BOARD OF WATER SUPPLY

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

August 28, 2017

Mr. Bob Pallarino
EPA Red Hill Project Coordinator
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California 94105

and

Mr. Steven Chang, P.E.
DOH Red Hill Project Coordinator
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801-3378

and

Mr. Mark Manfredi
Red Hill Regional Program Director/Project Coordinator
NAVFAC Hawaii
850 Ticonderoga Street, Suite 110
JBPHH, Hawaii 96860

Dear Messrs. Pallarino, Chang, and Manfredi:

Subject: Board of Water Supply (BWS) Comments on the Groundwater Modeling Working Group Meeting Held August 17, 2017 for Red Hill Administrative Order on Consent (AOC) Sections 6 and 7

Thank you for the opportunity to participate in the third Red Hill groundwater modeling working group meeting held on August 17, 2017. We believe the discussion about the Navy's proposed groundwater flow and transport modeling continues to be valuable because of its technical rigor and the numerous contributions from Dr. Delwyn Oki of the United States Geological Survey (USGS), Robert Whittier of the Department of Health (DOH), and several BWS experts. We hope that the Navy and its contractors recognize the value of these contributions from Subject Matter Experts (SMEs) as they continue to

develop the groundwater modeling work plan. We provide below a summary of important points from the meeting and our concerns about and recommendations for the Navy's groundwater model development.

Navy Preliminary Flow and Transport Model

The Navy stated that they will create a preliminary flow and transport model (preliminary model) for the Red Hill groundwater flow system that will be documented in an early 2018 technical memorandum. This "interim" memorandum is intended to provide input information for the tank upgrade alternative (TUA) study. According to AECOM, the December 2017 deadline for the preliminary model work will require the preliminary model to be developed using data available now and in the immediate term. It appears that development of the preliminary model will likely not include very important new data to be collected from the proposed installation of new Navy monitoring wells in Halawa Valley or some or all the valuable data from the ongoing USGS synoptic water level study. Furthermore, the Navy has yet to provide any information about how the sources of contaminants will be represented (source term selection) or the specifics of the transport model development. The Navy verbally agreed in the meeting to include SME review of the preliminary model and its files. The BWS reiterates its request that the Navy provide a detailed description and schedule for the development, calibration, and application of the Red Hill groundwater flow and transport model and how results from the preliminary model will be used in the TUA task.

There are insufficient data currently available about groundwater flow paths and aquifer properties in Halawa Valley between Red Hill and our Halawa Shaft to build a credible flow and transport model. A considerable amount of additional field data are necessary to develop a conceptual site model (CSM) for current critical areas of concern and past/future Red Hill contamination; to construct a defensible approach to simulate groundwater transport, and to quantify uncertainty in the transport predictions. The BWS has repeatedly pressed for such data to be collected and welcome the Navy's proposed new monitoring wells in Halawa Valley. However, our oft-stated concern about the defensibility of any model built without these necessary data remains unchanged. We ask that the regulatory agencies ensure timely technical review of the preliminary model and its files by SMEs before the preliminary model results are used or reported.

Development of the Numerical Groundwater Flow Model

Much of the meeting's discussion focused on how the interactions between fresh groundwater and denser seawater should be represented in the Navy's model. These discussions made it plainly evident that the USGS, DOH, and BWS modeling experts

disagree with the approach proposed by Dr. Sorab Panday, the Navy's modeling consultant (GSI Environmental, subcontractor to AECOM). Dr. Oki of the USGS and BWS experts expressed serious doubts that Dr. Panday's approach would provide a sufficiently accurate representation of the simple flow physics of fluids with varying densities. Dr. Oki suggested that Dr. Panday perform several simple model simulations that would show the bias and errors of his approach, but Dr. Panday would not agree to do so. The BWS supports Dr. Oki's suggestions and believes that a potentially important aspect of the Navy's model is an ability to simulate the evolution and changes of the thickness in the fresh water zone over time. We request that the regulatory agencies ask the Navy to demonstrate that their approach of not simulating density-dependent flow will not bias estimates of groundwater levels and flow rates over time within the model domain. Such a demonstration should begin with Dr. Oki's recommended test simulations.

