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Date: APR 16 2015
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John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of the Plugging and Abandonment Summary Report for Wells LAWS-01, LAWS-02, LAWS-03, Test Well DT-5, Test Well DT-5A, Test Well DT-9, Test Well SIMO, and Test Well SIMO-1

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of the Plugging and Abandonment Summary Report for Wells LAWS-01, LAWS-02, LAWS-03, Test Well DT-5, Test Well DT-5A, Test Well DT-9, Test Well SIMO, and Test Well SIMO-1. LAWS-02, LAWS-03, and Test Well DT-5A were completed per the Replacement Work Plans for the Plugging and Abandonment of Wells for 2014, dated March 5, 2014, for which the New Mexico Environment Department (NMED) had no comments. Work plans for Test Well DT-5, Test Well DT-9, SIMO, and SIMO-1 were submitted electronically and approved by e-mail. The work plan for plugging and abandoning LAWS-01 was not reviewed by NMED. This plugging and abandonment work was completed by Los Alamos National Laboratory as part of its ongoing program to plug and abandon wells that are no longer in use.

If you have any questions, please contact Ted Ball at (505) 665-3996 (tedball@lanl.gov) or Gene Turner at (505) 667-5794 (gene.turner@nnsa.doe.gov).

Sincerely,

Alison M. Dorries, Division Leader
Environmental Protection Division
Los Alamos National Laboratory

Sincerely,

Peter Maggiore
Office of the Manager
Los Alamos Field Office

AD/CG/DM/TB:sm

Enclosures: Two hard copies with electronic files – Plugging and Abandonment Summary Report for Wells LAWS-01, LAWS-02, LAWS-03, Test Well DT-5, Test Well DT-5A, Test Well DT-9, Test Well SIMO, and Test Well SIMO-1 (EP2015-0023)

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LA-UR-15-21849
April 2015
EP2015-0023

Plugging and Abandonment Summary Report for Wells LAWS-01, LAWS-02, LAWS-03, Test Well DT-5, Test Well DT-5A, Test Well DT-9, Test Well SIMO, and Test Well SIMO-1

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

EP2015-0023

Plugging and Abandonment Summary Report for Wells LAWS-01, LAWS-02, LAWS-03, Test Well DT-5, Test Well DT-5A, Test Well DT-9, Test Well SIMO, and Test Well SIMO-1

April 2015

Responsible project manager:

Printed Name	Signature	Title	Organization	Date
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Responsible LANS representative:

Printed Name	Signature	Title	Organization	Date
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Peter Maggiore	Peter Maggiore		DOE-NA-LA	4/15/15

EXECUTIVE SUMMARY

This report details the methods Los Alamos National Laboratory (the Laboratory) used to plug and abandon wells LAWS-01, LAWS-02, LAWS-03, DT-5, DT-5A, DT-9, SIMO, and SIMO-1. The wells were plugged and abandoned in accordance with direction from the New Mexico Environment Department (NMED), the Laboratory's Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory, and NMED's Notice of Approval with Modifications [for the] Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory.

Plugging and abandonment activities occurred from June 26, 2014, to December 9, 2014. Before the boreholes were abandoned, all aboveground and belowground appurtenances were removed. Water-level measurements and the total depths of the boreholes and wells were verified using a water-level meter, tremie pipe, and/or video equipment before abandonment.

Wells LAWS-01, LAWS-02, and LAWS-03; and test wells DT-5 and DT-5A were plugged and abandoned using a Pulstar 100k pump hoist rig. Test well DT-9 was plugged and abandoned using a Pulstar 20k pump hoist and Foremost DR-24HD drill rig. Test wells SIMO and SIMO-1 were plugged and abandoned using a CME-55 auger drilling rig. Hydrated bentonite chips/pellets, Portland Type I/II cement, and municipal water were used to plug and abandon the wells.

The wells were cement-grouted to approximately 2.0 ft below ground surface, and a small concrete surface plug/pad was installed near the ground surface and/or on top of the existing surface pad. If the existing surface pad did not have a brass marker, an aluminum survey marker was emplaced in the surface plug/pad. The surface completion was surveyed in accordance with Section IX.B.2.f of the Compliance Consent on Order.

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Appendix C NMOSE Plugging Plans of Operation and Plugging Records (on CD included with this report)

Acronyms and Abbreviations

amsl	above mean sea level
bgs	below ground surface
Consent Order	Compliance Order on Consent
ESH	Environment, Safety, and Health
I.D.	inside diameter
LANL	Los Alamos National Laboratory
MDA	material disposal area
NAD	North American datum
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
O.D.	outside diameter
PVC	polyvinyl chloride
TA	technical area
TD	total depth

1.0 INTRODUCTION

This report summarizes the methods Los Alamos National Laboratory (LANL or the Laboratory) used to plug and abandon wells LAWS-01, LAWS-02, LAWS-03, DT-5, DT-5A, DT-9, SIMO, and SIMO-1. The wells are located in and around Los Alamos County, New Mexico, as shown in Figure 1.0-1.

Well abandonment was consistent with the requirements and guidelines in Section X.D (Well Abandonment) of the Compliance Order on Consent (the Consent Order). Additionally, the plugging and abandonment procedures complied with 19.27.4 New Mexico Administrative Code Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells.

The following documents helped guide the implementation of the scope of work for the plugging and abandonment project:

- Replacement Work Plans for the Plugging and Abandonment of Wells for 2014 (LANL 2014, 254668);
- The New Mexico Environment Department's (NMED's) Notice of Approval with Modifications [for the] Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory (NMED 2014, 525052);
- Communications with NMED (Ball 2014, 600206; Dale 2014, 600253; Dale 2014, 600254);
- Work Plan to Plug and Abandon Intermediate Well LAWS-01 (TerranearPMC 2014, 600267);
- Work Plan to Plug and Abandon Test Well DT-5 (TerranearPMC 2014, 600268); and
- Field Implementation Plan to Plug and Abandon Boreholes LAWS-02, LAWS-03, DT-5A, and R-25 (TerranearPMC 2014, 600311).

A Plugging Plan of Operations was filed with the New Mexico Office of the State Engineer (NMOSE) for six of the eight wells that are on Laboratory property (NMOSE 2014, 600207; NMOSE 2014, 600208; NMOSE 2014, 600209; NMOSE 2014, 600210; NMOSE 2014, 600211; NMOSE 2014, 600212). NMOSE plans were not filed for two wells situated on San Ildefonso land (SIMO and SIMO-1) because NMOSE lacks jurisdiction over Pueblo lands. In addition, records were filed with NMOSE for the six wells drilled on Laboratory property (NMOSE 2014, 600278; NMOSE 2014, 600279; NMOSE 2014, 600280; NMOSE 2014, 600281; NMOSE 2014, 600282; NMOSE 2014, 600283).

2.0 BACKGROUND

This section describes the location, construction, and conditions of each well before plugging and abandonment activities.

2.1 Wells LAWS-01, LAWS-02, and LAWS-03

Wells LAWS-01, LAWS-02, and LAWS-03 are located in Technical Area TA 72 (TA-72) at the site of the Los Alamos Canyon low-head weir.

LAWS-01 was drilled to a depth of 281.5 ft below ground surface (bgs) and completed as a four-screen well. A 12-in.-diameter hole was augered to approximately 9.0 ft bgs to the top of basalt. A 10 ¾-in. outside diameter (O.D.) carbon steel surface casing was set and the borehole was advanced to 281.5 ft bgs using air-rotary, casing-advance methods. Flush threaded 4.5-in.-O.D. schedule 80 polyvinyl chloride (PVC) well casing was installed to 278 ft total depth (TD) with four screens set at 83–93 ft bgs, 158.0–168.0 ft bgs,

188.0–198.0 ft bgs, and 263.0–273.0 ft bgs. A FLUTe water-monitoring system was deployed with the associated transducers and sampling ports.

LAWS-02 was drilled at a 43-degree angle to 156.0 ft (length) under the Los Alamos Canyon weir site. A 12-in.-diameter hole was augered approximately 9.0 ft to the top of basalt. A 10 ¾-in.-O.D. carbon-steel surface casing was set, and the borehole was advanced to 156.0 ft bgs (length) using air-rotary, casing-advance methods. A scalloped 6.6-in.-O.D. schedule 80 PVC well casing was installed in the borehole before a FLUTe vadose zone–monitoring system was installed.

LAWS-03 was drilled at a 34-degree angle to 136.0 ft (length) under the Los Alamos Canyon weir site. A 12-in.-diameter hole was augered approximately 9.0 ft to the top of the basalt. A 10 ¾-in.-O.D. carbon-steel surface casing was set, and the borehole was advanced to 136.0 ft (length) using air-rotary, casing-advance methods. A scalloped 6.6-in.-O.D. schedule 80 PVC well casing was installed in the borehole but collapsed below 80.0 ft (casing length) from borehole formation materials. The upper scalloped portion of PVC was replaced with perforated 6.6-in.-O.D. schedule 40 PVC well casing to 80.0 ft (casing length) before a FLUTe vadose zone–monitoring system was installed.

Pre-abandonment Conditions

TD of well LAWS-01 was measured to 278.0 ft bgs with a static water level of 154.4 ft bgs on July 29, 2014, after the FLUTe water-monitoring system was removed from the well casing. TD and the static water level were verified with a water-level meter.

The bottom of well LAWS-02 was measured at 140.0 ft (casing length) with no water present on July 31 after the FLUTe vadose zone–monitoring system was removed from the well casing. TD and the lack of water were verified with a tremie pipe before plugging materials were added.

The FLUTe vadose zone–monitoring system installed in well LAWS-03 was not present in the well casing before plugging and abandonment activities were undertaken. The obstruction at 80.0 ft bgs (casing length) in well LAWS-03 was measured and the lack of water was verified with a tremie pipe before plugging materials were added.

Figures 2.1-1, 2.1-2, and 2.1-3 are well construction diagrams that depict the construction details and pre-abandonment conditions of wells LAWS-01, LAWS-02, and LAWS-03, respectively.

2.2 Test Wells DT-5 and DT-5A

Test wells DT-5 and DT-5A are located at TA-49 within Area 5 in close proximity to Material Disposal Area (MDA) AB.

DT-5 was drilled to 927.0 ft bgs in 1960 (Purtymun 1995, 045344) with air-rotary equipment. Circulation could not be maintained in the borehole because of numerous fractures, and the hole was terminated at 927.0 ft bgs. The well was constructed with 180.0 ft of 8 ¾-in.-O.D. casing and was open hole from 180.0–927.0 ft bgs.

DT-5A was drilled to 1821.0 ft bgs in 1960 (Purtymun 1995, 045344) with air-rotary equipment. The well was constructed with 12 ¾-in.-O.D. casing cemented in place from surface to 525.0 ft bgs. Inside the 12 ¾-in.-O.D. casing is 1821.0 ft of 8 ¾-in.-O.D. casing with torch-cut slots throughout the casing below 1172 ft bgs.

Pre-abandonment Conditions

A video log of DT-5 was collected using the Laboratory's camera trailer on July 11, 2014.TD of DT-5 was measured at 924.4 ft bgs with no water present on July 24. TD and the lack of water were verified with Laboratory video-logging equipment and a water-level meter.

A video log of DT-5A was collected using the Laboratory's camera trailer on July 24. TD of DT-5A was measured at 1788.0 ft bgs with water present at 1187.5 ft bgs. TD and the presence of water were verified with Laboratory video-logging equipment and a water-level meter. In addition, on July 25, a natural gamma log of DT-5A was obtained by Laboratory personnel from 1780.0 ft bgs to the surface.

The video logs for DT-5 and DT-5A are presented in Appendix A (on DVD). Natural gamma logs are presented in Appendix B.

Figures 2.2-1 and 2.2-2 are well construction diagrams that depict the construction details and pre-abandonment conditions of DT-5 and DT-5A, respectively.

2.3 Test Well DT-9

Test well DT-9 is located on Frijoles Mesa at TA-49.

DT-9 was drilled to 1501.0 ft bgs in 1960 (Purtymun 1995, 045344) with cable-tool methods. The well was constructed with 1335.0 ft of 12 ¾-in.-O.D. casing, with torch-cut slots below 819.0 ft bgs (Weir and Purtymun 1962, 011890). Inside the 12 ¾-in.-O.D. casing is 186.0 ft of 8 ¾-in.-O.D. casing with torch-cut slots throughout the casing. The 8 ¾-in.-O.D. casing is swaged into the 12 ¾-in. casing from 1317.0 ft to 1313.0 ft bgs.

Pre-abandonment Conditions

A video log of DT-9 was collected using the Laboratory's camera trailer on September 9, 2014, after the sampling system was removed. TD of DT-9 was recorded at 1308.0 ft bgs with water present at 1017.0 ft bgs. In addition, a natural gamma log of DT-9 was recorded on September 9 from 1300.0 ft bgs to the surface.

The video log for DT-9 is presented in Appendix A (on DVD). Natural gamma logs are presented in Appendix B.

Figure 2.3-1 is a well construction diagram that depicts the construction details and pre-abandonment conditions of DT-9.

