

Subgroup Combined Report

REPORT TO THE TWENTY-EIGHTH LEGISLATURE STATE OF HAWAII 2015

PURSUANT TO SENATE CONCURRENT RESOLUTION 73 REQUESTING THE DEPARTMENT OF HEALTH TO CONVENE A TASK FORCE TO STUDY THE EFFECTS OF THE JANUARY 2014 FUEL TANK LEAK AT THE RED HILL FUEL STORAGE FACILITY

**PREPARED BY:
STATE OF HAWAII
RED HILL FUEL STORAGE FACILITY TASK FORCE
DECEMBER 2014**

Introduction

The Red Hill Fuel Storage Facility (Facility) is the state's largest field constructed underground storage tank (UST) complex, located in the south-central portion of the Island of Oahu, Hawaii. It is owned and operated by the United States Navy and was built between 1940 and 1943.

The facility contains twenty (20) cylindrical tanks, each able to store up to 12.5 million gallons of fuel, and it sits 100 feet above a major groundwater aquifer that is used as a source of drinking water. The tanks have a history of fuel releases dating back to 1947 and Navy test reports document the presence of fuel contaminants in the groundwater and fractured rock beneath the facility

As a field constructed UST, the Red Hill Facility is currently exempt from certain existing state and federal UST regulations under Hawaii Administrative Rules (HAR) Chapter 281 and Title 40 Code of Federal Regulations (CFR) Parts 280. Field constructed tanks (FCTs) *are* subject to notification of confirmed releases. Between 1998 and 2002, the Navy conducted investigations at the Facility and determined that releases occurred from 19 of the 20 tanks. Beginning 2005 the Navy began construction of groundwater monitoring wells to determine impact, if any, to the groundwater. A total of seven (7) wells were installed and are sampled within the property confines of the Facility. The Navy has been submitting quarterly groundwater monitoring reports and monthly soil vapor reports to the Hawaii Department of Health (DOH). In one monitoring well located in the in the tunnel of the facility, MW 2, groundwater sampling results are consistently above DOH Environmental Action Levels (EALs) in every sample taken since sampling commenced in 2005.

In 2008, the Navy developed and implemented a Groundwater Protection Plan, which the DOH approved. The plan was updated in 2009 and 2014. The existing Groundwater Flow Model and

Contaminant Transport Analysis will also be updated and incorporated into the Groundwater Protection Plan.

January 13, 2014 release from Tank No. 5

A suspected fuel release was discovered and verbally reported to DOH on January 13, 2014. A release of Jet Propellant 8, also known as Jet Propulsion fuel, type 8 (JP-8) from Tank 5 was confirmed and reported to the DOH on January 23, 2014. The estimated fuel loss was up to 27,000 gallons. Immediately after the release was detected, the Navy began draining the contents of Tank 5 and collected soil vapor samples from existing vapor monitoring points from under each tank and groundwater samples from the 7 monitoring wells. Results indicated the presence of elevated levels of hydrocarbons in soil vapor and groundwater near Tank 5. However, no free product was detected in the groundwater samples.

During this time, drinking water samples were also collected at an increased frequency from the Navy's Red Hill drinking water well (2254-01) and the Honolulu Board of Water Supply (BWS) Halawa and Moanalua wells. BWS wells were non-detect for petroleum constituents, while the Navy wells showed detections but all under DOH EALs Laboratory analytical results showed that the water was within applicable safe drinking water standards.

In consultation with the United States Environmental Protection Agency (EPA) and DOH, the Navy continues to investigate the cause of the reported release from Tank 5 and whether any free product is present outside the tank liner, the concrete surrounding the tank, or in the adjacent basalt rock. In the event that free product is detected, the Navy will remove it to the maximum extent practicable.

Separate from the Task Force activities, DOH, EPA and Navy continue to work together on a negotiated agreement to assess the reported release of petroleum and minimize the threat of future releases.

Senate Concurrent Resolution 73 & Red Hill Task Force

In response to the leak and concerns over the potential impact to Oahu's drinking water aquifer, the environment and its residents, the Hawaii State Legislature on April 24, 2014 adopted Senate Concurrent Resolution (SCR) 73 which requested the Director of Health to convene a Task Force to study the effects of the January 2014 fuel tank leak at the Red Hill Facility and submit a report of the Task Force's findings and recommendations, including any proposed legislation, to the Legislature no later than twenty (20) days prior to the convening of the Regular Session of 2015.

