NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

TEST PLAN

TITLE: **Construction of Sonic Corehole NC-EWDP-19PB**	REVISION: **0** DATE: **11-15-03** PAGE: **1 OF 12**
TEST PLAN NUMBER: **TPN-5.1**	SUPERSEDES: **New Document**
APPROVAL 11-18-03 Project Manager Date	CONCURRENCE 11/19/03 On-Site Geotechnical Representative Date 11/19/03 Principal Investigator Date 11/18/03 Quality Assurance Officer Date

1.0 INTRODUCTION

This test plan (TPN) provides general instructions for the construction of Nye County Nuclear Waste Repository Project Office (NWRPO) Early Warning Drilling Program (EWDP) sonic corehole NC-EWDP-19PB. These instructions include the following tasks:

- Drilling and casing of 350 feet of the unsaturated zone.
- Continuous coring and geophysical logging of the upper 300 feet of the saturated zone.
- Geologic logging, sampling, and laboratory tests of textural layers within this core.

- Archival of the continuous core and representative samples from textural layers.
- Corehole completion with dual-string piezometers.

This TPN references applicable quality assurance (QA) technical procedures (TPs) that provide more detailed instructions to NWRPO personnel for routine data collection. In addition, this TPN references applicable portions of the NWRPO drilling contract that provide detailed drilling and well completion instructions and responsibilities for the drilling contractor.

This TPN applies solely to corehole NC-EWDP-19PB and includes information usually included in work plans developed for major phases of the EWDP to address the construction of a group of related wells.

2.0 PURPOSE AND JUSTIFICATION

The U.S. Department of Energy (DOE) has identified the saturated alluvium in Fortymile Wash as a potential groundwater flow pathway from Yucca Mountain to groundwater users in Amargosa Valley. Nye County believes that collecting continuous core from the upper portion of the alluvial aquifer is necessary in order to identify potential preferential flow pathways and provide small-scale estimates of flow and transport properties. These data will support and complement the interpretation of flow and transport data obtained on a much larger scale from single and cross-hole tracer tests and high rate/volume aquifer pump tests.

To date, only approximately 40 feet of alluvium core have been collected in Fortymile Wash. Samples were collected using drive-core methods from widely spaced intervals in boreholes NC-EWDP-10P, -22PA, -24P, and 29P. However, this coring approach has proven to be prohibitively expensive. Other coring methods attempted in the vicinity of Yucca Mountain have proven to be largely unsuccessful; that is, samples have been significantly disturbed and/or recovery has been poor.

To fill the need for continuous core in Fortymile Wash, Nye County will construct a corehole using conventional drilling and sonic coring methods at the Alluvial Testing Complex (ATC), the site of previous single-hole tracer tests and planned cross-hole tracer tests. Approximately 300 feet of continuous sonic core will be collected from the water table at approximately 350 feet below ground surface (bgs), to a total depth of approximately 650 feet bgs. The corehole will be completed with dual-string piezometers, with screens at depths corresponding to the upper two screens of other multiple-screen wells constructed previously at the site. These piezometers will be used as injection and/or monitoring points in tracer tests planned for the ATC.

The proposed sonic coring method has not yet been used in studies associated with Yucca Mountain. However, this approach has been used successfully to obtain continuous core in both coarse- and fine-grained alluvium and other unconsolidated sediments at a number of mines and groundwater recharge sites in the southwestern U.S. Moreover, the cost of sonic core per foot at depths below 350 feet has been shown to be one-fourth to one-tenth the cost of drive core. Nye County believes that the success of sonic coring at other locations, plus its relatively low cost, justify the coring investigation described in the following.

3.0 SCOPE OF WORK FOR DRILLING, CORING, LOGGING, AND WELL COMPLETION

3.1 Responsibilities and Pre- and Post-Drilling Requirements

3.1.1 Responsibilities, Chain of Command, and Communication

The Nye County NWRPO On-Site Geotechnical Representative will be the Principle Investigator (PI) responsible for supervising all technical data collection described in this plan. The NWRPO-designated field representative (NDFR), in most cases the contract managing geologist, will supervise the contract geologist and technicians, collectively referred to as NWRPO field personnel herein. NWRPO field personnel are responsible for conducting the activities described in this TPN.

The drilling contractor is responsible for the drilling, coring, and well construction specified in the NWRPO drilling contract documents (NWRPO, 2003). A drilling contractor-designated field representative (CDFR) will direct all drilling contractor activities, with the exception of the NWRPO-directed activities specified in the drilling contract, in which the NDFR or designee is responsible for directing the work. The NDFR and CDFR will communicate regularly and review, approve, and sign daily drilling records that document contract billable items.

3.1.2 Site Location, Surveying, and Pad Preparation

NC-EWDP-19PB will be located in lower Fortymile Wash approximately 5 miles northwest of Lathrop Wells, Nevada, within approximately 160 ft north-northeast of existing well NC-EWDP-19D (Figure 1).

When the final location is determined by the NWRPO, a stake will be driven at the proposed wellhead location, the location surveyed using the global positioning system (GPS), and the latitude and longitude recorded in the field notes to the nearest 0.01 second. The elevation estimate and the tolerance of the position will also be included, if the GPS has the capability to provide those parameters. All original GPS survey data collected will be transmitted to the NWRPO QA Records Center (QARC) along with associated metadata. Any additional processing of the data will also be transmitted to the QARC.

Since a large (i.e., approximately 300 by 300 feet) graded and fenced drilling pad is present at the site, no additional site preparation work will be required.

3.1.3 Permitting, License, and Reporting Requirements

The NWRPO, as the well owner, has completed all required federal and state permits. These permits were obtained for previous wells drilled at this site. Since NC-EWDP-19PB is located on an existing, fenced, and previously approved drill site, no additional permits are required from the U.S. Department of the Interior, U.S. Bureau of Land Management (BLM), Nevada Division of Water Resources (NDWR), or Nevada Division of Water Pollution Control.

The drilling contractor will be required to notify the NDWR before drilling operations by submitting a Notice of Intent to Drill at least 3 working days before the rig is set up, per the

requirements of Nevada Administrative Code (NAC) 534.320. The Notice of Intent to Drill will list any permits or waivers issued previously by the NDWR; the NWRPO will supply the drilling contractor with this list.

The drilling contractor will provide the NWRPO with copies of each individual driller's license before drilling operations begin. Per NAC 534.330, each individual driller will carry his license when he is present at the drilling site and produce the license upon request by an NDWR representative. At least one driller with a Nevada license will be present at the site when the drill rig is operating.

The drilling contractor is also required to meet the reporting requirements of Nevada Revised Statute (NRS) 534.170 and NAC 534.340 by submitting a completed Driller's Report and Record of Work to the NDWR within 30 days of completion for each well, with copies of these documents transmitted to the NWRPO.

3.1.4 Mobilization and Demobilization

Mobilization will be considered complete when the following steps have been taken:

1. The rig and associated equipment have been inspected and approved by the NDFR as being in clean condition and good working order.
2. A containment mat has been installed under the rig. The drilling contractor will use an appropriately heavy-gauge, single-piece plastic mat under the rig and other equipment, as appropriate, to contain all leaks of hydraulic oil, lubricants, or other liquids. The mat should be constructed at least 4 inches deep with a border of wooden skids or other material.
3. The format of the daily drilling record (i.e., field ticket) has been reviewed and approved by the CDFR.
4. Material safety data sheets (MSDSs) for all applicable materials on site have been submitted to the NDFR.
5. All proofs of insurance, personnel training, and other certifications as specified in the contract have been submitted to the NWRPO.
6. All State of Nevada requirements for the drilling contractor (e.g., Notice of Intent to Drill) have been met, and applicable documents submitted to the NDWR, with copies to the NWRPO.
7. The rig and its associated equipment (e.g., drilling fluid handling and sampling systems) have been set up on the proposed hole location and are ready to conduct linear footage drilling or other activities as directed by the NDFR.
8. All personnel, equipment, tools, and material required under the contract are on location, except those not needed immediately. The drilling contractor may use the NWRPO lay-down yard in Lathrop Wells for equipment storage; however, rig time incurred while waiting for such equipment to be retrieved will be at the drilling contractor's expense.