2.4 Test Wells SIMO and SIMO-1

Test wells SIMO and SIMO-1 are located on San Ildefonso Pueblo, east of the Laboratory, in Mortandad Canyon.

SIMO was drilled to 104.0 ft bgs in 1990 (Stoker et al. 1991, 007530) with a hollow-stem auger. The well was constructed with 104.0 ft of 2.0-in.-diameter schedule 40 PVC well casing with two perforated screens set at 50.0–60.0 ft bgs and 80.0–90.0 ft bgs.

SIMO-1 was drilled to 163 ft bgs in 1992 (Purtymun 1995, 045344). No other construction information is provided about this well other than a description that states its construction is similar to test well SIMO's, with screens at various depths. Thus, it is assumed the well is constructed with 116.0–163.0 ft of 2.0-in.-diameter schedule 40 PVC well casing with several perforated screen sections.

Pre-abandonment Conditions

TD of test well SIMO was measured to 57.0 ft bgs with no water present on November 17, 2014. TD and lack of water were verified with tremie pipe before plugging materials were added.

Two 2.0-in.-diameter schedule 40 PVC well casings were discovered at test well SIMO-1. TD of the easternmost casing was measured to 55.4 ft bgs with no water present on November 17. TD of the westernmost casing was measured to 22.9 ft bgs with no water present on November 17. TD and the lack of water were verified with a tremie pipe before plugging materials were added.

Figures 2.4-1 and 2.4-2 are well construction diagrams that depict the construction details and pre-abandonment conditions of test wells SIMO and SIMO-1, respectively.

3.0 PLUGGING AND ABANDONMENT

Plugging and abandonment activities included mobilization, removal of the sampling system, sealing and grouting, casing cutting and removal, and demobilization. All activities were performed following appropriate standard operating procedures and Laboratory-approved health and safety documents. The wells were plugged and abandoned in accordance with NMED-approved work plans and with NMOSE Plugging Plans.

3.1 Wells LAWS-01, LAWS-02, and LAWS-03

Plugging and abandonment activities at wells LAWS-01, LAWS-02, and LAWS-03 took place from June 26 to August 2, 2014. The final surface plugs were constructed on August 2, 2014.

LAWS-01

Plugging and abandonment activities at well LAWS-01 occurred from June 30 to August 2, 2014. The FLUTe water-monitoring system was removed from LAWS-01 on June 30, and plugging materials were added on July 29 and July 30. LAWS-01 was plugged with approximately 9.1 ft^3 of 3/8-in. hydrated bentonite chips from 278.0 ft bgs (TD) to 150.9 ft bgs via tremie pipe. Approximately 16.7 ft^3 of neat cement grout was emplaced from 150.9–2.0 ft bgs via tremie pipe. The protective casing was cut level with the surface pad, and the surface plug was constructed with 0.3 ft^3 of concrete from 2.0 ft bgs to the top of the surface pad. The volume and type of abandonment materials used to abandon LAWS-01 are presented in Table 3.1-1. The final well configuration after abandonment is shown in Figure 3.1-1.

LAWS-02

Plugging and abandonment activities at well LAWS-02 occurred from June 26 to August 2, 2014. The FLUTe vadose zone–monitoring system was partially removed from LAWS-02 on June 26. On June 27, removal of the monitoring system resumed until the system became wedged in the well casing. The monitoring system was successfully removed on July 29 using a 1 ½-in. tremie pipe and hook. Plugging materials were added on July 31 and August 1. LAWS-02 was plugged with approximately 32.3 ft^3 of 3/8-in. hydrated bentonite chips and ¼-in. bentonite pellets from 140.0 ft (casing length) to 10.0 ft (casing

length) via tremie pipe. Approximately 10.0 ft^3 of neat cement grout was emplaced from 10.0 ft (casing length) to 2.0 ft (casing length). The protective casing was cut level with the surface pad and the surface plug was constructed with 1.3 ft^3 of concrete from 2.0 ft (casing length) to the top of the surface pad. The volume and type of abandonment materials used to abandon LAWS-02 are presented in Table 3.1-2. The final well configuration after abandonment is shown in Figure 3.1-2.

LAWS-03

Plugging and abandonment activities at well LAWS-03 occurred from July 30 to August 2, 2014. On July 30, approximately 56.8 ft^3 of neat cement grout was tremied into LAWS-03 below 60.0 ft (casing length). No significant seal was established, and it was determined the cement was either lost to the formation and/or the well casing below the obstruction at 80.0 ft (casing length). Subsequently, LAWS-03 was plugged with approximately 14.0 ft^3 of 3/8-in. hydrated bentonite chips from 80.0 ft (casing length) to 7.0 ft (casing length) via tremie pipe. Approximately 6.0 ft^3 of neat cement grout was emplaced from 7.0 ft (casing length) to 2.0 ft (casing length). The protective casing was cut level with the surface pad and the surface plug was constructed with 1.3 ft^3 of concrete from 2.0 ft (casing length) to the top of the surface pad. The volume and type of abandonment materials used to abandon LAWS-03 are presented in Table 3.1-3. The final well configuration after abandonment is shown in Figure 3.1-3.

3.2 Test Wells DT-5 and DT-5A

Plugging and abandonment activities at test wells DT-5 and DT-5A occurred from July 23 to August 30, 2014.

DT-5

Plugging and abandonment activities at test well DT-5 occurred from July 24 to July 27, 2014. DT-5 was plugged with approximately 221.2 ft^3 of 3/8-in. hydrated bentonite chips from 924.4 ft bgs (TD) to 196.2 f bgs via tremie pipe. Approximately 73.5 ft^3 of neat cement grout was emplaced from 196.2 ft bgs to 2.5 ft bgs via tremie pipe. The 8 ¾-in.-O.D. well casing was cut and removed from 2.0 ft bgs. The surface pad was constructed on July 27, with 2.7 ft^3 of concrete from 2.5 ft bgs to the surface. The volume and type of abandonment materials used to abandon DT-5 are presented in Table 3.2-1. The final borehole configuration is shown in Figure 3.2-1.

DT-5A

Plugging and abandonment activities at test well DT-5A occurred intermittently from July 23 to August 30, 2014. The sampling system was removed with a Pulstar 100k pump hoist on July 23. Well DT-5A was plugged with approximately 184.7 ft^3 of 3/8-in. hydrated bentonite chips from 1788.0 ft bgs (TD) to 1170.3 ft bgs via tremie pipe. Portland Type I/II cement was emplaced from 1170.3–857.7 ft bgs with a tremie pipe. The tremie was removed from the well casing, and a pneumatic casing cutter was installed. The 8 ¾-in.-O.D. well casing was cut and removed from 241.3 ft bgs. The tremie pipe was reinstalled and cement was emplaced from 857.7–2.0 ft bgs. Approximately 707.2 ft^3 of neat cement grout was emplaced from 1170.3–2.0 ft bgs. The 12 ¾-in. surface casing was cut level with the surface pad. The surface plug was constructed on August 30, with 1.7 ft^3 of concrete from 2.0 ft bgs to the top of the surface pad. The volume and type of abandonment materials used to abandon DT-5A are presented in Table 3.2-2. The final well configuration after abandonment is shown in Figure 3.2-2.

3.3 Test Well DT-9

Plugging and abandonment activities at test well DT-9 occurred from September 8 to December 9, 2014. The sampling system was removed with a Pulstar 20k pump hoist on September 8 and 9. Approximately 387.6 ft^3 of neat cement grout was emplaced from 1501 ft bgs (TD) to 1013.5 ft bgs via tremie pipe. Because of significant cement loss at 1013.5 ft bgs, DT-9 was plugged with approximately 634.2 ft^3 of 3/8-in. hydrated bentonite chips from 1013.5–284.1 ft bgs.

A Foremost DR-24HD drill rig was used to cut the 12-in.-diameter casing at 280.0 ft bgs on December 4, but the casing could not be removed. A second cut was made at 40.0 ft bgs on December 5, but removing the casing was unsuccessful. Approximately 200.5 ft^3 of neat cement grout was emplaced in the well casing via tremie pipe from 284.1–280.0 ft bgs, and it was determined the cement was flowing out of the casing cut at 280.0 ft bgs and into the annular space. Approximately 537.6 ft^3 of 3/8-in. hydrated bentonite chips was used to seal the annulus to 282.6 ft bgs outside the 12 ¾-in.-O.D. well casing. Approximately 353.0 ft^3 of neat cement grout was emplaced in the well casing and annulus via tremie pipe from 282.6–43.0 ft bgs. Approximately 15.4 ft^3 of 3/8-in. hydrated bentonite chips was used to seal the well casing and casing cut (40.0 ft bgs) from 43.0–31.0 ft bgs. The 12 ¾-in.-O.D. well casing was cut and removed from 0.5 ft bgs. Approximately 32.1 ft^3 of neat cement grout was emplaced from 31.0 ft bgs to surface. The volume and type of abandonment materials used to abandon DT-9 are presented in Table 3.3-1. The final borehole configuration after abandonment is shown in Figure 3.3-1.

3.4 Test Wells SIMO and SIMO-1

Plugging and abandonment activities at test wells SIMO and SIMO-1 occurred on November 17, 2014.

SIMO

SIMO was plugged with Portland Type I/II cement grout from 57.0–4.0 ft bgs. Cement was emplaced through 1-in. PVC tremie pipe. After it was plugged with cement, the upper 10.0 ft of well casing was drilled out using a 4 ¼-in.–inside diameter (I.D.-) hollow-stem auger (7 5/8-in. O.D.). The auger hole was filled with 10.0 ft of concrete, and an aluminum survey pin was placed in the concrete surface pad. The volume and type of abandonment materials used to abandon SIMO are presented in Table 3.4-1. The final well configuration after abandonment is shown in Figure 3.4-1.

SIMO-1

Two PVC well casings were discovered at SIMO-1 during abandonment activities. The east SIMO-1 well casing was plugged from 55.4 ft bgs to surface with approximately 1.3 ft^3 of neat cement grout. The west SIMO-1 well casing was plugged from 22.9 ft bgs to surface with approximately 0.7 ft^3 of neat cement grout. Cement was emplaced via 1-in.-diameter PVC tremie pipe. After it was plugged with cement, the upper 10.0 ft of the well casings were drilled out using a 4 ¼-in. I.D. hollow-stem auger (7 5/8-in. O.D.). The auger holes were filled with approximately 4.9 ft^3 of neat cement grout from 10.0–1.0 ft bgs. A 1.0-ft concrete surface pad was constructed, and an aluminum survey pin was installed in the concrete surface pad. The volume and type of abandonment materials used to abandon SIMO-1 are presented in Table 3.4-2. The final well configuration after abandonment is shown in Figure 3.4-2.

4.0 SURFACE COMPLETIONS

Concrete surface plugs were installed to the top of the existing surface pads at LAWS-01, LAWS-02, LAWS-03, and DT-5A (brass survey markers were present in the pads). Concrete surface pads were installed at DT-5, DT-9, SIMO, and SIMO-1, and aluminum survey markers were installed in the pads. The brass or aluminum markers were surveyed in accordance with Section IX.B.2.f of the Consent Order.

4.1 Geodetic Survey

Geodetic surveys were conducted on the surface completions (Table 4.1-1) with a Trimble RTK global positioning system. The survey data collected conform to Laboratory Information Architecture project standards IA-CB02, "GIS Horizontal Spatial Reference System," and IA-D802, "Geospatial Positioning Accuracy Standard for A/E/C and Facility Management." All coordinates are expressed relative to the New Mexico State Plane Coordinate System Central Zone (North American Datum [NAD] 83); elevation is expressed relative to feet above mean sea level (amsl) using the National Geodetic Vertical Datum of 1929. The survey point was the brass or aluminum pin placed in the concrete plug/pad.

5.0 POST-ABANDONMENT ACTIVITIES

Post-abandonment activities are described below.

5.1 Site Restoration

Plugging and abandonment activities at the wells required only minimal restoration efforts to return the sites to preplugging and abandonment conditions.

5.2 Waste Management

Waste generated from the plugging and abandonment project included purge water, decontamination water, cement wash-out water, drill cuttings, and contact waste.

All waste streams produced during plugging and abandonment activities were sampled in accordance with the "Waste Characterization Strategy Form for Plug and Abandonment (P&A) of LANL Wells" (LANL 2011, 205839).

All wastes will be managed in accordance with the waste characterization strategy form and EP-DIR-SOP-10012, Characterization of Environmental Programs Waste. Characterization of contact waste will be based upon acceptable knowledge from historical site data per Laboratory Procedure P930-1, LANL Waste Acceptance Criteria.

6.0 DEVIATIONS FROM PLANNED ACTIVITIES

LAWS-01 was planned to be plugged and abandoned with cement grout placed from bottom to top with a tremie pipe. Instead of using cement under the static water level (154.4 ft bgs) and incurring significant cement loss, hydrated bentonite chips were emplaced from TD (278.0 ft bgs) to 150.9 ft bgs with a tremie pipe. Portland Type I/II cement was emplaced from 150.9–2.0 ft bgs with a tremie pipe.

