BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com

October 2, 2018

Mr. Omer Shalev
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California 94105

And

Ms. Roxanne Kwan
State of Hawaii
Department of Health
Solid and Hazardous Waste Branch
2827 Waimano Home Road
Pearl City, Hawaii 96782

Dear Mr. Shalev and Ms. Kwan:

Subject: Board of Water Supply (BWS) Comments on the Groundwater Protection and Evaluation Considerations for the Red Hill Bulk Fuel Storage Facility (RHBFSF) Report, dated July 27, 2018

The BWS reviewed the above reference report and offers the following comments. The report is available on the United States Environmental Protection Agency's (EPA) website and is titled "interim groundwater flow model". It also has been referred by the Navy as the "tank upgrade alternative (TUA) technical memo".

This report presents, among others, the following conclusions:

1. An undetected chronic release of 2,300 gallons of light non-aqueous phase liquid (LNAPL) per year per tank would be biodegraded in the vadose zone, prior to reaching groundwater.

2. A sudden release of approximately 120,000 gallons of LNAPL would likely be retained in the vadose zone and/or at the water table without causing an exceedance of risk-based decision criteria (RBDC) at Red Hill Shaft. According to the report, the RBDC is the conservative, initial screening criteria

that is protective of drinking and domestic water use. For total petroleum hydrocarbons – diesel (TPH-d), the RBDC is 400 parts per billion (ppb).

3. It is possible that a fuel release as large as 700,000 gallons would not cause an exceedance of the RBDC at Red Hill Shaft.

The BWS strongly opposes these conclusions. The report is granting acceptance to allowing fuel releases into our island's sole source drinking water aquifer. This is absurd and unacceptable. Regulatory agencies charged with protecting our environment and drinking water resources should not approve this report. The Red Hill fuel tanks should have secondary containment or be relocated away from the aquifer to ensure there are no more leaks into our environment and drinking water sources rather than continue "sustainment / maintenance of the existing tanks in accordance with current procedures." Oahu's sole source aquifer is the only one of its kind and cannot be replaced. Any cost to preserve, protect and prevent it from being contaminated is worth the investment. Allowing any amount of fuel leaks into this resource is passing along a problem to future generations.

The report also presents conclusions about the distribution of Navy fuel as LNAPL in the subsurface, dissolved groundwater contaminants, groundwater flow directions and groundwater capture by Red Hill Shaft pumping, degradation of fuel contaminants, and the migration extent of future fuel releases from the RHBFSF.

The BWS finds nearly all the conclusions presented are either unsupported or contradicted by available evidence, and that the report underestimates the risk to Oahu's drinking water supply from RHBFSF fuel releases. The report provides a non-conservative assessment of the risks from RHBFSF contamination to our sole source groundwater aquifer and our drinking water supply. The report concludes that with Red Hill Shaft pumping, groundwater from beneath the RHBFSF tanks is "entirely captured" even though the results of the interim groundwater flow models deviate considerably from observed groundwater levels and even though examination of groundwater head data indicates pumping at Red Hill Shaft induces a very small head change at the monitoring wells beneath the RHBFSF fuel tanks. The report concludes that fuel will likely be sequestered in the vadose zone for releases much larger than the January 2014 Tank 5 release even though there is credible evidence that LNAPL from the release reached the water table near monitoring well RHMW02. The report also concludes that biodegradation of fuel contaminants can effectively remove contaminants before groundwater migrates offsite of the RHBFSF even though it assumes a flow direction that does not match observed heads.

Given the unfounded and/or non-conservative nature of many of these conclusions, the report should not be used as an input to the upcoming Navy's TUA selection process unless and until these flaws are corrected. Accordingly, we request that the EPA and Hawaii Department of Health (DOH) (collectively, "Regulatory Agencies") take all steps necessary to protect our drinking water by ensuring that the Navy select a TUA that is in balance with a conservative estimate of environmental risk from the RHBFSF fuel tanks.

The BWS offers comments to the following, non-exhaustive list of conclusions in Section 10 (titled Summary and Conclusions) of the report:

1. Navy report Section 10.1: Navy states that the fuel LNAPL is "located primarily within the upper one-third of the vadose zone between the lower access tunnel and the water table" according to thermal measurements in wells.

   BWS Comment: This conclusion is unfounded because thermal data provide little to no indication of LNAPL location in the subsurface. As the DOH's subject matter expert (SME) explained on August 16, 2018, LNAPL can be found much lower than the depth intervals with high temperatures. Moreover, the EPA SME stated on August 16, 2018 that the inferred temperature differences at monitoring well RHMW02 were dependent on the choice of background well. The Navy's conclusion is further contradicted by the available evidence that LNAPL migrated to the water table after the January 2014 Tank 5 release and in other instances since 2005. Thus, the conclusion places inappropriate weight on the small temperature differences calculated for monitoring well RHMW02 given that the slightly elevated temperatures calculated for this well are a function of the choice of background well. Even if slightly elevated temperatures exist in the vadose zone around monitoring well RHMW02, the fuel undergoing degradation may have come from the fuel leak of unknown volume from Tank 6 reported to the DOH in 2002 (see Attachment 1) or from other unreported fuel leaks from the RHBFSF. The only clear evidence of elevated temperatures in the subsurface is at RHMW03, which is relatively distant from Tank 5. Lastly, the rapid rise in volatile organic compound concentrations in soil vapor at the "deep" (distal) soil vapor monitoring point beneath Tank 5 following the 2014 release shows that LNAPL quickly migrated to at least 26 feet (ft) below the lower access tunnel and then an unknown distance further downward over time.

