthalene Results
Week of March 7, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

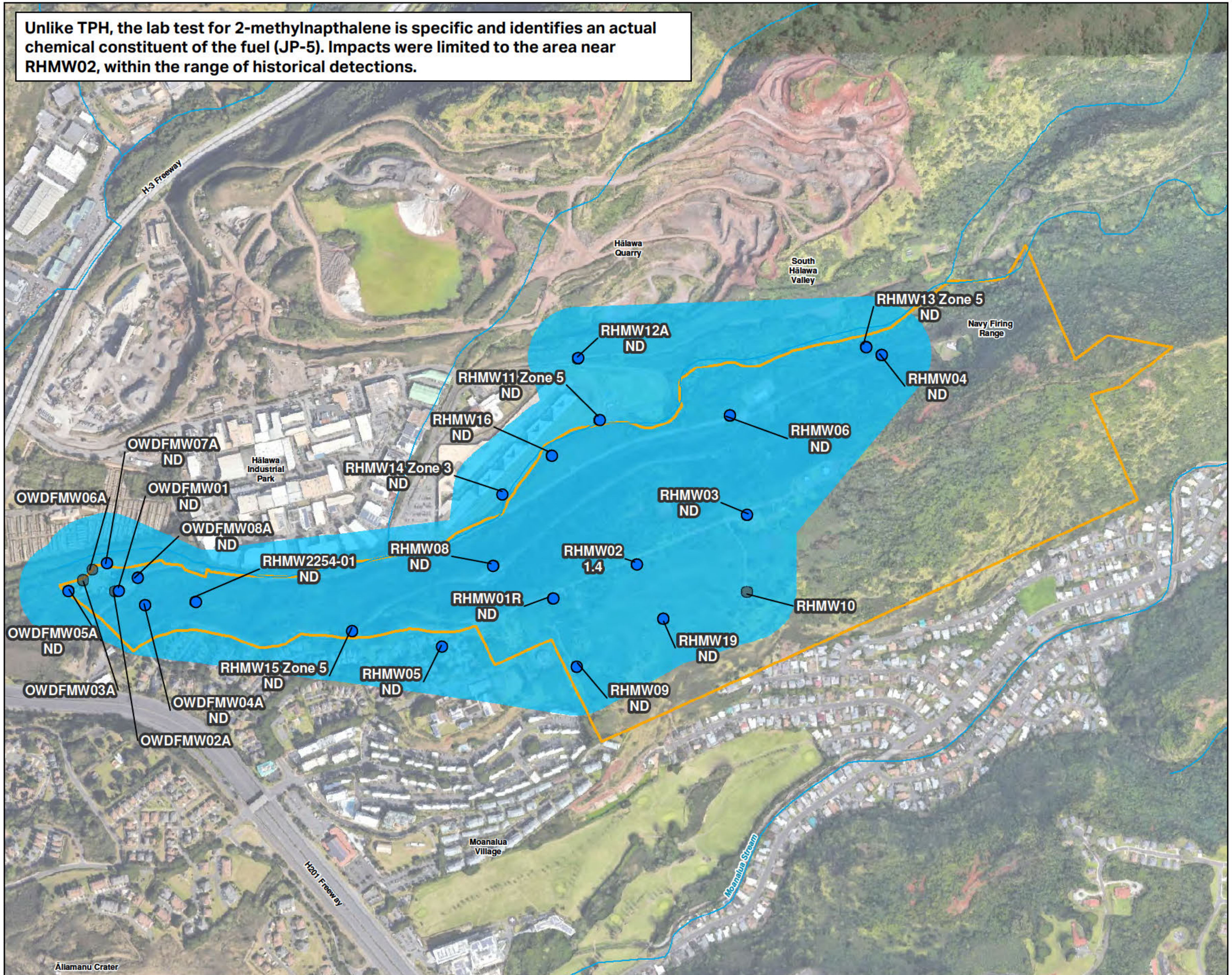
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

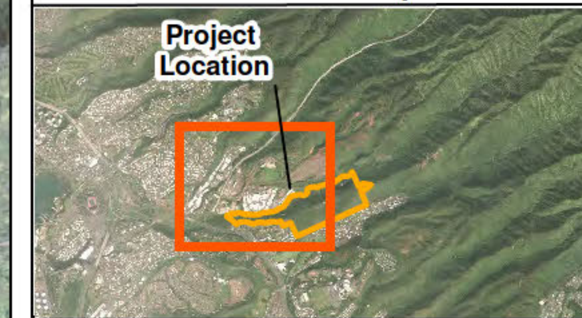
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of March 14, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- < 10
- > 10 - 15
- > 15 - 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50
- Stream
- Red Hill Installation Boundary

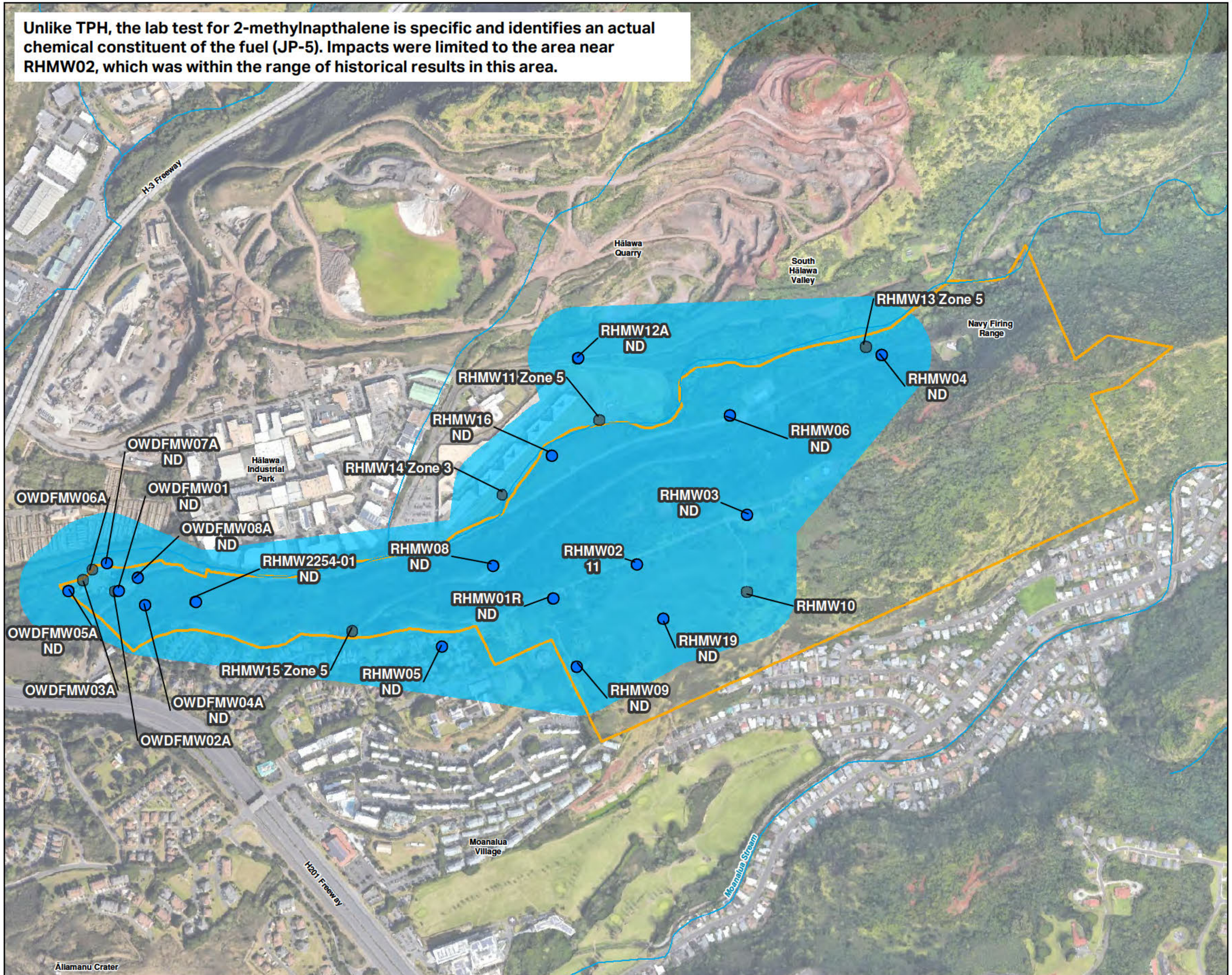
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

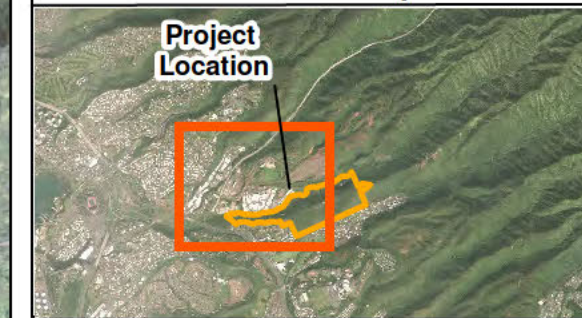
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of March 21, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

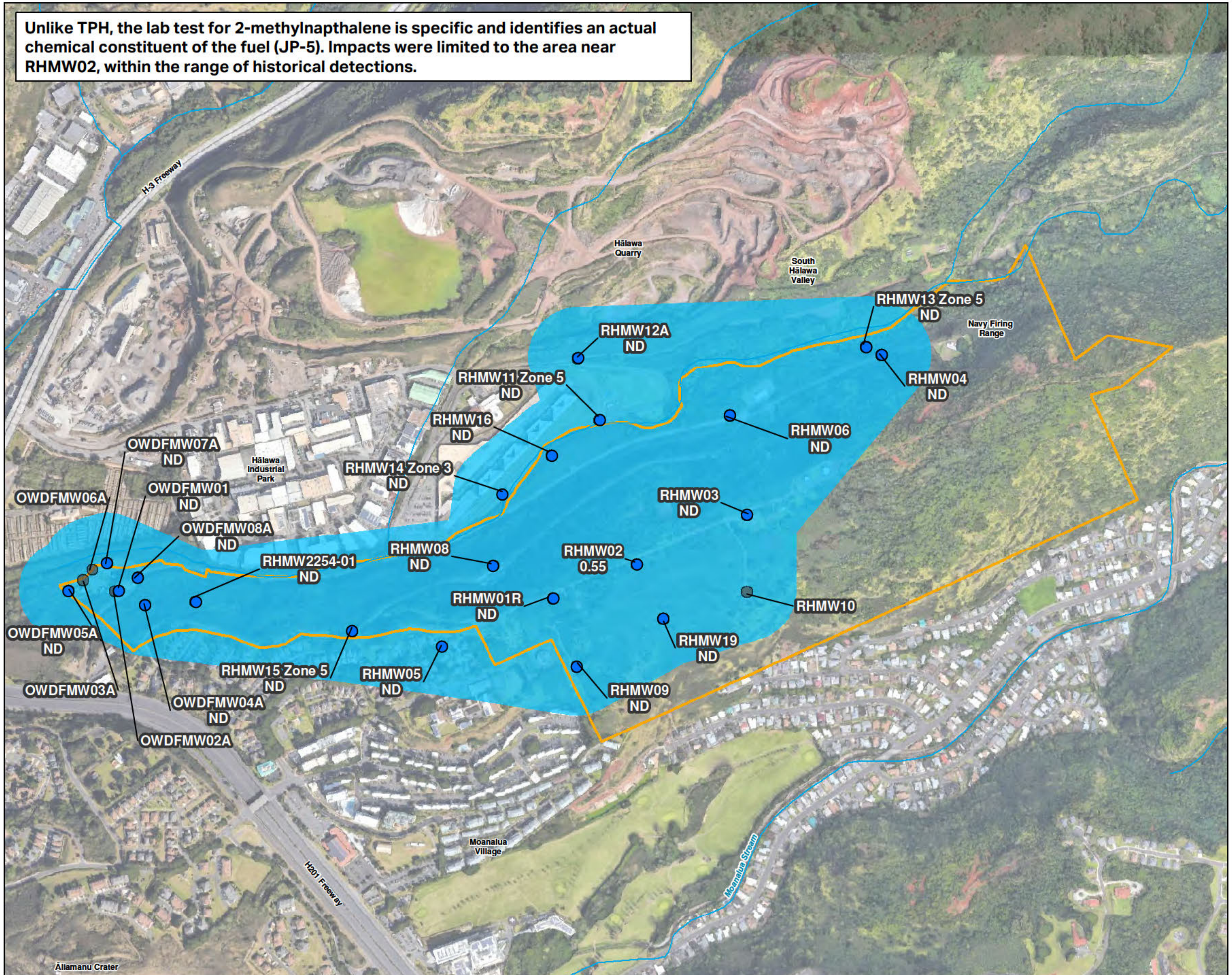
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

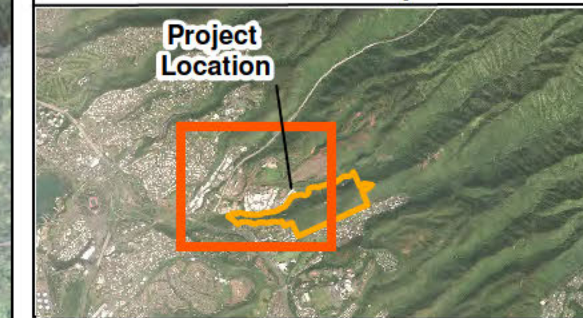
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of March 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

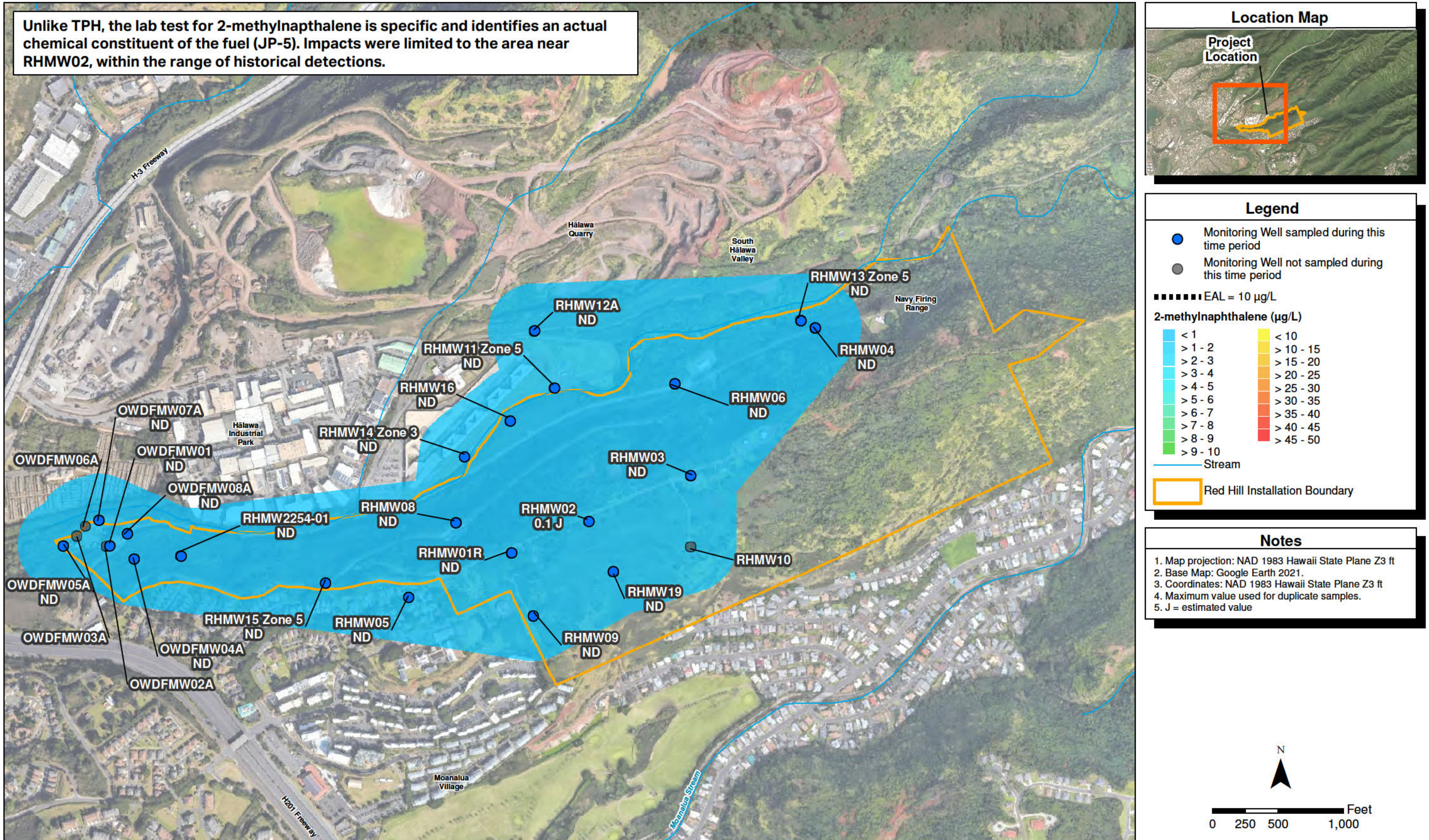
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

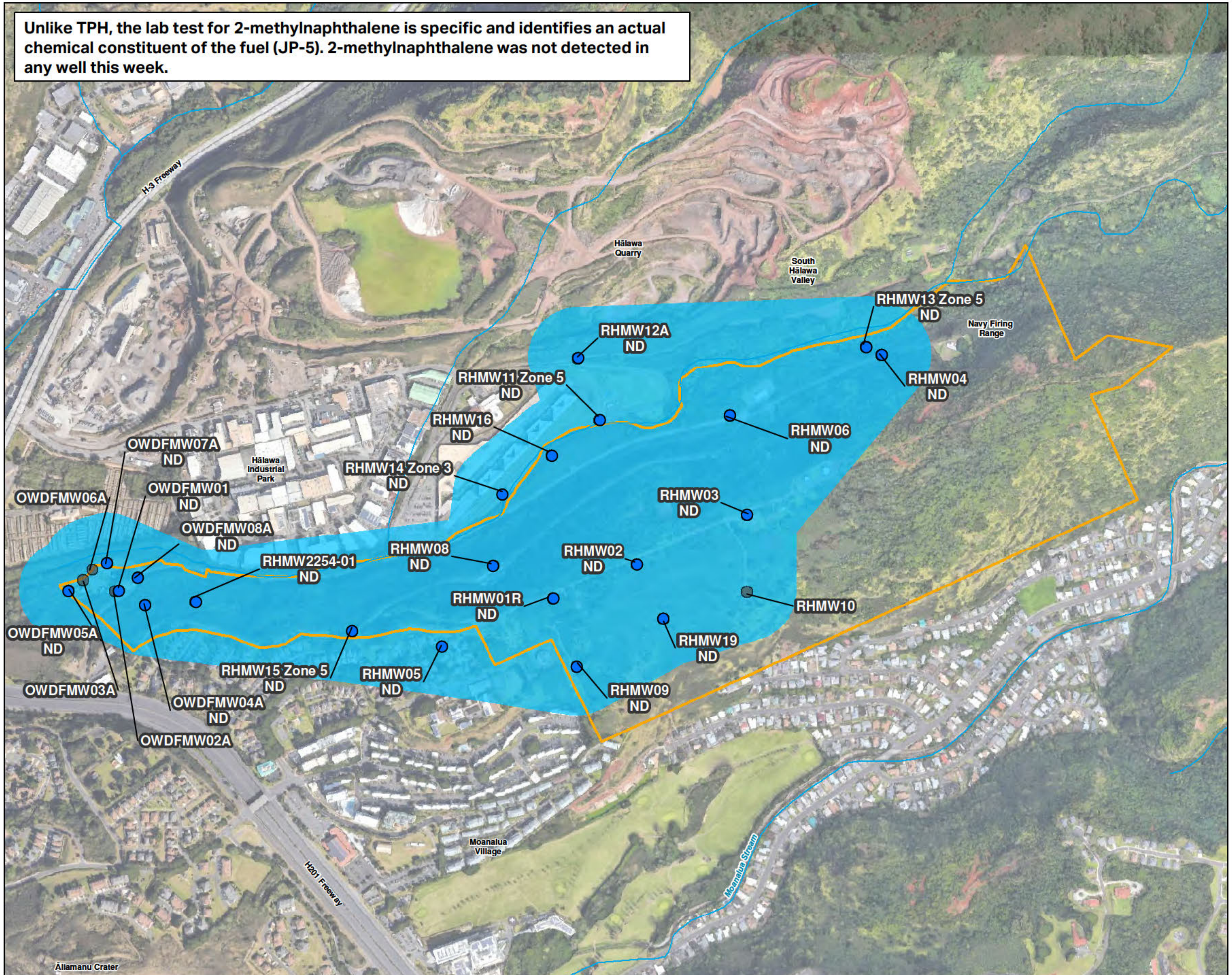
N

Feet
0 250 500 1,000

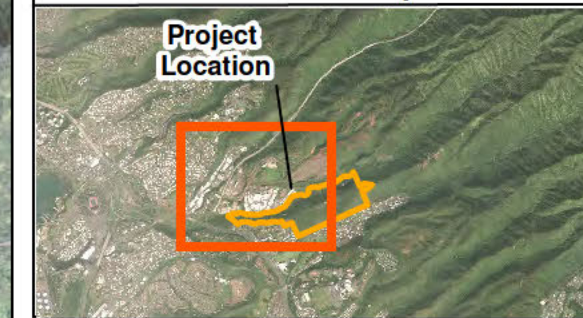
2-methylnaphthalene Results
Week of April 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



2-methylnaphthalene Results
Week of April 24, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

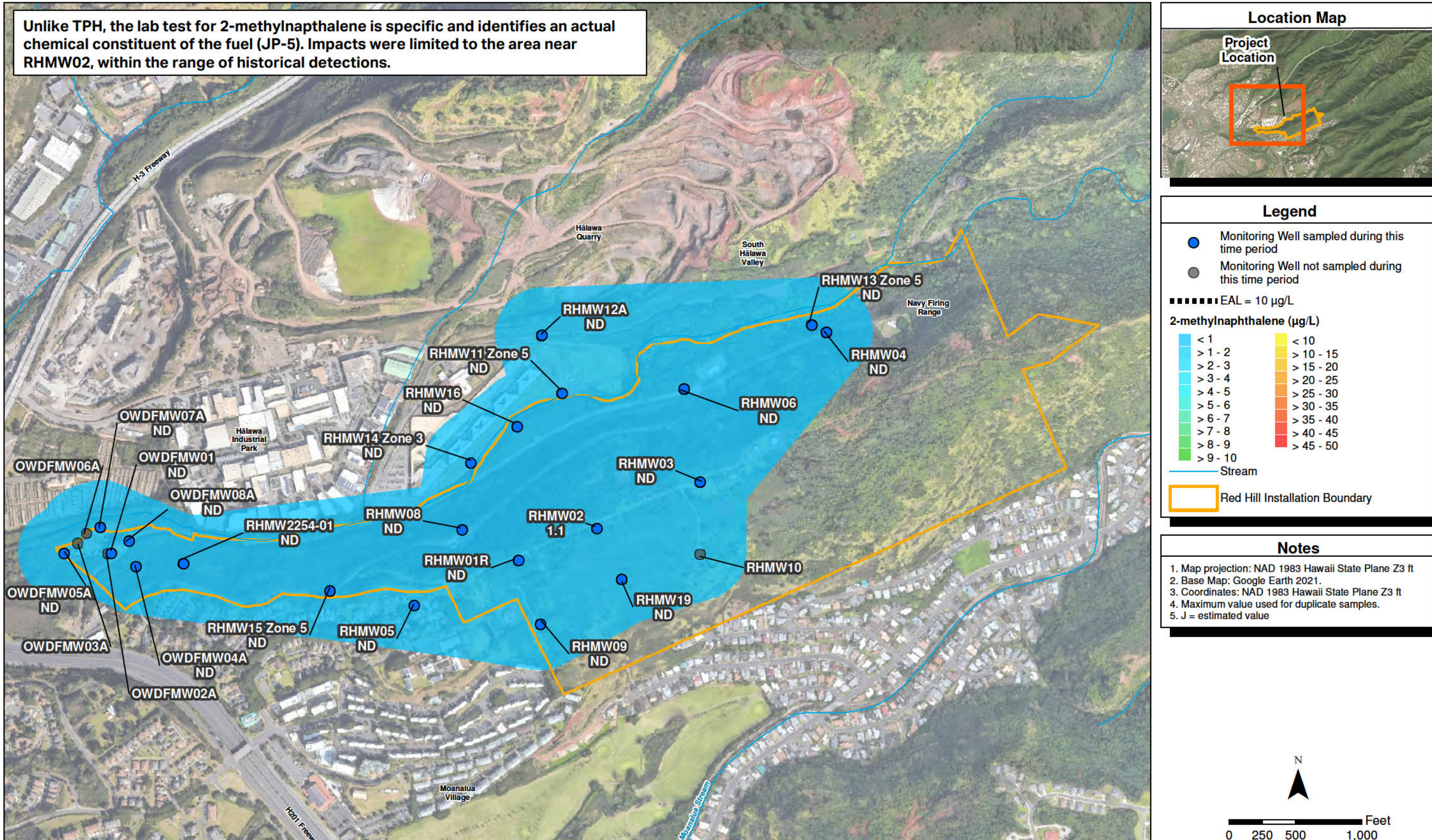
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

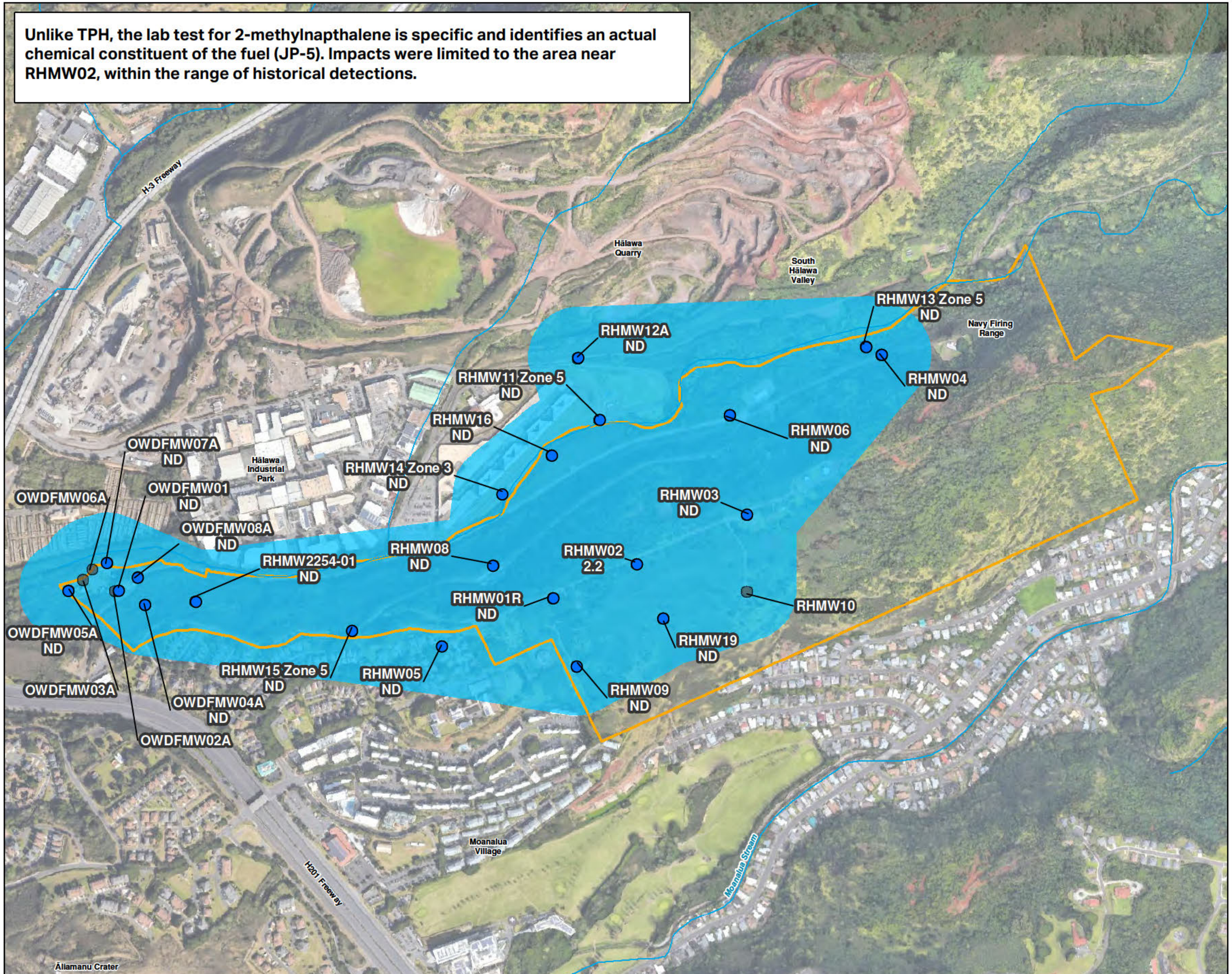
Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of May 2, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

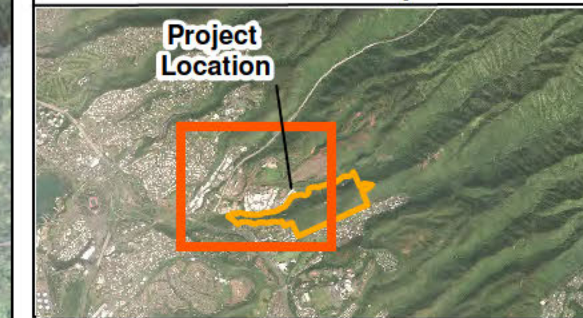


2-methylnaphthalene Results
Week of May 9, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 2-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

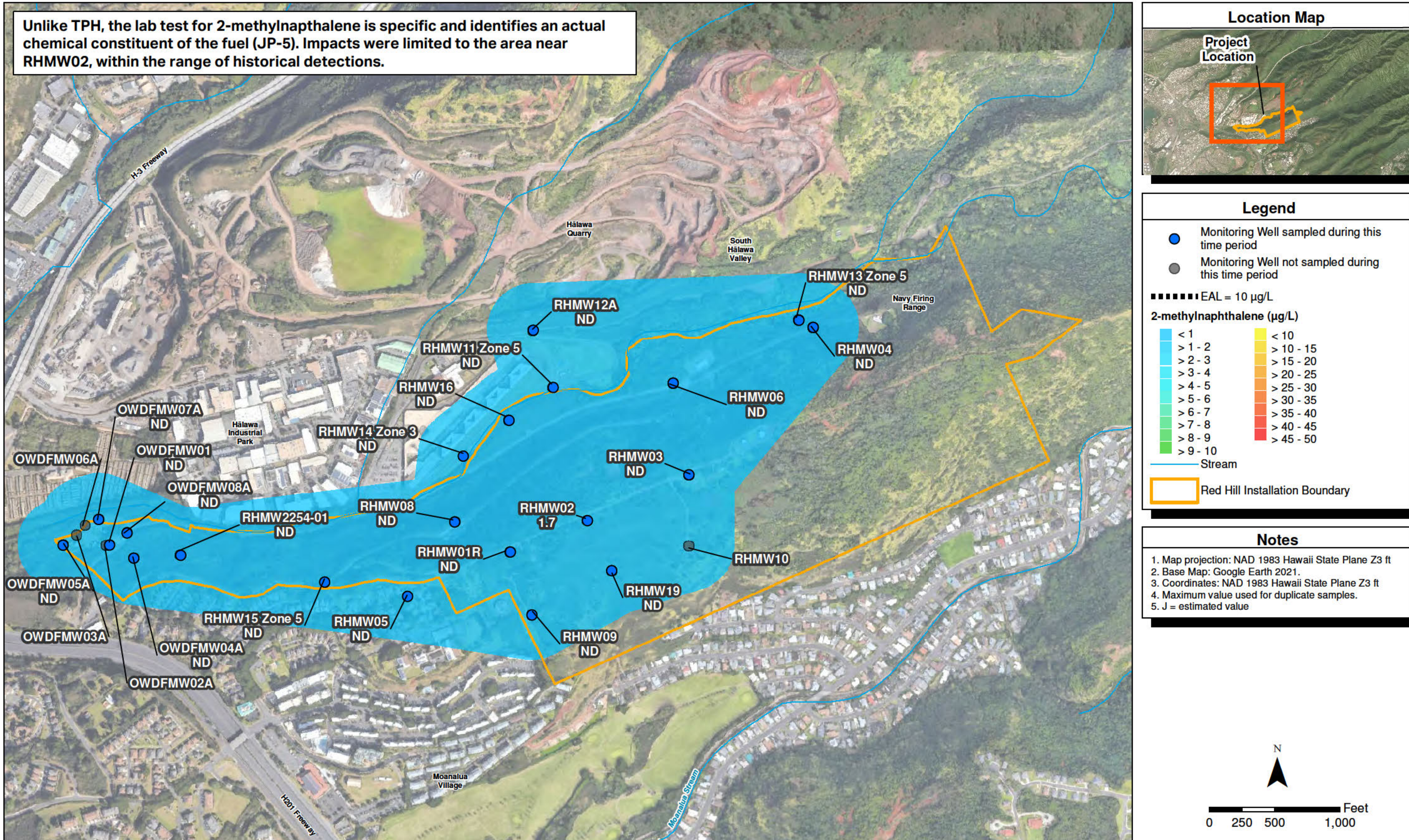
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

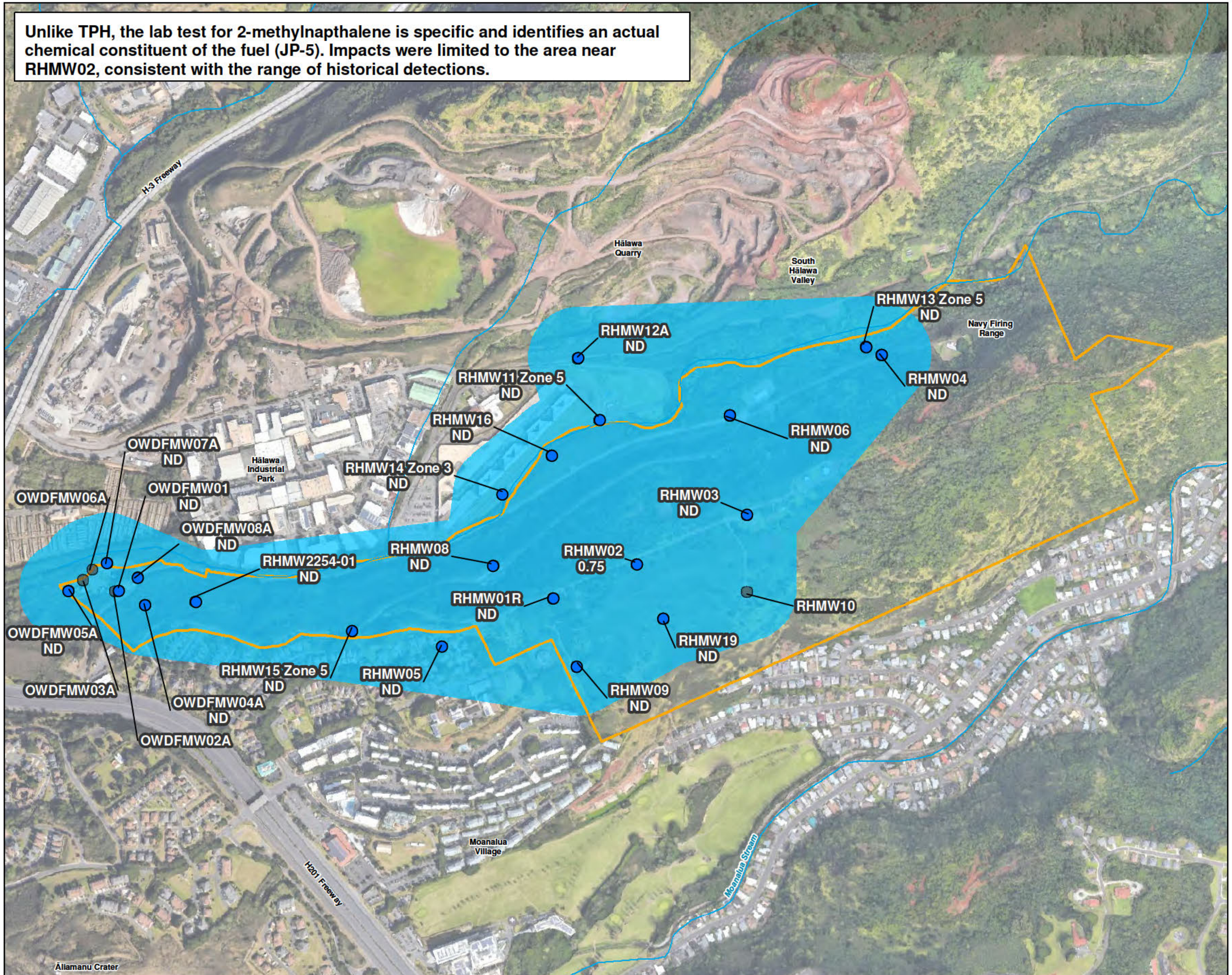
N

Feet
0 250 500 1,000

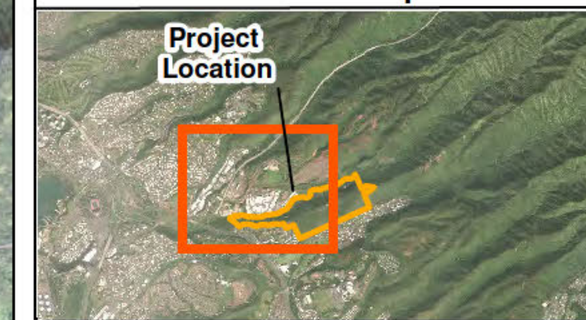
2-methylnaphthalene Results
Week of May 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



2-methylnaphthalene Results
Week of May 23, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- < 10
- > 10 - 15
- > 15 - 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50
- Stream
- Red Hill Installation Boundary

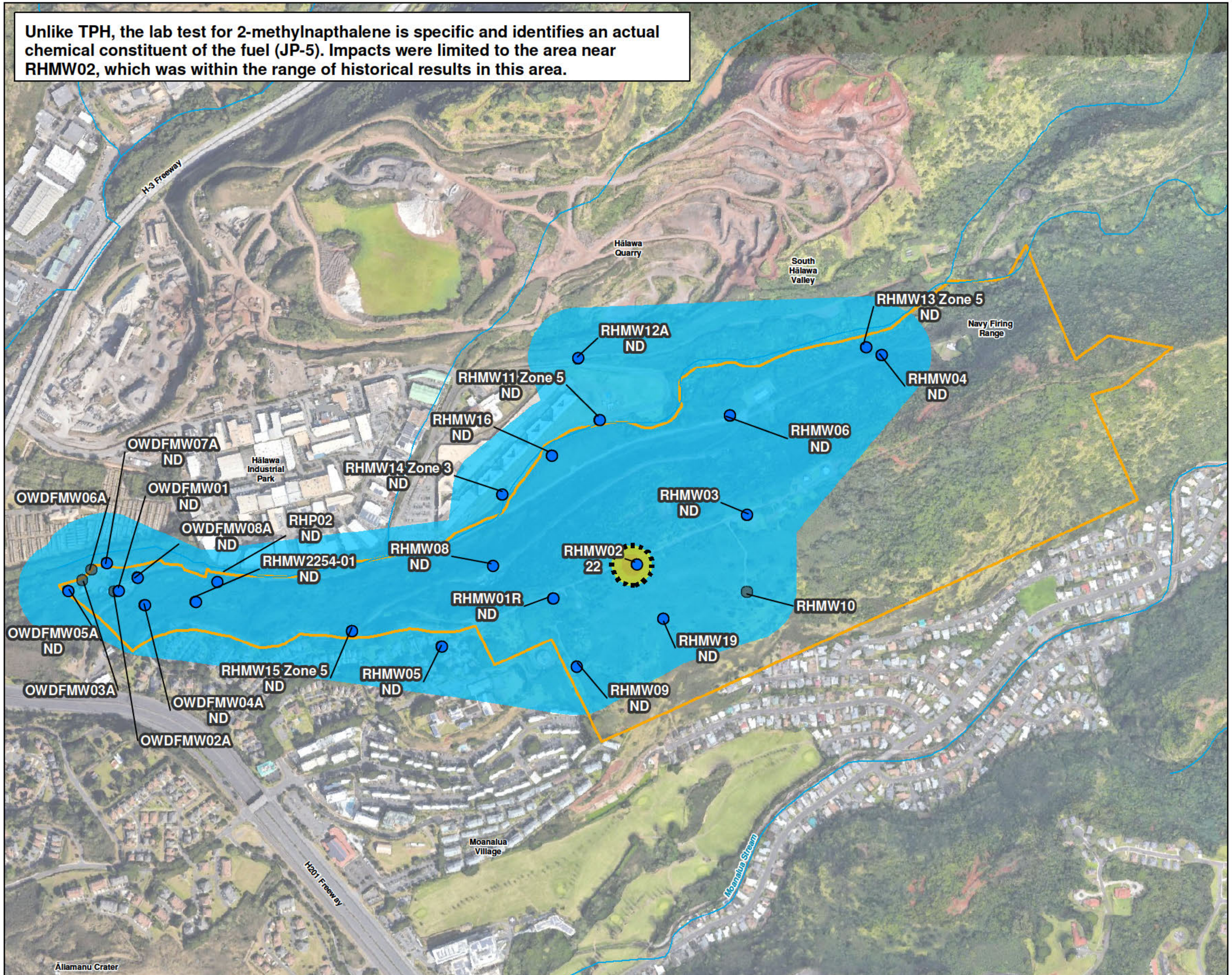
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

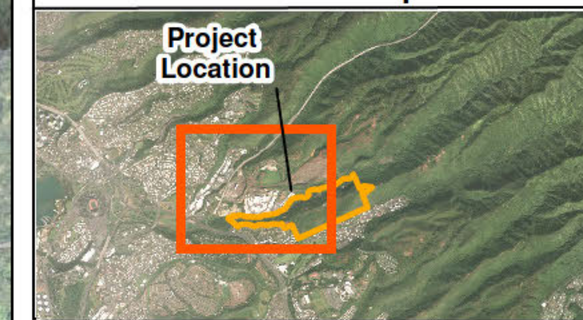
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of May 31, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

