EMID-700697

DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544

DEC 04 2019

EMLA-2020-1142-04-001

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 Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1

Enclosed please find two hard copies with electronic files of the "Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1." Included is an electronic copy of a redline strikeout version of the report that shows all changes made in response to the New Mexico Environment Department's (NMED's) comments, dated November 2018. Also enclosed are the comment response and a cross-reference table. Submittal of these documents meets the schedule of December 4, 2019 agreed to by the Designated Agency Managers and summarized in the meeting minutes from September 4, 2019 (EM-LA-30AD-00527).

The work plans summarize the methods Newport News Nuclear BWXT-Los Alamos, LLC (N3B) proposes to use in plugging and abandoning these wells. This work continues the effort to plug and abandon unused penetrations on Los Alamos National Laboratory property. Field work is currently scheduled in the baseline for fiscal year 2023; however, the U.S. Department of Energy and N3B commit to accelerating the schedule as funding becomes available. Plugging plans will be prepared in accordance with New Mexico Office of the State Engineer regulations (New Mexico Administrative Code 19.27.4.30) and copies of the final well plugging reports will be submitted to NMED 120 days following well abandonment activities.

If you have any questions, please contact Mark Everett at (505) 309-1367 (mark.everett@em-la.doe.gov) or Cheryl Rodriguez at (505) 257-7941 (cheryl.rodriguez@em.doe.gov).

Sincerely,

For:

Arturo Q. Duran
Compliance and Permitting Manager
Environmental Management
Los Alamos Field Office

Enclosures:

1. Two hard copies with electronic files (including a redline strikeout version) – Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1 (EM2019-0430)
2. Response to Notice of Disapproval Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Dated November 2018 (EM2019-0428)
3. Cross-Reference of NMED NOD Comments and Revisions to the Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019 (EM2019-0433)

CC (letter and enclosures emailed):
Laurie King, EPA Region 6, Dallas, TX
Raymond Martinez, San Ildefonso Pueblo, NM
Dino Chavarria, Santa Clara Pueblo, NM
David Cobrain, NMED
Neelam Dhawan, NMED
Steve Yanicak, NMED-DOE-OB
Craig Douglass, LANL
Enrique Torres, LANL
William Alexander, N3B
Emily Day, N3B
Erich Evered, N3B
Mark Everett, N3B
Lori Huntoon, N3B
Jeannette Hyatt, N3B
Danny Katzman, N3B
Kim Lebak, N3B
Joseph Legare, N3B
Dana Lindsay, N3B
Frazer Lockhart, N3B
Elizabeth Lowes, N3B
Pamela Maestas, N3B
Glenn Morgan, N3B
Bruce Robinson, N3B
Karen Armijo, NA-LA
Thomas McCrory, EM-LA
David Nickless, EM-LA
Cheryl Rodriguez, EM-LA
Hai Shen, EM-LA
emla.docs@em.doe.gov
N3Brecords@em-la.doe.gov
Public Reading Room (EPRR)
PRS Website

Cross-Reference of NMED NOD Comments and
Revisions to the Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019

NMED NOD Comment No.	Summary of NOD Comment Requirement	Section(s) in Original Report	Section(s) in Revised Report	Nature of Revision
General Comments				
1	DOE must provide historical background information describing the original purpose of the wells and boreholes to be abandoned in Ancho, Pajarito, and Sandia Canyons. Please indicate if these wells and boreholes were installed to investigate a Solid Waste Management Unit (SWMU) or Area of Concern (AOC), and the current status of the SWMU or AOC.	Sections 2.1, 2.3, and 2.5	Section 2.1, p. 2; section 2.3, p. 3; and section 2.5, p. 3.	Language has been added to sections 2.1, 2.3, and 2.5 to discuss the original purpose of the wells and to describe the current status of the solid waste management units and area of concern they are associated with.
2	For each well proposed for plugging and abandonment, the presence of groundwater must be determined prior to plugging and abandonment. DOE must indicate that this will be performed in the Work Plan.	Section 2.0	Section 2.0. p.1	Language has been added to section 2.0 that describes the steps that will be taken to determine the presence of groundwater before plugging and abandonment activities.
3	The following wells (which are designated for plugging and abandonment in the Work Plan) must be retained for future monitoring, assuming they are currently functional or can be repaired: LAO-0.6, LAO-1.6g, LAO-6A, 18-MW-7 and 3MAO-2. DOE must remove these wells from the Work Plan.	Section 2.3, p. 3; section 3.3, p. 6; Table 2.0-1; Figure 2.2-1; Figure 2.3-1, Figure 3.2-2, LAO-0.6 abandonment schematic; Figure 3.2-6, LAO-1.6G abandonment schematic; Figure 3.2-9, LAO-6A abandonment schematic; Figure 3.3-5, 18-MW-7 abandonment schematic; Figure 3.3-8, 3MAO-2 abandonment schematic	Section 2.3, p. 3 section 3.3, p. 7; Table 2.0-1; Figure 2.2-1; Figure 2.3-1; Figure 3.2-2, LAO-0.6 abandonment schematic (removed); Figure 3.2-6, LAO-1.6G abandonment schematic (removed); Figure 3.2-9, LAO 6A abandonment schematic (removed); Figure 3.3-5, 18 MW-7 abandonment schematic (removed); Figure 3.3-8, 3MAO2 abandonment schematic (removed)	The five wells that were required to be retained by NMED for future monitoring have been removed from this work plan.

NMED NOD Comment No.	Summary of NOD Comment Requirement	Section(s) in Original Report	Section(s) in Revised Report	Nature of Revision
4	DOE must indicate the anticipated start date of field work and anticipated delivery date of the field completion report for the plugging and abandonment activities.	Section 2.0, p. 2	Section 2.0, p. 2	Language has been added to section 2.0 that mentions the anticipated start date of fieldwork as well as an anticipated delivery date for the field completion report.
Specific Comments				
1	Section 3.1, Work Plan to Plug and Abandon Alluvial Boreholes and Groundwater Observation Wells in Ancho Canyon, page 4: DOE must indicate dates when historically dry wells were last monitored for the presence of groundwater.	Section 3.1, p. 4	Section 2.1, p. 2	Language has been added to section 2.1 to address when the monitoring wells in Ancho canyon were last monitored for the presence of groundwater.
2	Section 3.5, Work Plan to Plug and Abandon Alluvial Groundwater Test Boreholes in Sandia Canyon, page 8: For the wells in Sandia Canyon that surround SWMU-53-002(a-b), DOE must indicate if groundwater has ever been detected. If groundwater was detected, DOE must indicate if contaminants were ever detected in groundwater. Additionally, DOE must indicate the current status of PRS 53-002 (a,b).	Section 3.5, p. 8	Section 2.5, p. 4	Language has been added to section 2.5 to address the presence of groundwater and associated contaminants. The current status of PRS 53-002 (a,b) has been addressed.

Response to Notice of Disapproval Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Dated November 2018

INTRODUCTION

To facilitate review of this response, the New Mexico Environment Department's (NMED's) comments are included verbatim. The U.S. Department of Energy (DOE) Environmental Management Los Alamos Field Office responses follow each NMED comment.

GENERAL COMMENTS

NMED Comment

1. DOE must provide historical background information describing the original purpose of the wells and boreholes to be abandoned in Ancho, Pajarito, and Sandia Canyons. Please indicate if these wells and boreholes were installed to investigate a Solid Waste Management Unit (SWMU) or Area of Concern (AOC), and the current status of the SWMU or AOC.

DOE Response

1. Language has been added to sections 2.1, 2.3, and 2.5 to discuss the original purpose of the wells and to describe the current status of the solid waste management units and area of concern they are associated with.

NMED Comment

2. For each well proposed for plugging and abandonment, the presence of groundwater must be determined prior to plugging and abandonment. DOE must indicate that this will be performed in the Work Plan.

2. Language has been added to section 2.0 that describes the steps that will be taken to determine the presence of groundwater before plugging and abandonment activities.

NMED Comment

3. The following wells (which are designated for plugging and abandonment in the Work Plan) must be retained for future monitoring, assuming they are currently functional or can be repaired: LAO-0.6, LAO-1.6g, LAO-6A, 18-MW-7 and 3MAO-2. DOE must remove these wells from the Work Plan.

DOE Response

3. The five wells that were required to be retained by NMED for future monitoring have been removed from this work plan.

NMED Comment

4. DOE must indicate the anticipated start date of field work and anticipated delivery date of the field completion report for the plugging and abandonment activities.

DOE Response

4. *Language has been added to section 2.0 that mentions the anticipated start date of fieldwork as well as an anticipated delivery date for the field completion report.*

SPECIFIC COMMENTS

NMED Comment

1. Section 3.1, Work Plan to Plug and Abandon Alluvial Boreholes and Groundwater Observation Wells in Ancho Canyon, page 4:

DOE must indicate dates when historically dry wells were last monitored for the presence of groundwater.

DOE Response

1. *Language has been added to section 2.1 to address when the monitoring wells in Ancho canyon were last monitored for the presence of groundwater*.

NMED Comment

2. Section 3.5, Work Plan to Plug and Abandon Alluvial Groundwater Test Boreholes in Sandia Canyon, page 8:

For the wells in Sandia Canyon that surround SWMU-53-002(a-b), DOE must indicate if groundwater has ever been detected. If groundwater was detected, DOE must indicate if contaminants were ever detected in groundwater. Additionally, DOE must indicate the current status of PRS 53-002 (a,b).

DOE Response

2. Language has been added to section 2.5 to address the presence of groundwater and associated contaminants. The current status of PRS 53-002 (a,b) has been addressed.

December 2019
EM2019-0430

Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1

N3B Los Alamos

EM2019-0430

Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1

December 2019

Responsible program director:

Printed Name	Signature	Title	Organization	Date
Bruce Robinson		Program Director	Water Program	11/26/19

Responsible N3B representative:

Printed Name	Signature	Title	Organization	Date
Erich Evered		Program Manager	N3B Environmental Remediation Program	11/26/2019

Responsible DOE EM-LA representative:

Printed Name	Signature	Title	Organization	Date
Arturo Q. Duran FOR:		Compliance and Permitting Manager	Office of Quality and Regulatory Compliance	12/04/2019

CONTENTS

Figures

Table

1.0 INTRODUCTION

This document contains information for the plugging and abandonment of 45 observation wells in Ancho, Los Alamos, Pajarito, Pueblo, and Sandia Canyons at Los Alamos National Laboratory (LANL or the Laboratory) and is part of the U.S. Department of Energy's (DOE's) ongoing efforts to plug and abandon legacy wells and boreholes located on and adjacent to Laboratory property.

The work plans describe plugging and abandonment procedures that comply with Appendix F, Section II.D (Well Abandonment) of the 2016 Compliance Order on Consent (the Consent Order) as well as the New Mexico Office of the State Engineer (NMOSE) well or borehole abandonment regulations. Additionally, the plugging and abandonment procedures comply with 19 New Mexico Administrative Code 27.4, "Well Driller Licensing; Construction, Repair, and Plugging of Well." The work plans will be submitted to NMOSE by Newport News Nuclear BWXT-Los Alamos, LLC (N3B) before abandonment activities are undertaken.

This document includes five standalone work plans and associated figures, as shown in the following table. References for the work plans are provided in section 4.0 of this document.

Organization of Work Plans

Work Plan	Section
Work plan to plug and abandon 18 Ancho Canyon alluvial groundwater observation wells Figures 3.1-1–3.1-18, Plugging and abandonment schematics	3.1
Work plan to plug and abandon 7 Los Alamos Canyon alluvial groundwater observation wells Figures 3.2-1–3.2-7, Plugging and abandonment schematics	3.2
Work plan to plug and abandon 6 Pajarito Canyon alluvial groundwater observation wells Figures 3.3-1–3.3-6, Plugging and abandonment schematics	3.3
Work plan to plug and abandon 6 Pueblo Canyon alluvial groundwater observation wells Figures 3.4-1–3.4-6, Plugging and abandonment schematics	3.4
Work plan to plug and abandon 8 Sandia Canyon alluvial groundwater test holes and observation wells Figures 3.5-1–3.5-8, Plugging and abandonment schematics	3.5

2.0 BACKGROUND INFORMATION AND RATIONALE

Prioritization of wells and boreholes to be abandoned is based on criteria that determine their potential for providing a pathway for contaminants to migrate to depth. These criteria include the depth of the well, the location of the penetration (canyon bottom versus mesa top), the well's condition (the hole is wet or dry), its proximity to known sources of contamination, its age, its construction, and its accessibility to the public. In addition, recent experience from work performed from 2010 to 2018 has added some practical criteria to maximize cost savings and adhere to allocated budgets. These criteria include (1) grouping wells and boreholes within a given location to minimize mobilization costs and required permitting and (2) combining difficult, and thus expensive, wells with less difficult ones. The information available about legacy boreholes can be inaccurate, and unexpected conditions may be encountered. Before plugging and abandonment activities, field reconnaissance will be conducted at the wells and boreholes to verify field conditions and construction details of each well. A water-level measurement will be taken at each well to detect the presence and depth of groundwater. Additionally, water-level data will be reviewed to determine if a particular well can be considered historically dry. Field conditions impacting plugging and abandonment activities include possible obstructions, ease of site access, condition of surface well pad, surface casing,

and wellhead security. Construction details, including total borehole depth, current well depth, casing material and diameter, and screened interval (if present) are presented in Table 2.0-1.

Of the 50 wells planned for plugging and abandonment activities in the original work plan, 5 have been removed from this revised work plan. These five wells are LAO-0.6, LAO-1.6G, LAO-6A, 18-MW-7 and 3MAO-2. The New Mexico Environment Department (NMED) required that these 5 wells be retained for future monitoring.

The locations of all wells and boreholes currently planned to be plugged and abandoned starting in fiscal year 2023 are shown in Figure 2.0-1. Each well or borehole will have its own completion report. The delivery date of each field completion report is scheduled for 120 days following abandonment activities for the associated well. Background information on the installation of these wells and the rationale for plugging and abandoning each group is provided below.

2.1 Alluvial Angled Wells and Groundwater Observation Wells in Ancho Canyon

In 1994, 13 angled wells and 5 shallow wells were drilled in Ancho Canyon at Solid Waste Management Units (SWMUs) 39-001(a) and 39-001(b) (Figure 2.1-1) (LANL 2010, 108592, pp. 9–12, 104–106, 128-130; LANL 2011, 204397, pp. 27 and 28.). The angled wells were drilled to 80 ft in length (depths of 56.5 ft below ground surface [bgs]) to investigate possible contaminant migration beneath the base of a single disposal trench located at SWMU 39-001(a) and three buried waste material pits at SWMU 39-001(b), all of which consisted of firing-site debris. The angled wells are constructed of 2-in.–inside diameter (I.D.) schedule 40 polyvinyl chloride (PVC); well construction information is unknown. The shallow monitoring wells vary in total depth from 25 to 119 ft in depth and are constructed of 4-in.-diameter PVC and stainless steel. The wells were installed downgradient to intercept potential contaminant migration from the buried waste pits and were drilled to encounter the alluvium/tuff interface.

Wells ASC-0, ASC-2, ASC-4, ASC-12, ASC-13, ASC-14, ASC-17, and ASC-19 were last monitored in 2009. Wells ASC-3, ASC-11, ASC-15, ASC-16, ASC-18, 39-DM-2, 39-DM-4, 39-DM-6, 39-DMB-1 and 39-UM-3 were either dry at the time of drilling or during subsequent follow-up visits.

SWMU 39-001(a) has a corrective action status of In Progress and is included in the approved “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area , Revision 1” (LANL 2011, 201561; NMED 2011, 203447), which specifies sampling locations, numbers of samples, and analytical suites required to define the extent of contamination. The results will be presented in a Phase II investigation report for the North Ancho Canyon Aggregate Area. NMED issued a certificate of completion without controls for SWMU-39-001(b) in April 2010 (NMED 2010, 110430).

Although historical groundwater data indicate a lack of perched-intermediate groundwater in the area, local contaminant sources have been or will be remediated and the wells are no longer being used for monitoring activities. These wells should be plugged and abandoned to block any potential conduit for surface-water infiltration.

2.2 Alluvial Groundwater Observation Wells in Los Alamos Canyon

Two alluvial groundwater observation wells (LAO-4.5A and LAO-4.5B) were installed in Los Alamos Canyon in 1989. The wells were constructed to monitor quality of water in the alluvium and to fulfill the U.S. Environmental Protection Agency (EPA) Hazardous and Solid Waste Amendments Special Permit Condition (Figure 2.2-1) (Purtymun 1995, 045344, pp. 137–141; LANL 1997, 055622, p. 2-16). The wells were completed as 2-in.-diameter wells constructed of PVC. Each well has 10 ft of 0.010-in. slotted

screen and total depths vary between 18.5 and 35 ft. Because these wells may provide a pathway for contamination to move to the alluvial and perched groundwater, they should be plugged and abandoned.

Between 1994 and 1996, a series of five shallow alluvial wells (LAO-0.3, LAO-0.7, LAO-0.8, LAO-0.91 and LAO-B) was installed in Los Alamos Canyon to characterize alluvial groundwater quality downstream from Technical Area 02 (TA-02) and TA-41 and to provide water-level information (Figure 2.2-1) (LANL 1997, 055622, pp. 2-12 and 2-16; Gray 2001, 073307, pp. 4–5 and 67–76). These wells vary in total depth from 11 to 27 ft and terminate at the top of the bedrock. The wells were completed with 4-in.-I.D. PVC and 0.010-in. slotted screens that vary from 5 to 15 ft in depth. Because these wells may provide a pathway for contamination to move to the alluvial and perched groundwater, they should be plugged and abandoned.

2.3 Alluvial Groundwater Observation Wells in Pajarito Canyon

Between 1990 and 1995, six alluvial groundwater observation wells were completed through the alluvium in Pajarito Canyon to assess the potential for transport of radionuclides in the shallow groundwater system surrounding the Los Alamos Critical Experiment Facility (Figure 2.3-1) (LANL 1995, 055527, pp. 5-16, 5-17, and 5-79 through 5-83; LANL 1998, 059577, pp. 3-75, 3-76, C-24, and C-25). Four of these wells (18-MW-1, 18-MW-2, 18-MW-3, and 18-MW-4) were used to investigate Area of Concern (AOC) 18-006, which consisted of a former underground stainless-steel storage pipe. Liquid stored in the pipe was used in liquid-fueled reactor experiments.These wells vary in total depth from 7 to 32 ft and were cased with 2-in.-I.D. PVC. Each well has a single screen in the lower portion; well construction information and annulus backfill material is unknown. Alluvial wells 18-MW-1, 18-MW-2, 18-MW-3, and 18-MW-4 have not been sampled since they were drilled in 1990, and well 18-MW-17 was last sampled in 2004. These wells are no longer used for monitoring activities and should be plugged and abandoned to block any potential contaminant transport pathway. AOC 18-006 has a corrective action status of In Progress and will be investigated as part of the future Lower Pajarito Canyon Aggregate Area investigation.

In 1998, alluvial characterization well 18-BG-4 was installed in Threemile Canyon to determine background groundwater chemistry and to monitor water quality upgradient of TA-18 (Gray 2001, 073307, pp. 43–45). The borehole was drilled to 25 ft bgs and was completed in the alluvium/tuff interface with a 4-in.-I.D. PVC casing to 6.8 ft bgs. The lower portion of the well has a 4-ft slotted screen with a 20/40 silica sand filter pack. The borehole has 4-in.-I.D. PVC casing and a completion depth of 30 ft bgs with a lower 10-ft screen; annulus backfill material is unknown. This well was damaged during the 2011 flood and is no longer being monitored. Because this well may provide a pathway for contamination to move to the alluvial and perched groundwater, it should be plugged and abandoned.

2.4 Alluvial Groundwater Observation Wells in Pueblo Canyon

In 1994, six groundwater observation wells (73-01001, 73-01003, 73-01004, 73-01006, 73-01009 and 73-01011) were drilled around an inactive landfill on the Pueblo Canyon mesa top at the Los Alamos Airport (Figure 2.4-1). The landfill was associated with SWMUs 73-001(a), 73-001(b), 73-001(c), and 73-001(d) (LANL 1998, 063070, pp. 2-49 and 2-54). The wells were installed with vadose zone instruments consisting of soil gas sampling ports, lysimeters, heat dissipation sensors, and thermocouples. The boreholes have 8.25-in. diameters, are cased with 2-in.-I.D. PVC, and vary in total depth from 37.8 and 186 ft. These wells were installed along the perimeter of an abandoned municipal landfill to determine potential contamination migration to groundwater or atmosphere. These wells are not part of the Long-Term Monitoring Plan for the Los Alamos County Airport Landfill closure and they should be plugged and abandoned to eliminate any potential contaminant transport pathway (DOE 2017, 602320).

2.5 Alluvial Groundwater Test Boreholes and Observation Well in Sandia Canyon

In 1991, seven groundwater test boreholes and one pore gas well were drilled through the alluvium into tuff in Sandia Canyon (Figure 2.5-1) (McLin et al. 1997, 085422). These boreholes were drilled to investigate possible contaminant migration beneath SWMUs 53-002(a) and 53-002(b), which consisted of three former surface impoundments that were constructed to contain sanitary, industrial, and radioactive wastewater at TA-53. The test boreholes consist of five 2-in. –ID aluminum moisture access tubes (53-TH-1, 53-TH-2, 53-TH-3, 53-TH-4, and 53-TH-B), and two open boreholes (53-TH-6 and 53-TH-7). The observation well (53-TH-5) is a pore gas well with total depths varying from 46 to 150 ft. Pore gas well 53-TH-5 has five aluminum sampling ports that vary in depth from 20 to 93.5 ft bgs. Open borehole 53-TH-7 has a lysimeter port at 37 ft bgs.

There are no groundwater-level measurements or analytical sampling results in either the LANL or NMED DOE Oversight Bureau databases to indicate that groundwater or contaminants have been detected in the seven boreholes and one pore gas well surrounding SWMUs 53-002(a) and 53-002(b) that have been identified for plugging and abandonment.

Corrective actions were conducted at SWMUs 53-002(a) and 53-002(b) in 2000 and 2002, and decision-level data indicated the nature and extent of contamination were defined and the sites pose no potential unacceptable risk to industrial receptors. NMED issued a certificate of completion with controls in September 2006 for SWMUs 53-002(a) and 53-002(b) (NMED 2006, 095421).

Local contaminant sources have been remediated and the boreholes/observation well are no longer being used for monitoring activities. These test boreholes and observation well are no longer in use and should be abandoned to block any potential contaminant transport pathway.

3.0 WORK PLANS FOR PLUGGING AND ABANDONMENT

Field activities for plugging and abandonment activities will be developed in accordance with procedure N3B-AP-P300-1, "Integrated Work Control Process." This procedure categorizes activity-level work using a graded approach, provides instructions for generating and controlling suitable work control documents, facilitates the selection of proper planning tools and personnel, describes the process requirements for performing pre- and post-job briefings, and provides a mechanism for processing feedback to ensure continuous improvement. Planning will also take place under procedure N3B-P351 "Project Planning and Regulatory Review." This procedure allows N3B to identify institutional, state, and/or federal requirements early in the planning phase of a project; facilitate subject matter expert input and review; and document compliance with requirements.

3.1 Work Plan to Plug and Abandon Alluvial Angled Wells and Groundwater Observation Wells in Ancho Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial boreholes and groundwater observation wells in Ancho Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the boreholes and wells in Ancho Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	Thirteen angled wells and five shallow wells were installed in Ancho Canyon in 1994 to investigate possible contaminant migration from beneath buried waste material pits (LANL 2010, 108592). The existing boreholes and wells vary in total depth from 25 to 119 ft and are constructed of 2- and 4-in.-I.D. PVC and stainless-steel casing. Well construction is unknown for a majority of the wells and has not been found in any historical literature or well and borehole databases. Well 39-UM-3 has a 15-ft screened interval in a 27-ft sand filter pack and a 2.5-ft upper bentonite seal and was completed to surface with cement. Well 39-DM-6 has a 10-ft screen in a 20-ft sand filter pack and a 2.5-ft upper bentonite seal and was completed to surface with native material. Alluvial well 39-DMB-1 was the only well drilled beyond the alluvium/tuff interface and was extended into basalt at 119 ft bgs. These boreholes are historically dry, but water may be present.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be overdrilled to a depth of 20 ft bgs. In either scenario the borehole will be filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.1-1 to 3.1-18. Well ASC-3 was damaged during remediation activities in 2009 and a bentonite plug was placed over protruding PVC (LANL 2010, 111505, p. 10). The well needs to be overdrilled to 2 ft bgs for proper surface completion. This well has already been abandoned to ground surface, negating the need to be overdrilled to a depth of 20 ft bgs.
Surface Completion	A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with a global positioning system (GPS) with an accuracy of ±0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.2 Work Plan to Plug and Abandon Alluvial Groundwater Observation Wells in Los Alamos Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells in Los Alamos Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the wells in Los Alamos Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	A series of seven alluvial observation wells was installed in Los Alamos Canyon between 1989 and 1996 (LANL 2010, 108592). The wells were installed to monitor and characterize water quality, fulfill special EPA permit conditions, and provide water-level information. The wells are constructed of 2- and 4-in.-diameter PVC pipe, vary in total depth from 18.5 to 35 ft, and terminate at the top of bedrock. The alluvial wells are constructed with a 10/20 silica sand filter pack, an upper bentonite seal, and a cement seal to surface. Well construction is unknown for LAO-0.7 and has not been found in any historical literature or databases.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be overdrilled to a total depth of 20 ft bgs (or to total depth if less than 20 ft). In either scenario the borehole will be filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.2-1 to 3.2-7.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.3 Work Plan to Plug and Abandon Alluvial Groundwater Observation Wells in Pajarito Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells in Pajarito Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the wells in Pajarito Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	Five alluvial wells were installed in Pajarito Canyon to assess the potential for transport of radionuclides in the shallow groundwater system (LANL 1995, 055527) One additional well was installed in Threemile Canyon to monitor groundwater quality upgradient of TA-18 (Gray 2001, 073307). The wells vary in total depth from 7 to 25 ft. Well construction is incomplete for Pajarito Canyon well 18-MW-17. The remaining Pajarito Canyon wells were constructed with a silica sand filter pack and an upper bentonite seal. Threemile Canyon alluvial well 18-BG-4 has a 4-ft screened interval and is constructed with a silica sand filter pack and upper bentonite seal.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be overdrilled to a depth of 20 ft bgs (or to total depth if less than 20 ft). In either scenario the borehole will be filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.3-1 to 3.3-6.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.4 Work Plan to Plug and Abandon Alluvial Groundwater Observation Wells in Pueblo Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells in Pueblo Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the wells in Pueblo Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	In 1994, six observation wells were installed at the Los Alamos Airport on the Pueblo Canyon mesa top (LANL 1998, 063070). The wells were installed on the perimeter of an abandoned municipal landfill to determine potential contamination migration to groundwater and atmosphere. These wells were constructed with various vadose zone instrumentation and annulus backfill materials consisting of sand, bentonite, and native material. These wells vary in total depth from 37.8 to 186 ft.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be overdrilled to a depth of 20 ft bgs. In either scenario the borehole will be filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.4-1 to 3.4-6.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.5 Work Plan to Plug and Abandon Alluvial Groundwater Test Boreholes and Observation Well in Sandia Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater test boreholes and observation well in Sandia Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the test boreholes and observation well in Sandia Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	In 1991, eight test boreholes were installed in Sandia Canyon at TA-53 (Purtymun 1995, 045344). The wells consist of five moisture monitoring boreholes, two open boreholes, and one pore gas observation well. The moisture monitoring boreholes vary in total depth from 46 to 48 ft and are constructed of 2-in.-diameter aluminum pipe. Pore gas well 53-TH-5 is constructed of 4-in.-diameter aluminum casing to 4 ft, has five aluminum sampling ports, and has a total depth of 93.5 ft. Open borehole 53-TH-6 is open hole to 150 ft deep with an annulus of native material. Open borehole 53-TH-7 has a total depth of 77 ft with a 2-in.-diameter aluminum pipe, and the annular space is sand and bentonite.
Abandonment Methods	Boreholes/well with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Boreholes/well with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the casing from the boreholes or well. If this is not feasible, the borehole/well will be overdrilled to a depth of 20 ft bgs. In either scenario the borehole will be filled with bentonite to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.5-1 to 3.5-8.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

4.0 REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

DOE (U.S. Department of Energy), March 2017. "Long-Term Monitoring Plan, Los Alamos County Airport Landfill Cover Replacement, Solid Waste Management Units 73-001(a,d), Technical Area 73," report prepared by Dwyer Engineering, LLC, for DOE Environmental Management Los Alamos Field Office, Los Alamos, New Mexico. (DOE 2017, 602320)

Gray, R.N., November 2001. "Report on Alluvial Well Completions 1994-2001," report prepared for Los Alamos National Laboratory Los Alamos, New Mexico. (Gray 2001, 073307)

LANL (Los Alamos National Laboratory), November 2, 1995. "RFI Report for Potential Release Sites 18-002(a–c), 18-003(a–h), 18-004(a,b), 18-005(a), 18-008, 18-010(b–f), 18-011, 18-012(a–c), 18-013, 27-002, PCO Wells, LACEF Monitoring Wells, Wetlands (located in former Operable Unit 1093)," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 055527)

LANL (Los Alamos National Laboratory), April 1997. "Core Document for Canyons Investigations," Los Alamos National Laboratory document LA-UR-96-2083, Los Alamos, New Mexico. (LANL 1997, 055622)

LANL (Los Alamos National Laboratory), September 1998. "Work Plan for Pajarito Canyon," Los Alamos National Laboratory document LA-UR-98-2550, Los Alamos, New Mexico. (LANL 1998, 059577)

LANL (Los Alamos National Laboratory), November 1998. "RFI Report for Potential Release Sites 73-001(a, b, c, d) (Airport Landfill Areas)," Los Alamos National Laboratory document LA-UR-98-3824, Los Alamos, New Mexico. (LANL 1998, 063070)

LANL (Los Alamos National Laboratory), February 2010. "Information Concerning the Angled Boreholes Associated with Past Environmental Investigations at Technical Area 39," Los Alamos National Laboratory document LA-UR-10-0579, Los Alamos, New Mexico. (LANL 2010, 108592)

LANL (Los Alamos National Laboratory), December 2010. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area," Los Alamos National Laboratory document LA-UR-10-7869, Los Alamos, New Mexico. (LANL 2010, 111505)

LANL (Los Alamos National Laboratory), March 2011. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area Revision 1," Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011, 201561)

LANL (Los Alamos National Laboratory), June 2011. "Investigation Report for Ancho, Chaquehui, and Indio Canyons, Revision 1," Los Alamos National Laboratory document LA-UR-11-3305, Los Alamos, New Mexico. (LANL 2011, 204397)

McLin, S.G., W.D. Purtymun, S. Swanton, and R.J. Koch, August 1997. "Logs and Completion Data for Water Balance Wells in Mortandad and Ten Site Canyons," Los Alamos National Laboratory report LA-13297-MS, Los Alamos, New Mexico. (McLin et al. 1997, 085422)

NMED (New Mexico Environment Department), September 13, 2006. "Certificates of Completion for Solid Waste Management Units 53-002(a) and 53-002(b), Technical Area 53," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2006, 095421)

NMED (New Mexico Environment Department), April 6, 2010. "Approval, Request for Certificates of Completion for Two Solid Waste Management Units and Five Areas of Concern in the North Ancho Canyon Aggregate Area," 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 2010, 110430)

NMED (New Mexico Environment Department), May 13, 2011. "Approval with Modifications, Phase II Investigation Work Plan North Ancho Canyon Aggregate Area, Revision 1," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 203447)

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)

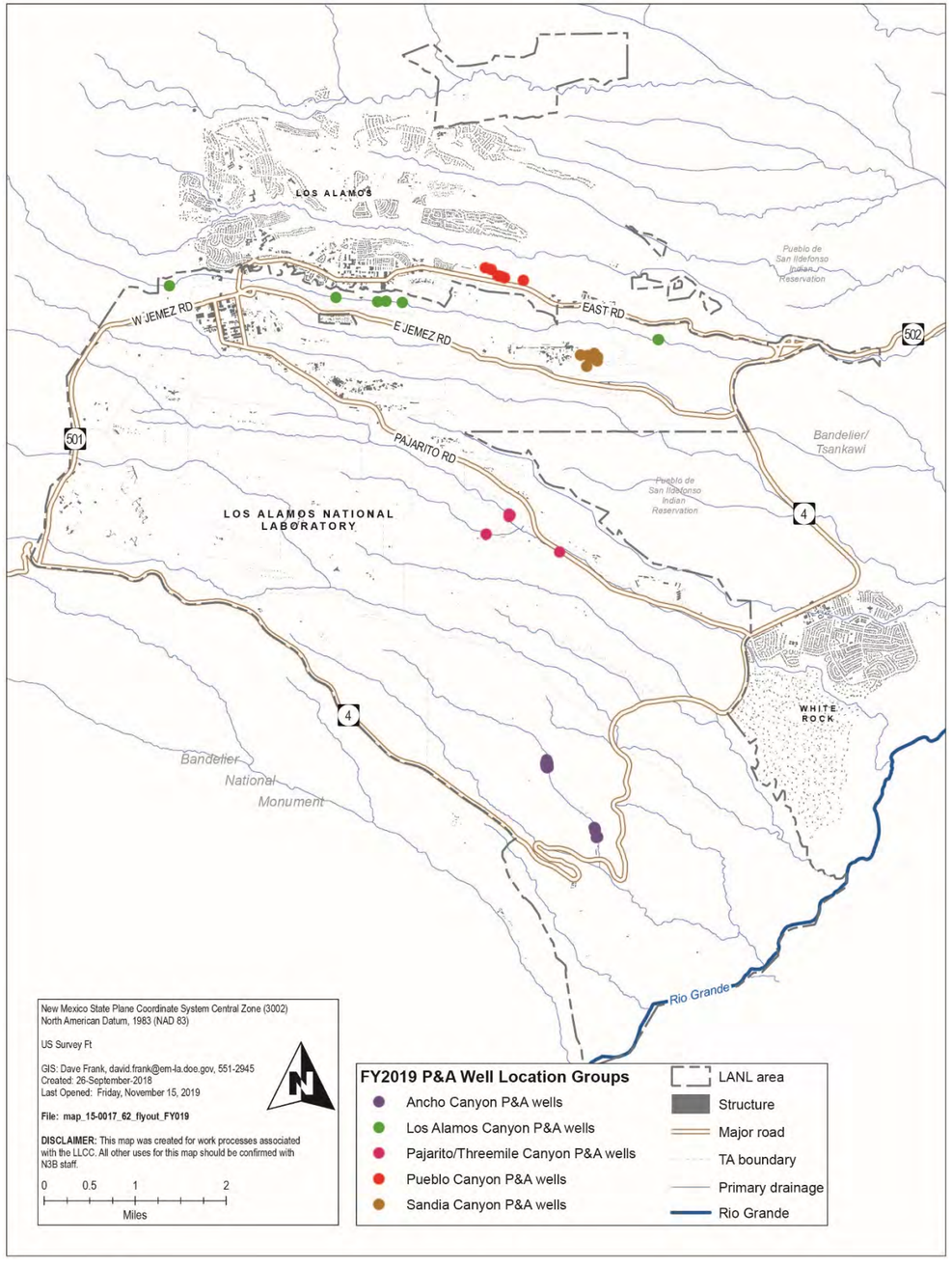


Figure 2.0-1 Locations of all wells and boreholes to be plugged

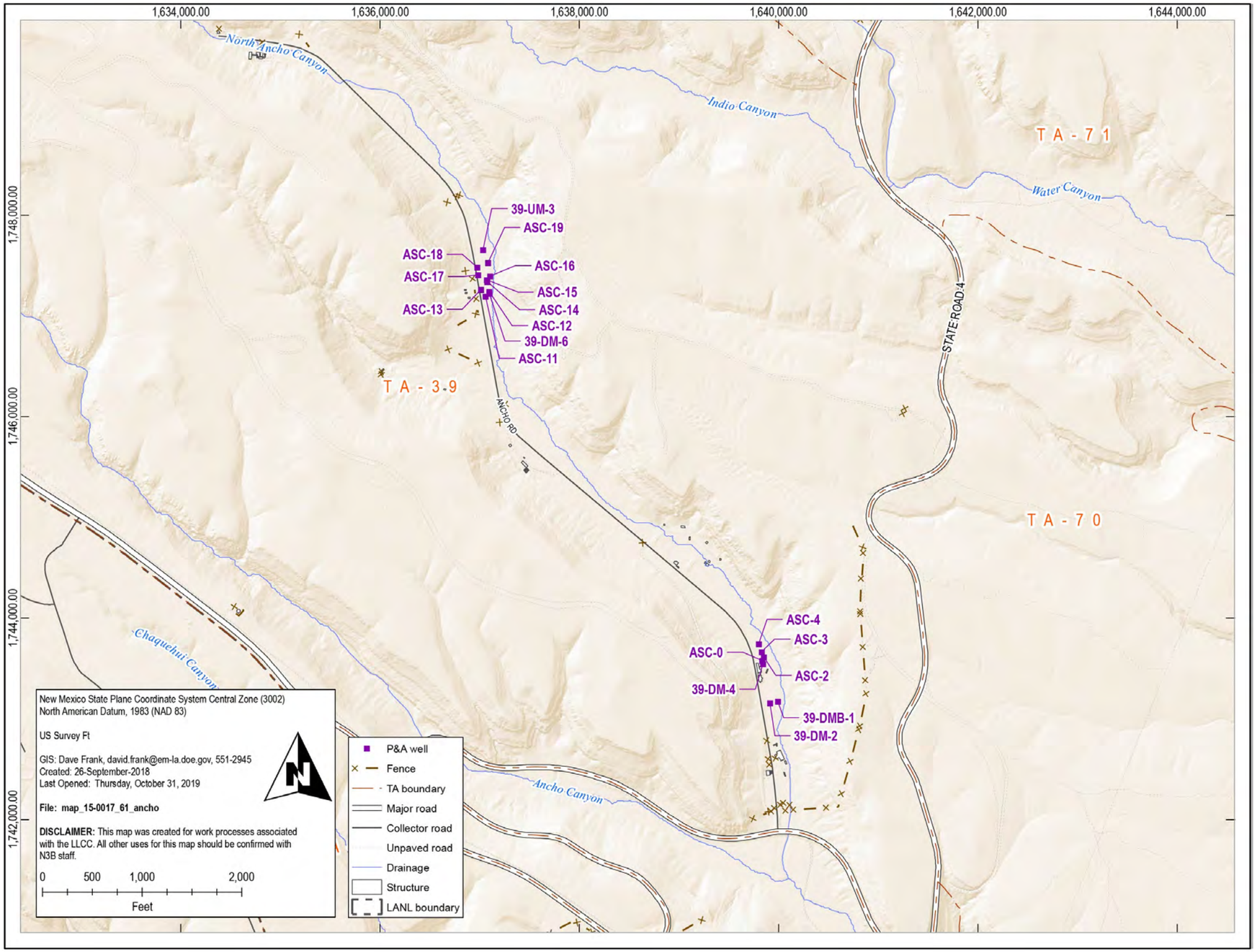


Figure 2.1-1 Locations of alluvial groundwater observation wells in Ancho Canyon

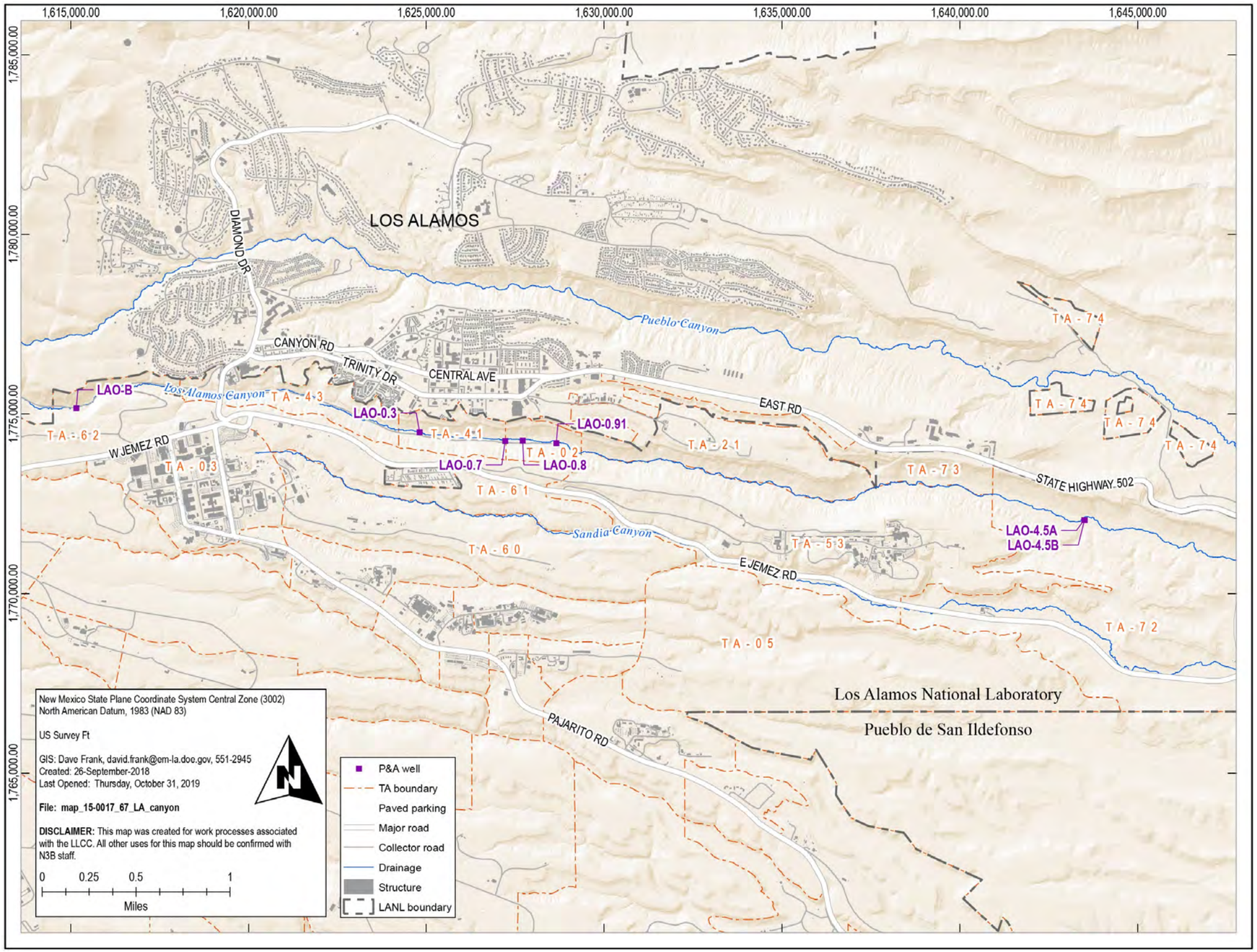


Figure 2.2-1 Locations of alluvial groundwater observation wells in Los Alamos Canyon

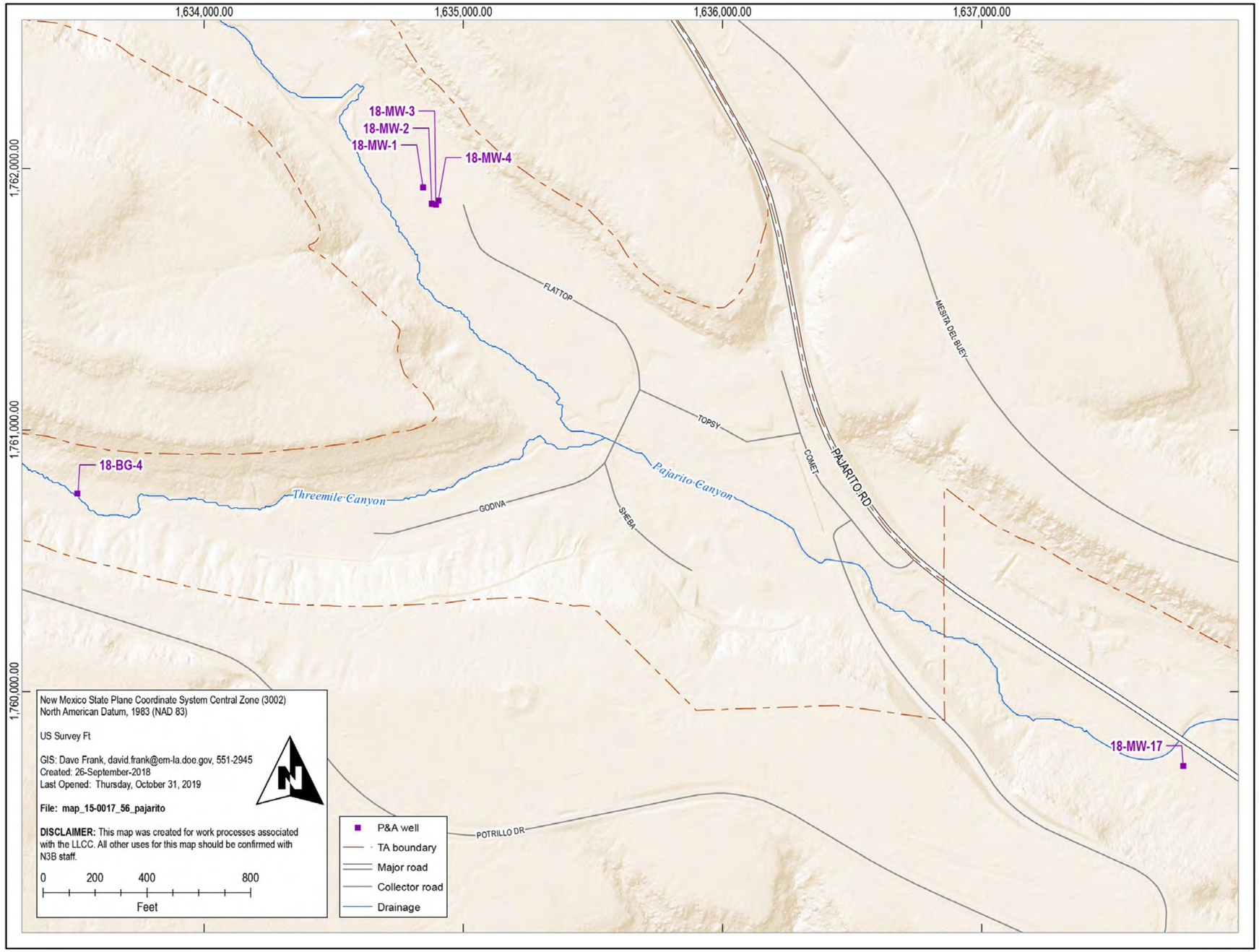


Figure 2.3-1 Locations of groundwater observation wells in Pajarito Canyon

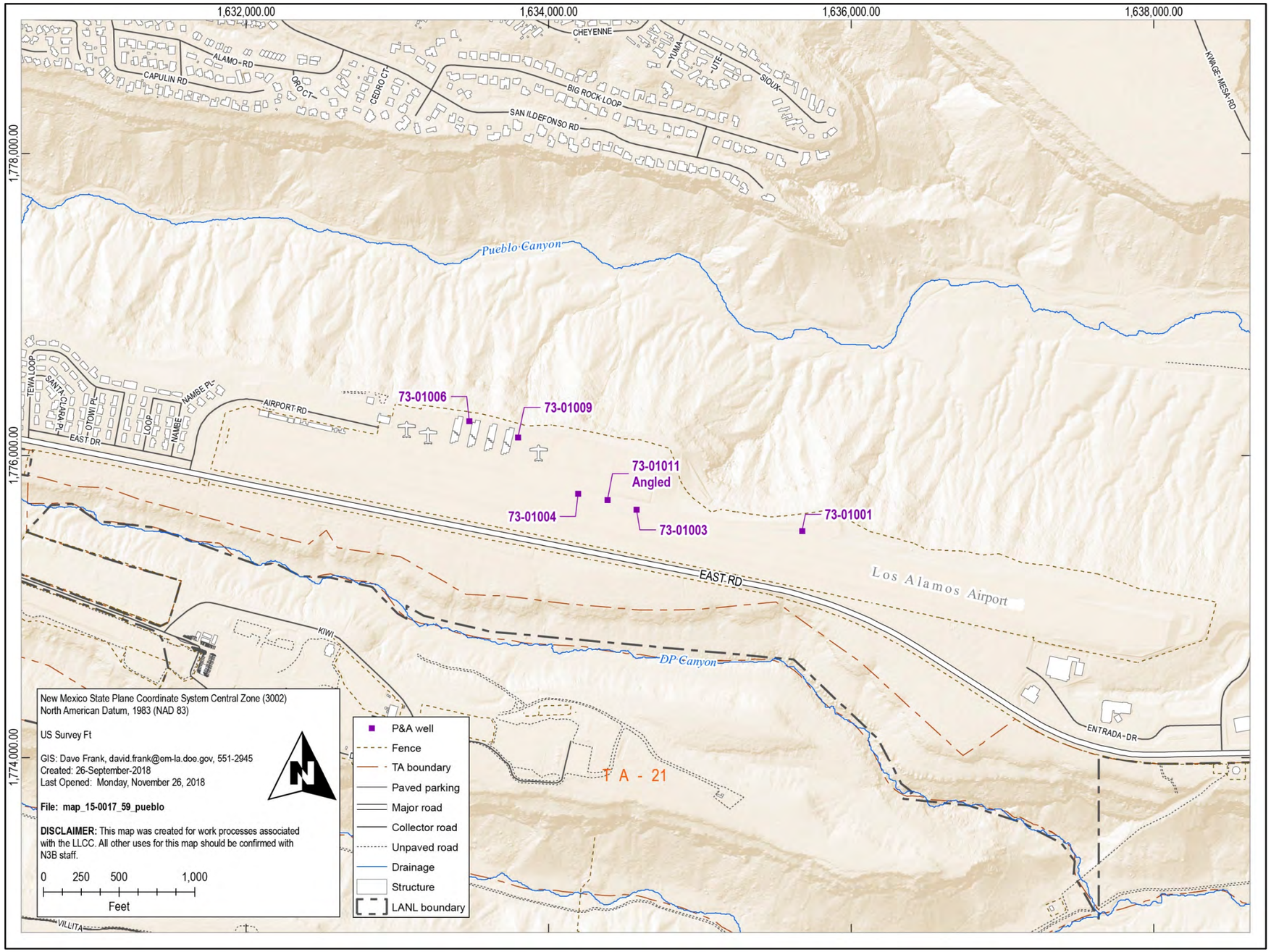


Figure 2.4-1 Locations of alluvial groundwater observation wells in Pueblo Canyon

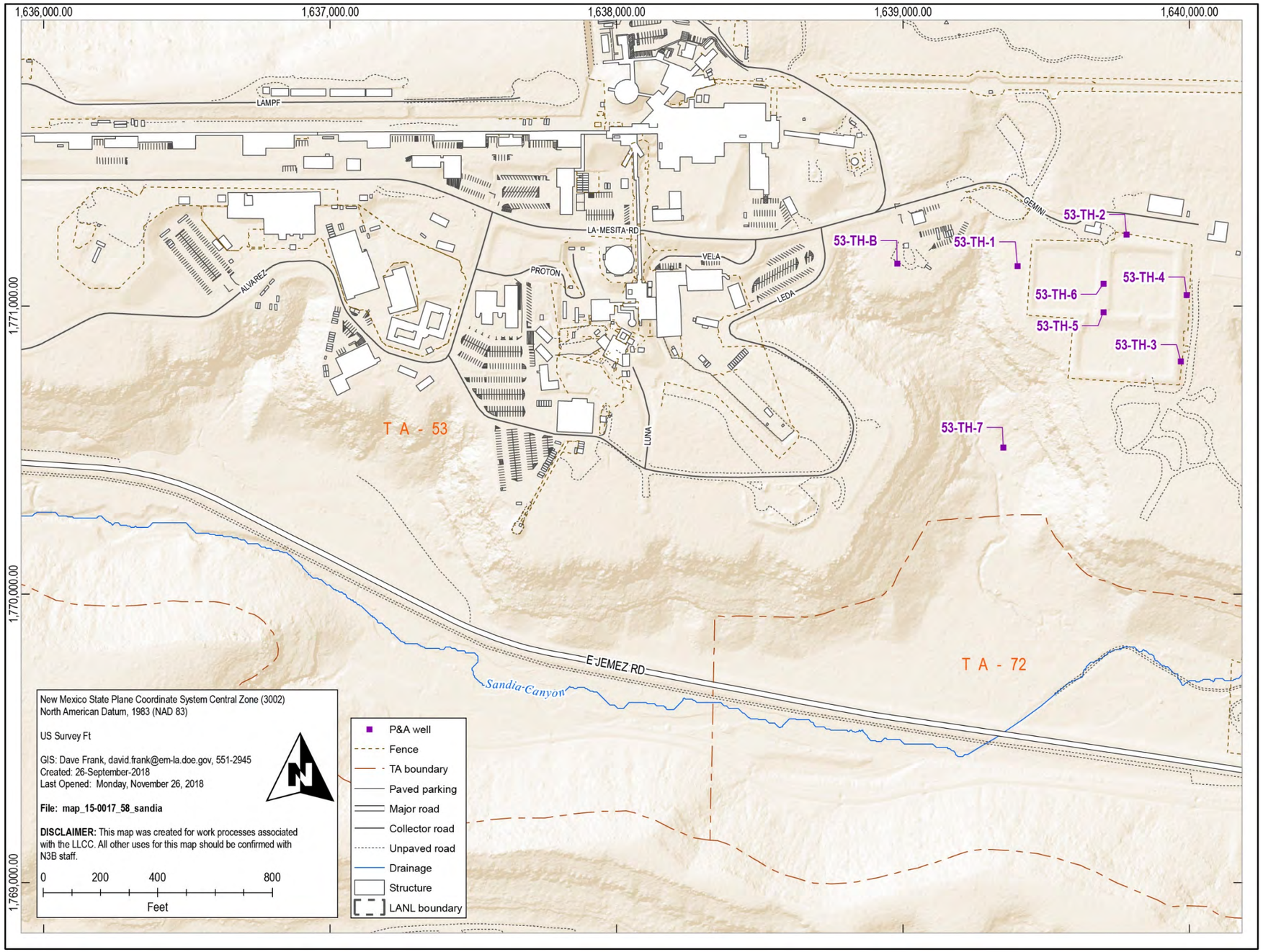


Figure 2.5-1 Locations of alluvial groundwater observation wells in Sandia Canyon

