

1345

**CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES**  
**TRIP REPORT**

**SUBJECT:** Early Warning Drilling Project (EWDP) Data and Information Exchange Meeting  
(20.01402.871)

**DATE/PLACE:** September 29 1999  
Denver, Colorado

**AUTHOR:** F. Paul Bertetti

**DISTRIBUTION:**

**CNWRA**

W. Patrick  
CNWRA Directors  
CNWRA Element Mgrs

**NRC**

J. Linehan  
D. DeMarco  
B. Stiltenspole  
B. Meehan  
~~L. Greaves~~  
J. Holonich  
W. Reamer  
K. Stablein  
D. Brooks  
N. Coleman  
B. Leslie  
J. Bradbury  
L. Hamden  
J. Ciocco  
B. Dam

**SwRI Contracts**

T. Nagy (Contracts)

NH15  
426.1

Delete all dist  
except:  
Files  
PDR

# **CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES**

## **TRIP REPORT**

**SUBJECT:** Early Warning Drilling Project (EWDP) Data and Information Exchange Meeting  
(20.01402.871)

**DATE/PLACE:** September 29, 1999  
Denver Federal Center  
Denver, Colorado

**AUTHOR:** F. Paul Bertetti

### **PERSONS PRESENT:**

Representatives of Nye County, United States Geological Survey (USGS); U.S. Department of Energy (DOE); Nuclear Regulatory Commission (NRC); Center for Nuclear Waste Regulatory Analyses (CNWRA); and various subcontractors involved in the EWDP (see attachments).

### **BACKGROUND AND PURPOSE OF TRIP:**

The EWDP was initiated as part of the Nye County Nuclear Waste Repository Project Office Yucca Mountain (YM) Oversight program and is funded by DOE. The stated purpose of the EWDP is to protect the residents of Nye County against radionuclide contamination, but the program is also becoming instrumental in obtaining critical data regarding the hydrology, stratigraphy, geology, and geochemistry of the saturated zone (SZ) along the expected flow path from the proposed repository.

The EWDP program, which began in earnest during the winter of 1998–1999, with the drilling and construction of eight wells and boreholes, has already provided useful data. For instance, observed water table elevations in wells immediately south of Crater Flat were higher than expected based on previously existing well data, and geochemical results from water sampling during well construction have indicated distinct differences among wells.

During drilling, cuttings as well as first water samples were obtained from each well. A few wells underwent pump tests upon completion, and composite water samples were obtained for geochemical analyses. Three of the wells were subsequently outfitted with screens and sampling systems that provided isolation of different water producing horizons in those wells. In May of 1999, the EWDP wells were again sampled for geochemistry. Several organizations, including staff from CNWRA, participated in the May sampling event (Bertetti, 1999).

This meeting was organized by the United States Geological Survey (USGS) and Nye County in an effort to facilitate the exchange of hydrologic and geochemical data collected from sampling of the EWDP wells and as a result of comments by the Nuclear Waste Technical Review Board that encouraged continued cooperation and exchange of information gathered from the EWDP. Staff from CNWRA and NRC participated in this meeting to share preliminary results of geochemical data from samples collected in May 1999 (see attachments) and to learn about plans for the upcoming EWDP well construction.

## **SUMMARY OF PERTINENT POINTS:**

The meeting was well attended and was conducted in an informal manner. Presentations were made by representatives from several organizations, but each attended on behalf of Nye County or the USGS (see attachments). The meeting was conducted in an open and cooperative manner, in keeping with the cooperative nature of participants in the program to date. Unfortunately, much of the geochemical data from the May sampling event was still unavailable at the time of the meeting. However, there were some generalizations that could be made from preliminary results and data collected during well construction. First, there appears to be a distinct difference between water collected from two wells (1S and 1D) relative to the other EWDP wells. Essentially the difference is that the 1S/1D wells have more in common with Crater Flat water, while the other wells are chemically similar to J12/J13 water. This fact is made a little more interesting considering the close proximity of wells 1S and 9S. Second, based on analyses of well cuttings, the deep boreholes penetrate an older part of the volcanic section and do not intersect rocks of the Paintbrush Tuff. Third, a gamma peak observed during geophysical logging of well 3D is associated with an elevated concentration of U. The gamma peak and associated increased U concentration is also observed in the same stratigraphic horizon below YM.

Plans for new EWDP construction and additional water sampling of existing wells were also discussed. A new drilling rig will provide the means to drill to depths of 6,000 ft in attempts to reach the Paleozoic carbonate rocks in the deep drill holes.

## **SUMMARY OF ACTIVITIES:**

Following a brief introduction by Zell Peterman (USGS) and Nick Stellavato (Nye County), Rick Spengler (USGS) began the meeting with a review of USGS studies of the well cuttings and geophysical logs from the EDWP boreholes. The primary purpose of the USGS study is to identify volcanic lithostratigraphic units and describe the stratigraphy of the wells/boreholes. The general approach is to identify marker beds; use borehole geophysics, well cuttings, and thin sections from those cuttings to identify pyroclastic flow deposits; identify stratigraphic units; and then to generate a stratigraphic cross section. Cuttings from all the EWDP wells are being studied, but Spengler's presentation focused on observations from wells 1D and 3D.