It appears that the Navy is planning to calibrate the groundwater flow model to observe groundwater levels and spring flows for the period from 2014 to the near present. Both the USGS and BWS are concerned that this length of time for demonstrating agreement between observations and model predictions is too short, even if the Navy includes a several year start-up period. Available groundwater level observations in the area of interest during this short period are very sparse and limited to only a few locations, which means the calibration will contain high uncertainty about the large model areas without any groundwater level observations. This high uncertainty can be reduced by calibrating over a longer time period, such as the calibration period used in Oki (2005). Both the USGS and BWS recommended that the Navy calibrate over the same time period used in Oki (2005) so that the Navy can: 1) reduce uncertainty about groundwater level predictions in large portions of the model; and, 2) generate a more defensible estimate of groundwater levels across the entire model area for present conditions. The BWS requests that the regulatory agencies direct the Navy to extend the calibration period to match that used by Oki (2005) in order to reduce uncertainties in model predictions.

Dr. Sorab Panday and BWS experts agreed it is very important that the Navy include the effects of uncertainty on predictions from the groundwater flow and transport models using best modeling practices. Specifically, it was agreed that the Navy formally investigate the impacts of uncertainty in model components (boundary conditions, aquifer properties, initial conditions, etc.) on model predictions using constrained uncertainty analysis. BWS strongly recommends that the regulatory agencies direct the Navy to include such analyses as a required part of the CSM and the calibration and application of the flow and transport model.

Mr. Mark Manfredi agreed that the Navy will provide the input and output files for the Navy preliminary and final groundwater flow and transport models to the BWS and other SMEs for technical review. The BWS appreciates the Navy's agreement and requests that the Navy's contractors include suitable times for SME review in their schedules for model development. AECOM agreed to provide a detailed schedule for the groundwater model development (both preliminary and final) in the next groundwater modeling working group meeting to be conducted the week of September 18, 2017.

The Navy stated that it will include measured flow rates at Kalauao Springs and spatially varying recharge as part of its model development. Using spatially-varying recharge rates such as those from Engott et al. (2015) will likely improve the model's ability to predict groundwater levels. Comparing simulated and observed spring flow rates will also help improve the calibration of the groundwater flow model.

Development of the Groundwater Transport Model

Dr. Sorab Panday proposed to use the MODFLOW-USG (unstructured grid) flow code to simulate groundwater flow and a currently unverified USG transport code to simulate migration of groundwater contaminants. The MODFLOW-USG flow code has been tested for numerous cases over the last several years and its documentation and source code have been available from the USGS for review over that same period, all of which make it a suitable choice for flow simulation. The BWS has serious concerns about the suitability of the USG transport code for the Red Hill project. According to Dr. Panday, the USG transport code has been applied to only two projects, for which there are no final reports available for review, and the source code and documentation will only be made available in September 2017. This means that the Navy's recommended modeling tool to predict migration of contaminants (transport) will have undergone very limited review and testing prior to being used for the Red Hill modeling, raising the possibility of significant errors in model predictions. Moreover, GSI has not demonstrated that the model input and output files can be easily and accurately modified and visualized using conventional MODFLOW interfaces such as Groundwater Vistas or Groundwater Modeling Systems (GMS). The BWS recommends that the regulatory agencies and the Navy avoid using MODFLOW-USG transport and instead adopt a very well tested and understood transport code paired with a suitable groundwater flow code. The combination of codes should also correctly simulate the variable density interactions between freshwater and seawater.

Thank you for the opportunity to comment. If you have any questions, please feel free to call Erwin Kawata, Program Administrator of our 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
75 Hawthorne Street
San Francisco, California 94105

Mr. Stephen Anthony
United State Geological Survey
Pacific Islands Water Science Center
1845 Wasp Boulevard, Building 176
Honolulu, Hawaii 96818

References

Engott, J.A., Johnson, A.G., Bassiouni, Maoya, and Izuka, S.K., 2015, Spatially distributed groundwater recharge for 2010 land cover estimated using a water-budget model for the Island of O'ahu, Hawai'i: U.S. Geological Survey Scientific Investigations Report 2015-5010, 49 p.

Oki, D. 2005. Numerical Simulation of the Effects of Low-Permeability Valley-Fill Barriers and the Redistribution of Ground-Water Withdrawals in the Pearl Harbor Area, Oahu, Hawaii. USGS Scientific Investigations Report 2005-5223.