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Basic Data Report for Drillhole WIPP 14 (Waste Isolation Pilot Plant – WIPP)

Sandia National Laboratories
D'Appolonia Consulting Engineers

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
for the United States Department of Energy
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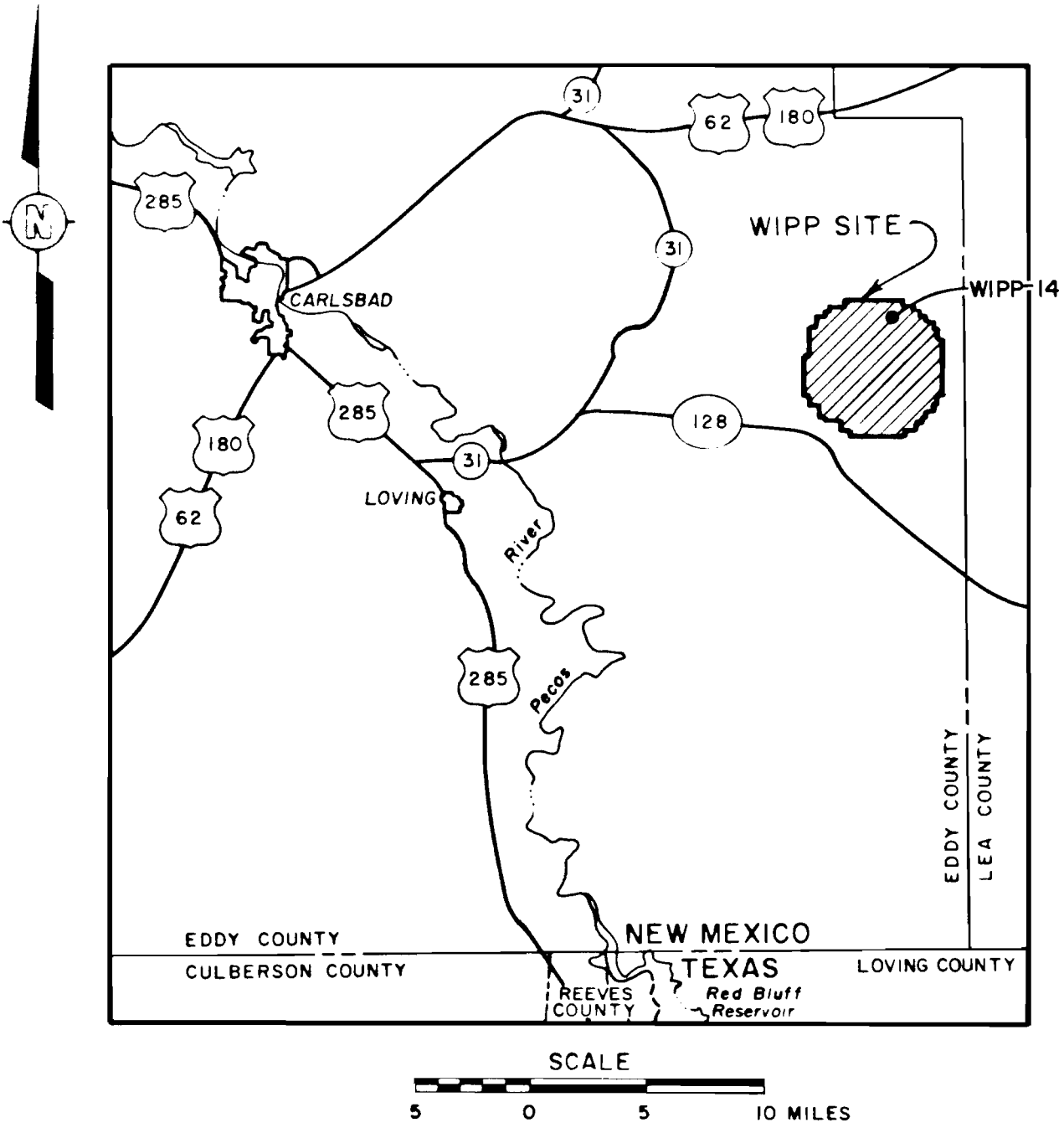

KEY MAP

FIGURE 3

LOCATION OF WIPP SITE AND BOREHOLE WIPP-14

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U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

REFERENCE:
U.S. GEOLOGICAL SURVEY

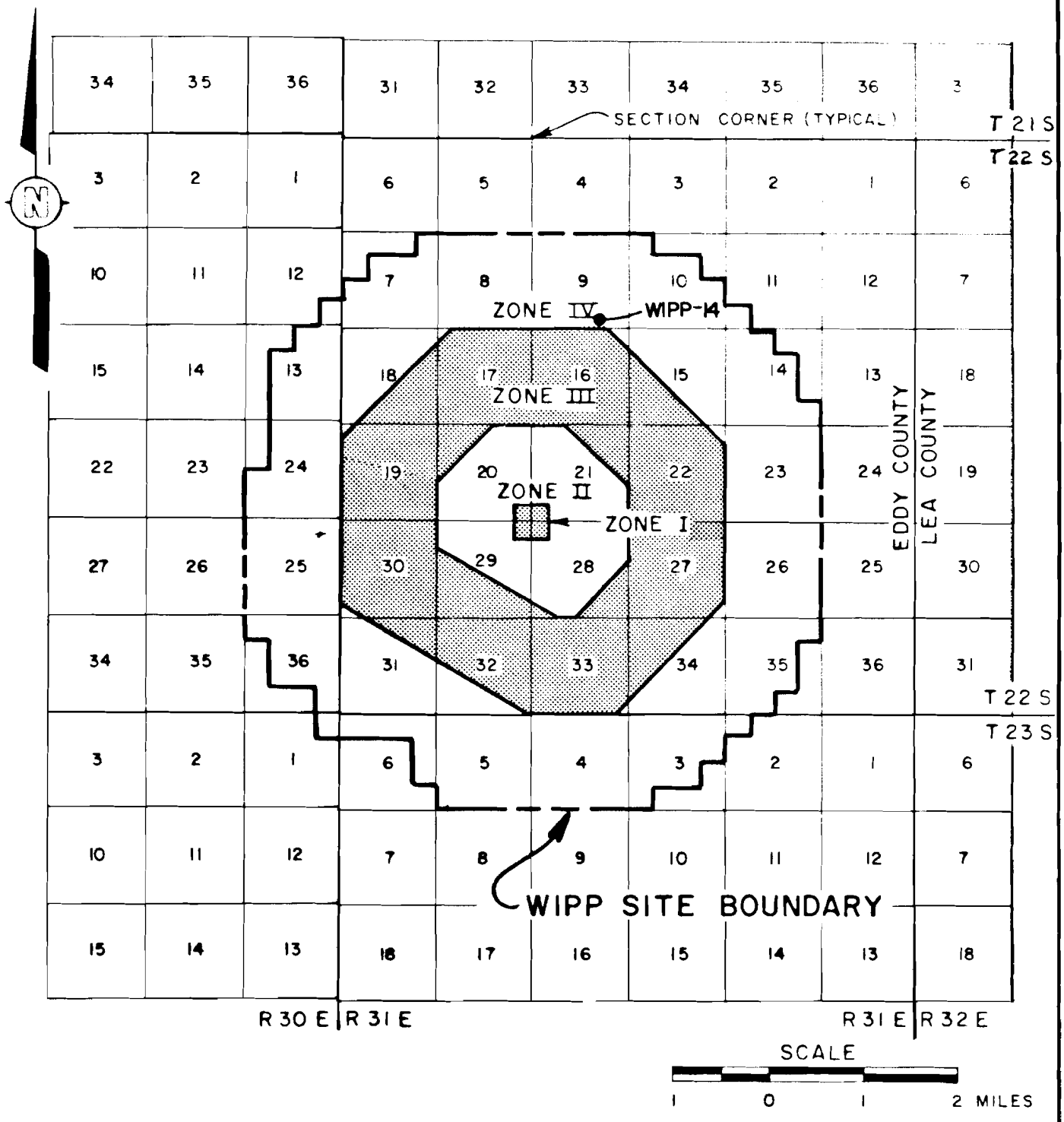

FIGURE 4
PLAN OF WIPP SITE
AND LOCATION OF BOREHOLE
WIPP - 14

PREPARED FOR

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

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feet of core in each photograph. The drilling operations and related supporting services provided by supply and logging companies were supervised by Fenix and Scission, Inc. Field-drawn stratigraphic columns, as well as descriptions of rock units and lithologic boundaries were made by geologists from Fenix and Scisson, Inc.

The basic data pertaining to WIPP-14 tabulated herein, as well as additional supporting information and guidance, were provided to the authors by Richard P. Snyder of the U. S. Geological Survey, Denver, Colorado. Details of the location and drilling of WIPP-14 are summarized in Table 1. Stratigraphic units penetrated by the boring are listed in Table 2. The rocks are identified and described in detail in Table 3.

3.3 DESCRIPTION OF WIPP-14

Borehole WIPP-14 is located in Section 9, T22S, R31E, in eastern Eddy County, New Mexico. The borehole was drilled to a depth of 1000.0 feet, measured from ground level (GL) at an elevation of 3429.0 mean sea level (MSL). Details of the drilling chronology for WIPP-14 are presented in Table 1.

The stratigraphic section includes unconsolidated deposits and sedimentary rocks from Quaternary to Permian age. The rocks are primarily marine evaporites of Permian age, with some younger continental rocks present in the upper portions of the section. The borehole stratigraphy is summarized in Table 2.

Cores were obtained at consecutive and nonconsecutive ten-foot intervals to a depth of 952.5 feet. The cores were marked according to the depths reported by the drillers, examined and described, photographed, and stored. Cuttings were collected, examined, and described for those intervals not cored.

A suite of geophysical logs was run to the total depth of WIPP-14. Selected logs, including neutron, gamma, and density, were used to: (1)

augment and corroborate the lithologic descriptions of WIPP-14 compiled from examination of rotary drill cuttings and cores; and (2) provide depth determinations independent of the depths indicated by drill-rod measurements. Figure 5 presents a compilation of lithologic and geophysical logs from Borehole WIPP-14.

When compared with nearby wells, no significant subsurface structural deviations were observed from analyses of the lithologic cores or the geophysical logs. The neutron logs show no unusual hydrogen (porosity) change, indicating the absence of gassy or dry zones. The density log shows no less-than-normal density features. No major deformations or other anomalous conditions were observed.

All depths reported herein, unless otherwise noted, are measured from ground level.

Measurements in this document for WIPP-14 are reported in the inch-pound (English) system. These units are consistent with the units used in the field to record the original observations. The inch-pound system also facilitates comparison of WIPP-14 measurements with those made by surveyors in establishing the geographic coordinates of the boring, by drillers in determining well depth and drilling conditions, and by geophysical loggers in recording in-hole variations of rock properties with depth. If metric equivalents are desired, the following conversion factors are provided:

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)
Pounds per square inch (psi)	0.006895	Megapascal (MPa)

Depth measurements presented graphically in Figure 5 are given in both English and metric units.

3.3.1 Stratigraphy

WIPP-14 encountered a normal sequence of clastic sedimentary and evaporitic rocks ranging in age from Quaternary to Permian. The stratigraphic sequence is similar to that encountered in other boreholes on the WIPP site, with no unusual structural, stratigraphic, or diagenetic phenomena observed. Following is a description of the major features of the rocks encountered in WIPP-14, which is summarized in Table 2. Detailed lithologic descriptions are presented in Table 3 and depicted graphically in Figure 5.

Quaternary System

The Quaternary System in WIPP-14 includes an unnamed deposit of eolian sand of Holocene age. These deposits are encountered from 0-15.4 feet. The eolian sands are ubiquitous and conceal the consolidated bedrock over much of the WIPP site.

Triassic System

Santa Rosa Sandstone

From 15.4 to 141.0 feet below ground level, a moderate to dark-reddish-brown, pale-red, and grayish-orange, sandstone, siltstone, and mudstone unit is believed to represent the basal part of the Santa Rosa Sandstone.

Permian System

The Permian System in WIPP-14 includes, in the order penetrated during drilling, the Dewey Lake Red Beds, the Rustler Formation, and the Salado Formation.

Dewey Lake Red Beds

Extending from 141.0 to 638.7 feet below ground level is a lithologically distinct, monotonous succession of reddish-brown sandstone, siltstone, and mudstone known as the Dewey Lake Red Beds. Much of this reddish-brown rock is irregularly mottled greenish-gray in splotchy, nodular, and lenticular masses. Veinlets of white, fibrous selenite are common in the lower part of the formation. The presence of selenite attests to the absence of circulating groundwater unsaturated with respect to calcium sulfate since vein formation.

