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Date: APR 02 2012
Refer To: EP2012-0080

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

Subject: Submittal of Plugging and Abandonment Summary Reports for 14 Wells and Boreholes at Los Alamos National Laboratory for 2011 Commitment

Dear Mr. Kieling:

Enclosed please find two hard copies with electronic files of two reports describing the plugging and abandonment of 14 wells at Los Alamos National Laboratory. The reports are (1) Plugging and Abandonment Summary Report for Test Holes TH-1, TH-2, TH-3, and TH-5 at Technical Area 49 and (2) Plugging and Abandonment Summary Report for Wells and Boreholes SHB-1, SHB-3, SHB-4, TH-5, TH-6, Beta Hole, H-19, TA-21 Distillation Hole, TW-3, and USGS Test Hole. Two separate reports are being submitted because Los Alamos National Security, LLC, subcontractors completed this work under separate task orders during the past year.

This work was completed per the Notice of Approval with Modifications Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory, dated March 9, 2011; the Notice of Approval, Additional Modifications to Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory, dated August 22, 2011; and the Approval with Modifications Work Plan to Plug and Abandon Test Well 3 Los Alamos National Laboratory, dated March 9, 2011.

The table included with this letter (**Attachment 1**) summarizes the progress to date on plugging and abandoning the initial 30 wells and boreholes described in the above-referenced approved work plans, in addition to TW-3. Thirteen of the first 30 wells described in the above-referenced work plans have now been completed, in addition to TW-3. Ten more wells and boreholes from the initial 30 will be completed in calendar year 2012 and will be reported on in March 2013. The remaining 7 of the initial 30 wells will not be plugged and abandoned because they are in use (these wells at located at Technical Area 46), or they are within the parcel of land being transferred from the U.S. Department of Energy to Los Alamos County. In a future work plan, additional wells will be identified for plugging and abandoning beyond 2012.



If you have any questions, please contact Ted Ball at (505) 665-3996 (tedball@lanl.gov) or Woody Woodworth at (505) 665-5820 (lance.woodworth@nnsa.doe.gov).

Sincerely,

Sincerely,



Michael J. Graham, Associate Director
Environmental Programs
Los Alamos National Laboratory



Peter Maggiore, Assistant Manager
Environmental Projects Office
Los Alamos Site Office

MG/PM/CD/TB:sm

Enclosures: Two hard copies with electronic files:

- (1) Plugging and Abandonment Summary Report for Test Holes TH-1, TH-2, TH-3, and TH-5 at Technical Area 49 (LA-UR-12-20068)
- (2) Plugging and Abandonment Summary Report for Wells and Boreholes SHB-1, SHB-3, SHB-4, TH-5, TH-6, Beta Hole, H-19, TA-21 Distillation Hole, TW-3, and USGS Test Hole (LA-UR-12-1084)

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Attachment 1

November 2010 Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory, Approved with Modifications on March 9, 2011

Well ID	Completed for 2011 Commitment and March 31, 2012, Report	Planned for 2012 Commitment	Deferred	Notes
TW-3	1			This well was not part of the original 30 wells work plans
H-19	1			
Layne Western Well			1	This well is affected by land-transfer issues. It may be plugged and abandoned in 2012 or 2013. A video survey was conducted on 2/28/2012, and the well was found to be dry.
Sigma Mesa Well		1		
TH-5 and TH-6 in Pajarito Canyon	2			
SHB-1, SHB-3, and SHB-4	3			
TA-21 Distillation Hole	1			
TA-46 Distillation Holes			6	These distillation holes are in use by a third party
USGS Test Hole east of Material Disposal Area C	1			
Beta Hole in Water Canyon	1			
Core Holes 1, 3, 4 at TA-49		3		
TH-1, TH-2, TH-3, TH-4, and TH-5 at TA-49	4	1		
Test Holes TBM-1 and TBM-2 at TA-49		2		
Boreholes 49-10046, 49-10047, and 49-10048		3		
Total	14	10	7	31

LA-UR-12-20068
March 2012
EP2012-0076

Plugging and Abandonment Summary Report for Test Holes TH-1, TH-2, TH-3, and TH-5 at Technical Area 49

Prepared by the Environmental Programs Directorate

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document pursuant to the Compliance Order on Consent, signed March 1, 2005. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

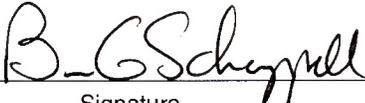
Plugging and Abandonment Summary Report for Test Holes TH-1, TH-2, TH-3, and TH-5 at Technical Area 49

March 2012

Responsible project manager:

Ted Ball		Project Manager	Environmental Programs	5/28/12
Printed Name	Signature	Title	Organization	Date

Responsible LANS representative:

Michael J. Graham		Associate Director	Environmental Programs	3/28/12
Printed Name	Signature	Title	Organization	Date

Responsible DOE representative:

Peter Maggiore		Assistant Manager	DOE-LASO	4-2-2012
Printed Name	Signature	Title	Organization	Date

EXECUTIVE SUMMARY

This report describes the methods Los Alamos National Laboratory used to plug and abandon neutron moisture logging Test Hole 1 (TH-1), TH-2, TH-3, and TH-5 at Technical Area 49 (TA-49), Los Alamos, New Mexico. TH-4 is located within the nuclear environmental site boundary at TA-49 and was not abandoned.

TH-1, TH-2, TH-3, and TH-5 were plugged and abandoned in accordance with the approved "Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory."

Plugging and abandonment activities at TH-1, TH-2, TH-3, and TH-5 occurred from May 16, 2011, to May 23, 2011, using a CME-85 hollow-stem auger all-terrain drill rig and ancillary equipment.

TH-3 was abandoned first, followed by TH-5, TH-1, and TH-2. Surface casing was removed, and the boreholes were plugged and abandoned via tremie pipe with 3/8-in. bentonite chips from the bottom to 10 ft below ground surface (bgs). The remainder of each borehole was then filled to within 2 ft bgs with Portland Type I/II neat cement. Concrete was placed above the cement to the top of the borehole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. A brass marker was embedded in the surface of the pad and surveyed in accordance with Section IX.B.2.f of the Compliance Order on Consent.

CONTENTS

1.0 INTRODUCTION 1

2.0 BACKGROUND 1

 2.1 Well History..... 1

 2.2 Rationale for Plugging and Abandonment..... 1

3.0 SCOPE OF ACTIVITIES 1

 3.1 Plugging and Abandonment Design and Approach 1

 3.2 Borehole Logging..... 2

 3.3 Plugging and Abandonment 2

 3.3.1 Field Activities 2

 3.3.2 Completion 2

4.0 POSTABANDONMENT ACTIVITIES 2

 4.1 Well Site Restoration 2

 4.2 Waste Management..... 2

5.0 DEVIATIONS FROM PLANNED ACTIVITIES 3

6.0 SUMMARY 3

7.0 REFERENCES 3

Figures

Figure 2.0-1 Location of TH-1, TH-2, TH-3, TH-4, and TH-5 5

Figure 2.0-2 Test hole as-built well construction diagram..... 6

Figure 3.3-1 Test hole as-built well abandonment diagram 7

Tables

Table 3.3-1 Materials and Quantities Used to Plug and Abandon Test Holes..... 9

1.0 INTRODUCTION

This report summarizes the methods Los Alamos National Laboratory (LANL or the Laboratory) used to plug and abandon Test Hole 1 (TH-1), TH-2, TH-3, and TH-5 at Technical Area 49 (TA-49). Well abandonment was consistent with the requirements and guidelines in Sections IV.B.1.b.v and X.D (Well Abandonment) of the New Mexico Environment Department (NMED) Compliance Order on Consent (the Consent Order). Additionally, the plugging and abandonment procedures complied with New Mexico Administrative Code 19.27.4, Well Driller Licensing; Construction, Repair and Plugging of Wells. The document titled "Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory" (LANL 2010, 111131) helped guide the implementation of the scope of work for the plugging and abandonment project of TH-1, TH-2, TH-3, and TH-5 at TA-49.

2.0 BACKGROUND

TH-1, TH-2, TH-3, and TH-5 are located at TA-49, Los Alamos, New Mexico (Figure 2.0-1). TH-4 is located within the nuclear environmental site (NES) boundary at TA-49. TH-1, TH-2, TH-3, TH-4, and TH-5 were installed in 1980 to 123 ft below ground surface (bgs) for neutron moisture logging at Area 2 in TA-49.

2.1 Well History

In 1980, a study was conducted to explain the observed accumulation of water in Core Hole 2 (CH-2). The study involved drilling five test holes (TH-1, TH-2, TH-3, TH-4, and TH-5) at locations adjacent to Areas 2, 2A, and 2B at TA-49. The boreholes were drilled to depths that would provide moisture monitoring of the tuff below the bottom of the shafts in Areas 2, 2A, and 2B. The boreholes were drilled through the sand fill and into the underlying tuff. Cuttings from the test holes were logged, and moisture content was determined over 5-ft drilling intervals. The test holes were cased to 2 ft bgs with 5-in. polyvinyl chloride (PVC) pipe to facilitate neutron logging (Purtymun and Ahlquist 1986, 014722, p. 16). The well construction diagram for the test wells before plugging and abandonment is presented in Figure 2.0-2 and is based on field observations.

2.2 Rationale for Plugging and Abandonment

TH-1, TH-2, TH-3, and TH-5 were abandoned in accordance with direction from NMED as communicated in the "Notice of Approval with Modifications, Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory" (NMED 2011, 201231). TH-4 will be plugged and abandoned at a later date.

3.0 SCOPE OF ACTIVITIES

The scope of activities for the plugging and abandonment of TH-1, TH-2, TH-3, and TH-5 is presented below.

3.1 Plugging and Abandonment Design and Approach

The total depth (TD) of each test hole was tagged before abandonment. The abandonment approach implemented at the test holes was to remove all aboveground and belowground appurtenances. The boreholes were abandoned by removing the 5-in. PVC casings and filling the open boreholes with 3/8-in. bentonite chips from TD to within 10 ft of ground surface. The remainder of each borehole was filled with neat cement to within 2 ft of ground surface. Concrete was placed above the cement.

3.2 Borehole Logging

No borehole logging was conducted before the plugging and abandonment of TH-1, TH-2, TH-3, and TH-5.

3.3 Plugging and Abandonment

Plugging and abandonment activities included mobilization, casing removal, grouting/sealing, and demobilization. All activities were performed following appropriate standard operating procedures and Laboratory-approved health and safety documents. TH-1, TH-2, TH-3, and TH-5 were plugged and abandoned in accordance with the NMED-approved work plans (LANL 2010, 111131). Figure 3.3-1 illustrates the final well configurations after plugging and abandonment.

3.3.1 Field Activities

Plugging and Abandonment of TH-1, TH-2, TH-3, and TH-5

Mobilization of a CME-85 hollow-stem auger all-terrain drill rig and ancillary equipment to TH-3 was performed on May 16, 2011. TH-3, TH-5, and TH-1 were abandoned on May 16, 2011. TH-2 was abandoned on May 17, 2011. Aboveground surface completions were completed on May 19 and 20, and the brass monuments were stamped on May 23. Each of the test holes was inspected and tagged. Inspection revealed that the casing extended only to 2 ft bgs with a 3-ft stick-up. Therefore, the casing at each of the test holes was pulled before the plugging and abandonment. After each borehole was tagged and the casing pulled, the test holes were filled from TD to approximately 10 ft bgs with 3/8-in. bentonite chips. The chips were tremied into the open borehole and hydrated using municipal water. The remainder of each of the boreholes was filled with neat cement to within 2 ft of ground surface and capped with concrete. The tagged depth and volume and type of abandonment materials used to abandon each of the test holes are presented in Table 3.3-1.

3.3.2 Completion

Concrete was placed above the cement at the top of each borehole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. Brass survey markers were surveyed in accordance with Section IX.B.2.f of the Consent Order.

4.0 POSTABANDONMENT ACTIVITIES

Postabandonment activities are described below.

4.1 Well Site Restoration

Plugging and abandonment activities at the test hole sites did not disturb site conditions, and no restoration efforts were required.

4.2 Waste Management

Contact waste (i.e., PVC casing) was generated during the plugging and abandonment of TH-1, TH-2, TH-3, and TH-5. All contact waste was recycled or reused.

5.0 DEVIATIONS FROM PLANNED ACTIVITIES

The work plan indicated that surface casing extended to approximately 10 ft bgs. However, the PVC surface casing at each of the test holes extended to only 2 ft bgs and had a 3-ft stick-up. Each 5-ft length of PVC casing was removed from the boreholes. TH-4 is located within the NES Boundary at TA-49 and was not abandoned during this effort because it is planned for abandonment with other wells and boreholes inside the NES, which will require a separate readiness process.

6.0 SUMMARY

TH-1, TH-2, TH-3, and TH-5 were plugged and abandoned in accordance with the NMED-approved work plans (LANL 2010, 111131). TH-3 was abandoned first, followed by TH-5, TH-1, and TH-2. Surface casing was removed, and the boreholes were plugged and abandoned via tremie pipe with 3/8-in. bentonite chips from the bottom to 10 ft bgs. The bentonite chips were hydrated with municipal water. The remainder of each of the boreholes was filled with Portland Type I/II neat cement. Concrete was placed above the cement at the top of the borehole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. A brass marker was embedded in the surface of the pad and surveyed in accordance with Section IX.B.2.f of the Consent Order.

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.

LANL (Los Alamos National Laboratory), November 2010. "Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-10-6972, Los Alamos, New Mexico. (LANL 2010, 111131)

NMED (New Mexico Environment Department), March 9, 2011. "Notice of Approval with Modifications, Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 201231)

Purtymun, W.D., and A.J. Ahlquist, 1986. "Geologic and Hydrologic Evaluation of Technical Area 49," Los Alamos National Laboratory document HSE-8-86-1183, Los Alamos, New Mexico. (Purtymun and Ahlquist 1986, 014722)

