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# Plugging and Abandonment Summary Report for Well CdV-16-2(i)

Los Alamos
NATIONAL LABORATORY
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Prepared by the Environmental Programs Directorate

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## EXECUTIVE SUMMARY

This report summarizes the methods Los Alamos National Laboratory (LANL or the Laboratory) used to plug and abandon groundwater-monitoring well CdV-16-2(i). This well is located on the mesa top east of well R-25 in Technical Area 16 (TA-16) of the Laboratory and was installed in 2003 using air-rotary and fluid-assisted air-rotary methods. The CdV-16-2(i) well was installed from December 8 to December 14, 2003, to a total depth (TD) of 1037.1 ft below ground surface (bgs) with two screened intervals. The upper screened interval was set from 850.2 ft to 867.8 ft bgs within the intermediate-depth perched groundwater zone. The lower screened interval was set from 992.0 to 1015.2 ft bgs in a deeper zone of saturation.

During well development, the well failed to recharge. Video logging confirmed the absence of recharge to both screened intervals. A sampling system was not installed in the well. A replacement well, CdV-16-2(i)r was drilled approximately 50 ft west of the CdV-16-2(i) location. Well CdV-16-2(i) was plugged and abandoned because of concerns that contaminated groundwater may be migrating downward, via the filter pack, into the vadose zone toward the regional aquifer.

Well CdV-16-2(i) was plugged and abandoned from June 26 to July 13, 2009, using a work-over rig and ancillary equipment. A mechanically actuated perforating tool was used to perforate screen 1 (837 to 877 ft bgs) and screen 2 (980 to 1023 ft bgs) filter-pack intervals before well plugging and abandonment. The screen/casing intervals were perforated to allow increased open area for movement of sealing material into the filter-pack intervals.

After both intervals were perforated, the well was pressure-grouted via tremie pipe with a mixture of Portland Type I/II/V cement, Baroid IDP-381 cement additive, and municipal water. A mixture of 0.53% (dry weight) Baroid IDP-381 was mixed with cement before it was mixed with water.

Well CdV-16-2(i) was grouted to ground surface on July 10, 2009, and the protective casing and stainless-steel well casing were cut off at ground surface. A total of 1217.6 gal. of cement grout was used to abandon the well.

The water level was measured at CdV-16-2(i)r during abandonment activities at CdV-16-2(i). The water level began rising as grouting was initiated on July 9, 2009 and rose approximately 0.5 ft by August 10, 2009. Water levels will continue to be monitored in CdV-16-2(i)r.

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## 1.0 INTRODUCTION

This report summarizes the methods Los Alamos National Laboratory (the Laboratory) used to plug and abandon groundwater-monitoring well CdV-16-2(i). Well abandonment was consistent with the requirements and guidelines in Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (the Consent Order) and the New Mexico Environment Department- (NMED-) approved Work Plan to Plug and Abandon Cañon de Valle Well CdV-16-2(i) (LANL 2009, 106054). Plugging and abandonment was performed by TerranearPMC and was supervised by Laboratory personnel.

## 2.0 BACKGROUND

Well CdV-16-2(i) is located on the mesa top east of well R-25 in Technical Area 16 (TA-16) of the Laboratory and was installed in December 2003 using air-rotary and fluid-assisted air-rotary methods. The well location is shown in Figure 2.0-1. Well CdV-16-2(i) is a dual-screen well and is constructed as follows:

- 0–12 ft below ground surface (bgs): 13 3/8-in.-outside diameter (O.D.) steel casing cemented in place from 0 to 12 ft bgs
- 0–1037 ft bgs: 5-in.-O.D./4.5-in. inside diameter (I.D.) stainless-steel casing with a bentonite chip seal from 75 to 837 ft bgs. Concrete backfill consisting of Portland cement with 4% bentonite was placed from 75 ft bgs to ground surface
- 850.2–867.8 ft bgs: 5.53-in. O.D. pipe-based stainless-steel screen with a secondary filter pack from 837 to 840 ft bgs and a primary filter pack from 840 to 877 ft bgs
- 992–1015.2 ft bgs: 5.27-in.-O.D. rod-based stainless-steel screen with a secondary filter pack from 980 to 982 ft bgs and a primary filter pack from 982 to 1023 ft bgs

### 2.1 Well History

Well CdV-16-2(i) was drilled from November 16 to December 3, 2003. The well was installed to identify potential contamination in groundwater associated with effluents containing high explosives (HE) discharged from TA-16.