Rustler Formation - The Rustler Formation, 638.7 to 951.6 feet below ground level is composed chiefly of anhydrite and fine-grained clastic rocks with interbeds of dolomite and clayey halite. Clastic rocks in the upper and middle parts of the formation are structureless, unconsolidated clays and silts that are dissolution residues derived from clayey and silty halite. Clastics in the lower part of the formation are well indurated mudstone and clayey siltstone with halite cement. Gypsum rims the anhydrite immediately above and below the dissolution residues bounding the interbeds of dolomite.

The Rustler Formation contains two dolomite beds which form distinct stratigraphic units. These appear at 706.5 to 730.0 and 817.2 to 836.2 feet below ground level. The upper unit is the Magenta Dolomite member and the lower unit is the Culebra Dolomite member. The Magenta Dolomite member is a fine-grained, silty dolomite with a platy (laminated) structure, composed of detrital dolomite and silt. The Culebra Dolomite member is a thin-bedded, well crystallized dolomite of chemical origin that contains solution pits from which calcium sulfates (gypsum and anhydrite) have been leached.

Salado Formation

The top of the Salado Formation was found at 951.6 feet below ground level at WIPP-14. The Salado Formation contains the salt beds of interest at the WIPP site. Throughout the area the formation is chiefly halite but contains many intervals of polyhalitic (or anhydritic) halite and argillaceous halite in beds ranging from a few inches to a few feet in thickness (Jones, 1960). In borings which penetrate the entire Salado interval, prominent interbeds of anhydrite, polyhalite, and siltstone, as well as many thin seams and partings of claystone are found. A few salt beds near the middle of the formation contain crystals and nodular masses of kainite, bloedite and, possibly, other uncommon potassium and magnesium minerals. In that portion of the Salado penetrated in WIPP-14, the formation is apparently free of dissolution residues related to the removal of salt by groundwater, and the rocks are unfractured and lacking in the deformation textures and structures found in folded and faulted salt beds.

The WIPP-14 borehole penetrated only a small portion of the unnamed upper unit of the Salado Formation. This unit consists of halite, polyhalite, and mudstone. None of the marker beds in the Salado Formation were penetrated by Borehole WIPP-14.

TABLE 1

ABRIDGED HISTORY OF BOREHOLE WIPP-14

Location: Sec. 9 T22S R31E
97.3 feet from the south line
2103.7 feet from the east line

Elevation: GL (ground level) 3429.0 feet

Datum for depth measurements given in Tables 1, 2, and 3, and throughout this report is ground level.

Field Lithologic Log Prepared By: S. L. Drellack, L. Parrish, Fenix and Scisson, Inc.

Geophysical Logs Recorded By: Dresser Atlas, U. S. Geological Survey

Drilling Contractor: Penn Drilling Company

Drilling Record: Commenced drilling May 1, 1981 and completed drilling June 8, 1981 at a total depth of 1000.0 feet below ground level.

Drilling Fluid: Brine Mud

TABLE 1
(Continued)

ABRIDGED HISTORY OF BOREHOLE WIPP-14

CORE NO.	DRILLER'S DEPTH INTERVAL (FEET)	CORRECTION FACTOR TOP OF CORE* (FEET)	CORRECT DEPTH BELOW GL (FEET)	CORE INTERVAL FEET CUT	CORE INTERVAL FEET RECOVERED	PERCENT RECOVERED
1	5.4 - 16.4	0	5.4 - 16.4	1.0	1.0	100
2	18.0 - 24.5	0	18.0 - 24.5	6.5	0.8	12
3	24.5 - 28.4	0	24.5 - 28.4	3.85	1.0	26
4	28.4 - 31.5	0	28.4 - 31.5	3.15	0.8	25
5	31.5 - 34.4	0	31.5 - 34.4	2.85	2.85	100
6	34.4 - 37.4	0	34.4 - 37.4	3.0	1.9	63
7	37.4 - 40.4	0	37.4 - 40.4	3.0	1.5	50
8	40.4 - 43.6	0	40.4 - 43.6	3.25	0.5	15
9	43.6 - 46.6	0	43.6 - 46.6	3.0	2.5	83
10	46.6 - 49.6	0	46.6 - 49.6	3.0	0.4	13
11	49.6 - 51.5	0	49.6 - 51.5	1.9	0	0
12	51.5 - 54.5	0	51.5 - 54.5	3.0	1.9	63
13	54.5 - 57.2	0	54.5 - 57.2	2.7	2.7	100
14	57.2 - 60.2	0	57.2 - 60.2	3.0	3.0	100
15	60.2 - 63.2	0	60.2 - 63.2	3.0	1.8	60
16	63.2 - 68.2	0	63.2 - 68.2	5.0	0	0
17	68.2 - 72.4	0	68.2 - 72.4	4.2	1.6	38
18	72.4 - 76.0	0	72.4 - 76.0	3.6	1.9	53
19	76.0 - 79.0	0	76.0 - 79.0	3.0	2.3	77
20	79.0 - 82.0	0	79.0 - 82.0	3.0	0	0
21	82.0 - 85.0	0	82.0 - 85.0	3.0	0	0
22	85.0 - 88.0	0	85.0 - 88.0	3.0	2.8	93
23	88.0 - 91.5	0	88.0 - 91.5	3.5	2.9	83
24	91.5 - 94.5	0	91.5 - 94.5	3.0	2.5	83
25	94.5 - 97.5	0	94.5 - 97.5	3.0	2.3	77
26	97.5 - 100.5	0	97.5 - 100.5	3.0	3.0	100
27	100.5 - 105.5	0	100.5 - 105.5	5.0	5.0	100
28	105.5 - 111.5	0	105.5 - 111.5	6.0	5.5	92
29	111.5 - 121.5	0	111.5 - 121.5	10.0	10.0	100
30	121.5 - 131.5	0	121.5 - 131.5	10.0	10.0	100
31	131.5 - 138.2	0	131.5 - 138.2	6.7	6.7	100
32	138.2 - 144.8	0	138.2 - 144.8	6.6	6.6	100
33	144.8 - 151.5	0	144.8 - 151.5	6.7	6.7	100
34	151.5 - 158.2	0	151.5 - 158.2	6.7	6.7	100
35	158.2 - 165.0	0	158.2 - 165.0	6.8	5.5	81
36	165.0 - 170.5	0	165.0 - 170.5	5.5	5.5	100
37	170.5 - 177.8	0	170.5 - 177.8	7.3	7.3	100
38	177.8 - 184.9	0	177.8 - 184.9	7.1	7.1	100
39	184.9 - 191.5	0	184.9 - 191.5	6.6	6.6	100
40	191.5 - 198.3	0	191.5 - 198.3	6.8	6.8	100
41	198.3 - 204.9	0	198.3 - 204.9	6.6	6.6	100
42	204.9 - 211.9	0	204.9 - 211.9	7.0	7.0	100
43	211.9 - 218.3	0	211.9 - 218.3	6.4	6.4	100
44	218.3 - 224.9	0	218.3 - 224.9	6.6	6.6	100
45	224.9 - 231.8	0	224.9 - 231.8	6.9	6.9	100
46	231.8 - 238.0	0	231.8 - 238.0	6.2	6.2	100
47	238.0 - 241.8	0	238.0 - 241.8	3.8	3.8	100
48	241.8 - 251.9	0	241.8 - 251.9	10.1	10.1	100
49	251.9 - 258.2	0	251.9 - 258.2	6.3	6.3	100
50	258.2 - 264.5	0	258.2 - 264.5	6.3	6.3	100
51	264.5 - 271.7	0	264.5 - 271.7	7.2	7.2	100
52	271.7 - 278.3	0	271.7 - 278.3	6.6	6.6	100
53	278.3 - 284.9	0	278.3 - 284.9	6.6	6.6	100
54	284.9 - 291.8	0	284.9 - 291.8	6.9	6.9	100
55	291.8 - 297.4	0	291.8 - 297.4	5.6	5.6	100
56	297.4 - 305.1	0	297.4 - 305.1	7.7	7.7	100
57	305.1 - 313.6	0	305.1 - 313.6	8.5	8.5	100
58	313.6 - 322.5	0	313.6 - 322.5	8.9	8.9	100
59	322.5 - 331.5	0	322.5 - 331.5	9.0	9.0	100
60	331.5 - 340.5	0	331.5 - 340.5	9.0	9.0	100
61	340.5 - 349.5	0	340-5 - 349.5	9.0	9.0	100
62	349.5 - 358.5	0	349.5 - 358.5	9.0	9.0	100
63	358.5 - 367.5	0	358.5 - 367.5	9.0	9.0	100
64	367.5 - 371.6	0	367.5 - 371.6	4.1	4.1	100
65	371.6 - 381.1	0	371.6 - 381.1	9.5	9.5	100
66	381.1 - 390.7	0	381.1 - 390.7	9.6	9.6	100
67	390.7 - 399.5	0	390.7 - 399.5	8.8	8.8	100
68	399.5 - 408.5	0	399.5 - 408.5	9.0	9.0	100
69	408.5 - 417.5	0	408.5 - 417.5	9.0	9.0	100
70	417.5 - 426.5	0	417.5 - 426.5	9.0	9.0	100
71	426.5 - 436.2	0	426.5 - 436.2	9.7	9.7	100
72	436.2 - 445.0	0	436.2 - 445.0	8.8	8.8	100
73	445.0 - 454.5	0	445.0 - 454.5	9.5	9.5	100
74	454.5 - 463.6	0	454.5 - 463.6	9.1	9.1	100

TABLE 1
(Continued)

CORE NO.	DRILLER'S DEPTH INTERVAL (FEET)	CORRECTION FACTOR TOP OF CORE* (FEET)	CORRECT DEPTH BELOW GL (FEET)	CORE INTERVAL FEET CUT	CORE INTERVAL FEET RECOVERED	PERCENT RECOVERED
75	463.6 - 471.9	0	463.6 - 471.9	8.3	8.3	100
76	471.9 - 480.8	0	471.9 - 480.8	8.9	8.9	100
77	480.8 - 485.6	0	480.8 - 485.6	4.8	4.8	100
78	485.6 - 494.5	0	485.6 - 494.5	8.9	8.9	100
79	494.5 - 503.5	0	494.5 - 503.5	9.0	9.0	100
80	503.5 - 511.8	0	503.5 - 511.8	8.3	8.3	100
81	511.8 - 520.9	0	511.8 - 520.9	9.1	9.1	100
82	520.9 - 529.6	0	520.9 - 529.6	8.7	8.7	100
83	529.6 - 538.6	0	529.6 - 538.6	9.0	9.0	100
84	538.6 - 545.6	0	538.6 - 545.6	7.0	7.0	100
85	545.6 - 554.6	0	545.6 - 554.6	9.0	9.0	100
86	554.6 - 563.5	0	554.6 - 563.5	8.9	8.9	100
87	563.5 - 570.8	0	563.5 - 570.8	7.3	7.3	100
88	570.8 - 580.5	0	570.8 - 580.5	9.7	9.7	100
89	580.5 - 589.9	0	580.5 - 589.9	9.4	9.4	100
90	589.9 - 599.0	0	589.9 - 599.0	9.1	9.1	100
91	599.0 - 608.0	0	599.0 - 608.0	9.0	9.0	100
92	608.0 - 618.0	0	608.0 - 618.0	10.0	10.0	100
93	618.0 - 626.7	0	618.0 - 626.7	8.7	8.7	100
94	626.7 - 635.9	0	626.7 - 635.9	9.2	9.2	100
95	635.9 - 644.9	0	635.9 - 644.9	9.0	9.0	100
96	644.9 - 654.0	0	644.9 - 654.0	9.1	9.1	100
97	654.0 - 663.0	0	654.0 - 663.0	9.0	9.0	100
98	663.0 - 672.0	0	663.0 - 672.0	9.0	9.0	100
99	672.0 - 680.5	0	672.0 - 680.5	8.5	8.5	100
100	920.0 - 928.9	-2.4	917.6 - 926.5	8.9	8.9	100
101	928.9 - 938.0	-2.4	926.5 - 935.6	9.1	9.1	100
102	938.0 - 939.0	-2.4	935.6 - 936.6	1.0	1.0	100
103	939.0 - 948.4	-2.4	936.6 - 946.0	9.4	9.4	100
104	948.4 - 957.0	-2.4	946.0 - 954.6	8.6	8.6	100

*Where geophysical log depths do not agree with reported driller's depths, core intervals and lithologic change depths are adjusted to agree with geophysical depths.