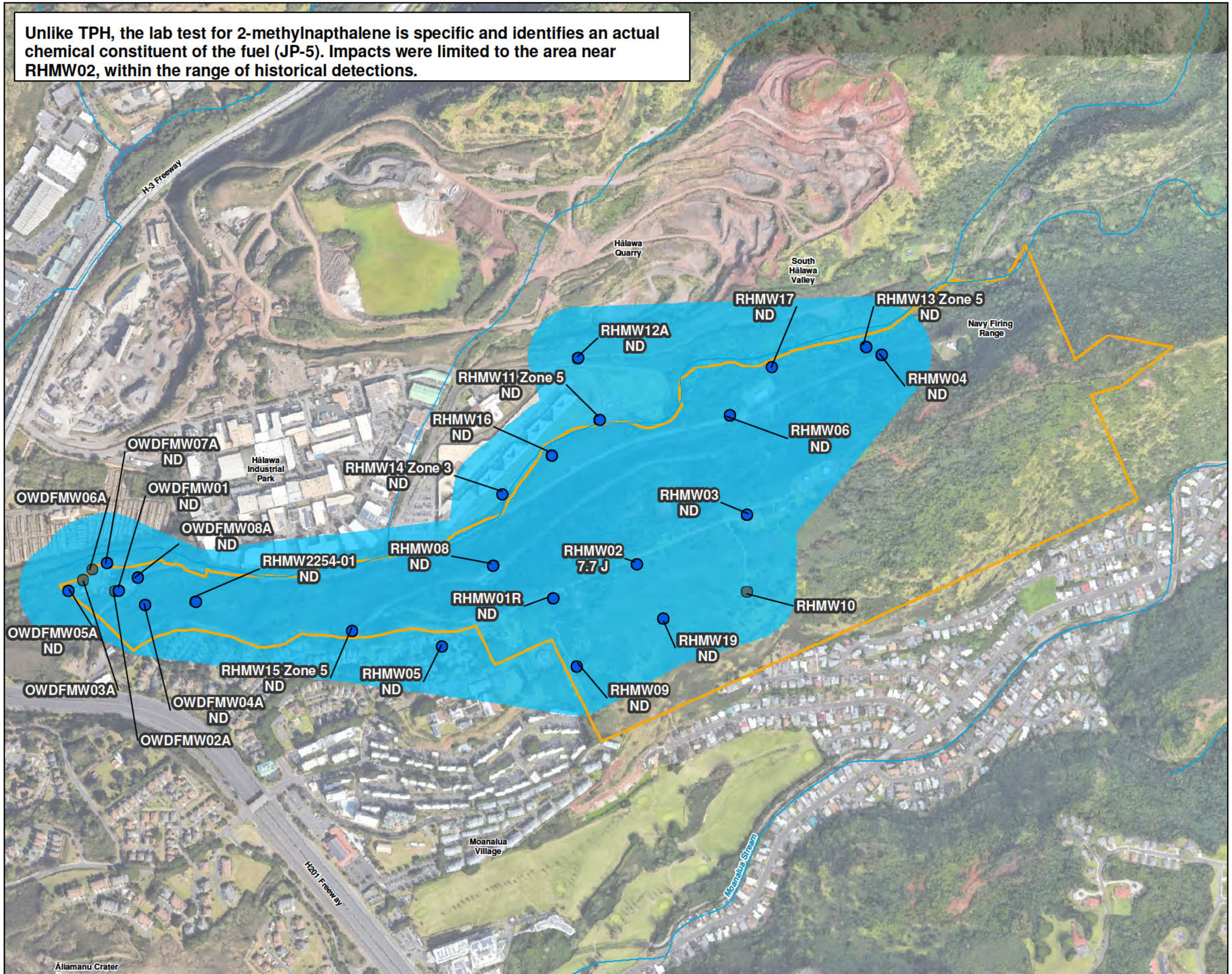
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

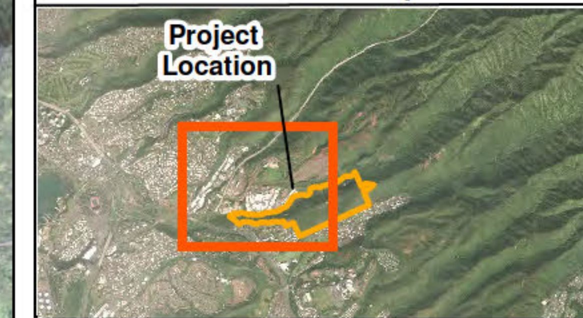
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of June 6, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

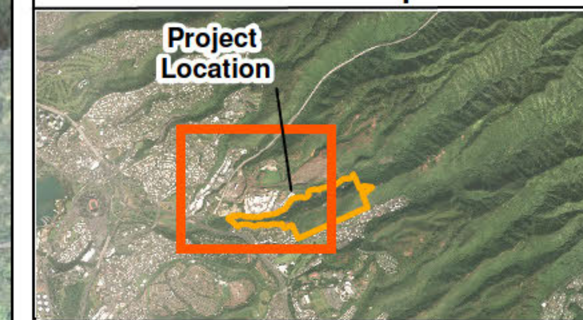
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of June 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 2-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

Notes

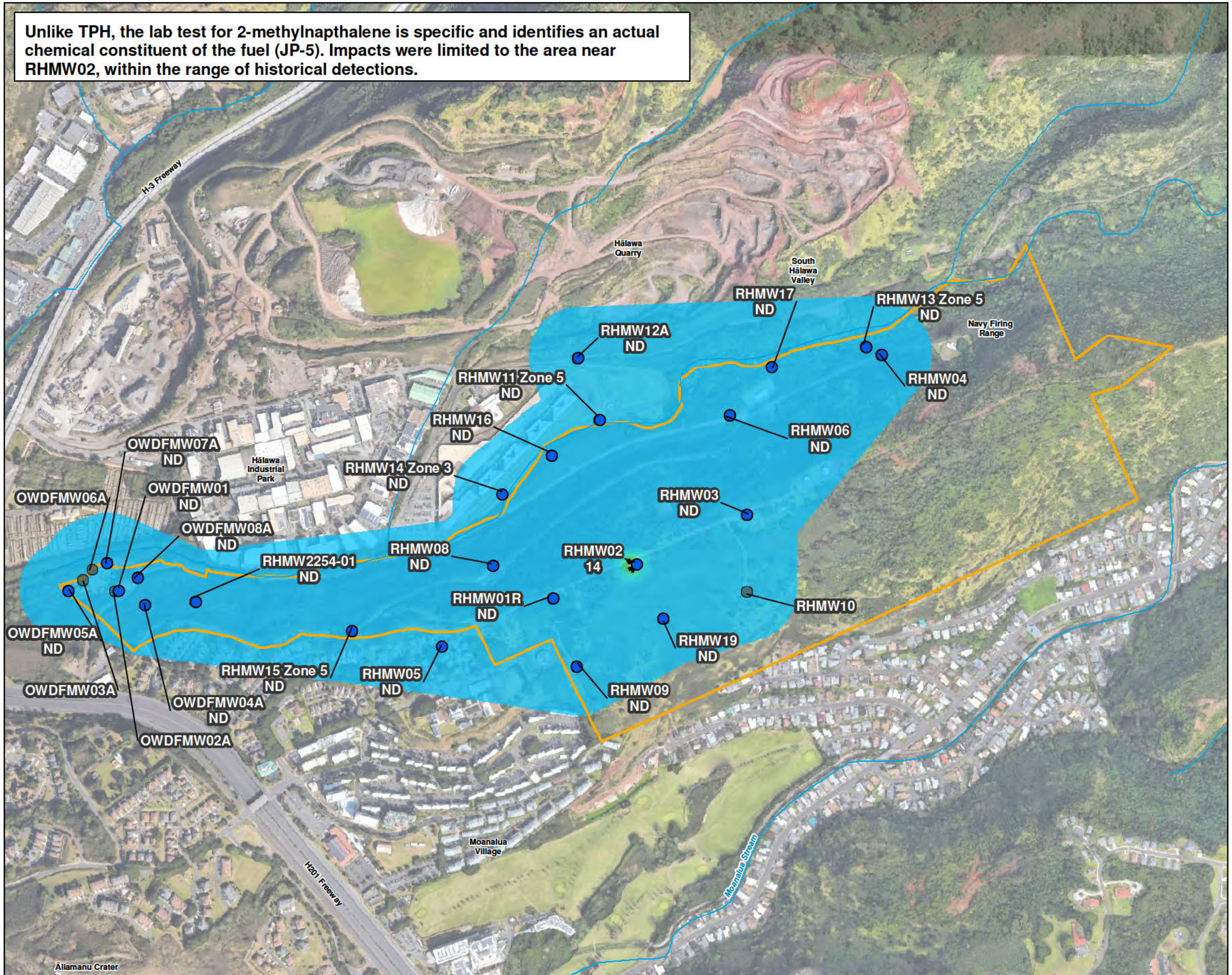
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

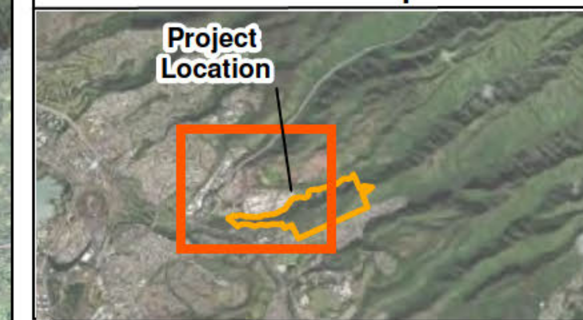
Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of June 20, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for 2-methylnapthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

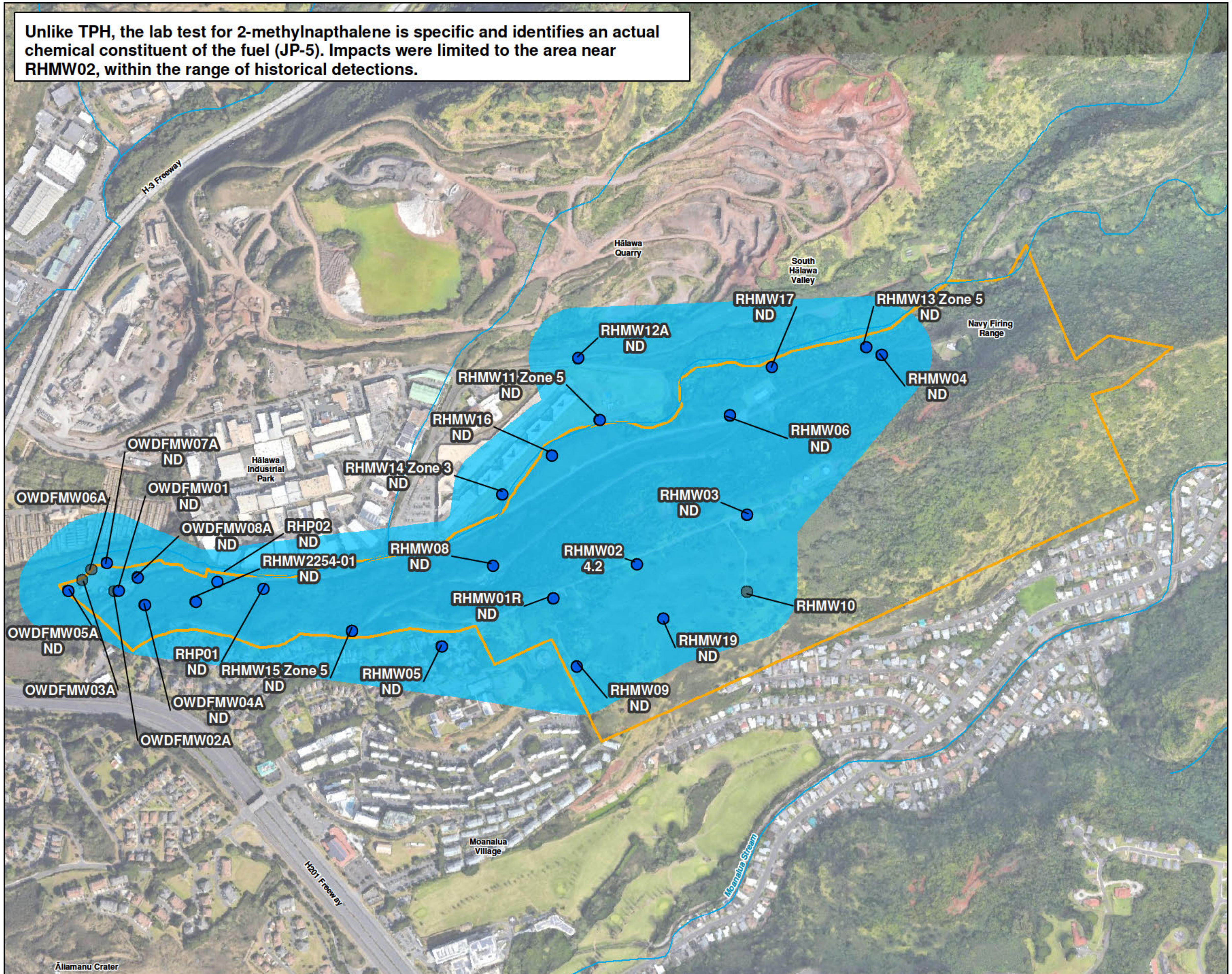
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

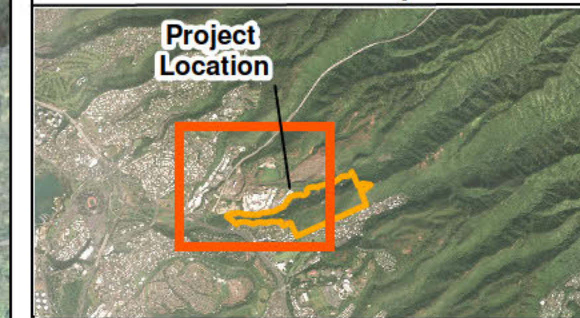
N

Feet
0 250 500 1,000

2-methylnaphthalene Results
Week of June 27, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 10 µg/L

2-methylnaphthalene (µg/L)

< 1	< 10
> 1 - 2	> 10 - 15
> 2 - 3	> 15 - 20
> 3 - 4	> 20 - 25
> 4 - 5	> 25 - 30
> 5 - 6	> 30 - 35
> 6 - 7	> 35 - 40
> 7 - 8	> 40 - 45
> 8 - 9	> 45 - 50
> 9 - 10	

- Stream
- Red Hill Installation Boundary

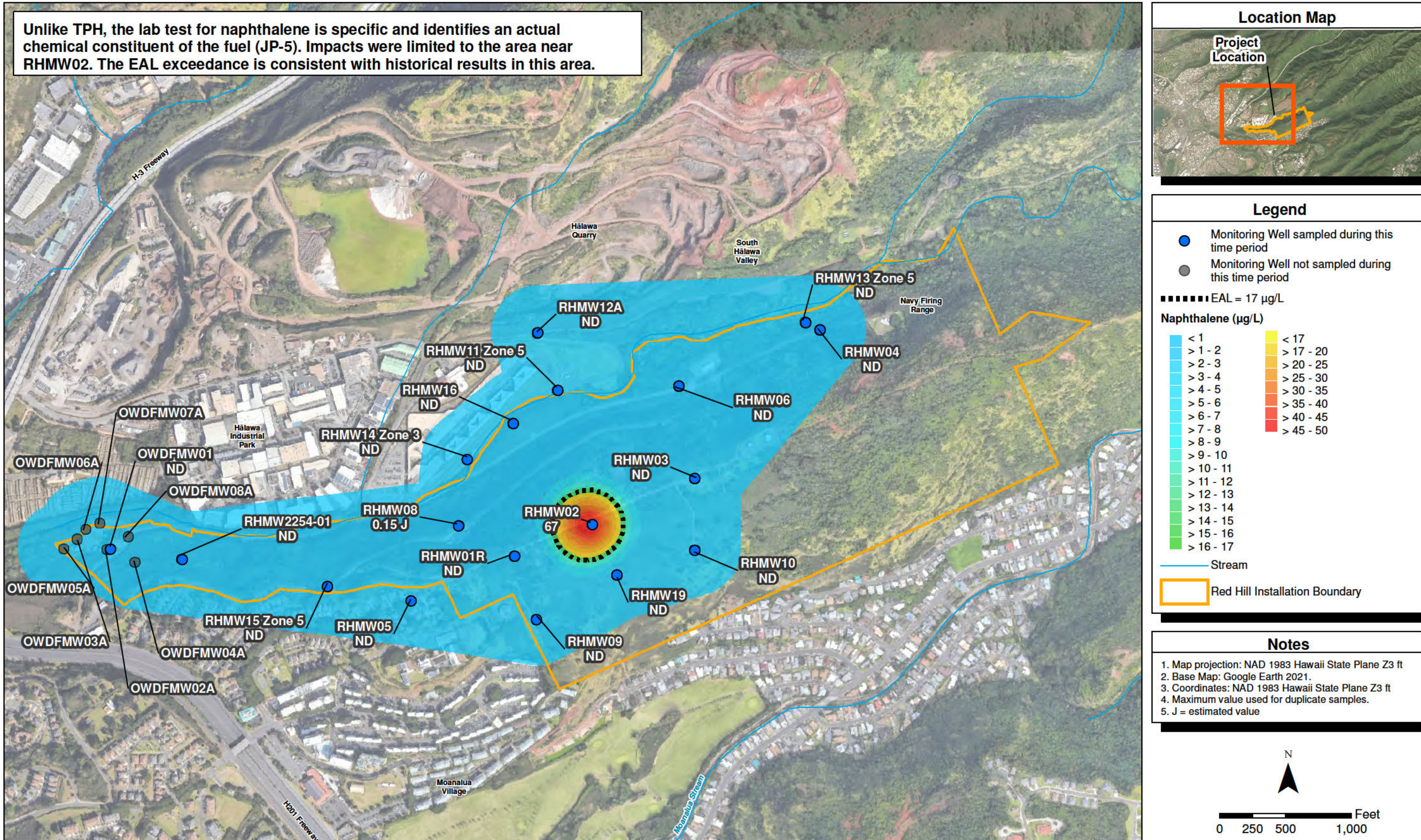
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

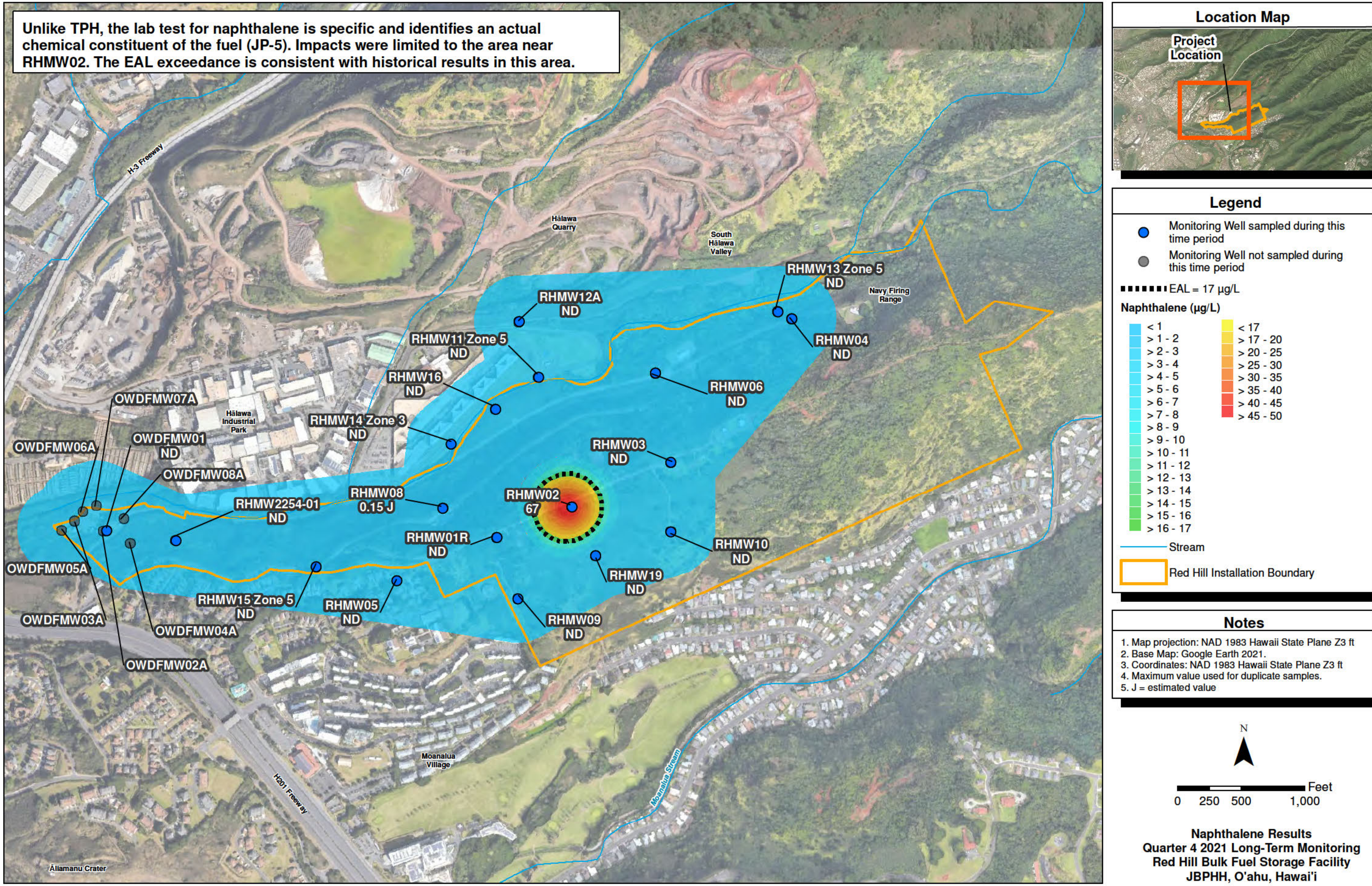
N

Feet
0 250 500 1,000

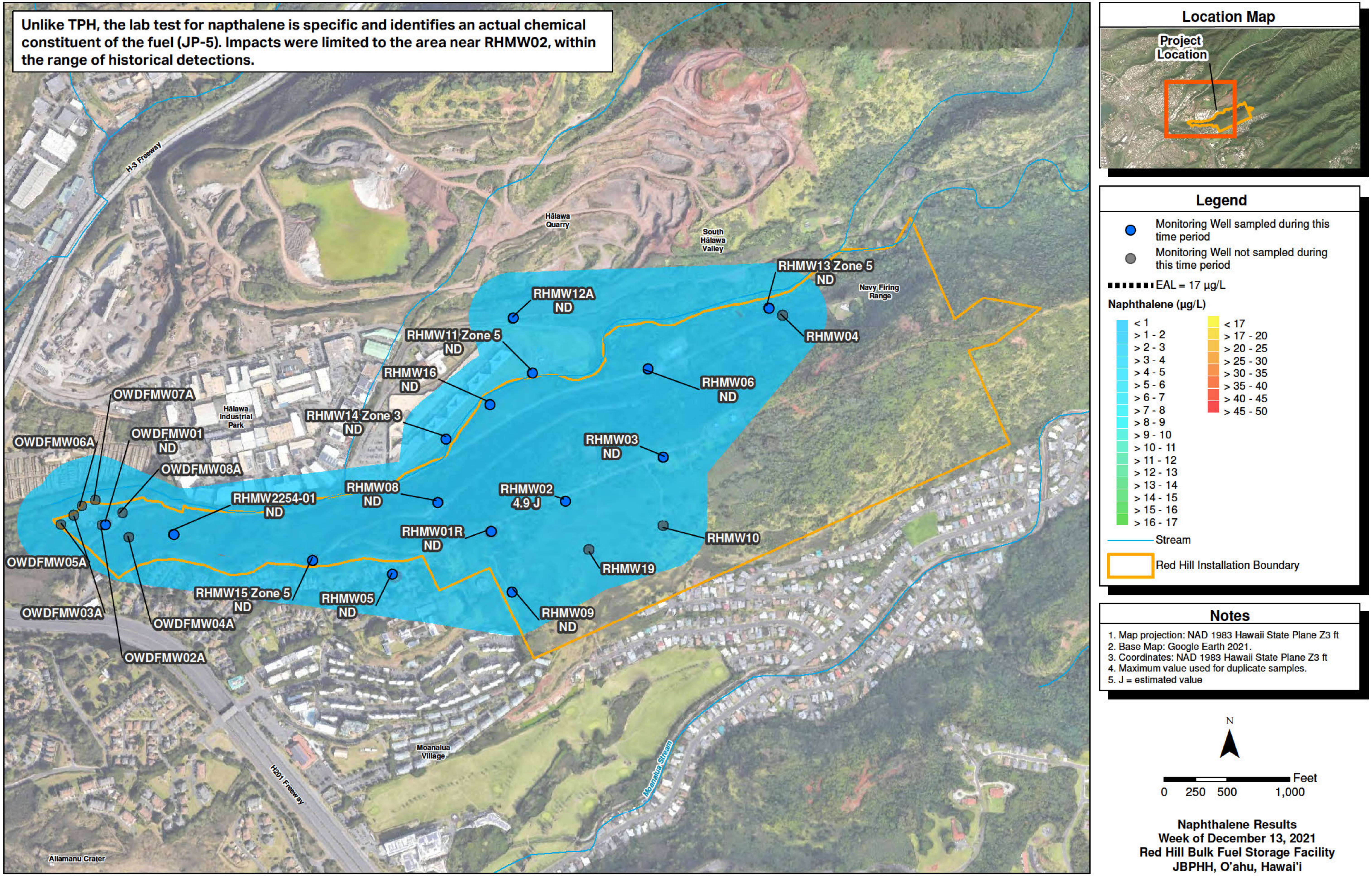
2-methylnaphthalene Results
Week of July 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



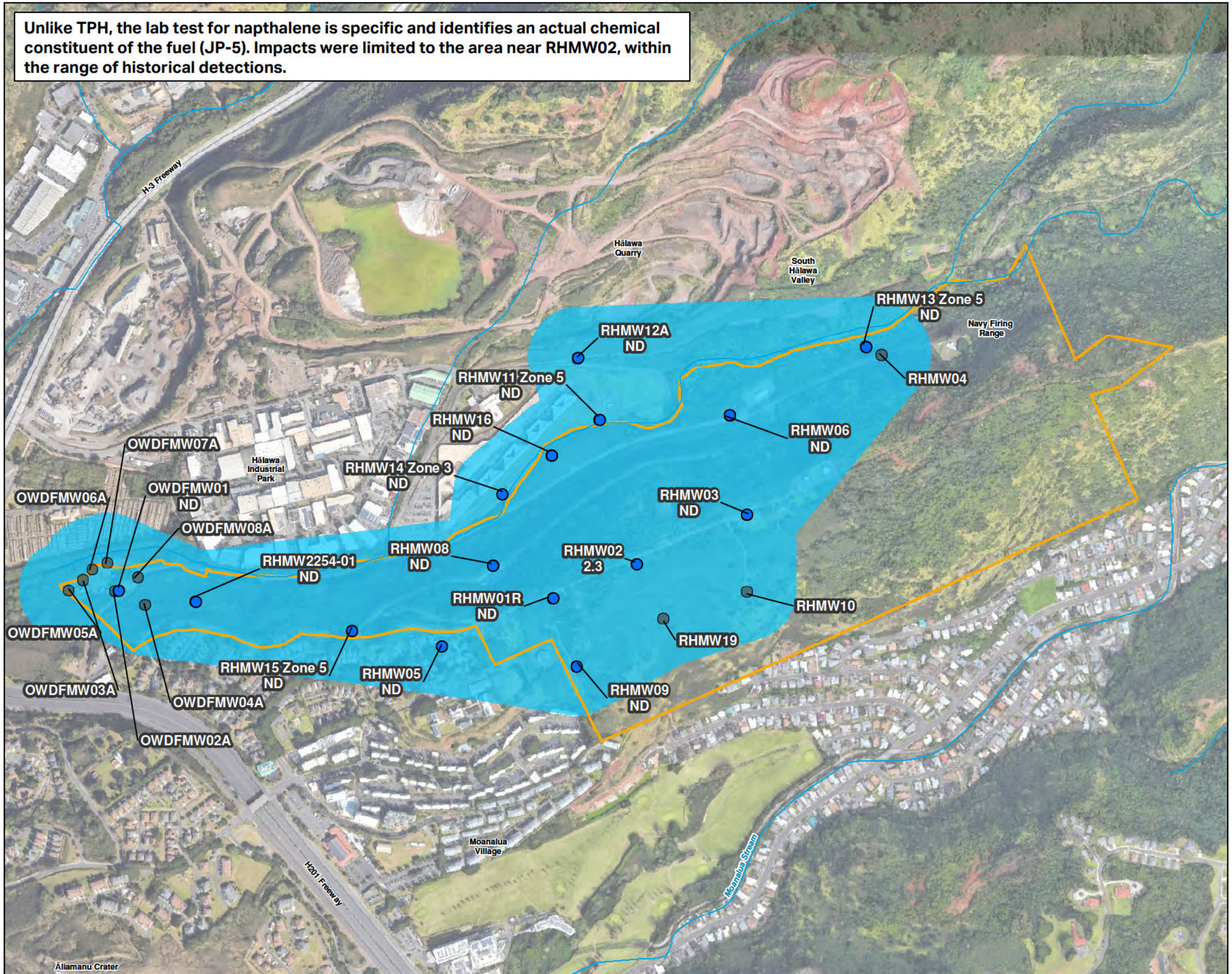
Naphthalene Results
Quarter 3 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



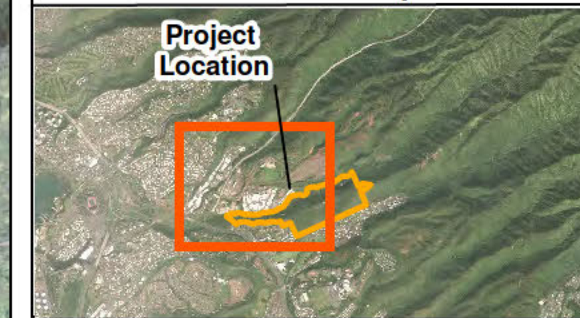
Naphthalene Results
Quarter 4 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i


Unlike TPH, the lab test for napthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.
H-3 Freeway
Hālawa Quarry
South Hālawa Valley
Navy Firing Range
Hālawa Industrial Park
RHMW13 Zone 5
ND
RHMW12A
ND
RHMW04
RHMW11 Zone 5
ND
RHMW16
ND
RHMW06
ND
OWDFMW07A
RHMW14 Zone 3
ND
OWDFMW06A
OWDFMW01
ND
RHMW03
ND
OWDFMW08A
RHMW08
ND
RHMW02
4.9 J
RHMW2254-01
ND
RHMW01R
ND
RHMW10
OWDFMW05A
RHMW19
RHMW15 Zone 5
ND
RHMW05
ND
OWDFMW03A
RHMW09
ND
OWDFMW04A
OWDFMW02A
Moanalua Village
H201 Freeway
Moanalua Stream
Āliamanu Crater
Location Map
Project Location
Legend
Monitoring Well sampled during this time period
Monitoring Well not sampled during this time period
EAL = 17 µg/L
Naphthalene (µg/L)
< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 17
< 17
> 17 - 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50
Stream
Red Hill Installation Boundary
Notes
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
N
Feet
0 250 500 1,000
Naphthalene Results
Week of December 13, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for napthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 17
< 17
> 17 - 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

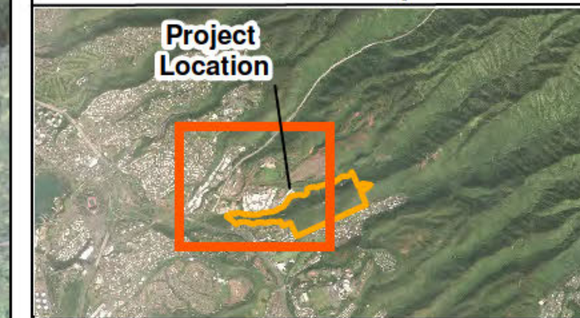
N

Feet
0 250 500 1,000

Naphthalene Results
Week of December 20, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for napthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 17
< 17
> 17 - 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

Notes

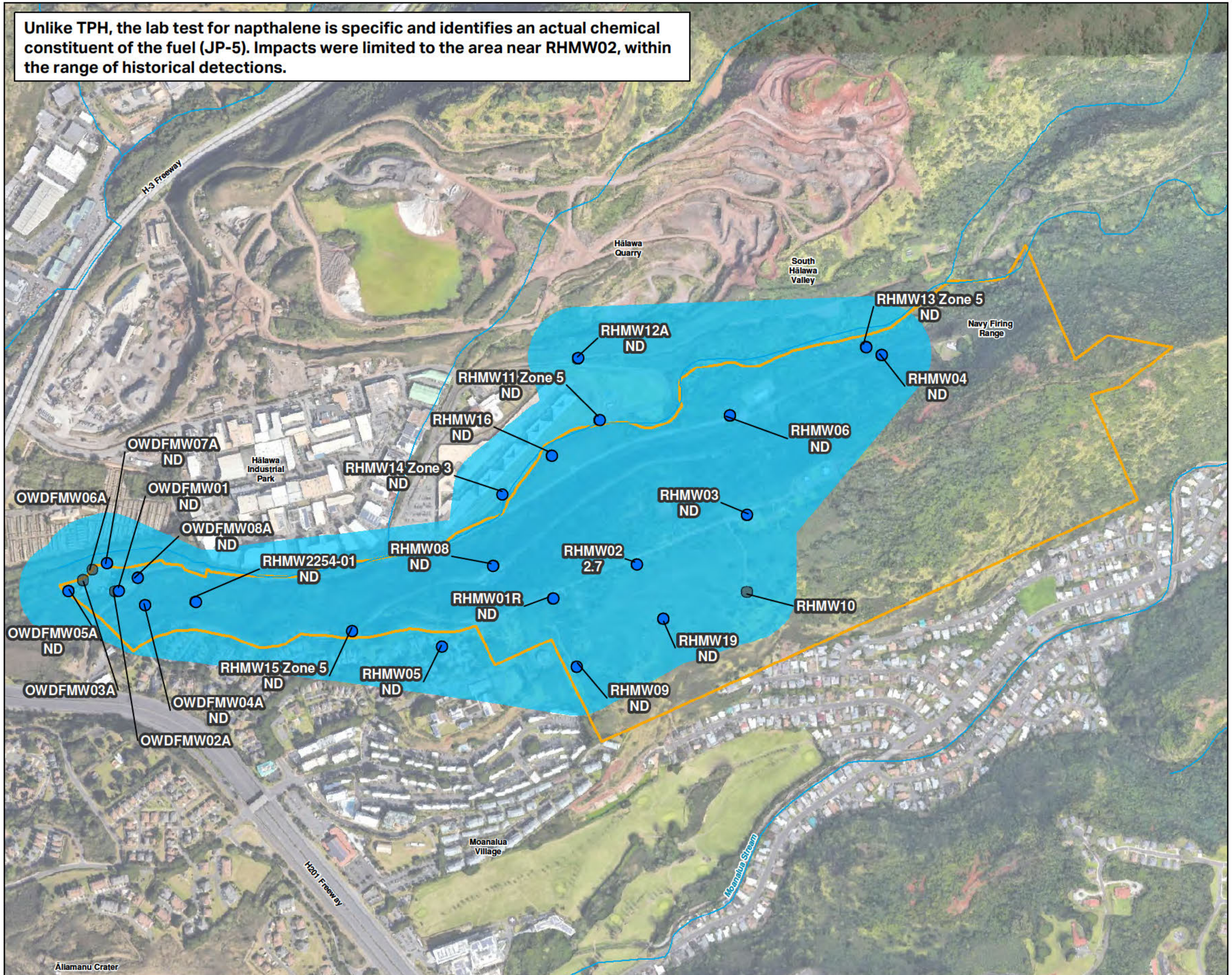
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

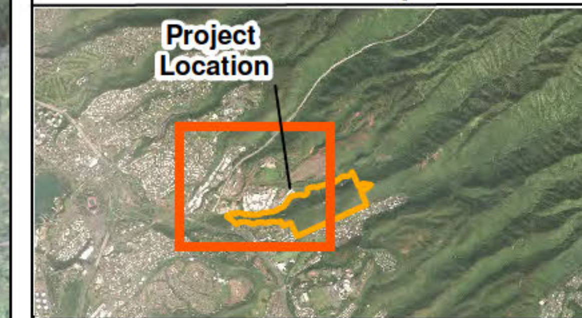
Feet
0 250 500 1,000

Naphthalene Results
Week of December 27, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for napthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1, > 1 - 2, > 2 - 3, > 3 - 4, > 4 - 5, > 5 - 6, > 6 - 7, > 7 - 8, > 8 - 9, > 9 - 10, > 10 - 11, > 11 - 12, > 12 - 13, > 13 - 14, > 14 - 15, > 15 - 16, > 16 - 17

< 17, > 17 - 20, > 20 - 25, > 25 - 30, > 30 - 35, > 35 - 40, > 40 - 45, > 45 - 50

- Stream
- Red Hill Installation Boundary

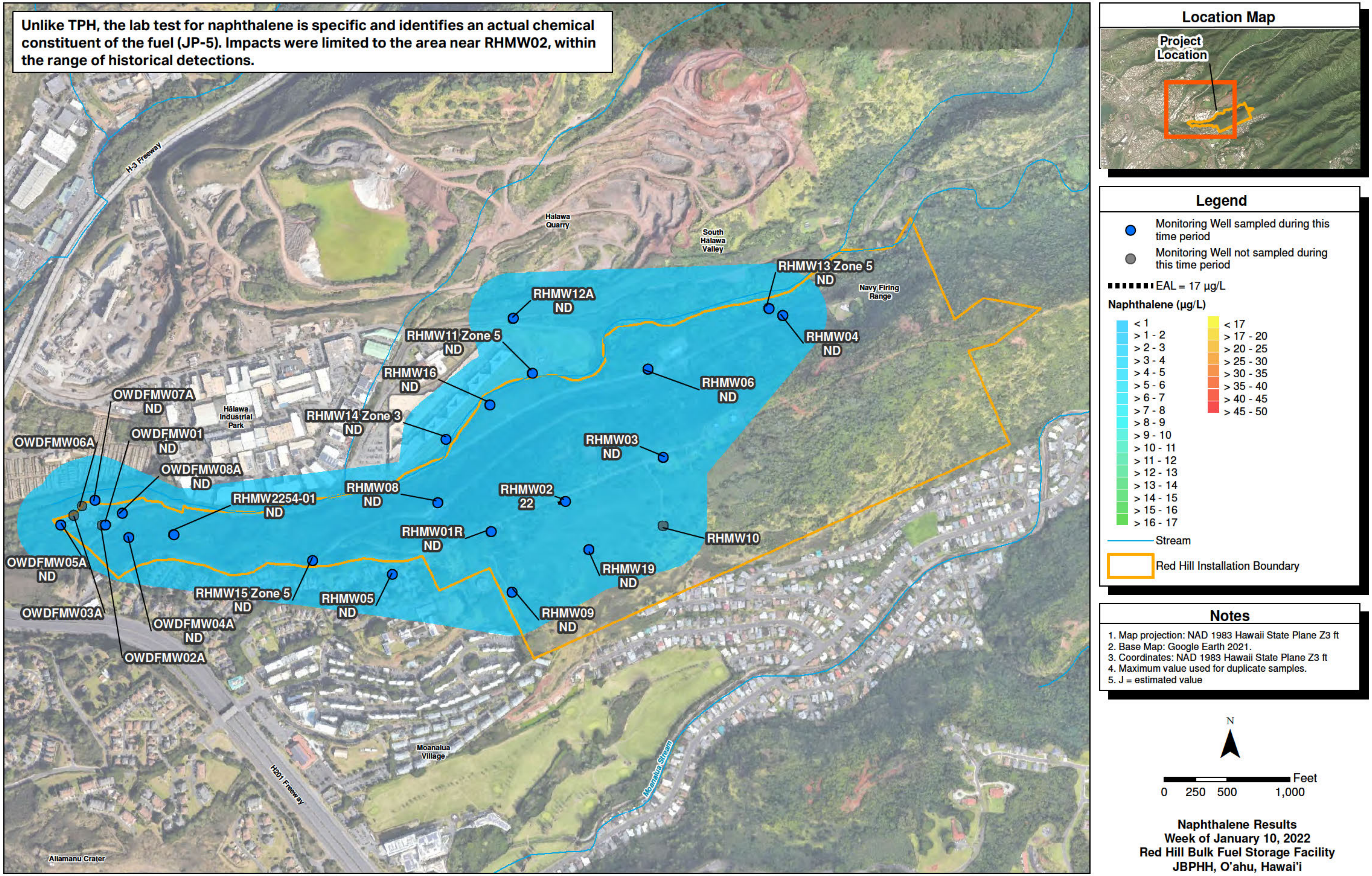
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

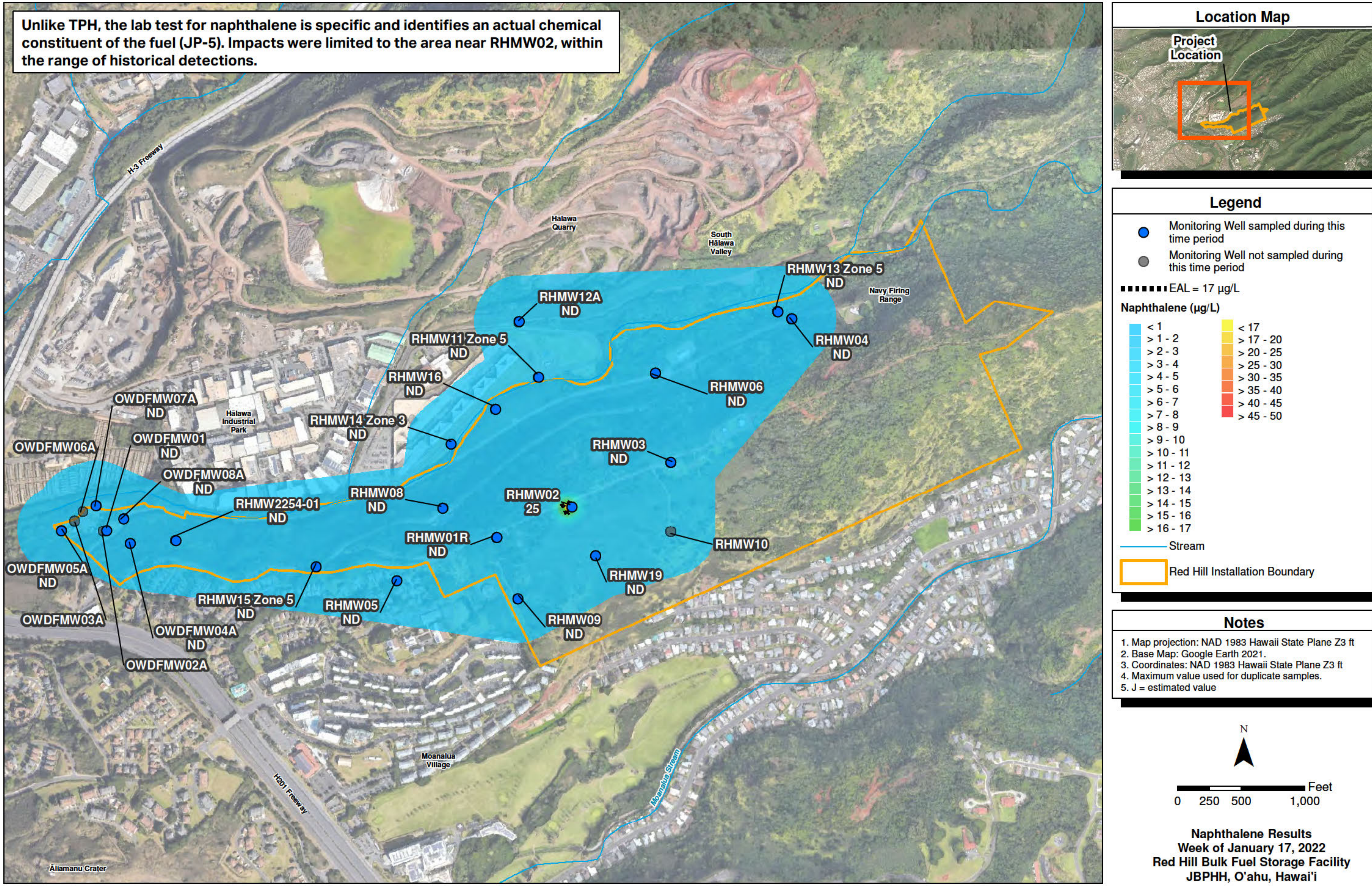
N

Feet
0 250 500 1,000

Naphthalene Results
Week of January 3, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

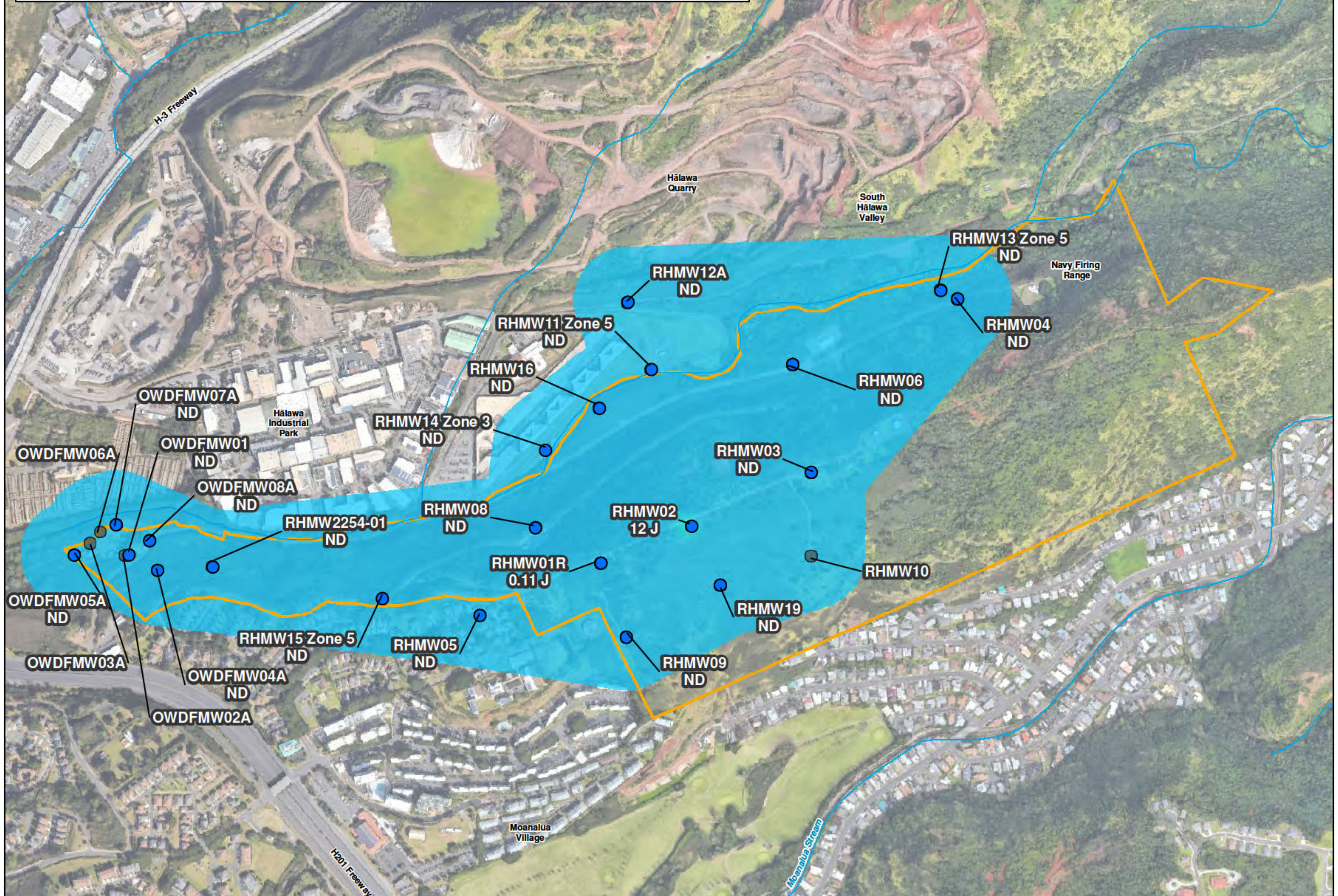


Naphthalene Results
Week of January 10, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



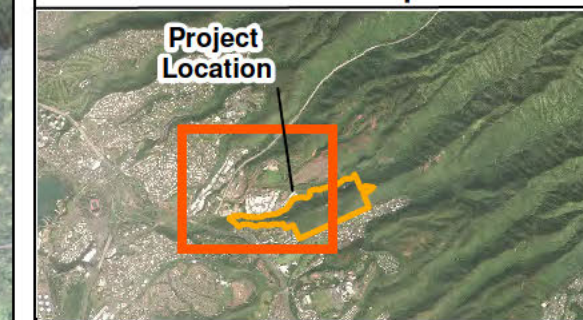
Naphthalene Results
Week of January 17, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for naphthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the tank farm (RHMW01R and RHMW02), within the range of historical detections.