After briefly reviewing the diagnostic characteristics of older tuff units (specifically the Tram Tuff, Lithic Ridge Tuff, and Rhyolite of Picture Rock), Spengler described identification of those units in boreholes 1D and 3D. In the vicinity of 1D and 3D, rocks of Paintbrush Tuff do not appear to extend across highway US95 to the south. In general, evidence showed that the wells intersected the lower part of the Tertiary volcanic section, the Tram Member of the Crater Flat Tuff, the Lithic Ridge Tuff, and the Rhyolite of Picture Rock (equivalent to Unit C of boreholes G1 and G2). Each unit was separated by sedimentary deposits of varying thickness. Well 3D showed the thickest and most complete succession of the older volcanic units. Neither 1D or 3D, both of which bottomed out at 2,500 ft, penetrated any Paleozoic carbonate rocks. A gamma peak observed during geophysical logging of 3D occurs near the base of the Tram Tuff. A similar peak also occurs in H4 and G1 in a similar stratigraphic horizon. The gamma peak was tied to occurrences of pyrite [and uranium (U) as noted later by Maury Morgenstein]. Spengler felt it was important to note that occurrence of pyrite is noted as characteristic of both the Tram and Lithic Ridge tuffs. The youngest pyroclastic deposit identified was the Rainier Mesa Tuff, found in 1D overlying 70 ft of fault gouge (close to the Bear Mountain fault trend). The oldest flow encountered in wells 1D and 3D was the Rhyolite of Picture Rock. Spengler reported that Tertiary sedimentary rocks between the pyroclastic deposits are 13.31–14.14 Ma, while those at bottom of borehole may be 15 to 20 Ma. Spengler described pyroclastic flow deposits as non to partially

welded and slightly to completely zeolitized, and noted that each hole exhibited a combination of flow deposits, fall deposits with siltstone and claystone, or sediments with no fall deposits. However, identification and correlation of specific units is difficult because of a lack of structural information. Future plans include (i) continuation of studies of well cuttings from existing holes, (ii) updating and merging petrographic databases, (iii) acquiring magnetic and TV logs (a Tram Unit characteristic is its reverse polarity) for the new EWDP wells, and (iv) processing and analyzing cuttings and samples from existing northern Amargosa Valley holes (US Borax) to correlate across the valley.

Maury Morgenstein (GMII/Nye County) presented Nye County results of mineralogical studies of the borehole cuttings. He specifically focused on studies of cuttings from 3D and, in particular, cuttings from the zone in which the gamma spike was observed during geophysical logging. Morgenstein has used standard petrographic techniques as well as SEM-EDX and neutron activation analyses in his work so far. He confirmed a change in lithology based on magnetic susceptibility and the gamma peak near the 500 ft level. The lithology change corresponds to the base of Tram Unit and the top of underlying sedimentary rocks. Neutron activation showed elevated levels of U, Hg, and Mo, but not Th or As. Morgenstein identified the U phase as a U silicate (coffinite) with associated pyrite. The U mineralized zone also contains an interesting mineralogy of disseminated oxides and metal silicates with some Cu and Zn silicate/oxides. The system now appears to be oxidizing with alteration of pyrite to Fe-oxides and oxyhydroxides. Morgenstein noted that Cs is correlated to the presence of zeolites, which consist essentially of clinoptilolite altered to analcime. He suggested that calcites appear to be soil carbonates contained in sedimentary rocks. As a preliminary hypothesis, Morgenstein proposed that the U horizon was formed by local chemical reduction at low temperatures, following deposition of the Tram Unit and formation and subsequent alteration of clinoptilolite, but before current oxidizing and weathering conditions were established. He indicated that there was no evidence for U deposition/sorption in the zeolite. During the question period following his presentation, it was suggested that an alternate hypothesis for the U deposition might be fumarolic activity that occurred shortly after deposition of the Tram Tuff. Support for the fumarolic argument included a general lack of sulfide minerals, a lack of distinct recognized mineral phases on either side of the roll front, and identification of unusual minerals (metal silicates/oxides) sometimes associated with fumarolic activity. Morgenstein also discussed future Nye County activities, which include continued study of the entire suite of 1D and 3D cuttings, investigations of S isotopes to gather temperature data, and addition of TEM and electron microprobe methods to develop more detailed chemical composition data for some mineral phases.

Don Shettel (GMII/Nye County) briefly reviewed Nye County hydrochemistry results from EWDP sampling. The Nye County geochemical analysis program is quite ambitious and includes standard and trace element chemistry, stable isotope analyses (H, O, N, S and C), gross  $\alpha/\beta$  radioactivity and  $^3\text{H}$ ,  $^{36}\text{Cl}$ , and radioactive isotope analyses and dating (U/Pb and Sr). Unfortunately, Nye County had received the majority of its hydrochemistry results only two days prior to the meeting. As a result, Shettel focused primarily on information gathered from water sampling during well construction in late 1998 and early 1999. He noted that, as expected, there were compositional differences in bailed water (first water) and the composite samples obtained during well pump tests. He also showed that  $\text{F}^-$  concentrations in sampled waters indicate a transport path southward along Fortymile Wash. Shettel also proposed that Sr concentration and  $^{87}\text{Sr}/^{86}\text{Sr}$  data indicates isolation of water between 1S/1D and 9S/3S. Shettel proposed a possible structural control for the isolation of water, and noted that the composition of 1S/1D water suggested upwelling of water from carbonate aquifer.