The CdV-16-2(i) well was installed from December 8 to December 14, 2003, to a total depth (TD) of 1037.1 ft bgs with two screened intervals. The upper screened interval was set from 850.2 ft to 867.8 ft bgs within the intermediate-depth perched groundwater zone. The lower screened interval was set from 992.0 to 1015.2 ft bgs in a lower zone of saturation.

During well development activities (December 18, 2003, to January 7, 2004), the well was bailed dry after approximately 30 gal. of water was removed. A downhole video survey was run inside the well casing to view the integrity of the screen intervals. The video survey indicated that no recharge was evident through either screened interval. Static water level was documented at 1015.2 bgs, equivalent to the depth of the bottom of the lower screen. No dedicated sampling system was installed and no groundwater samples were collected from this well. A replacement well, CdV-16-2(i)r, was successfully drilled and installed from July 12 to July 30, 2005. The replacement well is located approximately 50 ft west of CdV-16-2(i). It was installed as a single-screen well and was outfitted with a dedicated submersible pump. The replacement well has consistently provided groundwater samples during regularly scheduled sampling events.

### 2.2 Rationale for Plugging and Abandonment

Well CdV-16-2(i) was plugged and abandoned in accordance with direction from NMED, who noted that the upper screen and filter pack are positioned across the low-permeability perching unit located at an approximate depth of 850 ft. NMED expressed concern that contaminated groundwater perched on this unit may be migrating downward, via the filter pack, into the vadose zone toward the regional aquifer (NMED 2009, 104973). The well was plugged and abandoned in accordance with the work plan (LANL 2009, 106054) approved by NMED (2009, 106045).

## 3.0 SCOPE OF ACTIVITIES

The scope of activities is presented below.

### 3.1 Plug and Abandonment Design and Approach

Before abandoning the monitoring well, the well was logged using a Laboratory video camera and a gamma ray tool to document current well conditions. The results of the video and geophysical logs from well CdV-16-2(i) are discussed below. To plug and abandon well CdV-16-2(i), the entire sand filter pack intervals at screen 1 (837–877 ft bgs) and screen 2 (980–1023 ft bgs) were perforated. Perforating the filter pack interval allows the grout to penetrate the annular space between the well casing and borehole wall. Pressure-grouting (i.e., using a grout pressure greater than atmospheric pressure) from bottom to top using a tremie pipe was conducted after the well was perforated.

### 3.2 Borehole Logging

Well CdV-16-2(i) was video logged and gamma logged on June 26, 2009, before well abandonment. The well was also video logged on July 5, 2009.

#### 3.2.1 Video Logging

A downhole video camera was run in the CdV-16-2(i) well on June 26, 2009, to document preabandonment conditions, confirm screen depths of both screens, and observe the composite static water level prior to plugging and abandonment activities. The June 26 video confirmed the screened depths were consistent with the original construction records and that the static water level was just below the bottom of screen 2 (at the top of the sump). No water was observed entering either screen 1 or screen 2. Note that the June 26 video log DVD was damaged and could not be copied, but is archived and available for viewing upon request.

A second video log, taken on July 5, 2009, is described under Field Activities in section 3.3.1.

#### 3.2.2 Geophysical Logging

The gamma ray log of January 15, 2004 (Figure 3.2-1), recorded shortly after well installation, was compared to the gamma ray log run on June 26, 2009 (Figure 3.2-2). The purpose of the comparison was to discern whether annular fill depths at screens 1 and 2 had changed over time. Inspection of the two figures indicates negligible differences between the two logs at depths of 837–877 ft (filter pack interval of screen 1) and 980–1023 ft (filter pack interval of screen 2), suggesting that the annular fill had remained in place.

### 3.3 Plugging and Abandonment

Plugging and abandonment activities included mobilization, downhole video and geophysical logging, perforation of the filter pack intervals, pressure-grouting, surface completion, and demobilization. All activities were performed following appropriate standard operating procedures and Laboratory-approved health and safety documents. Well CdV-16-2(i) was plugged and abandoned in accordance with the NMED-approved work plan (LANL 2009, 106054).

