NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

WORK PLAN

TITLE:	REVISION: 7
Phase VI Drilling and Well Construction	DATE: **5-28-08**
	PAGE: **1 of 21**

WORK PLAN NUMBER:	SUPERSEDES:
WP-5.0	**Revision 6, 3-6-06**

APPROVAL

5/28/08

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CONCURRENCE

5/28/08

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5/28/08

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1.0 INTRODUCTION

This work plan (WP) has been prepared in accordance with the provisions of the Nye County Nuclear Waste Repository Project Office (NWRPO) Quality Assurance (QA) program and quality administrative procedure (QAP) 5.2, *Preparation of Work Plans, Test Plans, and Technical Procedures*. All NWRPO technical procedures (TPs), test plans (TPNs), WPs, and other QA documents referenced in this WP will be the most current versions of those documents.

2.0 PURPOSE

The purpose of this WP is to ensure that: 1) NWRPO Early Warning Drilling Program (EWDP) Phase VI is consistent with the requirements of the NWRPO QA program, 2) EWDP field activities are conducted in a technically defensible and safe manner, in full compliance with all applicable environmental and regulatory requirements, and 3) these activities support other Nye County Independent Scientific Investigation Program (ISIP) and Oversight objectives and related tasks. The EWDP is an important component of the larger ISIP, which encompasses a wider range of scientific activities.

This WP specifically addresses methods and procedures for the following: pre-drilling preparation, borehole drilling operations, sampling and onsite logging of geologic media, and well construction and development. Several other EWDP field activities, including sample management, geophysical logging, and aquifer testing, are described in detail in other WPs and described only briefly in this WP.

3.0 BACKGROUND

It is the policy of Nye County to protect the health, welfare, and economic well-being of its residents. All water supplies in southern Nye County are derived from groundwater wells or groundwater discharging to the surface at springs. These water supplies are protected to ensure that all public water supplies are in compliance with the requirements of the U.S. Safe Drinking Water Act (SDWA, 1974).

The results of U.S. Department of Energy (DOE) Yucca Mountain Project (YMP) models developed to assess the long-term performance of a high-level nuclear waste repository at Yucca Mountain indicate that releases from the repository may occur and groundwater contamination may result. To protect Nye County water supplies, a network of strategically placed monitoring wells is required along the potential pathways for contaminant transport downgradient of Yucca Mountain. The EWDP is designed to meet this need by drilling, constructing, testing, and monitoring a network of wells between the proposed repository site at Yucca Mountain and potentially populated areas in the Amargosa Desert.

In addition, basic geologic and hydrologic data gaps exist for a large area in the vicinity of Yucca Mountain. Past studies conducted by the DOE have concentrated on characterizing the conditions in the immediate vicinity of the repository. According to the information presented in a DOE site recommendation report (DOE, 2001), water level, aquifer test, and water chemistry data are not available for a large area of southern Jackass Flats, southern Crater Flat, Oasis Valley, Rock Valley, and the northern Amargosa Desert. Quantitative data are needed to better

define the hydrologic conditions in these areas so that the risk associated with long-term waste disposal can be identified and evaluated. The EWDP is designed to meet the need for additional data in these areas.

This WP describes activities that will be performed to help fill data gaps in the region, such as: 1) collection of representative geologic samples in order to describe geologic units, 2) collection of groundwater flow-related data from geophysical logging of fractured rock units, 3) construction of wells to provide monitoring points for groundwater elevation and chemistry data, and 4) construction of wells to provide multiple depth sampling and injection points for tracer tests in fractured rock.

4.0 SCOPE OF WORK

The EWDP is a phased program of drilling, well construction, and testing that began in 1998. Phases I through V have been completed. The scope of work for Phase VI is described in the following.

The locations of wells proposed for Phase VI are illustrated on Figure 1, which also shows previously completed wells. The scheduled completion date for Phase VI wells is September 30, 2008.

The Principal Investigators (PIs) for drilling and well construction activities conducted as specified in this WP will be the NWRPO Geoscience Manager (GSM) and the managing contract geologist. The PIs or designees will be responsible for all technical activities described in this WP and are referred to as “NWRPO personnel.”

Separate NWRPO contractors will serve as PIs for the aquifer testing and groundwater sampling and analysis activities discussed in this WP and are referred to as the “aquifer testing PI” and the "groundwater sampling and analysis PI" in the following.

Standard drilling equipment and well construction materials will be used, as specified in the NWRPO contract with the well driller.

The following summarizes the required drilling and well completion activities for NC-EWDP-4PC, -2P, -33PA, and -8P:

<u>Required not-to-exceed 2,000-foot boreholes with two piezometer strings (-4PC and -2P)</u>

- Install approximately 60 feet of surface casing and drill an approximately 5.5-inch diameter borehole to a maximum depth of 2,000 feet below ground surface (bgs) with an approximately 4.5-inch diameter dual-wall reverse-circulation (DWRC) drilling system, using air as the primary drilling fluid.
- Collect drill cutting samples at 5-foot intervals using a cyclone separator and a rotating Anaconda wet splitter attached to a cyclone separator in the saturated zone.
- Upon reaching total depth (TD), complete the well with two 2-inch PVC piezometer strings at screen depths specified by the NWRPO.

