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June 20, 2012

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Michael J. Graham
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RE: APPROVAL WITH MODIFICATIONS
TECHNICAL AREA 16 WELL NETWORK EVALUATION AND RECOMMENDATIONS
LOS ALAMOS NATIONAL LABORATORY
EPA ID#NM0890010515
HWB-LANL-12-022

Dear Messrs. Maggiore and Graham:

The New Mexico Environment Department (NMED) is in receipt of the United States Department of Energy (DOE) and Los Alamos National Security, L.L.C.'s (collectively, the Permittees) document entitled *Technical Area 16 Well Network Evaluation and Recommendations* (Evaluation) dated March 2012 and referenced by EP2012-0064. The Report was received on March 30, 2012. NMED has reviewed the Evaluation, and hereby issues this approval with the following modifications and comments.

1. **Section 3.3, Data Gaps in the Site Conceptual Model with Respect to the Monitoring Network, page 6:**

   As stated in this section, a significant amount of uncertainty exists with respect to the nature and extent of groundwater contamination in the deep intermediate and regional aquifers, and particularly for the lower-deep intermediate aquifer. The current monitoring for the lower-deep intermediate aquifer is restricted to only two wells, CdV-16-4ip Screen 2 and R-25 Screen 4.

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In Section 5.2 of the Evaluation, the Pemittees state that CdV-16-4ip Screen 2 should be plugged and abandoned in order to prevent potential significant cross-flow from the contaminated zone at Screen 1 in the event of packer failure between the two screens. In addition, the integrity of Screen 2 at CdV-16-4ip was likely compromised due to the rapid deflation of the inflatable packer set between Screens 1 and 2 after the 2011 aquifer-performance test.

As stated in NMED's Comment 2 below, the Permittees must plug and abandon well R-25 due to multiple problems with well construction and sample quality. After abandonment of CdV-16-4ip Screen 2 and R-25, there will be no adequate or reliable method for monitoring of the lower-deep intermediate aquifer south of Cañon de Valle. Therefore, the Permittees must install one monitoring well, screened at the lower-deep intermediate aquifer, at the eastern edge of Material Disposal Area P (MDA P). Specifically, the well will monitor contaminant releases from the 260 Outfall and MDA P (e.g., soluble compounds such as RDX), as well as recharge from Cañon de Valle. The Permittees must submit a work plan for the installation of this well no later than **April 3, 2013**.

2. Section 4.0, Monitoring Network Assessment, pages 7 - 14:

1. The Permittees performed Geochemical Evaluation of the Westbay wells CdV-R-15-3 and CdV-R-37-2 (both proposed for conversion to single-screened wells) based on a single post-redevelopment sample for each screen. A reliable determination as to whether particular screens meet the Geochemical Evaluation objectives cannot be made until the wells are converted as prescribed in Section 5.2, followed by the collection of at least four rounds of water quality data, including field parameters.

2. The Westbay well R-25, as a whole, is not viable for groundwater monitoring for contaminant detection. The integrity of R-25 was significantly compromised during drilling, well installation, and development:

    a) A variety of fluids and additives, such as EZ-MUD, bentonite, TORKease, cellophane, and Mag Fiber were used during borehole drilling. The organic-based compounds, producing total and dissolved organic carbon, affected the saturated portions of the borehole and adjacent aquifer material and may have provided adsorption sites for geochemical reactions and enhanced reducing conditions. Both reducing conditions and indications of stagnant groundwater have been observed in groundwater samples collected from several screens.
    b) During drilling and afterwards, when all eight screens were in communication (September 1998 to May 1999), large volume of contaminated groundwater from shallower perched zone was allowed to flow down the borehole to the regional aquifer, creating a secondary contaminant source in the regional

aquifer. As the result, groundwater samples from lower screens may not be representative of local aquifer conditions.

c) Prior to the placement of bentonite seals and filter packs, the entire well casing was dropped to the bottom of the borehole with such impact that the well-casing joint at Screen 9 separated. The damage was significant enough to warrant the abandonment of Screens 3 and 9. A cement plug was installed and drilled out at Screen 3. The presence and migration of the drilled-out cement particles and, possibly, shavings of screen material, likely impacted the natural geochemical environment at the remaining screens.

d) Sealant and filter packs at Screens 1 through 8 (1800 ft bgs) were emplaced via gravity through a tremie pipe. At these depths, filter-pack sand and bentonite slurry cannot be adequately installed by gravity flow. The material must be pumped under pressure to acquire an adequate seal between the screened intervals. It is likely that some bridging of sealant and sand within the annulus took place. Inadequate seals set within and between the deep-perched intermediate aquifers and the regional aquifer may provide a conduit for the migration of contaminated groundwater.

