LA-UR-08-3991
June 2008
EP2008-0304

Supplemental Investigation Work Plan for Intermediate and Regional Groundwater at Consolidated Unit 16-021(c)-99

Los Alamos
NATIONAL LABORATORY
EST.1943

Prepared by the Environmental Programs Directorate

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EXECUTIVE SUMMARY

This supplemental investigation work plan proposes additional site investigation to address uncertainties in the corrective measure evaluation (CME) for Consolidated Unit 16-021(c)-99 intermediate and regional groundwater at Los Alamos National Laboratory. These groundwater zones have been impacted by the discharge of wastewater into Cañon de Valle from past high explosives (HE) processing operations at Technical Area 16. The supplemental work plan was prepared in accordance with the New Mexico Environment Department's (NMED's) notice of disapproval, issued for the CME.

The CME reviewed existing data for intermediate and regional groundwater and concluded that regional groundwater does not require active remediation because HE levels do not exceed standards; however, continued groundwater monitoring and monitored natural attenuation were recommended. Standards for HE were exceeded in intermediate groundwater, and the CME recommended a phased approach involving continuing monitoring and a pump test to further evaluate options for active remediation of this zone. Critical data that can be obtained from a pump test include the hydraulic conductivity and heterogeneity of the intermediate zone, which the CME identified as important uncertainties in the evaluation of alternatives.

To address CME uncertainties, this work plan proposes installing wells, sampling and monitoring existing and new wells, screening existing and new well groundwater data against applicable standards, performing single-well pump tests in all new wells, and conducting a multiwell pump test. Because the multiwell pump test depends on both hydrological and geochemical data from the new wells, finalization of the testing plan is deferred until sufficient data from the new wells to define nature and extent are obtained, which will require 1 yr (four quarterly events) of sampling from the new wells. A final decision will be made in consultation with NMED; moreover, logistical issues related to the pump test, specifically the issue of water treatment and disposal, will require NMED collaboration. The proposed schedule calls for completion of the revised CME in 2010.

CONTENTS

Figures

Tables

1.0 INTRODUCTION

This supplemental investigation work plan proposes additional site investigation to address uncertainties in the corrective measure evaluation (CME) for Consolidated Unit 16-021(c)-99 intermediate and regional groundwater at Los Alamos National Laboratory (the Laboratory) Technical Area 16 (TA-16). These groundwater zones have been impacted by the discharge of wastewater into Cañon de Valle from past high explosives (HE) processing operations. Figure 1.0-1 presents a map of the area. The supplemental work plan was prepared in accordance with the New Mexico Environment Department's (NMED) notice of disapproval (NOD) (NMED 2008, 101311) issued for the CME report (LANL 2007, 098734).

Intermediate groundwater overlies regional groundwater within the approximate area of Cañon de Valle and is most likely the result of recharge of waters into Cañon de Valle or within recharge zones along the Pajarito Fault to the west. Figure 1.0-2 shows the hydrological conceptual model. Intermediate groundwater is found within the Otowi Member of the Bandelier Tuff and in the unconsolidated sediments of the Puye Formation. Regional groundwater is present on a regional scale throughout the Pajarito Plateau and is found within the lower Puye Formation and in deeper zones.

The CME reviewed existing data for intermediate and regional groundwater and concluded that regional groundwater does not require active remediation because HE levels do not exceed U.S. Environmental Protection Agency (EPA) standards (EPA Region 6 tap water screening levels adjusted to a 10^{-5} risk level [EPA 2005, 091002]); however, the CME recommended continued groundwater monitoring and monitored natural attenuation (MNA). In intermediate groundwater, the standards for HE were exceeded, and the CME recommended a phased approach involving continued monitoring and performing a pump test to further evaluate options for active remediation of this zone. Critical data that can be obtained from a pump test include the hydraulic conductivity and heterogeneity of the intermediate zone, which the CME identified as important uncertainties that affect the final determination of the preferred remedial alternative.