Note that sampling was discontinued in many of the wells from the end of January to the end of February, in consultation with the DOH and EPA, to allow for USGS water level monitoring.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1, > 1 - 2, > 2 - 3, > 3 - 4, > 4 - 5, > 5 - 6, > 6 - 7, > 7 - 8, > 8 - 9, > 9 - 10, > 10 - 11, > 11 - 12, > 12 - 13, > 13 - 14, > 14 - 15, > 15 - 16, > 16 - 17

< 17, > 17 - 20, > 20 - 25, > 25 - 30, > 30 - 35, > 35 - 40, > 40 - 45, > 45 - 50

- Stream
- Red Hill Installation Boundary

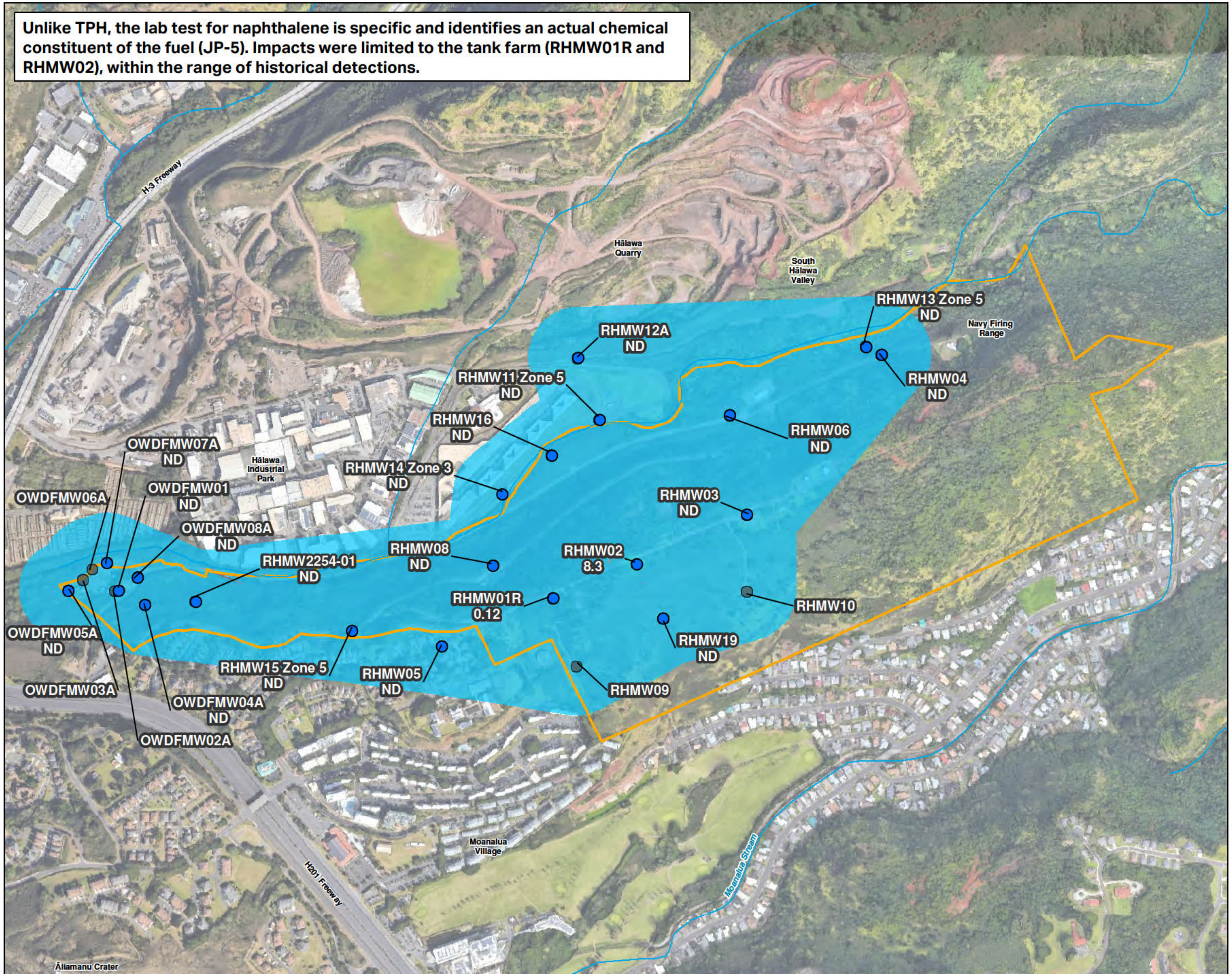
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

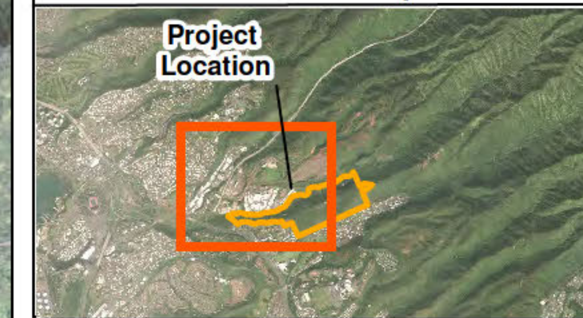
N

0 250 500 1,000 Feet

Naphthalene Results
Week of February 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1, > 1 - 2, > 2 - 3, > 3 - 4, > 4 - 5, > 5 - 6, > 6 - 7, > 7 - 8, > 8 - 9, > 9 - 10, > 10 - 11, > 11 - 12, > 12 - 13, > 13 - 14, > 14 - 15, > 15 - 16, > 16 - 17

< 17, > 17 - 20, > 20 - 25, > 25 - 30, > 30 - 35, > 35 - 40, > 40 - 45, > 45 - 50

- Stream
- Red Hill Installation Boundary

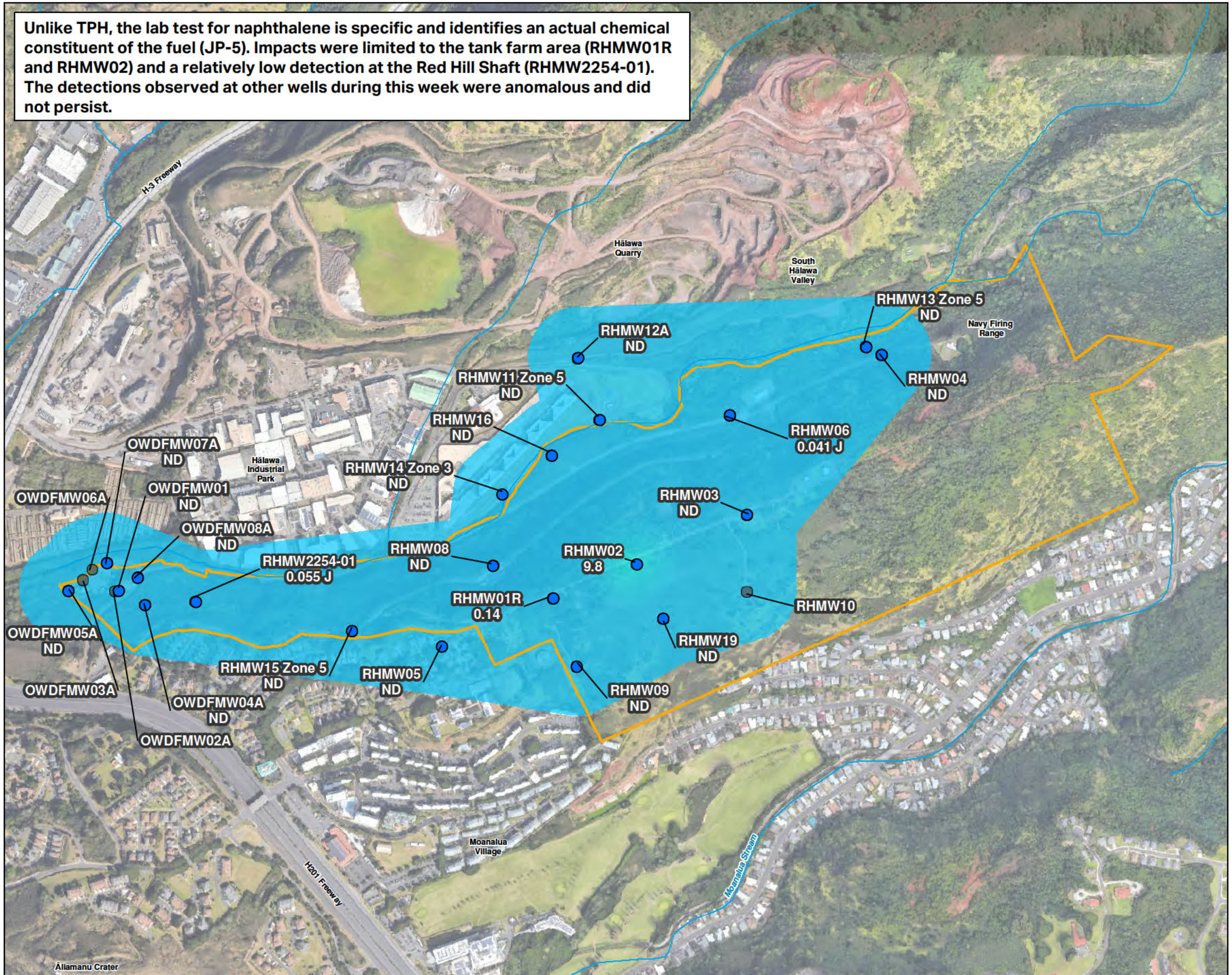
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

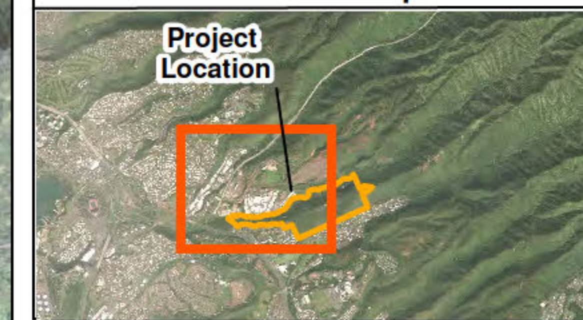
N

Feet
0 250 500 1,000

Naphthalene Results
Week of March 7, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 μg/L

Naphthalene (μg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

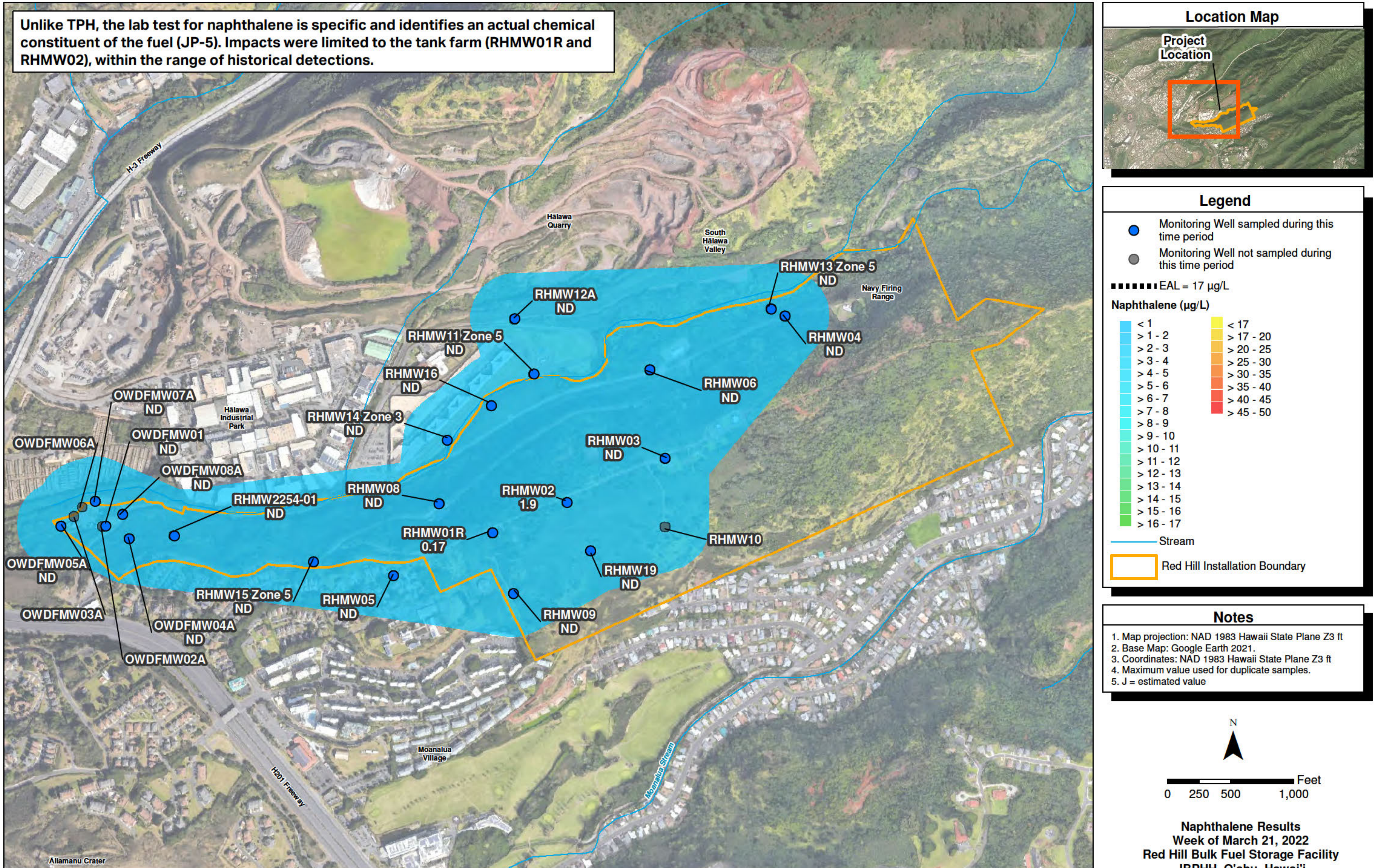
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

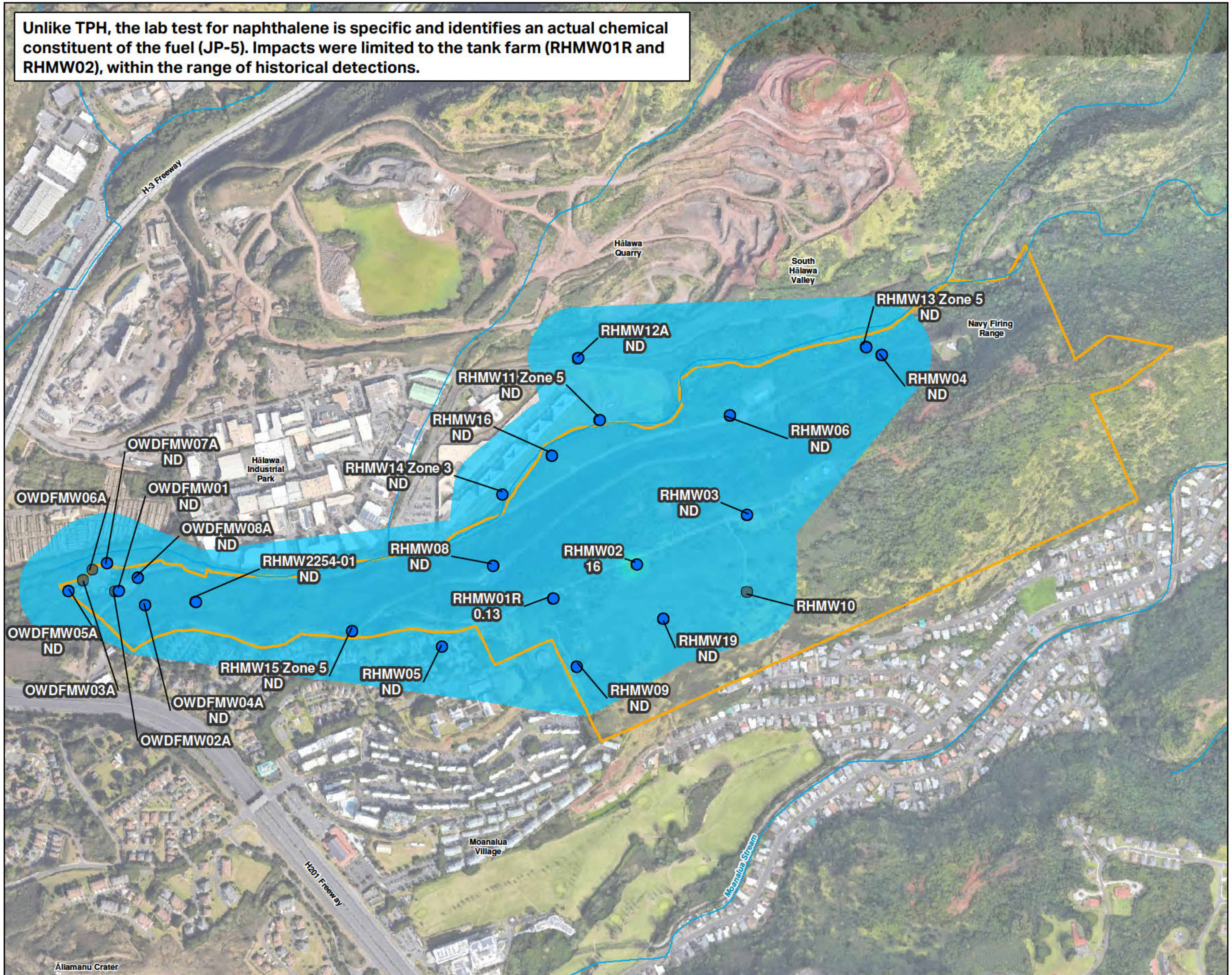
N

Feet
0 250 500 1,000

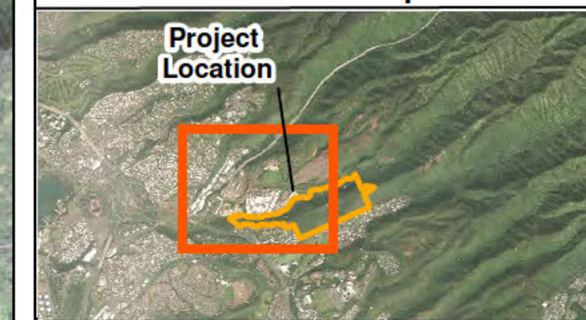
Naphthalene Results
Week of March 14, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Naphthalene Results
Week of March 21, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

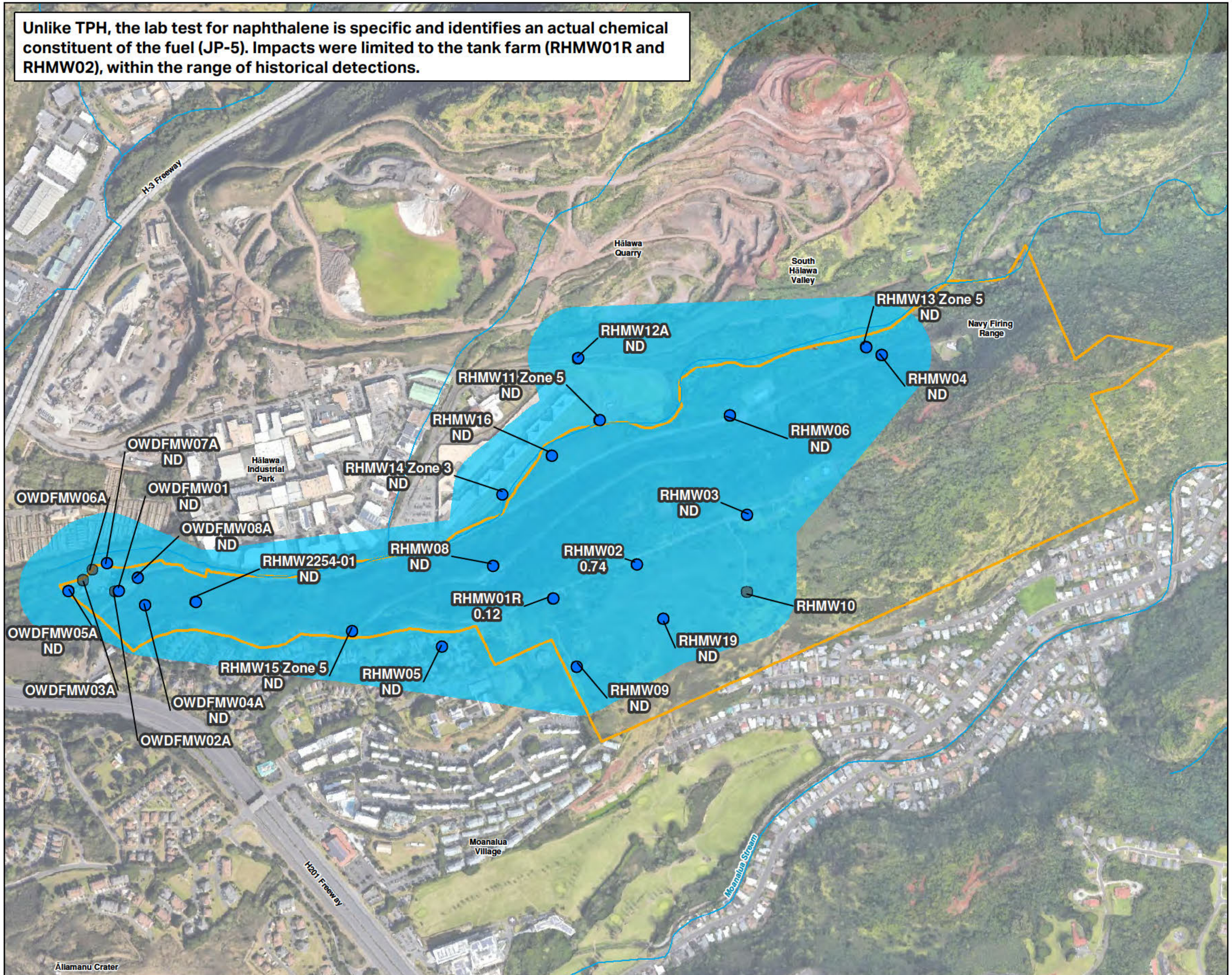
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

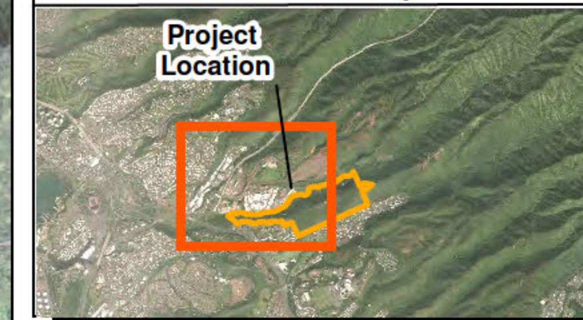
N

Feet
0 250 500 1,000

Naphthalene Results
Week of March 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

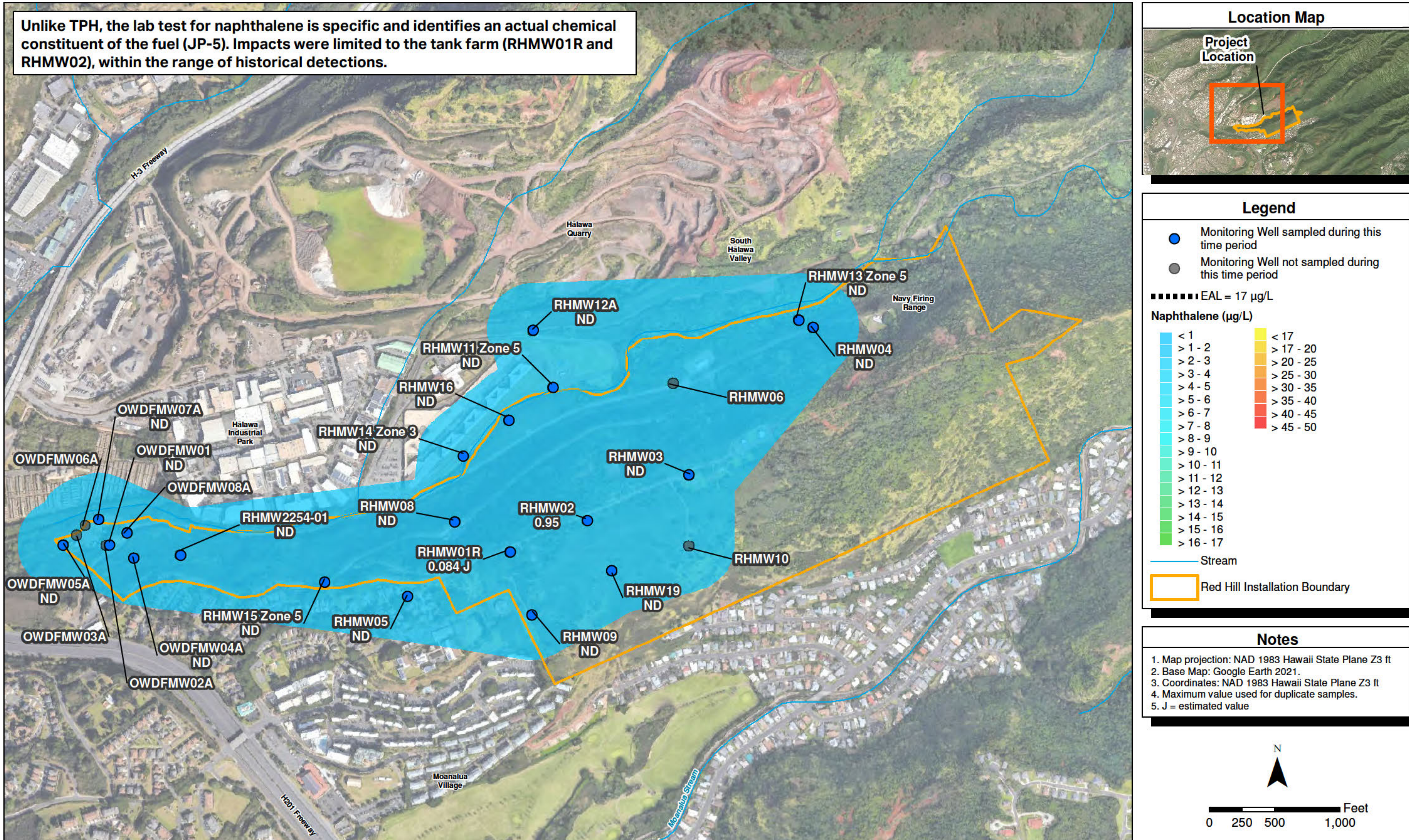
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

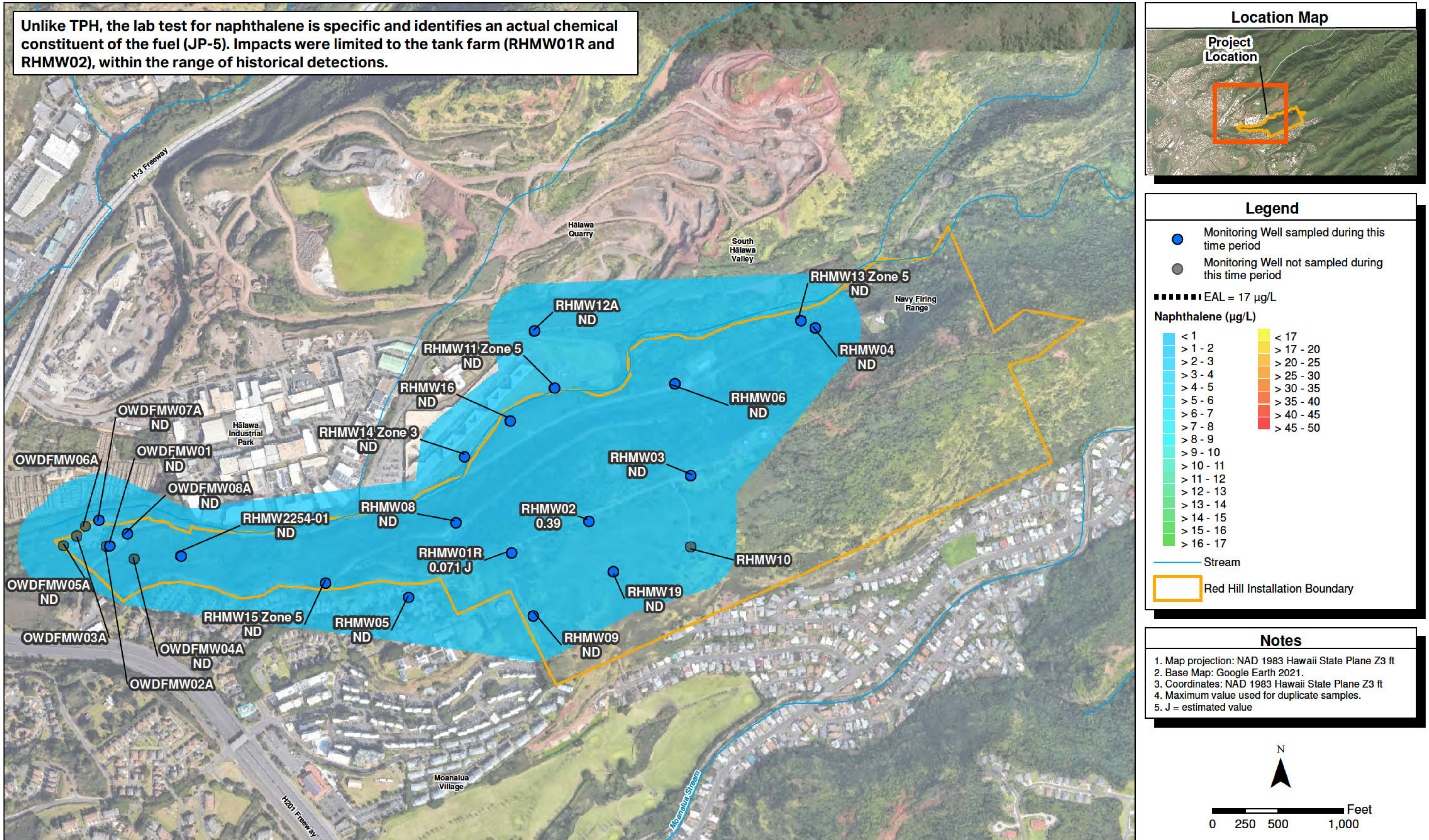
N

Feet
0 250 500 1,000

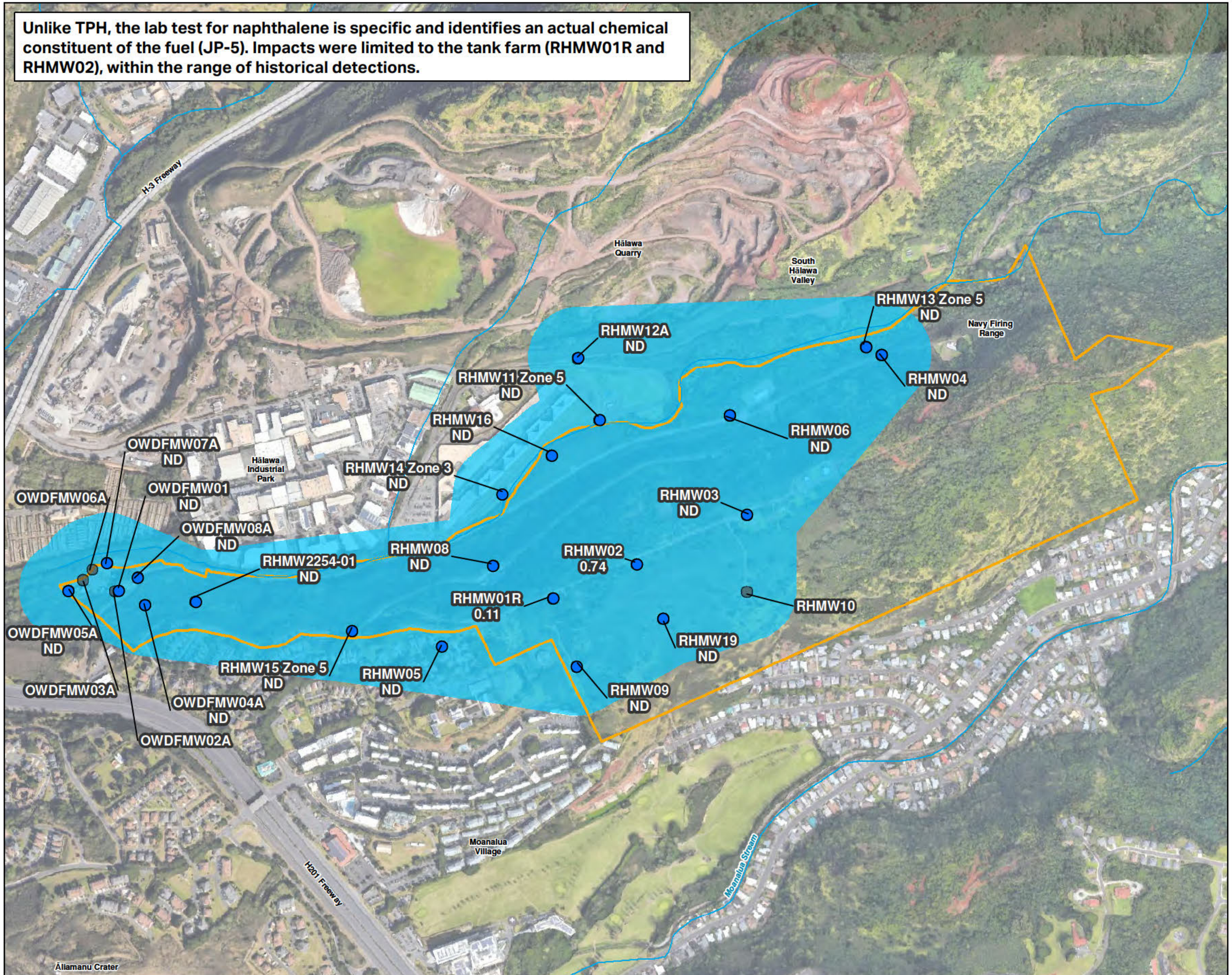
Naphthalene Results
Week of April 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



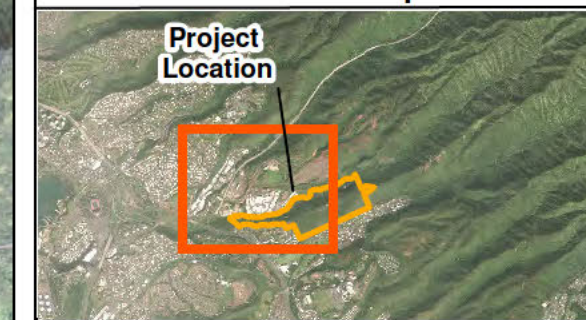
Naphthalene Results
Week of April 24, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Naphthalene Results
Week of May 02, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- > 10 - 11
- > 11 - 12
- > 12 - 13
- > 13 - 14
- > 14 - 15
- > 15 - 16
- > 16 - 17
- < 17
- > 17 - 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50

- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

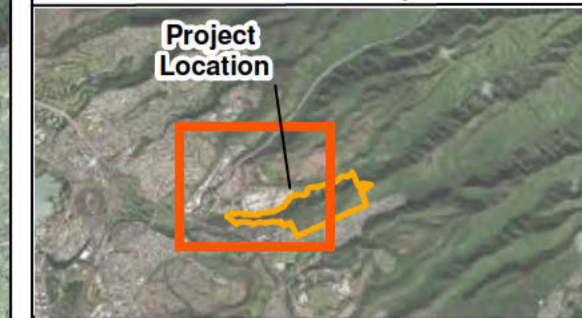
N

Feet
0 250 500 1,000

Naphthalene Results
Week of May 09, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for naphthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the tank farm (RHMW01R and RHMW02), within the range of historical detections.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

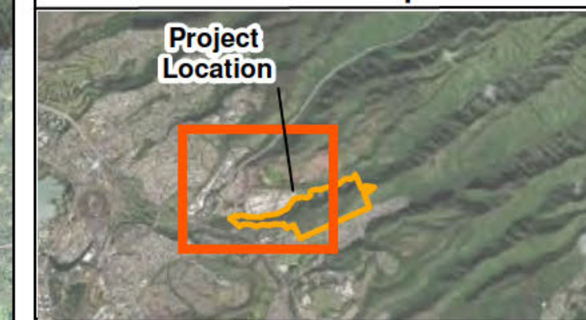
N

Feet
0 250 500 1,000

Naphthalene Results
Week of May 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for naphthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the tank farm (RHMW01R and RHMW02), within the range of historical detections.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