Klaus Stetzenbach (UNLV) discussed preliminary results from UNLV sampling during the May 1999 sampling event. Based on an analysis of results for major cations, Stetzenbach noted that wells 1S and 1D

were different in composition the other sampled EWDP wells. Using several comparison diagrams, 1S and 1D consistently plotted in a field defined by chemistry similar to Crater Flat wells such as VH-1, whereas the other EWDP wells (9S, 3S, etc.) showed trends similar to J12/J13 waters. Stetzenbach noted that trace element analyses were not yet finished, and he expected that the trace element data would provide better and more detailed information regarding potential sources for water sampled in the EWDP wells.

Tom Buqo (Nye County) led a discussion regarding Nye County information needs and plans to address those needs. He commented on the apparent compartmentalization of groundwater and compared a variety of groundwater flow maps for the region. Buqo presented various estimations of the groundwater "budget" as given by different sources. He also noted the differences between delineated groundwater flow paths into and out of Amargosa Valley. Buqo made a call for information that would aid in resolving several issues. One, Nye County needs an accurate and defensible estimate of the groundwater flow balance for Amargosa Valley. The county's economic development plans will be greatly impacted by this estimate, and local governments would like to be able to generate and use this critical information. Two, Nye County would like to resolve the apparent steep potentiometric gradient across US95 from 1S/1D southward to Rose's Well (site of 12D). Buqo suggested influences of permeability differences or faults, such as the Carrara Fault, in generating the disparity in observed water levels. Three, Buqo stressed the importance of better understanding of transport within Fortymile Wash and the alluvium. He added that the complex stratigraphy combined with the complex structure required better flow models. Buqo especially noted the recent work of Ferrill et al. at CNWRA, which he termed "outstanding". And four, Buqo called for use of hydrochemical modeling to assist in the determination of outflow and source waters for discharge areas in the region

Jamie Walker (Nye County) discussed plans for EWDP well construction during fiscal year 2000. This construction, which will likely begin in November 1999, will include four new deep wells and six new shallow wells (see attachments for summary). Additionally, two existing wells, 2D and 3D, will be reworked. Well 3D will be deepened, while well 2D will be reworked and undergo deep completion for possible use as a deep test well. A new drill rig will be able to drill to depths of 6,000 ft. Nye County specifically arranged for this in an effort to locate and identify the upper surface of the Paleozoic carbonate rocks in the deep EWDP wells. Specifications for shallow, deep and test well completion are provided in attachments to this report. Changes of note to the planned drilling program are the relocation of well 19D to a point approximately one mile north of the original planned site (just outside the NTS western boundary), a change to make 12D (formerly 12S) into a deep test well, change to make 4S a piezometer completion (formerly 4D), and the siting of wells 22S and 23S, both of which were added this year.

Pat Tucci (USGS) talked about changes to the potentiometric surface map as a result of the EWDP. He presented a revised potentiometric surface map that incorporated water level measurements from EWDP wells. The additional data had a net effect of further flattening the hydraulic gradient in the south end of Crater Flat. Tucci mentioned that the precise location of contours was still subject to interpretation and that additional data gathered this year would help to reduce uncertainties.

Tara Root, a student from the University of Wisconsin, described her thesis research, which involves an analysis of available geochemical data in an effort to determine possible source waters for the Franklin Lake Playa. She has been working with USGS personnel to use (and perform testing on the accuracy and working condition of) the integrated hydrochemical database.

Gary Patterson (USGS) informed the group that no USGS data from the May sampling event was available because internal QA requirements had not been satisfied in time for the meeting. As a result, the samples taken in May had only recently been submitted for analysis. Patterson expected results within about six weeks (mid-November). Patterson also reported that USGS had worked with Nye County and DOE to identify possible locations for EWDP wells west of the YM-Fortymile Wash trend.

Jim Paces (USGS) briefly reviewed results of USGS isotope hydrology studies. The review focused on results from first water and pump test samples (winter and early spring of 1999) as the May samples had not yet been analyzed. Paces indicated that the  $^{234}\text{U}/^{238}\text{U}$  anomaly observed under YM was not yet evident in groundwater further south. He also suggested that the results of  $^{234}\text{U}/^{238}\text{U}$  versus  $^{230}\text{Th}/^{238}\text{U}$  analyses also indicate a separate source for 1S and 9S spring mineral deposits. Paces also noted that Sr concentration data provide some distinction between 1S/1D and 9S, with 1D exhibiting the highest Sr values. However,  $\delta^{87}\text{Sr}$  values are similar between all three wells. Thus, the isotopic dissimilarity between 1S/1D and 9S based on  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios and  $\delta^{87}\text{Sr}$  will require further study.

To conclude the presentations, Tom Oliver (USGS) previewed the USGS integrated hydrochemical database for YM and vicinity. The database is accessible through ArcView software and enables a variety of search and analysis routines. The data include contributions from Perfect et al. (1995) and has been thoroughly reviewed for data errors. For instance, Oliver noted that some K data taken from Hunt (1966) (data source 20 in Perfect et al.) and included in Perfect et al. was incorrect; a combination of conversion and data entry errors resulted in values for Na to be entered again as values for K in the Perfect et al. spreadsheet. These errors and others have been corrected in the new integrated database. Oliver did not have an idea as to when the database would be available outside of the USGS development group, although he did indicate that current plans were to eventually release the database as an open file report. The database, which currently exists as a beta version, will be updated with newly acquired hydrochemical and isotopic data, and will also be tied into the IT-GeoTrans database.