Under SCR 73, the Task Force is requested to examine:

1. Short-term and long-term effects of the leak at the Red Hill Underground Fuel Storage Facility, including effects relating to the health of residents, safe drinking water, and the environment,

2. Response strategies to mitigate the effects of future leaks at the Red Hill Underground Fuel Storage Facility,
3. Ways to improve communication between the United States Navy, the State, and the public in the event of future leaks at the Red Hill Underground Fuel Storage Facility; and
4. Implications of closing the Red Hill Underground Fuel Storage Facility.

Task Force members include the U.S. Navy, Hawaii Department of Health (DOH), United States Environmental Protection Agency (EPA), one member from the State House of Representatives, one member from the State Senate, Department of Land and Natural Resources, Honolulu Board of Water Supply (BWS) and two members from the community. **Appendix A** contains a list of all the Task Force participants and any alternates.

Meetings were held on September 3, October 7, November 6 and December 11, 2014 to discuss the effects of the January 2014 release, results of on-going Navy investigations on the tank leak, Navy response actions since the leak was discovered and recommendations for improving operations to ensure protection of Hawaii's drinking water. These included regulatory requirements, facility improvements and improved communication to the public. Materials from the three meetings including attendance lists, minutes and other supportive materials are posted online at: <http://health.hawaii.gov/shwb/underground-storage-tanks/>.

This report contains the Task Force's findings and recommendations for each of the review topics in accord with SCR 73. *(NOTE: Because the EPA and the Navy are federal agencies, they are unable to provide recommendations on matters that are state legislative actions. All recommendations are from DOH, BWS, the two members of the Legislature and the public.)*

Findings and Recommendations

1. **Short-Term and Long-Term Effects of the leak at the Red Hill Fuel Storage Facility including effects relating to the health of residents, safe drinking water, and the environment**

Finding of Facts

Short-term effects

After the January release, increased groundwater and soil vapor monitoring indicated contamination in the environment outside of Tank 5. Groundwater monitoring in MW 2, located near tank 5, showed an increase in total petroleum hydrocarbons diesel (TPH(d)) upwards of 50 times DOH EAL. During the same period, soil vapor results increased from 794 ppbv to 204,000 ppbv (parts per billion by volume). There are also increases in soil vapor in the tanks closest to Tank 5. Refer to **Appendix B** for detailed groundwater and soil vapor results. The Navy's sampling and analysis indicated that increases of soil vapor volatile organic compound (VOC) concentrations beneath Tank 5 and nearby tanks may be attributed to the release of JP-8 from Tank 5 in January 2014. However, results of

groundwater sampling and analysis indicate the release of JP-8 from Tank 5 had limited impact on the underlying groundwater and has not impacted any drinking water source.

Data from groundwater samples taken from Navy Drinking Water Well 2254-01 indicate that contaminant levels were present but were below DOH EALs. Drinking water samples are also collected from BWS drinking water sources and the regulatory drinking water distribution point for Navy Drinking Water Well 2254-01. Analytical results from the drinking water samples results were within applicable safe drinking water standards.

The Task Force finds that the BWS and the Navy have undertaken significant efforts to assess the effects of the reported fuel leak on the environment and to protect drinking water resources. The Task Force acknowledges that the BWS has accelerated sampling at nearby drinking water sources. In addition, the Navy has performed extensive sampling and analysis of the groundwater, drinking water, and soil vapor at or near the Red Hill Fuel Storage Facility. The BWS has reported that drinking water sources remain safe.

Long-term effects

According to the most recent groundwater monitoring results dated, July, 21, 2014, levels of TPH(d) still persist in the groundwater beneath Tank 5 above DOH EALs. The monthly soil vapor results also remain elevated in the range of 100,000 – 200,000 pbv in the latest report dated September 25, 2014. Refer to **Appendix B** for more details regarding sampling results. Additional cumulative groundwater sampling results are posted online at: <http://health.hawaii.gov/shwb/underground-storage-tanks/>.

The Task Force expects that the BWS will continue periodic monitoring of its drinking water sources. The Navy will also continue periodic monitoring of the groundwater, drinking water, and soil vapor at the Red Hill Fuel Storage Facility, in accordance with the Groundwater Protection Plan. The Task Force expects the BWS and the Navy to continue providing reports on those efforts to the DOH and the EPA. The reports are available to the public from the DOH.

DOH and BWS Recommendations

- Navy must comply with state requirements for investigation of release points within Tank 5 and characterization and delineation of contamination released, including free product removal to “the maximum extent practicable”. The Navy has not completed these tasks as of October 31, 2014.
- Request Navy to graphically present all water quality data collected at the Facility by monitoring well location and contaminants detected.
- Continue groundwater modeling studies by the Navy and the BWS. The studies are critical to understanding the rate and direction of groundwater movement in the area to assess potential impacts to neighboring potable water wells. The studies will also complement groundwater monitoring well contaminant data collection to assess the overall condition of the aquifer.