In addition, the CME identified other uncertainties related to nature and extent that could influence the CME conclusions. These uncertainties include the reliability of certain well screens, including the intermediate zone upper well screens of R-25, a multiple completion well. Several of these uncertainties were addressed in a well evaluation study (LANL 2007, 100113).

The purpose of this supplemental work plan is to address these uncertainties so the CME can be revised and the best alternative for groundwater remediation identified. All data collected from activities conducted under this work plan will be summarized in the revised CME.

This supplemental work plan consists of a point-by-point tabular response to the NOD, which is presented in section 2. Section 3 provides a schedule, section 4 provides conclusions, and section 5 provides references and map data sources. Additional site background information can be found in the CME (LANL 2007, 098734).

2.0 INVESTIGATION PLAN FOR ADDRESSING SITE UNCERTAINTIES

Table 2.0-1, Required Elements of the Supplemental Investigation Work Plan, is based on the NOD (NMED 2008, 101311) issued for the CME (LANL 2007, 098734) and summarizes key CME uncertainties and corresponding work elements proposed in this supplemental work plan that have been approved by NMED in association with other studies, including a monitoring well network evaluation (LANL 2007, 100113) and associated work plans for four new monitoring wells (LANL 2007, 098121; NMED 2007,

100314; LANL 2008, 100696; NMED 2007, 100575; LANL 2008, 101875.18; NMED 2008, 101114; and LANL 2008, 101875.10; NMED 2008, 101114). Key elements of the supplemental work plan are as follows:

- *Monitoring well installation:* Intermediate zone monitoring wells R-25b and R-25c will be installed next to existing well R-25 to verify the HE data from R-25 screens 1 and 2. Existing well CdV-16-3(i), which is currently dry, will be drilled deeper to intercept regional groundwater for the purpose of determining the extent of HE. Monitoring well CdV-R-15-1 will be installed within regional groundwater for the same purpose. In addition, single-well, short-duration pump tests will be conducted in these wells as part of or after their installation. These tests will yield estimates for local hydraulic conductivity. Figure 2.0-1 shows the locations of these wells.
- *Sampling of new monitoring wells:* The new wells [R-25b, R-25c, CdV-16-3(i), and CdV-R-15-1] will be added to the existing monitoring well network and sampled quarterly for 1yr (four events). These wells will be added to the list of key CME wells, and all data will be screened against applicable standards for the revised CME.
- *Multiwell pump and tracer tests:* Important feasibility parameters such as permeability, sustainable pumping rate, contaminant concentrations, radius of influence, retardation, and groundwater travel times can be obtained from a multiwell pump and tracer tests conducted in the intermediate zone. In consultation with NMED, finalization of plans for a multiwell pump test will be made after approximately 1 yr of HE data have been collected and after several technical issues related to performance of the pump test, including the issue of water treatment and disposal, are resolved. Options for water disposal include recycling for other uses, such as construction dust suppression, or permitted discharge to the canyon. Based on current estimates, a pumping rate of 100 gal./min may be required. With regard to HE data, of particular interest is the extent of HE in the Puye Formation, which is the only interval of the intermediate zone in which groundwater recovery may be feasible because of the low permeability of the Otowi Member. In conjunction with the pump test, a tracer test will also be conducted using sorbing and nonsorbing tracers. Before the pump test is conducted, the Laboratory will prepare and submit to NMED for its approval an aquifer testing plan detailing the final location of the pump test well, the monitoring well network, the treatment and disposal of recovered groundwater, and other tests, such as the tracer tests. A preliminary location for the pump test well is shown in Figure 2.0-1. Monitoring wells in the vicinity of this well would serve as observation wells.

All data from these additional investigation activities will be used to update the CME. As part of the revised CME, data from all key wells will be screened against applicable standards.

