PUREX STORAGE TUNNELS
CHAPTER 11.0
CLOSURE AND FINANCIAL ASSURANCE

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
07/23/2020	PCN-PUREX-2019-03 (8C.2020.Q3)
02/28/2019	PCN-PUREX-2019-01 (8C.2019.Q1)
12/17/2018	8C.2018.5F
10/2006	

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11.0CLOSURE AND FINANCIAL ASSURANCE

This addendum details closure activities for the Plutonium Uranium Extraction (PUREX) Storage Tunnels Operating Unit Group 2. This Operating Unit Group consists of Tunnel Number 1 and Tunnel Number 2 Dangerous Waste Management Units (DWMUs).

11.1 Introduction

The PUREX Storage Tunnels are permitted and managed as *Resource Conservation and Recovery Act of 1976* (RCRA) miscellaneous units; however, the tunnels are no longer in active operation. In May 2017, workers discovered a portion of Tunnel Number 1 had collapsed, prompting an immediate response action to protect workers and the environment. A structural evaluation revealed the threat of further failure of Tunnel Number 1. An interim stabilization measure to fill Tunnel Number 1 with engineered grout was taken under Section J.4.5 of the PUREX Tunnels Contingency Plan and Permit Condition V.25.A.1 of the Hanford Facility RCRA Permit. Grouting in Tunnel Number 1 was completed in November 2017. Filling the tunnel void spaces with grout improved tunnel stability, provided additional radiological protection, and increased durability while not precluding final closure actions. Tunnel Number 1 will receive no new waste and will continue to store the existing encapsulated waste until final closure.

At the same time, a structural evaluation also revealed the threat of future failure of Tunnel Number 2. To protect stored waste containers from potential damage caused by a tunnel failure event (e.g., puncture of a container by a falling structural member) and to prevent any associated release of dangerous waste constituents to the environment, an interim closure action to cover the stored waste and fill Tunnel Number 2 void spaces around the waste with engineered grout is being taken. No waste has been added to Tunnel Number 2 since 1996 and no waste will be added or removed, nor will personnel entry be permitted prior to grouting because of the threat of structural failure. Following implementation of the interim closure action, Tunnel Number 2 will store encapsulated waste until final closure.

Interim closure activities will ensure safe storage of dangerous waste until final closure can be completed. The response action to grout Tunnel Number 1 serves as the interim closure action for Tunnel Number 1 and is described in Section 11.5.5. Interim closure of Tunnel Number 2 will be completed in accordance with the activities described in Section 11.5.6. Following completion of the interim closure activities, an extended closure period will commence and the tunnels will be monitored and maintained until final closure. Final closure activities will be completed concurrent with remediation of the PUREX Plant as described in Section 11.6.

11.2 Facility Contact Information

PUREX Operator and Property Owner:
Doug S. Shoop, Manager
U.S. Department of Energy, Richland Operations Office
P.O. Box 550
Richland, WA 99352
(509) 376-7395

PUREX Co-Operator:
L. Ty Blackford, President and Chief Executive Officer
CH2M HILL Plateau Remediation Company
P.O. Box 1600
Richland, WA 99352
(509) 373-0293

11.3 Facility Description

The PUREX Plant is located in the southeast portion of the 200 East Area. The PUREX Plant was used for the recovery of uranium and plutonium from irradiated reactor fuel. The PUREX Plant was built in 1956 and operated until 1972. It was restarted in 1983 and operated until 1989.

The PUREX Storage Tunnels are permitted as miscellaneous units under Washington Administrative Code (WAC) 173-303-680, but are no longer in active operation and comprise Closing Unit Group 25.

Both tunnels are planned for closure, and no new waste will be accepted for placement into the tunnels.

PUREX Tunnel Number 1. Construction of PUREX Storage Tunnel Number 1 was completed in 1956. Tunnel Number 1 is approximately 5.8 meters (19 feet) wide by 6.7 meters (22 feet) high by 109 meters (358 feet) long and provides storage space for eight railcars. The maximum process design capacity for storage in Tunnel Number 1 is approximately 4,129 cubic meters (5,400 cubic yards). The tunnel experienced a partial roof collapse in May 2017. An interim stabilization was taken, and the tunnel was filled with grout in October and November 2017.

PUREX Tunnel Number 2. Construction of PUREX Storage Tunnel Number 2 was completed in 1964. The storage area of Tunnel Number 2 is approximately 5.8 meters (19 feet) wide by 6.7 meters (22 feet) high by 514.5 meters (1,688 feet) long and provides storage space for 40 railcars. The maximum process design capacity for storage in Tunnel Number 2 is approximately 19,878 cubic meters (26,000 cubic yards). Due to the potential of roof collapse, the tunnel will be interim closed by grout filling of the waste in 2018.

Diagrams of the layout of Tunnel Numbers 1 and 2 are shown in the PUREX Storage Tunnels Part A.

11.3.1 Maximum Waste Inventory

The PUREX Tunnels currently store eight railcars in Tunnel Number 1 and 28 railcars in Tunnel Number 2. The waste volume in Tunnel Number 1 is approximately 596 cubic meters (780 cubic yards). The waste volume in Tunnel Number 2 is approximately 2,204 cubic meters (2,883 cubic yards). This is the maximum waste inventory as no additional waste will be stored.

11.4 Closure Performance Standards

Closure performance standards for final closure of the PUREX Storage Tunnels will be based on WAC 173-303-610(2)(a)(i)-(iii), which requires closure of the facility in a manner that accomplishes the following objectives:

- Minimizes the need for further maintenance.
- Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere.
- Returns the land to the appearance and use of surrounding land areas, to the degree possible, given the nature of the previous dangerous waste activity.

Annual surveillance of the PUREX Storage Tunnels will be conducted as described in Addendum I, “Inspection Requirements.” During the closure period until final closure activities are conducted, the miscellaneous unit performance standards identified in WAC 173-303-680(2)(b)(i) through (4), as required by WAC 173-303-610(2)(b), will apply. Compliance with these standards is addressed in Table 11-1.

11.4.1 Closure Decision

This closure plan describes interim closure actions through the filling of the PUREX Storage Tunnels DWMUs with grout. The final closure decision for the PUREX Tunnels DWMUs has not been made, and will be made together with the remedial actions decisions for the 200-CP-1 Operable Unit. There are two options for closure of the PUREX Tunnels:

1. **Clean Closure**. For more detailed description of clean closure of the PUREX Tunnels, see Section 11.6.1. Clean closure requires removal of all waste and confirmation of clean closure levels for the dangerous waste constituents. The grout will cure to a strength to provide structural support in less than 24 hours. After 28 days, the grout will have a minimum strength of 1200 to 2000 pounds per square inch and could be cut with a diamond wire saw or other technology to enable removal of the equipment. The clean closure levels will be adopted from the Record of Decision (ROD) for the 200-CP-1 Operable Unit.
2. **Landfill Closure**. For more detailed description of landfill closure of the PUREX Tunnels, see Section 11.6.2. Landfill closure leaves waste in place and requires that a final cover is constructed over the landfill. The cover design must meet the standards in WAC 173-303-806(4)(h)(v) and WAC 173-303-665(6)(a). In addition, the permittees must comply with all the post-closure requirements in WAC 173-303-665(6)(b).

It should be noted that the closure decision is made on a DWMU level. Thus, a different closure decision can be made for each of the PUREX Tunnels.

11.5 Interim Closure Activities

The following sections describe activities supporting closure of the PUREX Storage Tunnels.

11.5.1 Training Requirements

Training requirements are described in Hanford Facility RCRA Permit (WA7890008967), Attachment 5, *Hanford Facility Personnel Training Program*, and PUREX Storage Tunnels Addendum G, "Personnel Training."

11.5.2 Security

Located within the 200 Area of the Hanford Facility, the PUREX Storage Tunnels must comply with access control and warning sign requirements pursuant to WAC 173-303-310. Hanford Facility access is controlled by 24-hour surveillance as described in the Hanford Facility RCRA Permit (WA7890008967) Attachment 3, *Security*, and PUREX Storage Tunnels Addendum E, "Security."

11.5.3 Preparedness, Prevention, and Emergency Procedures

PUREX Storage Tunnels preparedness, prevention, and emergency procedures are described in Hanford Facility RCRA Permit (WA7890008967) Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), and PUREX Storage Tunnels Addendum F, "Preparedness and Prevention."

11.5.4 Inspections

To prevent threats to human health and the environment during the extended closure period, the PUREX Storage Tunnels will be inspected in accordance with WAC 173-303-320(2). Inspections will be performed as described in Addendum I, "Inspection Requirements," until the final closure certification is approved by the Department of Ecology (Ecology).

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Table 11-1 Washington Administrative Code 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
"(2) Environmental performance standards. A miscellaneous unit must be located, designed, constructed, operated, maintained, and closed in a manner that will ensure protection of human health and the environment. Permits for miscellaneous units are to contain such terms and provisions as necessary to protect human health and the environment, including, but not limited to, as appropriate, design and operating requirements, detection and monitoring requirements, and requirements for responses to releases of dangerous waste or dangerous constituents from the unit. Permit terms and provisions must include those requirements in WAC 173-303-630 through 173-303-670, 40 CFR Subparts AA through CC, which are incorporated by reference at WAC 173-303-690 through 173-303-692, WAC 173-303-800 through 173-303-806, 40 CFR, Part 63 Subpart EEE (which is incorporated by reference at WAC 173-400-075(5)(a)), and 40 CFR, Part 146 that are appropriate for the miscellaneous units being permitted. Protection of human health and the environment includes, but is not limited to:"	The PUREX Storage Tunnels will be managed and monitored in a manner that will ensure protection of human health and the environment.
"(a) Prevention of any releases that may have adverse effects on human health or the environment due to migration of wastes constituents in the groundwater or subsurface environment, considering: (i) The volume and physical and chemical characteristics of the waste in the unit, including its potential for migration through soil, liners, or other containing structures; (ii) The hydrologic and geologic characteristics of the unit and the surrounding area; (iii) The existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater; (iv) The quantity and direction of groundwater flow; (v) The proximity to and withdrawal rates of current and potential groundwater users; (vi) The patterns of land use in the region; (vii) The potential for deposition or migration of waste constituents into subsurface physical structures, and into the root zone of food-chain crops and other vegetation; (viii) The potential for health risks caused by human exposure to waste constituents; and (ix) The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents."	The interim closure activity to grout the PUREX Storage Tunnels will prevent migration of dangerous waste constituents to the groundwater or subsurface environment below the tunnels during the extended closure period.

Table 11-1 Washington Administrative Code 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
"(b) Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, or wetlands or on the soil surface considering: (i) The volume and physical and chemical characteristics of the waste in the unit; (ii) The effectiveness and reliability of containing, confining, and collecting systems and structures in preventing migration; (iii) The hydrologic characteristics of the unit and the surrounding area, including the topography of the land around the unit (iv) The patterns of precipitation in the region; (v) The quantity, quality, and direction of groundwater flow; (vi) The proximity of the unit to surface waters; (vii) The current and potential uses of nearby surface waters and any water quality standards established for those surface waters; (viii) The existing quality of surface waters and surface soils, including other sources of contamination and their cumulative impact on surface waters and surface soils; (ix) The patterns of land use in the region; (x) The potential for health risks caused by human exposure to waste constituents; and (xi) The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents."	The interim closure activity to grout the PUREX Storage Tunnels will prevent migration of dangerous waste constituents to the soil under the tunnels. There are no surface waters or wetlands near the PUREX Storage Tunnels.
"(c) Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air, considering: (i) The volume and physical and chemical characteristics of the waste in the unit, including its potential for the emission and dispersal of gases, aerosols and particulates; (ii) The effectiveness and reliability of systems and structures to reduce or prevent emissions of dangerous constituents to the air; (iii) The operating characteristics of the unit; (iv) The atmospheric, meteorologic, and topographic characteristics of the unit and the surrounding area; (v) The existing quality of the air, including other sources of contamination and their cumulative impact on the air; (vi) The potential for health risks caused by human exposure to waste constituents; and (vii) The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents."	The interim closure activity to grout the PUREX Storage Tunnels will prevent migration of dangerous waste constituents to the air outside of the tunnels. During grouting, contamination control methods, such as plastic sleeving, will be used when penetrations to the tunnel are opened. As the grout flows into placement locations, air will be displaced by the grout. Portable ventilation systems described in Sections 11.5.5.3.3 and 11.5.6.3 collect and filter the displaced air to prevent the spread of contamination to the environment.

Table 11-1 Washington Administrative Code 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
"(3) Monitoring, analysis, inspection, response, reporting, and corrective action. Monitoring, testing, analytical data, inspections, response, and reporting procedures and frequencies must ensure compliance with subsection (2) of this section, WAC 173-303-320, 173-303-340(1), 173-303-390, and 173-303-64620 as well as meet any additional requirements needed to protect human health and the environment as specified in the permit."	The stabilized tunnels will be maintained in a manner that prevents threats to human health and the environment and monitored through routine radiation surveillances, using radiation as an indication of contamination outside the stabilized tunnels. • Inspections required by WAC 173-303-320 are conducted as described in Addendum I. • Preparedness and Prevention measures required by WAC 173-303-340(1) are described in Addendum F. • Facility Reporting required by WAC 173-303-390 is met in accordance with Hanford Facility RCRA Permit Conditions I.E.22 and II.B. • There have been no releases from the PUREX Storage Tunnels subject to Corrective Action requirements from WAC 173-303-64620.
"(4) Post-closure care. A miscellaneous unit that is a disposal unit must be maintained in a manner that complied with subsection (2) of this section during the post-closure care period. In addition, if a treatment or storage unit has contaminated soils or groundwater that cannot be completely removed or decontaminated during closure, then that unit must also meet the requirements of subsection (2) of this section during post-closure care. The post-closure plan under WAC 173-303-610(8) must specify the procedures that will be used to satisfy this requirement."	A post-closure plan will be developed if required depending on the final closure option selected.