Optional not-to-exceed 2,000-foot boreholes with two piezometer strings (-33PA and -8P)

- Install approximately 60 feet of surface casing and drill an approximately 5.5-inch diameter borehole to a maximum depth of 2,000 feet below ground surface (bgs) with an approximately 4.5-inch diameter DWRC drill system, using air as the primary drilling fluid.
- Collect drill cutting samples at 5-foot intervals using a cyclone separator and a rotating Anaconda wet splitter attached to a cyclone separator in the saturated zone.
- Upon reaching TD, complete the well with two 2-inch PVC piezometer strings at screen depths specified by the NWRPO. The NWRPO will supply the PVC piezometer strings.

4.1 Predrilling Activities

4.1.1 Well Designations

New piezometers are designated NC-EWDP-XPY, where X is the site number, P refers to piezometer, and Y is the piezometer identification. The first piezometer at a particular site will be designated as PA, the second as PB, and so on. In some cases, the first piezometer at a particular site was designated NC-EWDP-XP, in which case the second piezometer will be designated as PA, the third as PB, and so on.

For wells that are recompletions of existing Nye County boreholes, the name of the well is the one recorded in published literature or State of Nevada files.

4.1.2 Drilling Site Selection

Locations for monitoring wells are based on a combination of hydrologic and geologic considerations and environmental, logistical, and practical constraints. When the NWRPO has identified the location for a potential well site, a field reconnaissance survey is conducted to determine access requirements, obvious environmental conflicts, and the suitability of the site to meet the scientific objectives of the EWDP. Following acceptance of the site by the NWRPO, a stake is driven at the proposed wellhead and the location is surveyed using a global positioning system (GPS), according to TP-9.8, *Development of GPS Data using the Trimble® GeoXH GPS*. All original GPS survey data collected during site selection, as well as post-processed data and associated will be transmitted immediately to the NWRPO QA records center (QARC), along with associated metadata, per the requirements of TP-9.8.

4.1.3 Site Staking

For each of the drilling sites, a 90,000-square-foot (ft^2) or smaller area will be temporarily disturbed for well drilling and construction. Environmental clearances will be obtained for these areas. The NWRPO will stake and flag an appropriately sized drill pad for the type of drilling to be conducted. All drilling activities, materials storage, and vehicular movement will be restricted to the well pad and access road. Of the initial disturbed area around each borehole, all but approximately 400 ft^2 will be reclaimed after well construction is complete.

Following site staking, any necessary environmental surveys will be conducted by an NWRPO contractor approved by the U.S. Bureau of Land Management (BLM). The NWRPO will provide an escort for the surveys and, if necessary, relocate drilling sites to eliminate environmental conflicts. The site pad location will then be surveyed with a GPS.

4.1.4 Nye County Permitting Responsibilities

No site-disturbing activities will take place until the necessary right-of-way grant has been approved and all necessary permits and/or waivers have been obtained.

The NWRPO will obtain a right-of-way grant from the BLM for access to all drilling sites and for the conduct of site-disturbing activities and restoration. In addition, the NWRPO will obtain the following waivers from the Nevada Division of Water Resources (NDWR), if required:

- Monitoring Well Drilling: Waiver to allow monitoring wells without regulatory requirement (Nevada Administrative Code [NAC] 534.4351.1(c)).
- Monitoring Well Testing: Waiver for sampling and testing of nonconforming well designs (NAC 534.4353.2).
- Drilling in Designated Basins: Waiver for wells located in the Amargosa desert (NAC 534.440).
- Temporary Groundwater Waiver or Appropriation: Permit to appropriate water before sinking well in designated groundwater basin. (Nevada Revised Statute [NRS] 534.050).

The NWRPO will also obtain new or modify existing permits, as required. Temporary discharge permits required by NRS 445A.485 will be obtained as necessary for well sampling and aquifer testing from the Nevada Bureau of Water Pollution Control. Copies of all required permits will be submitted to the QARC. Permits pursuant to federal and state air regulations are not required for any of the proposed activities. All parties engaged in work at the site will implement best management practices to control fugitive dust.

Finally, the NWRPO will provide the well driller with copies of any necessary affidavits, rights-of-way grants, and permit and/or waiver identification numbers required for the notifications described in the following.

4.1.5 Well Driller Responsibilities

The well driller will notify the NDWR by submitting a Notice of Intent to Drill at least three working days before the well rig is to be set up and drilling started, as required by NAC 534.320. The notice will indicate the identification number of each permit or waiver issued by the NDWR for that well.

The NWRPO will provide the NDWR with a notarized Affidavit of Intent to Abandon that covers all ISIP wells, as required by NAC 534.4353.2, and will provide the driller with the identification number of each applicable permit or waiver.

All solid waste, trash, and construction debris will be removed from the well site and managed in accordance with Environmental Management Procedure EP-1.0, *Waste Management*. No wastes will be disposed of onsite. Hazardous wastes are not expected to be generated during the drilling and monitoring processes; drilling returns are not hazardous wastes.

The health and safety of all workers, at drill sites and other locations, is of primary importance to the NWRPO. As such, the NWRPO Field Safety Supervisor will review the health and safety plan of the driller before drilling commences. The well driller shall comply with the provisions of their health and safety plan or the provisions of Health and Safety Plan HSP-1.0, *Independent Scientific Investigations Program Health and Safety Plan for General Field Activities*, whichever is more stringent.