e) As noted in the Evaluation (Appendix A, page A-32), tremie lines were dropped down the well annulus during well construction. The dropped tremie lines likely damaged the backfill material between Screens 6 and 7 and Screens 8 and 9. Multiple attempts at fishing the dropped tremie lines may have induced the movement of fine-grained material (natural clays), drilling fluids, and additives into the formation at the screened intervals, negatively affecting the physical (e.g., permeability) and geochemical properties at the screened intervals.

f) Well development at R-25 was conducted from December 1999 through October 2000. During development, there were periods of time when the well was not being pumped - sometimes as long as several months. The screened intervals were in direct communication during development, allowing RDX and other contaminants to be transported downward to the regional aquifer. Post-completion water quality data indicate that contamination (RDX, tritium, drilling additives, etc.) was introduced to depths exceeding 500 ft below the water table. Some of these contaminants, such as TNT, are still present at low levels in the regional aquifer as noted in the geochemical performance evaluation for Screen 7 (Appendix B, page B-14). Other TA-16 contaminants, such as tritium, were detectable for several years after the screens were isolated with the Westbay system, suggesting that groundwater at these screens is stagnant to some degree.

g) During well development, the agent sodium acid pyrophosphate (SAP) was used at each screen except Screens 3 and 9. As noted in the Evaluation (e.g., page 9, Screen 5), elevated phosphate concentrations derived from this agent are present at several screens after more than 10 years after emplacement. This provides more evidence of stagnant groundwater at the Westbay sampling ports.

Historical water-level data collected at R-25 suggest that Screens 1 and 2 may be leaking. The mechanism for leakage may be related to the possibility that the filter packs were set across the perching horizons at each zone. This scenario is understandable considering the difficulties in determining the perching horizons using only natural gamma radiation and electromagnetic induction logs. The complexity of the alternating wet and dry zones along the interval from 747ft to 1132 ft bgs made the proper placement of filter packs and screens difficult. As shown on pages 42 and 43 of the Permittees' document "Groundwater Level Status Report for 2010" (LA-14437-PR), water levels at the perched zone Screens 1 and 2 dramatically and consistently declined from the initial measurement period starting in late 2000. Since 2000, water level declines at Screens 1 and 2 are 14 ft and 10 ft, respectively. During the same time, water levels at perched-zone Screen 4 initially rose 6 ft for about 2-3 years, then declined for 2-3 years as noted in the symmetrical curve plotted on the hydrograph (LA-14437-PR). This does not definitively suggest that Screens 1 and/or 2 are leaking downward to Screen 4, but the possibility does exist considering the behavior of water levels at Screen 4. In addition, it is expected that the thickness of the perched zones at the Screens 1 and 2 is less than 20 ft. The length of filter packs for Screens 1 and 2 are 36 ft and 40 ft, respectively. These excessively long filter-packs may have been set across the perching horizons, providing a conduit for downward leakage. Note that a similar situation may have occurred at deep-intermediate well CdV-16-2(i) where water levels in the replacement well CdV-16-2(i)r rebounded after the perched zone at CdV-16-2(i) was adequately sealed off via plugging and abandonment.

Based on the information presented above, R-25 must be plugged and abandoned. The Permittees must submit a work plan to plug and abandon R-25 no later than **September 17, 2012**.

3. The instantaneous and constant declines of the water level at intermediate well CdV-16-1(i) suggest that one of the two large fractures encountered during borehole placement may have been sealed off during well construction. These two fractures are assumed to provide the bulk of groundwater flow at CdV-16-1(i). The two large fractures are located at depths 598 ft and 626 ft bgs, respectively. Initial water levels at the well were measured at approximately 570 ft bgs or about 41 ft above the top of the secondary filter pack and 54 ft above the top of the screen. Water level has dropped approximately 17 ft since well construction in late 2003. Figure A-27 in the Evaluation (page A-60) shows that the transition seal for CdV-16-1(i) is set from 540 ft to 611 ft bgs, effectively sealing off the upper fracture that may be associated with the initial measured water levels (570 ft bgs). Hence, water-level declines at CdV-16-1(i) may not be related to changes in recharge, as suggested in Appendix E, page E-1.

3. Section 5.2, Disposition of Existing Wells, pages 15 - 18:

1. As mentioned above in NMED's Comment 2, the work plan for plugging and abandonment of R-25 must be submitted to NMED no later than **September 17, 2012**.