LAWS-02 was planned to be plugged and abandoned with cement grout placed from bottom to top with a tremie pipe. Because of the amount of cement loss that occurred at LAWS-03, hydrated bentonite chips/pellets were emplaced from TD (140.0-ft casing length) to 10.0 ft (casing length) with a tremie pipe.

Portland Type I/II cement was emplaced from 10.0–2.0 ft (casing length) inside the well casing and from 10.0–2.0 ft (casing length) within the annulus.

LAWS-03 was planned to be plugged and abandoned with cement grout placed from bottom to top with a tremie pipe. Cement grout was tremied into the well casing with no significant seal established. Hydrated bentonite chips were placed from the top of the obstruction (80.0-ft casing length) to 7.0 ft (casing length) with a tremie pipe. Portland Type I/II cement was emplaced from 7.0–2.0 ft (casing length) inside the well casing and from 10.0–2.0 ft (casing length) within the annulus.

No deviations from planned activities occurred at test well DT-5.

DT-5A was planned to be plugged and abandoned with bentonite chips placed from bottom to top with a tremie pipe to approximately 520.0 ft bgs. The 8 ¾-in.-O.D. casing was to be cut and removed from 520 ft bgs. After the upper 520.0 ft of 8 ¾-in.-O.D. casing was removed, the remaining portion of the borehole was to be filled with neat cement. To reduce cement loss to the exposed formation behind the torch-cut slots in the 8 ¾-in.-O.D. casing, hydrated bentonite chips were placed from TD (1788.0 ft bgs) to 1170.3 ft bgs with a tremie pipe. After the torch-cut slots were plugged, Portland Type I/II cement was placed from 1170.3–857.7 ft bgs with a tremie pipe. The tremie was removed from the well casing and a pneumatic casing cutter was installed. The 8 ¾-in.-O.D. well casing was cut and removed from 241.3 ft bgs (scale on the sidewalls prevented the casing cutter from being lowered past 260.0 ft bgs). The tremie pipe was reinstalled and cement was emplaced from 857.7–2.0 ft bgs.

DT-9 was planned to be plugged and abandoned with cement grout emplaced from bottom to top with a tremie pipe. Portland Type I/II cement was emplaced with a tremie pipe from TD (1501.0 ft bgs) to 1013.5 ft bgs. Because of significant cement loss, hydrated bentonite chips were used to fill the well casing from 1013.5–284.1 ft bgs. The 12-in.-diameter casing was then cut at 280.0 ft bgs, but efforts to remove the well casing were unsuccessful. The well casing was then recut at 40.0 ft bgs, but removal efforts were again unsuccessful. Additional cement was emplaced, but no significant seal was established because of the loss of cement out of the casing cut at 280.0 ft bgs. Hydrated bentonite chips were used to fill the borehole annulus below the casing cut. Portland Type I/II cement was emplaced from 282.6–43.0 ft bgs. Hydrated bentonite chips were emplaced from 43.0–31.0 ft bgs to seal the annulus and casing cut at 40.0 ft bgs. Portland Type I/II cement was then emplaced from 31.0 ft bgs to the surface.

During abandonment of SIMO-1, it was discovered that two PVC well casings had been installed. Both SIMO-1 well casings were abandoned. No deviations from planned activities occurred at test well SIMO.

All deviations from submitted plugging plans were discussed via phone or email with the NMOSE.

7.0 SUMMARY

Before abandonment activities were undertaken, all aboveground and belowground appurtenances were removed. Plugging and abandonment was completed with a Pulstar 100k pump hoist, a Pulstar 20k pump hoist, a Foremost DR-24HD, and/or a CME-55 auger rig. All wells were plugged with hydrated bentonite chips/pellets and/or Portland Type I/II cement via tremie pipe. Concrete surface plugs/pads were constructed and the brass or aluminum pins were surveyed. All wells were plugged and abandoned in accordance with NMED-approved work plans and with NMOSE plugging plans. All deviations from submitted plugging plans were discussed with the NMOSE.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 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 or ESH ID. This information is also included in text citations. ER IDs were assigned by the Environmental Programs Directorate's Records Processing Facility (IDs through 599999), and ESH IDs are assigned by the Environment, Safety, and Health (ESH) Directorate (IDs 600000 and above). IDs are used to locate documents in the Laboratory's Electronic Document Management System and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the ESH 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.

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NMOSE (New Mexico Office of the State Engineer), July 3, 2014. "Well Plugging Plan of Operations [for LAWS-03]," Santa Fe, New Mexico. (NMOSE 2014, 600212)

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NMOSE (New Mexico Office of the State Engineer), July 18, 2014. "Well Plugging Plan of Operations [for DT-5A]," Santa Fe, New Mexico. (NMOSE 2014, 600208)

NMOSE (New Mexico Office of the State Engineer), September 18, 2014. "Well Plugging Plan of Operations [for DT-9]," Santa Fe, New Mexico. (NMOSE 2014, 600209)

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8.2 Map Data Sources for Plugging and Abandonment Report Location Map

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Hypsography, 100 and 20 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Surface Drainages, 1991; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0591; 1:24,000 Scale Data; Unknown publication date.

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Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

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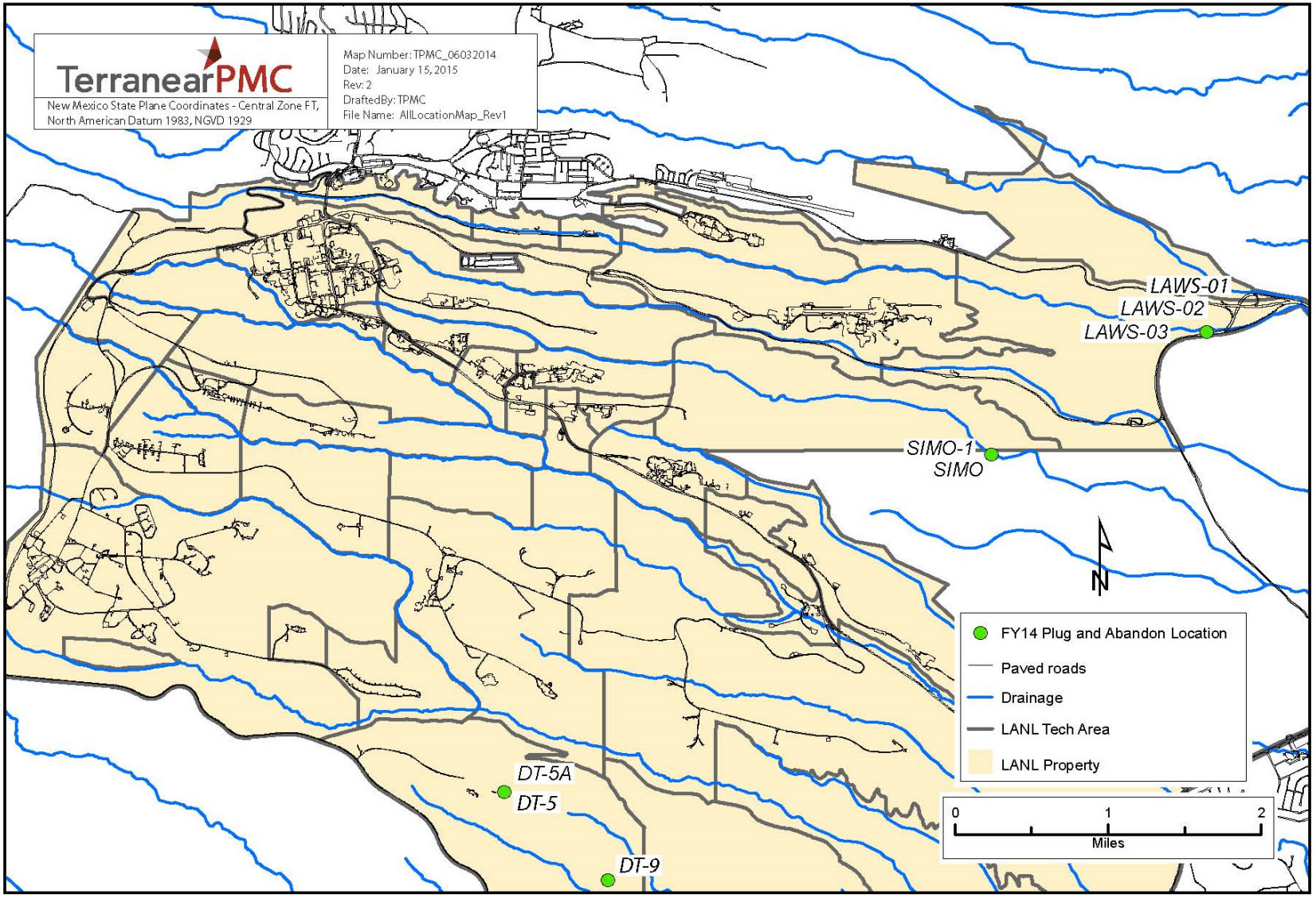

Figure 1.0-1 Location of plugged and abandoned wells LAWS-01, LAWS-02, LAWS-03, DT-5, DT-5A, DT-9, SIMO, and SIMO-1