The well driller will have experience in construction of boreholes using the drilling methods specified in this WP. A Nevada-licensed well driller will drill all EWDP wells. The well driller will provide the NWRPO with copies of each driller's license before the commencement of drilling operations at each site. As required by NAC 534.330, the well driller will carry the license when present at the drilling site and produce it when requested to do so by an NDWR representative. A Nevada-licensed driller will be present at the drilling site any time the drill rig is operating.

To comply with BLM permit requirements, the well driller will take steps to control noxious weeds. For example, the well driller will steam-clean the undercarriage of all drilling and heavy equipment prior to entry on all public lands.

4.1.6 Earthwork

Before mobilization, the NWRPO will grade sites and roads, as necessary, to allow setup for drilling operations. Care will be taken to limit the grading to only the areas needed for operations. The top 2 inches of soil will be scraped from the surface at each site and stockpiled, covered, and stored at the interior perimeter of the disturbed area. After drilling, stockpiled soils will be returned to the disturbed area and graded to follow the natural contour of the land. Depending on specific site topography, minor berms will be constructed to control the flow of water onto and off of the site during construction.

The drilling contractor will be required to 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. No borrow materials will be used for fill or grading; drill cuttings (i.e., small rock chips and fragments) will be used as fill material. No unsuitable excavated materials are expected to be generated.

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

4.1.7 Dust Control

As required by the BLM right-of-way grant, materials free-use permit, and operating permits issued by the Nevada Division of Environmental Protection, dust control measures will be implemented whenever work is conducted. Measures to be implemented include spraying of

water to control fugitive dust emissions resulting from the following activities: 1) grading of drill sites, 2) grading or improvement of dirt roads, 3) removal of materials from the gravel pit, 4) drilling site activities, 5) vehicular traffic on dirt roads, and 6) site reclamation activities. If extremely windy conditions occur (i.e., winds of more than 25 miles per hour), drill site and/or earthwork activities will be suspended until winds abate.

4.2 Borehole Construction Activities

The NWRPO will direct all borehole drilling, sampling, geologic logging, and well completion activities and document these activities in a scientific notebook assigned to each well as specified in QAP-3.2, *Documentation of Technical Investigations.*

4.2.1 Drilling Specifications

Detailed instructions for the drilling and construction of EWDP Phase VI boreholes are presented in Attachment 1. Several of these specifications and responsibilities are summarized below.

Drilling Methods

Dual-wall reverse-circulation will be used in each borehole.

Drilling Fluid Control

Air will be the primary drilling fluid; however, small amounts of water may be used at the bit to condition the borehole during drilling in the unsaturated zone. All other drilling fluids or additives will be pre-approved by the NWRPO. All discharged liquid drilling fluids will be initially collected in a mud pit for onsite storage. Discharge rates will be determined by timed volume measurements, as appropriate, and documented in accordance with the requirements of the temporary discharge permit. Only clear water will be discharged offsite. Photographic documentation of erosion controls for offsite discharge is required for each site from which discharges occur. No water containing drilling additives, batch water, wastewater, cement, or any fluids other than clear water will be discharged offsite.

Well Plumbness and Deviation Survey

There are no well plumbness or deviation requirements for Phase VI wells. The well driller has no responsibility for conducting deviation surveys. If required, deviation surveys will be conducted in completed wells by an NWRPO borehole geophysical logging contractor.

Nuisance Water

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

Utilities

No utilities will be available at any of the planned drilling locations. The well driller will provide portable power packs sufficient to meet all drilling and well construction needs. The well driller will obtain necessary water for drilling operations by purchasing the water from existing 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 water well owners interested in selling water supplies to the well driller.

Depth Control

Depth control will be maintained using the following methods:

1. Monitoring lengths of drill pipe in the borehole:

   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*.

2. Depth Sounding:

   Well depths will be periodically determined with an NWRPO-approved "tag line," which works best at depths of less than 1,000 feet.

3. Geophysical Logging:

   Geophysical log depths will be reviewed and compared with total borehole depths and depths of formation tops determined by other depth control methods.

4.2.2 Groundwater Sampling Specifications

First Water Measurements/Sampling

The time that first water is encountered, and its depth, will be recorded in the scientific notebook for each borehole. If free water is evident in the drill cuttings discharge line, drilling progress will stop, the drill string will be broken at the first joint near ground level, and the water level will be measured and recorded in the scientific notebook as specified in QAP-3.2.

If directed by the NWRPO after the first water level measurement has been obtained, the drill bit and stem will be raised approximately 1 to 2 feet and air circulated until the discharge water is reasonably free of sediment. The water will then be sampled for field determinations of temperature, pH, and electrical conductivity.

If the first water encountered is determined to be perched, the NWRPO will require that groundwater samples be sent to a testing laboratory for chemical analysis. The collection and handling of groundwater samples is described in TP-8.1, *Field Collection and Handling of Water Samples*. The management of all NWRPO groundwater samples collected for laboratory analysis will be conducted in accordance with WP-8.0, *Sample Management*.

Saturated Zone Water Measurements and Sampling

Once the borehole has been advanced to the water table, subsequent water level measurements and sampling will be conducted, if required by the NWRPO. Field measurements of temperature, pH, and electrical conductivity may be required for groundwater samples. The NWRPO may also require laboratory analyses.