TABLE 2

STRATIGRAPHIC SUMMARY OF BOREHOLE WIPP-14

	DEPTH INTERVAL IN FEET[1] (BELOW GROUND LEVEL)
QUATERNARY	
Sand (Holocene-eolian)	0 - 15.4
TRIASSIC	
Santa Rosa Sandstone	15.4 - 141.0
PERMIAN	
Dewey Lake Redbeds	141.0 - 638.7
Rustler Formation	638.7 - 951
Magenta Dolomite member	706.5 - 730.0
Culebra Dolomite member	817.2 - 836.2
Salado Formation[2] (upper member)	951.6

[1] Depths to units taken from geophysical logs and lithologic descriptions.
[2] Depth is top of unit when single number is given.

TABLE 3

LITHOLOGIC LOG OF BOREHOLE WIPP-14
(Depths are measured from ground level and corrected from geophysical logs. Color designations are from the Rock Color Chart, Goddard, et al., 1948)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Dune sand	0-15.4
Mudstone, moderate to dark-reddish-brown, moderately indurated, massive, calcareous, scarce subrounded chert(?) granules; grades to muddy siltstone at 16.0 ± feet	15.4-16.4
No core	16.4-18.0
Sandstone, dark-reddish-brown with grayish-red tint, friable to moderately indurated, fine to medium grained, fair sorting, calcareous	18.0-18.8
No core	18.8-24.5
Sandstone, dark- to moderate-reddish-brown, friable, few well indurated sandstone pieces, fine to medium grained, rare rounded to subangular grains up to 0.40 inches in diameter; probably some silt and clay material, fair sorting; rare subangular chert pieces 0.10 to 0.20 inches in diameter, calcareous; few poorly developed caliche zones	24.5-25.5
No core	25.5-28.4
Sandstone and conglomerate, moderate to dark-reddish-brown, some pale red, loose subrounded pebbles to well indurated poorly sorted conglomerate, fine grained sand to 0.80 inch diameter pebbles; caliche coating on some loose pebbles	28.4-29.2
No core	29.2-31.5
Mudstone, silty, moderate- to dark-reddish-brown, soft and pliable, calcareous; numerous 0.40 inch subrounded quartz pebbles in top 0.5 feet of interval; numerous black dendritic root molds, some organic material (live roots?)	31.5-34.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Sandstone, dark to moderate-reddish-brown, friable, firm, slightly pliable, fine grained; some clay and silt, poor to fair sorting, calcareous; rare black root molds as in unit above	34.4-36.3
No core	36.3-37.4
Sandstone, similar to unit at 34.4 to 36.3 feet, fine grained, argillaceous, soft and friable, slightly calcareous	37.4-38.9
No core	38.9-40.4
Sandstone, same as in unit at 37.4 to 38.9 feet	40.4-40.9
No core	40.9-43.6
Sandstone, same as in unit at 37.4 to 38.9 feet	43.6-46.1
No core	46.1-46.6
Sandstone, same as in unit at 37.4 to 38.9 feet	46.6-47.0
No core	47.0-49.6
No core	49.6-51.5
Sandstone to sandy silt, similar to unit at 37.4 to 38.9 feet	51.5-53.4
No core	53.4-54.5
Sandstone to sandy silt, similar to unit at 37.4 to 38.9 feet	54.5-57.2
Mudstone, silty, moderate- to dark-reddish-brown, pliable to fairly indurated and friable, massive, calcareous; parts alternately grading from muddy siltstone to silty mudstone; bottom 0.1 feet becoming sandy and less competent	57.2-60.2
Mudstone, silty, same as in unit at 57.2 to 60.2 feet	60.2-62.0
No core	62.0-63.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
No core	63.2-68.2
Mudstone, silty, same as in unit at 57.2 to 60.2	68.2-69.0
Sandstone, moderate- to dark-reddish-brown, firm to very friable, some soft and pliable, very fine grained, muddy and silty, calcareous	69.0-69.8
No core	69.8-72.4
Sandstone, same as in unit at 69.0 to 69.8 feet,	72.4-74.3
No core	74.3-76.0
Sandstone, same as in unit at 69.0 to 69.8 feet, alternating with muddy siltstone	76.0-78.3
No core	78.3-79.0
No core	79.0-82.0
No core	82.0-85.0
Mudstone, silty, interbedded with sandstone, silty and muddy, moderate- to dark-reddish-brown, firm, friable to pliable, massive, slightly calcareous, sandstone very fine grained	85.0-87.8
No core	87.8-88.0
Mudstone, silty, interbedded with sandstone, silty and muddy, same as in unit at 85.0 to 87.8	88.0-90.9
No core	90.9-91.5
Mudstone, silty, interbedded with sandstone, silty and muddy, same as in unit at 85.0 to 87.8 feet	91.5-94.0
No core	94.0-94.5
Mudstone, silty, interbedded with sandstone, silty and muddy, same as in unit at 85.0 to 87.8 feet	94.5-96.4

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Sandstone, greenish-gray, well indurated; very fine grained silt	96.4-96.8
No core	96.8-97.5
Siltstone, moderate- to dark-reddish-brown, well indurated, grades to mudstone in parts; 0.1 to 1.5 feet thick reduction zones, greenish-gray in color, randomly spaced	97.5-100.5
Siltstone, same as in unit at 97.5 to 100.5 feet	100.5-105.5
Siltstone, same as in unit at 97.5 to 100.5 feet	105.5-111.5
Siltstone, same as in unit at 97.5 to 100.5 feet	111.5-121.5
Mudstone, moderate- to dark-reddish-brown, grades to and alternates with siltstone; common greenish-gray reduction zones, 0.80 inches to 1.20 inches thick; similar to unit at 97.5 to 121.5 feet	121.5-131.5
Sandstone, greenish-gray, well indurated, very fine grained	131.5-132.4
Siltstone, moderate to dark-reddish-brown, well indurated, grading to and alternating with mudstone; greenish-gray reduction spots 0.04 to 0.20 inches in diameter in parts; slightly calcareous at 137.0 to 138.0 feet; calcite filled fracture at 137.5 feet dips 30°	132.4-138.0
Siltstone and mudstone, moderate to dark-reddish-brown, well indurated, faint horizontal wavy laminae in parts; rare to common greenish-gray reduction spots 0.04 to 0.20 inches in diameter; rare greenish-gray reduction bands up to 1.2 inches thick; slightly calcareous in parts; core has a tendency to part horizontally into 0.2 to 1.5 foot lengths	138.0-144.8
Siltstone and mudstone, same as in unit at 138.0 to 144.8 feet; calcite filled vugs 0.60 inches in diameter at 148.7 and 151.1 feet	144.8-151.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone and mudstone, same as in unit at 138.0 to 144.8 feet	151.5-158.2
Siltstone and mudstone, same as in unit at 138.0 to 144.8 feet	158.2-165.0
Siltstone and mudstone, same as in unit at 138.0 to 144.8 feet	165.0-169.4
Siltstone, moderate- to dark-reddish-brown, well indurated, common dark-reddish-brown mudstone laminae and thin beds; grading to very-fine grained sandstone in parts; clear to translucent selenite veins 0.04 to 0.30 inches thick usually parallel to bedding planes and 0.1 to 1.0 feet apart; rare greenish-gray reduction spots, scarce greenish-gray reduction zones as thick as 0.1 feet; few dark-reddish-brown mudstone clasts and broken laminae segments (maybe desiccation cracks)	169.4-170.5
Siltstone, same as in unit at 169.4 to 170.5 feet; small, muddy, slightly calcareous selenite-filled structures at 172.1 and 176.8 feet (maybe burrows)	170.5-177.8
Siltstone, same as in unit at 169.4 to 170.5 feet	177.8-184.9
Siltstone, same as in unit at 169.4-170.5 feet	184.9-191.5
Siltstone, same as in unit at 169.4-170.5	191.5-197.5
Sandstone, moderate to dark-reddish-brown with grayish-red tint, well indurated, very fine grained, massive; rare greenish-gray reduction spots; two selenite veins in this interval	197.5-198.3
Sandstone, same as in unit 197.5 to 198.3 feet	198.3-204.5
Siltstone and mudstone, similar to units at 169.4 to 197.5 feet; occassional horizontal selenite vein as thick as 1.95 inches	204.5-211.9
Siltstone and mudstone, same as in unit at 204.5 to 211.9 feet	211.9-218.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone and mudstone, same as in unit at 204.5 to 211.9 feet	218.3-224.9
Sandstone, grayish-red to dark-reddish-brown, well indurated, very fine grained, some small scale cross bedding and low angle darker laminae; rare 0.10 to 0.20 inch thick selenite veins	224.9-231.8
Sandstone, same as in unit at 224.9 to 231.8 feet; grades to medium grained sandstone at 234.5 to 236.0 feet with a 33° dip in bedding; 1.40 inch thick selenite vein at 236.0 feet	231.8-236.0
Mudstone, dark-reddish-brown, silty in parts; 0.10 to 0.20 inches thick horizontal selenite veins	236.0-238.0
Mudstone, same as in unit at 236.0 to 238.0 feet	238.0-241.8
Mudstone, same as in unit at 236.0 to 238.0 feet	241.8-243.1
Siltstone and mudstone, similar to unit at 169.4 to 197.5 feet, moderate- to dark-reddish-brown, well indurated, grading to very fine grained sandstone in parts; rare to common selenite veins 0.04 to 0.80 inches thick, usually horizontal; occasional selenite veins as thick as 2.30 inches, few selenite veins with dips from 25° to 70°; scarce to common reduction spots 0.04 to 0.10 inches in diameter, few as large as 0.40 inches in diameter	243.1-251.9
Siltstone and mudstone, same as in unit at 243.1 to 251.9 feet	251.9-258.2
Siltstone and mudstone, same as in unit at 243.1 to 251.9 feet	258.2-264.5
Siltstone and mudstone, same as in unit at 243.1 to 251.9 feet	264.5-271.8
Sandstone, grayish-red to dark-reddish-brown, well indurated, very fine grained, small scale cross bedding	271.8-273.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Mudstone, grading to and alternating with siltstone in parts, moderate to dark-reddish-brown, well indurated; rare to common 0.20 to 1.60 inches thick selenite veins, low angle to 60° dips; three yellowish-gray reduction spots at 274.0 feet 0.40 inches to 0.80 inches in diameter with irregular 0.10 inch black centers (maybe organic material)	273.5-278.3
Mudstone, same as in unit at 273.5 to 278.3 feet	278.3-281.0
Sandstone, moderate to dark-reddish-brown with grayish-red tint, well indurated, very fine to fine grained; greenish-gray reduction zone 0.80 to 1.20 inches thick at 281.3 to 281.9 feet	281.0-284.5
Mudstone, dark-reddish-brown, well indurated, silty in parts	284.5-285.4
Sandstone, moderate to dark-reddish-brown, well indurated, very fine to fine grained; rare selenite veins; rounded, greenish-gray, medium grained sandstone bed at 291.0 to 291.3 feet	285.4-291.8
Sandstone, same as in unit at 285.4 to 291.8 feet, very fine grained below 292.0 feet, grading to silt in parts, minor small scale cross bedding, rare dark-reddish-brown mud laminae in parts	291.8-297.4
Sandstone, same as in unit at 285.4 to 291.8 feet, greenish-gray and fine to medium grained at 298.0 to 298.2 feet; 0.04 to 0.40 inch reduction spots scarce to common in parts	297.4-305.1
Sandstone, same as in unit at 285.4 to 291.8 feet	305.1-311.7
Siltstone, moderate to dark-reddish-brown, well indurated, parts predominantly mudstone as laminae and thin beds, grading to very fine grained sandstone in places, small scale cross bedding in some silty and sandy zones; scarce to common (variable) greenish-gray reduction spots; horizontal to low angle 0.40 to 1.20 inch thick selenite veins	311.7-313.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone, same as in unit at 311.7 to 313.6 feet, nearly vertical 0.40 inches thick selenite vein at 315.4 to 318.0 feet	313.6-322.5
Siltstone, same as in unit at 311.7 to 313.6 feet, several 0.40 to 0.60 inch reduction spots at 326.0 with black centers	322.5-331.5
Siltstone, same as in unit at 311.7 to 313.6 feet	331.5-340.5
Siltstone, same as in unit at 311.7 to 313.6 feet	340.5-349.5
Siltstone, same as in unit at 311.7 to 313.6 feet	349.5-358.5
Siltstone, same as in unit at 311.7 to 313.6 feet	358.5-367.5
Siltstone, same as in unit at 311.7 to 313.6 feet	367.5-371.6
Siltstone, same as in unit at 311.7 to 313.6 feet	371.6-381.1
Siltstone, same as in unit at 311.7 to 313.6 feet	381.1-382.0
Siltstone, similar to unit at 311.7 to 382.0 feet; very numerous selenite veins 0.10 inches thick, usually parallel to bedding, selenite veins 0.20 to 0.40 inches in size with long dimension horizontal, few high angle selenite veins cutting others; reduction spots 0.04 to 0.10 inch in diameter, few up to 0.40 inch	382.0-390.7
Siltstone, same as in unit at 382.0 to 390.7 feet	390.7-399.5
Siltstone, same as in unit at 382.0 to 390.7 feet; very fine grained sandstone at 406.0 to 408.0 feet	399.5-408.5
Siltstone, same as in unit at 382.0 to 390.7 feet	408.5-417.0
Siltstone and mudstone, similar to unit at 311.7 to 382.0 feet; rare selenite veins 0.10 to 0.80 inch thick; rare to common reduction spots	417.0-417.5
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	417.5-426.5

