DOE/WIPP 02-3223

Basic Data Report For Drillhole C-2811 (Waste Isolation Pilot Plant - WIPP)

Dennis W. Powers
Consulting Geologist
140 Hemley Road
Anthony, TX 79821

Wayne A. Stensrud
Geotechnical Engineering
Washington TRU Solutions, LLC
Carlsbad, NM 88221

June 2003

This page is intentionally blank.

Basic Data Report
For Drillhole C-2811
(Waste Isolation Pilot Plant - WIPP)

Dennis W. Powers
Consulting Geologist
140 Hemley Road
Anthony, TX 79821

and

Wayne A. Stensrud
Geotechnical Engineering
Washington TRU Solutions, LLC
Carlsbad, NM 88221

1.0 Abstract

C-2811 was drilled with air and mist to a total depth of 80.5 ft below the ground level (bgl) to monitor a shallow saturated zone in the uppermost Dewey Lake Formation (Upper Permian-Lower Triassic) near the surface facilities of the Waste Isolation Pilot Plant (WIPP). C-2811 is located in the northeast quarter of section 29, T22S, R31E, in eastern Eddy County, New Mexico. Below surface dune sand and the Berino soil, C-2811 encountered in order the Mescalero caliche, Gatuña Formation, Santa Rosa Formation, and Dewey Lake Formation. Cuttings were collected during drilling to supplement the geological and geophysical data obtained from C-2737 on the same drillpad.

Water was encountered about 60 ft bgl while drilling C-2737, and C-2811 was drilled March 12, 2001, specifically to monitor this zone. Steel outer casing was placed in the hole to 9 ft bgl. PVC tubing (2 inch inside diameter) was placed to 80.5 ft, with perforations from 60–80 ft bgl. The annulus was filled with sand to a depth of 50 ft bgl. Bentonite was placed on top of the upper sand pack to a depth of 15 ft bgl, and the annulus was cemented from 15 ft bgl to the surface. Initial water levels were about 60 ft bgl (~3337 ft amsl); after a slight drop in April, 2001, water levels have generally been rising, although the total change is less than 2 ft (through May, 2003). Water samples taken December 19, 2001, show relatively good water quality, with total dissolved solids of 2630 mg/L. Calcium, magnesium, and sodium, respectively, dominate cations. Chlorides are higher than sulfate. The saturated zone probably connects to a saturated zone under WIPP surface facilities.

Table of Contents

Table of Figures & Tables

In keeping with general practice at the WIPP site, the basic data for C-2811 are reported in the inch-pound or English system; metric equivalents are given in one figure. The following conversion factors for metric equivalents may be useful:

MULTIPLY ENGLISH UNIT	BY	TO OBTAIN METRIC UNIT
foot (ft)	0.3048	meter (m)
inch (in)	25.4	millimeter (mm)
inch (in)	2.54	centimeter (cm)
pounds (lb)	0.4536	kilogram (kg)

This page is intentionally blank.

2.0 Introduction

C-2811 was drilled in the northeast quarter of Section 29, T22S, R31E, in eastern Eddy County, New Mexico (Figure 2-1). It is located 633.3 ft from the east line (fel) and 1522.4 ft from the north line (fnl) of the section (Figure 2-2). C-2811 is located on the west side of the drillpad where C-2737 was drilled (Powers, 2002). C-2811 was drilled and completed specifically to monitor shallow subsurface water encountered in the uppermost Permo-Triassic Dewey Lake Formation in C-2737.

Most drillholes at WIPP have been described after completion to provide an account of the geology, hydrology, or other basic data acquired during drilling and immediate completion of the drillhole. In addition, the basic data report provides an account of the drilling procedures and activities that may be helpful to later interpretations of data or for further work in the drillhole, including test activities and eventual plugging and abandoning activities. The basic data report provides a convenient means of reporting information about permits and other administrative activities necessary to drill the hole.

2.1 Purpose of WIPP

The WIPP is a US Department of Energy facility disposing of transuranic and mixed waste, byproducts of US defense programs, under permits issued respectively by the US Environmental Protection Agency and the New Mexico Environment Department. The WIPP is located about 25 miles east of Carlsbad, New Mexico, in eastern Eddy County (Figure 2-1). Disposal panels are being excavated in the Permian Salado Formation at a depth of about 2150 ft bgl.

2.2 Purpose of C-2811

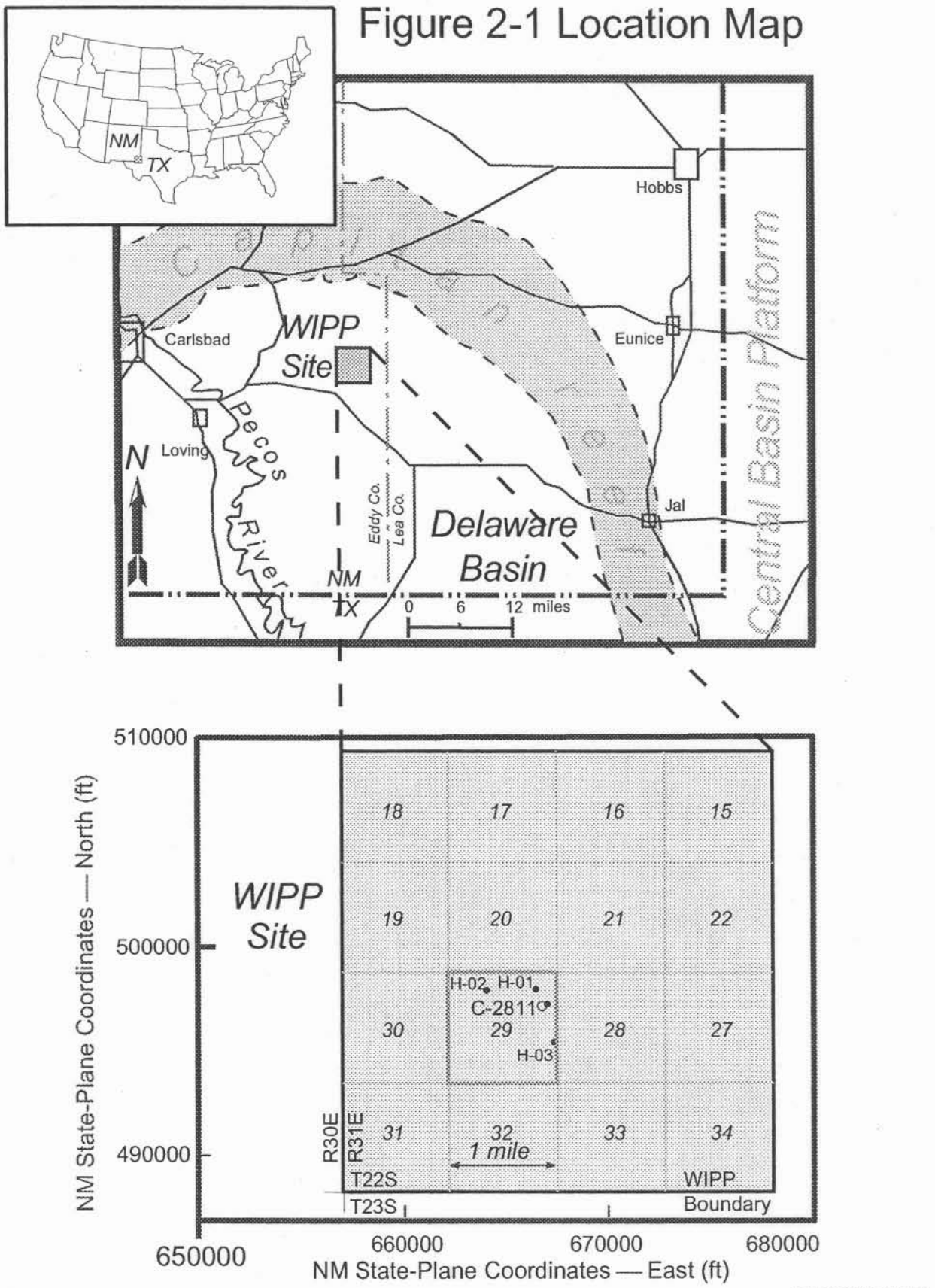
C-2811 was drilled to investigate shallow water encountered in C-2737. Water was estimated to be entering C-2737 at a depth of about 60 ft bgl from a saturated zone in the uppermost Dewey Lake (Powers, 2002).