- Navy to drill and install additional groundwater monitoring wells north and south of the facility to enable the collection of groundwater data and provide information for the updated area-wide groundwater modeling. This will increase and improve the scientific understanding of the present and long-term quality and condition of the aquifer beneath the Red Hill tanks and beyond its boundaries. Select sites for additional monitoring wells after sampling results are obtained from the two monitoring wells installed in September and October 2014. Obtain relative groundwater elevation data in the Halawa/Red Hill/Moanalua area for proper characterization.
- Devise a financial mechanism in which the Department of Health, the Honolulu Board of Water Supply, and the U.S. EPA may be reimbursed for site investigation activities needed to initiate (e.g. installation of additional monitoring wells, any increased groundwater and drinking water sampling, and any water treatment to remove contamination) within the area, to ensure that contamination is not migrating from the Red Hill facility into neighboring drinking water pump stations.
- Strengthen Hawaii’s groundwater protection program by increasing surveillance and identification of potentially contaminating activities from other field constructed tanks to protect and mitigate impacts to groundwater aquifers.
- Navy and Department of Health, Safe Drinking Water Branch should monitor the drinking water by collecting and testing duplicate samples for the parameters identified in the existing groundwater and drinking water sampling schedules and others identified by the Honolulu Board of Water Supply. The results should be shared with all interested parties to assure that all Quality Assurance/Quality Control procedures were followed.
- Navy should mitigate existing contamination beneath the tanks starting with the area adjacent to Red Hill groundwater monitoring well 2 to contain and prevent contamination from extending beyond the current location (e.g. active remedial activities like pump and treat).
- Navy should develop a system to continuously monitor the soil vapor probes as a form of leak detection, with alarm set points to alert operator(s) of organic vapors rising above pre-determined concentrations.

Further recommendations by BWS

1. Graph the Navy monitor well data and analyze for water quality data trends, correlation with past fuel releases, interrelationships between wells and groundwater flow.

Reason:

Graphing data provides a pictorial view of trends over time. Comparing the data with other information is standard scientific practice in conducting a thorough analysis of the information collected. The comparisons can show any correlations between data points when compared with past fuel releases and contaminant presence at other monitor wells. All of this data analysis enables a better understanding of the **“short and long term effects of the leak”**.

2. Fund and conduct a health effects study to assess the health significance of low level concentrations of petroleum chemicals in ground water and sources of drinking water.

Reason:

A health effects study will provide scientific data to understand the **“effects relating to the health of residents, safe drinking water, and the environment”** and is responsive to the Task Force’s charge under SCR 73.

3. *Conduct a scientific peer review and evaluation of the sampling and test methods and detection limits used by the Navy to develop a uniform monitoring protocol.*

Reason:

Understanding the short and long term effects of Red Hill leaks needs reliable peer-reviewed and vetted scientific data in order to accurately understand the issues and make sound decisions on those issues. Professional scientific peer-review and auditing is standard practice in all good testing and research studies undertaken to insure data validity, quality and transparency.

2. Response strategies to mitigate the effects of future leaks at the Red Hill Underground Fuel Storage Facility

Finding of Facts

REGULAR MAINTENANCE

The Red Hill facility consists of field constructed USTs that are currently deferred from federal and state UST regulations that require other regulated non-field constructed USTs to have secondary containment for all new tanks and piping. It also requires corrosion protection and leak detection for all existing tanks and piping.

Even though not required by regulations, the Navy performs periodic inspection of all petroleum, oil, and lubricant tanks and pipelines to ensure that the Red Hill Bulk Fuel Storage Tank system is properly maintained. Other protective measures include a Mass Technology Measurement System used by the Navy to assess tank tightness for all active Red Hill tanks. The tank tightness testing is performed every two years. In addition, the Navy employs an Automated Fuel Handling System to detect unscheduled fuel movements which alerts the operators of any potential fuel loss. Inventory levels are also assessed on a regular basis for trends that might reveal any potential fuel losses. Soil vapor monitoring equipment is also installed at the Facility to monitor hydrocarbon levels in the subsurface.

Recent maintenance cycles performed on tanks within Red Hill utilize a modified American Petroleum Institute (API) 653 procedure for determining integrity of steel plates and welds. According to the Navy, the goal of tank maintenance is to have at least 0.1 inches of steel plate remaining at the end of a 20 year operational cycle. The Navy reported up to 600+ deficiencies, which were repaired with weld patches, within Tank 5 during its maintenance cycle that ended December 2013.