## CONCLUSIONS:

The high level of participation and cooperative environment evident at the meeting typifies the Nye County EWDP to date. The participants recognize the importance of gathering and exchanging data from the EWDP wells, as no other research program is in place to identify and define the geochemical, hydrological, and geological characteristics of the alluvium and volcanic sequences in the SZ. The delays in producing results from the geochemical sampling event in May were discussed. One of the goals of the meeting, to facilitate a timely exchange of data, could not be met because little data had been processed and analyzed. Moreover, because there is no formal mechanism for exchange of collected data, participants remain highly dependent on personal contact and informal exchange to disseminate results. Because of the potential importance of information developed from the EWDP to the repository program, it is critical that Nye County and DOE receive timely feedback. For instance, the next round of sampling for the EWDP wells is scheduled for November 1999, but without data from the previous sampling event in May, there is no means of identifying and avoiding potential sampling problems or focusing on specific horizons that may be of interest to investigators. Additionally, Nye County and DOE could use results from sampling to better locate possible drilling sites. Nick Stellavato, lead geotechnical representative for Nye County, offered to take a more proactive role in ensuring that Nye County results are made available. It was suggested that other participants make an effort to do the same for their results.

Even without a majority of results from the May geochemical sampling event, the EWDP is providing data regarding the hydrology and stratigraphy of the SZ south of YM. This information will continue to contribute to the development of a more robust conceptual model of transport in the SZ.

**PROBLEMS ENCOUNTERED:**

None

**PENDING ACTIONS:**

None

**RECOMMENDATIONS:**

Because of the variations in sampling conditions and personnel involved in collection, it is a good practice to periodically monitor sampling activities at EWDP wells. Monitoring a portion of the sampling event requires a relatively small investment in time, but reaps important benefits such as QA reconnaissance and first hand knowledge of activities and practices during sampling. Also, because of the nature of sampling at the EWDP, it is reasonable and efficient to collect water samples for independent analyses. These independent samples have the benefit of providing quality assured data to NRC/CNWRA in a timely fashion, that can be used to test DOE or Nye County analytical results in a confirmatory exercise. And importantly, because of the nature of the data collected from EWDP wells, it is critical to maintain a clear and open line of communication with participants in this program. This allows NRC/CNWRA the ability to be prepared and responsive to new developments in a timely fashion. Therefore, it is recommended that NRC/CNWRA staff continue to be active in the EWDP, both as part of the periodic sampling program and as part of participant meetings.

**REFERENCE CITED:**

Bertetti, F.P. *Early Warning Drilling Project (EWDP) Data and Information Exchange Meeting*. CNWRA Trip Report (20.01402.871). San Antonio, TX: Center for Nuclear Waste Regulatory Analyses. 1999.

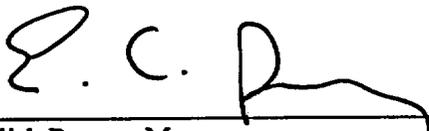
Perfect, D.L., C.C. Faunt, W.C. Steinkampf, and A.K. Turner. 1995. *Hydrochemical Data Base for the Death Valley Region, California and Nevada*. USGS Open-File Report 94-305. Denver, CO: U.S. Geological Survey.

**SIGNATURES:**

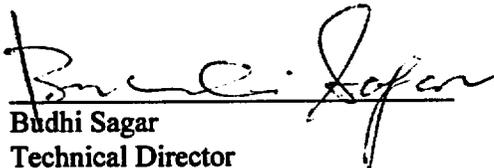
  
\_\_\_\_\_  
Paul Bertetti  
Research Scientist

10/30/99  
Date

**CONCURRENCE:**

  
\_\_\_\_\_  
English Percy, Manager  
Geohydrology and Geochemistry Element

10/26/99  
Date

  
\_\_\_\_\_  
Budhi Sagar  
Technical Director

10/26/99  
Date

**ATTACHMENTS**

**Nye County/USGS Technical Exchange  
Breckenridge Room, Bldg. 53, Denver Federal Center  
September 29, 1999**

- 8:00 Introduction and adjustments to agenda (Nick Stellavato and Zell Peterman)**
- 8:15 Status of lithologic logging and implications (Rick Spengler)**
- 9:00 Mineralogy of NC-EWDP-3D and 1D (Maury Morgenstein)**
- 9:30 EWDP hydrochemistry - preliminary results (Don Shettel)**
- 10:00 10:15 Break**
- 10:15 EWDP hydrochemistry - UNLV results (Klaus Stetzenbach)**
- 10:45 Hydrochemical Data and Analyses - Nye County Information Needs (Tom Buqo)**
- 11:15 Implications of Nye County water level data to regional potentiometric surface (Claudia Faunt)**
- 11:30 Lunch**
- 12:30 Hydrochemical study of lower Amargosa—Franklin Lake Playa system (Tara Root)**
- 1:00 Update on USGS Hydrochemistry studies (Gary Patterson)**
- 2:00 Update on USGS Isotope Hydrology studies (James Paces)**
- 2:30 Break**
- 2:45 Demonstration of USGS integrated hydrochemical/isotope data base (Tom Oliver)**
- 3:15 Wrapup and where do we go from here.**

# NATIONAL TRAINING CENTER

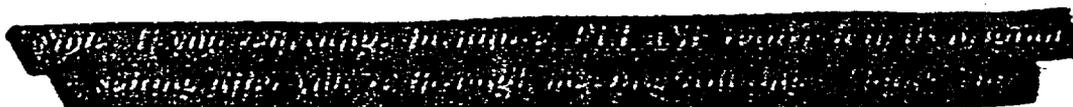
## Training Room Reservation Sheet

Room: Brockenridge  
 Date(s) 9/29/99 Time: 9.00 To 5.00  
 Sponsoring Agency or Division: Yucca Mtn  
 Contact Name: Zel Peterman Telephone Number: 6-7863

**Please sign the roster or give a group attendance number.**

**It's very important that the NTC secures this info.**

**If you need a copy of the roster, please request. Return to Room D-2302 or E-2306.**



Please Specify: Brown Bag  Meeting  Other  Tele Conf.  Training  Video Conf.