3.0 SCHEDULE

Monitoring wells R-25b and R-25c will be installed in 2008, and wells CdV-16-3(i) and CdV-R-15-1 will be installed in 2009. Consequently, the earliest finish date for the 1-yr sampling period at these wells will fall in December 2009. In early 2010, a decision will be made regarding the details of a multiwell pump test. After the aquifer test plan is submitted and approved, the multiwell pump test can be conducted in late 2010 with revision of the CME to be completed 6 mo later. Table 3.0-1 presents this proposed schedule.

4.0 CONCLUSIONS

This supplemental work plan proposes additional site investigation to address uncertainties in the CME for Consolidated Unit 16-021(c)-99 intermediate and regional groundwater at the Laboratory. It proposes installing wells, sampling and monitoring existing and new wells, screening existing and new well

groundwater data against applicable standards, performing single-well pump tests in the new monitoring wells, and conducting a multiwell pump test in a new pump test well to be installed at a later time. Because the multiwell pump test depends on both hydrological and geochemical data from the new wells, final plans for such a test and development of the testing plan are deferred until sufficient nature and extent data from the new wells are obtained, which will require approximately 1 yr (four quarters) of sampling. This final planning will be made in consultation with NMED; moreover, logistical issues related to the pump test, specifically the issue of water treatment and disposal, will require NMED collaboration.

5.0 REFERENCES AND MAP DATA SOURCES

5.1 References

The following list includes all documents cited in the main body of this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

EPA (U.S. Environmental Protection Agency), November 2005. "EPA Region 6 Human Health Medium-Specific Screening Levels," U.S. EPA Region 6, Dallas, Texas. (EPA 2005, 091002)

LANL (Los Alamos National Laboratory), June 2007. "Drilling Work Plan for Intermediate Aquifer Well R-25b," Los Alamos National Laboratory document LA-UR-07-3952, Los Alamos, New Mexico. (LANL 2007, 098121)

LANL (Los Alamos National Laboratory), August 2007. "Corrective Measures Evaluation Report, Intermediate and Regional Groundwater, Consolidated Unit 16-021(c)-99," Los Alamos National Laboratory document LA-UR-07-5426, Los Alamos, New Mexico. (LANL 2007, 098734)

LANL (Los Alamos National Laboratory), November 2007. "Evaluation of the Suitability of Wells Near Technical Area 16 for Monitoring Contaminant Releases from Consolidated Unit 16-021(c)-99, Revision 1," Los Alamos National Laboratory document LA-UR-07-6433, Los Alamos, New Mexico. (LANL 2007, 100113)

LANL (Los Alamos National Laboratory), February 2008. "Drilling Work Plan for Well R-25c," Los Alamos National Laboratory document LA-UR-08-0337, Los Alamos, New Mexico. (LANL 2008, 100696)

LANL (Los Alamos National Laboratory), March 2008. "Drilling Work Plan for Well CdV-R-15-1," Los Alamos National Laboratory document LA-UR-08-1535, Los Alamos, New Mexico. (LANL 2008, 101875.10)

LANL (Los Alamos National Laboratory), March 2008. "Drilling Work Plan for Well CdV-16-3(i)," Los Alamos National Laboratory document LA-UR-08-1534, Los Alamos, New Mexico. (LANL 2008, 101875.18)

NMED (New Mexico Environment Department), November 2, 2007. "Approval of the Drilling Work Plan for Regional Aquifer Well R-25b," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2007, 100314)

NMED (New Mexico Environment Department), March 11, 2008. "Notice of Approval, Drilling Work Plan for Well R-25c," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 100575)

NMED (New Mexico Environment Department), March 28, 2008. "Approval with Direction, Drilling Work Plans for Well CdV-16-3(i) and CdV-R-15-1," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 101114)

NMED (New Mexico Environment Department), April 22, 2008. "Notice of Disapproval Corrective Measures Evaluation Report, Intermediate and Regional Groundwater Consolidated Unit 16-021(c)-99," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 101311)

5.2 Map Data Sources

Data sources for all figures are provided below, unless otherwise indicated on the figures themselves.

