SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

DAVE MARTIN
Cabinet Secretary

BUTCH TONGATE
Deputy Secretary

ENTERED

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

December 16, 2011

Radel Bunker-Farrah
Environmental Program Manager
National Aeronautics and Space
Administration
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020
Attention of: RA-E11-101

**RE: APPROVAL WITH MODIFICATIONS
INVESTIGATION REPORT FOR EVALUATING THE
REPRESENTATIVENESS OF GROUNDWATER SAMPLES COLLECTED
FROM WESTBAY WELLS
NATIONAL AERONAUTICS SPACE ADMINISTRATION (NASA)
JOHNSON SPACE CENTER (JSC) WHITE SANDS TEST FACILITY (WSTF)
DOÑA ANA COUNTY, NEW MEXICO
EPA ID #NM08800019434
HWB-NASA-11-012**

Dear Ms. Bunker-Farrah:

The New Mexico Environment Department (NMED) has received the NASA WSTF (Permittee) *Investigation Report for Evaluating the Representativeness of Groundwater Samples Collected from Westbay Wells*, (Report) dated October 2011 and received October 21, 2011. NMED has completed its review of the Report and hereby issues this Approval with Modifications.

Modifications:

1. **Data Qualifiers; Appendix C Comparison of Analytical Results and Appendix D Complete Analytical Results:**

   Develop and include a page(s) for insertion into the beginning or end of both Appendices that defines the various data qualifiers used in the associated data tables. Do not include "user defined" qualifiers unless a clear definition is also provided. Submit one electronic copy and two paper copies of the new pages no later than **January 20, 2012**.

2. **General Data Observations:**

   In looking at general analyte concentration trends, wells ST-5-481, BLM-7-509, 700-D-186, 100-E-261, 100-A-182 and PL-7-630 all displayed the least amount of change (decreases or increases) in analyte concentrations over time. Of these six wells, only PL-7-630 is constructed as a Westbay well. This suggests conventional wells that can be purged prior to sample collection may produce more consistent results over time.

   Of the 22 wells or sampling ports tested, constituent concentration decreases (with time) outnumbered constituent increases at 14 of the locations. All 14 of those locations were Westbay wells. BLM-36-800 displayed the greatest number of constituent decreases (18 constituents, including volatile or other organic compounds, metals, and various anions/cations).

   While decreasing constituent concentrations (with purging volume/time) are generally preferable to concentration increases noted in the evaluation, the appearance of trichloroethylene (TCE) with increased purging in JP-3-315, JER-1-568 and JER-2-508 (along with Freon 113 in the latter case), indicates the importance of purging wells to ensure representative formation water is sampled versus relatively stagnant casing water.

   Elevated turbidity measurements (i.e., greater that five Nephelometric Turbidity Units [NTUs]) were noted at eight locations. All of those locations were Westbay wells. The initial and final reported measurements are summarized below:

Sample Location	Initial Measurement (NTUs)	Final Measurement (NTUs)
ST-5-485	8.7	1.79
WB-2-270	7.33	4.58(1)
200-H-225	3.67	1.02(2)
200-F-225	9.46	0.93
BLM-37-640	8.78	1.18
BLM-36-800	6.38	4.39(3)

Sample Location	Initial Measurement (NTUs)	Final Measurement (NTUs)
JP-3-970	9.6	1.26
PL-7-560	9.53	3.68[(4)]

Notes:

(1) Measurements peaked at 9.19 NTU after approximately 56 minutes of purging.
(2) Measurements peaked at 13.26 NTU after approximately 66 minutes of purging. Sample results ranged from 12.38 NTU to 11.4 NTU for a period of approximately 211 minutes before stabilizing measurements were evident.
(3) Measurements peaked at 9.03 NTUs after approximately 225 minutes of purging.
(4) Measurements were also elevated (9.44 NTU) after approximately 190 minutes of purging and at 6.91 NTU after approximately 210 minutes of purging.