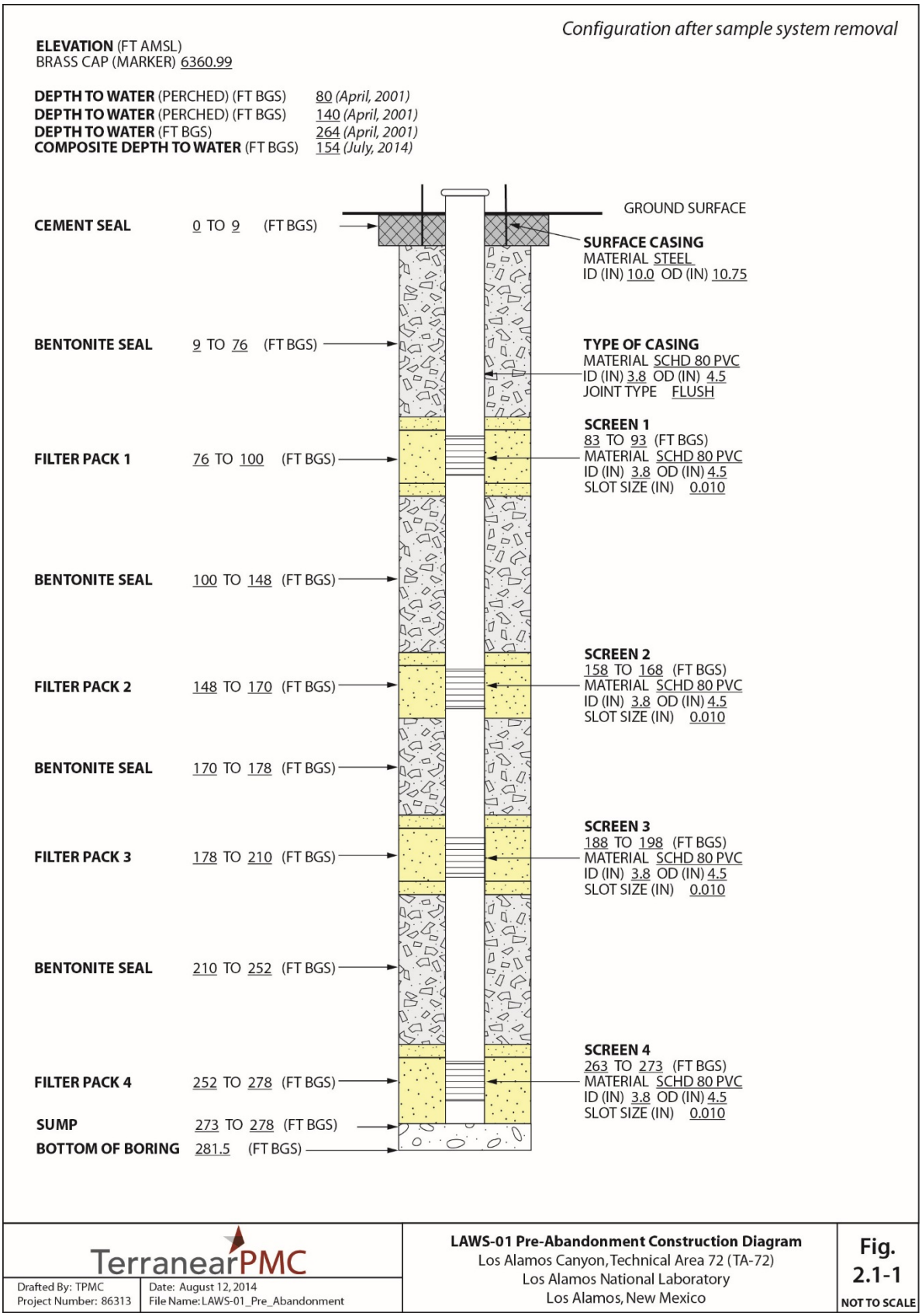

Figure 2.1-1 Well LAWS-01 pre-abandonment construction diagram

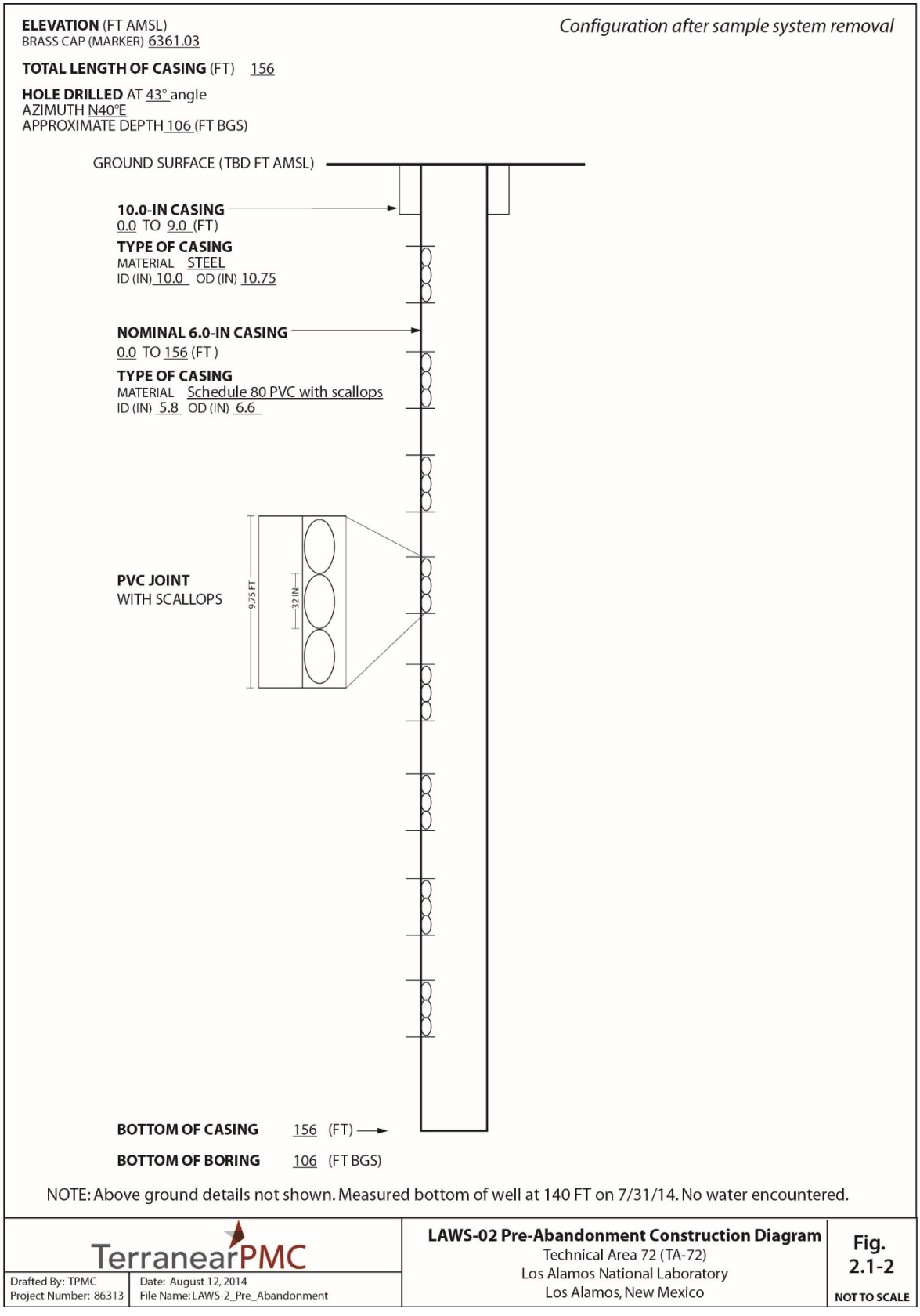

Figure 2.1-2 Well LAWS-02 pre-abandonment construction diagram

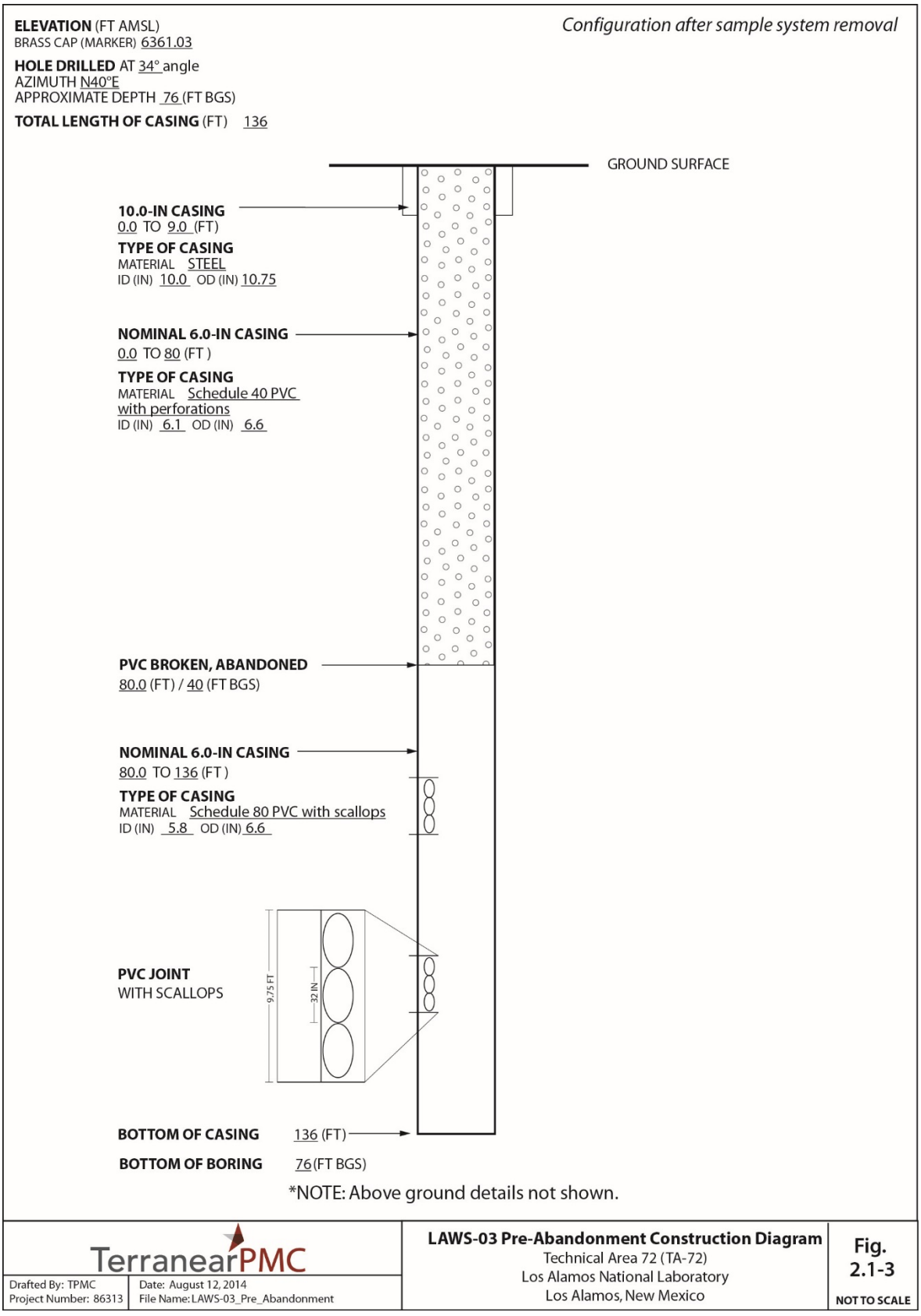

Figure 2.1-3 Well LAWS-03 pre-abandonment construction diagram

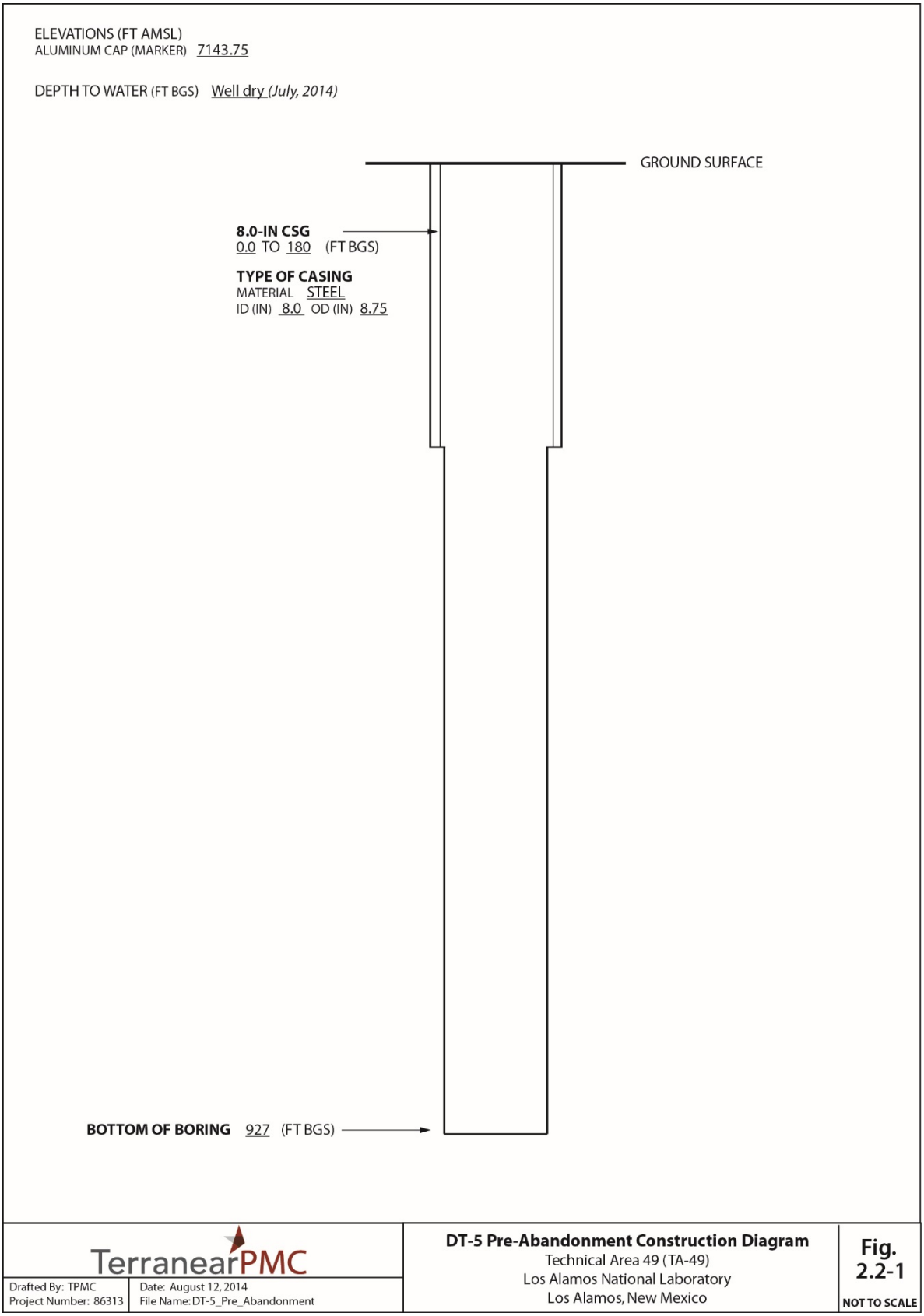

Figure 2.2-1 Test well DT-5 pre-abandonment construction diagram

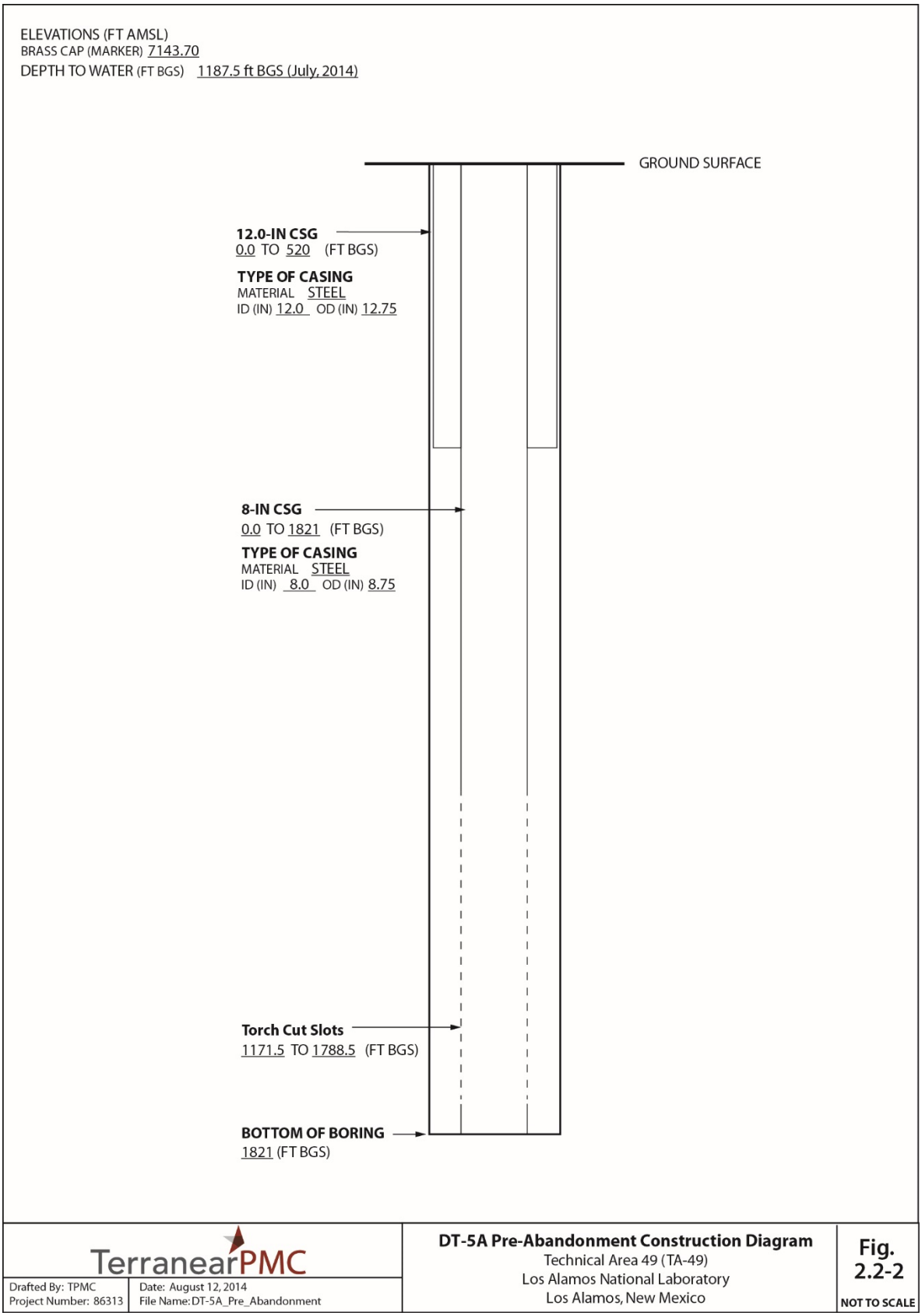

Figure 2.2-2 Test well DT-5A pre-abandonment construction diagram

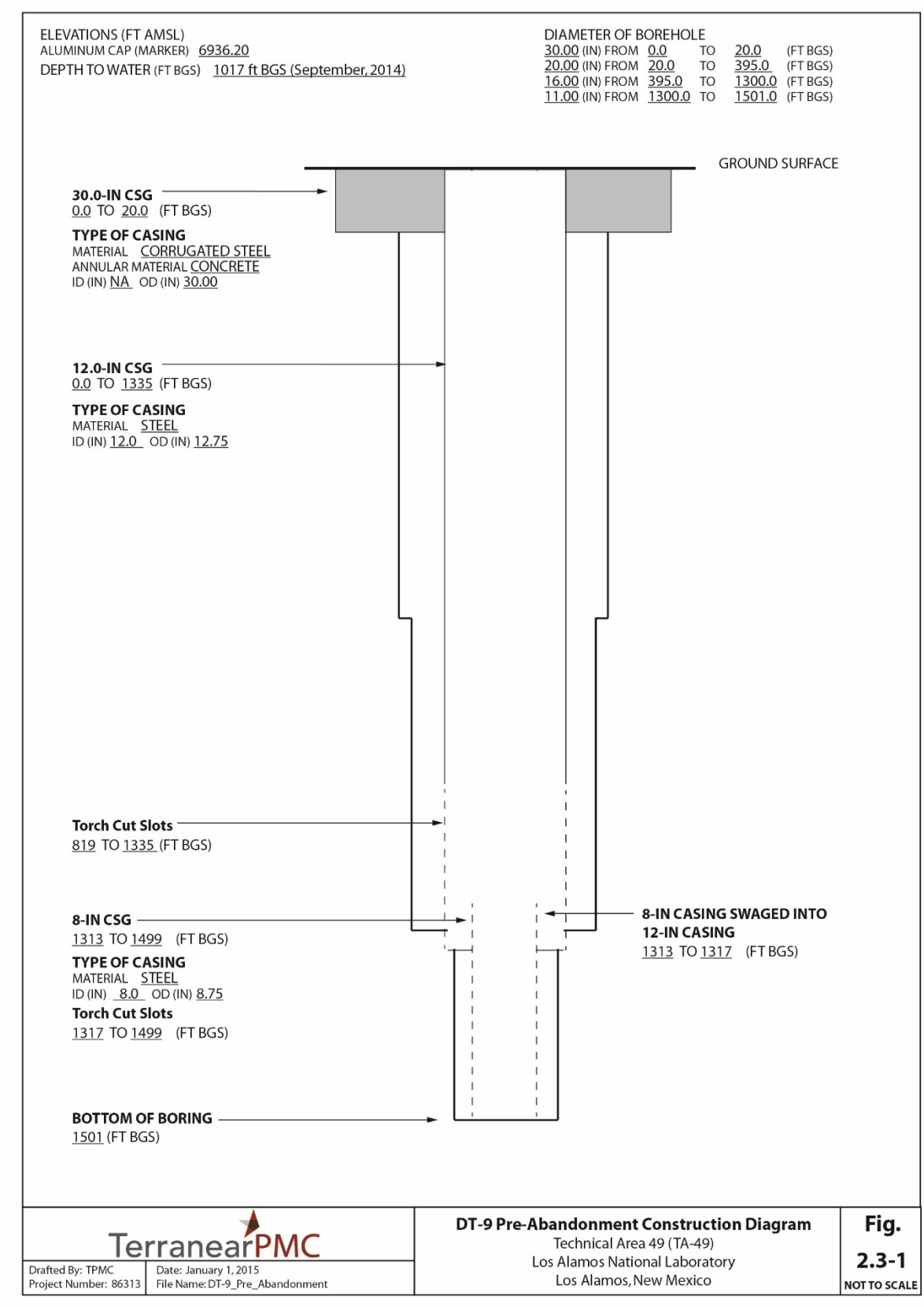

Figure 2.3-1 Test well DT-9 pre-abandonment construction diagram

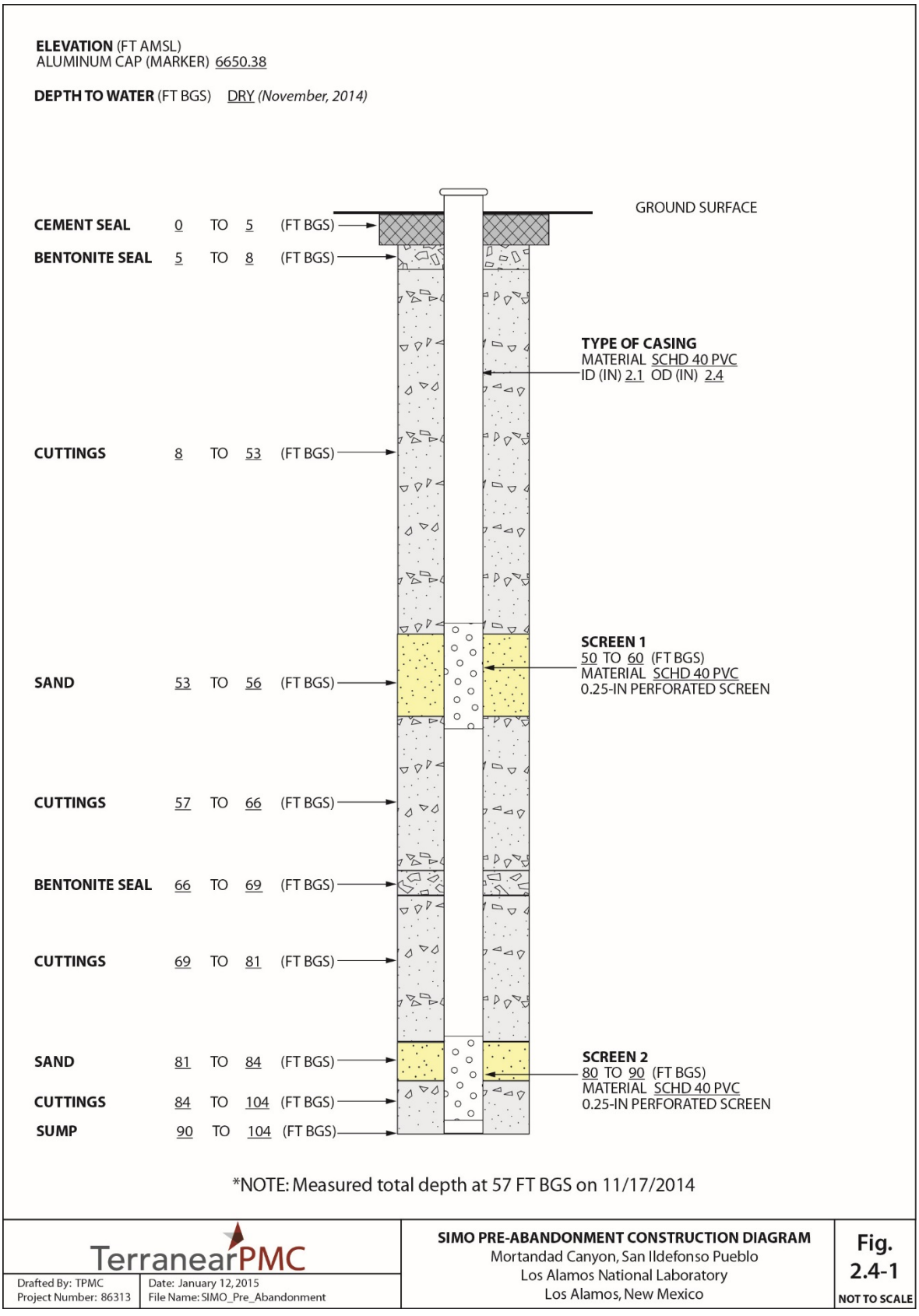

Figure 2.4-1 Test well SIMO pre-abandonment construction diagram

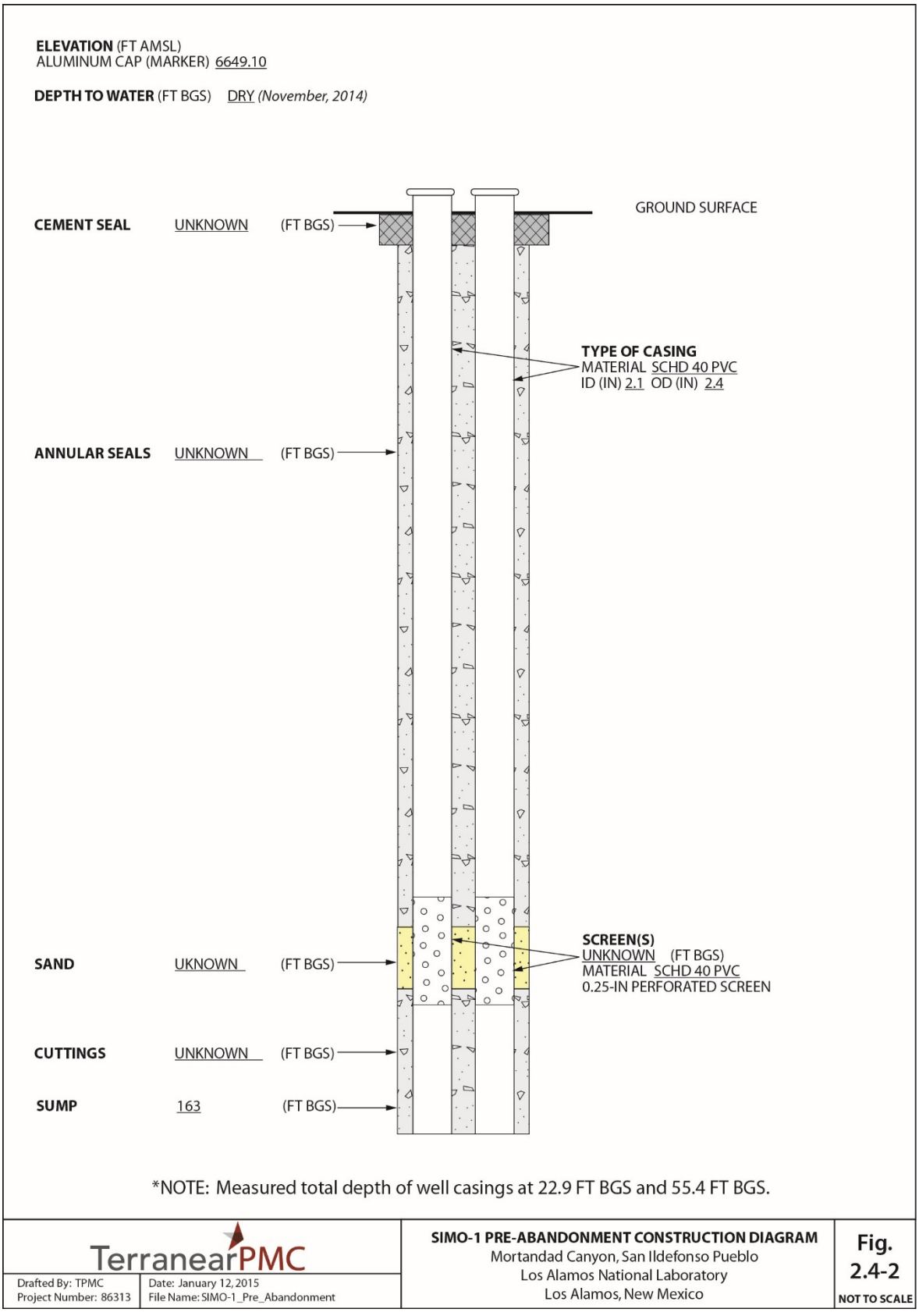

Figure 2.4-2 Test well SIMO-1 pre-abandonment construction diagram

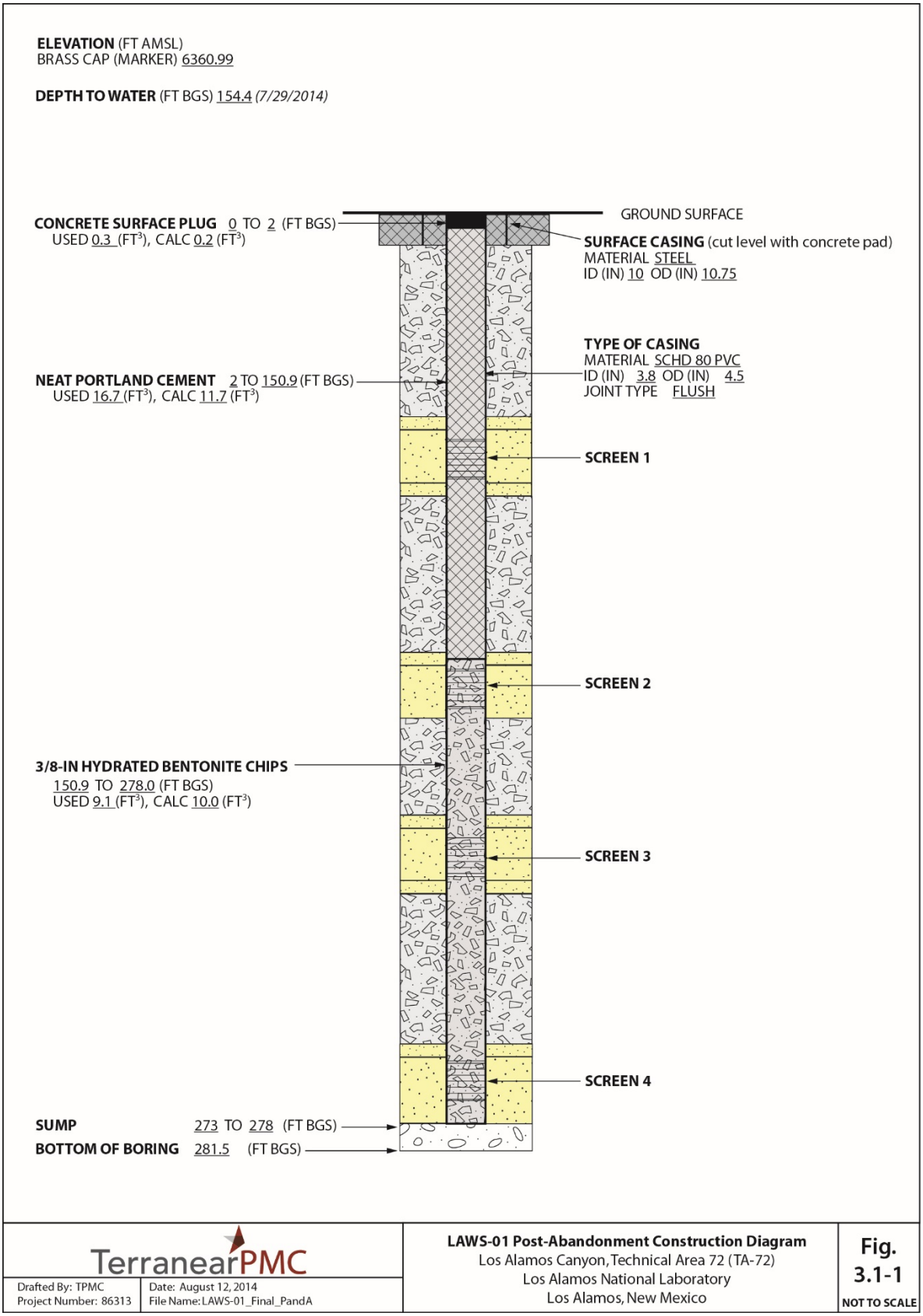

Figure 3.1-1 Well LAWS-01 post-abandonment construction diagram

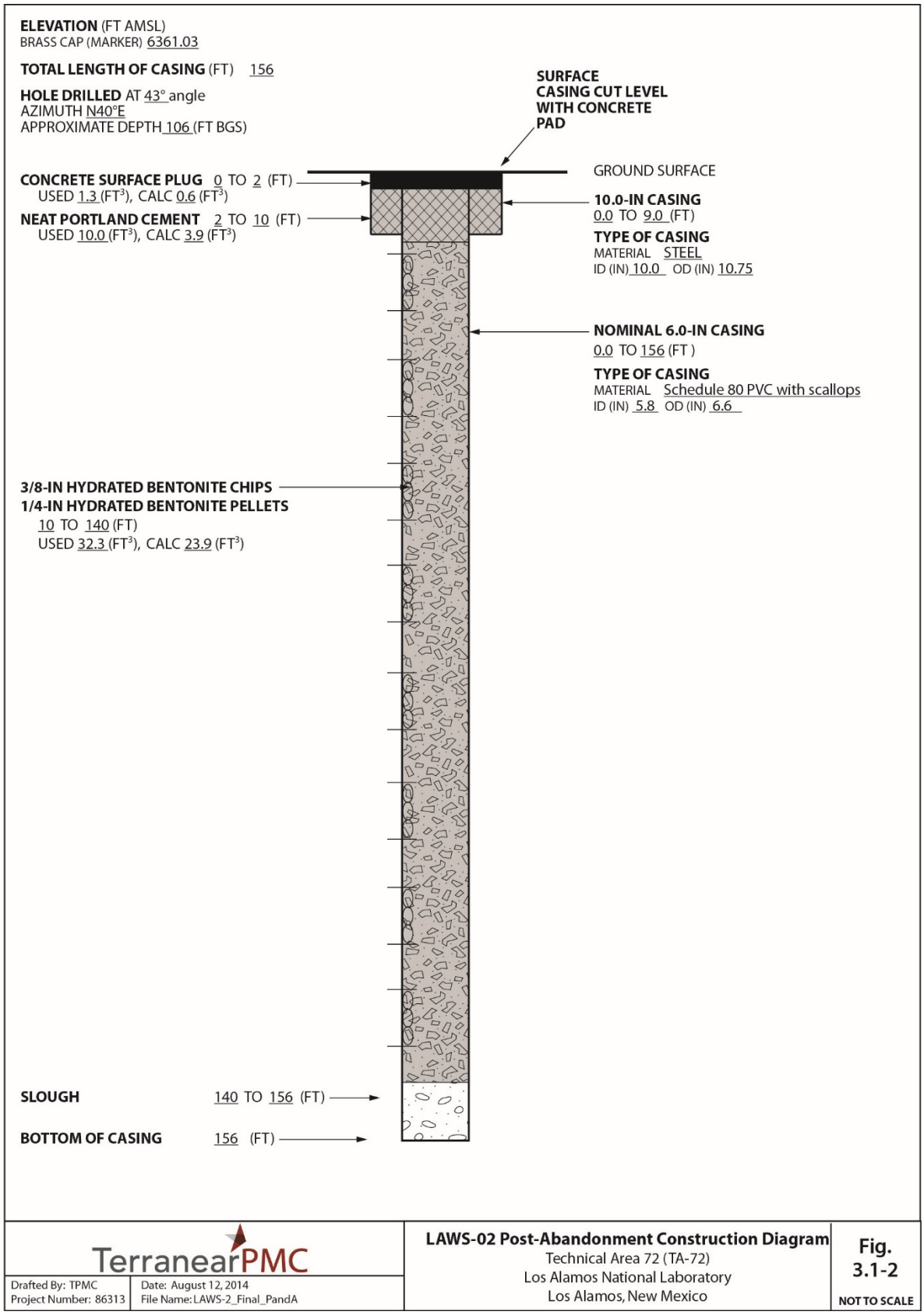

Figure 3.1-2 Well LAWS-02 post-abandonment construction diagram

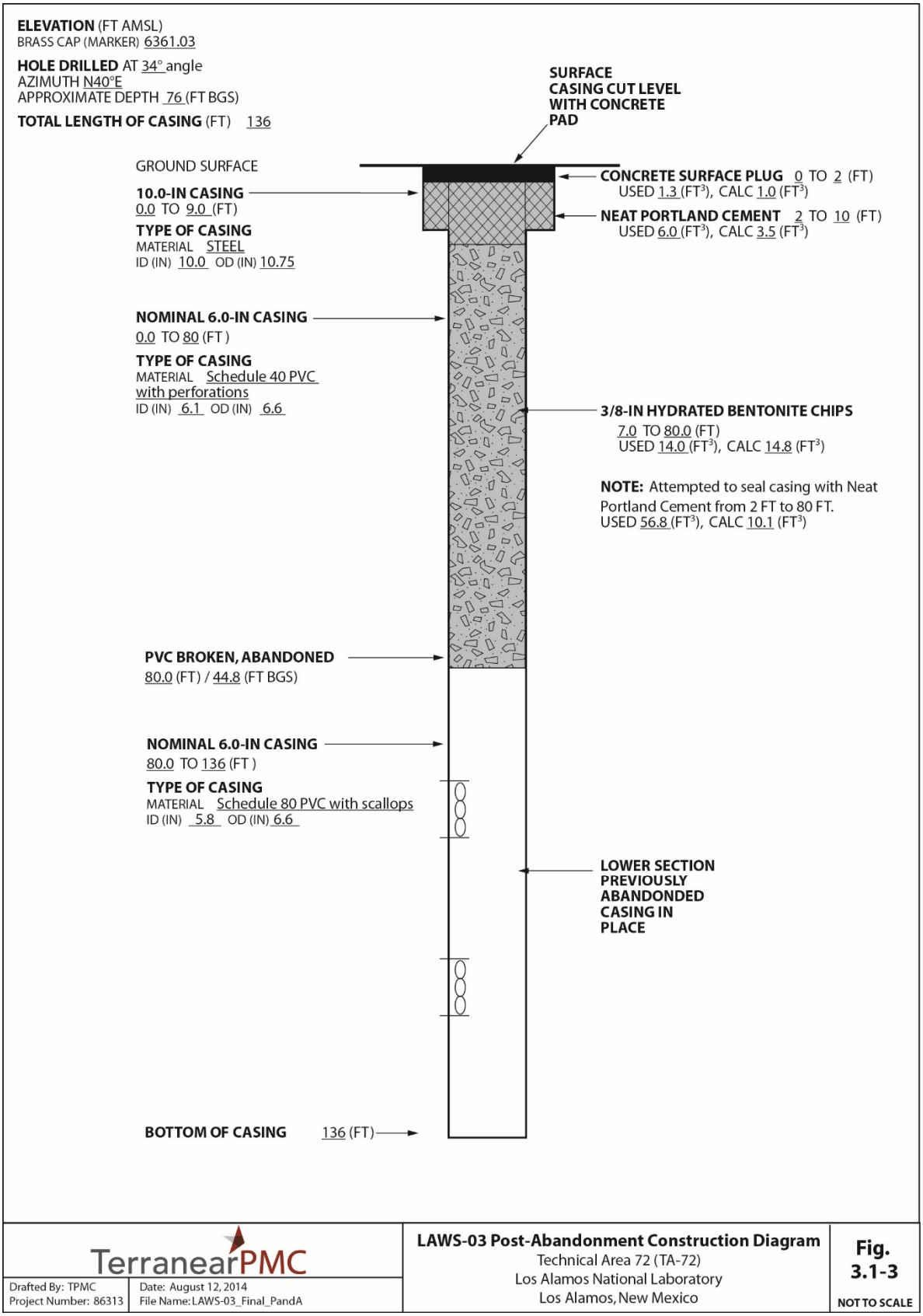

Figure 3.1-3 Well LAWS-03 post-abandonment construction diagram

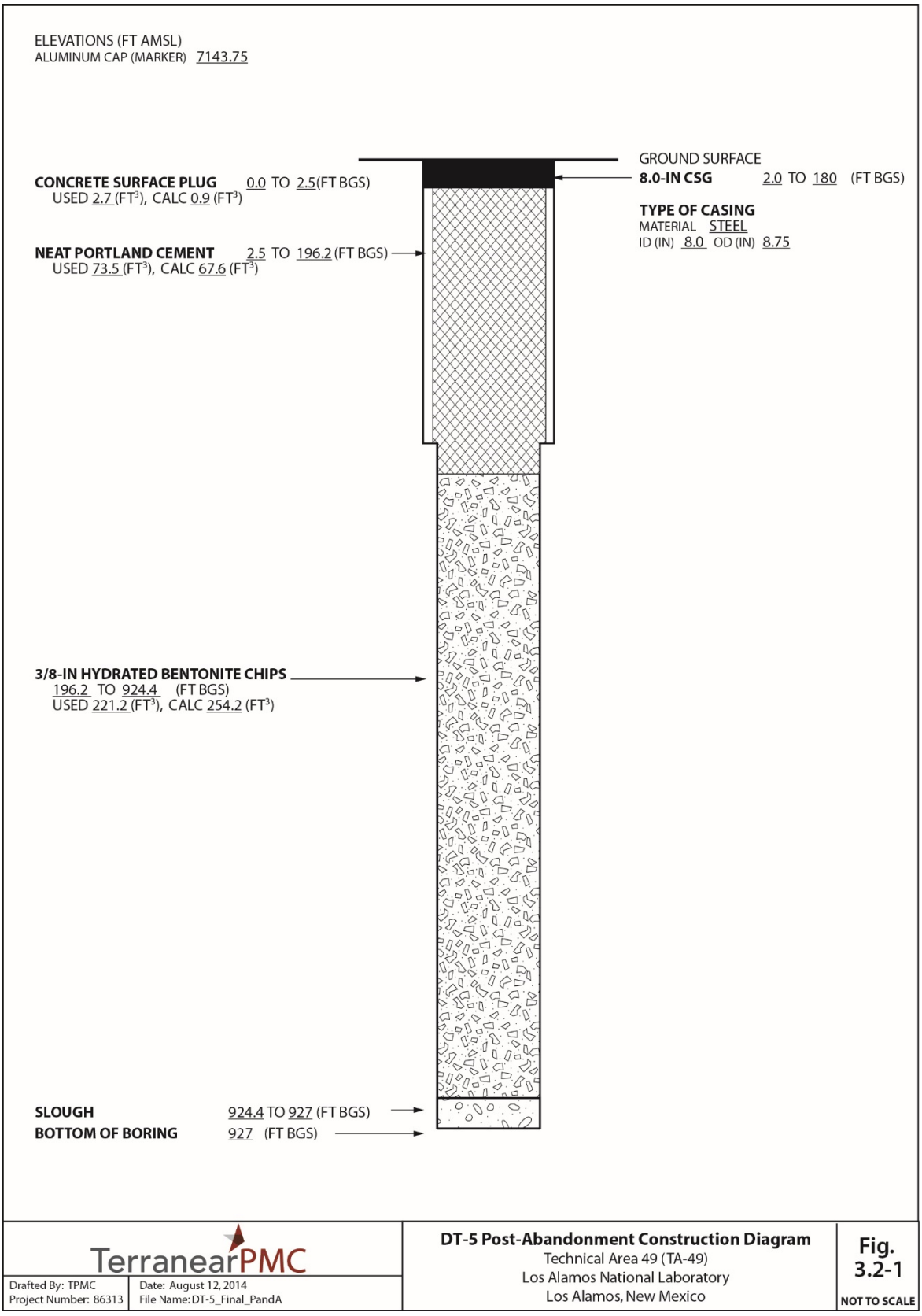

Figure 3.2-1 Test well DT-5 post-abandonment construction diagram

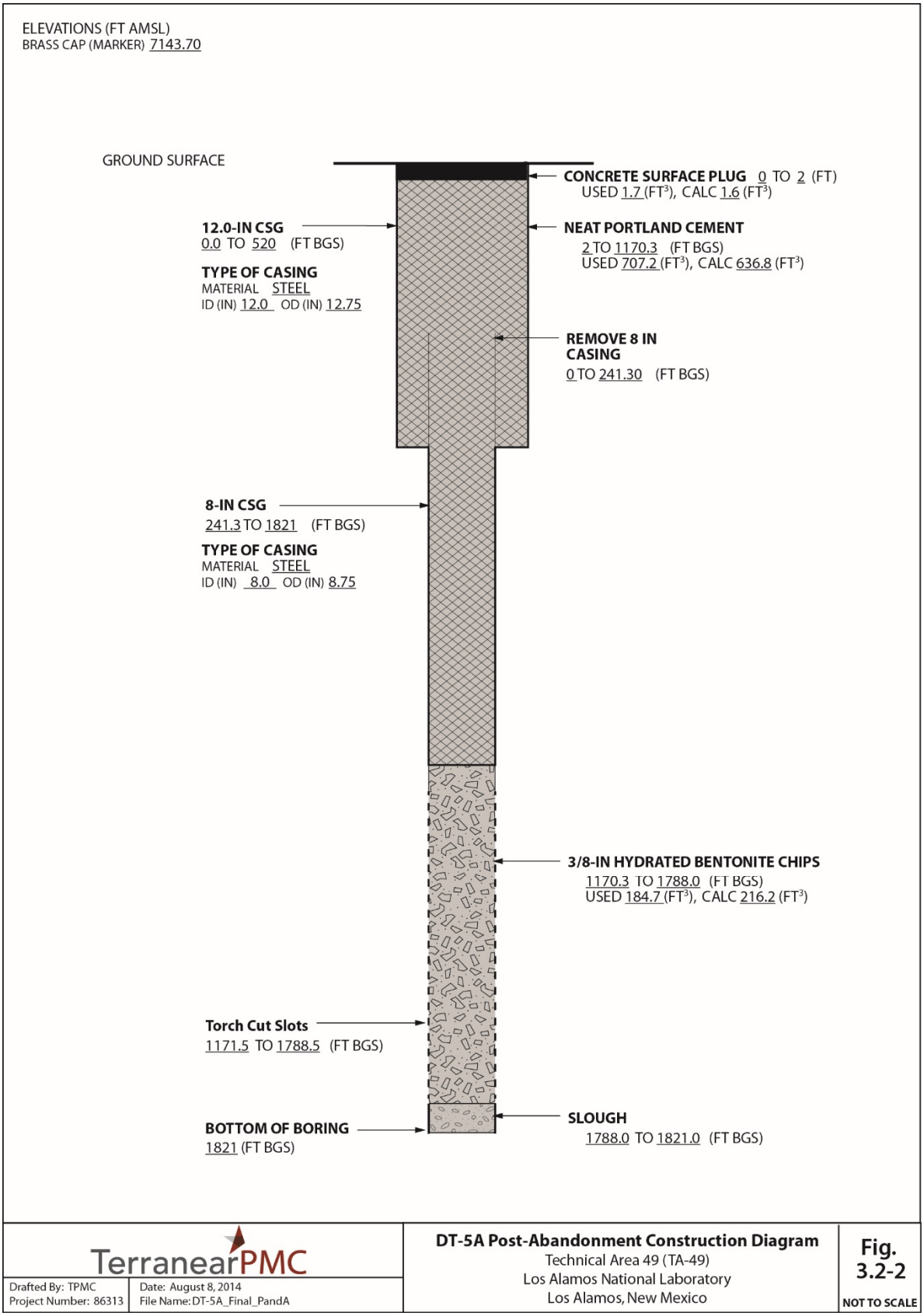

Figure 3.2-2 Test well DT-5A post-abandonment construction diagram

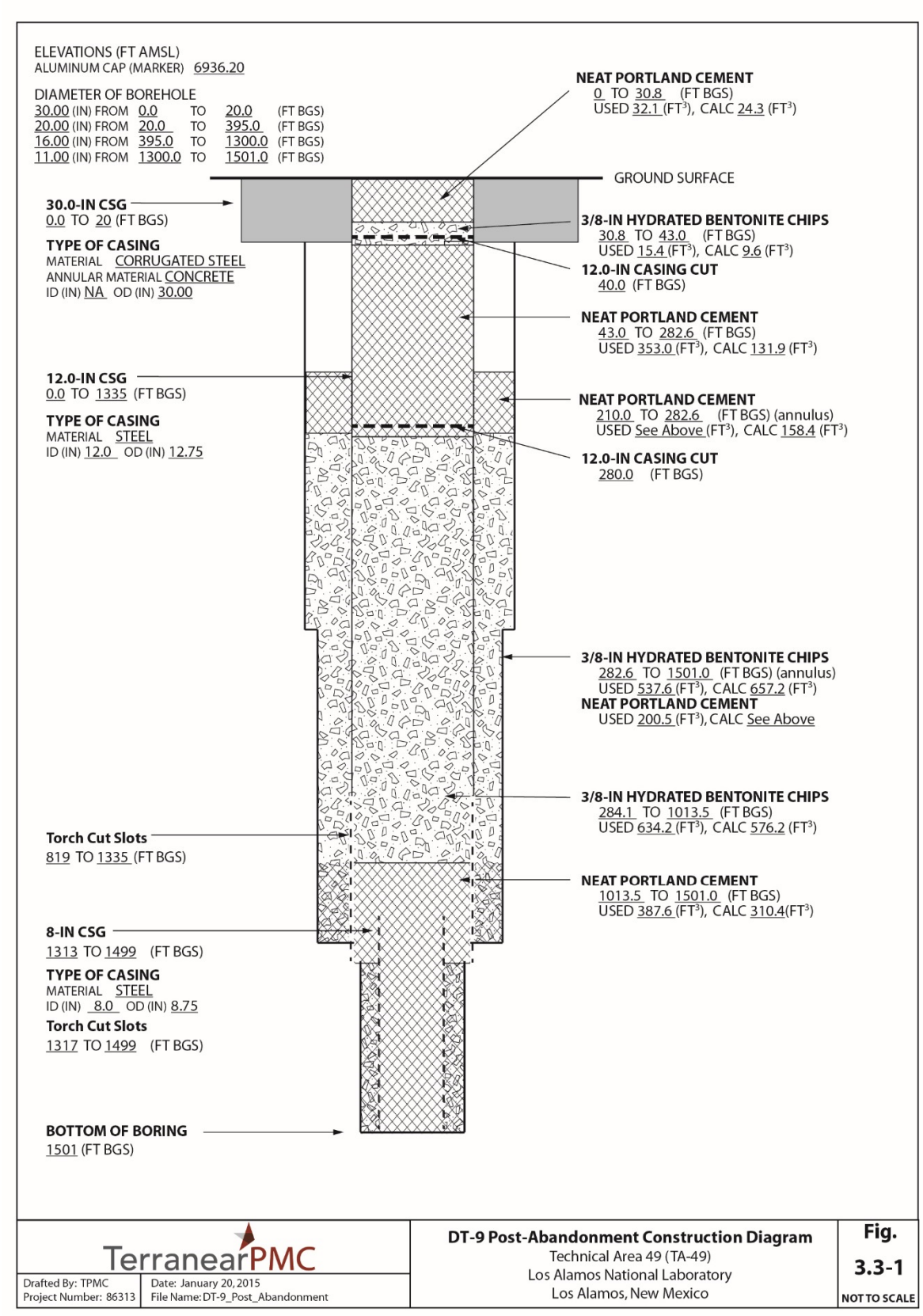