Boundary of Department of Energy Property In and Around the Los Alamos National Laboratory; LANL, Site and Project Planning Group; 01 February 2003 (Acquired 07 September 2004)

Locations of Springs; Los Alamos National Laboratory, Environmental Stewardship Division, in cooperation with the New Mexico Environment Department, DOE Oversight Bureau, ER2005-0495; 1:2500 Scale Data; 18 July 2005

Paved and Dirt Road Arcs, Existing and Former Structures, Security and Industrial Fences and Gates, Water and Gas Lines: Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005

Hypsography, 10, 20, and 100 Foot Contour Intervals: Los Alamos National Laboratory, Environmental Stewardship Remediation Services Project; 1991

ER Location ID Points: Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1:2500 Scale Data; 10 November 2005

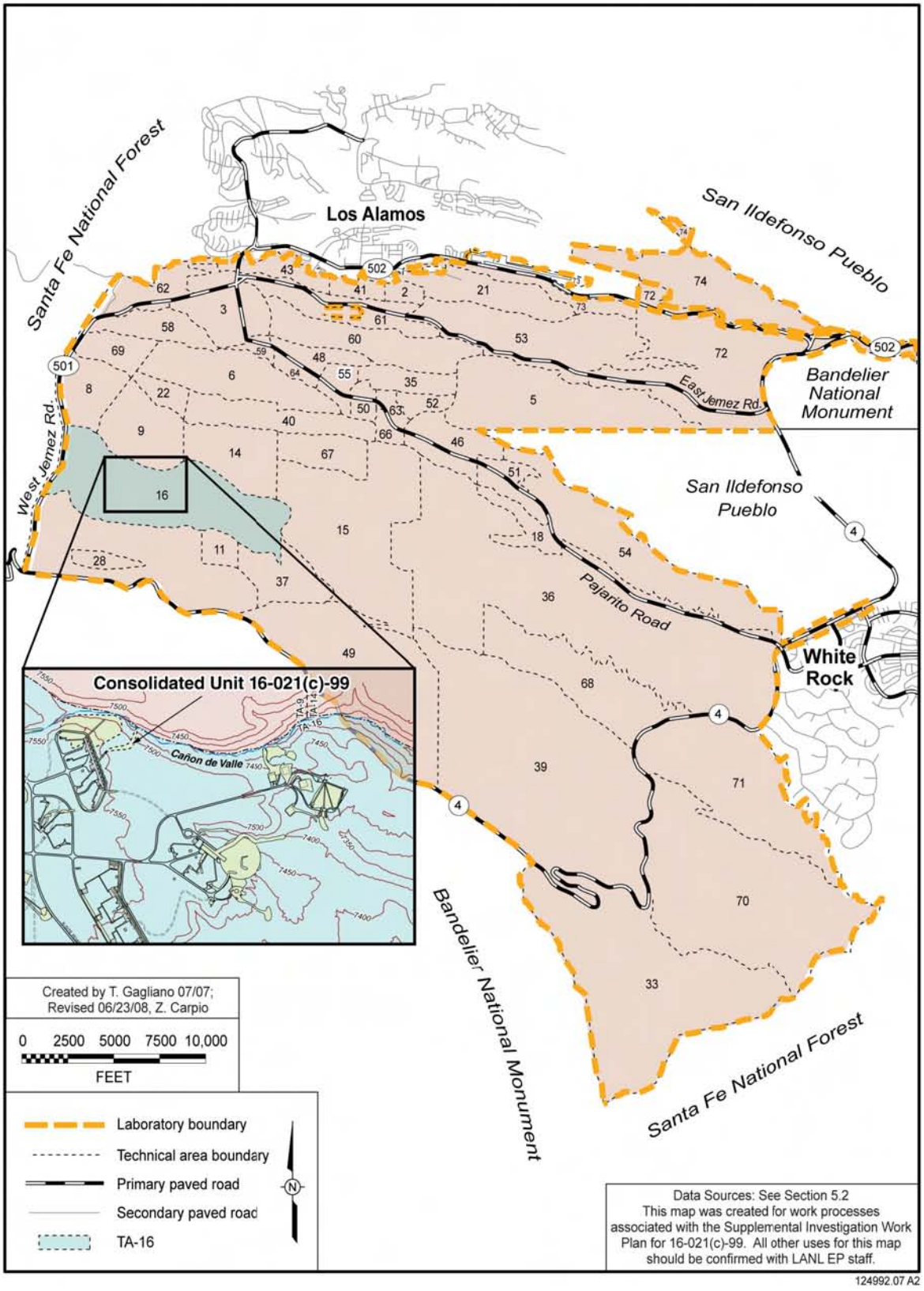

Figure 1.0-1 Location of TA-16 with respect to Laboratory technical areas and surrounding landholdings and Consolidated Unit 16-021(c)-99