NAME	AGENCY / DIVISION
1. ZELL PETERMAN	USGS / YMP13 / K5T
2. TOM OLIVER	USGS / PWT
3. MFahy	USGS - YMP
4. Gary Patterson	USGS - YMP
5. Tara Root	University of Wisconsin
6. Pat Tucci	USGS YMP
7. JIM McDERMICK	NYE CO.
8. Scott Stinson	Nye Co.
9. Jim Paces	USGS - YMP
10. Bill DAM	U.S. Nuclear Regulatory Commission
11. PAUL BERTETTI	Center for Nuclear Waste Reg. Analyses / NRC
12. LINDA LEHMAN	STATE OF NEVADA
13. Perry Montezzy	Nye County
14. DAVE COX	NYE CO.
15. Tom Budo	Nye Co.
16. JAMIE WALKER	Nye Co.
17. NICK STELLAUSTU	Nye Co

18.	RON LINDEN	MTS / GOLDER ASSOC.
19.	JERI SULLIVAN	LANL
20.	LES BRADSHAW	NYE
21.	AL EDDABOUBH	M&O/NEPO
22.	Russell Patterson	DOE/OPE
23.	Claire Muirhead	Nye Co.
24.	Klaus Helgenbach	HRC/UNLV
25.	Rick Snyder	USGS / WFD
26.	Don Shettel	G.M.II / Nye Co.
27.	SUSAN ZIMMERMAN	Agency for Nuclear Projects - Nevada
28.	MAURY MORGENSTEIN	G.M.II / NYE Co.
29.	Richard R Parizek	NWTRB.
30.	E. J. TIESSENHAUSEN	CLARK COUNTY
31.	Michael King	The Hydrodynamics Group for Inyo Co.
32.	John S. Stuckless	USGS / YMP
33.	Esra L. Wasson	M&O / NEPO / TCO
34.		
35.		
36.		
37.		
38.		
39.		
40.		
41.		
42.		
43.		
44.		
45.		
46.		
47.		

**Summary of geochemical data from EWDP sampling on May 17 and 18  
CNWRA – San Antonio, TX**

Well (screen interval)	1S – (160-180)	1S – (210-270)	9S – (330-340)
Approximate sample depth (ft)	170	250	335
Temperature (°C)	25.8	28.6	28.5
pH	7.33	7.40	8.03
Eh (mV)	310	208	245
Conductivity (µS)	828	836	489
Turbidity (NTU)	6.8	7.8	2.4
Alkalinity (mg/L as CaCO <sub>3</sub> )	256	274	158