2. Navy report Section 10.1: Navy states that "No LNAPL has been measured on any of the Red Hill monitoring wells." and "Weathered LNAPL from a release prior to 2005 may be present in the immediate vicinity of RHMW02 or within the saturated zone upgradient from this well."

   BWS Comment: The first statement cannot be considered conclusive because it assumes that any released LNAPL would necessarily find its way to the sparse set of Red Hill monitoring wells; the rapid rise in soil vapor concentration at the deep (distal) Tank 5 soil vapor monitoring point following the 2014 release shows that LNAPL quickly migrated to and below this location, which is located more than 100 ft to the northwest of RHMW02 whereas the soil vapor detector nearest to the well showed a delayed change in concentrations. The second statement appears to be unsupported conjecture and is contradicted by the available data. The Navy has presented no evidence that the concentrations observed at RHMW02 are from releases prior to 2005. Furthermore, groundwater concentration data show that the effective solubility values for TPH-d were exceeded at monitoring well RHMW02 between 2005 and 2014 and since the start of 2014, indicating that LNAPL has appeared in or near the well several times since 2005. (Figure 1 shows the maximum TPH-d concentrations observed at this well since 2005.) Naphthalene concentrations in groundwater at RHMW02 were near or exceeded its effective solubility value for jet fuels several times during 2006 and 2008, indicating that LNAPL is in or near the well (Lau, 2016). The anoxic reducing groundwater conditions observed at RHMW02 also indicate that LNAPL is and has been present near the well.

3. Navy report Section 10.2: Navy states that "Available data suggest the presence of weathered LNAPL (i.e., pre-2005) in the immediate vicinity of RHMW02 or within the saturated zone upgradient from this well."

   BWS Comment: Again, this conclusion appears to be mere conjecture because the Navy has presented no evidence that the weathered LNAPL observed at this well was released prior to, during, or after 2005. The rapid rise in TPH-d concentration to exceed the effective solubility of jet fuel (ATSDR, 2016) at this well during January 2014 and the essentially simultaneous increases in soil vapor concentrations at the central and deep (distal) soil vapor monitoring points appear to demonstrate that LNAPL from the 2014 release migrated rapidly through the vadose zone and reached groundwater. It is possible that some weathering of the LNAPL released in 2014 occurred as the fuel migrated through the vadose zone to the aquifer. Apparently, the Navy concurs because in Section 10.4 it states, "Soil vapor monitoring and fingerprinting analysis show that rapid weathering of petroleum is occurring in the vadose zone."

4. Navy report Section 10.3: Navy states that the dozens of interim groundwater flow models show no flow from groundwater at the RHBFSF to Halawa Shaft (barring one model it disregards), that "When operating under normal pumping conditions (REDACTED mgd), Red Hill Shaft captures all groundwater flow from beneath the tanks underlying Red Hill", and that "groundwater flow from beneath the Facility is toward Red Hill Shaft even when Red Hill Shaft is not pumping."

   BWS Comment: These conclusions, even if consistent with the Navy's modeling efforts to date, should not be relied upon because the large data set collected during the 2017-2018 synoptic water level survey show very different groundwater levels and gradients than those predicted by the model. Examination of the synoptic water level data show that water levels at Red Hill Shaft often are higher than those at RHMW04 and OWDFMW01 when the shaft is not pumping, contradicting the modeling-based conclusion that "groundwater flow from beneath the Facility is toward Red Hill Shaft even when Red Hill Shaft is not pumping." Examination of the head changes at RHMW01, RHMW02, and RHMW03 (the monitoring wells nearest to the tanks) caused by the normal pumping schedule at Red Hill Shaft reveals that pumping causes maximum changes of roughly 0.1 ft. This raises serious questions as to whether Red Hill Shaft is in reality capturing any water from beneath the tanks because the models appear to predict far larger head changes than those observed. Our calculations of groundwater gradients using three monitoring wells and all available 2017-2018 synoptic water level data demonstrate that the groundwater gradient from Red Hill ridge is oriented toward Halawa Shaft whether Red Hill Shaft is pumping or not (please see Figure 2 of the report). This data-based analysis calls into question the model-based conclusion that groundwater from the RHBFSF will not migrate toward Halawa Shaft, particularly where, as here, the interim groundwater flow model predicts results that do reflect real world conditions. Moreover, it highlights the importance of conservatively interpreting the information available about the valley fill and saprolite in Halawa Valley. Unless and until these flaws are addressed, the Regulatory Agencies should not use the Navy interim models as an input to the TUA selection process. During the August 16, 2018 groundwater modeling working group meeting, EPA and DOH contractors stated that the interim model and its results are not "believable" because of the large mismatches between the measured and the simulated hydraulic gradients in the area of Red Hill Shaft. Their statements corroborate our statement that the BWS has no confidence in the current interim model (Lau, 2018a; 2018b; 2018c). When it comes to choosing between actual observations or several dozen poorly-calibrated models that do not match those observations, we recommend that the Regulatory Agencies and other decision makers put aside the models and focus on the actual data.