Shallow water has been investigated under and in the immediate vicinity of the surface facilities for the WIPP through drilling and geophysical studies (e.g., Intera, 1997). That water was not present during pre-construction drilling and testing (Powers, 1997), and the saturated zone developed at least in part because of runoff concentrated by WIPP facilities. The encounter in C-2737 indicates that a shallow saturated zone exists well beyond the boundaries of the surface facilities. The saturated zone at C-2811 is likely continuous with the saturated zone under the surface facilities. Water quality testing could help verify that. C-2811 serves as an additional piezometer to monitor water levels, and it may provide a location for testing hydraulic properties of the shallow saturated zone.

2.3 Other Background

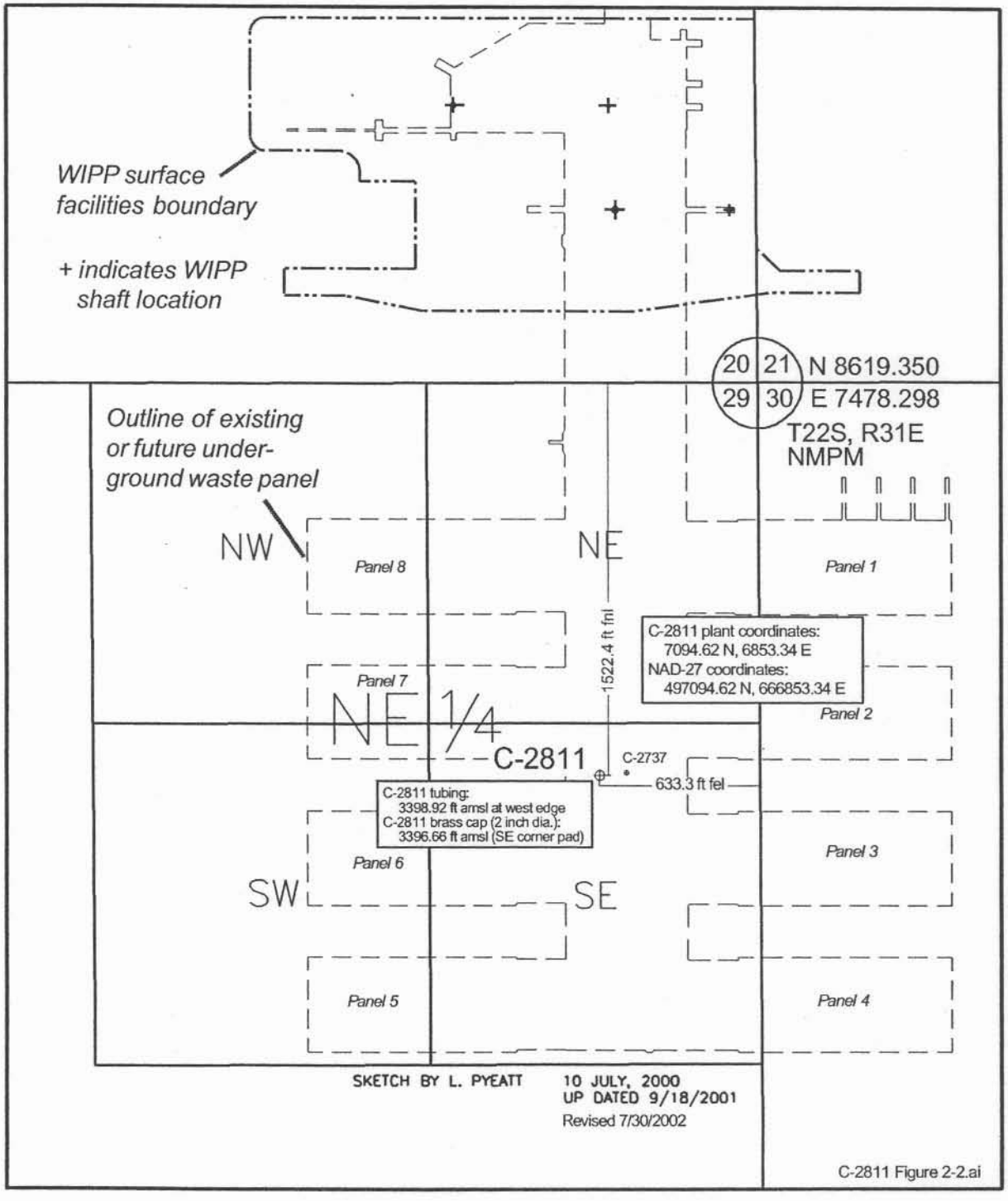
C-2811 was drilled and completed by the West Texas Water Well Service, 3432 W. University, Odessa, TX, under contract from Westinghouse Government Environmental Services Company (see Appendix A for a statement of work). Geological support was provided by Dennis W. Powers under contract from Westing-house TRU Solutions LLC. Archeological clearances were obtained from the US Bureau of Land Management for the drillpad at C-2737 (see Appendix D, Powers, 2002) where C-2811 was also drilled. C-2811 is monitored by the Geotechnical Engineering Department, Westinghouse TRU Solutions LLC.

Figure 2-1 Location Map



C-2811 Fig 1 location.ai

Figure 2-2 Plat Map of C-2811 Location



2.4 C-2811 Drillhole Statistics

The basic information about drilling and completion of C-2811 are presented here in tabular form for ease of reference (see Figure 2-3). Appendix B includes details based on daily drilling logs.

Table 2-1. Summary of Drilling and Well Completion Records For Hydrologic Drillhole C-2811

WELL NAME: C-2811

LOCATION: Section 29, Township 22 South, Range 31 East

SURFACE COORDINATES: The well is located 1522.4 ft from the North line (fnl) and 633.3 ft from the East line (fel) of Section 29. The NM State Plane (NAD 27) coordinates are 497094.62 N, 666853.34 E (New Mexico - East grid) for the tubing in C-2811. The NM State Plane (NAD 27) coordinates for the brass cap set in the southeast corner of the cement pad at C-2811 are 497093.11 N, 666854.03 E.