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11.5.5 Interim Closure of Tunnel Number 1

The response action to grout Tunnel Number 1 in accordance with Section J.4.5 of the PUREX Storage Tunnels Contingency Plan and Permit Condition V.25.A.1 of the Hanford Facility RCRA Permit serves as the interim closure action for Tunnel Number 1 and is described in the following sections. The tunnel will be monitored and maintained during an extended closure period until final closure. Final closure activities will be completed concurrent with remediation of the PUREX Plant as described in Section 11.6.

11.5.5.1 Interim Response Activities

On May 9, 2017, workers discovered a collapse in a portion of the Tunnel 1 wood timber roof structure resulting in a hole approximately 5.8 meters (19 feet) wide by 5.2 meters (17 feet) long. Immediate and follow-on actions included the following:

- The Emergency Operations Center was activated to manage the immediate response to the event, including response actions necessary to protect personnel (May 9).
- Informational notification was made to Ecology that the RCRA contingency plan was being implemented, although no evidence of release from the unit was found (May 9).
- Fifty-three truckloads of soil fill were placed through the roof opening at the collapsed area to provide contamination control, shielding, protection from ambient conditions, and stabilization of the tunnel support walls (May 10).
- A temporary protective cover was installed over the full length of Tunnel 1 (May 20).
- A 15-day report was prepared and submitted to Ecology in compliance with Permit Condition II.A.1 because the contingency plan was implemented (May 24).
- United States Department of Energy (USDOE) notified Ecology of its plan to address the significant threat of further failure of Tunnel Number 1 by void filling the tunnel with grout (May 31).
- Ecology approved the plan to grout Tunnel Number 1 as an interim stabilization measure for the tunnel structure that will not preclude future closure or remedial decisions (June 8).
- Grouting was initiated on October 2 and completed on November 11.

The response action taken under the contingency plan performed the steps necessary to achieve interim closure of Tunnel Number 1. The response action stabilized contaminated equipment by filling the tunnel with engineered grout to improve tunnel stability, provide additional radiological protection, and increase durability while not precluding any final closure actions. The following sections describe the technical details of the response action taken for Tunnel Number 1.

11.5.5.2 Records Review

The structural evaluation conducted for Tunnel Number 1 reviewed tunnel drawings and specifications as well as structural properties of the tunnel components and adjacent soil. The structural evaluation is described in Chapter 4, “Process Information,” Appendix 4A. Tunnel inventory as described in Chapter 3, “Waste Analysis Plan,” was also reviewed to identify dangerous waste constituents within Tunnel Number 1.

11.5.5.3 Site Preparation and Modifications Made Prior to Stabilization

Figure 11-1 and Figure 11-2 show the layout and location for the grouting equipment in relation to Tunnel Number 1. The piping system for grout injection was placed at the location of the roof collapse. Two systems were provided, one servicing the south section of the tunnel (area from the location of the roof opening where fill soil was added to the southern end of the tunnel) and one servicing the north section. The individual pipes in each system were inserted into the top of the soil mound and routed underneath the existing roof timbers bordering each side of the collapsed roof area. The mechanism for insertion of the pipes was developed by mockup testing. Once the pipes were inserted, this area was backfilled with soil to provide a 4 foot (nominal) covering over the area. The existing 4-inch and 1.5-inch-diameter tunnel roof penetrations were used for camera and lighting placement.

11.5.5.3.1 **Piping System**

Figure 11-3, Figure 11-4, and Figure 11-5 illustrate detail for the piping systems. Two systems were required, one to service the north section of the tunnel and one for the south section. Each system consisted of the following:

- Two 8-inch steel pipes for grouting.
- One 8-inch steel pipe for camera and lighting.
- One 8-inch steel pipe for passive ventilation.

Each individual pipe was inserted into a box embedded in the top of the fill soil mound and routed underneath the existing roof timbers. Pipe ends terminated into the internal space of each tunnel section.

Once all piping was placed, thrust blocks of concrete were placed in the boxes, and soil was backfilled over the area to a height of 4 feet (nominal) above the top of the exiting roof timbers. Additionally, concrete and grout were poured on the outside of the boxes to prevent the soil from collapsing into the tunnel. The vertical load of the pipe was supported by the soil mound.

11.5.5.3.2 **Work Platform**

A work platform was placed across the east/west centerline of collapsed roof section. The work platform facilitated the grouting operation, camera/light placement, and connection of the ventilation system. Figure 11-1 and Figure 11-2 show the placement of the work platform in relation to Tunnel Number 1. Figure 11-3 provides details of the work platform. The work platform met the following requirements:

- The platform was ground supported with 45-foot clear span and a 6-foot minimum wide working area.
- The platform was designed in accordance with the 2012 International Building Code (IBC) with a uniform live loading of 100 pounds per square foot with two 1,000-pound concentrated loads applied at midspan (one on each side of the platform).
- The platform was designed for end bearing condition based on 1,500 pounds per square foot allowable soil-bearing pressure.
- The platform included a guardrail system along each side designed in accordance with 2012 IBC provisions for non-public access with openings that prevent passage of a 21-inch-diameter sphere.

11.5.5.3.3 **Ventilation System**

Passive ventilation was provided during the grouting operation to control contamination in accordance with the Washington Department of Health License (EU 1471 NOC 1262 for Tunnel Number 1) conditions and limitations. Figure 11-6 shows details of the High-Efficiency Particulate Air (HEPA) filter skid and assembly. The passive ventilation HEPA filter skids were located to one side of the tunnel berm and connected to the piping vent pipe with flex hose. Displaced air from the tunnel was routed via the vent pipe through a HEPA filter. Condensate from displaced air was collected prior to the inlet of the filter.

11.5.5.4 **Stabilization Activities**

Grouting of Tunnel Number 1 was conducted in October and November 2017. The grout used and the actions taken to stabilize the tunnel are described in the following sections.

11.5.5.4.1 Grout Design

During development of the grout design, the Waste Encapsulation and Storage Facility (WESF) Hot Cell A through F grouting project was reviewed to identify lessons learned that were applicable to grouting the PUREX tunnels. The differences in how the grout was inserted and the spaces to fill proved to be the major difference between the WESF and PUREX tunnel grouting activities. The WESF grout formulation demonstrated desirable characteristics that matched tunnel grout fill design requirements. Minor modifications were made to reduce cement content while maintaining overall cementitious materials (cement plus fly ash) content to reduce compressive strength and heat of hydration while maintaining stable and uniform batching and placement behavior characteristics. The grout was tested using a mockup facility to verify performance. In addition, tests were conducted to determine when the compressive strength of a grout lift was sufficient to allow the next lift to be poured. Testing demonstrated that 1-day curing time was adequate.

The standard grout formulation used in Tunnel Number 1 was established after mockup testing and is shown in Table 11-2. The grout was a flowable, nonaggregate void-filling grout formulated to meet the functional requirements listed below.

- The grout will be able to flow easily to the extent of the tunnel length and flow into open spaces in and between rail cars and equipment.
- The grout will minimize the amount of heat generated during curing.
- The target range of minimum compressive strength is 1200 to 2000 pounds per square inch after 28 days.
- The grout will provide extended placement time (typically a minimum of 3 hours) to facilitate batching and placement during construction.

Table 11-2 Standard Grout Formulation

Constituent	Quantity (per yard)
Sand	2,105 lb
Type III cement	374 lb
Fly ash	796 lb
Water	56 gal
Viscosity-modifying admixture	60 oz
Hydration-controlling admixture	60 oz
Water-reducing admixture	22 oz
Workability-retaining admixture	22 oz

The grout will have sufficient strength to provide structural support for the Tunnel. The formula was developed to also allow it to be cut using a diamond wire saw or other technology if Clean Closure is selected as the final closure action.

Minor adjustments were made to the contents as needed based on factors such as weather conditions and location in the tunnel to achieve functional requirements. A quality assurance testing program was used to ensure that the grout used for Tunnel Number 1 complied with project specifications. Engineering and laboratory-scale testing was performed to confirm that the grout formulation met the performance criteria prior to the addition of grout to PUREX Tunnel Number 1. Field inspection and testing was performed during the grouting operation. A minimum of one set of grout samples (two cylinders) was cast and tested for every 170 cubic yards of grout placed per day. Samples were taken from randomly selected trucks. Visual inspection of each truck was performed by the structural engineer (or designated representative) to visually confirm grout flowability characteristics were consistent with grout batch test results. Testing was performed in accordance with:

- ASTM C1611, *Standard Test Method for Slump Flow of Self-Consolidating Concrete.*
- ASTM C1064, *Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.*
- ASTM C138, *Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.*
- ASTM C39, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*.

11.5.5.4.2 Evaluations Conducted During Design

The grout design process included several evaluations to determine how well the grout would perform under conditions expected at PUREX.

Over long time periods, concrete structures may degrade as a result of exposure to ionizing radiation. A conservative calculation has been performed that shows that the time frame necessary for the recognized cumulative exposure threshold associated with concrete degradation is greater than 110 years. A more realistic, yet still conservative, calculation conducted for WESF Hot Cells A through F closure shows that the time frame necessary to reach a radiation exposure of concern is in excess of 590 years (CHPRC-02499, *W-130 Project Calculation: Estimate of Impacts to Grout as a Result of Radiation Exposure*). Radiation fields in the PUREX Storage Tunnels are much lower than those encountered in the WESF Hot Cells. No significant degradation of grout due to radiation exposure in the near time frame is expected.

Grout can also be affected by exposure to high temperature. The grout design limits temperatures due to heat of hydration to 160°F, which will not negatively affect the grout or structural concrete. Potential impacts to the grout as a result of heat of hydration and decay heat have been evaluated (CHPRC-02499), and there are no deleterious effects.

11.5.5.4.3 Grout Delivery

Grout was prepared offsite and trucked to Tunnel Number 1. Figure 11-7 includes a site plan for the grouting operations. Grout samples were collected and tested during daily placements. A grout pump vehicle was placed on the west side of the tunnel entrance.

After equipment installation, the grouting was performed by connecting a grouting pipe from the grout pumping vehicle to the pipe system. Addition of the grout into each section of the tunnel displaced air from the tunnel. The displaced air was routed through a flex hose to the HEPA filter skids described in Section 11.5.5.3.3. A second skid, collocated next to the primary filter skid, served as backup.

Cameras with lighting were used to monitor the progress of the fill and to provide visual confirmation that the spaces being grouted were filled to maximum extent possible. A temporary washout pit was set up to the south of PUREX along PUREX Drive and was part of the exit route for the delivery vehicles.

11.5.5.4.4 Grout Placement

Placement of grout began at the location of the roof collapse and subsequent soil fill. This location allowed both ends of the tunnel on either side of the soil fill to be grouted from a single point. Each section of the tunnel (north and south) used a dedicated piping arrangement to facilitate grouting. The sequence for grouting is described below.

The grout in the south end of the tunnel was placed in a series of lifts to prevent the equipment on the railcars from floating. The initial pours were approximately 1 to 2 feet of grout to reach from the floor to the bottom of the railcars. The initial pours were allowed to set up before additional grout was added. Subsequent lifts locked the equipment in place on the railcars. The final additions of grout were conducted to totally encapsulate the equipment and fill the south end to the maximum extent practicable.

The grout in the north section of the tunnel was placed in 1- to 2-foot lifts. This was done to capture the equipment on the rail cars and also to limit the hydraulic pressure on the seals of the water-fillable door. The grout additions continued in small increments until all of the equipment was covered in grout and the north section was filled to the maximum extent practicable.

Grout was distributed from the grout pump vehicle located west of the tunnel. Valves were used at the fill connections to enable quick shutoff of grout once the volume is filled. As grout flowed into the tunnel, air was displaced by the grout. The displaced air contained water vapor and was considered potentially radioactively contaminated. To control contamination during grouting, portable ventilation systems, described in Section 11.5.5.3.3, were used to collect and filter the displaced air. A total of 4,396 cubic yards of grout was placed into Tunnel 1. This totally encapsulated the equipment to within approximately 6 inches from the roof timbers.

The work platform and ventilation equipment were removed after grouting was completed and soil fill was placed in the area to match the profile of existing tunnel soil cover. The piping system and camera and lighting components added on to the existing tunnel penetrations were abandoned in place.

11.5.6 Interim Closure of Tunnel Number 2

Interim closure of Tunnel Number 2 will be completed as described in the following sections. Following completion of interim closure, an extended closure period will commence and the tunnel will be monitored and maintained until final closure.

11.5.6.1 Records Review

The structural evaluation conducted for Tunnel Number 2 reviewed tunnel drawings and specifications as well as structural properties of the tunnel components and adjacent soil. The structural evaluation is described in Chapter 4, "Process Information," Appendix 4B. Tunnel inventory as described in Chapter 3, "Waste Analysis Plan," was also reviewed to identify dangerous waste constituents within Tunnel Number 2.

11.5.6.2 Site Preparation

The Tunnel Number 2 area will be prepared to enable the safe insertion of the engineered grout while limiting the risks to the workers and the environment. Roads required for the grout trucks will be prepared to provide a stable platform to deliver the grout. The path of the trucks will be designed to limit the potential for interfering with the normal traffic patterns of the area. A site plan for Tunnel Number 2 activities is shown in Figure 11-8.

Additionally, investigative work was performed to verify the assumptions utilized in the engineering design process. This included removing a 3-inch plug in an existing 30-inch tunnel riser plug to enable samples to be taken in the interior of the tunnel and ensuring the main plug can be removed. These samples included industrial hygiene (e.g., flammable gas, volatile organics, or hazardous materials) and radiological samples to determine the status of the atmosphere and the potential for radiation exposure from both direct radiation and airborne. The 30-inch plugs on the risers that will be utilized for grout insertion were pulled and put back in place to confirm the plugs could be removed. The investigation also revealed that the length and configuration of some of the railcars was different than previously assumed. The artist's rendition of Tunnel Number 2, shown in Figure 4-2 and Figure 11-11, show the updated configuration.