Demobilization will be considered complete when the following steps have been taken.

1. Tasks specified in the contract are complete or exempt from completion by approval from the NWRPO.
2. Any pits and berms on the drill site have been graded to approximately the original elevation.
3. All personnel, equipment, tools, unused materials, and drilling-related debris have been removed from the drill site, as well as from the NWRPO lay-down yard.

3.2 Drilling, Coring, and Well Completion

The alluvium of concern will include alternating thin (i.e., sometimes less than 2.5-foot-thick) layers of relatively clean sand and gravel, sand and gravel with silt and/or clay, and silty sand with gravel. A summary lithologic log for a well approximately 120 feet from NC-EWDP-19PB is shown on Figure 2.

3.2.1 Summary of Drilling Contractor Scope of Work

The detailed scope of work for drilling, coring, and well completion is included in the drilling contract and included as Attachment A. In summary, this scope of work includes the following steps:

1. Using conventional rotary, dual rotary, or another proven drilling method, drill a borehole and install a 9-inch diameter or larger conductor casing to approximately 350 feet bgs, approximately 10 feet above the water table.
2. Collect nearly continuous sonic core from approximately 350 to 650 feet bgs using, to the extent possible, a 6-inch-diameter steel core casing (i.e., core barrel) inside an 8-inch-diameter steel drill casing. Switch to a 3.5-inch core barrel inside a 5.5-inch drill casing when advancement of the larger sonic drilling/coring system is no longer feasible, if jointly determined by the NDFR and CDFR.
3. Collect 2-foot-long by 4-inch-diameter solid-tube drive-core samples ahead of the larger diameter sonic drilling/coring system at approximately 60-foot intervals beginning at approximately 380 feet bgs.
4. Install two 2-inch schedule 80 PVC piezometer strings with 20-foot screens and approximately 40-foot sand packs, the first sand pack extending from approximately 400 to 440 feet bgs and the second from approximately 505 to 545 feet bgs.

3.2.2 Well Completion

Figure 3 shows a detailed subsurface completion diagram for the dual-string piezometer with a 9-inch conductor casing grouted into place with concrete grout in a 12¼-inch-diameter borehole. If the casing is drilled to 350 feet bgs using a dual-rotary method, Figure 3 will be modified to show the casing in contact with the formation below 60 feet and the 60 feet of permanent surface casing in the upper portion of the borehole. Figure 3 may be modified before beginning completion activities to accommodate field conditions.

Figure 4 shows a dual-string piezometer surface completion diagram. If the casing is drilled in place using dual-rotary methods, Figure 4 will be modified to show a larger diameter steel surface casing terminating in the concrete pad.

NC-EWDP-19PB will be completed with the well screen, casing, and stemming materials shown on Figure 3. All stemming materials will be emplaced using tremmie pipe no more than 20 to 30 feet from the bottom of the hole.

To minimize the potential for caving on the dual-string piezometer during the emplacement of stemming materials below 350 feet (i.e., the bottom of the conductor casing), the sonic drill casing should be pulled back in 10- to 30-foot stages. After each pull-back, the bottom of the well will be sounded to determine if caving has occurred. Completion materials will then be emplaced (i.e., tremmied) in each pull-back interval to a depth of approximately 5 feet below the sonic drill casing.

Coarse-grained 8/12 silica sand will be used as sand pack from approximately 10 feet below to 10 feet above each well screen. A two to one by weight sand/granular bentonite mixture will be placed above and below the sand pack to provide a buffer between the sand pack and grout slurry sealants and to provide a solid surface for accurate depth measurements with a measuring tag line. A centrifugal pump will be used to emplace the sand pack as well as the bentonite mixture.

A bentonite grout slurry will then be emplaced to provide a seal in the annular space between the casing and the formation wall. This slurry will be emplaced upward by tremmie pipe and a standard grout pump to displace any fluid present in the interval being grouted. The upper 50 feet of borehole will be filled with a fine-grained dry bentonite by the gravity free-fall method.

3.2.3 Drilling and Coring Specifications

3.2.3.1 Drilling Equipment Requirements

The upper 350 feet of unsaturated alluvium will be drilled by conventional or dual rotary drilling methods. Sonic coring equipment will be used primarily to core and advance the borehole from 350 to 650 feet in saturated alluvium. Equipment specifications for these drilling systems are detailed in the drilling contract (NWRPO, 2003). In addition, drive core will be collected at selected depths in the saturated zone between 350 and 650 feet. The NWRPO will supply drive core barrels, shoes, and crossover connections for drive coring.

3.2.3.2 Drilling Fluids

Permissible drilling fluids for the upper 350 feet of unsaturated alluvium are limited to water, untreated bentonite mud (e.g., Aqua Gel Gold Seal®), and compressed air. The drilling contractor will obtain NWRPO approval before using any other drilling fluid or additive. No drilling fluids will be permitted when coring saturated alluvium from approximately 350 to 650 feet bgs.

All discharged liquid drilling fluid will be initially collected in a mud pit for onsite storage. Discharge rates will be determined by timed volume measurements as appropriate and will be documented in accordance with the requirements of the temporary discharge permit. No water

containing drilling additives, batch water, wastewater, cement, or any fluids other than clear water may be discharged offsite. The NWRPO will photograph erosion controls for any offsite discharges.

3.2.3.3 Hole Deviation

The drilling contractor will use methods (e.g., drilling collars) to prevent hole deviation from exceeding 2 degrees from vertical at 350 feet bgs. In addition, no deviation exceeding 0.5 degrees per 100 feet (i.e., dogleg) is permitted. The drilling contractor will conduct a deviation survey at 350 feet bgs; if there appears to be a significant dogleg, the NWRPO will conduct a survey to determine whether it exceeds the maximum allowed deviation.

3.2.3.4 Nuisance Water

It is anticipated that nuisance water, such as rainfall or surface runoff, may be encountered during well drilling and construction. The drilling contractor will at all times protect the work from damage by such water and take all due measures to prevent delays in progress of the work caused by such water. The drilling contractor will dispose of nuisance water without adverse effects onto the adjacent property.

3.2.3.5 Utilities

No utilities will be available at the drilling location. The drilling contractor will provide portable power packs sufficient to meet all drilling and well construction needs. The drilling contractor will purchase all necessary water for drilling operations from well owners. Construction and makeup water will be fresh water only and the source of the supply will be approved by the NWRPO. To the extent possible, the NWRPO will facilitate the identification of well owners interested in selling water supplies to the drilling contractor.

3.2.3.6 Depth Control

Depth control will be maintained by the following methods:

- Direct monitoring: the NWRPO will inventory drill pipe and collars and their sizes before use. During drilling, the NWRPO will document the drilled interval by completing a Drilling/Coring Data Sheet and Tubing and Casing Record as detailed in TP-7.0, *Drill Site Management*.
- Depth sounding: well depths may be periodically sounded with an NWRPO-approved “tag line.”
- Geophysical logging: logs will be reviewed to compare the total borehole depth and depth of formation tops with the results of monitored and recorded depth controls.

3.2.3.7 Dust Control

Dust will be controlled on the gravel access road by limiting vehicle speed to 25 mph and by spraying water as necessary while digging mud pits. Compressed air will be injected with water to control dust production (i.e., the air mist method); other drilling fluids used to drill the

unsaturated zone do not produce dust. Coring methods required for the saturated zone also do not yield dust.

3.2.4 Other Drilling Contractor Responsibilities

It is the responsibility of the drilling contractor to be aware of, and comply with, the conditions of the EWDP Drilling and Well Construction Health and Safety Plan. A copy of this plan will be given to the drilling contractor upon the award of the contract and is included in this TPN as Attachment B.

All solid waste, trash, and construction debris will be removed from the site and managed in accordance with applicable regulations. No wastes will be disposed onsite. Hazardous wastes are not expected to be generated during the drilling and monitoring processes; drilling returns are not hazardous wastes.

In compliance with BLM permit requirements, the drilling contractor will take steps to control noxious weeds. The drilling contractor will steam-clean the undercarriage of all drilling and heavy equipment before entering public lands.