ELEVATION: The elevation of the 2-inch diameter tubing in C-2811, at the west side, is 3398.92 ft amsl. The elevation of the brass cap in the southeast corner of the cement pad at C-2811 is 3396.66 ft amsl. Water levels are measured relative to the top of tubing. Depths of geologic units are given as ft bgl. Elevations can be calculated using ground level as 3396.5 ft amsl for convenience, as the brass cap is slightly above the drill pad level.

DRILLING RECORD:

Dates: C-2811 was drilled and completed March 12, 2001. The hole was drilled with a diameter of 7.875 inches to 80.5 ft (TD). The upper 9.33 ft was reamed to a diameter of 12.25 inches, and steel casing 8.625 inches diameter was set as surface casing.

Circulation Fluid: Air was used to drill to about 70 ft depth. After a short drilling delay to check for inflow to the drillhole, the hole was continued to TD with mist.

Cored Intervals: none

Rig and Drilling Contractor: Gardner-Denver 1500; West Texas Water Well Service, 3432 W. University, Odessa, TX.

Drillhole Record:

Size (inches)	From (ft bgl)	To (ft bgl)
12.25	0	9.33
7.875	9.33	80.5

Casing and Tubing Record:

Size (inches)	Weight/ft (pounds)	From (ft bgl)
8.625		~0
2.0 (i.d)	PVC tubing	+ ~2.4

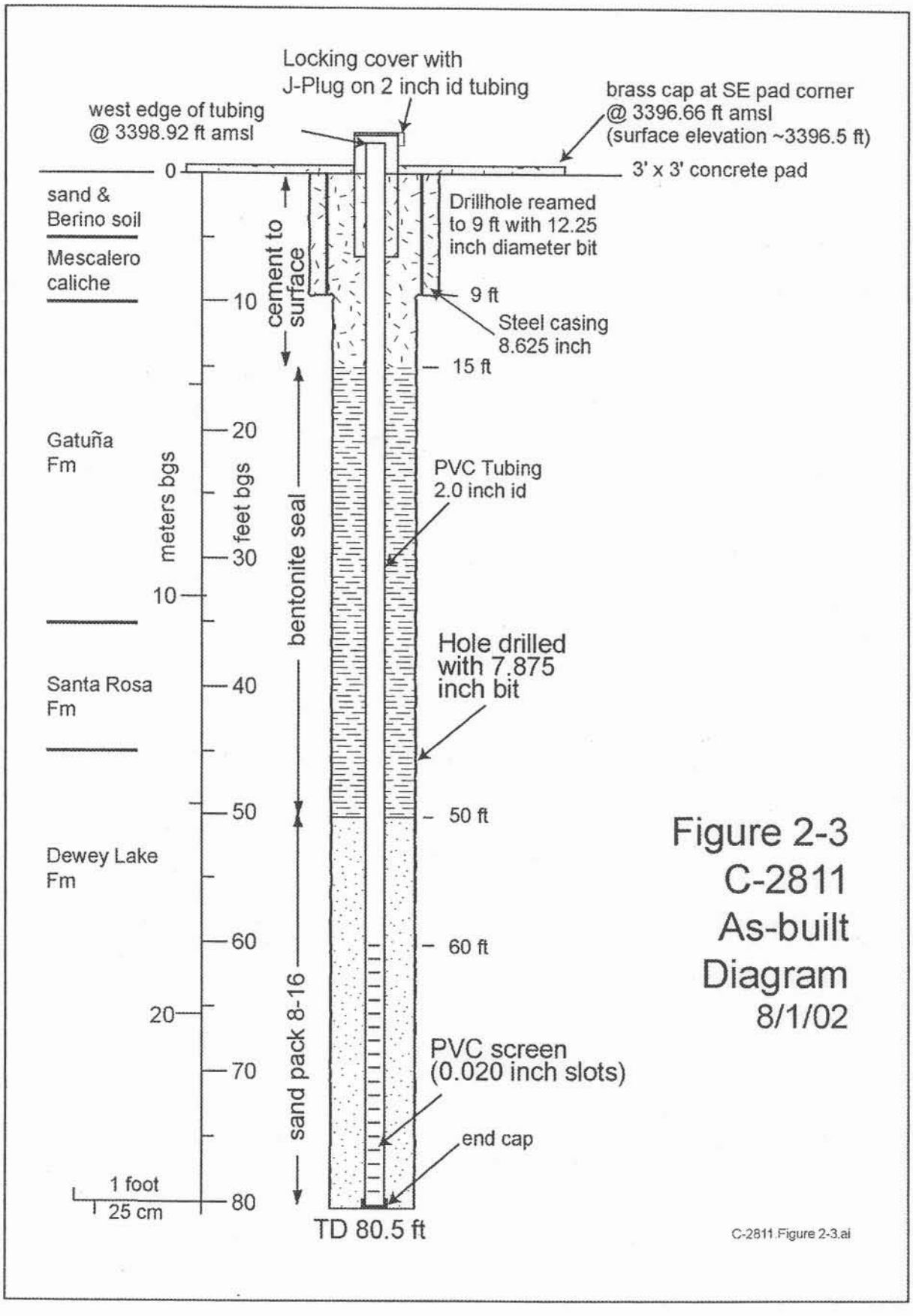


Figure 2-3
C-2811
As-built
Diagram
8/1/02

3.0 Geological Data

3.1 General Geological Background

The geology and hydrology of formations at the WIPP site and surroundings have been intensively investigated since 1975, and the information and interpretations have been reported in numerous documents. The most thorough compilation is certainly the Compliance Certification Application (CCA) submitted in 1996 by the US Department of Energy to the US Environmental Protection Agency. Some salient features of the broader geological history are relevant to understanding the geology and hydrology at C-2811.

The Delaware Basin (Figure 2-1) was a large structural feature that controlled deposition through much of the Paleozoic. By late Permian, the basin was restricted, and evaporite minerals dominated. The basin filled with sediments, and it no longer significantly affected sedimentation. Near the end of the Permian, circulation with the ocean improved, and some of the Rustler Formation, for example, was deposited in saline water rather than brine. As the Permian ended and Triassic began, continental environments prevailed, and significant redbeds, the Dewey Lake Formation (Figure 3-1), were deposited. Although surrounding areas accumulated variable thicknesses of later Mesozoic and Cenozoic age sediments, the WIPP area appears to have mainly been subject to erosion during an extended period from mid-Mesozoic to mid-Cenozoic (Figure 3-1). Some basin tilting about mid-Cenozoic exposed the evaporite beds to faster solution and erosion, and weathered material accumulated. The Pecos River drainage became integrated through the region during this period, and late Cenozoic deposits reflect this sedimentary environment and sediment sources outside the local area. Although the region is still subject to evaporite dissolution and erosion, large areas have remained geologically stable for about the last half million years, resulting in the formation and preservation of pedogenic calcrete (Mescalero caliche) deposits.