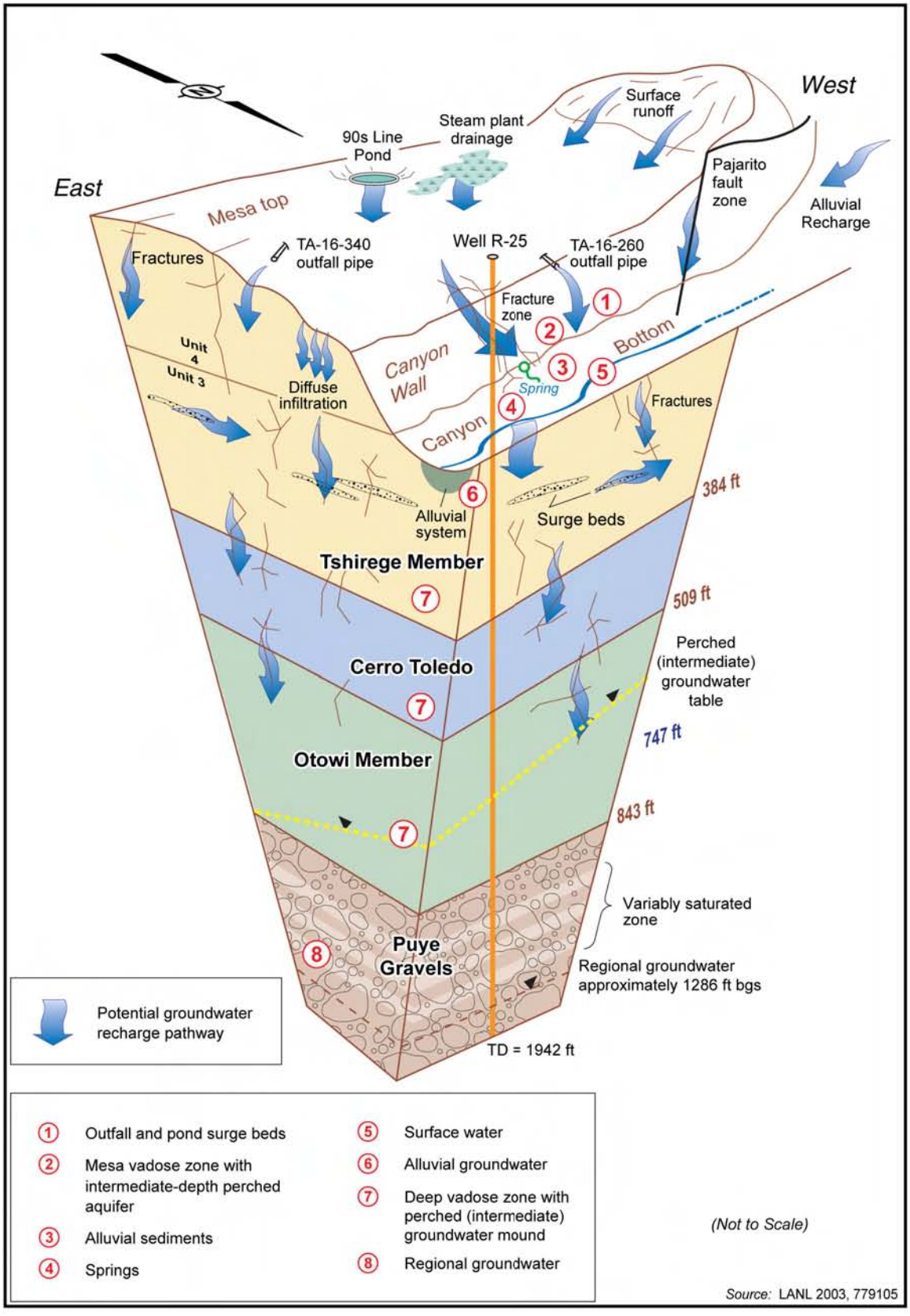

Figure 1.0-2 Conceptual site model of hydrogeology and contaminant transport for TA-16 and Consolidated Unit 16-021(c)-99