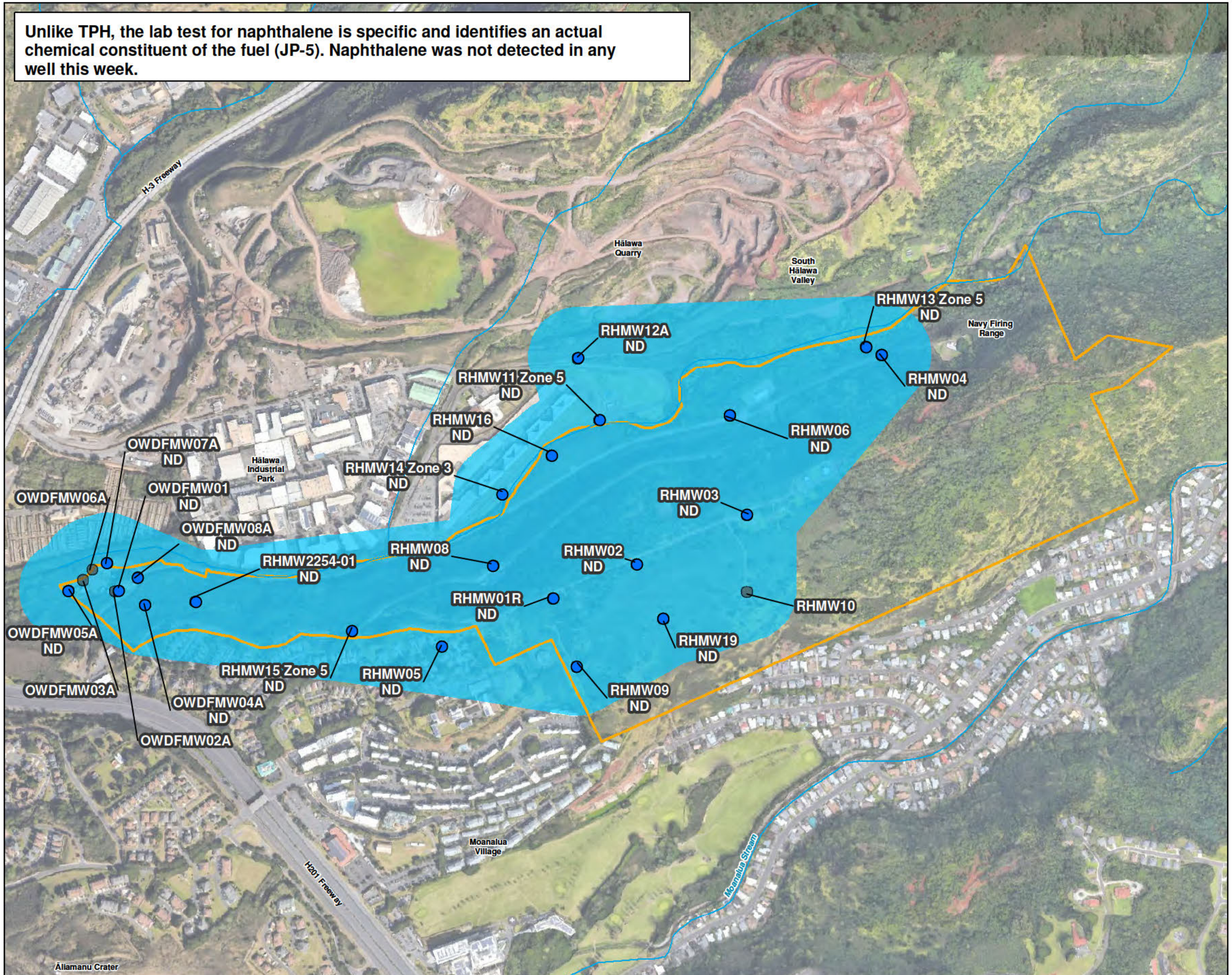
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

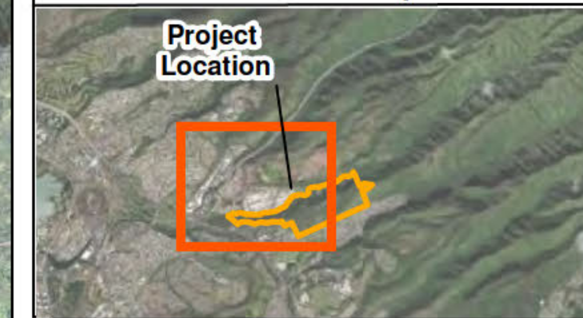
N

Feet
0 250 500 1,000

Naphthalene Results
Week of May 23, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- > 10 - 11
- > 11 - 12
- > 12 - 13
- > 13 - 14
- > 14 - 15
- > 15 - 16
- > 16 - 17
- < 17
- > 17 - 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50

- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

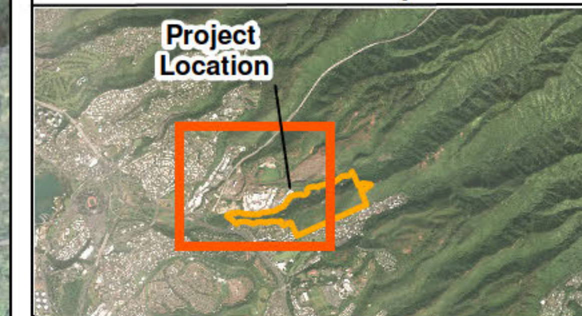
N

Feet
0 250 500 1,000

Naphthalene Results
Week of May 31, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for naphthalene is specific and identifies an actual chemical constituent of the fuel (JP-5). Impacts were limited to the area near RHMW02, within the range of historical detections.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 17
< 17
> 17 - 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

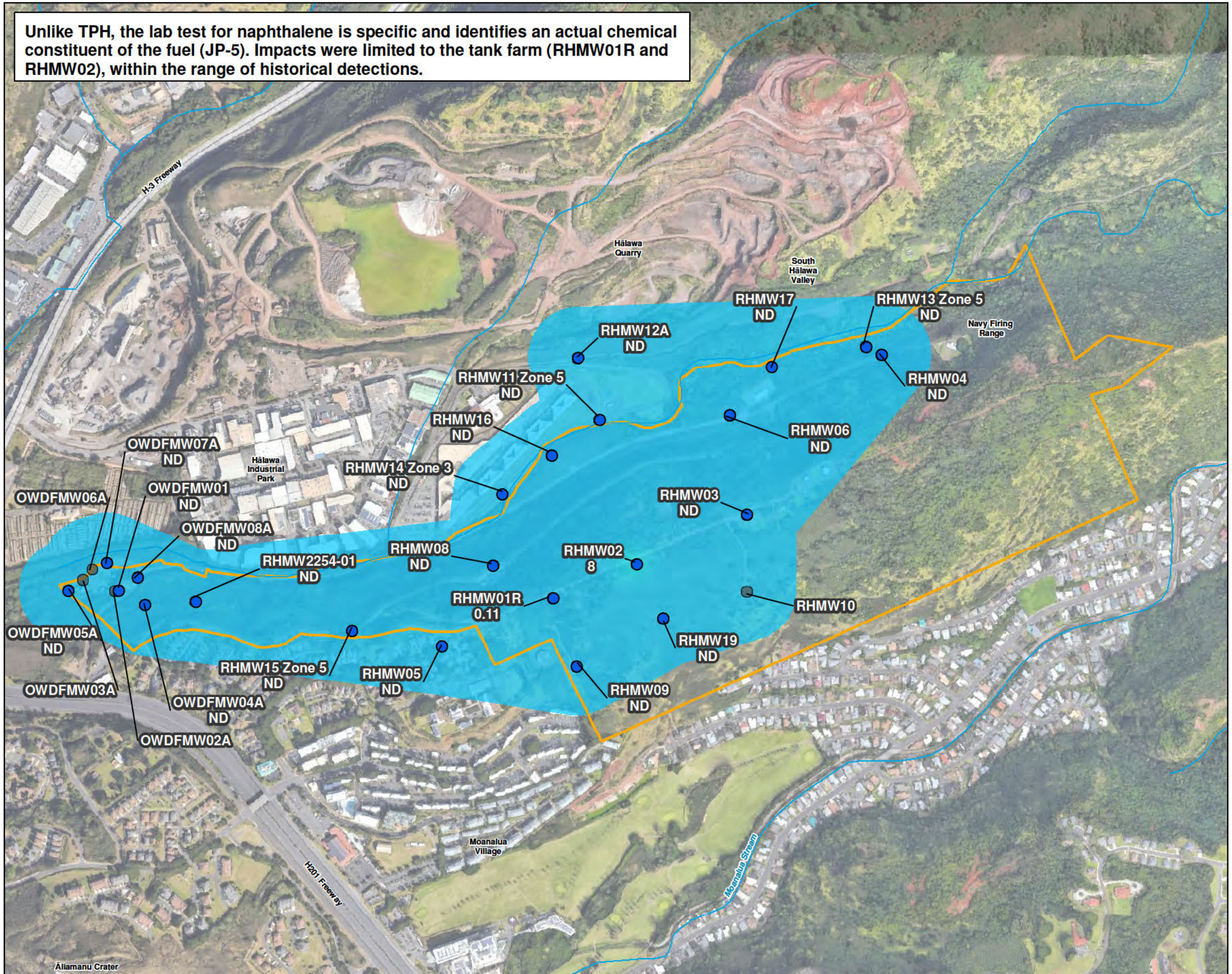
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

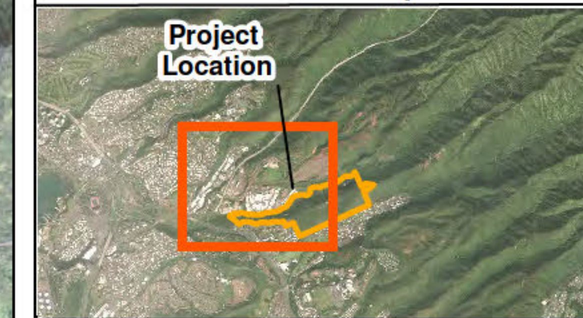
N

Feet
0 250 500 1,000

Naphthalene Results
Week of June 6, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period; RHMW17
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

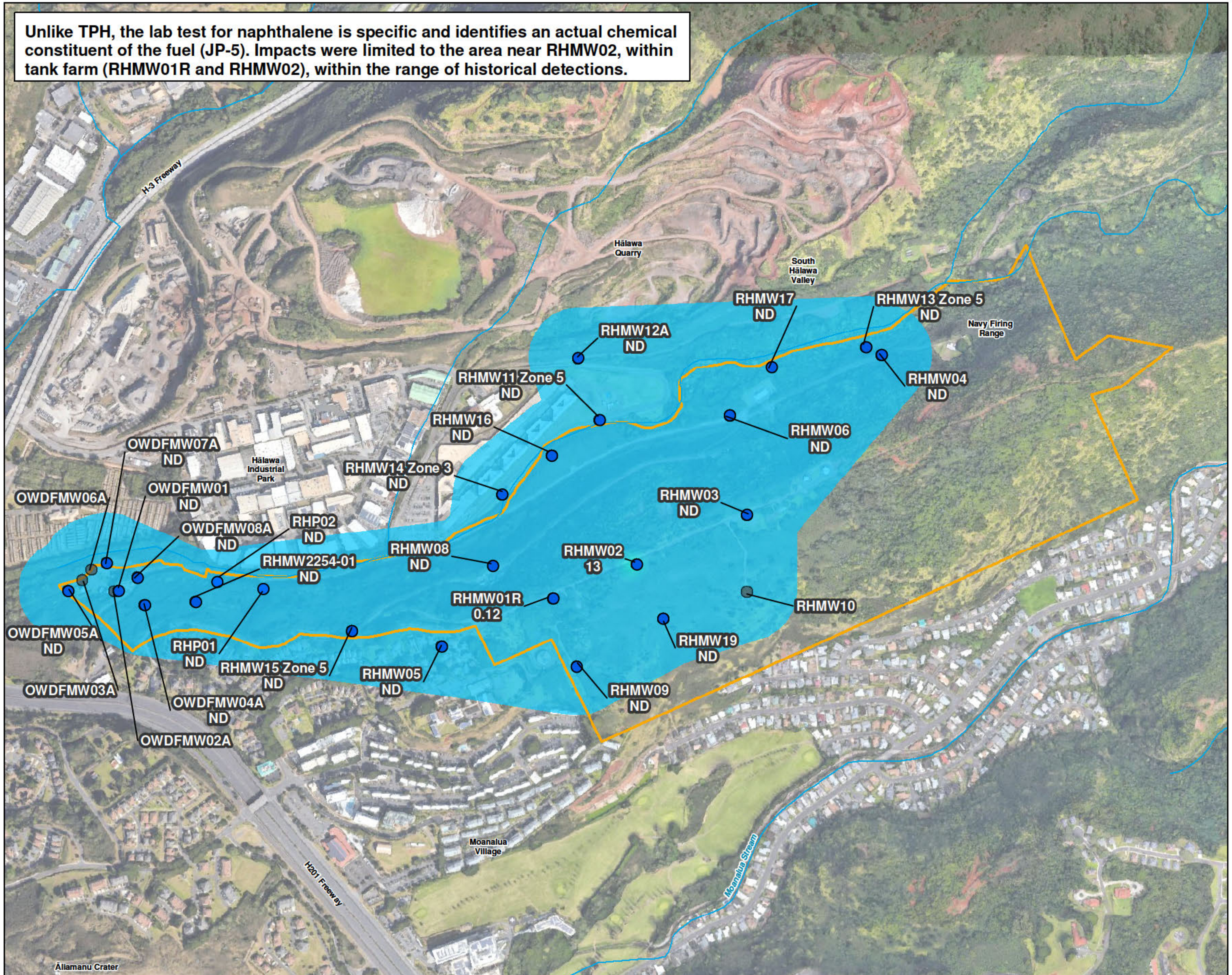
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

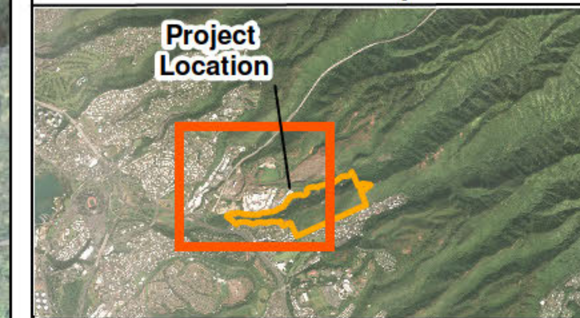
N

Feet
0 250 500 1,000

Naphthalene Results
Week of June 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1; > 1 - 2; > 2 - 3; > 3 - 4; > 4 - 5; > 5 - 6; > 6 - 7; > 7 - 8; > 8 - 9; > 9 - 10; > 10 - 11; > 11 - 12; > 12 - 13; > 13 - 14; > 14 - 15; > 15 - 16; > 16 - 17; < 17; > 17 - 20; > 20 - 25; > 25 - 30; > 30 - 35; > 35 - 40; > 40 - 45; > 45 - 50

- Stream
- Red Hill Installation Boundary

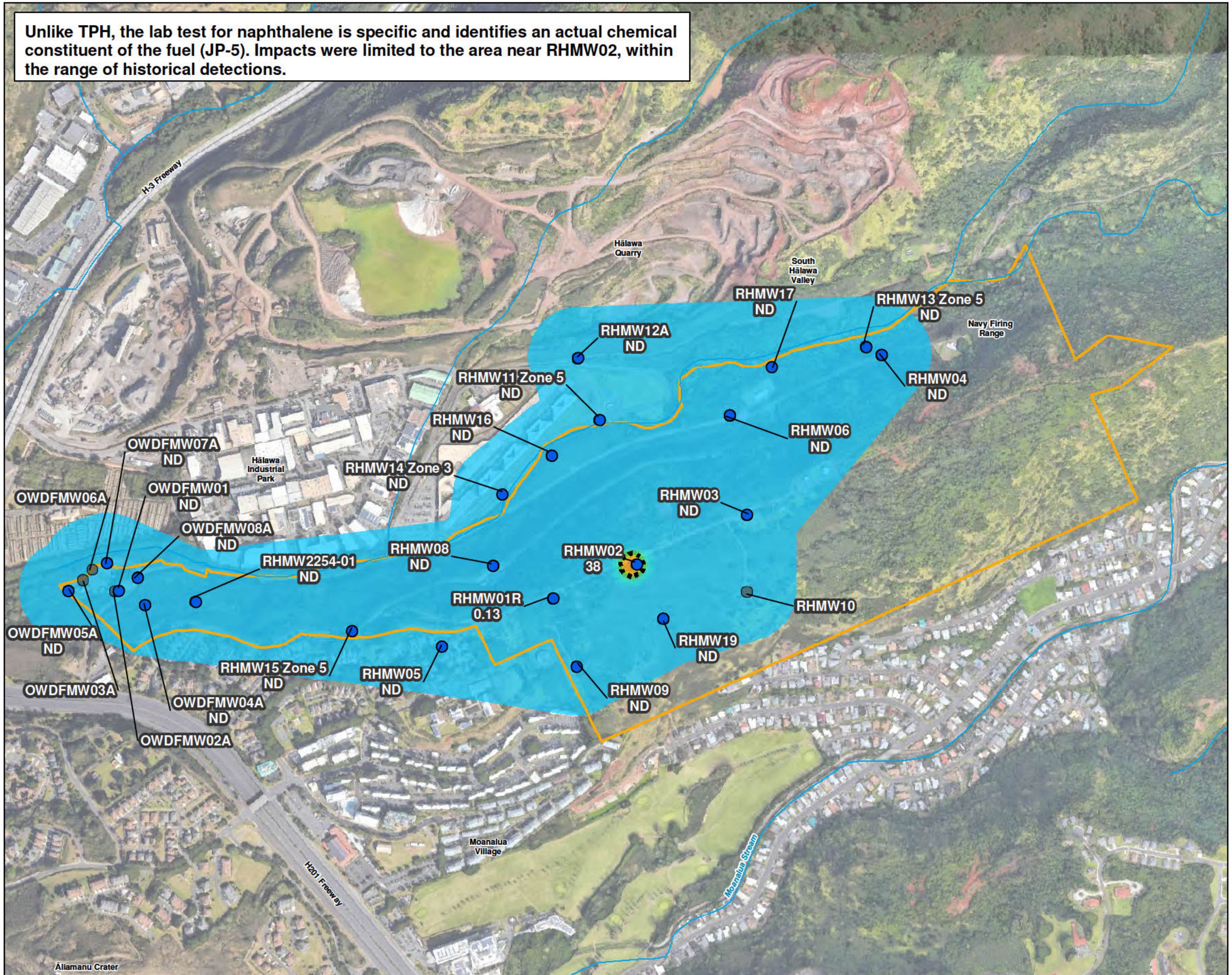
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

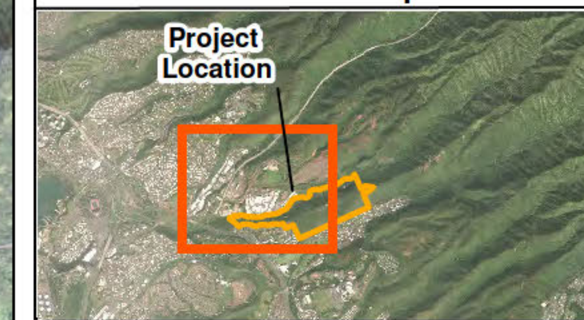
N

0 250 500 1,000 Feet

Naphthalene Results
Week of June 20, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

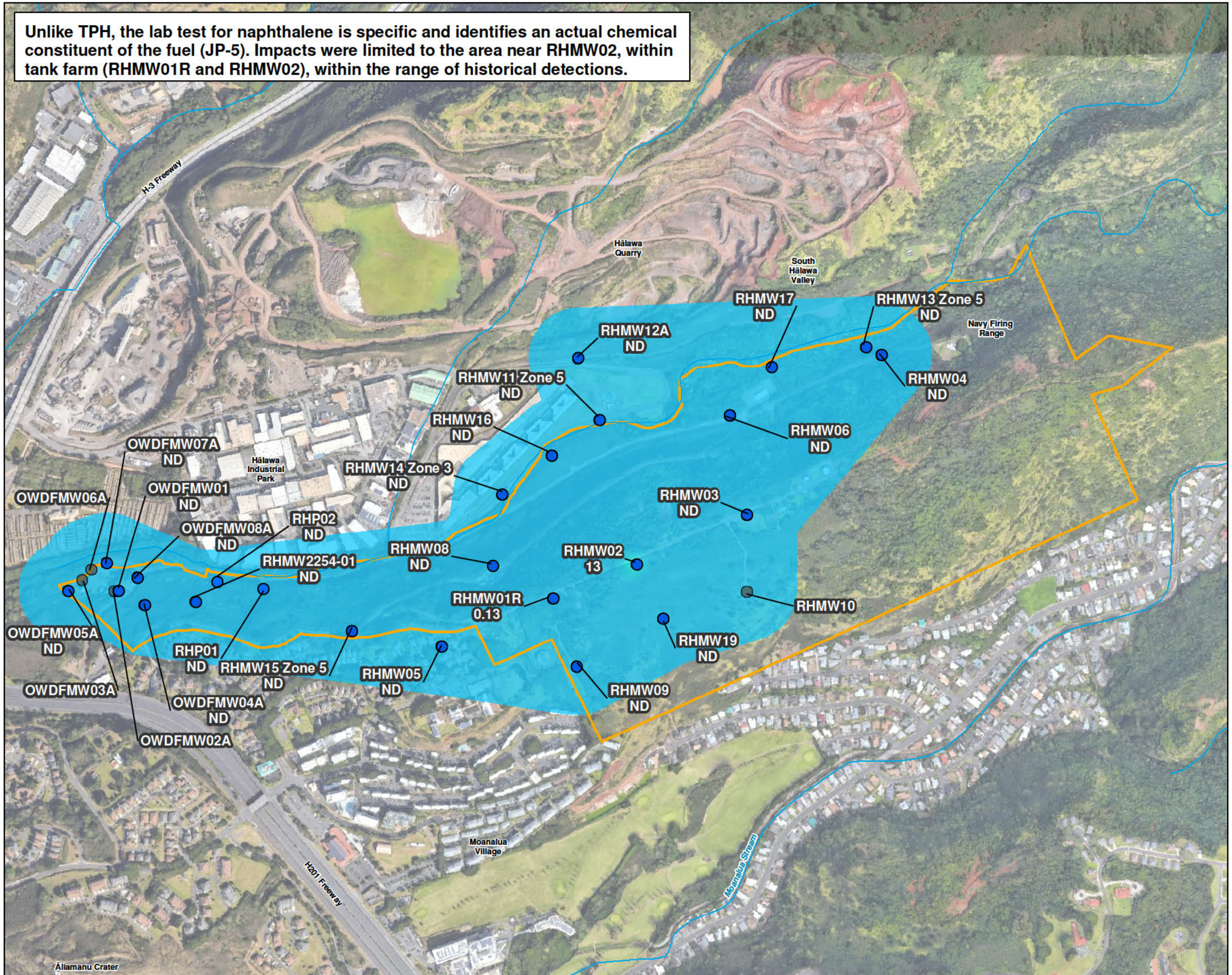
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

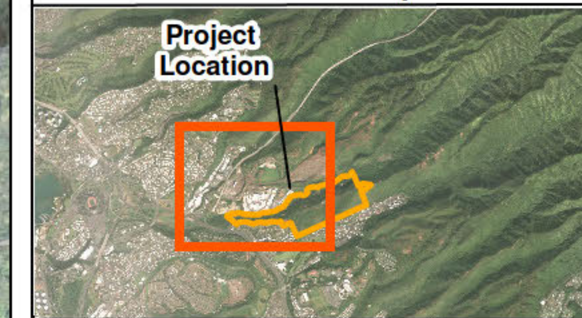
N

Feet
0 250 500 1,000

Naphthalene Results
Week of June 27, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 17 µg/L

Naphthalene (µg/L)

< 1	< 17
> 1 - 2	> 17 - 20
> 2 - 3	> 20 - 25
> 3 - 4	> 25 - 30
> 4 - 5	> 30 - 35
> 5 - 6	> 35 - 40
> 6 - 7	> 40 - 45
> 7 - 8	> 45 - 50
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 17	

- Stream
- Red Hill Installation Boundary

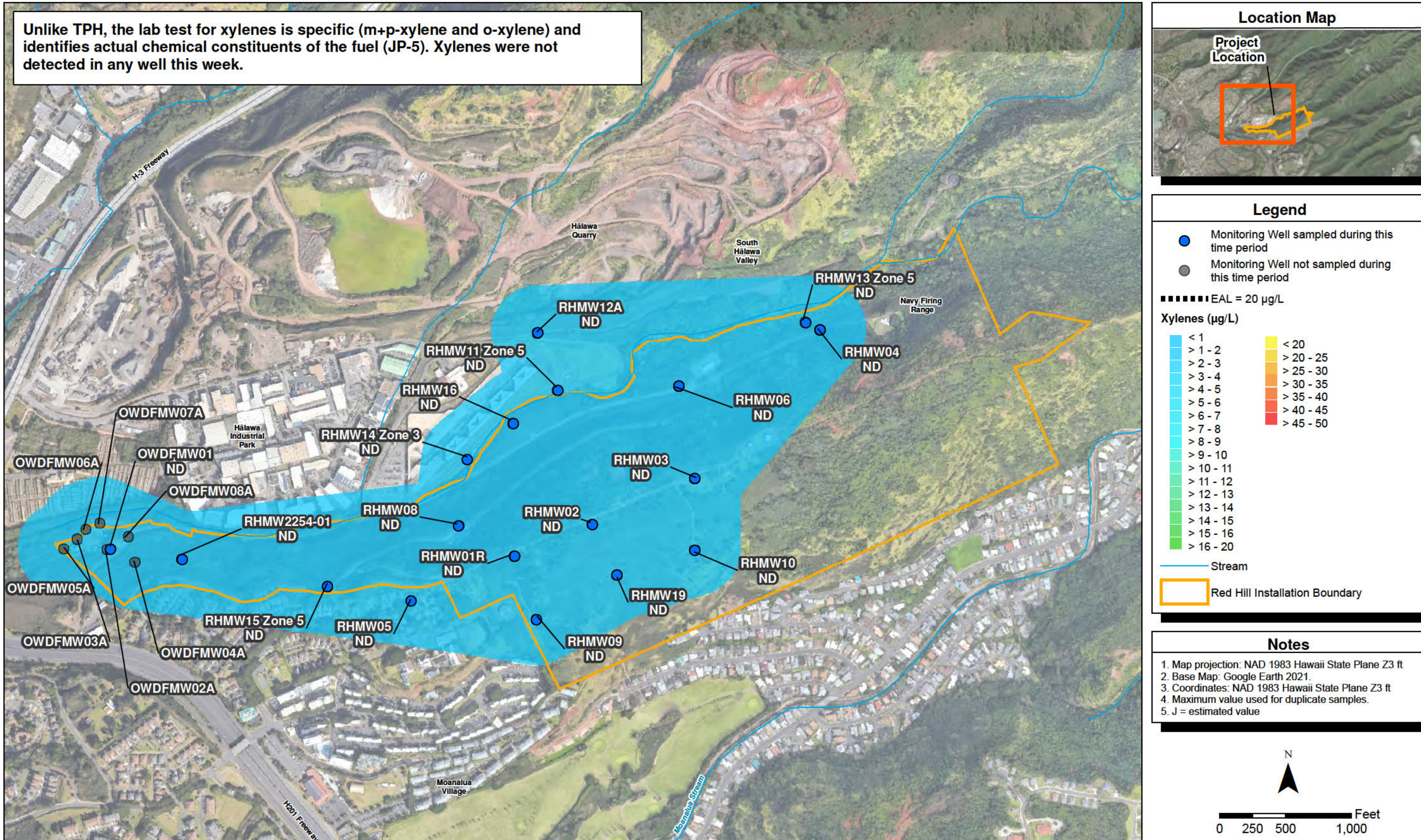
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

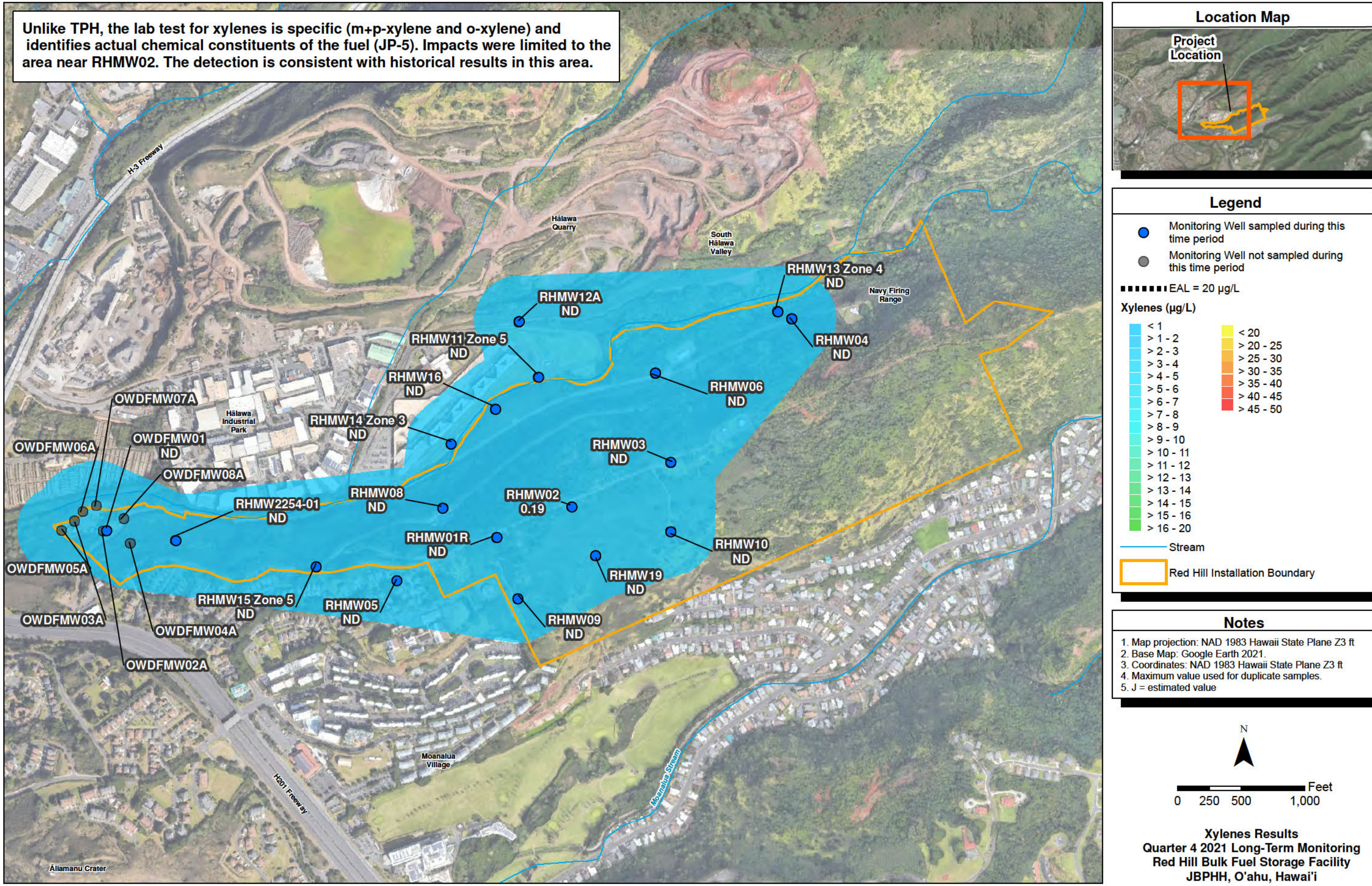
N

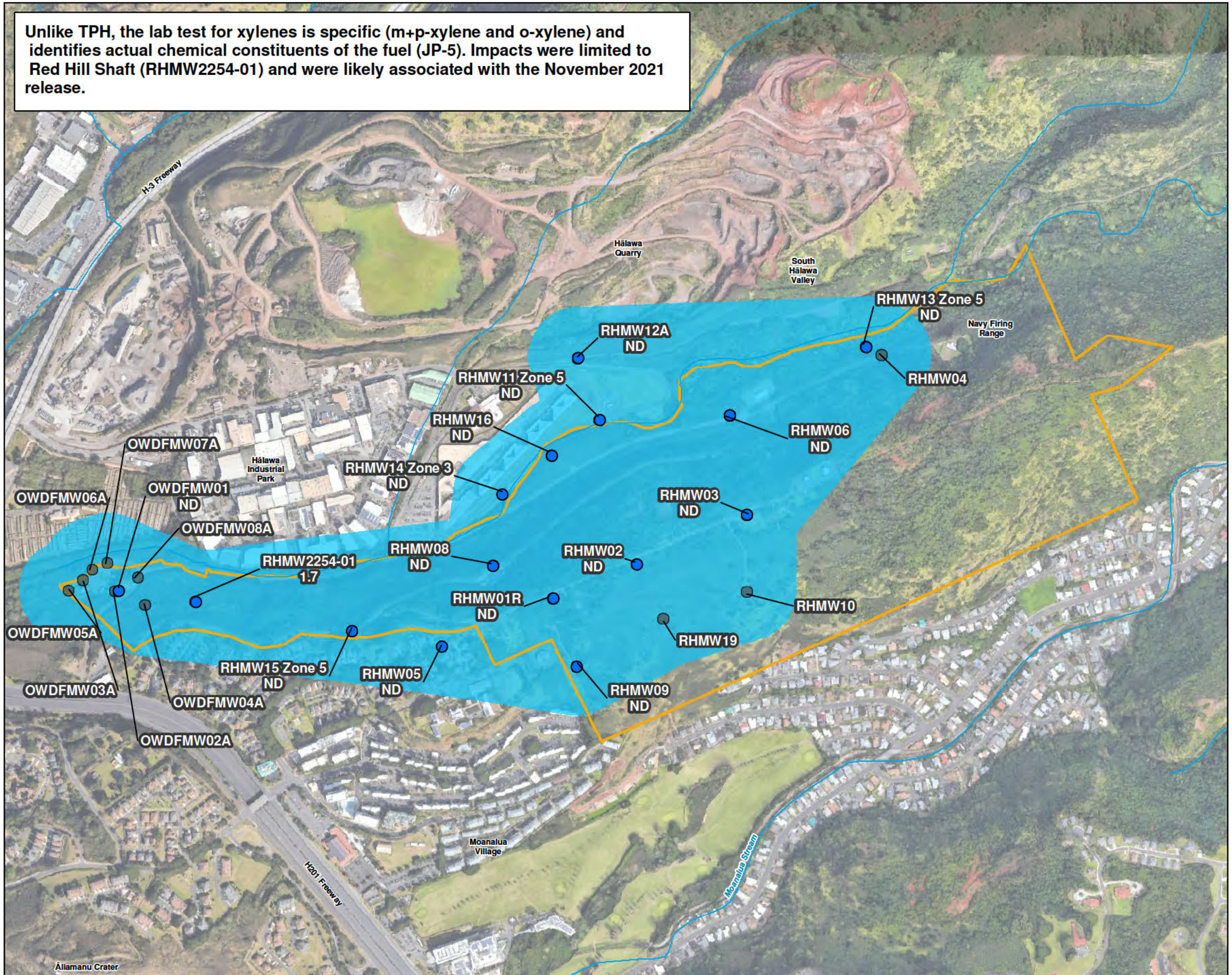
0 250 500 1,000 Feet

Naphthalene Results
Week of July 04, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

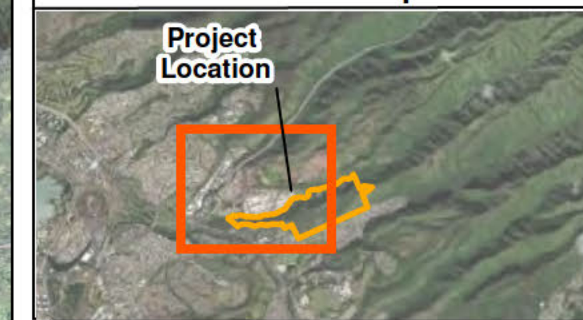


Xylenes Results
Quarter 3 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i


Unlike TPH, the lab test for xylenes is specific (m+p-xylene and o-xylene) and identifies actual chemical constituents of the fuel (JP-5). Impacts were limited to the area near RHMW02. The detection is consistent with historical results in this area.
H-3 Freeway
Hālawa Quarry
South Hālawa Valley
Navy Firing Range
Hālawa Industrial Park
Moanalua Village
Moanalua Stream
H201 Freeway
Āliamanu Crater
RHMW13 Zone 4 ND
RHMW12A ND
RHMW11 Zone 5 ND
RHMW04 ND
RHMW16 ND
RHMW06 ND
OWDFMW07A
RHMW14 Zone 3 ND
OWDFMW06A
OWDFMW01 ND
RHMW03 ND
OWDFMW08A
RHMW08 ND
RHMW02 0.19
RHMW2254-01 ND
RHMW01R ND
RHMW10 ND
OWDFMW05A
RHMW19 ND
RHMW15 Zone 5 ND
RHMW05 ND
OWDFMW03A
RHMW09 ND
OWDFMW04A
OWDFMW02A
Location Map
Project Location
Legend
Monitoring Well sampled during this time period
Monitoring Well not sampled during this time period
EAL = 20 µg/L
Xylenes (µg/L)
< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50
Stream
Red Hill Installation Boundary
Notes
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
N
Feet
0 250 500 1,000
Xylenes Results
Quarter 4 2021 Long-Term Monitoring
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

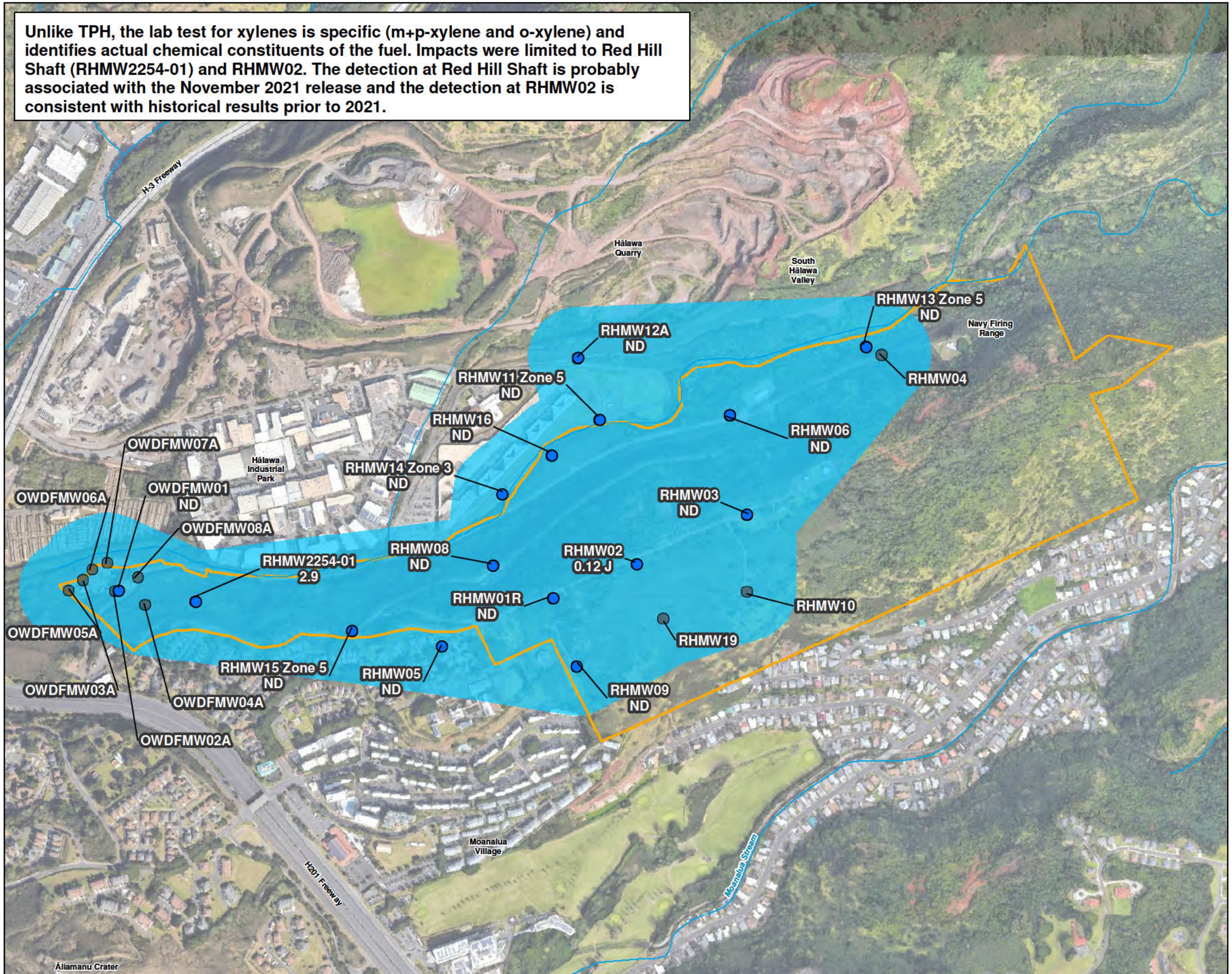
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

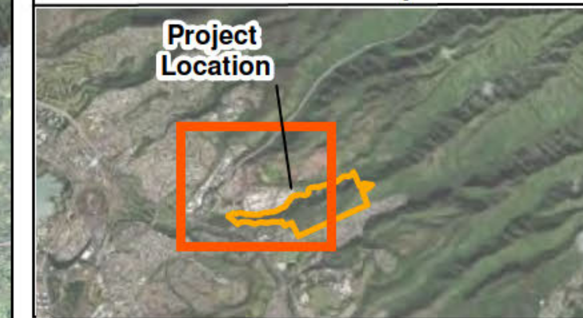
N

Feet
0 250 500 1,000

Xylenes Results
Week of December 13, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