The drilling contractor will excavate one or more shallow pits to manage cuttings and fluids resulting from drilling. Any pits, trenches, or berms constructed during drilling will be filled by the drilling contractor prior to demobilization. Drill cuttings (i.e., small rock chips and fragments) will be used as fill material. No borrow materials will be used for fill or grading. No unsuitable excavated materials are expected to be generated.

After the NWRPO has approved general restoration, Nye County will be responsible for final site reclamation in accordance with BLM requirements.

3.2.5 Groundwater Measurements and Sampling During Drilling

3.2.5.1 First Groundwater Measurements/Sampling

Based on previous data from boreholes and wells completed at this site, first water will be encountered between 350 and 360 feet bgs during sonic coring. A groundwater level measurement will be made with an electric well sounder, as detailed in TP-9.9, *Measurement of Groundwater Levels Using Electric Well Sounders*, when the sonic core barrel is removed from the borehole after reaching 360 feet bgs.

No first groundwater samples will be collected or field chemical parameters measured, due to the following:

1. Groundwater may be impacted from drilling fluids and grout material used while drilling and casing the overlying unsaturated zone.
2. The groundwater chemistry of the alluvium at this site has likely been impacted from groundwater originating in the underlying volcanic aquifer that has moved upward into the alluvium in response to a significant upward pointing hydraulic gradient via the open multiple-screen boreholes at this site (e.g. NC-EWDP-19D and -19IM2).

3.2.5.2 Saturated Zone Measurements/Sampling

The NWRPO will routinely measure the groundwater level before the start of drilling/coring activities each day. However, groundwater samples will not be collected for the reason stated in item 2 above.

3.2.6 Geologic Sampling, Logging, and Processing

Unsaturated zone drill cuttings have been collected, logged, and archived from four previous boreholes drilled within 120 feet of the planned borehole. Therefore, there is no need to collect drill cuttings from the upper 350 feet of unsaturated alluvium in NC-EWDP-19PB.

Nearly continuous sonic core samples will be collected, logged, and processed from 350 to 650 feet bgs following procedures detailed in TP-8.0, *Field Collection, Logging, and Processing of Borehole Geologic Samples.* At a few selected depth intervals in saturated alluvium, drive core samples will also be collected, logged, and processed using procedures documented in TP-8.0. Core collection is described briefly in the following.

3.2.6.1 Sonic Core Collection

A single sonic core run will be 10 feet long, where possible; in no cases will a run exceed 10 feet. In cases where refusal is met before the target 10-foot depth interval is reached, one or more additional core runs will be conducted.

After a core run is brought to the ground surface, the drilling contractor will transfer the core in approximately 2-foot lengths from the core barrel to plastic socks with an inside diameter approximately equal to the outside diameter of the core barrel.

If more than one core run is required to meet the 10-foot target, the corehole will be depth sounded between runs to determine whether core has been left behind in the corehole (i.e., lost core) and/or caving has occurred. Disturbed material will be removed from the hole before the next run. NWRPO personnel will determine whether disturbed material is lost core or caved material.

After each 10-foot interval has been cored, the drill casing will be advanced to the bottom of the hole. The core barrel will then be used to clean out disturbed sediments to the bottom of the hole before initiating a new core run. The drilling contractor will remove any fill or caved material from the borehole between runs.

3.2.6.2 Drive Core Collection

Solid-tube drive-core samples will be collected ahead of the larger diameter sonic drilling/coring system at approximately 60-foot intervals, beginning at approximately 380 feet bgs. Disturbed geologic material (i.e., fill) will be removed to the extent reasonably possible from the bottom of the hole before running in the core barrel. The core barrel will be advanced with the sonic system rather than the downhole air percussion hammer used in most drive core operations. Where possible, core barrels will be advanced a total distance that exceeds the length of the barrel plus the drive shoe by at least several inches to ensure that sediments are tightly packed.

3.2.7 Borehole Geophysical Logging

Two suites of borehole geophysical logs will be conducted in NC-EWDP-19PB by an NWRPO contractor after total depth in reached. A suite of drill string logs (i.e., density, deviation, fluid temperature, natural gamma, moisture, and spectral gamma) will be run inside the sonic drill casings. After the well is completed, a suite of well completion logs will be run in each of the two piezometer strings. The completion suite will be the same as the drill string suite with the addition of a sonic log and without the spectral gamma log.

In addition, a second NWRPO contractor will run gamma-gamma density and epithermal neutron porosity logs inside the sonic drill casings to total depth. The relatively large nuclear sources on the downhole tools used to produce these logs have the potential to see farther into the formation and be less affected by the sonic drill casings than density and moisture downhole tools.

Both logging companies will be required to meet the calibration, documentation, and deliverable requirements specified in TP-11, *Borehole Geophysical Logging Data Identification and Acceptance.*

4.0 CORE SAMPLE MANAGEMENT AND TESTING

4.1 Overview

Sonic and drive core sample processing, addressed in TP-8.0, includes collecting representative grab samples from the major textural layers present in sonic core for geologic logging and laboratory testing purposes.

The total numbers of drive and sonic core segments and grab samples of textural layers are summarized in Table 1. The distribution of these samples among different users is shown in Table 2. Distribution will be controlled and documented with the NWRPO Transfer of Custody Form. Geologic samples will be maintained under chain of custody at all times, either in view of the current holder or secured in locked storage.

All core and grab sample data will be reviewed by NWRPO personnel not directly involved in recording the data and submitted to the QARC with all supporting documentation and metadata.

The NFDR will use the numbers and types of segments in Table 1 to ensure that all necessary containers and packing, marking, and preservation materials are available at the drill site.

4.2 Drive-Core Sample Management

Each 2-foot drive-core barrel will contain three 6-inch and two 3-inch brass liners, as shown on Figure 5. Liners are referred to as segments after they are filled with geologic material. The top and bottom surface of each segment will be geologically logged, as well as the unconsolidated geologic sample from the shoe of the core barrel.

Two of the 6-inch segments from each of the five planned core runs will be sent to the NWRPO testing laboratory for the analyses listed in Table 3. The total number of each test type is also

included in Table 3. The laboratory will use the testing methods listed in Table 4. The remaining segments and shoe sample will be assigned to users listed in Table 2 and transported to the DOE Sample Management Facility (SMF) for storage until used.

4.3 Sonic Core and Grab Sample Management

Sonic core will be collected in approximately 2-foot-long plastic socks, referred to as segments in Table 1, and grab samples will be taken of the major textural layers observed in these segments. These textural layers will often extend across adjacent segments and may range in length from less than 1 foot to more than 10 feet. For Table 1, an average length of 2 feet is assumed.

Grab samples will be split into three representative subsamples for NWRPO use (Table 2). One of the subsamples will be used for detailed geologic logging, one for laboratory testing, and one will be stored at the SMF for future use. Laboratory tests for grab subsamples are specified in Table 3.

After digital photographs have been taken of each sonic core segment, the DOE will assume custody of the core segments and transport and store them at the SMF for future use.

5.0 MANAGEMENT

All NWRPO field personnel performing the tasks described in this TPN will be trained in the procedures specifically applicable to the equipment and methods used before conducting work. Personnel will document that they have read and understand this TPN and other applicable QA documents, (i.e., the most recent version TP-7.0, TP-8.0, TP-9.9, and TP-11).

The Quality Assurance Officer is responsible for ensuring that this plan meets QA requirements and that NWRPO field personnel are trained to and comply with the requirements of this TPN. The PI is responsible for the preparation, technical review, and revision of this TPN, as well as oversight of its performance. NWRPO field personnel are responsible for conducting field sampling and testing.

7.0 REFERENCES

NWRPO (Nuclear Waste Repository Project Office), 2002. *EWDP Health and Safety Plan*, Nye County Department of Natural Resources and Federal Facilities, Pahrump, Nevada.

NWRPO (Nuclear Waste Repository Project Office), 2003. *Drilling, Sonic Coring, and Construction of One EWDP Phase V Monitoring Well - Bid Specifications and Request for Bids.* Notice of Invitation to Bid # 2003-27: Drilling, Sonic Coring, and Construction of One EWDP Phase V Monitoring Well. Nye County Department of Natural Resources and Federal Facilities. Pahrump, Nevada.