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	426.5-436.2
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	436.2-445.0
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	445.0-454.5
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	454.5-463.6
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	463.6-471.9
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	471.9-480.8
Siltstone and mudstone, same as in unit at 417.0 to 417.5 feet	480.8-485.5
Siltstone and mudstone, moderate- to dark-reddish-brown, numerous small subparallel irregular selenite veins 0.04 to 0.10 inch thick, spaced 0.20 to 0.80 inches apart; large selenite vein at 486.2 to 486.9 feet, 0.20 inch thick, dips ± 80°; small irregular reduction mottling spots to 0.40 inches, light-olive-gray in color	485.5-494.5
Siltstone and mudstone, same as in unit 485.5 to 494.5 feet; fine grained sandstone laminations, pale-olive-gray, 0.04 inches thick at 494.9 feet; horizontal selenite veins 0.20 inches thick at 499.2 and 500.8 feet	494.5-503.5
Siltstone and mudstone, same as in units at 494.5 to 503.5 feet; 0.40 inches thick horizontal selenite vein at 506.5 feet	503.5-511.5
Siltstone and mudstone, same as in unit at 494.5 to 511.5 feet with fewer selenite veins	511.5-520.9
Siltstone and mudstone, same as in unit at 511.8 to 520.9 feet	520.9-529.6

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone and mudstone, moderate- to dark-reddish-brown, well consolidated; sparse selenite veins dip 75° ±; scattered light-olive-gray reduction mottling spots to 0.80 inches in diameter	529.6-538.6
Siltstone and mudstone, same as in unit at 529.6 to 538.6 feet; irregular selenite-filled fractures 0.20 inches thick at 543.2 to 544.0 feet, dips 75° ±	538.6-544.0
Siltstone and mudstone, same as in unit at 529.5 to 544.0 feet	544.0-545.6
Siltstone and mudstone, same as in unit at 529.6 to 538.6 feet; vertical selenite vein 0.10 inches thick at 553.0 to 554.6 feet	545.6-554.6
Siltstone and mudstone, same as in unit at 529.6 to 538.6 feet; thin irregular selenite laminations at 560.4 to 563.5 feet	554.6-563.5
Siltstone and mudstone, same as in unit at 529.6 to 538.6 feet; small rubble zone with subrounded siltstone fragments in clay matrix; selenite vein dips 45° at 568.6 feet	563.5-570.8
Siltstone and mudstone, same as in unit at 529.5 to 544.0 feet; selenite-filled fracture with possible minor movement at 580.1 feet dips 45°	570.8-580.5
Siltstone and mudstone, moderate- to dark-reddish-brown, well indurated; small irregular selenite-filled fractures; halite-filled fracture at 585.0 feet; light-olive-gray reduction mottling in siltstone from 586.0 to 586.6 feet	580.5-589.9
Siltstone and mudstone, same as in unit at 580.5 to 589.9 feet	589.9-599.0
Siltstone and mudstone, same as in unit at 580.5 to 589.9 feet	599.0-608.0
Siltstone and mudstone, same as in unit at 580.5-589.9 feet	608.0-618.0

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone and mudstone, same as in unit at 580.5-589.9 feet	618.0-626.7
Siltstone and mudstone, same as in unit at 580.5 to 589.9 feet	626.7-635.9
Siltstone and mudstone, same as in unit at 580.5 to 589.9 feet	635.9-638.7
Anhydrite, light to white, very finely crystalline, massive, upper contact with siltstone dips 35°; light-olive-gray and moderate-red siltstones interbedded with anhydrite from 638.7 to 638.8 feet	638.7-642.3
Siltstone, moderate to dark-reddish-brown; anhydrite filled fractures dip 50° ±	642.3-642.7
Anhydrite, same as in unit at 638.7 to 642.3	642.7-644.9
Anhydrite, medium- to light-gray and white, laminated, finely crystalline, light-brown and dark-gray laminations dip 15° to 20°	644.9-649.3
Anhydrite, medium- to light-gray, finely crystalline, very thin horizontal laminations	649.3-654.0
Anhydrite, medium- to light-gray and white, finely crystalline, irregular wavy laminations	654.0-663.0
Anhydrite, medium to light-gray and white, finely crystalline, wavy laminations, pale-purple to moderate-red laminations from 665.0 to 666.4 feet; irregular, angular anhydrite clast 1.20 inches at 668.1 feet, anhydrite lamination (fracture filling?) at 668.2 feet dips 45°	663.0-672.0
Gypsiferous anhydrite, medium to light-gray and white, anhydrite to gypsum alteration, wavy anhydrite laminations; irregular moderate reddish-brown siltstone interbedded with gypsiferous anhydrite at 676.0 feet	672.0-676.3

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone and mudstone, moderate- to dark-reddish-brown, minor light-olive-gray reduction mottling spots 0.20 ± inch in diameter	676.3-680.5
Mudstone, moderate (10R 4/6) to dark-reddish-brown (10R 3/4), minor anhydrite and gypsum	680.5-687.0
Gypsiferous anhydrite, white; minor translucent selenite	687.0-697.0
Gypsum, white; with white to light-gray anhydrite and selenite	697.0-706.5
Dolomite; with light-gray mudstone	706.5-730.0
Siltstone, light-olive-gray (5Y 6/1) to white, and minor sandstone, moderate-reddish-brown (10R 4/6)	730.0-740.0
Sandstone, light-olive-gray (5Y 6/1) to white, and minor siltstone, moderate-reddish-brown (10R 4/6)	740.0-748.0
Anhydrite, white, finely crystalline	748.0-769.0
Anhydrite, white to light-gray, finely crystalline	769.0-779.0
Anhydrite, same as in unit at 769.0 to 779.0 feet; with white gypsum	779.0-789.0
Gypsiferous anhydrite, white to light-gray; and mudstone, moderate-reddish-brown (10R 4/6)	789.0-800.0
Clay, moderate-reddish-brown (10R 4/6)	800.0-807.0
Gypsiferous, anhydrite, white to light-gray, finely crystalline, with moderate-reddish-brown (10R 4/6) clay	807.0-817.2
Gypsum, light-gray; and light-olive-gray (5Y 6/1) dolomite	817.2-827.2
Dolomite, light-olive-gray (5Y 6/1), finely crystalline; minor light-gray gypsum and white (N9) anhydrite	827.2-836.2

TABLE 3
(Continued)

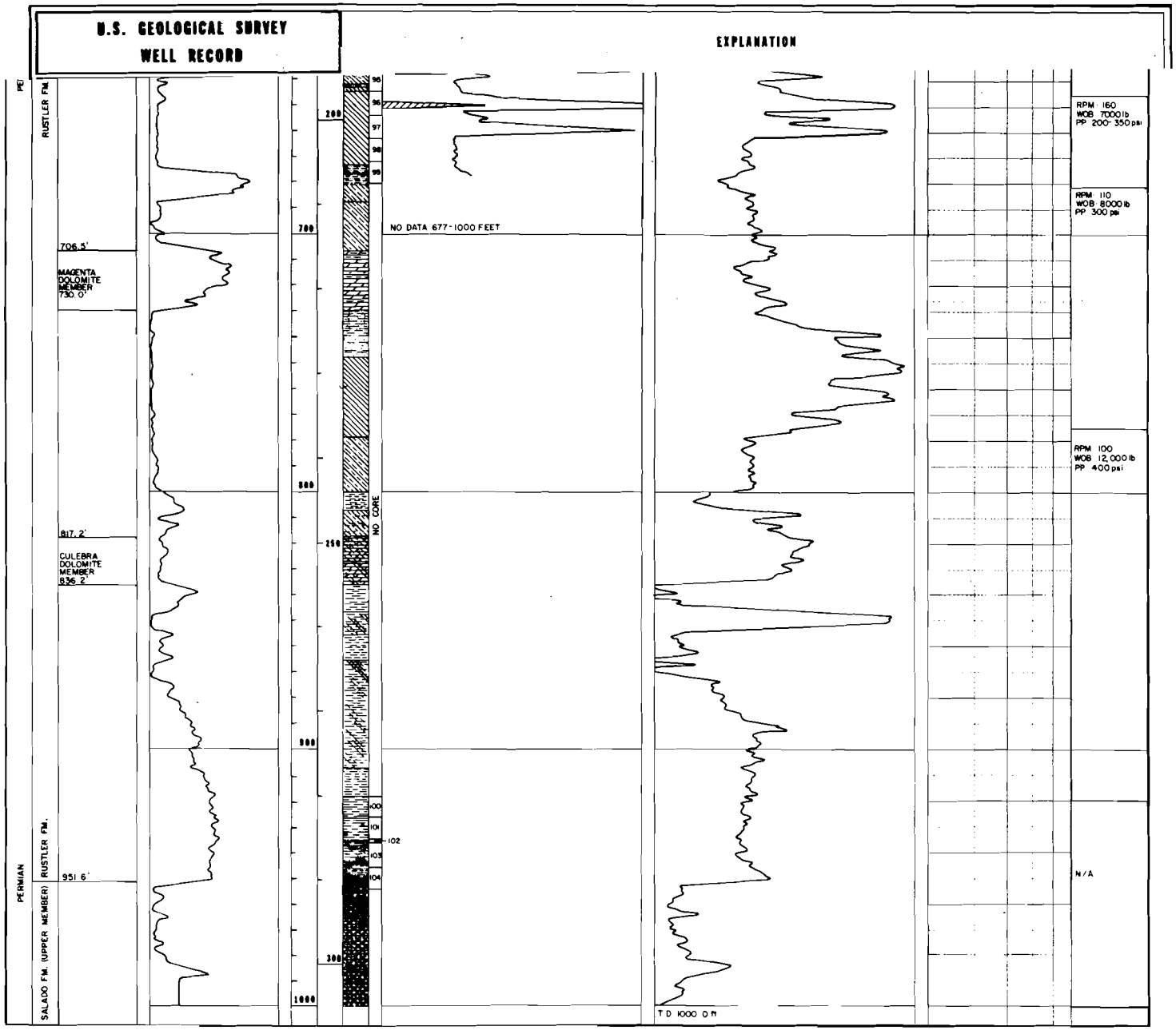
LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Mud, dark-reddish-brown (10R 3/4)	836.2-847.0
Mud, dark-reddish-brown (10R 3/4); with gypsum and anhydrite	847.0-856.0
Mud, dark-reddish-brown (10R 3/4)	856.0-865.9
Mud, dark-reddish-brown (10R 3/4); with gypsum and anhydrite fragments	865.9-907.6
Mud, dark-reddish-brown (10R 3/4); and siltstone, light-olive-gray	907.6-917.6
Siltstone, medium to dark-gray	917.6-926.5
Siltstone, medium to dark-gray, fine grained; minor moderate-reddish-brown polyhalite filling solution vugs as large as 0.20 inches in diameter	926.5-935.6
Siltstone, medium to dark-gray, fine grained	935.6-936.6
Siltstone, medium to dark-gray, fine grained; halite and polyhalite filled fracture from 944.0 to 944.4, feet dips 55° ±	936.6-945.6
Siltstone, medium to dark-gray, fine grained, finely laminated with minor bedding displacements 0.20 to 0.40 inches	945.6-946.9
Siltstone and mudstone, moderate- to dark-reddish-brown	946.9-947.6
Siltstone and mudstone, moderate- to dark-reddish-brown; with anhydrite laminations, white to medium-gray, 0.10 inches to 0.40 inches thick dipping 15° ±	947.6-947.9
Mudstone, moderate to dark-reddish-brown; halitic; numerous small solution pits	947.9-951.6
Halite, translucent to transparent; and polyhalite, pale-red (10R 6/2), moderate-reddish-orange (10R 6/6), and dark-reddish-brown (10R 3/4); moderate-reddish-brown (10R 4/6) mud seam at 952.7 feet	951.6-954.2

TABLE 3
(Continued)

LITHOLOGIC DESCRIPTION	DEPTH INTERVAL (IN FEET)
Siltstone, medium gray; mudstone, moderate-reddish-brown; with halite and polyhalite	954.2-957.2
Mudstone, moderate-reddish-brown; and transparent halite and polyhalite	957.2-967.2
Halite, transparent; and polyhalite, moderate-reddish-brown; mudstone, moderate-reddish-brown	967.2-977.2
Halite, translucent to transparent; polyhalite, pale-red to dark-red; mudstone, moderate-reddish-brown	977.2-987.2
Halite, translucent; polyhalite, pale-red, moderate-reddish-orange, and dark red	987.2-1000.0 T.D.