11.5.6.3 **Modifications Made Prior to Stabilization**

Modifications will be required to prepare the tunnel for the insertion of the grout. Plugs in existing riser positions that will be utilized during the grouting process will be removed. The plug will then be replaced with an engineered replacement to allow grout insertion as well as provide locations for cameras and necessary lighting (Figure 11-9 and Figure 11-10). Work on the tunnel is being done using lifts and cranes. No work platform is required.

Additionally, a riser will be modified to connect the ventilation system to capture the air expelled from the tunnel during the grouting activities. Projected riser locations for cameras, lighting, and ventilation equipment are shown in Figure 11-11.

A passive ventilation system skid similar to that used for Tunnel Number 1 will be utilized to filter air discharged from the tunnel during grouting (Figure 11-6). The system will be designed and licensed in accordance with the Hanford Site Air Operating Permit (AOP 00-05-006).

11.5.6.4 **Stabilization Activities**

The stabilization activities for Tunnel Number 2 are described in the following sections. To the extent possible, materials and process used for stabilization of Tunnel Number 1 will be used for Tunnel Number 2.

11.5.6.4.1 **Grout Design**

The grout design that will be utilized for Tunnel Number 2 will be similar to the grout that was utilized in Tunnel Number 1 with the only difference being Type I/II cement will be utilized in Tunnel 2 instead of Type III. Functional requirements and formulation of the grout is shown in Section 11.5.5.4.1.

11.5.6.4.2 **Grout Delivery**

The grout will be delivered through the modified riser plugs located along the top of the tunnel. To prevent loading the top of the tunnel, the piping will be a goose-neck type delivery system located off the tunnel surface (Figure 11-12). The piping will be connected to the modified riser plug shown in Figure 11-9 and Figure 11-10 utilizing industrial concrete rubber hose. The projected location for grout insertion is shown in Figure 11-11. This will limit the load on the tunnel while enabling the grout insertion into the tunnel.

11.5.6.4.3 **Grout Placement**

It is estimated that Tunnel 2 will require approximately 43,000 cubic yards to stabilize. The grout will be placed in the tunnel in layers. The layers will be small enough to prevent the possibility of creating a buoyant force to lift the equipment on the railcars in the tunnel. It will be delivered in multiple locations to ensure the grout flows and covers the entire tunnel.

A ventilation skid with a passive HEPA filter system will be connected to one of the risers. This will enable the air in the tunnel to escape through a filtered media to prevent the release of airborne contamination. The skid will have equipment to collect the condensate from the system.

During the evolution to grout the tunnel, standard radiological controls will be utilized to prevent the release and/or spread of contamination. This may include the use of sleeving, glovebags, negative air machines, etc. The type of control will be selected based on the risk of the work being performed and the potential for a release. Quality control testing will be conducted during grout placement in the same manner used for Tunnel Number 1 as described in Section 11.5.5.4.1. Grout that does not meet the grout design standards listed in Section 11.5.5.4.1 will be returned to the vendor and will not be used for the tunnel.

11.6 Final Closure Activities

Final closure of the PUREX Storage Tunnels will be coordinated with closure/remediation of the PUREX Plant in accordance with the *Hanford Federal Facility Agreement and Consent Order* (HFFACO or Tri-Party Agreement [TPA]), Section 5.5. The final closure decision for the PUREX Storage Tunnels will be deferred until the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial action for the 200-CP-1 Operable Unit because the close proximity of the two facilities will impact the final disposition of each facility. Coordination of the RCRA unit closure and the CERCLA operable unit investigation and remediation is necessary to prevent overlap and duplication of work.

The CERCLA remedial investigation process will be initiated in accordance with the schedule established in TPA Milestone M-085-80. The nature and extent of contamination and alternatives to mitigate risks to human health and the environment will be evaluated in a CERCLA feasibility study.

A feasibility study evaluates alternatives for compliance with applicable or relevant and appropriate requirements, including substantive closure requirements defined in WAC 173-303-610. A CERCLA proposed plan identifies a preferred alternative for remediation and is submitted for public comment in accordance with the Hanford Public Involvement Plan (http://www.hanford.gov/files.cfm/FacAgreementand-Consent-Order_FINAL.pdf). Following consideration of public comment, a ROD documents the selected remedial alternative. A remedial design/remedial action work plan documents the design and schedule for remediation activities.

USDOE will work with Ecology to integrate the CERCLA decision information as it becomes effective into the closure plan. The final closure plan will meet the requirements of WAC 173-303-140 and WAC 173-303-610. Potential final closure options for the PUREX Storage Tunnels are described in Sections 11.6.1 and 11.6.2. These options may be modified and additional options may be developed based on the remedial investigation results and the examination of available technologies.

11.6.1 Retrieval/Clean Closure Options

As part of an interim stabilization measure in response to a collapse event discovered by workers on May 9, 2017, Tunnel Number 1 was filled with grout to improve tunnel stability, provide additional radiological protection, and increase durability while not precluding final closure actions. Because of the threat of future failure of Tunnel Number 2, interim closure activities are being taken to stabilize Tunnel Number 2 with grout.

Clean closure by retrieval could be implemented if the results of the decision-making process determine that it is practicable, protective of human health and the environment, and in compliance with applicable regulations. If clean closure is the selected option, the closure action might consider but will not be limited to the options described in Sections 11.6.1.1, 11.6.1.2, and 11.6.1.3. These options could be modified based on the remedial investigation results and the examination of available technologies.

11.6.1.1 Retrieval and Disposal in the PUREX Plant

In this option, railcars and grout in both tunnels would be retrieved after excavation of the tunnel by cutting and removal using water jets, wire saws, excavation equipment, or other technologies. A detailed excavation plan, including specific cut locations, would be developed as part of the final remediation/closure evaluation described in Section 11.6. Waste material would be moved from the tunnels to the PUREX Plant canyon deck area or an alternate location if disposal in the plant is the selected alternative. Waste such as empty railcars that could not be placed in the PUREX Plant for disposal (e.g., insufficient space) would be removed for final disposition at other approved disposal facilities.

Final disposition of the waste transferred to the plant, including characterization or size reduction as needed as well as disposition of the tunnel structure, would be completed as part of the coordination with the 200-CP-1 Operable Unit remedial action. Closure activities would be conducted in compliance with applicable WAC requirements. The excavation plan and waste disposition processes would be developed to ensure that the silver nitrate contained in Tunnel Number 2 is not exposed to conditions that would cause it to ignite and that mercury contained in Tunnel Number 2 is not released to the environment. Verification sampling would be performed in accordance with an approved sampling and analysis plan.

11.6.1.2 Retrieval and Physical Processing (Size Reduction) in the PUREX Plant and Subsequent Disposal

In this option, retrieval of waste material stored in the tunnels would be similar to that described in the previous section if physical processing in the plant and disposal elsewhere is the selected alternative in the remedial action decision for the 200-CP-1 Operable Unit. Once the waste material was transferred to the PUREX Plant canyon deck area or alternate location within the plant, characterization and size reduction of waste material would proceed as needed. An area located on the canyon deck, in a process cell, or in an alternate location would be modified to include all necessary equipment to perform characterization, size reduction, and packaging activities. Size reduction would be performed through various technologies that include but are not limited to flame cutting, water jet cutting, sawing, or other technologies.

Final disposition of the processed waste material either onsite or offsite, as well as disposition of the tunnel structure, would be completed as part of the coordination with the 200-CP-1 Operable Unit remedial action. Closure activities would be conducted in compliance with applicable WAC requirements. The excavation plan and waste disposition processes would be developed to ensure that the silver nitrate contained in Tunnel Number 2 is not exposed to conditions that would cause it to ignite and that mercury contained in Tunnel Number 2 is not released to the environment. Verification sampling would be performed in accordance with an approved sampling and analysis plan

11.6.1.3 Construction of a New Facility for Retrieval, Processing, and Treatment of Equipment for Disposal

This option involves the construction of a new facility that is either mobile or stationary to remove and treat waste material stored in the tunnels. The facility would be constructed in a manner consistent with the retrieval and handling requirements for large, contaminated waste material. Retrieval of the waste and grout from Tunnel Numbers 1 and 2 could involve cutting and removal using water jets, wire saws, excavation equipment, or other technologies. Following retrieval, treatment and disposition of the waste material, as well as disposition of the tunnel structure, would be completed as part of the coordination with the 200-CP-1 Operable Unit remedial action.

Closure activities would be conducted in compliance with applicable WAC requirements. The excavation plan and waste disposition processes would be developed to ensure that the silver nitrate contained in Tunnel Number 2 is not exposed to conditions that would cause it to ignite and that mercury contained in Tunnel Number 2 is not released to the environment. Verification sampling would be performed in accordance with an approved sampling and analysis plan.

11.6.2 In Situ Disposal (Landfill Closure)

As part of an interim stabilization measure in response to a collapse event discovered by workers on May 9, 2017, Tunnel Number 1 was filled with grout to improve tunnel stability, provide additional radiological protection, and increase durability while not precluding final closure actions. Because of the threat of future failure of Tunnel Number 2, interim closure activities are being taken to fill Tunnel Number 2 with grout.

In situ disposal (landfill closure) of Tunnel Numbers 1 and 2 could be implemented if the results of the decision-making process determine that landfill disposal of the stored waste is protective of human health and the environment and in compliance with applicable regulations. If in situ disposal (landfill closure) is the selected option, the closure action might consider but will not be limited to the option described in Section 11.6.2.1. This option could be modified based on the remedial investigation results and the examination of available technologies.

11.6.2.1 Maintain Grout and Install Landfill Cover

This option would involve maintaining the grout fill placed in Tunnel Numbers 1 and 2 as part of the interim stabilization/interim closure measures described in Sections 11.5.5 and 11.5.6. At final closure, remaining external equipment (e.g., risers or monitoring equipment) would be removed from the tunnel surface if necessary. Final closure activities would comply with applicable WAC requirements for landfill closure, including construction of a surface barrier that meets RCRA landfill cover requirements to prevent water from leaching mixed waste contained in the tunnels. Final landfill cover design and installation would be completed as part of the coordination with the 200-CP-1 Operable Unit remedial action.

11.6.3 Identifying and Managing Contaminated Media

If contaminated media removal is required during final closure, it will be managed as a newly generated waste stream in accordance with WAC 173-303-610(5). The contaminated media must be handled in accordance with all applicable requirements of WAC 173-303-170 through WAC 173-303-230, containerized, labeled, characterized in accordance with WAC 173-303-070 requirements, designated as a dangerous or non-dangerous waste, stored, and transported to an appropriate disposal facility. It will be treated (if necessary) to meet Land Disposal Restriction requirements in 40 CFR 268, incorporated into WAC 173-303-140(2)(a) by reference, then ultimately disposed.

11.6.4 Role of Independent Qualified Registered Professional Engineer

An Independent, Qualified, Registered Professional Engineer (IQRPE) will be retained to provide certification of final closure, as required by WAC 173-303-610(6). The IQRPE will be responsible for observing field activities and reviewing documents associated with closure of the PUREX Storage Tunnels.

The IQRPE will perform a number of field activities. However, these field activities are dependent on the closure decision and will be defined when the closure decision has been made.

The IQRPE will record his or her observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to develop the closure certification, which will then be provided to Ecology.

11.6.5 Certification of Closure

In accordance with WAC 173-303-610(6), within 60 days of completing final closure activities for the PUREX Storage Tunnels, certification that closure activities have been completed in accordance with the approved closure plan will be submitted to Ecology by registered mail or other means that establish proof of receipt (including applicable electronic means). The certification will be signed by the owner or operator and signed and certified by an IQRPE. Information supporting IQRPE closure certification will be submitted upon request by Ecology.

11.6.6 Conditions that will be Achieved when Closure is Complete

Depending on the final closure decision, the PUREX Storage Tunnels will be demolished, and components removed and disposed, or they will be closed as a landfill with a surface barrier that meets RCRA landfill cover requirements.

11.7 Closure Schedule and Time Frame

Preparation for and implementation of interim closure activities are being completed to target start of stabilization of Tunnel Number 2 in 2018. Final closure activities for the PUREX Storage Tunnels will take place in conjunction with the remedial actions for the PUREX Plant and the 200-CP-1 Operable Unit. It is anticipated that a number of years will elapse before remedial actions for the PUREX Plant can be initiated. The first step in the remedial action process – developing a draft remedial investigation/feasibility study work plan – is subject to TPA Milestone M-085-80.

Continued storage of dangerous waste in the tunnels will necessitate an extension to the 180 days to complete final closure activities required in WAC 173-303-610(4)(b). This extension is being requested in accordance with WAC 173-303-610(4)(b)(i). Stabilization of the PUREX Storage Tunnels with grout as described in Sections 11.5.5 and 11.5.6 mitigates the potential for exposing workers to dangerous wastes or releasing dangerous wastes into the environment until final closure can be completed.

Approval of this closure plan will grant the Hanford Facility an extended closure period for performance of final closure activities, in accordance with WAC 173-303-610(4)(b), and a separate extension request will not be filed.

During this extended closure period, the Hanford Facility will comply with all applicable requirements of the permit. Additionally, the PUREX Storage Tunnels will be maintained in a manner that prevents threats to human health and the environment. Interim closure activities will be initiated within 60 days after receipt of approved permit. Interim closure activities and extended closure period expected durations are outlined in the closure activities schedule in Table 11-3.