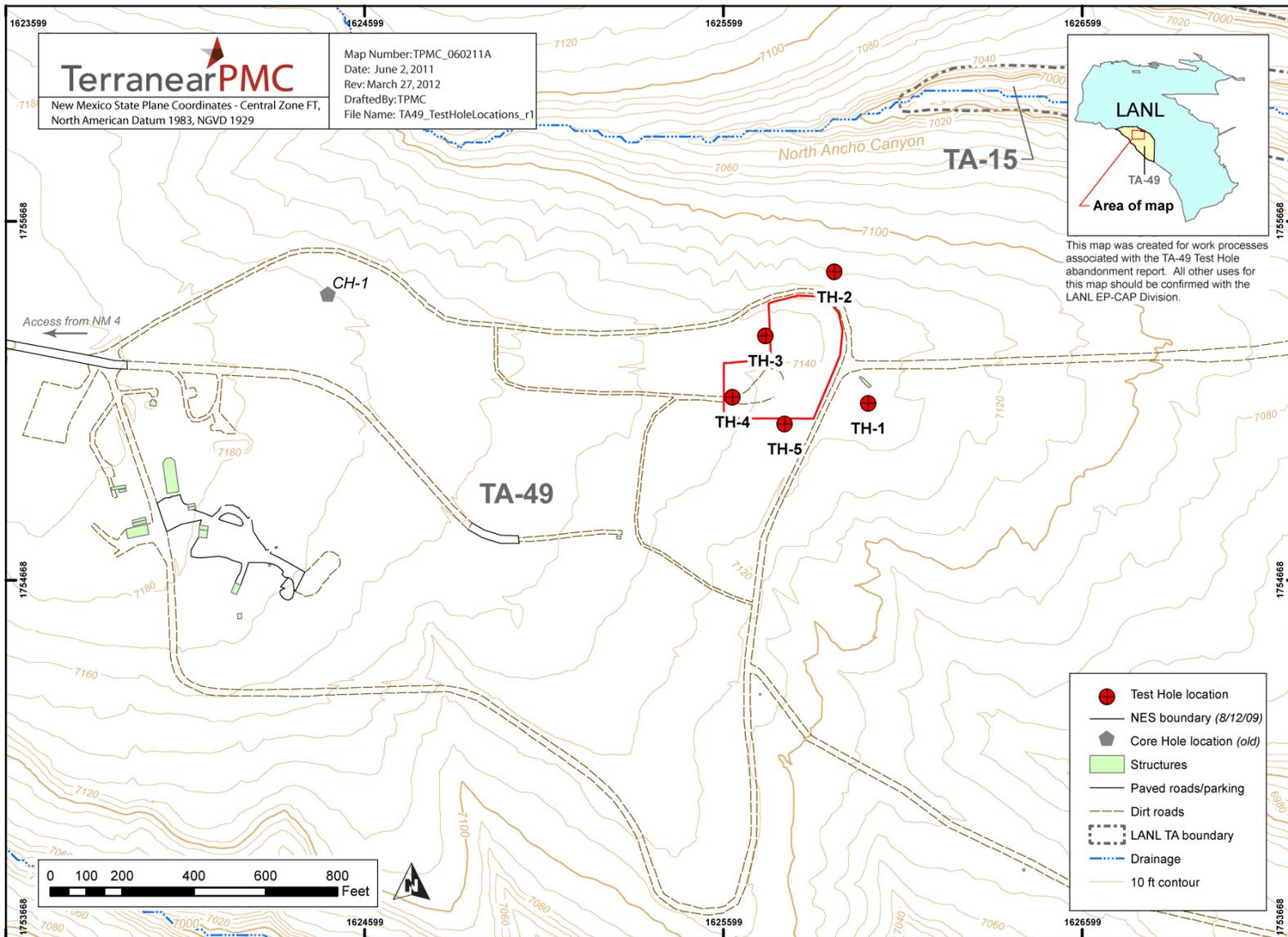


Figure 2.0-1 Location of TH-1, TH-2, TH-3, TH-4, and TH-5

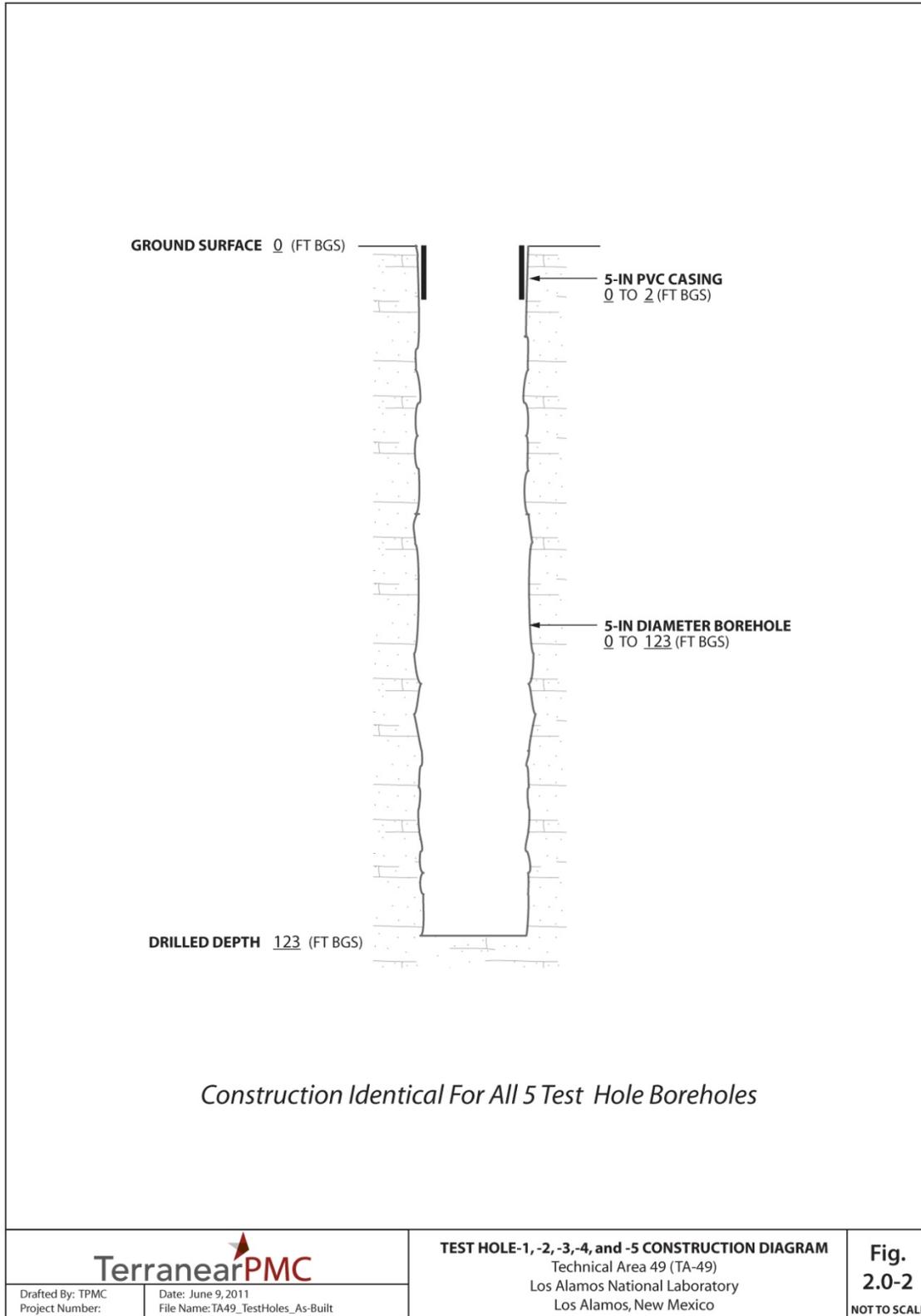
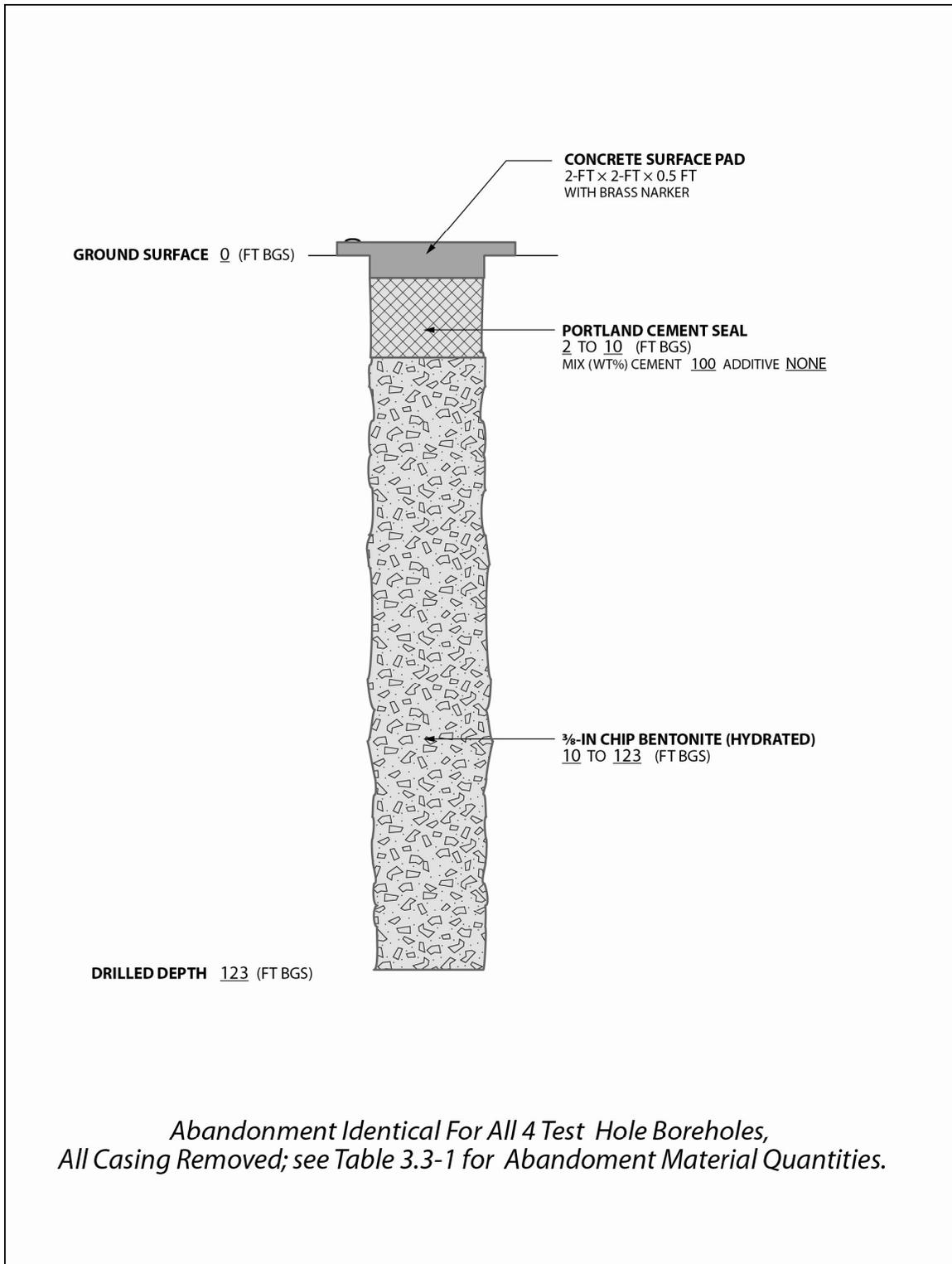


Figure 2.0-2 Test hole as-built well construction diagram



		TEST HOLE-1, -2, -3, and -5 ABANDONMENT DIAGRAM Technical Area 49 (TA-49) Los Alamos National Laboratory Los Alamos, New Mexico	Fig. 3.3-1 NOT TO SCALE

Figure 3.3-1 Test hole as-built well abandonment diagram

**Table 3.3-1
Materials and Quantities Used to Plug and Abandon Test Holes**

Test Hole ID	Depth Interval (ft bgs)	Quantity Portland Type I/II/IV Used (lb)	Quantity 3/8-in. Bentonite Used (lb)	Quantity Municipal Water Used (gal.)	Calculated Volume (ft ³) ^a	Actual Volume (ft ³)
TH-1	0-10	94	na ^b	10	15.1	20.6
TH-1	10-111	n/a	900	144		
TH-2	0-10	94	n/a	10	14.1	16.3
TH-2	10-104	n/a	700	112		
TH-3	0-10	94	n/a	10	14.8	18.4
TH-3	10-109	n/a	800	128		
TH-5	0-10	94	n/a	10	15.4	20.6
TH-5	10-113	n/a	900	144		

^a Calculated volumes are based on the following dimensions:
0-respective TD ft bgs: 5-in. open hole.

^b n/a = Not applicable.

LA-UR-12-1084
March 2012
EP2012-0059

Plugging and Abandonment Summary Report for Wells and Boreholes SHB-1, SHB-3, SHB-4, TH-5, TH-6, Beta Hole, H-19, TA-21 Distillation Hole, TW-3, and USGS Test Hole

Prepared by the Environmental Programs Directorate

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document pursuant to the Compliance Order on Consent, signed March 1, 2005. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

Plugging and Abandonment Summary Report for Wells and Boreholes SHB-1, SHB-3, SHB-4, TH-5, TH-6, Beta Hole, H-19, TA-21 Distillation Hole, TW-3, and USGS Test Hole

March 2012

Responsible project manager:

Ted Ball		Project Manager	Environmental Programs	3/28/12
Printed Name	Signature	Title	Organization	Date

Responsible LANS representative:

Michael J. Graham		Associate Director	Environmental Programs	3/28/12
Printed Name	Signature	Title	Organization	Date

Responsible DOE representative:

Peter Maggiore		Assistant Manager	DOE-LASO	4-2-2012
Printed Name	Signature	Title	Organization	Date

EXECUTIVE SUMMARY

This report details the methods Los Alamos National Laboratory (the Laboratory) used to plug and abandon Seismic Hazard Borehole 1 (SHB-1), SHB-3, SHB-4, Test Hole 5 (TH-5), TH-6, the Beta Hole, Borehole H-19, the Technical Area 21 (TA-21) Distillation Hole, Test Well 3 (TW-3), and the United States Geological Survey (USGS) Test Hole. The wells and boreholes were plugged and abandoned in accordance with direction from the New Mexico Environment Department and the New Mexico Office of the State Engineer.

Plugging and abandonment activities occurred from November 15, 2011, to February 27, 2012. Before abandonment, all aboveground and belowground appurtenances were removed. SHB-3 was video logged in 2004. SHB-4, TH-5, TH-6, the Beta Hole, and TW-3 were video logged in 2011. H-19 was video logged twice before plugging and abandonment activities in 2011 and five times during plugging and abandonment activities in 2012. SHB-1, the TA-21 Distillation Hole, and the USGS Test Hole were not video logged before abandonment. Final water-level measurements and the total depths of the wells and boreholes were verified using a water-level meter and/or a tag line.

A Foremost DR-24 drill rig and ancillary equipment were used during plugging and abandonment activities at SHB-3, SHB-4, H-19, and TW-3 and for the completion of the Beta Hole and TH-6. SHB-3 and SHB-4 were reamed to remove polyvinyl chloride casing and cement seals. The steel casing string at H-19 was drilled out and perforated to seal off an intermediate-perched zone encountered during initial drilling. The internal casing string at TW-3 was perforated and then cut and removed. The drill rig was used to remove the surface casing at the Beta Hole and to overdrill the surface casings at H-19, TH-6, and TW-3. The wells and boreholes were plugged with hydrated bentonite chips and Portland Type I/II cement and municipal water.

A pump hoist rig was used during plugging and abandonment activities at SHB-1, TH-6, and the TA-21 Distillation Hole. SHB-1 and the TA-21 Distillation Hole were plugged with Portland Type I/II cement and municipal water.

High-voltage power lines presented clearance issues at TH-5 and made setup of any sort of rig impossible. TH-5 was plugged and abandoned from its current bottom depth with Portland Type I/II cement and municipal water.

The Laboratory's Maintenance and Site Services personnel plugged and abandoned the USGS Test Hole with Portland Type I/II cement and municipal water.

The wells and boreholes were cement-grouted to approximately 2 ft below ground surface, and a small concrete surface pad was installed near ground surface with a brass survey marker. The surface completion was surveyed in accordance with Section IX.B.2.f of the Compliance Order on Consent.

CONTENTS

1.0 INTRODUCTION 1

2.0 BACKGROUND 1

2.1 SHB-1, SHB-3, and SHB-4 1

2.2 TH-5 and TH-6 2

2.3 Beta Hole 2

2.4 H-19 2

2.5 TA-21 Distillation Hole 3

2.6 TW-3 3

2.7 USGS Test Hole 4

3.0 PLUGGING AND ABANDONMENT 4

3.1 SHB-1, SHB-3, and SHB-4 4

3.2 TH-5 and TH-6 5

3.3 Beta Hole 6

3.4 H-19 6

3.5 TA-21 Distillation Hole 7

3.6 TW-3 7

3.7 USGS Test Hole 8

4.0 COMPLETION 8

4.1 Geodetic Survey 8

5.0 POSTABANDONMENT ACTIVITIES 8

5.1 Well/Borehole Site Restoration 8

5.2 Waste Management 8

6.0 DEVIATIONS FROM PLANNED ACTIVITIES 9

6.1 OSE-Approved Modifications to Work Plan 10

7.0 SUMMARY 10

8.0 REFERENCES AND MAP DATA SOURCES 11

8.1 References 11

8.2 Map Data Sources for Plugging and Abandonment Report Location Map 12

Figures

Figure 1.0-1 Location of plugged and abandoned wells and boreholes SHB-1, SHB-3, SHB-4, TH-5, TH-6, the Beta Hole, Borehole H-19, the TA-21 Distillation Hole, TW-3, and the USGS Test Hole 13

Figure 2.1-1 SHB-1 well construction diagram 14

Figure 2.1-2 SHB-3 well construction diagram 15

Figure 2.1-3 SHB-4 well construction diagram 16

Figure 2.2-1 TH-5 well construction diagram 17

Figure 2.2-2 TH-6 well construction diagram 18

Figure 2.3-1 Beta Hole well construction diagram 19

Figure 2.4-1 H-19 well construction diagram 20

Figure 2.5-1	TA-21 Distillation Hole well construction diagram.....	21
Figure 2.6-1	TW-3 well construction diagram.....	22
Figure 3.1-1	SHB-1 well abandonment diagram	23
Figure 3.1-2	SHB-3 well abandonment diagram	24
Figure 3.1-3	SHB-4 well abandonment diagram	25
Figure 3.2-1	TH-5 well abandonment diagram.....	26
Figure 3.2-2	TH-6 well abandonment diagram.....	27
Figure 3.3-1	Beta Hole well abandonment diagram	28
Figure 3.4-1	H-19 well abandonment diagram	29
Figure 3.5-1	TA-21 Distillation Hole well abandonment diagram	30
Figure 3.6-1	TW-3 well abandonment diagram.....	31

Tables

Table 2.0-1	Video and Gamma Logging	33
Table 3.1-1	Materials and Quantities Used to Plug and Abandon SHB-1	33
Table 3.1-2	Materials and Quantities Used to Plug and Abandon SHB-3	33
Table 3.1-3	Materials and Quantities Used to Plug and Abandon SHB-4	34
Table 3.2-1	Materials and Quantities Used to Plug and Abandon TH-5.....	34
Table 3.2-2	Materials and Quantities Used to Plug and Abandon TH-6.....	34
Table 3.3-1	Materials and Quantities Used to Plug and Abandon Beta Hole	35
Table 3.4-1	Materials and Quantities Used to Plug and Abandon H-19	35
Table 3.5-1	Materials and Quantities Used to Plug and Abandon TA-21 Distillation Hole	36
Table 3.6-1	Materials and Quantities Used to Plug and Abandon TW-3	36
Table 4.1-1	Survey Coordinates from Brass Pin Embedded in Surface Pad	37

Appendixes

Appendix A	2011 Video Logs of Plugged and Abandoned Wells (on DVDs included with this document)
Appendix B	Gamma Ray Logs

Acronyms and Abbreviations

ags	above ground surface
amsl	above mean sea level
bgs	below ground surface
Consent Order	Compliance Order on Consent
I.D.	inside diameter
LANL	Los Alamos National Laboratory
MSS	Maintenance and Site Services
NMED	New Mexico Environment Department
O.D.	outside diameter
OSE	Office of the State Engineer (New Mexico)
PVC	polyvinyl chloride
RPF	Records Processing Facility
SHB	seismic hazard borehole
TA	technical area
TD	total depth
TH	test hole
TW	test well
USGS	United States Geological Survey
WCSF	waste characterization strategy form

1.0 INTRODUCTION

This report summarizes the methods Los Alamos National Laboratory (LANL or the Laboratory) used to plug and abandon Seismic Hazard Borehole 1 (SHB-1), SHB-3, SHB-4, Test Hole 5 (TH-5), TH-6, the Beta Hole, Borehole H-19, the Technical Area 21 (TA-21) Distillation Hole, Test Well 3 (TW-3), and the United States Geological Survey (USGS) Test Hole. The wells and boreholes are located in Los Alamos, New Mexico as shown in Figure 1.0-1.

Well and borehole abandonment was consistent with the requirements and guidelines in Sections IV.B.1.b.v and X.D (Well Abandonment) of the New Mexico Environment Department (NMED) Compliance Order on Consent (the Consent Order). Additionally, the plugging and abandonment procedures complied with New Mexico Administrative Code 19.27.4, 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: "Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory" (LANL 2010, 111131), "Field Implementation Plan to Plug and Abandon Wells and Boreholes SHB 1, SHB 3, SHB 4, TH 5, TH 6, Beta Hole, Sigma Mesa Well, H-19, and TA-21 Distillation Hole" (TerranearPMC 2011, 206495), and "Field Implementation Plan to Plug and Abandon Test Well (TW) 3" (TerranearPMC 2012, 213293). A Well Plugging Plan of Operations was filed for each well and borehole, except the USGS Test Hole, with the New Mexico Office of the State Engineer (OSE).

2.0 BACKGROUND

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

A summary of video and gamma logging activities at these locations is presented in Table 2.0-1. The video logs collected in 2011 are presented in Appendix A (on DVDs included with this document). Appendix B includes gamma ray logs for H-19, TH-6, TW-3, and the Beta Hole. The Laboratory's camera trailer and logging equipment were used to complete the logging.

2.1 SHB-1, SHB-3, and SHB-4

SHB-1, SHB-3, and SHB-4 were seismic investigation boreholes drilled in 1991 and 1992. SHB-1 was drilled in upper Pajarito Canyon to 700.0 ft below ground surface (bgs), SHB-3 was drilled to 860.0 ft bgs in upper Water Canyon, and SHB-4 was drilled to 200.0 ft bgs in lower Pajarito Canyon (Gardner et al. 1993, 012582). The SHB holes were 6 in. in diameter and were constructed with 2.9-in.-inside diameter (I.D.) polyvinyl chloride (PVC) casing to total depth (TD); the PVC casings were cemented in place in the boreholes.

Preabandonment Conditions

- SHB-1 was open to 660.8 ft bgs with no water present. TD and lack of water were verified with a water-level meter. No video log was collected at SHB-1.
- SHB-3 was open to 759.7 ft bgs with water present at 659.5 ft bgs. TD and presence of water were verified with a water-level meter. SHB-3 was video logged on February 27, 2004.
- SHB-4 was open to 200.0 ft bgs with no water present. TD and lack of water were verified with a water-level meter. SHB-4 was video logged on October 17, 2011.

Figures 2.1-1, 2.1-2, and 2.1-3 are well construction diagrams that depict the construction details and preabandonment conditions of SHB-1, SHB-3, and SHB-4, respectively.

2.2 TH-5 and TH-6

TH-5 and TH-6 were investigation boreholes drilled in Pajarito Canyon in 1950; TH-5 was drilled to 263.0 ft bgs and TH-6 was drilled to 300.0 ft bgs (Purtymun 1995, 045344; Purtymun and Swanton 1998, 099096). TH-5 was 24 in. in diameter with 24-in. surface casing to 24.0 ft bgs. TH-6 was constructed with 8-in.-diameter casing from surface to an unknown depth and 6-in.-diameter casing to 208.0 ft bgs.

Preabandonment Conditions

- TH-5 was open to 31.9 ft bgs with no water present. During video logging, a solid bridge was encountered at 31.9 ft bgs. Because of the presence of overhead power lines, a rig could not be set up in this location. TD and lack of water were verified with a water-level meter. TH-5 was video logged on June 1, 2011.
- TH-6 was open to 291.0 ft bgs with no water present. TD and lack of water were verified with a water-level meter. TH-6 was video logged and gamma logged on June 1, 2011.

Figures 2.2-1 and 2.2-2 are well construction diagrams that depict the construction details and preabandonment conditions of TH-5 and TH-6, respectively.

2.3 Beta Hole

The Beta Hole was drilled in 1950 with a bucket auger rig to 180.0 ft bgs (Purtymun 1995, 045344). The borehole was 24 in. in diameter and was uncased. A corrugated metal surface casing extended to 14 ft bgs.

Preabandonment Conditions

The Beta Hole was open to 178.5 ft bgs with no water present. TD and lack of water were verified with a water-level meter. The Beta Hole was video and gamma logged on December 12, 2011.

Figure 2.3-1 is a well construction diagram that depicts the construction details and preabandonment conditions of the Beta Hole.

2.4 H-19

The H-19 borehole was drilled by the cable tool method in 1949 to 2000 ft bgs (Purtymun 1995, 045344). The borehole was approximately 12 in. in diameter.

Preabandonment Conditions

H-19 was video logged on seven occasions. Videos were run on June 7, 2011, and November 3, 2011, to document preabandonment conditions, but the first video was terminated at 60.0 ft bgs because of a tree limb in the hole, blocking access. The second video terminated at 68 ft bgs because of bridged hole conditions.