4.2.3 Lithologic Sampling Specifications

Drill cuttings samples will be collected, logged, and handled from selected depth intervals of formation rock as specified in TP-8.0, *Field Collection, Logging and Processing of Borehole Geologic Samples*. Sample management requirements are detailed in this TP and in WP-8.0. Detailed instructions regarding sampling of Phase VI boreholes are presented in Attachment 1.

4.2.4 Well Completion, Well Development, and Geophysical Logging Specifications

The NWRPO will direct well completion, well development, and geophysical logging, and document these activities in scientific notebooks dedicated to specific boreholes, as specified in QAP-3.2.

Figure 2 shows a typical subsurface well completion diagram for Phase VI piezometers. Figure 3 shows a typical surface completion. Field "as-built" diagrams will be drafted by the NWRPO, carefully reviewed and checked for accuracy, and submitted to the QARC. The hand-drafted diagrams will then be drafted electronically and also submitted to the QARC.

Well Screen and Casing Specifications

Well screen and casing specifications will be determined by the NWRPO. Well screen locations will be determined based on instructions in the scope of work (Attachment 1), geologic and geophysical logs, and other information collected during drilling.

Well casing materials will meet the minimum requirements of NAC 534.360 and 534.362. PVC casing will be flush-jointed and meet the standards adopted by the American Society for Testing and Materials (ASTM F-480).

Well Stemming Specifications

Well stemming specifications are presented in the scope of work (Attachment 1).

Well Development Specifications

The NWRPO will direct the development of wells. Piezometers and wells will be developed using air-lifting methods until the discharge is as clear as reasonably possible of drilling fluids and excess sediment.

Geophysical Logging Specifications

When possible, borehole geophysical and other logs will be run in the open boreholes after TD is reached, and in completed boreholes within the blank casing and well screen. In addition, nuclear logs may be run inside blank steel casing. Geophysical and other logs will be conducted as required by WP-6.0, *Early Warning Drilling Program Geophysical Logging Work Plan*, which addresses geophysical and video logging and other specialized logs for EWDP boreholes.

4.2.5 Post-Completion Regulatory Requirements

Well Driller Responsibilities

The well driller is required to meet the reporting requirements of NRS 534.170 and NAC 534.340 for each well and to submit a completed well driller's report and Record of Work to the NDWR within 30 days of completion of each well. The well driller will also submit copies of these documents to the QARC.

4.3 Aquifer Testing and Groundwater Sampling and Analysis

Following well completion and development activities, aquifer testing and groundwater sampling will be directed by NWRPO PIs and conducted by NWRPO personnel. All activities will be documented in scientific notebooks, as specified in QAP-3.2.

4.3.1 Aquifer Testing

Aquifer testing in Phase VI wells will be described in one or more TPN(s). The aquifer testing PI will ensure that all data are collected as specified in QA procedures and transmitted to the QARC following test completion, along with associated metadata. Any additional processed data will also be submitted after data analysis.

4.3.2 Groundwater Sampling and Analysis

After well completion and development, groundwater samples will be collected for the chemical analysis of a comprehensive suite of analytes from all new wells. Groundwater sample collection will be conducted in accordance with TP-8.1 and WP-8.0. The comprehensive suite of analytes will include major anions and cations, trace metals, gross alpha and beta, tritium, stable isotopes of carbon in water, stable isotopes of oxygen and hydrogen in water, stable isotopes of nitrogen in nitrate, and carbon-14.

The groundwater sampling and analysis PI will ensure that groundwater sample chemistry results, including original laboratory reports, are submitted to the QARC. Evaluations of QA sample results and other metadata will be submitted to the QARC upon completion by the PI.

5.0 MANAGEMENT

The project QA Officer or designee is responsible for the coordination of the internal review of this WP, ensuring proper training of NWRPO personnel, and verifying compliance with the

requirements of this WP. The PIs are responsible for the preparation and modification of this WP, as well as oversight of its performance.

To ensure that the work involved will be quality controlled and accomplished in accordance with the scope and objectives of the ISIP, specific training will be accomplished and documented before conducting the activities described in this WP. All individuals performing these activities will be trained in the applicable QA procedures listed below before conducting work, and will document that they have read and understand these procedures.

WP-6.0, *Early Warning Drilling Program Geophysical Logging Work Plan.*

WP-8.0, *Sample Management.*

TP-7.0, *Drill Site Management.*

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

TP-8.1, *Field Collection and Handling of Water Samples.*

QAP-3.2, *Documentation of Technical Investigations*.

HSP-1.0, *Independent Scientific Investigations Program Health and Safety Plan for General Field Activities*.

EP-1.0, *Waste Management*.

6.0 REFERENCES

ASTM F-480. *Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH40 and SCH80.* Philadelphia, Pennsylvania. American Society for Testing and Materials. http://www.astm.org/Standards/F480.htm.

DOE, 2001. *Yucca Mountain Total System Performance Assessment – Site Recommendation.* Washington, D.C.: U.S. Department of Energy. TDR-WIS-PA-00001, MDL-WIS-PA-00001.

HSP-1.0, *Independent Scientific Investigations Program Health and Safety Plan for General Field Activities*. Health and Safety Plan. Nye County Nuclear Waste Repository Project Office (NWRPO). Pahrump, Nevada.

NAC 534.320. *Notice of Intent to Drill: Contents, Submission.* Nevada Administrative Code. NAC index available at http://www.leg.state.nv.us/NAC/CHAPTERS.HTML.