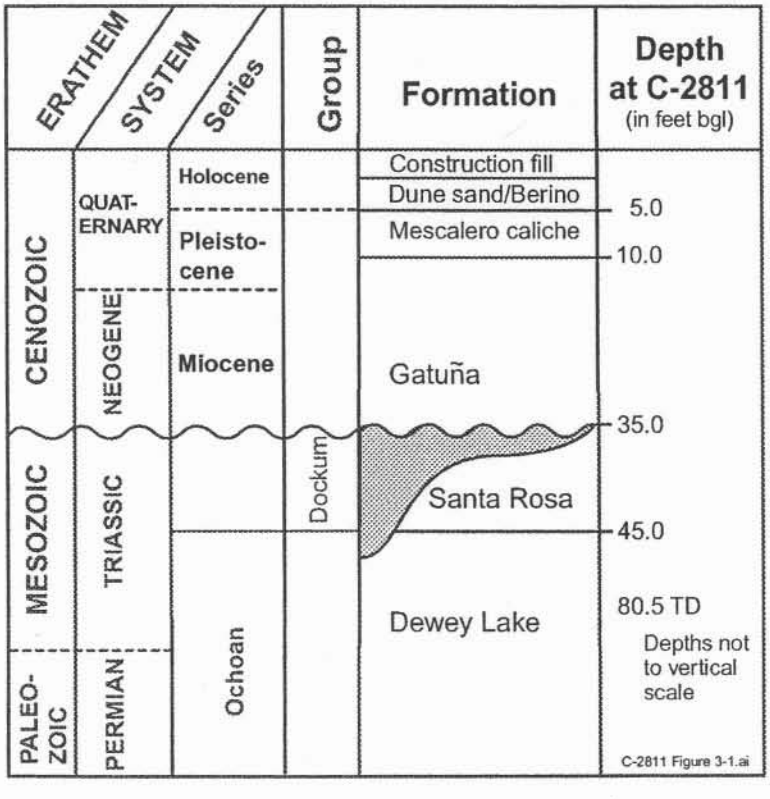


Figure 3-1. Stratigraphic units encountered in C-2811. Depths are based on cuttings collected over 5 ft intervals measured from the surface of the drillpad. Nearby drillhole C-2737 (Powers, 2002) provides consistent data. The Dewey Lake has commonly been considered part of the Permian, but radiometric dates (Renne et al., 1996) and geologic arguments (Schiel, 1994) indicate most of the Dewey Lake is probably part of the Triassic.

3.2 Geological Data From C-2811

Three sources of information contribute to understanding the geology of C-2811: 1) the general near-surface geology of this area (e.g., Powers, 1997), 2) drilling and logging of C-2737 (Powers, 2002), and 3) cuttings collected during drilling of C-2811.

The first 70 feet of C-2811 were drilled with air, and the interval from 70 feet to 80.5 ft (TD) was drilled with air and mist. Cuttings were collected over 5 ft intervals and bagged. The cuttings from this drillhole are better preserved and more informative than those from the equivalent interval of nearly C-2737.

The geology of C-2811 is quite similar to C-2737, and it is as expected from the general geology of the area. The shallow water encountered in C-2737 and in C-2811 occurs in the upper part of the Dewey Lake Formation (Figure 3-1). The location appears to be slightly deeper in the Dewey Lake than was found in the vicinity of the surface facilities.

3.2.1 Permo-Triassic Dewey Lake Formation

The Dewey Lake was encountered from about 45 ft deep to the total depth (TD) at 80.5 ft (Figure 3-2). The Dewey Lake is dominated by reddish brown siltstone with greenish gray reduction spots. Some fine sandstone was included in the cuttings, and it may be mixed between what occurs in the Dewey Lake and the Santa Rosa. The Dewey Lake cuttings were platy, reflecting common thin bedding or laminae of the unit. The cuttings were also generally moderately calcareous in this interval.

During drilling of C-2737, numerous thin hard-drilling zones were encountered beginning at a depth of about 45 feet, in the upper Dewey Lake (Powers, 2002). Cuttings were very fine and didn't reveal lithologic variations. It is likely that these harder drilling zones are due to differential cementation by carbonate.

The Dewey Lake has most commonly been assigned to the Permian System (e.g., Hills and Kottlowski, 1983), although there is no direct evidence, either paleontological or radiometric, of age in the vicinity of the WIPP. Schiel (1994) suggested on geologic grounds that the Dewey Lake was mostly Triassic. More recently, Renne et al. (1996) obtained radiometric (Ar-Ar) ages from ash beds near the base of lithologically equivalent red beds (Quartermaster Formation) in the Texas panhandle. These ages show that the basal Quartermaster is Permian, but most of the formation is early Triassic in age. Although lithologic contacts are not inherently isochronous, the particular relationships of evaporite to red bed suggest that the Dewey Lake is mainly Triassic in age (e.g., Powers and Holt, 1999). Lucas and Anderson (1993) have asserted that the Quartermaster, and Dewey Lake, are Permian in age, but more recent direct evidence supersedes their discussion.

3.2.2 Triassic Santa Rosa Formation

The Santa Rosa is thin at this location and is probably a maximum of 10 ft thick. It ranges from about 35 ft to 45 ft deep, although mixed cuttings and erosion of the Santa Rosa by the Gatuña can add to uncertainty. The Santa Rosa is mixed sandstone, siltstone, and claystone. The sandstone tends to be dark reddish brown to greenish gray, fine to coarse, and includes some chert fragments. The siltstone is brown and has some small reduction spots. The claystone is dark brown with a purplish hue. The unit is variably calcareous, and it is usually moderately well indurated.

3.2.3 Miocene-Pleistocene Gatuña Formation

The Gatuña Formation is about 25 feet thick at this location, ranging from depths of about 10 ft to about 35 ft. The Gatuña is a light brown to reddish brown sandstone, with generally fine to medium sand grains. The Gatuña includes some opaque grains, and it commonly displays some dark bluish-black stains believed to be MnO. The formation can be friable to moderately well lithified. It is very calcareous in the upper part because of penetration of pedogenic processes during early stages of the development of the Mescalero caliche. The main distinctions between the underlying Santa Rosa Formation or Dewey Lake Formation are color, degree of induration, and siliceous pebbles that tend to be more common in the Santa Rosa. The Gatuña generally increases in thickness to the west, and the

HOLE ID: C-2811	LOCATION: 1522.4 ft fnl, 633.3 ft fel, Section 29, T22S, R31E	
DRILLING DATE: 3/12/2001	EXCAVATION DATE:	NORTHING: 497094.62 (NMSP NAD 27)
DRILLING DIRECTION: Vertical Downward	DRILL METHOD: Rotary w/air or mist	EASTING: 666853.34 (NMSP NAD 27)
DRILL MAKE/MODEL: Gardner-Denver 1500		COLLAR ELEVATION: 3396.6649 ft amsl (brass cap in cement)
HOLE DIAMETER: 7.875 (IN)	HOLE DEPTH: 80.5 (FT)	DRILLING CREW: West Texas Water Well Service
LOGGED BY: Dennis W. Powers	DATE: 3/20/2001	SCALE: 1" = 10' (orig) SHEET 1 OF 1