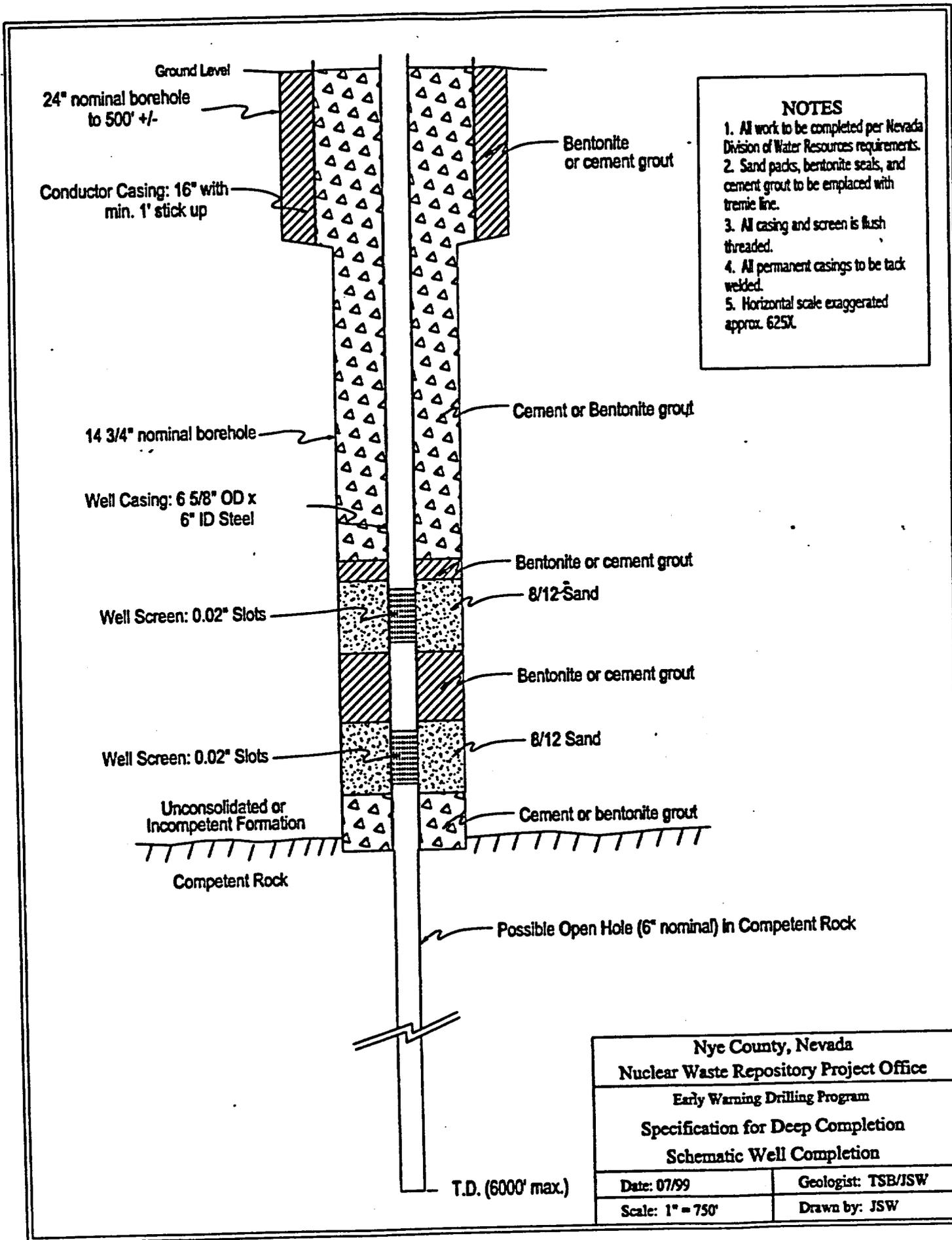
Well	1S – (160-180)			1S – (210-270)			9S – (330-340)		
	sample	FA	UF	UFUA	FA	UF	UFUA	FA	UF
Element	(mg/L)			(mg/L)			(mg/L)		
Al	<0.05			<0.05			<0.05		
Sb	<0.005			<0.005			<0.005		
As	<0.01			<0.01			0.011		
Ba	0.042			0.035			<0.005		
Be	<0.005			<0.005			<0.005		
B	0.233			0.231			0.195		
Cd	<0.005			<0.005			<0.005		
Ca	61.0			60.8			20.0		
Cr	<0.005			<0.005			<0.005		
Co	<0.005			<0.005			<0.005		
Cu	<0.005			<0.005			<0.005		
Fe	<0.05	0.466	0.079	<0.05	2.04	0.267	<0.05	0.176	<0.05
Pb	<0.005			<0.005			<0.005		
Li	0.074			0.073			0.080		
Mg	32.2			32.4			7.81		
Mn	0.027			0.053			0.006		
Mo	<0.005			<0.005			<0.005		
Ni	<0.005			<0.005			<0.005		
P	<0.02			<0.02			<0.02		
K	10.8			10.7			4.32		
Se	<0.005	<0.005	0.023	<0.005	<0.005	0.021	<0.005	<0.005	0.013
Si	26.3			25.6			23.9		
Ag	<0.005			<0.005			<0.005		
Na	75.6			74.3			77.2		
Sr	0.644			0.629			0.162		
S	47.7			46.9			21.5		
Sn	<0.005	<0.005	0.029	<0.005	0.005	0.030	<0.005	<0.005	0.017
V	<0.005			<0.005			<0.005		
Zn	0.029			0.013			0.096		
U	<0.1			<0.1			<0.1		

Notes: alkalinity – filtered sample (0.45 mm)  
 FA – Sample filtered (0.45 mm) and acidified (HNO<sub>3</sub>)  
 UF – Sample acidified (HNO<sub>3</sub>), not filtered  
 UFUA – Sample not filtered, not acidified  
 Data in UF and UFUA columns entered only when values differ from FA sample.

## Early Warning Drilling Program FY '00 – Planned Program

<u>Designator</u>	<u>Well Completion Type*</u>	<u>General Location</u>	<u>ROW</u>
<b>Four new deep wells</b>			
NC-EWDP-12D	Test Well Completion *	Rose's Well Site; SW of 1D	BLM
NC-EWDP-15D	Deep Completion*	South of Cinderlite @ Highway 95	BLM
NC-EWDP-19D	Deep Completion*	East of 19D, SW corner of NTS	BLM
NC-EWDP-20D	Deep Completion*	ATC hole on west side of FMW	NTS
<b>Rework two existing wells/holes</b>			
NC-EWDP-2D	Deep Completion* (poss. Test Well)	Highway 95 West of FMW	BLM
NC-EWDP-3D	Deepen*	West of Cinderlite on Highway 95	BLM
<b>Six shallow wells</b>			
NC-EWDP-4S	Piezometer Completion	510 Road – south of gate.	BLM
NC-EWDP-23S	Shallow Completion	510 Road – north of gate	NTS
NC-EWDP-22S	Shallow Completion	East side of FMW	NTS
NC-EWDP-7S	Shallow Completion	Southern Crater Flat, north of 9S	YM
NC-EWDP-10S	Shallow Completion	ATC	NTS
NC-EWDP-11S	Shallow Completion	ATC	NTS

\* depending on method, deep wells may also have proximal piezometer completion



- NOTES**
1. All work to be completed per Nevada Division of Water Resources requirements.
  2. Sand packs, bentonite seals, and cement grout to be emplaced with tremie line.
  3. All casing and screen is flush threaded.
  4. All permanent casings to be tack welded.
  5. Horizontal scale exaggerated approx. 625X.