SECONDARY CONTAINMENT EVALUATION

All current methods of release detection that the Navy implements at the Facility are reactionary. There is no 'alarm' until contamination has entered the environment. Secondary containment would capture fuel released from the inner wall into an interstitial space and alert Navy operators of releases.

At the October 7, 2014 Task Force meeting, the Navy stated the importance of the Facility and its need to continually maintain the capacity at Red Hill (15 out of 20 tanks in operations) to support its fuel needs. The Navy also stated that secondary containment is "definitely in the future" of the Red Hill facility and estimated a 20 year time frame to conduct feasibility studies and complete installation of secondary containment. The Task Force also finds that the Navy plans to study secondary containment options and advanced leak detection technologies in collaboration with the DOH and EPA.

SITE ASSESSMENT & CONTINGENCY PLANS

In continuing efforts to monitor the groundwater for contamination and to better assess the fate-transport model, the Task Force further acknowledges that the drinking water from BWS and the Navy's drinking water wells are within applicable safe drinking water standards, and that several monitoring wells have been installed in and around the Facility. Subsequent to the January 2014 release, the Navy, in coordination with the DOH and EPA, installed two additional groundwater monitoring wells. Sampling results will be submitted to the BWS and to DOH, which in turn, will make the data available to the public.

The Task Force is in agreement that two additional wells is a start. But the installation of more wells may be warranted depending on the data that comes from these two additional wells. **Diagram 1** maps the location of the existing wells and the two new wells recently installed.

The Task Force recognizes that the Navy has developed contingency plans to address potential future release. These plans are detailed in the Navy's Integrated Contingency Plan and Red Hill Storage Facility Groundwater Protection Plan (2008). In coordination with DOH and EPA, the Navy will periodically review and update these plans and will take responsible actions consistent with the plans, if necessary.

DOH and BWS Recommendations

- Support proposed EPA regulatory changes to cancel the deferral of field constructed USTs from 40 CFR Parts 280 and 281.
- Issue resolution to encourage Navy to install double-walled secondary containment and real time leak detection at Red Hill.
- Amend the state UST regulations to require secondary containment and leak detection for field constructed USTs.

Further recommendations by BWS

1. Revise the DOH UST leak response requirements to specify the Resource Conservation and Recovery Act (RCRA) methodology for characterizing the nature and extent of contamination.

Reason:

The RCRA site characterization approach is a comprehensive data collection method for producing a clear understanding of the current contamination problem and its extent in the environment. From there targeted measures can be developed to mitigate the situation that can lead to developing strategies to mitigate the effects of future leaks at Red Hill.

The major elements of the RCRA methodology are:

- Identify and determine the velocity of contaminant movement in the groundwater (saturated zone), amounts present, factors influencing plume movement and extrapolation of future movement (modeling)
- Examine the contamination in vadose zone (unsaturated zone), amounts present, factors influencing plume movement and extrapolation of future movement (modeling)
- Employ contaminant characterization presentation tools to create three-dimensional data plots to show lateral and vertical extent of contaminant plumes
- Examine impacts to potential receptors such as potentially affected human populations, environmental systems, ecology, biota and endangered/threatened species.

2. Release and use EPA Drinking Water State Revolving Fund (DWSRF) set-aside grants to fund the drilling and installation of additional monitor wells in the Red Hill area.

Reason:

The use of DWSRF set asides describes a specific funding source and strategy to mitigate the effects of future leaks at Red Hill. The installation of additional sentinel wells provides long

range surveillance and advance planning information to mitigate the effects of past and future leaks. The number of additional monitor wells to drill should be based on sound science data generated through the RCRA site characterization process.

The Board of Water Supply believe the Hawaii State Legislature will expect the Taskforce's report to contain specific targeted action steps, strategies and recommendations that are based on sound science and the most state-of-the-art technical approaches for characterizing and mitigating the short and long term effects of leaking Red Hill underground fuel tanks.

3. Improve communications between the United States Navy, the State, and the public in the event of future leaks at the Red Hill Underground Fuel Storage Facility

Finding of Facts

The technical information on Red Hill is primarily communicated between the Navy and the DOH and EPA. Copies are not readily available at a central data location nor easily obtained through written requests. The Task Force finds that access to this information is essential to its understanding and completing the tasks set before it as described in SCR 73, as well as aiding the public's understanding of the situation at Red Hill and how it may affect them.

The Task Force finds that all Red Hill tank reports and other information cannot and should not be limited to a few agencies on a facility that has been declassified since 1995. While the Task Force recognizes the need for confidentiality and agency security policies, these areas should not supersede the need to protect the ground water aquifer, the environment and the welfare of our citizens including their right-to-know.