5. <u>Navy report Section 10.4:</u> Navy states that natural source zone depletion (NSZD) is active in the vadose zone near the RHBFSF fuel tanks based on measurements of carbon dioxide concentrations and temperature differences. Using the temperature data, the Navy estimates that between "between 2,600 and 17,300 gallons per year" are metabolized in the vadose zone within the RHBFSF tank footprint.

   <u>BWS Comment:</u> The BWS does not disagree that some degradation of past and ongoing fuel releases occurs in the vadose zone. However, the depletion rates may not be significant for either past, ongoing, or future releases. As we explained in comment 1 above, the purported temperature differences at RHMW02 and RHMW01 are very small and most likely the result of the choice of background well. The temperature differences may also be affected by conduction into the vadose zone of the heat brought into the access tunnels by ventilation, which may lead to overestimates of heat produced by NSZD. The maximum NSZD rate assumes that the LNAPL is distributed across the footprint,

which is not likely unless LNAPL migrates across the entire footprint surrounding the tanks. The minimum leak rate that can be detected using the present methods is about 0.5 gallon per hour per tank, which equates to about 4,400 gallons of fuel per year per tank. Thus, the range of NSZD rates can be exceeded when chronic leaks below the detection level occur at one to four fuel tanks.

6. Navy report Section 10.4: Navy states that "Based on available data, the plume attenuation half-lives for dissolved constituents are likely on the order of 10–100 days."

   BWS Comment: This conclusion is based on an assumption that groundwater flows from monitoring well RHMW02 to monitoring well RHMW01, a situation predicted by the interim groundwater flow model but not observed in the actual groundwater level data from the 2017-2018 synoptic water level survey. Examination of Figure 3 in the report, which depicts the mean water level for each monitoring well based on the thousands of observations collected over the survey period, shows no difference in mean water levels at the two monitoring wells (18.4 ft at both wells). It is not valid practice to derive degradation rates from the differences in concentrations between monitoring wells when the groundwater flow direction is unknown. As in the past, we recommend that the Navy install more groundwater and vadose zone monitoring wells to adequately define the distribution of fuel in the vadose zone and the direction of groundwater flow in the shallow aquifer.

7. Navy report Section 10.7: Navy states that 120,000 to 700,000 gallons could be released from a tank, depending on its location relative to Red Hill Shaft, and "not cause an exceedance of the RBDC at Red Hill Shaft." These release volumes were calculated assuming that the LNAPL remains entrapped in the 20 to 30 ft below the lower access tunnel.

   BWS Comment: As we explain in comment 1 above, this assumption is suspect as no defensible data has been provided demonstrating that LNAPL is retained solely in this part of the vadose zone. Also, Red Hill Shaft water quality is not the only important water quality to be considered. Furthermore, we remain concerned about continuous migration of fuel contaminants captured by infiltrated water that encounters LNAPL in the vadose zone. This recharge-driven mass flux of contaminants will increase as the vadose zone extent of the LNAPL increases.

8. Navy report Section 10.8: In this section on the path forward, Navy states that "Given the results of the interim environmental analysis of current data, conditions are reasonably bounded by the current monitoring well network."

BWS Comment: This conclusion is unfounded because the current monitoring well network is insufficient to determine the actual hydraulic gradients across Halawa Valley or even the gradients along Red Hill ridge. The dozens of interim models do not adequately match the groundwater levels observed in 2015 or 2017-2018. Evidence indicates that LNAPL has migrated through the vadose zone to the groundwater following the 2014 release and perhaps on several occasions since 2005.