Table 11-3 PUREX Storage Tunnels Closure Activities Schedule

Activity Description	Expected Duration/Date
Interim Closure of Tunnel Number 2	
Preparation (construction of piping systems, ventilation system, etc.)	5 months
Grouting	6 months
Submit interim closure report	60 days after interim closure activities complete
Extended Closure Period	
Extended closure period deferring closure to be concurrent with remedial action of PUREX Plant and 200-CP-1 Operable Unit, including continued surveillance and inspection	To be determined

Table 11-3 PUREX Storage Tunnels Closure Activities Schedule

Activity Description	Expected Duration/Date
Initiate remedial action process (TPA M-085-80, *Submit Remedial Investigation/Feasibility Study Work Plan for 200-CP-1 to Ecology*)	9/30/2020
Implementation of final closure decision (clean closure or landfill closure)	To be determined
Completion of Closure Activities	
Submit final closure certification	60 days after final closure activities complete
Post-Closure (if required)	
Groundwater monitoring and reporting	As required by post-closure plan
Maintenance and monitoring of waste containment systems	As required by post-closure plan

11.8 Cost of Closure

A detailed written estimate outlining updated projections of anticipated closure costs for the Hanford Facility treatment, storage, or disposal units having final status is not required per Permit Condition II.H.

11.9 References

ASTM C39/C39M-17b, 2017, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*, ASTM International, West Conshohocken, Pennsylvania. Available at: https://www.astm.org/Standards/C39.htm.

ASTM C138/C138M-17a, 2017, *Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete*, ASTM International, West Conshohocken, Pennsylvania. Available at: https://www.astm.org/Standards/C138.htm.

ASTM C1064/C1064M-17, 2017, *Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete*, ASTM International, West Conshohocken, Pennsylvania. Available at: https://www.astm.org/Standards/C1064.htm.

ASTM C1611/C1611M-14, 2014, *Standard Test Method for Slump Flow of Self-Consolidating Concrete*, ASTM International, West Conshohocken, Pennsylvania. Available at: https://www.astm.org/Standards/C1611.htm.

CHPRC-02499, 2015, *W-130 Project Calculation: Estimate of Impacts to Grout as a Result of Radiation Exposure*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

2012 International Building Code, International Code Council, May 2011. Available at: http://tyrone.org/wp-content/uploads/2017/05/icc.ibc_.2012.pdf.

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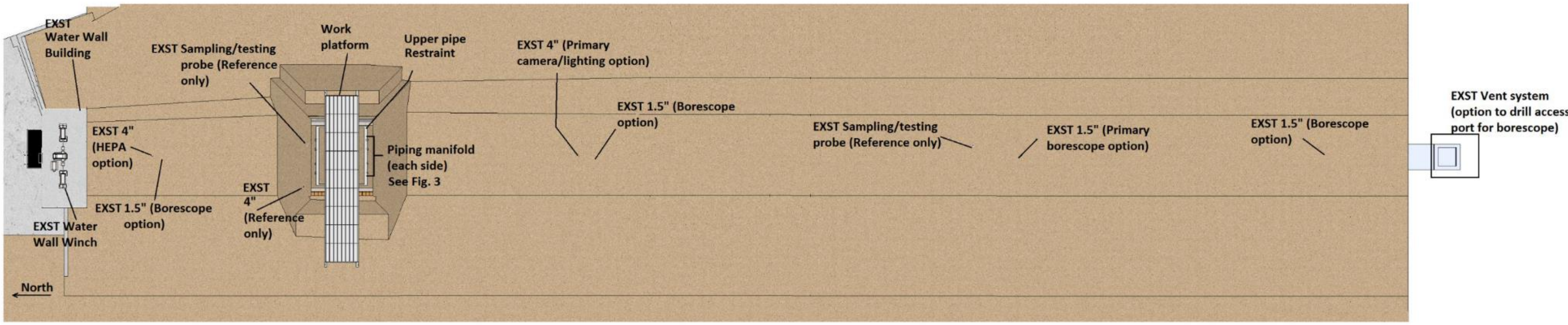


Figure 11-1 Plan View of Tunnel Number 1 with Equipment Placement and Layout

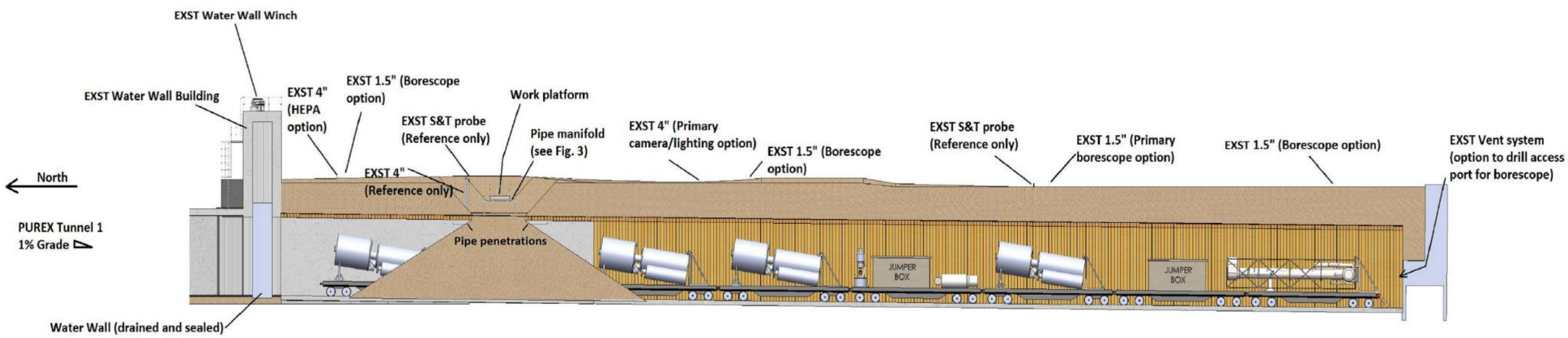
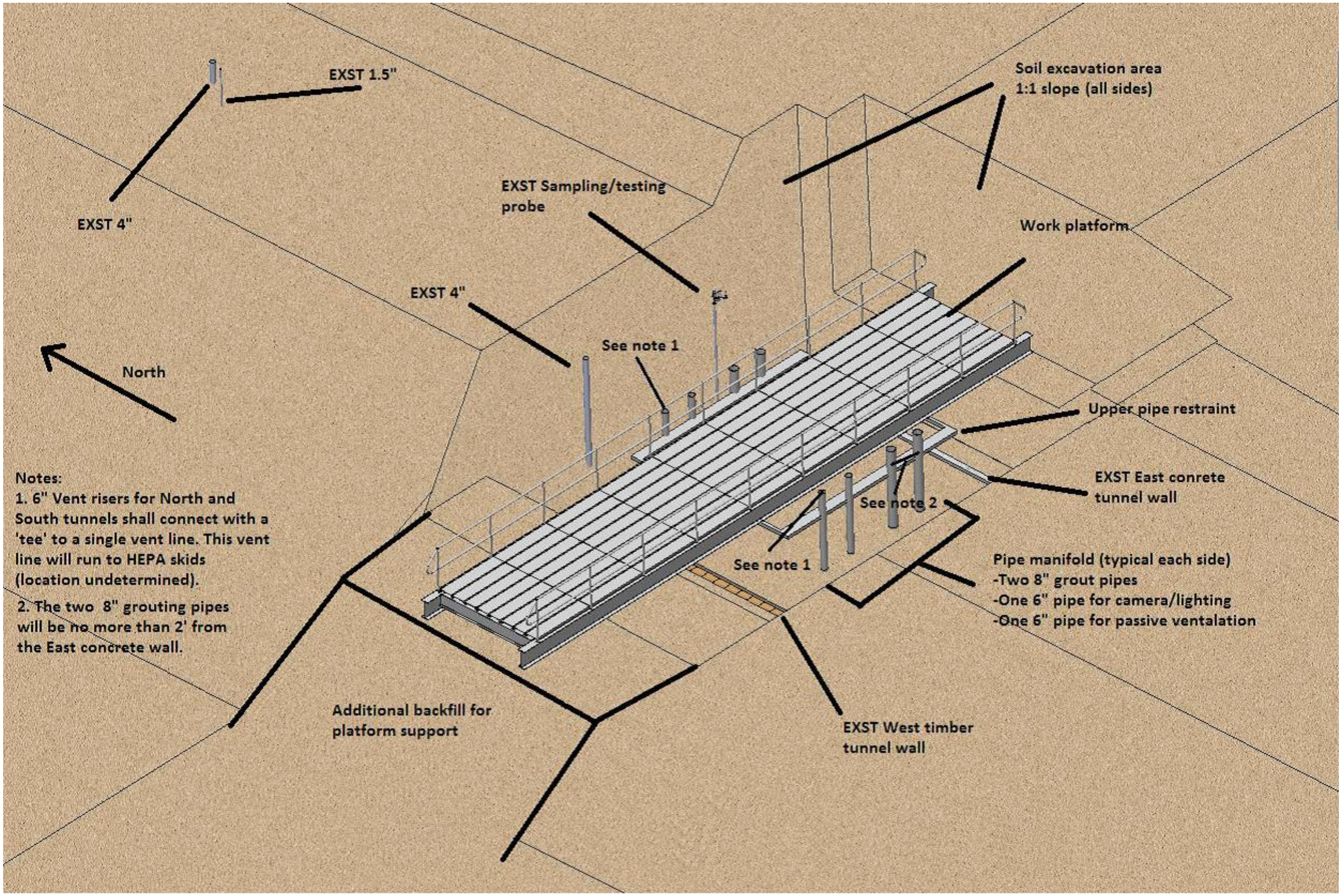


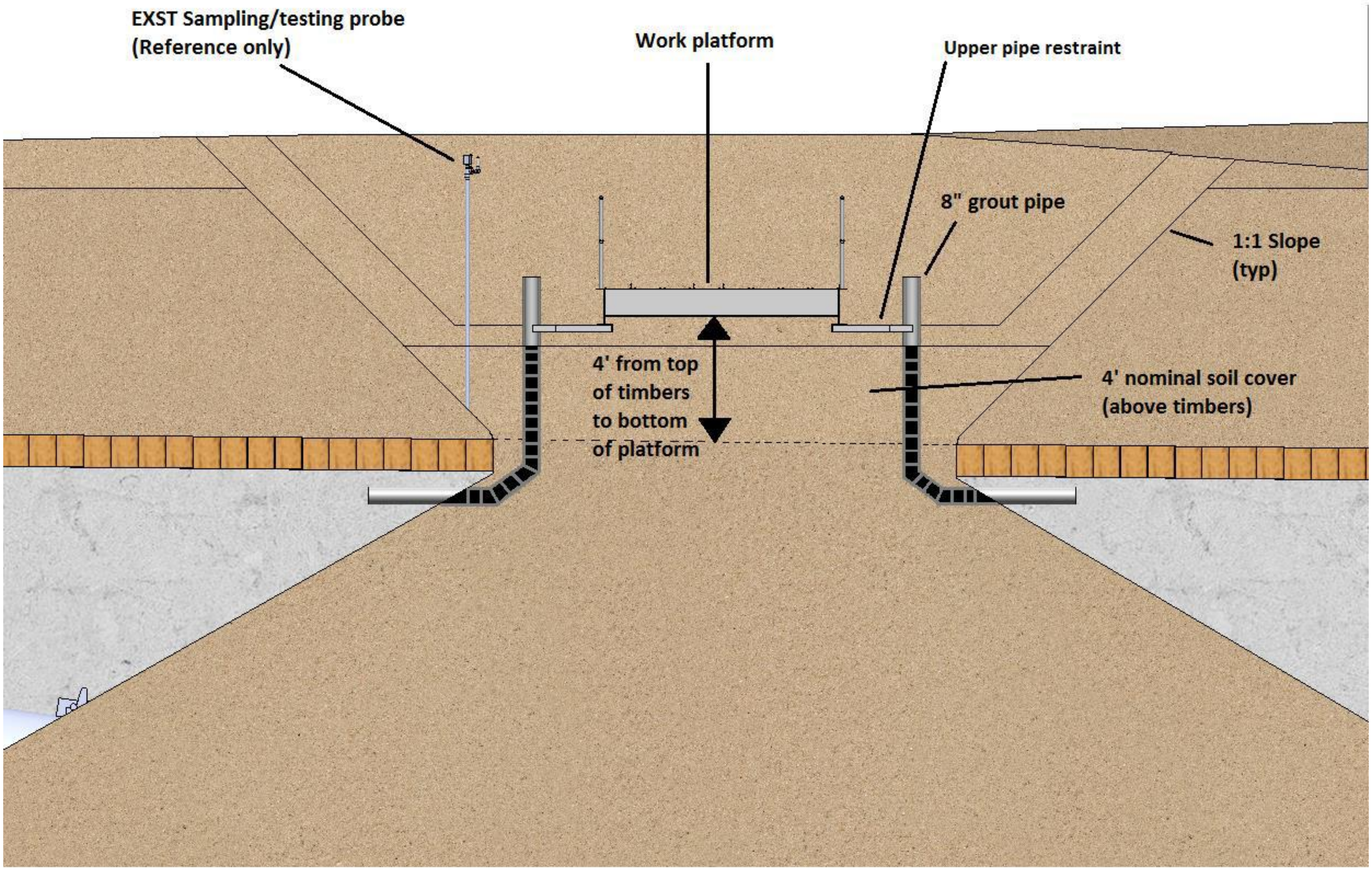
Figure 11-2 West Elevation of Tunnel Number 1 with Equipment Placement

Note: Water wall refers to the water-fillable door.