RUN NUMBER	RECOVERED LENGTH	RQD	DEPTH ( ) FT	LITHOLOGY	DESCRIPTION	REMARKS
N/A	N/A	N/A	5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75		0-5 ft. Sand, very fine to medium, generally fine, medium orange brown. Very slightly calcareous, loose. Dune sand, construction fill, Berino soil mixed. 5-10 ft. Sand, sandstone, and caliche, white to light brown, fine to very fine sand grains, very calcareous. Also observed in mud pit. *Mescalero caliche* (~5-10 ft). 10-15 ft. Sandstone, light brown to medium reddish brown, fine to medium, some opaques, some MnO stains. Friable to moderately lithified, very calcareous. Some siltstone. *Gatuna Formation* (~10-35 ft). 15-20 ft. Sandstone, siltstone, some mudstone, medium reddish brown. Moderately lithified, very calcareous. Sand is fine to medium. some opaques, some MnO. 20-25 ft. As above. Slightly darker color from less carbonate, still very calcareous. 25-30 ft. As above, mudstone more abundant, color slightly purplish brown. 30-35 ft. As above,less mudstone. Similar to 20-25 ft. MnO more abundant. Some pores may be bioturbation. 35-40 ft. As above. With small (~ 5 mm) chert frags. Approximate contact *Gatuna Formation* and *Santa Rosa Formation* (~35-45 ft). 40-45 ft. Sandstone, fine to coarse, dark reddish brown, calcareous, with dark purplish brown claystone and light brown siltstone with small (< 1 mm) white reduction spots. 45-50 ft. Siltstone, dark reddish brown; with some fine to medium sandstone with greenish gray to reddish brown color; some silty claystone. Fissile, moderately calcareous. *Dewey Lake Formation* (~ 45 ft-TD). 50-55 ft. Siltstone, as above, fissile, with tiny reduction spots (greenish gray) in reddish brown rock. 55-60 ft. As above, slightly calcareous. 60-65 ft. As above, moderately calcareous. 65-70 ft. As above. 70-75 ft. As above. 75-80 ft. As above. C-2811 Figure 3-2.ai	begin drilling 8:58 am (Stensrud notes) cuttings were collected over 5 ft intervals. 70 ft observed well for ~ 1 hr for fluid inflow 70-80.5 ft drilled with air-mist. TD @ 12:25 pm

Figure 3-2. Geologic log for drillhole C-2811. The figure has been reduced to about 71.5% of the original scale for printing here.

depositional edge of the formation at the WIPP site is in the same general area where the Santa Rosa pinches out because of erosion that preceded Gatuña deposition (Powers and Holt, 1993).

Although the Gatuña ranges in age from at least 13.5 to about 0.5 million years old (Powers and Holt, 1993), the deposit at the WIPP site is of unknown age. From general relationships along Livingston Ridge, Powers and Holt (1993) infer that thin upland deposits of the Gatuña, such as at C-2737, probably represent younger portions of the unit range.

3.2.4 Pleistocene Mescalero caliche

Cuttings indicate the Mescalero caliche is about 5 ft thick at this location, although the calcification from pedogenic (soil-forming) processes that developed the Mescalero have penetrated deeper into the underlying Gatuña Formation. The Mescalero commonly has intervals in which calcite dominates, but the cuttings are dominated by a very calcareous sandstone. Bachman and Machette (1977) classified six useful stages of pedogenic calcrete development, ranging from I as the least developed to VI morphologies showing multiple generations of calcrete development. [Pedogenic calcrete is preferred by many geologists and pedologists because of the wide variation in use of the term "caliche."] The Mescalero is generally at stage V in the vicinity of WIPP, as it is in the mud pit adjacent to C-2737.

The Mescalero is an informal soil stratigraphic unit defined by Bachman (1973). It is widespread in southeastern New Mexico, and it is a continuous stratigraphic unit at the WIPP site. Uranium-disequilibrium ages indicate the Mescalero formed as a pedogenic unit between about 570,000 (± 100,000) and about 420,000 (± 60,000) years ago (Rosholt and McKinney (1980). The age is further bounded by the Lava Creek B ash, about 600,000 years old, which underlies the Mescalero at one location along Livingston Ridge (Izett and Wilcox, 1982).

3.2.5 Pleistocene Berino soil and surficial sands

From the cuttings and from observations of the fresh surface of the mud pit adjacent to C-2737, there is about 5 ft of unlithified dune sand and a basal argillaceous sand (commonly called the Berino soil) in this area (Powers, 2002). The sand is very fine to medium in grain size and is only slightly calcareous.

The Berino soil is not a geologic unit; it is a pedogenic unit defined by the soil scientists in the area (Chugg et al., 1971). Although originally thought to be a soil B horizon associated with the Mescalero, uranium-disequilibrium ages indicate formation of the Berino at about 330,000 (± 75,000) years ago. Although Powers (1993) agreed with Bachman (1980) that the Berino probably represented a remnant B horizon for the Mescalero, the Berino most likely developed separately. The Berino is inset into the Mescalero in "flowerpots" that developed in the Mescalero. These local dissolution features are commonly lined with carbonate laminae that cross-cut calcrete features (indicating later development) and the Berino set into the "flowerpots" is sharply differentiated from the laminar carbonate lining. The uranium-disequilibrium ages are also enough different between calcrete and Berino to indicate different periods of development.

The surface sand across much of the WIPP site is eolian, and the sand grains are generally fine to medium and moderately well sorted. The sand is not indurated. The dunes across the WIPP site are partially stabilized by vegetation; the thickness at the drill pad of about 5 ft is a result of leveling the area and redistributing sand that is variable in thickness.

4.0 Preliminary Hydrological Data for C-2811

No testing has been conducted to determine hydraulic properties of the saturated interval at C-2811. That testing may be conducted when water quality and water level are better determined or patterns established.

4.1 Shallow Subsurface Water in the Upper Dewey Lake Formation

Water has been found at similar shallow depths under and in the immediate vicinity of the surface facilities for the WIPP. Three initial drillholes (C-2502, C-2506, and C-2507) showed that water was found in the immediate vicinity of the exhaust shaft of the WIPP. Twelve piezometer holes (PZ1 through PZ12) were drilled and developed showing that shallow water extended areally well beyond the vicinity of the exhaust shaft and outside the fenced area for the WIPP facilities. The PZ holes also demonstrated large variations in the concentrations of dissolved solids across the area of investigation. It is clear that this zone became saturated after WIPP activities began. Drillholes for design work did not encounter such a saturated zone, and some of the water has high salt (Na and Cl) content that can only have developed as a result of shaft drilling or salt pile runoff, or both. These conclusions are developed and well-supported in previous reports on the investigations of the shallow water under the WIPP facilities (Intera, 1997).

4.2 Water Levels in C-2811

Water levels have been measured in C-2811 since March 14, 2001, shortly after the well was completed and initially developed. After a small drop in April, 2001, the general trend at C-2811 has been slightly rising (Figure 4-1; Table 4-1), although the total rise is less than 2 ft through May, 2003. Water level elevations are uncorrected for specific gravity; the total dissolved solids are relatively low and the specific gravity is effectively 1 (see section 4.3).