Specific Technical Comments to the Sections Noted Below

1. Navy report Section 2.C: LNAPL Release and Source-Zone Model makes no mention of the evidence from concentrations exceeding effective solubility of TPH-d that LNAPL reached groundwater at in monitoring well RHMW02 on multiple occasions. See Figure 1 of the report. Average TPH-d concentrations at RHMW02 have exceeded 5,000 micrograms per liter (µg/L) five times since 2005: once in 2008 and four times since the January 2014 fuel spill at Tank 5 (Element Environmental, LLC, 2016). The most recent sample's value was slightly below the GWPP Site-Specific Risk-Based Screening Level (SSRBL) of 4,500 µg/L (Element Environmental, LLC, 2016). The water solubility for JP-5 and JP-8 is 5,000 µg/L (ATSDR, 2016), which is also the water solubility for the F-76 marine diesel fuel (CITGO, 2015) that was stored at the nearby Tank 6 (AMEC, 2002). TPH-d concentrations at RHMW02 have exceeded the ATSDR 5,000 µg/L fuel solubility value for JP-5, JP-8, and F-76 five times since 2005 and four times since the January 2014 fuel spill at Tank 5. Thus, the historical TPH-d concentrations indicate the presence of NAPL from one or more of the tanks near RHMW02. The rapid rise in groundwater TPH-d in RHMW02 immediately after the Tank 5 releases to above the effective solubility appears to indicate that the LNAPL from Tank 5 migrated to groundwater within days.

2. Section 2.D: Vadose Zone Model states that basalt vertical hydraulic conductivity is "often orders of magnitude lower" than horizontal hydraulic conductivity. This statement may be true, but, is potentially misleading and/or speculative because it does not explain what is known and what is estimated. Available estimates of horizontal to vertical anisotropy are inherently difficult to determine and, in this case, are solely based on flow models. According to Hunt, "Anisotropy has not been measured directly in Hawaiian lavas" (Hunt, 1996). Hunt listed anisotropy rates of 5:1 to 200:1 for models of regional flow on Maui and Oahu (Hunt, 1996). This sentence should be revised to explain that horizontal-vertical anisotropy has not been measured and estimates are highly uncertain because they are based on models only. Furthermore, anisotropy may be scale-dependent, and so for contaminant transport, it may depend on plume length.

3. Section 2.D: Vadose Zone Model states that "Horizontal permeability is significantly higher in the direction that the lava flowed." This appears to be mere conjecture because the Navy has neither cited nor presented any studies or other evidence that demonstrate whether there is horizontal anisotropy at any scale in the basalt aquifer.

4. Section 2.F: Fate and Transport of LNAPL and Dissolved COPCs in Groundwater states "Occurrence of LNAPL is primarily limited to a depth of 30 ft beneath wells RHMW02 and RHMW03." As explained by the DOH's SME on August 16, 2018, studies have shown that thermal data provide little to no indication of LNAPL location in the subsurface. Any temperature anomaly at monitoring well RHMW02 (if it exists), may be due to leaks from Tank 6, not Tank 5. AMEC reported forensic analysis of 2 core samples and 2 fluid samples revealed weathered fuels from beneath Tanks 6, 11, and 14 and unweathered fuel from beneath Tanks 6 and 14 (AMEC, 2002). The Navy's conclusion is directly contradicted by the available evidence that LNAPL migrated to the water table after the January 2014 release and at recent times since 2005. The conclusion places inappropriate weight on the small temperature differences calculated for monitoring well RHMW02 given that the slightly elevated temperatures calculated for this well are a function of the choice of background well. The only clear evidence of elevated temperatures in the subsurface is at monitoring well RHMW03, which is relatively distant from Tank 5. Lastly, the rapid rise in concentration at the "deep" (distal) soil vapor monitoring point beneath Tank 5 following the 2014 release shows that LNAPL quickly migrated to at least 26 ft below the lower access tunnel and then an unknown distance further downward over time.

5. Section 2.G: Exposure Model ends with the text below. BWS comments are found in italicized underlined parentheses following each sentence:

   "Even if some LNAPL had migrated to the saturated zone, the source would be very small, as evidenced by the depletion in naphthalene concentrations after the 2014 release. *(BWS Comment: Section 4.2 states "The concentrations of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene are equal to or greater than the expected concentration based on the effective solubility of these compounds in jet fuel" at monitoring well RHMW02. Continued anaerobic conditions and high TPH-d concentrations in 2014-2016 provide strong indications that LNAPL was present in or near RHMW02).* The thermal study conducted in October 2017 shows evidence that residual LNAPL is primarily limited to a depth of 30 ft beneath wells RHMW02 and RHMW03 and is being biodegraded. *(BWS Comment: According to the DOH's SME, studies have shown that temperature is a poor indicator of the location of LNAPL in the subsurface.)* COPC concentrations in groundwater suggest that there is not a significant source of LNAPL at the water table. *(BWS Comment: Continued* *anaerobic conditions and high TPH-d concentrations in 2014-2016 provide strong indications that LNAPL was present in or near RHMW02.)* General transport of COPCs in the dissolved plume is in the southwest direction toward Red Hill Shaft. *(BWS Comment: Synoptic water level data do not show such a migration direction – see report Figure 3).* Migration to the southeast and northwest is limited by the extent of lower-permeability materials (valley fill and saprolite) extending below the water table in the valleys bounding the Facility. *(BWS Comment: The Navy's interpretation of the core from RHMW11 is not the only possible interpretation and is not conservative. Our review of the core indicates saprolite does not extend as deep as the Navy has interpreted.)* Attenuation of COPCs in the dissolved plume in the saturated zone limit the extent of the existing dissolved plume before reaching Red Hill Shaft under present conditions and within the context of historical releases"