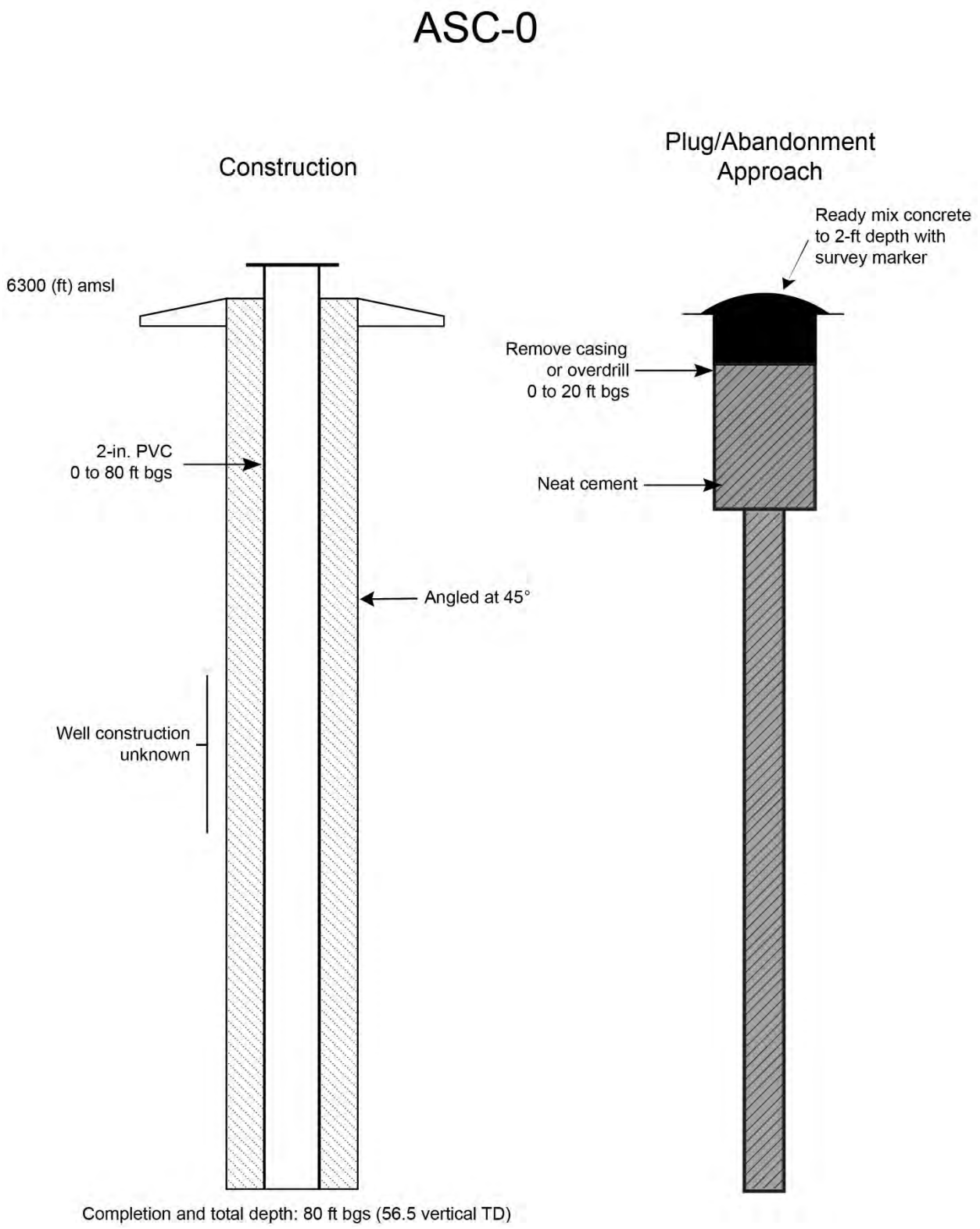


Figure 3.1-1 ASC-0 abandonment schematic

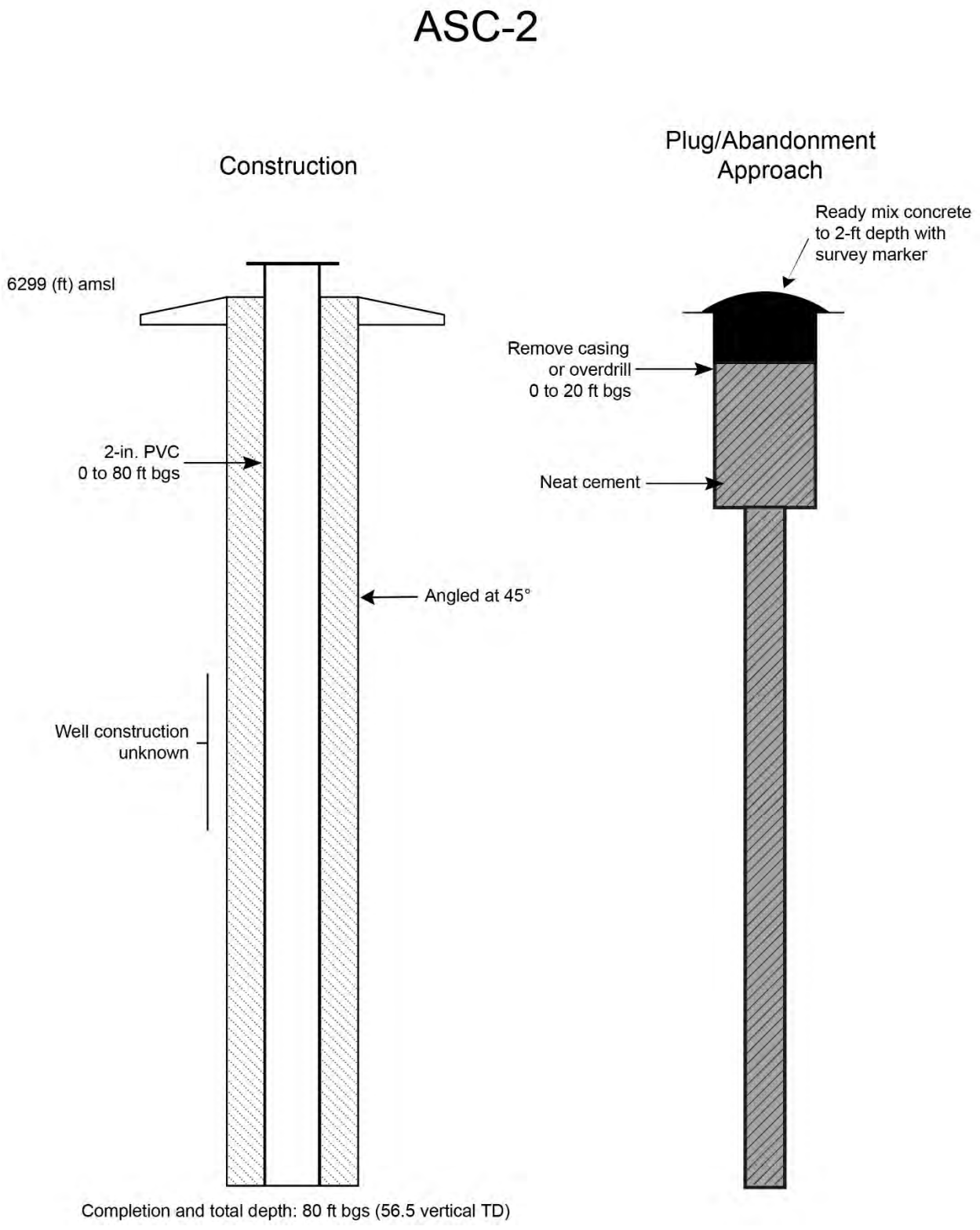


Figure 3.1-2 ASC-2 abandonment schematic

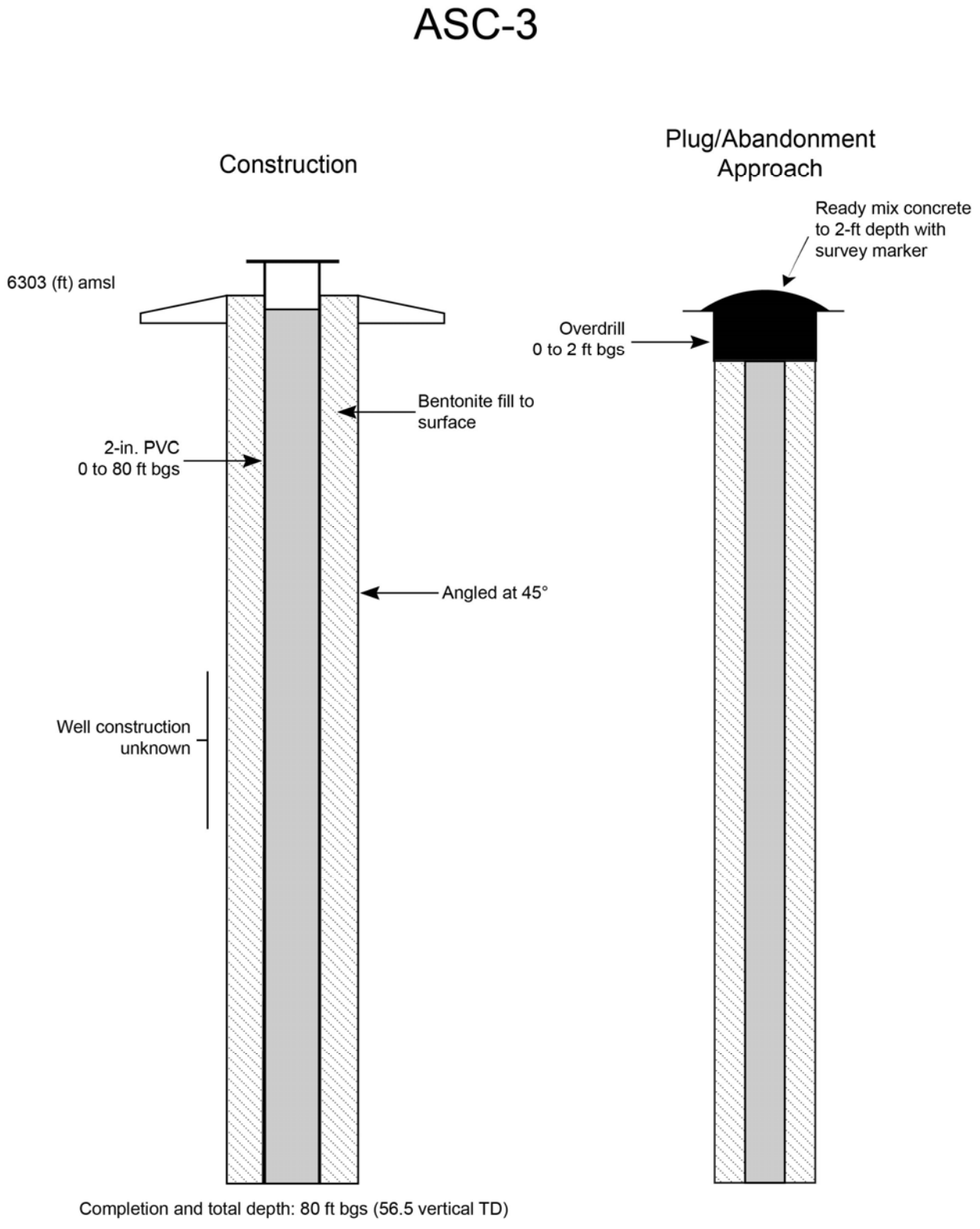


Figure 3.1-3 ASC-3 abandonment schematic

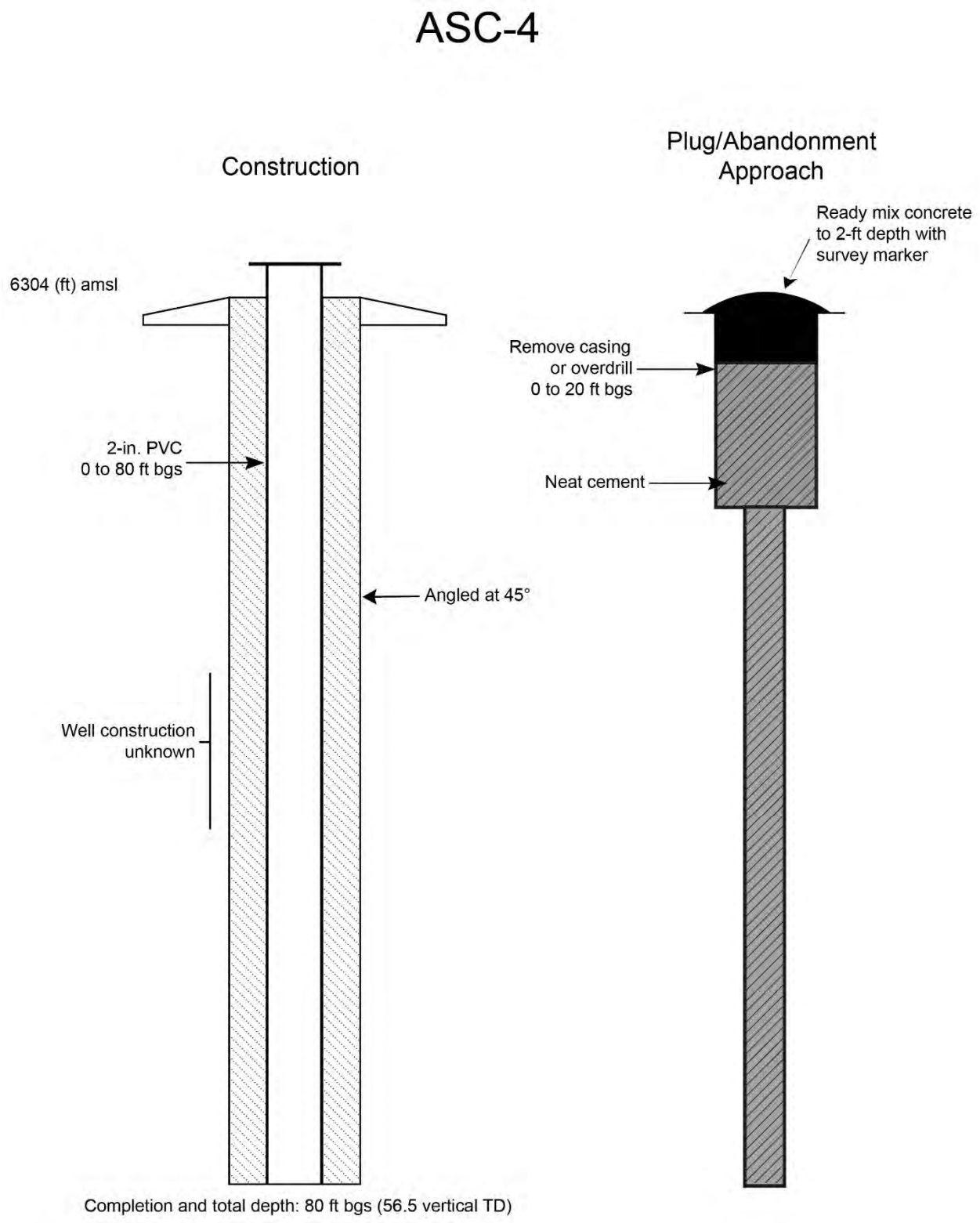


Figure 3.1-4 ASC-4 abandonment schematic

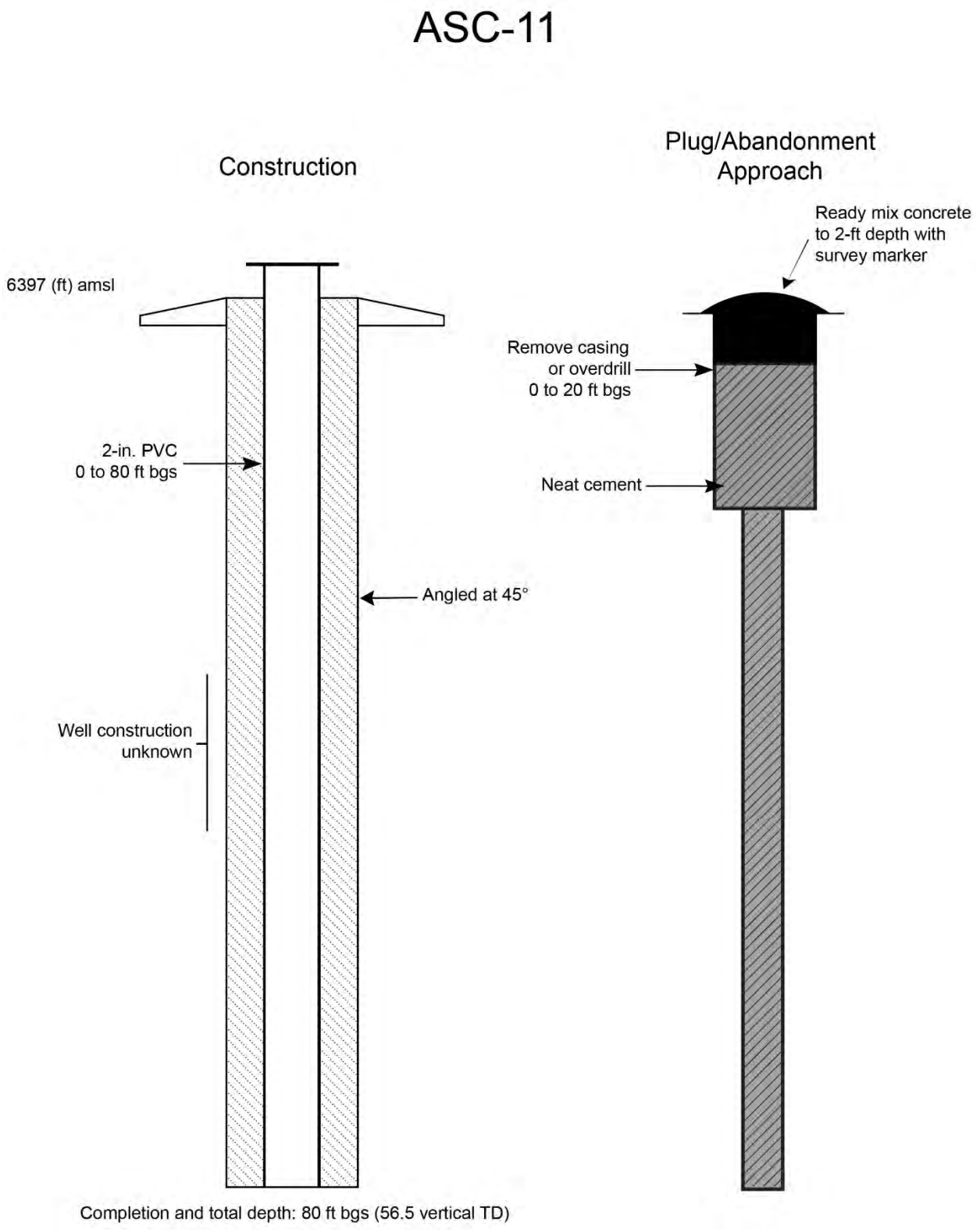


Figure 3.1-5 ASC-11 abandonment schematic

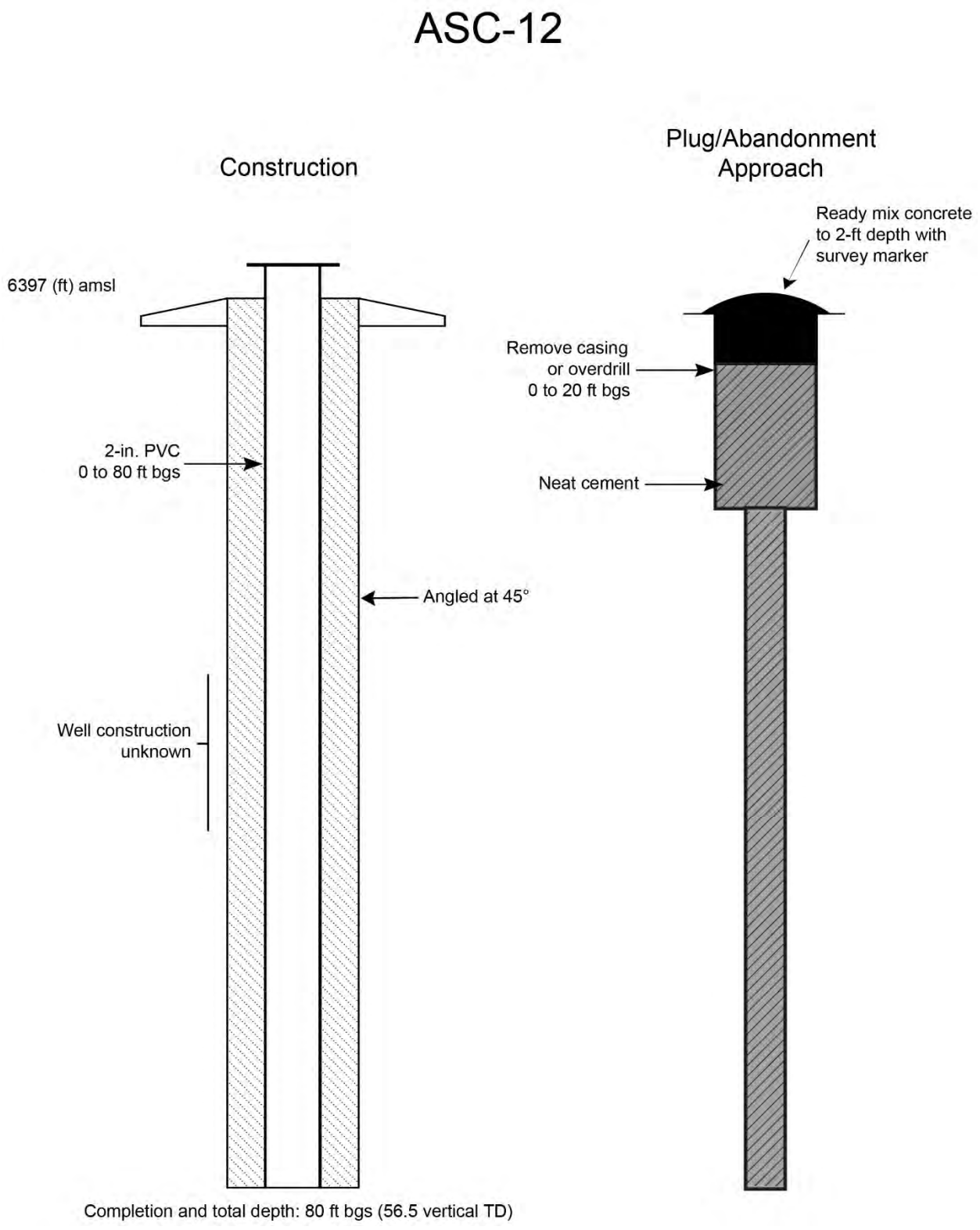


Figure 3.1-6 ASC-12 abandonment schematic

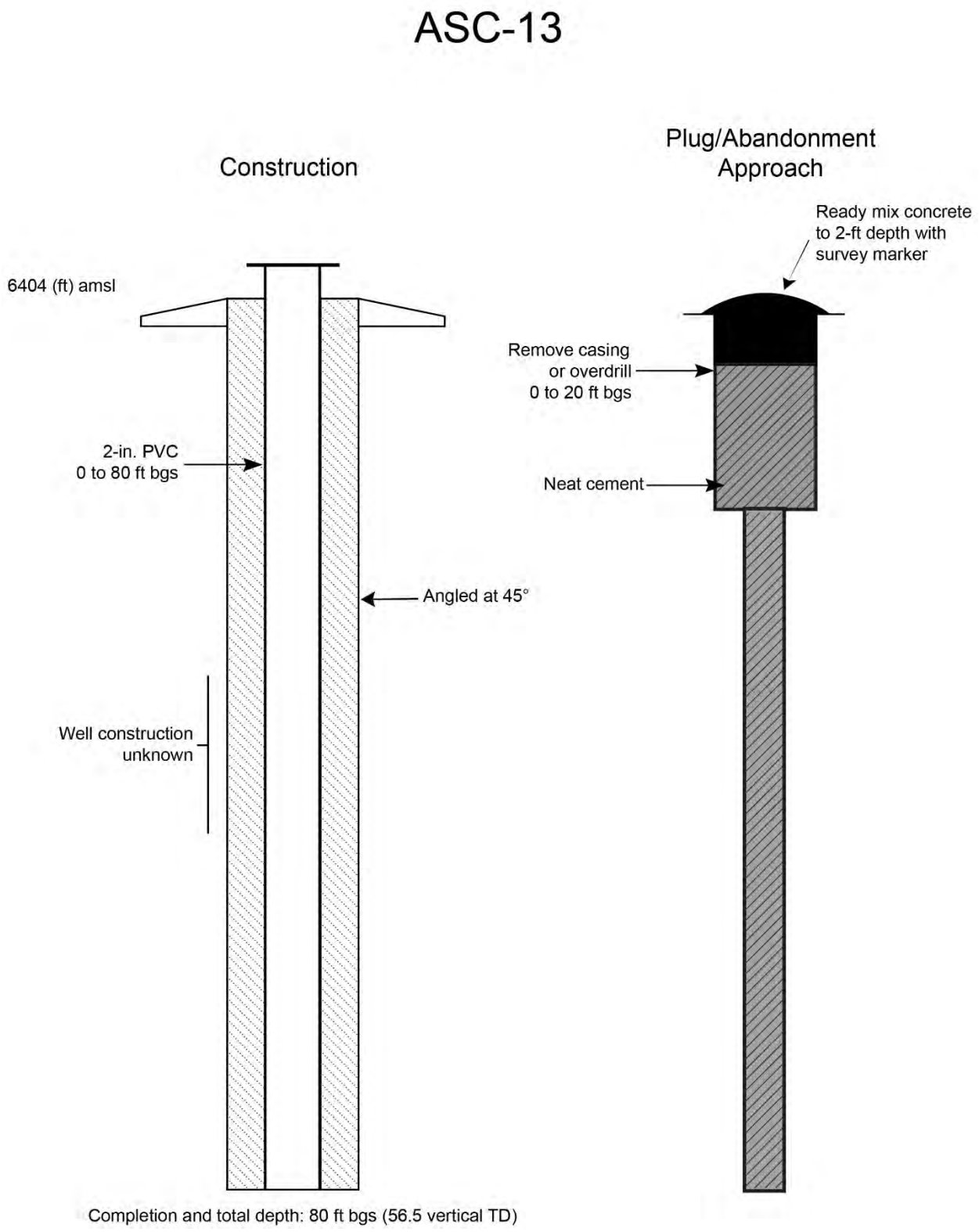


Figure 3.1-7 ASC-13 abandonment schematic

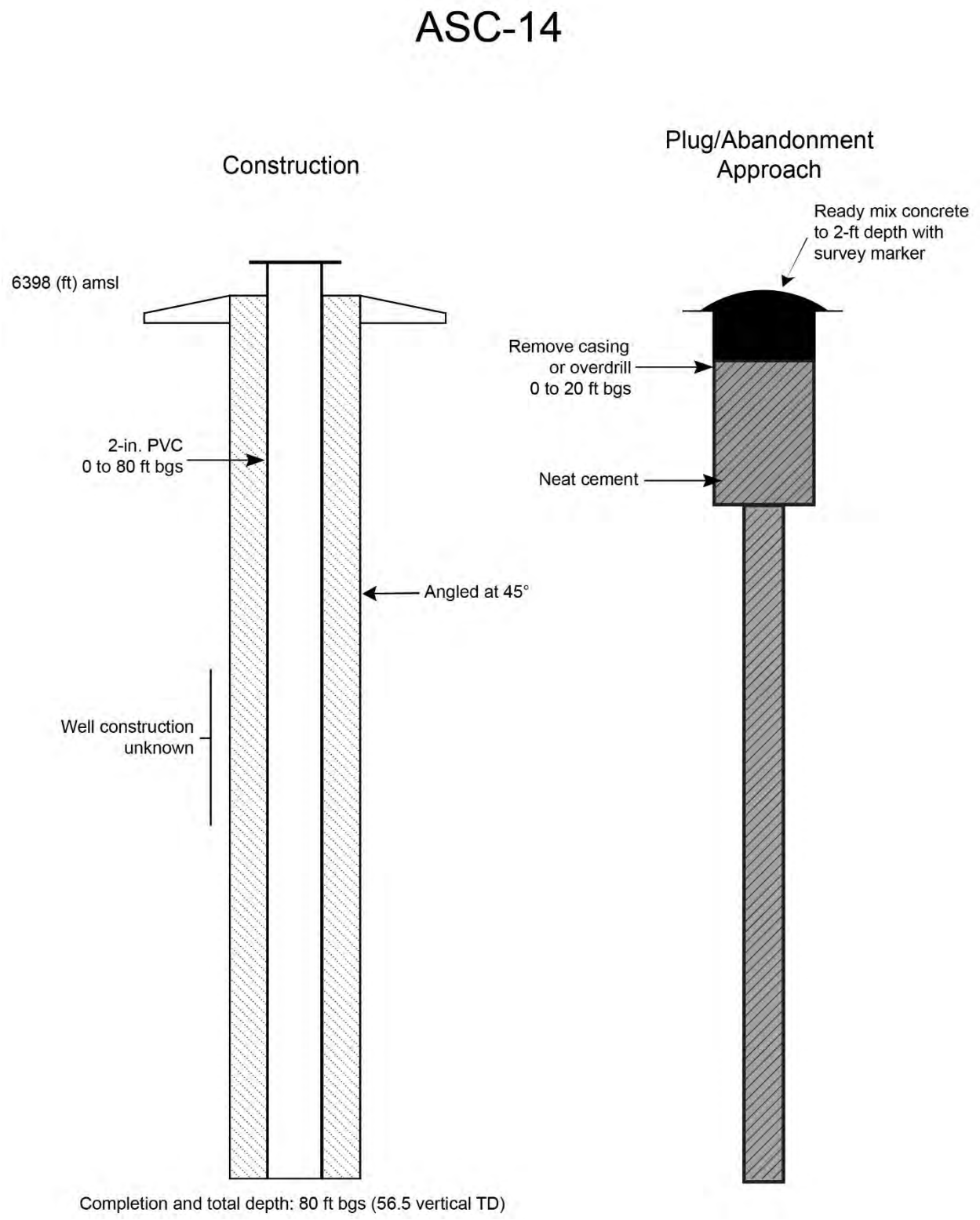


Figure 3.1-8 ASC-14 abandonment schematic

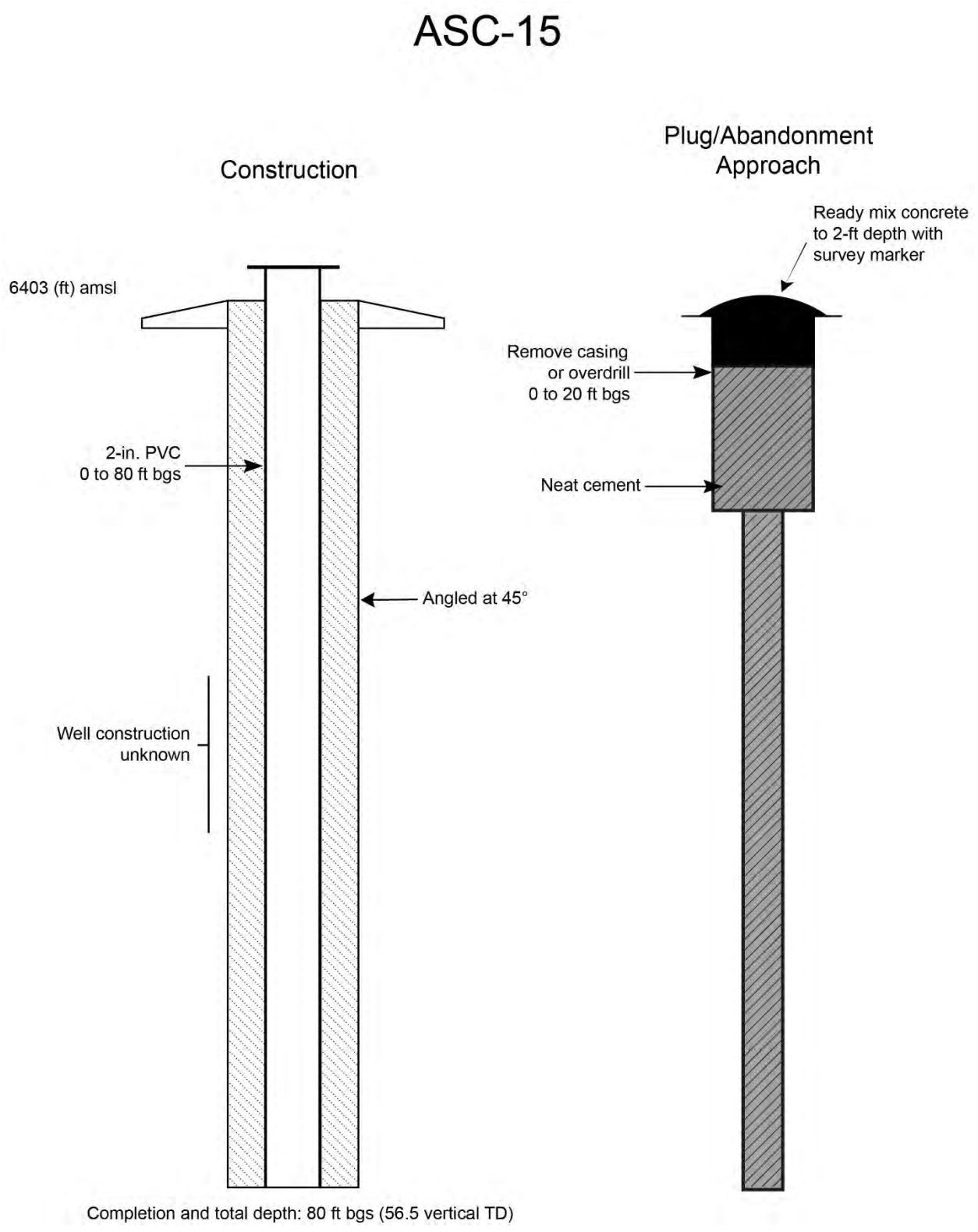


Figure 3.1-9 ASC-15 abandonment schematic

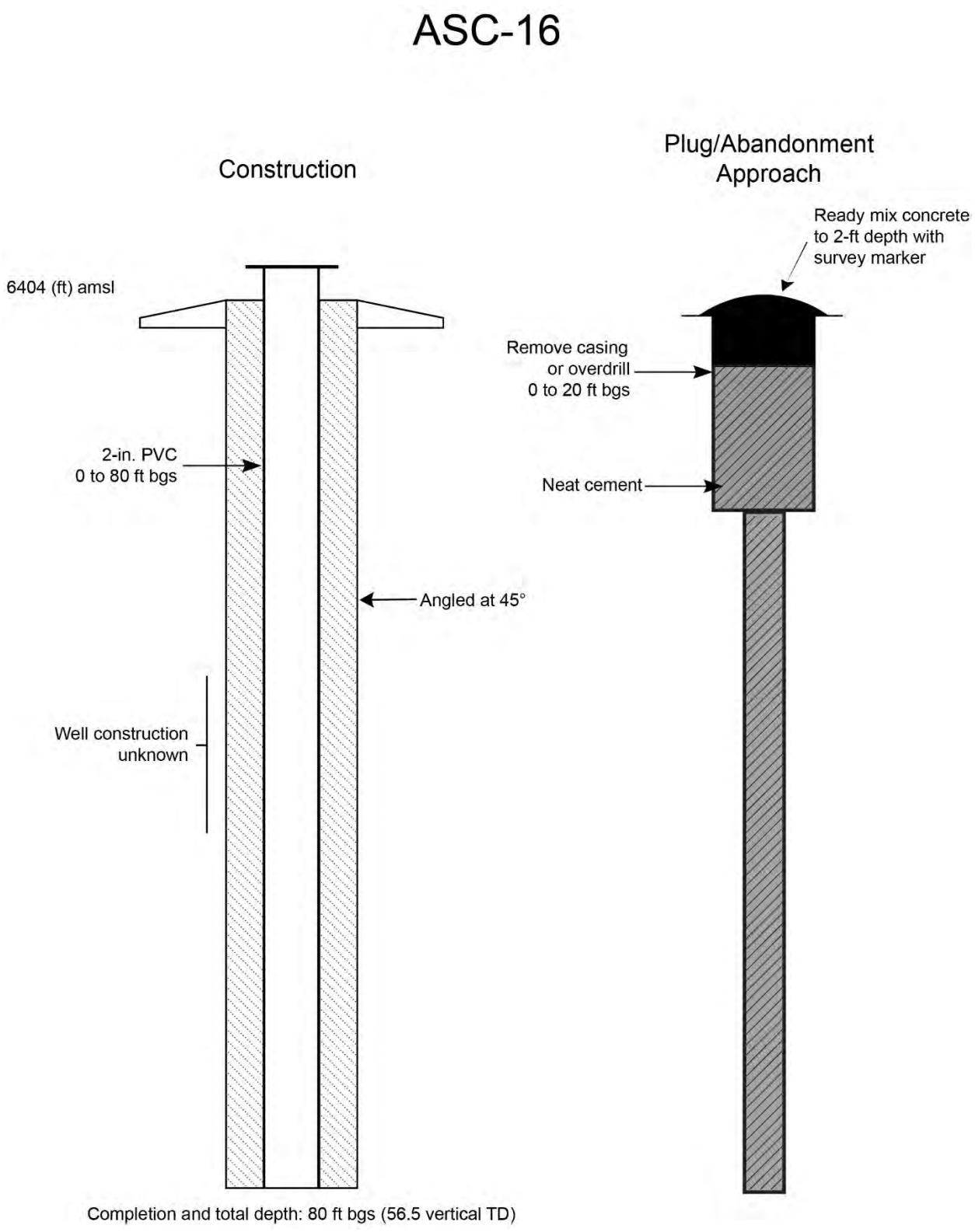


Figure 3.1-10 ASC-16 abandonment schematic

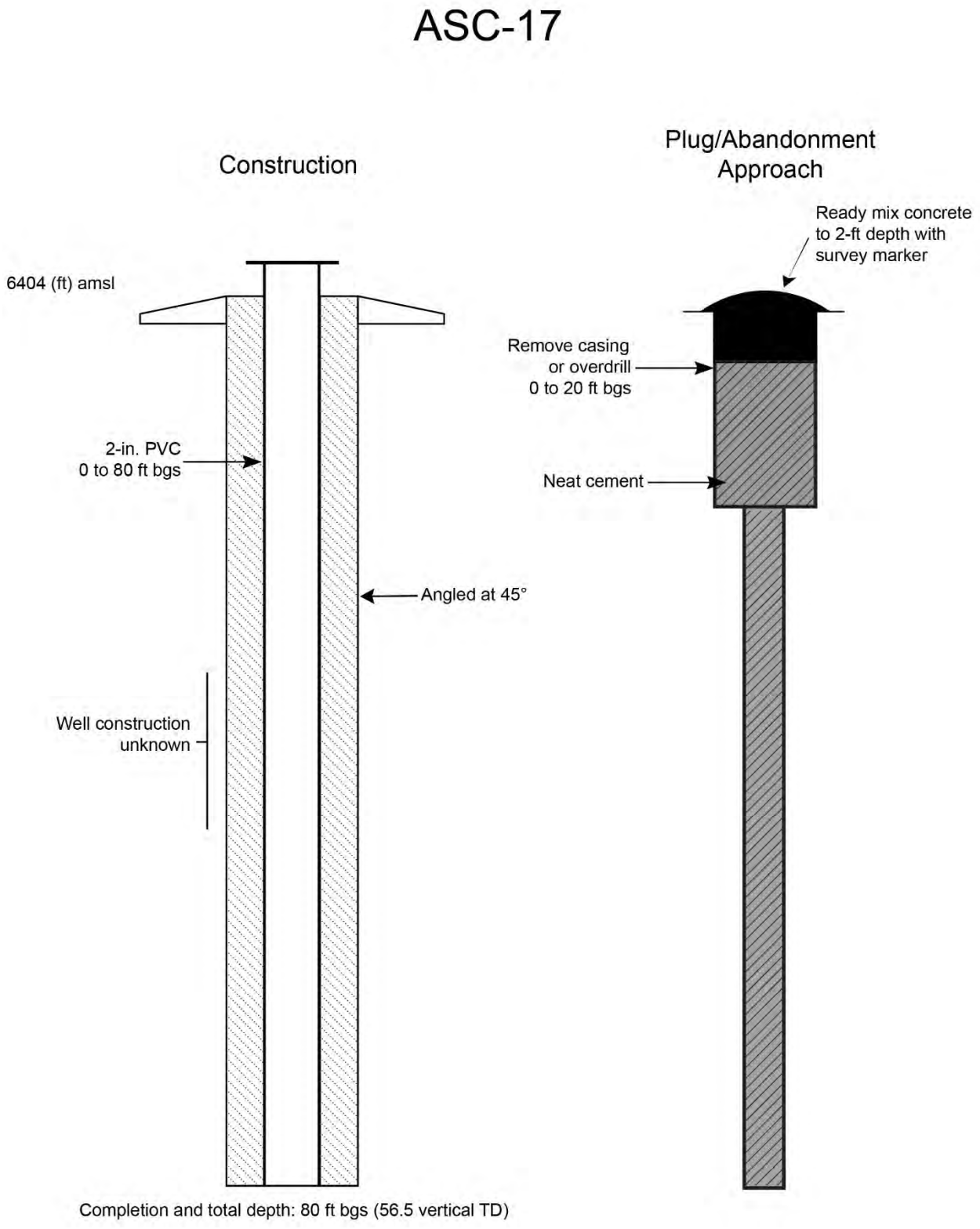


Figure 3.1-11 ASC-17 abandonment schematic

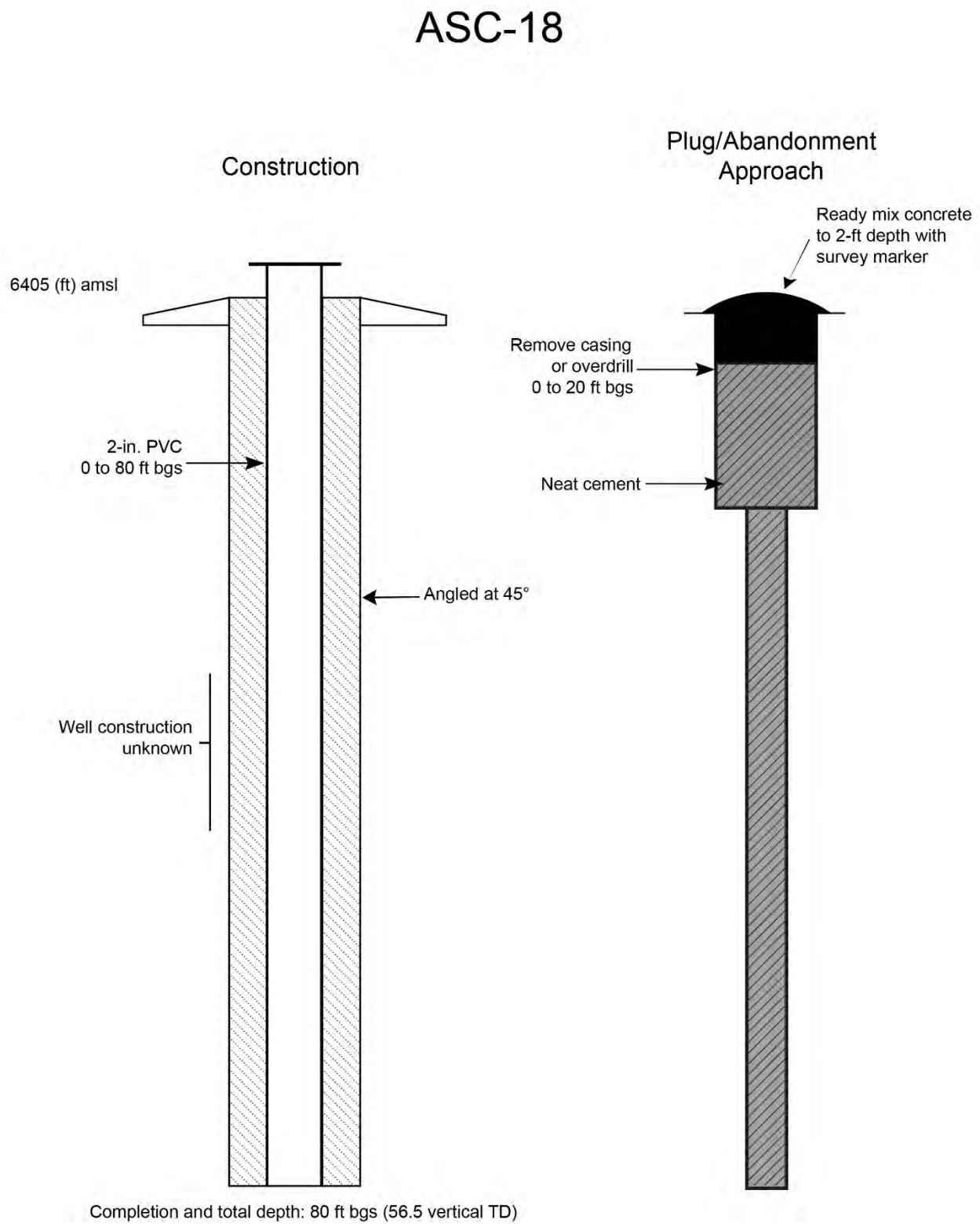


Figure 3.1-12 ASC-18 abandonment schematic

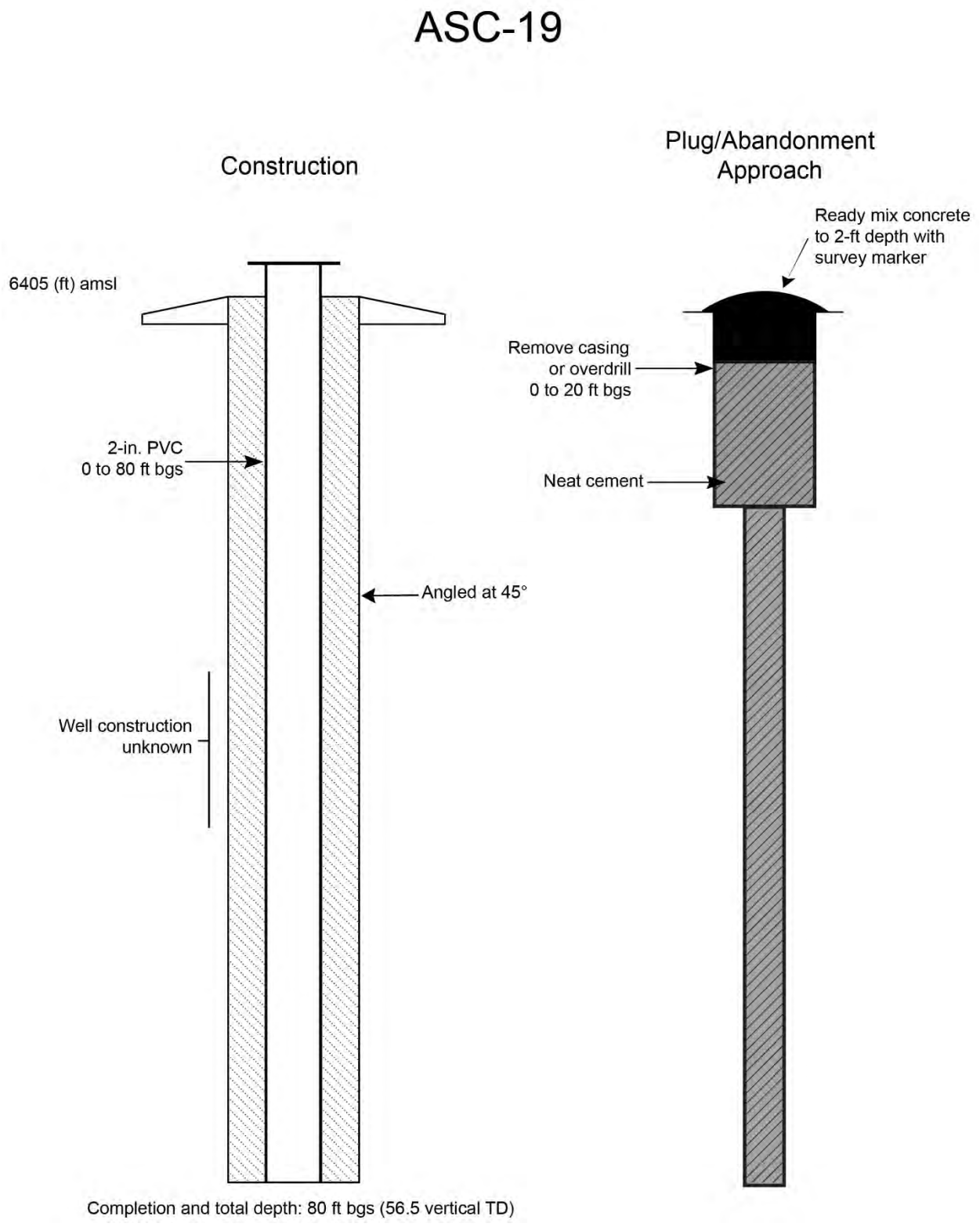


Figure 3.1-13 ASC-19 abandonment schematic

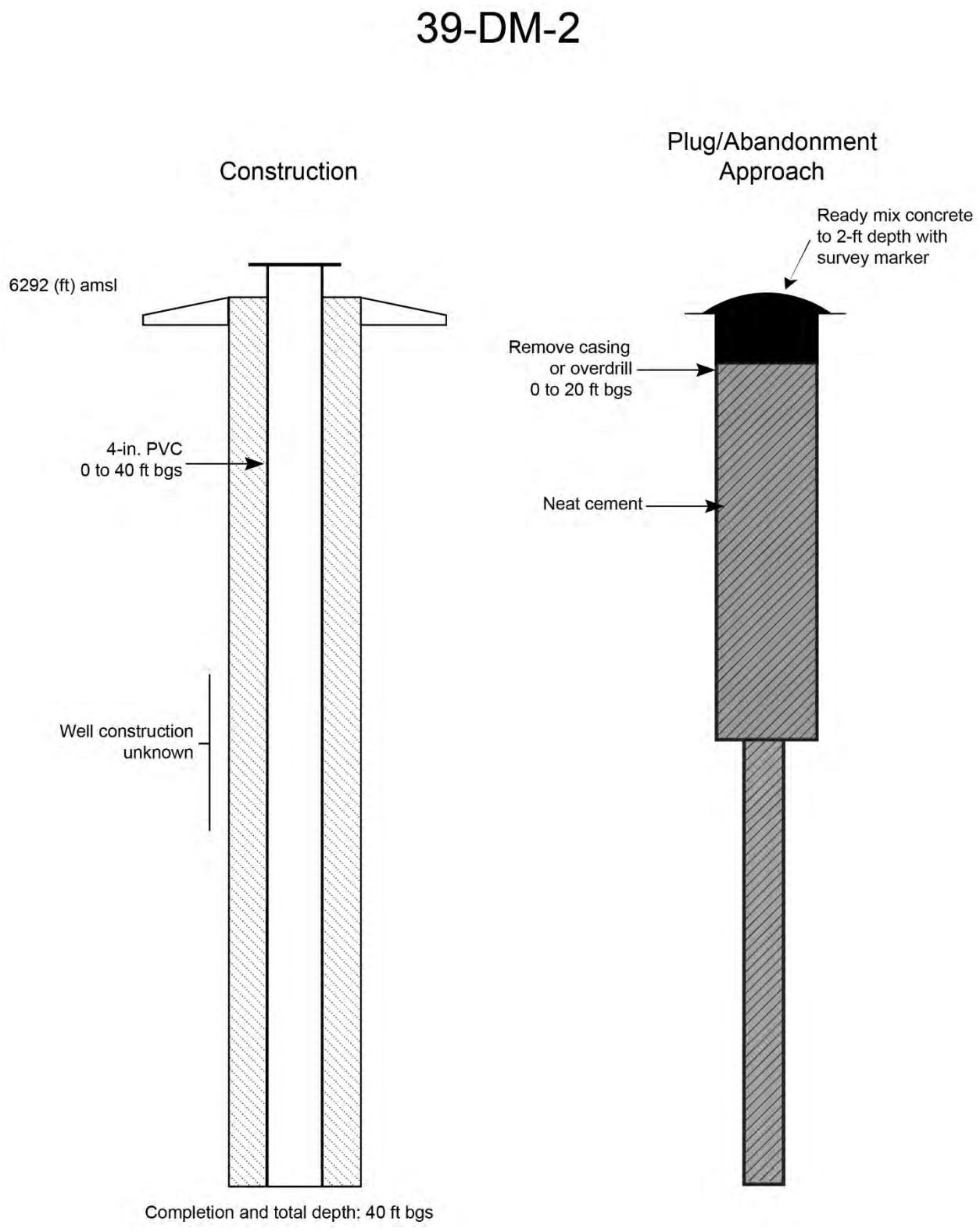


Figure 3.1-14 39-DM-2 abandonment schematic

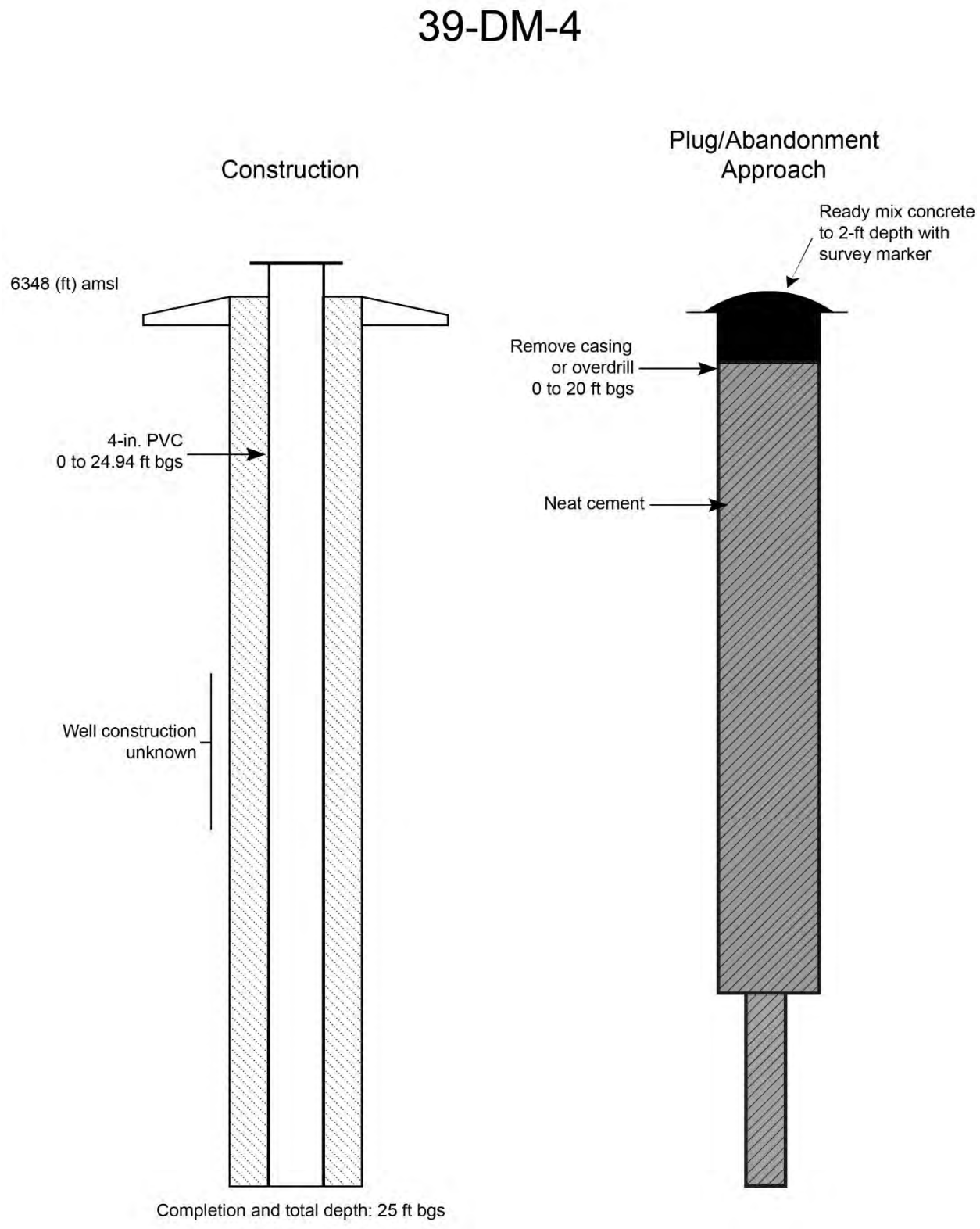


Figure 3.1-15 39-DM-4 abandonment schematic

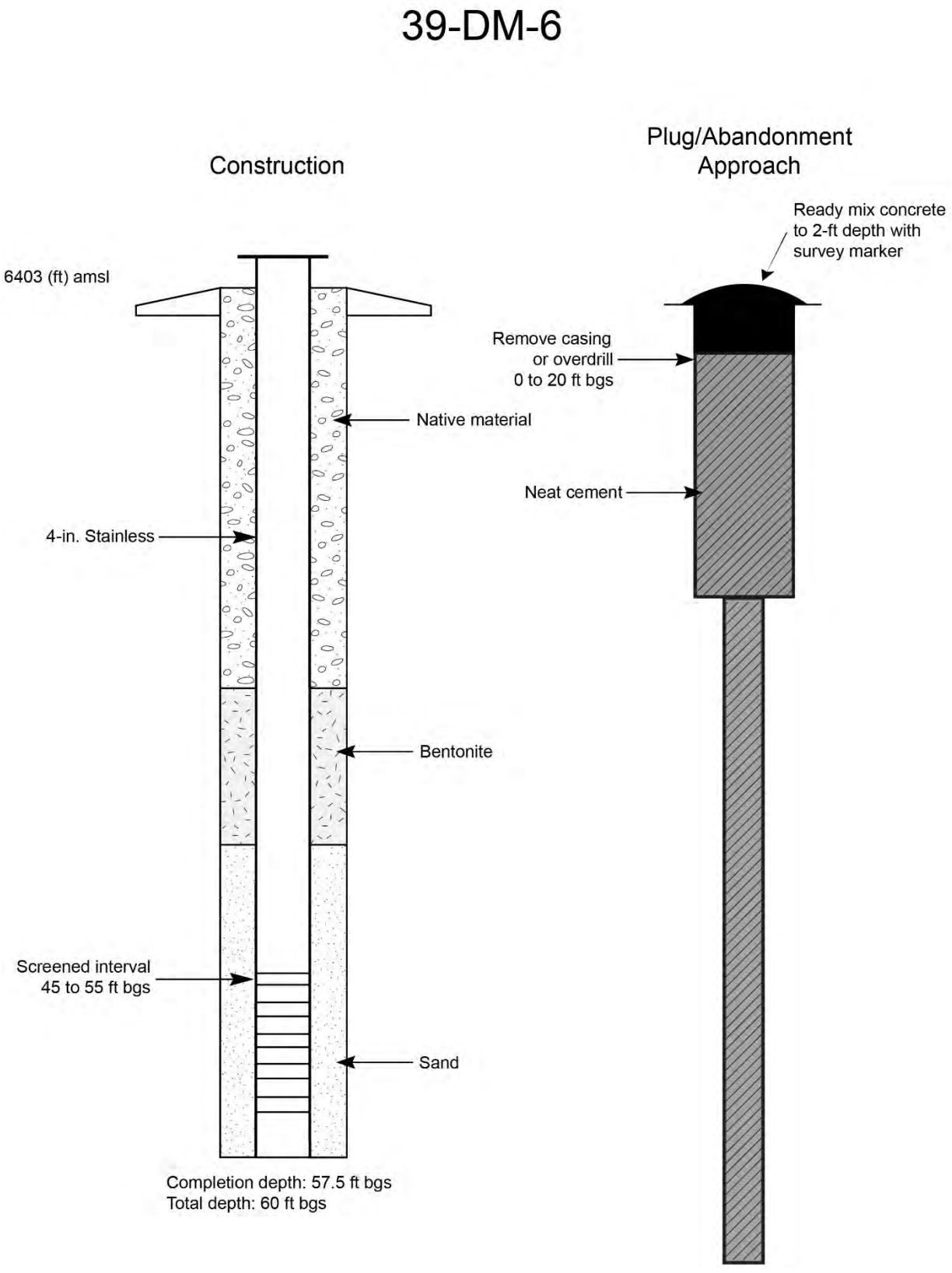


Figure 3.1-16 39-DM-6 abandonment schematic

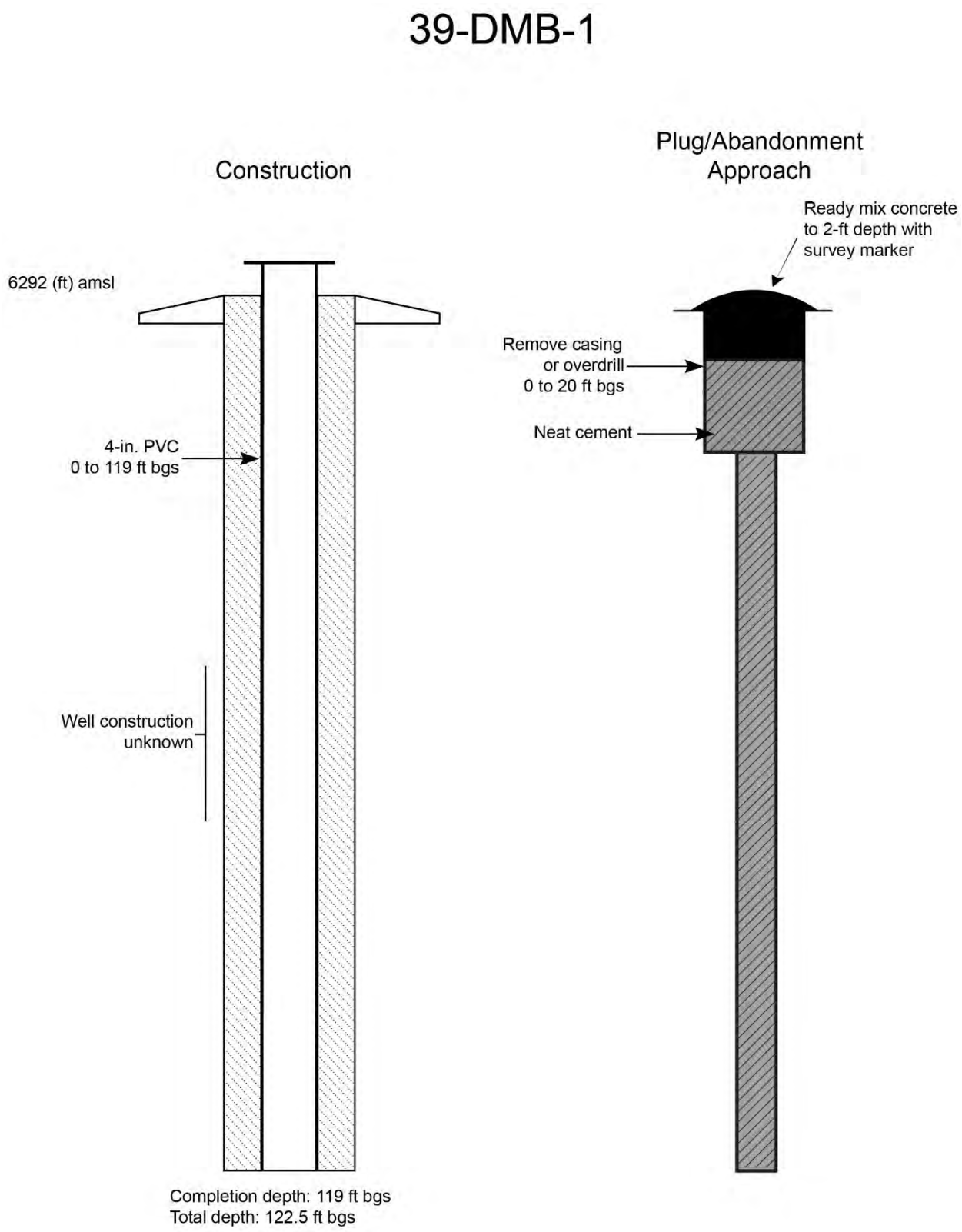


Figure 3.1-17 39-DMB-1 abandonment schematic

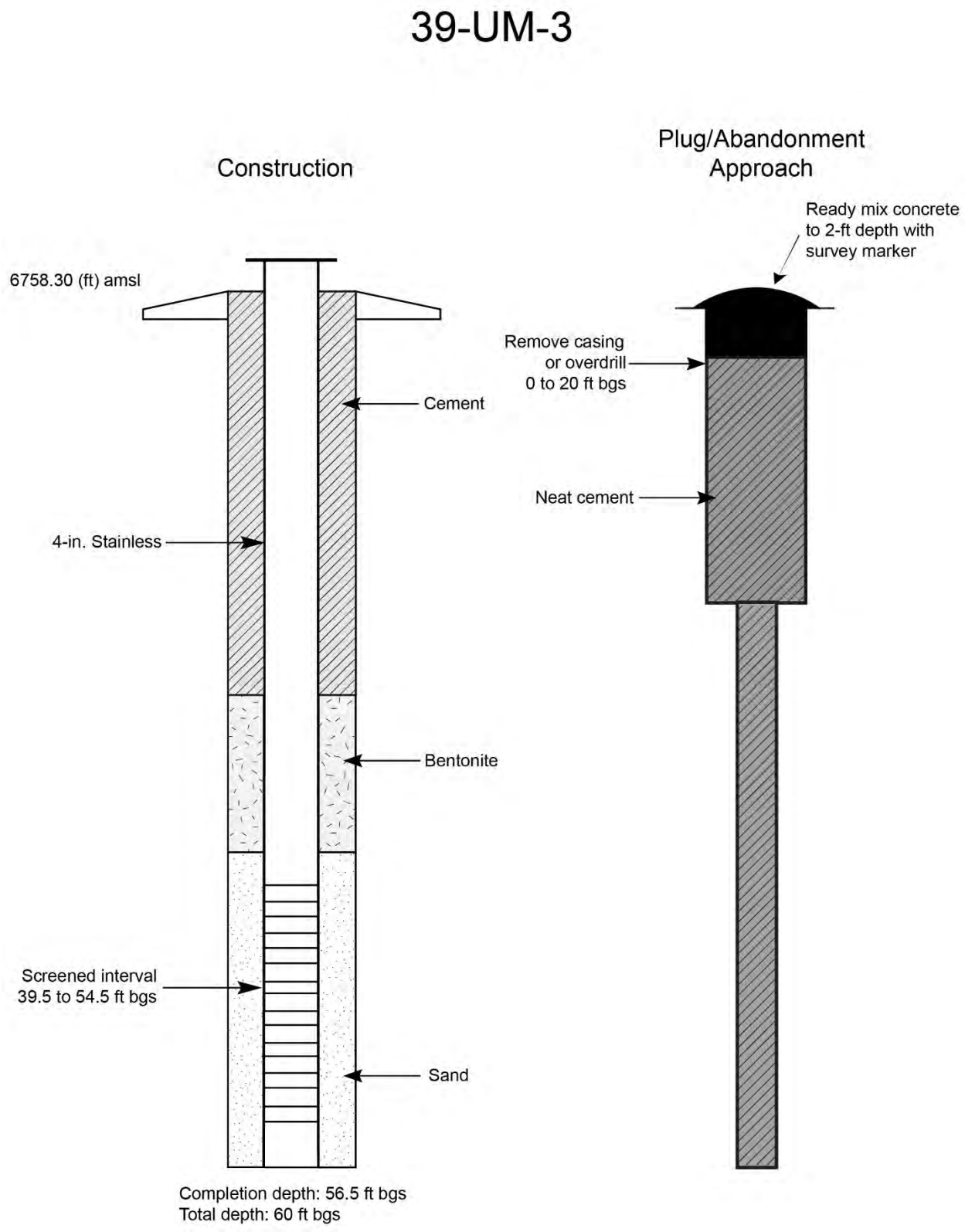


Figure 3.1-18 39-UM-3 abandonment schematic

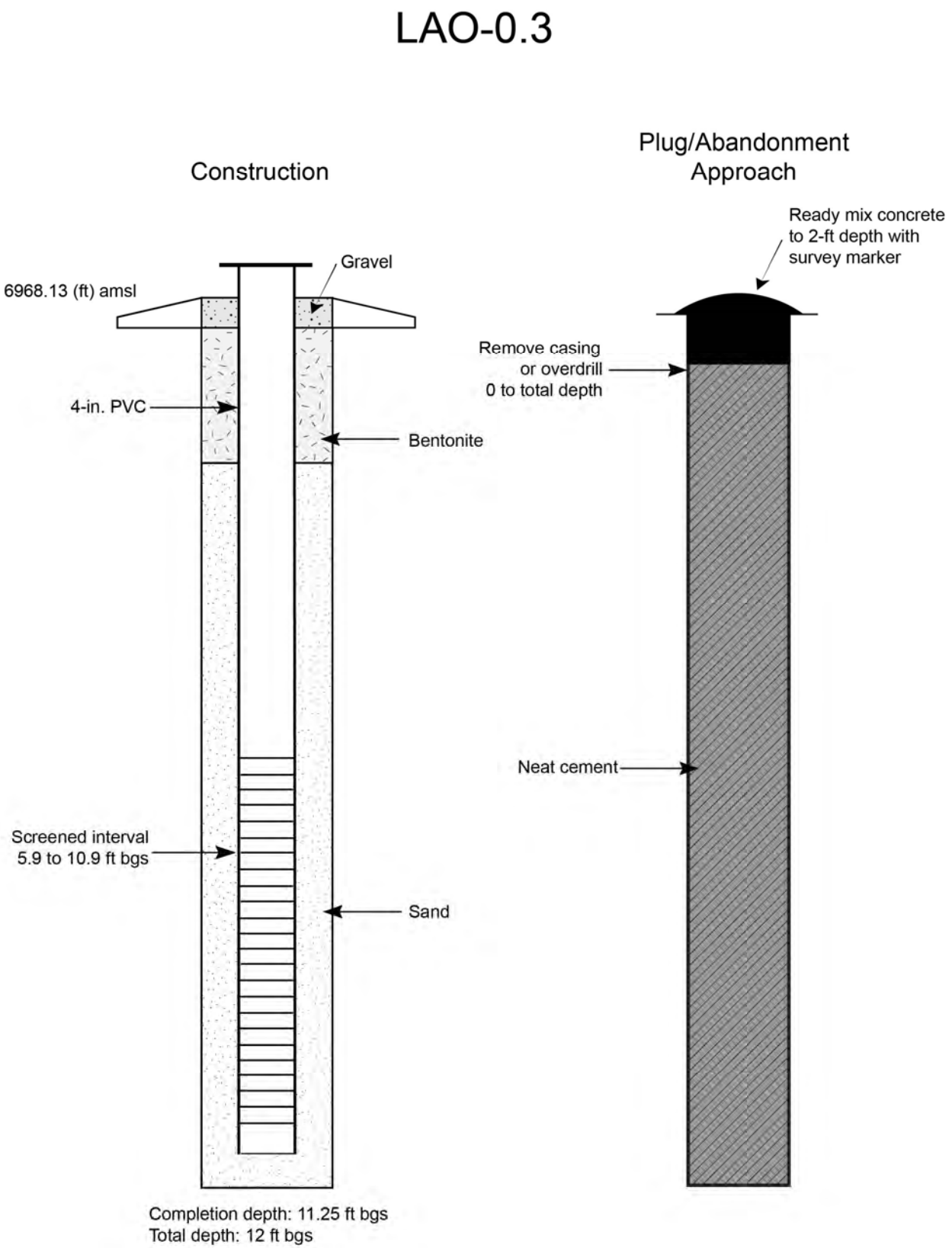


Figure 3.2-1 LAO-0.3 abandonment schematic

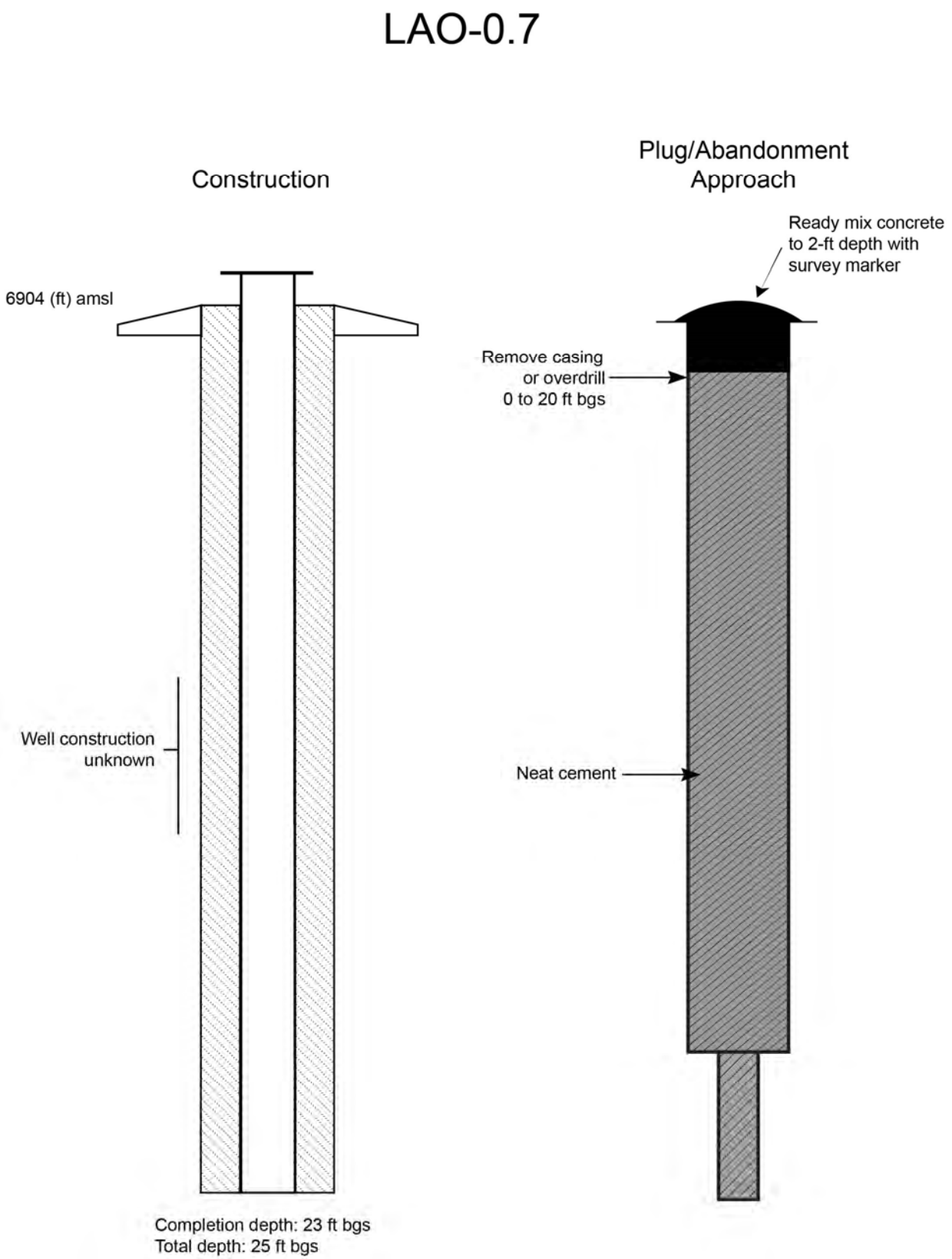


Figure 3.2-2 LAO-0.7 abandonment schematic

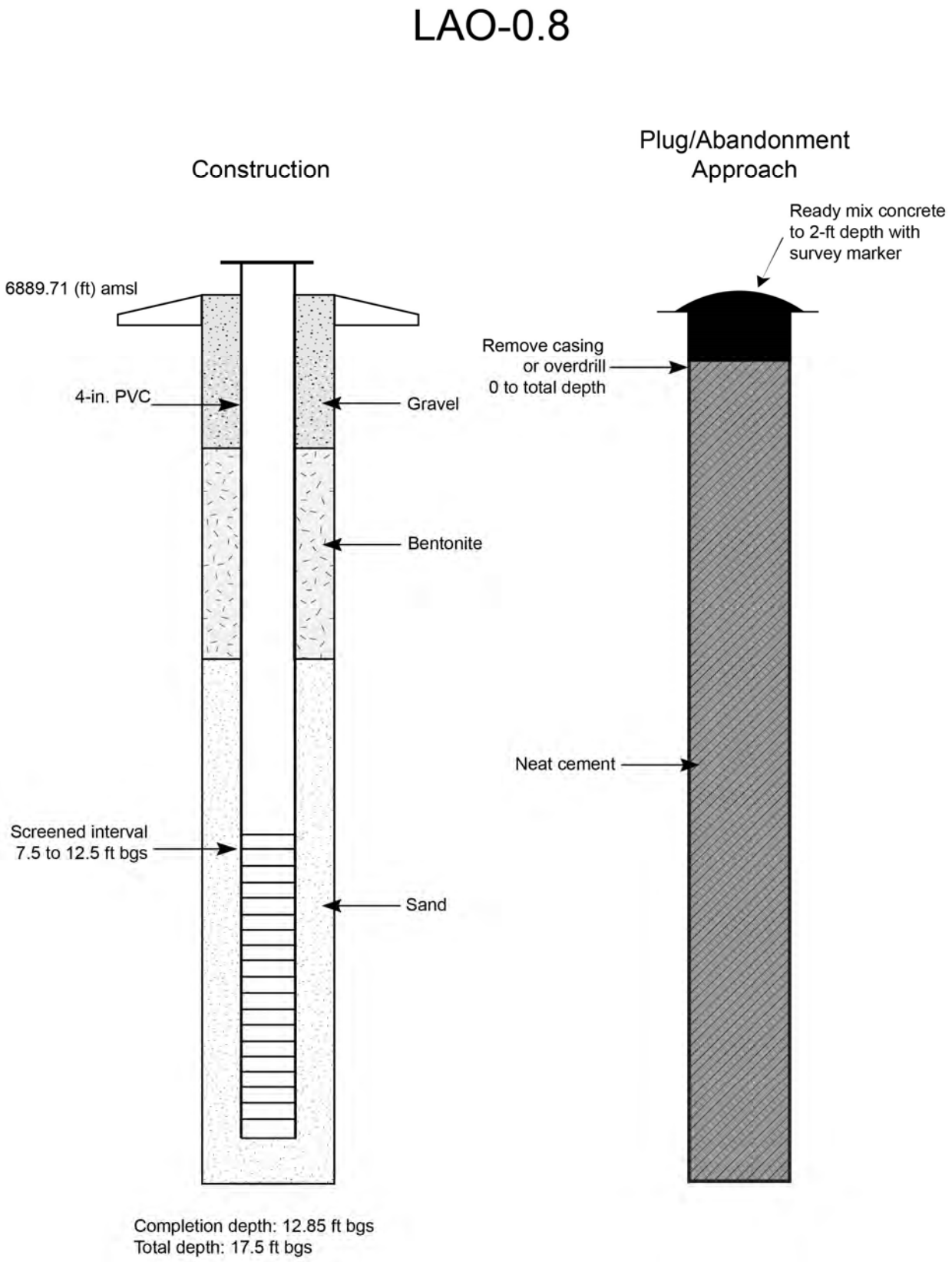


Figure 3.2-3 LAO-0.8 abandonment schematic

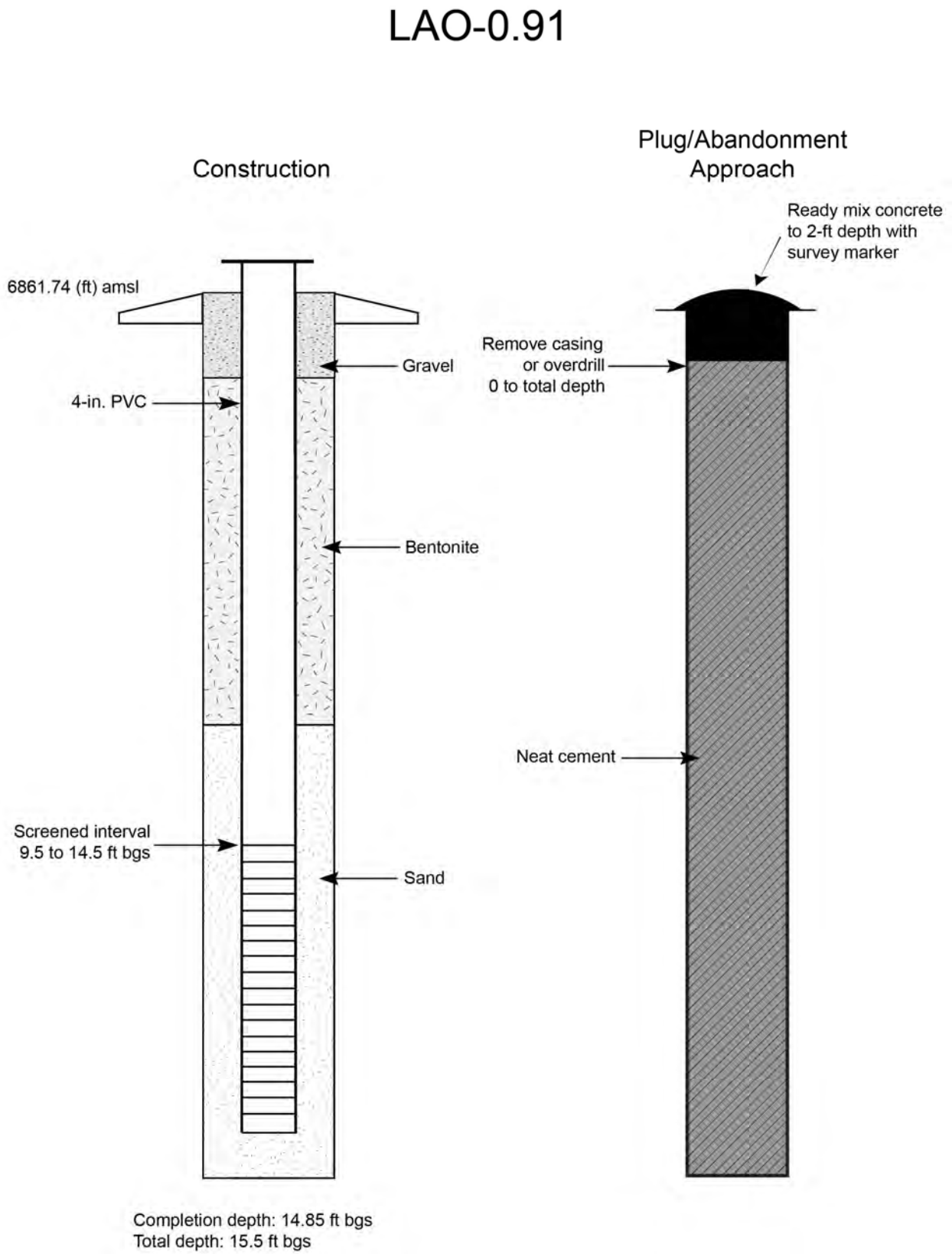


Figure 3.2-4 LAO-0.91 abandonment schematic

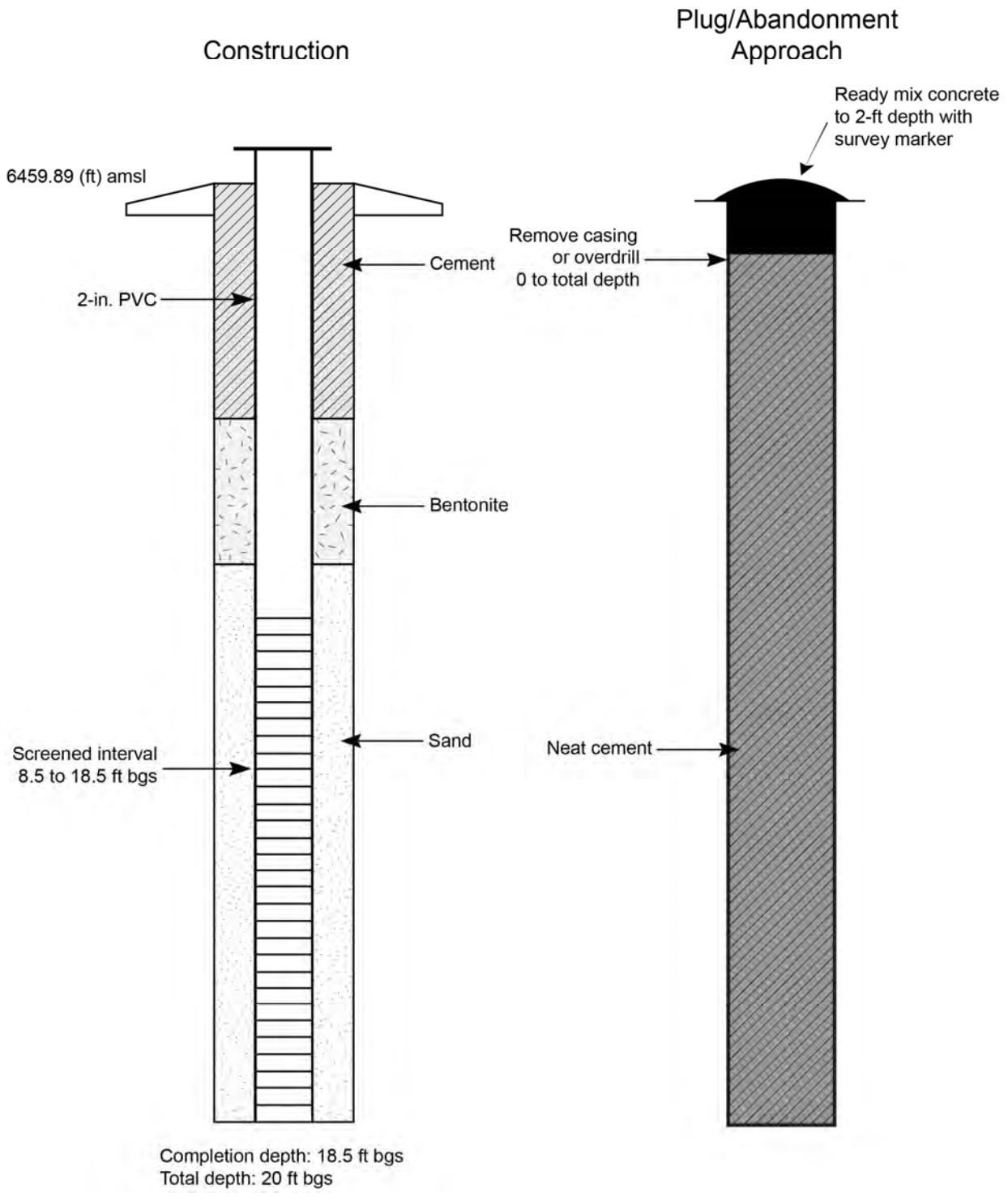


Figure 3.2-5 LAO-4.5A abandonment schematic

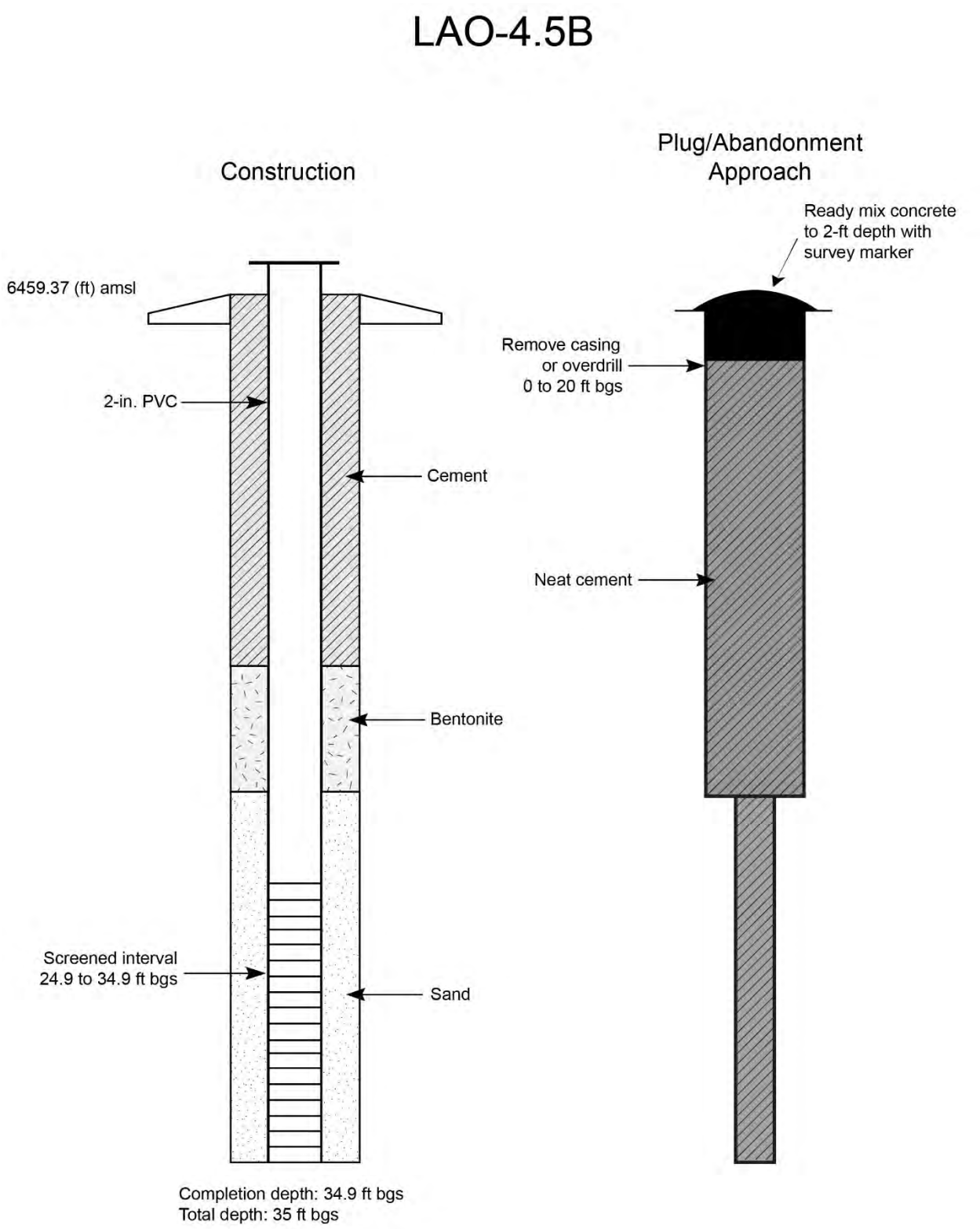


Figure 3.2-6 LAO-4.5B abandonment schematic

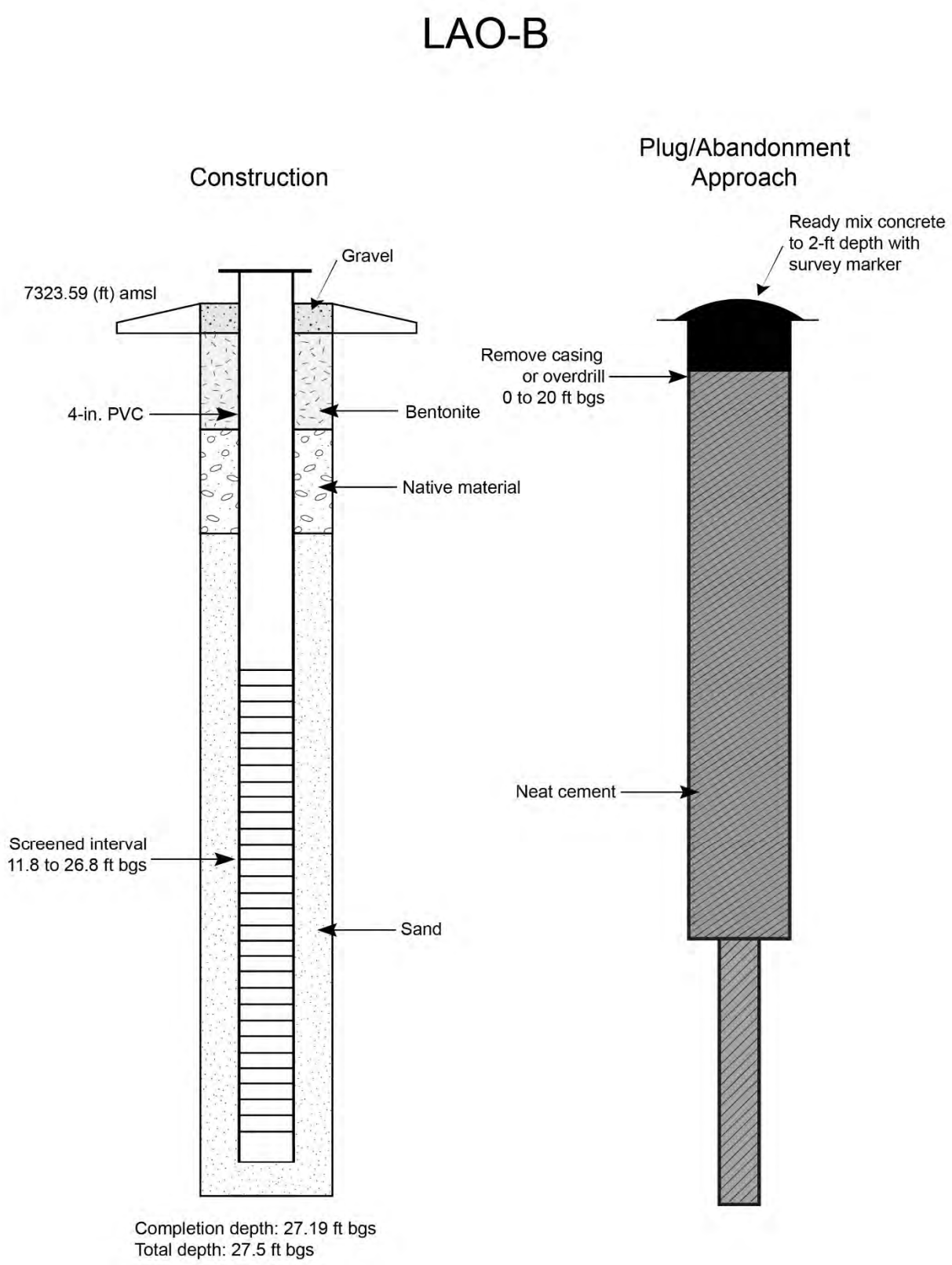


Figure 3.2-7 LAO-B abandonment schematic

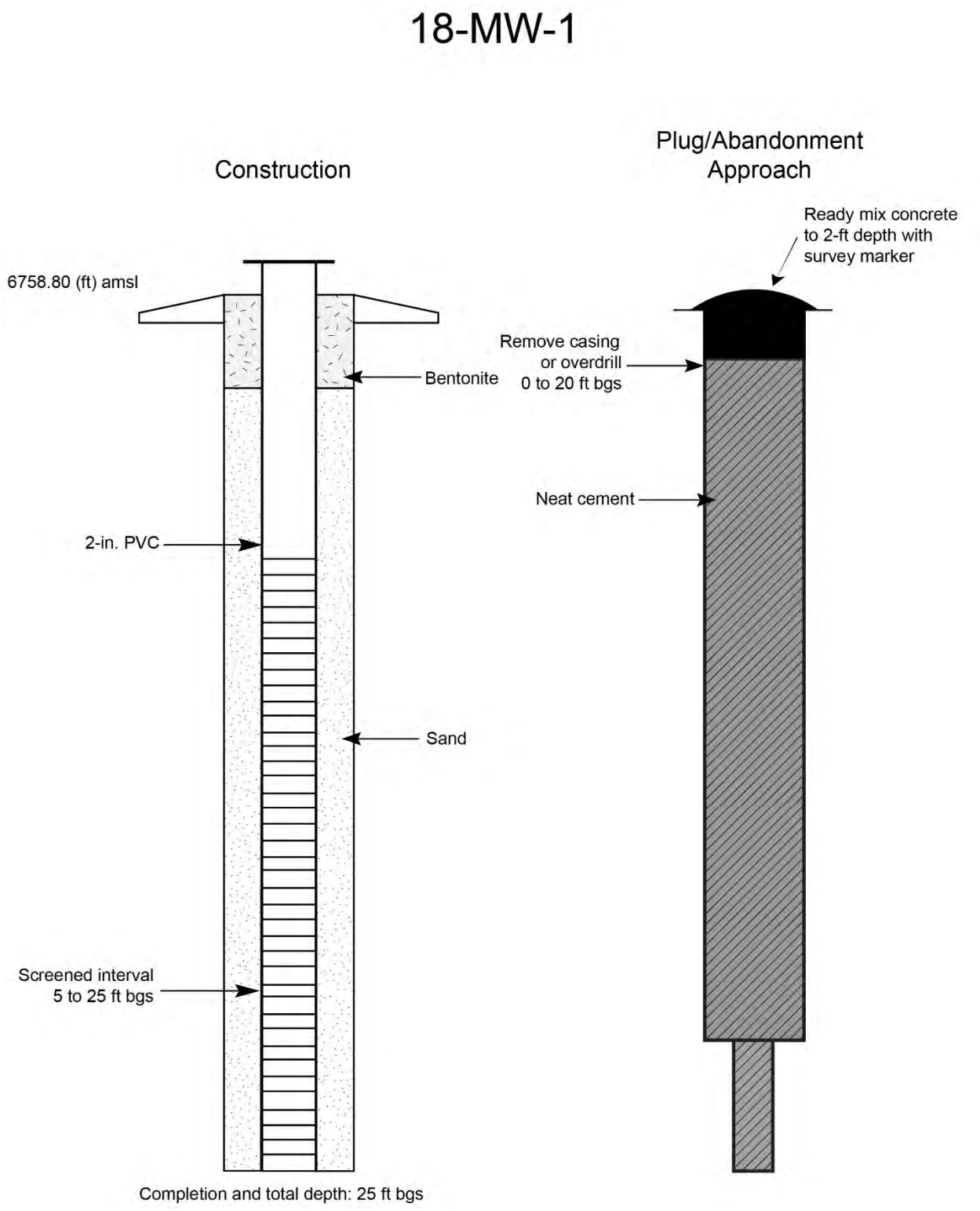


Figure 3.3-1 18-MW-1 abandonment schematic

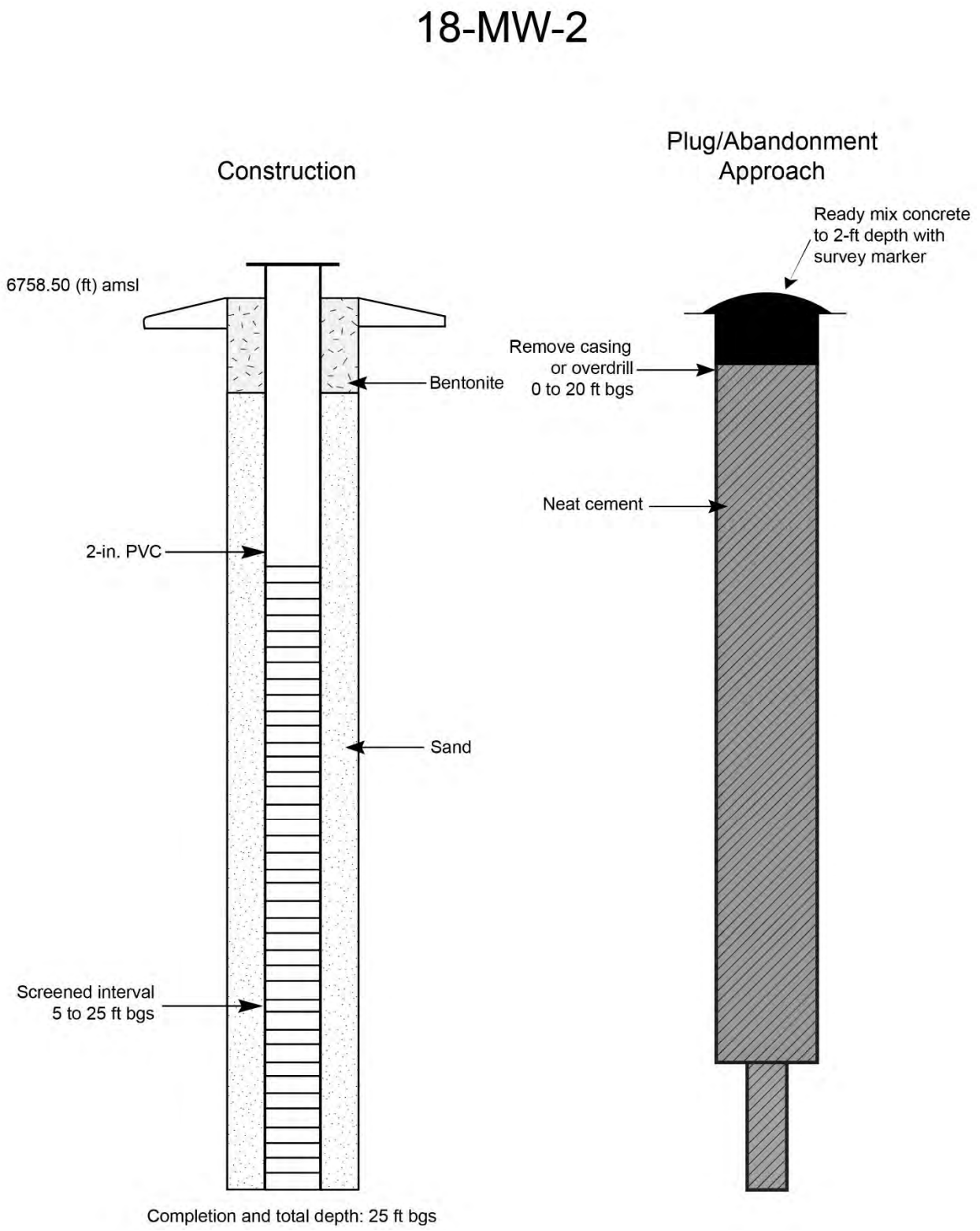


Figure 3.3-2 18-MW-2 abandonment schematic

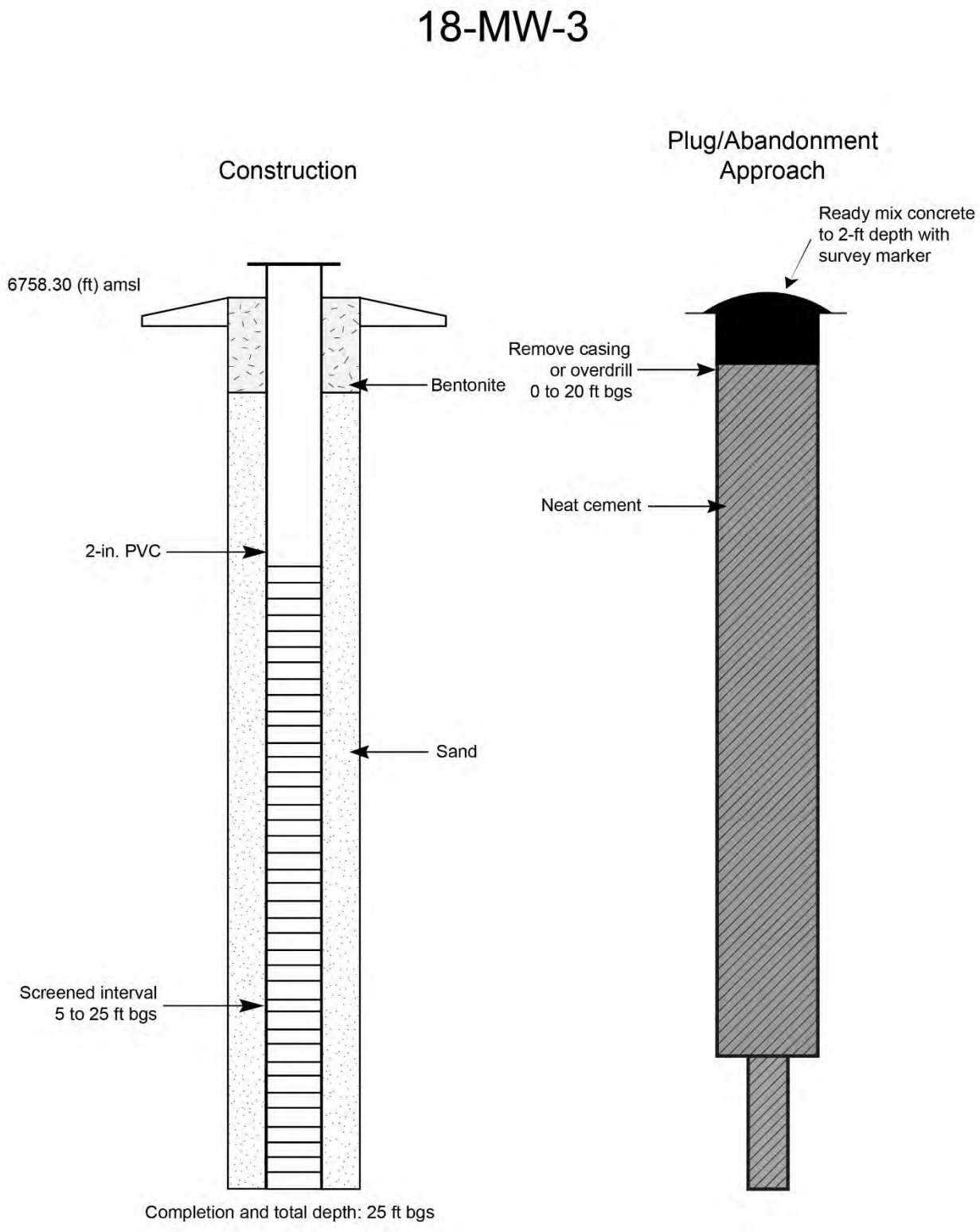


Figure 3.3-3 18-MW-3 abandonment schematic

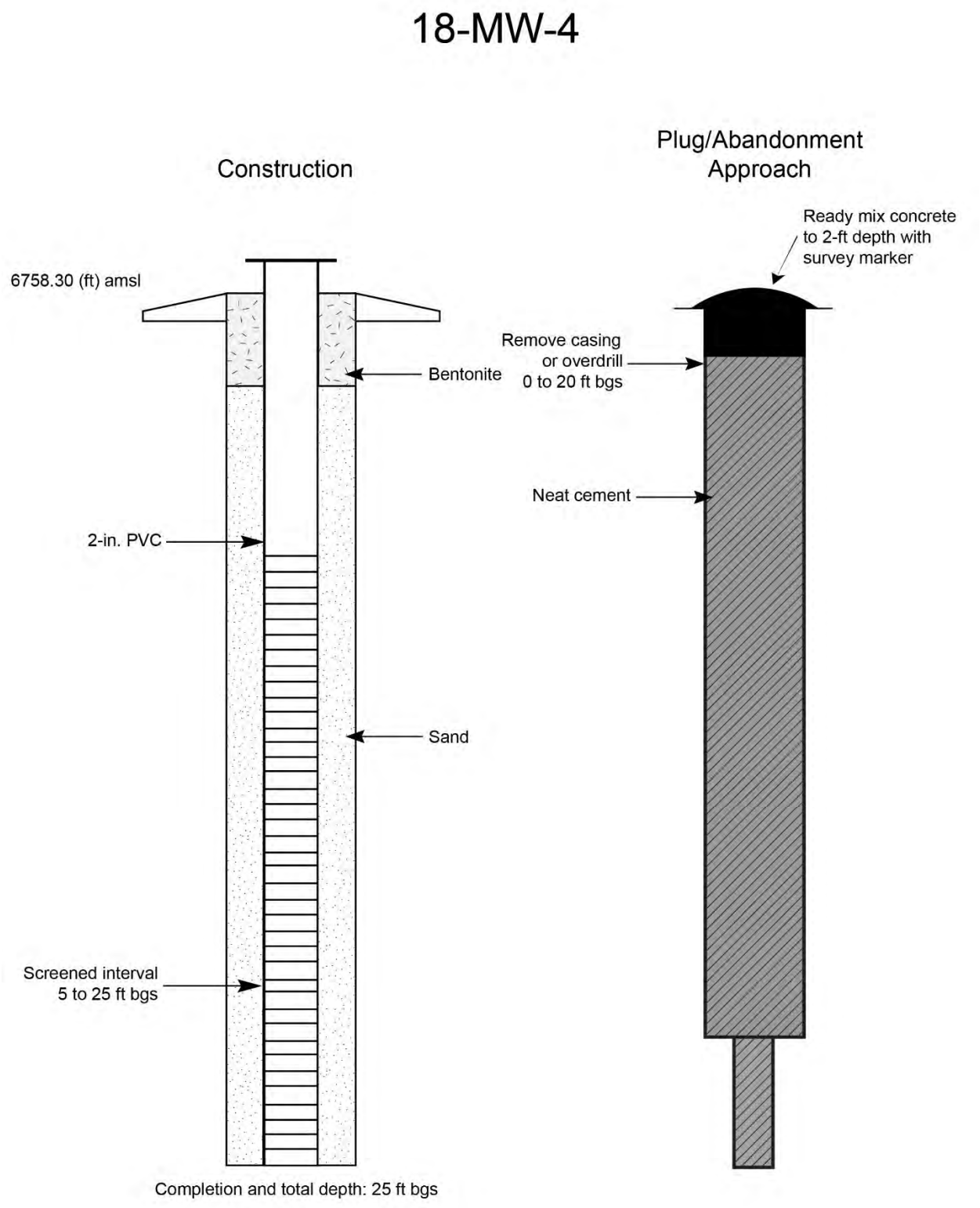


Figure 3.3-4 18-MW-4 abandonment schematic

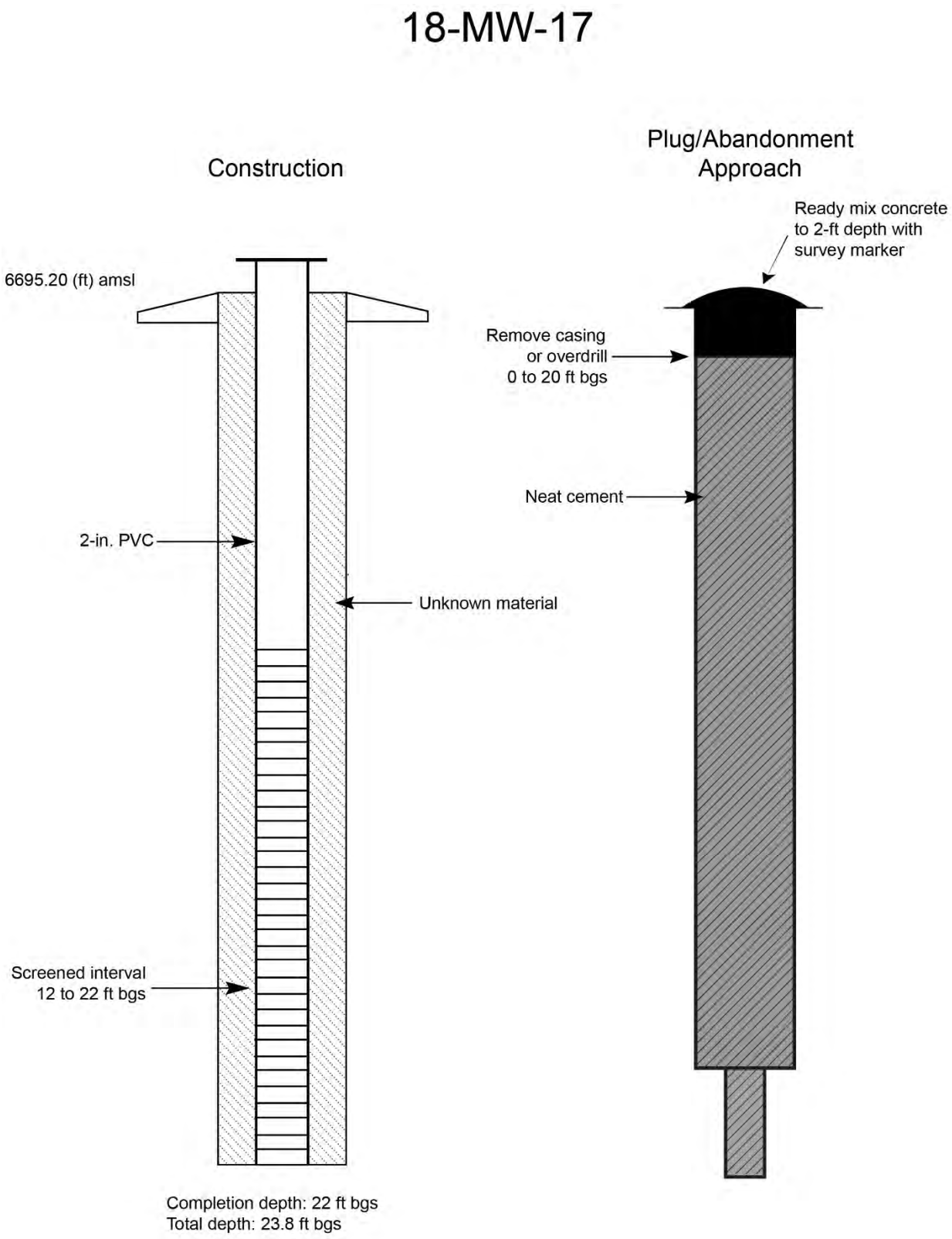


Figure 3.3-5 18-MW-17 abandonment schematic

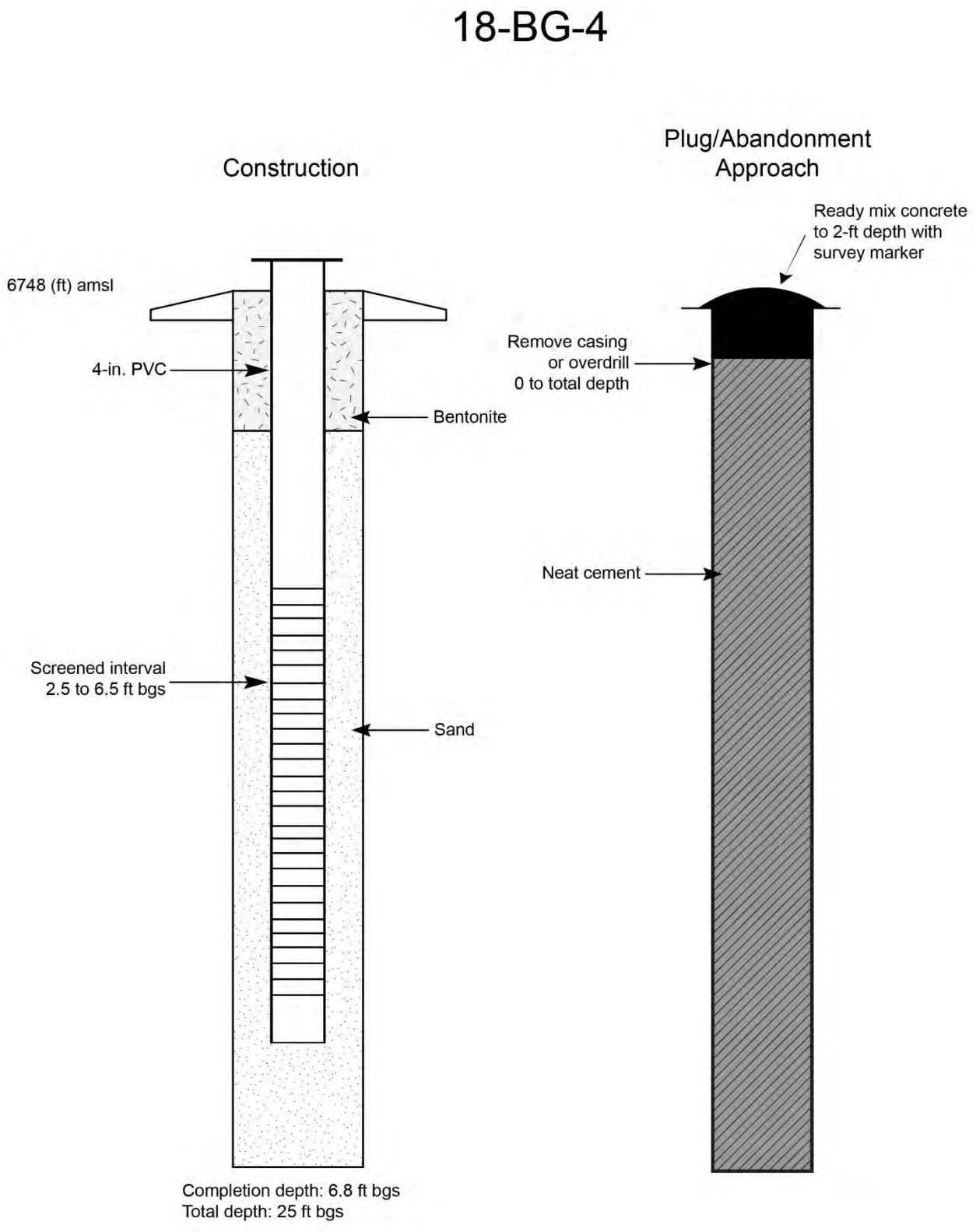


Figure 3.3-6 18-BG-4 abandonment schematic

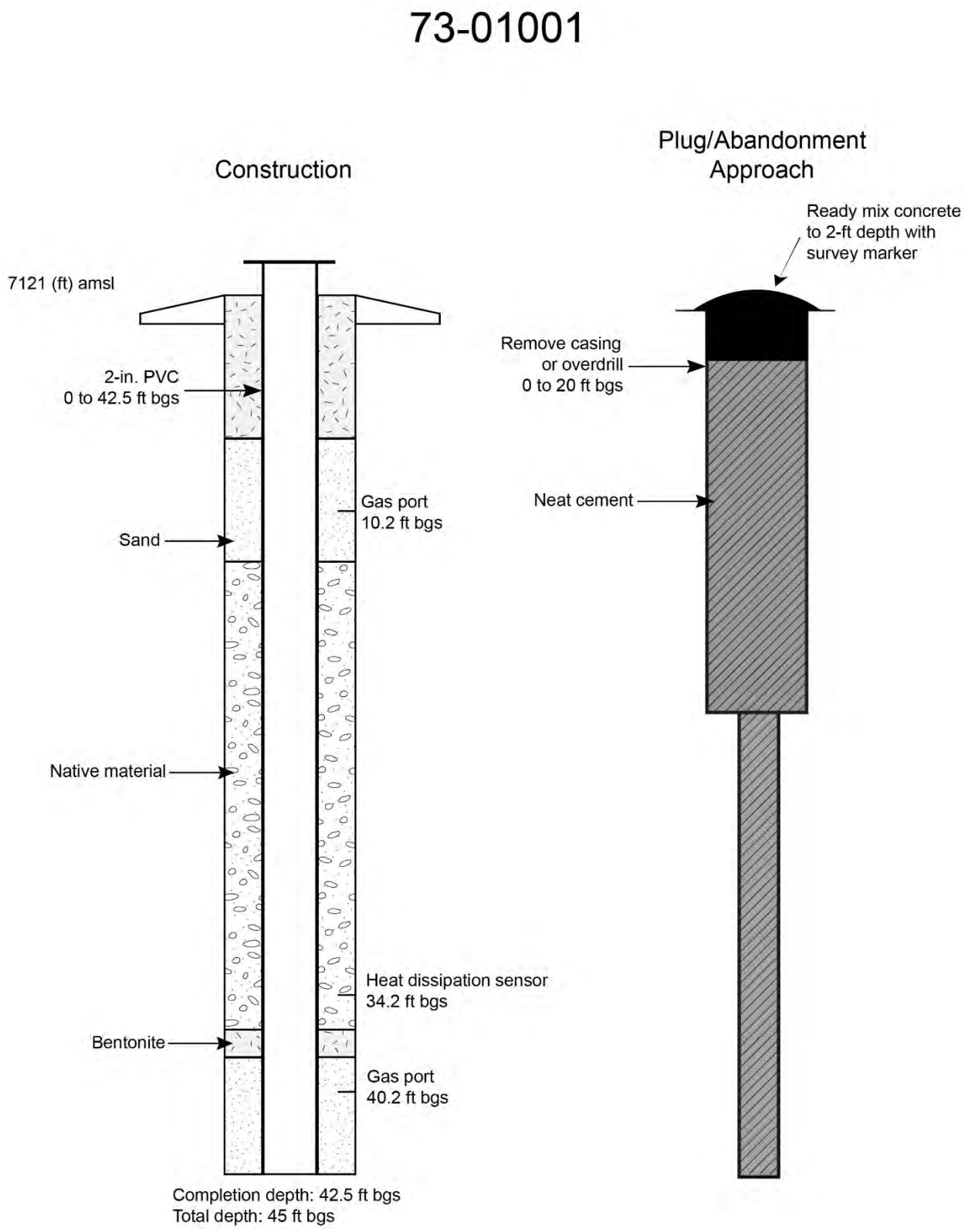


Figure 3.4-1 73-01001 abandonment schematic

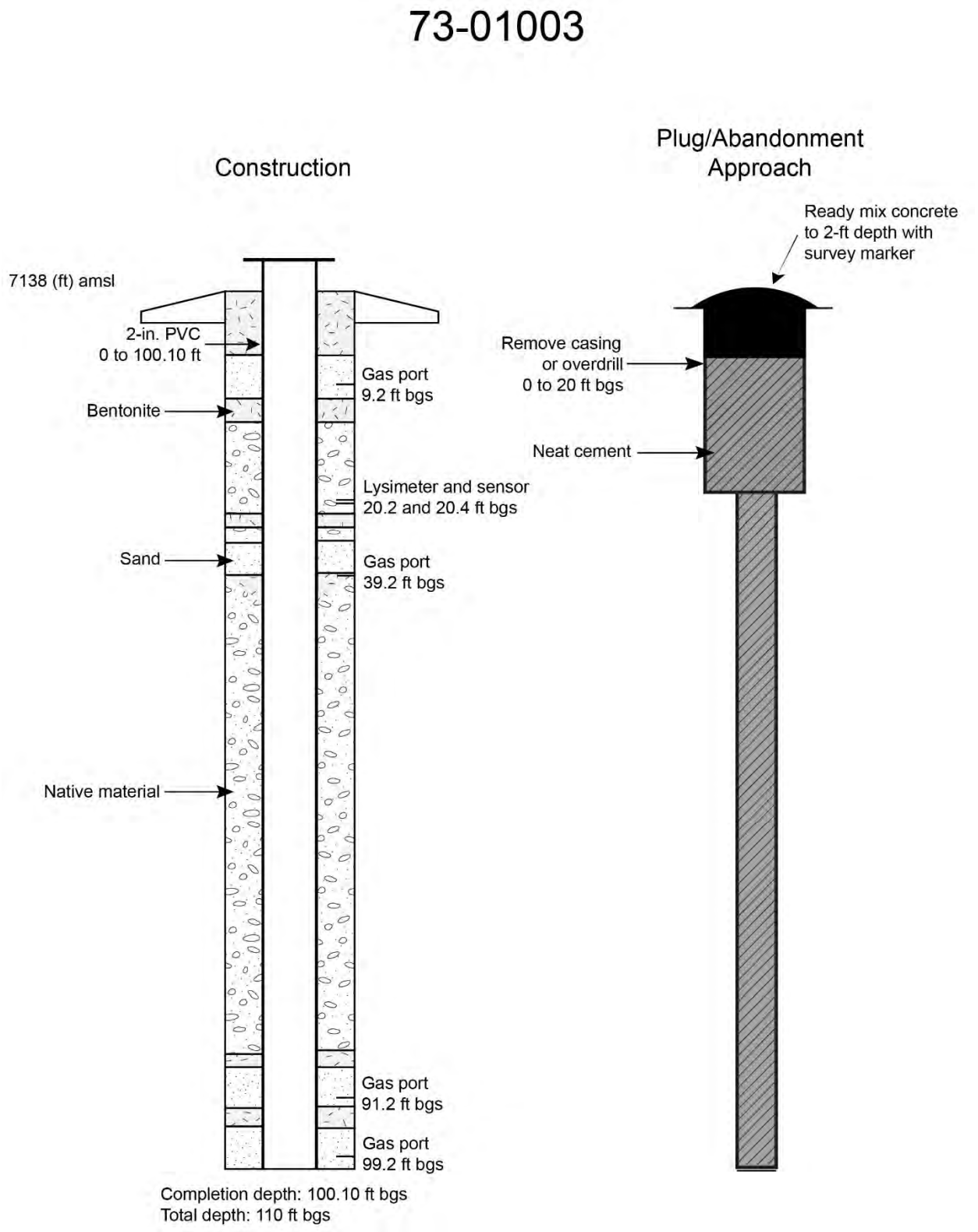


Figure 3.4-2 73-01003 abandonment schematic

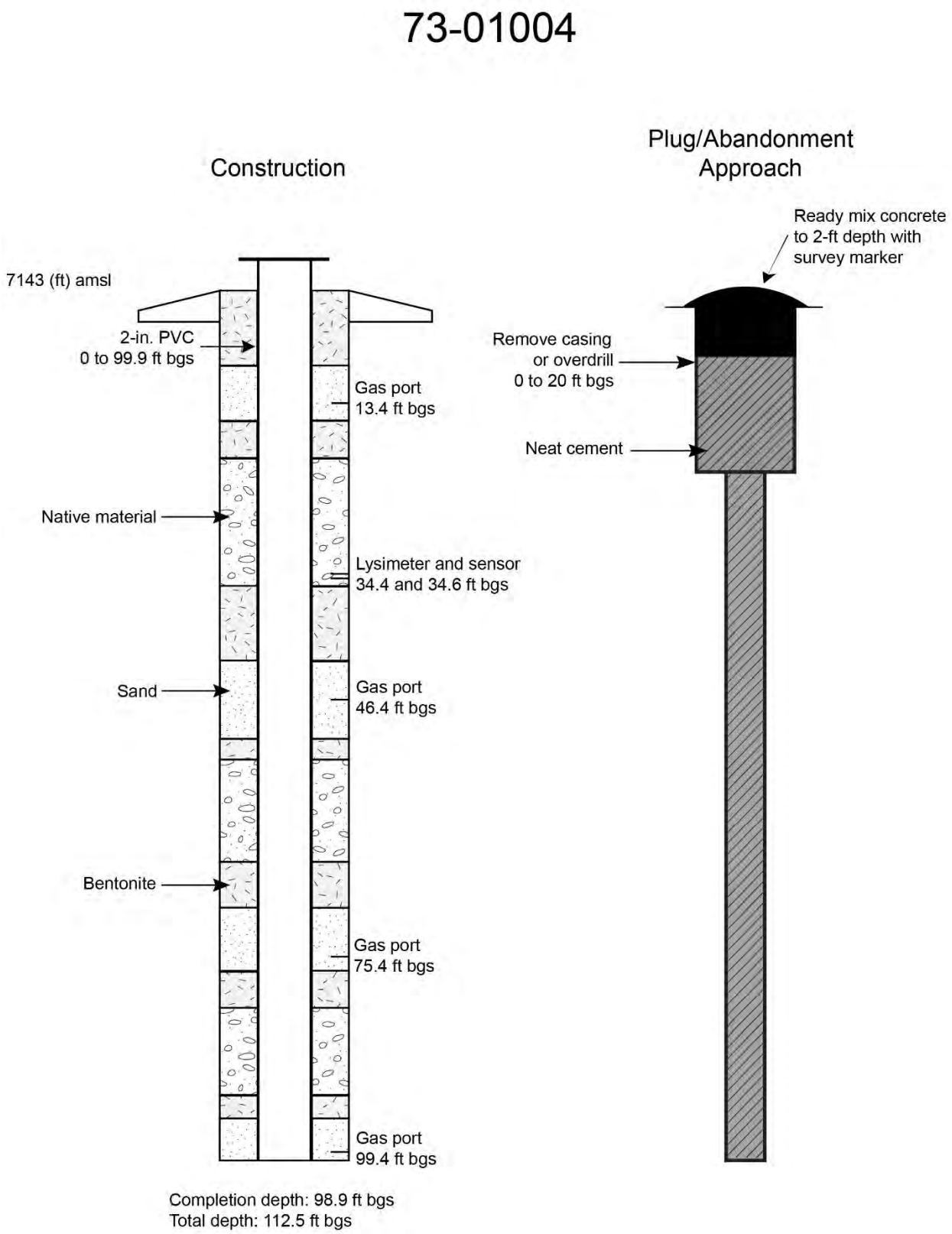


Figure 3.4-3 73-01004 abandonment schematic

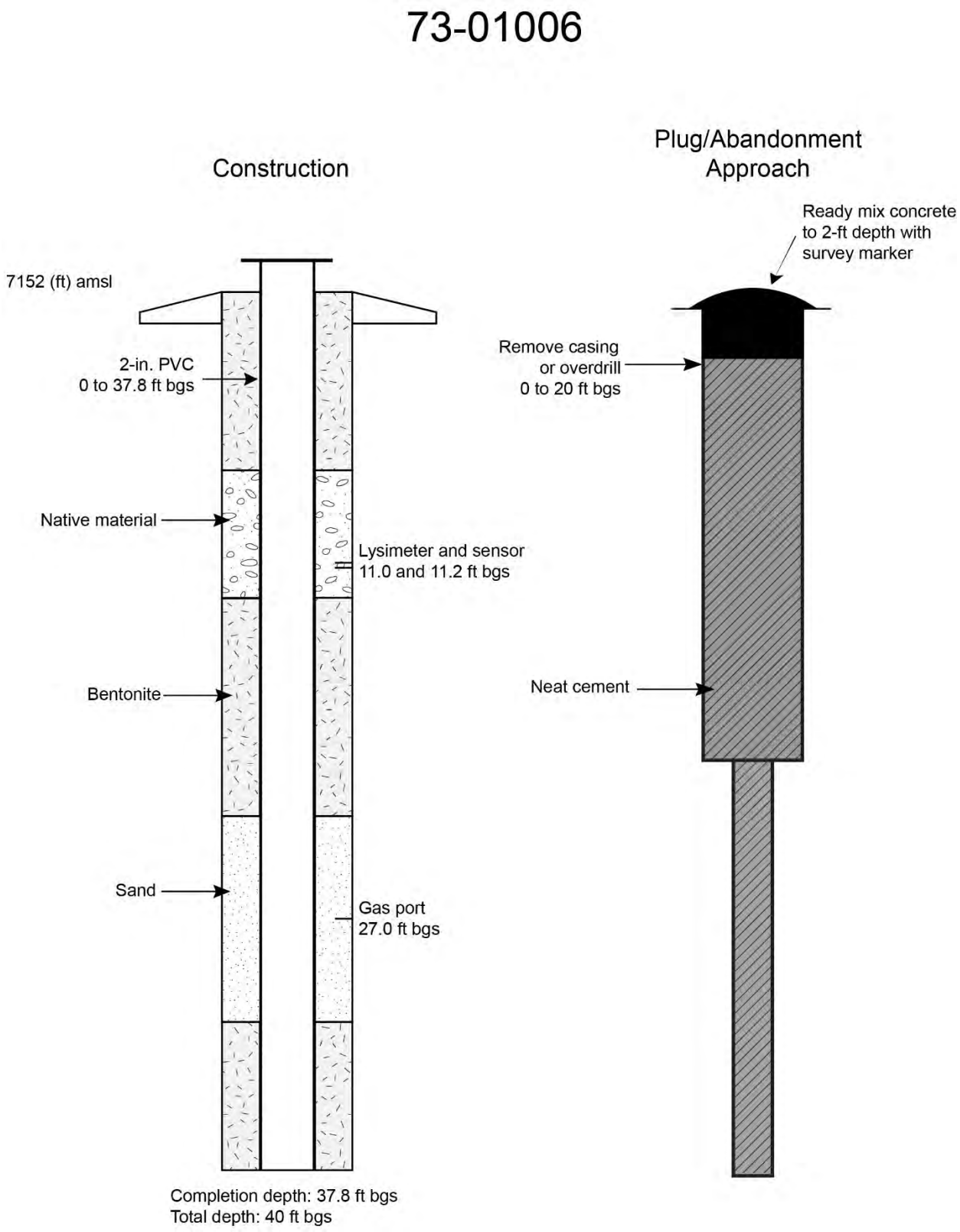


Figure 3.4-4 73-01006 abandonment schematic

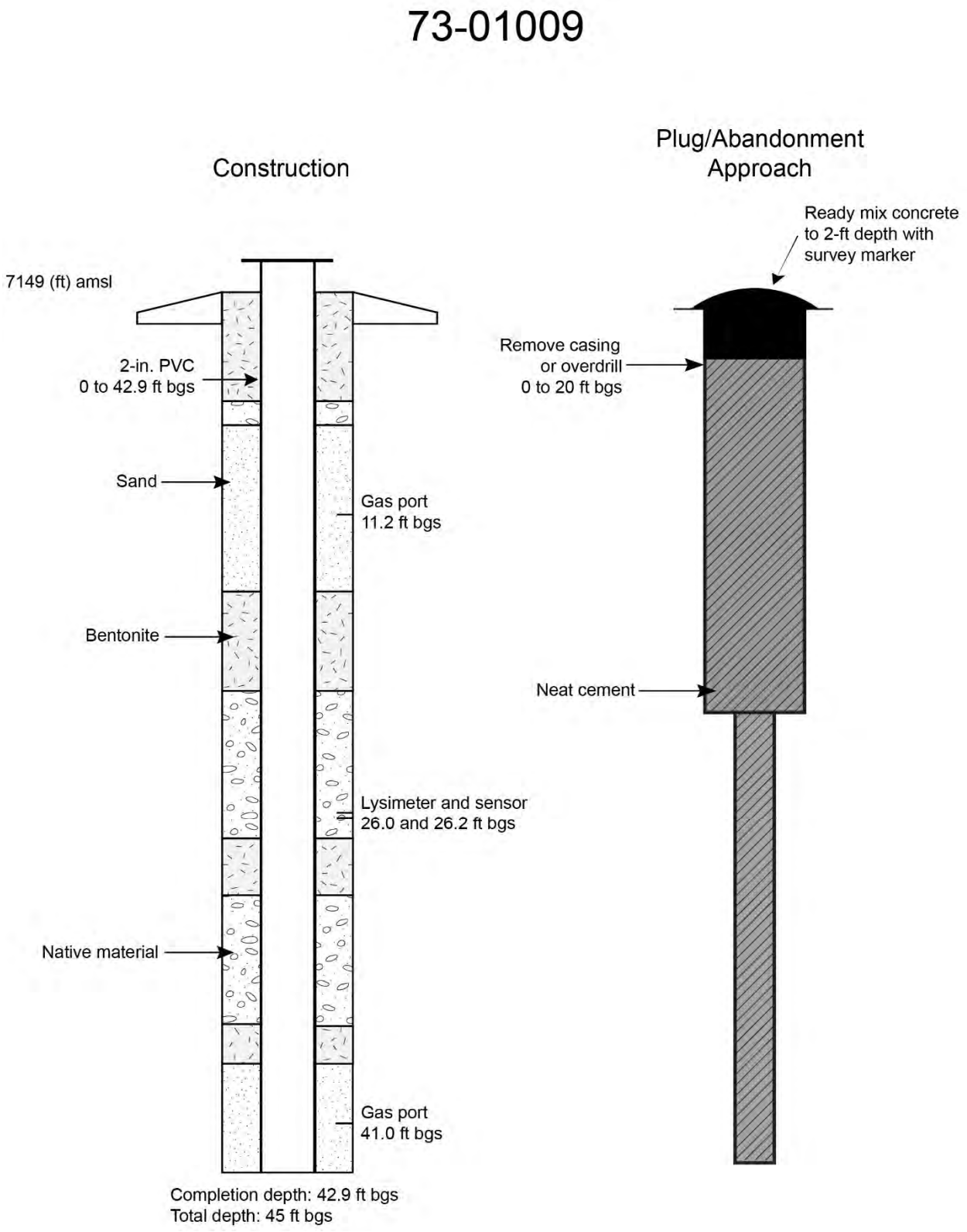


Figure 3.4-5 73-01009 abandonment schematic

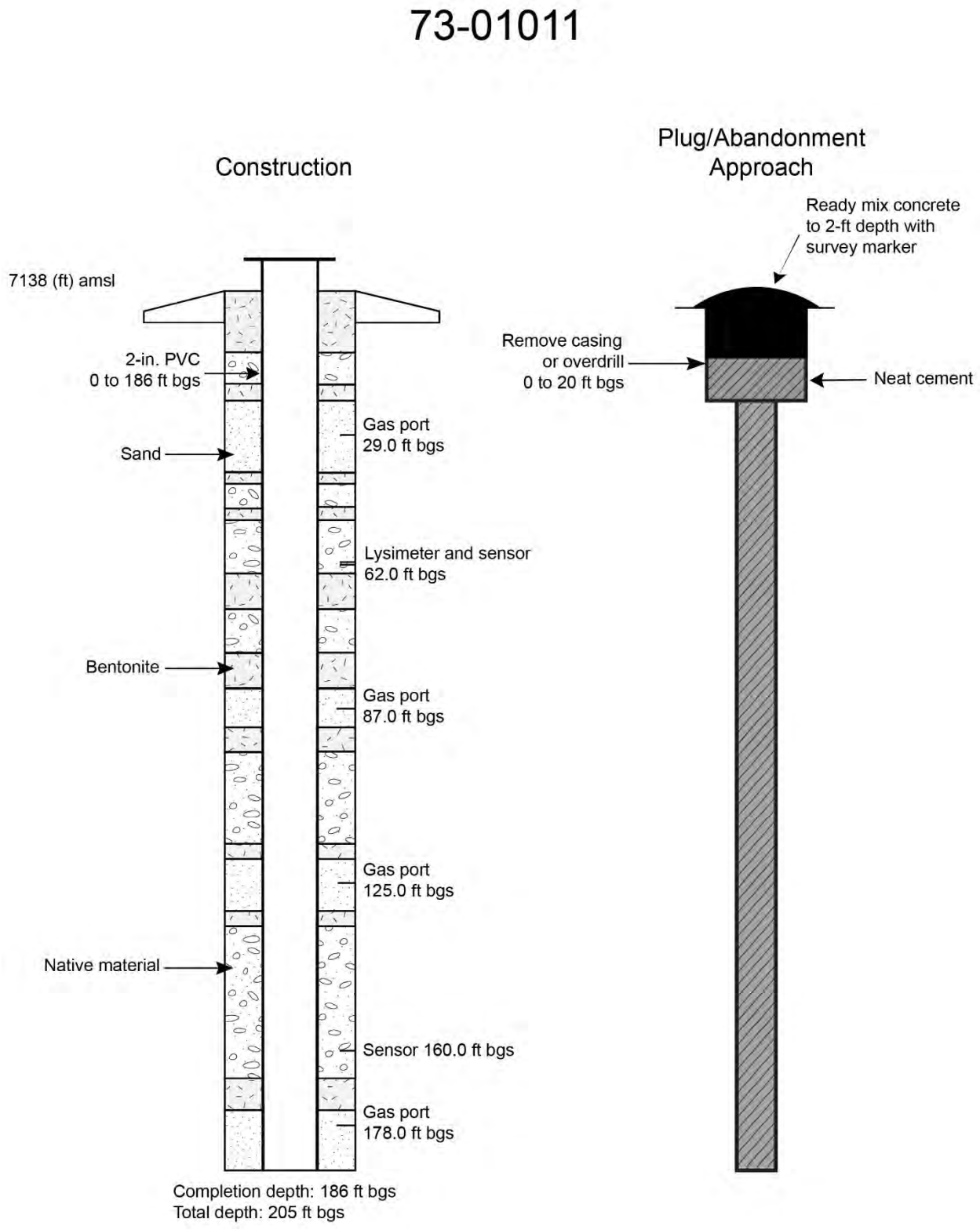


Figure 3.4-6 73-01011 abandonment schematic

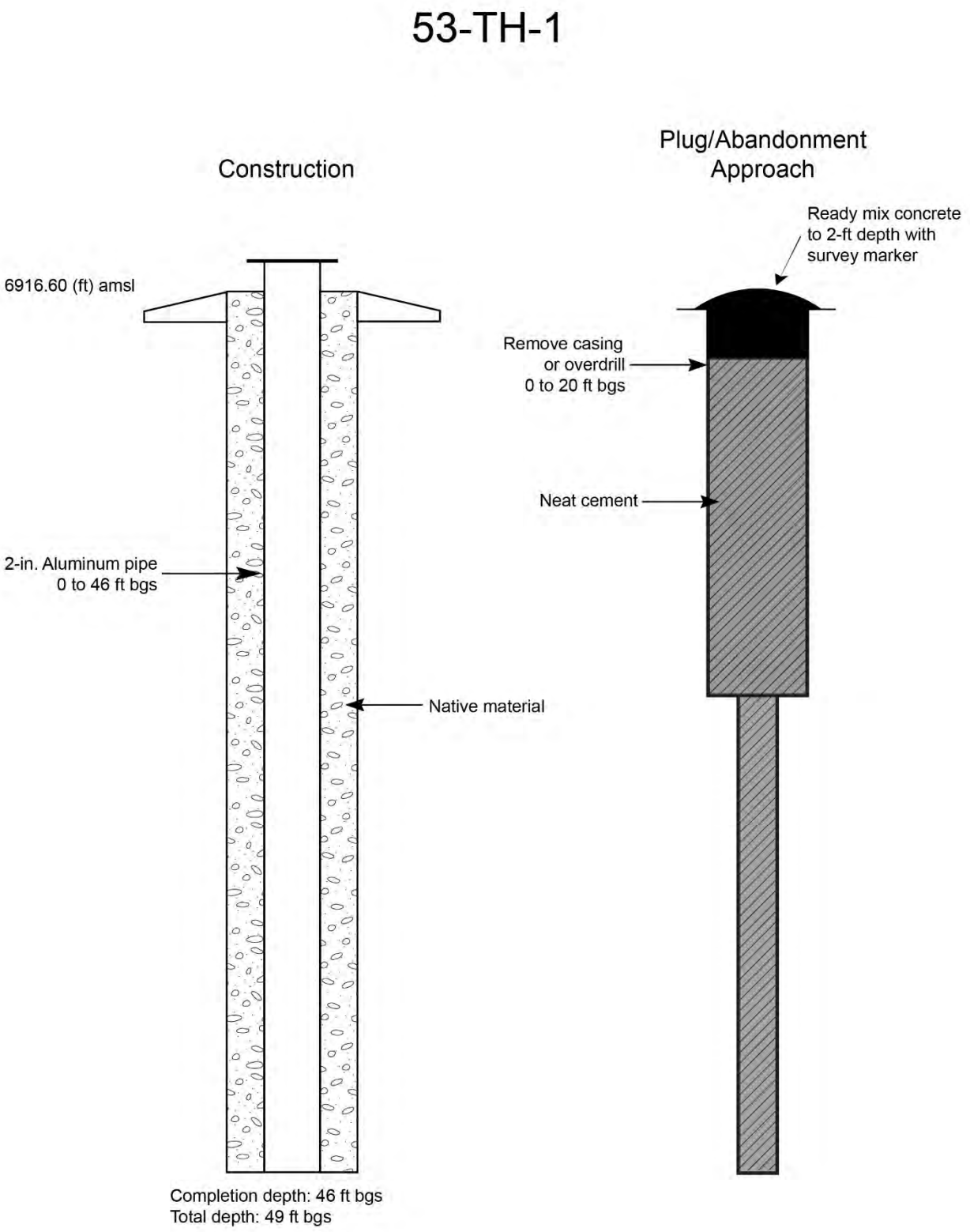


Figure 3.5-1 53-TH-1 abandonment schematic

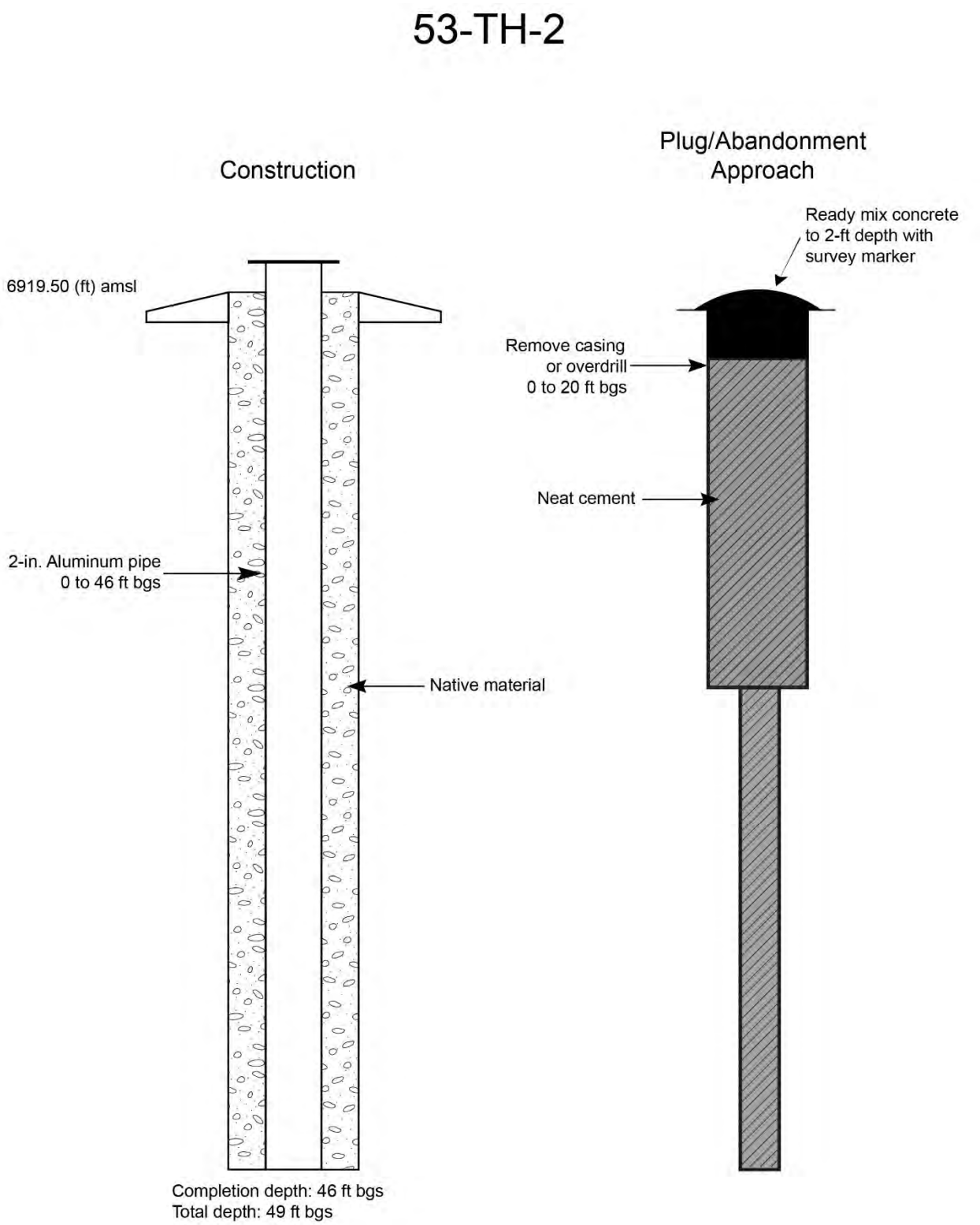


Figure 3.5-2 53-TH-2 abandonment schematic

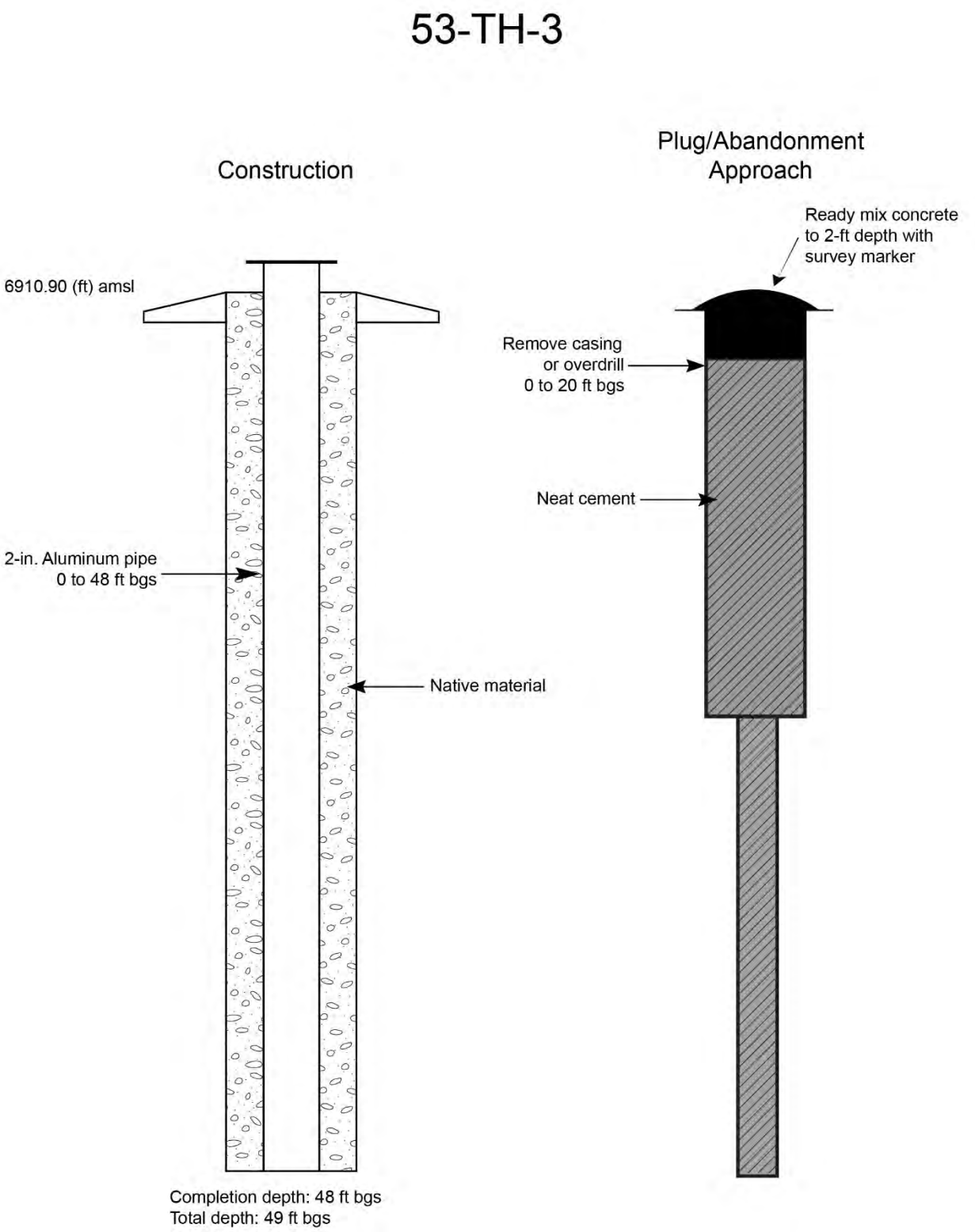


Figure 3.5-3 53-TH-3 abandonment schematic

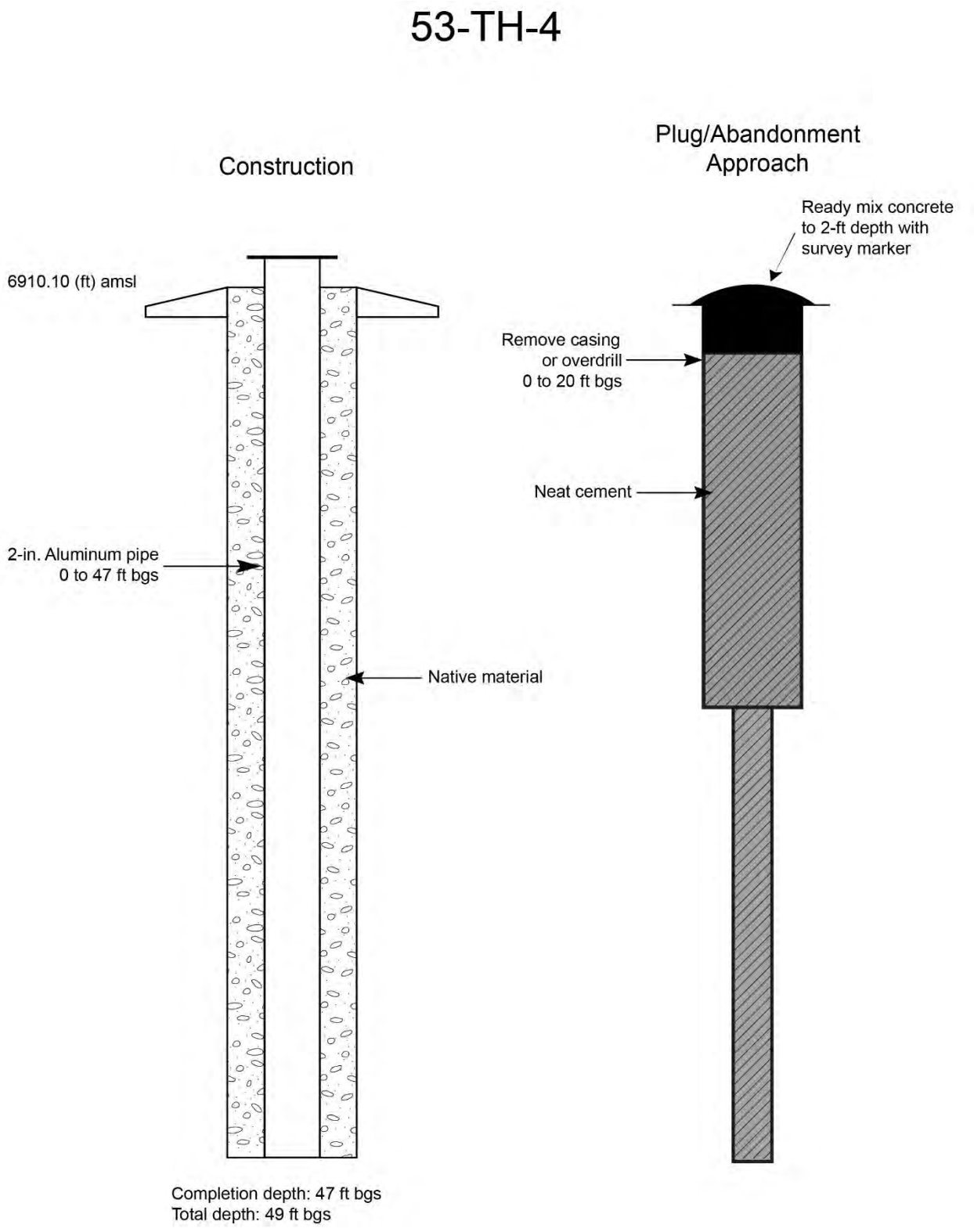


Figure 3.5-4 53-TH-4 abandonment schematic

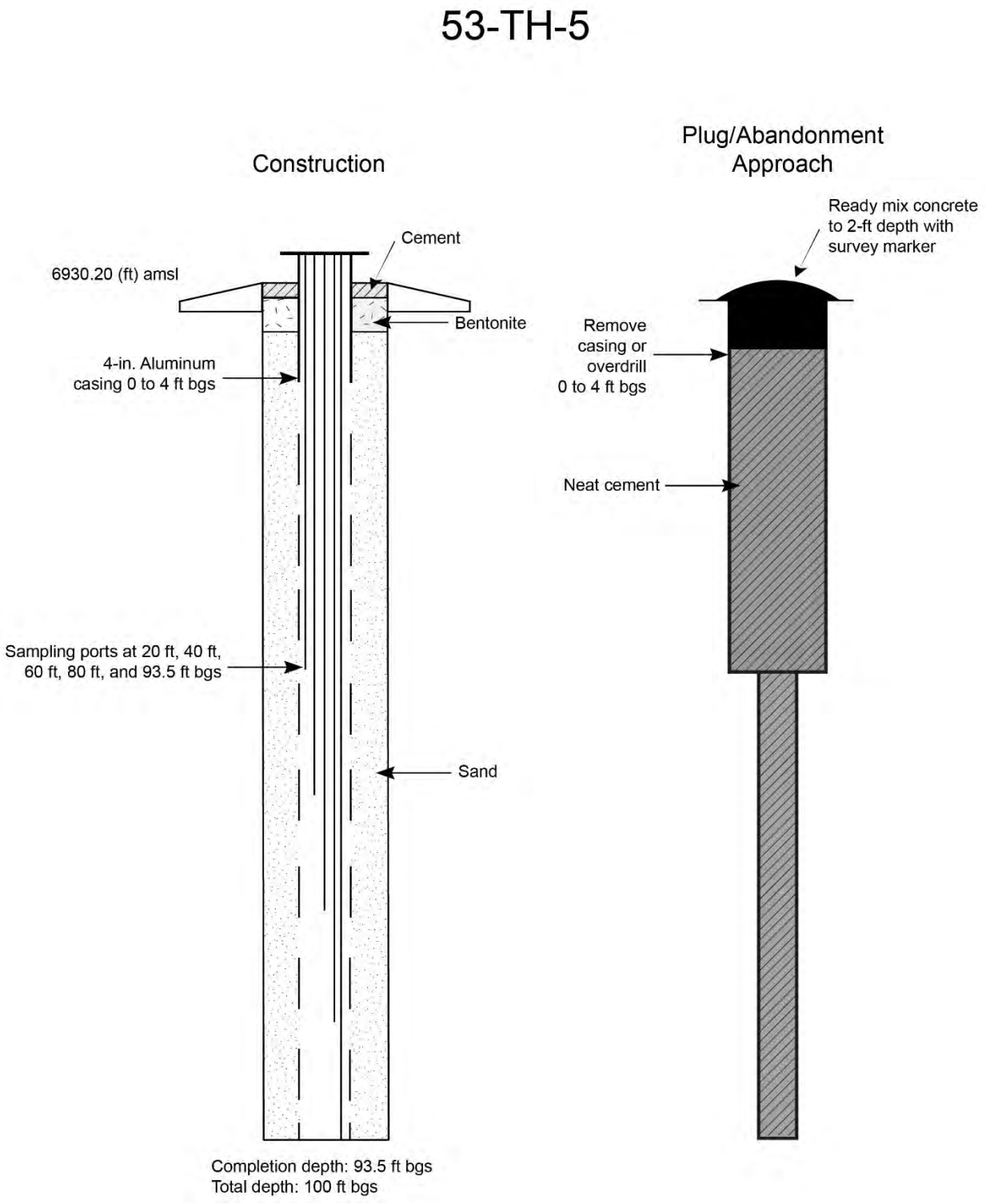


Figure 3.5-5 53-TH-5 abandonment schematic

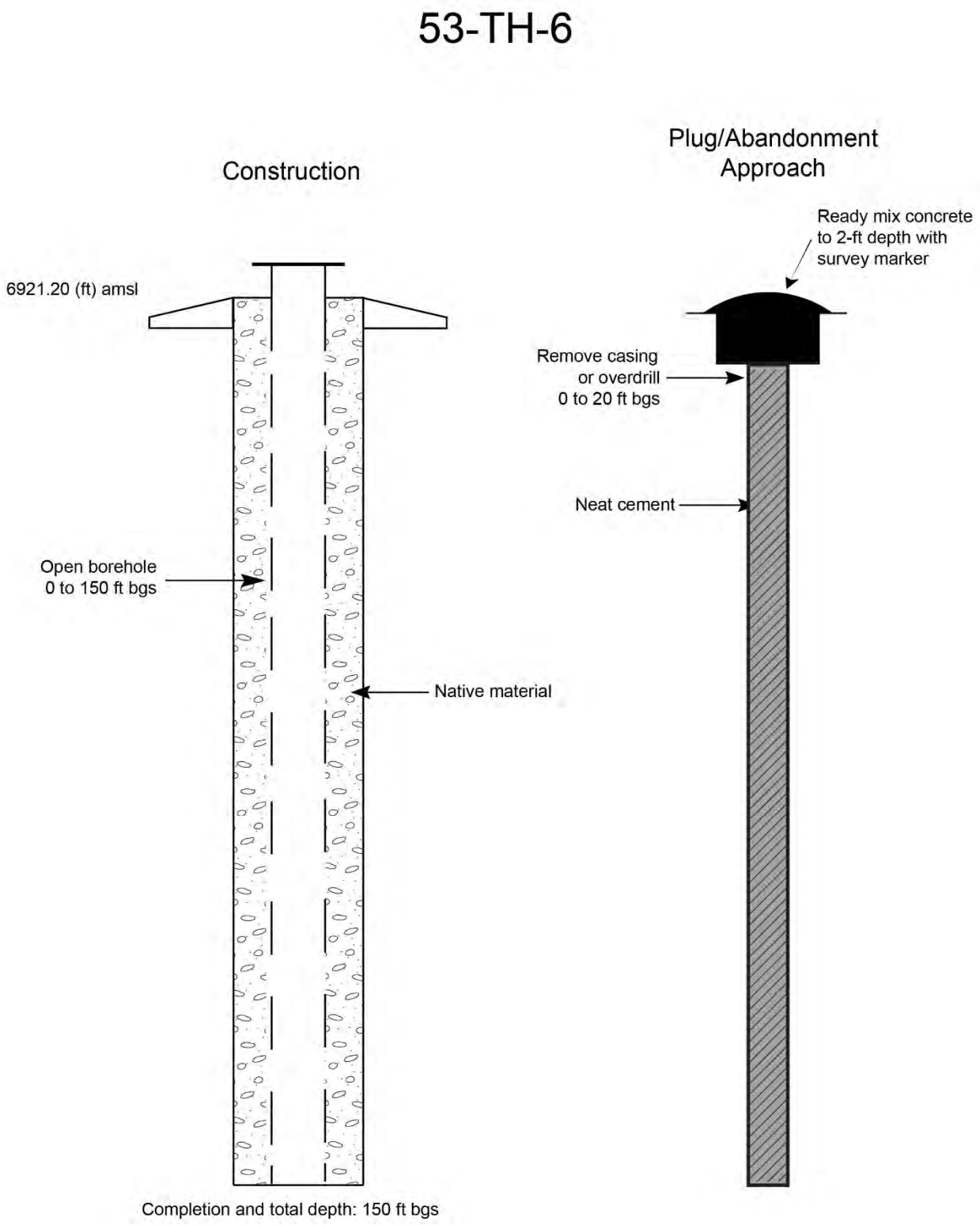


Figure 3.5-6 53-TH-6 abandonment schematic

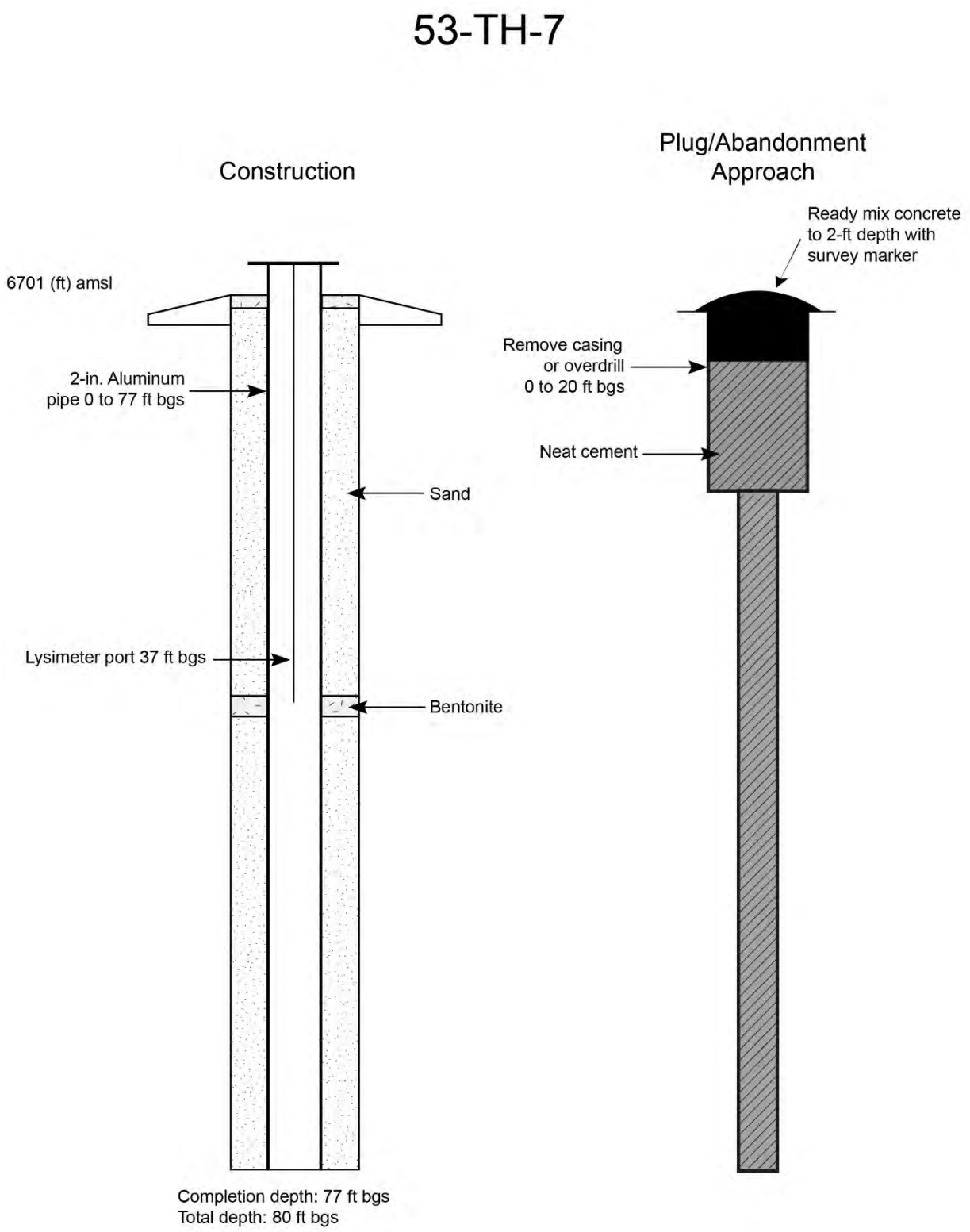


Figure 3.5-7 53-TH-7 abandonment schematic

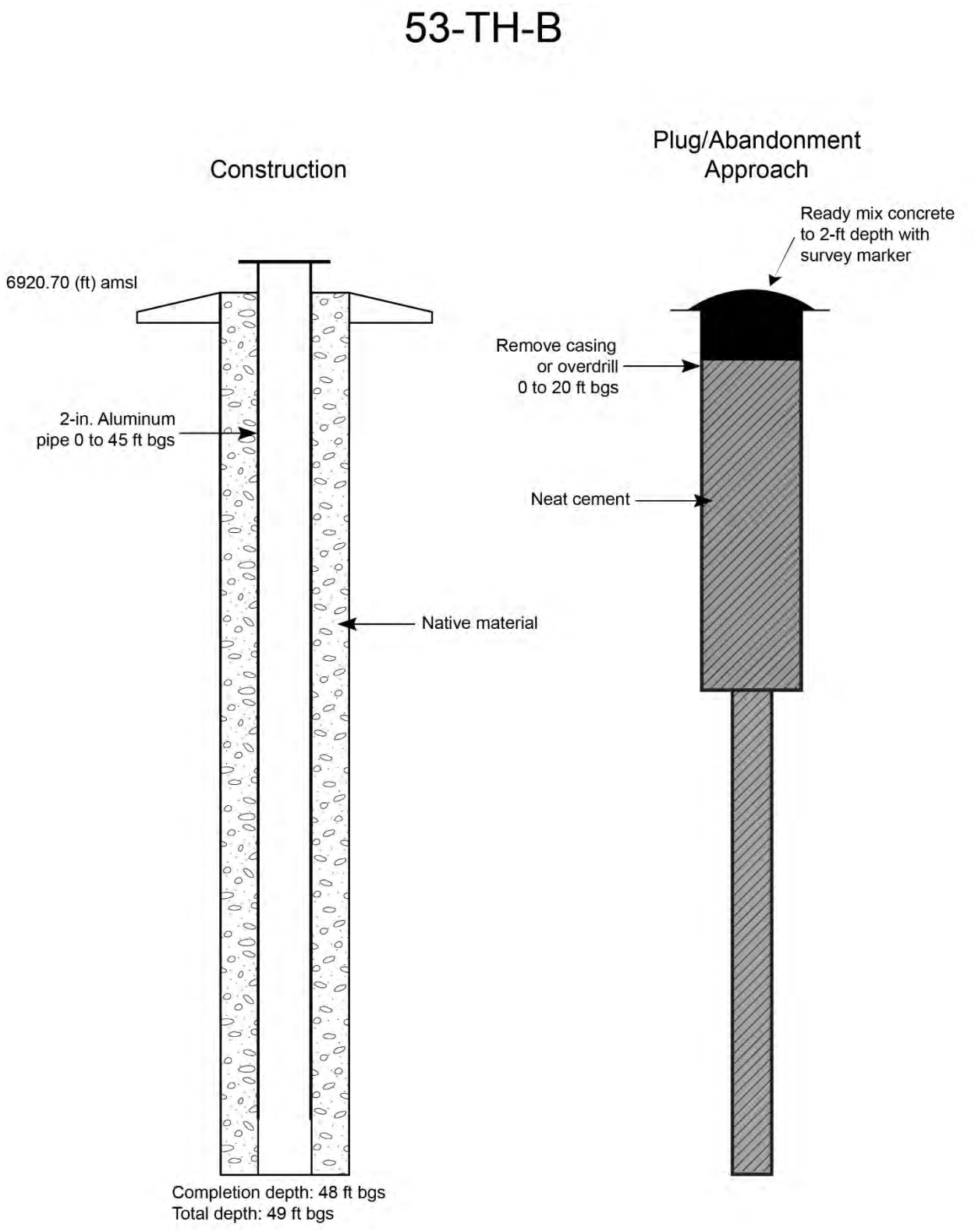


Figure 3.5-8 53-TH-B abandonment schematic

Table 2.0-1
Wells and Boreholes for Plugging and Abandonment

Well Name	Total Depth (ft)	Completion Depth (ft)	Diameter (in.)	Screened Interval (ft)	Construction Material	Easting	Northing	Elevation (ft amsl[a])
ASC-0	80	80	2	Unknown	PVC	1639833.00	1743580.00	6300
ASC-2	80	80	2	Unknown	PVC	1639850.00	1743618.00	6299
ASC-3	80	80	2	Unknown	PVC	1639831.00	1743668.00	6303
ASC-4	80	80	2	Unknown	PVC	1639800.00	1743748.00	6304
ASC-11	80	80	2	Unknown	PVC	1637060.00	1747199.00	6397
ASC-12	80	80	2	Unknown	PVC	1637095.00	1747243.00	6397
ASC-13	80	80	2	Unknown	PVC	1637014.00	1747265.00	6404
ASC-14	80	80	2	Unknown	PVC	1637077.00	1747343.00	6398
ASC-15	80	80	2	Unknown	PVC	1637071.00	1747361.00	6403
ASC-16	80	80	2	Unknown	PVC	1637104.00	1747399.00	6404
ASC-17	80	80	2	Unknown	PVC	1636984.00	1747412.00	6404
ASC-18	80	80	2	Unknown	PVC	1636976.00	1747487.00	6405
ASC-19	80	80	2	Unknown	PVC	1637084.00	1747532.00	6405
39-DM-2	40	40	4	Unknown	PVC	1639912.00	1743157.00	6292