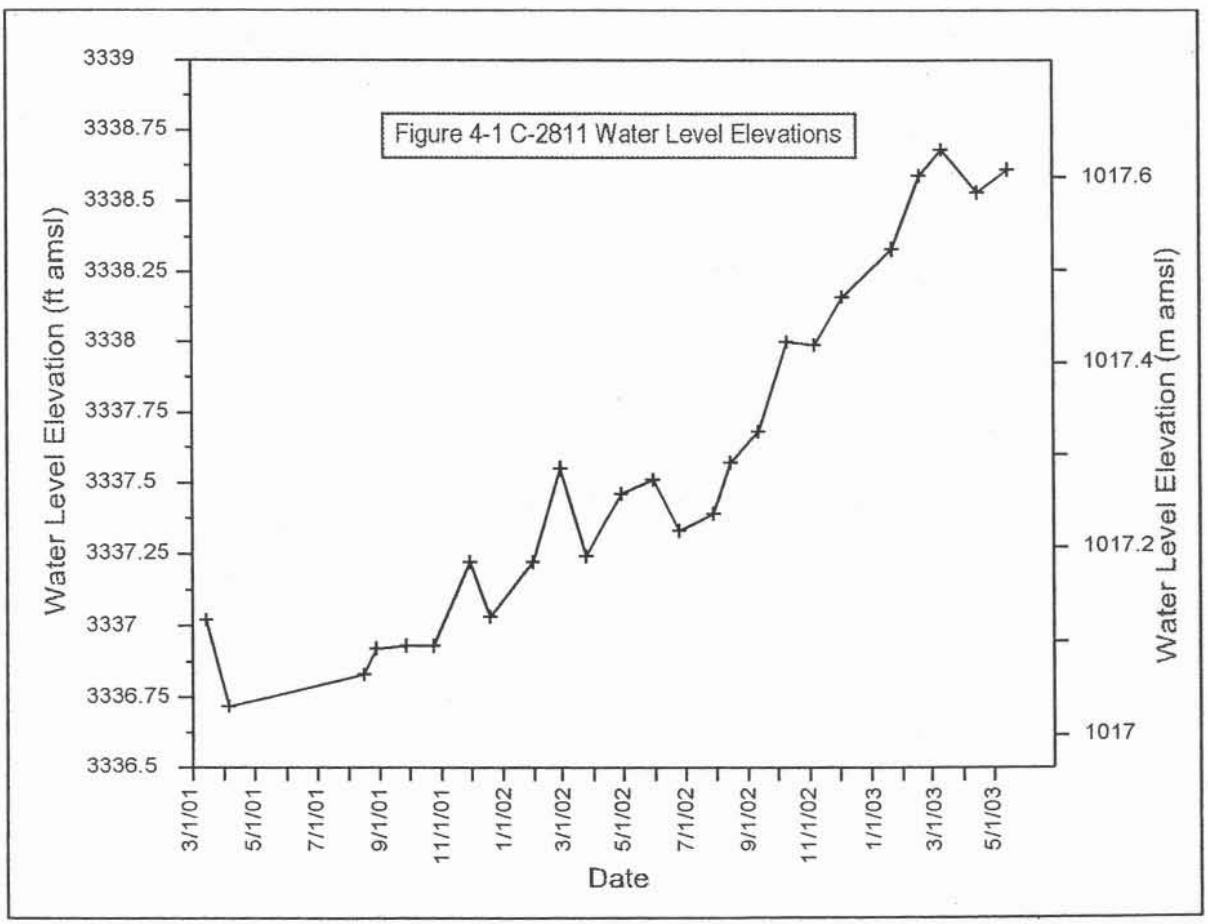


Table 4-1				
Water Level Data for Drillhole C-2811				
	Depth		Water Level Elevation	
Date	(ft)	(m)	(ft amsl)	(m amsl)
3/14/01	61.90	18.87	3337.02	1017.12
4/5/01	62.20	18.96	3336.72	1017.03
8/16/01	62.09	18.93	3336.83	1017.07
8/28/01	62.00	18.90	3336.92	1017.09
9/27/01	61.99	18.89	3336.93	1017.10
10/24/01	61.99	18.89	3336.93	1017.10
11/29/01	61.70	18.81	3337.22	1017.18
12/19/01	61.89	18.86	3337.03	1017.13
1/31/02	61.70	18.81	3337.22	1017.18
2/28/02	61.37	18.71	3337.55	1017.29
3/25/02	61.68	18.80	3337.24	1017.19
4/29/02	61.46	18.73	3337.46	1017.26
5/30/02	61.41	18.72	3337.51	1017.27
6/25/02	61.59	18.77	3337.33	1017.22
7/29/02	61.53	18.75	3337.39	1017.24
8/15/02	61.35	18.70	3337.57	1017.29
9/12/02	61.24	18.67	3337.68	1017.32
10/10/02	60.92	18.57	3338.00	1017.42
11/6/02	60.93	18.57	3337.99	1017.42
12/4/02	60.76	18.52	3338.16	1017.47
1/22/03	60.59	18.47	3338.33	1017.52
2/18/03	60.33	18.39	3338.59	1017.60
3/12/03	60.24	18.36	3338.68	1017.63
4/16/03	60.39	18.41	3338.53	1017.58
5/15/03	60.31	18.38	3338.61	1017.61
Depth to water is measured from the top of casing (TOC), which has an elevation of 3398.92 ft amsl (1035.99 m amsl) as of 6/1/03.				

4.3 Water Quality in C-2811

One sample was obtained on December 19, 2001, from C-2811 for chemical analyses (Table 4-2). Overall, the water quality (total dissolved solids: 2630 mg/L) at C-2811 is better than the water quality from piezometer holes near the site center.

The analysis does show that some components have unusual relationships. For example, the molar ratio of sodium and chloride is commonly expected to be near 1.0 for water in contact with halite. The molar ratio for sodium and chloride from this sample

Table 4-2 Groundwater Quality in C-2811		
Sample Date: 12/19/2001	*Sample ID: WST01171*	
DISSOLVED SOLIDS		
Solid	**mg/L**	**Code**
Chloride	956	
Sulfate	379	
Calcium	283	
Magnesium	207	
Sodium	163	
Total Inorganic Carbon	49.5	
Nitrate	27.9	
Silicon	22.3	
Potassium	4.6	B
Bromide	2.8	
Total Organic Carbon	1.4	
Boron	0.17	B,E
Barium	0.0934	B
Zinc	0.0357	
Selenium	0.0243	
Ammonium	0.0042	U
Chromium	0.0017	B
Arsenic	0.0014	B
Iron	0.0008	U
Mercury	0.0002	U
Cadmium	0.0001	U
Lead	0.0001	U
Silver	0.0001	U
Total Dissolved Solids	2630	
Codes: U - Analyte was not detected; value is the instrument detection limit (DL) corrected for any dilution in sample preparation and for percent solids. B - Reported value was obtained from a reading that was less than the Required Detection Limit (RDL) but greater than or equal to the DL. E - Reported value is estimated because of the possible presence of interference. The E qualifier is present if the result of the ICP serial dilution is not within limits.		
OTHER MEASUREMENTS		
pH	7.56	
Specific Gravity	1	

is about 0.26 ([(163 mg/L)/(22989.8 mg/mole)]/[(956 mg/L)/(35453 mg/mole)]). The ratio of chloride to bromide indicates higher relative concentrations of bromide than was encountered in some of the earlier drillholes such as C-2505, C-2506, and C-2507 (Intera, 1997). The chloride:sulfate molar ratio is about 6.8, and the chloride is evidence that the saturated zone is likely connected to the chloride-bearing waters sampled from the piezometer holes at the site center. The anomaly would appear to be the relatively low sodium concentration. The calcium:magnesium molar ratio is about 0.83 and is slightly higher than was found in some of the early drillholes (Intera, 1997).