#### 3.3.1 Field Activities

Mobilization of equipment to the well site was performed on June 26, 2009, following a field management, operations, and verification that included inspection of the work-over rig and heavy equipment. A groundwater level measurement of 1013 ft bgs was collected on June 26, 2009, and the bottom of the well was tagged at 1037.03 ft bgs before abandonment.

Well CdV-16-2(i) was plugged and abandoned from June 26 to July 13, 2009, using a PulStar 100K work-over rig and ancillary equipment. A mechanically actuated perforating tool (a mill knife) was tripped into the well on a 2-in. steel tremie pipe and actuated with a winch cable. The mill knife was used to perforate screen 1 (837–877 ft bgs) and screen 2 (980–1023 ft bgs) filter-pack intervals before grouting. Screen 2 was perforated between June 27 and July 2, 2009. Screen 1 was perforated between July 3 and July 8, 2009. Perforations were made every 6 in. and 180 degrees apart at both screens. On July 8, 2009, the bottom of the well was tagged at 1018.78 ft bgs, indicating approximately 18.25 ft of filter pack sand had entered the well. No water was detected in the well at that point. Because water was absent in the well and the filter sand did not come up into the lower screen (screen 2) interval, no attempt was made to bail out the filter sand.

Problems were encountered with the mill knife during the perforating task. The blade of the mill knife was replaced on June 29 and again on July 2, 2009. The camera was run in the well on July 5, 2009, to investigate why the blade was breaking and to confirm that the mill knife was cutting the stainless-steel well casing. The camera inspection (included as a DVD in Appendix A) indicated that the well couplings were likely the cause for the broken blade. The coupled unions of the well casing have short intervals where the casing between the coupled unions is considerably thicker than the regular pipe intervals. The camera inspection did reveal that the mill knife was perforating the casing when functioning properly and deployed in uncoupled pipe and/or screen intervals.

After both filter pack intervals were perforated, well CdV-16-2(i) was abandoned with a mixture of Portland Type I/II/V cement, Baroid IDP-381 cement additive and municipal water. A mixture of 0.53% (dry weight) Baroid IDP-381 was mixed with cement before it was mixed with water. A ratio of 35 gal. water, four (94 lb) bags cement, and one (2 lb) bag IDP-381 was mixed for each nominal 50-gal. batch of cement grout. The well was pressure-grouted via tremie pipe from July 9 to July 12, 2009. On July 9, the well was grouted from 1018.78 ft bgs to 137.5 ft bgs. Approximately 1000 gal. of grout was used to abandon this interval, indicating grout was entering the perforated filter pack intervals because the actual grout-fill volume (linear ft of fill/gal.) exceeded the calculated linear-fill volume. On July 10, 2009, the well was tagged at 263.5 ft bgs, indicating the grout dropped approximately 126 ft. An additional 217 gal. of grout was added to fill the well to the surface. Total grout volume added was 1218 gal., which represents 129% of the calculated well casing only fill volume (946 gal., 0 to 1019 ft); thus, an excess of 272 gal. of grout entered the well filter packs. The excess grout volume also represents 64% of the total well filter-pack volume (56.6 $ft^3$ or 423.4 gal.), indicating good cementation of the filter packs. The volume and type of abandonment materials used are presented in Table 3.3-1.

A pneumatic diaphragm pump was used to deliver the grout from mixing drums at the ground surface to the bottom of the well in a 2-in. tremie pipe. Pumping the grout in nearly one continuous lift built a column of grout inside the well casing that ensured the perforated intervals were under continuous head pressure. Estimated head pressures of the grout at each perforated interval on the first day of grouting (to 137.5 ft bgs) were approximately 650 lb per square in. (psi) (lower interval) and 550 psi (upper interval).

The addition of Baroid IDP-381 helped ensure a thorough plugging operation. IDP-381 is a cement curing retardant that enhances the cement's flow properties and improves bonding characteristics. Small samples of the cement used at CdV-16-2(i) indicated that the cement's actual set time was between 24 and 36 h.

### 3.3.2 Completion

Once the well was cement-grouted to within 12.9 ft bgs, the protective casing and stainless-steel well casing were cut off at ground surface (Figure 3.3-1). Cement was mixed and added to the well from the surface to fill the remaining 12.9 ft of void space. A brass marker was surveyed during well completion in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system to within 0.5 ft. The surveyed location is recorded in the as-built figure in the well completion report (Kleinfelder 2004, 087843). No new survey of the abandoned well is planned.