Figure 3.3-1 Test well DT-9 post-abandonment construction diagram

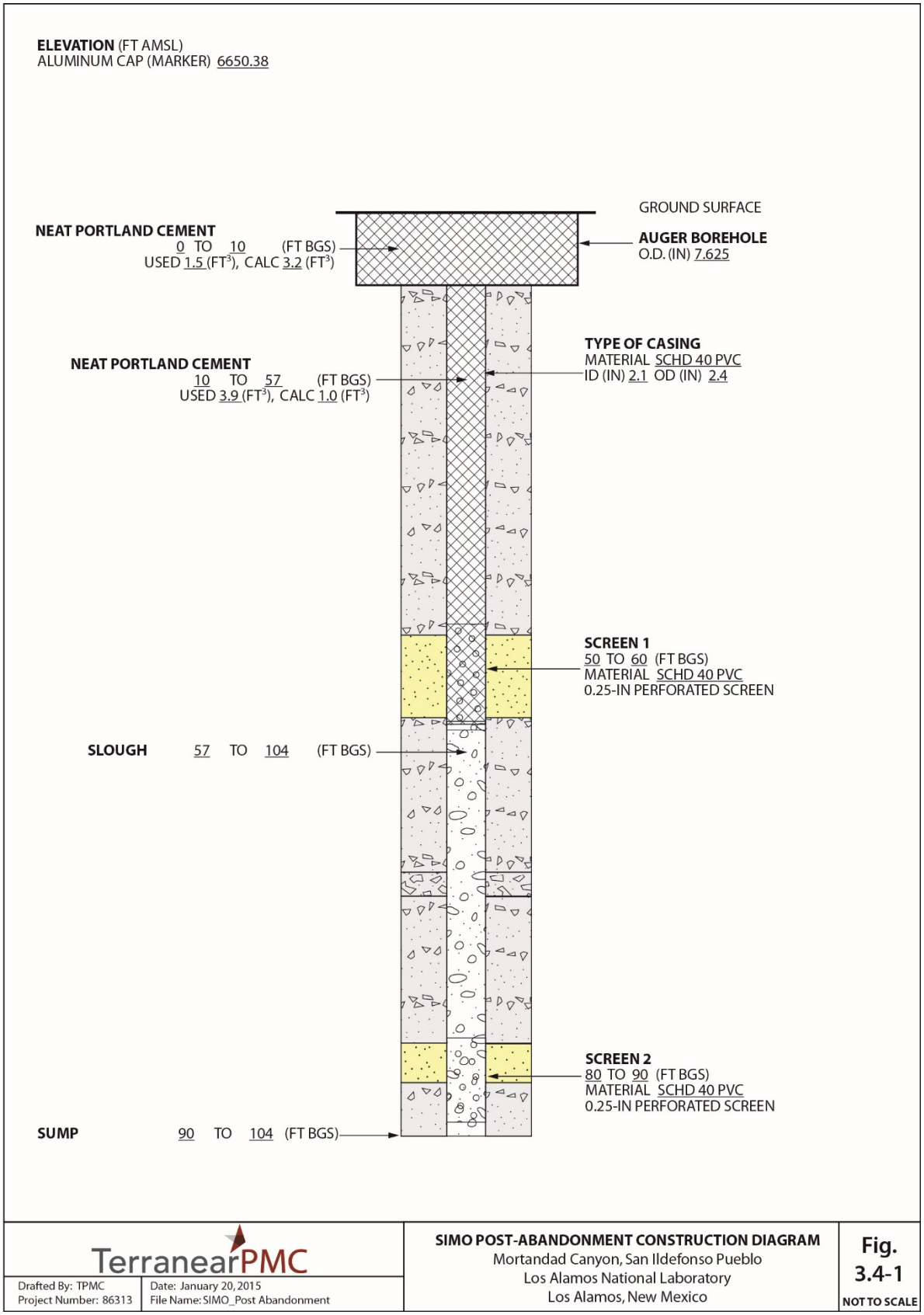

Figure 3.4-1 Test well SIMO post-abandonment construction diagram

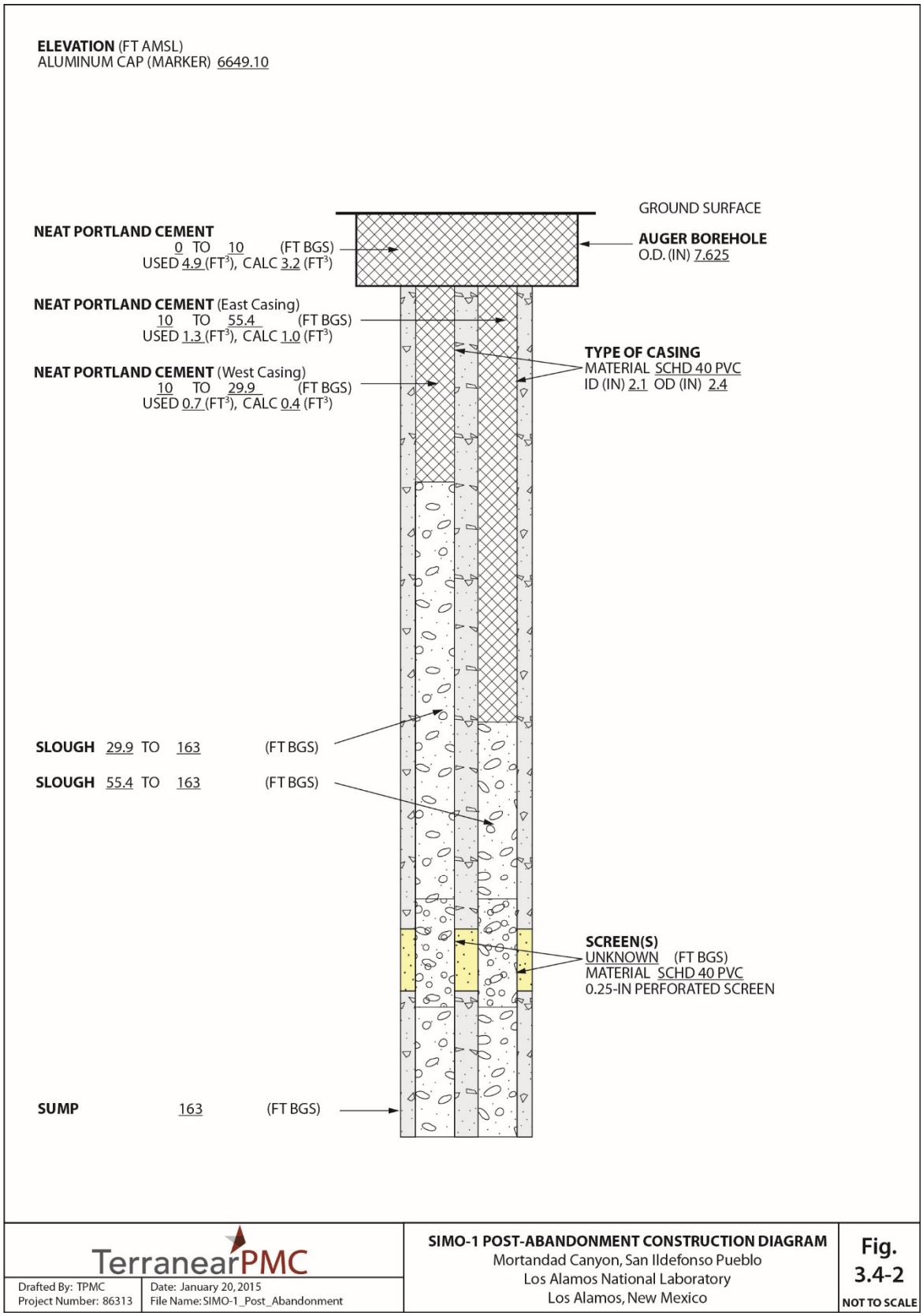

Figure 3.4-2 Test well SIMO-1 post-abandonment construction diagram

Table 3.1-1
Quantity and Materials Used to Plug and Abandon Well LAWS-01

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity 3/8-in. Bentonite Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
7/29/14	278–258.8	0	500	100	1.5	1.4
7/30/14	258.8–150.9	0	1000	550	8.5	7.7
7/30/14	150.9–2.0	1175	75	0	11.7	16.7
Total		**1175**	**1575**	**650**	**21.7**	**25.8**

Table 3.1-2
Quantity and Materials Used to Plug and Abandon Well LAWS-02

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity 3/8-in. and 1/4-in. Bentonite Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
7/31/14	140.0–120.0	0	1500	350	3.7	4.9
8/1/14	120.0–10.0	0	700	2000	20.2	27.4
8/1/14	10.0–2.0	705	45	0	3.9	10.0
Total		**705**	**2245**	**2350**	**27.8**	**42.3**

Table 3.1-3
Quantity and Materials Used to Plug and Abandon Well LAWS-03

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity 3/8-in. Bentonite Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
7/30/14	Below 80.0	3995	255	0	10.1	56.8*
7/31/14	80.0–7.0	0	500	1000	14.8	14.0
8/1/14	7.0–2.0	423	27	0	3.5	6.0
Total		**4418**	**782**	**1000**	**34.1**	**76.8**