39-DM-4	25	25	4	Unknown	PVC	1639844.00	1743548.00	6348
39-DM-6	60	57.5	4	45–55	Stainless steel	1637094.00	1747228.00	6403
39-DMB-1	122.5	119	4	Unknown	PVC	1639992.00	1743176.00	6292
39-UM-3	60	56.5	4	39.5–54.5	Stainless steel	1637032.00	1747663.00	6758.30
LAO-0.3	12	11.25	4	5.9–10.9	PVC	1624799.00	1774511.60	6968.13
LAO-0.7	25	23	Unknown	Unknown	Unknown	1627212.3	1774260.37	6904
LAO-0.8	17.5	12.85	4	7.5–12.5	PVC	1627699.70	1774274.66	6889.71
LAO-0.91	15.5	14.85	4	9.5–14.5	PVC	1628654.30	1774207.00	6861.74
LAO-4.5A	20	18.5	2	8.5–18.5	PVC	1643500.00	1772052.00	6459.89
LAO-4.5B	35	34.9	2	24.9–34.9	PVC	1643512.00	1772055.00	6459.37
LAO-B	27.5	27.19	4	11.8–26.8	PVC	1615148.80	1775170.40	7323.59
18-MW-1	25	25	2	5–25	PVC	1634843.7	1761930.30	6758.80
18-MW-2	25	25	2	5–25	PVC	1634878.4	1761868.10	6758.50
18-MW-3	25	25	2	5–25	PVC	1634893.6	1761864.10	6758.30
18-MW-4	25	25	2	5–25	PVC	1634904.5	1761878.60	6758.30
18-MW-17	23.8	22	2	12–22	PVC	1637778.2	1759717.10	6695.20
18-BG-4	25	6.8	4	2.5–6.5	PVC	1633510.00	1760760.00	6748

Table 2.0-1 (continued)

Well Name	Total Depth (ft)	Completion Depth (ft)	Diameter (in.)	Screened Interval (ft)	Construction Material	Easting	Northing	Elevation (ft amsl[a])
73-01001	45	42.5	2	n/a[b]	PVC	1635675.27	1775500.94	7121
73-01003	110	100.10	2	n/a	PVC	1634580.67	1775644.52	7138
73-01004	112.5	99.9	2	n/a	PVC	1634194.73	1775749.51	7143
73-01006	40	37.8	2	n/a	PVC	1633476.08	1776230.67	7152
73-01009	45	42.9	2	n/a	PVC	1633798.46	1776121.12	7149
73-01011	205	186.00	2	n/a	PVC	1634390.69	1775707.50	7138
53-TH-1	49	46	2	n/a	Aluminum	1639400.00	1771140.00	6916.60
53-TH-2	49	46	2	n/a	Aluminum	1639780.00	1771250.00	6919.50
53-TH-3	49	48	2	n/a	Aluminum	1639970.00	1770810.00	6910.90
53-TH-4	49	47	2	n/a	Aluminum	1639990.00	1771040.00	6910.10
53-TH-5	100	93.5	1	n/a	Aluminum	1639700.00	1770980.00	6930.20
53-TH-6	150	150	4	Open borehole	Aluminum	1639700.00	1771080.00	6921.20
53-TH-7	80	77	2	Open borehole	Aluminum	1639350.00	1770510.00	6701
53-TH-B	49	48	2	n/a	Aluminum	1638980.00	1771150.00	6920.70

[a] amsl = Above mean sea level.

[b] n/a = Not applicable.

December 2019
EM2019-0430

Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1

N3B Los Alamos

EM2019-0430

Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1

December 2019

Responsible program director:

Printed Name	Signature	Title	Organization	Date
Bruce Robinson		Program Director	Water Program	

Responsible N3B representative:

Printed Name	Signature	Title	Organization	Date
Erich Evered		Program Manager	N3B Environmental Remediation Program	

Responsible DOE EM-LA representative:

Printed Name	Signature	Title	Organization	Date
Arturo Q. Duran		Compliance and Permitting Manager	Office of Quality and Regulatory Compliance	

CONTENTS

Figures

Table

1.0 INTRODUCTION

This document contains information for the plugging and abandonment of ~~50~~ 45 observation wells in Ancho, Los Alamos, Pajarito, Pueblo, and Sandia Canyons at Los Alamos National Laboratory (LANL or the Laboratory) and is part of the U.S. Department of Energy's (DOE's) ongoing efforts to plug and abandon legacy wells and boreholes located on and adjacent to Laboratory property.

The work plans describe plugging and abandonment procedures that comply with Appendix F, Section II.D (Well Abandonment) of the 2016 Compliance Order on Consent (the Consent Order) as well as the New Mexico Office of the State Engineer (NMOSE) well or borehole abandonment regulations. Additionally, the plugging and abandonment procedures comply with 19 New Mexico Administrative Code 27.4, "Well Driller Licensing; Construction, Repair, and Plugging of Well." The work plans will be submitted to NMOSE by Newport News Nuclear BWXT-Los Alamos, LLC (N3B) before abandonment activities are undertaken.

This document includes five standalone work plans and associated figures, as shown in the following table. References for the work plans are provided in section 4.0 of this document.

Organization of Work Plans

Work Plan	Section
Work plan to plug and abandon 18 Ancho Canyon alluvial groundwater observation wells Figures 3.1-1–3.1-18, Plugging and abandonment schematics	3.1
Work plan to plug and abandon ~~10~~ 7 Los Alamos Canyon alluvial groundwater observation wells Figures 3.2-1–3.2-~~10~~7, Plugging and abandonment schematics	3.2
Work plan to plug and abandon ~~8~~ 6 Pajarito Canyon alluvial groundwater observation wells Figures 3.3-1–3.3-~~8~~6, Plugging and abandonment schematics	3.3
Work plan to plug and abandon 6 Pueblo Canyon alluvial groundwater observation wells Figures 3.4-1–3.4-6, Plugging and abandonment schematics	3.4
Work plan to plug and abandon 8 Sandia Canyon alluvial groundwater test holes and observation wells Figures 3.5-1–3.5-8, Plugging and abandonment schematics	3.5

2.0 BACKGROUND INFORMATION AND RATIONALE