The Task Force finds that all parties have demonstrated and continue to be fully committed to communicating with the public for any matters of public interest regarding the Red Hill Fuel Storage Facility. The Task Force acknowledges that the DOH, EPA, BWS and the Navy have made significant efforts to keep the public informed on the reported fuel leak. This began with a joint press conference by the DOH, BWS and Navy immediately following the January 2014 release, and continued with participation in community outreach events, publication of numerous media releases, and active coordination between and among appropriate State and Federal agencies to remediate any potential contamination and prevent future leaks at the Facility. The Task Force expects that all parties will continue to keep the public informed of any events at the Red Hill Storage Facility that would impact the public or the environment.

DOH and BWS Recommendations

- Create and maintain a public website containing all information from the Task Force, Navy, DOH, BWS, and other agencies (e.g., meeting notices, notes of meetings, reports, data, trend graphs, laboratory analysis, etc.) to provide easier access to information and improve transparency.

- Continue the work of the Red Hill Task Force to ensure the long-term management, information access and decision making on issues related to leaks at Red Hill and the protection of Oahu’s ground water aquifer, environment and public health.
- Utilize notification systems to communicate future leaks and incidences at Red Hill or other underground storage tanks located above or in the vicinity of drinking water aquifers. The alert system should be targeted to specific persons for first response action.

4. Implications of Closing the Red Hill Underground Fuel Storage Facility

Finding of Facts

The Task Force finds that the Navy operates and maintains the Red Hill Fuel Storage Facility as a strategic petroleum facility that provides critical fuel to operating forces in the Pacific region. The Task Force acknowledges that the Navy has no plans to close the Facility. The Task Force expects that the Navy will inform the public should those plans change.

The Navy indicated at the October 7, 2014 meeting that assessments are underway to explore alternative fuel storage solutions in lieu of either continued full or partial use of the Red Hill Facility.

The Department of Health does not have information regarding implications of shutting down this facility. DOH’s priority is the protection of the environment and it views the storage of up to 187 million gallons of fuel, 100 feet above a drinking water resource, inherently dangerous.

DOH and BWS Recommendations

- The operation of this facility should only exist on the condition that the aging facility be upgraded with secondary containment and state-of-the-art leak detection to ensure safe operations and adverse impact to the environment.
- The Navy should have facility-wide implementation of secondary containment by December 31, 2024.
- In the interim, while the Navy studies available technologies, increased protection and monitoring must be applied until secondary containment can be implemented.

Legislative Recommendations from the Task Force

- Passage of a resolution that would request owners and operators of the 46 FCTs in Hawaii to update the Legislature and the Department of Health on the status and condition of each of their 70+ year old tanks (e.g. leak detection and liner upgrades, visual inspections, maintenance procedures, etc... This is currently not required of FCTs in the current UST rules.
- Pass an increase in the Environmental Response Revolving Fund (ERRF), that receives funding primarily from a tax of 5 cents, on every barrel of oil imported into the State under the Environmental Response, Energy, and Food Security Tax (“Barrel Tax”), to 15 cents. This will provide the Solid & Hazardous Waste Branch and the Safe Drinking Water Branch additional personnel and resources to support oversight to the Red Hill case over the next ten years.
- Support adoption of revisions to existing DOH UST rules requiring increased protection from Hawaii’s 46 field constructed tanks, of which Red Hill tanks make up 20. All of these tanks are 70 years or older.

Navy Comments

- The Task Force recommends that the Legislature encourage the DOH, EPA, BWS, and Navy to continue efforts to protect Hawaii’s groundwater and drinking water sources.
- The Task Force recommends that the Legislature encourage the DOH, EPA, BWS, and Navy keep the public informed on matters of public interest regarding the Red Hill Fuel Storage Facility.
- The Task Force further recommends that the Legislature encourage the DOH, EPA, and Navy to finalize a negotiated agreement for the Red Hill Fuel Storage Facility that protects drinking water resources, appropriately responds to the reported release of petroleum, and minimizes the threat of potential future releases.