NAC (Nevada Administrative Code) 534.320. “Notice of Intent to Drill: Contents, Submission.”

NAC (Nevada Administrative Code) 534.330. “Responsibilities of Licensed Well Drillers at Drilling Site.”

NAC (Nevada Administrative Code) 534.340. "Log and Record of Work: Form; Contents."

NRS (Nevada Revised Statutes) 534.170. "Underground Water and Wells, Well Driller to Keep Log and Records; Contents; Information to be Furnished to State Engineer; Report of Test."

TP-7.0, *Drill Site Management*.

TP-8.0, *Field Collection, Logging, and Processing of Borehole Samples*.

TP-9.9, *Measurement of Groundwater Levels Using Electric Well Sounders.*

TP-11, *Borehole Geophysical Logging Data Identification and Acceptance.*

TABLES

Table 1
Geologic Sample Types and Numbers

Geologic Sample Type	Core Diameter (inches)	Estimated Total Footage (feet)	Estimated Average Core Run Length (feet)	Estimated Number of Core Runs	Core Segment Length (feet)	Number of Segments per Core Run	Total Number of Segments or Samples
Drive Core	4	10	2.27	5	0.25	2	10
					0.5	3	15
					0.27[a]	1	5
Sonic Core	6	145	5[b]	29	2.0	2.5	72.5
	3.5	145	5[b]	29	2.0	2.5	72.5
Grab Sample	NA[c]	290	NA	NA	NA	NA	145[d]

[a] Drive core shoe sample not contained in a brass liner.
[b] Conservatively assumes an average core run length of 5 feet. Target core run length is 10 feet.
[c] Not applicable.
[d] Assumes the average layer length is 2 feet.

Table 2
Distribution of Geologic Samples

Geologic Sample Type	Segment Length/Diameter	Total Number Of Segments/ Samples	Number of Segments/Samples Sent			
			NWRPO			DOE
			YMP SMF[a]	Laboratory	Field	YMP SMF
Drive Core	0.25 feet long	10	5	0	0	5
	0.5 foot long	15	5	10	0	0
	0.27 foot long	5	0	0	0	5
Sonic Core	6-inch diameter	72.5	0	0	0	72.5
	3.5-inch diameter	72.5	0	0	0	72.5
Grab Sample	NA[b]	435[c]	145	145	145	0

[a] Yucca Mountain Project Sample Management Facility.
[b] Not applicable.
[c] Each of the 145 textural layer samples is split into three subsamples.

Table 3
Summary of Laboratory Tests on Geologic Samples

Geologic Sample Type	Number of Samples Tested					
	Hydraulic Conductivity	Grain Density	Dry Bulk Density	Saturated Volumetric Water Content	Wet Sieve Particle Size Distribution	Hydrometer Particle Size Distribution
Drive Core	10	10	10	10	10	10
Sonic Core	TBD[a]	TBD	TBD	TBD	TBD	TBD
Textural Layer Grab Sample	NA[b]	50	NA	NA	145	50

[a] To be determined
[b] Not applicable

Table 4
Laboratory Test Methods for Geologic Samples

Laboratory Test	Method
Saturated Hydraulic Conductivity (Constant Head Method)	Klute, A., and C. Dirksen, 1986. Hydraulic Conductivity and Diffusivity: Laboratory Methods. In: Klute, A. (ed), Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods (2nd ed.), American Society of Agronomy, Chapter 28, p. 694-700.
Hydrometer Analysis (Silt/Clay Break Starting with No. 4 Sieve)	ASTM D422. Standard method for Particle Size Analysis of Soils. In: 1996 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Materials.
Wet Sieve Analysis	ASTM D1140 (97). Standard method for the amount of material in soils finer than the No. 200 (75um) sieve. In: 1998 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Materials.
Volumetric Water Content	ASTM D2216-92. Method for laboratory determination of water (moisture content) of soil, rock, and soil-aggregate mixtures. In: 1996 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Materials.
Dry Bulk Density	Blake, G.R. and K.H. Hartge. 1986. Bulk Density. In: Klute, A. (ed), Methods of Soil Analysis, Part 1, Physical and Mineralogical Methods (2nd ed.), American Society of Agronomy, Chapter 13, p. 363-367.
Specific Gravity (Grain Density)	ASTM D854-92. Standard test method for specific gravity of soils. In: 1996 Annual Book of ASTM Standards, Vol. 04.08, American Society for Testing and Materials.