Prioritization of wells and boreholes to be abandoned is based on criteria that determine their potential for providing a pathway for contaminants to migrate to depth. These criteria include the depth of the well, the location of the penetration (canyon bottom versus mesa top), the well's condition (the hole is wet or dry), its proximity to known sources of contamination, its age, its construction, and its accessibility to the public. In addition, recent experience from work performed from 2010 to 2018 has added some practical criteria to maximize cost savings and adhere to allocated budgets. These criteria include (1) grouping wells and boreholes within a given location to minimize mobilization costs and required permitting and (2) combining difficult, and thus expensive, wells with less difficult ones. The information available about legacy boreholes can be inaccurate, and unexpected conditions may be encountered. Before plugging and abandonment activities, field reconnaissance will be conducted at the wells and boreholes to verify field conditions and construction details of each well. A water-level measurement will be taken at each well to detect the presence and depth of groundwater. Additionally, water-level data will be reviewed to determine if a particular well can be considered historically dry. Field conditions impacting plugging and abandonment activities include possible obstructions, ease of site access, condition of surface well pad, surface casing,

and wellhead security. Construction details, including total borehole depth, current well depth, casing material and diameter, and screened interval (if present) are presented in Table 2.0-1.

~~Five o~~Of the 50 wells planned for plugging and abandonment activities in the original work plan, 5 have been removed from this revised work plan. These five wells ~~include~~are LAO-0.6, LAO-1.6G, LAO-6A, 18-MW-7 and 3MAO-2. The New Mexico Environment Department (NMED) required that these ~~five~~5 wells be retained for future ~~use~~monitoring. ~~These five wells include LAO-0.6, LAO-1.6G, LAO-6A, 18-MW-7 and 3MAO-2.~~

The locations of all wells and boreholes currently planned to be plugged and abandoned starting in fiscal year ~~2019~~2023 are shown in Figure 2.0-1. Each well or borehole will have its own completion report. The delivery date of each field completion report is scheduled for 120 days following abandonment activities for the associated well. Background information on the installation of these wells and the rationale for plugging and abandoning each group is provided below.

2.1 Alluvial ~~Boreholes~~ Angled Wells and Groundwater Observation Wells in Ancho Canyon

In 1994, 13 angled wells ~~boreholes~~ and 5 shallow wells were drilled in Ancho Canyon at Solid Waste Management Units (SWMUs) 39-001(a) and 39-001(b) (Figure 2.1-1) (LANL 2010, 108592, pp. 9–12, 104–106, 128-130; LANL 2011, 204397, pp. 27 and 28.). The angled wells ~~boreholes~~ were drilled to 80 ft in length (depths of 56.5 ft below ground surface [bgs]) to investigate possible contaminant migration beneath the base of a single disposal trench located at SWMU 39-001(a) and three buried waste material pits at SWMU- 39-001(b), all of which consisted of firing-site debris. The angled wells ~~boreholes~~ are constructed of
2-in.–inside diameter (I.D.) schedule 40 polyvinyl chloride (PVC); well construction information is unknown. The shallow monitoring wells vary in total depth from 25 to 119 ft in depth and are constructed of 4-in.-diameter PVC and stainless steel. The wells were installed downgradient to intercept potential contaminant migration from the buried waste pits and were drilled to encounter the alluvium/tuff interface.

Wells ASC-0, ASC-2, ASC-4, ASC-12, ASC-13, ASC-14, ASC-17, and ASC-19 were last monitored in 2009. Wells ASC-3, ASC-11, ASC-15, ASC-16, ASC-18, 39-DM-2, 39-DM-4, 39-DM-6, 39-DMB-1 and 39-UM-3 were either dry at the time of drilling or during subsequent follow-up visits.

SWMU 39-001(a) has a corrective action status of In Progress and is included in the approved “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area , Revision 1” (LANL 2011, 201561; NMED 2011, 203447), which specifies sampling locations, numbers of samples, and analytical suites required to define the extent of contamination. The results will be presented in a Phase II investigation report for the North Ancho Canyon Aggregate Area. NMED issued a certificate of completion without controls for SWMU-39-001(b) in April 2010 (NMED 2010, 110430).

Although historical groundwater data indicate a lack of perched-intermediate groundwater in the area, local contaminant sources have been or will be remediated and the wells are no longer being used for monitoring activities. These ~~boreholes and~~ wells should be plugged and abandoned to block any potential conduit for surface-water infiltration.