The third video log was run on January 10, 2012, to a depth of 179.5 ft bgs. The fourth video was run on January 10, 2012, from the surface to 209.5 ft bgs.

The fifth video log was run on January 12, 2012 from the surface to 256 ft bgs, after the hole was drilled to 260.0 ft bgs, to identify an obstruction, which was not observed on previous video runs because of murky drilling water in the bottom of the hole.

The sixth video log was conducted after drilling to 530.0 ft bgs on January 14, 2012. The sixth video log revealed corroded 12-in. casing from ground surface to the top of water at 436.1 ft bgs; the video was terminated because of lack of visibility. A gamma log was also collected at this time. The driller indicated that the casing was most likely continuous from 436.1 to 530.0 ft bgs while monitoring cutting returns during drilling.

The seventh video log was conducted after the 12-in. casing string was perforated during plugging and abandonment activities on January 17, 2012. The video revealed perforations from 480 to 400 ft bgs (the planned length to be perforated).

Figure 2.4-1 is a well construction diagram that depicts the construction details and preabandonment conditions of the H-19 borehole.

2.5 TA-21 Distillation Hole

The TA-21 distillation hole was drilled and instrumented in 1969 as part of a carbon isotope production experiment. The 36-in.-diameter borehole was drilled to 125.0 ft bgs, and 140.0 ft of 18-in.-diameter casing was cemented in place to TD (it originally protruded 15 ft above ground surface [ags]). The 140-ft-long distillation column was fitted with distillation equipment, which included three 5.5-in.-I.D. aluminum casing strings, 2-in.- and 1-in.- outside diameter (O.D.) aluminum pipe strings, 0.25-in. copper and stainless-steel tubes, Styrofoam and film insulation, and electrical wires.

Preabandonment Conditions

The part of the distillation column that extended 15 ft ags was removed during demolishing and decommissioning of the building structure. Several feet of distillation equipment was removed by the Laboratory's Maintenance and Site Services (MSS) personnel in order to gain access to the hole before plugging and abandonment activities began. Water, later determined to be surface runoff, was present at 20.0 ft bgs.

Figure 2.5-1 is a well construction diagram that depicts the construction details and preabandonment conditions of the TA-21 Distillation Hole.

2.6 TW-3

TW-3 was drilled by the cable tool method in 1949 in order to monitor the regional aquifer in Los Alamos Canyon. TW-3 was drilled to 815 ft bgs (Purtymun 1995, 045344). TW-3 had a 6-in.-diameter screened section located between 805 and 815 ft bgs. The screened section was swaged into the bottom of 10-in.-diameter casing, which extended from ground surface to 805 ft bgs. A 16-in.-diameter surface casing was located between ground surface and 33 ft bgs.

Preabandonment Conditions

TW-3 was open to 807.5 ft bgs with water present at 787.5 ft bgs. TD and presence of water were verified with a water-level meter. TW-3 was video logged and gamma logged on November 4, 2011.

Figure 2.6-1 is a well construction diagram that depicts the construction details and preabandonment conditions of TW-3.

2.7 USGS Test Hole

The USGS Test Hole east of Material Disposal Area C was drilled in 1983 to 210 ft bgs (Purtymun 1995, 045344). The dry borehole was 4.5 in. in diameter, and casing was installed with six screens to conduct vadose zone monitoring tests. Screened intervals were installed at the following depths (bgs):

- 25–30 ft
- 50–55 ft
- 78–83 ft
- 105–110 ft
- 140–145 ft
- 190–195 ft

The upper 22 ft of the annulus was sealed with cement; a mixture of cement and cuttings was placed in the annulus above and below each screen. In addition, heat dissipation probes were set in the annular space from 118 to 122 ft bgs.

Preabandonment Conditions

The USGS well had been sheared off near the surface and buried during previous soil-vapor activities. The coordinates to relocate this point were incorrect, with the northing off by approximately 40 ft. After extensive excavation work, the well was located within approximately 3 ft of the finished concrete pad for regional aquifer monitoring well R-60. The annulus outside the PVC casing was cemented, and the inside of the PVC was filled with neat cement.

3.0 PLUGGING AND ABANDONMENT

Plugging and abandonment activities included mobilization, casing removal, drilling, reaming, perforating, pressure-grouting/sealing, and demobilization. All activities were performed following appropriate standard operating procedures and Laboratory-approved health and safety documents. The wells and boreholes were plugged and abandoned in accordance with NMED-approved work plans and New Mexico OSE plugging plans.

3.1 SHB-1, SHB-3, and SHB-4

SHB-1

Plugging and abandonment activities at SHB-1 occurred from December 13 to December 15, 2011, using a pump hoist rig. The surface was excavated around SHB-1 to 4 ft bgs, and 5 ft of 6-in.-diameter surface casing and 2.9 in.-I.D. PVC casing were removed before mobilizing to the site. SHB-1 was grouted from 660.8 (TD) to 1.5 ft bgs via tremie pipe with approximately 48.1 ft³ of neat cement grout. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. Approximately 500 ft of the 1-in. PVC tremie pipe was grouted in place. The tremie pipe was left in place as a waste minimization measure to avoid the cost of decontaminating the pipe and disposing of the decontamination water. The volume and type of abandonment materials used to abandon SHB-1 are presented in Table 3.1-1. The final borehole configuration is shown in Figure 3.1-1.

SHB-3

Plugging and abandonment activities at SHB-3 occurred from November 15 to December 12, 2011, using a Foremost DR-24 drill rig and ancillary equipment. Approximately 5 ft of 6-in.-diameter surface casing and 2.9-in.-I.D. PVC casing were removed from the borehole before reaming the PVC casing and cement seal to 265.0 ft bgs using a 6 1/8-in. tricone bit. The drill string became stuck at 104.6 ft bgs in the reamed hole during an attempt to remove the drill tools to unplug the tricone bit. The drilling tools were dislodged from the hole using an extraction tool. An 11 5/8-in. tricone bit and 12-in.-diameter casing string were advanced into the reamed hole to approximately 103.4 ft bgs. Because of continued borehole collapse, an 8-in.-diameter casing string was advanced to approximately 122.3 ft bgs using a 6 1/8-in. tricone bit. The borehole was reamed back down to 265.0 ft bgs with the 6 1/8-in. tricone bit.

SHB-3 was plugged from 265 ft bgs to 130.1 ft bgs with approximately 22.8 ft³ of 3/8-in. bentonite chips via tremie pipe before removing the tremie and 8-in. casing string. The 12-in. casing shoe was cut at 99.4 ft bgs, and the casing string was removed while simultaneously plugging the borehole to 10.3 ft bgs with approximately 89.1 ft³ of 3/8-in. bentonite chips. The borehole was then grouted to 2.0 ft bgs with approximately 9.0 ft³ of neat cement grout on December 12, 2011. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon SHB-3 are presented in Table 3.1-2. The final borehole configuration is shown in Figure 3.1-2.

SHB-4

Plugging and abandonment activities at SHB-4 occurred from January 5 to January 7, 2012, using a Foremost DR-24 drill rig and ancillary equipment. Approximately 5 ft of 6-in.-diameter surface casing and 2.9-in.-I.D. PVC casing were removed from the borehole before setting an 8-in.-diameter piece of casing with a 6 1/8-in. tricone bit to 16.1 ft bgs. The remaining PVC casing and cement seal were reamed with open-hole drilling methods with a 6 1/8-in. tricone bit to 201.1 ft bgs.

SHB-4 was plugged from 201.1 (TD) to 14.0 ft bgs with approximately 38.2 ft³ of 3/8-in. bentonite chips. The borehole was then grouted to 2.0 ft bgs with approximately 9.6 ft³ of neat cement grout on January 7, 2012. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon SHB-4 are presented in Table 3.1-3. The final borehole configuration is shown in Figure 3.1-3.

3.2 TH-5 and TH-6

TH-5

Plugging and abandonment activities at TH-5 occurred on December 7, 2011. TH-5 was plugged with approximately 150.4 ft³ of neat cement grout from 31.9 (TD) to 3.0 ft bgs. The 24-in.-diameter surface casing was cut and removed from 2.0 ft bgs. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon TH-5 are presented in Table 3.2-1. The final borehole configuration is shown in Figure 3.2-1.

TH-6

Plugging and abandonment activities at TH-6 occurred from December 9, 2011, to February 8, 2012, using a pump hoist rig and a Foremost DR-24 drill rig and ancillary equipment. The 6-in.-diameter casing string was removed from the borehole with the pump hoist rig as the seal was emplaced from 291.0 (TD) to 9.7 ft bgs with approximately 226.5 ft³ of 3/8-in. bentonite chips. TH-6 was grouted to 1.7 ft bgs on December 11, 2011. After removing the casing jacks, an 8-in.-diameter casing string was revealed at the

surface. An attempt was made to remove the casing string, which parted 4.0 ft bgs after removing approximately 19.9 ft of casing and sealant.

On February 6, 2012, a Foremost DR-24 drill rig and ancillary equipment were used to overdrill the 8-in. casing. An overwash shoe and 12-in.-diameter casing were advanced to approximately 20.0 ft bgs. The 12-in. casing was removed while simultaneously grouting the annulus between the open borehole and 8-in.-diameter casing. On February 8, 2012, approximately 24.1 ft³ of neat cement grout was used to grout the annulus from 20.0 to 2.5 ft bgs. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon TH-6 are presented in Table 3.2-2. The final borehole configuration is shown in Figure 3.2-2.

3.3 Beta Hole

Plugging and abandonment activities at the Beta Hole occurred from January 9 to February 3, 2012. The Beta Hole was plugged from 178.5 (TD) to 12.6 ft bgs with approximately 552.8 ft³ of 3/8-in. bentonite chips. A piece of 18-in.-diameter casing was set inside the corrugated surface casing from 2.0 ft ags to 15.5 ft bgs. A cement seal was placed between the annulus of the 24-in.-diameter corrugated surface casing and the 18-in. piece of casing from 12.6 ft bgs to the surface.

On February 2, 2012, a Foremost DR-24 drill rig and ancillary equipment was used to remove both sticks of casing. The open borehole was plugged to 10.0 ft bgs with approximately 13.4 ft³ of 3/8-in. bentonite chips. Approximately 25.3 ft³ of neat cement grout was used to plug the open borehole from 10.0 ft to 2.0 ft bgs on February 3, 2012. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon the Beta Hole are presented in Table 3.3-1. The final borehole configuration is shown in Figure 3.3-1.

3.4 H-19

Plugging and abandonment activities at borehole H-19 occurred from January 8 to February 1, 2012, using a Foremost DR-24 drill rig and ancillary equipment. The inside of the 12-in.-diameter casing string was drilled out with an 11 7/8-in. tricone bit to 218.0 ft bgs, where drilling was suspended because of an apparent obstruction. A 6 1/8-in. tricone bit was advanced into the casing and cleared the obstruction. At 260.0 ft bgs another obstruction was encountered. The tricone bit was removed and a video log was run, but no obstruction was identified. The 11 7/8-in. tricone bit was readvanced, and drilling proceeded to 530.0 ft bgs, where another obstruction was encountered. A video log revealed that the 12-in. casing string was set from ground surface to at least the top of water at 436.1 ft bgs. The video log was terminated because of a lack of visibility in the water.

Per the NMED and OSE approved work plan, H-19 was plugged from 530.0 to 498.9 ft bgs via tremie pipe with approximately 17.4 ft³ of 3/8-in. bentonite chips. The 12-in. casing string was then perforated from 480.0 to 400.0 ft bgs, and approximately 168.4 ft³ of neat cement grout was used to plug and seal the casing from 498.9 to 397.5 ft bgs. These actions sealed off the lower part of the borehole from the perched water identified during the initial drilling of the borehole and discussed in the NMED and OSE approved work plan.

H-19 was plugged from 397.5 to 95.1 ft bgs with approximately 268.0 ft³ of 3/8-in. bentonite chips before the 12-in. casing string was cut at 60.0 ft bgs. The casing parted at approximately 7.0 ft bgs during an attempt to remove the casing string from 60.0 ft bgs. The 12-in. casing string was plugged with approximately 60.3 ft³ of 3/8-in. bentonite chips from 95.1 to 22.0 ft bgs and grouted to 7.0 ft bgs with approximately 12.0 ft³ of neat cement grout.

Several attempts were made to overdrill the 12-in.-diameter casing to 20.0 ft bgs with a 27-in. overwash shoe and 20-in.-diameter casing. On the last attempt, the 12-in. casing was overdrilled to 19.0 ft bgs, but the hole collapsed to 14.5 ft bgs as the 20-in. casing was removed. The 12-in. casing was grouted in place, and the overdrilled borehole was abandoned with approximately 78.2 ft³ of neat cement grout to 2.0 ft bgs on February 1, 2012. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon H-19 are presented in Table 3.4-1. The final borehole configuration is shown in Figure 3.4-1.

3.5 TA-21 Distillation Hole

Plugging and abandonment activities at the TA-21 Distillation Hole occurred from January 4 to January 24, 2012, using a pump hoist rig. Three 5.5-in.-I.D. distillation casing strings and their internal distillation components were removed from the 18-in.-diameter casing. The distillation casing strings and components were approximately 121.4 ft, 109.5 ft, and 100.4 ft in length. All three distillation casing strings were capped on the bottom end.

Work was paused on two occasions during distillation casing and component removal to collect water samples. The samples were submitted to the Laboratory's Geology and Geochemistry Research Laboratory and Health Physics Analysis Laboratory for analysis. The water was determined to be rain and snowmelt runoff, and work was resumed.

An attempt was made to remove the water and material (Styrofoam and film insulation) from the 18-in.-diameter casing using a 12-in.-diameter bailer, but an obstruction prevented bailing activities deeper than approximately 40.0 ft bgs. Several unsuccessful attempts were made to fish out the obstruction before grouting commenced using a 2-in.-diameter tremie pipe installed to 121.0 ft bgs. The placement of cement raised the water in the 18-in. casing to the surface. The water was pumped into a waste container each time a lift of cement was emplaced. The 18-in. casing was cut and removed from 2.0 ft bgs, and the remaining casing was grouted to 2.0 ft bgs with approximately 162.4 ft³ of neat cement grout on January 24, 2012. The Laboratory conducted the final surface completion, including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon the TA-21 Distillation Hole are presented in Table 3.5-1. The final borehole configuration is shown in Figure 3.5-1.

3.6 TW-3

Plugging and abandonment activities at TW-3 occurred from February 13 to February 27, 2012, using a Foremost DR-24 drill rig and ancillary equipment. The 6-in.-diameter screen and 10-in.-diameter casing string were plugged from 807.5 to 311.0 ft bgs via tremie pipe with approximately 267.4 ft³ of neat cement grout. The 10-in. casing string was then perforated from 270.0 to 140.0 ft bgs before the string was cut at 275.0 ft bgs. The 10-in. casing string could not be removed with the cut made at 275.0 ft bgs. Another cut was made at 274.0 ft bgs, and the casing string was removed from the borehole.

TW-3 was plugged from 311.0 to 189.0 ft bgs with approximately 321.6 ft³ of 3/8-in. bentonite chips before an attempt was made to remove the 16-in.-diameter surface casing. The attempt to remove the 16-in. casing was unsuccessful, so the casing was overdrilled with a 27-in. overwash shoe and 20-in.-diameter casing from the surface to 20.0 ft bgs. The borehole was then plugged from 189.0 to 56.0 ft bgs with approximately 281.4 ft³ of 3/8-in. bentonite chips.

The 16-in. surface casing was cut and removed from 2.0 ft bgs, and the remaining casing, borehole, and annulus between the casing and 27-in. borehole were abandoned with approximately 156.5 ft³ of neat cement grout to 2.0 ft bgs on February 27, 2012. The Laboratory conducted the final surface completion,

including placing and stamping a brass cap. The volume and type of abandonment materials used to abandon TW-3 are presented in Table 3.6-1. The final borehole configuration is shown in Figure 3.6-1.

3.7 USGS Test Hole

To protect the location while the pad was restored, a piece of temporary 12-in.-diameter casing was placed over the well location. After pad restoration, MSS personnel filled the casing with neat cement from 3 ft bgs to within 6 in. of the finished pad surface. The casing stub was removed, and a brass monument was placed in the concrete. Gravel was placed over the concrete, leaving a smooth pad surface to work upon.

Given its proximity to the R-60 well, no 2 ft × 2 ft pad was placed here because of safety (tripping) concerns and pad clearance concerns.

4.0 COMPLETION

Except for the USGS Test Hole, each well and borehole was cement-grouted to approximately 2 ft bgs, and a concrete surface pad was installed. A brass survey marker was installed in the pad, and it was surveyed in accordance with Section IX.B.2.f of the Consent Order.

4.1 Geodetic Survey

The Laboratory conducted geodetic surveys on the wells and boreholes (Table 4.1-1). 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 (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 pin in the concrete pad.

5.0 POSTABANDONMENT ACTIVITIES

Postabandonment activities are described below.

5.1 Well/Borehole Site Restoration

Plugging and abandonment activities at the wells and boreholes 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 fluids, drill cuttings, and contact waste.

All waste streams produced during plugging and abandonment activities were sampled in accordance with "Waste Characterization Strategy Form for Plug and Abandonment of LANL Wells" (LANL 2009, 106892).

Fluids produced are expected to be land-applied after a review of associated analytical results per the waste characterization strategy form (WCSF) and the ENV-RCRA-QP-010.2, Land Application of Groundwater. If it is determined the fluids are nonhazardous but cannot meet the criteria for land

application, they will be evaluated for treatment and disposal at one of the Laboratory's wastewater treatment facilities. If analytical data indicate that the fluids are hazardous/nonradioactive or mixed low-level waste, the fluids will be disposed of at an authorized facility.

Cuttings produced during drilling are anticipated to be land-applied after a review of associated analytical results per the WCSF and ENV-RCRA-QP-011.2, Land Application of Drill Cuttings. If the drill cuttings do not meet the criteria for land application, they will be disposed of at an authorized facility. Characterization of contact waste will be based upon acceptable knowledge, pending analyses of the waste samples collected.

6.0 DEVIATIONS FROM PLANNED ACTIVITIES

SHB-3

SHB-3 was planned to be abandoned by reaming the PVC well and original borehole with a 6 1/8-in. drill bit to the original TD of 860.0 ft bgs. At 265.0 ft bgs, the bit became plugged and was being removed from the borehole when the drill tools became stuck at 104.6 ft bgs. Borehole collapse prevented open-hole reaming between 100.0 and 120.0 ft bgs, and 12-in.- and 8-in.-diameter casing strings were advanced into the hole. The borehole was reamed back down to 265.0 ft bgs before plugging and abandonment proceeded.

TH-6

Plugging and abandonment of TH-6 was initially performed as specified in the scope of work and field plan. However, 8-in.-diameter casing was revealed at the surface as the field crew removed the casing jacks during demobilization. An unsuccessful attempt was made to remove the 8-in. casing, which parted at 4 ft bgs. A drill rig was mobilized to the location, and the 8-in. casing string was overdrilled from the surface to 20.0 ft bgs. The annulus between the open hole and 8-in. casing was abandoned with neat cement grout to 2.0 ft bgs.

H-19

The 12-in.-diameter surface casing at H-19 was observed to be set from the surface to at least 530.0 ft bgs (historical records indicate the casing was set from the surface to 10.0 ft bgs). Bentonite was placed from 530.0 to 498.9 ft bgs before the 12-in. casing string was perforated from 480.0 to 400.0 ft bgs. Neat cement grout was used to seal the perforations, borehole wall, and 12-in. casing from 498.9 to 397.5 ft bgs. Bentonite was placed from 397.5 to 22.0 ft bgs after unsuccessfully cutting and removing the 12-in. casing string from 60.0 ft bgs. During removal, the casing string parted at 7.0 ft bgs. Neat cement grout was placed from 22.0 to 7.0 ft bgs within the 12-in. casing before removing the 7-ft stick of casing and overdrilling the remaining casing to 19.0 ft bgs. The 12-in. casing was grouted in place, and the borehole was abandoned with neat cement grout to 2.0 ft bgs.