FIGURES

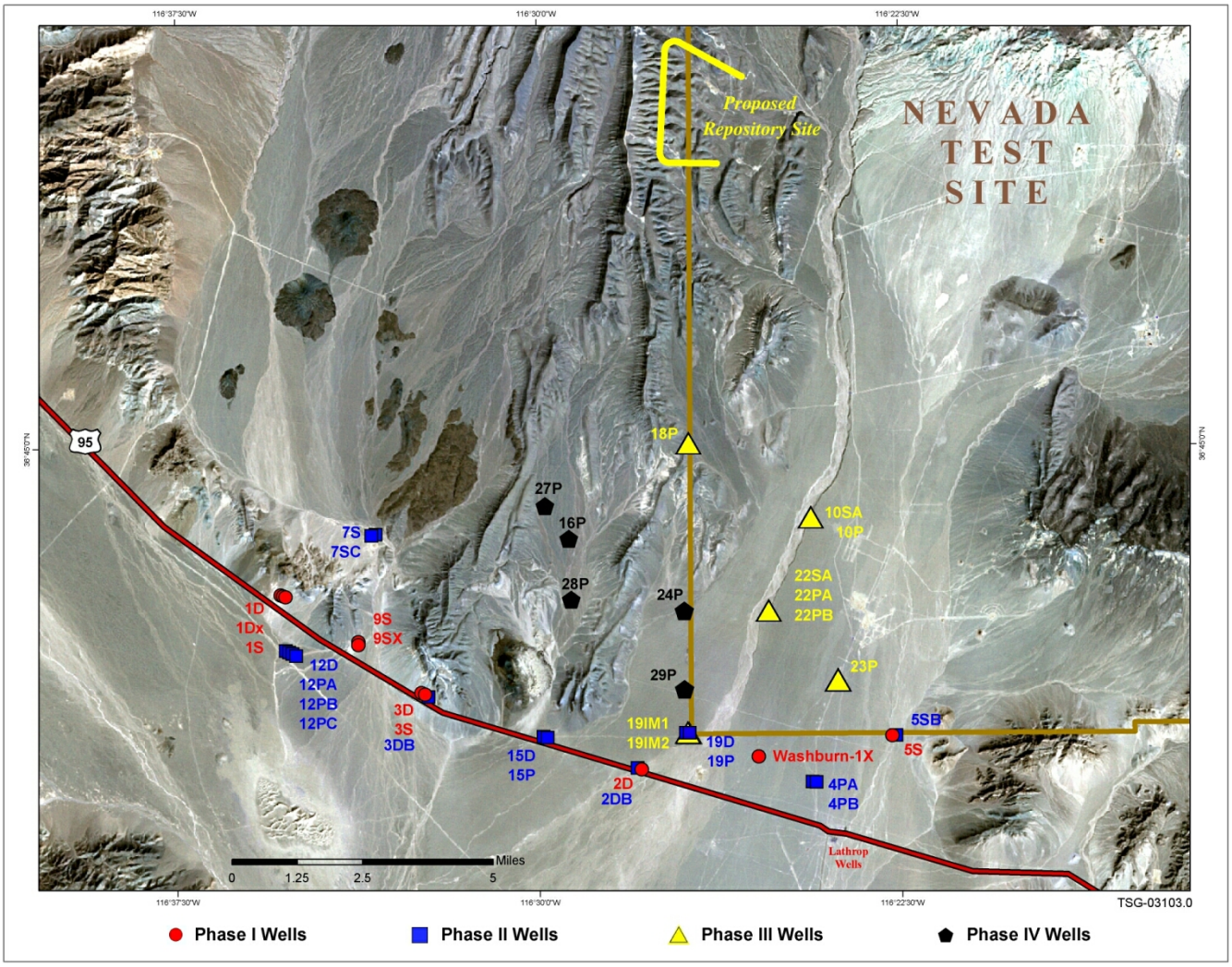


Figure 1
Location Map

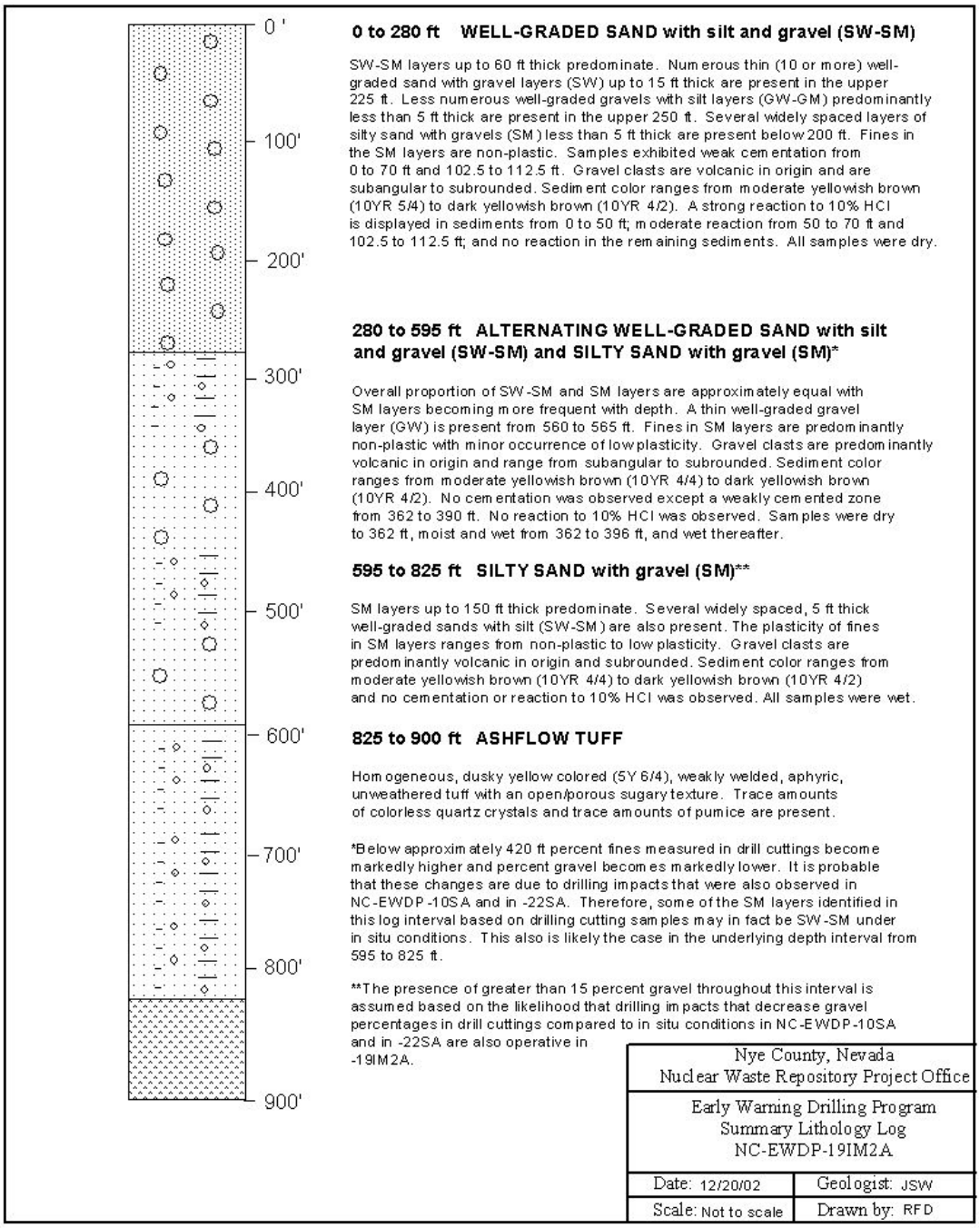


Figure 2
Summary Lithology Log for NC-EWDP-19IM2A

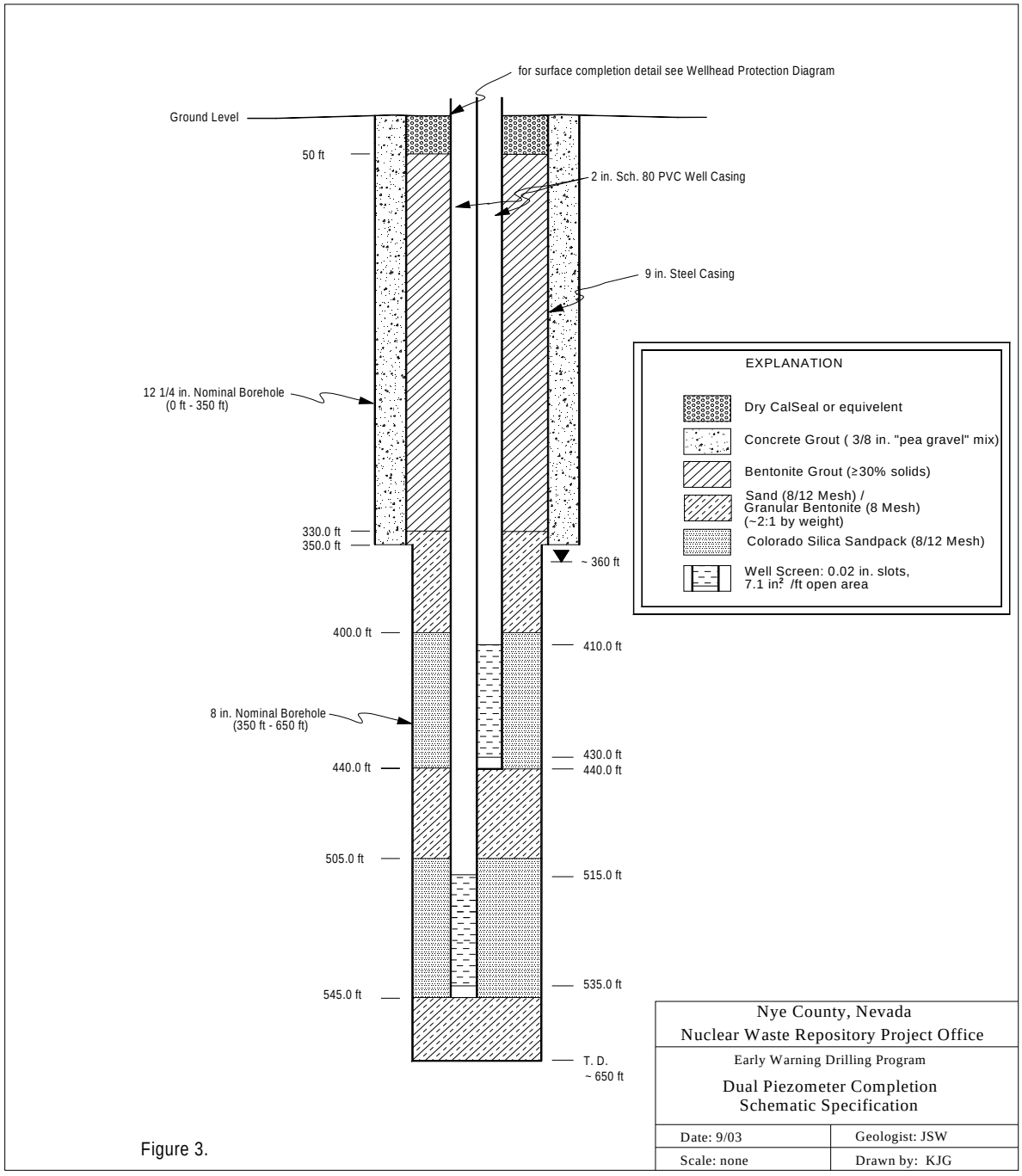
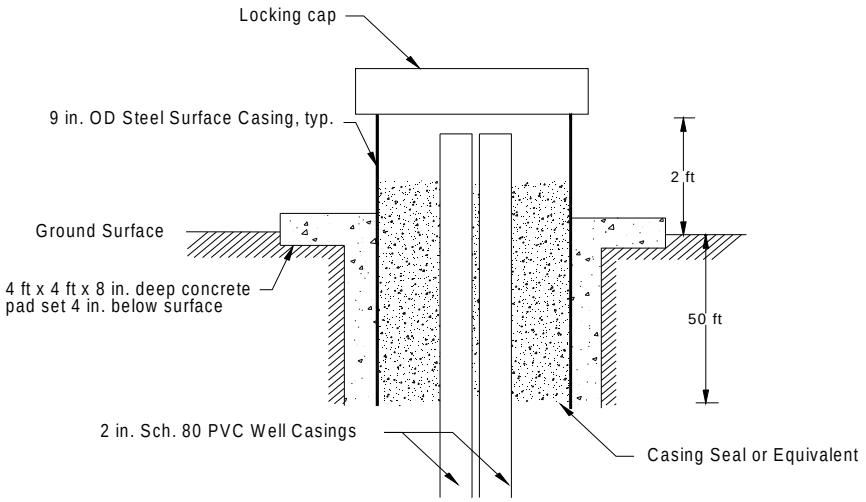