Further sampling and analyses will be important to determine if the fluid chemistry from C-2811 has stabilized and is representative of the saturated zone here.

5.0 Significance/Discussion

C-2811 (and C-2737) showed that shallow zones in the upper Dewey Lake are now saturated in an area where drilling at H-1 and the H-3 complex in earlier years did not indicate saturated zones. The stratigraphic position of the saturated zone, in the upper Dewey Lake, and the relatively low total dissolved solids appear to continue trends observed along the southern edge of the central facilities in piezometer hole PZ-12. This encounter at C-2811 and C-2737, however, is not sufficient to indicate the areal bounds of the saturated zone or the rate at which it may be migrating laterally. The encounter at C-2811 and C-2737 is stratigraphically lower than the encounters in the piezometer holes near the center of the site. It is unknown whether this is the result of a lower (stratigraphically) zone restricting or impeding vertical infiltration or is showing vertical infiltration over time to a lower zone. To differentiate between such alternatives, the areal bounds to the saturated zone will need to be found, and the position of the saturated zone will need to be monitored over time in drillholes. C-2811 may provide a suitable location for testing the hydraulic properties of the saturated zone.

6.0 Acknowledgements

Drafts of this document were reviewed by Rey Carrasco and Sean White, and their comments improved the final report. Gil Gillespie (West Texas Water Well Service) provided daily drilling logs for C-2811. Larry Pyeatt (Westinghouse TRU Solutions LLC) provided survey data for the drillhole location and elevations. Chris Mahoney provided support in drafting the basic data report.

7.0 References Cited

Bachman, G.O., 1973, Surficial features and late Cenozoic history in southeastern New Mexico: US Geological Survey Open-file Report USGS-4339-8, 32 p.

Bachman, G.O., 1980, Regional geology and Cenozoic history of Pecos region, southeastern New Mexico: US Geological Survey Open-file Report 80-1099.

Bachman, G.O., and Machette, M.N., 1977, Calcic soils and calcretes in the southwestern United States: US Geological Survey Open-file Report 77-794, 163 p.

Chugg, J.C., Anderson, G.W., Kink, D.L., and Jones, L.H., 1971, Soil survey of Eddy area, New Mexico: US Department of Agriculture, 82 p plus figures.

Hills, J.M., and Kottlowski, F.E. (coordinators), 1983, Southwest/southwest mid-continent region: American Association of Petroleum Geologists, Correlation Chart Series.

INTERA, 1997, Exhaust Shaft Hydraulic Assessment Data Report, DOE/WIPP 97-2219, US Department of Energy, Carlsbad, NM.

Izett, G.A., and Wilcox, R.E., 1982, Map showing localities and inferred distribution of the Huckleberry Ridge, Mesa Falls and Lava Creek ash beds in the western United States and southern Canada: US Geological Survey, Miscellaneous Investigations Map I-1325, Scale 1:4,000,000.

Lucas, S.G., and Anderson, O.J., 1993, Stratigraphy of the Permian-Triassic boundary in southeastern New Mexico and west Texas, *in*

Hawley, J.W., and others, eds., Geology of the Carlsbad Region, New Mexico and West Texas: 44th NMGS Fall Field Conference Guidebook, New Mexico Geological Society, Socorro, NM, p. 219-230.

Powers, D.W., 1993, Surficial units and inferences of stability, Sand Point Site, Eddy County, New Mexico: NMBM OFR 0418 D, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM (dated 03/23/93).

Powers, D.W., 1997, Geology of piezometer holes to investigate shallow water sources under the Waste Isolation Pilot Plant, *in* Intera, 1997, Exhaust Shaft Hydraulic Assessment Data Report, DOE/WIPP 97-2219, US Department of Energy, Carlsbad, NM.

Powers, D.W., 2002, Basic data report for drillhole C-2737 (Waste Isolation Pilot Plant - WIPP) site: DOE/WIPP 01-3210, US Department of Energy, Carlsbad, NM.

Powers, D.W., and Holt, R.M., 1993, The upper Cenozoic Gatuña Formation of southeastern New Mexico, *in* Hawley, J.W., and others, eds., Geology of the Carlsbad Region, New Mexico and West Texas: 44th NMGS Fall Field Conference Guidebook, New Mexico Geological Society, Socorro, NM, p. 271-282.

Powers, D.W., and Holt, R.M., 1999, The Los Medaños Member of the Permian Rustler Formation: *New Mexico Geology*, v. 21, no. 4, p. 97-103.

Renne, P.R., Steiner, M.B., Sharp, W.D., Ludwig, K.R., and Fanning, C.M., 1996, $^{40}Ar/^{39}Ar$ and U/Pb SHRIMP dating of latest Permian tephras in the Midland Basin, Texas: American Geophysical Union, EOS, Transactions, v. 77, p. 794.

Rosholt, J.N., and McKinney, C.R., 1980, Uranium series disequilibrium investigations related to the WIPP site, New Mexico, Part II: Uranium trend dating of surficial deposits and gypsum spring deposit near WIPP site, New Mexico: US Geological Survey Open-file Report 80-879, p. 7-16.

Schiel, K.A., 1994, A new look at the age, depositional environment and paleogeographic setting of the Dewey Lake Formation (Late Permian?): West Texas Geological Society Bulletin, v. 33, no. 9, p. 5-13.

Appendix A
Field Operations Plan/Scope of Work/Justification

The paragraph below was added to the Statement of Work for Purchase Requisition 3737, which is included in Powers (2002, Appendix A).

TRU-Solutions intends to drill a shallow well penetrating a perched water-bearing horizon located approximately 60 feet below land surface in Santa Rosa Sandstone. The well is intended to monitor the fluid level and water-quality in the Santa Rosa. The well will be drilled to about 7-7/8-inches diameter to a depth of about 80 feet (bgs). The monitoring well will be installed with 2-inch PVC screen (2-inch bottom & J-plug) from a depth of about 60-80 feet (bgs) and blank casing to surface. The well will be gravel packed from about 50-to-80 feet (bgs), bentonite sealed from 50 to 15 feet (bgs) and cemented to the surface. The well will be located at the C-2737 hydropad located approximately 100 feet southwest of C-2737. The well will be completed with a steel sleeve with a 3ft x 3 ft x 4inch concrete pad for protection. The tentative startup date for the well is Friday, March 2, 2001.