_NAC 534.330. *Responsibilities of Licensed Well Drillers at Drilling Site.*

_NAC 534.340. *Log and Record of Work: Form; contents.*

_NAC 534.360. *Construction of Well: Casing.*

_NAC 534.362. *Construction of Well: Thermoplastic Casing.*

_NAC 534.4351.1(c). *Monitoring Wells: Restrictions on Construction: Submission of Plat Maps and Record of Work.*

_NAC 534.4353.2. *Monitoring Wells: Responsibilities of Owner, Permits, Affidavit of Responsibility for Plugging.*

_NAC 534.440. *Waivers to Drill Exploratory Well to Determine Quality or Quantity of Water in Designated Basin.*

NRS 534.050. *Permit to Appropriate Water Required before Sinking Well in Designated Groundwater Basin; Requirements in Undesignated Areas; Waivers; Penalties.* Nevada Revised Statutes. NRS index available at http://www.leg.state.nv.us/Nrs/.

_NRS 445A.485. *Water Controls: Permits: Issuance of Temporary Permits.*

_NRS 534.170. *Underground Water and Wells, Well Driller to Keep Log and Records; Contents; Information to be Furnished to State Engineer; Report of Test.*

QAP-3.2. *Documentation of Technical Investigations.* Quality Administrative Procedure. Nye County NWRPO. Pahrump, Nevada.

_QAP-5.2. *Preparation of Work Plans, Test Plans, and Technical Procedures.*

SDWA, 1974. Safe Drinking Water Act of 1974, 42 U.S.C. 300f, et seq., enacted by Pub. L. No. 93-523, as amended. Readily available.

TP-7.0. *Drill Site Management.* Technical Procedure. Nye County NWRPO. Pahrump, Nevada.

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

_TP-8.1. *Field Collection and Handling of Water Samples.*

_TP-9.8, *Development of GPS Data using the Trimble® GeoXH GPS.*

WP-5.0. *Phase V Drilling and Well Construction, Revisions 4 and 5*. Work Plan. Nye County NWRPO. Pahrump, Nevada.

_WP-6.0. *Early Warning Drilling Program Geophysical Logging Work Plan*.

_WP-8.0. *Sample Management*.

Table 1
Proposed Phase VI Drilling Information

Well No. (NC-EWDP-)	Drilling Method	Maximum Total Depth (feet)	Completion Type	Approximate Screen Depths (feet below ground surface [bgs])	Approximate Depth to Water (ft bgs)	Approximate Alluvium Thickness (ft)
Required Wells						
4PC	RC[a]	2,000	Two 2-inch PVC piezometer strings	960-1,000 1,160-1,200	300	1,000
2P	RC	2,000	Two 2-inch PVC piezometer strings	760-800 960-1,000	300	670
Optional Wells						
33P	RC	2,000	Two 2-inch PVC piezometer strings	760-800 960-1,000	200	195
8P	RC	2,000	Two 2-inch PVC piezometer strings	340-380 960-1,000	350	250