EPA Comments

APPENDIX A

Red Hill Task Force Members

1. Gary Gill, Deputy Director, Department of Health
2. Aaron Poentis, NAVFAC Hawaii
 - a. Capt. Mike Williamson
3. Senator Mike Gabbard, Chair, Energy/Environment Committee
4. Representative Chris Lee, Energy/Environmental Committee
5. Steven Linder, EPA Region IX
 - a. Dean Higuchi, Hawaii EPA representative
6. Ernest Y.W. Lau, P.E., Honolulu Board of Water Supply
 - a. Erwin Kawata, HWBS
7. Patrick N. Casey, P.G., CHG, Geologist, Commission on Water Resource Management
 - a. Robert Chenet, alternate
8. Steven Y. Onoue, President, Moanalua Valley Community Association
9. David Yomes, Chair Aliamanu/Salt Lake Neighborhood Board

DOH revised draft 10/31/14

APPENDIX B

Navy studies and test reports show the Red Hill tanks have a history of fuel releases dating back to 1949 and the presence of fuel contaminants in groundwater and fractured rock beneath the tanks. Soil vapor and groundwater monitoring well data consistently show petroleum detections from 2005 to the present.

Samples from Red Hill groundwater monitoring well #2 (RHMW02), located in the tunnel near Tank 5 and Tank 6, contain the highest levels of total petroleum hydrocarbons as diesel (TPH-d) at 12 to 50 times above the DOH environmental action levels (EALs) of 100 µg/L (parts per billion) from 2005 to the present. The latest groundwater sampling event occurred on July 21, 2014 with 1,300 ppb of TPH-d (1.3 ppm). Based on Navy monitoring well test results submitted to DOH, the range of petroleum chemical contaminants detected and EPA health advisories, DOH Hazard Evaluation & Emergency Response Office Environmental Action Levels (DOH HEER EALs) and EPA safe drinking water Maximum Contaminant Levels (MCLs) are summarized in **Table 1**.

Soil Vapor sampling points were installed by the Navy beneath each of the 18 operational tanks at Red Hill. Tank 1 & Tank 19 were removed from service in the 1980s and lack soil vapor sampling points. The Navy has collected and reported monthly soil vapor for volatile organic compounds (VOCs) by photo ionization detector (PID) beneath each tank from 2008 to present.

Soil vapor VOCs spiked to 225,000 ppbv (parts per billion by volume) beneath Tank 5 in the sampling event of January 15, 2014. The prior event on December 23, 2013 showed 794 ppbv. The Navy increased SV monitoring to a weekly basis from Feb 2014 to July 2014. Maximum SV VOCs beneath Tank 5 increased to 450,000 ppbv on May 1, 2014 and have since declined to 208,000 ppbv on September 25, 2014.

Soil vapor sampling beneath the adjacent Tank 6 showed maximum VOCs of 43,600 ppbv on May 21, 2014 and 18,700 ppbv on September 25, 2014. Similar results were seen in the direction of Tanks 6-10 and sporadic high readings beneath Tanks 2, 3, 4 indicating air pathways thru the fractured basalt surrounding the tanks within the complex.

Monthly data from the Navy's soil vapor sampling report for Tank 5 is shown in **Table 2**. **Figure 1** illustrates this information in graphical form (Navy report, Oct 2014).

Table 1
Petroleum Contaminants Detected
Navy Red Hill Groundwater Monitoring Wells 2005 to 2014
(values that exceed DOH/EPA levels in Bold)

#	Contaminant	DOH EAL drinking water (ppb)	EPA drinking water MCL** (ppb)	EPA health advisory (ppb)	Minimum value reported (ppb)	Maximum value reported (ppb)
1	TPH-d (diesel)	100	None	None	<20	5,000
2	TPH-g (gasoline)	100	None	None	13.2	650
3	Xylene	20	10,000	None	0.37	1.1
4	Benzene	5	5	None	0.14	0.92
5	Toluene	40	1,000	None	0.5	2.5
6	Acenaphthene	20	None	None	0.02	0.86
7	Fluorene	240	None	None	0.03	0.3
8	1-methylnaphthalene	4.7	None	None	0.02	109
9	2-methylnaphthalene	10	None	None	0.007	88.5
10	Naphthalene	17	None	100	0.03	180
11	Ethyl benzene	300	700	None	0.15	0.58
12	Lead	15	15	None	0.14	11.9
13	Pyrene	68	None	None	0.03	0.11
14	Chrysene	1	None	None	0.0159	0.062
15	Phenanthrene	240	None	None	0.02	0.14
16	Fluoranthene	130	None	None	0.026	0.24
17	Benzo[k]fluroanthene	0.4	None	None	0.0068	0.017
18	Benzo[a] anthracene	0.092	None	None	0.077	0.047
19	Indeno[1,2,3-c,d]pyrene	0.092	None	None	0.0075	0.037
20	Benzo[a]pyrene	0.2	0.2	None	0.0086	0.045
21	Benzo[g,h,i]perylene	0.13	None	None	0.0057	0.034
22	1,2-dibromoethane (EDB)	0.04	None	0.05	ND***	ND***
23	1,2-dichloroethane (1,2 DCA)	0.15	None	5	ND***	ND***