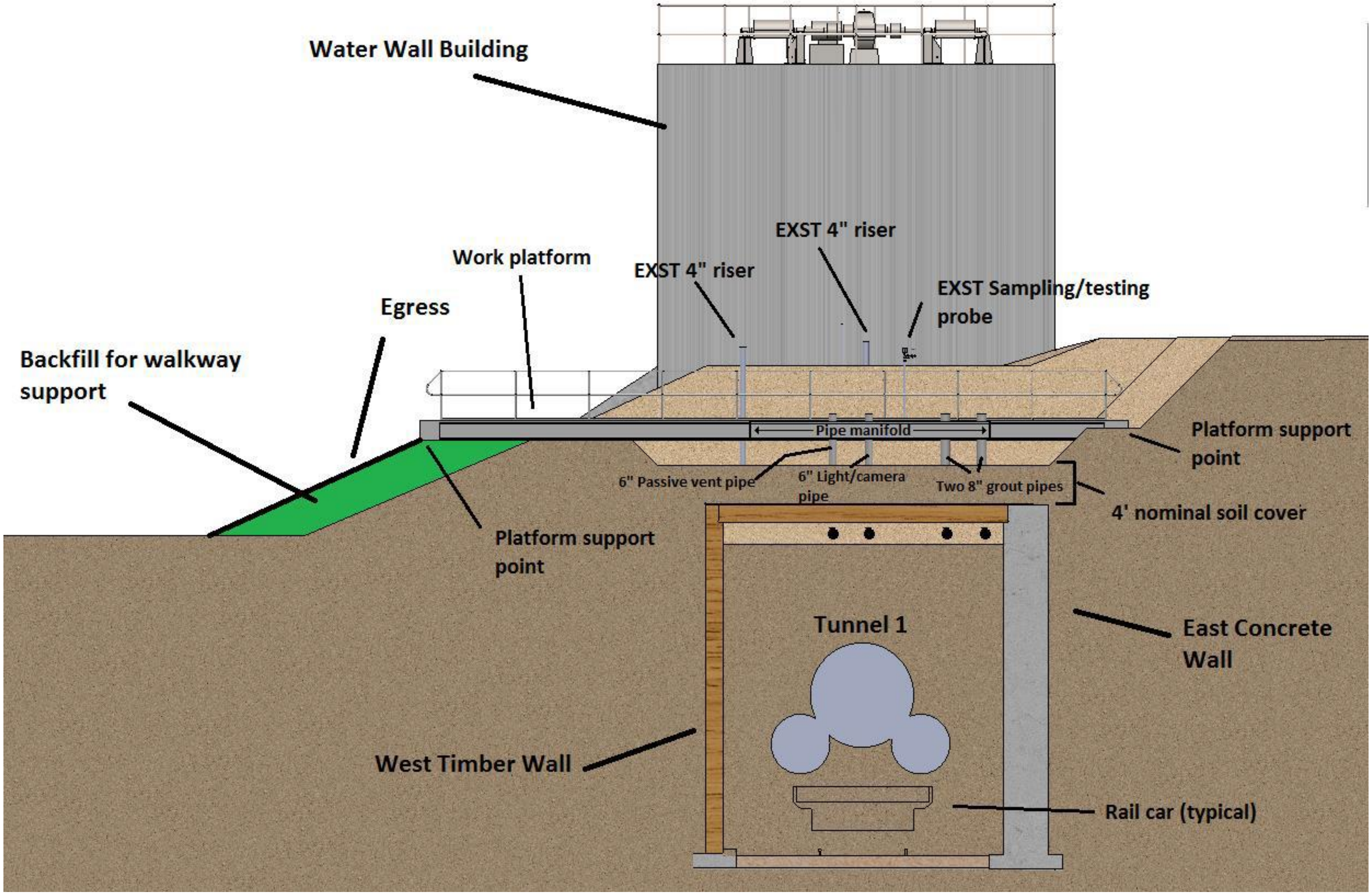
1 **Figure 11-3 Isometric of Tunnel Number 1 Grouting Equipment – Platform and Piping Arrangement**

2



1 **Figure 11-4 West Elevation of Tunnel Number 1 Grouting Equipment – Platform and Piping**

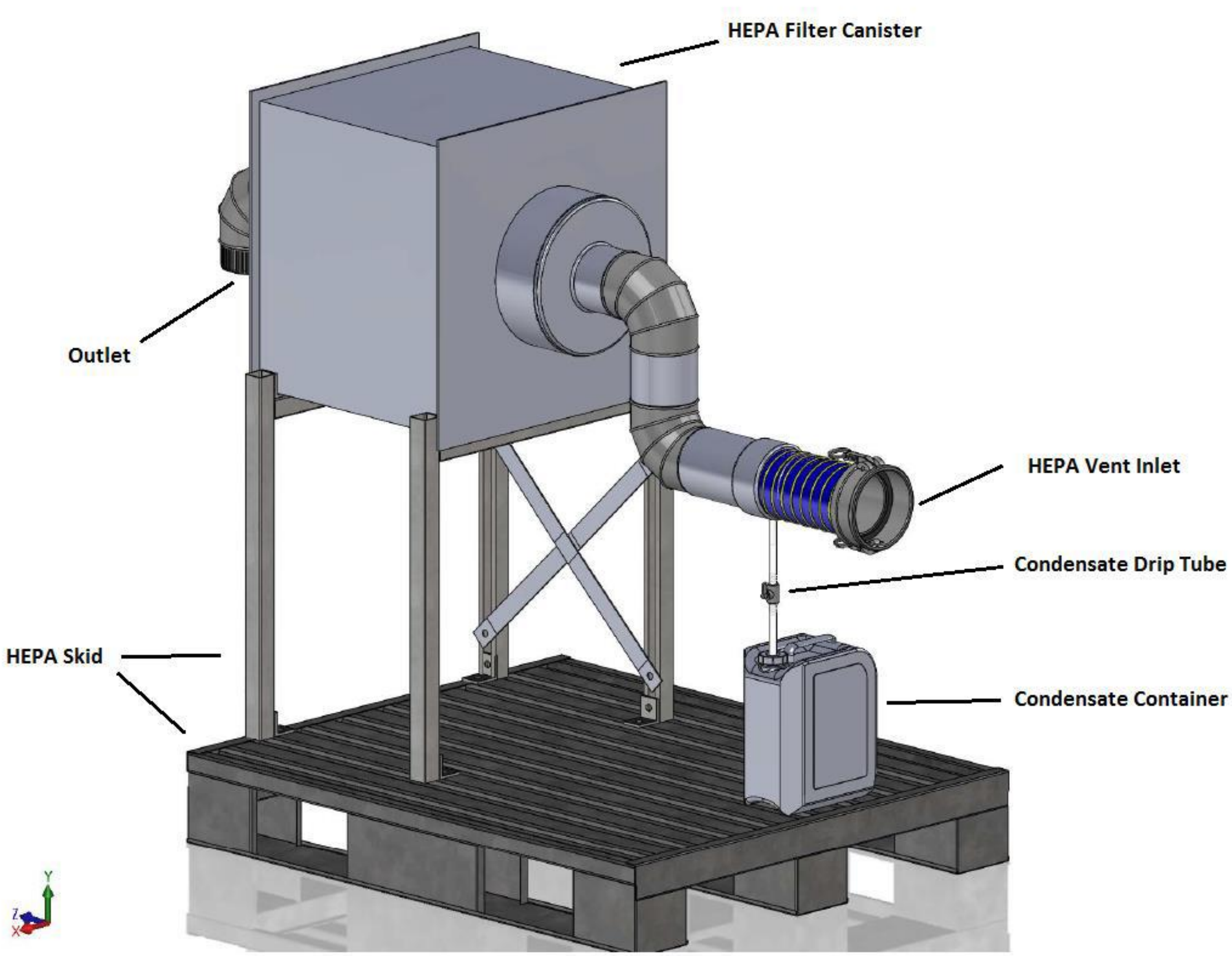
2



1 **Figure 11-5 South Elevation of Tunnel Number 1 Grouting Equipment – Platform and Piping**