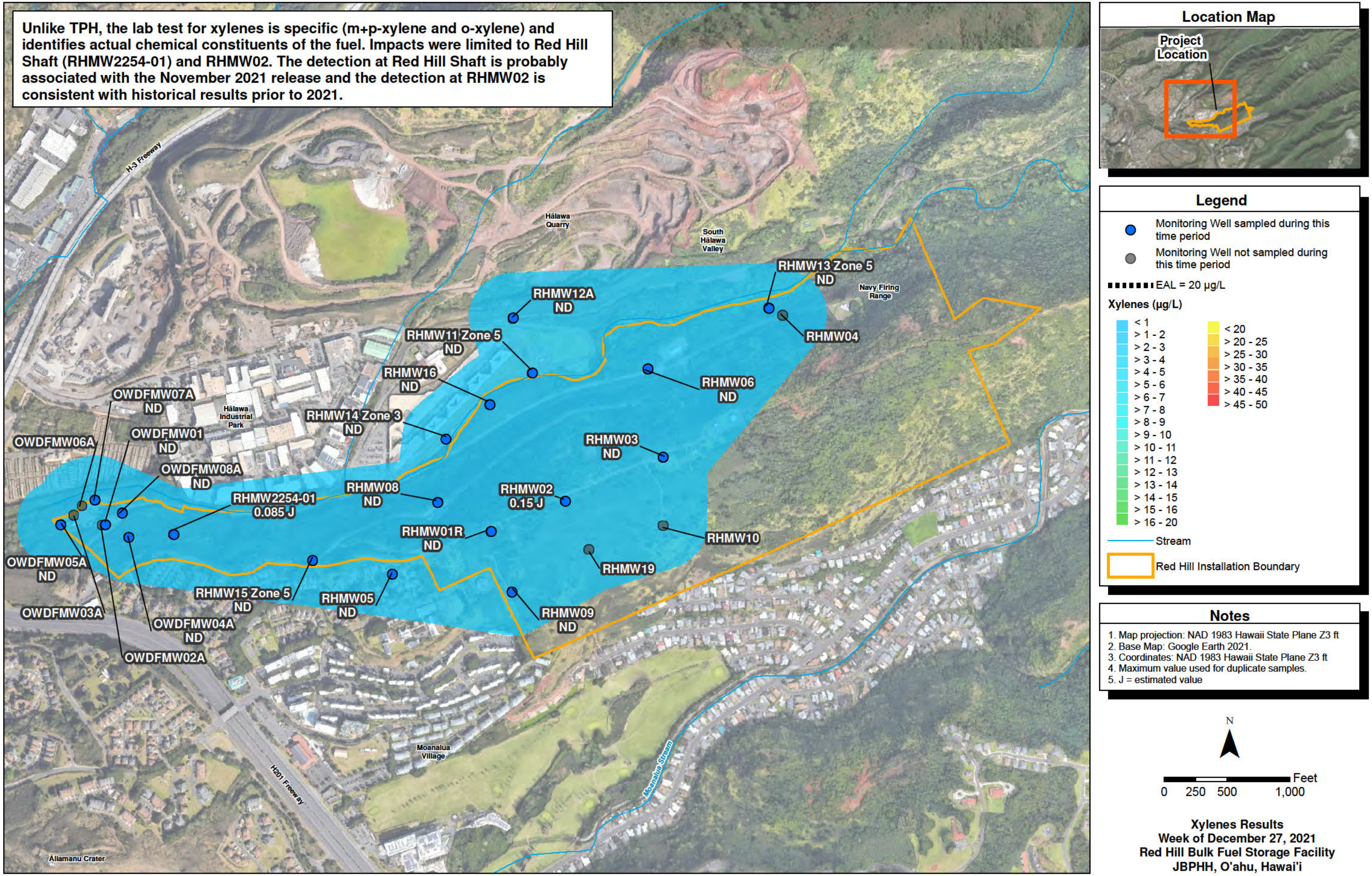
Notes

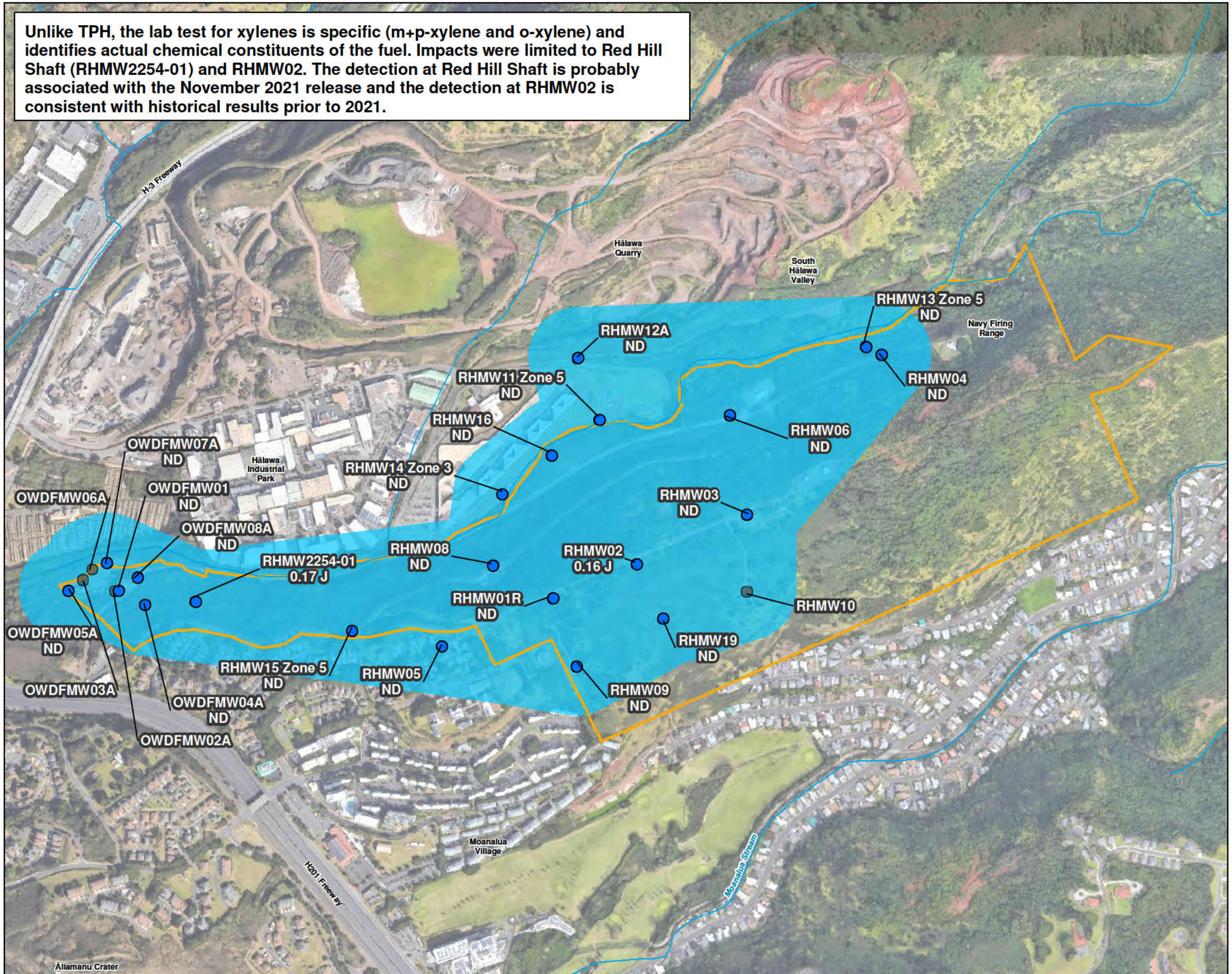
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

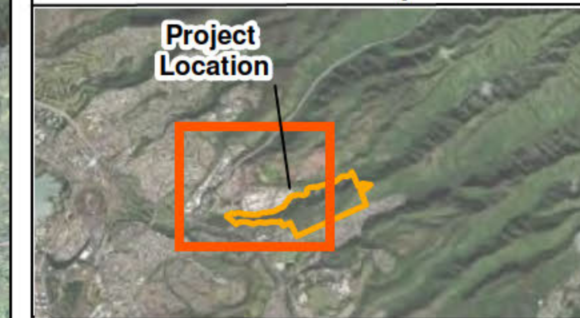
Feet
0 250 500 1,000

Xylenes Results
Week of December 20, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i


Unlike TPH, the lab test for xylenes is specific (m+p-xylene and o-xylene) and identifies actual chemical constituents of the fuel. Impacts were limited to Red Hill Shaft (RHMW2254-01) and RHMW02. The detection at Red Hill Shaft is probably associated with the November 2021 release and the detection at RHMW02 is consistent with historical results prior to 2021.
H-3 Freeway
Hālawa Quarry
South Hālawa Valley
Navy Firing Range
Hālawa Industrial Park
RHMW13 Zone 5
ND
RHMW12A
ND
RHMW04
RHMW11 Zone 5
ND
RHMW16
ND
RHMW06
ND
OWDFMW07A
ND
RHMW14 Zone 3
ND
OWDFMW06A
OWDFMW01
ND
RHMW03
ND
OWDFMW08A
ND
RHMW2254-01
0.085 J
RHMW08
ND
RHMW02
0.15 J
RHMW01R
ND
RHMW10
RHMW19
OWDFMW05A
ND
RHMW15 Zone 5
ND
RHMW05
ND
RHMW09
ND
OWDFMW03A
OWDFMW04A
ND
OWDFMW02A
Moanalua Village
Moanalua Stream
H201 Freeway
Āliamanu Crater
Location Map
Project Location
Legend
Monitoring Well sampled during this time period
Monitoring Well not sampled during this time period
EAL = 20 µg/L
Xylenes (µg/L)
< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50
Stream
Red Hill Installation Boundary
Notes
1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value
N
Feet
0 250 500 1,000
Xylenes Results
Week of December 27, 2021
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- > 10 - 11
- > 11 - 12
- > 12 - 13
- > 13 - 14
- > 14 - 15
- > 15 - 16
- > 16 - 20
- < 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50
- Stream
- Red Hill Installation Boundary

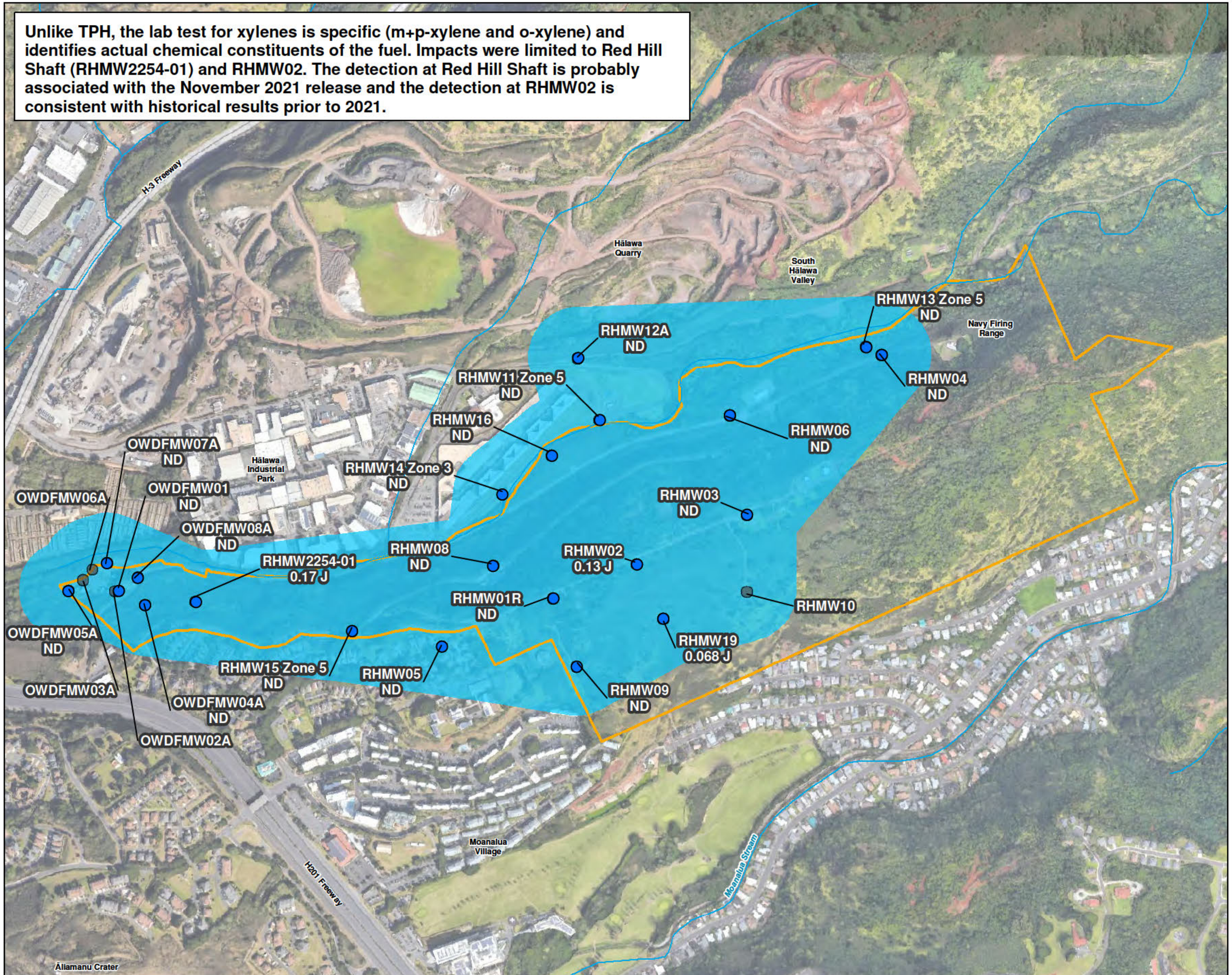
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

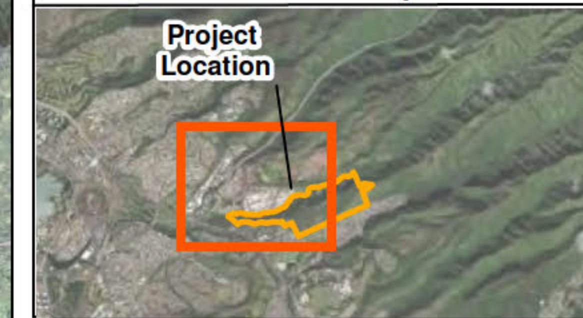
N

Feet
0 250 500 1,000

Xylenes Results
Week of January 3, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1, > 1 - 2, > 2 - 3, > 3 - 4, > 4 - 5, > 5 - 6, > 6 - 7, > 7 - 8, > 8 - 9, > 9 - 10, > 10 - 11, > 11 - 12, > 12 - 13, > 13 - 14, > 14 - 15, > 15 - 16, > 16 - 20

< 20, > 20 - 25, > 25 - 30, > 30 - 35, > 35 - 40, > 40 - 45, > 45 - 50

- Stream
- Red Hill Installation Boundary

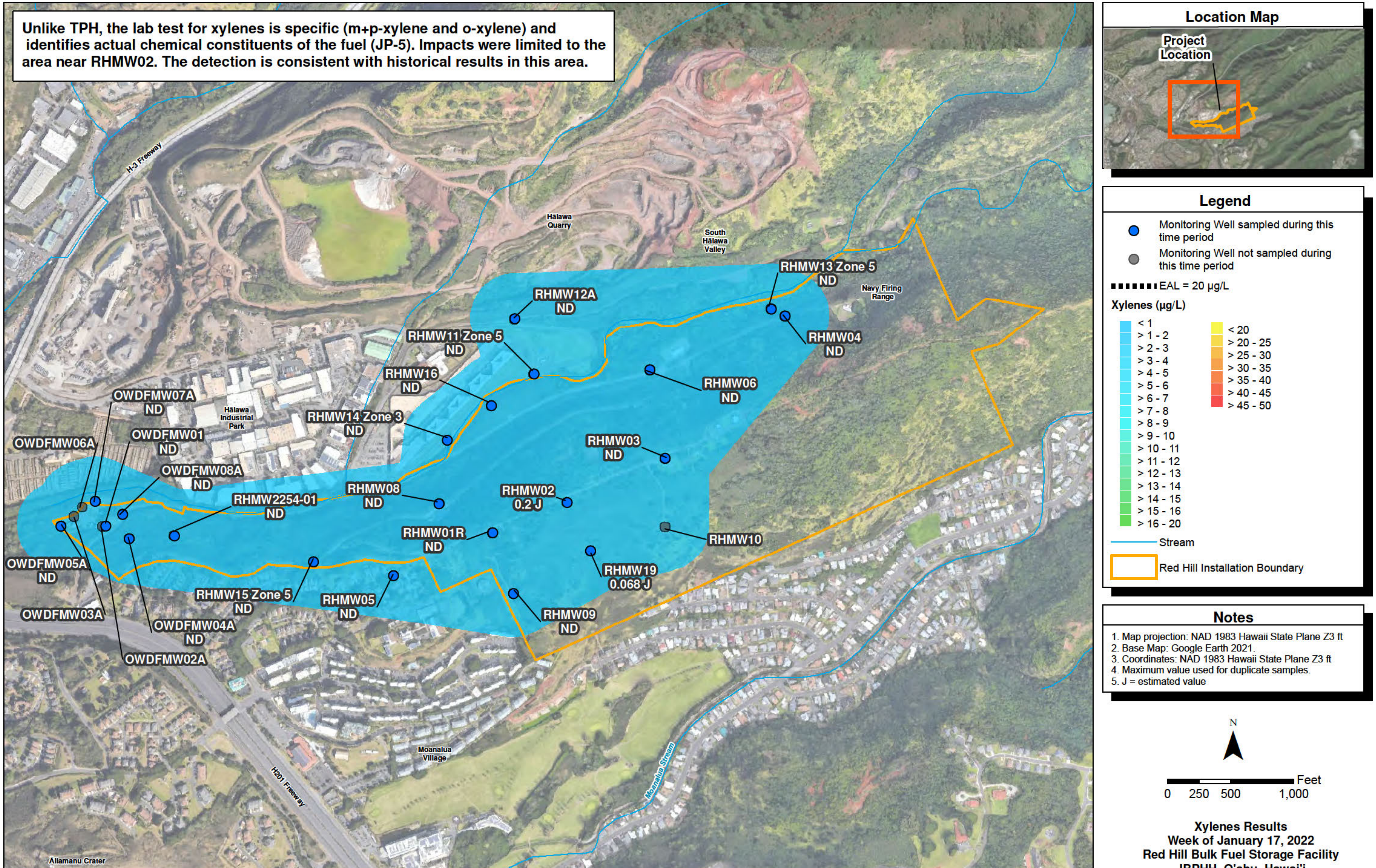
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

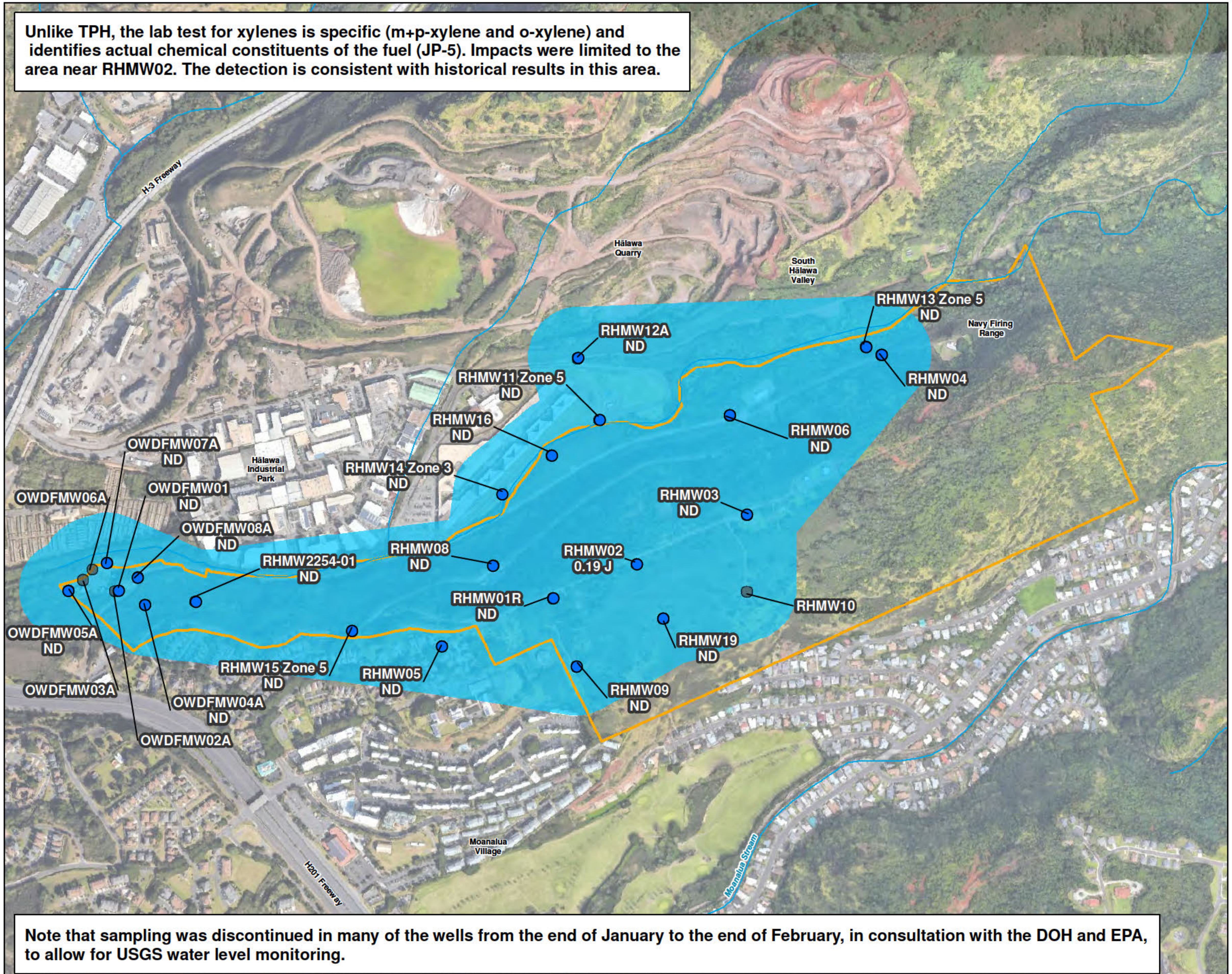
0 250 500 1,000 Feet

Xylenes Results
Week of January 10, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



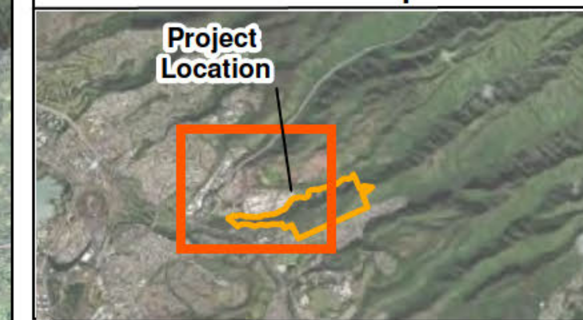
Xylenes Results
Week of January 17, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for xylenes is specific (m+p-xylene and o-xylene) and identifies actual chemical constituents of the fuel (JP-5). Impacts were limited to the area near RHMW02. The detection is consistent with historical results in this area.



Note that sampling was discontinued in many of the wells from the end of January to the end of February, in consultation with the DOH and EPA, to allow for USGS water level monitoring.

Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

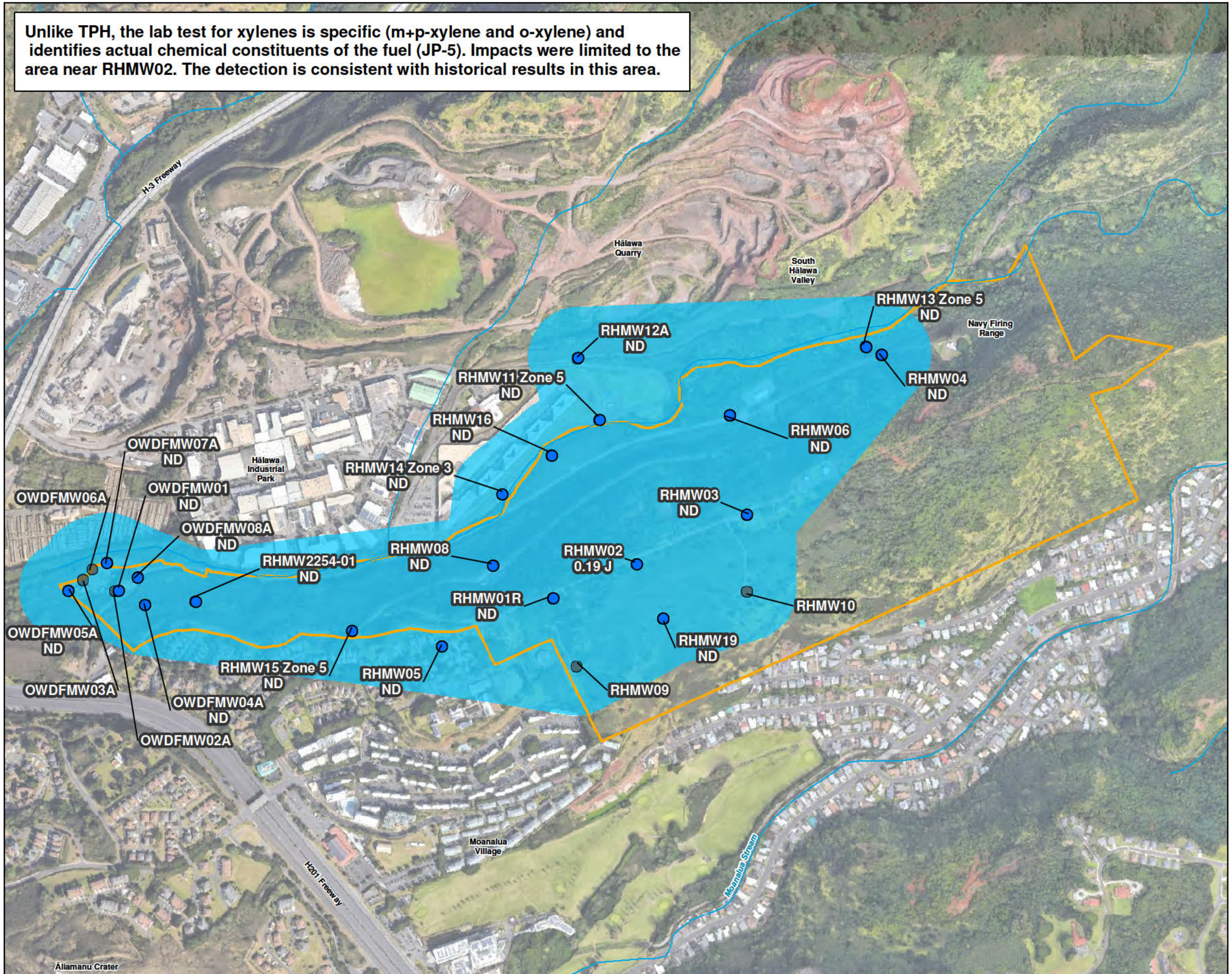
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

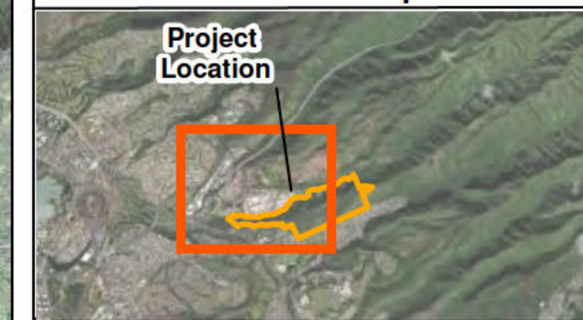
N

Feet
0 250 500 1,000

Xylenes Results
Week of February 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1	< 20
> 1 - 2	> 20 - 25
> 2 - 3	> 25 - 30
> 3 - 4	> 30 - 35
> 4 - 5	> 35 - 40
> 5 - 6	> 40 - 45
> 6 - 7	> 45 - 50
> 7 - 8	
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 20	

- Stream
- Red Hill Installation Boundary

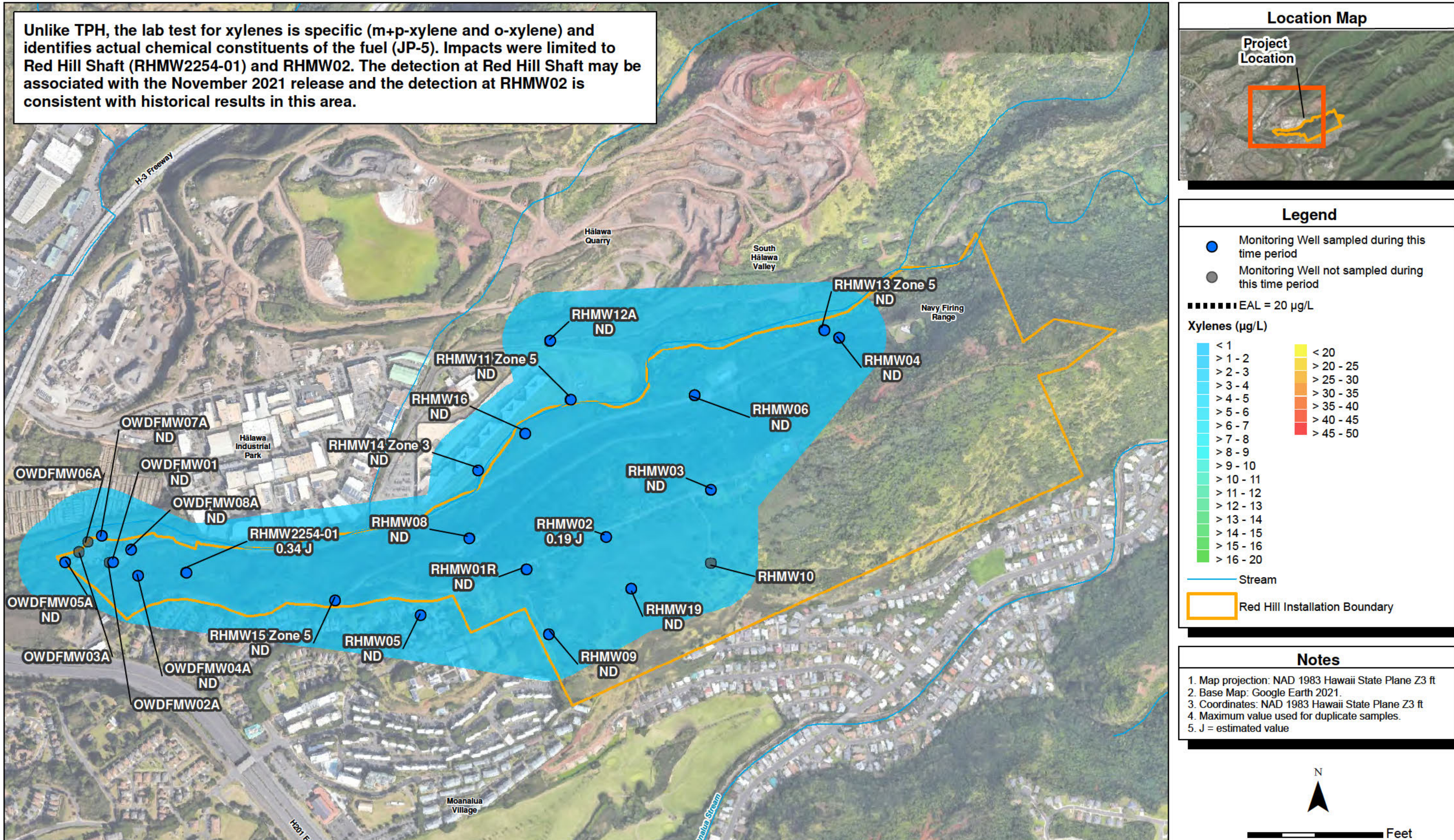
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

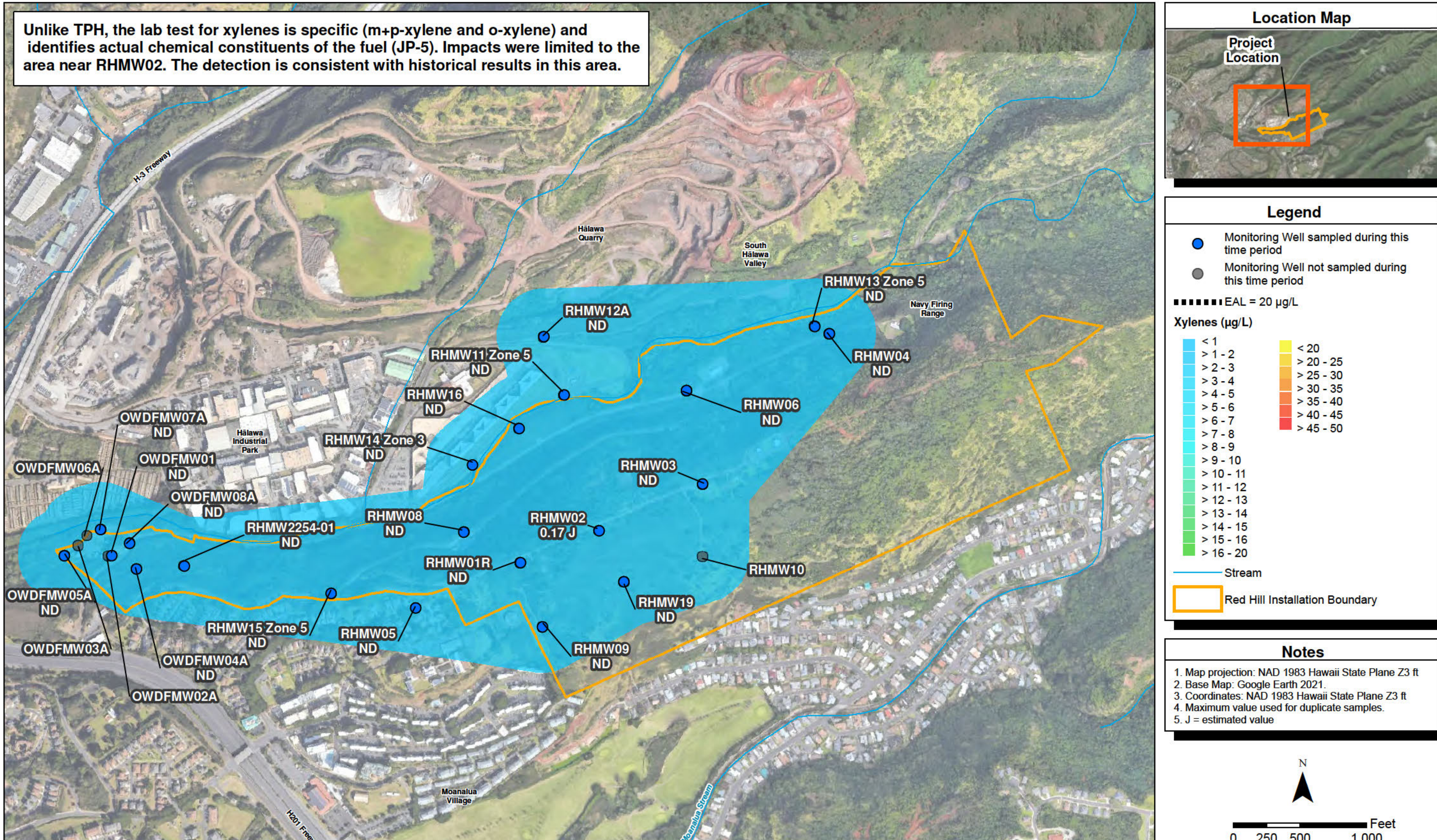
N

Feet
0 250 500 1,000

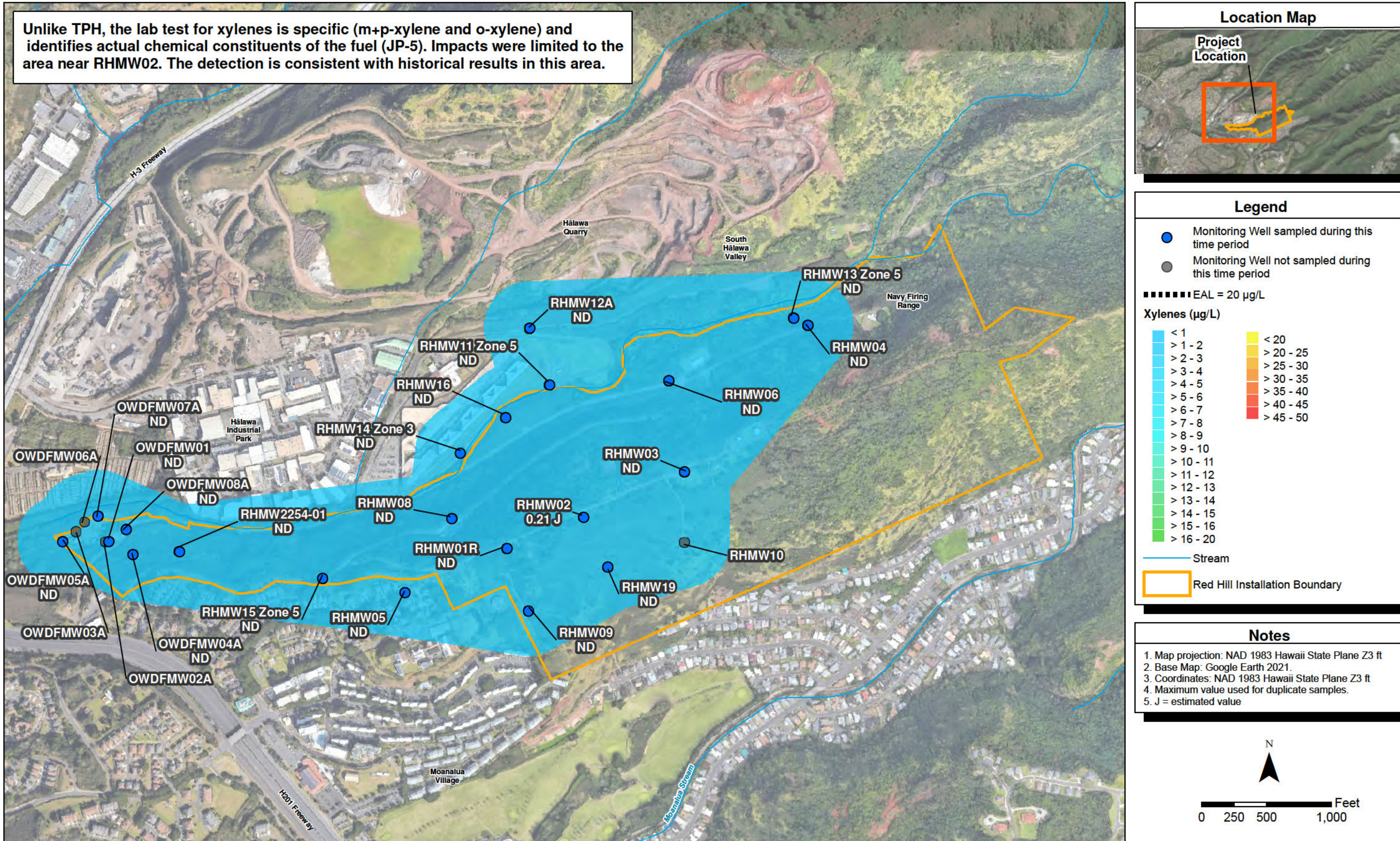
Xylenes Results
Week of March 7, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



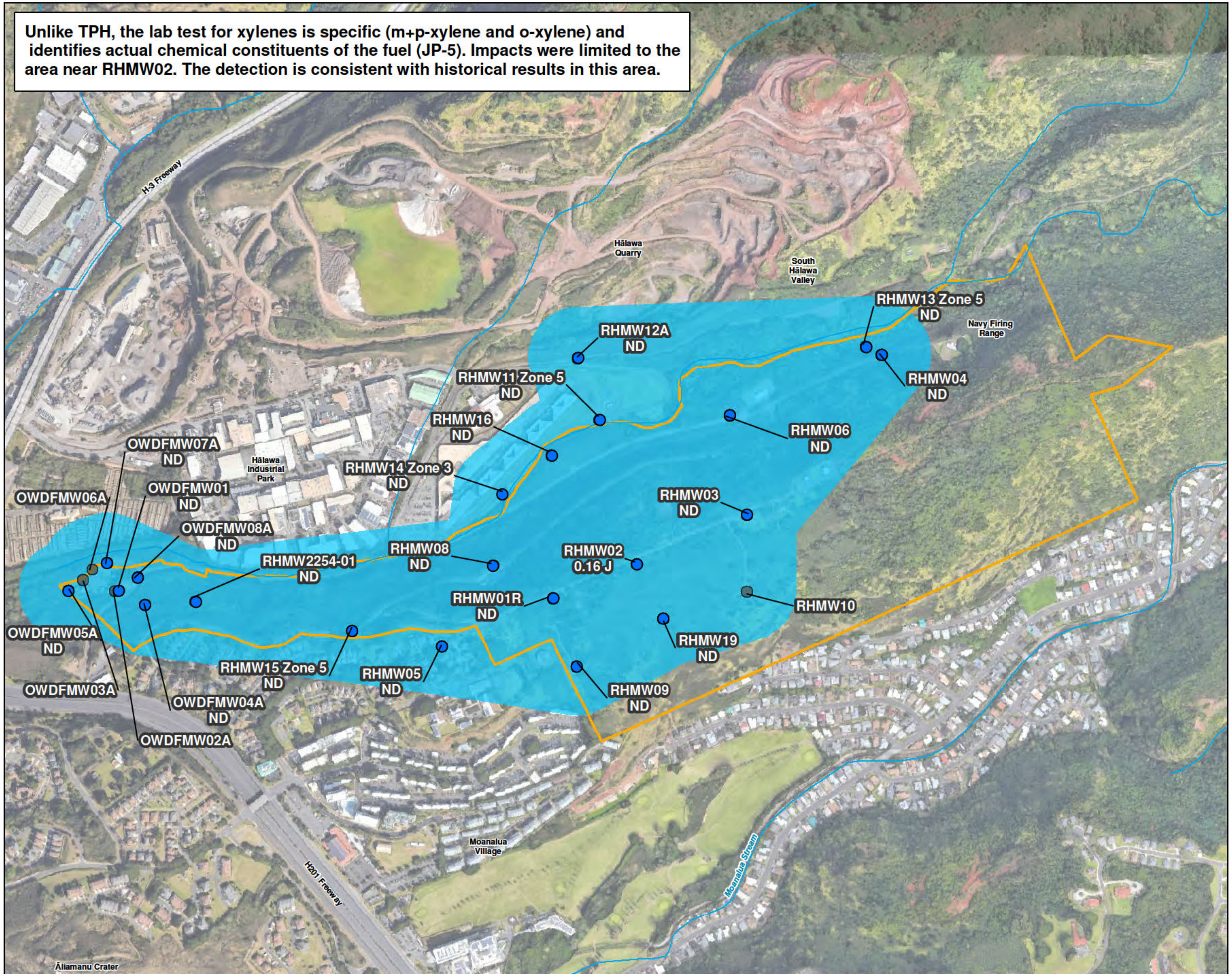
Xylenes Results
Week of March 14, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



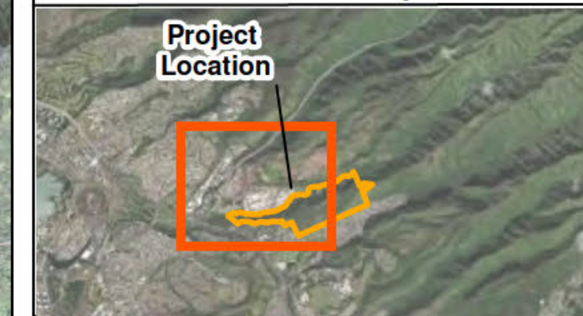
Xylenes Results
Week of March 21, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Xylenes Results
Week of March 28, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1	< 20
> 1 - 2	> 20 - 25
> 2 - 3	> 25 - 30
> 3 - 4	> 30 - 35
> 4 - 5	> 35 - 40
> 5 - 6	> 40 - 45
> 6 - 7	> 45 - 50
> 7 - 8	
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 20	