*ppb = parts per billion same as micrograms per liter

** MCL = maximum contaminant level (EPA safe drinking water standard)

***Non-Detectable however, minimum detection limits were higher than DOH HEER EALs

NOTE: Additional constituents have been analyzed but have not shown significant detections

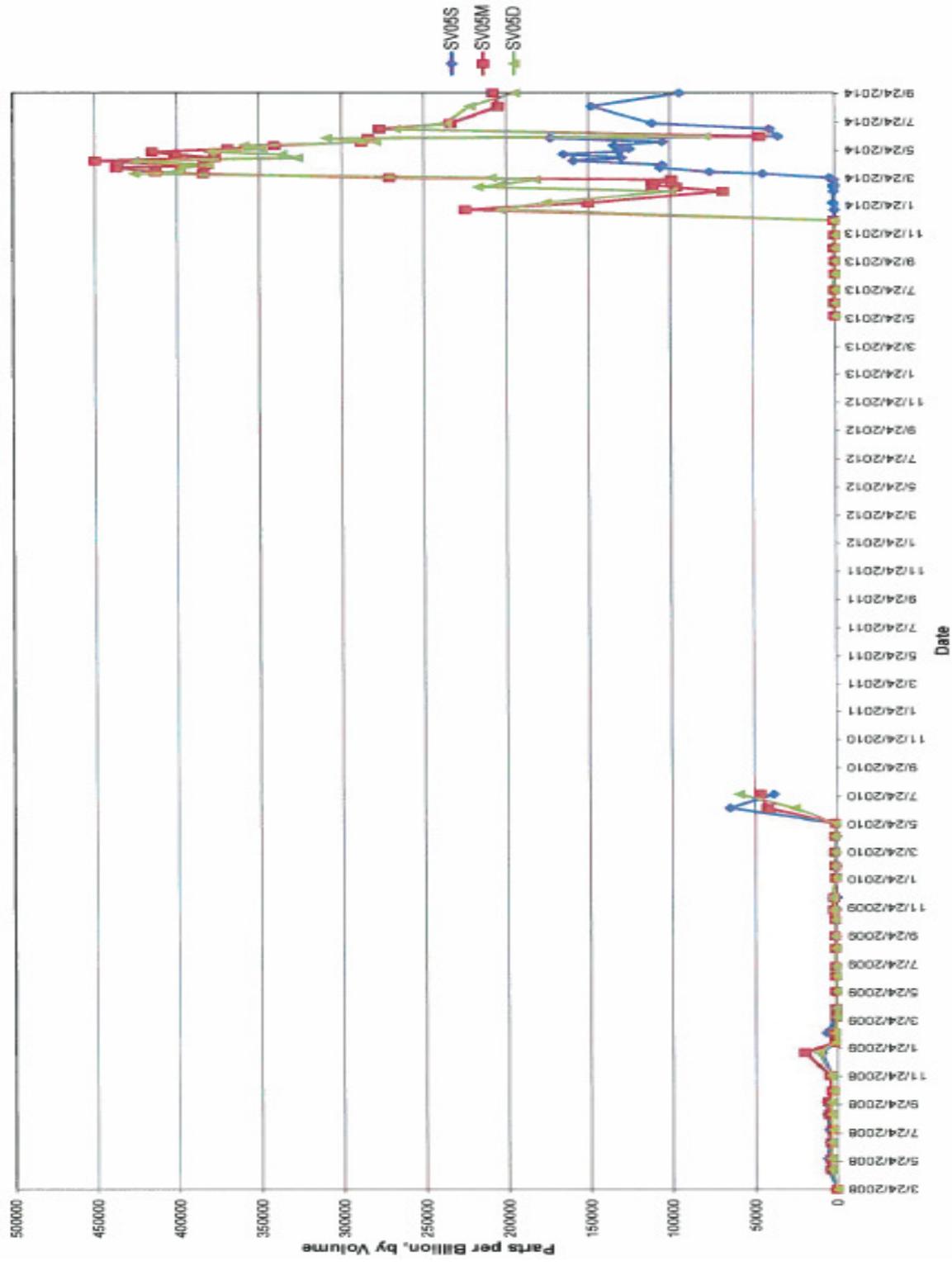
Table 2
Soil Vapor Results from SV05
Soil Vapor Monitoring Letter Report
Red Hill Bulk Fuel Storage Facility