*Total volume of cement added on July 30, 2014, was lost either to the formation or around the obstruction at 80.0 ft.

Table 3.2-1
Quantity and Materials Used to Plug and Abandon Test Well DT-5

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity 3/8-in. Bentonite Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
7/24/14	924.4–719.4	0	315	3150	71.6	62.3
7/25/14	719.4–464.1	0	600	6000	89.0	77.5
7/26/14	464.1–196.2	0	665	6650	93.6	81.4
7/26/14	196.2–2.5	5170	330	0	67.6	73.5
Total		**5170**	**1910**	**15,800**	**321.8**	**294.7**

Table 3.2-2
Quantity and Materials Used to Plug and Abandon Test Well DT-5A

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity 3/8-in. Bentonite Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
8/4/14	1788.0–1778.0	0	800	250	3.5	3.5
8/5/14	1778.0–1640.4	0	3000	2795	48.2	39.1
8/6/14	1640.4–1625.5	0	800	300	5.2	4.2
8/7/14	1625.5–1583.6	0	2500	1000	14.7	14.0
8/8/14	1583.6–1471.1	0	6000	2500	39.4	35.0
8/9/14	1471.1–1401.3	0	4500	1450	24.4	20.3
8/18/14	1401.3–1351.2	0	2400	1000	17.5	14.0
8/19/14	1351.2–1262.4	0	5600	1900	31.1	26.6
8/20/14	1262.4–1217.2	0	4000	1000	15.8	14.0
8/21/14	1217.2–1170.3	0	3200	1000	16.4	14.0
8/22/14	1170.3–857.7	6580	420	0	109.4	93.6
8/27/14	857.7–243.3	16,920	1080	0	215.0	240.6
8/28/14	243.3–234.9	14,100	900	0	128.4[1]	200.5
8/29/14	234.9–2.0	12,126	774	0	184.0	172.5
Total		**49,726**	**35,974**	**13,195**	**853.0**	**891.9**