<b>Nye County, Nevada</b> <b>Nuclear Waste Repository Project Office</b>	
<b>Early Warning Drilling Program</b> <b>Specification for Deep Completion</b> <b>Schematic Well Completion</b>	
Date: 07/99	Geologist: TSB/JSW
Scale: 1" = 750'	Drawn by: JSW

Conductor Casing: 30" with min. 1' stick up  
 Ground Level

36" nominal borehole to 100' minimum.

Well Casing: 16" with min. 1' stick up

24" nominal borehole (depth to be determined)

Casing adaptor

14 3/4" nominal borehole

Well Casing: 6 5/8" OD x 6" ID Steel

Well Screen: 0.02" Slots (optional)

Well Screen: 0.02" Slots (optional)

Unconsolidated or Incompetent Formation

Competent Rock

Possible Open Hole (6" nominal) in Competent Rock

T.D. (6000' max.)

Bentonite or cement grout

Cement or Bentonite grout

8/12" Sand

Bentonite or cement grout

8/12" Sand

Cement or bentonite grout

**NOTES**

1. All work to be completed per Nevada Division of Water Resources requirements.
2. Sand packs, bentonite seals, and cement grout to be emplaced with tremie line.
3. All casing and screen is flush threaded.
4. All permanent casings to be tack welded.
5. Horizontal scale exaggerated approx. 625X.

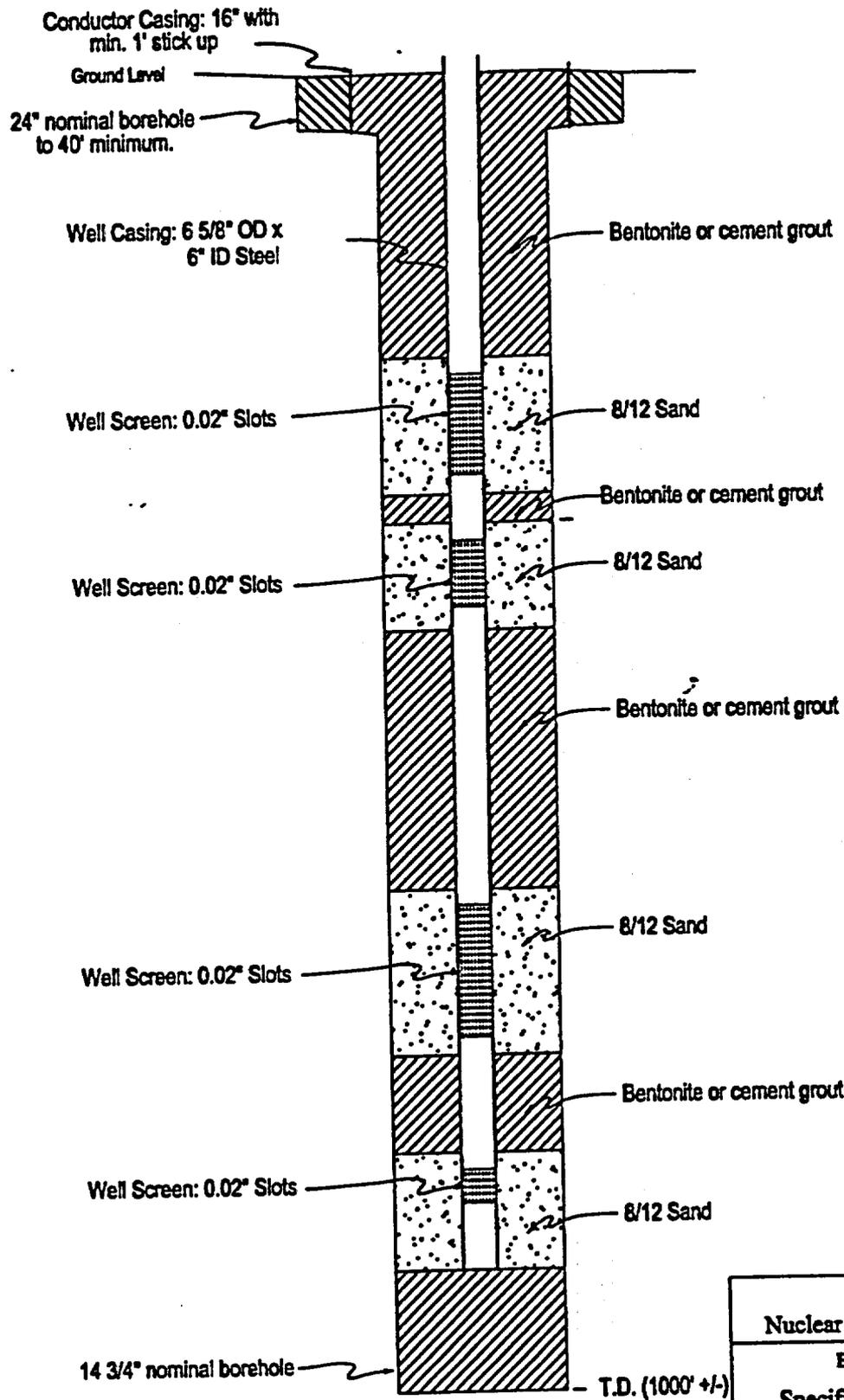
Nye County, Nevada  
 Nuclear Waste Repository Project Office  
 Early Warning Drilling Program  
 Specification for Test Well Completion  
 Schematic Well Completion