[a] Dual-wall reverse-circulation air-rotary

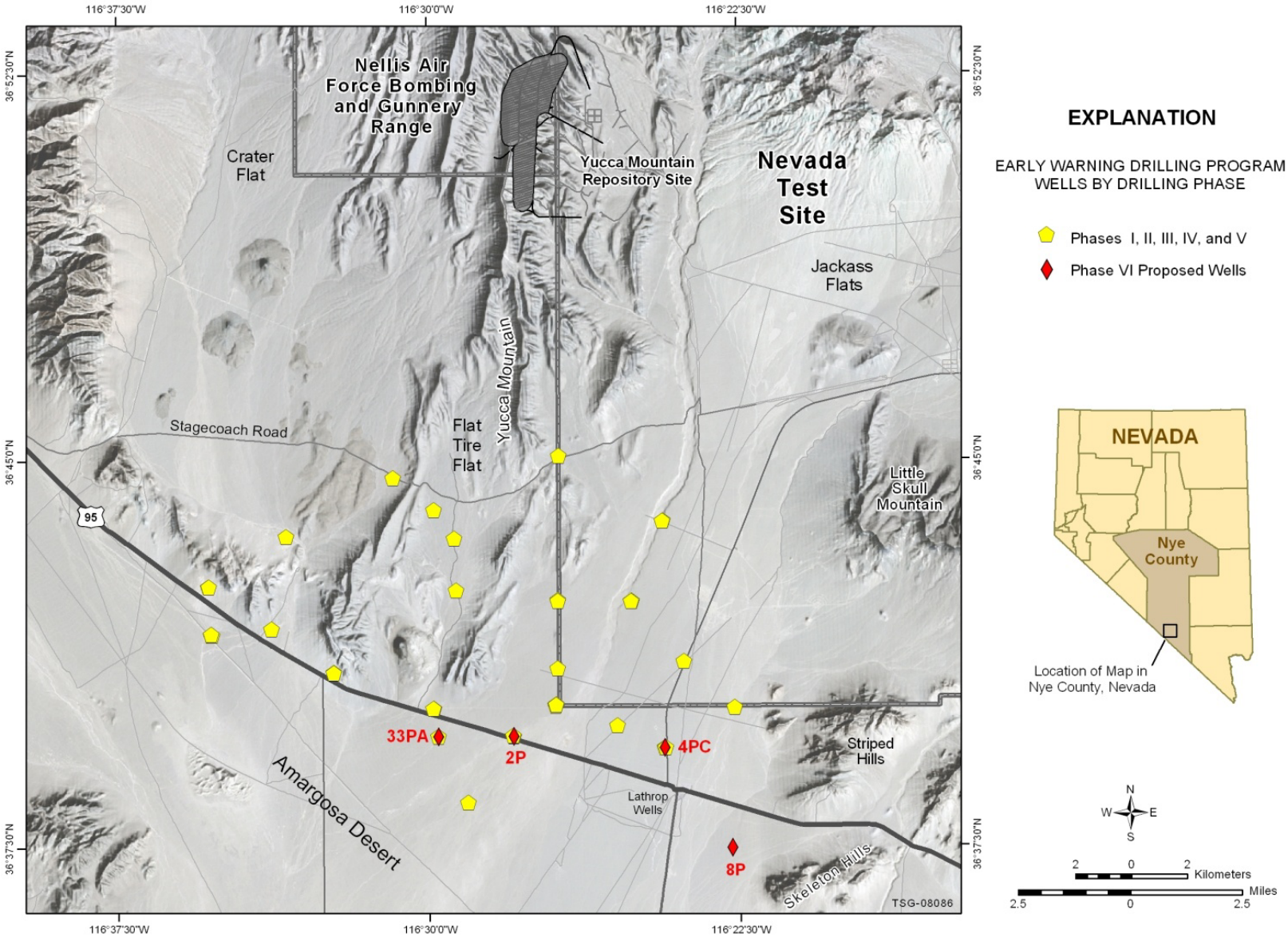


Figure 1
Locations of Proposed Phase VI Wells

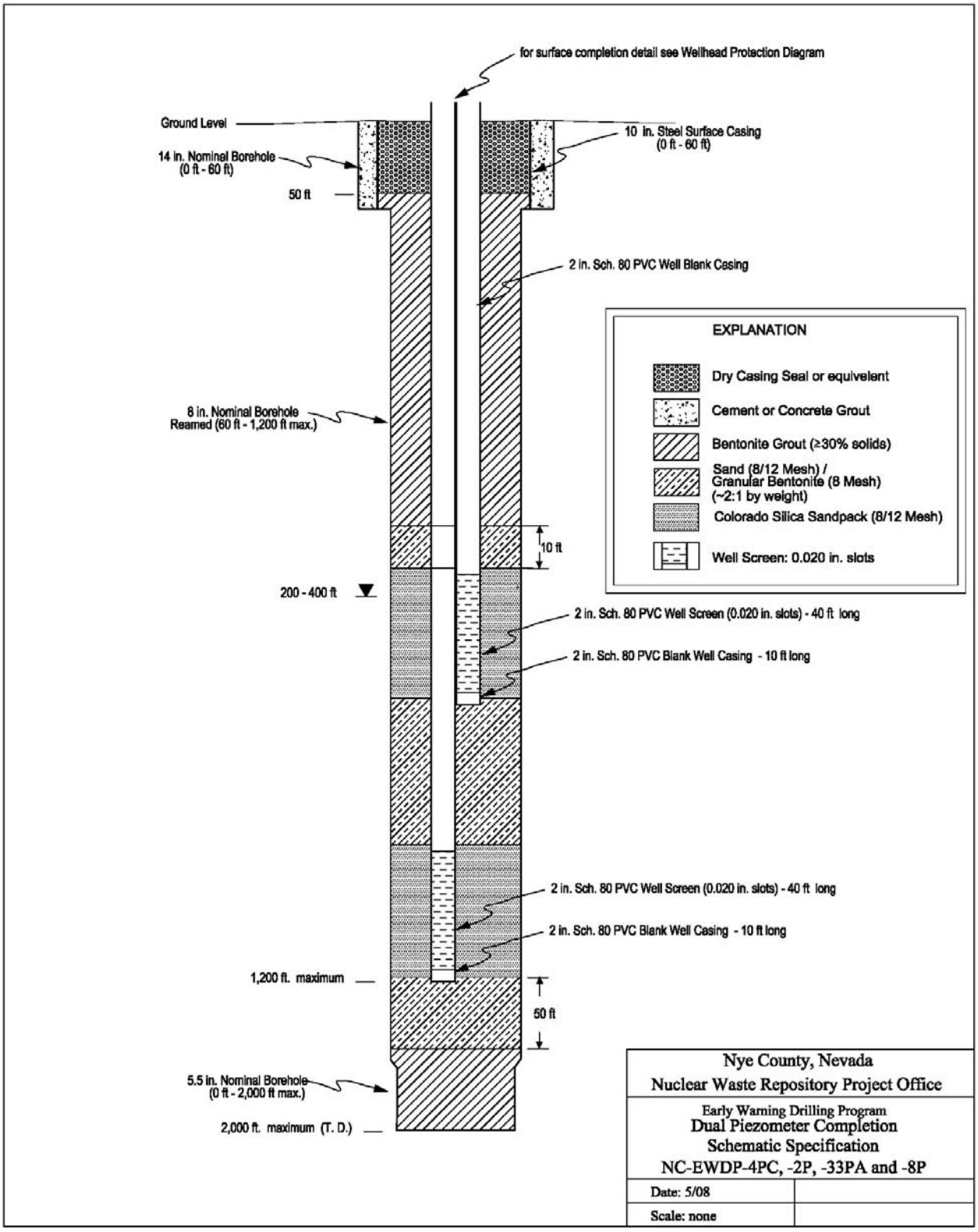
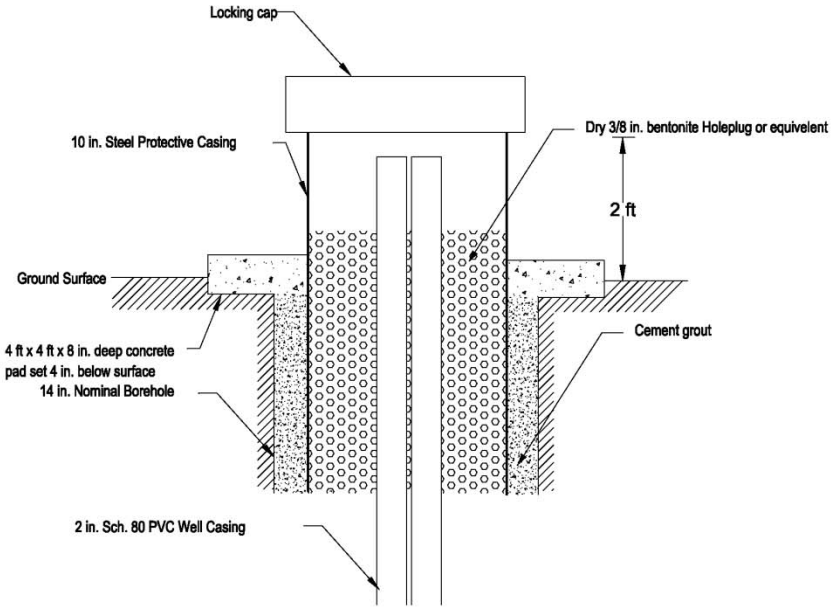