* Volume includes annulus between 8-in. and 12-in. casing strings from 241.3 (8-in. casing cut/removed) to 520 ft bgs (bottom of 12-in. casing).

Table 3.3-1
Quantity and Materials Used to Plug and Abandon Test Well DT-9

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity 3/8-in. Bentonite Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
9/12/14	1501.0–1243.5	2820	180	0	128.7	40.1
9/13/14	1243.5–1115.2	5640	360	0	101.4	80.2
9/14/14	1115.2–1015.3	8460	540	0	78.9	120.3
9/15/14	1015.3–1013.5	10,340	660	0	1.4	147.0
12/2/14	1013.5–747.7	0	1400	16,800	210.0	235.2
12/3/14	747.7–284.1	0	1500	28,500	366.2	399.0
12/6/14	284.1–280.81	14,100	900	0	5.8	200.5
12/6/14	1501–Unknown[a,b]	0	2100	2400	540.5	33.6
12/7/14	Unknown–368.4[a]	0	3600	24,000	See above	336.0
12/8/14	368.4–282.6[a]	0	2286	12,000	110.9	168.0
12/8/14	282.6–210.0[a]	11,186	714	0	158.4	159.1
12/9/14	210.0–43.0	13,630	870	0	131.9	193.9
12/9/14	43.0–30.8	0	786	1100	9.6	15.4
12/9/14	30.8–0	2256	144	0	24.3	32.1
Total		**68,432**	**16,040**	**84,800**	**1868.0**	**2160.4**

[a] Calculated volumes include the annulus between 12-in.-I.D. well casing and the borehole. See Figure 2.3-1 for borehole sizes.

[b] No reliable tag was successfully measured at the end of the shift on 12/6/14.

Table 3.4-1
Quantity and Materials Used to Plug and Abandon Test Well SIMO

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity Quikrete Concrete Mix used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
11/17/14	57.0–10.0	282	20	0	1.0	3.9