6. Section 3.2: Release History does not list all of the evidence for LNAPL beneath the RHBFSF tanks. According to AMEC (AMEC, 2002), multiple lines of evidence for LNAPL contamination were collected beneath Tanks 1, 2, 3, 4, 5, 6, 7, 11, 12, 13, 14, 16, 17, 18, 19, and 20:

    a. LNAPL or a mixture of fuel and water was detected in the borings beneath Tanks 1, 13, 14, 17, and 19;
    b. Core samples from Tanks 1, 2, 6, 14, 16, and 17 had concentrations of TPH-d, ethylbenzene, naphthalene, or methylene chloride that exceeded DOH Tier I Environmental Action Limits (EALs) with TPH-d values of 25,300 ppm (milligrams per kilogram of core – mg/kg) at Tank 1, 10,200 and 43,100 mg/kg at Tank 6, and 26,200 mg/kg at Tank 16; Additional constituents detected in core samples where a EAL has not been established by DOH include: 2-methylnaphthalene, 4-methyl-2-pentanone, bis(2-ethylhexyl)phthalate, chrysene, dibenzofuran, fluorene, methyl ethyl ketone (MEK), phenanthrene, pyrene, and total xylenes;
    c. Forensic analysis of 2 core samples (Tank 6 and Tank 14) and 2 fluid samples (Tank 6 and Tank 11 – samples collected during boring activities not from the vapor monitoring wells) revealed weathered fuels from beneath Tanks 6, 11, and 14 and unweathered fuel from beneath Tanks 6 and 14.

7. Section 3.6: Conclusions. BWS disagrees with all but one of the seven conclusions for the reasons already discussed above.

8. Section 5: Interim Groundwater Flow Model.

    a. During the August 16, 2018 meeting EPA and DOH's contractors identified significant concerns and short-comings about the Navy's interim groundwater flow model. EPA and DOH contractors stated that the interim model and its results are not "believable" because of the large mismatches between the measured and the simulated hydraulic gradients in the area of Red Hill Shaft. In addition to the concerns with the mismatches between the observed and simulated hydraulic gradients, EPA and DOH shared nine other concerns with the USGS, the Navy, and the BWS. The discussions of concerns by DOH's and EPA's consultants support the BWS position that the interim model and its results are not adequate for assessing the risk from the RHBFSF to our drinking water supply.

b. EPA and DOH SMEs analyzed the synoptic water level data from 2017-2018 to estimate the groundwater gradient between each pair of wells for every 10-minute period with measurements (DOH-EPA comment number 4). They also calculated the frequency of occurrence of those gradients for times when Red Hill Shaft was pumping and times when it was not. They then compared the observed water level gradients to those predicted by the interim model and identified very large differences between observed and modeled gradients. These findings corroborate our recently communicated concerns about the significant discrepancies between observed groundwater levels and those predicted by the interim model (Lau, 2018b; 2018c). Because the model-predicted groundwater levels are incorrect, the model-predicted capture zones for Red Hill Shaft are also incorrect, and the Navy's argument that Red Hill Shaft pumping will intercept all fuel contaminants that leak from the tanks is without merit. Consequently, the current interim model should not be used to inform the tank upgrade alternative (TUA) decision process.

c. Robert Whittier of the DOH pointed out early this year that the "calibrated" interim model predicted groundwater heads did a poor job of matching the observed heads and created a gradient along Red Hill ridge where none exists (Lau, 2018a). In our comment letter for the ninth groundwater modeling working group meeting (Lau, 2018a), the BWS showed how the interim groundwater flow model's predicted 2017 steady-state groundwater levels did not match any measured levels made during six different months in 2017 at the monitoring wells at the RHBFSF. Nor did the interim groundwater model's predictions match the Navy's 2017 steady-state observed levels for these same monitoring wells. Furthermore, average 2017 heads based on thousands of measurements made during the synoptic water level survey show no evidence of a gradient from northeast to southwest along Red Hill ridge (see report Figure 3). The heads and gradients predicted by the interim model for 2017 in and around Red Hill ridge do not match the observed heads and gradients (see Figures 2 and 3). This disparity is readily apparent in Table 5.8.2-1, which shows differences between predicted and observed 2017 heads as large as roughly 3 ft.

d. The synoptic water level data for a two-week period when Red Hill Shaft is not pumping reveal that water levels at Red Hill Shaft often are higher than those at RHMW04 and OWDFMW01. The head differences between the shaft and RHMW02, where the highest levels of contamination have been observed, are very small. Thus, the available data and observed real world conditions appear to be in direct conflict with the Navy's modeling-based conclusion that "groundwater flow from beneath the Facility is toward Red Hill Shaft even when Red Hill Shaft is not pumping".