### 3.3.3 Water Level Monitoring in Well CdV-16-2(i)r

Water levels at nearby well CdV-16-2(i)r were monitored during the plugging and abandonment activities at CdV-16-2(i). Transducer measurements at CdV-16-2(i)r indicate that after a year-long period in which the static water level declined gradually by approximately 0.4 ft, the water level began to rise slightly on July 9, 2009, when grouting began at CdV-16-2(i). The water level rose approximately 0.5 ft between July 9 and August 10 (Figure 3.3-2). CdV-16-2(i)r is screened at the equivalent level of screen 1 in CdV-16-2(i). The water level at CdV-16-2(i)r will continue to be monitored and the well will be sampled in accordance with the 2009 Interim Facility-Wide Groundwater Monitoring Plan (LANL 2009, 106115).

## 4.0 POSTABANDONMENT ACTIVITIES

Postabandonment activities are described below.

### 4.1 Well Site Restoration

The well casing and protective casing were cut to ground surface and topped with cement. Plugging and abandonment activities were not obtrusive to site conditions and no restoration efforts were required.

### 4.2 Waste Management

No waste was generated during the plugging and abandonment of well CdV-16-2(i). The Laboratory removed the concrete pad surrounding the well. There was no excess cement grout generated during the plugging and abandonment of well CdV-16-2(i).

## 5.0 DEVIATIONS FROM PLANNED ACTIVITIES

There were no deviations from or modifications to the NMED-approved work plan.

## 6.0 SUMMARY

Well CdV-16-2(i) screened intervals, including the filter-pack intervals, were perforated using a mechanically actuated mill knife prior to plugging and abandonment. The well was plugged and abandoned from bottom to top via tremie pipe with a mixture of Portland Type I/II/V cement, Baroid IDP-381 cement additive, and municipal water. The well casing was cut off at ground surface.

## 7.0 REFERENCES

*The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs 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 and the 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.*

Kleinfelder, May 14, 2004. "Final Well CdV-16-2(i) Completion Report," report prepared for Los Alamos National Laboratory, Project No. 37151/10.12, Albuquerque, New Mexico. (Kleinfelder 2004, 087843)

LANL (Los Alamos National Laboratory), May 2009. "Work Plan to Plug and Abandon Cañon de Valle Well CdV-16-2(i)," Los Alamos National Laboratory document LA-UR-09-2704, Los Alamos, New Mexico. (LANL 2009, 106054)

LANL (Los Alamos National Laboratory), May 2009. "2009 Interim Facility-Wide Groundwater Monitoring Plan," Los Alamos National Laboratory document LA-UR-09-1340, Los Alamos, New Mexico. (LANL 2009, 106115)

NMED (New Mexico Environment Department), January 26, 2009. "Approval with Modifications, Suppl[e]mental Investigation Work Plan for Intermediate and Regional Groundwater at TA-16 (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 2009, 104973)

NMED (New Mexico Environment Department), May 19, 2009. "Notice of Approval, Work Plan to Plug and Abandon Well CdV-16-2(i), 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 2009, 106045)