2.2 Alluvial Groundwater Observation Wells in Los Alamos Canyon

~~Three~~Two alluvial groundwater observation wells (LAO-4.5A and LAO-4.5B) were installed in Los Alamos Canyon in 1989. The wells were constructed to monitor quality of water in the alluvium and to fulfill the U.S. Environmental Protection Agency (EPA) Hazardous and Solid Waste Amendments Special Permit Condition (Figure 2.2-1) (Purtymun 1995, 045344, pp. 137–141; LANL 1997, 055622, p. 2-16). The wells

were completed as 2-in.-diameter wells constructed of PVC. Each well has 10 ft of 0.010-in. slotted screen and total depths vary between 14 18.5 and 35 ft. Because these wells may provide a pathway for contamination to move to the alluvial and perched groundwater, they should be plugged and abandoned.

Between 1994 and 1996, a series of five seven shallow alluvial wells (LAO-0.3, LAO-0.7, LAO-0.8, LAO-0.91 and LAO-B) was installed in Los Alamos Canyon to characterize alluvial groundwater quality downstream from Technical Area 02 (TA-02) and TA-41 and to provide water--level information (Figure 2.2-1) (LANL 1997, 055622, pp. 2-12 and 2-16; Gray 2001, 073307, pp. 4–5 and 67–76). These wells vary in total depth from 11 to 31 27 ft in depth and terminate at the top of the bedrock. The wells were completed with 4-in.-I.D. PVC and 0.010-in. slotted screens that vary from 5 to 15 ft in depth. Because these wells may provide a pathway for contamination to move to the alluvial and perched groundwater, they should be plugged and abandoned.

2.3 Alluvial Groundwater Observation Wells in Pajarito Canyon

Between 1990 and 1995, six alluvial groundwater observation wells were completed through the alluvium in Pajarito Canyon to assess the potential for transport of radionuclides in the shallow groundwater system surrounding the Los Alamos Critical Experiment Facility (Figure 2.3-1) (LANL 1995, 055527, pp. 5-16, 5-17, and 5-79 through 5-83; LANL 1998, 059577, pp. 3-75, 3-76, C-24, and C-25). Four of these wells (18-MW-1, 18-MW-2, 18-MW-3, and 18-MW-4) were used to investigate Area of Concern (AOC) 18-006, which consisted of a former underground stainless-steel storage pipe. Liquid stored in the pipe was used in liquid-fueled reactor experiments. These wells vary in total depth from 25 7 to 32 ft in depth and were cased with 2-in.-I.D. PVC. Each well has a single screen in the lower portion; well construction information and annulus backfill material is unknown. Alluvial wells 18-MW-1, 18-MW-2, 18-MW-3, and 18-MW-4, and MW-7 have not been sampled since they were drilled in 1990, and well 18-MW-17 was last sampled in 2004. These wells are no longer used for monitoring activities and should be plugged and abandoned to block any potential contaminant transport pathway. AOC 18-006 has a corrective action status of In Progress and will be investigated as part of the future Lower Pajarito Canyon Aggregate Area investigation.

In 1998, alluvial characterization well 18-BG-4 was installed in Threemile Canyon to determine background groundwater chemistry and to monitor water quality upgradient of TA-18 (Gray 2001, 073307, pp. 43–45). The borehole was drilled to 25 ft bgs and was completed in the alluvium/tuff interface with a 4-in.-I.D. PVC casing to 6.8 ft bgs. The lower portion of the well has a 4-ft slotted screen with a 20/40 silica sand filter pack. Alluvial well 3MAO-2 was installed in 2008 at the confluence of

Threemile Canyon and Pajarito Canyon (LANL 2008, 104909, pp. 7-59 and L-25). The borehole has 4-in.-I.D. PVC casing and a completion depth of 30 ft bgs with a lower 10-ft screen; annulus backfill material is unknown. These This wells were was damaged during the 2011 flood and are is no longer being monitored. Because thisthese wells may provide a pathway for contamination to move to the alluvial and perched groundwater, they it should be plugged and abandoned.

2.4 Alluvial Groundwater Observation Wells in Pueblo Canyon

In 1994, six groundwater observation wells (73-01001, 73-01003, 73-01004, 73-01006, 73-01009 and 73-01011) (five vertical and one angled) were drilled around an inactive landfill on the Pueblo Canyon mesa top at the Los Alamos Airport (Figure 2.4-1). The landfill was associated with SWMUs 73-001(a), 73-001(b), 73-001(c), and 73-001(d) (LANL 1998, 063070, pp. 2-49 and 2-54). The wells were installed with vadose zone instruments consisting of soil gas sampling ports, lysimeters, heat dissipation sensors, and thermocouples. The boreholes have 8.25-in. diameters, and are cased with 2-in.-I.D. PVC, and vary in total depth from with varying depths between 37.8 and 186 ft. These wells were installed along the perimeter of

an abandoned municipal landfill to determine potential contamination migration to groundwater or atmosphere. These wells are not part of the Long-Term Monitoring Plan for the Los Alamos County Airport Landfill closure and they should be plugged and abandoned to eliminate any potential contaminant transport pathway (DOE 2017, 602320).

2.5 Alluvial Groundwater Test Boreholes and Observation Well~~s~~ in Sandia Canyon

In 1991, ~~eight~~ seven groundwater test boreholes and one pore gas well were drilled through the alluvium into tuff in Sandia Canyon (Figure 2.5-1) (McLin et al. 1997, 085422). These boreholes were drilled to investigate possible contaminant migration beneath SWMUs 53-002(a) and 53-002(b), which consisted of three former surface impoundments that were constructed to contain sanitary, industrial, and radioactive wastewater at TA-53. The test boreholes consist of five 2-in. ~~–~~ID ~~and 4-in. I.D.~~ aluminum moisture access tubes (53-TH-1, 53-TH-2, 53-TH-3, 53-TH-4, and 53-TH-B), and two open boreholes (53-TH-6 and 53-TH-7).~~,~~ ~~and one~~ The observation well (53-TH-5) is a pore gas well with ~~varying~~ total depths ~~between~~ varying from 46 ~~and~~ to 150 ft. Pore gas well 53-TH-5 has five aluminum sampling ports that vary in depth from 20 to 93.5 ft bgs. Open borehole 53-TH-7 has a lysimeter port at 37 ft bgs.

There are no groundwater-level measurements or analytical sampling results in either the LANL or NMED DOE Oversight Bureau databases to indicate that groundwater or contaminants have been detected in the seven boreholes and one pore gas well surrounding SWMUs 53-002(a) and 53-002(b) that have been identified for plugging and abandonment.

Corrective actions were conducted at SWMUs 53-002(a) and 53-002(b) in 2000 and 2002, and decision-level data indicated the nature and extent of contamination were defined and the sites pose no potential unacceptable risk to industrial receptors. NMED issued a certificate of completion with controls in September 2006 for SWMUs 53-002(a) and 53-002(b) (NMED 2006, 095421).

Local contaminant sources have been remediated and the boreholes/observation well are no longer being used for monitoring activities. These test boreholes and observation well are no longer in use and should be abandoned to block any potential contaminant transport pathway.

3.0 WORK PLANS FOR PLUGGING AND ABANDONMENT

Field activities for plugging and abandonment activities will be developed in accordance with procedure N3B-AP-P300-1, "Integrated Work Control Process." This procedure categorizes activity-level work using a graded approach, provides instructions for generating and controlling suitable work control documents, facilitates the selection of proper planning tools and personnel, describes the process requirements for performing pre- and post-job briefings, and provides a mechanism for processing feedback to ensure continuous improvement. Planning will also take place under procedure N3B-P351 "Project Planning and Regulatory Review." This procedure allows N3B to identify institutional, state, and/or federal requirements early in the planning phase of a project; facilitate subject matter expert input and review; and document compliance with requirements.

3.1 Work Plan to Plug and Abandon Alluvial ~~Boreholes~~ Angled Wells and Groundwater Observation Wells in Ancho Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial boreholes and groundwater observation wells in Ancho Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the boreholes and wells in Ancho Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	Thirteen ~~boreholes~~ angled wells and five shallow wells were installed in Ancho Canyon in 1994 to investigate possible contaminant migration from beneath buried waste material pits (LANL 2010, 108592). The existing boreholes and wells vary in total depth from 25 to 119 ft ~~in depth~~ and are constructed of 2- and 4-in.-I.D. PVC and stainless-steel casing. Well construction is unknown for a majority of the wells and has not been found in any historical literature or well and borehole databases. Well 39-UM-3 has a 15-ft screened interval in a 27-ft sand filter pack and a 2.5-ft upper bentonite seal and was completed to surface with cement. Well 39-DM-6 has a 10-ft screen in a 20-ft sand filter pack and a 2.5-ft upper bentonite seal and was completed to surface with native material. Alluvial well 39-DMB-1 was the only well drilled beyond the alluvium/tuff interface and was extended into basalt at 119 ft bgs. These boreholes are historically dry, but water may be present.~~Angled borehole ASC-1 was abandoned during drilling activities and replaced with ASC-0. It is shown in Figure 2.1-1 as a reference point.~~
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be overdrilled to a depth of 20 ft bgs. In either scenario the borehole will be ~~and then~~ filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.1-1 to 3.1-18. Well ASC-3 was damaged during remediation activities in 2009 and a bentonite plug was placed over protruding PVC (LANL 2010, 111505, p. 10). The well needs to be overdrilled to 2 ft bgs for proper surface completion. This well has already been abandoned to ground surface, negating the need to be overdrilled to a depth of 20 ft bgs.
Surface Completion	A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with a global positioning system (GPS) with an accuracy of ±0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment.

Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.2 Work Plan to Plug and Abandon Alluvial Groundwater Observation Wells in Los Alamos Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells in Los Alamos Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the wells in Los Alamos Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	A series of seven ~~10~~ alluvial observation wells was installed in Los Alamos Canyon between 1989 and 1996 (LANL 2010, 108592). The wells were installed to monitor and characterize water quality, fulfill special EPA permit conditions, and provide water-level information. The wells are constructed of 2- and 4-in.-diameter PVC pipe, ~~have varying~~vary in total depth~~s~~ from ~~11~~ 18.5 to 35 ft, and terminate at the top of bedrock. The alluvial wells are constructed with a 10/20 silica sand filter pack, an upper bentonite seal, and a cement seal to surface. Well construction is unknown for LAO-0.7 and has not been found in any historical literature or databases.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be overdrilled to a total depth of 20 ft bgs (or to total depth if less than 20 ft). In either scenario the borehole will be ~~and then~~ filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.2-1 to 3.2-7~~10~~.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.3 Work Plan to Plug and Abandon Alluvial Groundwater Observation Wells in Pajarito Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells in Pajarito Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the wells in Pajarito Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	~~Six~~Five alluvial wells were installed in Pajarito Canyon to assess the potential for transport of radionuclides in the shallow groundwater system (LANL 1995, 055527) One~~Two~~ additional well~~s~~ was~~were~~ installed in Threemile Canyon to monitor groundwater quality upgradient of TA-18 (Gray 2001, 073307). The wells vary in total depth from 7 to 25 ft. Well construction is ~~unknown~~ incomplete for Pajarito Canyon well 18-MW-17. The remaining Pajarito Canyon wells were constructed with a silica sand filter pack and an upper bentonite seal. Threemile Canyon alluvial well 18-BG-4 has a 4-ft screened interval and is constructed with a silica sand filter pack and upper bentonite seal~~; 3MAO-2 annulus materials are unknown~~.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be ~~filled with cement grout to 20 ft bgs and then~~ overdrilled to a depth of 20 ft bgs (or to total depth if less than 20 ft). In either scenario the borehole~~. The overdrilled volume~~ will be filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.3-1 to 3.3-~~8~~6.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.4 Work Plan to Plug and Abandon Alluvial Groundwater Observation Wells in Pueblo Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells in Pueblo Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the wells in Pueblo Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	In 1994, six observation wells were installed at the Los Alamos Airport on the Pueblo Canyon mesa top (LANL 1998, 063070). The wells were installed on the perimeter of an abandoned municipal landfill to determine potential contamination migration to groundwater and atmosphere. These wells were constructed with various vadose zone instrumentation and annulus backfill materials consisting of sand, bentonite, and native material. These wells vary in total depth ~~between~~ from 37.8 ~~and~~ to 186 ft ~~in depth~~.
Abandonment Methods	Wells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Wells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the borehole. If this is not feasible, the well will be ~~filled with cement grout to 20 ft bgs and then~~ overdrilled to a depth of 20 ft bgs. In either scenario the borehole ~~The overdrilled volume~~ will be filled with cement grout to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.4-1 to 3.4-6.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

3.5 Work Plan to Plug and Abandon Alluvial Groundwater Test Boreholes and Observation Well in Sandia Canyon

Primary Purpose	The purpose for plugging and abandoning the alluvial groundwater observation wells, test boreholes, and vapor wellobservation well in Sandia Canyon is to prevent the migration of surface water and contaminants in the wells to depth. This work plan summarizes the plugging and abandonment methods N3B proposes for the test boreholes and observation wells in Sandia Canyon. Abandonment will be consistent with Appendix F, Section II.D (Well Abandonment) of the Consent Order and NMOSE regulations. A plugging plan of operations will be submitted to NMOSE before abandonment.
Construction	In 1991, eight test boreholes were installed in Sandia Canyon at TA-53 (Purtymun 1995, 045344). The wells consist of five moisture monitoring wellsboreholes, two open hole wellsboreholes, and one pore gas observation well. All The moisture monitoring wells boreholes vary in total depth are from 46 to 489 ft deep and are constructed of 2-in.-diameter aluminum pipe. Pore gas well 53-TH-5 is constructed of 4-in.-diameter aluminum casing to 4 ft, and has five aluminum sampling ports, and has a total depth of 93.5 ft. Test Open borehole 53-TH-6 is open hole to 150 ft deep with an annulus of native material. Test Open borehole 53-TH-7 has a total depth of 77 ft is 80 ft deep with a 2-in.-diameter aluminum pipe, and the annular space is sand and bentonite.
Abandonment Methods	Boreholes/Wwells with standing water will be bailed for 3 casing volumes or until dry, then allowed to recharge overnight. Boreholes/wWells with standing water after the recharge period will be sampled using standard alluvial sampling protocol and analyte lists. N3B will attempt to remove the well casing from the boreholes or well. If this is not feasible, the borehole/well will be filled with cement grout to 20 ft bgs and then overdrilled to a depth of 20 ft. bgs. In either scenario the borehole The overdrilled volume will be filled with bentonite to ground surface. Schematic diagrams of the well abandonment approaches for each well are shown in Figures 3.5-1 to 3.5-8.
Surface Completion	A neat-cement mound with a marker will be installed over the borehole at ground surface. The marker will be surveyed with a GPS with an accuracy of ±0.5 ft.
Waste Disposal	A WCSF will be prepared to guide disposal of any wastes generated during abandonment.
Summary Report	A report will be prepared detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

4.0 REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

DOE (U.S. Department of Energy), March 2017. "Long-Term Monitoring Plan, Los Alamos County Airport Landfill Cover Replacement, Solid Waste Management Units 73-001(a,d), Technical Area 73," report prepared by Dwyer Engineering, LLC, for DOE Environmental Management Los Alamos Field Office, Los Alamos, New Mexico. (DOE 2017, 602320)

Gray, R.N., November 2001. "Report on Alluvial Well Completions 1994-2001," report prepared for Los Alamos National Laboratory Los Alamos, New Mexico. (Gray 2001, 073307)

LANL (Los Alamos National Laboratory), November 2, 1995. "RFI Report for Potential Release Sites 18-002(a–c), 18-003(a–h), 18-004(a,b), 18-005(a), 18-008, 18-010(b–f), 18-011, 18-012(a–c), 18-013, 27-002, PCO Wells, LACEF Monitoring Wells, Wetlands (located in former Operable Unit 1093)," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 055527)

LANL (Los Alamos National Laboratory), April 1997. "Core Document for Canyons Investigations," Los Alamos National Laboratory document LA-UR-96-2083, Los Alamos, New Mexico. (LANL 1997, 055622)

LANL (Los Alamos National Laboratory), September 1998. "Work Plan for Pajarito Canyon," Los Alamos National Laboratory document LA-UR-98-2550, Los Alamos, New Mexico. (LANL 1998, 059577)

LANL (Los Alamos National Laboratory), November 1998. "RFI Report for Potential Release Sites 73-001(a, b, c, d) (Airport Landfill Areas)," Los Alamos National Laboratory document LA-UR-98-3824, Los Alamos, New Mexico. (LANL 1998, 063070)

LANL (Los Alamos National Laboratory), February 2010. "Information Concerning the Angled Boreholes Associated with Past Environmental Investigations at Technical Area 39," Los Alamos National Laboratory document LA-UR-10-0579, Los Alamos, New Mexico. (LANL 2010, 108592)

LANL (Los Alamos National Laboratory), December 2010. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area," Los Alamos National Laboratory document LA-UR-10-7869, Los Alamos, New Mexico. (LANL 2010, 111505)

LANL (Los Alamos National Laboratory), March 2011. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area Revision 1," Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011, 201561)

LANL (Los Alamos National Laboratory), June 2011. "Investigation Report for Ancho, Chaquehui, and Indio Canyons, Revision 1," Los Alamos National Laboratory document LA-UR-11-3305, Los Alamos, New Mexico. (LANL 2011, 204397)

McLin, S.G., W.D. Purtymun, S. Swanton, and R.J. Koch, August 1997. "Logs and Completion Data for Water Balance Wells in Mortandad and Ten Site Canyons," Los Alamos National Laboratory report LA-13297-MS, Los Alamos, New Mexico. (McLin et al. 1997, 085422)

NMED (New Mexico Environment Department), September 13, 2006. "Certificates of Completion for Solid Waste Management Units 53-002(a) and 53-002(b), Technical Area 53," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2006, 095421)

NMED (New Mexico Environment Department), April 6, 2010. "Approval, Request for Certificates of Completion for Two Solid Waste Management Units and Five Areas of Concern in the North Ancho Canyon Aggregate Area," 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 2010, 110430)

NMED (New Mexico Environment Department), May 13, 2011. "Approval with Modifications, Phase II Investigation Work Plan North Ancho Canyon Aggregate Area, Revision 1," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 203447)

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)

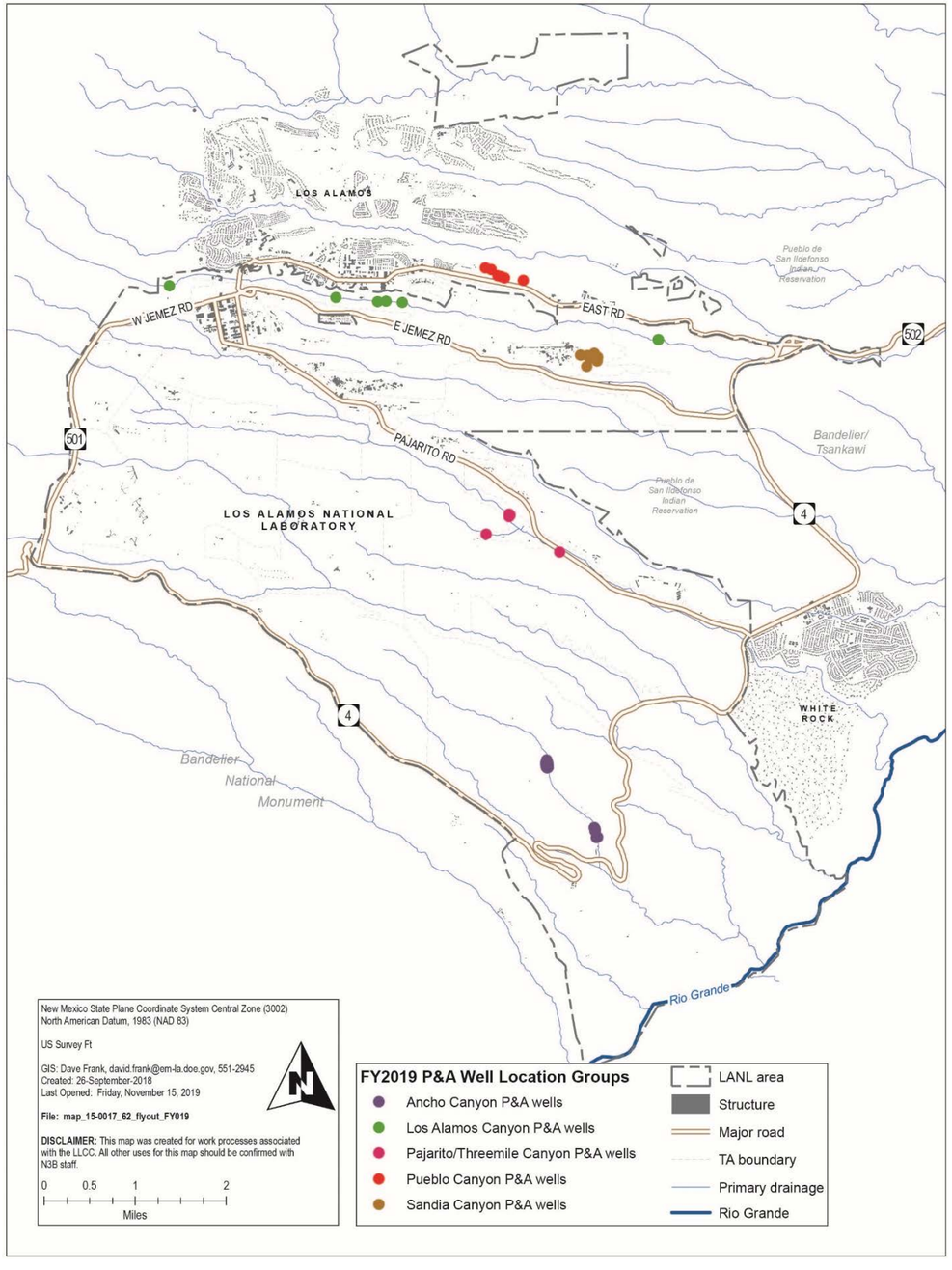


Figure 2.0-1 Locations of all wells and boreholes to be plugged ~~in fiscal year 2019~~

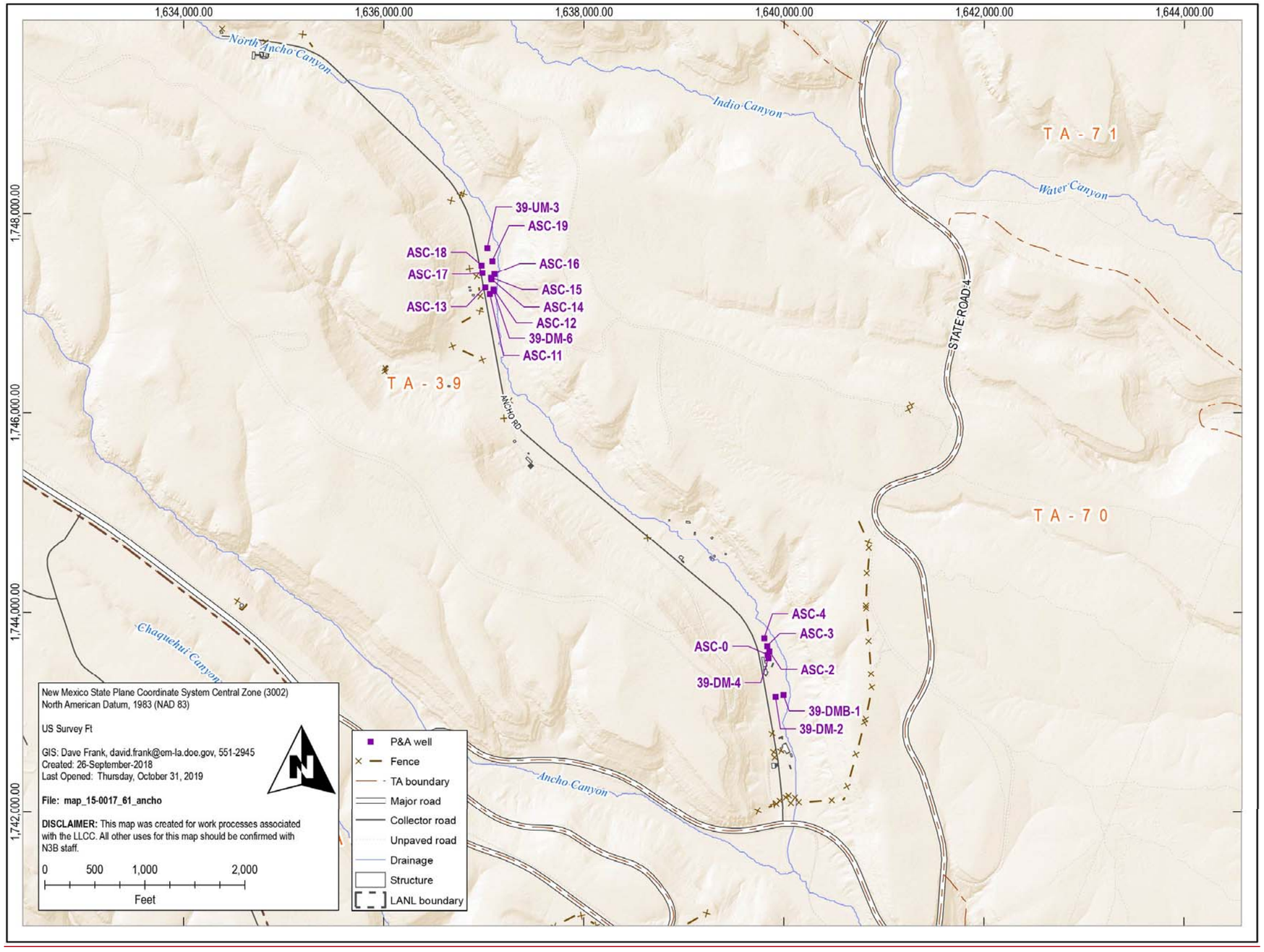


Figure 2.1-1 Locations of alluvial groundwater observation wells in Ancho Canyon

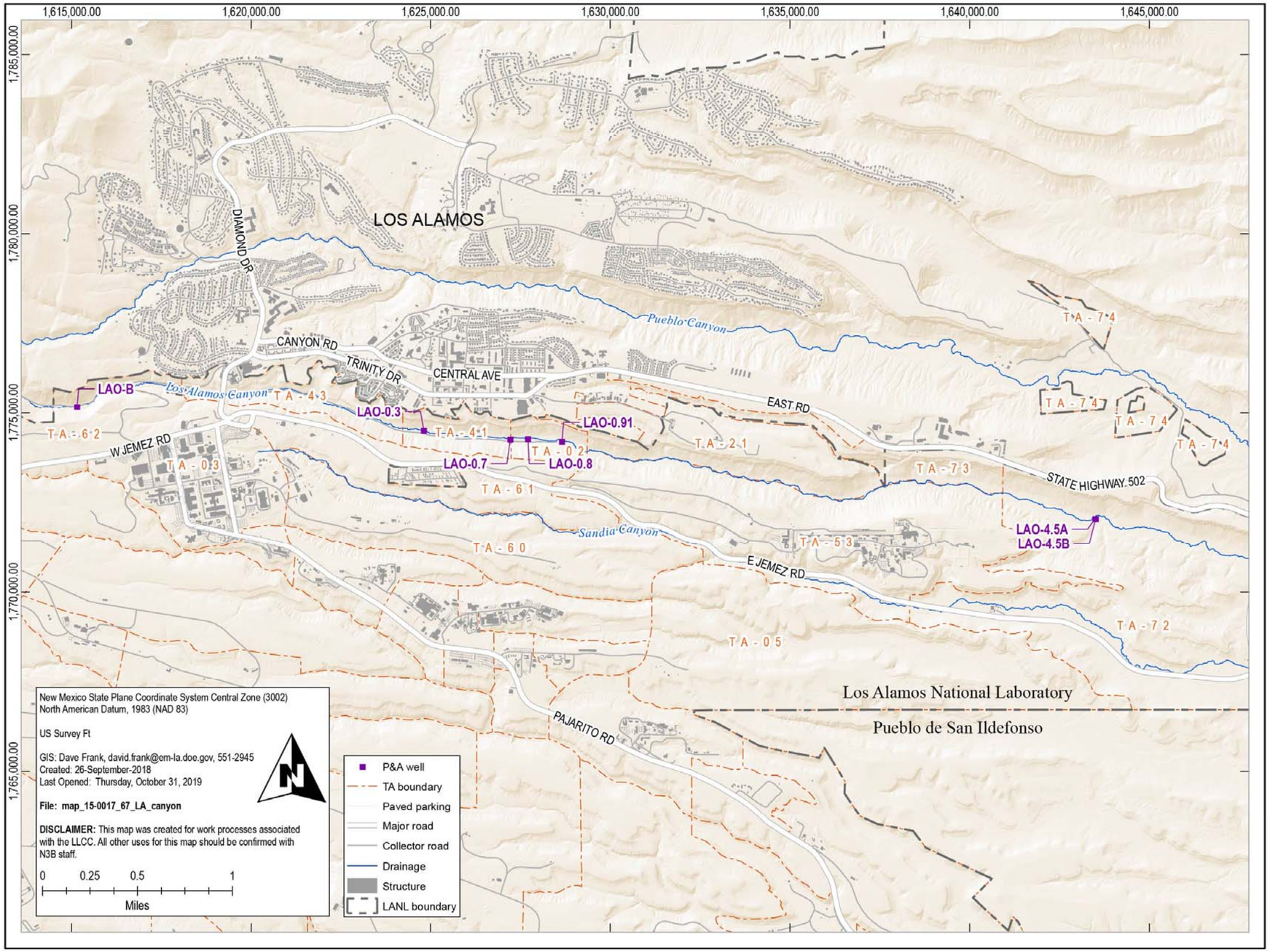


Figure 2.2-1 Locations of alluvial groundwater observation wells in Los Alamos Canyon

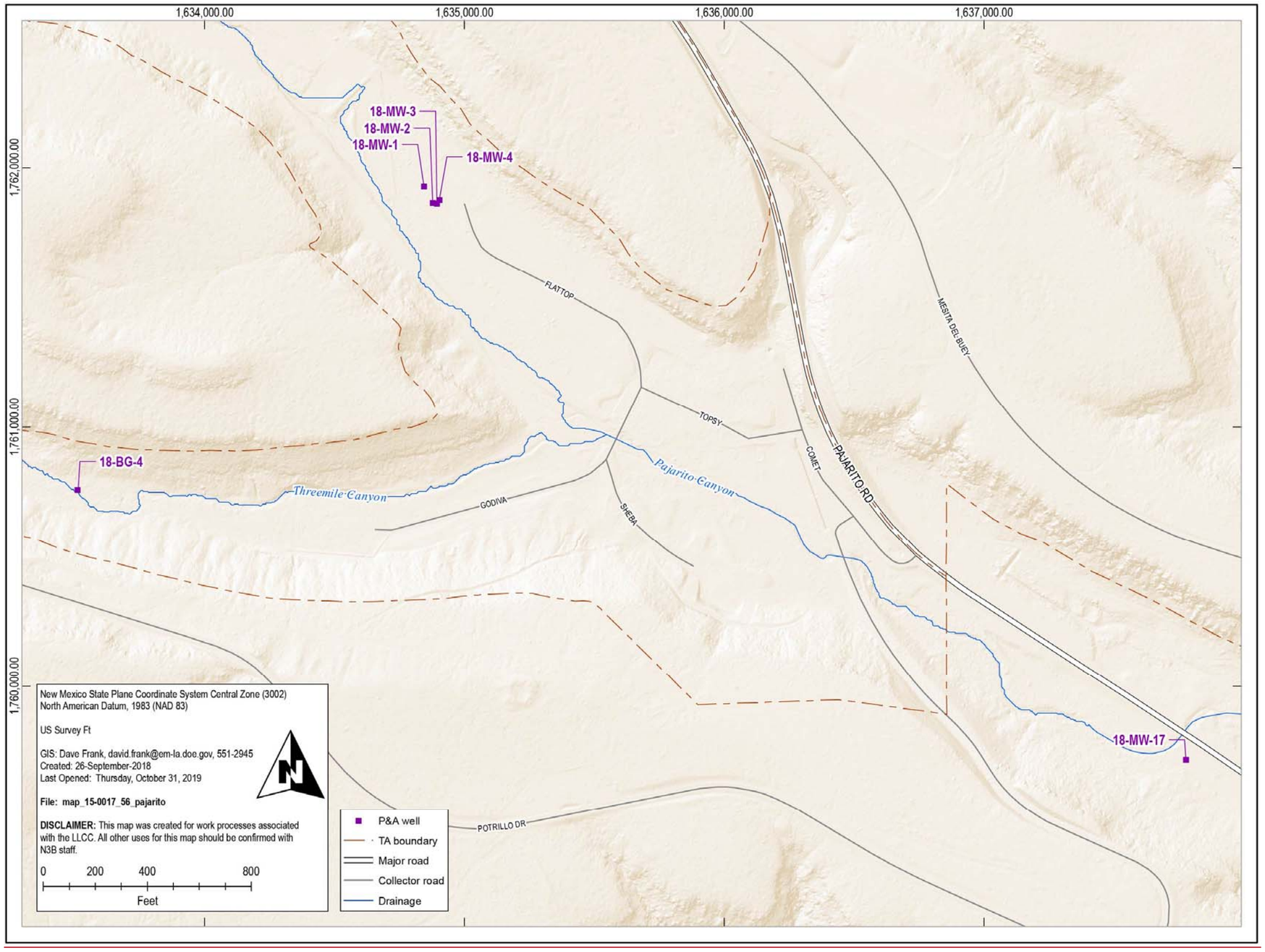


Figure 2.3-1 Locations of groundwater observation wells in Pajarito Canyon

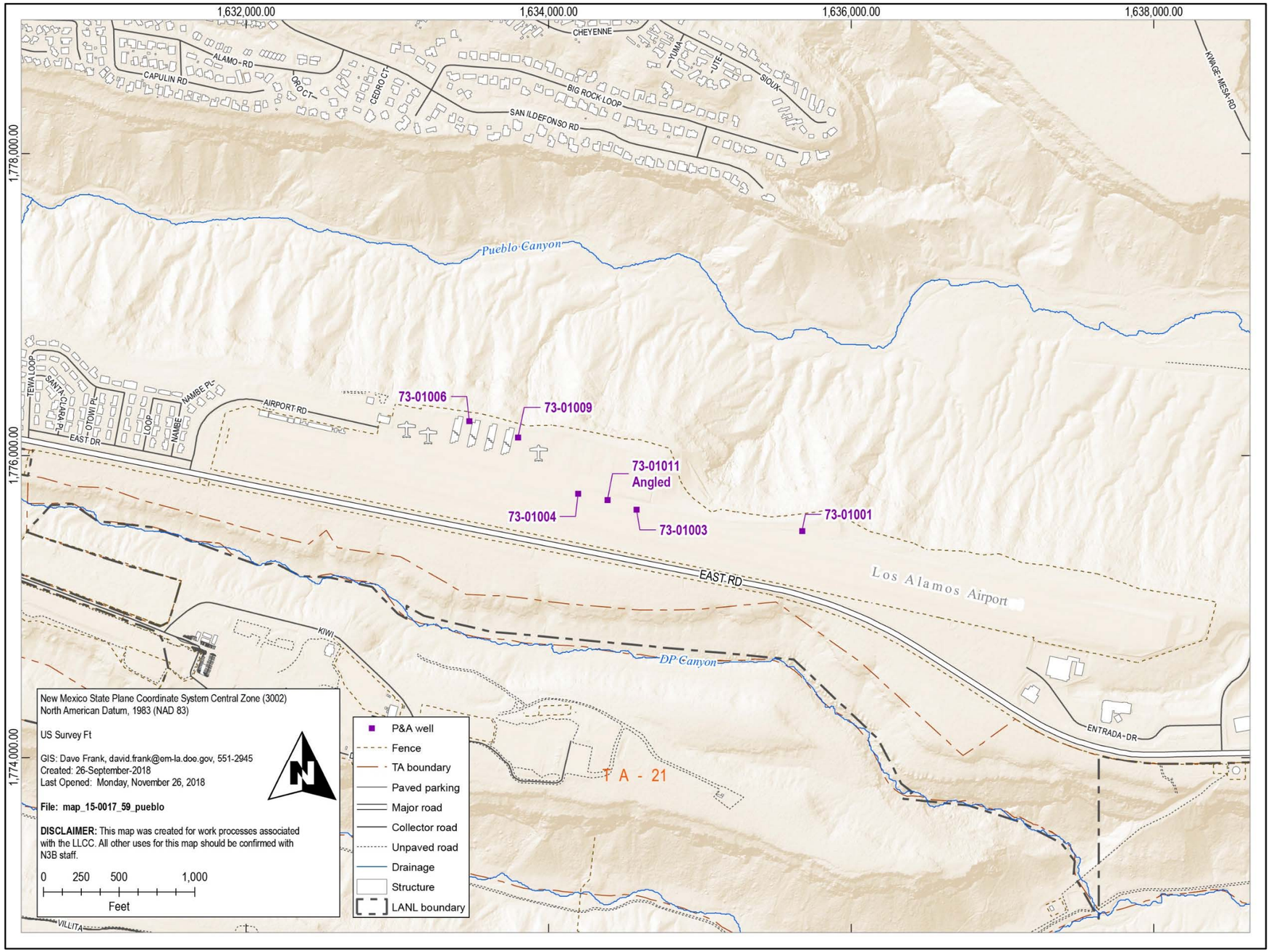


Figure 2.4-1 Locations of alluvial groundwater observation wells in Pueblo Canyon

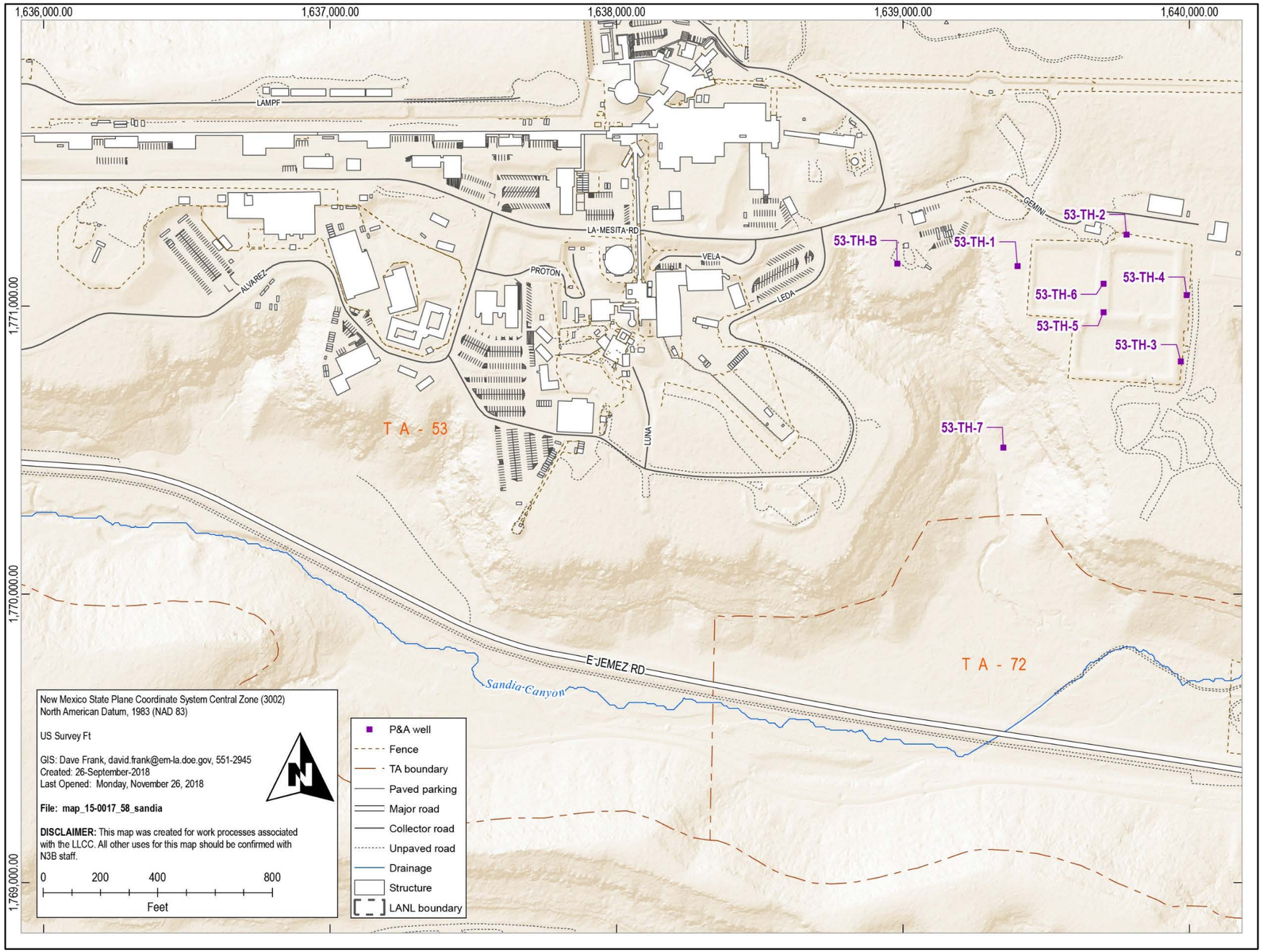


Figure 2.5-1 Locations of alluvial groundwater observation wells in Sandia Canyon