- Stream
- Red Hill Installation Boundary

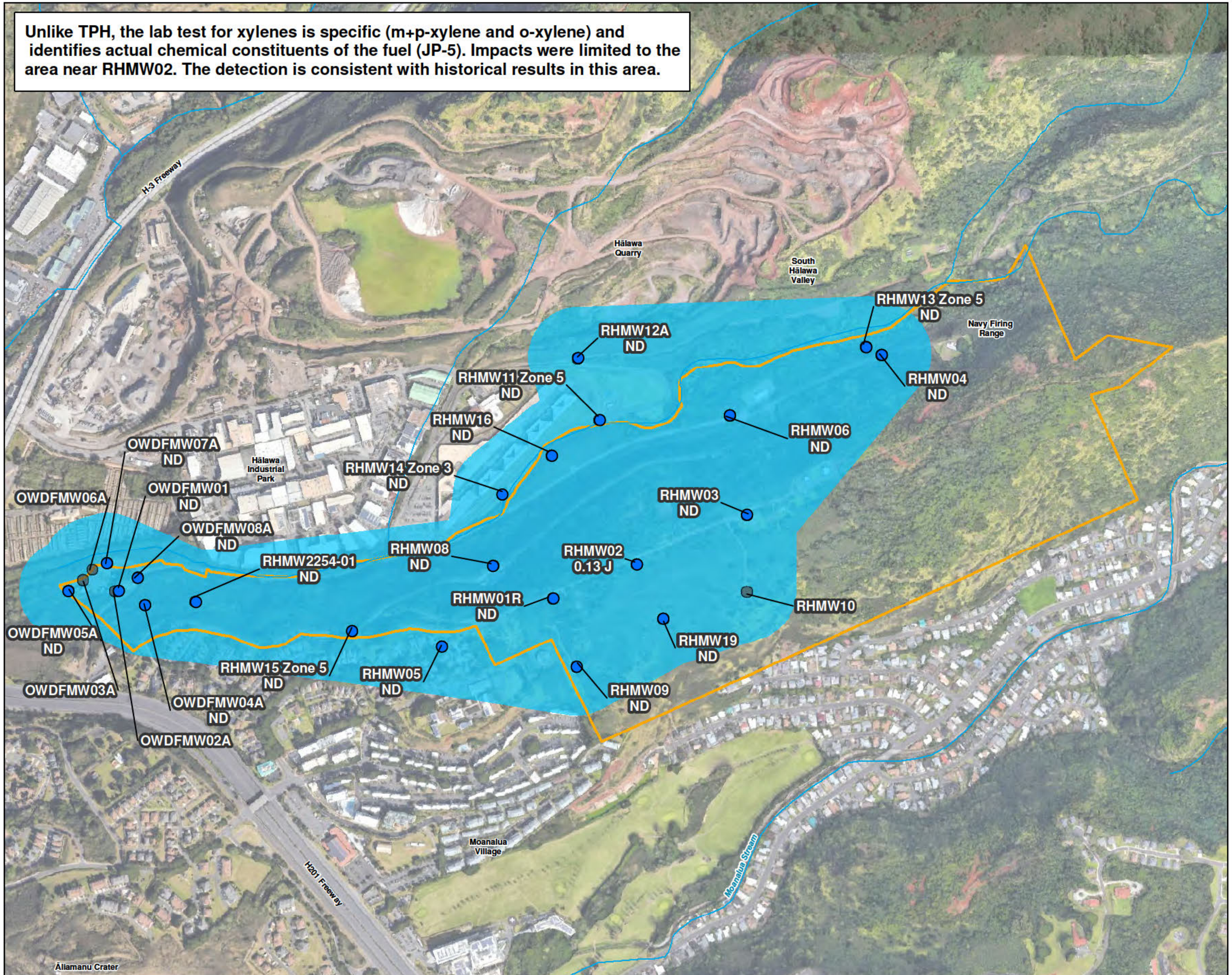
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

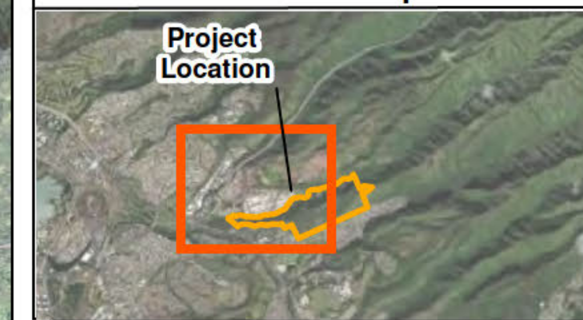
N

Feet
0 250 500 1,000

Xylenes Results
Week of April 4, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1	< 20
> 1 - 2	> 20 - 25
> 2 - 3	> 25 - 30
> 3 - 4	> 30 - 35
> 4 - 5	> 35 - 40
> 5 - 6	> 40 - 45
> 6 - 7	> 45 - 50
> 7 - 8	
> 8 - 9	
> 9 - 10	
> 10 - 11	
> 11 - 12	
> 12 - 13	
> 13 - 14	
> 14 - 15	
> 15 - 16	
> 16 - 20	

- Stream
- Red Hill Installation Boundary

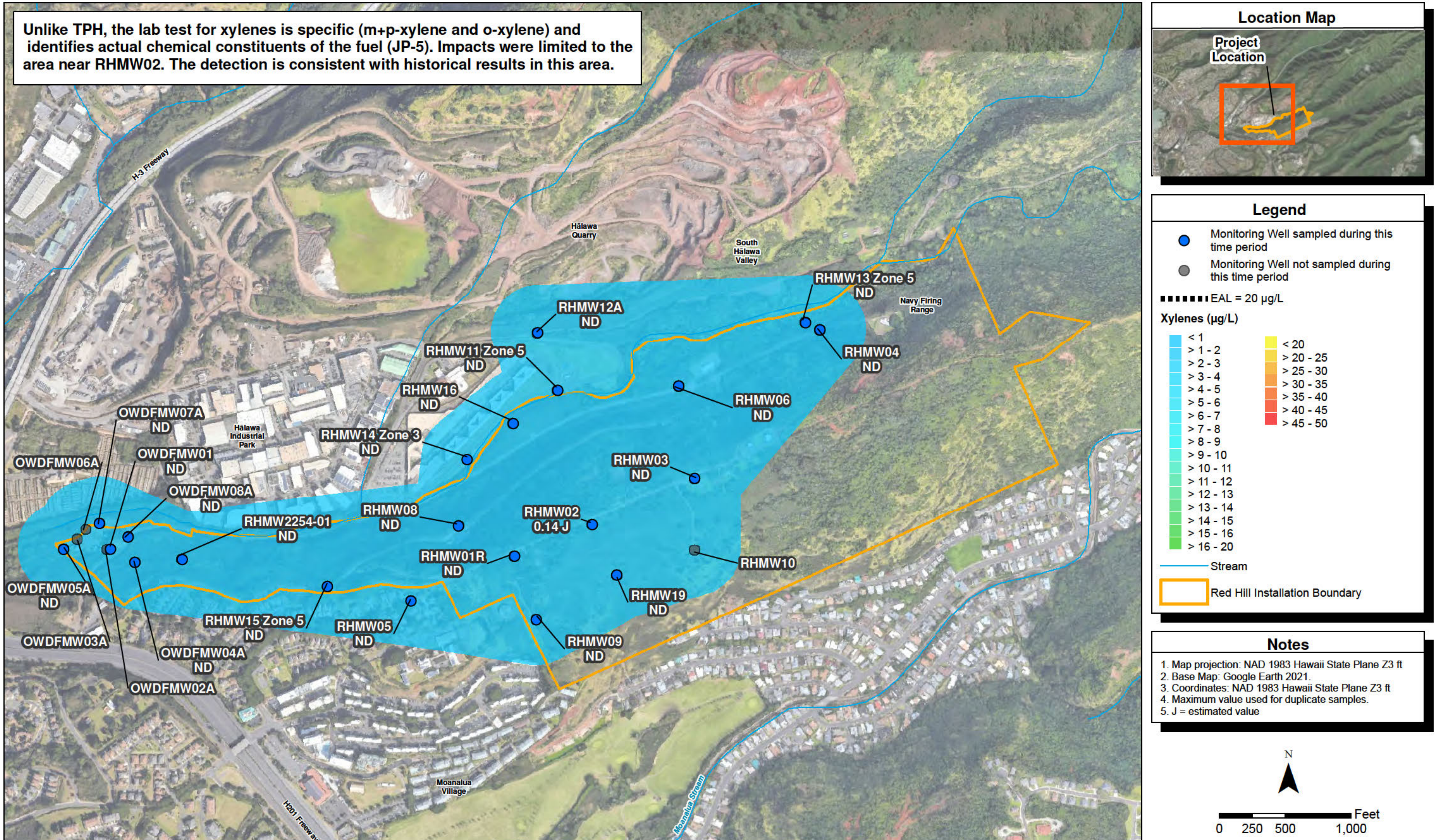
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

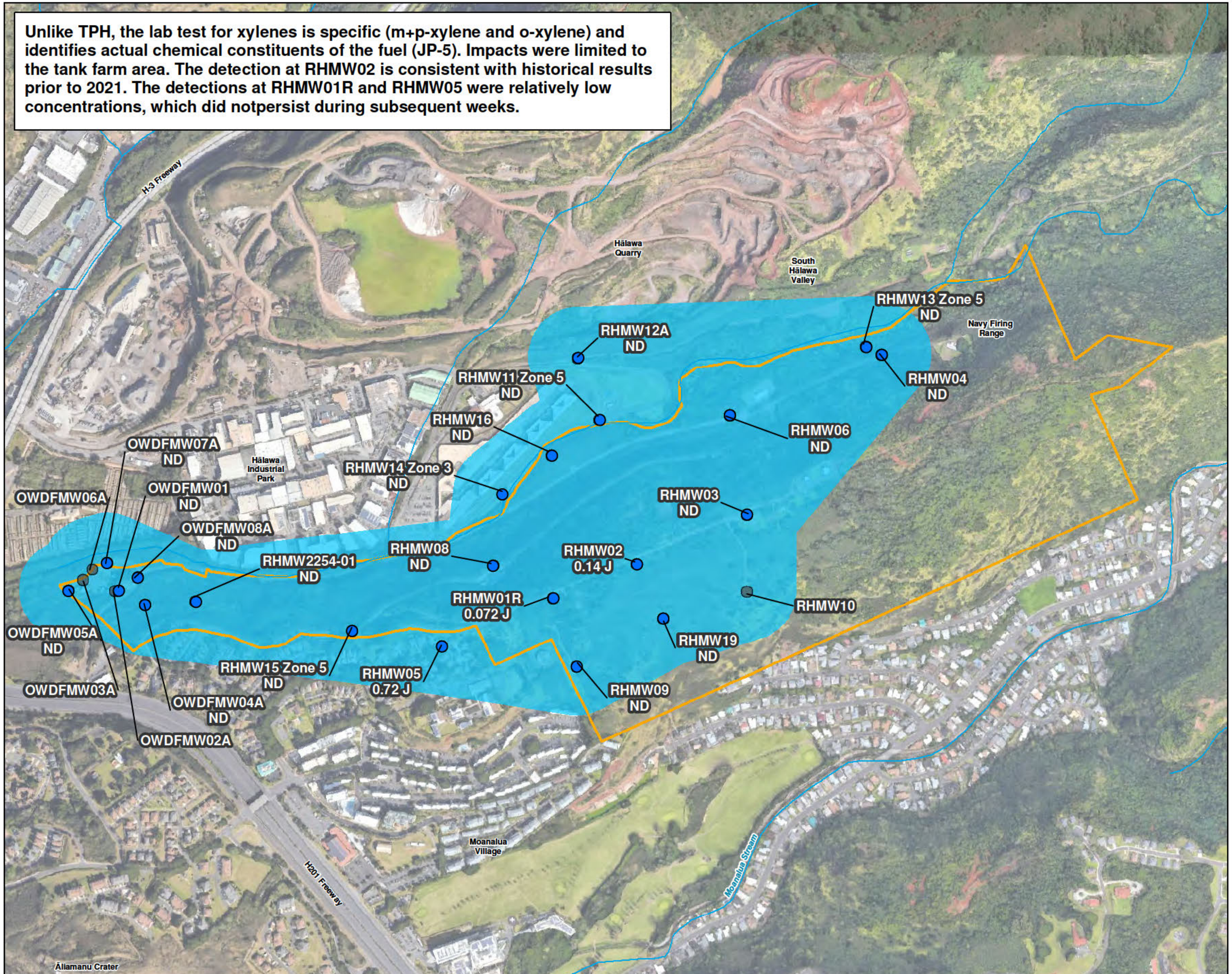
Feet
0 250 500 1,000

Xylenes Results
Week of April 24, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

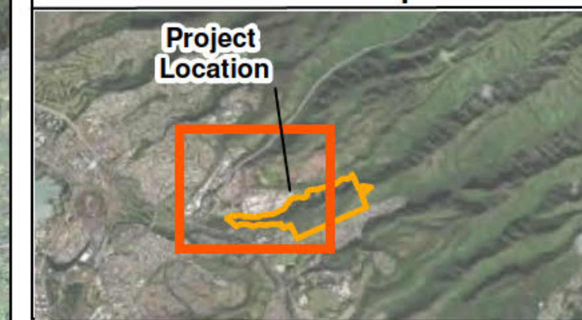


Xylenes Results
Week of May 2, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Unlike TPH, the lab test for xylenes is specific (m+p-xylene and o-xylene) and identifies actual chemical constituents of the fuel (JP-5). Impacts were limited to the tank farm area. The detection at RHMW02 is consistent with historical results prior to 2021. The detections at RHMW01R and RHMW05 were relatively low concentrations, which did notpersist during subsequent weeks.



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

- < 1
- > 1 - 2
- > 2 - 3
- > 3 - 4
- > 4 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 9
- > 9 - 10
- > 10 - 11
- > 11 - 12
- > 12 - 13
- > 13 - 14
- > 14 - 15
- > 15 - 16
- > 16 - 20
- < 20
- > 20 - 25
- > 25 - 30
- > 30 - 35
- > 35 - 40
- > 40 - 45
- > 45 - 50

- Stream
- Red Hill Installation Boundary

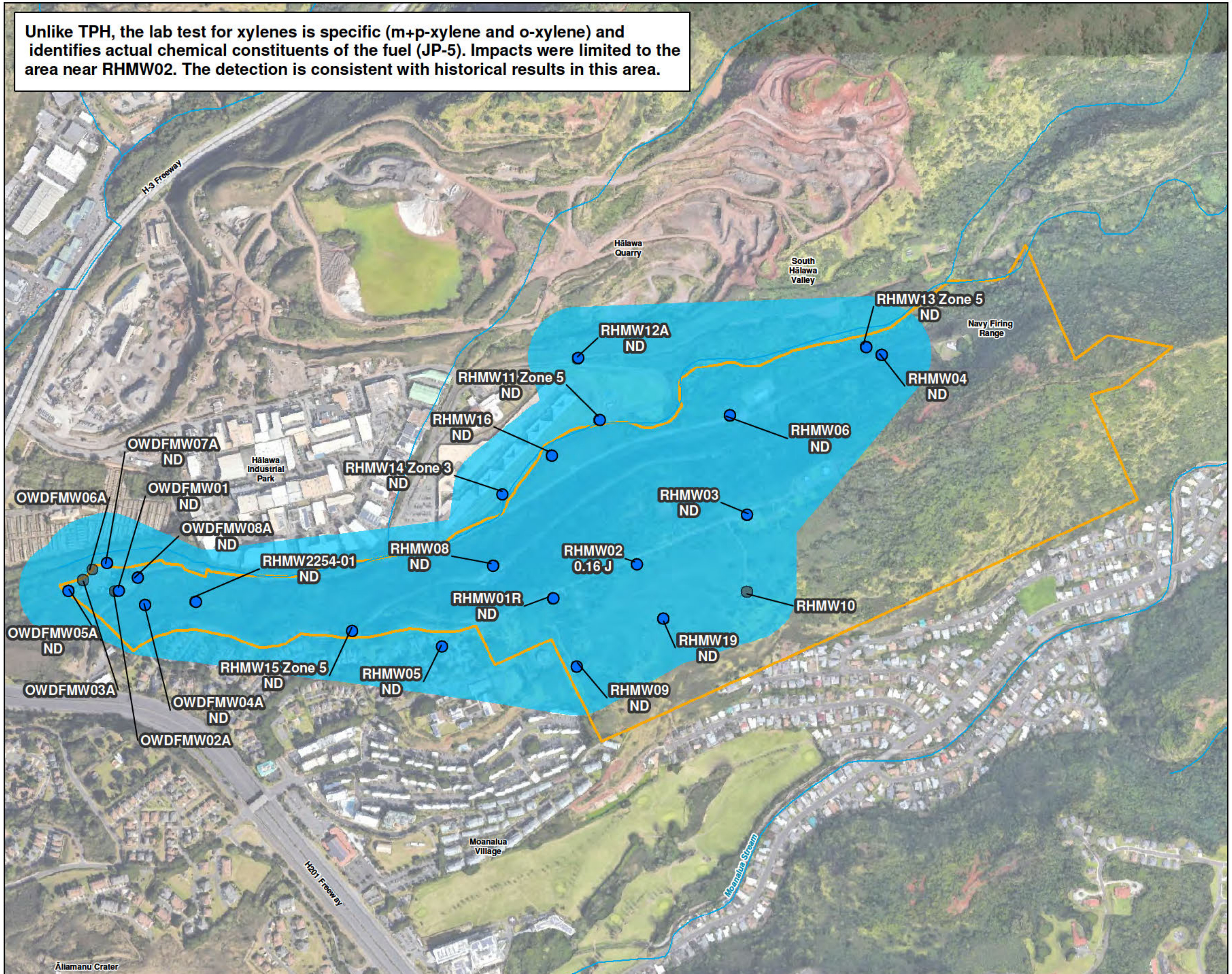
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

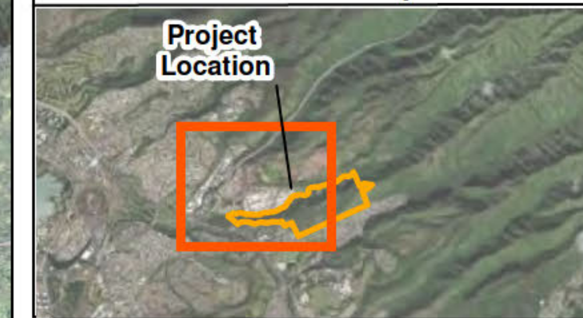
N

Feet
0 250 500 1,000

Xylenes Results
Week of May 9, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

Stream

Red Hill Installation Boundary

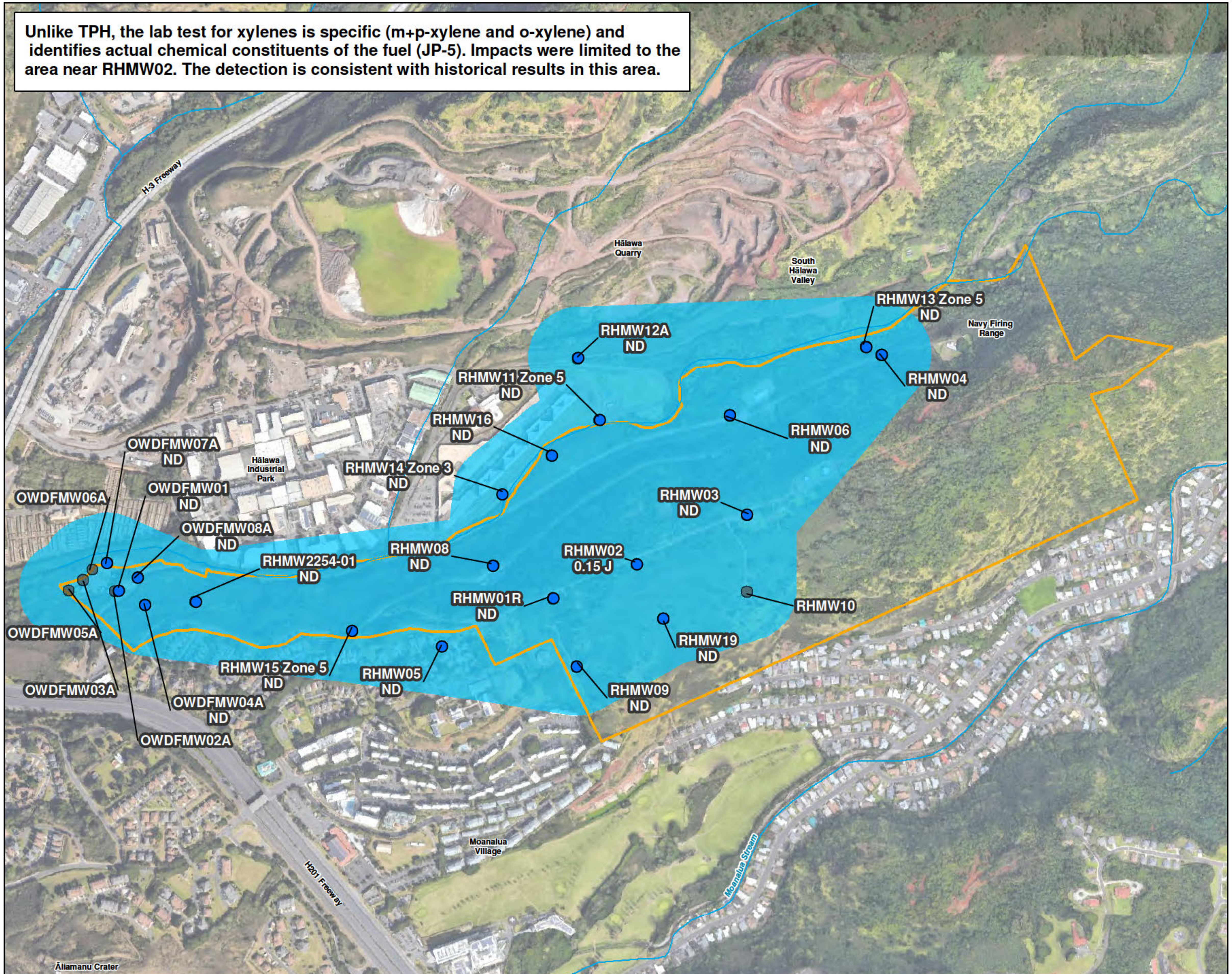
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

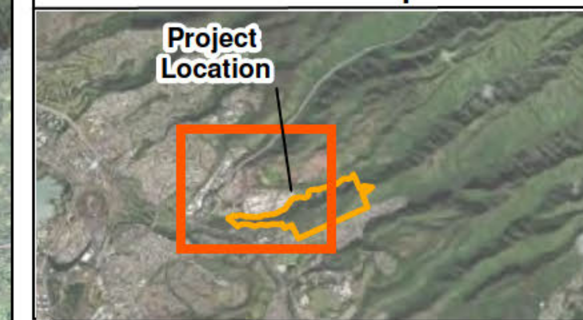
N

Feet
0 250 500 1,000

Xylenes Results
Week of May 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

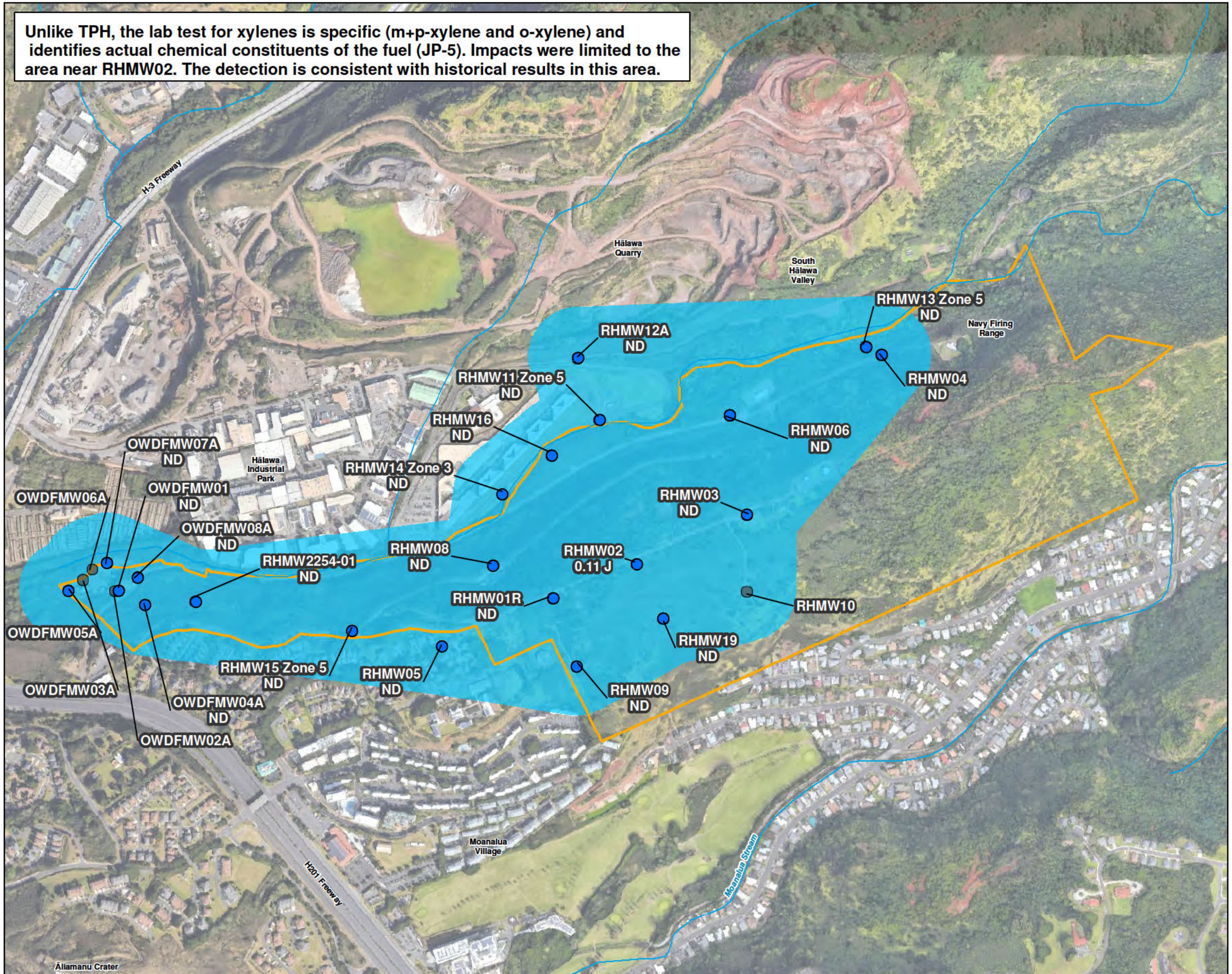
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

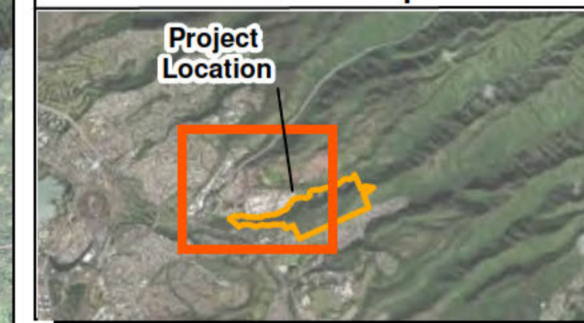
N

Feet
0 250 500 1,000

Xylenes Results
Week of May 23, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

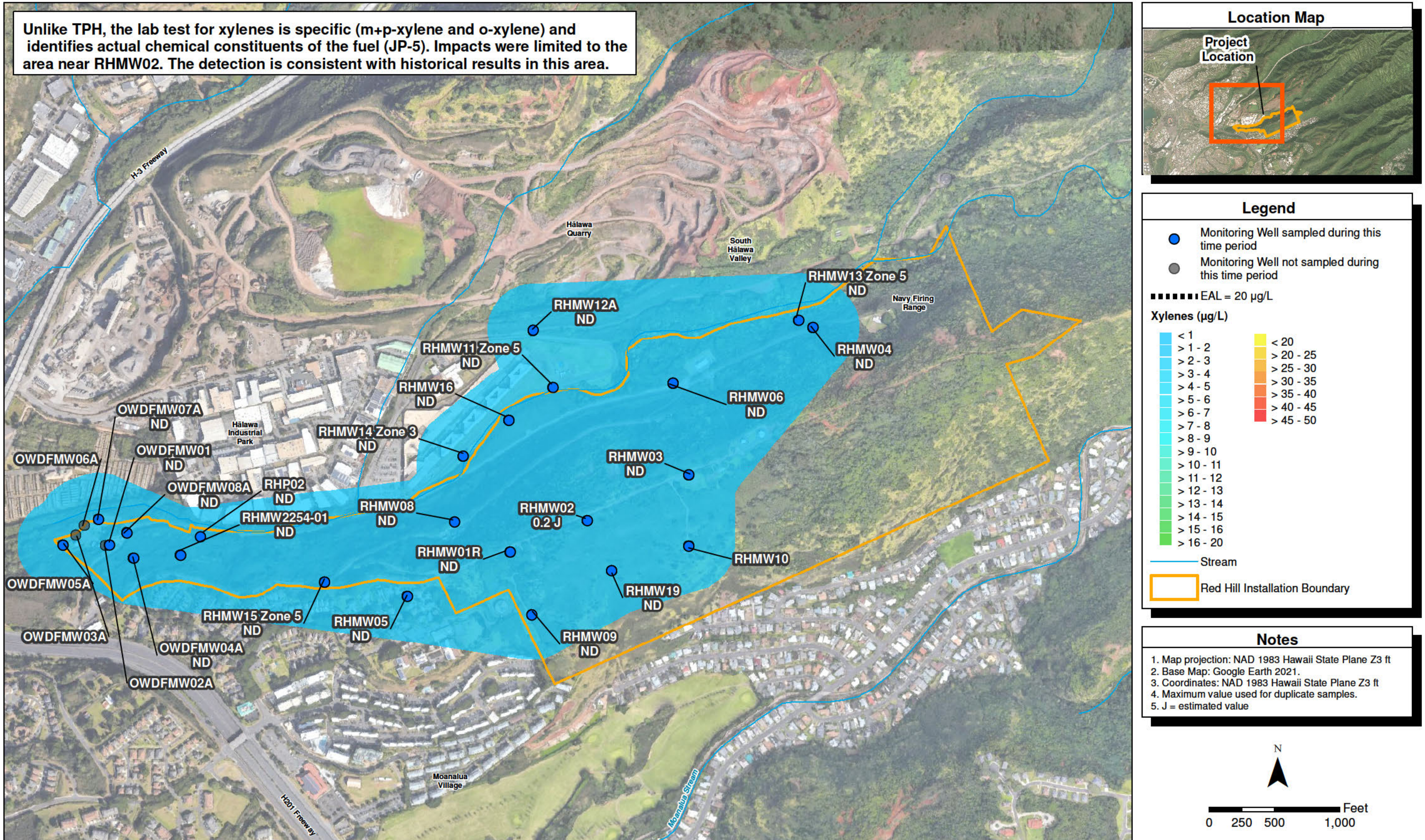
Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

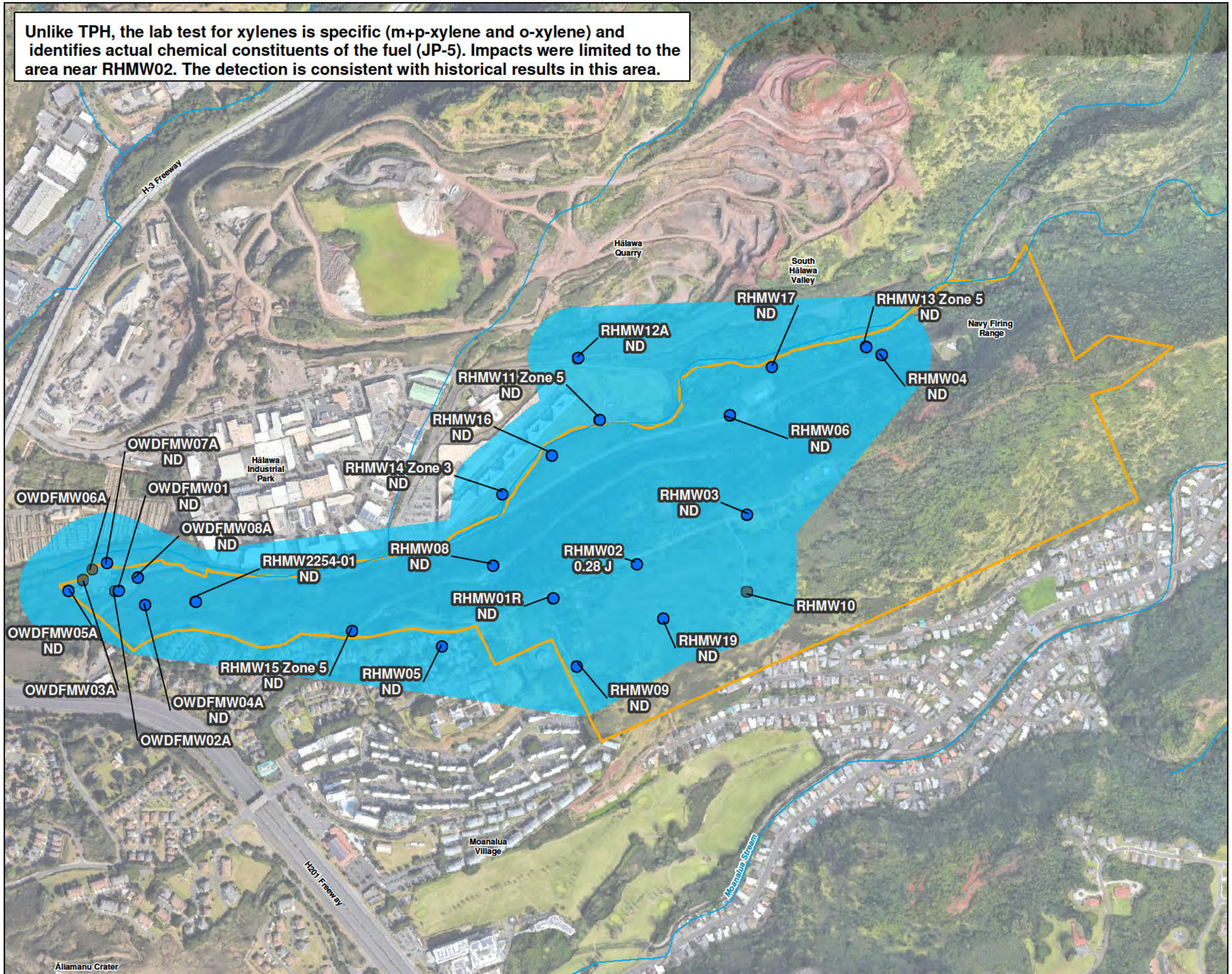
N

Feet
0 250 500 1,000

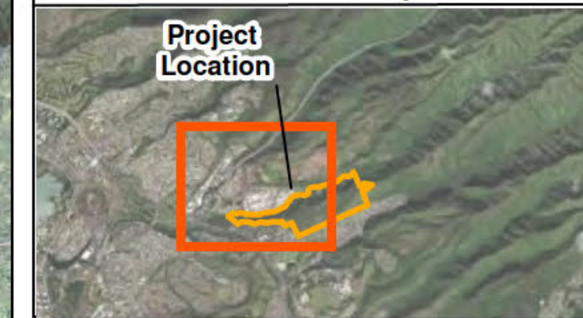
Xylenes Results
Week of May 31, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Xylenes Results
Week of June 6, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i



Location Map



Legend

- Monitoring Well sampled during this time period
- Monitoring Well not sampled during this time period
- EAL = 20 µg/L

Xylenes (µg/L)

< 1
> 1 - 2
> 2 - 3
> 3 - 4
> 4 - 5
> 5 - 6
> 6 - 7
> 7 - 8
> 8 - 9
> 9 - 10
> 10 - 11
> 11 - 12
> 12 - 13
> 13 - 14
> 14 - 15
> 15 - 16
> 16 - 20
< 20
> 20 - 25
> 25 - 30
> 30 - 35
> 35 - 40
> 40 - 45
> 45 - 50

- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. Maximum value used for duplicate samples.
5. J = estimated value

N

Feet
0 250 500 1,000

Xylenes Results
Week of June 13, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

Appendix B: Preliminary Hydraulic Analysis

Contents

Attachments

Figures

Tables

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Acronyms and Abbreviations

ft/d	feet per day
ft^2/d	square feet per day
GAC	granular activated carbon
K_h:K_v	vertical to horizontal anisotropy ratio
mgd	million gallons per day
mS/cm	millisiemens per centimeter
msl	mean sea level
NOI	Notice of Interest
RHS	Red Hill Shaft

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[redacted]

1.0 Introduction

This appendix document describes a preliminary analysis of the 2022 Red Hill Shaft (RHS) Startup Synoptic Water Level Survey data. Pumping at RHS was implemented in response to the November 20, 2021 release of petroleum in the RHS area, and the granular activated carbon (GAC) system was installed to treat the produced water. Data were collected from monitoring wells prior to RHS startup and during pumping, and from transducers that continuously monitored water levels in observation wells. Only a subset of wells available at the time were monitored, very few of which were located near RHS. At the time, no wells existed north or south of RHS.

The current data sets do not have sufficient data to create a robust estimate of capture created by RHS, particularly given the lack of data from previous studies in the area surrounding RHS. In particular, the distribution of monitoring wells, geologic and hydrogeologic complexity (including anisotropic conditions), influence of subsurface features between wells in the RHS area and the neighboring areas, and uncertain hydraulic connection between the RHS area and neighboring valleys render interpretation of observed water levels highly uncertain. Because of this uncertainty, calculation of a capture zone in the vicinity of RHS from potentiometric surface contours is not possible with the current data. The preliminary analyses that follow identify the data gaps that this work plan is designed to fill.

In general, the Navy analyzed the synoptic data as follows:

- Evaluated hydrographs;
- Evaluated drawdown at select times;
- Evaluated drawdown in plan view at specific times;
- Prepared 3-point solutions;
- Plotted specific conductivity results vs. time;
- Prepared Type-curve analyses of aquifer responses; and
- Completed pump test analyses for RHS to calculate hydraulic parameters using the following method:
  - Cooper-Jacob Approximation to the Theis Method – drawdown versus time and drawdown versus distance in Microsoft Excel.

The 2017/2018 Synoptic Study data are referenced here; the full synoptic data evaluation is presented in the Red Hill *Conceptual Site Model* report (DON 2019).

Center of Mass Calculations were also completed using the analytical data collected during the Notice of Interest (NOI) (DOH 2021a; 2021b) sampling.

2.0 Preliminary Data Evaluation

2.1 Hydrographs

Hydrographs for all wells monitored during the 2022 RHS Startup Synoptic Water Level Survey are presented on Figure B-1 (B-1.1–B-1.5). In addition, drawdown was plotted versus the logarithm of pumping time at RHS (time since pumping started in January 2022) (Figure B-2). The slopes of these semi-logarithmic lines and the x-intercepts were recorded. These values were then used to estimate aquifer transmissivity and storativity using the Cooper-Jacob approximation to the Theis equation (Cooper and Jacob 1946), as shown in Table B-1. To convert transmissivity to hydraulic conductivity, it is necessary to specify the aquifer thickness. Considering the depth of the basalt (thousands of feet), the high horizontal to vertical anisotropy, and the shallow depths of most wells and shafts, the total actual aquifer depth would not provide reasonable estimates. Therefore, the effective thickness was set to 100 feet (this preliminary value can be adjusted for future analyses in consultation with subject matter experts). Results are presented in Table B-1, along with results from the 2017/2018 study for comparison. Values from the 2022 and 2017/2018 synoptic studies are summarized in Table B-2 for comparison.

2.2 Drawdown at Select Times

Drawdown at selected time during the 2022 RHS Startup Synoptic Water Level Survey and during the 2017/2018 Synoptic Study are plotted for wells surrounding RHS on Figure B-2. After the synoptic water level survey was performed in early 2022, four plume delineation wells around RHS have been installed. Two additional wells are currently being installed and may be available for the proposed survey. Water levels from the plume delineation wells, which were not available in previous studies, will be critical in defining drawdown, flow, and capture near RHS.

2.3 Drawdown in Plan View at Specific Times

After approximately 4 weeks (29.4 days) of pumping RHS at an average rate of 4.2 million gallons per day (mgd), Figure B-3 shows the drawdown values derived from the 2022 RHS Startup Synoptic Water Level Survey in the area near RHS. Drawdown increases in proximity to the shaft, but there are insufficient data points for great precision in these estimates. The locations of the wells do not support development of a definitive potentiometric surface that could be used to establish the extent of groundwater capture. Rather, the collection of detailed data proposed in this work plan under various pumping scenarios, especially from the plume delineation wells near RHS, is expected to provide critical data for contouring and evaluating drawdown and the potentiometric surface near RHS.

2.4 3-Point Solutions

Figure B-4 shows 3-point solutions that were developed for water levels approximately 4 weeks (29.4 days) of pumping RHS at 4.2 mgd. Due in part to the relatively minor differences in elevations, the apparent flow directions are somewhat ambiguous. Additional triangles around

RHS can be drawn once water level data are collected from the newly installed plume delineation wells.

2.5 Specific Conductivity vs. Time Plots

Figure B-5 shows specific conductivity measurements collected during the weekly NOI sampling at RHS, plotted along with RHS pumping rates. Prior to the shut-down of RHS, specific conductance was fairly constant, with values around approximately 0.64 millisiemen per centimeter (mS/cm). During shutdown of RHS, chloride concentrations steadily decreased to as low as 0.46 mS/cm. Shortly after RHS was restarted, specific conductance rose to approximately 0.57 mS/cm. This work plan proposes collecting continuous water quality parameters, including specific conductivity, via transducers, including in the newly installed plume delineation wells. The higher-resolution data set will allow for a more detailed evaluation at both RHS and at nearby wells.

2.6 Type-Curve Analyses of Aquifer Responses

AQTESOLV software (Duffield 2007) was used to conduct an initial evaluation of drawdown data collected during the 2022 RHS Startup Synoptic Water Level Survey. The Neuman solution for unconfined aquifers was applied, which accounts for partial penetration of wells and delayed yield (Neuman 1974). (We note, however, that confined conditions existed west of RHS at the Oily Waste Disposal Facility.) In addition to obtaining information on hydraulic properties of the aquifer and their spatial distribution, derivative analysis was used to infer the effects of contributions from preferential flow paths or other water sources by observing deviations from standard-type curves.

Several assumptions were applied to all tests including a 100-foot effective aquifer thickness, a storativity of 1E-04, and a vertical anisotropy ratio (K_h:K_v) of 600. All these values can be adjusted as appropriate during future evaluations in consultation with subject matter experts. Although the actual aquifer is significantly thicker, the effective thickness is based on the assumption that the majority of water comes from the upper 100 feet. The assumed depth to the saltwater-freshwater interface in the area is 700–800 below mean sea level (msl). Derivative-type curves were used to estimate contributions from additional sources. AQTESOLV cannot explicitly model the complex geometry of RHS as an open conduit or horizontal well; therefore, an approach was used to implement RHS as ten equivalent single wells with a large diameter along the length of RHS. With the 4.2 mgd flow rate, 80 percent was allocated to the six eastern wells and 20 percent to the western wells, to account for known regions of higher permeability in the eastern portion of the water development shaft.