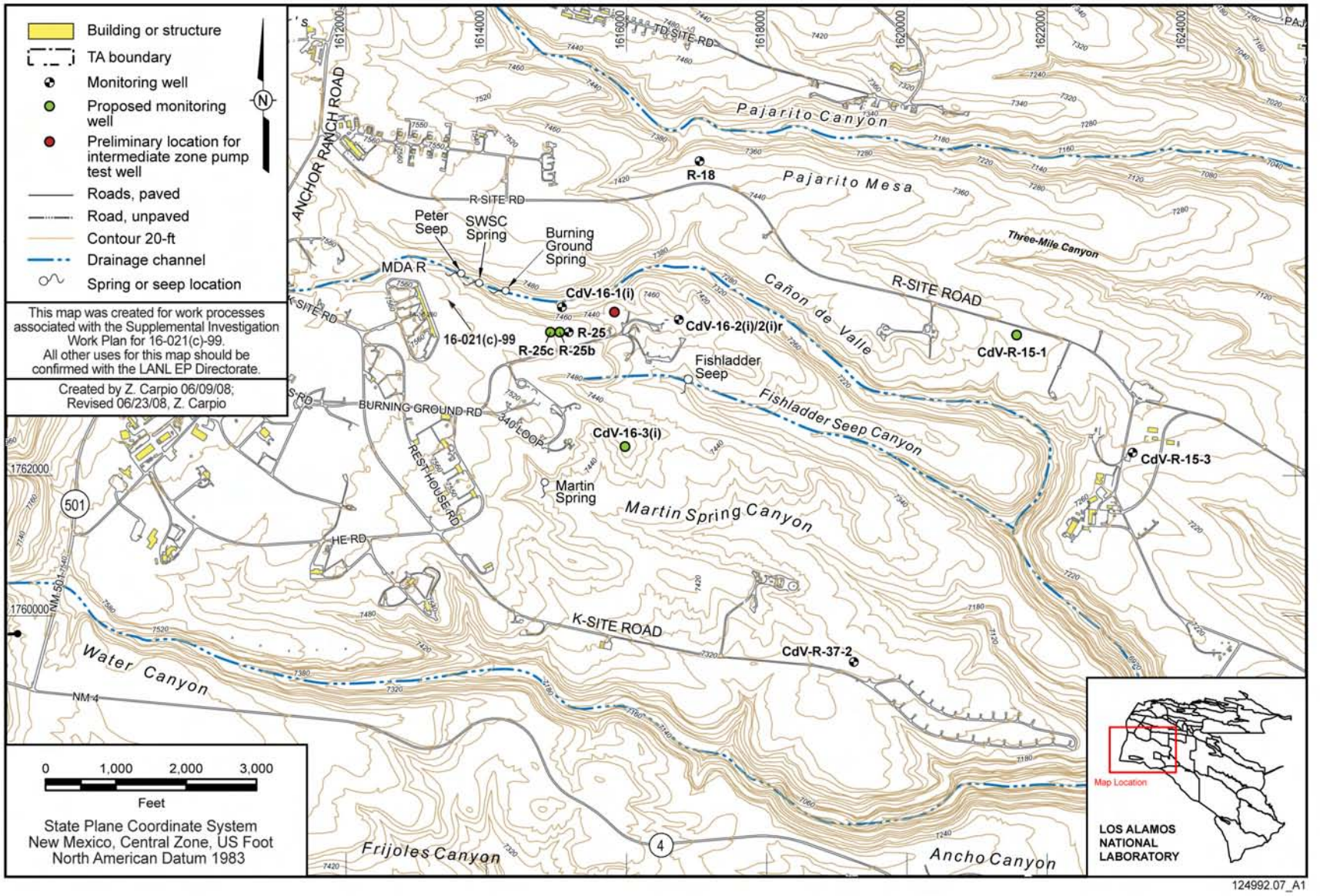

Figure 2.0-1 Proposed and existing monitoring wells for the Consolidated Unit 16-021(c)-99 supplemental investigation

Table 2.0-1
NOD Requirements for the Supplemental Investigation Work Plan

NMED Item Number	NOD Requirement	Element	Schedule	Data and Target Zone	Comments
1	Characterize extent of contaminant plume in the intermediate zone	Install new wells R-25b and R-25c; sample quarterly for 1 yr.	Installation of new wells has already been approved as a result of previous monitoring well network evaluation studies (NMED 2007, 100314; NMED 2008, 100575) and is scheduled to be completed in 2008.	HE concentrations in the Otowi Member (R-25b) and Puye Formation (R-25c) of the intermediate zone	These wells will corroborate existing data from R-25 screens 1 and 3. HE concentration data obtained from a 1-yr period of quarterly sampling will be used to revise the CME.
2	Characterize extent of contaminant plume in the regional aquifer	Install new wells CdV-16-3(i) and CdV-R-15-1; sample quarterly for 1 yr.	Installation of new wells has already been approved (NMED 2008, 101114) and is scheduled for 2009.	