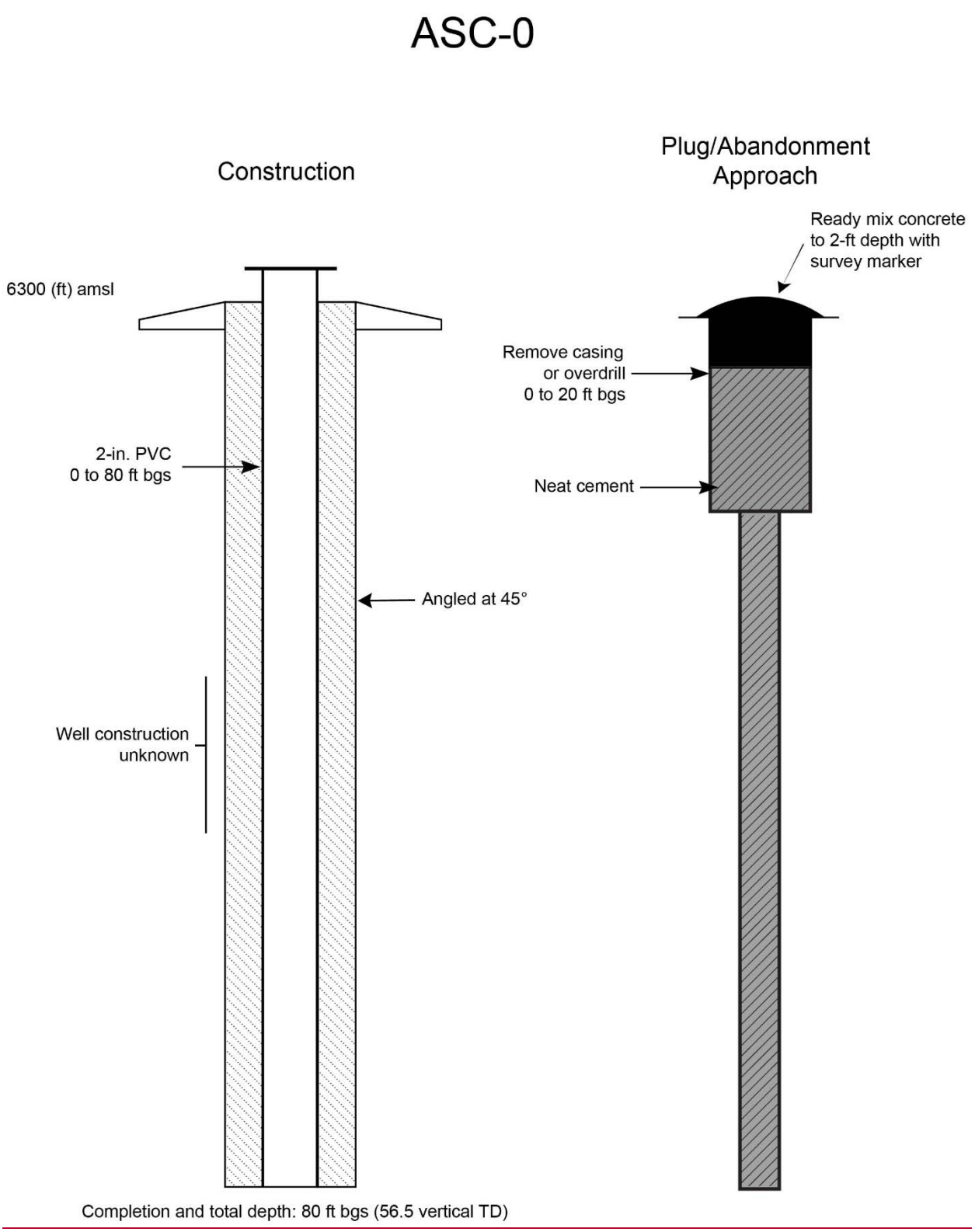


Figure 3.1-1 ASC-0 abandonment schematic

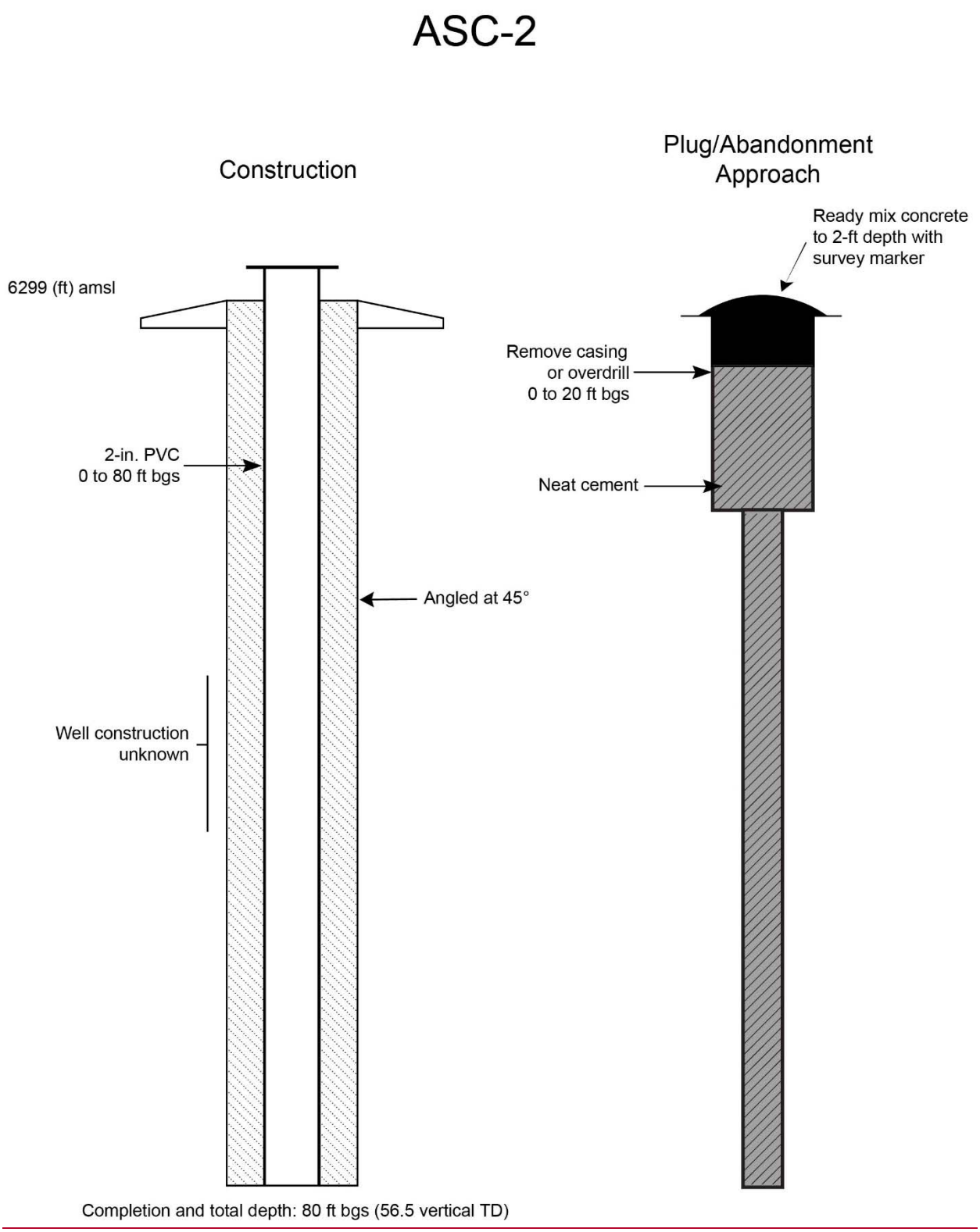


Figure 3.1-2 ASC-2 abandonment schematic

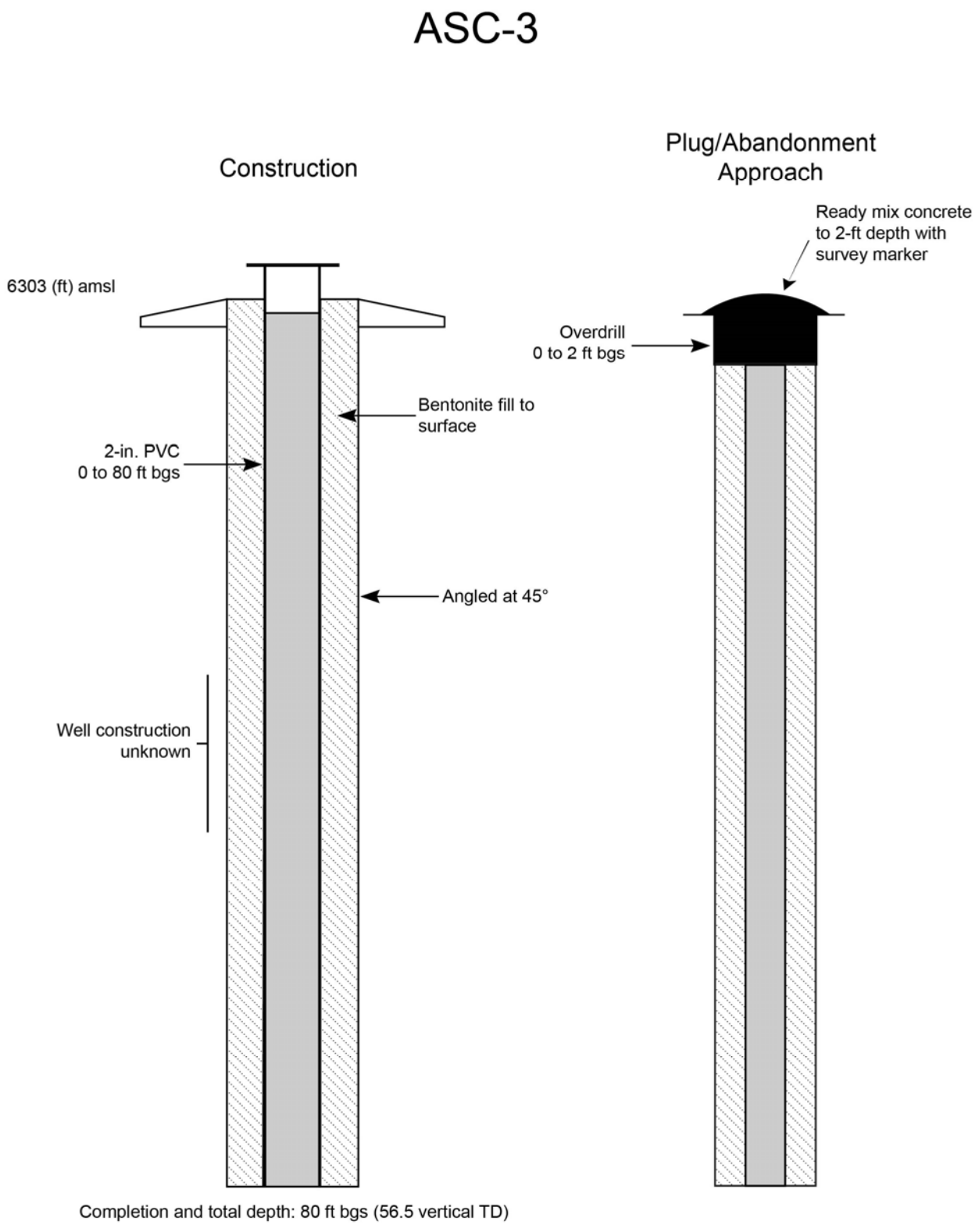


Figure 3.1-3 ASC-3 abandonment schematic

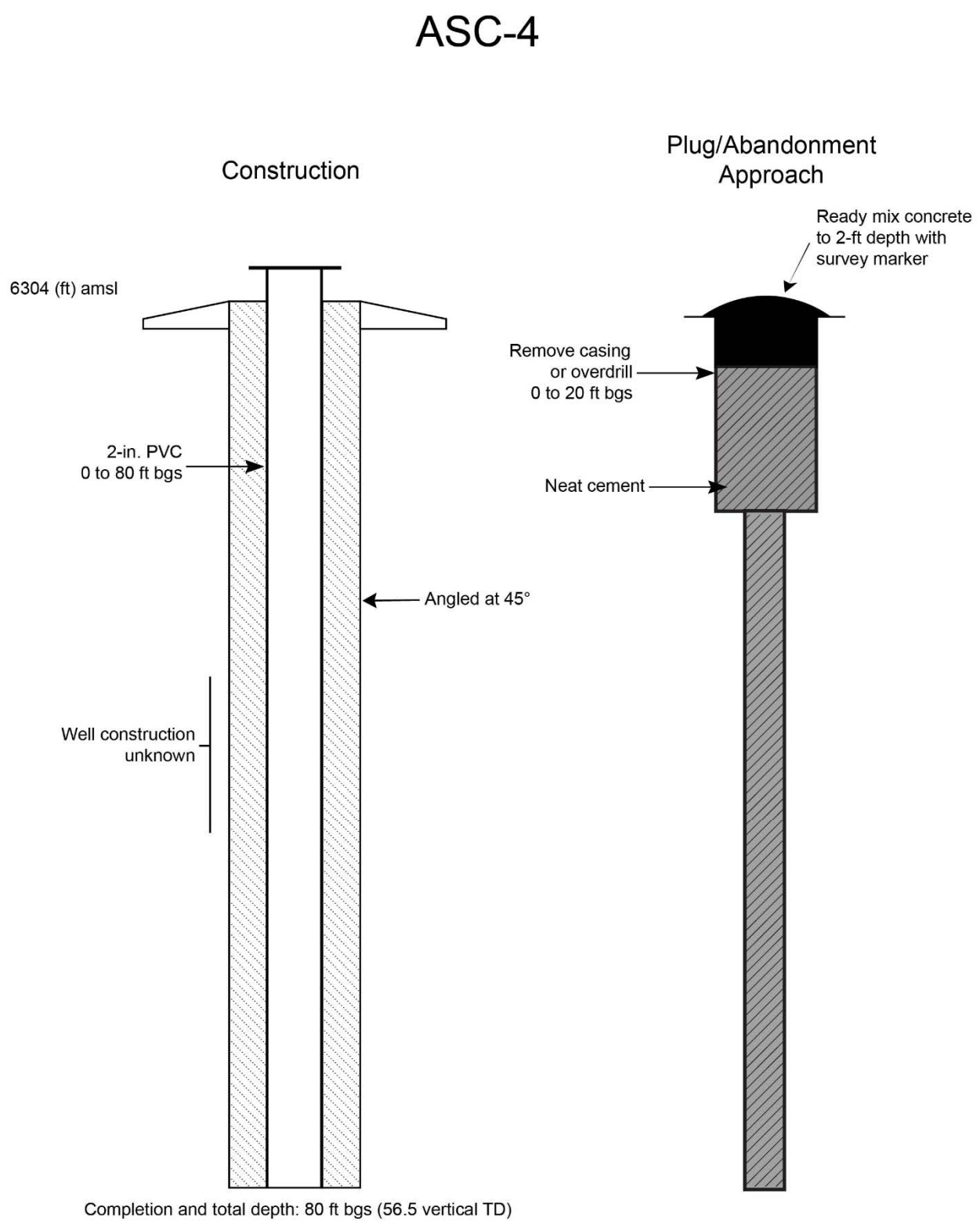


Figure 3.1-4 ASC-4 abandonment schematic

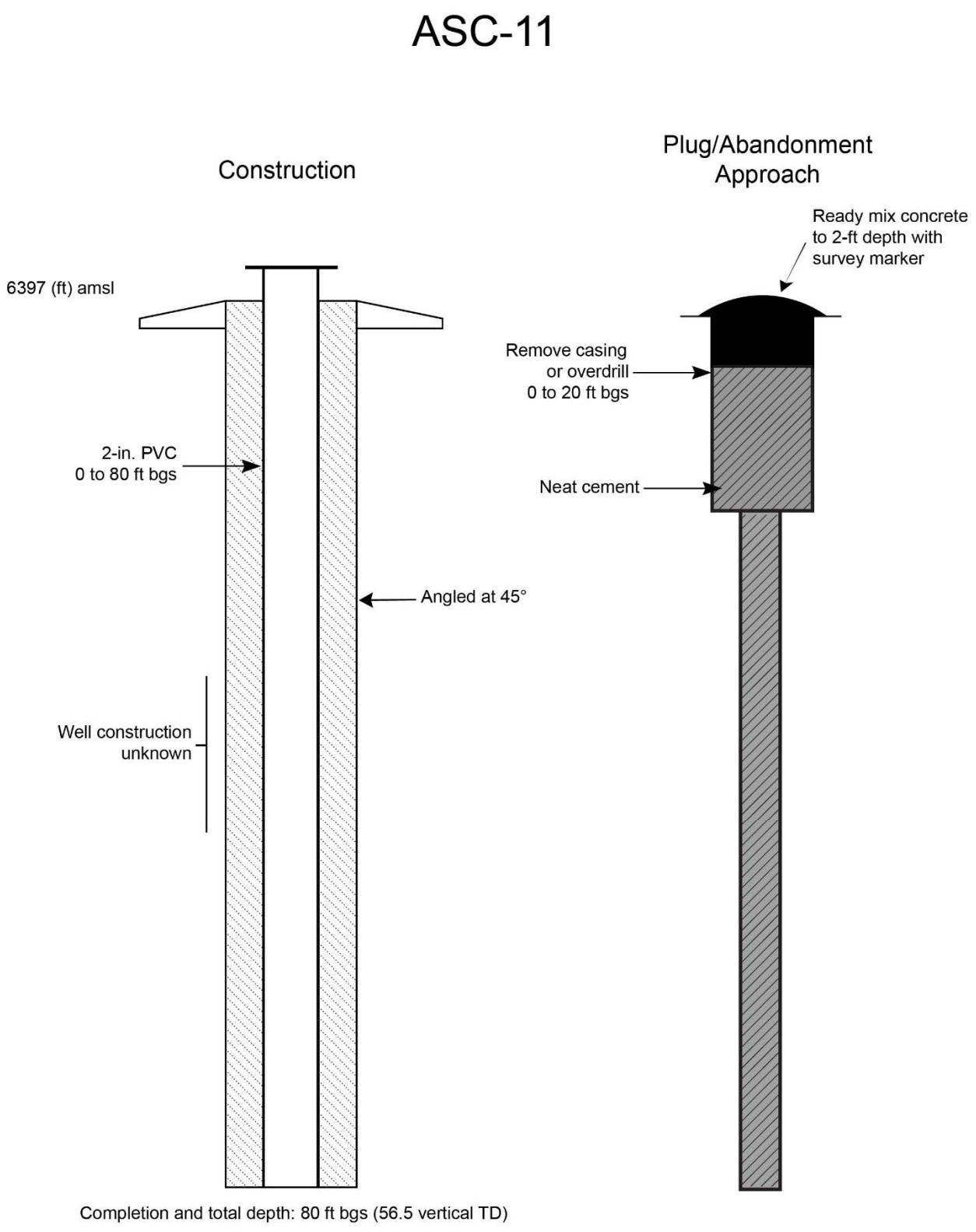


Figure 3.1-5 ASC-11 abandonment schematic

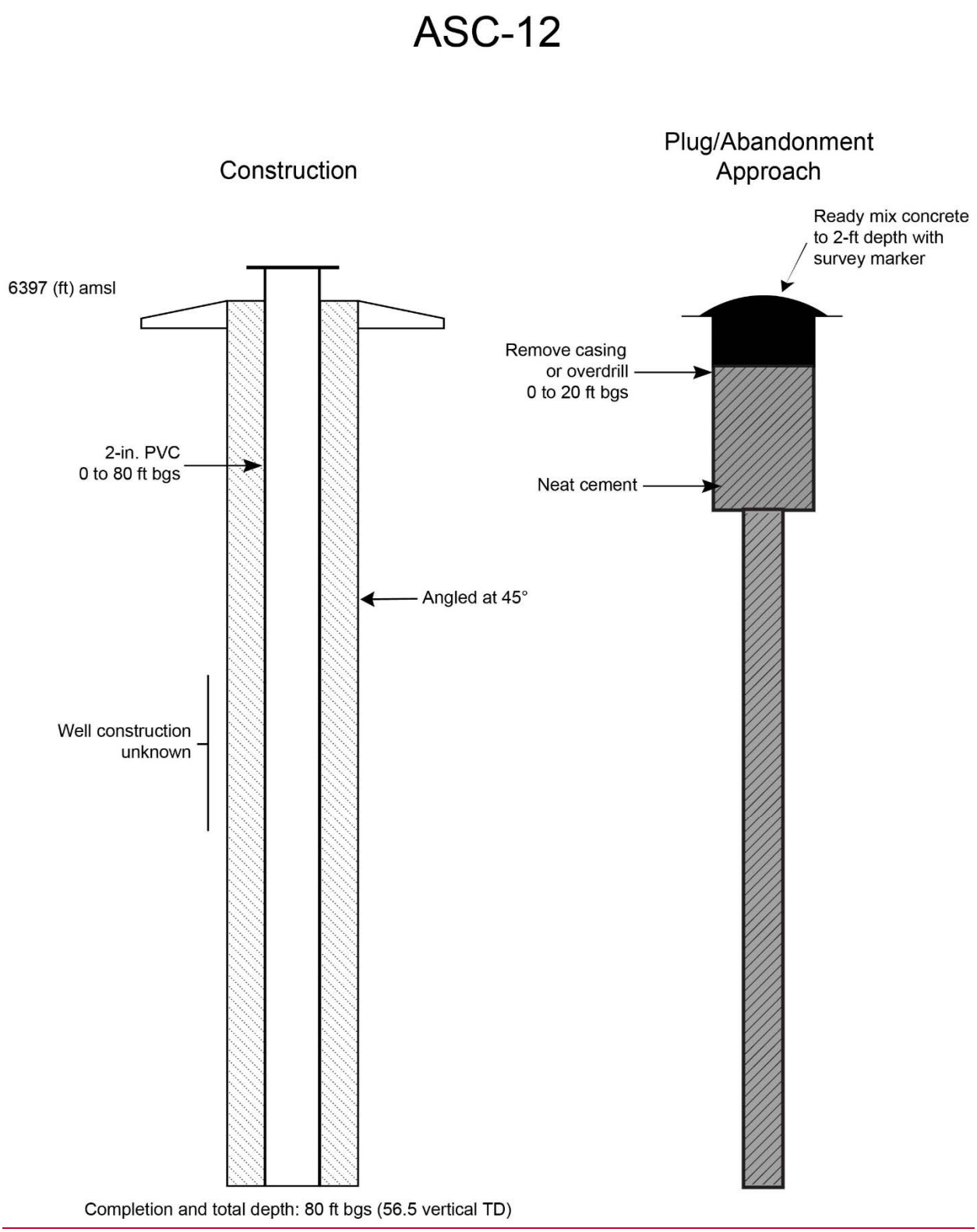


Figure 3.1-6 ASC-12 abandonment schematic

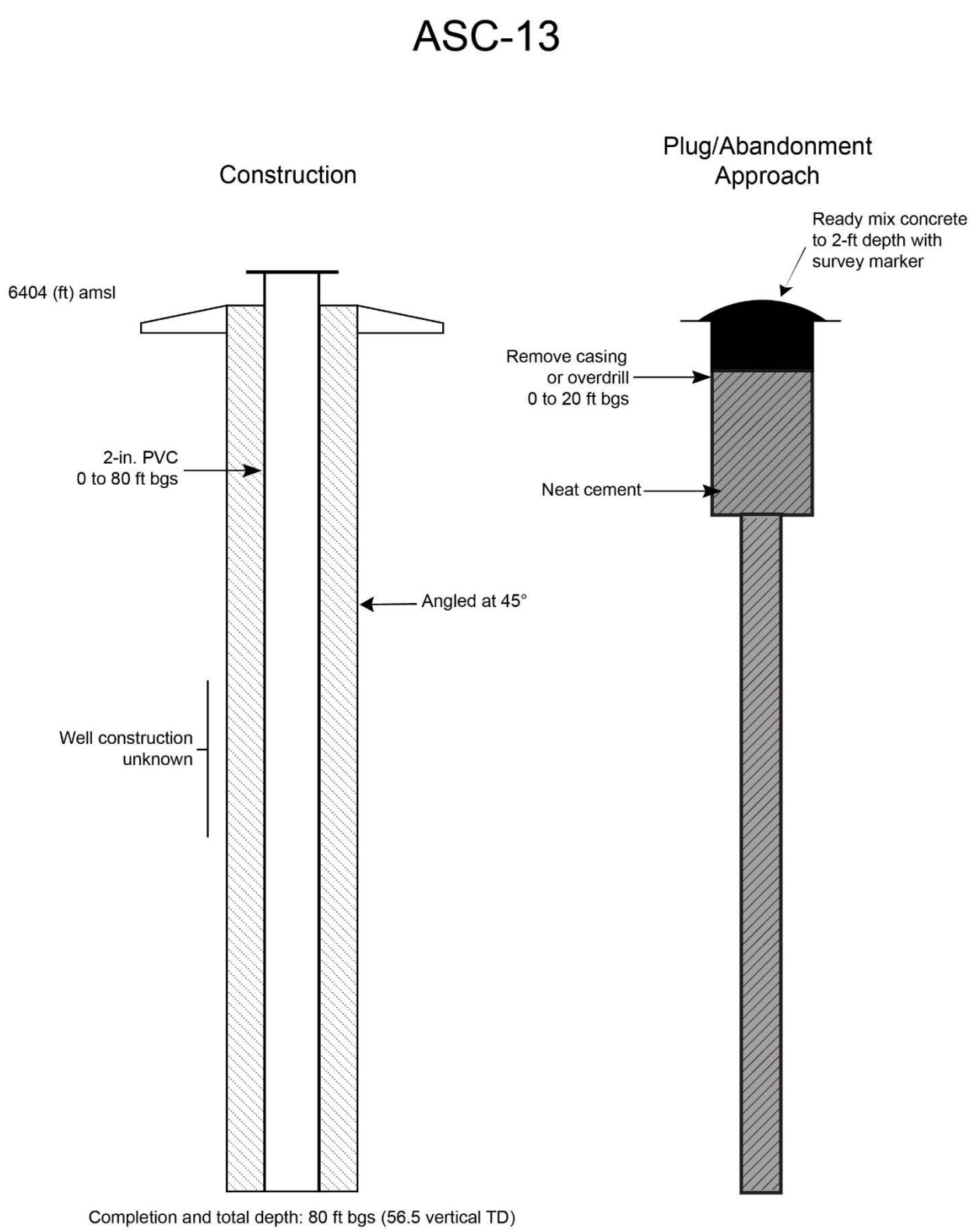


Figure 3.1-7 ASC-13 abandonment schematic

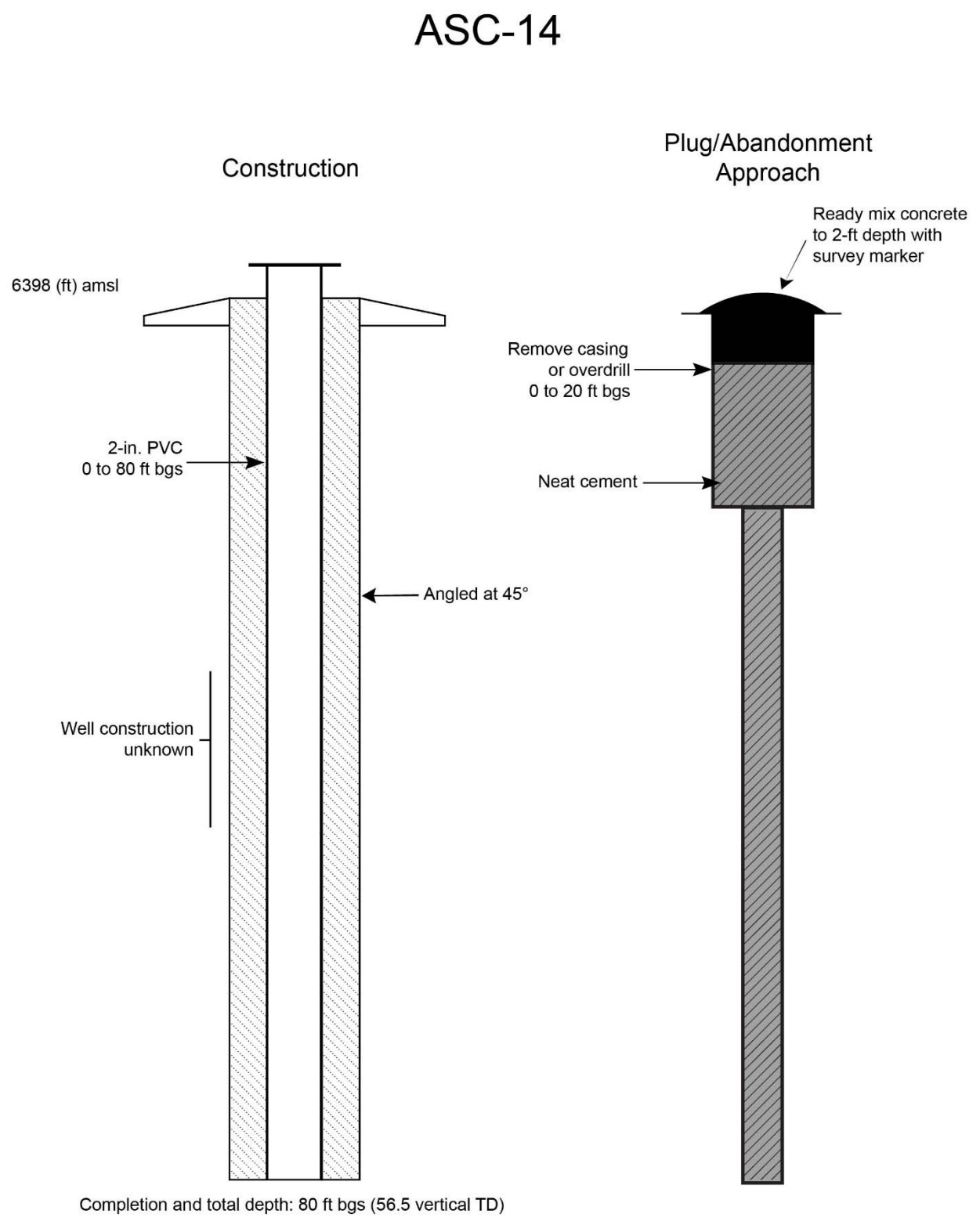


Figure 3.1-8 ASC-14 abandonment schematic

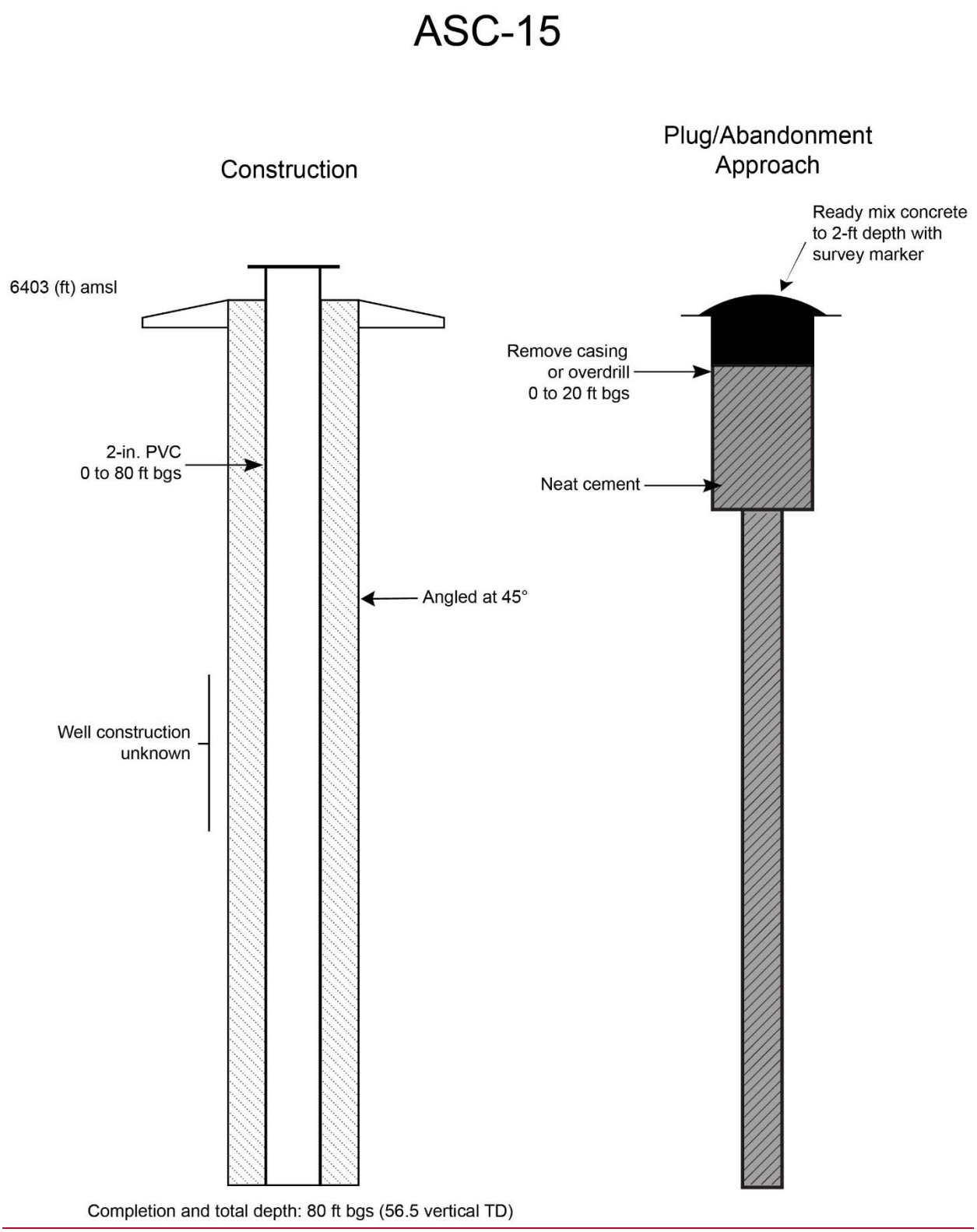


Figure 3.1-9 ASC-15 abandonment schematic

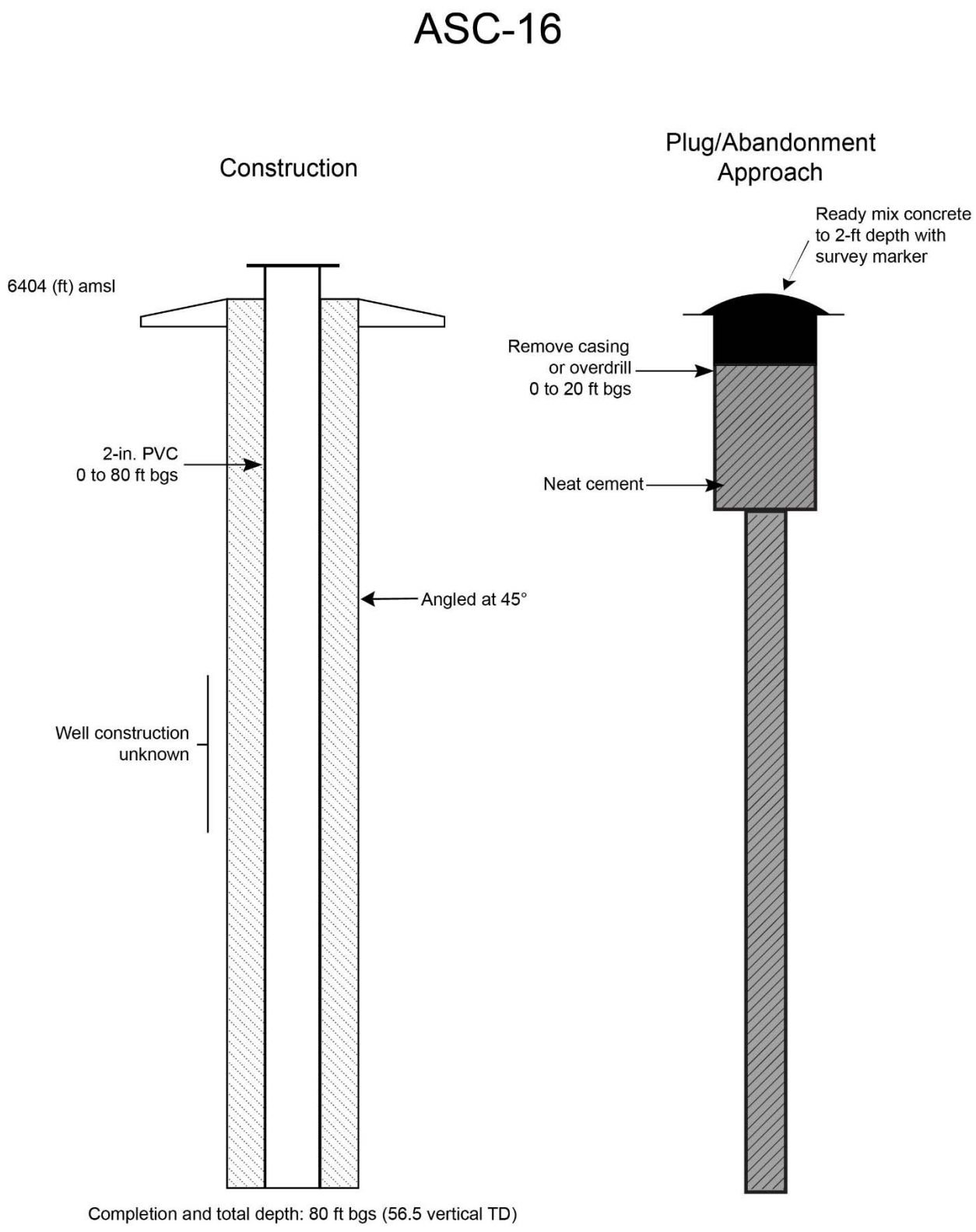


Figure 3.1-10 ASC-16 abandonment schematic

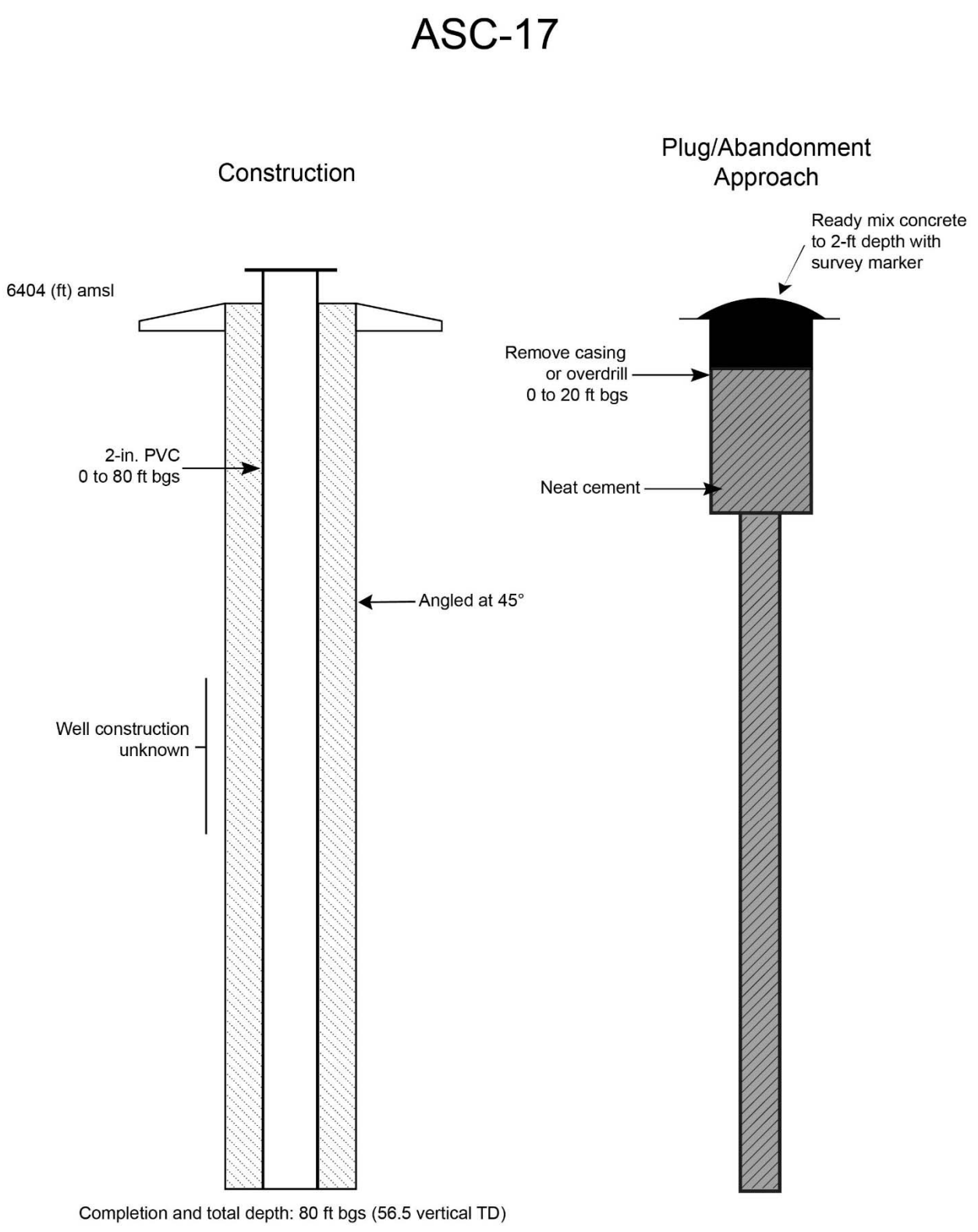


Figure 3.1-11 ASC-17 abandonment schematic

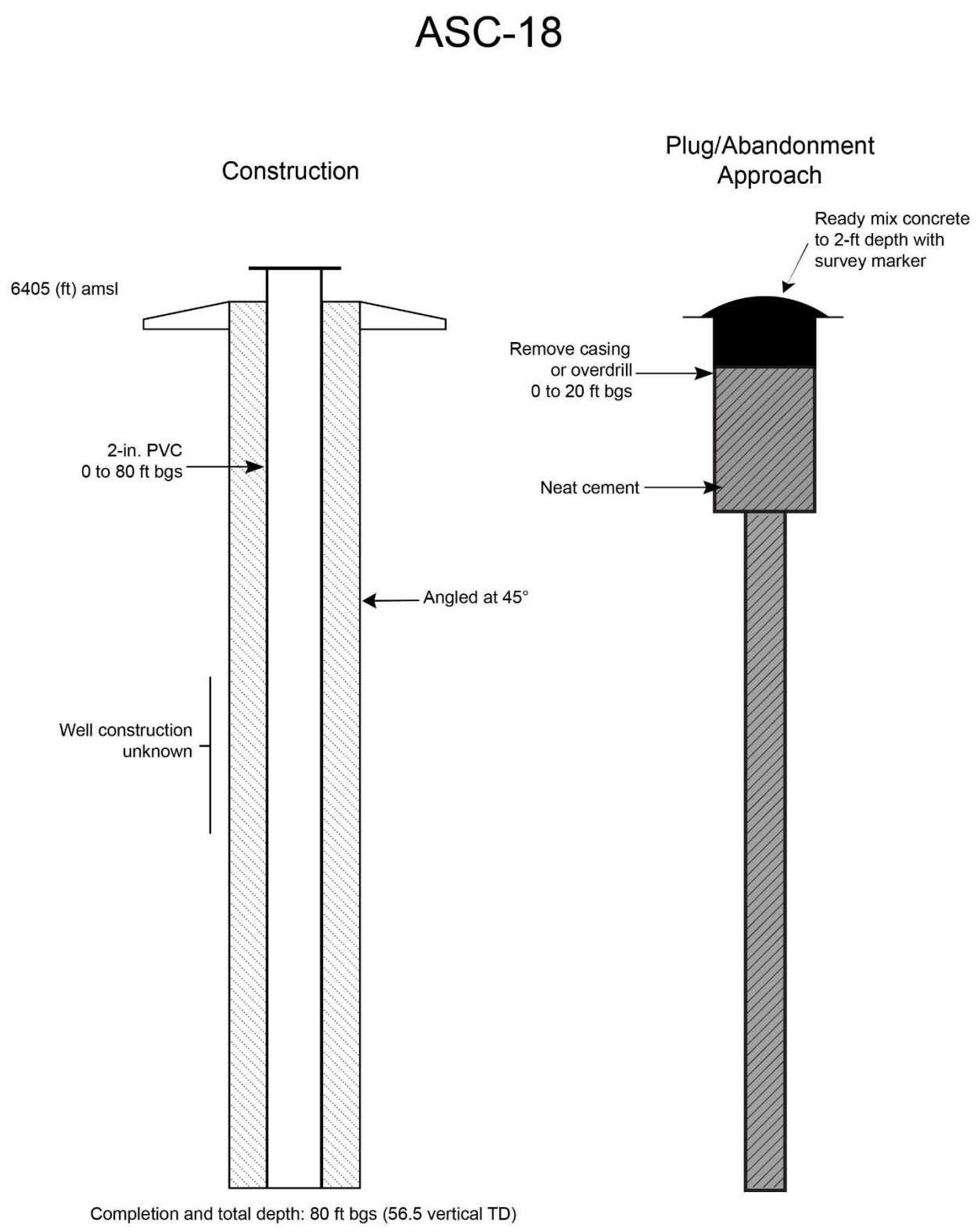


Figure 3.1-12 ASC-18 abandonment schematic

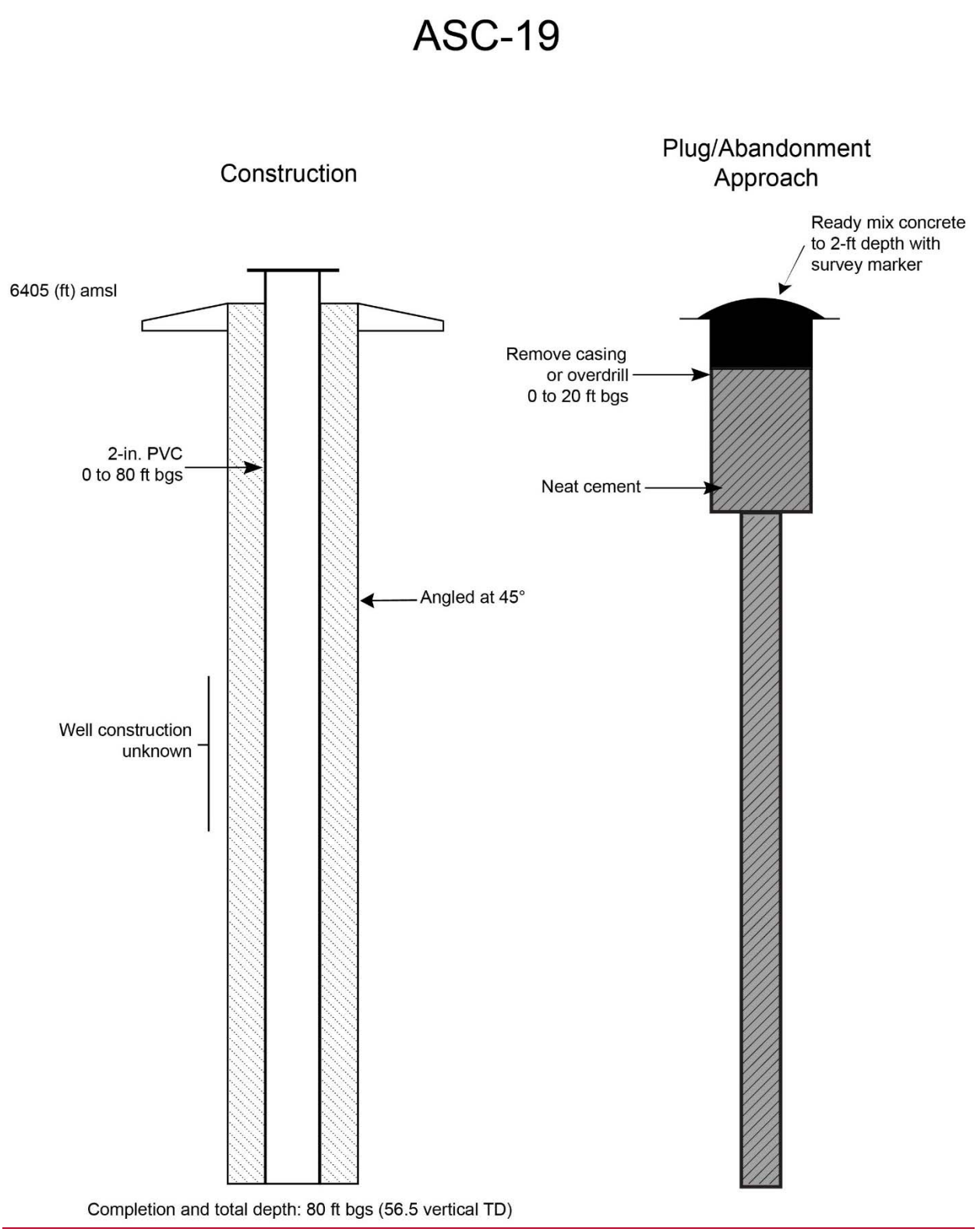


Figure 3.1-13 ASC-19 abandonment schematic

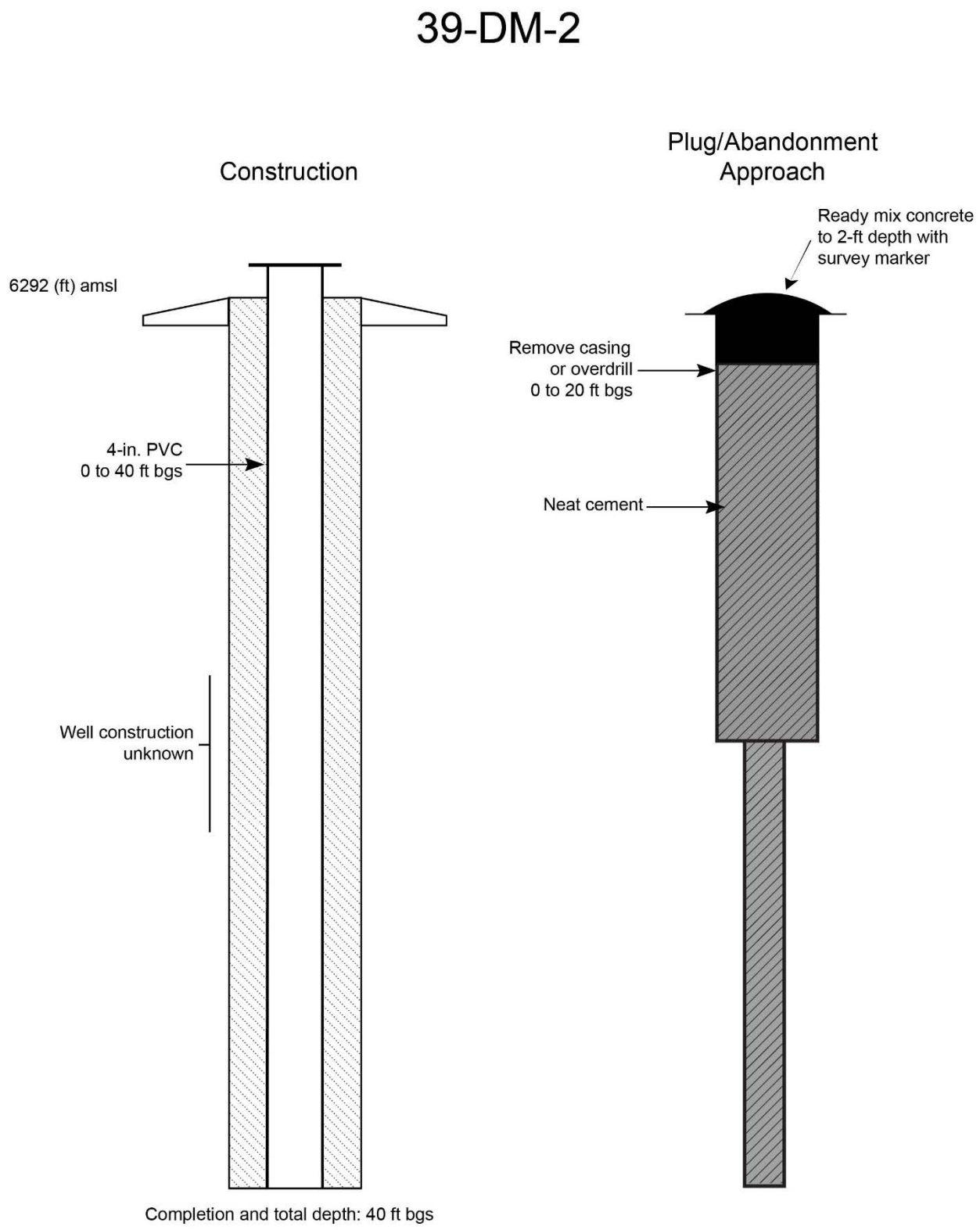


Figure 3.1-14 39-DM-2 abandonment schematic

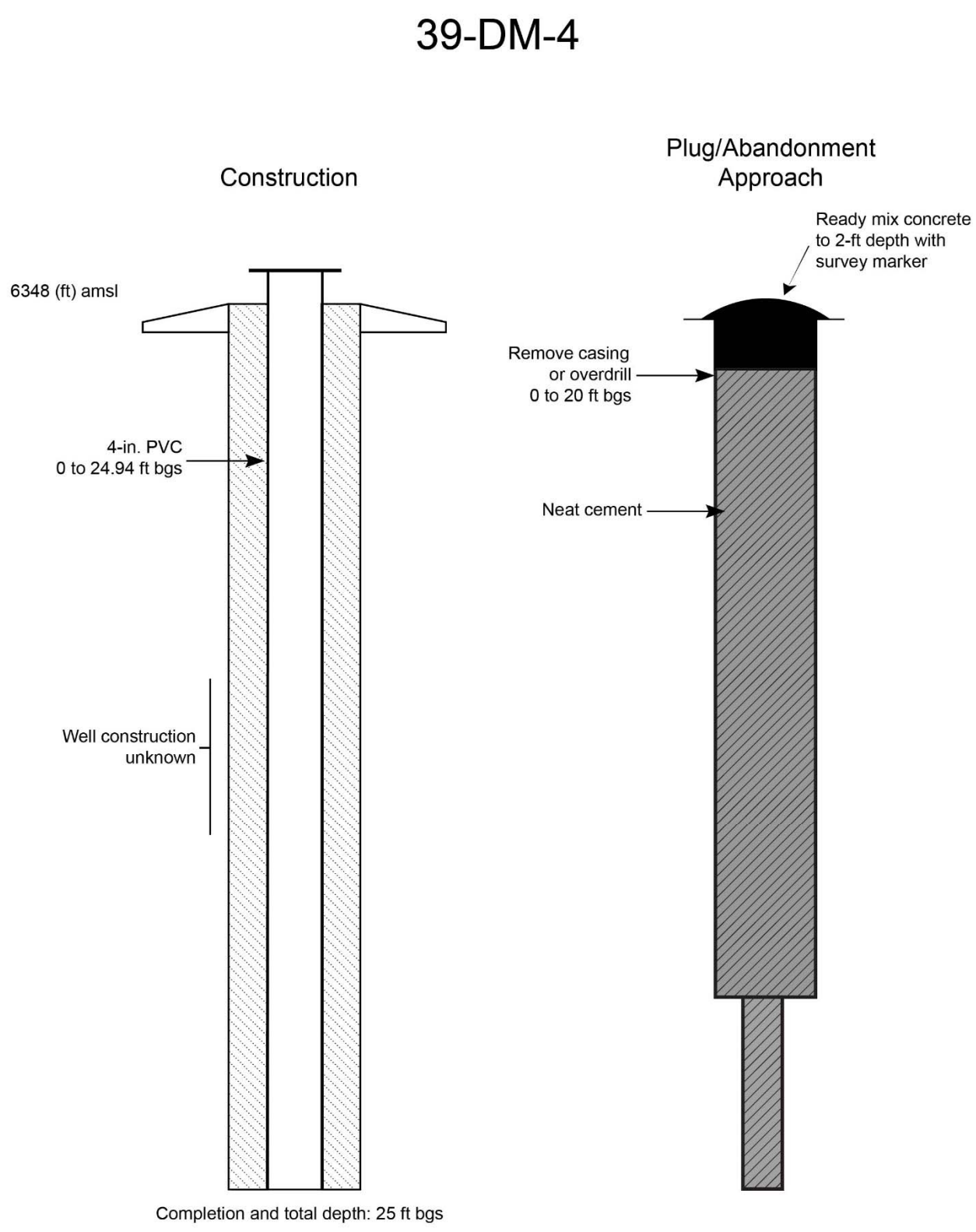


Figure 3.1-15 39-DM-4 abandonment schematic

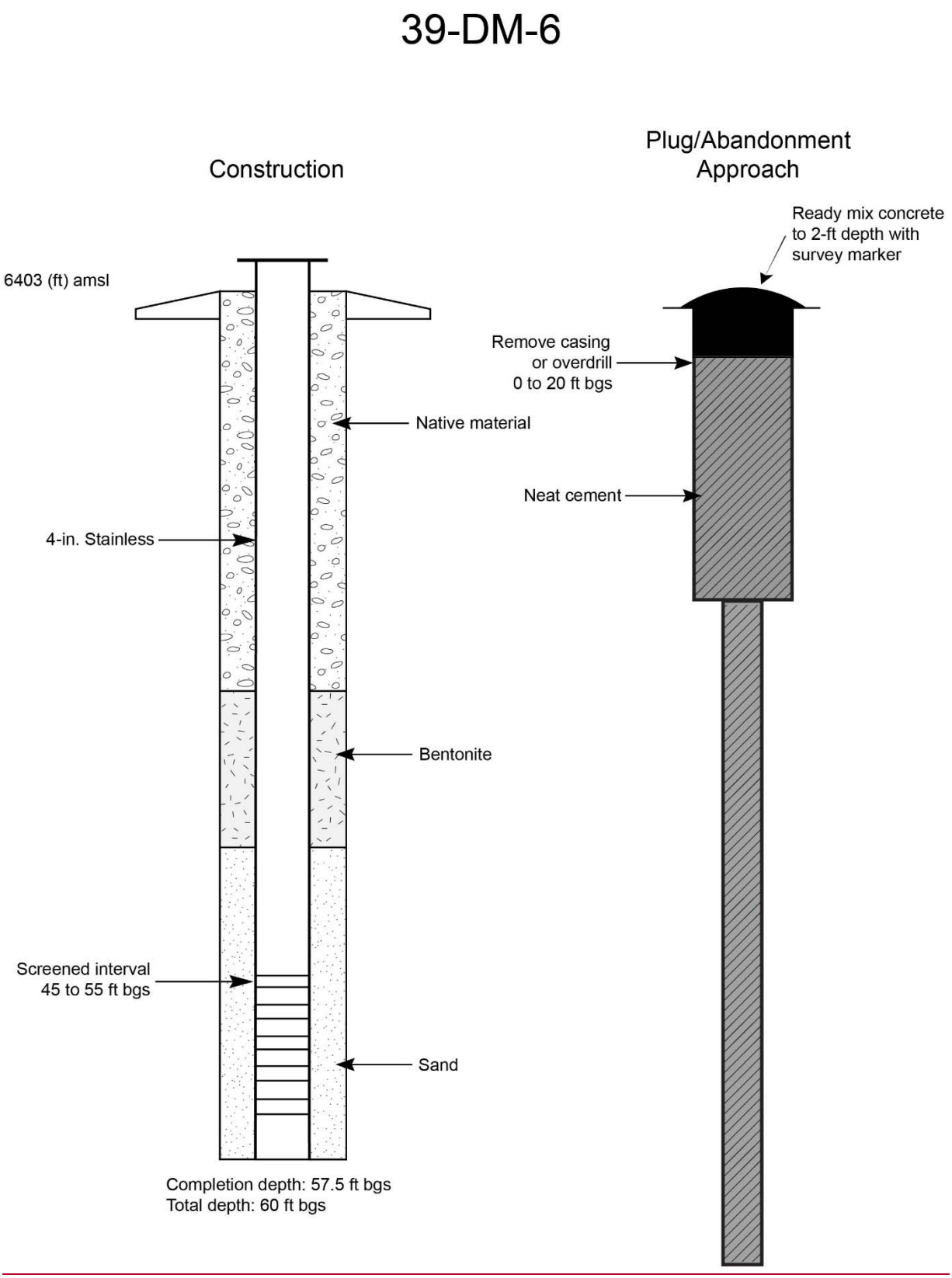


Figure 3.1-16 39-DM-6 abandonment schematic

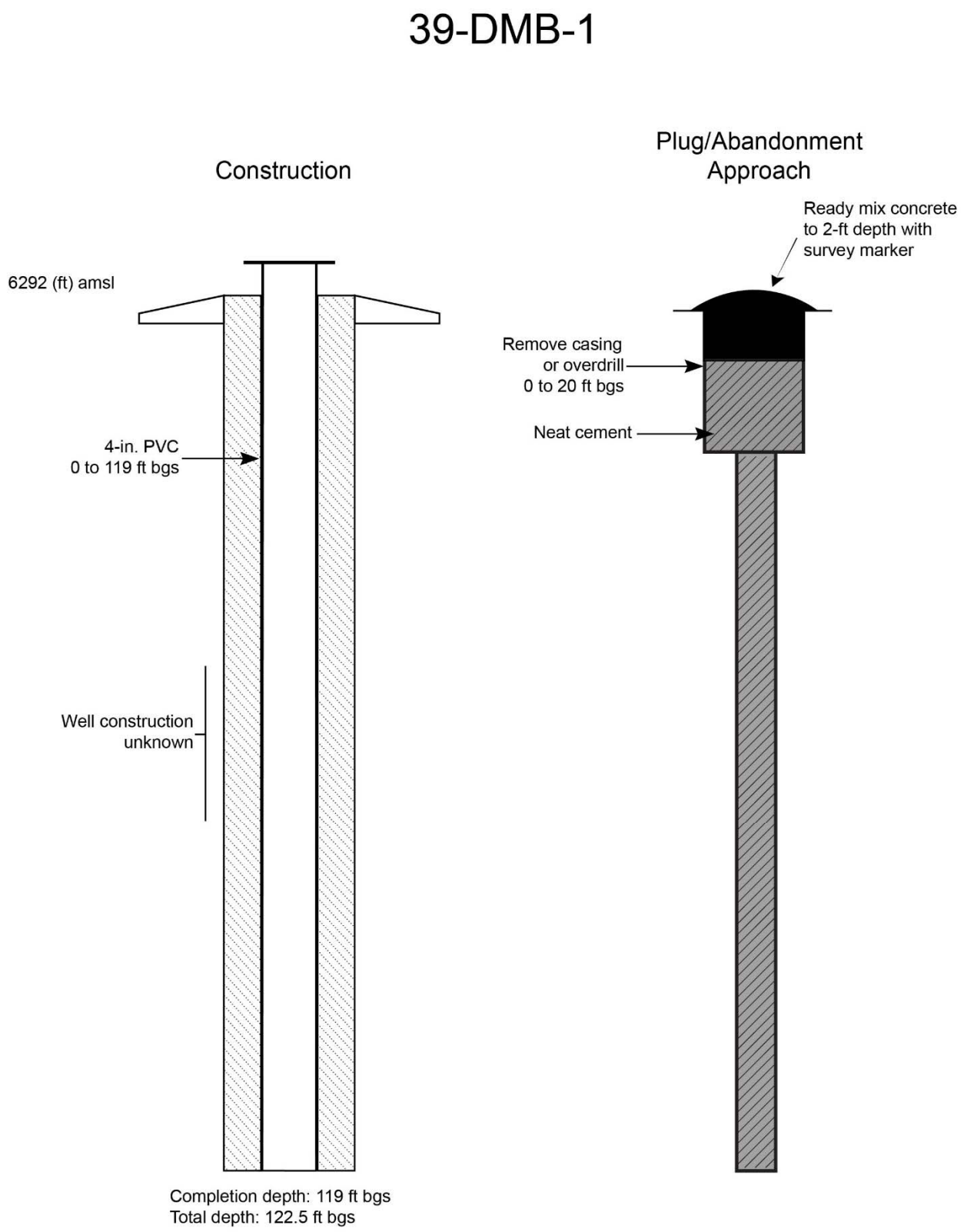


Figure 3.1-17 39-DMB-1 abandonment schematic

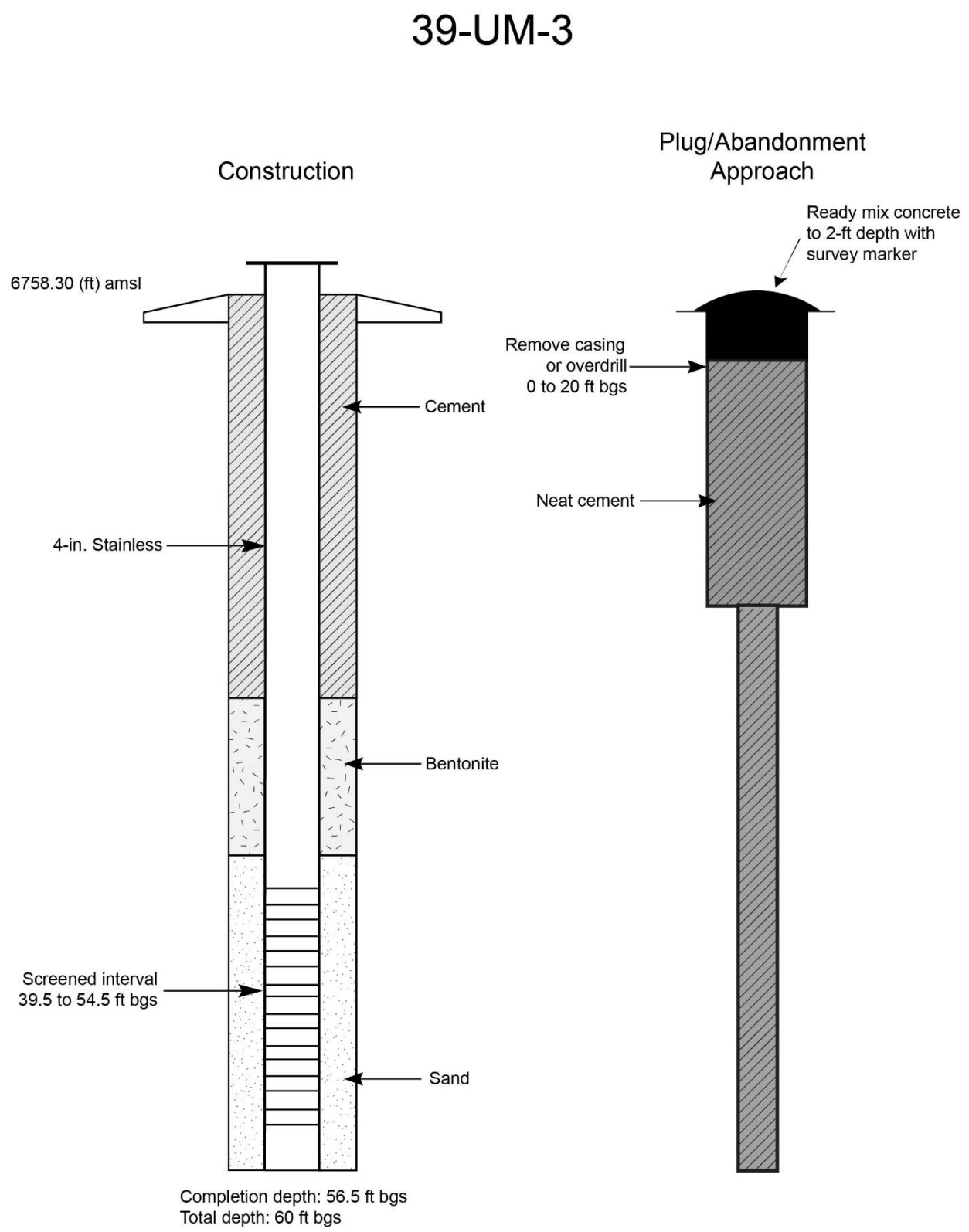


Figure 3.1-18 39-UM-3 abandonment schematic

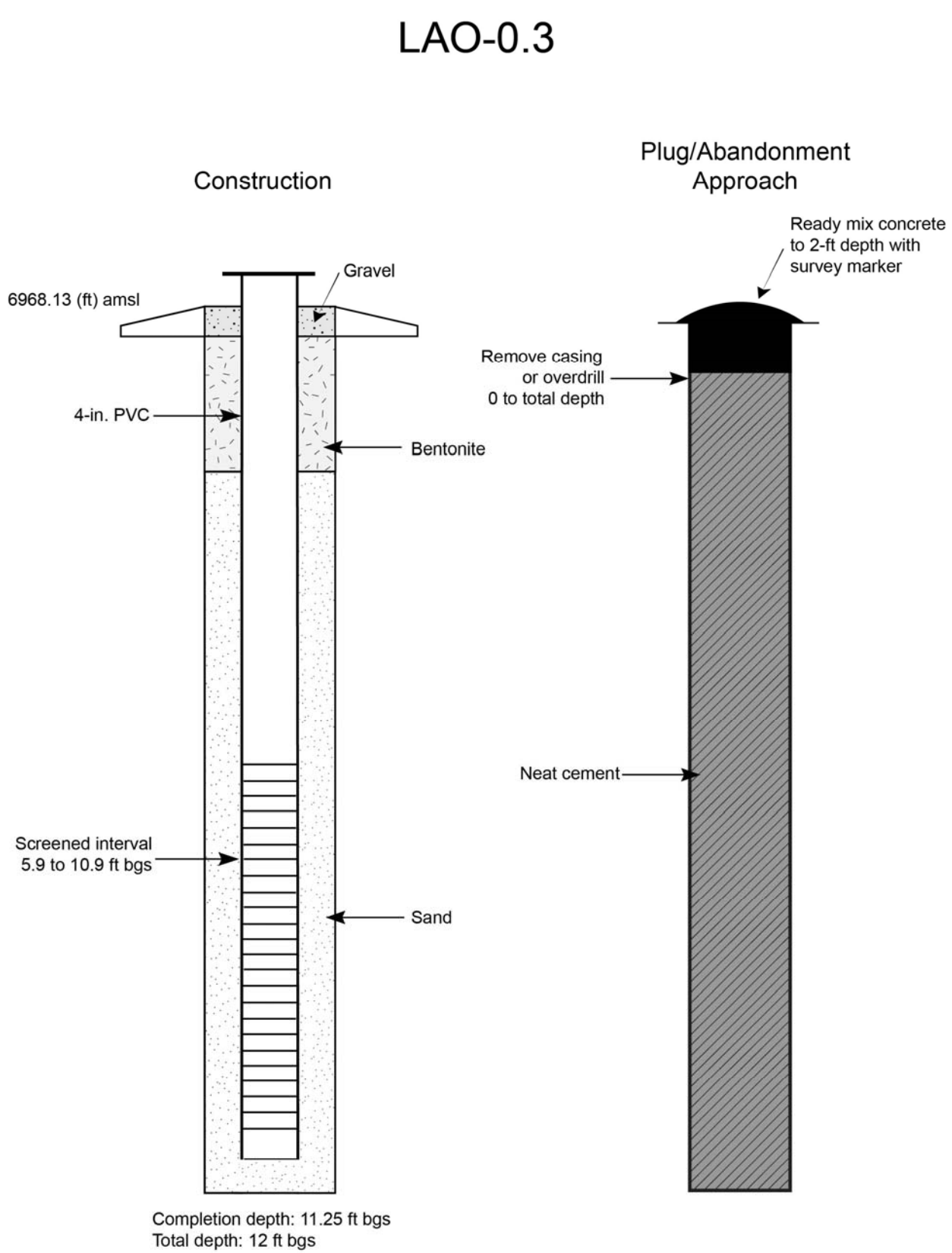
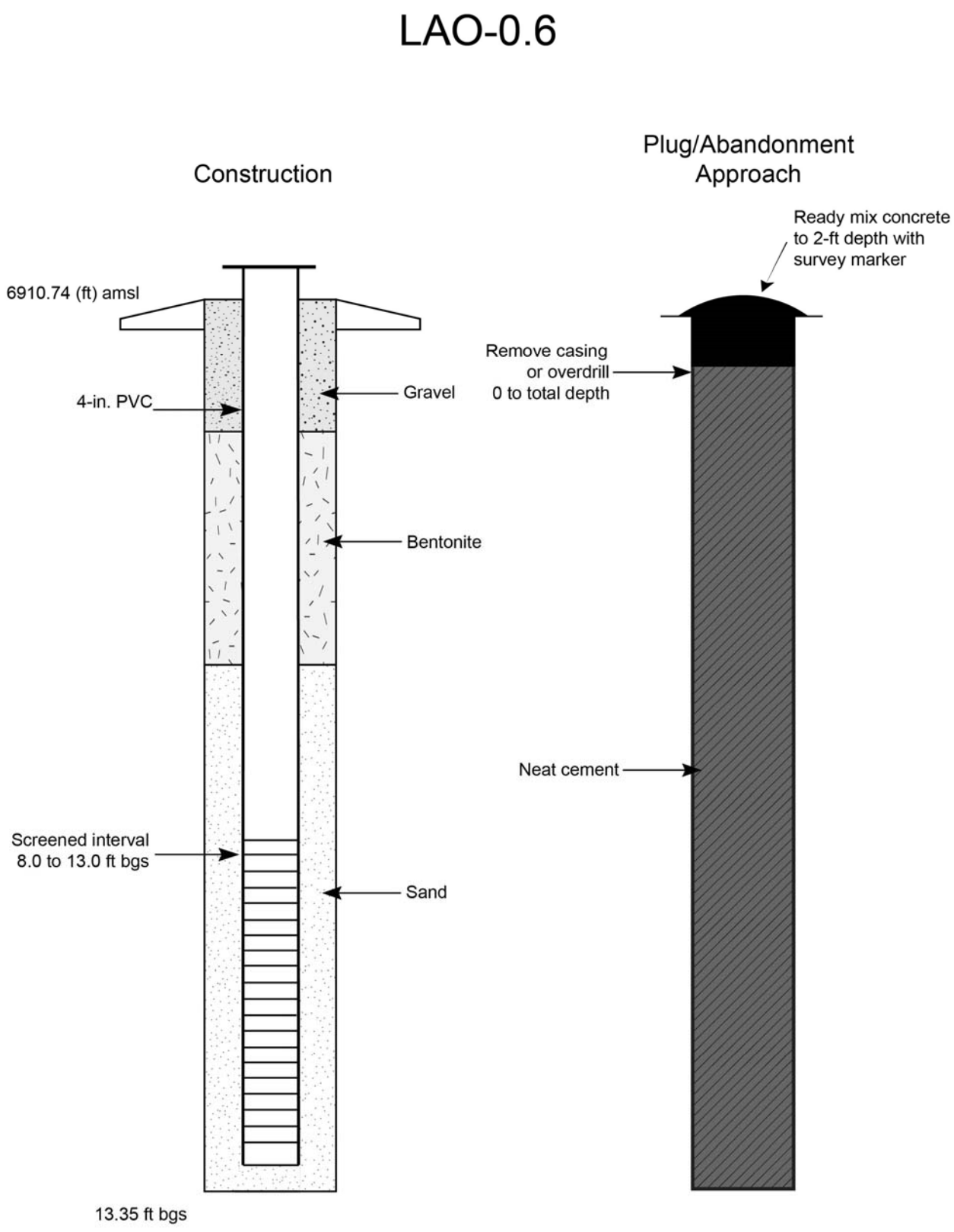