Figure 2
Example Dual-Piezometer Well Completion Diagram for Phase VI Well



Nye County, Nevada Nuclear Waste Repository Project Office
Early Warning Drilling Program Schematic Specification Well Head Protection Detail
Date: 05/08
Scale: none

Figure 3
Example Dual-Piezometer Wellhead Protection Detail Phase VI Well

ATTACHMENT 1

SCOPE OF WORK FOR WELL DRILLING AND CONSTRUCTION OF EWDP PHASE VI WELLS NEAR THE NEVADA TEST SITE

Two required and two optional not-to-exceed 2,000 ft deep boreholes will be drilled at four locations. These exploratory wells will be drilled primarily with open-hole dual-wall reverse-circulation drilling and completed as monitor wells to maximum depths of 1,200 ft.

Drill pads and access roads will be constructed and maintained by the NWRPO.

1.0 Drilling and Completing of Required and Optional Wells (Not to Exceed 2,000 feet)

The locations of these wells are shown in Figure 1. Upon reaching TD these boreholes will be plugged with bentonite grout to a depth approximately 50 ft below the proposed piezometer string (maximum depth of 1,200 ft). A dual-string piezometer with a well screen will then be completed to the ground surface in each borehole. Table 1 summarizes the approximate alluvium thickness, depth to water, maximum borehole depths, and the approximate piezometer screen depth interval for the optional wells.

A well completion diagram for NC-EWDP-4PC, -2P, -33PA, and -8P showing borehole diameter and well completion requirements is shown in Figure 2.

1.1 Background Information

The NWRPO has successfully drilled and completed many primarily air-drilled, open-hole, small diameter exploratory boreholes up to depths of 2,900 ft (e.g., NC-EWDP-16P). The method has used 4.5- and 5.5-inch dual-wall reverse-circulation pipe and mostly center-return tricone bits. The drilling method minimizes drilling additives and water injection during borehole advancement. Unsaturated zone borehole conditioning is used with conventional circulation prior to advancing dry. No saturated zone conditioning beyond water injection was needed. In difficult drilling conditions or at TD, borehole advancement is stopped, the deep saturated portion of the borehole is plugged back with grout, and a single or dual 2-inch PVC piezometer well is constructed.

1.2 Drilling and Sampling

1.2.1 Drill approximately 5.5-inch diameter boreholes to maximum depths of 2,000 ft below ground surface (bgs) with an approximately 4.5-inch diameter dual-wall reverse-circulation drill system using air as the primary drilling fluid. Small amounts of water may be injected with the air circulation to cool the rotary bit and stabilize the unsaturated formation.

1.2.2 After drilling and sampling to a depth of approximately 60 ft bgs in alluvium, or to a depth of at least 10 ft into competent bedrock (whichever is reached first), ream the borehole to approximately 14-inches in diameter, and install an approximately 8- to 10-inch diameter surface casing with concrete grout in the

annular space. Alternatively, the borehole can be drilled and cased with dual-rotary method, by advancing a 12- to 16-inch casing system to 60 ft and installing an 8- to 10-inch surface casing, later to be grouted during the removal of the larger casing during surface completion.

1.2.3 Collect geologic samples (drill cutting samples) at 5-ft intervals using a rotating Anaconda wet splitter attached to a cyclone separator.