Puye Formation sediments and Tschicoma Formation lava flows of the regional aquifer beneath TA 16	These wells will help further define the extent of HE in the regional groundwater zone. HE concentration data obtained from a 1-yr period will be used to revise the CME. In addition to determining extent of HE contamination, wells CdV-16-3(i) and CdV-R-15-1 are being installed to improve the monitoring well efficiency to >95% confidence, and both wells will refine the water table map for the TA-16 area.
3	Characterize regional hydrogeological properties	Conduct single-well pump test in CdV-16-3(i) and CdV-R-15-1; use regional wells as observation wells for an intermediate-zone pump test.	Installation of CdV-16-3(i) and CdV-R-15-1 has already been approved (NMED 2008, 101114) and is scheduled to be completed in 2009.	Puye Formation sediments and Tschicoma Formation lava flows of the regional aquifer beneath TA-16	As part of CdV-16-3(i) and CdV-R-15-1 well installations, a single-well short duration pump tests will be conducted. These tests will provide local estimates of regional groundwater zone permeability. Inclusion of these wells in the long-term monitoring program will also provide additional information on regional groundwater hydrogeology. If a pump test is performed in the intermediate zone, area regional monitoring wells will also be monitored, which will help clarify the hydraulic communication between these zones.

Table 2.0-1 (continued)