Figure 3.2-1 LAO-0.3 abandonment schematic



~~**Figure 3.2-2 LAO-0.6 abandonment schematic**~~

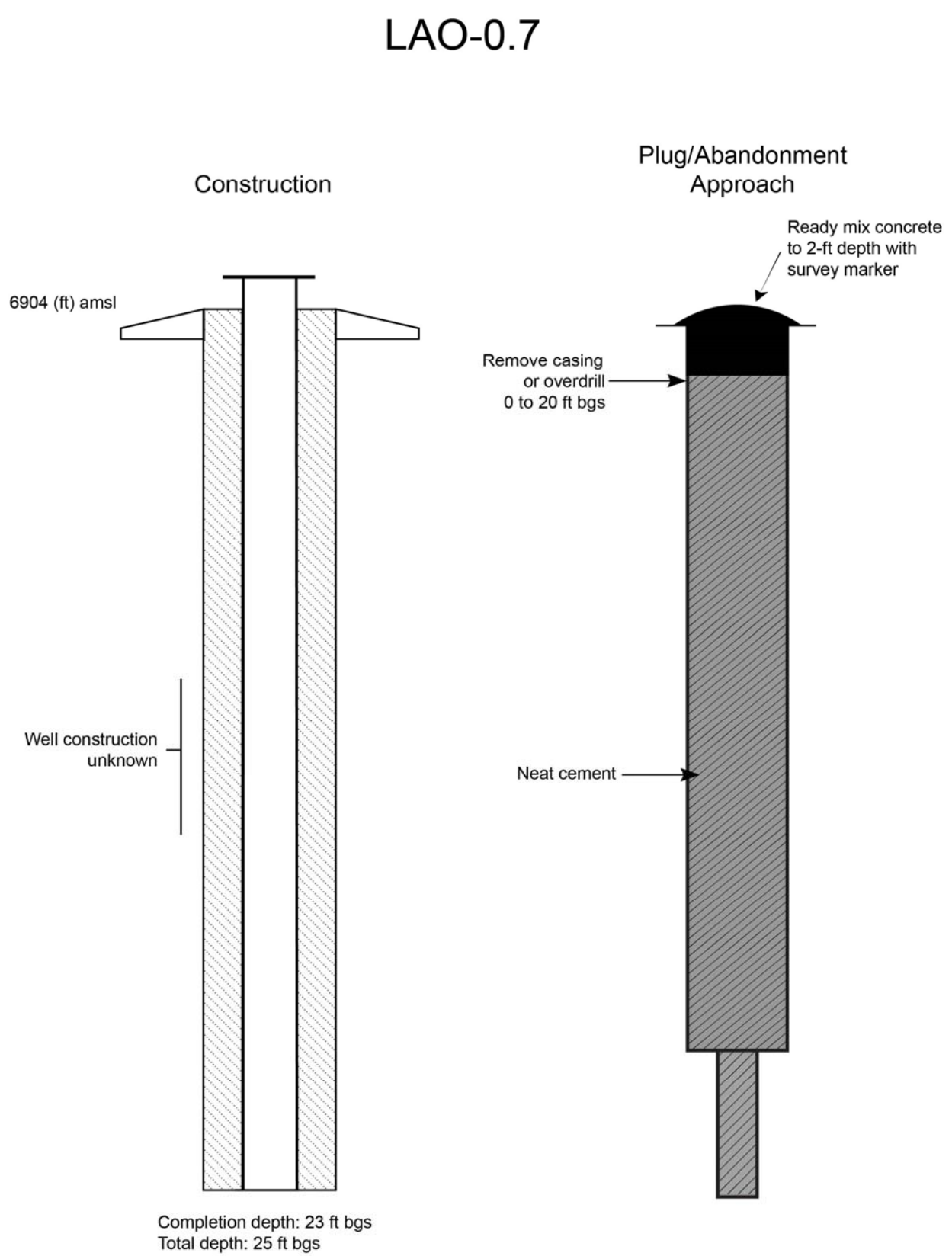


Figure 3.2-~~3~~2 LAO-0.7 abandonment schematic

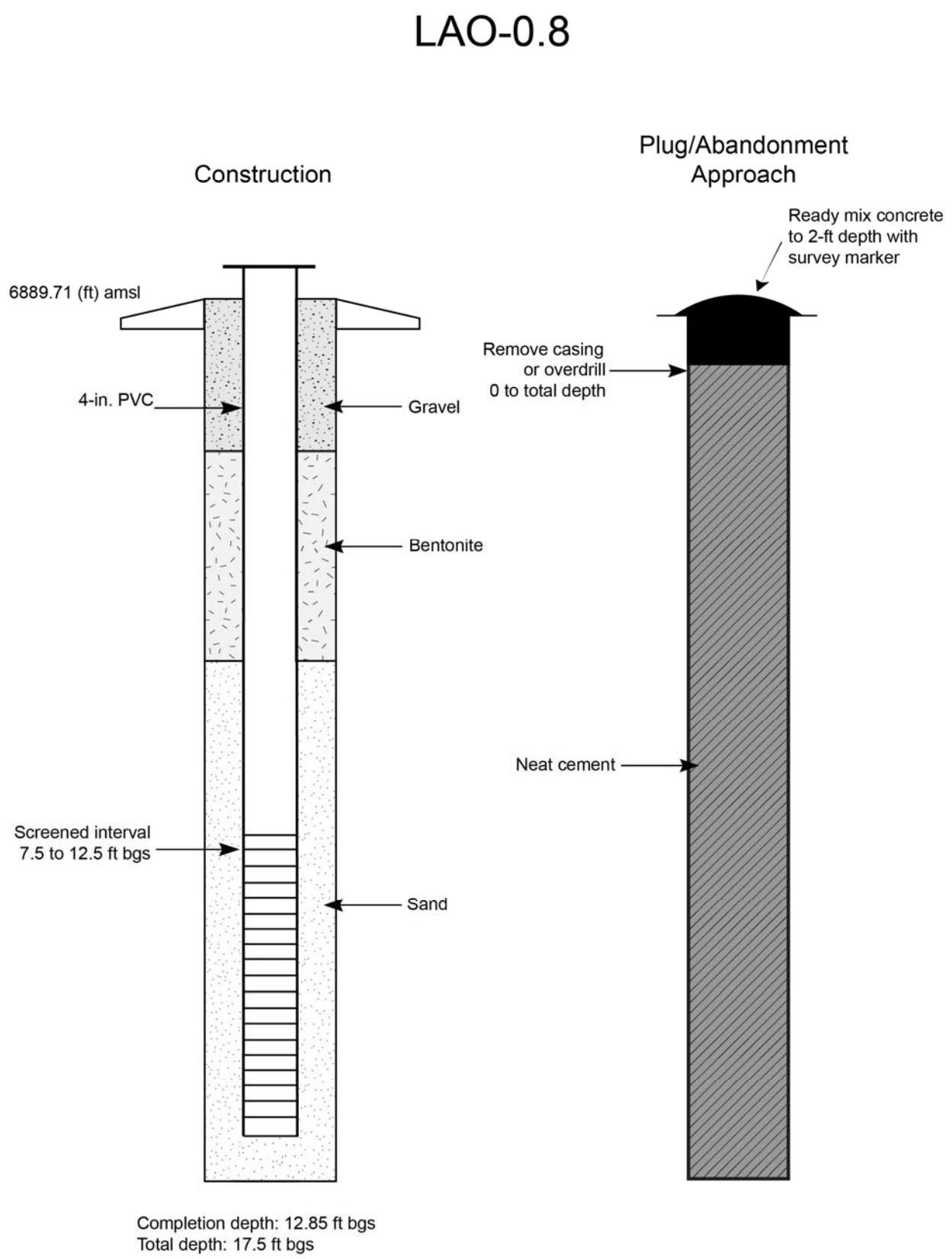


Figure 3.2-43 LAO-0.8 abandonment schematic

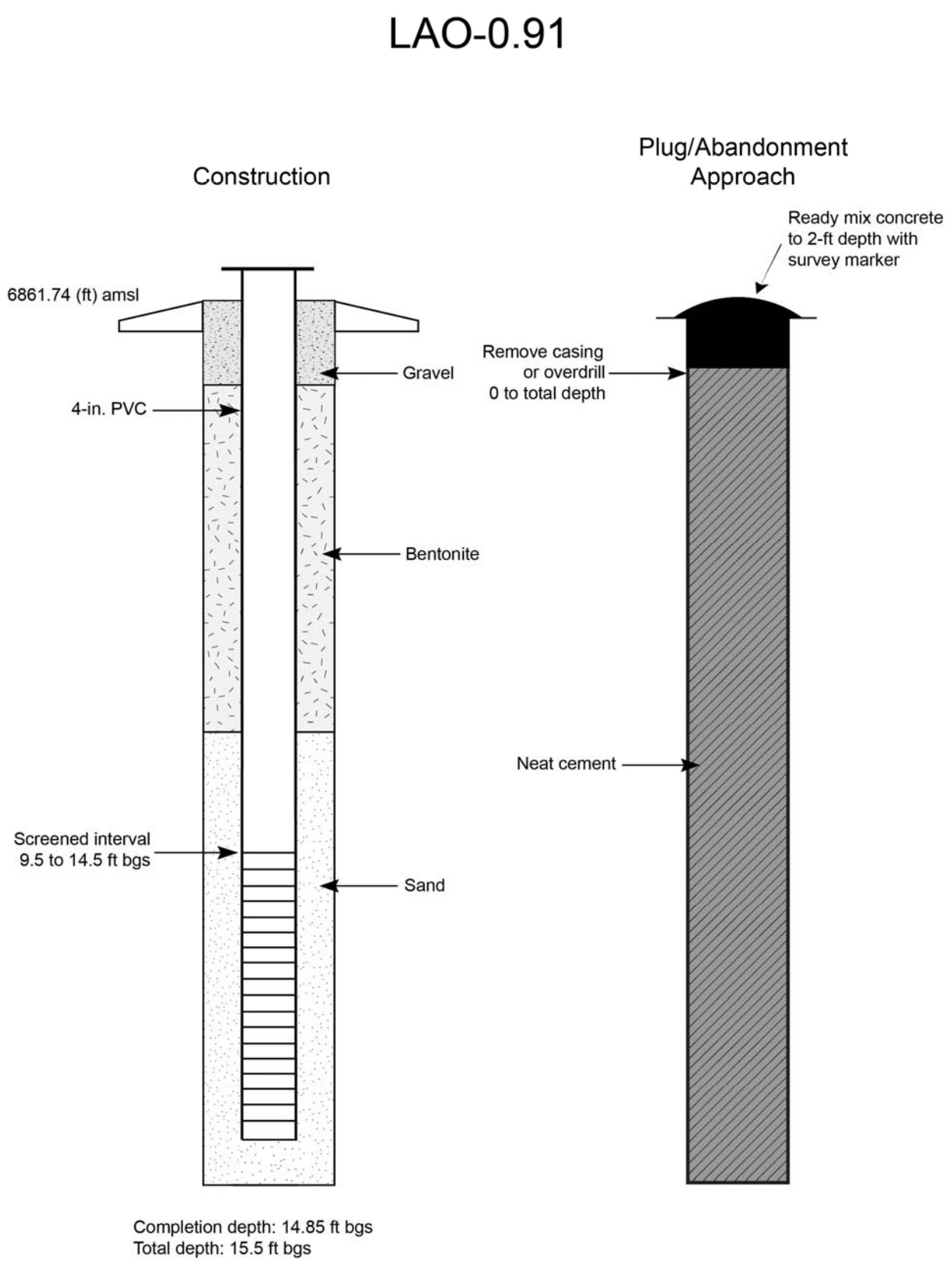


Figure 3.2-~~54~~ 54 LAO-0.91 abandonment schematic

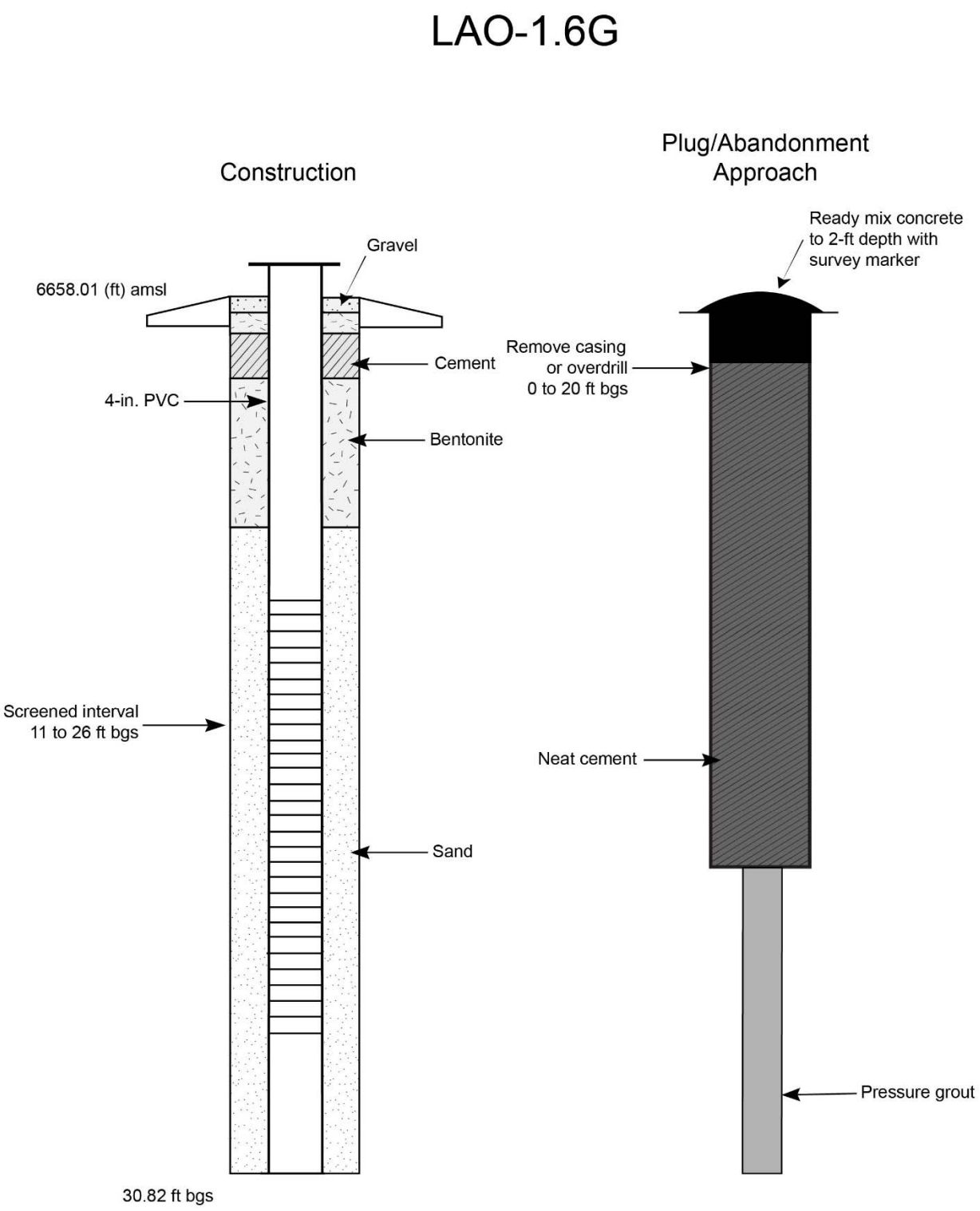


Figure 3.2-6 LAO-1.6G abandonment schematic

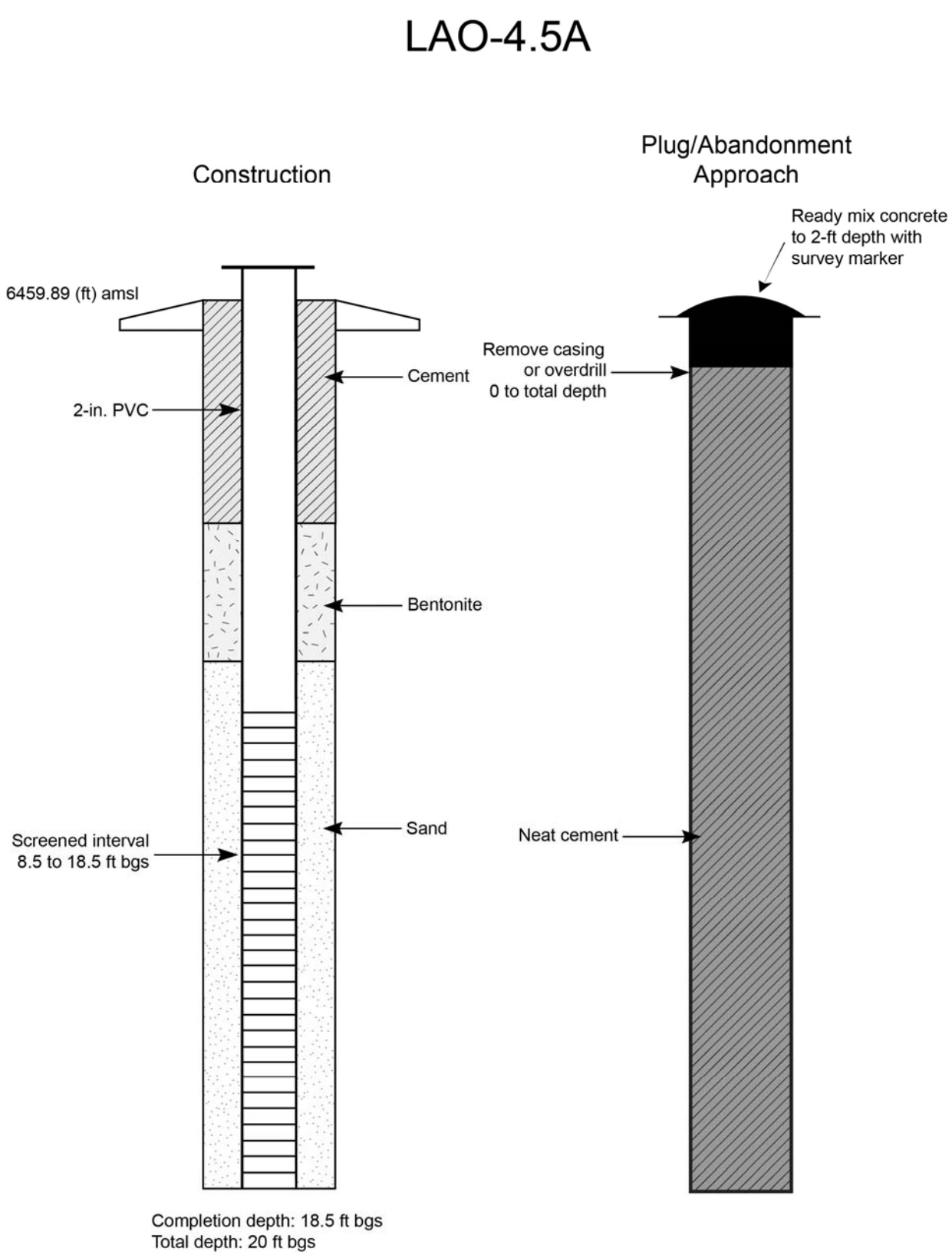


Figure 3.2-~~7~~5 LAO-4.5A abandonment schematic

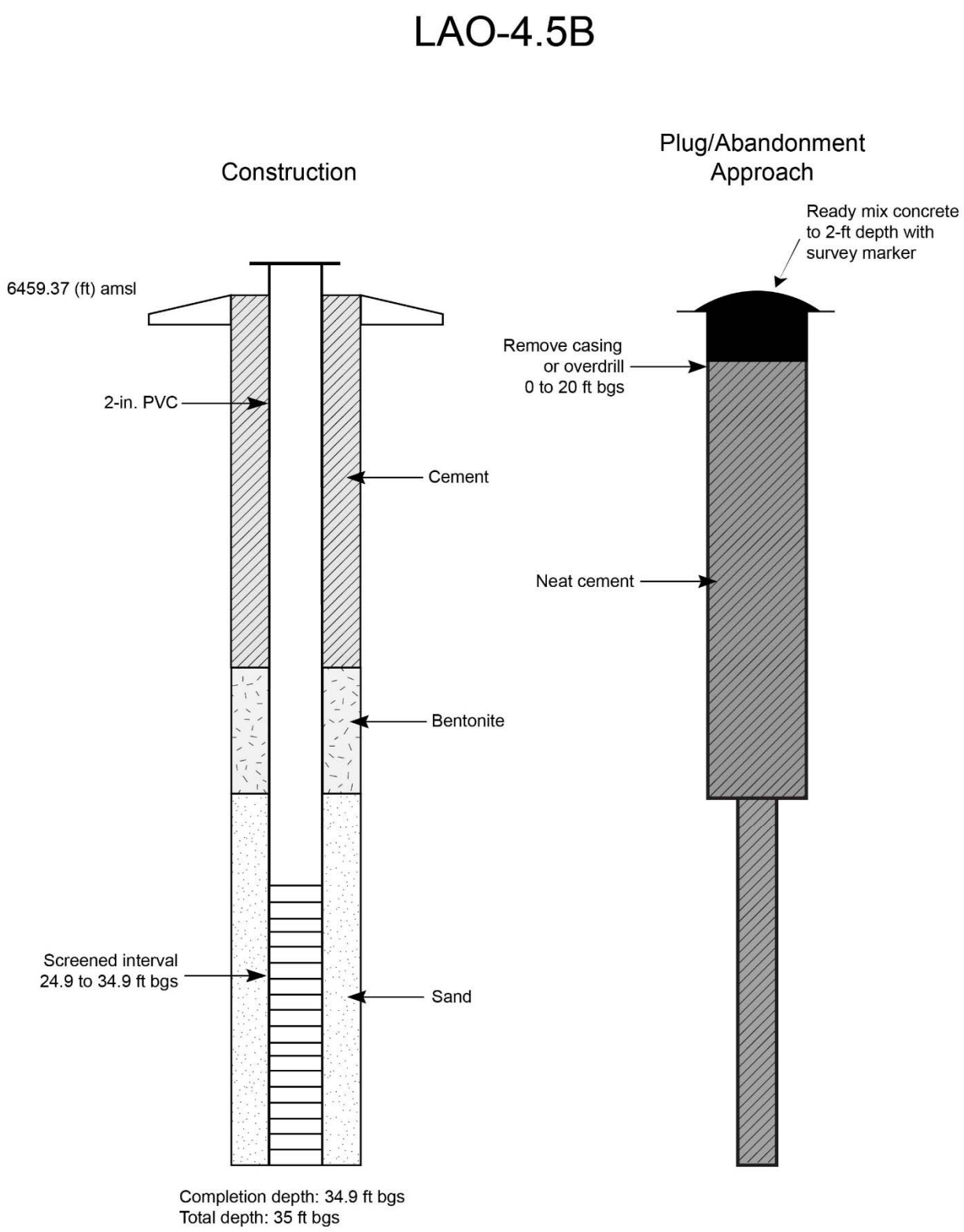


Figure 3.2-~~86~~ 86 LAO-4.5B abandonment schematic

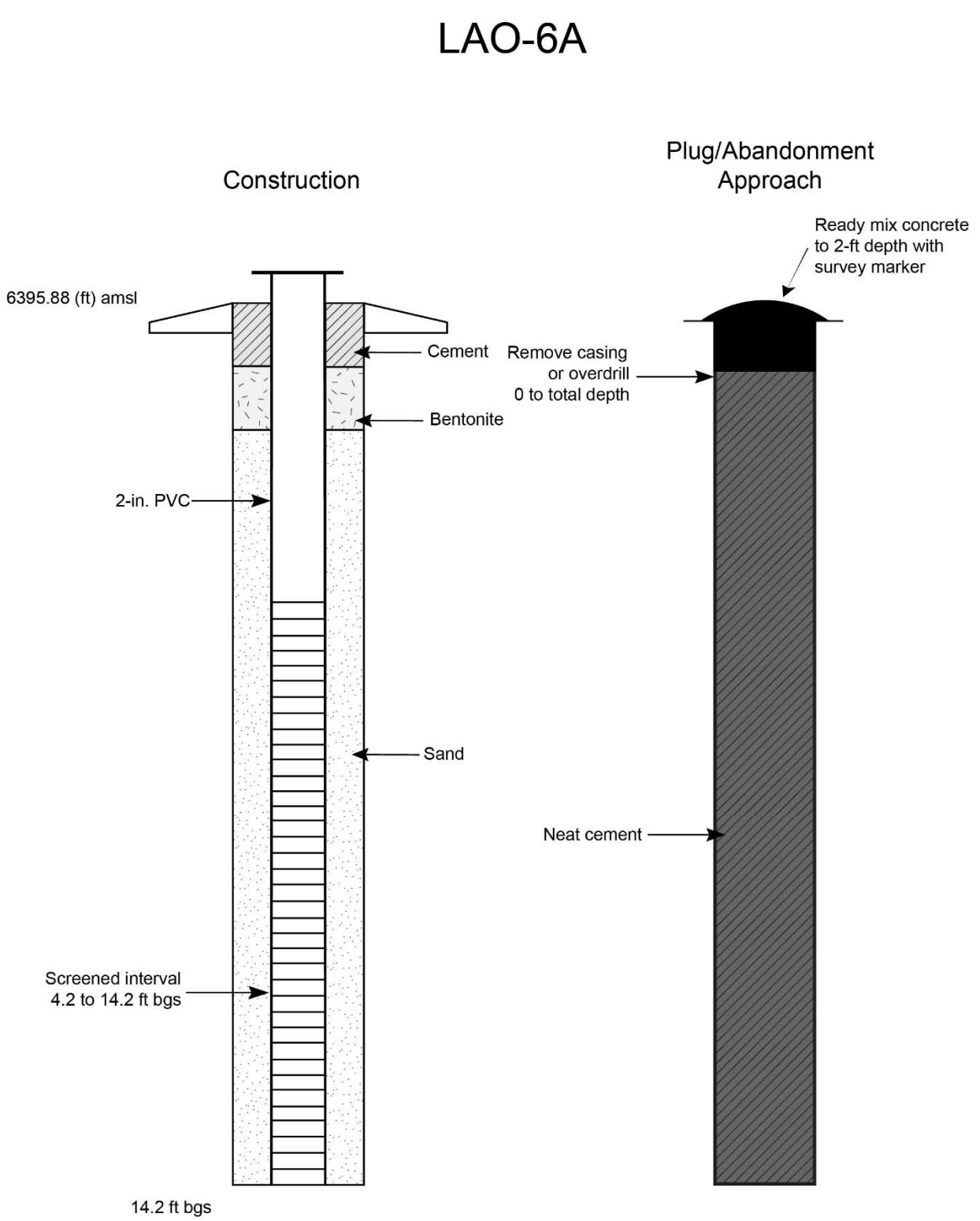


Figure 3.2-9 LAO-6A abandonment schematic

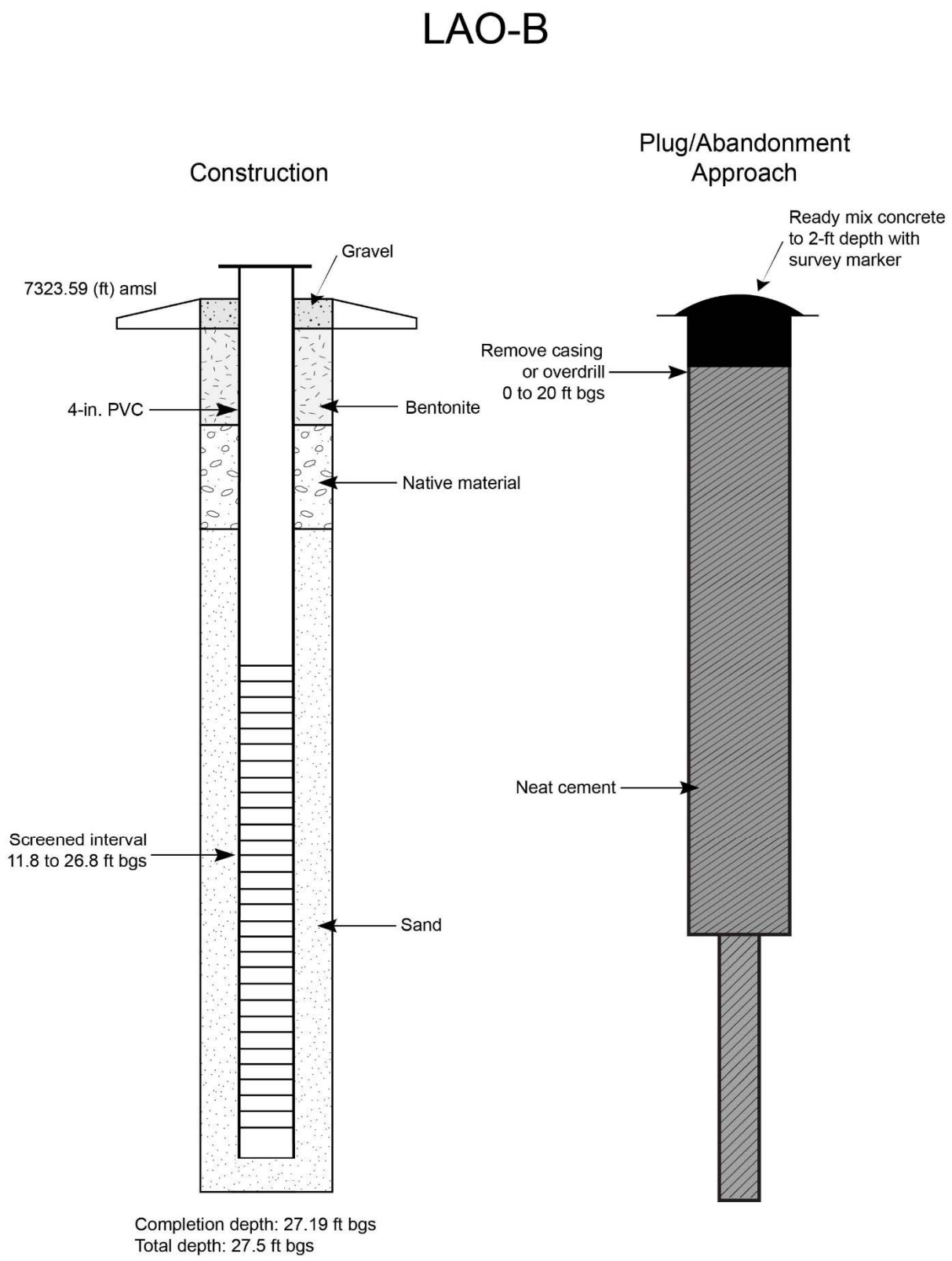


Figure 3.2-~~10~~7 LAO-B abandonment schematic

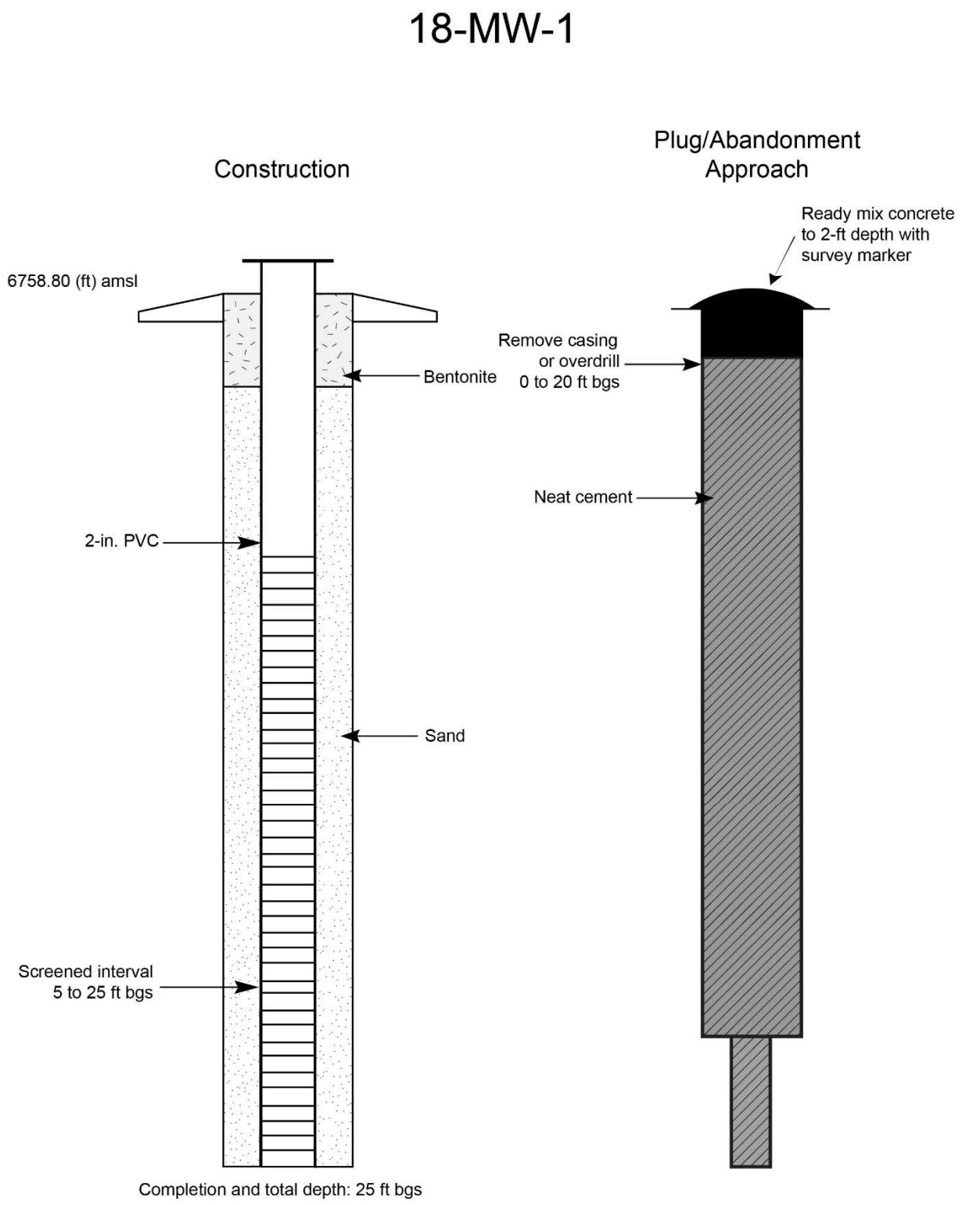


Figure 3.3-1 18-MW-1 abandonment schematic

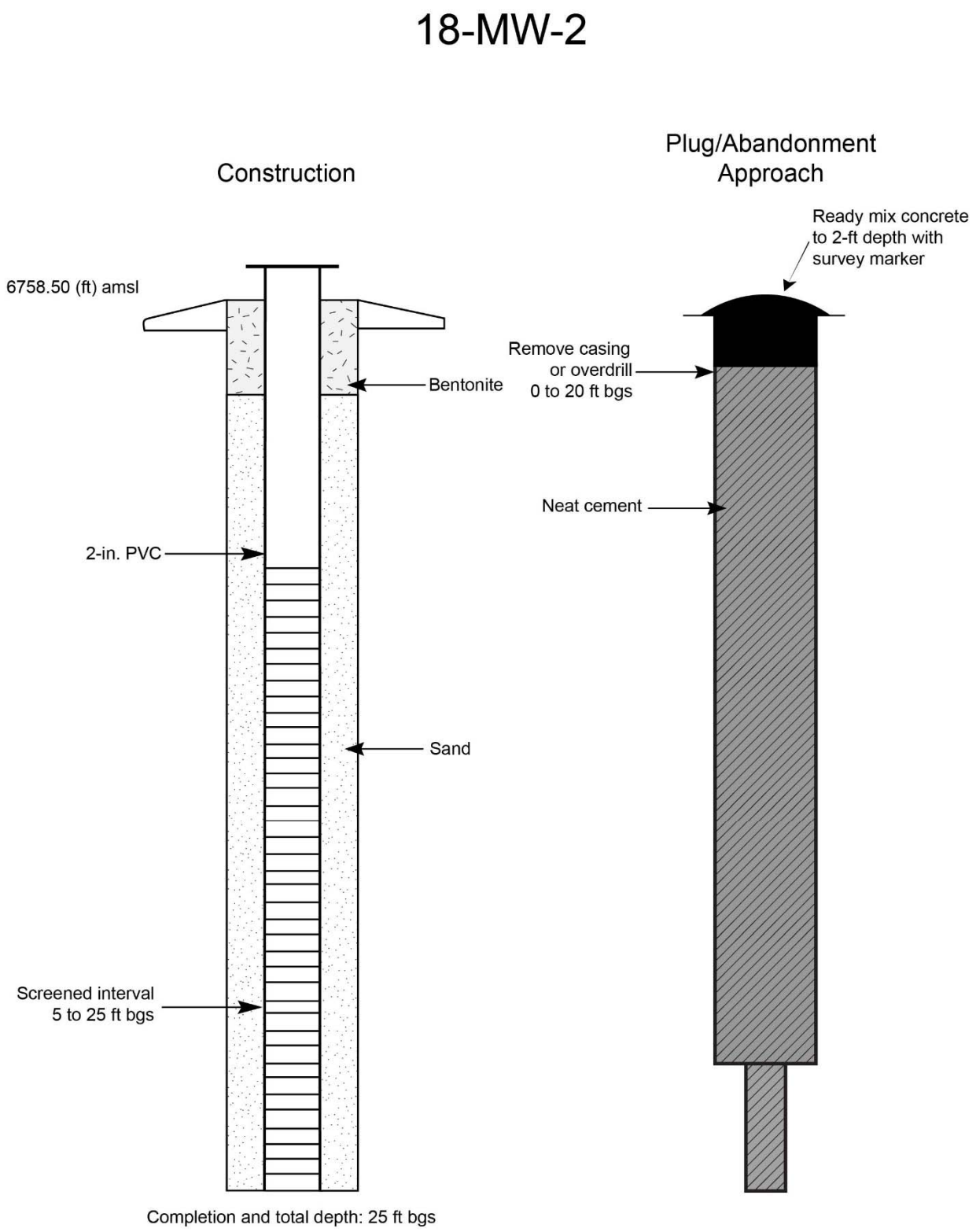


Figure 3.3-2 18-MW-2 abandonment schematic

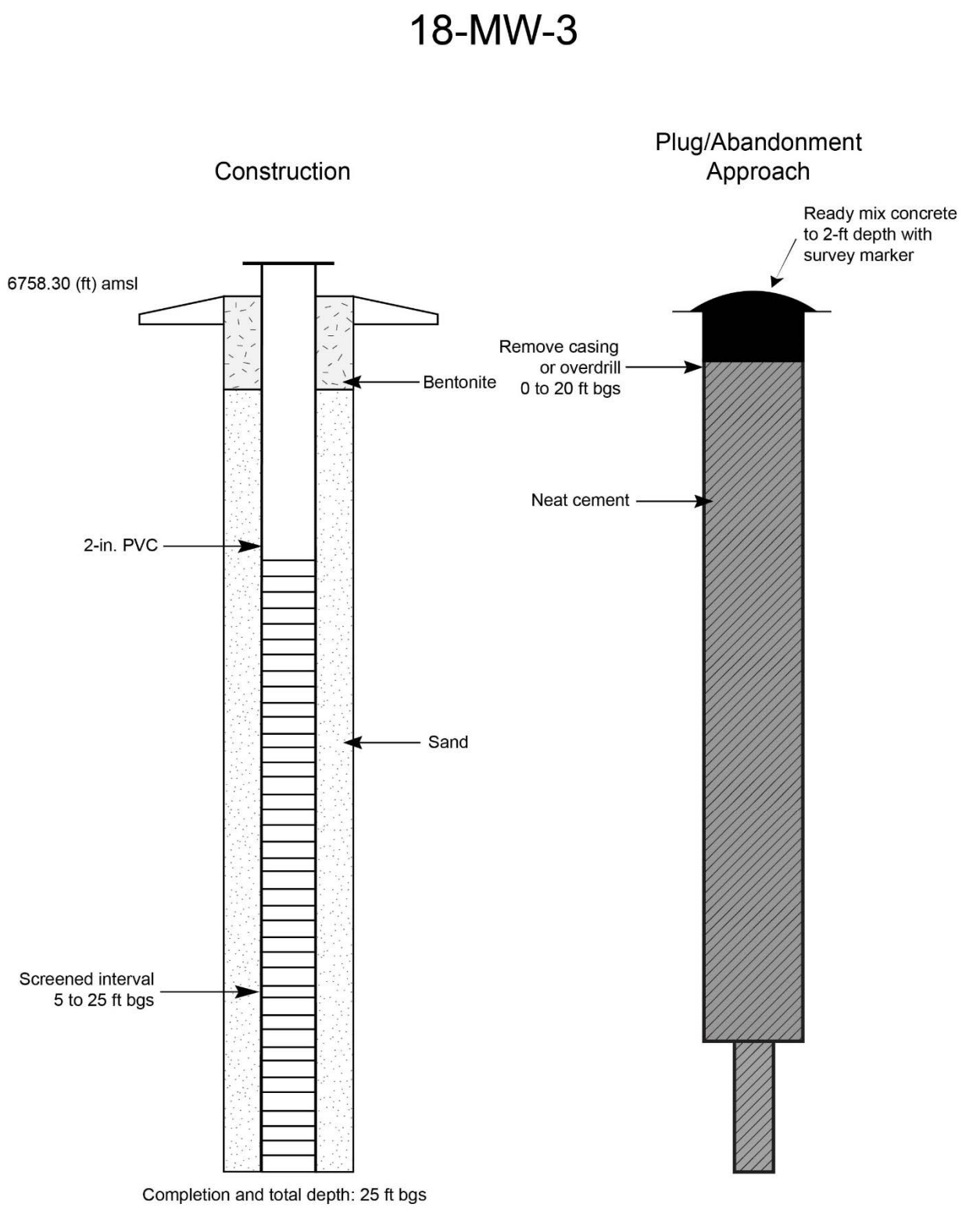


Figure 3.3-3 18-MW-3 abandonment schematic

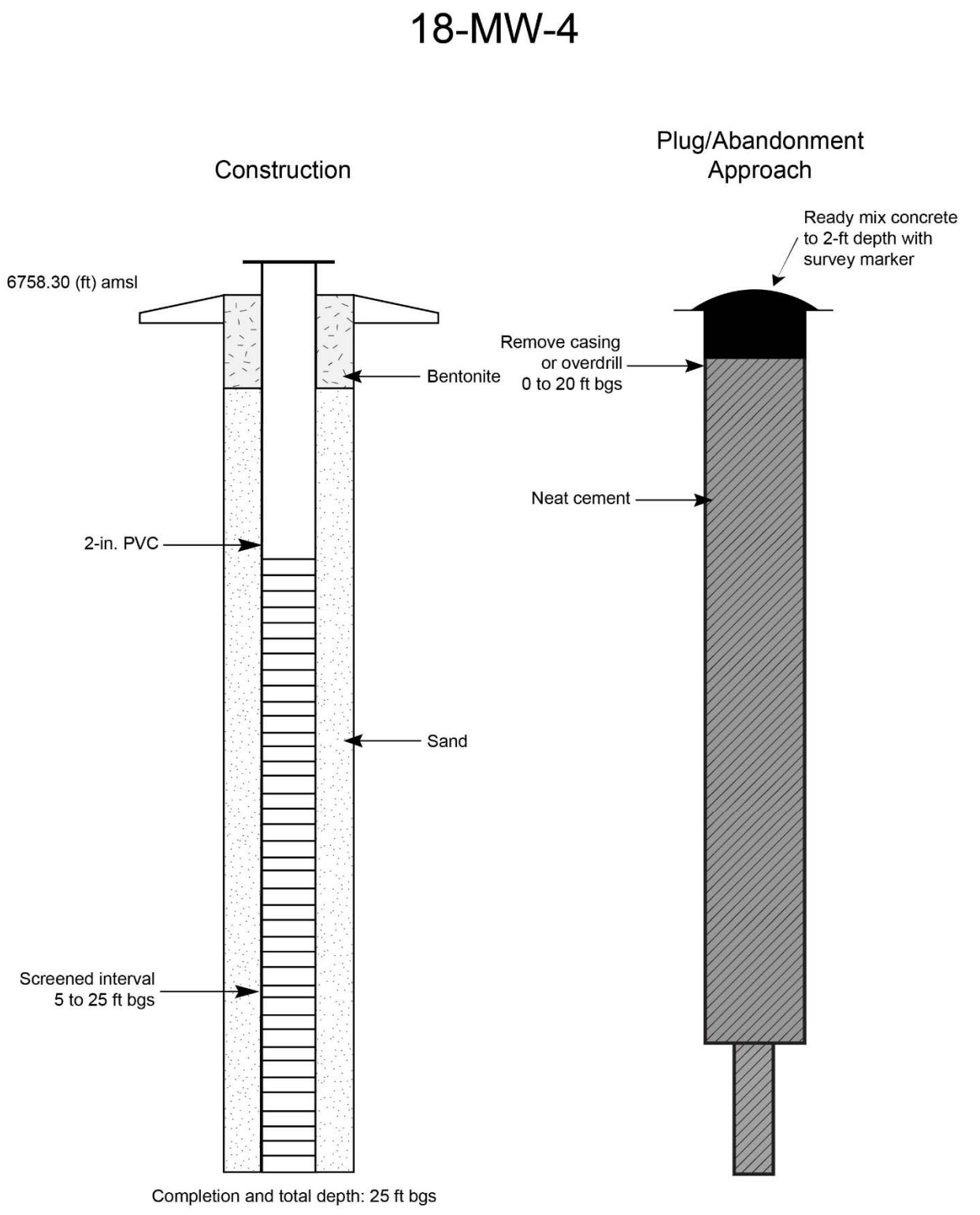


Figure 3.3-4 18-MW-4 abandonment schematic

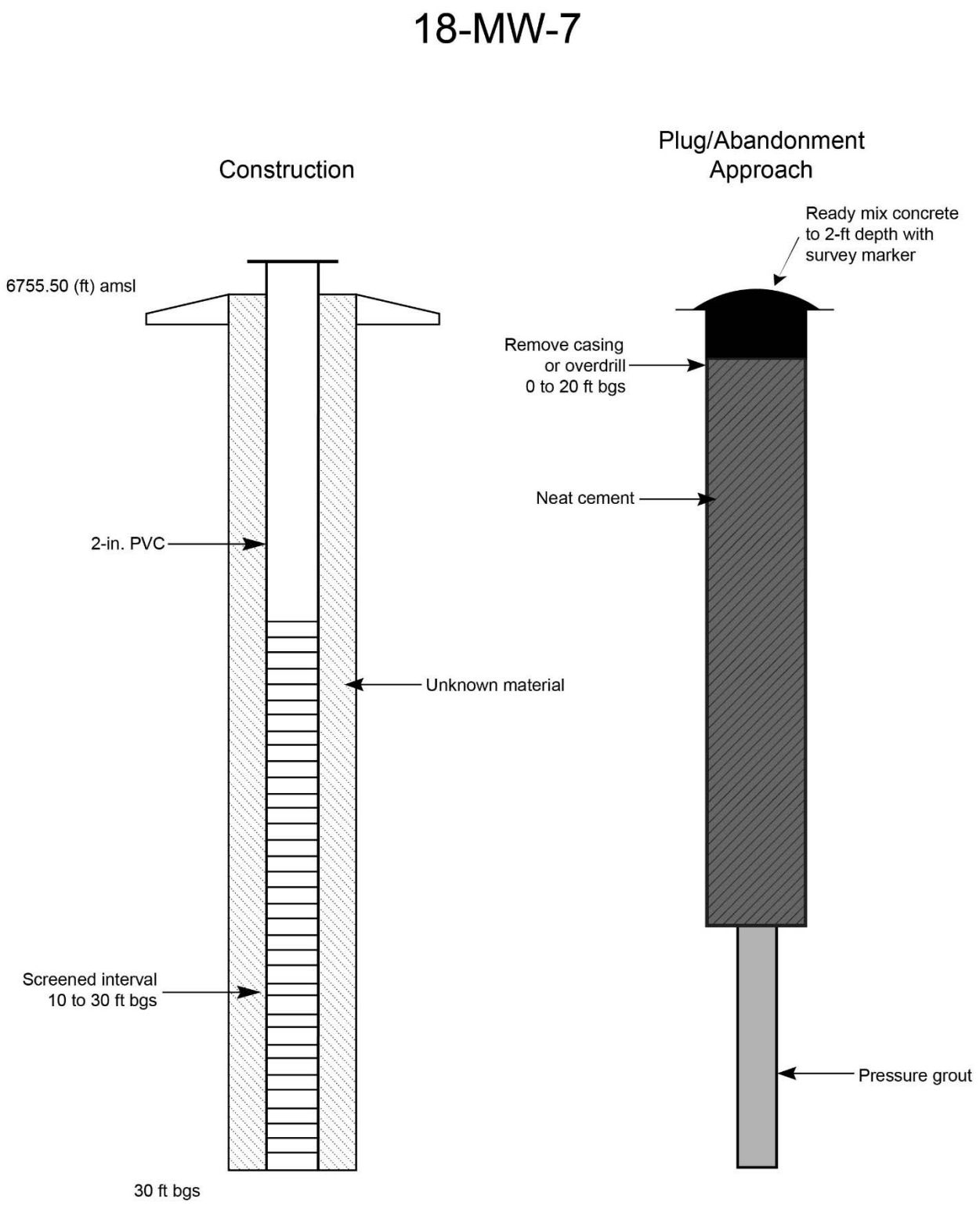


Figure 3.3-5 18-MW-7 abandonment schematic

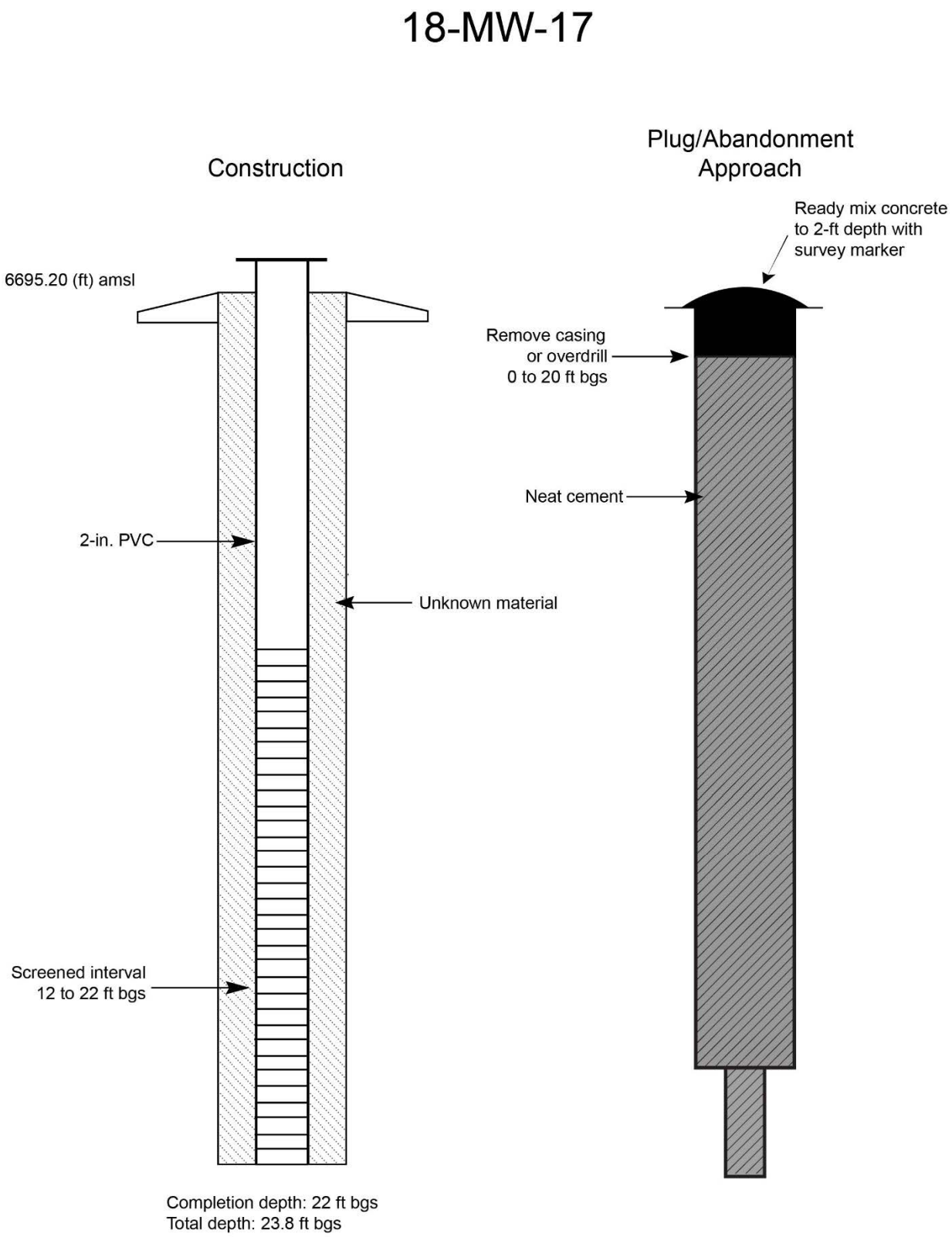


Figure 3.3-~~65~~ 5 18-MW-17 abandonment schematic

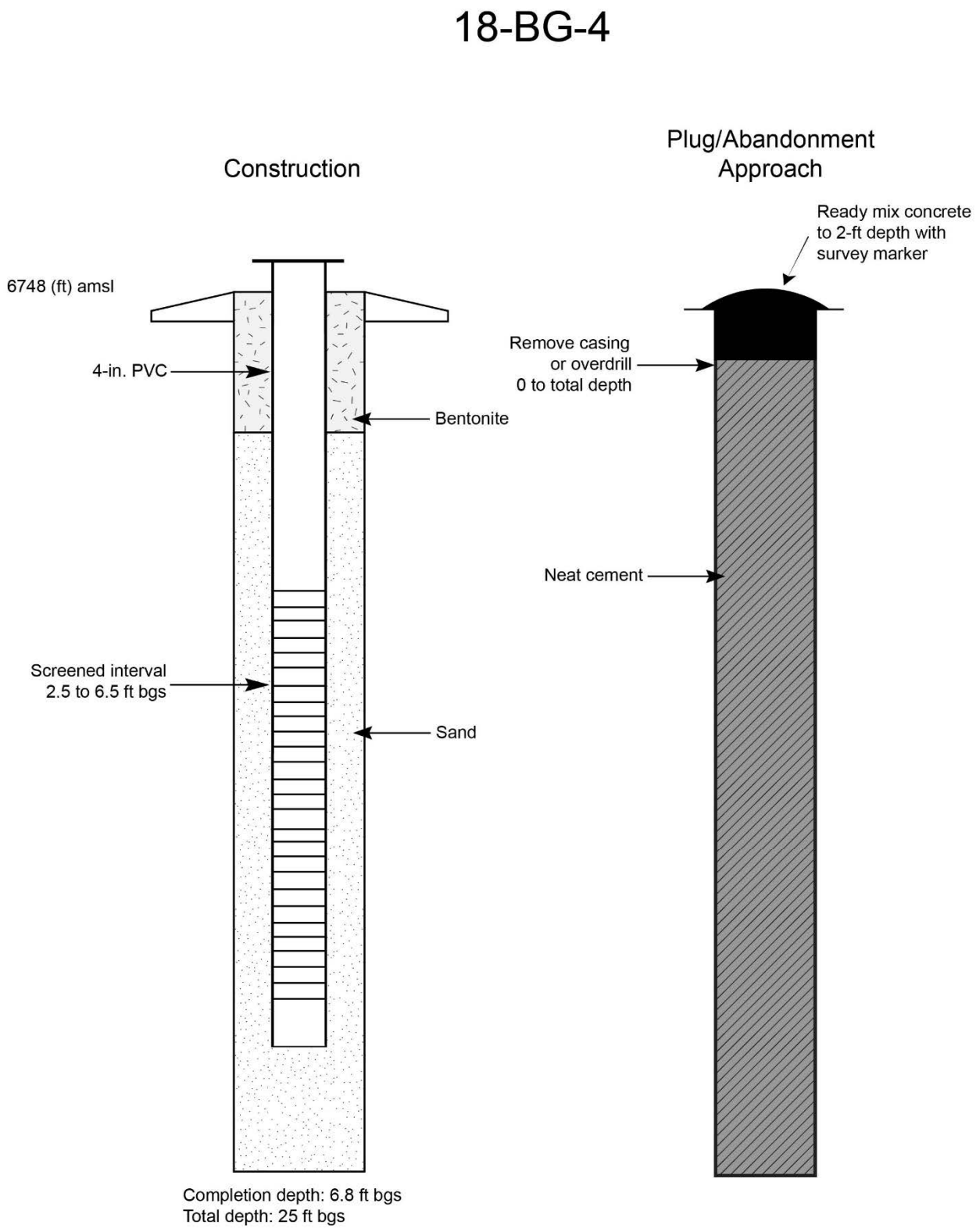
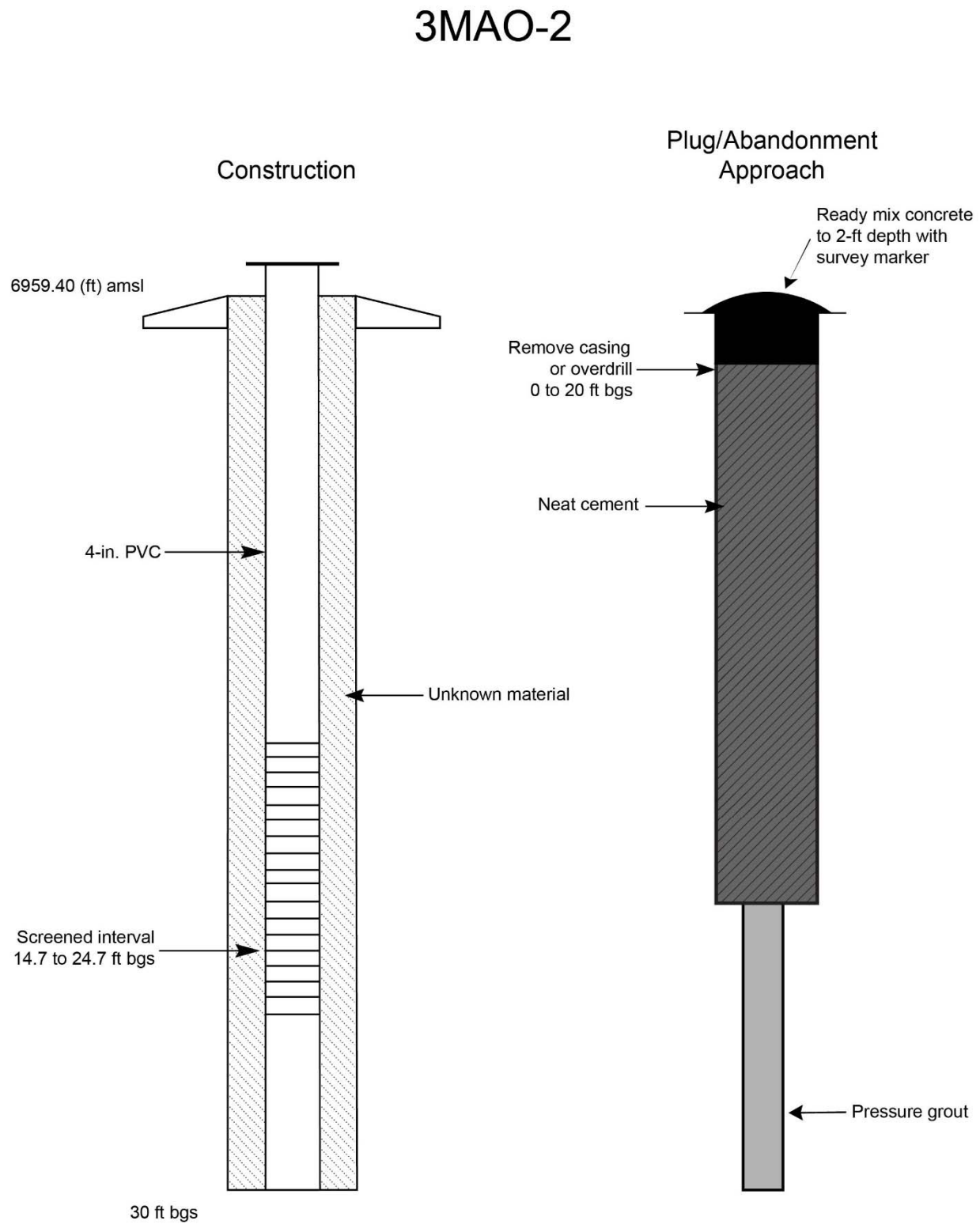