AQTESOLV reports for each well are presented in Attachment 1. Each page of the attachment shows the observed and modeled drawdown and derivative curves for the individual monitoring well analyzed. Curve matching was performed to obtain hydraulic conductivity and specific yield for each well. Emphasis in curve fitting was placed on late time data. Early time data and solutions are influenced by hydraulics within RHS as well as storativity, which is of less concern for long-

[redacted]

term drawdown and capture. Resulting hydraulic conductivity and specific yield values for each well are presented in Table B-3. Hydraulic conductivity values are within the range calculated using the Cooper-Jacob method with the same 2022 RHS Startup Synoptic Water Level Survey and 2017/2018 Synoptic Study data sets. Additionally, it is noted whether the derivative curve deviated from the Neuman unconfined solution. Deviations from the Neuman-type curve show decreases in the rate of drawdown in late time, indicated by the derivative curve of the data dropping to near zero when the Neuman-type curve derivative continues at a near constant value. Table B-3 summarizes the results of these analyses.

2.7 Center of Mass Calculations

Center of mass calculations for TPH-d, based on the weekly "heat maps" shown in Appendix A of this work plan, are plotted on Figure B-6 and Figure B-7. The data were separated into western wells (which may have been impacted by the November 20 Release, and therefore span the area of concern identified in the Red Hill Shaft Recovery and Monitoring Plan (RHSRMP)) and other wells (more likely to have impacts related to the tank farm area). The center of mass calculated for each week is plotted on a color scale of red to green, with red representing the oldest samples beginning the week of December 20, 2021 and green representing the most recent samples from June 13, 2022. The cluster of points near RHS are likely related to the November 20 Release (Figure B-7). The cluster of points beneath the tank farm are primarily driven by persistent detections at RHMW02, which have been observed since the well was installed prior to 2006. The points generally show a slight easterly trend over the period analyzed. Prior to the restart of RHS, centers of mass appeared to show a trend in the easternly direction, while the movement appears to have slowed in response to pumping. These calculations assume continuous concentration profiles, which may not be present in the complex, anisotropic, and heterogeneous conditions of the site subsurface. Data may also be biased simply by the geometrical configuration (location) of the wells. The additional data points collected from the plume delineation wells will help refine this analysis in the vicinity of RHS.

2.8 Capture Zone Estimation

Water levels from the plume delineation wells, unavailable in previous studies, will aid in evaluating drawdowns, flow directions, and the extent of hydraulic capture near RHS. Data collected during the trial period described in this work plan may also be used to estimate the extent of influence or hydraulic capture of RHS over a range of pumping rates. Methods for estimating the potential capture extent of RHS may include the following:

- Two-dimensional water level contours with interpreted flow nets
- Simulations using analytical or analytical element models
- Updated center of mass evaluations
- Use of natural tracer information proposed to be collected in this work plan
- Local-scale numerical simulations allowing increased detail, structure, and heterogeneity

- Regional-scale numerical simulations that include additional features, events, and processes that may potentially influence groundwater flow directions and rates

It is anticipated that the estimation of the extent of hydraulic capture will follow the multiple-lines-of-evidence approach as outlined by EPA (2008), progressing from approximate methods that require many simplifying assumptions to more detailed methods that require fewer assumptions and simplifications. The details and application of each method, and the interpretation of results, will be conducted in collaborative consultation with the Regulatory Agencies and their subject matter experts.

3.0 References

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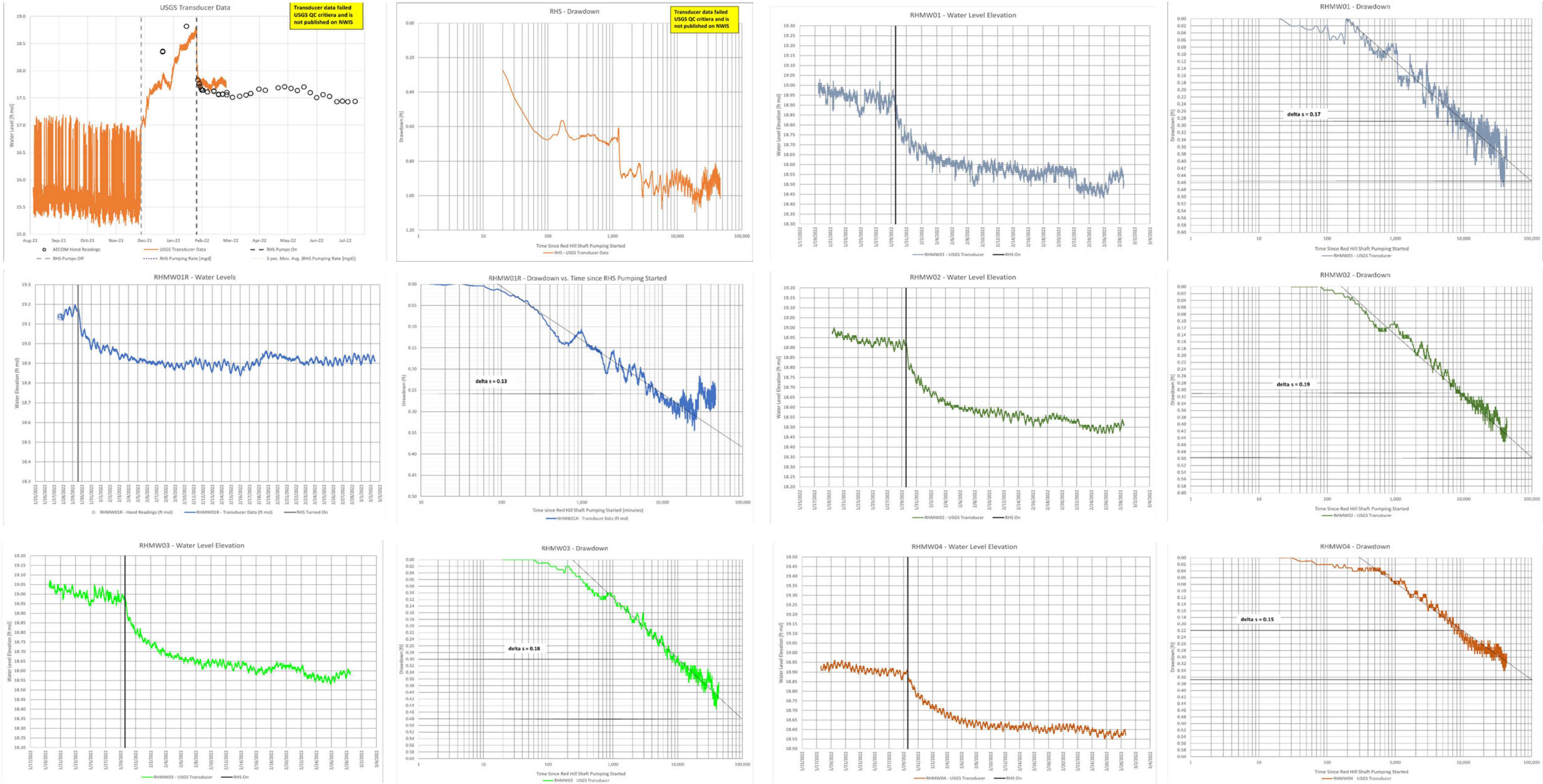
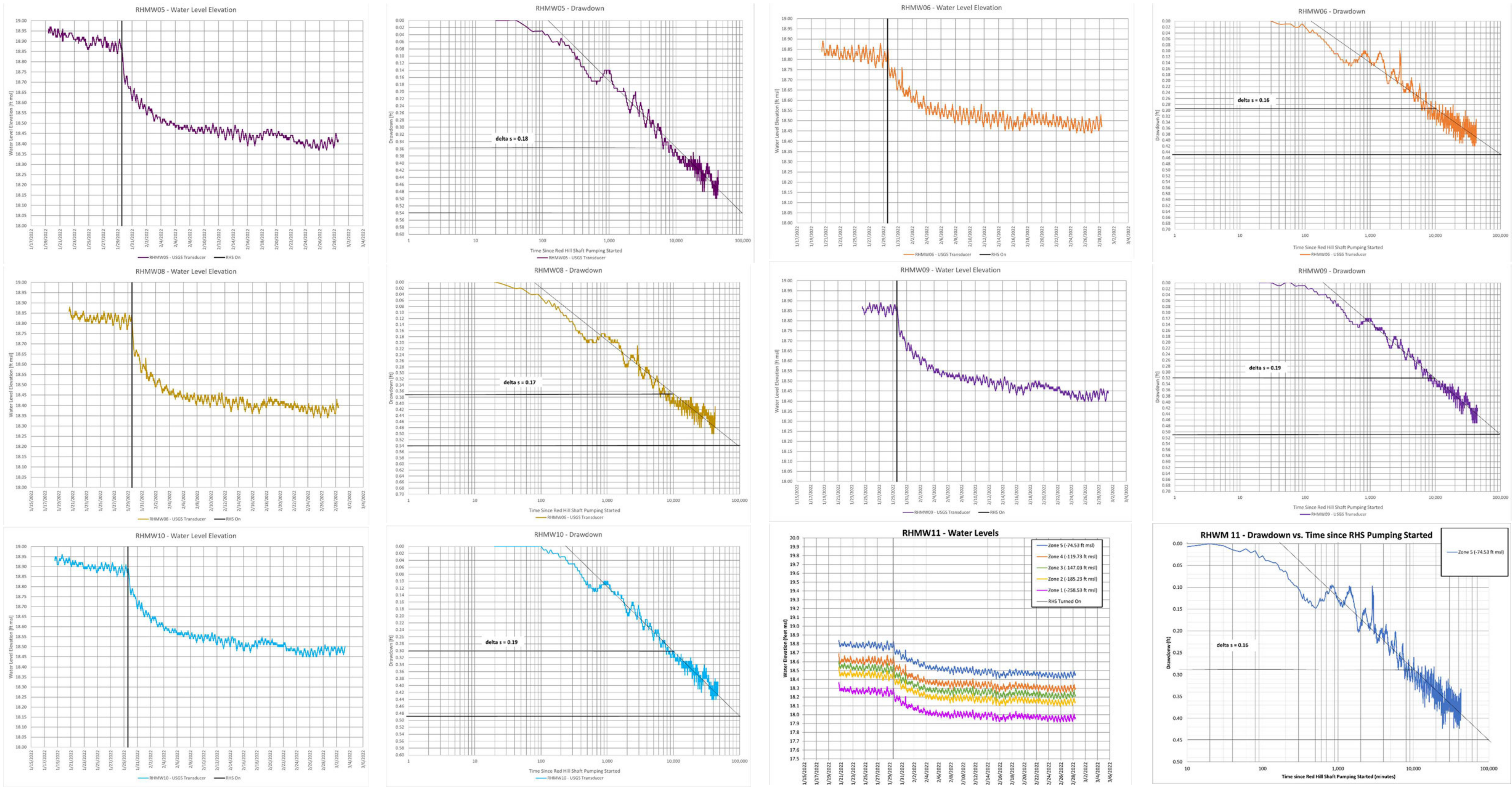


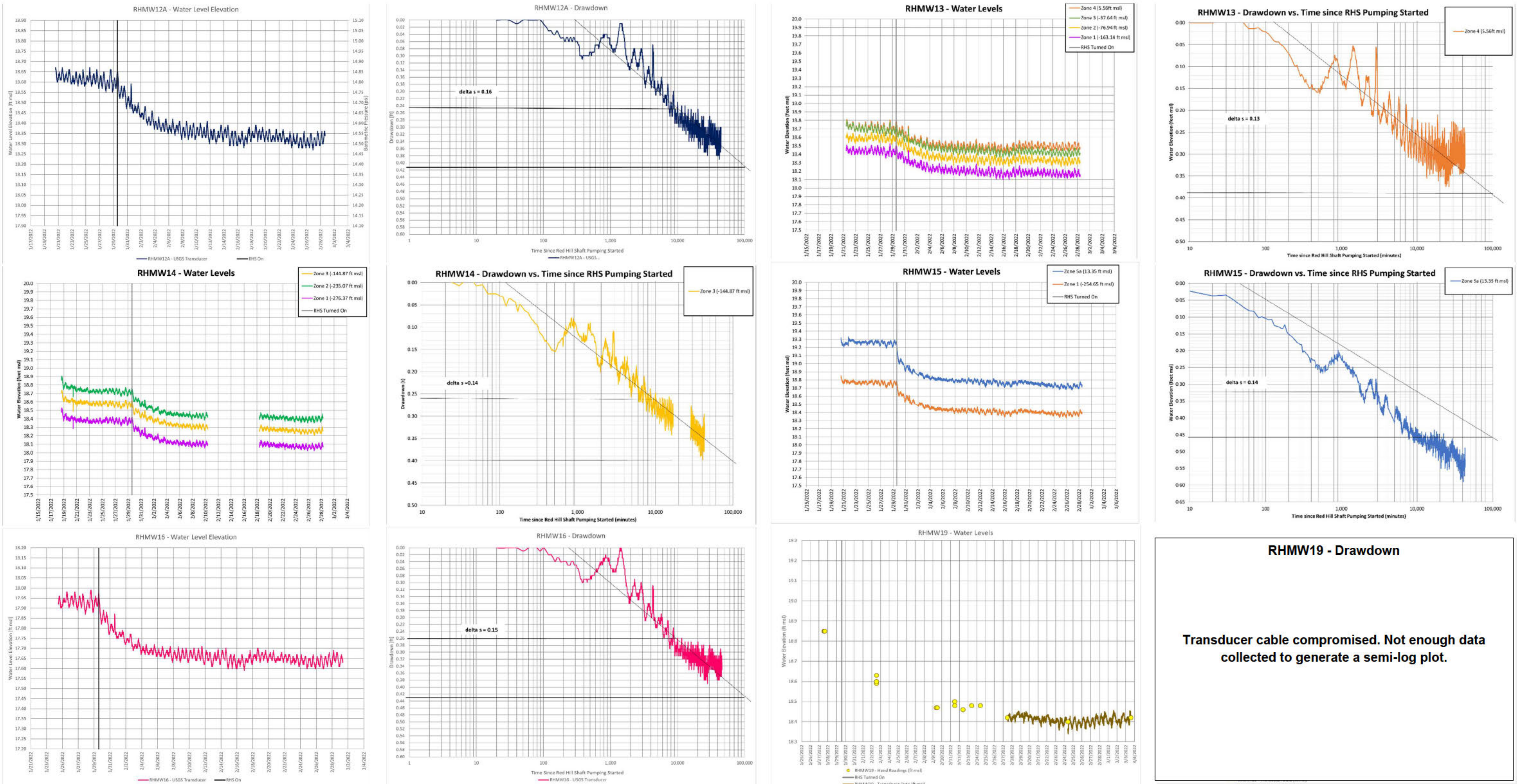
Cooper-Jacob Water Level and Cooper-Jacob Drawdown Plots (RHMW2254-01, RHMW01, RHMW01R, RHMW02, RHMW03, RHMW04)
Figure B-1.1
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O’ahu, Hawai’i

[redacted]



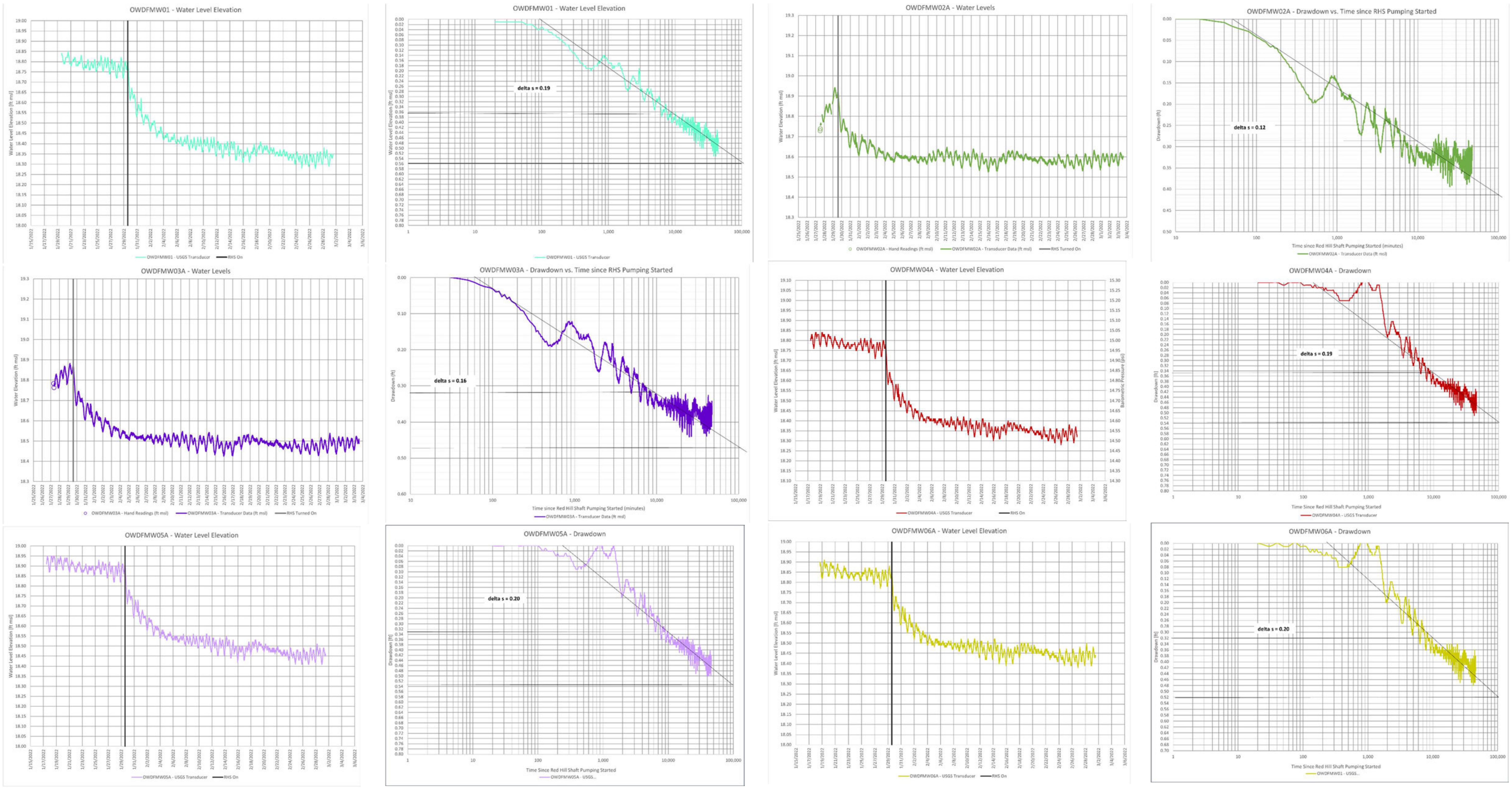
Cooper-Jacob Water Level and Cooper-Jacob Drawdown Plots (RHMW05, RHMW06, RHMW08, RHMW09, RHMW10, RHMW11)
Figure B-1.2
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O’ahu, Hawai’i

[redacted]



Cooper-Jacob Water Level and Cooper-Jacob Drawdown Plots (RHMW12A, RHMW13, RHMW14, RHMW15, RHMW16, RHMW19)
Figure B-1.3
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

[redacted]



Cooper-Jacob Water Level and Cooper-Jacob Drawdown Plots (OWDFMW01, OWDFMW02A, OWDFMW03A, OWDFMW04A, OWDFMW05A, OWDFMW06A)

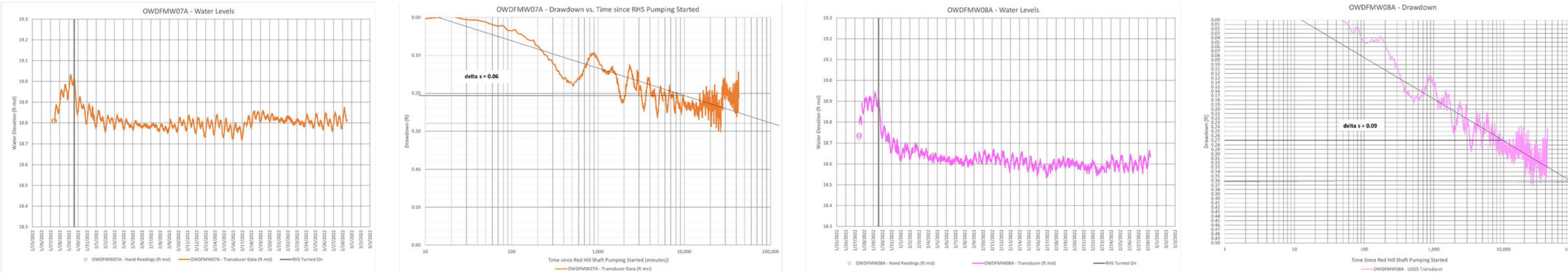
Figure B-1.4

Red Hill Shaft Flow Optimization Work Plan

Red Hill Bulk Fuel Storage Facility

JBPHH, O'ahu, Hawai'i

[redacted]



Cooper-Jacob Water Level and Cooper-Jacob Drawdown Plots (OWDFMW07A, OWDFMW08A)
Figure B-1.5
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O’ahu, Hawai’i

OWDFW03A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.30
4.2 MGD - DD (ft) - 7 days	0.33
4.2 MGD - max DD (ft) /days	0.44 / 17.4

OWDFW06A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.29
4.2 MGD - DD (ft) - 7 days	0.36
4.2 MGD - max DD (ft) /days	0.48 / 29.3

OWDFW07A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.21
4.2 MGD - DD (ft) - 7 days	0.23
4.2 MGD - max DD (ft) /days	0.30 / 17.4

OWDFW08A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.26
4.2 MGD - DD (ft) - 7 days	0.28
4.2 MGD - max DD (ft) /days	0.37 / 17.4

RHMW15-Z5	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.42
4.2 MGD - DD (ft) - 7 days	0.44
4.2 MGD - max DD (ft) /days	0.59 / 28.3

RHMW2254-01	
7.6 MGD - DD (ft) - 5 days	1.62
4.2 MGD - DD (ft) - 5 days	0.99
4.2 MGD - DD (ft) - 7 days	0.94
4.2 MGD - max DD (ft) /days	1.09 / 13

OWDFW04A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.31
4.2 MGD - DD (ft) - 7 days	0.37
4.2 MGD - max DD (ft) /days	0.51 / 29.3

RHMW05	
7.6 MGD - DD (ft) - 5 days	0.51
4.2 MGD - DD (ft) - 5 days	0.34
4.2 MGD - DD (ft) - 7 days	0.37
4.2 MGD - max DD (ft) /days	0.50 / 27.3

OWDFW05A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.28
4.2 MGD - DD (ft) - 7 days	0.35
4.2 MGD - max DD (ft) /days	0.50 / 27.3

OWDFW02A	
7.6 MGD - DD (ft) - 5 days	not installed
4.2 MGD - DD (ft) - 5 days	0.29
4.2 MGD - DD (ft) - 7 days	0.31
4.2 MGD - max DD (ft) /days	0.39 / 16.4

OWDFMW01	
7.6 MGD - DD (ft) - 5 days	0.48
4.2 MGD - DD (ft) - 5 days	0.33
4.2 MGD - DD (ft) - 7 days	0.36
4.2 MGD - max DD (ft) /days	0.53 / 26.3

Location Map

Legend

Current Water Level Monitoring Configuration

- Navy 700H Transducer
- Navy Micro Diver Transducer
- Navy MOSDAX Transducer
- Navy Hand Reading
- not currently monitored
- RHMW01 - USGS 700H Transducer
  RHMW01R - Navy 700H Transducer
- Navy Hand Readings and two USGS 700H Transducers
- USGS 700H Transducer
- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. 4.7 MGD: 5 days after RHS started pumping on 1/29/22.
5. 7.6 MGD: 5 days after RHS started pumping on 1/15/18.
6. The Navy's cable at RHMW19 malfunctioned (2022). A replacement transducer was installed on 2/17/22.
7. RHS 2018 and 2022 data did not meet UGSS QC requirements.

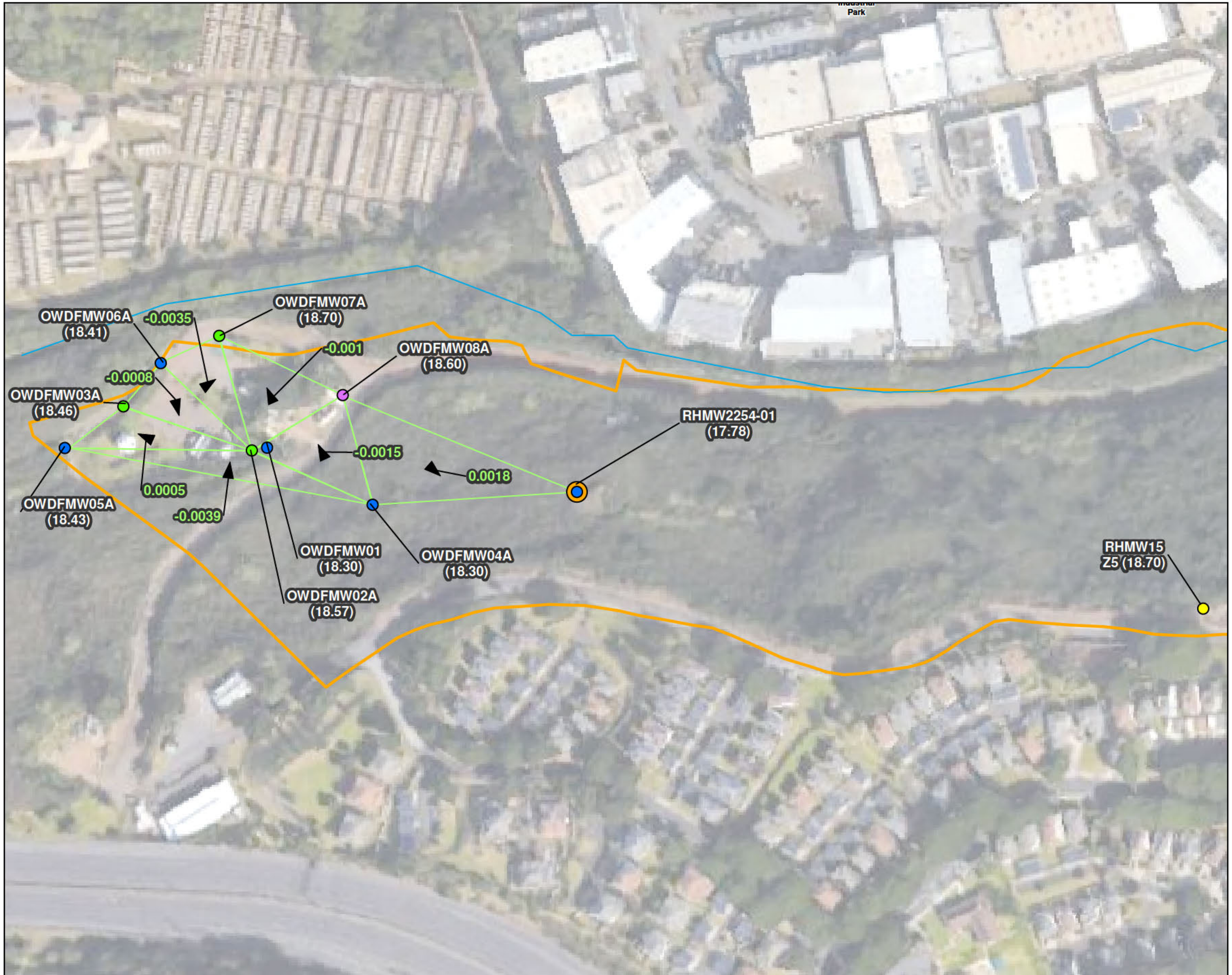
N

0 100 200 400 Feet

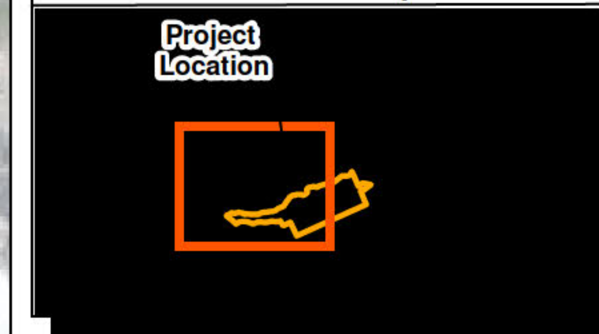
Figure B-2
Drawdown After Pumping at RHS - 4.2 mgd (Jan - Feb 2022) and 7.6 mgd (Jan 2018)
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

[redacted]

[redacted]



Location Map



Legend

Jan/Feb 2022 Water Level Monitoring Configuration

- Navy 700H Transducer
- Navy Micro Diver Transducer
- Navy MOSDAX Transducer
- Navy Hand Reading and 2 USGS 700H Transducers
- USGS 700H Transducer
- Stream
- Red Hill Installation Boundary

Notes

1. Map projection: NAD 1983 Hawaii State Plane Z3 ft
2. Base Map: Google Earth 2021.
3. Coordinates: NAD 1983 Hawaii State Plane Z3 ft
4. RHMW2254-01 data did not meet USGS QC criteria.

N

Feet
0 50 100 200

Figure B-4
Water Levels After ~1 Month of Pumping at RHS ~ 4.2 mgd
January to February, 2022
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

[redacted]

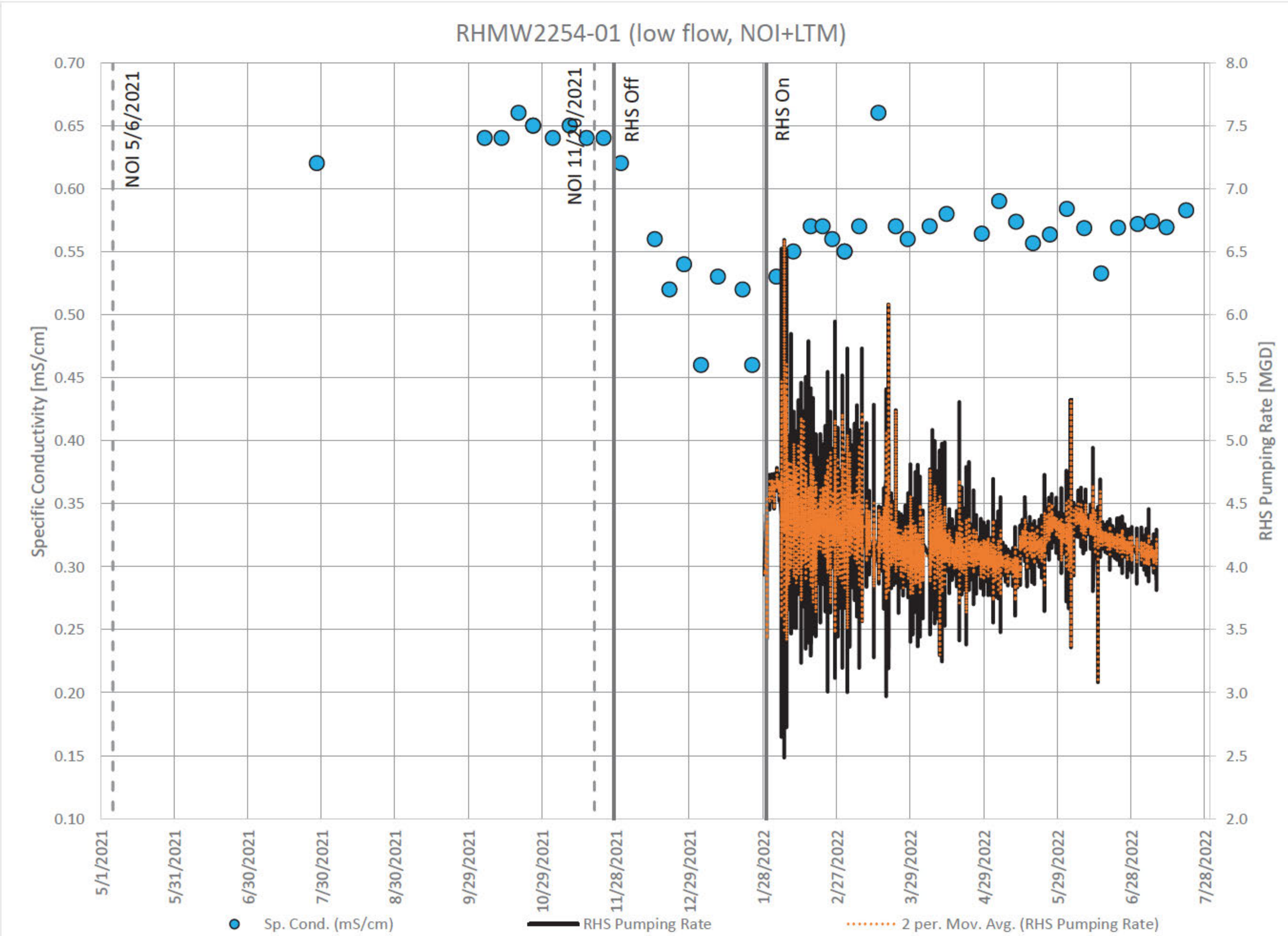


Figure B-5
Specific Conductivity and RHS Pumping Rates vs. Time
Red Hill Shaft Flow Optimization Work Plan
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, Hawai'i

[redacted]

[redacted]

C:\Users\MintzB\OneDrive - AECOM Directory\Desktop\AECOM 2\Transducer Evaluation_Jan_Feb_2022\GIS\CenterofMass_20220830.mxd 8/30/2022

[redacted]

C:\Users\MintzB\OneDrive - AECOM Directory\Desktop\AECOM 2\Transducer Evaluation_Jan_Feb_2022\GIS\CenterofMass_east__20220830.mxd 8/30/2022

[redacted]

Table B-1: Estimated Hydraulic Parameters from the 2017/2018 Synoptic Study and 2022 RHS Startup Synoptic Water Level Survey

Transducer Location	Distance to Eastern Clinker Zone at RHS [ft]	2022 RHS Synoptic Water Level Survey					2017/2018 Synoptic Study				
		Δ s[ft]	t_0 [day]	T [ft^2/day]	K [ft/day] (b = 100 ft)	S	Δ s[ft]	t_0 [day]	T [ft^2/day]	K [ft/day] (b = 100 ft)	S
OWDFMW01	1,500	0.19	0.07	550,000	5,500	0.04	0.30	0.08	990,000	9,900	0.08
OWDFMW02A	1,500	0.12	0.03	860,000	8,600	0.03	[b]	[b]	[b]	[b]	[b]
OWDFMW03A	1,900	0.16	0.04	650,000	6,500	0.02	[b]	[b]	[b]	[b]	[b]
OWDFMW04A	330	0.19	0.10	550,000	5,500	1.18 [a]	[b]	[b]	[b]	[b]	[b]
OWDFMW05A	2,000	0.20	0.17	520,000	5,200	0.05	[b]	[b]	[b]	[b]	[b]
OWDFMW06A	1,800	0.20	0.17	520,000	5,200	0.06	[b]	[b]	[b]	[b]	[b]
OWDFMW07A	1,700	0.06	0.01	1,720,000	17,200	0.01	[b]	[b]	[b]	[b]	[b]
OWDFMW08A	1,500	0.09	0.01	1,150,000	11,500	0.01	[b]	[b]	[b]	[b]	[b]
RHMW01	1,600	0.17	0.14	610,000	6,100	0.07	0.26	0.06	724,000	7,240	0.04
RHMW01R	1,600	0.13	0.06	800,000	8,000	0.04	[b]	[b]	[b]	[b]	[b]
RHMW02	2,300	0.19	0.12	550,000	5,500	0.03	0.28	0.10	672,000	6,720	0.03
RHMW03	3,100	0.18	0.17	580,000	5,800	0.02	0.28	0.13	672,000	6,720	0.02
RHMW04	4,400	0.15	0.21	690,000	6,900	0.02	0.30	0.20	627,000	6,270	0.02
RHMW05	810	0.18	0.09	580,000	5,800	0.17	0.26	0.04	724,000	7,240	0.10
RHMW06	3,300	0.16	0.09	650,000	6,500	0.01	0.26	.015	724,000	7,240	0.02
RHMW08	1,300	0.17	0.06	610,000	6,100	0.05	0.30	0.06	627,000	6,270	0.05
RHMW09	1,800	0.19	0.14	550,000	5,500	0.05	0.28	0.08	672,000	6,720	0.04
RHMW10	3,000	0.19	0.17	550,000	5,500	0.02	0.23	0.13	818,000	8,180	0.03
RHMW11 Zone 5	2,500	0.16	0.13	650,000	6,500	0.03	0.23	0.11	818,000	8,180	0.03
RHMW12A	2,700	0.16	0.21	650,000	6,500	0.04	[b]	[b]	[b]	[b]	[b]
RHMW13 Zone 4	4,300	0.13	0.09	800,000	8,000	0.01	[b]	[b]	[b]	[b]	[b]
RHMW14 Zone 3	1,600	0.14	0.09	740,000	7,400	0.06	[b]	[b]	[b]	[b]	[b]
RHMW15 Zone 5	210	0.14	0.02	740,000	7,400	0.92 [a]	[b]	[b]	[b]	[b]	[b]

Transducer Location	Distance to Eastern Clinker Zone at RHS [ft]	2022 RHS Synoptic Water Level Survey					2017/2018 Synoptic Study				
		Δ s[ft]	t_0 [day]	T [ft^2/day]	K [ft/day] (b = 100 ft)	S	Δ s[ft]	t_0 [day]	T [ft^2/day]	K [ft/day] (b = 100 ft)	S
RHMW16	2,100	0.15	0.17	690,000	6,900	0.06	[b]	[b]	[b]	[b]	[b]
RHMW2254-01	0	0.06	--	1,720,000	17,200	--	[b]	[b]	[b]	[b]	[b]

Notes:

[a] S values are too high to be real and are likely due to being too close to the water.

[b] Well was not installed at the time of the 2017/2018 Synoptic Study.

Table B-2: Comparison of Parameters

Transducer Location	T [ft^2/day]			S		
	2022 RHS Synoptic Water Level Survey	2017/2018 Synoptic Study	Ratio	2022 RHS Synoptic Water Level Survey	2017/2018 Synoptic Study	Ratio
OWDFMW01	550,000	990,000	1.8	0.04	0.08	2.0
RHMW01	610,000	724,000	1.2	0.07	0.04	0.6
RHMW02	550,000	672,000	1.2	0.03	0.03	1.0
RHMW03	580,000	672,000	1.2	0.02	0.02	1.0
RHMW04	690,000	627,000	0.9	0.02	0.02	1.0
RHMW05	580,000	724,000	1.2	0.17	0.10	0.6
RHMW06	650,000	724,000	1.1	0.01	0.02	2.0
RHMW08	610,000	627,000	1.0	0.05	0.05	1.0
RHMW09	550,000	672,000	1.2	0.05	0.04	0.8
RHMW10	550,000	818,000	1.5	0.02	0.03	1.5
RHMW11 Zone 5	650,000	818,000	1.3	0.03	0.03	1.0

[redacted]

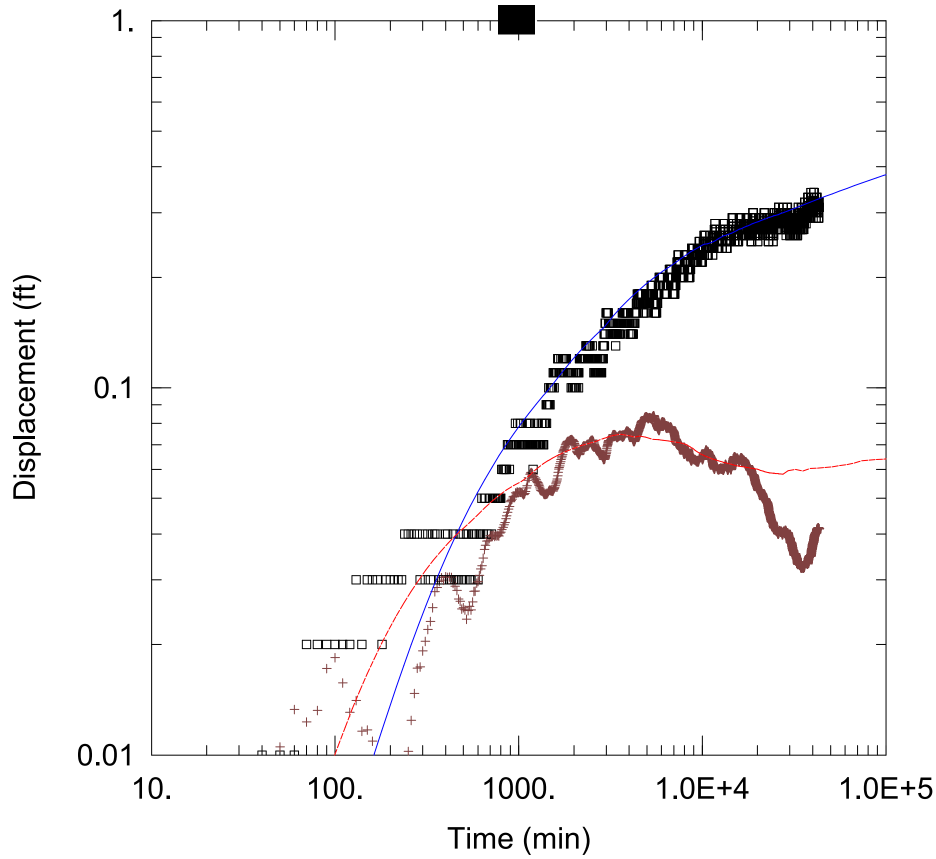
Table B-3: AQTESOLV Analysis Results

Observation Well	Transmissivity (ft^2/d)	Hydraulic Conductivity (ft/d)	Specific Yield
RHMW04	709,000	7,090	1.5%
RHMW05	604,300	6,043	8.2%
RHMW06	708,000	7,080	1.1%
RHMW08	679,700	6,797	2.0%
RHMW09	576,250	5,763	4.1%
RHMW10	598,300	5,983	1.9%
RHMW12A	682,300	6,823	3.2%
RHMW16	584,900	5,849	4.9%
RHMW2254-001 (Red Hill Shaft)[a]	812,000	8,120	0.5%
OWDFMW01	652,000	6,520	7.7%
OWDFMW05A	467,900	4,679	12.0%
OWDFMW06A	558,000	5,580	9.3%
RHMW01	621,000	6,210	5.5%
RHMW01R	954,640	9,546	2.1%
RHMW02	709,100	7,091	1.5%
RHMW03	616,800	6,168	1.7%

Notes:

[a] Drawdown data for RHS analyzed as within the fourth equivalent pumping well from the eastern end of the shaft.