FIGURE 5

LITHOLOGIC AND GEOPHYSICAL LOGS OF WIPP-14



4.0 HYDROLOGICAL DATA

No hydrological data has been obtained for WIPP 14 at this date.

5.0 REMARKS

The lack of significant structural disturbance of the stratigraphic markers to the upper Salado Formation is an indication that the gravity anomaly is not due to the "disturbed zone". All of the density information obtained from the geophysical logs in WIPP 14 also indicates that the source of the gravity low is due to loss of mass from relatively shallow depths. No cavities are indicated by the drilling record or geophysical logs, and there were no indications of fluids entering the borehole. Though these are gross indicators, the features that were considered to be of interest would have been solution cavities, either dry or fluid-filled, that would give gross indications of their presence.

Barrows (in preparation) proposes that the gravity low is best explained by solution within the Rustler Formation, and possibly the Dewey Lake Red Beds, which results in the formation of karst and features such as alluvial dolines. The hypotheses of origin of the gravity anomaly are under discussion in view of the borehole data which have been obtained. Based on the relatively shallow source of the gravity anomaly and the lack of disolution or structural complexity, an interpretation of the feature as a breccia pipe is rejected. Later reports on hydrology and geology are expected to deal further with the interpretation of gravity and drilling results.

6.0 BIBLIOGRAPHY

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APPENDIX A

JUSTIFICATION

by

D. W. Powers
Division 9731
Sandia National Laboratories

INTRODUCTION TO APPENDIX A, JUSTIFICATION

Appendix A consists of the WIPP Statement of Work for WIPP 14 (revised) and WIPP 35, dated May 7, 1981 and the WIPP Statement of Work for WIPP 14, dated December 22, 1980.

These documents provide details of background information and program options as understood at the time of initiation. The reader is cautioned, therefore, that the details of the program may have been altered as information became available and that preliminary interpretative hypotheses or ideas guiding the program formulation may need revision based on information presented in this report. Later interpretive reports may deal with such items.

Draft: May 4, 1981
Approval Issue: May 7, 1981

WIPP

STATEMENT OF WORK

FOR

WIPP 14 (revised) and WIPP 35

Prepared By: _____
D. W. Powers, Principal Investigator
Supervisor, Division 4511

Reviewed By: _____
L. J. Barrows, Peer Reviewer

_____
P. D. Seward, Peer Reviewer

_____
J. T. Henderson, QA Chief

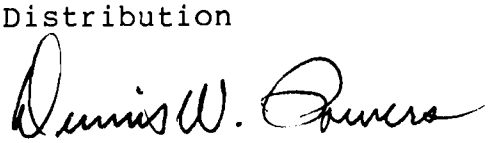
Approved By: _____
W. D. Weart, Project Manager

Sandia National Laboratories

Albuquerque, New Mexico 87185

date: May 5, 1981

to: Distribution



from: Dennis W. Powers, 4511

subject: Scope of Work, WIPP 14 (revised) and WIPP 35

This memorandum provides the justification and scope of work for drilling and testing WIPP 14 and 35. It supplements the Scope of Work, WIPP 14, dated December 17, 1980, in order to conduct the immediate operations of drilling shallow exploratory boreholes.

Objective: To determine, through a drilling, logging, and testing program (if warranted), the nature of stratigraphic and structural relationships in the formations overlying the Salado at the location of gravity and seismic anomalies. The objective of this exploratory drilling is to provide preliminary information on the upper beds and to determine the need for deeper drilling.

The location of WIPP 14 is 2104' fel, 97' fsl, section 9, T.22S., R.31E. WIPP 35 is located 1210'fnl, 280' fel, section 8, T.22S., R.31E. These locations are based on a combination of high precision gravity data and seismic reflection data. WIPP 14 is also located in the center of a surficial sink.

Method: The plan is to conduct exploratory drilling by coring to about the top of the Rustler Formation at either location, rotary drilling to about the Rustler/Salado contact, and then coring through the Rustler/Salado contact. Small diameter core will be appropriate for this test, and the logging suite will be limited. The principal commercial log of interest is the density log. The USGS/WRD will probably also log the hole using their standard logging tools and techniques. A borehole gravity log of these boreholes and WIPP 34 will be obtained following the completion of the exploratory drilling or the end of deep drilling.

It is possible that highly permeable zones will be encountered in view of the density anomaly. A modified, simple slug injection test may be performed to obtain a preliminary estimate of hydraulic parameters.

Details: The drilling is based on the following assumptions:

that the shallow drilling plan will give information relevant to the gravity and shallow seismic data.

that a minimal program of shallow drilling will indicate which, if any, target is worth pursuing with further, deeper, more expensive drilling.

The minimum size core that is acceptable is NX. Core handling procedures have previously been established for AEC 7, and we will follow those procedures. It is also important that salt within the core be preserved during the drilling process.

If rather large drill string drops, lost circulation zones, or drilling fluid freshening are encountered, a limited form of slug injection test will be performed. The logging and coring record from WIPP 33 may provide a guide to the types of lost circulation or cavities that would be tested under this plan. Complete hydrologic characterization of such a zone is not to be attempted during this program, but may well be a recommendation for the future if such zones are encountered. Careful monitoring for such events as large loss of fluid, drops of the drill string, and extensive freshening of the drilling mud should be conducted by the duty geologist and drilling specialists. If such events occur, either D. D. Gonzalez or J. W. Mercer may be consulted as to the advisability of conducting the test. It is expected that R. K. De Wees will monitor the slug test for its duration. Operational conditions will determine some of the conditions of such a test; the testing plan will be developed at the site and reported as conducted.

Geophysical logs of the borehole should be conducted in accordance with good standard practices by a trained logging engineer. Commercial logs will be compensated for borehole effects and will be recorded on magnetic tape for permanent retention. The USGS Water Resources Division is asked to independently log the hole for cross-documentation. The borehole gravity logging will be conducted by the USGS or by a commercial firm in accordance with their normal operating procedures.

Hole plugging programs may be deferred if the hole will be re-entered later or monitored. The borehole may be plugged if there is general agreement that it will serve no further purpose.

Decision Points: The principal operational decision is whether or not to conduct a modified slug test. The decision will be made by the principal investigator or a designated alternate in consultation with the duty geologist and a hydrologist. The criteria for initiating such a test are somewhat elusive; examples of conditions that might be good reason to conduct the slug test are: sudden loss of 50% of the drilling fluid or indications (reduced pressure on drilling string or a drop of the drill string over a depth of a foot or more) of cavities in the rock.

Decisions regarding deepening of either hole will be documented separately.

Field Support: D. W. Powers, 4511, is responsible for the technical program and technical decisions for WIPP 14; R. D. Statler, 1133, is responsible for the field engineering and operations. Decisions regarding the exact depth of coring may be delegated to the field geologist at the drilling site.

Quality Assurance: The quality level for this program is "minor." Particular elements of the program will require professional services in the field. Core description will require trained geologists and will mainly be conducted after the coring has been completed; the duty geologist will provide a preliminary core description. Borehole logging is an important interpretive tool, and the logging should be completed by an experienced logging engineer using standard practices.

D. W. Powers and R. D. Statler will review the information and operations and conduct quality surveillance as appropriate.

Copies of the drilling records will be periodically forwarded to the QA chief for review. Significant non-conformances will be documented on Forms WMP XV-2.

Further Studies: The extent of sample examination and study will depend on the nature of the samples obtained. Visual examination of core will be conducted and may be followed by slabbing/petrographic examination. Geochemical analyses may also be undertaken to provide information on the age and genesis of the feature. Extraordinary measures or techniques will be developed and described elsewhere if appropriate.

Further testing of the hydraulic parameters of highly permeable zones in the lower Dewey Lake or upper Rustler may be recommended in a separate, dedicated program after the exploratory drilling is complete. Such a recommendation would be probable if zones more permeable than the normal Rustler "aquifers" are observed.

The decision to drill deeper will also be made subsequent to the completion of the exploratory drilling. Such a recommendation would be based on whether the stratigraphy and structure of the Rustler/upper Salado are "normal". Normalcy might be defined as no brecciation and beds within about 50' of their anticipated structural position.

Background Information: The slight low (about 40') in the 124 MB at F-92 has been known since 1976 when C. L. Jones (then of the USGS) provided information on the elevations of the 124 MB from WIPP and industry boreholes. The structural low has generally been given little consideration because the overlying beds in the area do not reflect this structure. More recently, however, R. Y. Anderson, for example, has pointed out that Slick Sink, Bell Lake Sink, and the low at F-92 are roughly aligned. He considers it very possible that Slick Sink and Bell Lake Sink are dissolution features; by inference perhaps the F-92 low is also a dissolution feature. During the field trip to the Carlsbad area in June, 1980, which was sponsored by the Environmental Evaluation Group, it was proposed that the Bell Lake Sink should be investigated as a possible dissolution feature and that the F-92 low might then be shown to be a target of investigation.

Though Bell Lake Sink might be of interest as a feature of regional importance, we choose direct investigation of the structural features of interest in the northern part of the site. As a means of identifying anomalies further, a high precision gravity survey was conducted over $8^2/3$ square miles through the center of the site and extending just beyond the northern edge of zone IV. Preliminary maps of the gravity data (ltr to Robert Neill from L. J. Barrows, dated April 28, 1981) indicate gravity lows trending roughly east-west across the northern part of the site. These lows have characteristics that indicate relatively shallow (less than 500') sources of the anomalies. One of the prominent features (at WIPP 14) also exhibits a surficial sink. The area around F-92 does not have such a gravity anomaly, and the modest structural low on the 124 Marker Bed does not seem a very important target.

As information is now available that indicates WIPP 13 and 33 also have pronounced gravity lows of a similar sort to WIPP 14 and 35, a working hypothesis has been developed. The working hypothesis is generally that the low density for the gravity anomalies is due to solution of gypsum from the Dewey Lake Red Beds and/or upper Rustler Formation with possible cavernous development in some of these zones. Surficial gypsite deposits in Nash Draw west of WIPP 33 may indicate the time (350,000 years ago or more) when the process was last active. It is possible that the stratigraphy of the lower Rustler will appear normal. If highly permeable zones are developed as a result of this process, further evaluation may be necessary. However, the zone would need to have significantly greater permeability than existing Rustler "aquifers" before evaluation would be required.

It will also be important to examine evidence for any relationship of the gravity anomalies to deeper structure of the "disturbed zone." One of the additional working hypotheses is that the disturbed zone indicates dissolution and that dissolution features may be working up toward the surface. Without evidence of the effects of such a process at the top of the Salado, there will exist no definite target for further exploration of such a process at the WIPP 14 and 35 locations.

These boreholes are exploratory in that it is quite possible either may lead to a further program - perhaps even one not now envisioned. The effort is to conduct relatively simple and cheap initial tests of some hypotheses before committing much money into extensive tests. Caution will be needed in interpreting the results and in recommending further programs.

DWPowers:4511:dwp

Distribution:
W. P. Armstrong, WPO, DOE/ALO
M. W. Wilson, Fenix and Scisson, Carlsbad
R. P. Snyder, USGS, Special Projects Branch, Denver, CO
J. F. Daniel, USGS, Water Resources Division, Albuq., NM
J. W. Mercer, USGS, Water Resources Division, Albuq., NM
1133 R. D. Statler
1135 P. D. Seward
4510 W. D. Weart
4511 L. J. Barrows
4511 D. D. Gonzalez
4511 S. J. Lambert
4542 J. T. Henderson
4542 Sandia WIPP Central File (2)
4511 D. W. Powers

Draft: December 17, 1980
Approval Issue: December 22, 1980

WIPP

STATEMENT OF WORK

FOR

WIPP 14

Prepared By: Dennis W. Powers
D. W. Powers, Principal Investigator
Supervisor, Division 4511

Reviewed By: L. J. Barrows
L. J. Barrows, Peer Reviewer

R. D. Statler 12/19/80
R. D. Statler, Peer Reviewer

J. T. Henderson 12/19/80
J. T. Henderson, QA Chief

Approved By: Wendell D. Weart 12/19/80
W. D. Weart, Project Manager

Sandia National Laboratories

Albuquerque, New Mexico 87185

date: December 17, 1980

to: Distribution

Dennis W. Powers

from: Dennis W. Powers, 4511

subject: Scope of Work, WIPP 14

This memorandum provides the justification and scope of work for drilling and testing WIPP 14.