e. Observed head changes at RHMW01, RHMW02, and RHMW03 (the monitoring wells nearest to the tanks) caused by the normal pumping schedule at Red Hill Shaft during the 2017-2018 synoptic water level survey show that pumping causes maximum changes of roughly 0.1 ft at each of these wells. This calls into question whether Red Hill Shaft is in reality capturing any water from beneath the RHBFSF fuel tanks with such small head changes attributable to Red Hill Shaft pumping. In contrast, the interim models appear to predict far larger head changes than those observed. We request that the Regulatory Agencies ensure that the Navy carry out the work necessary to demonstrate with a high degree of confidence that such small head changes do indeed guarantee capture of groundwater beneath the tanks by pumping at Red Hill Shaft. If capture is not occurring now, then it remains unclear what will happen to any contaminants released from the RHBFSF to the groundwater. The disparities between observed and modeled heads and gradients indicate that the several dozen interim models cannot provide answers with any confidence.

9. <u>Section 8.1:</u> Mass Flux and Trigger Levels. The approach described in this section is neither conservative nor defensible. It unjustifiably assumes that pumping at Red Hill Shaft will maintain a completely effective capture zone without fail into the future. The BWS questions the validity of estimating risk-based levels for contaminant levels at the sentinel wells without directly addressing important uncertainty about the subsurface environment and flow system in Halawa and Moanalua Valleys.

   a. This section states that the site-specific risk-based levels (SSRBLs) will be calculated as a function of pumping at the Red Hill Shaft but does not explain how such a calculation is applicable to receptors other than Red Hill Shaft. Where is the approach for calculating the SSRBLs for Halawa Shaft and Moanalua Wells? On what basis should the SSRBL for a sentinel well in Halawa Valley (or Moanalua Valley) be calculated as a function of Red Hill Shaft pumping?

   b. The equation for calculating SSRBL values for each sentinel well that is shown in lines 6 to 14 on page 52 contains conceptual and numerical errors. SSRBL concentration is defined as the ratio of some mass flux and pumping at Red Hill Shaft. If the pumping rate is kept very low, this equation could yield SSRBLs with dangerously high concentrations that will allow extensive contamination, instead of protecting our aquifer. This section should be revised because the conversion factor of "184 micrograms - gallon - day [µg-gal-day] / grams - liter - day [g-L-min]" is either numerically incorrect or the equation itself is in error assuming concentration is defined as parts per billion (µg/L).

10. Section 9.1: Hypothetical Large Release. This section assumes that LNAPL from the Tank 5 leak was retained within the upper one third of the vadose zone below the lower access tunnel. For the reasons we have explained above, this assumption is poorly supported or contradicted by the available data. Therefore, all of the calculations and results that rely upon this assumption are also flawed. In brief, the volume of fuel that hypothetically could be released without resulting in any exceedances of RBDC at Red Hill Shaft or other water supplies becomes much smaller if this assumption is not applicable. Based on our review of the available data, it is our understanding that LNAPL from the January 2014 release reached the water table. The Navy's statement that 120,000 to 700,000 gallons could be released from a tank, depending on its location relative to Red Hill Shaft, without affecting water quality at Red Hill Shaft depends on this assumption. Given the importance of understanding how LNAPL is distributed throughout the vadose zone, BWS requests that the AOC Parties collect data about LNAPL distribution in the subsurface from cores. We remain concerned that this analysis ignores the migration of fuel contaminants to the drinking water aquifer within infiltrating water (which will become groundwater recharge) that dissolves out contaminants from LNAPL present in the vadose zone.

Thank you for the opportunity to comment. If you have any questions, please feel free to call Erwin Kawata, Program Administrator of the Water Quality Division, at 808-748-5080.

Very truly yours,

ERNEST Y. W. LAU, P.E.
~~Manager and Chief Engineer~~

cc: Mr. Steve Linder, United States Environmental Protection Agency, Region IX
Mr. Mark Manfredi, NAVFAC Hawaii

Enclosure: Attachment 1 – Release Response Report, RHBFSF Tank 6, 2002

References

AMEC Earth & Environmental, Inc. (AMEC). 2002. Comprehensive Long-Term Environmental Action Navy (CLEAN) for Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i. Red Hill Bulk Fuel Storage Facility Investigation Report (Final) for Fleet Industrial Supply Center O'ahu, Hawai'i. August.

Agency for Toxic Substances and Disease Registry (ATSDR). 2016. Draft Toxicological Profile for JP-5, JP-8, and Jet A Fuels. Draft for public comment. TP-121. February 2016.

Element Environmental, LLC. 2016. Final Second Quarter 2016 – Quarterly Groundwater Monitoring Report Inside Tunnel Wells. Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam, Oahu, Hawaii. July 2016.

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Lau, E. 2016. Response to Cover Letter Enclosing Work Plan / Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, November 5, 2016, Revision 01 Under the Administrative Order on Consent (AOC) Statement of Work (SOW} Sections 6 and 7. November 21.