Attachment 1: AQTESOLV Analysis Results



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/25/22 Time: 13:09:57

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW04	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined

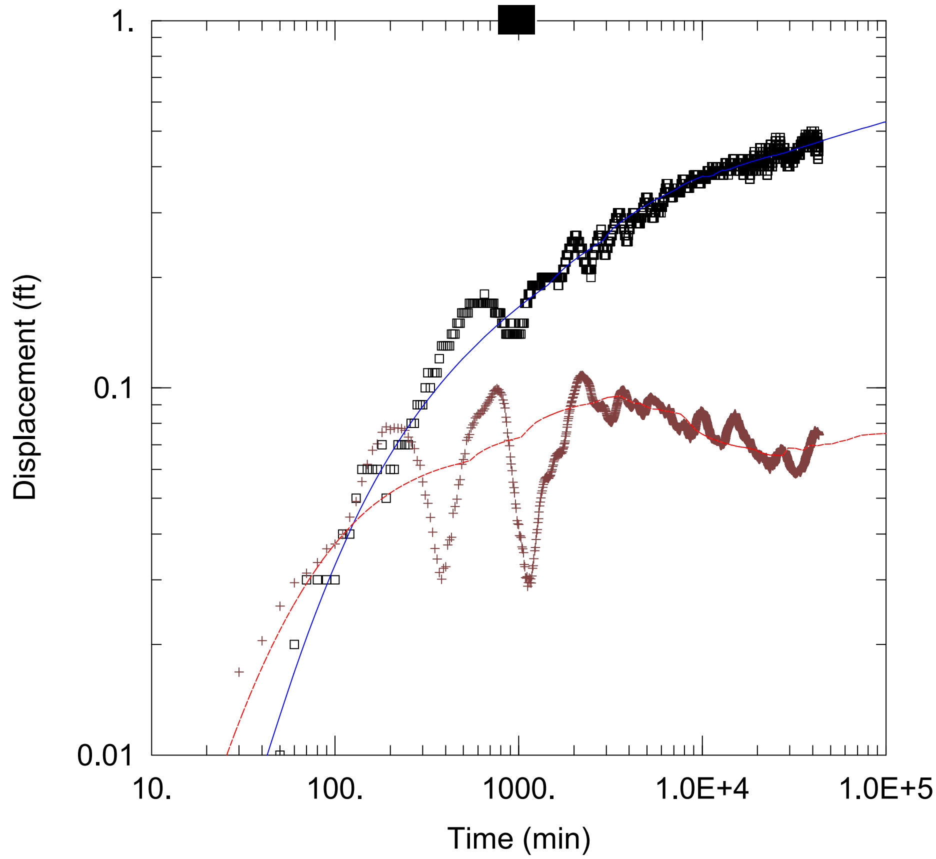
Solution Method: Neuman

T = 7.091E+5 ft^2/day

S = 0.0001

Sy = 0.0154

ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 09:05:01

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

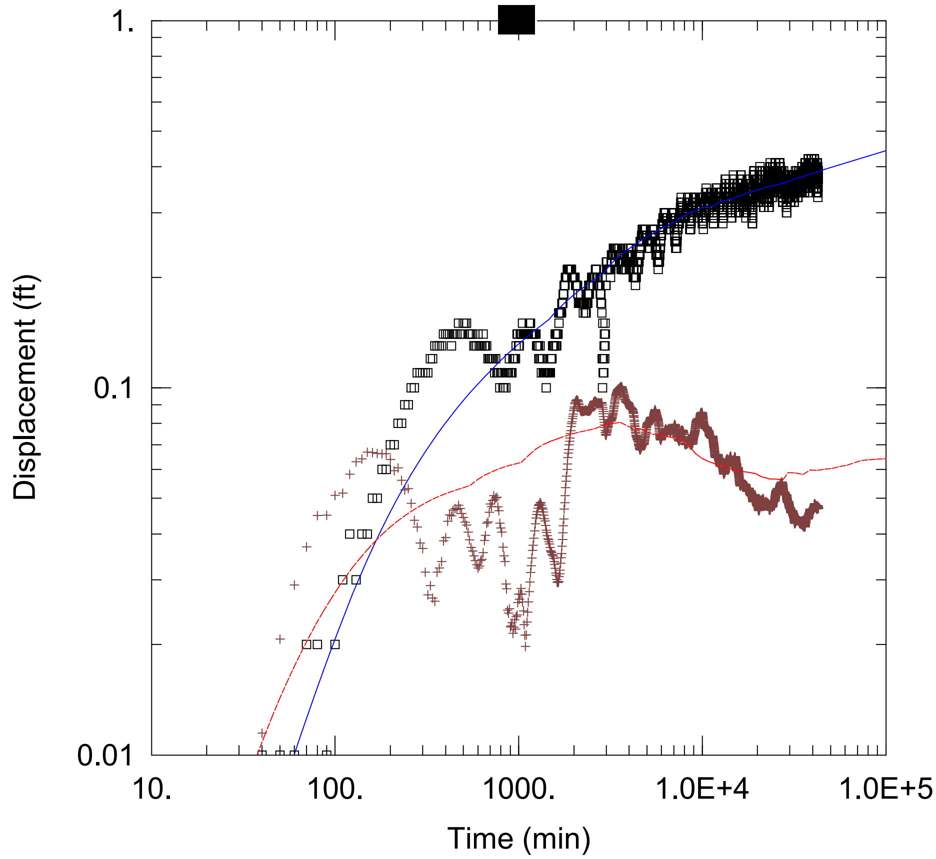
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW05	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 6.043E+5 ft^2/day
S = 0.0001
Sy = 0.08231
ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 09:10:29

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

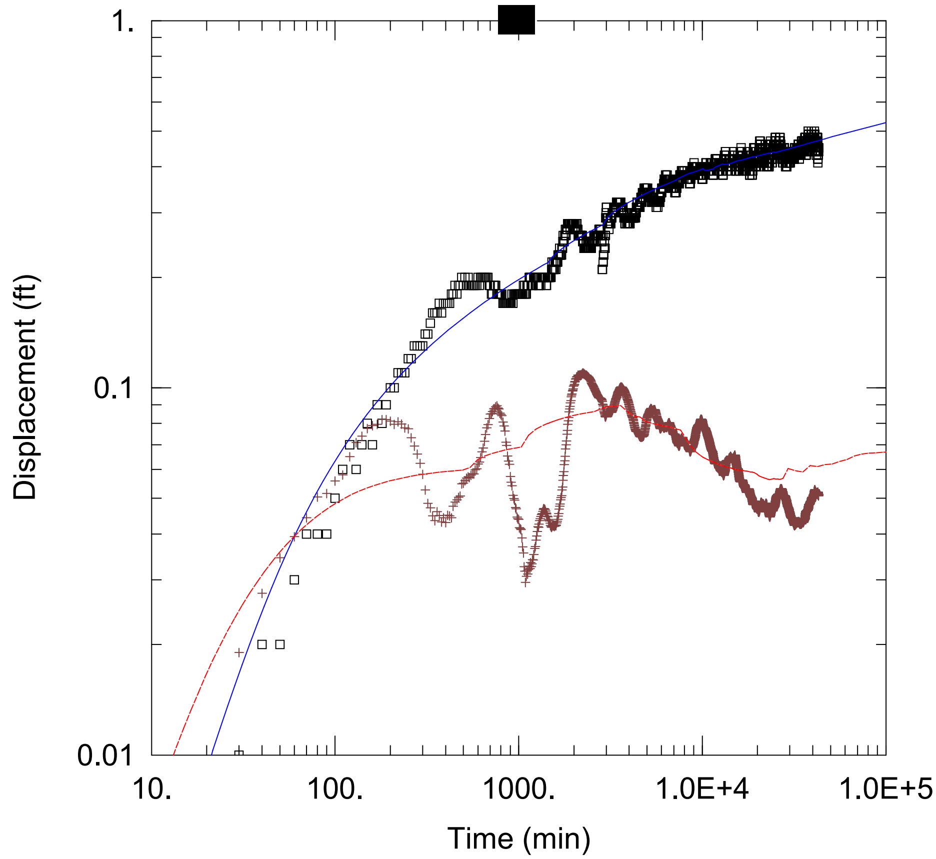
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW06	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 7.08E+5 ft^2/day
S = 0.0001
Sy = 0.0107
ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 09:11:18

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1		
RHS_2		
RHS_3		
RHS_4		
RHS_5		
RHS_6		
RHS_7		
RHS_8		
RHS_9		

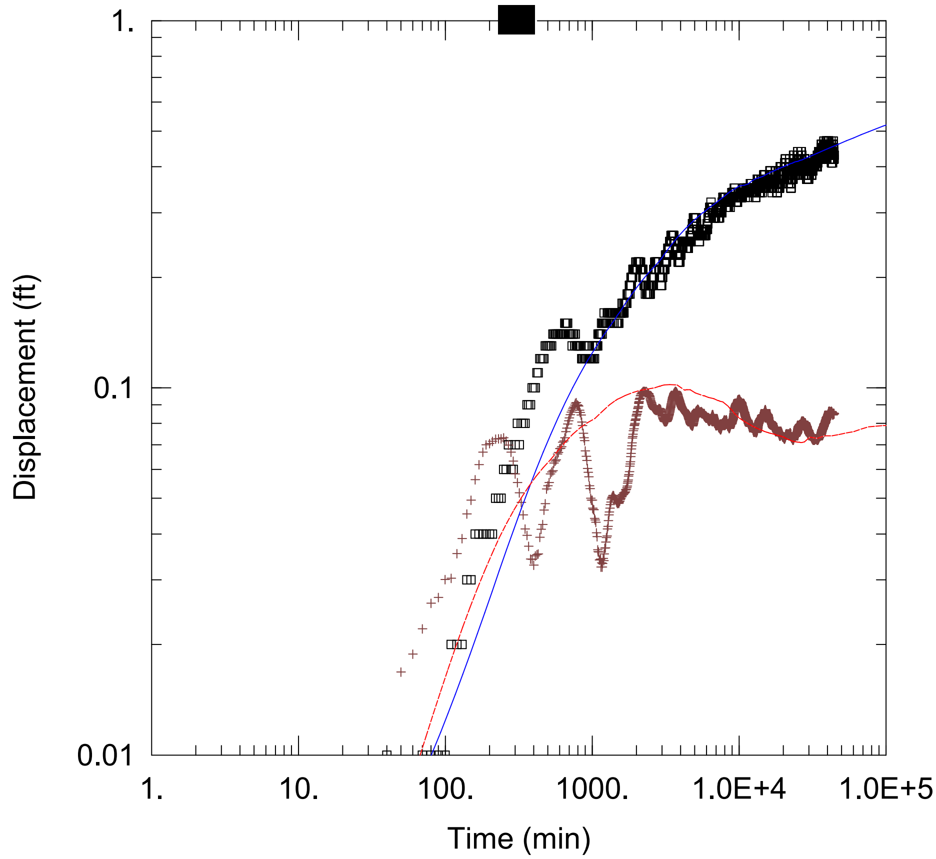
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW08	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 6.797E+5 ft^2/day
S = 0.0001
Sy = 0.02035
ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 09:25:28

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1		
RHS_2		
RHS_3		
RHS_4		
RHS_5		
RHS_6		
RHS_7		
RHS_8		
RHS_9		

Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW09	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined

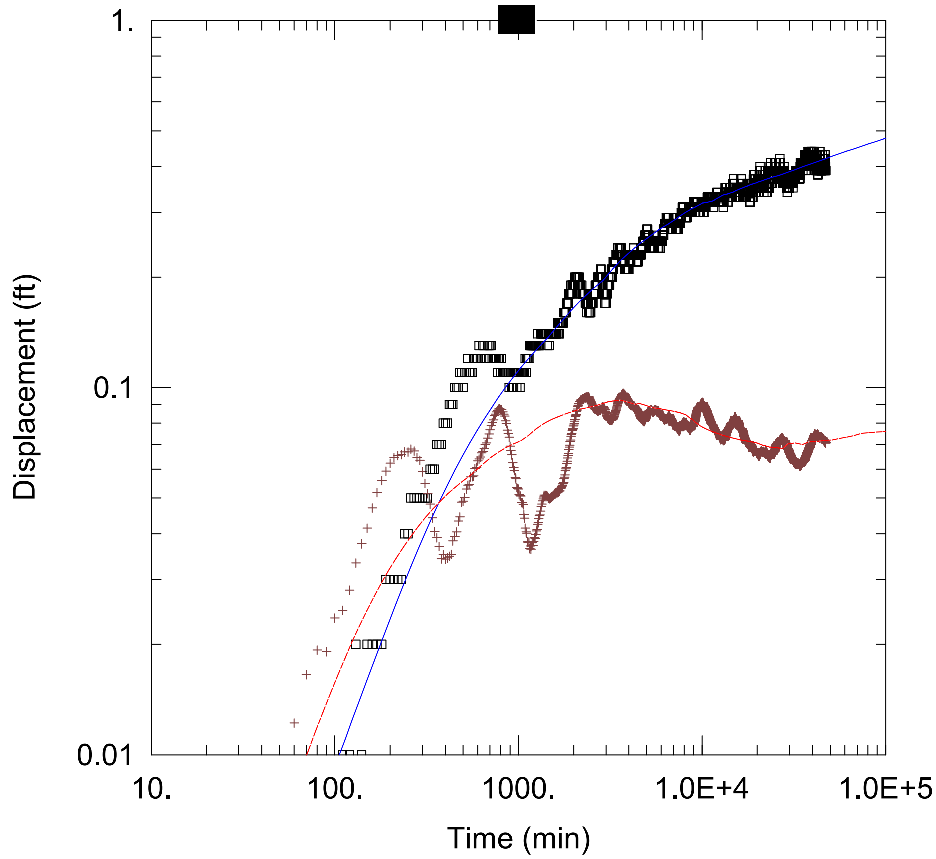
Solution Method: Neuman

T = 5.762E+5 ft^2/day

S = 0.0001

Sy = 0.04127

ß = 0.4981



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 09:24:21

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1		
RHS_2		
RHS_3		
RHS_4		
RHS_5		
RHS_6		
RHS_7		
RHS_8		
RHS_9		

Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW10	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined

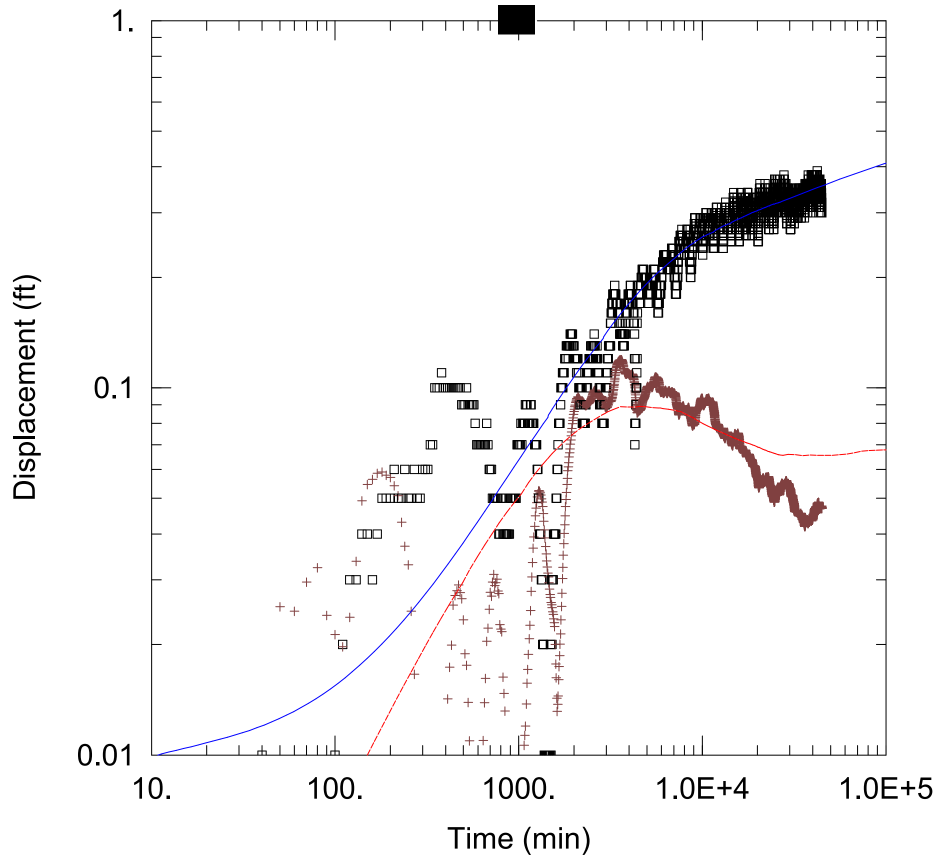
Solution Method: Neuman

T = 5.983E+5 ft^2/day

S = 0.0001

Sy = 0.01926

ß = 1.444



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 09:41:42

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 215. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

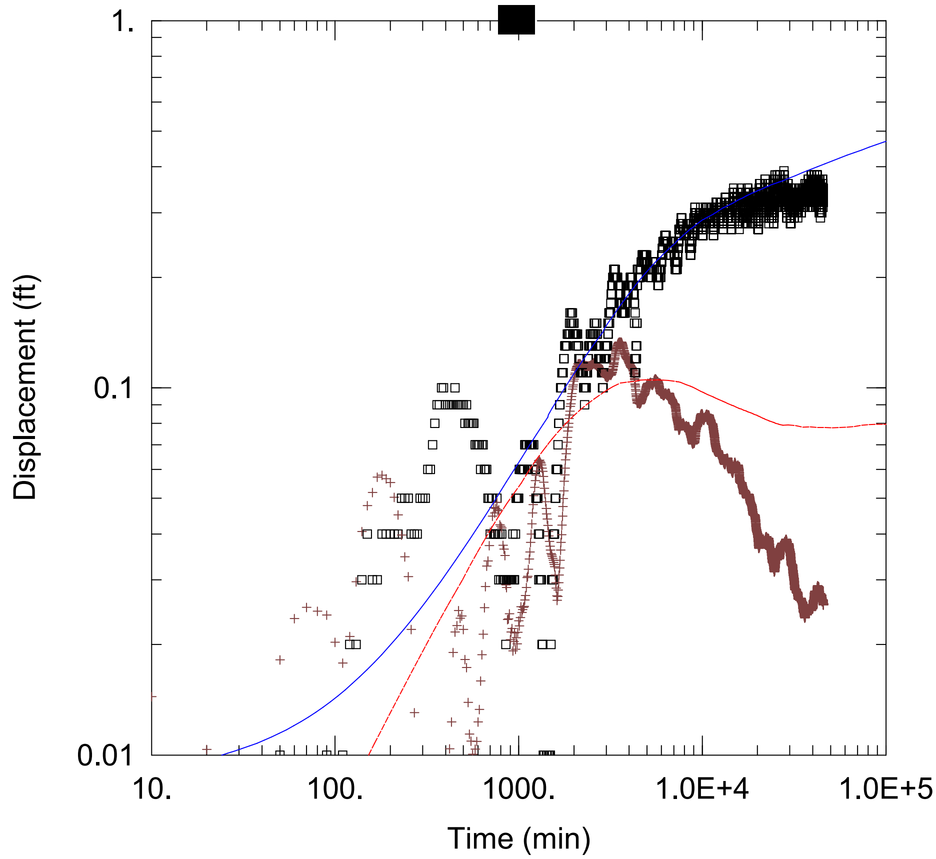
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW12A	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 6.823E+5 ft^2/day
S = 0.0001
Sy = 0.03241
ß = 0.09405



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 11:24:05

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 315. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

Observation Wells

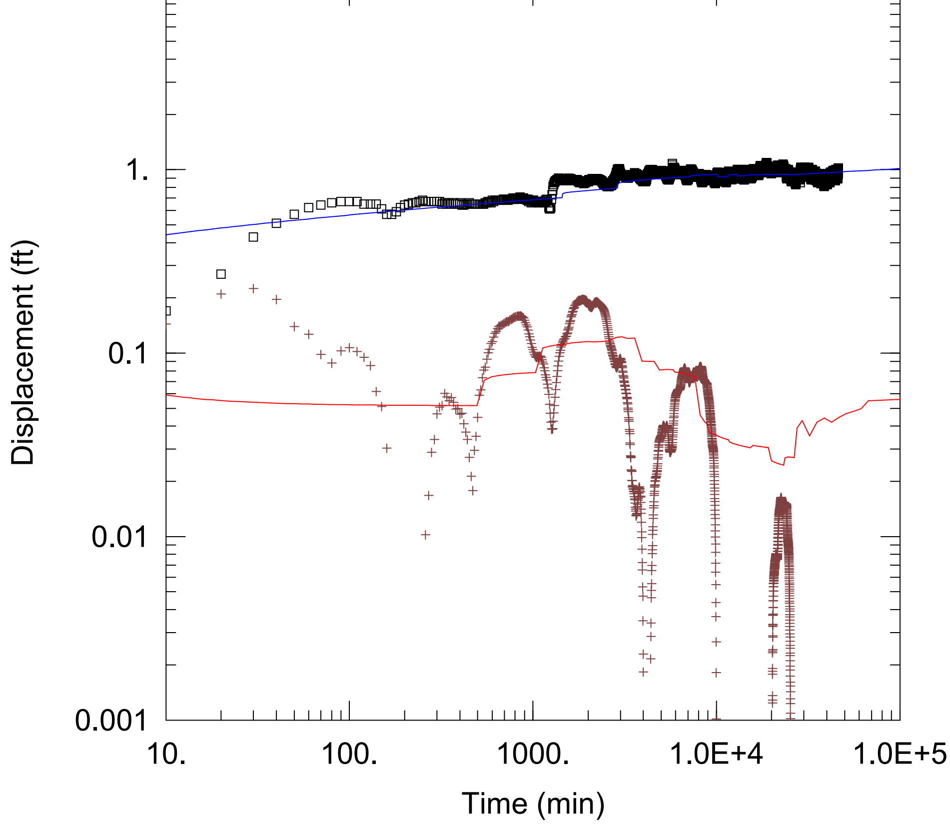
Well Name	X (ft)	Y (ft)
□ RHMW16	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 5.849E+5 ft^2/day
S = 0.0001
Sy = 0.04909
ß = 0.07526

[redacted]



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 21:32:18

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 115. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1		
RHS_2		
RHS_3		
RHS_4		
RHS_5		
RHS_6		
RHS_7		
RHS_8		
RHS_9		

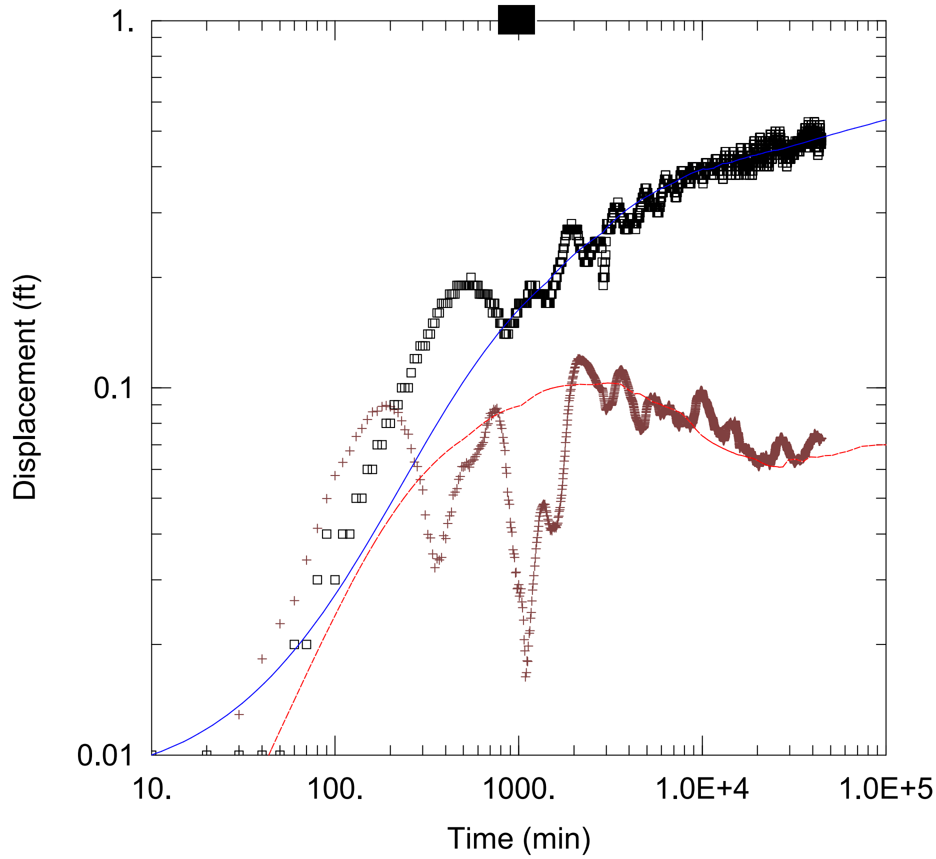
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHS_3	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 8.124E+5 ft^2/day
S = 0.0001
Sy = 0.005
ß = 0.4



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22
Time: 10:01:24

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

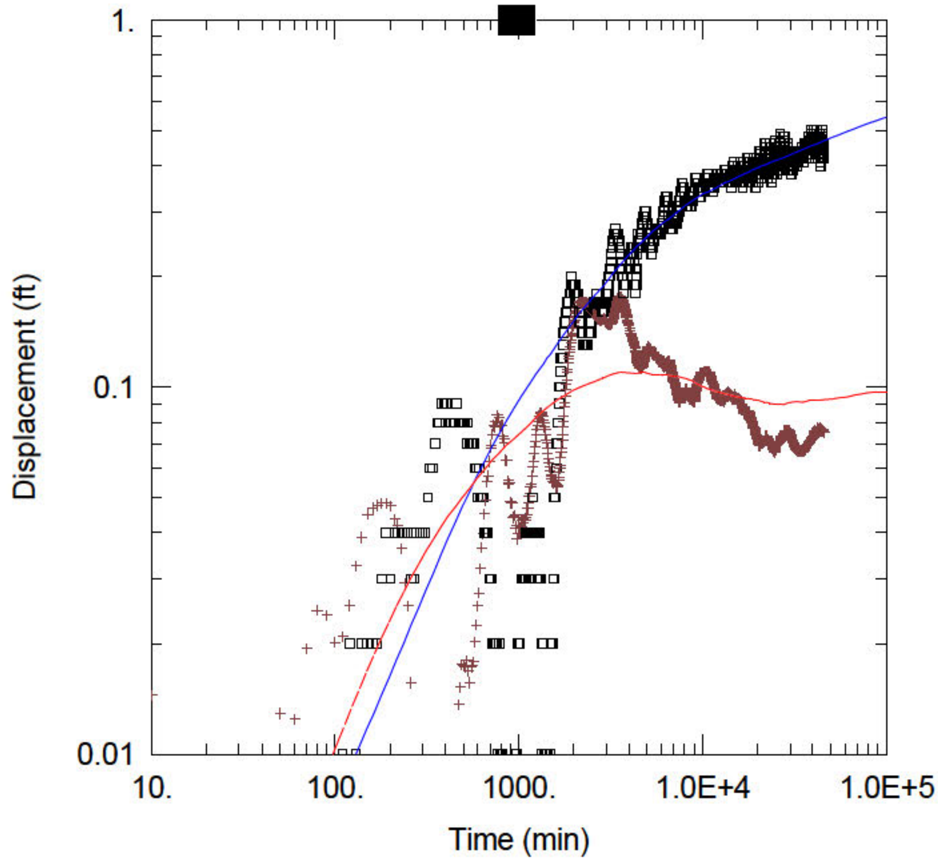
Observation Wells

Well Name	X (ft)	Y (ft)
□ OWDFMW01	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 6.52E+5 ft^2/day
S = 0.0001
Sy = 0.07738
ß = 0.4112



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/25/22 Time: 14:31:26

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1		
RHS_2		
RHS_3		
RHS_4		
RHS_5		
RHS_6		
RHS_7		
RHS_8		
RHS_9		

Observation Wells

Well Name	X (ft)	Y (ft)
□ OWDFMW05A	[redacted]	[redacted]

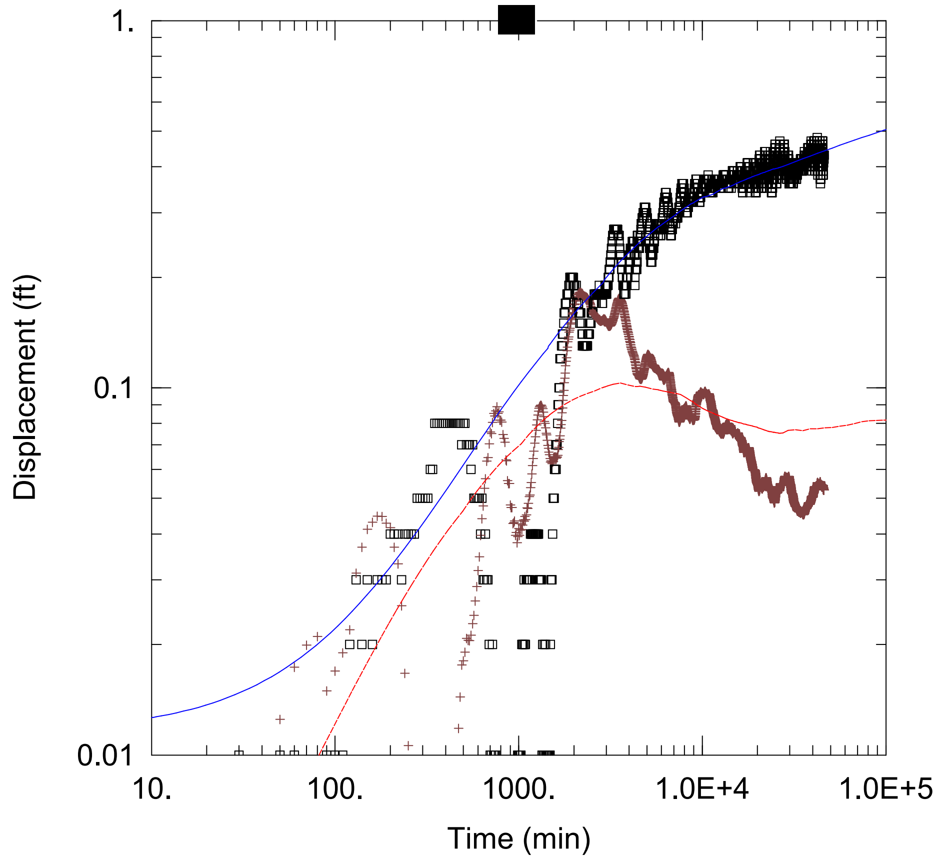
SOLUTION

Aquifer Model: Unconfined

T = 4.679E+5 ft^2/day
Sy = 0.12

Solution Method: Neuman

S = 0.0001
ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set [redacted]
Date: 08/24/22 Time: 14:31:16

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 115. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

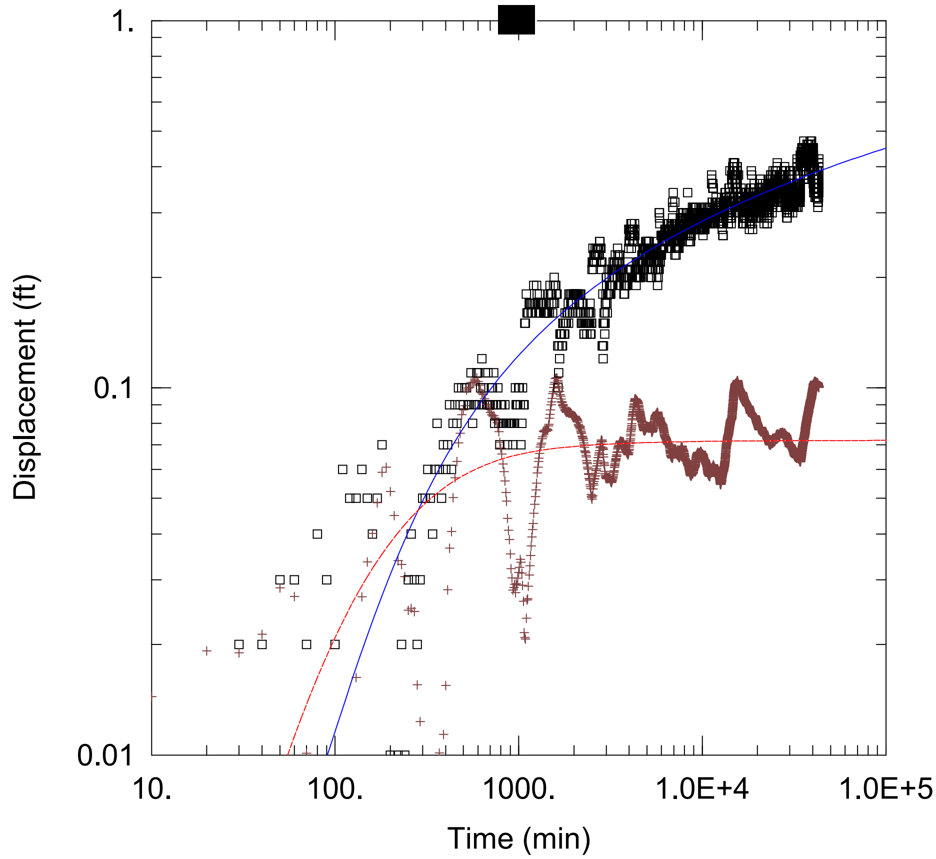
Observation Wells

Well Name	X (ft)	Y (ft)
□ OWDFMW06A	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined Solution Method: Neuman

T = 5.582E+5 ft^2/day S = 0.0001
Sy = 0.09326 ß = 0.4075



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/23/22 Time: 17:48:23

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1		
RHS_2		
RHS_3		
RHS_4		
RHS_5		
RHS_6		
RHS_7		
RHS_8		
RHS_9		

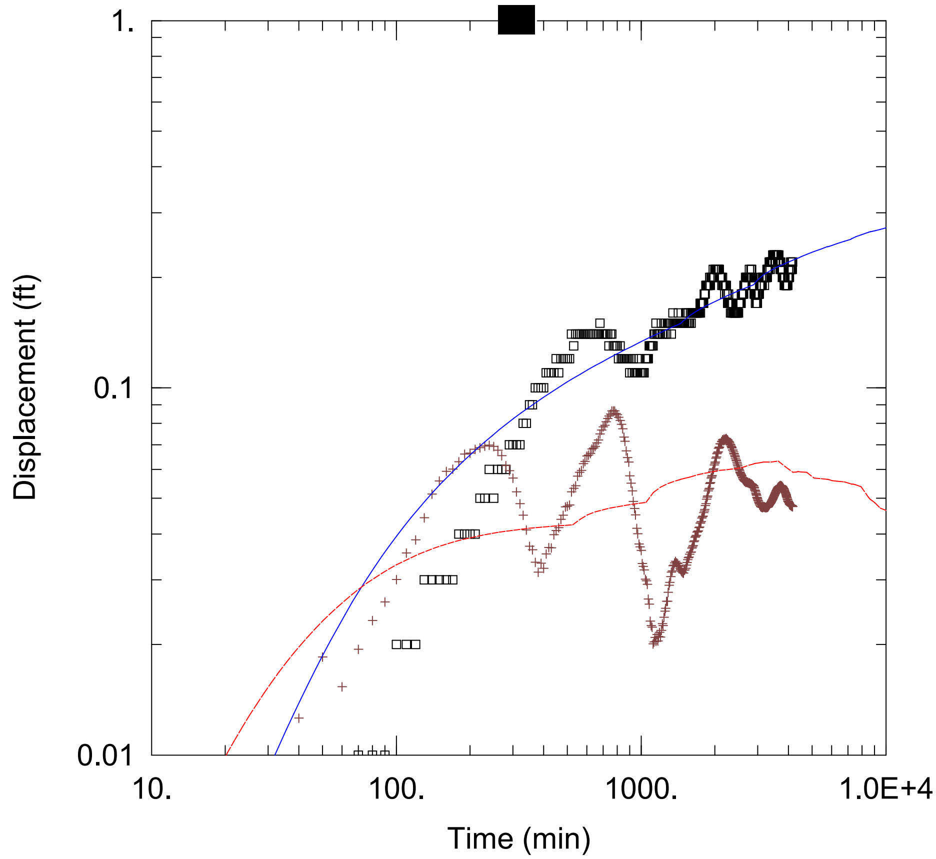
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW01	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 6.21E+5 ft^2/day
S = 0.0001
Sy = 0.05504
ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/23/22 Time: 18:57:04

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

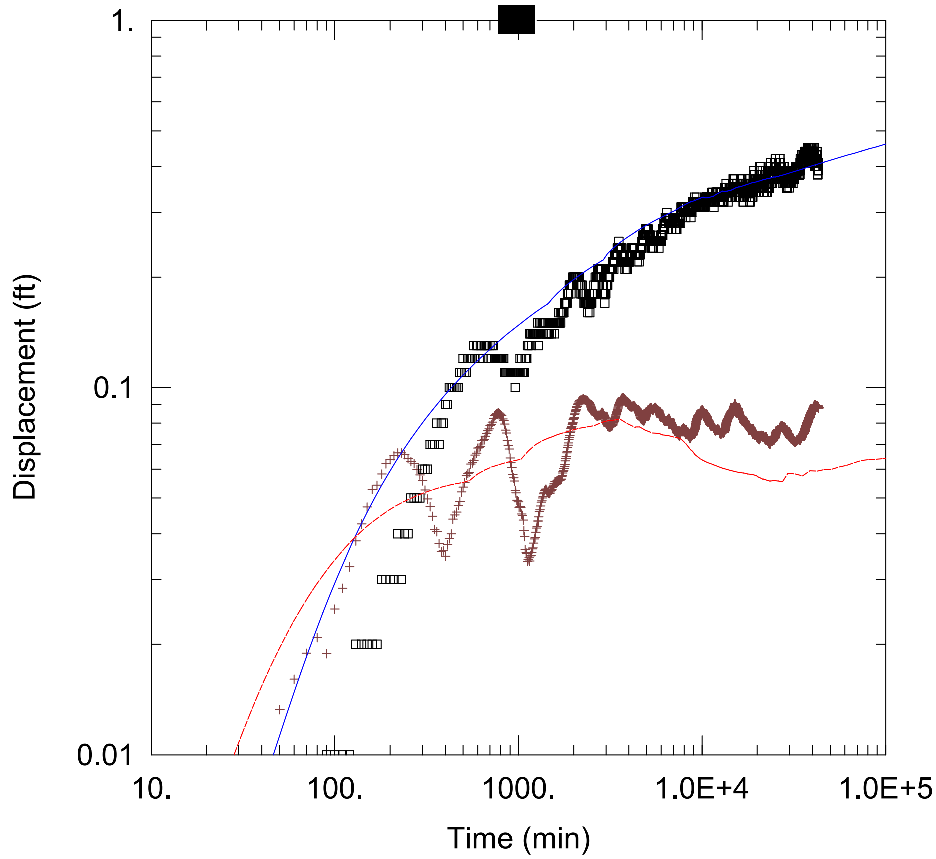
Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW01R	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 9.564E+5 ft^2/day
S = 0.0001
Sy = 0.02135
ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 08:44:57

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW02	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined

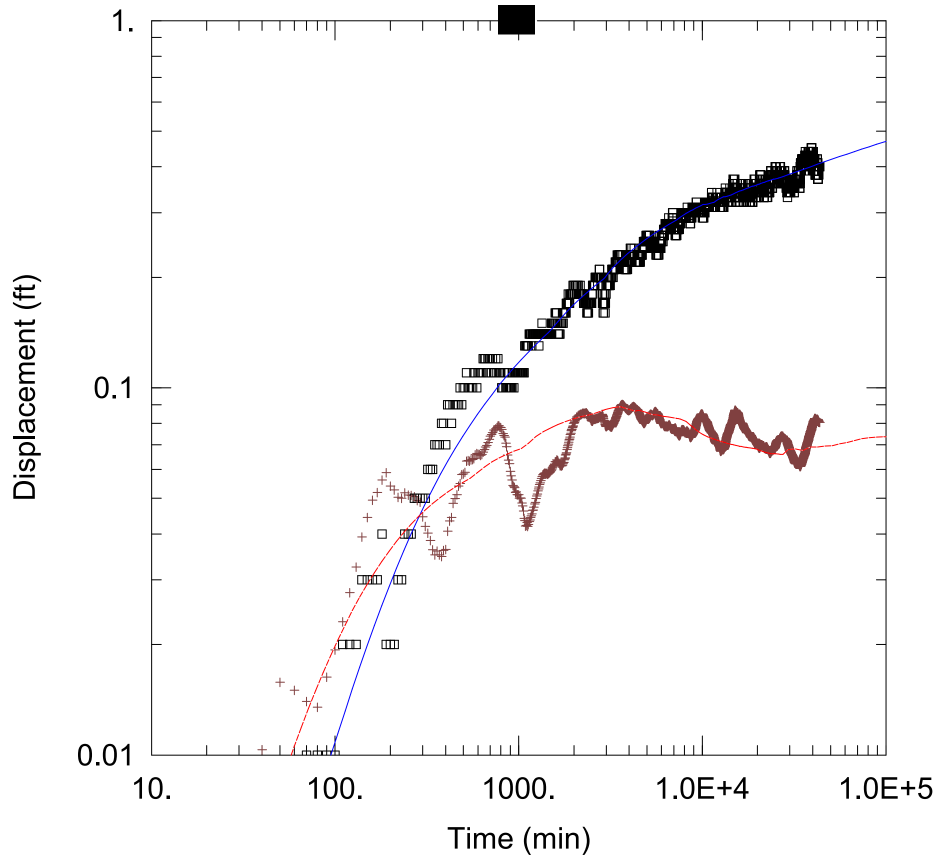
Solution Method: Neuman

T = 7.091E+5 ft^2/day

S = 0.0001

Sy = 0.0154

ß = 3.202



RED HILL SHAFT - 4.2 MGD

Data Set: [redacted]
Date: 08/24/22 Time: 08:54:18

PROJECT INFORMATION

Company: AECOM
Client: DON
Project: 60679921
Location: Honolulu, HI
Test Well: Red Hill Shaft
Test Date: 1/29/22

AQUIFER DATA

Saturated Thickness: 100. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RHS_0	[redacted]	[redacted]
RHS_1	[redacted]	[redacted]
RHS_2	[redacted]	[redacted]
RHS_3	[redacted]	[redacted]
RHS_4	[redacted]	[redacted]
RHS_5	[redacted]	[redacted]
RHS_6	[redacted]	[redacted]
RHS_7	[redacted]	[redacted]
RHS_8	[redacted]	[redacted]
RHS_9	[redacted]	[redacted]

Observation Wells

Well Name	X (ft)	Y (ft)
□ RHMW03	[redacted]	[redacted]

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 6.168E+5 ft^2/day
S = 0.0001
Sy = 0.017
ß = 3.202