2 Note: Water wall refers to the water-fillable door.

3



1 **Figure 11-6 Passive Ventilation Filter Assembly for Tunnel Number 1**

2

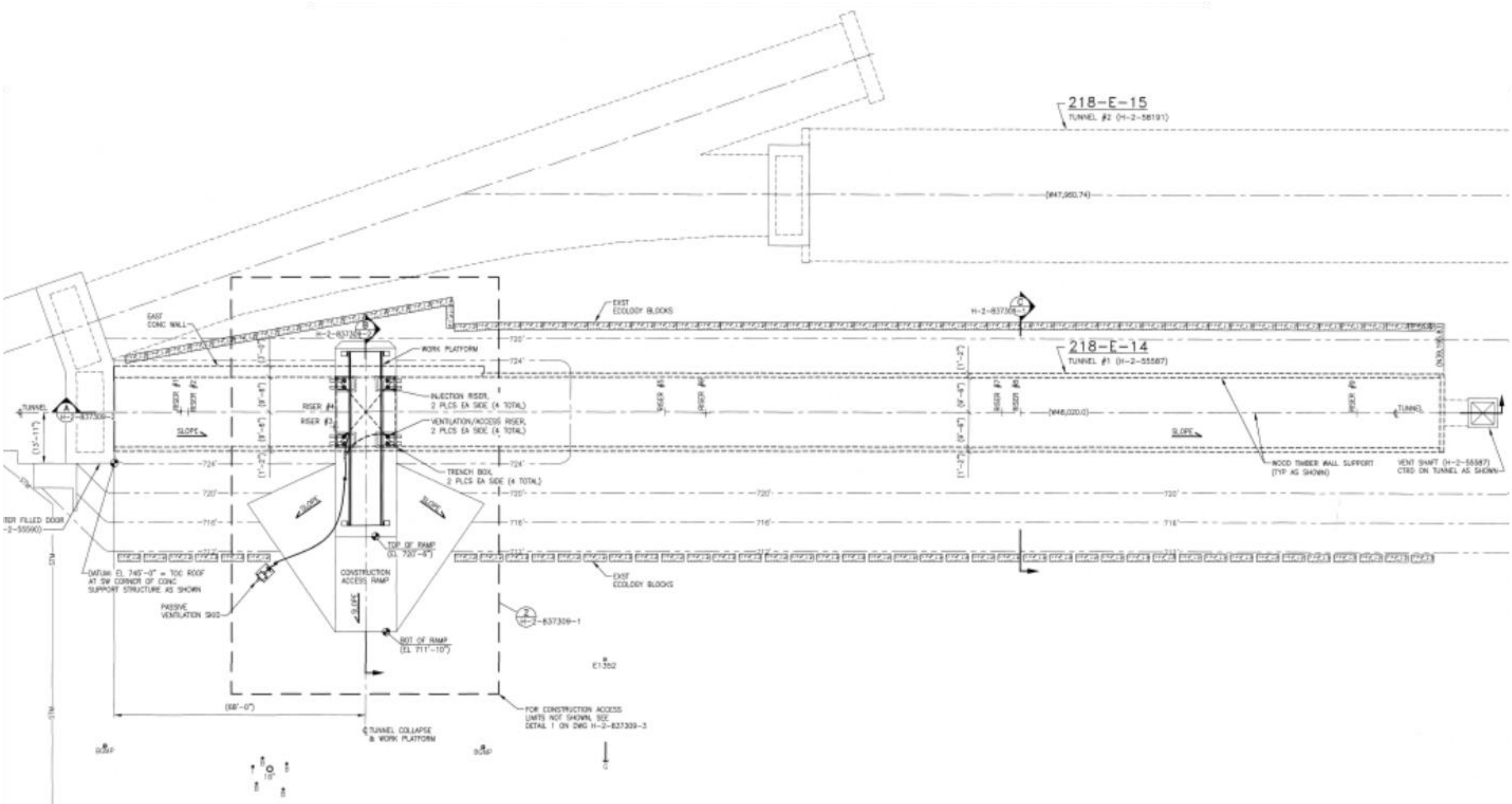


Figure 11-7 Tunnel Number 1 Site Plan

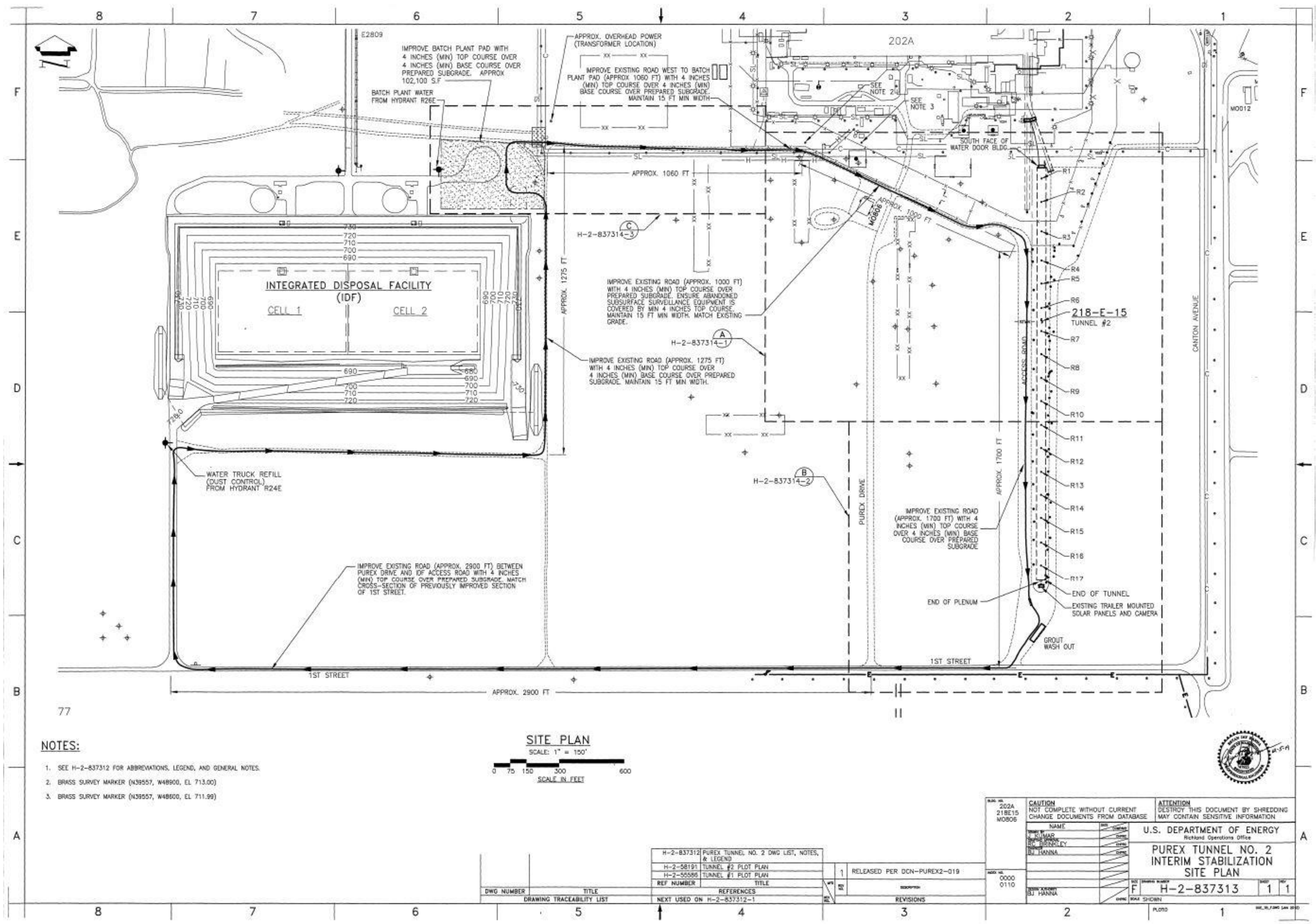


Figure 11-8 Tunnel Number 2 Site Plan

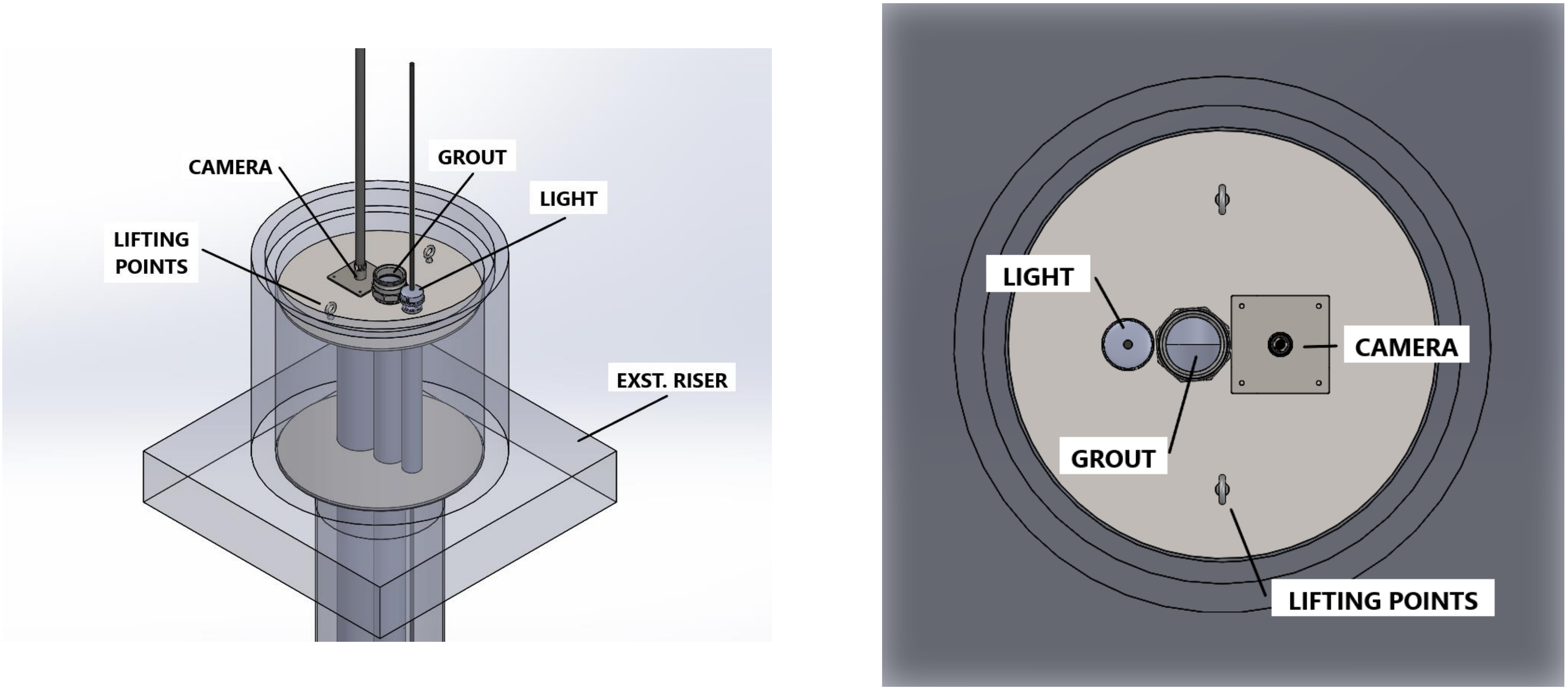


Figure 11-9 Plug Replacement for Existing Riser in Tunnel Number 2 (Isometric and Plan Views)

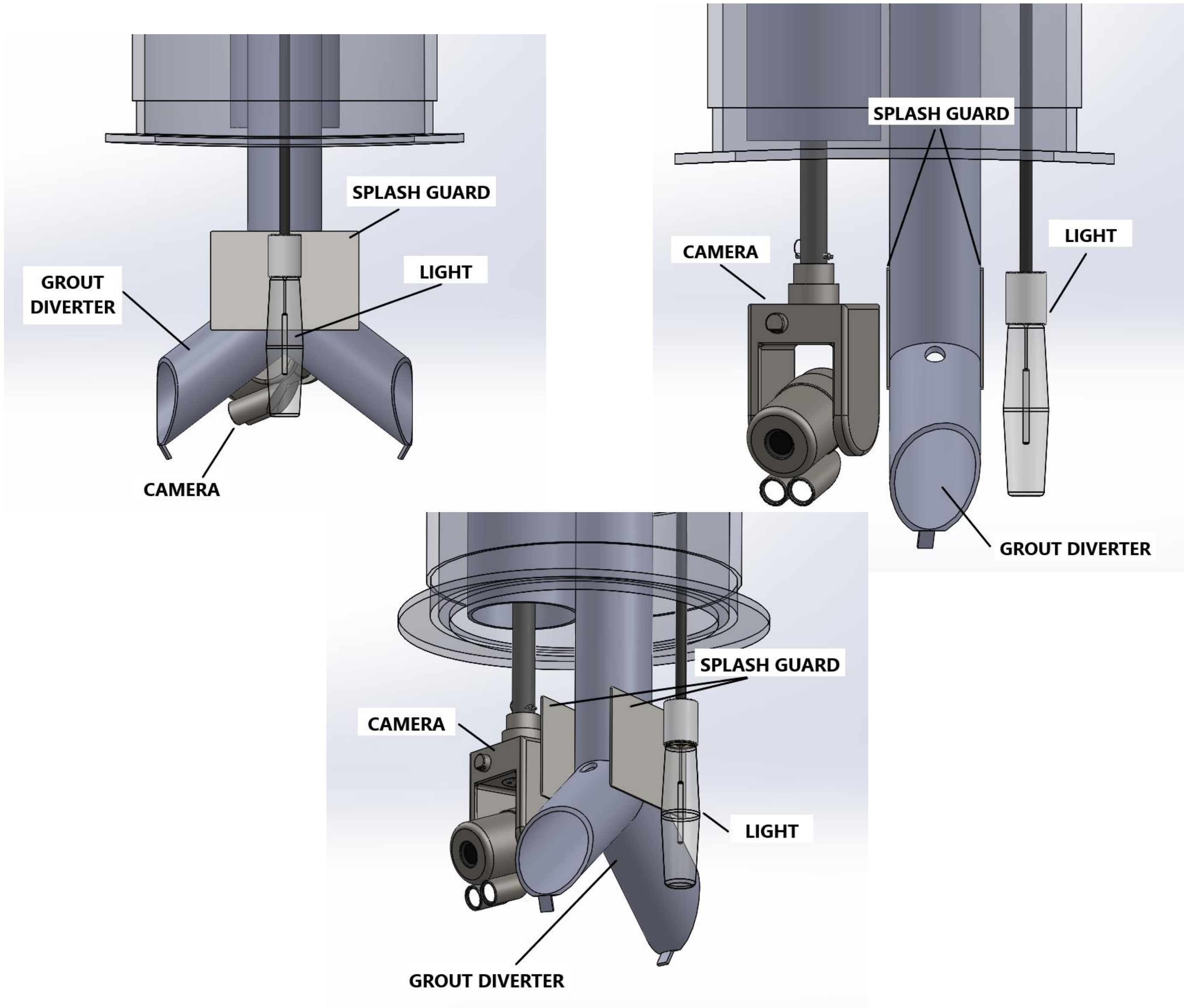


Figure 11-10 Equipment to be Deployed Through Existing Riser in Tunnel Number 2 (Two Elevations and Isometric)