TA-21 Distillation Hole

Water in the casing and distillation tooling at the TA-21 Distillation Hole were unexpected. Four fluid samples were collected and submitted for analysis.

6.1 OSE-Approved Modifications to Work Plan

SHB-3

The Laboratory sought and received permission from the OSE to abandon SHB-3 from 265.0 ft bgs instead of reaming the borehole to its original TD.

TH-6

The Laboratory sought and received permission from the OSE to overdrill TH-6 with a 12-in.-diameter casing string from the surface to 20.0 ft bgs and grout the annulus between the open hole and 8-in.-diameter surface casing.

H-19

The Laboratory sought and received permission from the OSE to perforate the 12-in.-diameter casing string from 480.0 to 400.0 ft bgs and cement the perforated interval.

The Laboratory sought and received permission from the OSE to cut and remove the 12-in.-diameter casing string at 60.0 ft bgs. When the casing string parted at 7.0 ft bgs, the Laboratory sought and received permission from the OSE to overdrill the remaining casing to approximately 15.0 to 20.0 ft bgs and abandon the remaining borehole and 12-in. casing with neat cement grout.

7.0 SUMMARY

SHB-1, SHB-3, SHB-4, TH-5, TH-6, the Beta Hole, Borehole H-19, the TA-21 Distillation Hole, TW-3, and the USGS Test Hole were plugged and abandoned in accordance with the NMED-approved work plans (LANL 2010, 111131). Before abandonment activities, all aboveground and belowground appurtenances were removed.

A Foremost DR-24 drill rig and ancillary equipment were used during plugging and abandonment activities at SHB-3, SHB-4, H-19, and TW-3, and for the completion of the Beta Hole and TH-6. SHB-3 and SHB-4 were reamed to remove PVC casing and cement seals. The casing at H-19 was drilled out to remove obstructions before perforating and sealing off an intermediate-perched zone. The drill rig was used at TW-3 to perforate, cut, and remove the inner casing string. The drill rig was used at the Beta Hole to remove the surface casing and was used at H-19, TH-6, and TW-3 to overdrill the surface casings. The wells and boreholes were plugged with hydrated bentonite chips and Portland Type I/II cement and municipal water.

A pump hoist rig was used during plugging and abandonment activities at SHB-1, TH-6, and the TA-21 Distillation Hole. SHB-1 and the TA-21 Distillation Hole were plugged with Portland Type I/II cement and municipal water.

TH-5 and the USGS Test Hole were plugged and abandoned with Portland Type I/II cement and municipal water, without the use of a drill rig or pump hoist.

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. 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.

Gardner, J.N., T. Kolbe, and S. Chang, January 1993. "Geology, Drilling, and Some Hydrologic Aspects of Seismic Hazards Program Core Holes, Los Alamos National Laboratory, New Mexico," Los Alamos National Laboratory report LA-12460-MS, Los Alamos, New Mexico. (Gardner et al. 1993, 012582)

LANL (Los Alamos National Laboratory), June 16, 2009. "Waste Characterization Strategy Form for Plug and Abandonment of LANL Wells," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2009, 106892)

LANL (Los Alamos National Laboratory), November 2010. "Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-10-6972, Los Alamos, New Mexico. (LANL 2010, 111131)

Purtymun, W.D., January 1995. "Geologic and Hydrologic Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface Water Stations in the Los Alamos Area," Los Alamos National Laboratory report LA-12883-MS, Los Alamos, New Mexico. (Purtymun 1995, 045344)

Purtymun, W.D., and A.S. Swanton, February 5, 1998. "Engineering, Geology, and Construction Data of Twenty-Five Test Holes and Test Wells on and Adjacent to the Pajarito Plateau," draft, Los Alamos National Laboratory, Los Alamos, New Mexico. (Purtymun and Swanton 1998, 099096)

TerranearPMC, August 2011. "Field Implementation Plan to Plug and Abandon Wells and Boreholes SHB 1, SHB 3, SHB 4, TH 5, TH 6, Beta Hole, Sigma Mesa Well, H-19, and TA-21 Distillation Hole," plan prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (TerranearPMC 2011, 206495)

TerranearPMC, January 2012. "Field Implementation Plan to Plug and Abandon Test Well (TW) 3," plan prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (TerranearPMC 2012, 213293)

8.2 Map Data Sources for Plugging and Abandonment Report Location Map

Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0109; 12 April 2010.

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.

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

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.

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 4 December 2009.

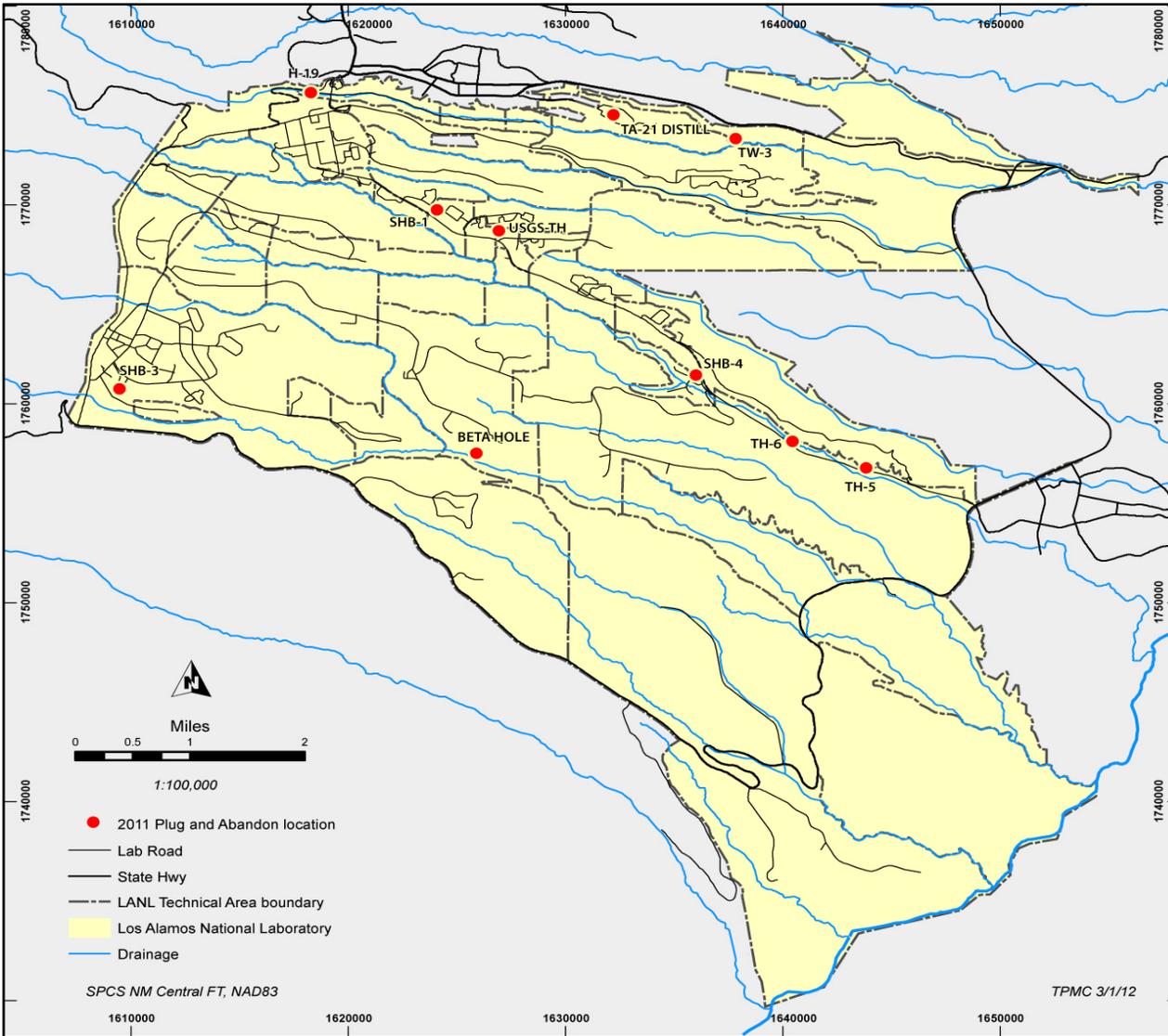


Figure 1.0-1 Location of plugged and abandoned wells and boreholes SHB-1, SHB-3, SHB-4, TH-5, TH-6, the Beta Hole, Borehole H-19, the TA-21 Distillation Hole, TW-3, and the USGS Test Hole