Lau, E. 2018a. Honolulu Board of Water Supply (BWS) Comments on the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 6 and 7 Groundwater Modeling Working Group Meeting No. 9 held March 16, 2018. April 24.

Lau, E. 2018b. Honolulu Board of Water Supply (BWS) Comments on the Red Hill Administrative Order on Consent (AOC) Statement of Work (SOW) Sections 6 and 7 Groundwater Modeling Working Group Meeting (GWMWG) No. 10 held April 13, 2018. April 30.

Lau, E. 2018c. Honolulu Board of Water Supply (BWS) Comments on the Groundwater Flow Model Progress Report 04, Red Hill Bulk Fuel Storage Facility (RHBFSF), dated April 5, 2018. May 24.

DEPARTMENT OF THE NAVY
COMMANDER
NAVY REGION HAWAII
517 RUSSELL AVENUE, SUITE 110
PEARL HARBOR, HAWAII 96860-4884

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17 JUL 2002

Hawaii State Department of Health
Environmental Management Division
Solid and Hazardous Waste Branch
Underground Storage Tank Section
919 Ala Moana Boulevard Suite 212
Honolulu HI 96814

QT

SUBJECT: CONFIRMED RELEASE NOTIFICATION FOR RELEASE AT RED HILL TANK COMPLEX, FLEET AND INDUSTRIAL SUPPLY CENTER (FISC) PEARL HARBOR

Gentlemen:

In accordance with Subchapter 7, Chapter 281, Title 11 of the Hawaii Administrative Rules, and as discussed during the meeting at the State of Hawaii DOH on July 2, 2002, enclosure (1) is submitted. The suspected releases were discovered during a preliminary site investigation of the Red Hill Tank Complex. The final report should be completed shortly, and will be forwarded to your office as soon as it is available. We are submitting a single Confirmed Release Notification form for the entire Red Hill Tank Complex, even though previous notifications were made for suspected releases at tanks 6 and 16. This is because any response or remedial actions from now on will likely be directed at the Complex as a whole instead of at individual tanks. We will notify your office of follow on actions at a later date.

If there are any questions regarding this matter, please contact Mr. John T. Muraoka at (808) 471-1171, extension 214.

Sincerely,

R. M. WAKUMOTO
Director (Acting)
Regional Environmental Department
By direction of
Commander, Navy Region Hawaii

Enclosure: 1. State of Hawaii Confirmed Release Notification Form for Red Hill Tank Complex, FISC Pearl Harbor

Copy to: Commanding Officer, Fleet Industrial Supply Center, Pearl Harbor (Code 700)

APPENDIX 5-B

CONFIRMED RELEASE NOTIFICATION FORM

STATE USE ONLY			
Facility ID:	Release ID:	Date Sent:	Date Received: JUL 23 2002

GENERAL INFORMATION AND INSTRUCTIONS

This form should be completed immediately and only after reporting a confirmed release by telephone within 24-hours to the Hawai'i DOH UST Section. Completion of this notice will serve to fulfill part of the notification requirements of HAR 11-64-71. **Please type or print in ink** all items except "Signature" in Section III. This form must be completed for each UST release occurrence. Completed form must be mailed to: Department of Health, Solid and Hazardous Branch. 919 Ala Moana Boulevard, Room 212, Honolulu, Hawaii 96814

I. REPORTING PARTY AND FACILITY INFORMATION

24-Hour Reporting Party Name, Title, & Affiliation:

John Santo Salvo, LCDR, USN, Director, FISC Fuel Department

Facility Name & Address:

Red Hill Tank Complex, FISC, Pearl Harbor

Facility Contact Person, Affiliation, & Address:

John Muraoka, Environmental Engineer, CNR-HI, Ph: 471-1171

Facility Information: (Check only one item)

___Gas Station	___Aircraft Owner	___State Government	___Commercial	___Utilities
___Petroleum Distributor	___Auto Dealership	___Federal Non-Military	___Industrial	___Other
___Airline	___County Government	XXFederal Military	___Truck/ Transportation	

II. RELEASE INFORMATION (Circle all that apply in Items A-H)

A. Source of the Release: Piping Tank(s) Spill Overfill

If "Tank(s)" list tank sizes: Red Hill Tank Complex (see atch)

B. Method of Discovery & Confirmation: Closure Monthly Release Detection Tightness Test Site Check

Other (Specify): site investigation

C. Estimated Quantity of Substance Released:6 Gallons XX Unknown

D. Type of Substance Released: Unleaded Gas Leaded Gas Diesel Used or Waste Oil Hazardous Substance

Other (Specify): unknown

E. Immediate Hazards: Explosion Fire Vapor Exposure Recoverable Free Product Drinking Water Threat

Other (Specify): none

F. Release Impact: Surface Water possible Ground Water XX Soil Air

G. Migration Pathways: None Utility Conduits Subsurface Drains Sewer Lines Unknown

Other (Specify): unknown

H. Actions Taken: Evacuated Nearby Area/Removed UST Contents/Recovered Free Product/Excavated Soils/Ground Water/Recovery

Other (Specify):

III. UST OWNER OR OPERATOR CERTIFICATION (Read and sign after completing all sections to the extent possible)

I certify under penalty of law that I have examined and am familiar with the information submitted in this notice, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true and accurate.