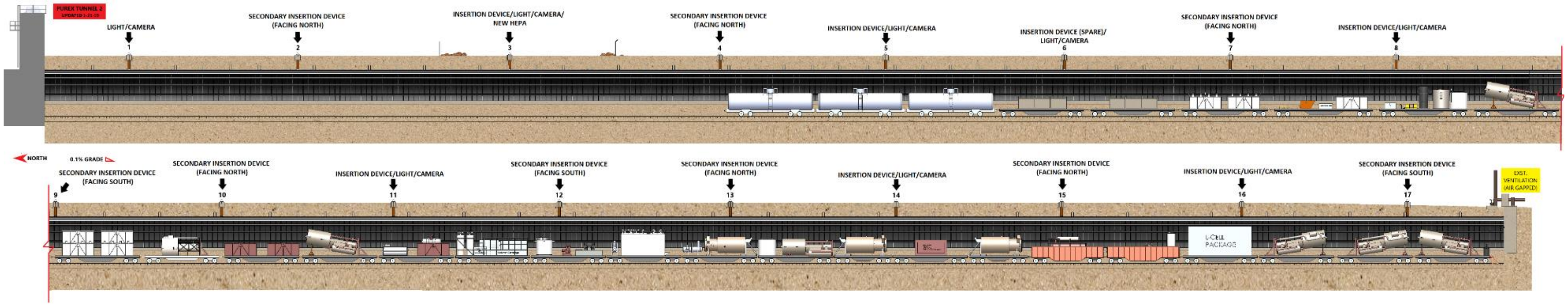


Figure 11-11 Location of Risers and Equipment for Grouting Tunnel Number 2

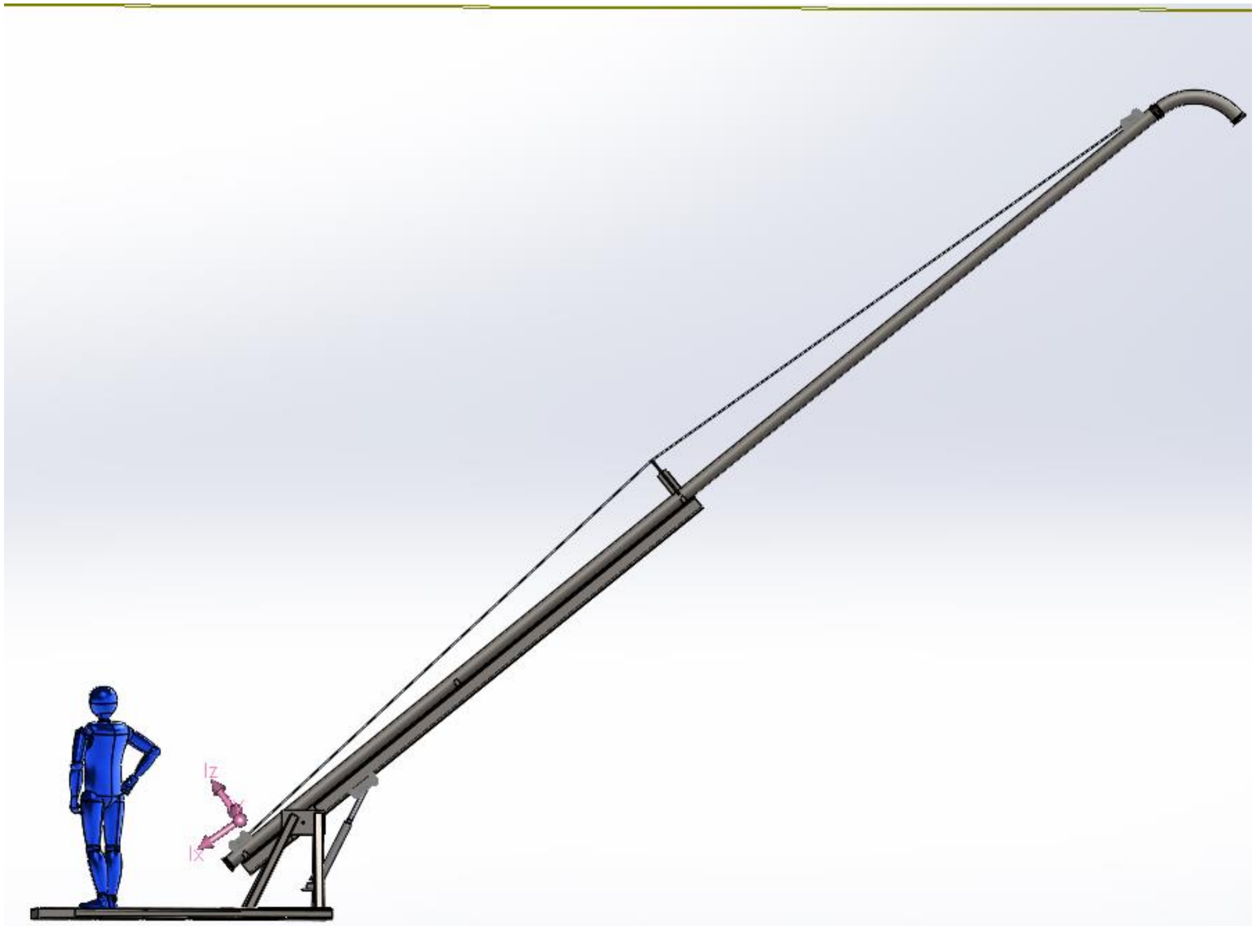


Figure 11-12 Goose-Neck Grout Delivery Piping for Tunnel Number 2

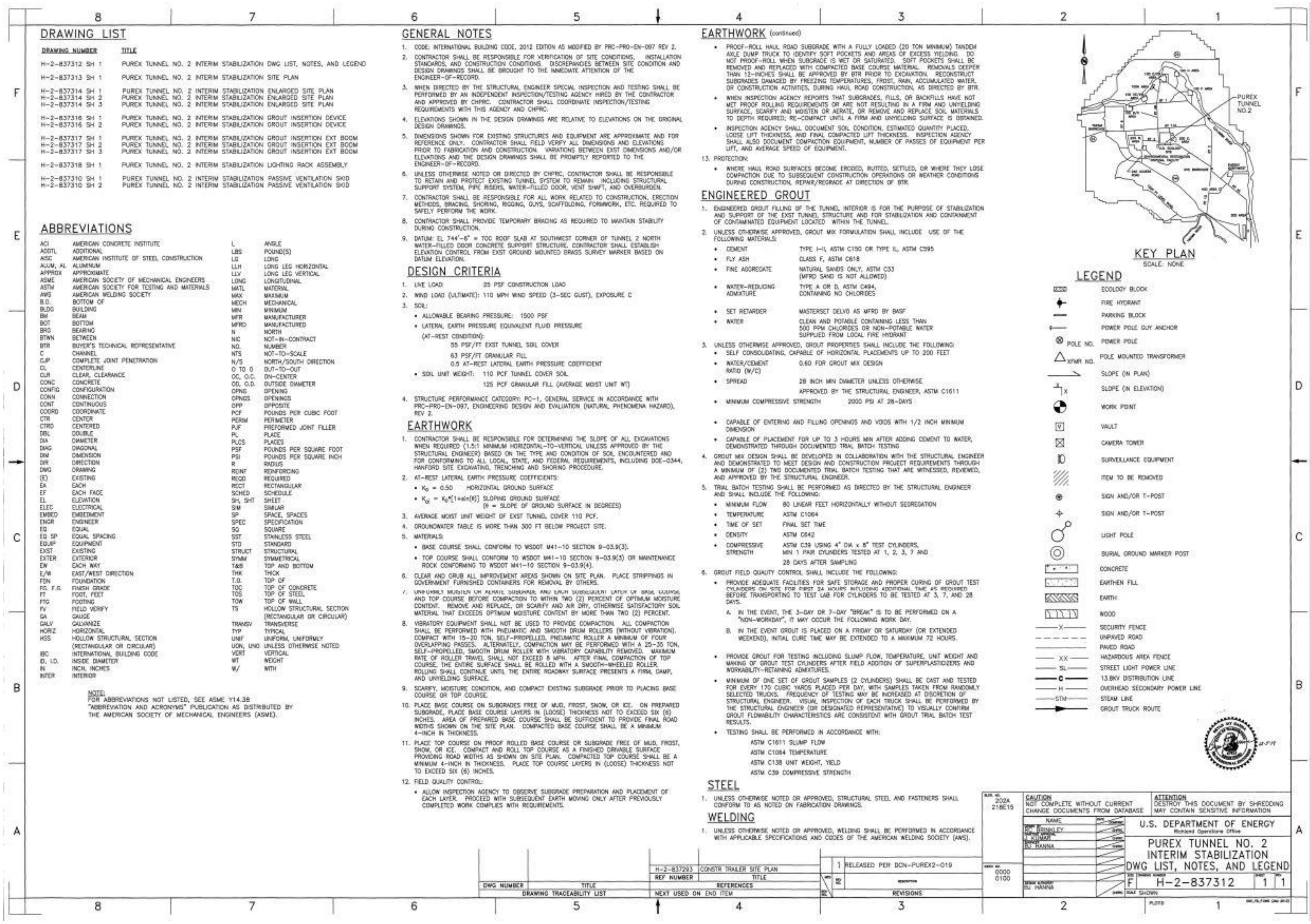
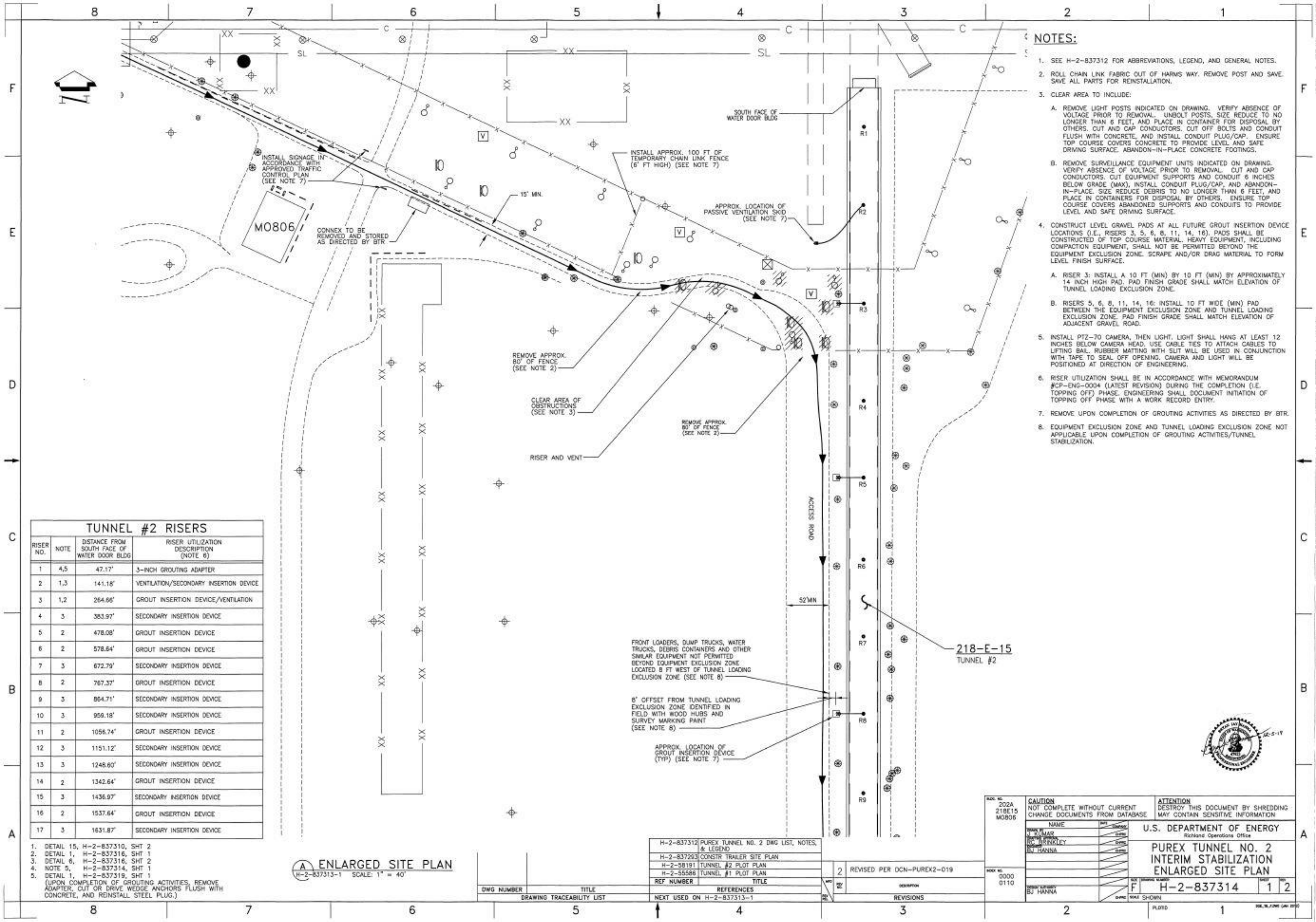


Figure 11-13 PUREX Tunnel No. 2 Interim Stabilization Drawing List, Notes, and Legend, #H-2-837312-1



TUNNEL #2 RISERS			
RISER NO.	NOTE	DISTANCE FROM SOUTH FACE OF WATER DOOR BLDG	RISER UTILIZATION DESCRIPTION (NOTE 6)
1	4,5	47.17'	3-INCH GROUTING ADAPTER
2	1,3	141.18'	VENTILATION/SECONDARY INSERTION DEVICE
3	1,2	264.66'	GROUT INSERTION DEVICE/VENTILATION
4	3	383.97'	SECONDARY INSERTION DEVICE
5	2	478.08'	GROUT INSERTION DEVICE
6	2	578.64'	GROUT INSERTION DEVICE
7	3	672.79'	SECONDARY INSERTION DEVICE
8	2	767.37'	GROUT INSERTION DEVICE
9	3	864.71'	SECONDARY INSERTION DEVICE
10	3	959.18'	SECONDARY INSERTION DEVICE
11	2	1056.74'	GROUT INSERTION DEVICE
12	3	1151.12'	SECONDARY INSERTION DEVICE
13	3	1248.60'	SECONDARY INSERTION DEVICE
14	2	1342.64'	GROUT INSERTION DEVICE
15	3	1436.97'	SECONDARY INSERTION DEVICE
16	2	1537.64'	GROUT INSERTION DEVICE
17	3	1631.87'	SECONDARY INSERTION DEVICE

1. DETAIL 15, H-2-837310, SHT 2
2. DETAIL 1, H-2-837316, SHT 1
3. DETAIL 6, H-2-837316, SHT 2
4. NOTE 5, H-2-837314, SHT 1
5. DETAIL 1, H-2-837319, SHT 1 (UPON COMPLETION OF GROUTING ACTIVITIES, REMOVE ADAPTER, CUT OR DRIVE WEDGE ANCHORS FLUSH WITH CONCRETE, AND REINSTALL STEEL PLUG.)

Figure 11-14 PUREX Tunnel No. 2 Interim Stabilization Enlarged Site Plan 1, #H-2-837314-1

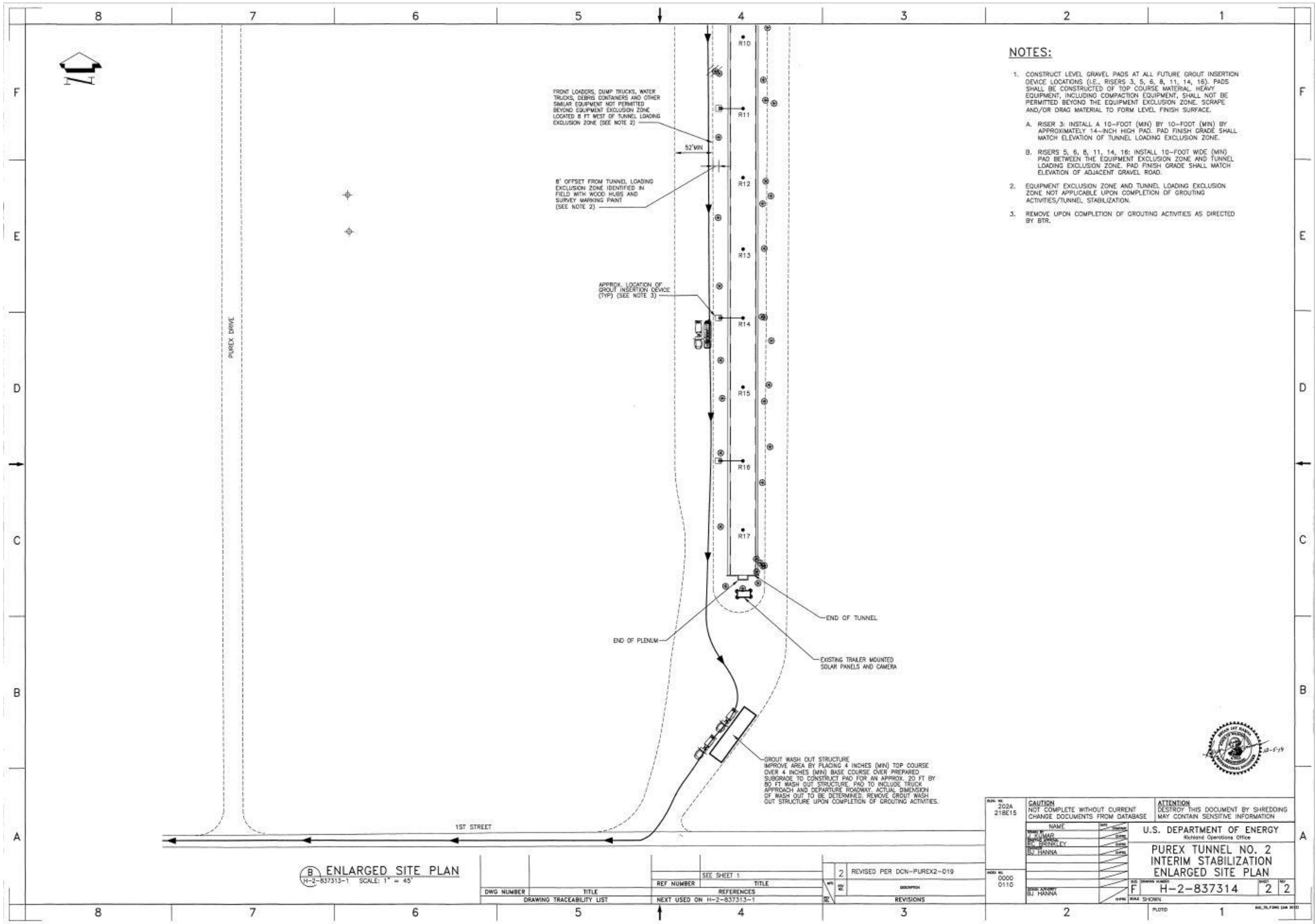
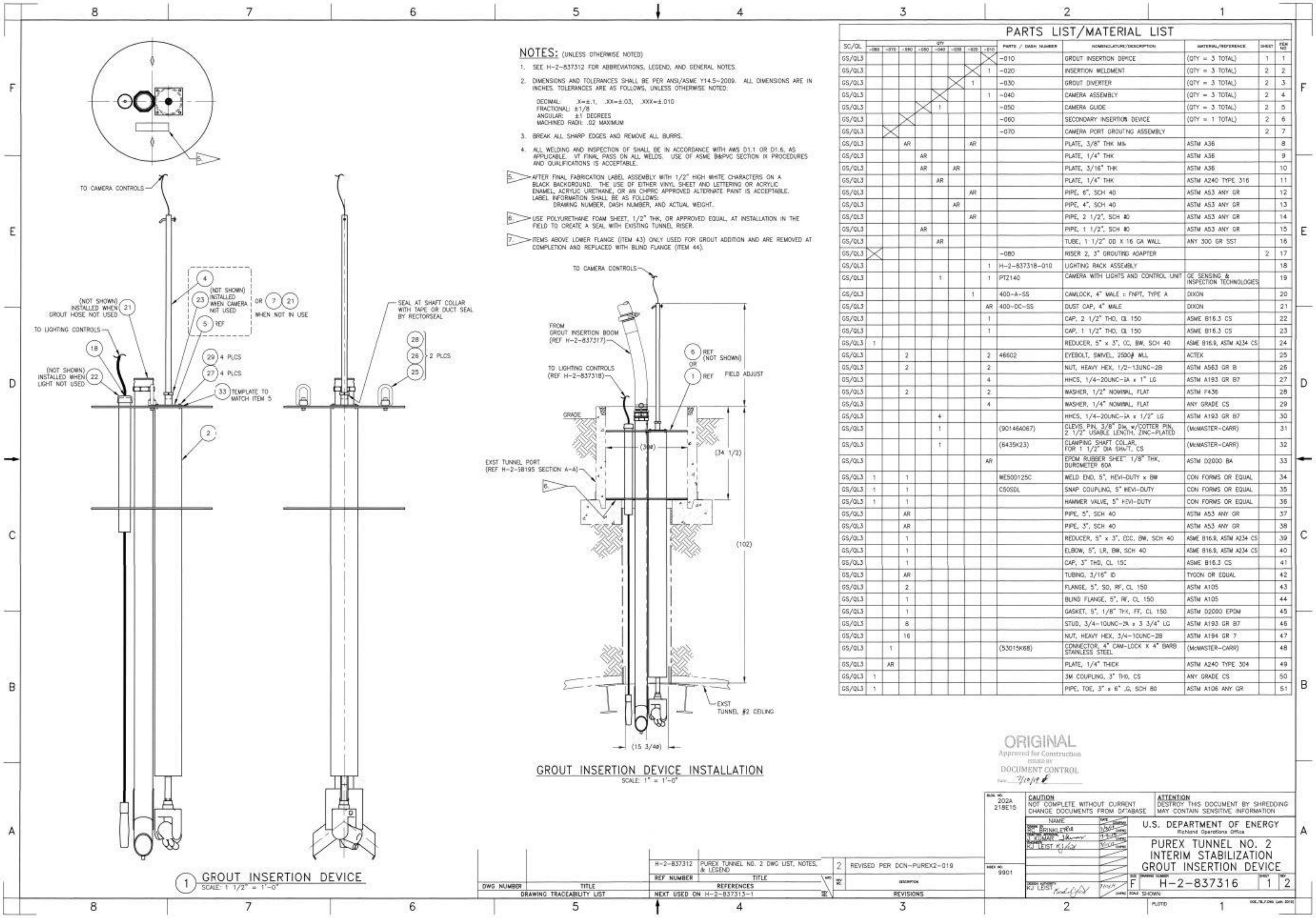