11/17/14	10.0–0.0	0	30	200	3.2	1.5
Total		**282**	**50**	**200**	**4.2**	**5.4**

Table 3.4-2
Quantity and Materials Used to Plug and Abandon Test Well SIMO-1

Date	Depth Interval (ft bgs bottom to top)	Quantity Portland Type I/II Used (lb)	Quantity Municipal Water Used (gal.)	Quantity Quikrete Concrete Mix Used (lb)	Calculated Volume (ft^3)	Actual Volume (ft^3)
11/17/14	55.4–10.0 (east casing)	90	18	0	1.0	1.3
11/17/14	29.9–10.0 (west casing)	51	12	0	0.4	0.7
11/17/14	10.0–0.0	329	30	50	3.2	4.9
	Total	**470**	**60**	**50**	**4.6**	**6.9**

Table 4.1-1
Survey Coordinates of Brass/Aluminum Pin Embedded in Surface Pad

Identification	Northing	Easting	Elevation
LAWS-01	1770845.95	1649518.71	6360.99
LAWS-02	1770847.26	1649529.75	6361.03
LAWS-03	1770845.27	1649536.23	6361.03
DT-5	1754837.20	1625311.27	7143.75
DT-5A	1754789.39	1625309.92	7143.70
DT-9	1751497.21	1628990.71	6936.20
SIMO	1766633.93	1641883.46	6650.38
SIMO-1	1766694.57	1641897.64	6649.10

Note: All coordinates are expressed as New Mexico State Plane Coordinate System Central Zone (NAD 83); elevation is expressed in feet amsl using the National Geodetic Vertical Datum of 1929.

Appendix A

Video Logs of DT-5, DT-5A, and DT-9
(on DVDs included with this document)

Appendix B

Natural Gamma Logs of DT-5A and DT-9
(on CD included with this document)

Appendix C

NMOSE Plugging Plans of Operation and Plugging Records
(on CD included with this document)