Date	SV05S	SV05M	SV05D
3/24/2008	1295	716	697
5/6/2008	5441	4214	4012
5/29/2008	6523	4636	3984
7/3/2008	5195	4218	3957
7/31/2008	5190	3785	2894
9/2/2008	6905	5581	3681
9/29/2008	7149	6405	3960
10/23/2008	3497	3690	2518
11/25/2008	3750	5221	3741
1/14/2009	9519	20567	12473
2/5/2009	1744	1824	1638
2/26/2009	7015	2820	1616
4/1/2009	1178	996	1179
4/20/2009	1209	1146	1326
5/27/2009	1120	1054	1123
6/29/2009	1055	1061	1131
7/20/2009	1237	1296	1582
8/28/2009	1776	1314	1457
9/24/2009	1901	1722	1906
10/29/2009	1430	1507	1724
11/19/2009	780	2100	2715
12/16/2009	210	2068	3418
1/28/2010	818	976	1227
2/22/2010	487	1453	2234
3/25/2010	1028	1473	1484
4/28/2010	398	1417	1532
5/26/2010	1002	980	1147
6/28/2010	64900	42100	25600
7/28/2010	38167	46633	59433
9/29/2010	NC ₁	NC ₁	NC ₁
10/18/2010	NC ₁	NC ₁	NC ₁
11/16/2010	NC ₁	NC ₁	NC ₁
12/14/2010	NC ₁	NC ₁	NC ₁
1/13/2011	NC ₁	NC ₁	NC ₁
2/15/2011	NC ₁	NC ₁	NC ₁
3/15/2011	NC ₁	NC ₁	NC ₁
4/18/2011	NC ₁	NC ₁	NC ₁
5/18/2011	NC ₁	NC ₁	NC ₁
6/22/2011	NC ₁	NC ₁	NC ₁
7/27/2011	NC ₁	NC ₁	NC ₁
8/26/2011	NC ₁	NC ₁	NC ₁
9/22/2011	NC ₁	NC ₁	NC ₁
10/27/2011	NC ₁	NC ₁	NC ₁
11/22/2011	NC ₁	NC ₁	NC ₁
12/16/2011	NC ₁	NC ₁	NC ₁
1/20/2012	NC ₁	NC ₁	NC ₁

Date	SV05S	SV05M	SV05D
2/23/2012	NC ₁	NC ₁	NC ₁
3/13/2012	NC ₁	NC ₁	NC ₁
4/16/2012	NC ₁	NC ₁	NC ₁
5/15/2012	NC ₁	NC ₁	NC ₁
6/19/2012	NC ₁	NC ₁	NC ₁
7/10/2012	NC ₁	NC ₁	NC ₁
8/14/2012	NC ₁	NC ₁	NC ₁
10/24/2012	NC ₁	NC ₁	NC ₁
11/26/2012	NC ₁	NC ₁	NC ₁
12/18/2012	NC ₁	NC ₁	NC ₁
1/31/2013	NC ₁	NC ₁	NC ₁
2/28/2013	NC ₁	NC ₁	NC ₁
3/28/2013	NC ₁	NC ₁	NC ₁
4/25/2013	NC ₁	NC ₁	NC ₁
5/30/2013	215	221	184
6/27/2013	115	233	232
7/25/2013	208	218	322
8/29/2013	63	68	161
9/26/2013	14	29	114
10/24/2013	229	250	201
11/21/2013	94	120	109
12/23/2013	50	622	794
1/15/2014	96	225000	204000
1/30/2014	818	150000	176000
2/24/2014	597	68200	100000
3/5/2014	492	96600	217000
3/10/2014	308	111000	204000
3/21/2014	593	99600	182000
3/25/2014	3144	271000	209000
4/3/2014	43700	384000	426000
4/7/2014	76100	413000	401000
4/16/2014	106000	437000	398000
4/22/2014	105000	383000	381000
5/1/2014	159000	450000	426000
5/8/2014	130000	377000	327000
5/15/2014	165000	401000	337000
5/21/2014	131000	415000	380000
5/27/2014	125000	369000	349000
6/3/2014	134000	341000	359000
6/11/2014	105000	288000	279000
6/19/2014	173000	284000	309000
6/23/2014	34500	45600	78700
7/9/2014	39700	277000	267000
7/21/2014	111000	234000	237000
8/27/2014	148000	205000	222000
9/25/2014	94500	208000	195000

ppbv: parts per billion by volume
 NC₁: Not collected due to maintenance work

Figure 1
Soil Vapor Measurements
SV05



DC

4

Diagram 1 - Locations of the seven monitoring wells routinely tested by the Navy in green, and the two new sentinel wells north installed in Sep/Oct 2014 in blue.