Figure 3.

Figure 3
Dual-Piezometer Subsurface Completion Diagram



Nye County, Nevada Nuclear Waste Repository Project Office	
Early Warning Drilling Program Dual Piezometer Surface Completion Detail	
Date: 9/03	
Scale: none	Drawn by: KJG

Figure 4.

Figure 4
Dual-Piezometer Surface Completion Diagram

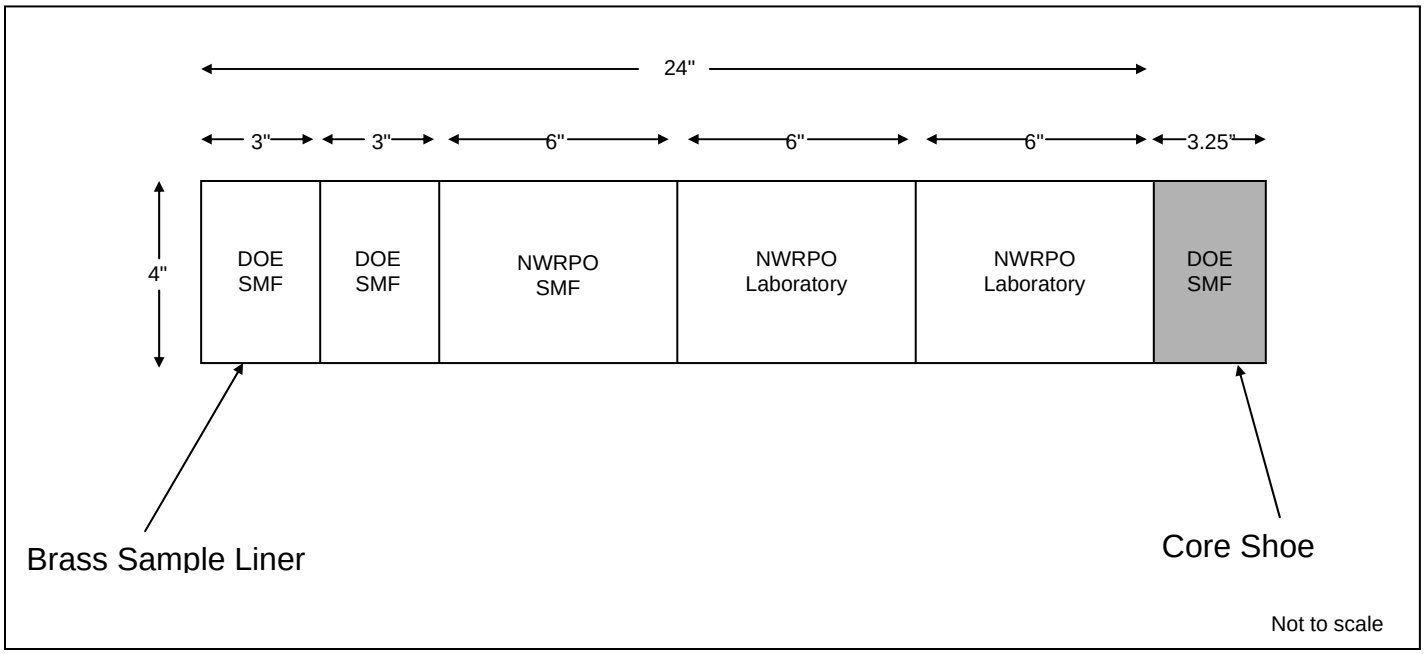


Figure 5
Distribution of Core Segments in 2.0-foot Core Barrel

ATTACHMENT A

SCOPE OF WORK FOR
DRILLING, SONIC CORING, AND CONSTRUCTION OF
ONE EWDP MONITORING WELL

SCOPE OF WORK FOR
DRILLING, SONIC CORING, AND CONSTRUCTION
OF ONE EWDP PHASE V MONITORING WELL

1.0 Introduction

The scope of work encompasses all activities associated with the drilling, sonic coring, and construction of a dual string piezometer monitor well to a total depth of 650 ft below ground surface (bgs) in Fortymile Wash alluvial sediments at a location approximately 5 miles northwest of Lathrop Wells, NV. This well will be located approximately 60 ft due west of existing well number 19IM1 shown in Figure 1.

This single EWDP borehole will only penetrate relatively coarse grained alluvium. The alluvium will include alternating thin (sometimes less than 2.5 ft thick) layers of relatively clean sand and gravel, sand and gravel with silt and/or clay, and silty sand with gravel. A summary lithologic log for a well located approximately 120 ft from the well proposed herein is presented in Figure 2. Some loss of bentonite drilling fluids (11,500 to 14,000 gallons) were observed while drilling the upper approximately 350 ft of two previous boreholes at this location using flooded mud reverse circulation methods. The water table is expected to be encountered at approximately 360 ft bgs.

It is expected the Contractor will use two drill rigs, one for drilling and casing of the unsaturated alluvium, and one for the Sonic coring and borehole advancement in saturated alluvium. However, if available, a multipurpose rig with all the required capabilities will of course be acceptable. The drill site has been graded and fenced by the Nye County Nuclear Waste Repository Project Office (NWRPO). The Contractor will be responsible for digging pits for liquid drilling fluids/cuttings.

The NWRPO and the Department of Energy contractors (DOE) will be responsible for maintaining depth control through pipe tally records. Pipe tally records will be kept for all drilling, coring, and completion activities. The Contractor will cooperate with the NWRPO and DOE in maintaining these records.

Contractor responsibilities regarding drilling permits required by the state of Nevada Department of Water Resources, waste disposal, health and safety, training, fire prevention, spill prevention and cleanup, good drilling/completion operation practices, supply of electricity and water, handling of nuisance water, water sampling, use of drilling fluids and lubricants, and other miscellaneous activities/requirements are described in Part V, Sections A and B of this document (*Drilling, Sonic Coring, and Construction of One EWDP Phase V Monitoring Well – Bid Specifications and Request for Proposal*). In addition, communication and record keeping responsibilities for both the Contactor and the NWRPO are listed in Section B of Part V. Finally, equipment and material specifications are described in Part V Sections C and D.

Detailed specifications and requirements regarding mobilization/demobilization, drilling and casing of unsaturated alluvium, continuous Sonic coring of saturated alluvium, selected drive coring of saturated alluvium, borehole geophysical logging, subsurface completion of a dual

piezometer monitor well, and the surface completion of this well are presented in the following.

2.0 Mobilization/Demobilization

2.1 The rig(s), auxiliary equipment, drillpipe and other downhole equipment and tools shall be mobilized in a clean condition, generally free of surface grease, soil, or other potential contaminants. Steam cleaning of grease, dirt, etc., from previous jobs not related to the subject work on NWRPO locations will not be allowed.

2.2 Mobilization will be considered complete when all of the items listed in Part V, Section B, Item 2 have been accomplished.