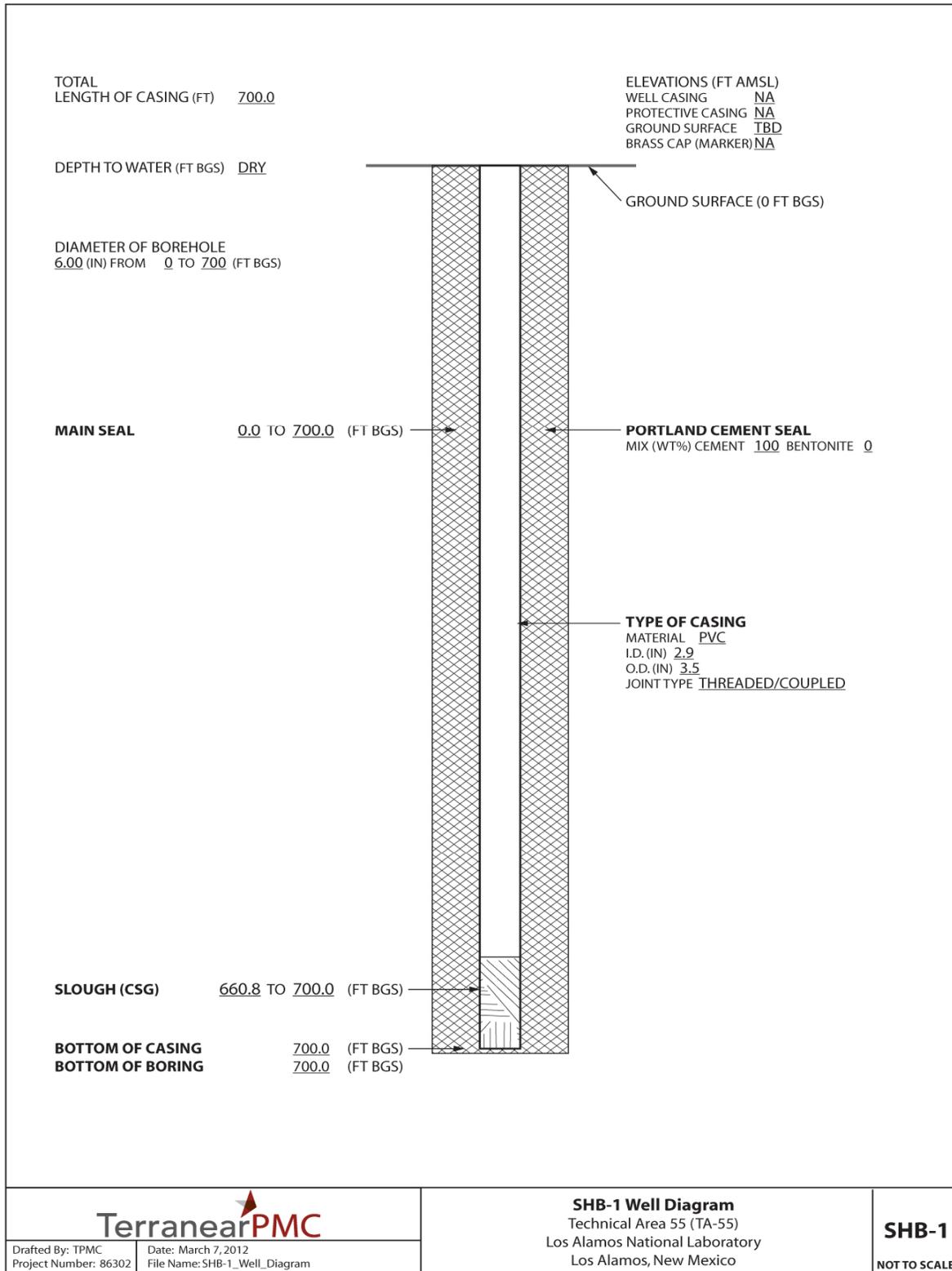


Figure 2.1-1 SHB-1 well construction diagram

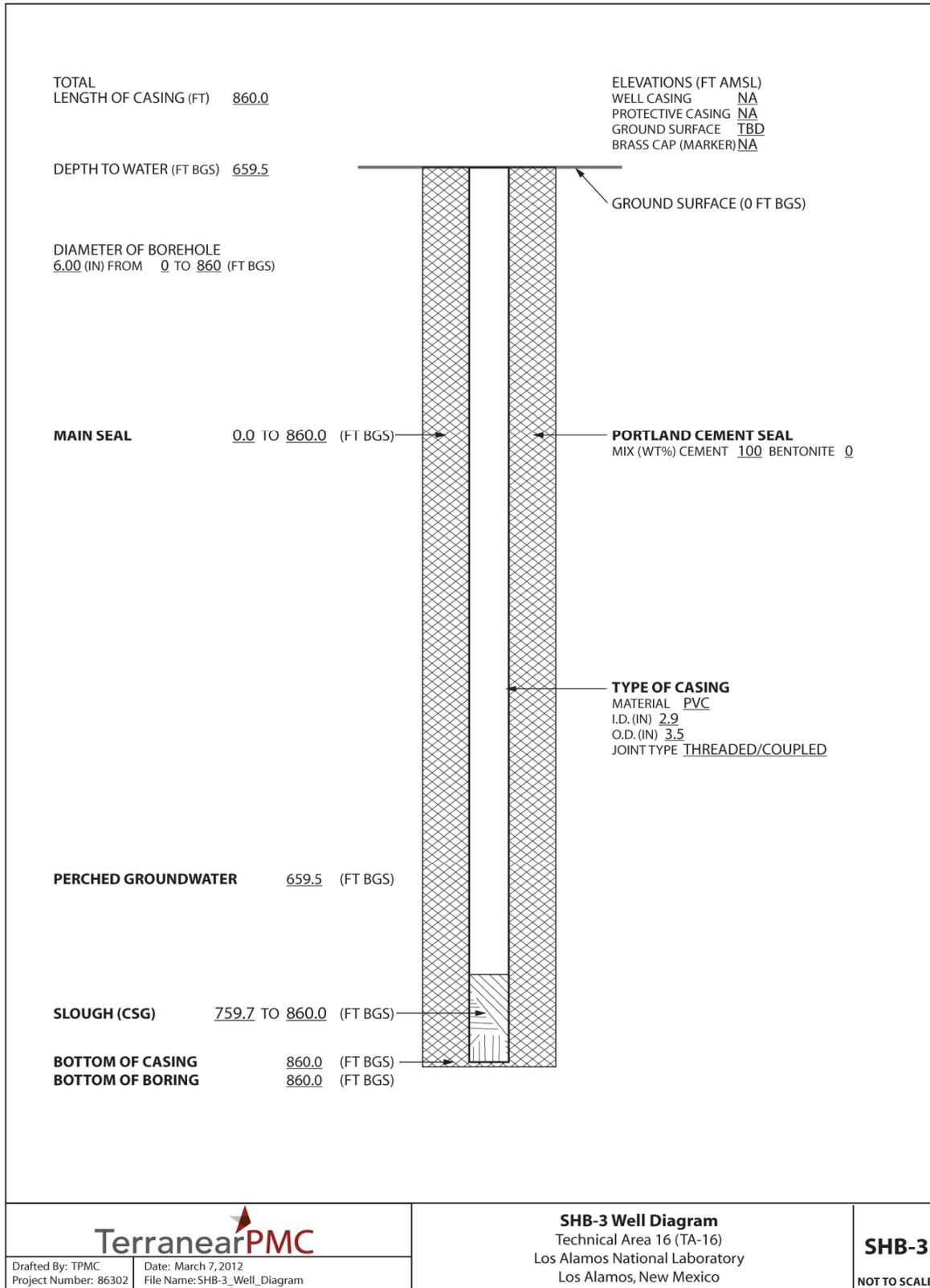


Figure 2.1-2 SHB-3 well construction diagram

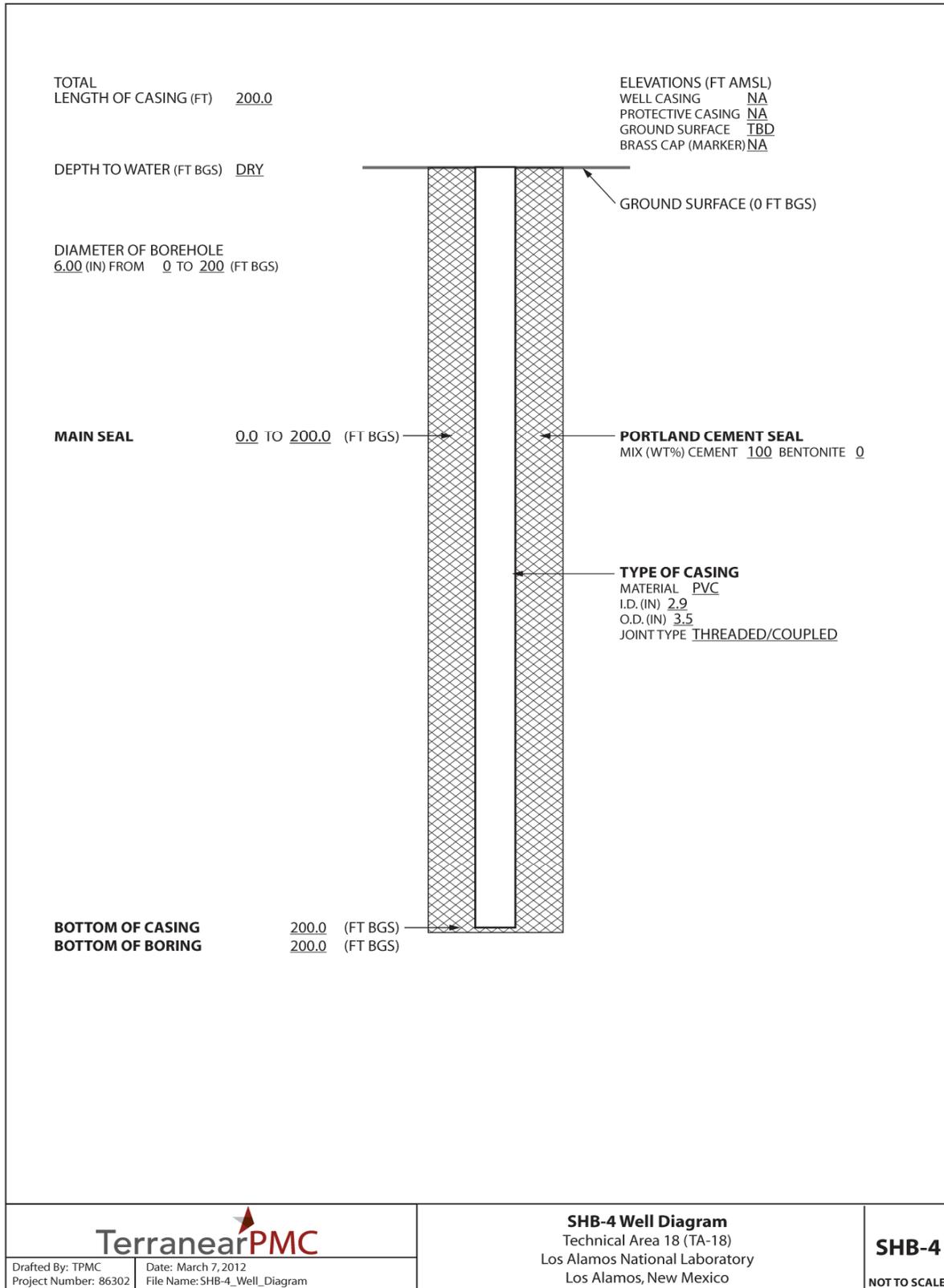


Figure 2.1-3 SHB-4 well construction diagram

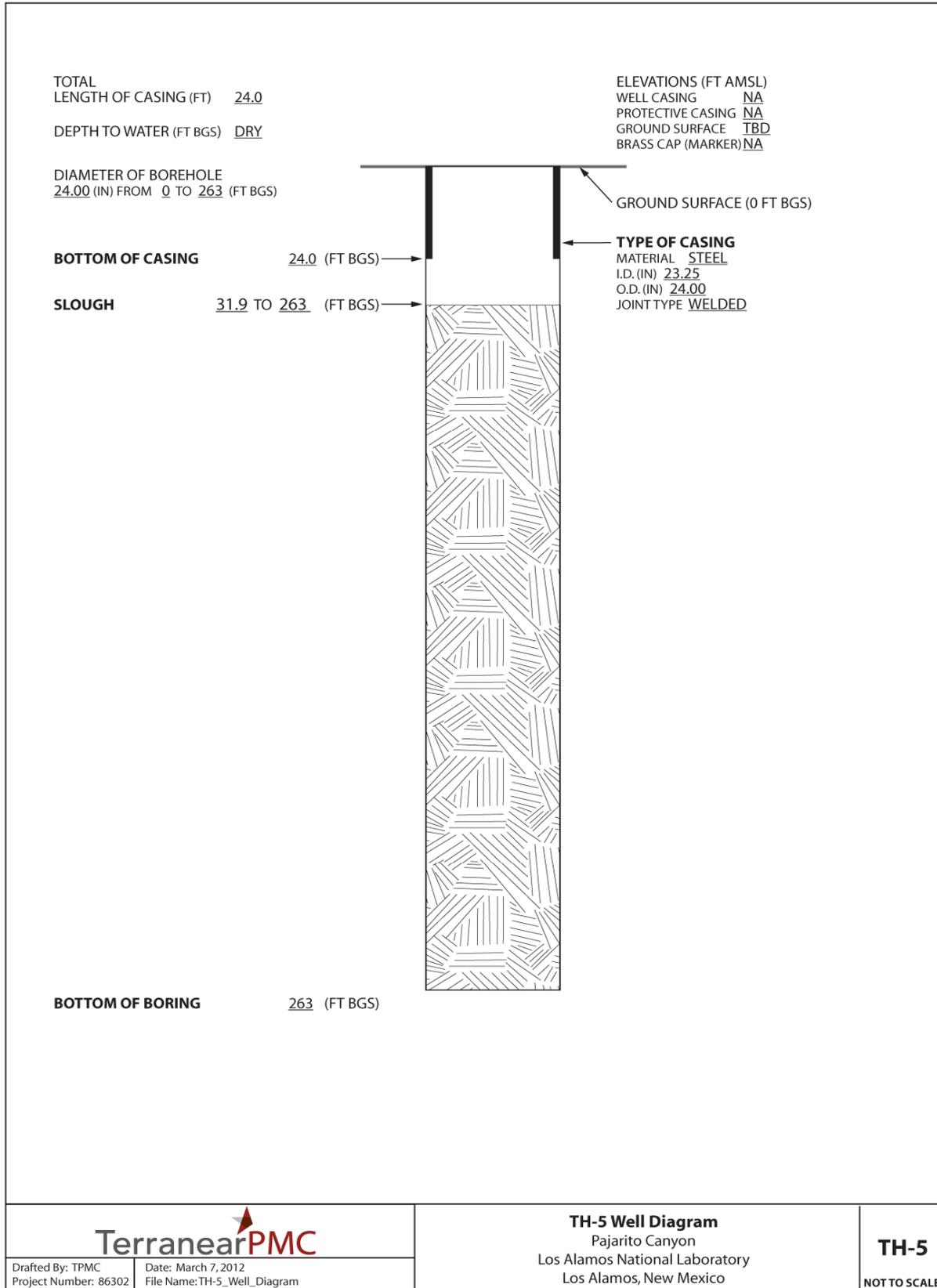


Figure 2.2-1 TH-5 well construction diagram

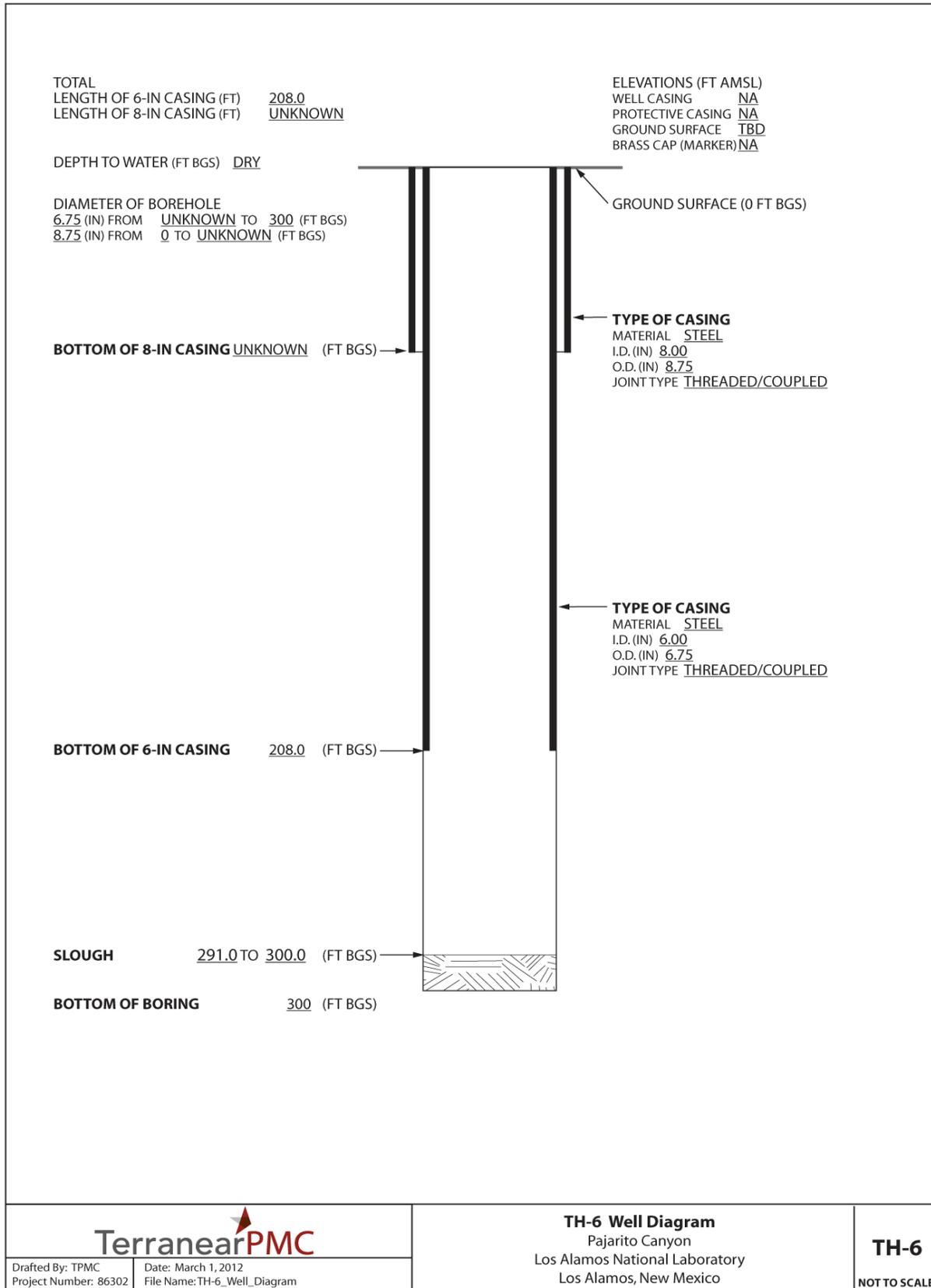


Figure 2.2-2 TH-6 well construction diagram

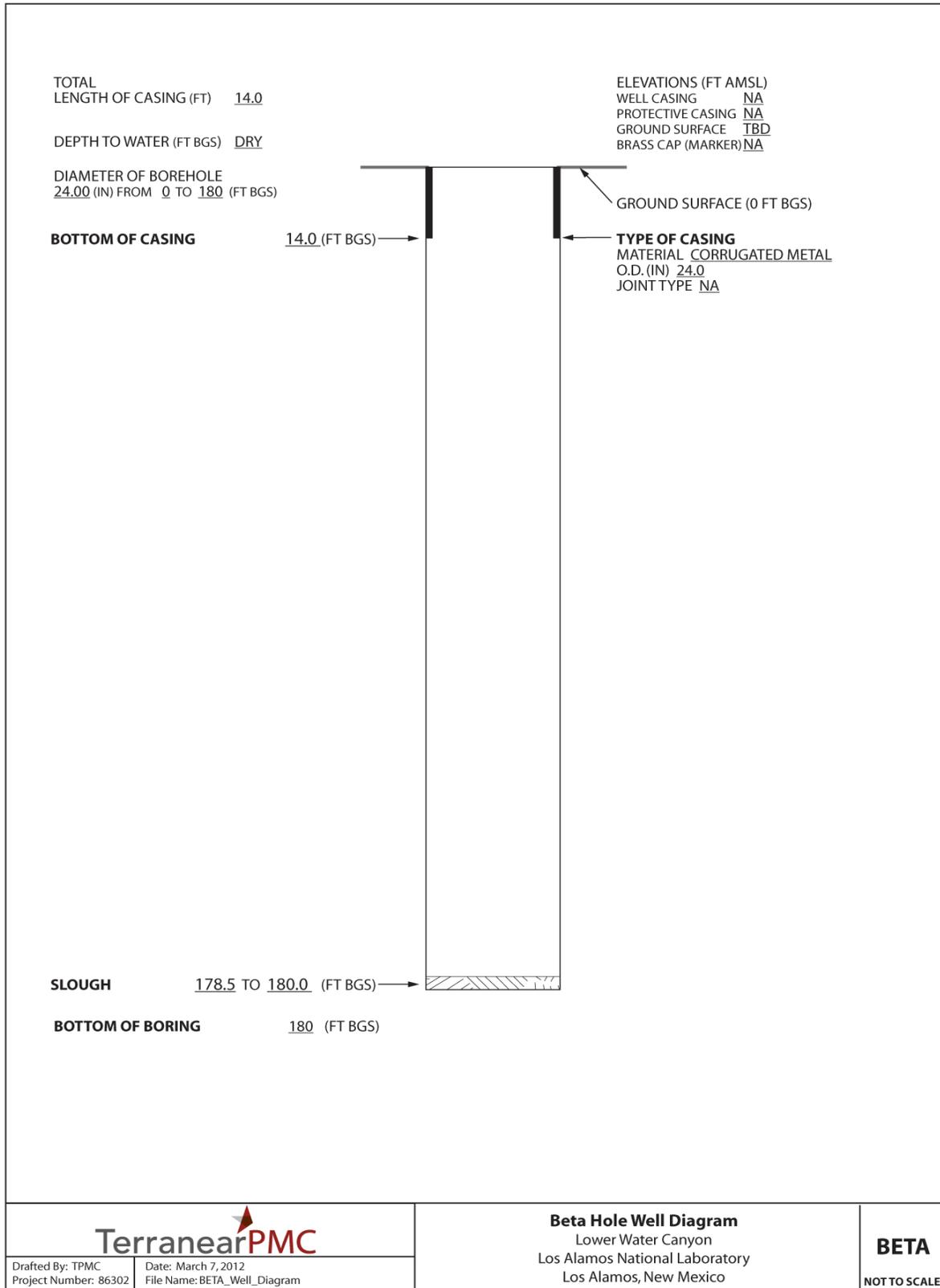


Figure 2.3-1 Beta Hole well construction diagram

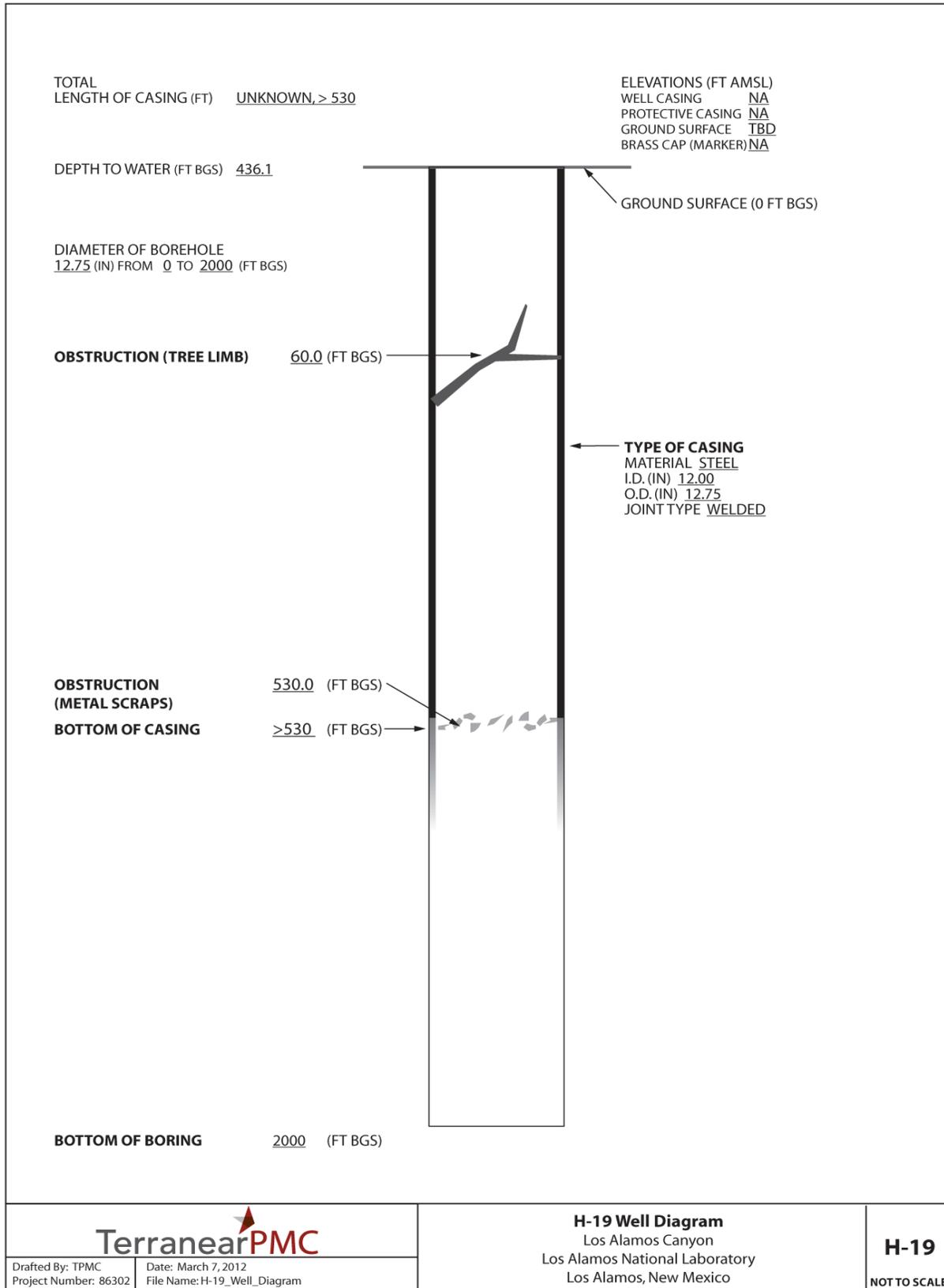
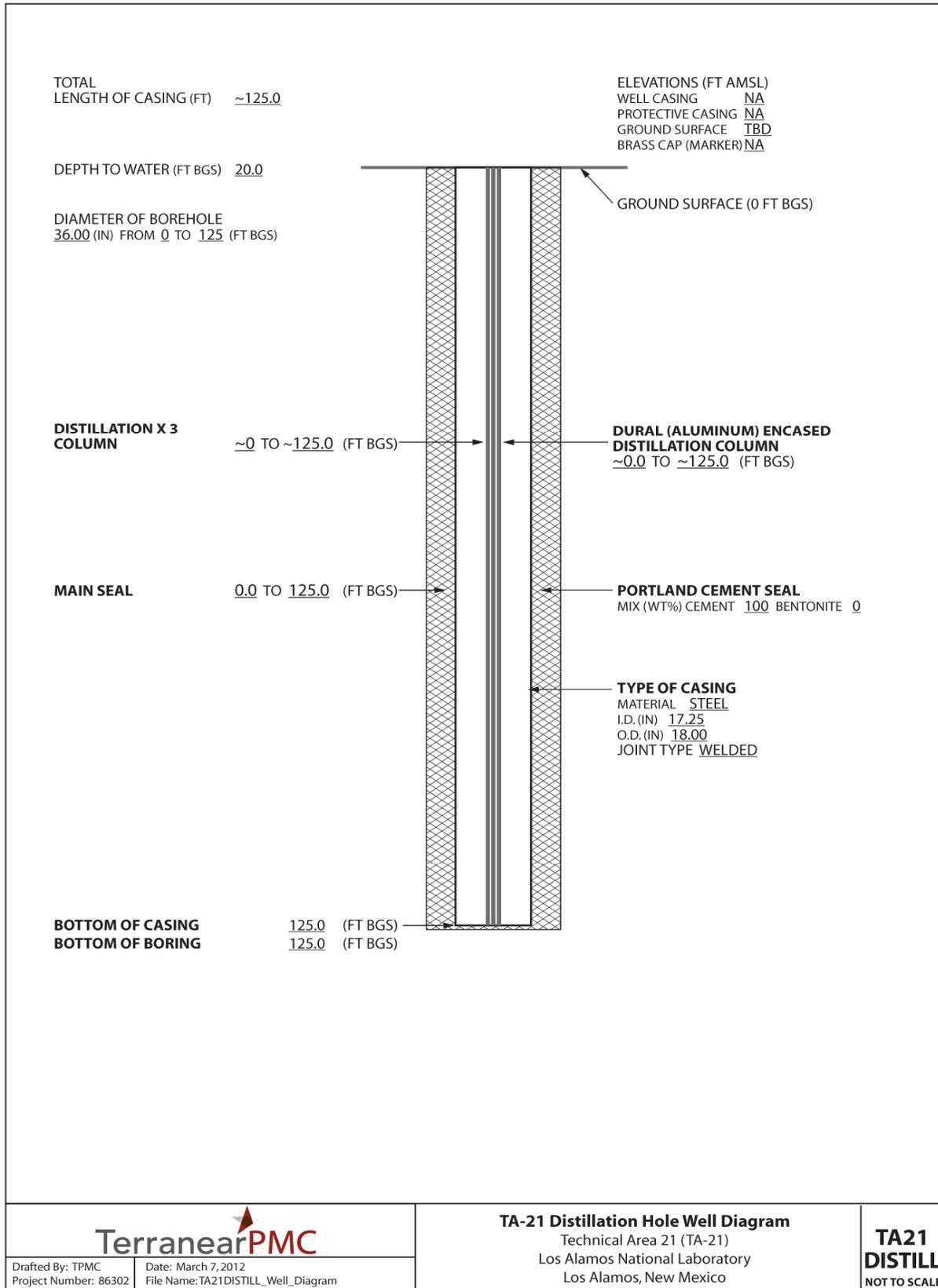


Figure 2.4-1 H-19 well construction diagram



		TA-21 Distillation Hole Well Diagram Technical Area 21 (TA-21) Los Alamos National Laboratory Los Alamos, New Mexico	TA21 DISTILL NOT TO SCALE