2. For wells CdV-R-15-3 and CdV-R-37-2 that are proposed for conversion from multi-screen to single-screened wells, the Permittees must collect sufficient post-conversion water-quality data at each well to assess the representativeness of the data.

3. The piezometer R-26 PZ-2 was not designed for contaminant detection or monitoring purposes as evidenced by its construction flaws. The Permittees must install a replacement monitoring well at this location to properly characterize contaminants (e.g., PCE) and their concentrations within the perched zone where the piezometer is screened. The Permittees must submit a work plan for the installation of the replacement well to NMED no later than **July 27, 2012**.

4. Section 5.3, Recommendations for New Wells, pages 18 - 20:

1. For the proposed deep intermediate well located north of Cañon de Valle, the Permittees must install two single-screened wells if both upper- and lower-deep zones are capable of adequate groundwater yield for monitoring purposes.

2. For the proposed regional wells located north of Cañon de Valle and in S-Site Canyon, the Permittees must make an attempt to collect representative groundwater samples during the first encounter of intermediate aquifer groundwater during borehole advancement. If the groundwater is shown to be contaminated (i.e., RDX), the Permittees may be required to install intermediate aquifer wells at these locations.

3. As directed in NMED's Comment 1, the Permittees must install one additional well that targets the contaminated lower-deep intermediate aquifer south of Cañon de Valle. The work plan for this well must be submitted to NMED no later than **April 3, 2013**.

4. The location of the proposed well W38 must be evaluated in more detail with input from NMED. The Permittees' method for determining the location for W38 is based on modeling results shown in Appendix C of the Evaluation. The numerical simulations and outputs, as presented in Appendix C, are sensitive to the spatial distribution of water-levels in the modeled area. A significant amount of uncertainty in the modeling results is attributable to the lack of water-level data for the southwestern portion of the modeled area. Specifically, water-level contours for the regional aquifer beneath Water Canyon, as shown on Figures C-1.0-1 and C-1.0-2, may not accurately represent the actual water table. Similar to

Cañon de Valle, a significant amount of recharge likely occurs beneath Water Canyon east from State Road 501. This is based on multiple field observations taken during baseflow conditions (≈0.25 cfs) showing complete surface-water loss along a short two-mile reach east of State Road 501. A recharge "mound" or water-level high is likely present beneath Water Canyon along this reach.

5. Section 6.0, Schedule, page 20:

The following schedule requirements must be included in the list of actions presented by the Permittees:

1. The work plan to conduct DC-resistivity profiling in Cañon de Valle (dated April 2012) was approved by NMED on May 18, 2012, with direction to submit a report summarizing the implementation of the plan and associated results to NMED no later than **April 3, 2013**.

2. The work plan for the installation of the proposed deep intermediate well north of Cañon de Valle must be submitted to NMED no later than **April 3, 2013**.

3. The work plan for the installation of proposed regional well R-47 at location "W11" must be submitted to NMED no later than **August 10, 2012**.

4. The work plan for the reconfiguration of well CdV-16-4ip to a single-screen well must be submitted to NMED no later than **August 17, 2012**.

5. The work plan for the reconfiguration of well CdV-R-15-3 to a single-screened well must be submitted to NMED no later than **August 24, 2012**.

6. The work plan for the reconfiguration of well CdV-R-37-2 to a single-screened well must be submitted to NMED no later than **August 31, 2012**.

7. The work plan for the installation of proposed regional well "W38" must be submitted to NMED no later than **September 7, 2012**. The final location for this well must be determined with input from NMED.

6. Appendix B, Table B-2.0-3, page B-79:

Iron concentrations in unfiltered samples from well R-25 Screen 4 (Port MP4A) collected on April 7, 2010 and June 15, 2011 are lower than iron concentrations in corresponding filtered samples. Since constituent concentrations in unfiltered water samples physically cannot be lower than corresponding concentrations in filtered samples, this occurrence indicates an error related to the Permittees' data quality review. NMED's cursory review of R-25 Screen 4 data in the Intellus database identified similar errors with manganese and nickel concentration data. The Permittees must perform data quality review of all R-25 geochemical data that

involves filtered and unfiltered samples, identify and correct errors in all relevant databases, and submit an explanation letter and replacement pages for the affected portions of the Evaluation to NMED no later than **July 30, 2012.**

Please contact Michael Dale at (505) 661-2673 or Jerzy Kulis at (505) 476-6039 if you have questions.

Sincerely,

John E. Kieling
Chief
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