DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFMC)

MAR 24 2011

Colonel Robert L. Maness
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2000 Wyoming Blvd SE
Kirtland AFB NM 87117-5000

Mr. Mark Sanchez, Executive Director
Albuquerque Bernalillo County Water Utility Authority
PO Box 1293
Albuquerque NM 87103-1293

Dear Mr. Sanchez

I want to thank you for your comments and concerns regarding the Kirtland Air Force Base (KAFB) Light Non-Aqueous Phase Liquid (LNAPL) Containment Work Plan that were addressed in the 11 Feb letter from Mr. Rick Shean. Your inputs are valuable to our efforts to build a technically sound approach to ensuring the City's drinking water supply remains safe.

Shaw Environmental, our Performance Based Contract support for addressing this matter, and KAFB have taken all of your comments and concerns into consideration as we work towards perfecting the approach for effective interim measures to contain the fuel plume and prevent further expansion of the LNAPL and dissolved phase. We have spoken to the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB), who is also in possession of your memorandum, and they are expected to take all your comments on our LNAPL Containment Plan into consideration.

The attached document, written by Dr. Gary Hecox, Shaw's Senior Hydrogeologist, addresses each of your recommendations within your 11 Feb 2011 memorandum and provides insight into the reasoning behind the proposed approach prescribed in the work plan. Through extensive evaluation of the data obtained in the investigative process thus far, Dr. Hecox and the Shaw team have developed the proposed approach described in the work plan. Shaw is quick to acknowledge that as more data is obtained and a more complete understanding of the hydrogeology in the area of the fuel plume is obtained, changes to various parameters in the work plan may be required. Additionally, insight into the situation and inputs from all stakeholders will be invaluable to reaching our shared objective of getting the fuel out of the ground and ground water as quickly as possible.

If you have additional questions or concerns, please contact Mr. D. Brent Wilson, Base Civil Engineer, at (505) 846-7911. Thank you again for your valued input.

Sincerely

ROBERT L. MANESS, Colonel, USAF
Commander

Attachment:
Response to Comment from ABCWUA

cc:
Mr. David Martin, NMED Secretary
Mr. Raj Saloman, NMED Deputy Secretary
Mr. James Bearzi, NMED Hazardous Waste Bureau Director

Response to Recommendations from Albuquerque Bernalillo County Water Utility Authority

Gary Hecox, Ph.D.

March 2, 2011

1. **Recommendation 1**

    a. **Comment:** "Use a more appropriate aquifer thickness in design simulations for the interim containment system. Explain the how the simulations of a 50-ft-thick aquifer accommodate a 100-ft screened interval for the injection well."

    b. **Response:**

        i. The injection simulations were all conducted using a 50-foot screen interval but in the final development of the work plan, it was decided that a 100-foot injection well screen length would be used as a well screen transmitting capacity factor of safety.

        ii. As outlined in the draft work plan, the capture zone modeling will be redone using three-dimensional MODFLOW and MODPATH once the basic hydrogeologic data described in the work plan become available. This will include appropriate aquifer thickness, vertical and horizontal hydraulic conductivity, and anisotropy derived from the slug and pumping tests described in Section 6.2.2 of the work plan. It should be noted that the necessary three-dimensional hydrogeologic field data cannot be collected until the NAPL extraction wells are installed and pumping tests conducted. This is because the slot size (0.010 inch) and well diameter (4 or 5–inch Schedule 80 PVC with slotted PVC well screens) of the existing and proposed monitor wells are not viable for pumping tests.

2. **Recommendation 2**

    a. **Comment:** "Move location of proposed injection well upgradient of the interim containment system, so injected water can be potentially captured by the extraction wells."

    b. **Response:** This option was evaluated during the initial design modeling and it was found that installing an injection well upgradient from the extraction wells, within the available Kirtland Air Force Base working area, would lead to spreading of the dissolved-phase contaminant plume outside of the containment area. This is because it is not possible to balance the injection and withdrawal rates, given the magnitude of the regional groundwater flow volume. With an upgradient injection well, there is more water coming into the containment area (regional groundwater flow + injection flow) than can be contained by the extraction well pumping (extraction flow = injection flow) leading to dissolved plume spreading. To offset this mass balance volume, some extracted water would have to be discharged elsewhere.