Objective: To determine, through a drilling, logging, and testing program (if warranted), the nature of stratigraphic disturbances within the upper Salado Formation as expressed by the structural low on the 124 Marker Bed (MB) at borehole F-92 and in the general area of Section 9, T22S, R31E.

The objective may include evaluation of age, process, and stratigraphic limit to the disturbance of the beds. We will be prepared to drill to or into anhydrite I of the Castile Formation if the structure persists with depth and the information appears relevant to the genesis of the structure.

The location of WIPP 14 is expected to be within a half mile radius of F-92 (near southeast corner of section 8, T22S, R31E). A more exact location is pending completion of a high precision gravity survey in the vicinity of F-92.

Method: WIPP 14 will be drilled and intermittently cored from the surface to a depth at which the structural low is penetrated and the stratigraphic sequence and structural position of beds are normal. Drill stem tests may be conducted if warranted by the findings during drilling. Logging of the hole will be undertaken to provide information on acoustic velocities, formation resistivities, porosity, density and natural radioactivity (gamma). Optional logging may be conducted to provide formation attitudes, and an uphole velocity survey may be conducted to aid interpretation of available seismic reflection data. The USGS will be contacted to help determine the usefulness and availability of a borehole gravimeter survey to interpret surface-based gravity information.

Details: The drilling will be based on the following assumptions:

that the total depth of the hole may be about 3600 feet if it is necessary to drill to the lower Castile Formation

that intermittent core will suffice through the upper Salado Formation

that a possible outcome is to terminate the borehole at a depth of less than 2000 feet

that the coring will be about 15% of the total depth.

The minimum size core that is acceptable is NX. Core handling procedures have previously been established for AEC 7, and we will follow those procedures. It is also important that salt within the core be preserved during the drilling process.

If fluids and/or gases are encountered, sampling will be attempted in accordance with procedures established in a memorandum from S. J. Lambert to R. D. Statler, dated March 6, 1979, subject: Specifications for Fluid Sampling at Well Heads. Although significant gas is not anticipated, continuous logging of drilling fluid is required to determine the presence and amounts of nitrogen, carbon dioxide, hydrogen sulfide and hydrocarbons.

Geophysical logs of the borehole should be conducted in accordance with good standard practices by a trained logging engineer. Commercial logs will be compensated for borehole effects and will be recorded on magnetic tape for permanent retention. The USGS Water Resources Division is asked to independently log the hole for cross-documentation.

Hole plugging programs may be deferred if the hole will be re-entered later or monitored. The borehole may be plugged if there is general agreement that it will serve no further purpose.

Decision Points: The following intervals, with appropriate depths, are to be cored: 1) the Rustler-Salado contact (about 930-980'), 2) the 109 MB (about 1220-1270'), 3) the 115 MB through Vaca Triste (about 1400-1450'), and 4) the 123 through 126 MB zone (about 1675-1825'. A decision will be made after the 124 MB and immediately subjacent beds have been penetrated: the borehole may be abandoned and plugged if objectives have

been met or cannot be met through continuation of the drilling. Alternatively, the borehole may be drilled as deep as the lower anhydrite of the Castile Formation if there is reasonable prospect of recovering additional information bearing on the origin of the structural low on the 124 MB.

Field Support: D. W. Powers, 4511, is responsible for the technical program and technical decisions for WIPP 14; R. D. Statler, 1133, is responsible for the field engineering and operations. Decisions regarding the exact depth of coring may be delegated to the field geologist at the drilling site.

Quality Assurance: The quality level for this program is "minor". Particular elements of the program will require professional services in the filed. Core description will require trained geologists. Borehole logging is an important interpretive tool, and the logging should be completed by an experienced logging engineer using standard practices. G. J. Long and Associates will be called upon to provide quality control on an uphole velocity survey if one is conducted.

D. W. Powers and R. D. Statler will review the information and operations and conduct quality surveillance as appropriate.

Further Studies: The extent of sample examination and study will depend on the nature of the samples obtained. Visual examination and slabbing of core is expected and may be followed by petrographic examination. Geochemical analyses may also be undertaken to provide information on the age and genesis of the feature. Extraordinary measures or techniques will be described elsewhere if appropriate.

Background Information: The slight low (about 40') in the 124 MB at F-92 has been known since 1976 when C. L. Jones (then of the USGS) provided information on the elevations of the 124 MB from WIPP and industry boreholes. The structural low has generally been given little consideration because the overlying beds in the area do not reflect this structure. More recently, however, R. Y. Anderson, for example, has pointed out that Slick Sink, Bell Lake Sink, and the low at F-92 are roughly aligned. He considers it very possible that Slick Sink and Bell Lake Sink are dissolution features; by inference perhaps the F-92 low is also a dissolution feature. During the

field trip to the Carlsbad area in June, 1980, which was sponsored by the Environmental Evaluation Group, it was proposed that the Bell Lake Sink should be investigated as a possible dissolution feature and that the F-92 low might then be shown to be a target of investigation.

Though Bell Lake Sink might be of interest as a feature of regional importance, we choose direct investigation of the structural low in the vicinity of F-92. The location for WIPP 14 will be determined through consideration of the previously developed structural data tied with the high precision gravity survey now underway in the area. Because this low at the 124 MB is geographically located in the "disturbed zone", the information developed from the borehole is expected to shed more light on the disturbed zone than on the relationship to Bell Lake Sink and Slick Sink as possible dissolution features or "breccia pipes".

DWPowers:4511:dwp

Distribution:
W. P. Armstrong, WPO, DOE/ALO
W. S. Twenhofel, USGS, Special Projects Branch, Denver, CO
R. P. Snyder, USGS, Special Projects Branch, Denver, CO
J. Daniels, USGS, Water Resources Division, Albuq., NM
J. W. Mercer, USGS, Water Resources Division, Albuq., NM
1133 R. D. Statler
1135 P. D. Seward
4510 W. D. Weart
4511 L. J. Barrows
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Copy WIPP 14

APPENDIX B

DRILLING AND TESTING PLAN

compiled by

R. D. Statler
Division 7133
and
P. D. Seward
Division 7135
Sandia National Laboratories

INTRODUCTION TO APPENDIX B, DRILLING AND TEST PLAN

The drilling and testing plan is the translation of technical objectives contained in the document in Appendix A into field engineering terms. Changes or amendments are included as well. The approvals and permits obtained from various agencies prior to drilling are kept on file but are not included here.

SANDIA NATIONAL LABORATORIES

FIELD OPERATIONS PLAN

FOR WIPP-14

Sandia Laboratories

Albuquerque, New Mexico
Livermore, California

date: MAY 1 1981

to: J. M. McGough, WPO, DOE/ALO

Wendell D. Weart

from: W. D. Weart, 4510

subject: Field Operations Plan for WIPP-14

The attached document contains the Field Operations Plan for the drilling of the exploratory hole WIPP-14. We request your approval and your authorization to Fenix and Scisson to proceed with the work in accordance with this plan and their Quality Assurance Manual for the Waste Isolation Pilot Plant Project.

RDStatler:1133:bdg

Copy to:
L. M. Gard, USGS, Special Projects Div., Denver, CO
R. P. Snyder, USGS, Special Projects Div., Denver, CO
J. W. Mercer, USGS/WRD, Albuquerque, NM (3)
J. A. Cross, F&S, Las Vegas, NV
Matt Wilson, F&S, Carlsbad, NM (3)
W. P. Armstrong, DOE/WPO, Albuquerque, NM
D. Van Sickle, USGS/Area Geologist, Roswell, NM

1130 H. E. Viney
1133 R. D. Statler
1133 C. W. Gulick
1133 W. C. Wilson
1135 P. D. Seward
1135 B. Lacher
1556 F. Hensley
4511 L. J. Barrows
4511 S. J. Lambert
4511 D. W. Powers
4511 D. D. Gonzalez
4542 J. W. McKiernan
4542 J. T. Henderson
4542 WIPP Central Files (2)
4510 W. D. Weart

FIELD OPERATIONS PLAN OF SANDIA NATIONAL LABORATORIES
WIPP SITE INVESTIGATIONS

Exploratory Hole: WIPP-14

Location: Section 9, T22S, R31E
Eddy County, New Mexico

Purpose: To further the investigation of a suspected disturbed zone by coring and logging an exploratory hole.

Prepared by: R. D. Statler
R. D. Statler, 1133

Reviewed by: P. D. Seward
P. D. Seward, 1135

Reviewed by: L. J. Barrows
L. J. Barrows, 4511

Approved by: Wendell D. Weart for
D. W. Powers, 4511

Approved by:
J. T. Henderson, 4542
QA Chief

Approved by: Wendell D. Weart
W. D. Weart, 4510
WIPP Project Manager

TABLE OF CONTENTS

INTRODUCTION

This document contains the plans, procedures and specifications for drilling an exploratory hole to determine if the stratigraphic sequence and the position of beds are normal. In view of the possibility that stratigraphy may be abnormal and that zones of lost circulation, cavitation and/or fluid production may be encountered, it will be incumbent upon the drilling crew and the duty geologist to carefully monitor the hole conditions as drilling progresses. Continuous core will be taken from ~15' to 650' and then rotary drilling to 30' above the Rustler/Salado contact where coring will resume through the contact. Core will be logged, photographed and packaged at the site and placed on file in the WIPP core library in Carlsbad, New Mexico. A minimal suite of geophysical logs will also be taken.

1. FIELD OPERATIONS CRITERIA

This operations plan is based on criteria established by D. W. Powers, 4511.

2. FIELD OPERATIONS PLAN

2.1 Organization and Responsibilities

2.1.1 The technical program in this operation is the responsibility of Division 4511. Field decisions affecting the technical objectives will be made with full concurrence of Division 4511.

2.1.2 The U.S. Geological Survey Water Resources Division will be responsible for logging and is expected to provide their expertise and recommendations throughout the program.

2.1.3 The direction of field operations described in this plan is the responsibility of R. D. Statler and P. D. Seward of Department 1130. They will coordinate and administer field activities as necessary to ascertain a timely and orderly completion of the plan's objectives.

2.1.4 Arrangements have been made through the DOE/WPO for support of Fenix & Scisson, a DOE/NVOO drilling engineering contractor. F&S will plan, contract for and administer the drilling, coring, logging, testing and other associated services according to the technical criteria provided by Sandia and according to the F&S WIPP Quality Assurance Manual.

2.1.5 The quality level for this program is categorized as "minor." Appropriate Quality Assurance measures shall be applied in accordance with the existing SNL WIPP Quality Assurance Plan.

2.2 Supporting Data

R. P. Snyder, USGS, Special Projects, Denver provides the following projections of formation depths for the WIPP-14 area:

Top of Dewey Lake	139
Top of Rustler	649
Top of Magenta	700
Top of Culebra	819
Rustler/Salado Contact	949
Base 124 MB	1679

The preliminary survey records the location about 1177 feet east of WIPP-34 at an elevation of 3429'.

2.3 Drilling Program

The specifics of the proposed initial drill program for WIPP-14 are as follows:

2.3.1 Construct suitable minimum access road from existing access road to WIPP-34.

2.3.2 Construct minimum size drill pad to accommodate small rig.

2.3.3 Construct minimum cellar and set conductor pipe as required.

2.3.4 Rig up to take continuous wireline core (NC or larger) from ~15' to 650' depth.

2.3.5 Rotary drill to ~30' above the Rustler/Salado contact (~930').

2.3.6 Take continuous core (NC or larger) through the R/S interface for an estimated T.D. of ~1000'.

2.3.7 Use drilling fluid best suited to promote good core recovery.

2.3.8 Run USGS/WRD logs: Density, Neutron, Gamma and Caliper.

2.3.9 Rig down and temporarily abandon hole pending further testing or deepening according to indicated results.

2.4 Testing Program

In the event that unusual conditions are encountered, i.e., excessive lost circulation, cavitation, and/or fluid production, drilling operations will cease and a testing program will be formulated and documented as existing conditions dictate.

3. FIELD OPERATING PROCEDURES FOR QUALITY ASSURANCE REQUIREMENTS

3.1 Cementing

The plans for cementing or plugging WIPP-14 are unknown at this time. There are no plans for casing the hole and any plans for plugging will be made after completion of the hole.

3.2 Coring Operations Procedure of Sandia National Laboratories - WIPP Site Investigations

3.2.1 Introduction

This procedure is prepared by the Field Engineering Division 1133 for use in Sandia National Laboratories' WIPP Program. The objective is to establish the methods and techniques to be used in coring operations in order to obtain reliable samples in a uniform manner.