2.3 Demobilization will be considered complete when:

- Tasks specified in the contract are completed or exempted from completion with approval of the NWRPO.
- All personnel, equipment, tools, unused materials, and drilling related debris are removed from the drill site location as well as the NWRPO laydown yard in Lathrop Wells. In addition, any pits and berms on the drill site must be graded to approximately the original elevation.

3.0 Proposed Drilling and Casing of Unsaturated Alluvium

Using conventional rotary, dual rotary, or another proven drilling method, drill a suitable borehole and install an approximately 9-inch diameter (or larger) conductor casing to a depth of 350 ft bgs (approximately 10 ft above the water table) in accordance with specifications listed below. The Contractor may elect to drill a borehole significantly larger in diameter (e.g. >12-inches) than the conductor casing and then grout the casing in place with concrete grout, or the Contractor may choose to drill the conductor casing to 350 ft bgs using a drilling method such as dual rotary.

3.1 Regardless of the drilling method employed, permissible drilling fluids are limited to water, untreated bentonite mud (e.g. AQUA GEL GOLD SEAL®), and compressed air. The Contractor must obtain NWRPO approval before using any other drilling fluid or additive.

3.2 The Contractor must employ methods (e.g. drilling collars) to keep the borehole deviation from exceeding 2 degrees from vertical at 350 ft bgs. In addition, no “dog legs” are permitted where deviation exceeds 0.5 degrees per 100 ft. The Contractor must conduct a deviation survey at 350 ft bgs to demonstrate the first requirement. If there appears to be a significant dog-leg, the NWRPO will conduct a survey to determine if the second requirement is met.

3.3 If the Contractor elects to use conventional rotary drilling methods and concrete grout the approximately 9-inch conductor casing in place, the borehole must be drilled to at least 12-inch in diameter to 350 ft bgs. The concrete grout must be pumped through a tremmie pipe using a “bottom-up” approach in stages to prevent casing collapse. In addition, the Contractor may also want to set a larger diameter

surface casing (temporary or permanent) to prevent near surface caving of unconsolidated coarse grained sediments.

3.4 If the Contractor chooses to drill the approximately 9-inch conductor casing to down to 350 ft bgs using a drilling method such as dual rotary, the contractor must first permanently install a larger diameter steel surface casing to at least 60 ft bgs. The diameter of the upper 60 ft of borehole and the diameter of the steel surface casing must be sufficient to permit grouting the surface casing with concrete and to support dual rotary drilling of the approximately 9-inch conductor casing to 350 ft bgs.

4.0 Sonic Coring of Saturated Alluvium

4.1 Run in approximately 8-inch diameter steel drill casing inside the approximately 9-inch conductor casing to 350 ft bgs.

4.2 Run in approximately 15 ft of approximately 6-inch steel core barrel attached to smaller diameter drill rods to 350 ft bgs.

4.3 Advance the approximately 6-inch core barrel using Sonic methods to a maximum target depth 10 ft below the approximately 8-inch drill casing. In some cases the core barrel will meet refusal before 10 ft is reached. When the target depth of 10 ft is reached or the when barrel meets refusal at a depth of less than 10 ft, return the core barrel to the ground surface and transfer the core sample to approximately 2 foot lengths of 4 to 6 mil polyethylene tubing. NWRPO and DOE will be responsible for determining and labeling the depth intervals of each approximately 2 ft length of core in polyethylene tubing.

4.4 If the necessary 10 ft target depth was not reached on the above core run, run the approximately 6-inch core barrel back into the bore hole and continue advancing it to a depth 10 ft ahead of the approximately 8-inch drill casing. At this point, use Sonic methods to advance the 8-inch drill casing down to the bottom of the borehole using the approximately 6-inch core barrel to clean out sediments from inside the drill casing. Remove the cleanout sediments from the borehole and core barrel prior to advancing the approximately 6-inch core barrel as described in section 4.3 above. Prior to each advance with the 6-inch core barrel, the bottom of hole will be sounded with a tagging tool and the core barrel will be empty, thus simplifying the determination of the length of core sample vs. the length of cleanout material collected in the core barrel.

Continue collecting approximately 6-inch Sonic core and advancing the approximately 8-inch drill casing until (in the opinion of the Contractor) it is no longer feasible to do so. This depth of advancement must be greater than or equal to 450 ft bgs and not exceed 650 ft bgs. It is realistically expected that the maximum depth of advancement of this drilling/coring system will be between 450 and 550 ft bgs. For the purpose of the Cost Consideration Schedule (Table 1) in Part I, Section C of this document, it will be assumed that the 6-inch core barrel and 8-inch drill casing will be advanced from 350 to 500 ft bgs.

4.5 When advancement is no longer feasible with the above drilling/coring system, remove the approximately 6-inch Sonic core barrel and run in an approximately 5.5-inch drill casing and an approximately 3.5-inch core barrel. Continue collecting continuous Sonic core and advancing the borehole in a similar manner as sections 4.3 and 4.4 above using this smaller drilling/coring system to a maximum depth of 650 ft bgs.

For the purpose of the Cost Consideration Schedule (Table 1) in Part I, Section C of this document, it will be assumed that the approximately 5.5-inch drill casing and the approximately 3.5-inch core barrel will be advanced from 500 to 650 ft bgs.

5.0 Drive Coring of Selected Intervals of Saturated Alluvium

The NWRPO will supply solid tube samplers, brass liners to fit inside the samplers, and necessary cross-over subs to connect to the Contractors percussion hammer. The contractor will supply drill rod, a 5-inch air percussion hammer, and a 350 psi and 900 cfm compressor. The drive coring program will involve collecting 2 ft long by 4-inch diameter solid-tube drive core samples in saturated alluvium at approximately 40 ft depth intervals in the region of the borehole where approximately 8-inch drill casing is used to advance the borehole. For example, if 8-inch drill casing is advanced to 560 ft bgs, drive core will be collected at approximately 380, 420, 480, 520, and 560 ft bgs in saturated alluvium.

5.1 Advance the approximately 6-inch core barrel and the approximately 8-inch drill casing to the required drive core depth. Clean out all sediment from inside the 8-inch drill casing and remove the 6-inch core barrel.

5.2 Run the drive core system to the bottom of the borehole. Apply air to the percussion hammer and steadily advance the solid tube sampler through an interval of undisturbed alluvium that exceeds the length of the core barrel and drive shoe by approximately 0.2 ft. This overdriving is required to prevent the sample from falling out of the drive core barrel. Drive coring of the 2 ft plus interval should be completed in 1 to 2 minutes.

5.3 Bring the core barrel to the ground surface and remove cross-over sub from the top of the core barrel and the shoe from the bottom.

5.4 The NWRPO and DOE will supply and operate a hydraulic core extruder to remove core segments from the core barrel.

6.0 Borehole Geophysical Logging and Subsurface Completion

Figure 3 shows the detailed completion diagram for the dual string piezometer monitor well with approximately 9-inch conductor casing grouted in place with concrete grout in a 12¼ inch diameter borehole. If the 9-inch conductor casing is drilled to 350 ft bgs using a method such as dual rotary, Figure 3 would be modified to show the 9-inch conductor casing in contact with the formation below 60 ft, and to show the 60 ft of permanent surface casing in the upper portion of the borehole.

In addition, Figure 3 may be modified by the NWRPO prior to initiating subsurface completion activities to accommodate field conditions. The target depths for all completion materials

(including well casing/screen and stemming materials) must be achieved within several feet. Thus the completion process must be conducted with extreme care including frequent tagging (i.e. measurement) of completion (stemming) material depths. The NWRPO will supply a tagging instrument

6.1 When the borehole total depth of 650 ft bgs is reached or drilling and coring is terminated at a shallower depth because it is not feasible to proceed deeper, remove the core barrel from the borehole and standby while borehole geophysical logging is conducted inside the drill casing(s) by other NWRPO contractors.

6.2 Upon completion of borehole geophysical logging, retract 8-inch and/or 5.5-inch drill casing to approximately 530 ft bgs.