Figure 11-15 PUREX Tunnel No. 2 Interim Stabilization Enlarged Site Plan 2, #H-2-837314-2



PARTS LIST/MATERIAL LIST

SC/QL	QTY -080	-070	-060	-050	-040	-030	-020	-010	PARTS / DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
GS/QL3								X	-010	GROUT INSERTION DEVICE	(QTY = 3 TOTAL)	1	1
GS/QL3							X	1	-020	INSERTION WELDMENT	(QTY = 3 TOTAL)	2	2
GS/QL3						X	1		-030	GROUT DIVERTER	(QTY = 3 TOTAL)	2	3
GS/QL3					X			1	-040	CAMERA ASSEMBLY	(QTY = 3 TOTAL)	2	4
GS/QL3				X	1				-050	CAMERA GUIDE	(QTY = 3 TOTAL)	2	5
GS/QL3			X						-060	SECONDARY INSERTION DEVICE	(QTY = 1 TOTAL)	2	6
GS/QL3		X							-070	CAMERA PORT GROUTING ASSEMBLY		2	7
GS/QL3			AR				AR			PLATE, 3/8" THK MIN	ASTM A36		8
GS/QL3				AR						PLATE, 1/4" THK	ASTM A36		9
GS/QL3				AR		AR				PLATE, 3/16" THK	ASTM A36		10
GS/QL3					AR					PLATE, 1/4" THK	ASTM A240 TYPE 316		11
GS/QL3							AR			PIPE, 6", SCH 40	ASTM A53 ANY GR		12
GS/QL3						AR				PIPE, 4", SCH 40	ASTM A53 ANY GR		13
GS/QL3							AR			PIPE, 2 1/2", SCH 80	ASTM A53 ANY GR		14
GS/QL3				AR						PIPE, 1 1/2", SCH 80	ASTM A53 ANY GR		15
GS/QL3					AR					TUBE, 1 1/2" OD X 16 GA WALL	ANY 300 GR SST		16
GS/QL3	X								-080	RISER 2, 3" GROUTING ADAPTER		2	17
GS/QL3								1	H-2-837318-010	LIGHTING RACK ASSEMBLY			18
GS/QL3					1			1	PTZ140	CAMERA WITH LIGHTS AND CONTROL UNIT	GE SENSING & INSPECTION TECHNOLOGIES		19
GS/QL3							1		400-A-SS	CAMLOCK, 4" MALE x FNPT, TYPE A	DIXON		20
GS/QL3								AR	400-DC-SS	DUST CAP, 4" MALE	DIXON		21
GS/QL3								1		CAP, 2 1/2" THD, CL 150	ASME B16.3 CS		22
GS/QL3								1		CAP, 1 1/2" THD, CL 150	ASME B16.3 CS		23
GS/QL3	1									REDUCER, 5" x 3", CC, BW, SCH 40	ASME B16.9, ASTM A234 CS		24
GS/QL3			2					2	46602	EYEBOLT, SWIVEL, 2500# WLL	ACTEK		25
GS/QL3			2					2		NUT, HEAVY HEX, 1/2-13UNC-2B	ASTM A563 GR B		26
GS/QL3								4		HHCS, 1/4-20UNC-2A x 1" LG	ASTM A193 GR B7		27
GS/QL3			2					2		WASHER, 1/2" NOMINAL, FLAT	ASTM F436		28
GS/QL3								4		WASHER, 1/4" NOMINAL, FLAT	ANY GRADE CS		29
GS/QL3					4					HHCS, 1/4-20UNC-2A x 1/2" LG	ASTM A193 GR B7		30
GS/QL3					1				(90146A067)	CLEVIS PIN, 3/8" DIA, w/COTTER PIN, 2 1/2" USABLE LENGTH, ZINC-PLATED	(McMASTER-CARR)		31
GS/QL3					1				(6435K23)	CLAMPING SHAFT COLLAR, FOR 1 1/2" DIA SHAFT, CS	(McMASTER-CARR)		32
GS/QL3								AR		EPDM RUBBER SHEET 1/8" THK, DUROMETER 60A	ASTM D2000 BA		33
GS/QL3	1		1						WE500125C	WELD END, 5", HEVI-DUTY x BW	CON FORMS OR EQUAL		34
GS/QL3	1		1						C50SDL	SNAP COUPLING, 5" HEVI-DUTY	CON FORMS OR EQUAL		35
GS/QL3	1		1							HAMMER VALVE, 5" HEVI-DUTY	CON FORMS OR EQUAL		36
GS/QL3			AR							PIPE, 5", SCH 40	ASTM A53 ANY GR		37
GS/QL3			AR							PIPE, 3", SCH 40	ASTM A53 ANY GR		38
GS/QL3			1							REDUCER, 5" x 3", CCC, BW, SCH 40	ASME B16.9, ASTM A234 CS		39
GS/QL3			1							ELBOW, 5", LR, BW, SCH 40	ASME B16.9, ASTM A234 CS		40
GS/QL3			1							CAP, 3" THD, CL 150	ASME B16.3 CS		41
GS/QL3			AR							TUBING, 3/16" ID	TYGON OR EQUAL		42
GS/QL3			2							FLANGE, 5", SO, RF, CL 150	ASTM A105		43
GS/QL3			1							BLIND FLANGE, 5", RF, CL 150	ASTM A105		44
GS/QL3			1							GASKET, 5", 1/8" THK, FF, CL 150	ASTM D2000 EPDM		45
GS/QL3			8							STUD, 3/4-10UNC-2A x 3 3/4" LG	ASTM A193 GR B7		46
GS/QL3			16							NUT, HEAVY HEX, 3/4-10UNC-2B	ASTM A194 GR 7		47
GS/QL3		1							(53015K68)	CONNECTOR, 4" CAM-LOCK X 4" BARB STAINLESS STEEL	(McMASTER-CARR)		48
GS/QL3		AR								PLATE, 1/4" THICK	ASTM A240 TYPE 304		49
GS/QL3	1									3M COUPLING, 3" THD, CS	ANY GRADE CS		50
GS/QL3	1									PIPE, TOE, 3" x 6" LG, SCH 80	ASTM A106 ANY GR		51

Figure 11-16 PUREX Tunnel No. 2 Interim Stabilization Grout Insertion Device, #H-2-837316-1

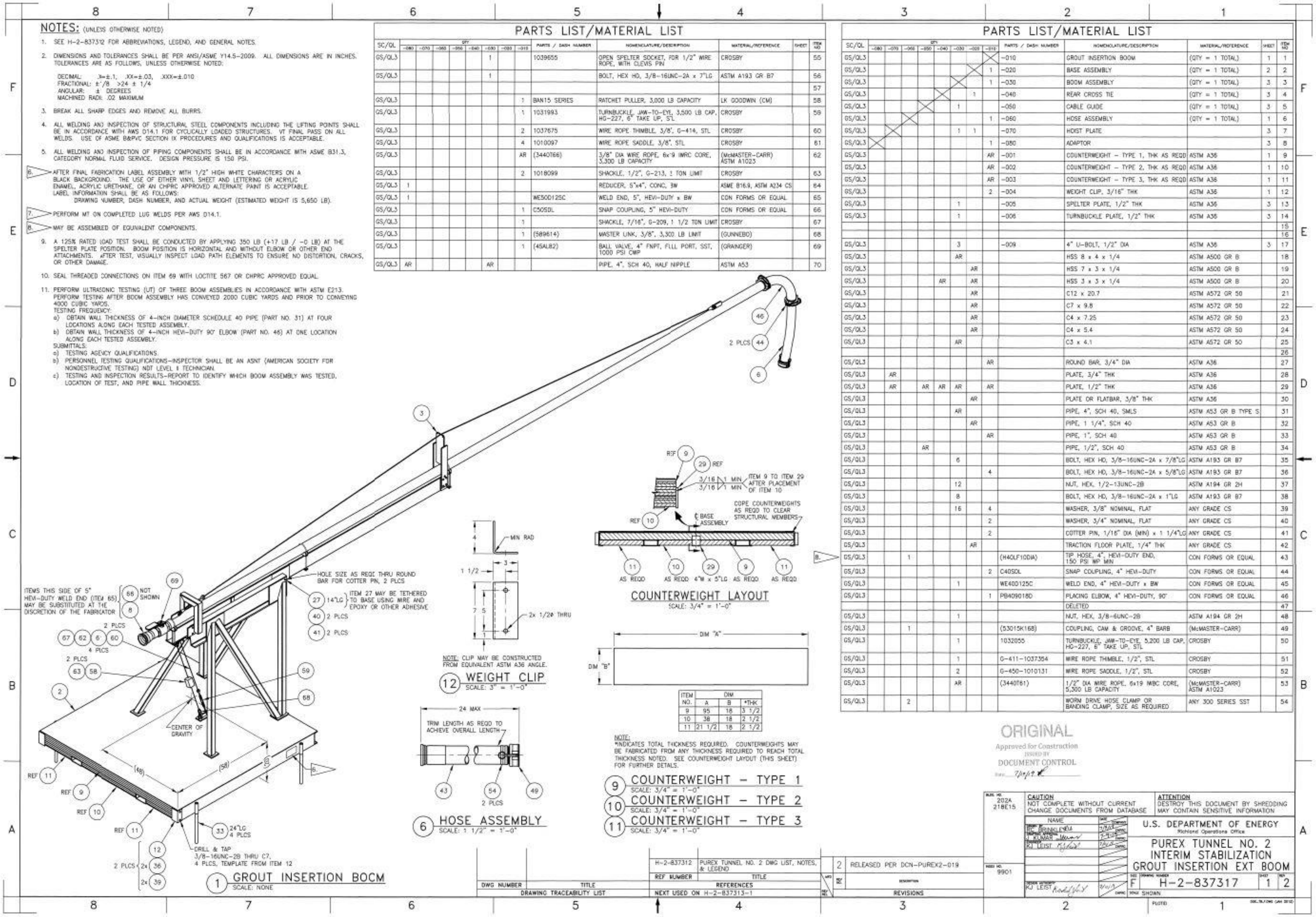


Figure 11-17 PUREX Tunnel No. 2 Interim Stabilization Grout Insertion EXT Boom, #H-2-837317

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