1.2.4 Condition/stabilize (with NWRPO approval) intervals of borehole wall in the unsaturated zone that are unstable and/or are responsible for lost circulation by injecting bentonite mud into the annular space between the drill pipe and the formation wall using conventional circulation methods. Excess bentonite mud that has been added during borehole conditioning must be removed from the borehole by conventional circulation prior to advancing the borehole deeper into undrilled formation. Lost circulation zones in the open borehole can be addressed with bentonite mud and/or lost circulation materials only with prior NWRPO approval. However, if for any reason unstable borehole conditions and/or lost circulation conditions cannot be rapidly, easily, and safely overcome, borehole drilling will be stopped immediately. In short, when drilling becomes difficult, the drilling may be terminated at any point starting from a depth of approximately 1,200 ft.

1.2.5 Upon reaching TD, remove the drill string from the borehole to permit open borehole geophysical logging by another Nye County contractor.

1.2.6 Run in a 4-inch O.D. steel casing to TD to allow logging with radioactive source geophysical logging tools.

1.2.7 Remove 4-inch O.D. steel casing following geophysical logging.

1.3 Subsurface Completion

A typical dual string piezometer subsurface well completion diagram is presented in Figure 2. Depths for the well screens and sandpacks will be determined from geologic and geophysical logging data. The depths of the 2-inch schedule 80 PVC casings will not exceed 1,200 ft. Note that target depths for all completion materials (including well casing/screen, sand pack and grout seals) must be achieved within several feet. Thus, the completion process must be conducted with extreme care, including frequent tagging (i.e., measurement) of completion material depths. All materials will be emplaced with pump/tremmie line methods and at no time should the open end of the tremmie be more than 30 ft above the completion material level of the well. The tagging instrument will be supplied by the NWRPO and will include a small diameter (light weight) wire, a comparatively heavy tagging bar, and an accurate depth counting meter. Subsurface completion procedures are briefly described below.

1.3.1 Run a steel tremmie pipe (e.g., 1.5-inch ID) to near the bottom of the borehole.

1.3.2 Pump high-solids (30% by weight) bentonite grout slurry through the tremmie into the borehole in stages using a “bottom up” approach to a depth of

approximately 50 ft below the bottom of the proposed piezometer casing. Move the tremmie upward in the borehole after each stage.

1.3.3 After several of these grouting stages, pump a 2:1 by weight mixture of silica sand (8/12 mesh) and granular (8 mesh) bentonite (Baroid Benseal) through the tremmie using a suitable centrifugal pump to create an approximately 10-ft thick interval of solid material that can be easily "tagged" with a tag line to accurately determine its depth from ground surface. The addition of the sand/Benseal mixture is accomplished by pumping clean water down the tremmie and adding the dry sand/Benseal mixture to the water stream on the suction side of the pump.

1.3.4 Pump in additional approximately 10-ft intervals of solid sand/bentonite mixture as needed to accurately determine the depth of the high-solids bentonite grout while sealing the borehole from the total depth to approximately 50 ft below the bottom of the proposed lower piezometer. Remove tremmie line.

1.3.5 Ream upper section of 5.5-inch borehole to 7.825-inches with an approximately 4.5-inch diameter dual-wall reverse-circulation drill system using air as the primary drilling fluid. Small amounts of water may be injected with the air circulation to cool the rotary bit and stabilize the unsaturated formation. Ream to the top of the bentonite grout installed earlier. Re-install tremmie line to approximately 10 feet above reamed depth.

1.3.6 Follow this by running the 2-inch Schedule 80 PVC piezometer blank casings, well screens, and centralizers to a maximum depth of 1,200 ft. The piezometer strings must be maintained under tension during the remaining completion activities.

1.3.7 Continue pumping sand/Benseal mixture down the tremmie to a depth of 5 ft below the lower piezometer screen.

1.3.8 Emplace the Colorado silica sand pack (8/12 mesh) around the lower piezometer screen using the same method as used for the sand/Benseal mixture. The target depth interval for the sand pack is approximately 5 ft below to 5 ft above the piezometer screen.

1.3.8 Continue pumping sand/Benseal mixture down the tremmie to a depth of 5 ft below the upper piezometer screen.

1.3.9 Emplace the Colorado silica sand pack (8/12 mesh) around the upper piezometer screen using the same method as used for the sand/Benseal mixture. The target depth interval for the sand pack is approximately 5 ft below to 5 ft above the piezometer screen.

1.3.10 Following the emplacement of the sand pack, pump another approximately 40-ft interval of the sand/bentonite mixture down the tremmie into the borehole.

1.3.11 Then pump high solids (30%) bentonite grout to a depth of approximately 50 ft below ground surface using methods in 1.3.2.

1.3.12 Remove excess water from the conductor pipe, remove the tremmie pipe and continue filling the annular space with dry granular bentonite (Baroid Benseal, HolePlug Fine or equivalent).

1.4 Surface Completion

A typical piezometer surface completion diagram is presented in Figure 3. Surface completion procedures are briefly described below.

1.4.1 Weld on an above ground extension to the approximately 10-inch diameter surface casing. The surface casing should extend approximately 2 ft above the ground surface. The 2-inch PVC blank casing should extend slightly below the surface casing. If the surface casing was installed with dual rotary methods, install 40 ft of tremmie line in the annular space between the 16-inch diameter surface casing and the smaller conductor casing. Fill annular space with cement grout. Remove the 16-inch surface casing from the borehole. Add sufficient grout to complete surface seal between the 8-inch conductor casing and the native soils.

1.4.2 Install a locking cap on the surface casing.

1.4.3 Install an approximately 8-inch thick by 4-ft square 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.