6.3 Run an approximately 1 ½-inch diameter steel temmie to the bottom of hole and backfill to approximately 550 ft bgs with "bensand" grout (2:1 by weight mixture of 8/12 sand and 8 mesh bentonite [e.g. Benseal®]) in 10 to 20 ft stages. Use centrifugal pump to emplace bensand grout. Use pumped water to carry the bensand through the tremmie. Add the dry bensand mixture through an open "T" connection on the water intake side of the centrifugal pump.

6.4 If the borehole only contains 8-inch drill casing at 530 ft (i.e. the 5.5-inch casing is not present), run in dual string piezometer casing/screen (2-inch Schedule 80 PVC) to approximately 550 ft bgs as shown in Figure 3. The upper and lower piezometers strings shall be strapped together. Attach centralizers above and below each well screen. Use tremmie pipe and centrifugal pump as described previously to emplace the sandpack and bensand grout as shown in Figure 3. Emplace high solids bentonite grout interval with a standard grout pump, and the fine particle size dry bentonite seal in the upper 50 ft of borehole by gravity free-fall methods.

To minimize the potential for the borehole to cave on the dual string piezometer during the emplacement of stemming materials below 350 ft (i.e. the bottom of the 9-inch conductor casing), pull the 8-inch drill casing back in 10 to 30 ft stages. Following each pull back, the bottom of the well will be sounded to determine if caving has occurred. Completion materials will then be emplaced (tremmied) in each pull back interval up to a depth of approximately 5 ft below the 8-inch drill casing.

If the borehole contains 5.5-inch drill casing at 530 ft bgs, only run in the deeper piezometer string with centralizers located above and below the screen. Emplace stemming materials to within 10 ft of the proposed bottom depth of the shallower piezometer string following methods described above and in accordance with depth intervals specified in Figure 3. Then run in the shallower piezometer string without centralizers to 540 ft bgs. This will be feasible because the 5.5-inch drill casing will have been removed from the borehole and there is adequate room in the 8-inch drill casing for two piezometers strings and a tremmie.

When completion materials reach the bottom of the 9-inch casing at approximately 350 ft bgs, pull all of the remaining 8-inch drill casing from the borehole and continue emplacing completion materials according to the specifications in Figure 3.

7.0 Surface Completion

The required surface completion diagram for a borehole containing 9-inch conductor casing in a 12 ¼-inch borehole is presented in Figure 4. If the 9-inch conductor casing is drilled in place, Figure 4 would also show a larger diameter steel surface casing terminating in the concrete pad.

7.1 Weld on an above ground extension to the approximately 9-inch diameter conductor casing. The steel conductor casing should extend approximately 2 ft above the ground surface. The 2-inch PVC blank casing should extend slightly below the surface casing.

7.2 Install caps on the PVC casings and a locking cap on the surface casing.

7.3 Install an approximately 8-inch thick concrete pad that extends approximately 4 inches below and 4 inches above ground surface. Slope the top of the concrete pad approximately 0.25 inches per horizontal ft away from the surface casing.

ATTACHMENT B

EWDP DRILLING AND WELL CONSTRUCTION HEALTH AND SAFETY PLAN

EWDP
DRILLING AND WELL CONSTRUCTION HEALTH AND SAFETY PLAN

It is the responsibility of the drilling contractor (Contractor) to be aware of, and comply with, the conditions of this health and safety plan. The Contractor and any subcontractors will conduct all operations in accordance with all local, state, and federal regulations or requirements currently in effect concerning employee health and safety. In the event that any of these regulations or requirements requires variance from the provisions set forth in this work plan, the regulatory requirements shall take precedence.

1.0 TRAFFIC CONTROL

Because of the remote locations of the planned wells, traffic control will not be required as part of the EWDP. However, the Contractor is required to ensure that all drivers operate their vehicles and equipment in a safe manner. The Contractor will comply with all applicable state and local limits and restrictions and with any Nevada Department of Transportation and/or U.S. Department of Transportation requirements. The Nye County Sheriff's Office patrols the Nevada Test Site and all applicable county and state limits, and restrictions are enforced.

2.0 SAFETY SUPERVISOR

The Contractor will appoint a safety supervisor for each crew. This supervisor will be given the responsibility of providing a safe work environment and the authority to enforce safety as a first priority. The safety supervisor together with the NWRPO field safety officer will provide a tailgate review of work site hazards, including management of any potentially hazardous materials; trip, slip, and fall hazards; and discussion of desert environment related hazards (e.g., heat stroke and stress, dehydration, poisonous snakes and spiders) before the start of each work shift. The NWRPO field safety officer will document the tailgate safety meeting in the scientific notebook for the designated well. The safety supervisor will ensure that all equipment operators have adequate training and will inspect and test all safety equipment and devices are functioning properly including gauges, warning lights, and horns. On a daily basis, the safety supervisor will inspect the drilling equipment daily for damage, loose parts, missing guards, fluid leaks, damaged hoses, etc.

3.0 PERSONNEL PROTECTIVE EQUIPMENT

Clothing for all onsite personnel must be appropriate for drilling and sampling operations. Safety headgear and safety boots are required. Gloves are required for equipment handling and operation. All onsite personnel should wear safety glasses

4.0 GENERAL DRILL SITE OPERATIONS

Suitable storage locations will be provided for all tools, materials, and supplies so that these items can be retrieved safely and used without injury to drill crew members, other onsite personnel, and visitors. Tools, materials, and supplies are not to be stored on the mast. Pipe, drill rods, casings, augers, and similar materials are to be stacked orderly on racks or sills to prevent spreading, rolling, or sliding. Work areas, platforms, walkways, and other access ways

will be kept clear of materials, debris, and obstructions. All warning lights and lenses, controls, control linkages, and operation lights will be kept clear of mud, oil, grease, and ice.

5.0 UTILITY HAZARDS

The NWRPO will obtain utility clearances for drill sites. In some instances, drill sites are located inside of rights-of-way for gas pipelines, telephone lines, and/or overhead electrical transmission lines. All transmission wires and underground cables are to be considered live. Drill rigs and other heavy equipment will maintain safe distances when used near transmission lines. The National Drilling Federation recommends a distance of at least 20 ft from any portion of the drill rig and mast to a transmission line. This minimum distance should take into account that both the transmission line and the rig mast may be affected by high winds.

6.0 FIRE PREVENTION

The Contractor will exercise due care at all times to ensure that fire danger is avoided. Flammable liquids, if present, will be stored in flammable-approved containers, and will be protected from ignition sources. Open ignition sources will be not be used in the presence of flammable liquids. Welding or cutting will not be performed near a storage tank or container. Gasoline or other volatile liquids will not be used as cleaning agents or around the drill rig.

7.0 SPILL PREVENTION AND CONTINGENCY PLAN

Minor quantities of hazardous products and fuels may be used during the drilling process and will be properly handled by the Contractor. All such products will be used and managed in accordance with their labeling instructions, and will be stored in a locked cabinet when not in use. The Contractor will inform the onsite crew of the potential hazards associated with the products that will be onsite, and spill kits will be maintained for any material kept onsite in excess of the reportable quantity. Well casings, specialized cements and grouts, foaming agents or other additives, and other routinely required drilling materials will be delivered to the site and prepared for use as needed. Cements, grouts, and drilling additives will be mixed in a portable tank and/or a mud pit. All excess materials will be disposed in accordance with applicable regulations. The Contractor will be equipped with either radio or cellular telephone communication. Spill notification information will be maintained onsite by the Contractor if reportable quantities of hazardous materials are present.

8.0 FIRST AID

The Contractor will have a first aid kit onsite at all times. The safety supervisor and all NWRPO personnel should be trained in first aid methods, including CPR.

9.0 NOTIFICATIONS AND EMERGENCY RESPONSE

In the event of any injury or medical need, the Contractor will notify the appropriate emergency response organization. For well sites located outside of the Nevada Test Site, the following organizations should be contacted**:**

Pahrump Emergency Services 911

Beatty Emergency Services 775-553-2345

Amargosa Emergency Services 775-372-5345

For well sites on the Nevada Test Site, the following organizations should be contacted:

NTS Emergency Services 911

Ranch Control 702-295-5915

After emergency services have been contacted, the Contractor will call the NWRPO as soon as it is safe and prudent to do so.