BOARD OF WATER SUPPLY

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May 19, 2017

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and

Mr. Steven Chang, P.E.
DOH Red Hill Project Coordinator
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Dear Messrs. Pallarino and Chang:

Subject: Board of Water Supply (BWS) Comments to the Data Gap Analysis (DGA) Report, Investigation and Remediation of Releases and Groundwater Protection and Evaluation (AOC Sections 6 and 7), Red Hill Bulk Fuel Storage Facility JOINT BASE PEARL HARBOR-HICKAM, OAHU, HAWAII Dated April 25, 2017

We have reviewed the subject document and offer the following comments and recommendations.

The BWS agrees with some of the major conclusions from the DGA Report, but find that the report has not identified very important gaps that need to be resolved before it is possible to adequately understand the impact to the groundwater from the Red Hill Bulk Fuel Storage Facility (RHBFSF). Our review found that the DGA Report, like the recent existing data summary and evaluation (EDSE) Report, focuses too much on data needs for the numerical model and not those for the conceptual site model (CSM).

The following section provides our specific comments together with supporting examples. The last section lists the references cited.

1. Cross-Valley Gradients are Missing but Vital

Our review found the DGA Report lacks critically important data to understand whether contamination from the RHBFSF has or will migrate toward Halawa Shaft, the Moanalua Wells, or other surrounding water supplies. The hydraulic gradients (groundwater head differences) between the RHBFSF tanks and the nearby water supplies will drive contaminant migration from Red Hill.

Available data show that the head difference between Red Hill and nearby water supplies can be large. Based on May 2015 pumping test data, the head difference between Red Hill and Halawa Shaft ranged from approximately 2 to approximately 8 feet with an average head difference of about 3 feet to 4 feet during steady pumping at a long-term average rate. The head differences between Red Hill and other water supplies, such as the Moanalua Wells, Aiea Halawa Shaft, Aiea Wells, etc. are not known. Nor are there data to show how these head differences change in time over each year even though the pumping rates are expected to vary with seasonal demands.

The uncertainty about whether valley fill and saprolite affect groundwater flow between Red Hill and the water supply points calls for more measurement points between Red Hill and the area groundwater pumping centers. Head measurements taken at multiple locations across each valley are needed to determine how the gradients vary in space and time within the valleys separating Red Hill from the water supply points. Without such data, it will not be possible for the model calibration process to indicate whether valley fill is important to groundwater migration between Red Hill and Oahu's water supplies.

The DGA Report does not address this data gap. The BWS asks that the Regulatory Agencies ensure that the Navy revises the report to identify and remedy this important data gap.

2. Insufficient Focus on Conceptual Data Gaps

We recently observed that "the Navy is moving forward with a numerical model that may not adequately represent all the features, events, and processes that are most important to conceptually understanding flow and transport in the vadose zone and saturated zones beneath and around the RHBFSF" (Lau, 2017a). The DGA Report confirms our observation because the DGA Report focuses on data gaps for the numerical model, particularly the Navy (2007) model, and does not identify conceptual data gaps that are important for the CSM. We noted that there is some mention of the CSM in the DGA Report, but there is no discussion of what is conceptually missing from the CSM underlying the Navy (2007) numerical model.

Important concerns identified during our review include:

- The Navy should take advantage of the conceptual model components described in Oki (2005) (among others) and compare them to their current CSM components to identify important conceptual gaps.

- The DGA Report incorrectly designates recharge as a secondary data gap but ignores the parts of Moanalua and Halawa Valleys where most of the recharge originates: on the highest elevation areas of the Koolau Ridge to the south of the dike-dominated basalts. Recharge rates in those areas are on the order of 100 inches per year whereas, those near Red Hill are between 1 and 20 inches per year, not including the stream valleys. As Dr. Oki recommended during the October 2016 AOC meeting, the Navy's study area should be extended to include the most important source of recharge to these valleys and the DGA Report should be revised to identify this as a remaining data gap. The DGA Report should also be revised to state that recharge is a primary (not secondary) data gap because it is the primary source of water to the study area.

- The DGA Report states that there could be significant amounts of recharge coming from the stream valleys and the quarry in Halawa Valley. We recommend that the Navy focus on resolving data gaps about the largest recharge areas (see above) before focusing on areas where recharge is estimated to have much smaller rates.

- The DGA Report ignores the importance of dynamics in groundwater elevations, such as those observed between Red Hill Shaft pumping rates and groundwater heads at the nearby Red Hill monitoring wells. It also ignores the dynamics during each water year. Pumping at Red Hill Shaft should be recorded consistently on a daily basis and on an hourly basis when groundwater head measurements are being collected. Seasonal effects cannot be understood with a 4-month-long synoptic water level survey.

3. Too Few Wells to Remedy Groundwater Data Gaps

During the October 2016 AOC meeting, Dr. Oki recommended putting in more monitoring wells across the valleys to understand groundwater flow direction and rate and that the cost of drilling these monitoring wells is insignificant compared to the cost of remediating contaminated groundwater (Lau, 2016). Based on the May 2015 and November 2016 synoptic surveys, groundwater heads measured at the Red Hill monitoring wells are very similar along the Red Hill ridge's orientation. We pointed out during the February 2017 AOC meeting that this indicates that Red Hill ridge is likely oriented along a groundwater head contour and therefore groundwater flow should be expected to be more or less perpendicular to the ridge. The current monitoring network has an insufficient number of wells to determine the gradient perpendicular to the ridge. The DGA Report should be revised to describe and resolve this important data gap.

4. Contaminant Source Data Gaps

Our review has identified several important data gaps for contaminant sources that require correction. A non-exhaustive list of examples includes:

- The effective solubility of fuel constituents should be included as an important data gap and resolved so that the AOC Parties can better track the presence of non-aqueous phase liquid (NAPL) fuels in or near monitoring wells. Raoult's law limits the solubility of a constituent according to the mole fraction of that constituent in the NAPL. Solubility limits for each pair of a dissolved contaminant and groundwater are not applicable when the source concentration is controlled by Raoult's law, i.e., fuel NAPL in the vadose zone or the aquifer.

- Where are the NAPL and dissolved contaminants located in the subsurface? We agree with the objective of understanding the fate and transport of these contaminants, but how will that be possible if so much of the important components have large uncertainties? With such uncertainties, how will the modeling be defensible? Where are the data that show how contaminant concentrations change with depth below the water table in the source area? The existing data gaps about source location in the subsurface should be better constrained through further site characterization.

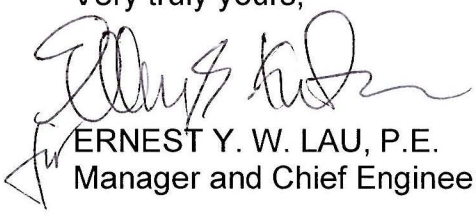
- The DGA Report does not identify the inadequate number of wells as an important data gap. At present, Monitoring Well RHMW02 has the highest concentrations of contaminants but appears to be upgradient of Tank 5. In order to understand degradation rates and biogeochemical conditions in the source areas, the Regulatory Agencies should direct the Navy to install wells in the source areas in the aquifer and the vadose zone.

5. Appendix A Evaluation Needs Greater Justification

Appendix A of the DGA Report is titled "Detailed Evaluation of Existing Data Sets". Our review of this appendix found it lacking in any justification for the decisions made about data suitability and it did not reflect the errors we noted in our comment letter reviewing the EDSE Report (Lau, 2017).

Thank you for the opportunity to comment. If you have any questions, please feel free to call me at (808) 748-5061.

Very truly yours,



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References

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