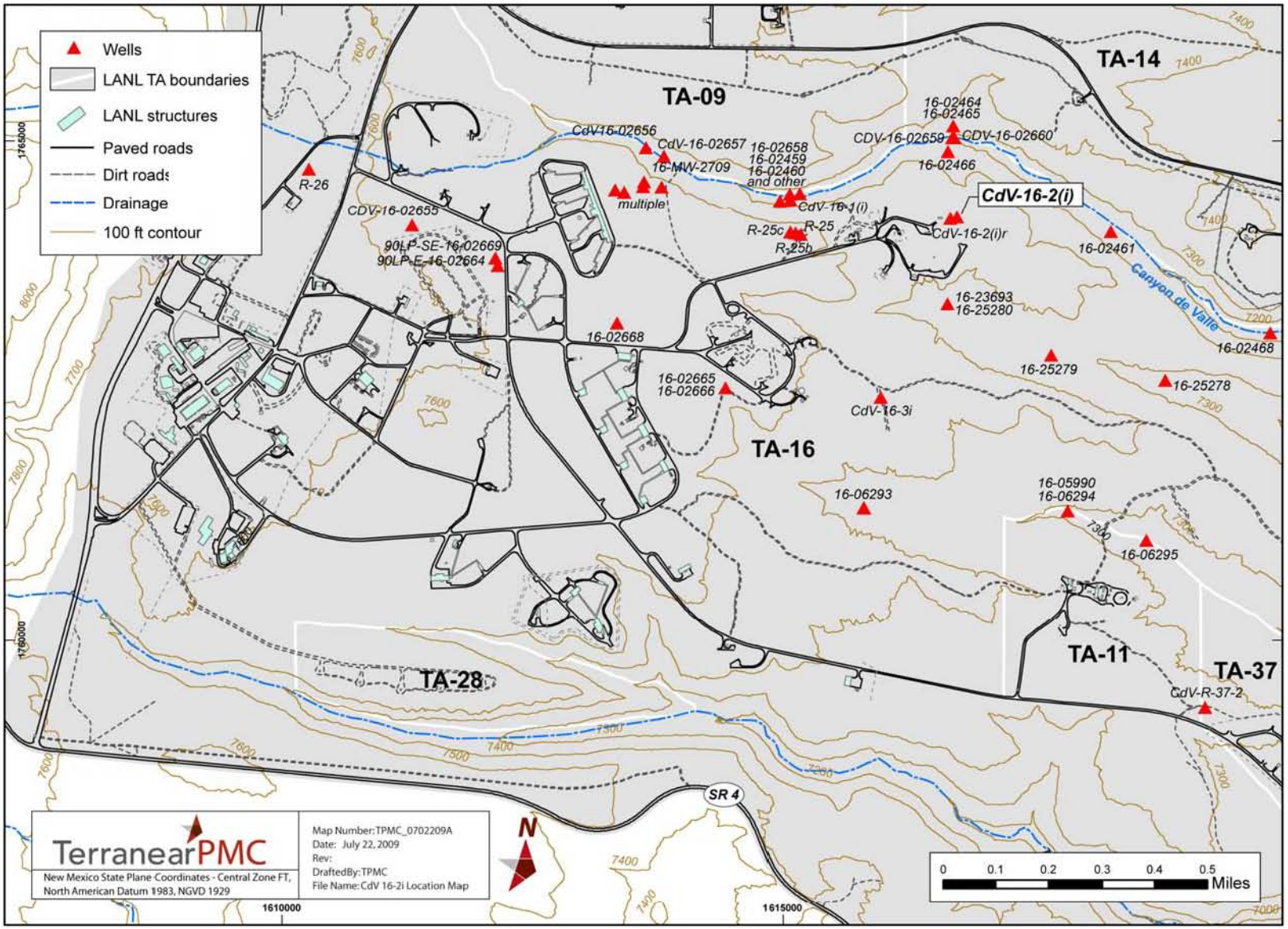


**Figure 2.0-1 Location of Well CdV-16-2(i) in the western part of the Laboratory**

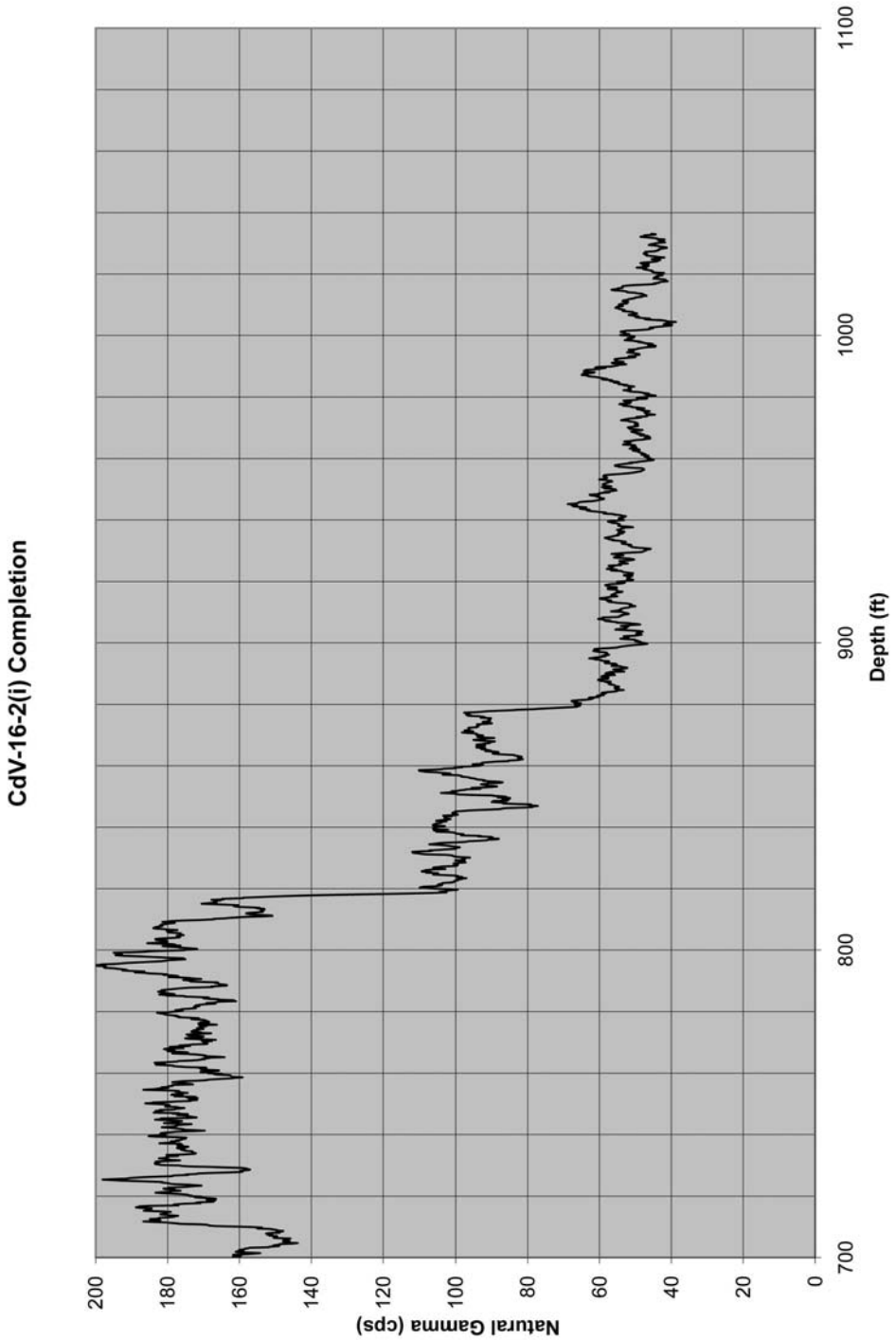


**Figure 3.2-1 Gamma log of January 15, 2004**

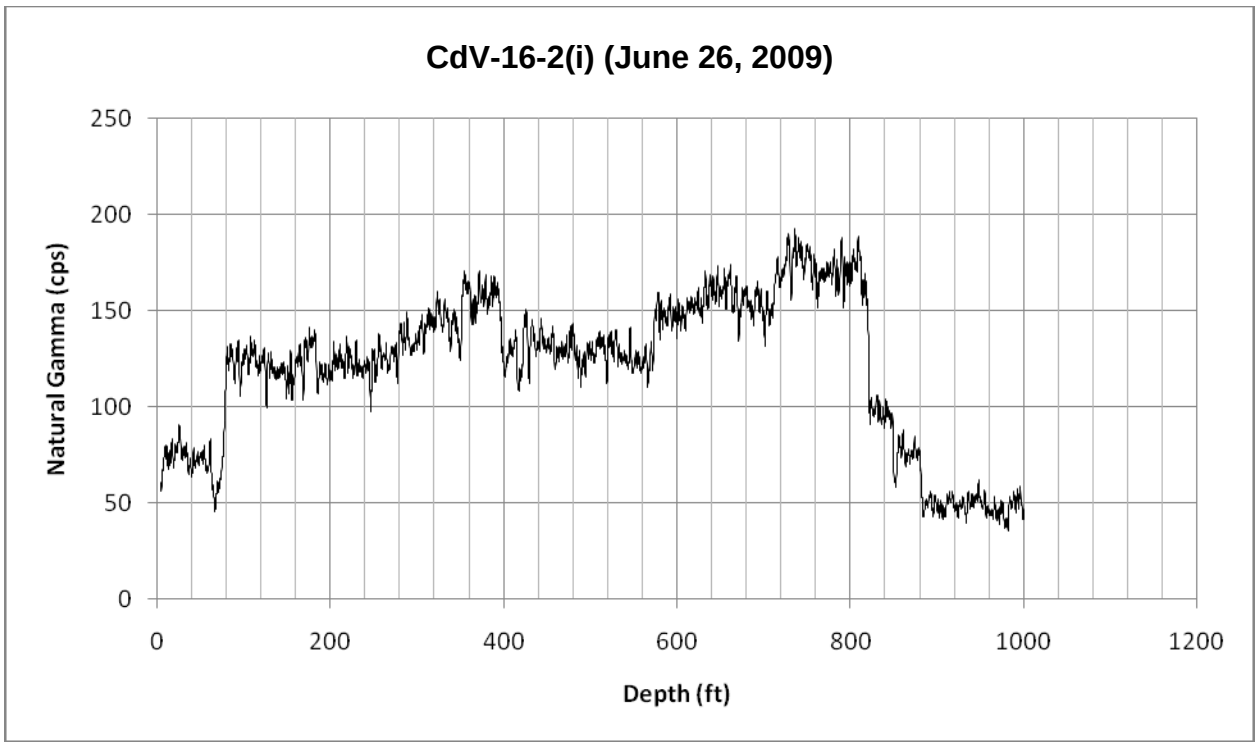


**Figure 3.2-2 Gamma log of June 26, 2009**

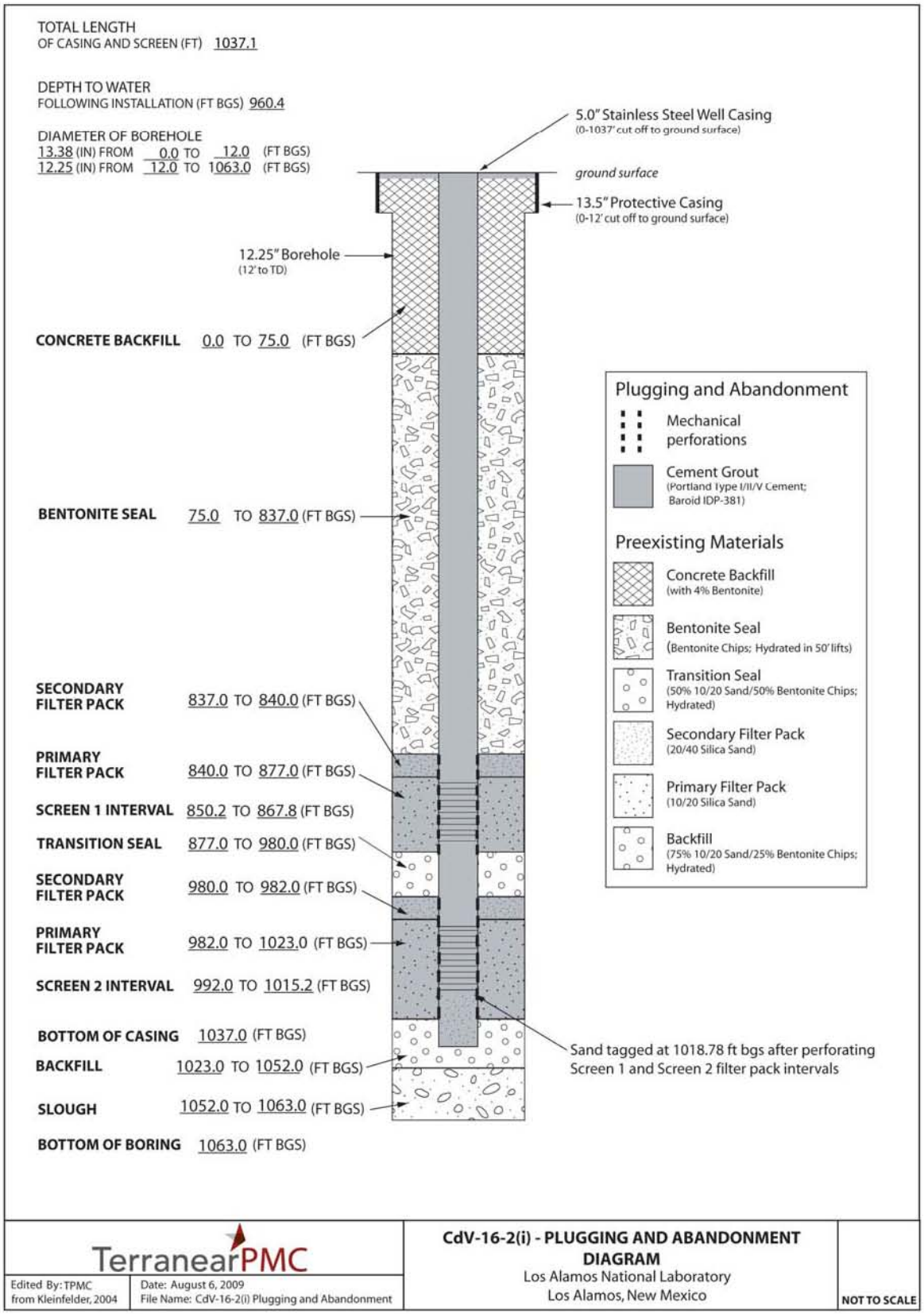