Figure 3.3-~~7~~6 18-BG-4 abandonment schematic



~~Figure 3.3-8 3MAO-2 abandonment schematic~~

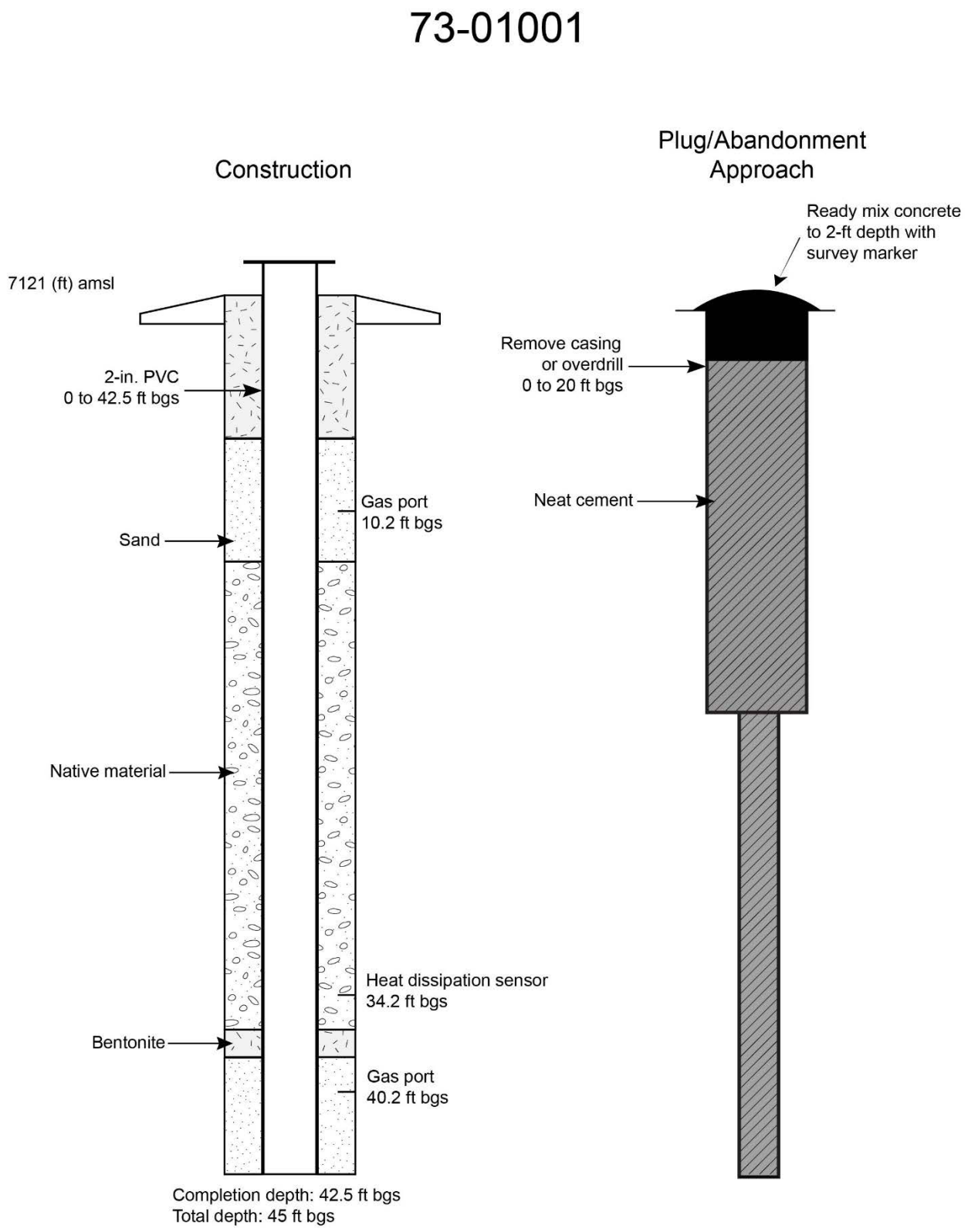


Figure 3.4-1 73-01001 abandonment schematic

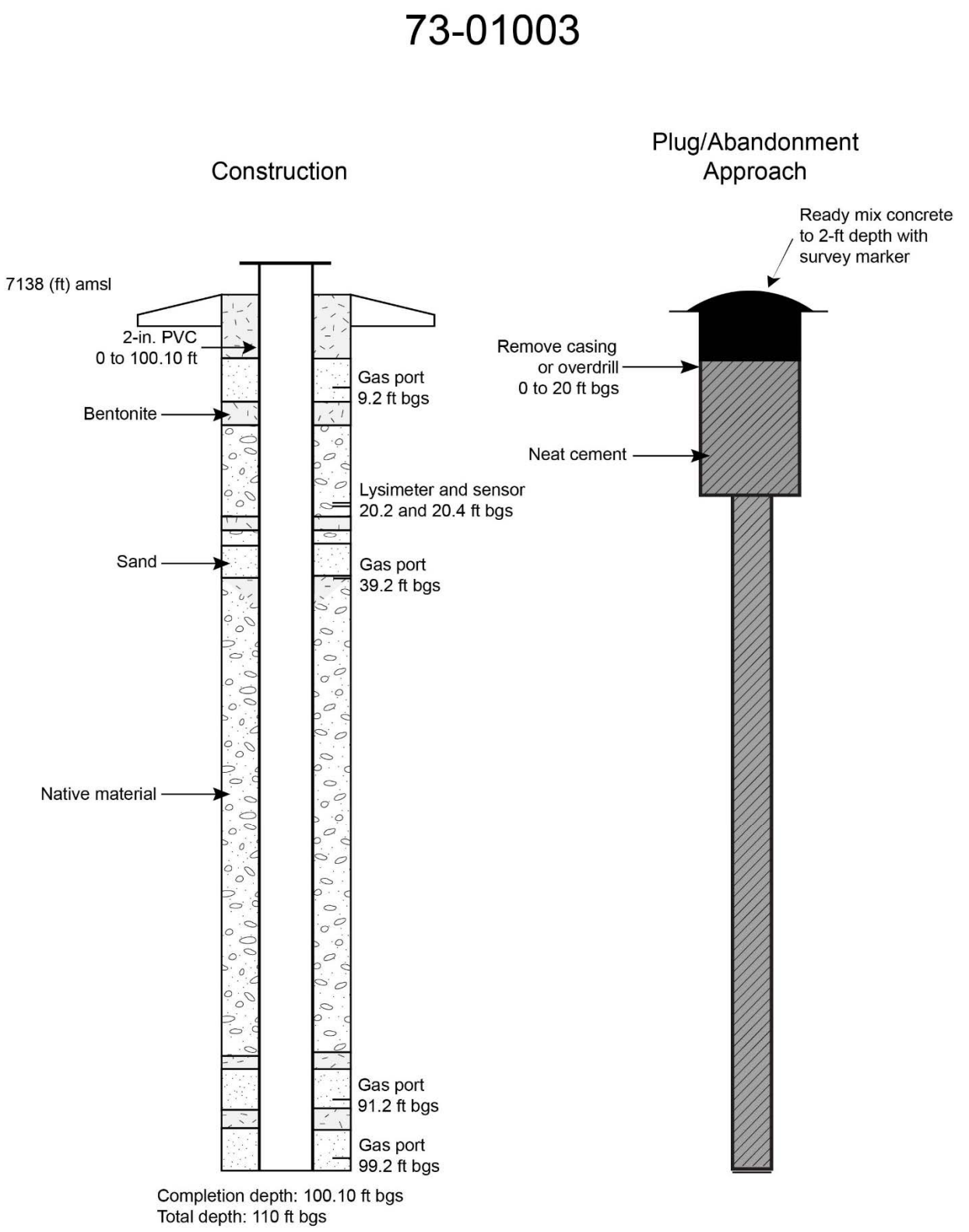


Figure 3.4-2 73-01003 abandonment schematic

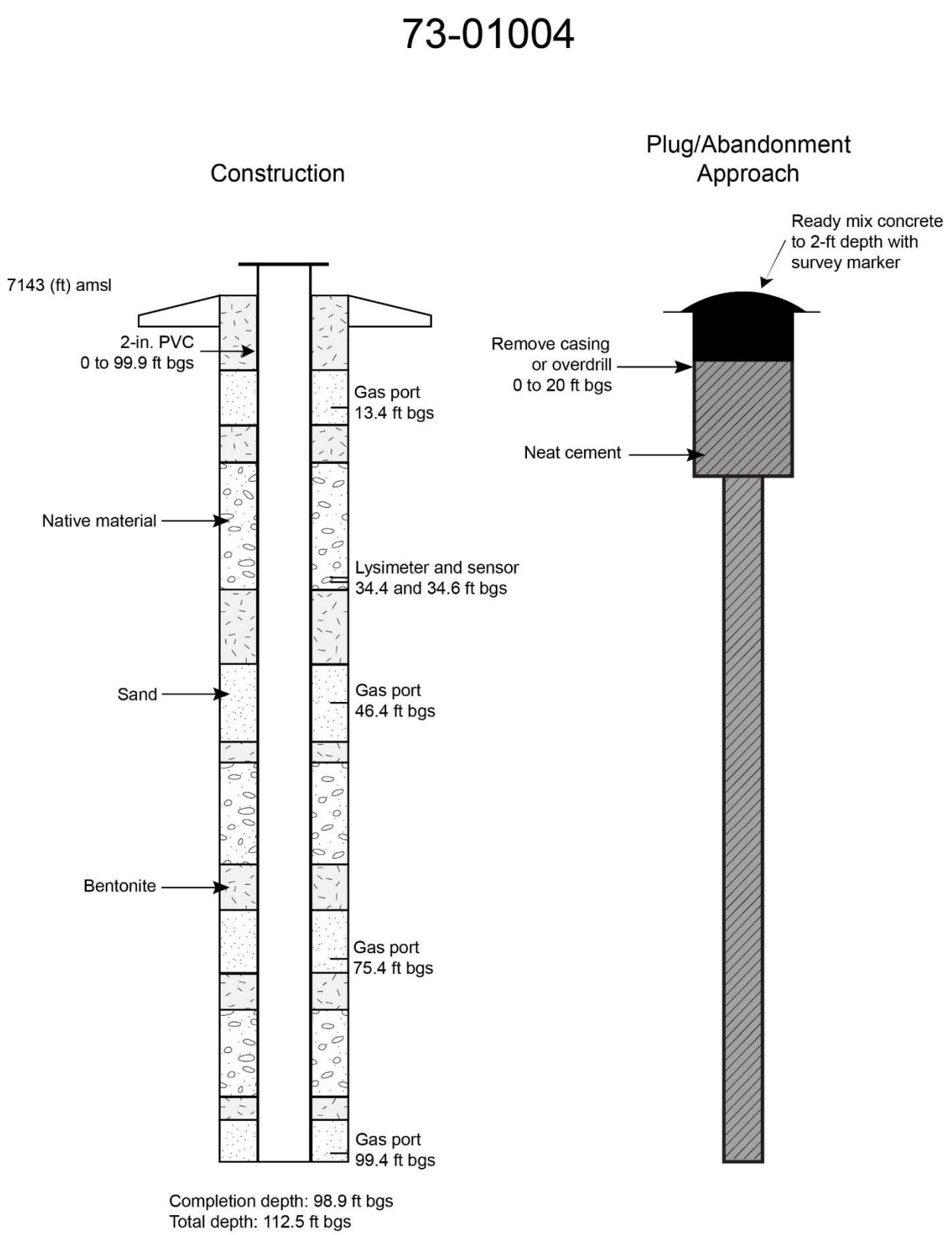


Figure 3.4-3 73-01004 abandonment schematic

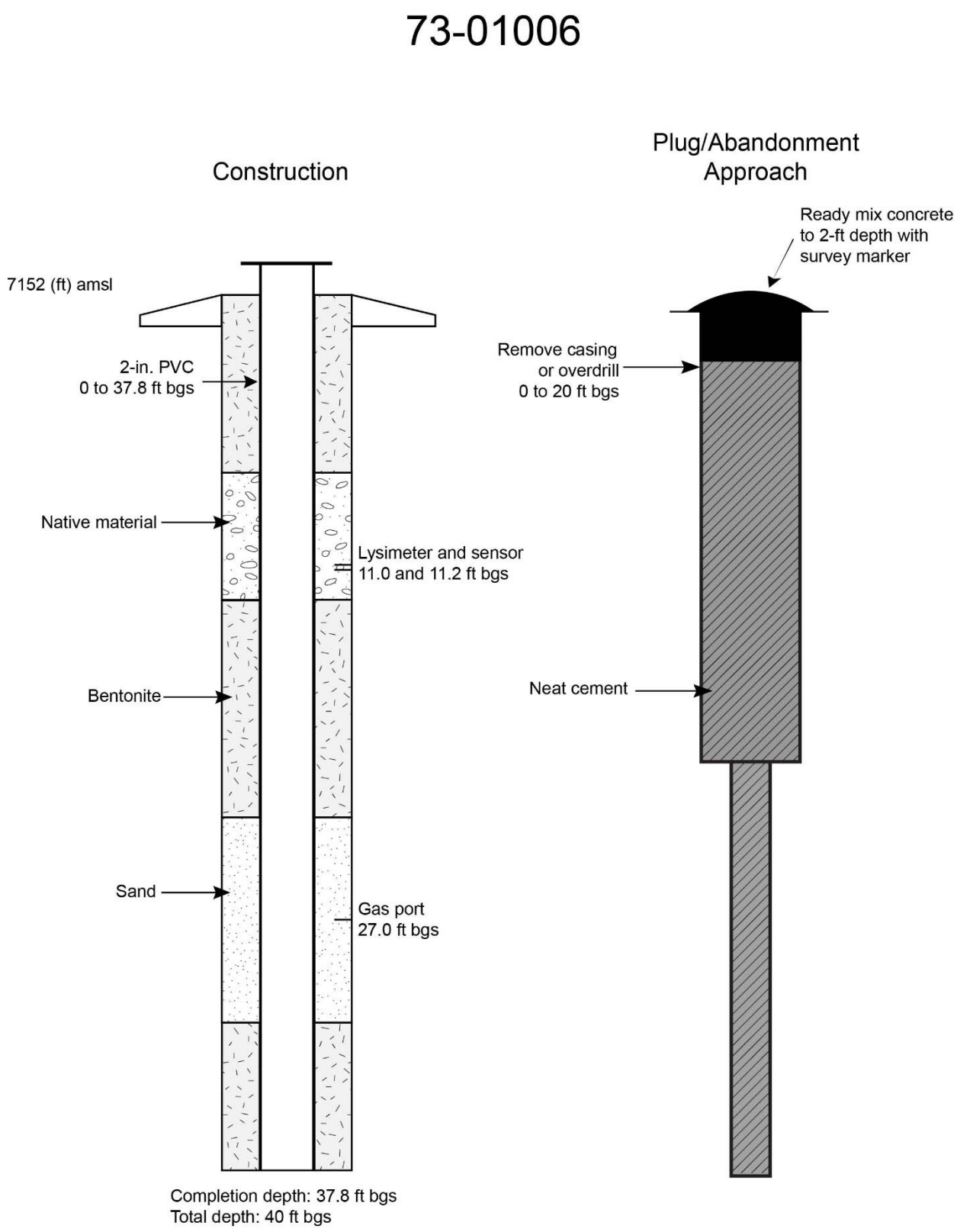


Figure 3.4-4 73-01006 abandonment schematic

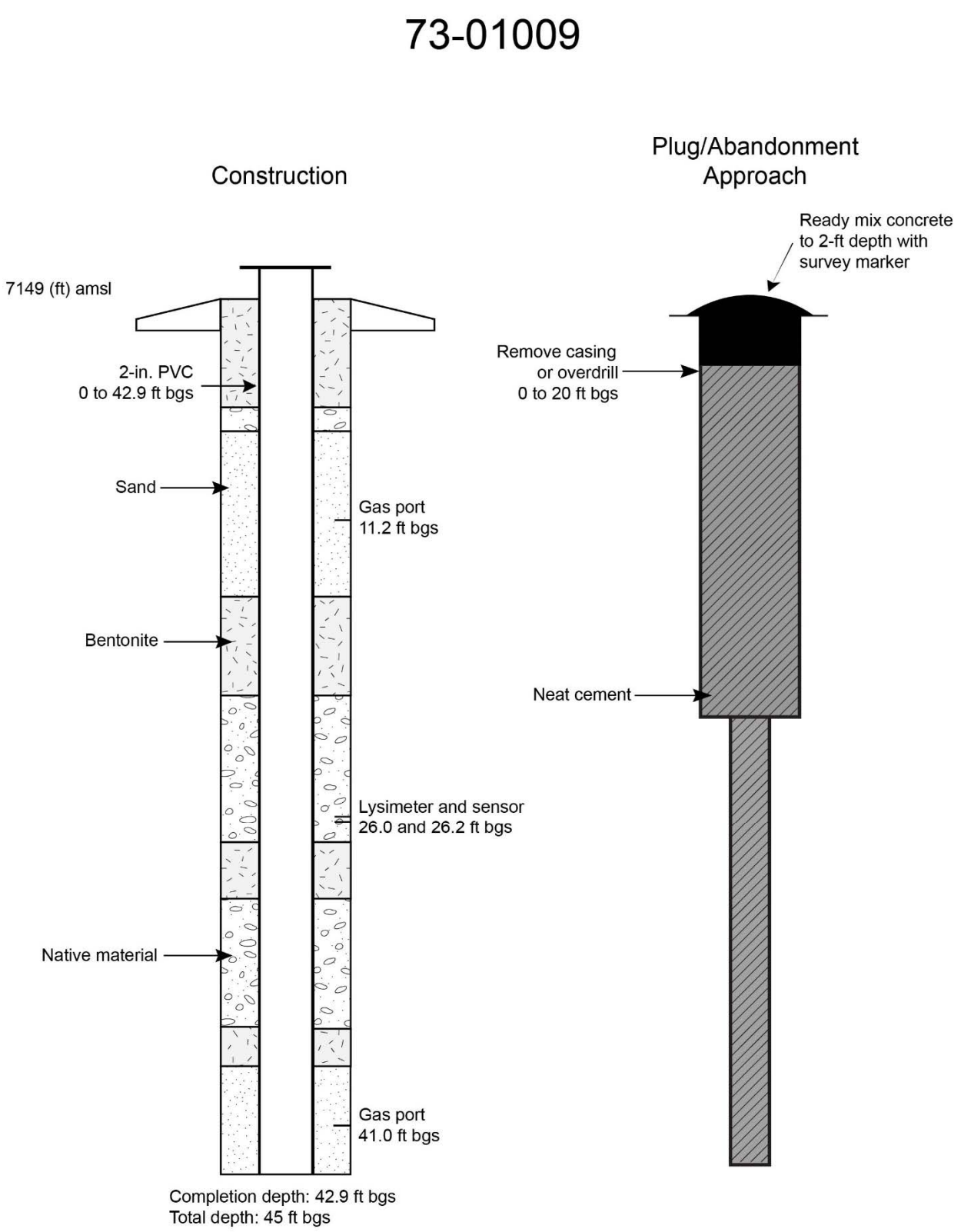


Figure 3.4-5 73-01009 abandonment schematic

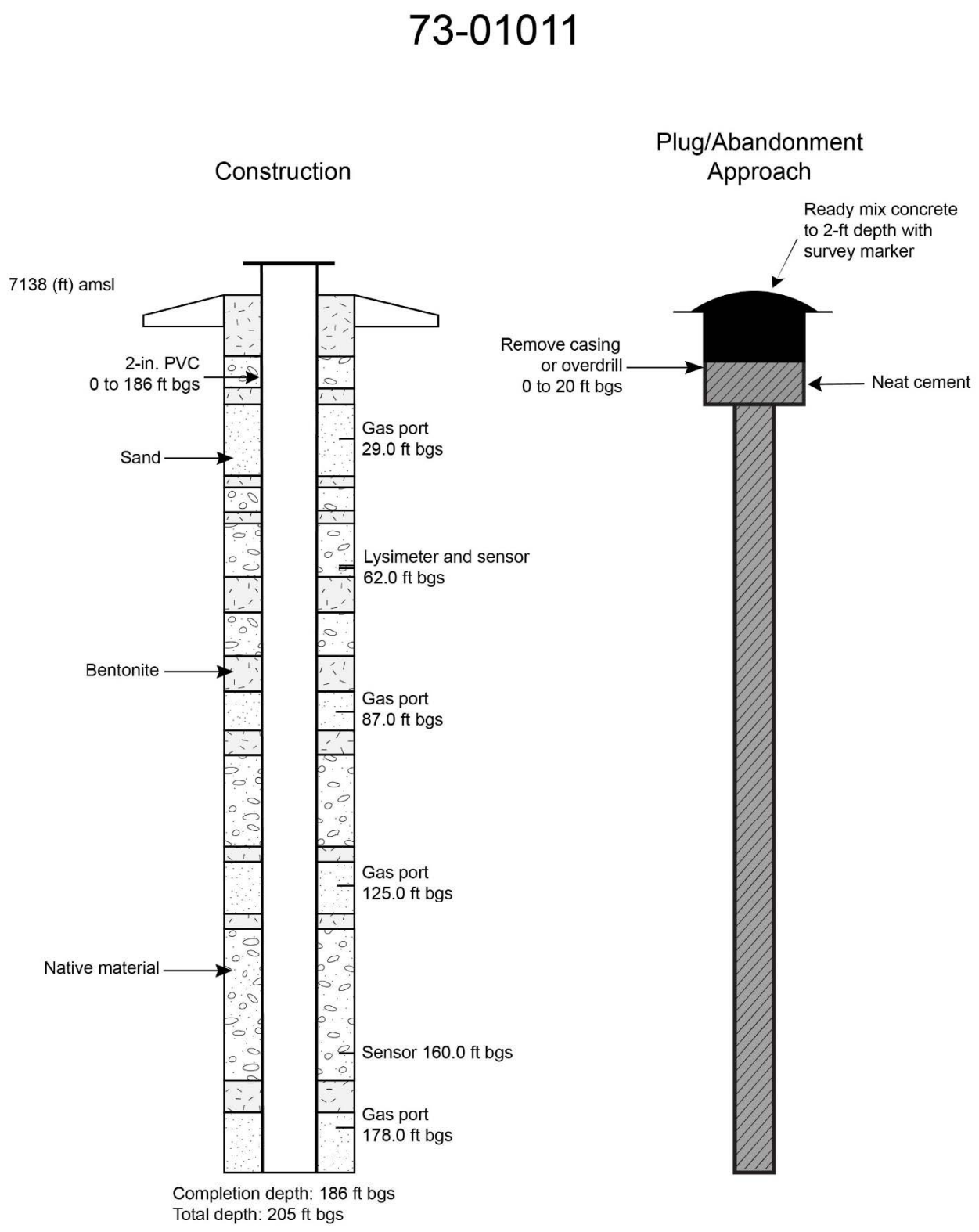


Figure 3.4-6 73-01011 abandonment schematic

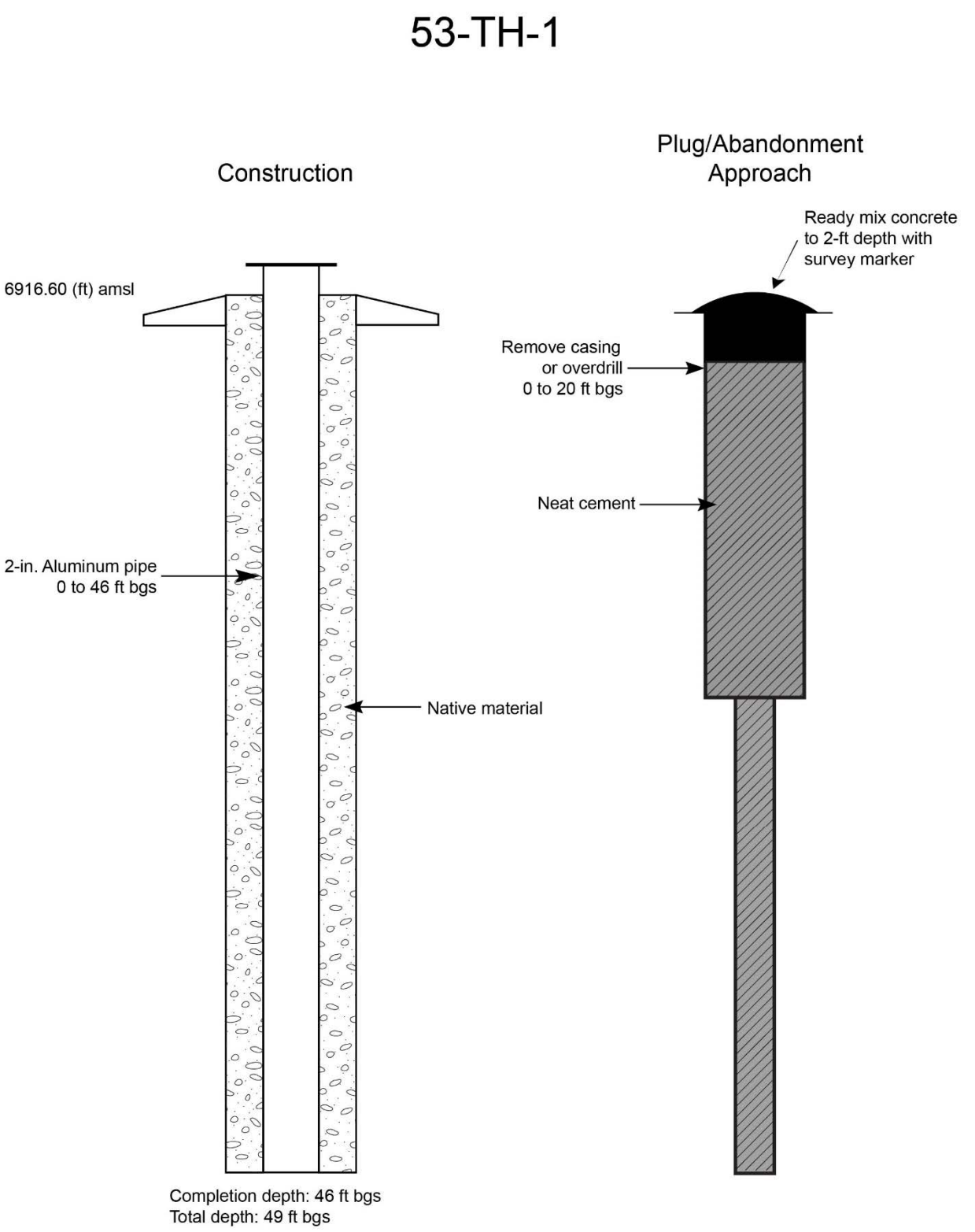


Figure 3.5-1 53-TH-1 abandonment schematic

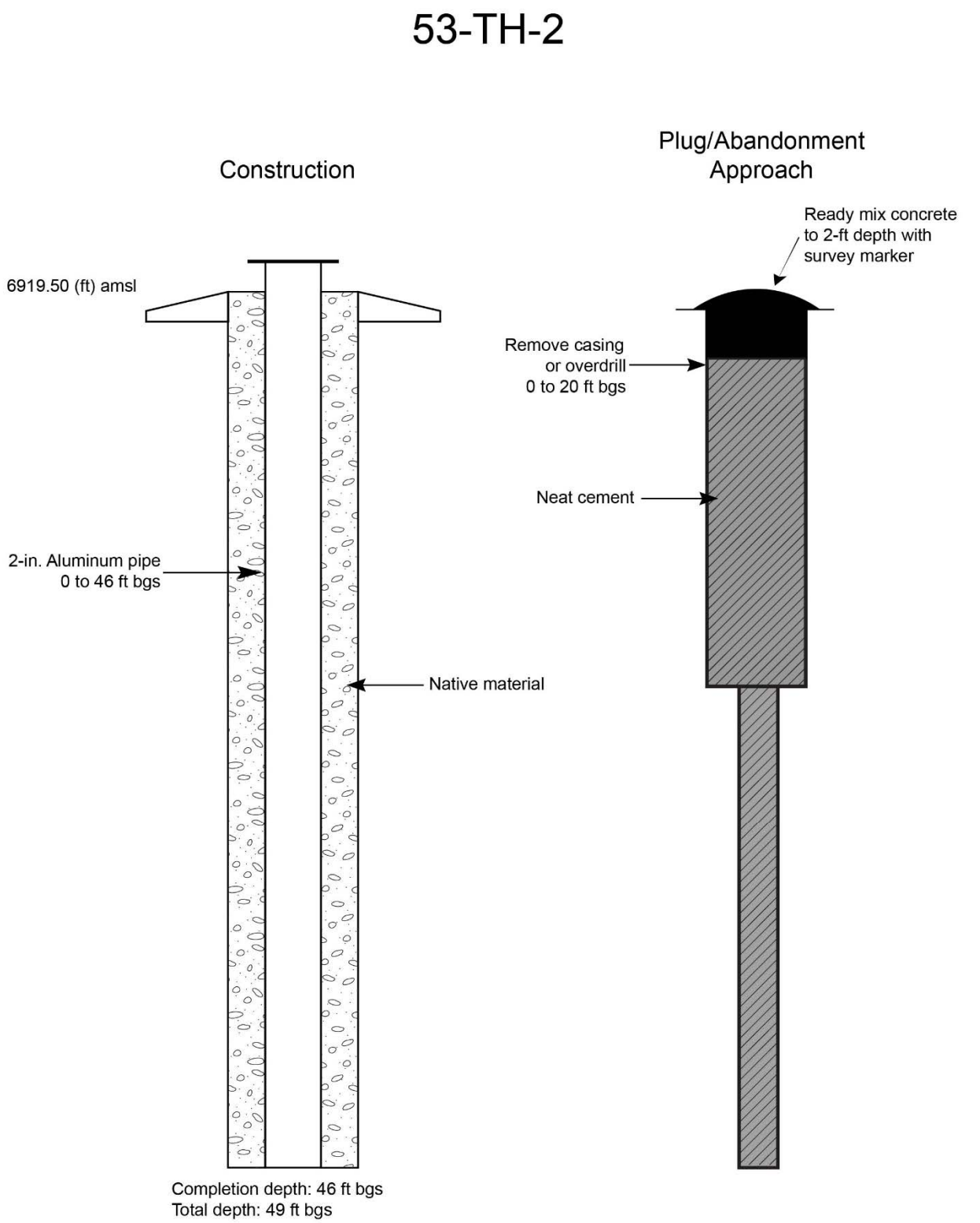


Figure 3.5-2 53-TH-2 abandonment schematic

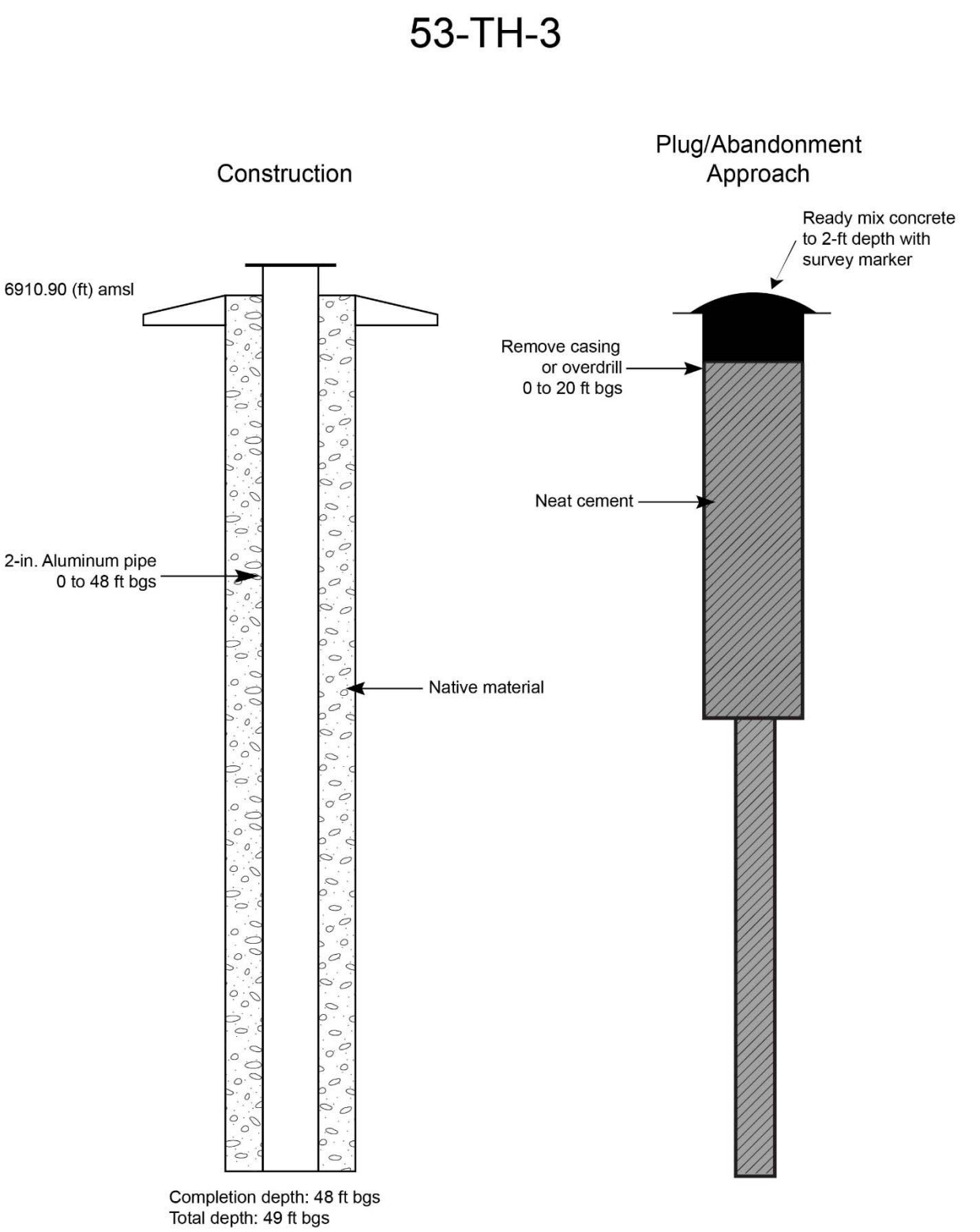


Figure 3.5-3 53-TH-3 abandonment schematic

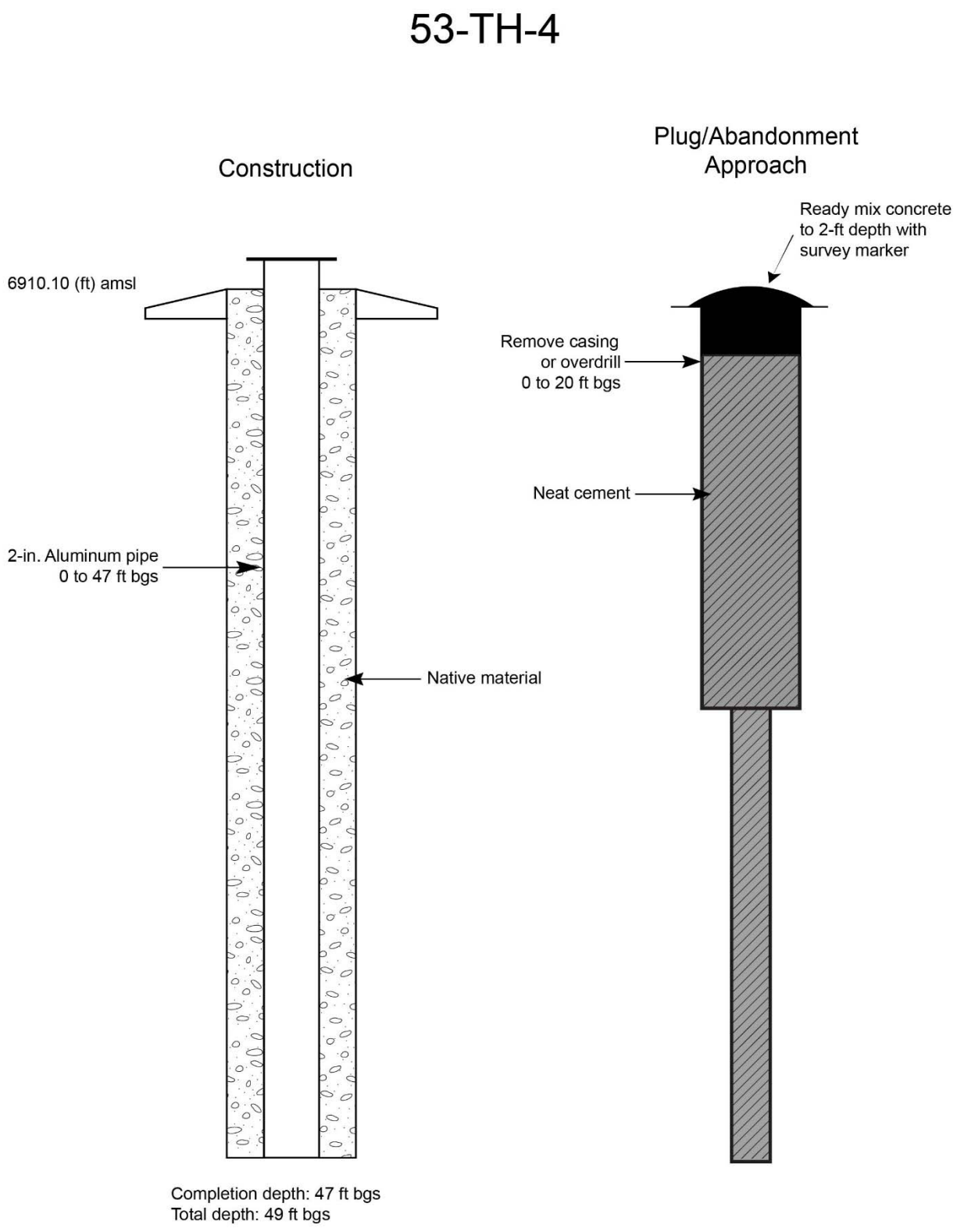


Figure 3.5-4 53-TH-4 abandonment schematic

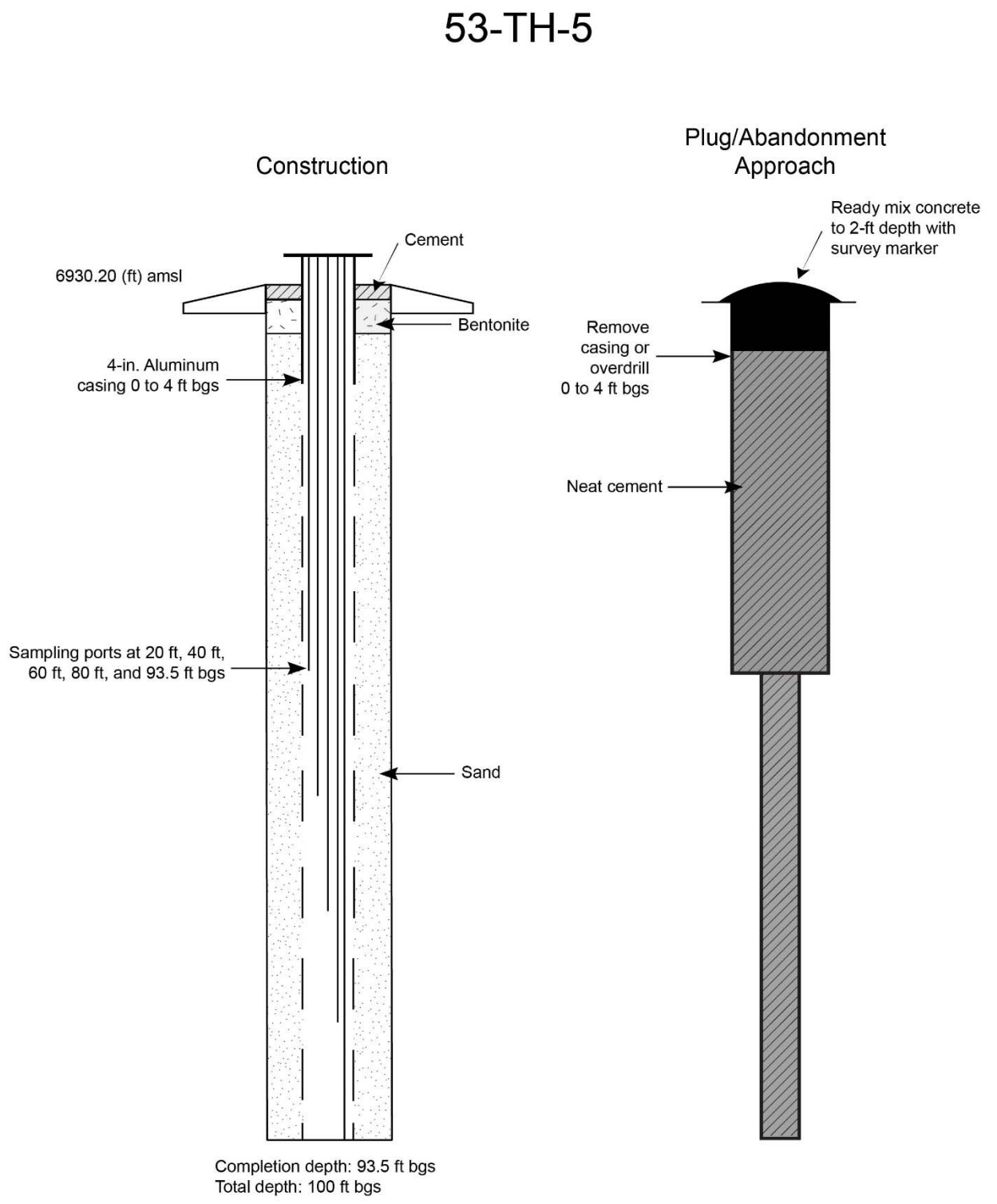


Figure 3.5-5 53-TH-5 abandonment schematic

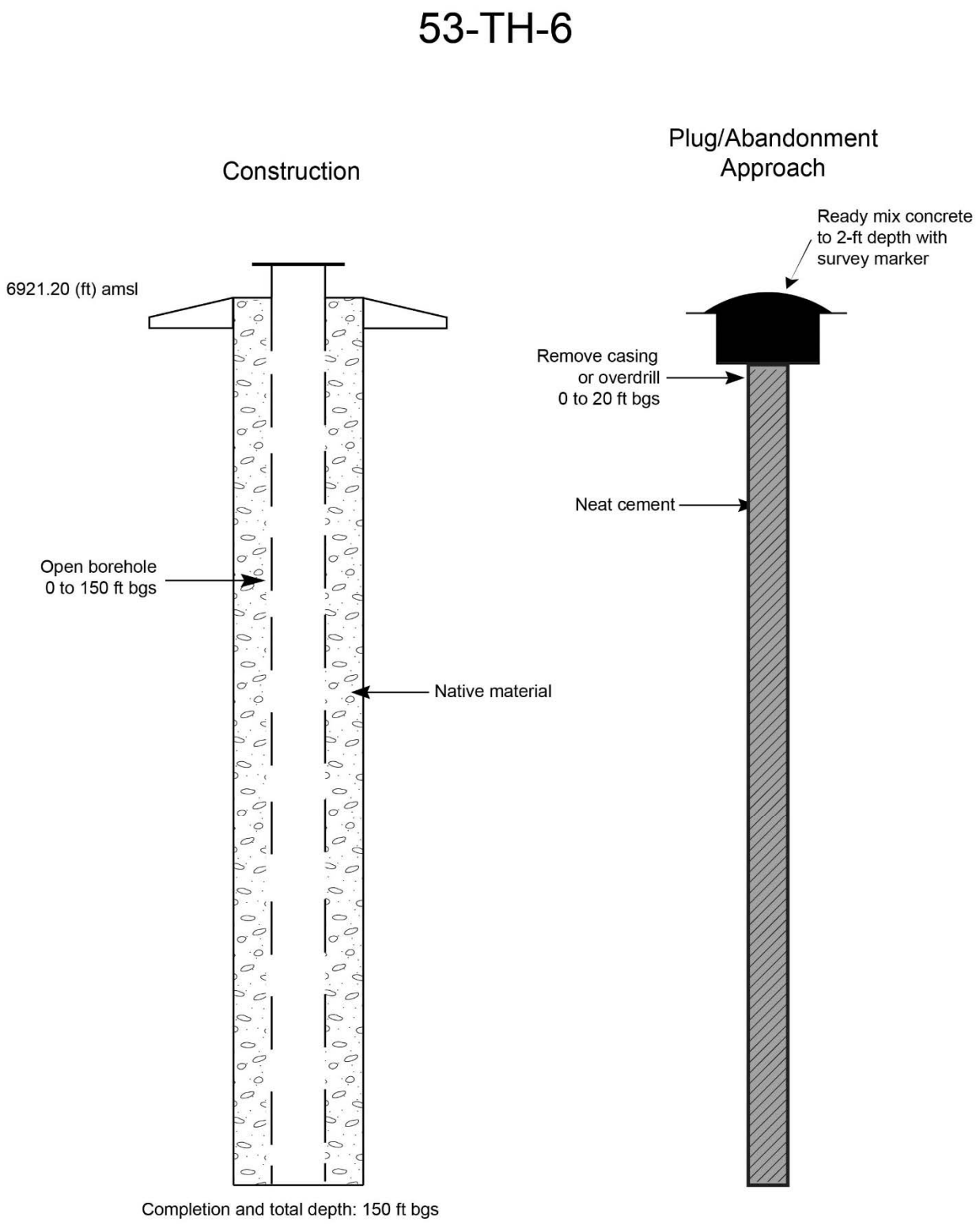


Figure 3.5-6 53-TH-6 abandonment schematic

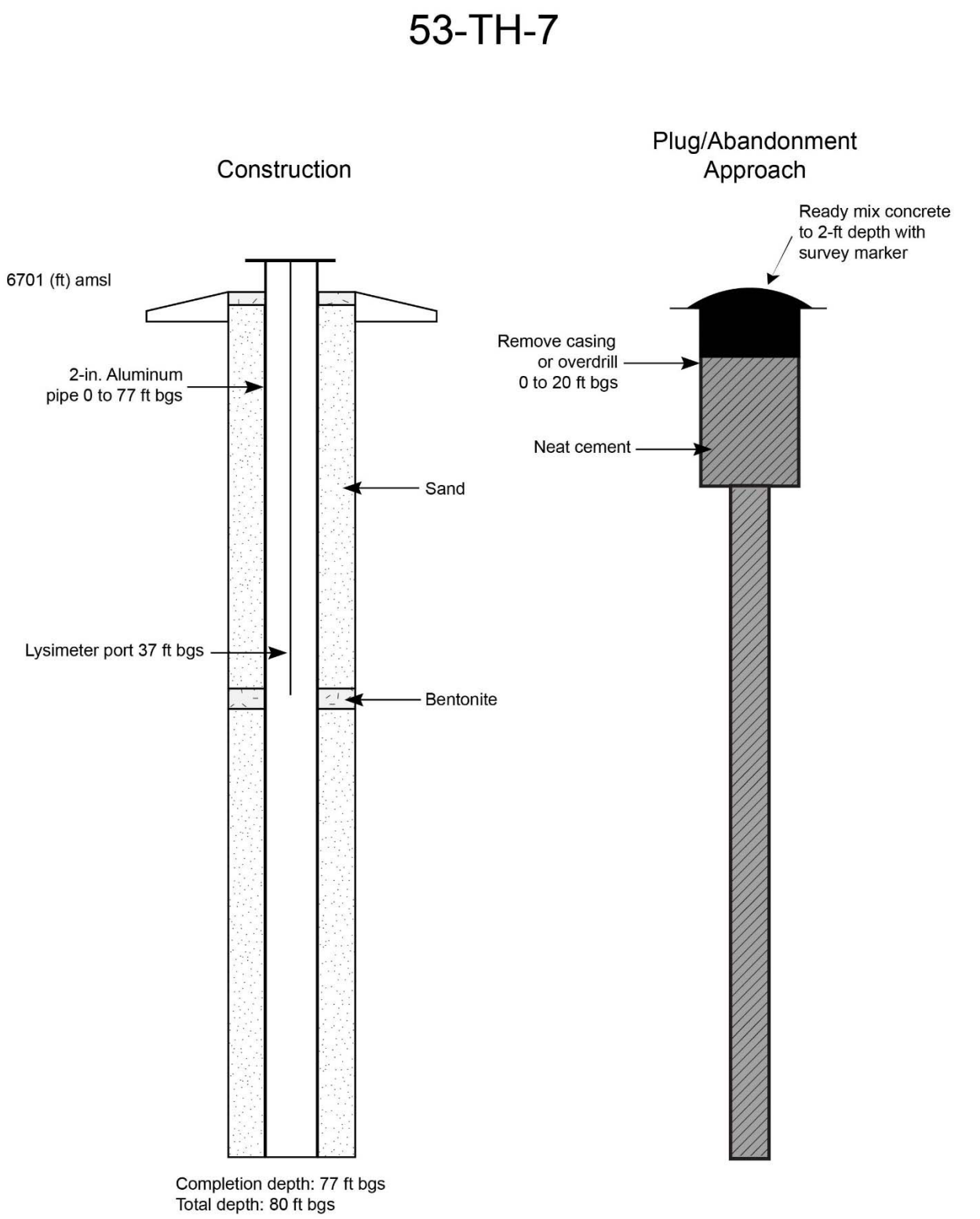


Figure 3.5-7 53-TH-7 abandonment schematic

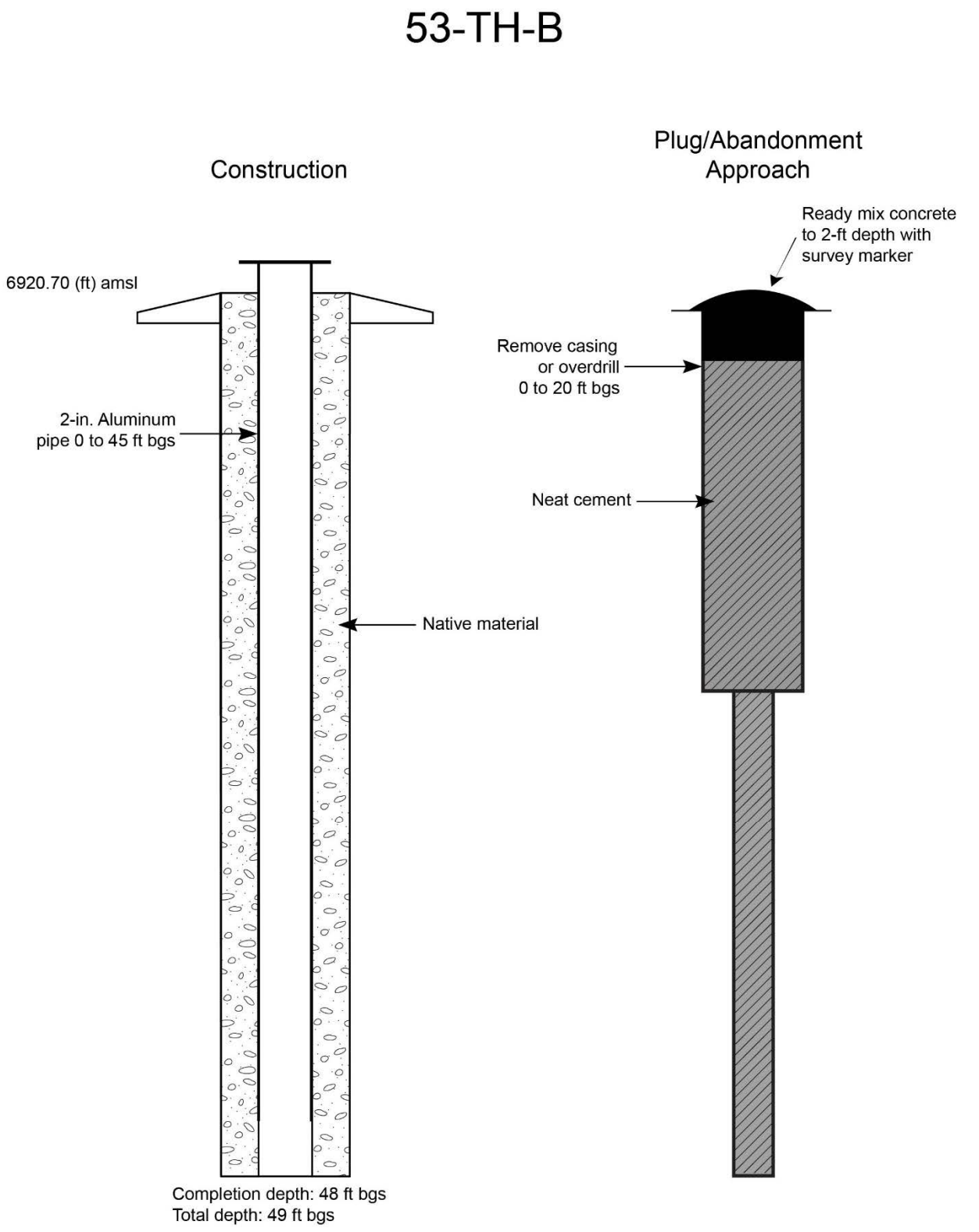


Figure 3.5-8 53-TH-B abandonment schematic

Table 2.0-1
Wells and Boreholes for Plugging and Abandonment

Well Name	Total Depth (ft)	Completion Depth (ft)	Diameter (in.)	Screened Interval (ft)	Construction Material	Easting	Northing	Elevation (ft amsl[a])
ASC-0	80	80	2	Unknown	PVC	1639833.00	1743580.00	6300
ASC-2	80	80	2	Unknown	PVC	1639850.00	1743618.00	6299
ASC-3	80	80	2	Unknown	PVC	1639831.00	1743668.00	6303
ASC-4	80	80	2	Unknown	PVC	1639800.00	1743748.00	6304
ASC-11	80	80	2	Unknown	PVC	1637060.00	1747199.00	6397
ASC-12	80	80	2	Unknown	PVC	1637095.00	1747243.00	6397
ASC-13	80	80	2	Unknown	PVC	1637014.00	1747265.00	6404
ASC-14	80	80	2	Unknown	PVC	1637077.00	1747343.00	6398
ASC-15	80	80	2	Unknown	PVC	1637071.00	1747361.00	6403
ASC-16	80	80	2	Unknown	PVC	1637104.00	1747399.00	6404
ASC-17	80	80	2	Unknown	PVC	1636984.00	1747412.00	6404
ASC-18	80	80	2	Unknown	PVC	1636976.00	1747487.00	6405
ASC-19	80	80	2	Unknown	PVC	1637084.00	1747532.00	6405
39-DM-2	40	40	4	Unknown	PVC	1639912.00	1743157.00	6292
39-DM-4	25	25	4	Unknown	PVC	1639844.00	1743548.00	6348
39-DM-6	60	57.5	4	45–55	Stainless steel	1637094.00	1747228.00	6403
39-DMB-1	122.5	119	4	Unknown	PVC	1639992.00	1743176.00	6292
39-UM-3	60	56.5	4	39.5–54.5	Stainless steel	1637032.00	1747663.00	6758.30
LAO-0.3	12	11.25	4	5.9–10.9	PVC	1624799.00	1774511.60	6968.13
~~LAO-0.6~~	~~17.5~~	~~13.35~~	~~4~~	~~8–13~~	~~PVC~~	~~1626748.10~~	~~1774332.90~~	~~6910.74~~
LAO-0.7	25	23	Unknown	Unknown	Unknown	1627212.3	1774260.37	6904
LAO-0.8	17.5	12.85	4	7.5–12.5	PVC	1627699.70	1774274.66	6889.71
LAO-0.91	15.5	14.85	4	9.5–14.5	PVC	1628654.30	1774207.00	6861.74
~~LAO-1.6G~~	~~36~~	~~30.82~~	~~4~~	~~11–26~~	~~PVC~~	~~1636083.40~~	~~1772557.63~~	~~6658.01~~
LAO-4.5A	20	18.5	2	8.5–18.5	PVC	1643500.00	1772052.00	6459.89
LAO-4.5B	35	34.9	2	24.9–34.9	PVC	1643512.00	1772055.00	6459.37
~~LAO-6A~~	~~15~~	~~14.2~~	~~2~~	~~4.2–14.2~~	~~PVC~~	~~1646221.62~~	~~1771344.00~~	~~6395.88~~
LAO-B	27.5	27.19	4	11.8–26.8	PVC	1615148.80	1775170.40	7323.59
18-MW-1	25	25	2	5–25	PVC	1634843.7	1761930.30	6758.80
18-MW-2	25	25	2	5–25	PVC	1634878.4	1761868.10	6758.50
18-MW-3	25	25	2	5–25	PVC	1634893.6	1761864.10	6758.30
18-MW-4	25	25	2	5–25	PVC	1634904.5	1761878.60	6758.30
~~18-MW-7~~	~~32~~	~~30~~	~~2~~	~~10–30~~	~~PVC~~	~~1634846.28~~	~~1761791.52~~	~~6755.50~~
18-MW-17	23.8	22	2	12–22	PVC	1637778.2	1759717.10	6695.20
18-BG-4	25	6.8	4	2.5–6.5	PVC	1633510.00	1760760.00	6748
~~3MAO-2~~	~~30~~	~~30~~	~~4~~	~~14.7–24.7~~	~~PVC~~	~~1633782.47~~	~~1760716.45~~	~~6959.40~~

Table 2.0-1 (continued)

Well Name	Total Depth (ft)	Completion Depth (ft)	Diameter (in.)	Screened Interval (ft)	Construction Material	Easting	Northing	Elevation (ft amsl[a])
73-01001	45	42.5	2	n/a[b]	PVC	1635675.27	1775500.94	7121
73-01003	110	100.10	2	n/a	PVC	1634580.67	1775644.52	7138
73-01004	112.5	99.9	2	n/a	PVC	1634194.73	1775749.51	7143
73-01006	40	37.8	2	n/a	PVC	1633476.08	1776230.67	7152
73-01009	45	42.9	2	n/a	PVC	1633798.46	1776121.12	7149
73-01011	205	186.00	2	n/a	PVC	1634390.69	1775707.50	7138
53-TH-1	49	46	2	n/a	Aluminum	1639400.00	1771140.00	6916.60
53-TH-2	49	46	2	n/a	Aluminum	1639780.00	1771250.00	6919.50
53-TH-3	49	48	2	n/a	Aluminum	1639970.00	1770810.00	6910.90
53-TH-4	49	47	2	n/a	Aluminum	1639990.00	1771040.00	6910.10
53-TH-5	100	93.5	1	n/a	Aluminum	1639700.00	1770980.00	6930.20
53-TH-6	150	150	4	Open borehole	Aluminum	1639700.00	1771080.00	6921.20
53-TH-7	80	77	2	Open borehole	Aluminum	1639350.00	1770510.00	6701
53-TH-B	49	48	2	n/a	Aluminum	1638980.00	1771150.00	6920.70

[a] amsl = Above mean sea level.

[b] n/a = Not applicable.