In the case of wells/ports where the general turbidity trend is decreasing from the initial "no purge" condition, the process of installing the purging equipment could introduce some degree of disturbance to the water column which may dislodge fines from the sand pack materials and increase the initial turbidity readings. In the case of wells/ports where turbidity starts to decrease and then increases (i.e., PL-7-560), the data was likely affected by the unanticipated need for reintroduction of purging equipment or mishaps with the flow-through cell. In other cases, such as well 200-H-225 where "spiking" occurs after relatively low initial readings, the associated field notes do not indicate that unusual events occurred during well purging or sample collection.

A response to these observations is not necessary.

3. **Other Data Observations:**

Data collected during the investigation indicate that the Westbay wells do not produce representative samples of ambient groundwater beneath and surrounding the facility. This is indicated by the chemical concentration gradients that became apparent as the Westbay system wells were purged.

The first indication of the lack of representativeness is the oxygen-depleted (e.g., anoxic) condition exhibited by a majority of the Westbay wells. On average, the dissolved oxygen (DO) measurements collected during purge testing at the Westbay wells were observed at concentrations ranging from about 0.3 to 1 milligrams per liter (mg/L) with a few exceptions as observed at Westbay wells 200-F-225, 200-H-225, WB-1-200, BLM-37-640, PL-7-560, and PL-7-630 where DO concentrations were initially low then increased towards a projected background or baseline level. DO measurements collected at the conventional pumped wells indicate that baseline DO concentrations for the alluvial and limestone/andesite aquifers range from about 5 to 6 mg/L and 3.5 to 4 mg/L, respectively, far exceeding the concentrations observed at most of the Westbay wells.

The second indicator of non-representativeness is the unstable behavior (concentration) of the primary cations and anions and trace elements/compounds during purge testing.

During purge testing, there is some consistency between the Westbay wells with respect to decreasing concentration trends for dissolved zinc, boron, manganese and potassium, and total organic carbon (TOC), total dissolved solids (TDS) and pH – indicating that adsorption-desorption processes and/or cation exchange and redox reactions may have occurred or are occurring at the Westbay sample-collection ports. At many Westbay wells, nitrate and perchlorate concentrations increased in value during purge testing, suggesting that oxidation-reduction reactions may be controlling the chemical system near the Westbay sampling ports. These observations suggest that water near the Westbay sampling ports is stagnant; meaning that groundwater exchange near the measurement point is being restricted. During purge testing, the stagnant water mixes with fresh or less altered groundwater at varying rates, resulting in the variable parameters discussed above. The variability in mixing is likely dependent on the hydraulic properties of the aquifer at the measurement point.

Comparison of dissolved iron, manganese and zinc concentrations for the purged Westbay wells versus the conventional pumped wells provides further evidence that poor flow-through (stagnation) of groundwater at and near the Westbay monitoring points is occurring. The presence and variability of iron and zinc, and manganese to a lesser degree, was observed in the Westbay purged samples in comparison to the absence of iron, manganese, and zinc in samples collected in the nearby conventional pumped wells. Iron, manganese, and zinc in this context may be remnant elements from earlier redox reactions occurring when the well was installed.

Comparison of concentrations of primary contaminants such as N-nitrosodimethylamine (NDMA) and TCE from samples collected during the pumping of the Westbay wells versus the three-year averages of no-purge Westbay data show both consistencies and inconsistencies which is most likely related to the non-representativeness of both sets of data.

Data collected at conventional well 100-E-261 indicate the well may not be capable of supplying representative samples and may need to rehabilitated. Dissolved oxygen concentrations and other parameters collected at the time of purging were erratic and may not have fully stabilized by the end of purging. In addition, the absence of nitrate and perchlorate indicate that reducing conditions may exist at the screened interval. The driving force of the reducing conditions may be the presence of residual drilling fluids. Records indicate that 3,000 gallons of water and foam were lost to the formation with only 1,100 gallons recovered during well development.

Report Table 4 (*Results of Statistical Tests Performed on Analytical Data from Samples Collected During Westbay Evaluation*) further indicates support for the observation that many of the Westbay wells/sampling ports are not producing samples that are truly representative of groundwater conditions at a given well/sampling port. Of all analytes where sufficient historical data was available to conduct paired t-test evaluations or

Wilcoxon rank sum test evaluations, only NDMA, nitrite/nitrate as nitrogen and perchlorate did not result in rejection of the null hypothesis. In other words, based on the data collected during the evaluation and historical data from the site wells, the population historic mean concentrations are not equal to the population mean concentrations collected during the evaluation for several metals, acetone, fluoride and various anions/cations.