Date: 07/99

Geologist: TSB/JSW

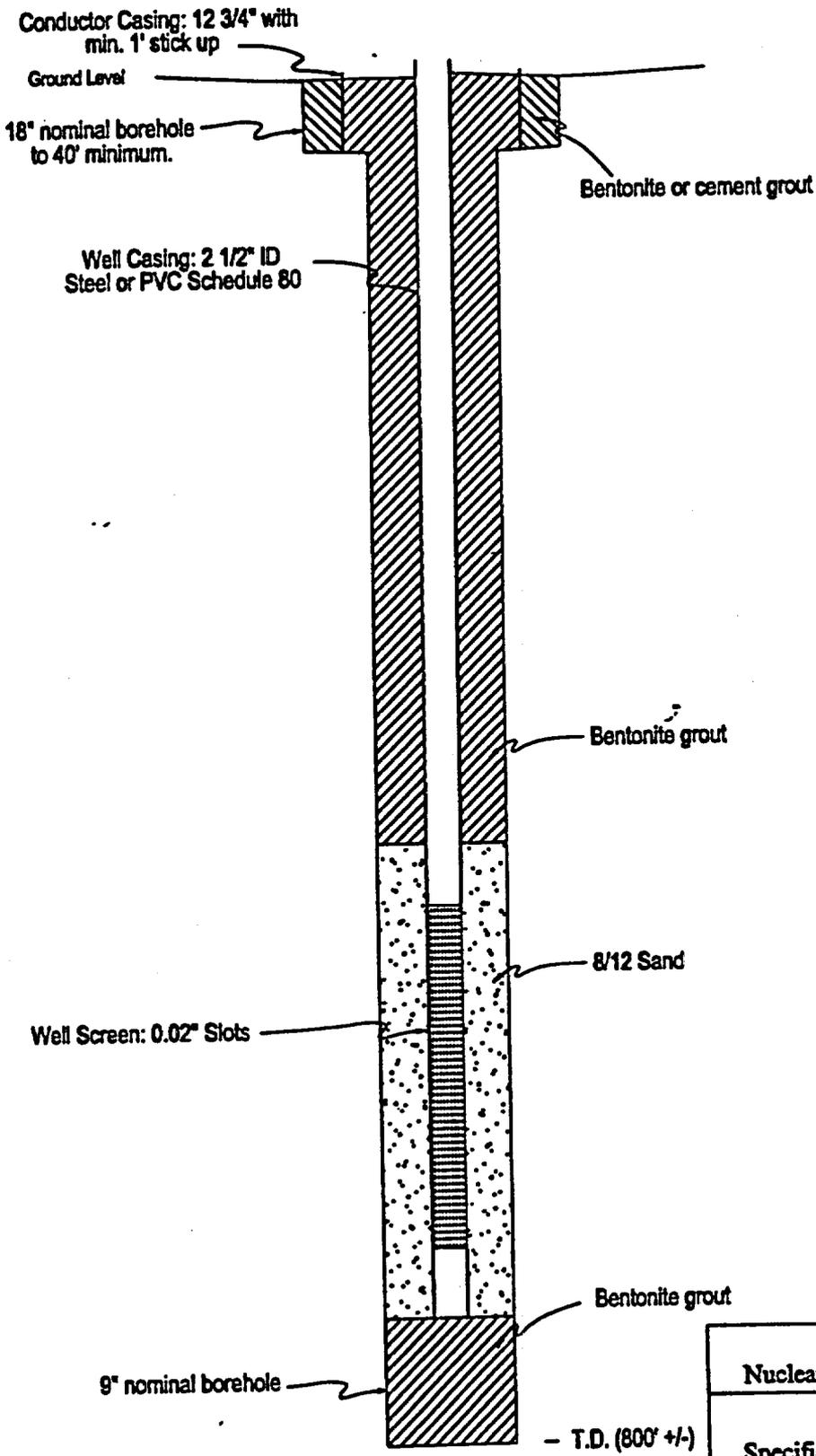
Scale: 1" = 750'

Drawn by: JSW



- NOTES**
1. All work to be completed per Nevada Division of Water Resources requirements.
  2. Sand packs, bentonite seals, and cement grout to be emplaced with tremie line.
  3. All casing and screen is flush threaded.
  4. All permanent casings to be tack welded.
  5. Horizontal scale exaggerated 105X.

<b>Nye County, Nevada</b> <b>Nuclear Waste Repository Project Office</b>	
Early Warning Drilling Program <b>Specification for Shallow Completion</b> <b>Schematic Well Completion</b>	
Date: 07/99	Geologist: TSB/JSW
Scale: 1" = 125'	Drawn by: JSW



- NOTES**
1. All work to be completed per Nevada Division of Water Resources requirements.
  2. Sand packs, bentonite seals, and cement grout to be emplaced with tremie line.
  3. All casing and screen is flush threaded.
  4. All permanent casings to be tack welded.
  5. Bentonite grout must be used on PVC casings.
  6. Horizontal scale exaggerated 100X.

<b>Nye County, Nevada</b> <b>Nuclear Waste Repository Project Office</b> Early Warning Drilling Program <b>Specification for Piezometer Completion</b> <b>Schematic Well Completion</b>	
Date: 07/99	Geologist: TSB/JSW
Scale: 1" = 100'	Drawn by: JSW