Figure 2.5-1 TA-21 Distillation Hole well construction diagram

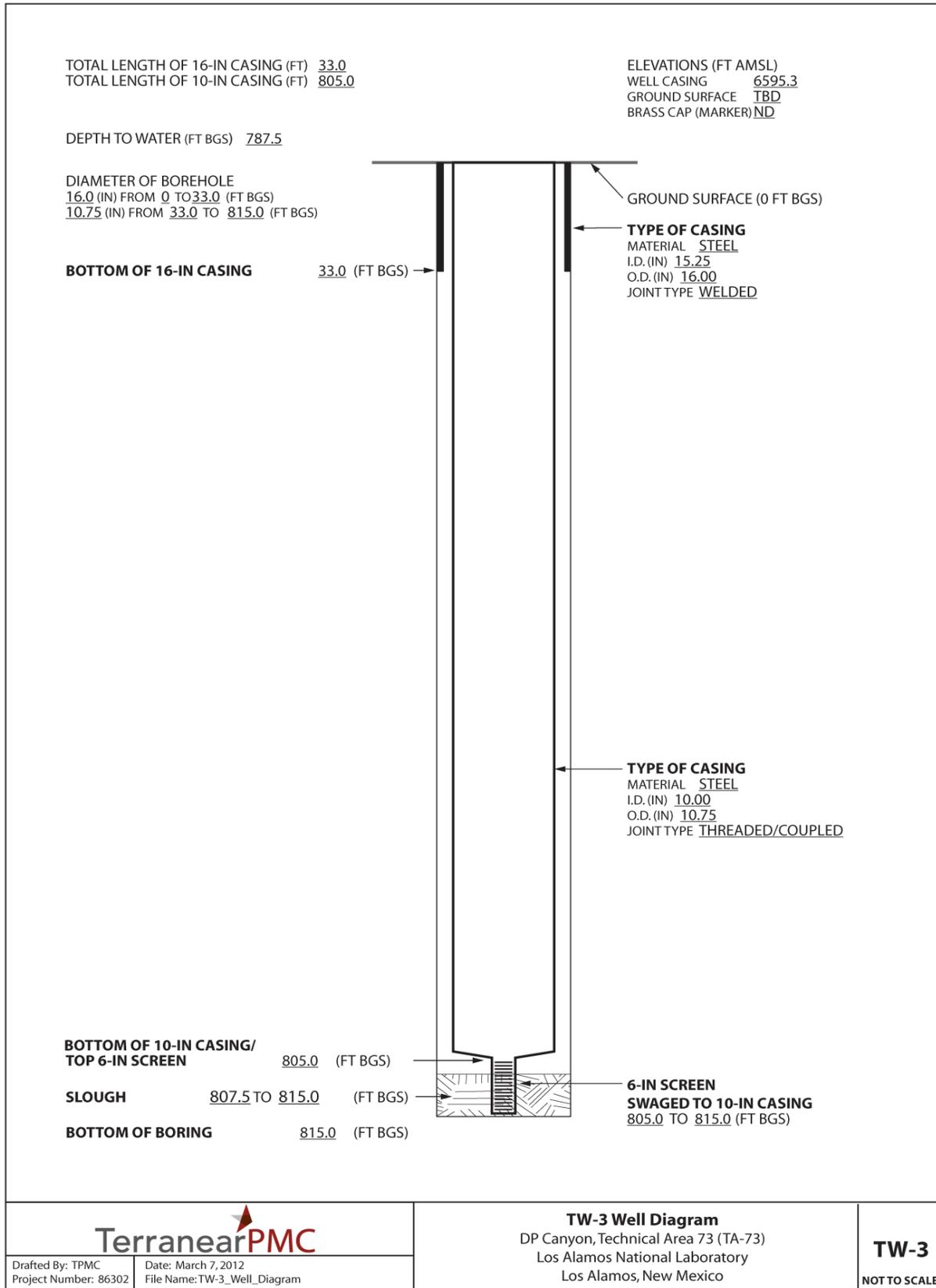


Figure 2.6-1 TW-3 well construction diagram

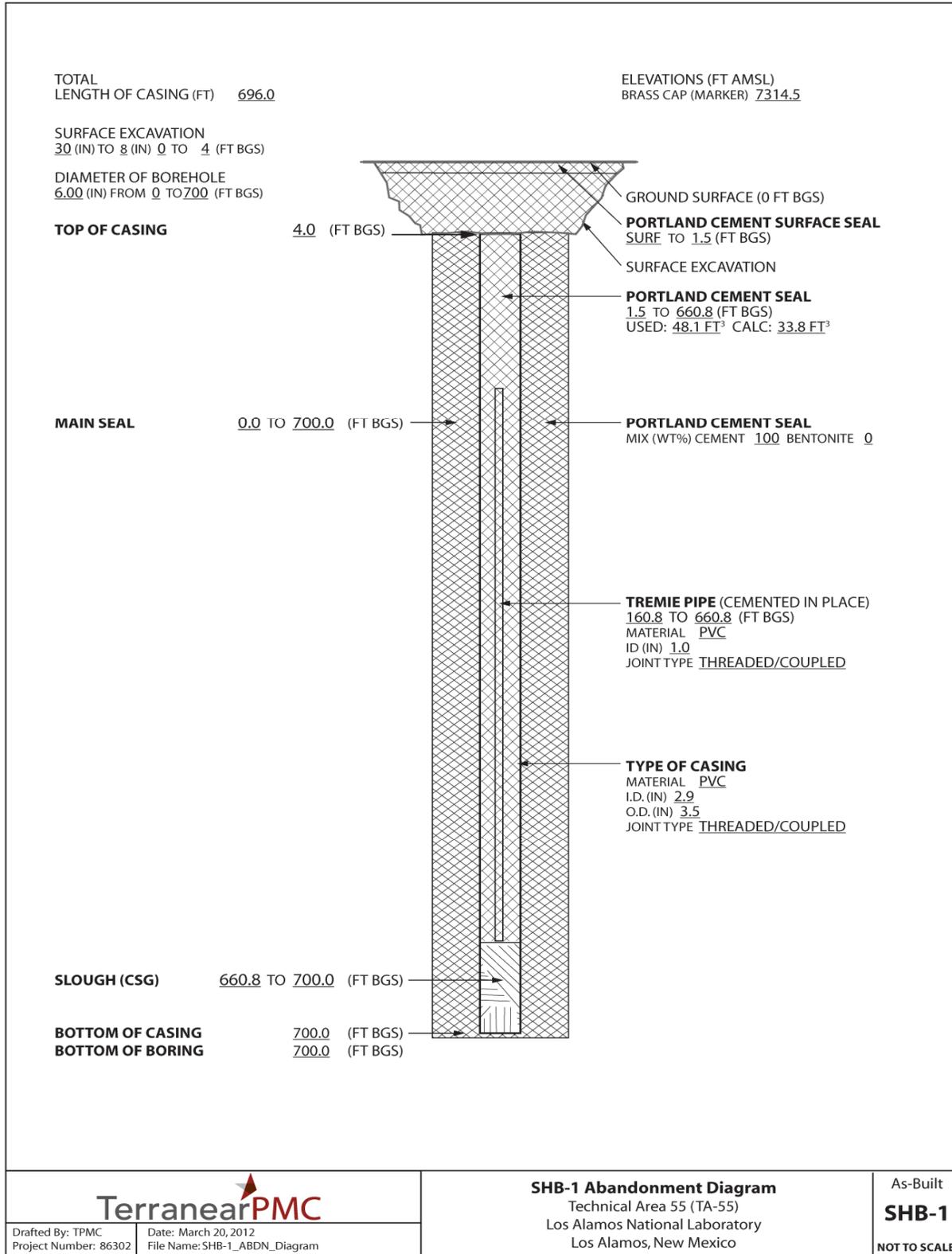


Figure 3.1-1 SHB-1 well abandonment diagram

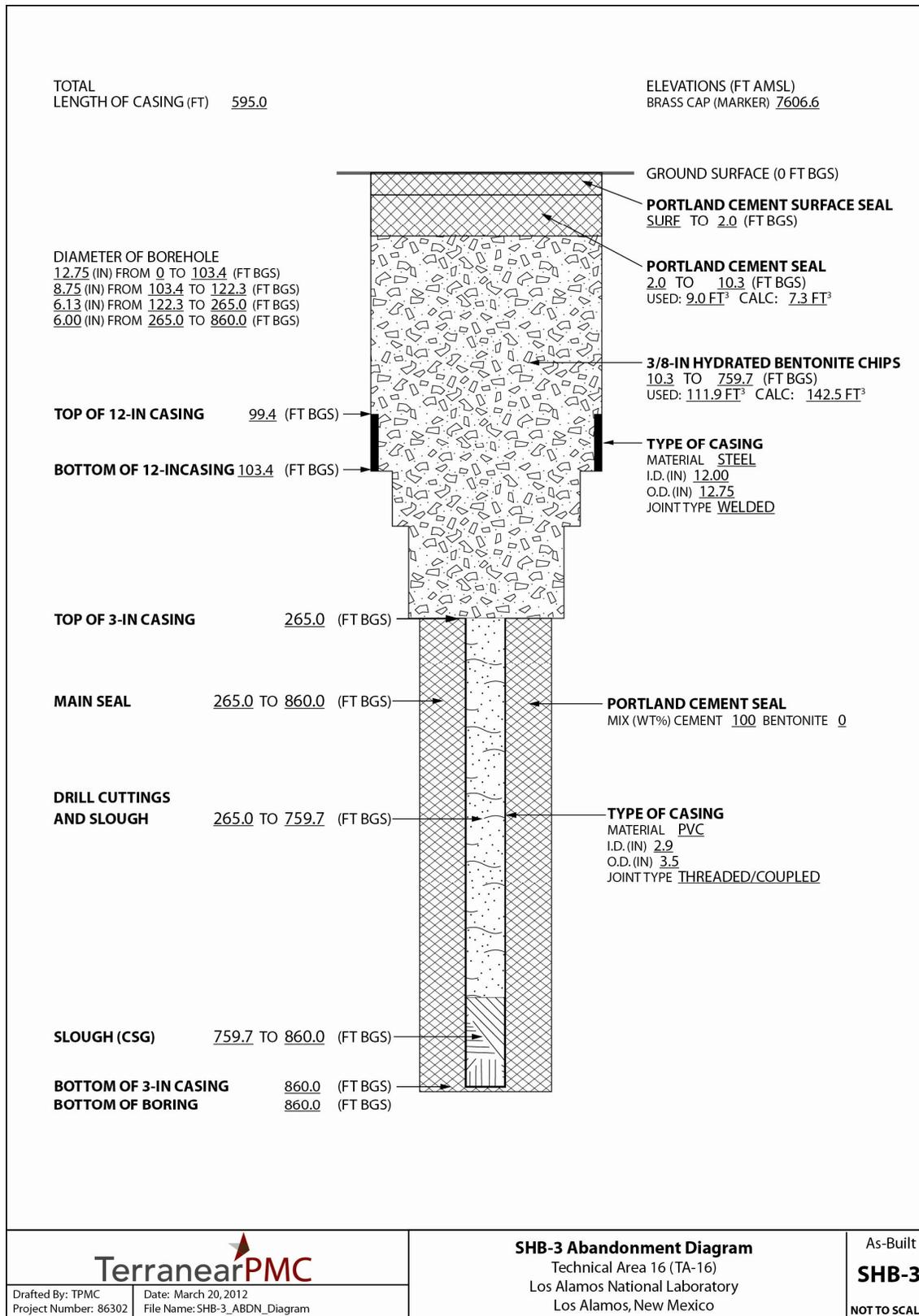


Figure 3.1-2 SHB-3 well abandonment diagram

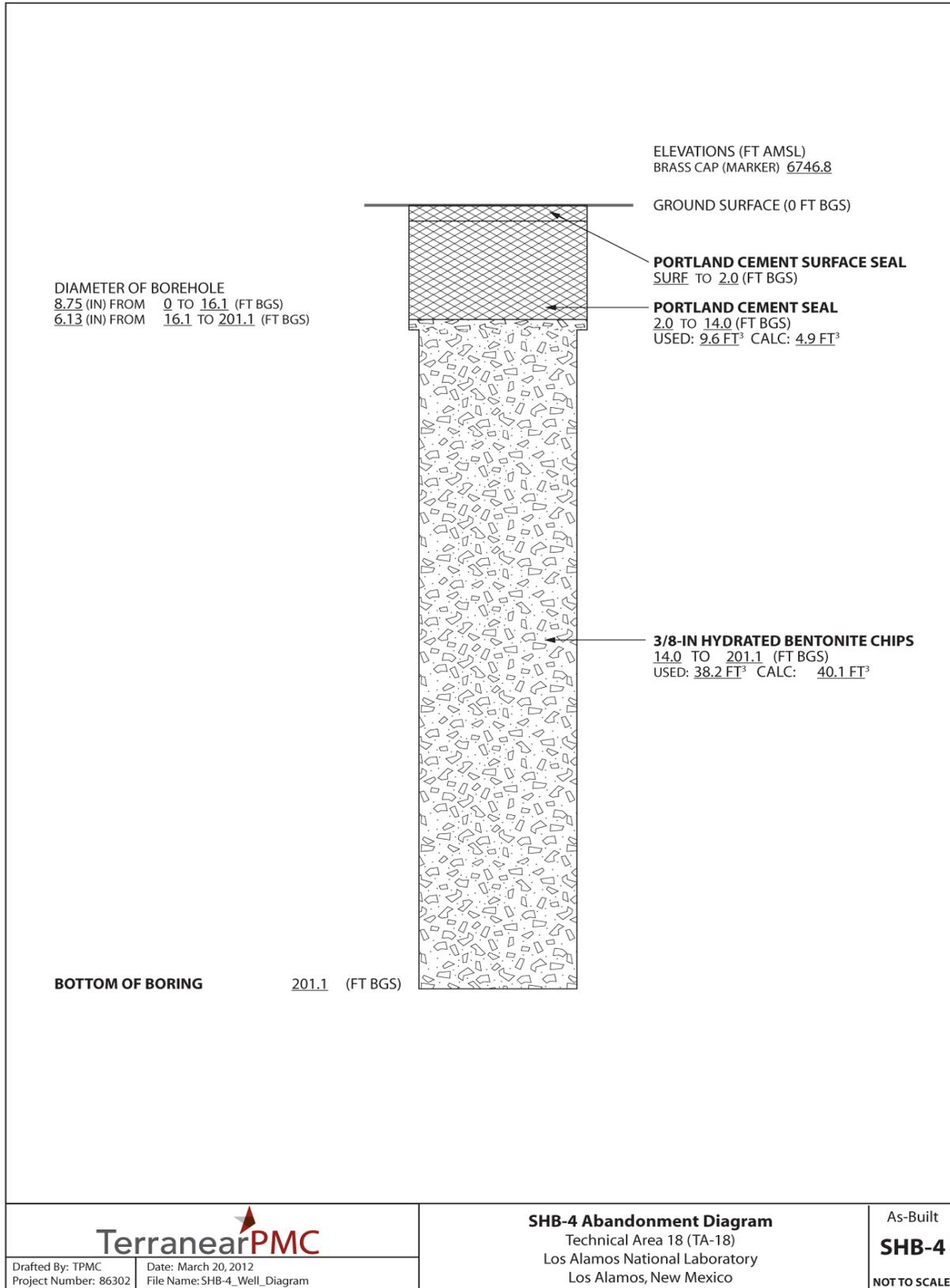


Figure 3.1-3 SHB-4 well abandonment diagram

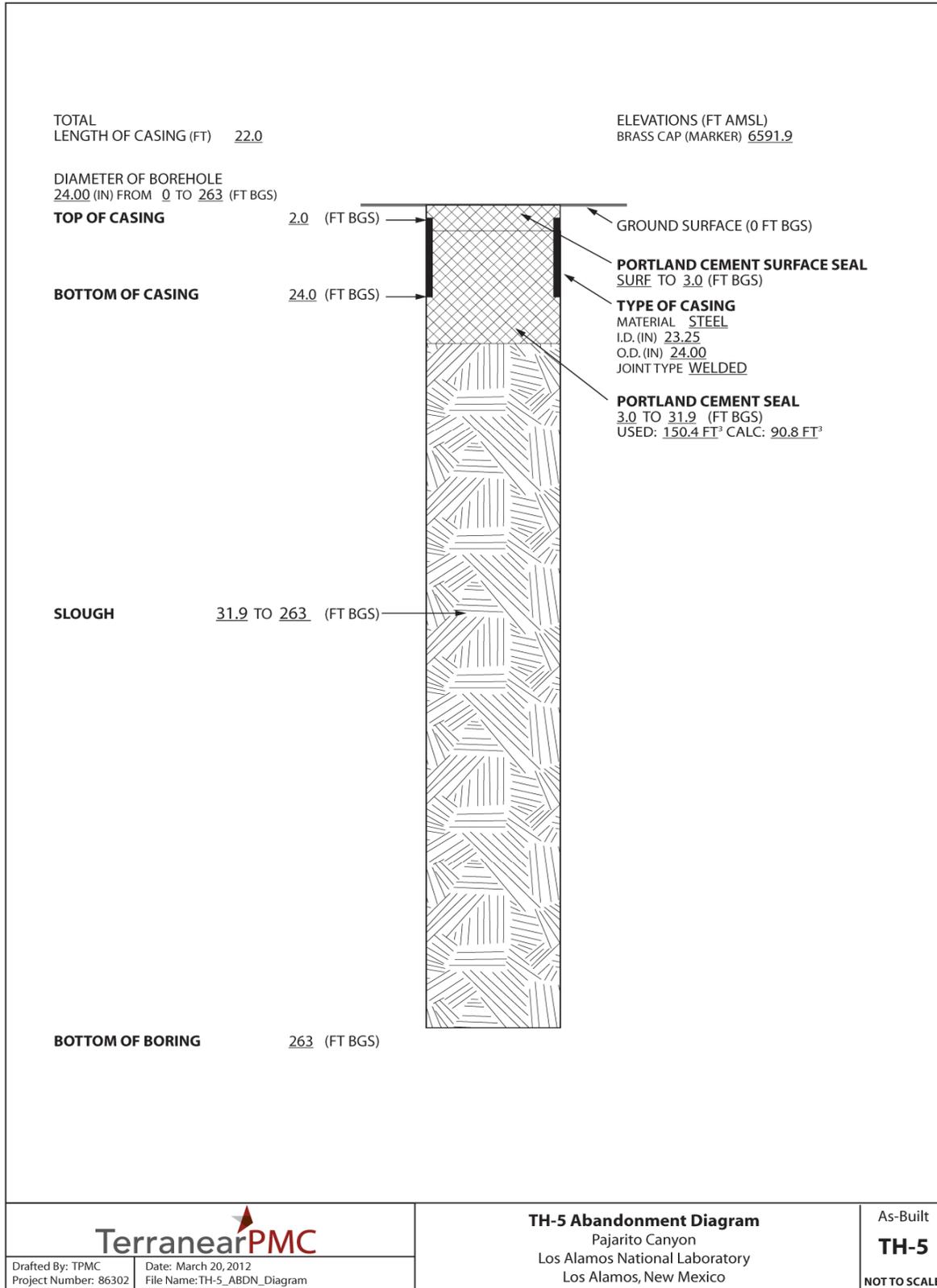


Figure 3.2-1 TH-5 well abandonment diagram

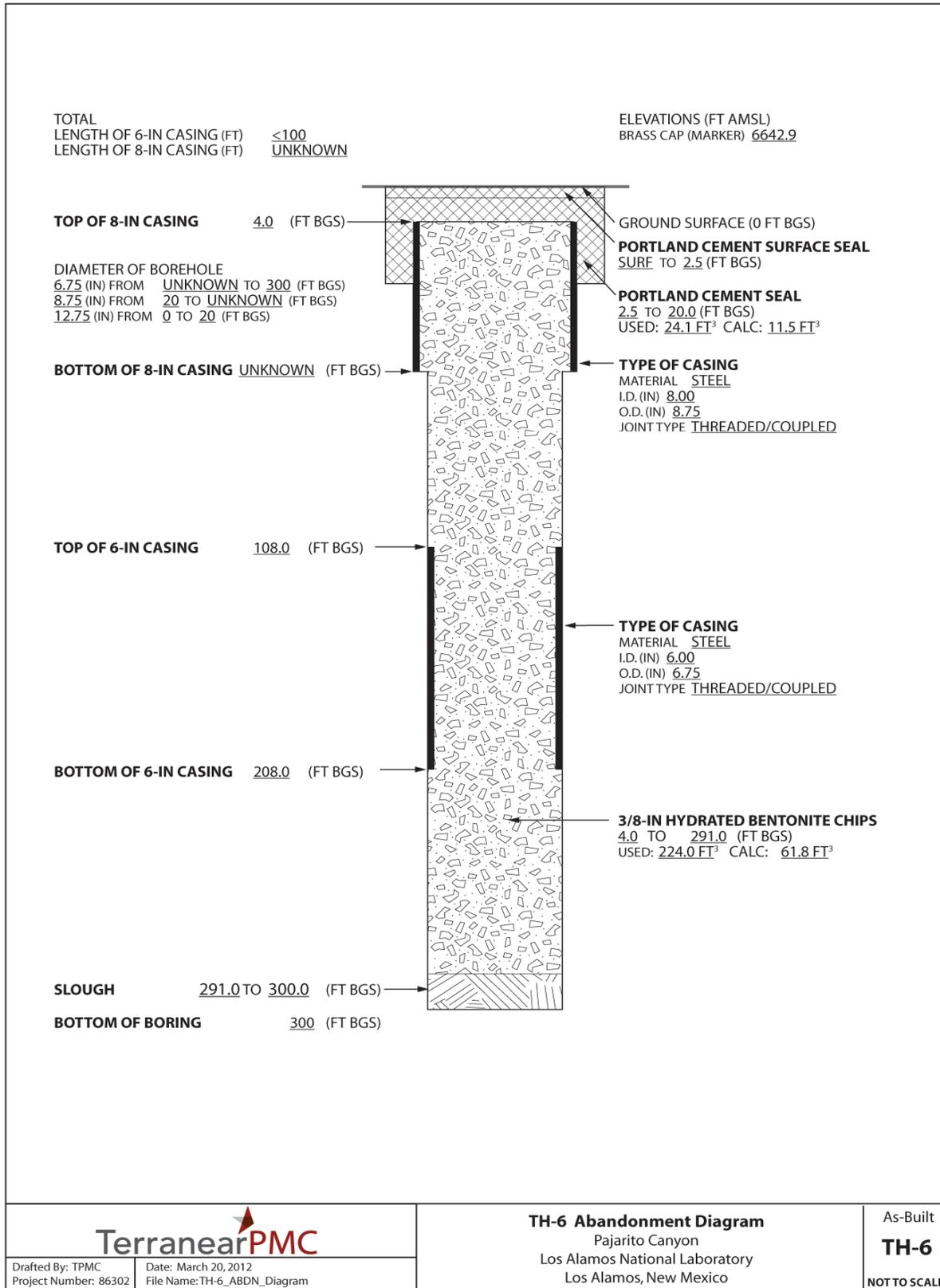


Figure 3.2-2 TH-6 well abandonment diagram

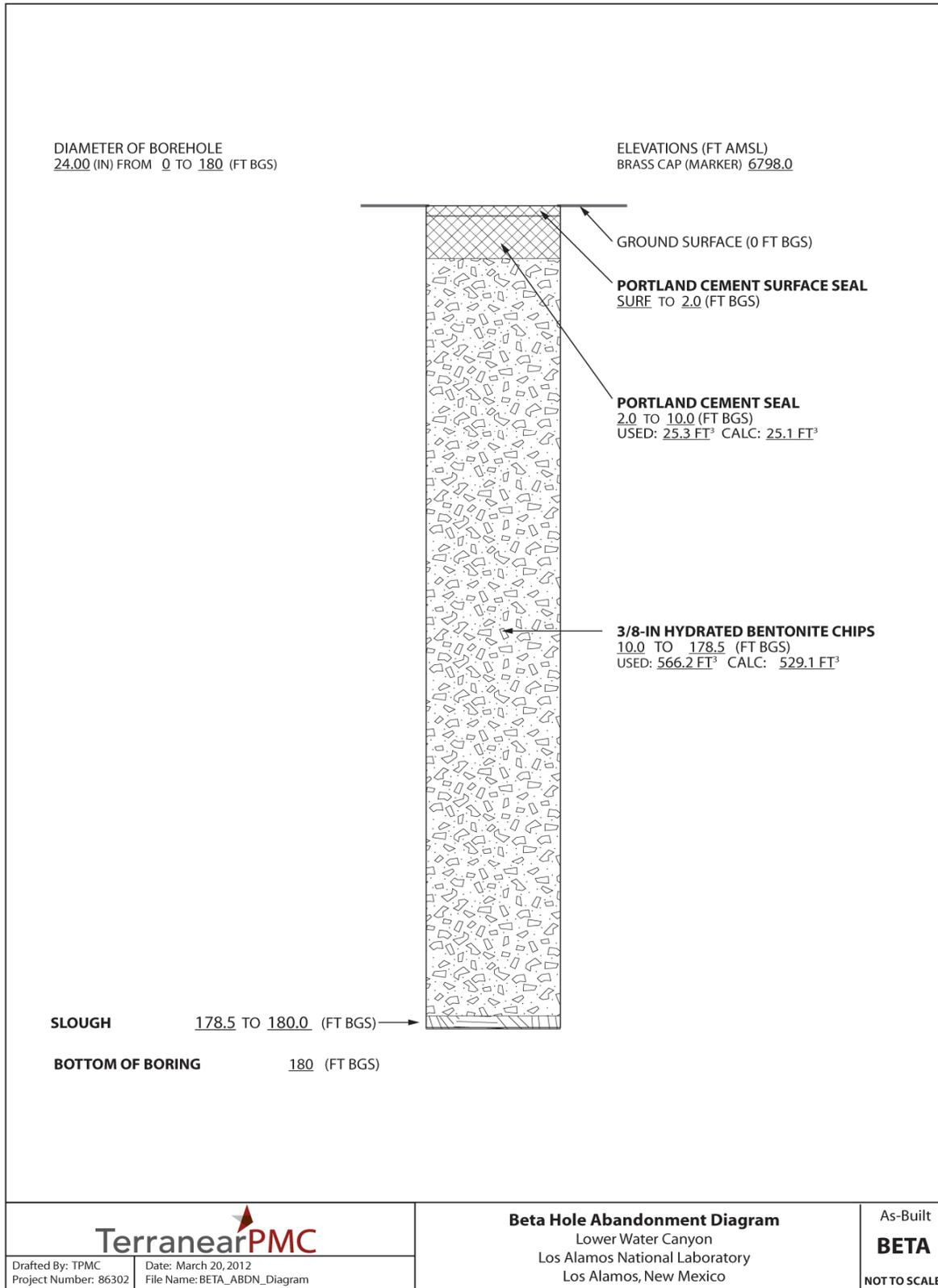


Figure 3.3-1 Beta Hole well abandonment diagram

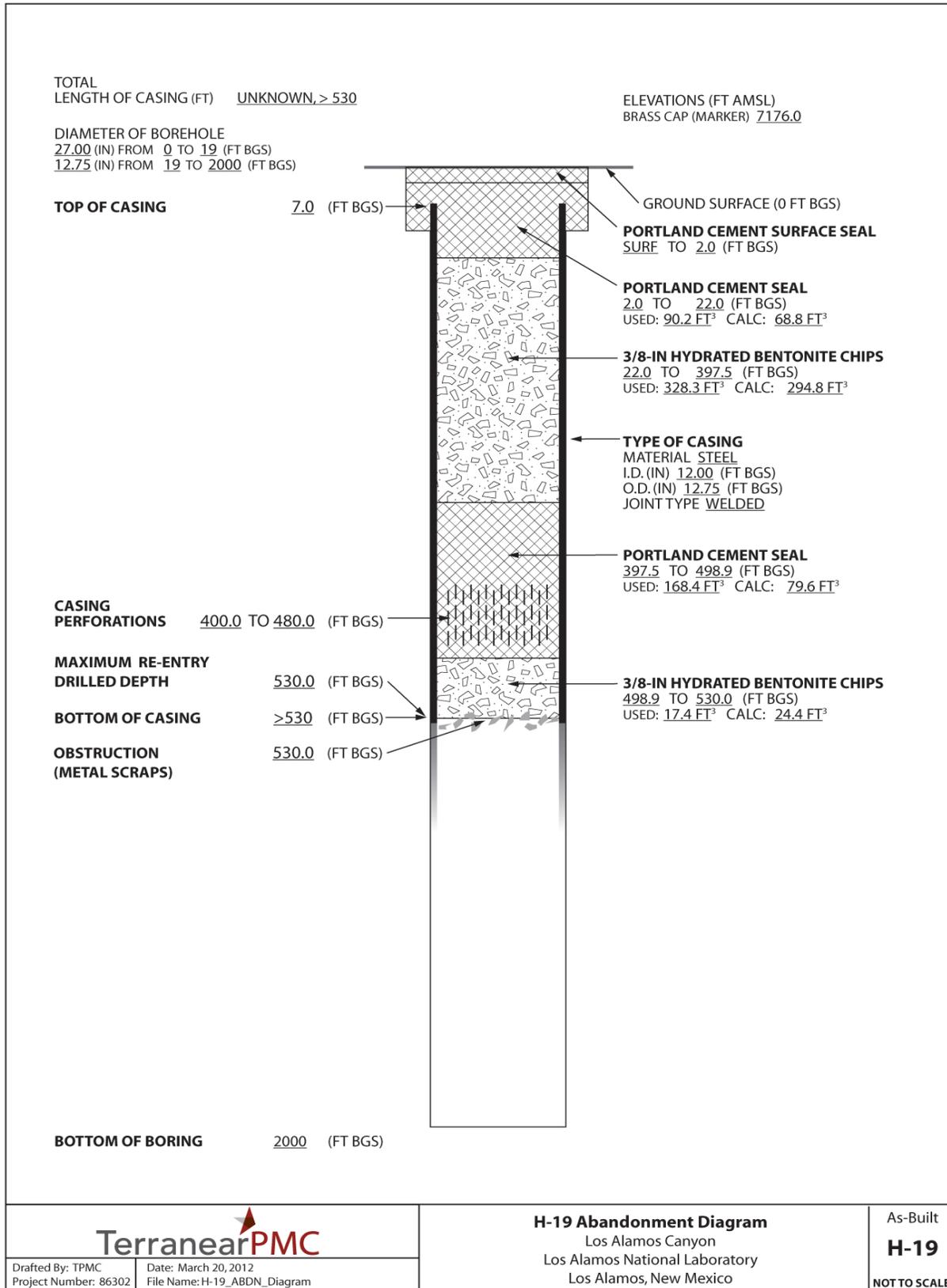
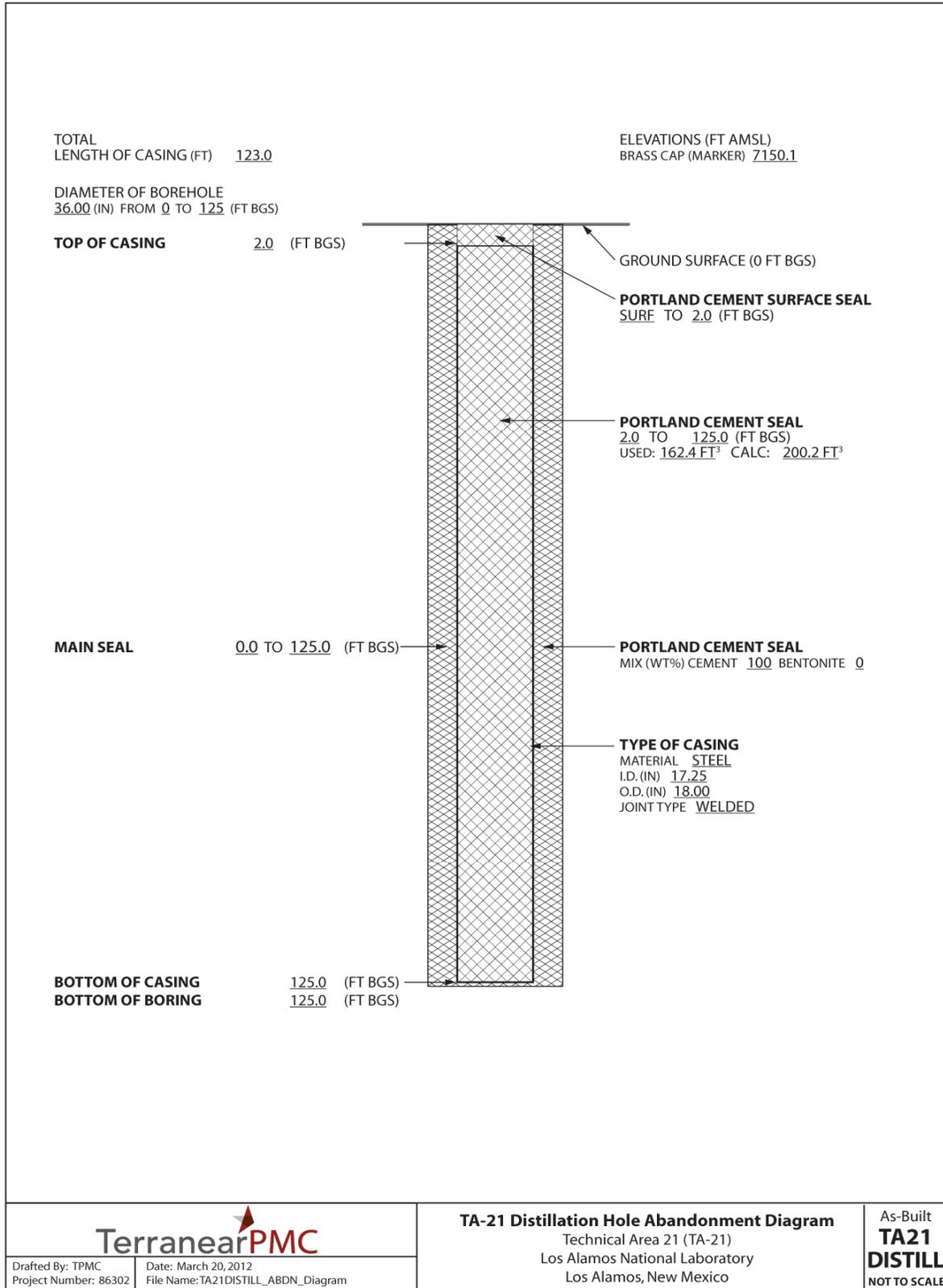


Figure 3.4-1 H-19 well abandonment diagram



		TA-21 Distillation Hole Abandonment Diagram Technical Area 21 (TA-21) Los Alamos National Laboratory Los Alamos, New Mexico	As-Built TA21 DISTILL NOT TO SCALE
Drafted By: TPMC Project Number: 86302	Date: March 20, 2012 File Name: TA21DISTILL_ABDN_Diagram		