A response to these observations is not necessary.

4. **Future Efforts Needed:**

NMED noted the Permittee's observation concerning the presence and absence of hydrogen sulfide in wells WB-2-270 and 100-E-261, respectively (*see also*, paragraph six in NMED comment 3 above). The Permittee indicated a potential future need for additional development of one or both wells. Available information indicates approximately 760 gallons of water were used to develop WB-2-270 in the spring of 1990. Information is not available concerning how much fluid was introduced and/or lost to the formation during drilling and construction of the well. Provide additional discussion of this matter, including a recommended course of action (if any), in the upcoming *Comprehensive Periodic Monitoring Report* (CPMR).

Provide discussion in the CPMR concerning how and whether malfunctioning sampling ports in well WW-3 can or should be repaired. Fixing the malfunctioning sampling port(s) in well WW-5 will not be necessary at this time (*see* discussion below).

During preparation of the CPMR and subsequent annual review and revision of the 2012 *Groundwater Monitoring Plan* and the *Plume Front System Monitoring Plan*, the Permittee may consider discontinuing sampling of selected Westbay wells and/or reductions in monitoring frequencies located in the plume front and mid-plume site areas. The Permittee's selection of wells to discontinue sampling in the mid-plume monitoring network may be based in part on the results of future groundwater tracer testing in the mid-plume area being contemplated by the Permittee in early- to mid-2012. Alternatively, if mid-plume tracer testing results are not available or are inconclusive prior to preparation of the CPMR (or revisions of the related monitoring plans), Westbay wells in the mid-plume area with the "BLM" designation may be proposed for removal from the monitoring network sampling list. Use of the Westbay wells for water level measurements must be continued. Unless noted otherwise below, Westbay wells with the "ST" and "PL" designations in the plume front area can be proposed for suspension of routine sampling but their use for water level measurements must be retained.

Downgradient and cross-gradient Westbay wells WW-2, WW-4, WW-5, ST-6, JP-3, BLM-28, BLM-32 and BLM-37 must be replaced or converted to wells containing purgeable systems. Due to the nature of wells constructed with multiple (three or more) well screens, if the Permittee converts the Westbay systems with single or dual screened conventional wells, only the lower one or two screens or the upper one or two screens of the multi-screened well can be replaced. This is not a regulatory constraint and is related to the nature of converting multi-screened wells. In general, grouting of the lower screens and converting the upper screen(s) is less costly than plugging the upper screen and converting the lower screen(s). The Permittee's choice of purgeable sampling systems will affect the total cost of converting the wells and there are several pros and cons for selection and use of available systems. Additionally, there are systems available which utilize mechanical packers to block off unused well screens obviating the need for grouting and retaining their potential for future use, if appropriate.

Conversion of these wells is necessary to demonstrate that "break-through" of NDMA or TCE (or other contaminants of concern) has not occurred in the outer perimeter down- and cross-gradient wells that may currently be "masking" the possible presence of these constituents due to continued sampling of stagnant water surrounding the Westbay sampling ports.

In order to spread out the total annual costs of the well conversions over a period of time, the Permittee may propose to limit the number of wells converted annually to one or two wells per year starting in federal Fiscal Year (FY) 2013. This also will allow the Permittee time to evaluate the type of purging system(s) selected and to consider possible use of alternate systems in future well conversions, if appropriate.

NMED will not consider future proposals for installation of Westbay wells at WSTF.

The Permittee must provide a proposed schedule for starting and completing conversion of the eight existing Westbay wells no later than **June 29, 2012**.

If you have any questions concerning this approval, please contact Daniel Comeau at (505) 476-6043.

Sincerely,

John E. Kieling
Acting Chief
Hazardous Waste Bureau

cc: N. Dhawan, NMED HWB
D. Cobrain, NMED HWB
D. Comeau, NMED HWB
R. Isaac, NMED GWQB
J. Dyer, NMED SWB
L. King, EPA 6PD-N
M. Zigmond, NASA WSTF

File: Westbay Well Evaluation Rpt NoA w/Mods - December 2011