3. **Recommendation 3**

   a. **Comment:** "Implement a phased or iterative approach to designing the interim containment system that acknowledges (and characterizes) the large uncertainties, seeks to reduce the most important uncertainties, and incorporates new information into the design of the next stage of the interim containment."

   b. **Response:**

      i. Since the Santa Fe aquifer system has been studied and characterized by the U.S. Geological Survey and other scientific agencies for over 100 years and these data and modeling are available to Shaw, the current phased approach of site data gaps investigation, installation and testing of the extraction wells, and final design modeling is sufficient to incrementally collect the data necessary for final design.

      ii. Uncertainties will be incorporated into the final system design once data are available to quantify these uncertainties. Currently, under the Groundwater Investigation and Vadose Zone Investigation Work Plans, 78 groundwater and 35 soil vapor monitoring wells are being installed that provide additional information on the subsurface geology. Additionally, core samples will be collected from 4 well locations in the plume core for analysis of physical properties (e.g., grain size, relative permeability, capillary pressure, etc.) and NAPL properties to inform the system design (Section 6.1 of the Groundwater Investigation Work Plan). Given the historical studies and available data on the aquifer and the good definition of site geology from site geologic and geophysical logs, the uncertainty is within the work plan well design factor of safety.

      iii. Given the plume geometry, regional hydrogeologic characteristics, site-specific geology (from borehole and geophysical logs), and groundwater gradients that vary between 0.002 and 0.004 (from site-specific liquid level data), the only major uncertainty are the individual containment well flow rates required to contain the plume. The current design of the well casing diameter and screen transmitting capacity will allow for each well to be pumped at up to 250 gpm for a five times factor of safety compared to the work plan 50 gpm flow rate. If for some reason, it is found that two wells are not sufficient to contain the plume, a third well can be installed.

4. **Recommendation 4**

   a. **Comment:** "It is the Water Authority's preference that interim containment activities be replaced with more vadose zone investigations to ensure a more responsive source are(a) (sic) remediation effort."

   b. **Response:**

      i. The dissolved contaminant groundwater plume is currently migrating towards the Ridge Crest municipal supply well field. Based on the available data, several compounds in this plume are not apparently being attenuated by natural mechanisms. As such, the dissolved plume compounds will reach these wells at some time in the future without active containment efforts. The LNAPL currently in the subsurface on the water table and in the capillary fringe immediately above the water table will be a persistent source of the dissolved plume contamination for the foreseeable future. The containment system is proposed to contain the high-concentration dissolved plume emanating from the LNAPL.

      ii. Once the source area is contained, work will begin on addressing the downgradient dissolved plume to protect groundwater users. Downgradient active remediation efforts cannot begin until the LNAPL area is contained because such efforts may result in higher plume migration velocities and plume spreading compared to current site conditions.

      iii. While aggressive vadose zone remediation efforts have been ongoing since 2004 in the initial release locations, these efforts physically cannot address the LNAPL on the water table and the resulting dissolved-phase contaminant plume. The SVE efforts on the LNAPL wells have removed some contaminant mass in the immediate vicinity of each well, but overall, they have had a minimal effect on the overall LNAPL plume.

iv. Under the Vadose Zone Investigation Work Plan, 35 soil vapor monitoring wells are being installed in the plume core area and in the far-field area of the plume in order to characterize the vadose zone. Twenty-seven of these locations include soil sampling every 5 ft for the first 50 ft and every 10 ft to total depth for analysis of VOCs, SVOCs, TPH, and lead. This work is currently underway and the data collected will be used to inform system design.

5. **Recommendation 5**

a. **Comment:** "Construct new wells within the LNAPL lens vicinity to determine vertical gradients, anisotropy, and vertical extent of the dissolved phase plume. Conduct appropriate testing to determine the magnitude of any anisotropy and variability in hydraulic conductivity and storage properties.

b. **Response:** Shaw is currently installing 78 new monitoring wells within and adjacent to the dissolved and LNAPL plume areas under the Groundwater Investigation Work Plan. Shaw is working with NMED on the hydraulic testing program for these new wells and the existing wells. These tests will include slug, pumping, and LNAPL baildown tests. Additionally, under the Groundwater Investigation Work Plan, four continuous core samples will be collected across the LNAPL/water interface for analysis of grain size, capillary pressure, and relative permeability (Section 6.1).

6. **Recommendation 6.**

a. **Comment:** "Plan to characterize aquifer properties at all existing and all new wells to determine the spatial variability of hydraulic conductivity and identify potential preferential flow pathways. Conduct more aquifer testing by pump tests rather than slug tests. Plan to estimate anisotropy in hydraulic conductivity."

b. **Response:**

i. Shaw is working with NMED on the hydraulic testing program for these new wells and the existing wells.

ii. It must be noted that the required design of the monitor wells—5-inch schedule 80 PVC, PVC slotted casing with 0.010 inch slots, and depth to groundwater of 500 feet—limits the pump options for pumping tests. Based on slotted PVC transmitting capacity of 4 gpm per 10-feet of slots, it is likely that pumping tests will be less than successful because of low drawdown in the test wells. During the recent sampling event, water levels were measured in a well during a 2 gpm purge test and no drawdown was measurable using a manual water level meter.

iii. Horizontal and vertical anisotropy will be included in the analysis of the LNAPL containment well pumping tests.

7. **Recommendation 7.**

   a. **Comment:** "Work with the Water Authority to determine an appropriate alternative to disposing of IDW water in sewer facilities."

   b. **Response:** Comment is noted.