**Figure 3.3-1 Well CdV-16-2(i) plugging and abandonment diagram**

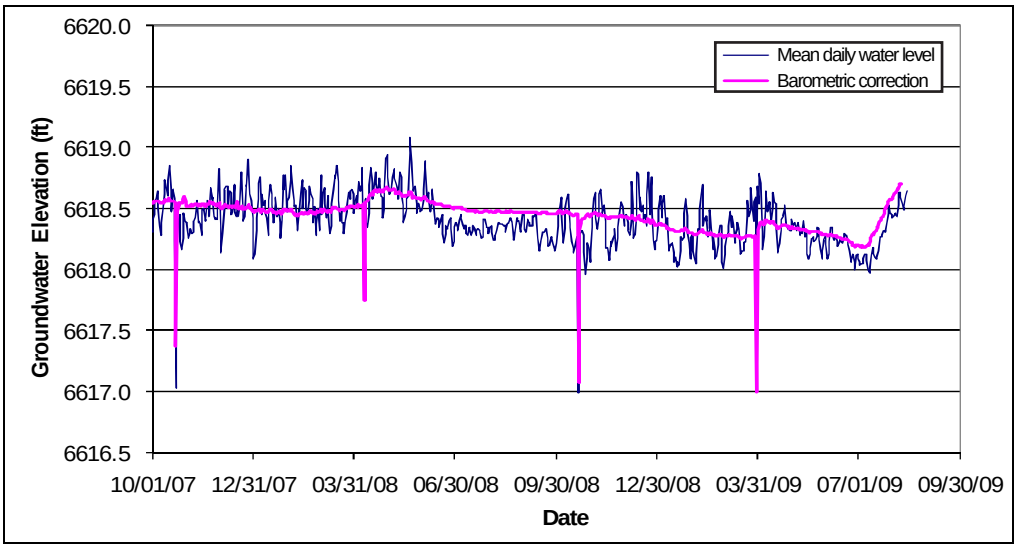


**Figure 3.3-2 Hydrograph for well CdV-16-2(i)r from October 2007 through August 10, 2009**

**Table 3.3-1**
**Quantity and Materials Used to Plug and Abandon Well CdV-16-2(i)**

| Date | Depth Interval (ft bgs bottom to top) | Quantity Portland Type I/II/V Used (No. 94-lb bags/total lb) | Quantity Municipal Water Used (gal.) | Quantity Baroid IDP-381 Used (lb) | Calculated Volume (gal.) | Actual Volume (gal.) |
|---|---|---|---|---|---|---|
| 7/9/2009 | 1019–137.5[a] | 80/7520 | 700 | 40 | 727.9 | 1000 |
| 7/10/2009 | 263.5–surface[b] | 17/1598 | 145 | 8 | 217.6 | 217.6 |
| Total | | 97/9118 | 845 | 48 | 945.47 | 1217.6 |

[a] After perforating screened intervals, the sand was tagged at 1018.78 ft bgs.

[b] The well was tagged at 263.5 ft bgs on the morning of 7/10/2009; grout dropped approximately 126 ft.

# Appendix A

*DVD of Video Camera Run – July 5, 2009*