Figure 3.5-1 TA-21 Distillation Hole well abandonment diagram

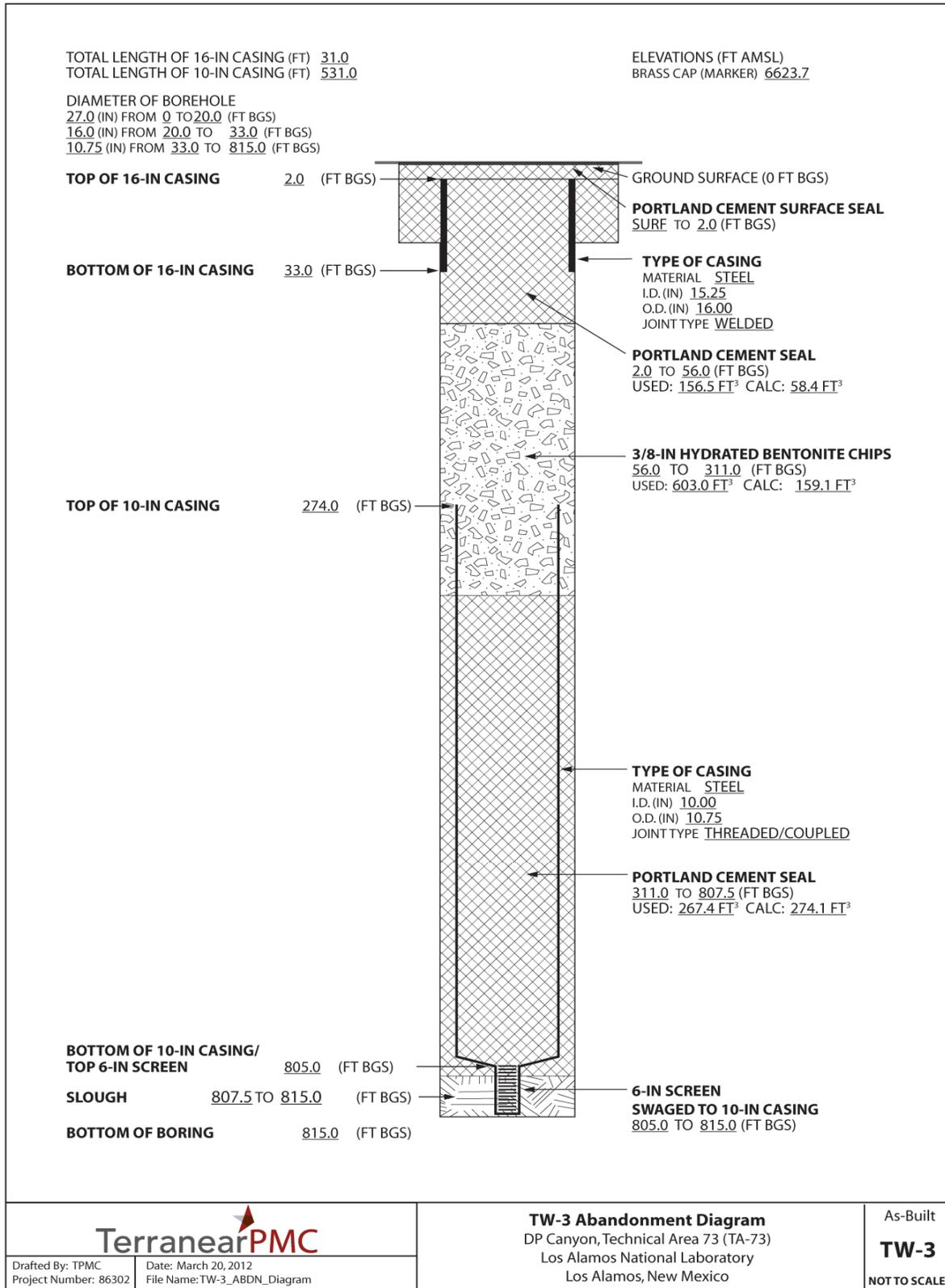


Figure 3.6-1 TW-3 well abandonment diagram

**Table 2.0-1
Video and Gamma Logging**

Well	Video	Gamma Ray
USGS	No	No
SHB-1	No	No
SHB-3	02/27/04	No
SHB-4	10/17/11	No
TH-5	06/01/11	No
TH-6	06/01/11	06/01/11
Beta Hole	12/12/11	12/12/11
H-19	06/07/11; 11/03/11; 01/10/12 (two videos); 01/12/12; 01/14/12; 01/17/12	01/14/12
TW-3	11/04/11	11/04/11

**Table 3.1-1
Materials and Quantities Used to Plug and Abandon SHB-1**

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)
12/14/11	660.8–8.5	3290	210	n/a*	29.0	42.1
12/15/11	18.5–1.5	470	30	n/a	4.8	6.0
Total		3760	240	0	33.8	48.1

*n/a = Not applicable.

**Table 3.1-2
Materials and Quantities Used to Plug and Abandon SHB-3**

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)
12/10/11	265.0–130.1	n/a ^a	300	1700	28.1 ^b	22.8
12/11/11	130.1–101.7	n/a	200	950	10.9	12.7
12/12/11	101.7–10.3	n/a	600	5700	80.6	76.4
12/12/11	10.3–2.0	705	45	n/a	7.3	9.0
Total		705	1145	8350	126.9	120.9

^a n/a = Not applicable.