Appendix B
Abridged Hole History

Note: The abridged drillhole history provided here has been compiled from the daily recoreds produced by personnel of West Texas Water Well Service and provided to Ron Richardson (Westinghouse TRU Solutions LLC) and from the field notes of Wayne A. Stensrud (Westinghouse TRU Solutions LLC). Additions or modifications from Stensrud notes are generally in italics.

3-13-01 Arrived at location at 08:15 CST (see note above). *Held safety briefing and discussed drilling of C-2811.* Began drilling monitor well *with air* at 7 7/8 inch diameter at 08:58. *At depth of 5 ft at 09:04. At depth of 10 ft at 09:06. At depth of 15 ft at 09:08. At depth of 15-20 ft at 09:10. At depth of 20-25 ft at 09:12. At depth of 25-30 ft at 09:14. Added drill collar at 09:17. Started drilling with air again at 09:25. At depth of 30-35 ft at 09:26. At depth of 35-40 ft at 09:30. Starts getting harder at 41 ft. At depth of 40-45 ft at 09:32. At depth of 45-50 ft at 09:34. At depth of 50-55 ft at 09:39. At depth of 55-60 ft at 09:43. Mudstone starts balling up at 09:50. Possibly indicates some moisture; examined bit. Started drilling again at 10:03. Added drill collar at 10:08. Began drilling with air again at 10:13. At depth of 60-65 ft at 10:15. At depth of 65-70 ft at 10:29. Shut down at 10:45. Pulled tubing and let hole rest. No significant quantities of fluid; a little dried mud on collars, but nothing significant. Decided to let hole sit for one hour to see if it filled with fluid. Water level of 70.4 ft at 12:07; maybe an inch of water located on the bottom of hole. Started drilling with mist at 12:18. At depth of 70-75 ft at 12:22. At total depth of 75-80 ft at 12:25. Began reaming top 9 ft of hole to 12¼ inch diameter to set casing at 12:58. Pulled 12 inch bit at 13:02.* Set 9 ft of 12 ¼ inch diameter surface casing *with 8 5/8 inch outer casing at 13:06. Began to clean (ream) out bottom of borehole at 13:45. Prepared to run sand pack, PVC casing and screen. Fluid coming in at about 60-62 ft.* Set 2 inch blank casing from 3 ft above ground level to 60 ft *at 14:05.* Set 2 inch (i.d.) screen (0.020 inch slots) from 60–80 ft. Packed *8 ft³ of sand* from 50 ft to 80 ft *at 14:30.* Bentonite seal from 15 ft to 50 ft *at 14:45. Used 18 bags of Hole Plus – Wyoming bentonite. Added approximately 10 gallons of fresh water and let bentonite swell for approximately 20 minutes.* Cemented from 0 ft to 15 ft *at 15:30.*

3-14-01 Arrived at location at 07:00. Poured 3 ft x 3 ft slab on C-2811. Began removal of equipment from location at 11:30. Completed equipment removal and left site at 18:30.

Appendix C
Additional Completion Information

Thomas C. Turney
State Engineer

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER

Roswell Office
1900 WEST SECOND STREET
ROSWELL, NM 88201

Trn Nbr: 207295
File Nbr: C 02811

Mar. 02, 2001

HAROLD JOHNSON
U.S. DEPT. OF ENERGY - WIPP
P.O. BOX 3090
CARLSBAD, NM 88221

Greetings:

Enclosed is your copy of the above numbered permit which has been approved subject to the conditions set forth on the approval page thereof.

Sincerely,

Mikeal Stapleton
(505)622-6467

Enclosure
cc: Santa Fe Office

adm

COPY

UNIQUE #	DOE UFC	DATE REC'VD	ADDRESSEES
D100878	5417.00	MAR 05 2001	H. Johnson

C-2811 Basic Data Report

2-110'no 360-

File Number: C-2811

Received: March 1, 2001

NEW MEXICO STATE ENGINEER OFFICE
APPLICATION TO APPROPRIATE UNDERGROLJND WATERS
IN ACCORDANCE WITH SECTION 72-12-1 NEW MEXICO STATUTES

. APPLICANT

Name: U.S. Department of Energy, Waste Isolation Pilot Plant Work Phone: (505)234-7349 or 234-8739
Contact: Mr. Harold Johnson Home Phone: N/A
Address: U.S. Department of Energy, Waste Isolation Pilot Plant
P.O. Box 3090
City: Carlsbad State: NM Zip: 88201

2. LOCATION OF WELL (E thru H optional)

A. NE 1/4 SE 1/4 NE 1/4 Section: 29 Township: 22S Range: 31E N. M. P. M.
in Eddy County.

B. X = 497,105.23N feet, Y = 666,959.89 E feet, N.M. Coordinate System
East Zone in the _____ Grant.
U.S.G.S. Quad Map ___

C. Give State Engineer File Number if existing well: N/A

D. On land owned by: U.S. Department of Energy, Waste Isolation Pilot Plant

E. Tract No. , Map No. of the

F. Lot No. _____, Block No. _____ of Unit/Tract of the
_____ Subdivision recorded in County

G. Latitude: Longitude:

H. Other:

2001 MAR -1 PM 1:12

3. USE OF WATER (check use applied for)

N/A One household, non-commercial trees, lawn and garden not to exceed a total of one acre.

N/A Livestock watering

Note: If any of the following items are marked, give the name and nature of business or use under item 5 of the additional statements or explanations section.

N/A More than one household, non-commercial trees, lawns and gardens not to exceed a total of one acre.

N/A Drinking and sanitary purposes and the irrigation of non-commercial trees, shrubs and lawns not to exceed one acre in conjunction with a commercial operation.

N/A Prospecting, mining or drilling operations to discover or develop natural resources.

N/A Construction ot public works, highways and roads

"SEE ATTACHMENT"

Trn Desc:
Log Due Date: 03-02-2002
Form: wr-01 page 1

WR Filed:
File Number: C-2811
Trn Number: 207295

File Number: C-2811

NEW MEXICO STATE ENGINEER OFFICE
APPLICATION TO APPROPRIATE UNDERGROUND WATERS
IN ACCORDANCE WITH SECTION 72-12-1 NEW MEXICO STATUTES

4. WELL INFORMATION (Change, Repair, Drill, Test, Supplement)

Name of well driller and driller license number
West Texas Water Well Service
Approximate depth 80 feet; Outside diameter of casing 2 inches.

Change Location of existing well or replacement well

___ Repair or Deepen:
___ Clean out well to original depth
___ Deepen well from _____ to _____ feet
X Other This well is intended for groundwater monitoring only

___ Drill and test a well for Water monitoring only use

Supplemental well

5. ADDITIONAL STATEMENTS OR EXPLANATIONS:
See Attachment

ACKNOWLEDGEMENT FOR NATURAL PERSONS

I, Wayne Stensrud (Please Print) affirm that the foregoing statements are true to the best of my knowledge and belief, By:

Wayne A Stensrud 2/23/01
Signature Signature

Trn Desc:
Log Due Date: 03-02-2002
Form: wr-01

File Number: C-2811
Trn Number: 207295

page 2