3.2.2 Scope of Work

This coring operation is to be done as a part of exploratory drilling of a suspected disturbed zone. Intermittent coring will consist of taking approximately 550' of NC core to a TD of approximately 1000'. Core is to be removed from the core barrel, logged, measured, cleaned, marked, photographed and packaged, transported and stored according to the procedures presented in this document.

3.2.3 Organization

Sandia National Laboratories is conducting this field work under technical direction from Division 4511. The Sandia Field Engineering Division 1133 will manage the field operations.

Fenix & Scisson will prepare and administer a drilling program from criteria provided by Sandia that includes the taking of core. The drilling contractor, the coring contractor and the roustabout contractor are under contract to F&S.

F&S will provide the duty geologist for logging and identifying the core and supervision of core handling in the field.

Sandia National Laboratories will provide core photography.

Sandia National Laboratories will provide core storage.

3.2.4 Operations

3.2.4.1 Coring (F&S and their contractors)

Wireline coring with a 3-7/8 x 2-1/4" core bit and a nominal 10 or 20' conventional core barrel is recommended.

Other equipment and material such as drill-collars and stabilizers, drilling fluid should be utilized according to best judgment to match the formation and produce optimum core recovery.

Select and use drilling weight, rotary speed and circulation rates that will produce optimum core recovery.

Maintain a daily record which shows: date; tour and operating personnel; sequence of core interval; depth of core interval; drilling time of core interval; drilling

weight; rotary speed and circulation rate; and type circulating fluid.

3.2.4.2 Removal from Barrel (F&S and their contractors)

Core should be removed from core barrel as gently as possible to cause minimum alteration of the core. Light hammering or jarring is permissible, but heavy hammering or pounding the barrel on its end is to be avoided. Removal by pumping is permissible.

As the core is removed, it will be placed in troughs in the order coming out of the barrel. Troughs will be marked with red at top end and black at bottom indicating down direction.

3.2.4.3 Core Marking

If core is suitable for marking, each major piece should be marked with a visible waterproof ink arrow pointing in the direction the hole is advancing. Each core piece should be measured, identified and logged indexing each foot with footage expressed to the closest 1/10 of a foot. Depths should be reconciled from measurements of the drill pipe to the nearest foot taken from the top side of the Kelly bushing (KB) unless otherwise specified.

Any lost recovery should be logged at the bottom of each core interval unless known to be otherwise and so explained on the core log.

3.2.4.4 Cleaning (F&S and contractors)

Core will be wiped or brushed to remove soft mud cake and excess mud as soon as possible following removal from the core barrel. A rag dampened in drilling fluid will be used to wipe the core. If core is accidently washed with fresh water, it will be noted in the log stating intervals exposed and time of occurrence.

3.2.4.5 Photograph (Sandia and Duty Geologist)

After core has been logged, labeled and cleaned, it will be carefully moved to the core/photo shed and prepared for photography. Core may be wetted with brine to enhance photo coverage. Core should be positioned by the duty geologist to promote coverage of pertinent features such as fractures, bedding plane, color or any other significant characteristics. Each photo should have a title block showing well number, date, core interval and photo number.

3.2.4.6 Preservation (Duty Geologist, F&S Contractor)

After core has been photographed it will be wiped dry and preserved for transportation and storage in the following method.

3.2.4.6.1 Core pieces will be separated into lengths appropriate to fit into the core boxes. Pieces will be placed into plastic sleeves of appropriate length or wrapped and taped with plastic sheet. When using sleeves, use a hot iron sealing tool, seal both ends of plastic sleeve after squeezing all air possible from sleeve. Place sleeved or wrapped core into box and tape shut. When core intervals are missing, spacers marked with missing footage figures may be inserted in the box as necessary to preserve sequence. Boxes should be labeled in sequence with name of agency, well number, date, core number and depth of core pieces in the box.

3.3 Borehole Geophysical Logging Operations Procedure of Sandia National Laboratories - WIPP Site Investigations

3.3.1 Introduction

This procedure is prepared by the Sandia National Laboratories Field Engineering Division 1133 for use in Sandia's WIPP Site Investigation. The objective is to establish standard routines and methods for borehole geophysical logging in order to assure qualified data in a reliable manner.

3.3.2 Scope of Work

Geophysical logging of boreholes in the WIPP Site Investigations may include a wide variety of individual logging services. Logging services may be provided by several different commercial firms utilizing different types of tools and techniques. Services may be purchased directly by Sandia National Laboratory or through engineering firms such as Fenix & Scisson.

The scope of logging services will change from borehole to borehole and will depend on the specific objectives of the borehole program.

It is not the intent of this document to tell the logger how to run his business. Rather it is to ensure quality through standard routines and a "check list" and in so doing make certain the objectives of the logging program as stated by the Technical Director can be achieved through the exchange of pertinent information and utilization of qualified personnel.

3.3.3 Organization

The Sandia Laboratories is conducting this field work with technical direction from Division 4511. Field operations is managed by Sandia Field Engineering Division 1133.

Sandia Labs has arranged with DOE/NVOO for their contractor, F&S, to prepare and administer a drilling program and associated subcontracts from criteria provided by Sandia which include borehole logging on WIPP 31.

3.3.4 Operations

3.3.4.1 The Field Operations Plan prepared for each borehole will identify the probable logs to be run. Since the logging program is usually customized to fit the hole conditions, the specific logs to be run are not be included here but will be the sub-

ject of a written supplement to the Field Operations Plan and distributed in time to select the proper service.

3.3.4.2 Prior to selecting a logging service, a Sandia representative will meet with Fenix & Scisson and prepare the form "Instructions to Logging Company" for the specific logs to be run.

3.3.4.3 Prior to logging, a qualified representative of Sandia Labs will meet with the logging service company's logging engineer. He will present the "Instructions...." and discuss:

a) the entire logging program and special requirements,

b) hole conditions that may cause problems, and

c) zones of special interest.

3.3.4.4 During the pre-log conference, the Sandia representative will discuss and request the following to be done:

- The equipment will be "warmed up" for the adequate amount of time and tools will be checked to see that they are calibrated as appropriate and functioning properly upon arrival at the location.

- Rm, Rmf, and Rmc will be measured on mud samples. Estimated values are not acceptable. The service company should run the sample through a mud press.

- All Sidewall and Compensated Neutron logs and all density porosity curves will be run on limestone matrix over the zones of interest, regardless of the lithology.

- Equipment will be tested while running in hole.

- Before and after log calibrations will be shown for all curves.

- Panel calibrations will be shown for all density and neutron logs, integration checks will be shown for all integrated Acoustic logs.

- In addition to caliper rings, the caliper calibration should show "tool full open" and casing readings.
- A minimum 200 feet repeat must be shown.
- Overlap previous runs by at least 200 feet.
- All headings information will be completely filled out.

3.3.4.5 The Sandia logging representative will be present and observe the logging operation to the extent necessary to assure objectives have been met. He should complete a "Log Quality Report" following the operation and, along with a copy of "Instructions to Logging Company," forward to Sandia Field Engineering Division 1133.

3.3.5 Records

3.3.5.1 "Instruction to Logging Company"

F&S should prepare, following a conference with Sandia representative, and provide ten copies to Sandia Field Eng. Div. 1133.

Distribution should be made as follows:

1 Logging Company

1 Sandia Representative - observing log operations

1 F&S

1 Sandia Carlsbad Hole File

2 Sandia WIPP Central Files (SCWF)

1 Sandia Division 1133, ABQ

1 Sandia Division 4511, ABQ

1 USGS, Spec. Proj., Denver (Attn: R. P. Snyder)

1 USGS/WRD, ABQ, Attn: J. Mercer

3.3.5.2 Log Quality Report

Sandia representative should prepare and distribute as follows:

3 Original and two copies to Sandia Field Engineering Division 1133, ABQ, who will be responsible for forwarding to WIPP Central Files

1 Sandia Carlsbad Hole File

1 F&S, Carlsbad

3.3.5.3 Geophysical Logs (Field Prints)

F&S Carlsbad should obtain 9 copies of log field prints and distribute as follows:

1 Sandia Carlsbad Hole File

2 USGS, Spec. Proj. Denver, Attn: R. P. Snyder

1 USGS/WRD, ABQ, Attn: J. Mercer

1 Sandia Division 4511, ABQ, Attn: D. W. Powers

4 F&S, Carlsbad (4 copies)

3.3.5.4 Geophysical Logs (Final Prints)

F&S should order 15 final copies of logs and two copies of library magnetic tapes of the logs and distribute as follows:

1 Sandia Carlsbad Hole File

2 USGS, Spec. Proj., Denver, Attn: R. P. Snyder

2 USGS/WRD, ABQ, Attn: J. Mercer

3 Sandia Division 4511, ABQ, Attn: D. W. Powers

2 Sandia Division 4542, WIPP Central File, ABQ; 2 copies logs and 2 copies tapes

1 F&S, Carlsbad

1 F&S, Las Vegas

1 State Engineer, Roswell, NM

1 USGS Area Geologist, Roswell, NM

1 West Texas Electric Log Service

3.3.5.5 Core Photos (Final Prints)

Sandia National Lab will arrange for core photography as described previously in paragraph 3.2.4.5. 8-1/2" x 11" prints will be made and distributed as follows:

1 set USGS, Spec. Proj., Denver, Attn: R. P. Snyder

1 set USGS/WRD, ABQ, Attn: J. M. Mercer

1 set Sandia Division 4511, ABQ

2 sets Sandia Division 4542, ABQ, WIPP Central File

3.4 Verification

Verification shall be accomplished by suitable peer observation and shall be noted in the WIPP-14 log book or by means of Telecon/conference notes to the SWCF.

3.5 Nonconformance/Unusual Occurrence Reporting

Nonconformances and/or unusual occurrences shall be noted in the WIPP-14 log book and by means of completed WMPXV-2 forms.

3.6 Log book Reviews

Copies of the WIPP-14 log book shall be routinely forwarded to the WIPP QA chief for review.

4. REPORTS

4.1 Daily Report

F&S, Carlsbad office, will provide to Sandia, Carlsbad, a copy of the daily report. Sandia, Carlsbad, will telefax the daily report on weekdays to Division 4511 and Division 1133 in Albuquerque. A copy of the daily report will be kept on file in the Sandia Carlsbad office.

4.2 Daily Time Log

A Daily Time Log will be maintained by the F&S drilling specialist. Two copies will be provided to the Sandia, Carlsbad, office. Sandia, Carlsbad, office will maintain a file of the log.

4.3 Hole History

A Hole History of the drilling activities will be prepared by F&S from their daily time logs and other pertinent records. A reproducible copy of this history is to be sent to R. D. Statler, Division 1133, ABQ, following completion of field activities for subsequent distribution.

4.4 Miscellaneous Records

A variety of records are kept by F&S that will be useful in historical preparation. These are to be kept on file in Carlsbad while the program is active and on completion a copy forwarded to R. D. Statler, Division 1133, for placement in the WIPP central file. They include:

Driller Logs, Bit Records, Drilling Fluid Re-caps, Equipment Certification, Drilling History Chart, and Cost Records.

Sandia Laboratories

Albuquerque, New Mexico
Livermore, California

date May 21, 1981

to M. W. Wilson, F&S, Carlsbad, NM

from R. D. Statler, SNL, 1133

subject: Supplement to Field Operations Plan for WIPP-14 Distributed May 1, 1981

The referenced operations plan for WIPP-14 should be modified as follows:

Paragraph 2.3 Drilling Program

2.3.4 Rig up to take continuous wireline core (NC or larger) from ∿ 15' through the anhydrite at the top of the Rustler formation ∿ 650'

2.3.4 Condition the hole and run USGS gamma, neutron, density and caliper logs

2.3.5 Open the hole to ∿ 125' and hang temporary 7" casing.

2.3.6 Continue inside casing and open hole and drill with nominal 6½" bit to base of Rustler ∿ 900'

2.3.7 Resume coring w/NC wireline core through the Rustler/ Salado interface to ∿ 960'

2.3.8 Open hole w/6½" bit to a TD of ∿ 1000'

2.3.9 Condition hole and prepare to log the hole. Repeat the USGS log suite and also run commercial log compensated density w/gamma.

2.3.10 Rig down and temporarily abandon hole pending further testing and logging.

RDS:1133:bl

Copy to:

R. P. Snyder - USGS, Spec.Proj.Div.,Denver
J. W. Mercer - USGS/WRD, ABQ, NM
J. A. Cross - F&S, Las Vegas, NV
W. P. Armstrong - DOE/WPO,Carlsbad, NM
B. Melton - USGS/Area Geologist,Roswell
1130 H. E. Viney
1133 R. D. Statler
1135 P. D. Seward
1135 B. Lacher
4510 W. D. Weart
4511 D. W. Powers
4542 J. T. Henderson
4542 WIPP Central Files (2)

November 26, 1980

Mr. Matt Wilson
Fenix & Scisson, Inc.
104 N. Canal Street
Carlsbad, New Mexico 88220

Dear Matt:

Here are the predicted depths to the marker beds for WIPP-14 that you requested by phone on November 26th. I believe the depths to be accurate to ±20 feet. Note the change where I have starred the interval.