^b Calculated volume for seal emplaced on December 10, 2011, is based on the 6 1/8-in. open borehole from 265.0 to 130.1 ft bgs.

**Table 3.1-3
Materials and Quantities Used to Plug and Abandon SHB-4**

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)
01/07/12	201.1–14.0	n/a*	500	2850	40.1	38.2
01/07/12	14.0–2.0	752	48	n/a	4.9	9.6
Total		752	548	2850	45.0	47.8

* n/a = Not applicable.

**Table 3.2-1
Materials and Quantities Used to Plug and Abandon TH-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)
12/07/11	31.9–3.0	11,750	750	n/a*	90.8	150.4
Total		11,750	750	0	90.8	150.4

* n/a = Not applicable.

**Table 3.2-2
Materials and Quantities Used to Plug and Abandon TH-6**

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)
12/09/11	291.0–177.7	n/a ^a	500	3750	26.4	50.3
12/10/11	177.7–106.5	n/a	1000	8250	14.1	110.6
12/11/11	106.5–4.0	n/a	750	4709	21.3 ^b	63.1 ^c
02/08/12	20.0–2.5 ^d	1880	120	n/a	11.5	24.1
Total		1180	2370	16,709	73.3	248.1

^a n/a = Not applicable.

^b Calculated volume for seal emplaced on December 11, 2011, is based on a borehole diameter of 6.75 in. (i.e., the O.D. of the removed casing).

^c Actual volume for seal emplaced on December 11, 2011, accounts for the bentonite that was removed along with the 6-in.-I.D. casing.

^d Surface casing overdrilled with 12.75-in.-O.D. casing from surface to 20.0 ft bgs.

**Table 3.3-1
Materials and Quantities Used to Plug and Abandon Beta Hole**

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)
01/09/12	178.5–163.3	n/a*	200	3750	47.7	50.3
01/10/12	163.29–12.6	n/a	2000	37,500	473.2	502.5
02/02/12	12.6–10.0	n/a	100	1000	8.2	13.4
02/03/12	10.0–2.0	1974	126	n/a	25.1	25.3
Total		1974	2426	42,250	554.2	591.5

* n/a = Not applicable.

**Table 3.4-1
Materials and Quantities Used to Plug and Abandon H-19**

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)
01/16/12	530.0–498.9	n/a ^a	2000	1300	24.4	17.4
01/18/12	498.9–477.0	1504	96	n/a	17.2	24.0
01/19/12	477.0–454.2	5640	360	n/a	17.9	72.2
01/20/12	454.2–397.5	5640	360	n/a	44.5	72.2
01/25/12	397.5–95.1	n/a	1500	20,000	237.4	268.0
01/27/12	95.1–22.0	n/a	500	4500	57.4	60.3
01/27/12	22.0–7.0	940	60	n/a	11.8	12.0
01/31/12	19.0–8.0	2820	180	n/a	34.0 ^b	36.1
02/01/12	8.0–2.0	3290	210	n/a	23.0 ^b	42.1
Total		19,834	5266	25,800	467.6	604.3

^a n/a = Not applicable.

^b Calculated volume for seal emplaced on January 31 and February 1, 2012, accounts for the annulus between the 12-in.-I.D. casing and the 27-in. overdrilled borehole and the open 27-in. borehole above the 12-in. casing.

**Table 3.5-1
Materials and Quantities Used to Plug and Abandon TA-21 Distillation Hole**

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)
01/23/12	125.0–31.2	9400	600	n/a ^a	152.7	120.3 ^b
01/24/12	31.2–2.0	3290	210	n/a	47.5	42.1
Total		12,690	810	n/a	200.2	162.4

^a n/a = Not applicable.

^b Actual volume for seal emplaced on January 23, 2012, was less than the calculated volume and was a result of the material (Styrofoam and film insulation) and unidentified obstruction that was abandoned inside the 18-in.-diameter casing.

**Table 3.6-1
Materials and Quantities Used to Plug and Abandon TW-3**

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) ^a	Actual Volume (ft ³)
02/14/12	807.5-311.0	18,800	1200	n/a ^b	274.1	267.4
02/20/12	311.0-189.0	n/a	1000	24,000	74.5	321.6
02/24/12	189.0-56.0	n/a	1000	21,000	84.6	281.4
02/24/12	56.0-46.0	4700	300	n/a	6.4	60.2
02/27/12	46.0-2.0	7520	480	n/a	52.0	96.3
Total		31,020	3980	45,000	491.6	1026.9

^a Calculated volume is based off the O.D. of the casing strings that were in the borehole (i.e. 10.75-in. and 16.0-in., respectively).

^b n/a = Not applicable.

**Table 4.1-1
Survey Coordinates from Brass Pin Embedded in Surface Pad**

Identification	Northing	Easting	Elevation (amsl)
SHB-1	1769848.59	1624052.22	7314.5
SHB-3	1760988.60	1609319.92	7606.6
SHB-4	1761222.13	1636242.96	6746.8
TH-5	1756579.74	1643553.56	6591.9
TH-6	1757882.05	1640514.46	6642.9
Beta Hole	1757573.92	1625321.48	6798.0
H-19	1775600.97	1618444.47	7176.0
TA-21 Distillation Hole	1774420.23	1632252.94	7150.1
TW-3	1773137.79	1637725.26	6623.7
USGS Test Hole	1768519.38	1626742.62	7227.5

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

*2011 Video Logs of Plugged and Abandoned Wells
(on DVDs included with this document)*

***TO VIEW THE VIDEO
THAT ACCOMPANIES
THIS DOCUMENT,
PLEASE CALL THE
HAZARDOUS WASTE
BUREAU AT 505-476-6000
TO MAKE AN
APPOINTMENT***

Appendix B

Gamma Ray Logs

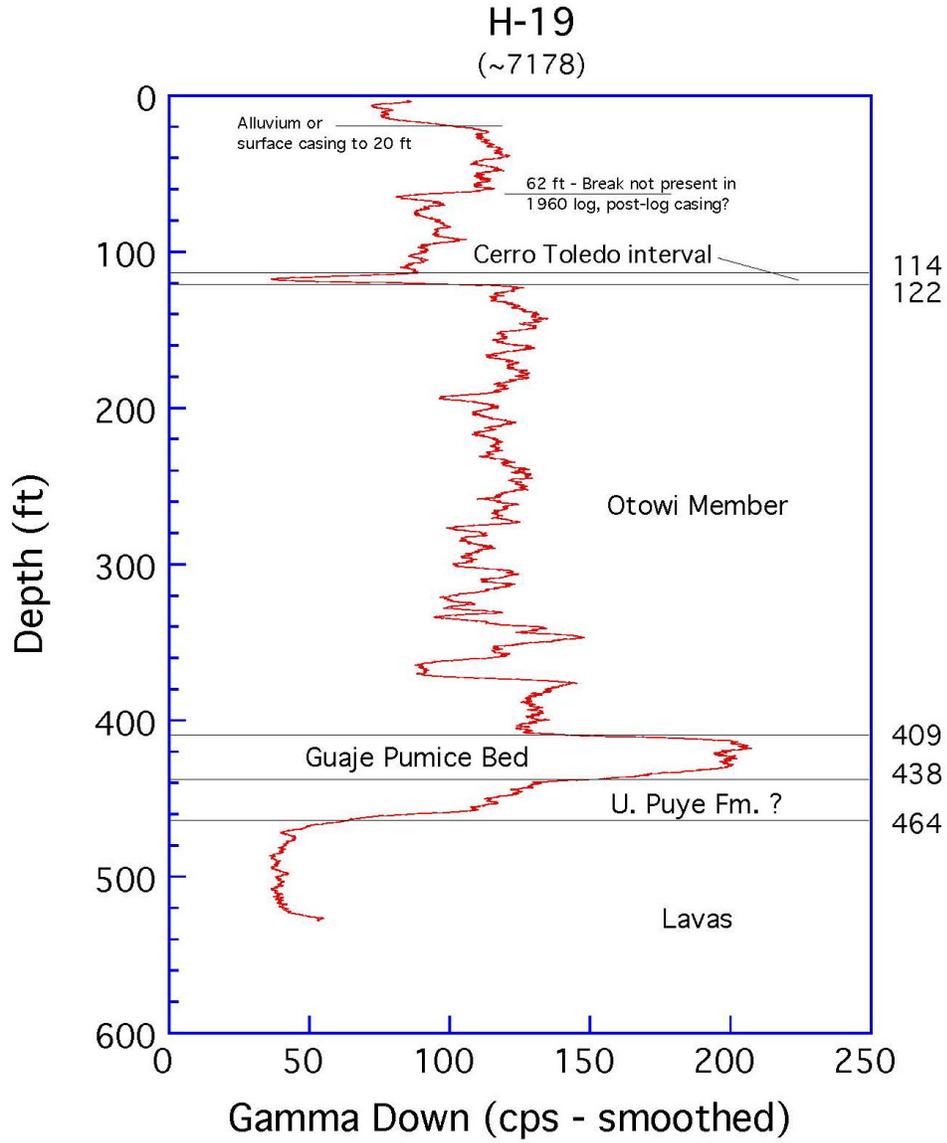


Figure B-1 H-19 gamma ray log

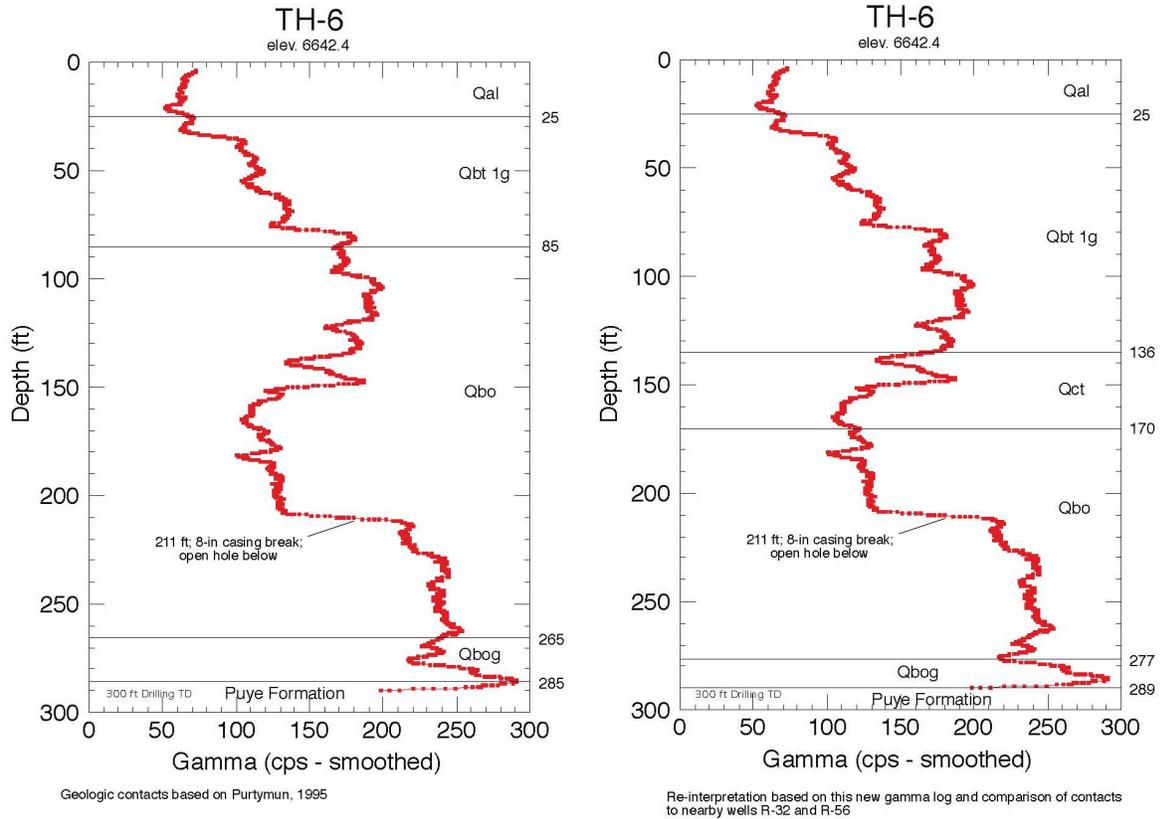


Figure B-2 TH-6 gamma ray log

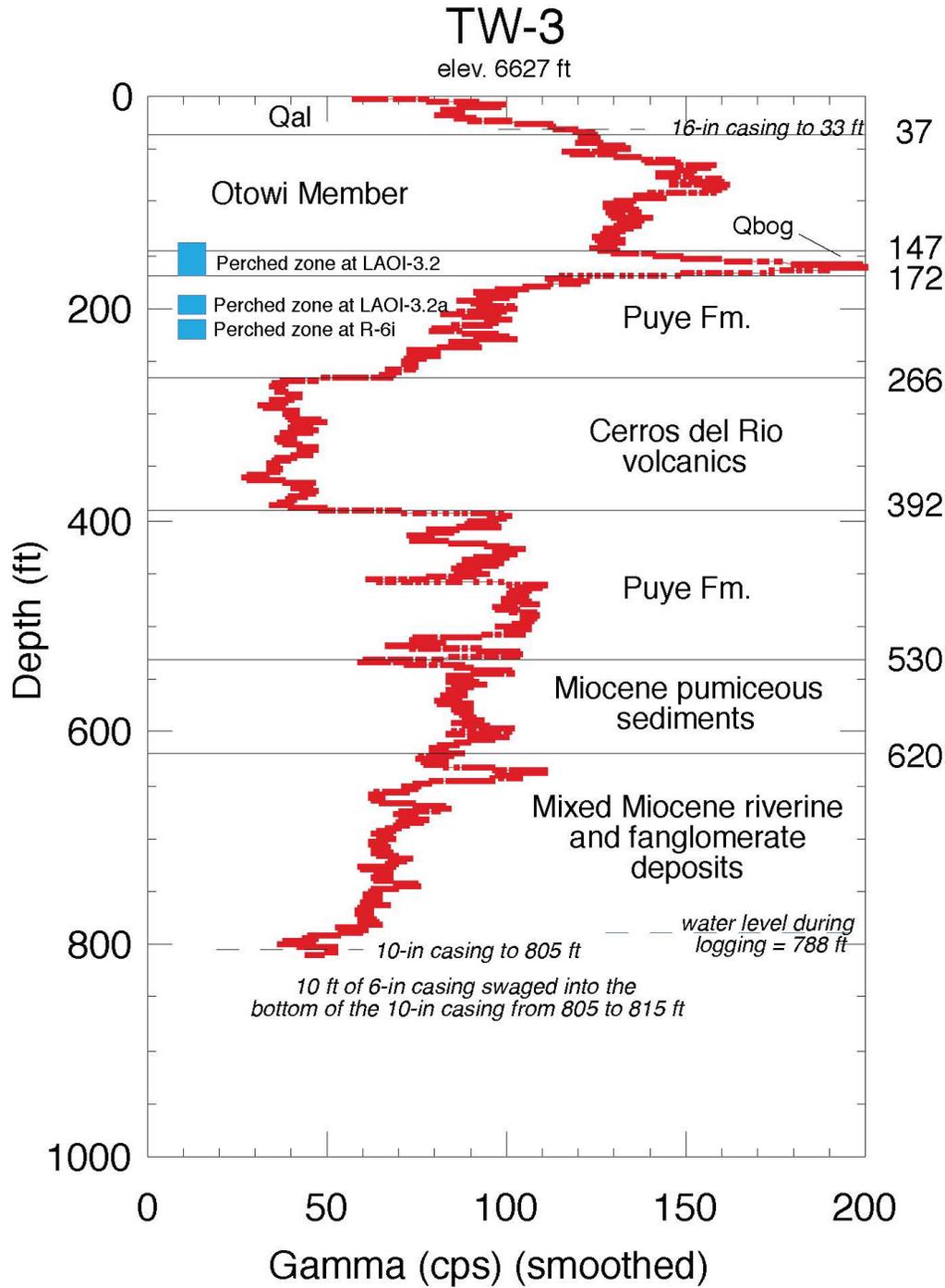


Figure B-3 TW-3 gamma ray log

Beta Hole (TA-49)

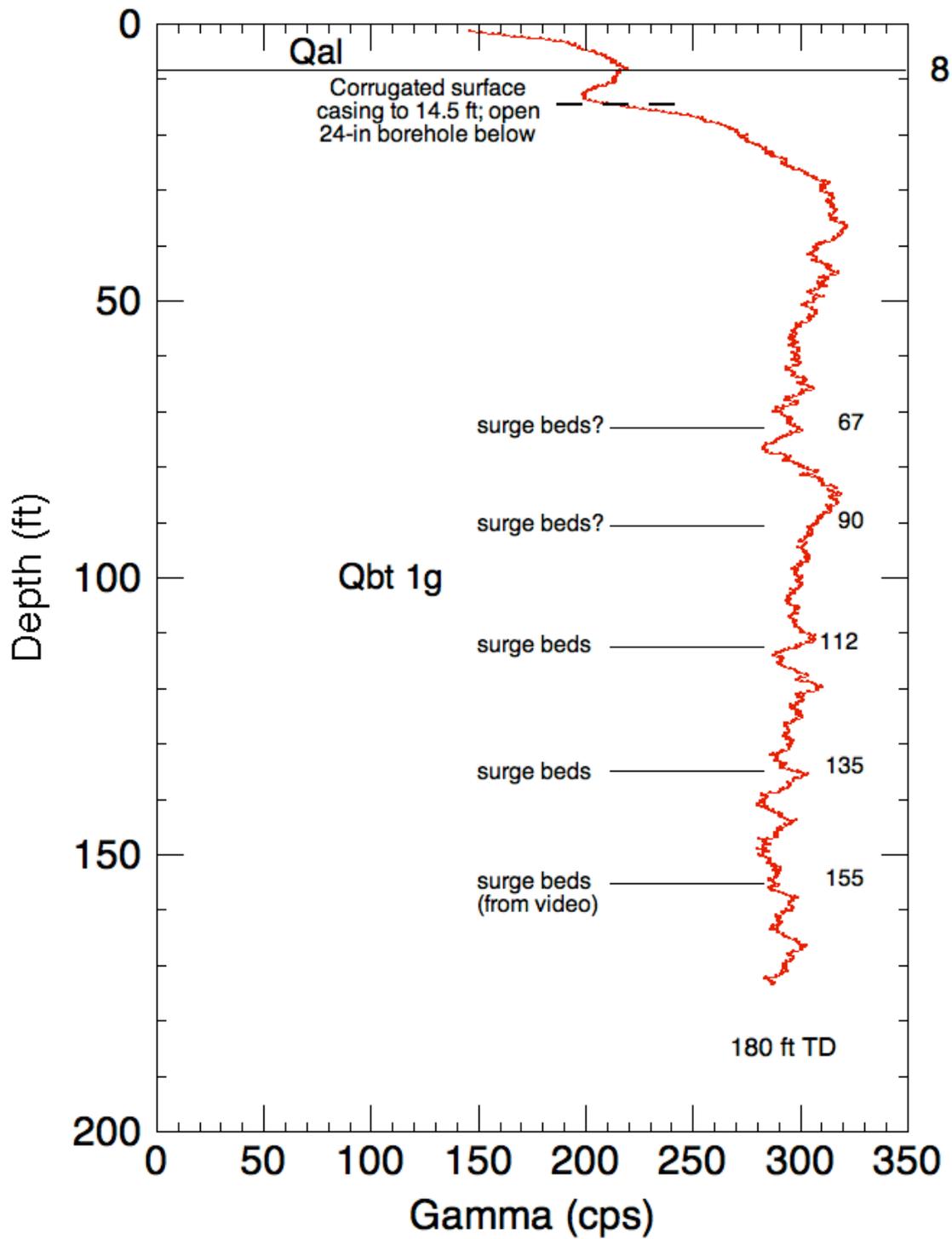


Figure B-4 Beta Hole gamma ray log