Name, Title, & Company:
John Santo Salvo, LCDR, USN, Director, FISC Fuel Department

Signature: [signature] LCDR SC USN | Date: 7/10/02 | DOH Form CRN (8/92)

ENCLOSURE(1)

Summary of Site Investigation of Red Hill Tank Complex

Tank No.	Date sampled	Items Detected: Core	Items Detected: liquid
1	7 Feb 01	**TPH,** lead	TPH, **lead**
2	5 Feb 01	TPH, **methylene chloride**	
3	31 Jan 01	TPH, lead, acetone	
4	29 Jan 01	TPH, lead, acetone	
5	25 Jan 01	TPH, lead, acetone, napthalene	
6	19 Jan 01	**TPH,** lead	**lead**
7	17 Jan 01	TPH, lead, acetone, napthalene, xylene, ethylbenzene	
8	15 Jan 01	TPH, lead	
9	26 Jan 01	unknown hydrocarbon	
10		**nothing detected**	
11	15 Dec 00	TPH, toluene, xylene, ethylbenzene lead, acetone	
12	12 Dec 00	TPH	
13	11 Dec 00	TPH, lead, acetone	TPH
14	6 Dec 00	**TPH**, toluene, xylene, **ethylbenzene**, napthalene	
15	4 Dec 00	TPH, acetone	
16	22 Oct 98	**unknown hydrocarbon, napthalene,** toluene, xylene, ethylbenzene	unknown hydrocarbob, xylene
17	1 Nov 00	TPH, **methylene chloride,** toluene, lead	**lead**
18	6 Nov 00	toluene, lead	
19	22 Nov 00	TPH, napthalene, ethylbenzene, xylene	**lead**
20	2 Mar 01	TPH, lead	
vertical well			TPH, **lead**

Note:
1. Under items detected, for both the core and liquid samples, the values in bold denote values exceeding tier I levels.
2. In some cases, a liquid was found in the boring. In these cases, the liquid was sampled and tested. The results are shown in the 'liquid' column.
3. Confirmed Release Notifications have already been submitted for tanks 6 and 16.

APPENDIX 5-B

CONFIRMED RELEASE NOTIFICATION FORM

STATE USE ONLY			
Facility ID:	Release ID: 020024	Date Sent:	Date Received:

GENERAL INFORMATION AND INSTRUCTIONS

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I. REPORTING PARTY AND FACILITY INFORMATION

24-Hour Reporting Party Name, Title, & Affiliation:

John Santo Salvo, LCDR, USN, Director, FISC Fuel Department

Facility Name & Address:

Red Hill Tank Complex, FISC Pearl Harbor

Facility Contact Person, Affiliation, & Address:

John T. Muraoka, Envir. Engnr., CNR-HI Ph: (808) 471-1171

Facility Information: (Check only one item)

__Gas Station __Aircraft Owner __State Government __Commercial __Utilities
__Petroleum Distributor __Auto Dealership __Federal Non-Military __Industrial __Other
__Airline __County Government XX Federal Military __Truck/ Transportation

II. RELEASE INFORMATION (Circle all that apply in items A-H)

A. Source of the Release: Piping Tank(s) Spill Overfill

If "Tank(s)" list tank sizes: Tank 6, 13 million gallons

B. Method of Discovery & Confirmation: Closure Monthly Release Detection Tightness Test Site Check

Other (Specify): Inventory check

C. Estimated Quantity of Substance Released:6 Gallons X Unknown

D. Type of Substance Released: Unleaded Gas Leaded Gas Diesel Used or Waste Oil Hazardous Substance

Other (Specify): JP-5 Fuel

E. Immediate Hazards: Explosion Fire Vapor Exposure Recoverable Free Product Drinking Water Threat

Other (Specify): None

F. Release Impact: Surface Water possible Ground Water x Soil Air

G. Migration Pathways: None Utility Conduits Subsurface Drains Sewer Lines XX Unknown

Other (Specify):

H. Actions Taken: Evacuated Nearby Area/Removed UST Contents/Recovered Free Product/Excavated Soils/Ground Water/Recovery

Other (Specify): Tank has been drained and taken out of service

III. UST OWNER OR OPERATOR CERTIFICATION (Read and sign after completing all sections to the extent possible)

I certify under penalty of law that I have examined and am familiar with the information submitted in this notice, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true and accurate.

Name, Title, & Company:

John Santo Salvo, LCDR, USN, Director, FISC Fuel Department

Signature: [signature] Date: 4/16/02 DOH Form CRN (8/92)

ENCLOSURE(1)