NMED Item Number	NOD Requirement	Element	Schedule	Data and Target Zone	Comments
4	Characterize intermediate hydrogeological and hydrogeochemical properties	Conduct a single-well pump tests in R-25b and R-25c; perform a multiwell pump and tracer test, as needed, in a new well installed in the Puye Formation intermediate zone.	The single-well pump tests in these wells will be conducted during and after installation (completed in 2009). Finalization of the multiwell pump test is contingent on HE-concentration data from the Puye Formation intermediate zone. If HE concentrations exceed standards and water disposal issues can be resolved, an aquifer testing plan will be developed and submitted to NMED for approval, and a pump test will be conducted.	Permeability, sustainable pumping rate, contaminant concentrations, radius of influence, retardation, groundwater travel times in the Puye Formation of the intermediate zone. Pump-test response will also be monitored in intermediate zone wells.	The single-well test provides a local estimate for permeability. The multiwell pump and tracer test provides data from a greater area, and is critical for evaluating the feasibility of groundwater recovery and treatment in the intermediate zone; however, a determination of the efficacy of a pump test and its proper design requires hydrological and geochemical data from the new monitoring wells. The multiwell pump test would be conducted over a period of several days and would use intermediate and regional monitoring wells as observation points. Pump/tracer test details, such as the monitoring well network, test duration, and disposal and treatment options for recovered groundwater, is deferred until completion of an aquifer testing plan. Groundwater recovery and treatment are probably more feasible in the Puye than in the Otowi Member because of the relatively low permeability of tuff.
5	Determine HE degradation rates	Update the literature review.	A literature review will be included in the revised CME.	HE hydrolysis rates, sorption of HE; intermediate and regional zone sediments	This information will help address uncertainties in the conceptual model and in the groundwater transport model used for estimating travel times of HE to municipal wells. Specifically, terms for the degradation rate and sorption rate will be determined. These data will also be useful in the revised CME for the evaluation of MNA.
6	Install new wells within the monitoring network	Install new wells as a result of previous network evaluation study. See items 1 and 2.	See items 1 and 2.	Extent of HE contamination in the intermediate and regional zone	The monitoring network was recently evaluated (LANL 2007, 100113), resulting in planned installation of new monitoring wells.

Table 2.0-1 (continued)

NMED Item Number	NOD Requirement	Element	Schedule	Data and Target Zone	Comments
Conceptual Model Uncertainties					
7	Characterize infiltration rates, travel times, fluxes	Conduct pump and tracer tests in the intermediate zone; continue to monitor and sample groundwater.	Finalization of plans for intermediate zone pump and tracer test will be made after 1 yr of HE-concentration data have been collected from new wells. An aquifer testing plan will be prepared and submitted to NMED.	Hydrogeologic data such as intermediate and regional drawdowns and tracer travel times and fluxes	The pump and tracer test will provide data that can be used to determine the infiltration rate (vertical flux) between the intermediate and regional. These data will also be used to refine the parameter values in transport models, thereby reducing the uncertainty in travel time predictions to area municipal drinking water wells.
8	Determine source-term uncertainties	Install new wells (R-25b, R-25c, CdV-16-3(i), and CdV-R-15-1) and sample for 1 yr. Monitor these wells and others during the multiwell pump test.	See items 1, 2, and 4.	HE data over 1 yr at new wells in the intermediate and regional zones. Hydraulic data from the multiwell pump test	An HE source-term study based on observed concentration data was included in Appendix C of the CME report (LANL 2007, 098734). The study concluded that the HE mass in the intermediate and regional zones was uncertain. Additional concentration data from new wells in these zones will better constrain this mass estimate and better define the extent of the HE plume.
9	Determine hydraulic uncertainties	Install new wells; complete single-borehole pump tests in the new wells; perform a multiwell pump test.	See items 1, 2, and 4.	Intermediate and regional zones	See comments in item 4 above.
10	Characterize HE trends	Install new wells and obtain sample data for 1 yr; evaluate HE data from other wells during this period.	See items 1 and 2 above.	Intermediate and regional zones	HE data from the new wells and ongoing monitoring will be used to revise the CME.

Table 3.0-1
Schedule for Supplemental Investigation Activities

Activity	Schedule
Supplemental investigation work plan submitted to NMED	June 30, 2008
Install R-25b and R-25c	2008
Install CdV-16-3(i)	2009
Install CdV-R-15-1	2009
Sample and evaluate HE data	2008–2009
Reach decision point regarding multiwell pump test	2009
Develop multiwell pump test plan	2010
Perform multiwell pump test	2010
Prepare revised CME	6 mo after pump test