If WIPP is:	Near FC-92	1/2 mile north of FC-92, in sec. 9
Rustler/Salado contact	960	970
MB 109	1,262-1,284	*1,242-1,264
Top of MB 115	1,422	1,402
MB 123-124	1,709-1,732	1,693-1,715

Sincerely yours,

Richard P. Snyder
Geologist
Special Projects Branch

CC: L. M. Gard
R. Statler, Sandia

bcc: SPB subject
SPB reading (2)
RPSnyder:emo

United States Department of the Interior
GEOLOGICAL SURVEY
BOX 25046 M.S. 954
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

October 31, 1980

Mr. Dennis Powers
Sandia National Laboratories
Department 4511
P.O. Box 5800
Albuquerque, New Mexico 87115

Dear Dennis:

This letter is in answer to your telephone request of October 30, asking for Special Projects Branch requirements for WIPP-14. We are interested in a two-phase operation. Phase I would include drilling and coring to and through the 124 MB at an estimated depth of 1,695-1,725 feet, depending on where the hole is to be located. An estimated 15 percent of the hole would be cored. Specific units to be cored are (1) the Rustler-Salado contact, (2) the 109 MB, (3) the 115-Vaca Triste zone, and (4) the 123-124 MB zone. Phase II would depend upon the information gained from Phase I. The plan would be to continue drilling and coring below MB 124 to and into Anhydrite I of the Castile Formation, estimated to be about 3,600 feet deep, depending on where the hole is located. As in Phase I, only about 15 percent of the hole would need to be cored. Most contacts can be obtained from geophysical logs and the core would be examined for any indications of salt flowage and/or fracturing and stretching of the anhydrite in the Castile.

The location of WIPP-14 has not yet been chosen. Two areas where it might be located are (1) somewhere within a few hundred feet of FC-92 or (2) about one-half mile north of FC-92 and 500 feet east of the west line of section 9.

As you know, Special Projects Branch will not be able to field a geologist during the drilling of WIPP-14 because of the commitment laid on us to write the breccia pipe report.

Sincerely yours,

Richard P. Snyder
Geologist
Special Projects Branch

APPENDIX C

HOLE HISTORY

compiled by

R. D. Statler
Division 7133
and
P. D. Seward
Division 7135
Sandia National Laboratories

INTRODUCTION TO APPENDIX C, HOLE HISTORY

The hole history is a document provided soon after completion of the borehole, and it summarizes the relevant information on the daily log kept by the contractor. The hole history is not edited to ensure conformance in every detail with later information developed for previous chapters. Further information may be obtained as necessary through examination of the original daily time logs.

FENIX & SCISSON, INC.

HOLE HISTORY DATA

DATE: 7-31-81 APPROVED: _____

HOLE No.: WIPP #14	W. O. No.:	I. D. No.:
USER: Sandia Lab	TYPE HOLE: Exploratory	
LOCATION: New Mexico	COUNTY: Eddy	AREA: WIPP
SURFACE COORDINATES: Section 9, Township 22S, Range 31E*		GROUND ELEVATION: 3429'
RIG ON LOCATION: 5-1-81	SPUDDED: 5-2-81	COMPLETED: 6-8-81
CIRCULATING MEDIA: Brine		
No. of COMPRESSORS & SIZE:		

BORE HOLE RECORD			CASING RECORD							
FROM	TO	SIZE	I. D.	WT./FT.	WALL	GRADE	CPL'G	FROM	TO	CU. FT. CMT.
0'	110.4'	8-3/4"								
110.4'	111.4'	7-5/8"	6.366"	23#		J-55		0'	110.69'	-
111.4'	1000'	6-1/8"		With 7-7/8" shoe		built up to 8-1/4"				

TOTAL DEPTH: 1000' MANDREL DEPTH PLUGS:

JUNK:

LOGGING DATA: See History SURVEYS PAGE: CORING PAGE:

BOTTOM HOLE COORDINATES: @ REFERENCE:

NON-OPERATIONAL TIME		OPERATIONAL DELAY TIME		WORKING TIME	
Move Rig up & down	1.15 days	Equipment Repair	1.01 days	Drilling Time	1.97 days
Secured	27.41 days	Caving	____ days	Trip Time	.65 days
Bail & Run Mandrel	____ days	Lost Circ.	____ days	Single Shot Survey Time	____ days
Logging	.42 days	Fishing	____ days	Coring	4.27 days
Survey	____ days	W.O. Equipment	.10 days	Total	6.89 days
Casing	.24 days	Lay down drill pipe	.35 days	Total Suspended Time	____ days
Cement	____ days	W.O. Loggers	.04 days	Non-Operational Time	29.30 days
Coring	____ days	Work Stuck Core Barrel	.31 days	Operational Delay Time	2.14 days
	____ days	Condition Hole-Mix Mud	.33 days	Working Time	6.89 days
TOTAL	29.30 days	TOTAL	2.14 days	TOTAL ELAPSED TIME	38.33 days

REMARKS: * 97.3' FSL, 2103.7' FEL

Rig No.	Name	Type	
3	Penn Drilling Co.	Failing 1500	38.33 days
			____ days
			____ days
			____ days
			____ days
			____ days

JRG:sjw

WIPP #14
HOLE HISTORY

5-1-81	Moved in Pennsylvania Drilling Co., rig #3 and rigged up. Eight hour daily operations.
5-2-81	Drilled 7-7/8" hole from 0' to 15.40'.
5-3-81	Rig was secured.
5-4-81	Opened 7-7/8" hole to 8-3/4" hole from 0' to 15.40'. Set 7-5/8" O.D. casing at 15.40' with 0.8' stick up. Cemented top 3' around casing with 2 sacks of cement.
5-5-81	Cored run #1 using NC wireline core barrel from 15.40' to 16.40' with 3-7/8" x 2-1/4" core bit. Recovered 1.9'. The conductor pipe was leaking while coring. Opened 3-7/8" to 4-3/4" from 15.40' to 16.40' and drilled 4-3/4" hole to 18.00'. Set 4-1/2" 9.5# casing at 18.00' with 1.7' stick up. Cored run #2 from 18.00' to 24.50' using salt water as the circulating medium. Recovered 0.80'. Mixed mud and conditioned hole.
5-6-81	Repaired hydraulic pull down. Cored runs #3, #4, and #5 from 24.50' to 34.35'. Cored 9.85' and recovered 4.35'. Mixed mud and waited on fuel. Cored runs #6 through #13 from 34.35' to 57.20'. Cored 22.85' and recovered 12.7'.
5-7-81	Cored runs #14 through #31 from 57.2' to 138.0'. Cored 80.8' and recovered 61.1'.
5-8-81	Cored runs #32 through #37 from 138.0' to 177.50', cored 39.5' and recovered 38.5'.
5-9-81	Rig was secured.
5-10-81	Rig was secured.
5-11-81	Cored runs #38 through #47 from 177.50' to 244.50'. Cored 67.0' and recovered 63.95'. Started coring run #48 from 244.50' to 247.0'.
5-12-81	Finished coring runs #48 through #56 from 247.0' to 304.50'. Cored 60.0' and recovered 60.0' plus 3.3' recovery from run #47. Started coring run #57 from 304.50' to 308'.
5-13-81	Finished coring run #57 from 308' to 313.50'. Cored 9.0'. Recovered 8.70'. Cored runs #58 through #62 from 313.5' to 358.5'. Cored 45.0'. Recovered 45.0'. Started coring run #63 from 358.5' to 362.8'.

5-14-81 Finished coring run #63 from 362.80' to 367.50'. Cored 9.0'. Recovered 9.3'. Cored runs #64 through #70 from 367.5' to 426.5'. Cored 59,0'. Recovered 58.80'. Started coring run #71 from 426.5' to 430.5'.

5-15-81 Finished coring run #71 from 430.50' to 435.50'. Cored 9.0'. Recovered 9.8'. Cored runs #72 through #77 from 435.50' to 485.50'. Cored 50'. Recovered 49.5'. Pulled core barrel out of hole and secured rig.

5-16-81 Rig was secured.

5-17-81 Rig was secured.

5-18-81 Cored runs #78 through #83 from 485.50' to 538.50'. Cored 53.0'. Recovered 53.0'. Started coring run #84 from 538.5' to 544.50' and the core bit plugged and was unable to pull the inner barrel. Started pulling the core barrel out of hole.

5-19-81 Finished pulling core barrel out of hole and corrected hole depth 1.0' from 544.50' to 545.50'. Cored 7.0'. Recovered 7.0'. Core bit was damaged. Ran 3-7/8" x 2-1/4" bit #2 (rerun) and washed bit down from 544.50' to 545.50'. Cored runs #85 through #88 from 545.50' to 580.80'. Cored 35.30'. Recovered 34.90'. Started coring run #89 from 580.8' to 589.80'.

5-20-81 Pulled core #89. Cored 9.0'. Recovered 9.4'. Cored runs #90 through #95 from 589.80' to 645.0'. Cored 55.20'. Recovered 55.0'. The top of the Rustler Formation was at 638.70'.

5-21-81 Cored runs #96 through #99 from 645.0' to 681.2'. Cored 36.20'. Recovered 35.6'. The bottom of the Rustler Formation was at 676.30'. Mixed mud and conditioned hole. Ran USGS logs.

5-22-81 Rigged up and pulled 4-1/2" O.D. casing set at 18.0'. Pulled 7-5/8" casing set at 15.40'. Ran 8-3/4" rerun bit and reamed 4-3/4" hole to 8-3/4" from 15.40' to 18.0' and 3-7/8" core hole from 18.0' to 110.40'. Pulled 8-3/4" bit and ran 7-5/8" rerun bit and opened 3-7/8" core hole to 7-7/8" from 110.40' to 111.40'. Conditioned hole to run casing. Pulled 7-7/8" bit out of hole. Ran 7" O.D., 23# casing with 7-7/8" casing shoe built up to 8-1/4" with duct tape. Landed casing at 110.69' with 1.20' stick up. Secured rig.

5-23-81	Rig was secured.
5-24-81	Rig was sucured.
5-25-81	Rig was secured.
5-26-81	Ran 6-1/8" bit and reamed 3-7/8" core hole to 6-1/8" from 110' to 372'. Pulled bit out of hole.
5-27-81	Ran 6-1/8" bit #2 in hole and reamed tight hole from 282' to 372'. Reamed 3-7/8" core hole to 6-1/8" from 372' to 445'. Pulled 6-1/8" bit up to 100' and secured rig.
5-28-81	Ran 6-1/8" bit back to 445' and reamed 3-7/8" core hole to 6-1/8" from 445' to 670'.
5-29-81	Made trip and put on new bit. Reamed 3-7/8" core hole from 670' to 680.5'. Drilled 6-1/8" hole from 680.5' to 775'. Made trip out and secured rig.
6-1-81	Rig was secured from 1800 hours, 5-29-81 to 0800 hours 6-1-81. Made trip in hole and drilled 6-1/8" hole from 775' to 920'. Pulled bit out of hole.
6-2-81	Made trip and laid drill pipe down. Ran core barrel and bit to 920'. Cored run #100 from 920' to 929'. Recovered 8.9'. Cored run #101 from 929' to 938'. Could not pull inner barrel.
6-3-81	Pulled core barrel out of hole and removed stuck inner barrel. Cored 9'. Recovered 9.1'. Made trip in hole. Worked on fuel pump.
6-4-81	Replaced fuel pump. Cored run #102 from 938' to 939'. Cored 1'. Recovered 1'. Cored runs #103 and #104 from 939' to 957'. Cored 18'. Recovered 18'. The top of the Saludo Formation was at 950'. Laid NQ rods down.
6-5-81	Ran 6-1/8" bit and opened 3-7/8" core hole to 6-1/8" from 920' to 957' then drilled 6-1/8" hole from 957' to 1000'. Laid drill pipe down. Ran Dresser-Atlas combination gamma-ray, caliper and density log to 999' and logged out from 996' to surface. Ran USGS gamma ray, neutron and density logs to 1000' and logged out to surface.
6-8-81	Rig was secured from 2200 hours, 6-5-81 to 0800 hours 6-8-81. Rigged down and moved off.

CORE RECORD

CORE NO.	INTERVAL CORED-FT.	FEET CORED	FEET RECOVERED	% RECOVERY
1	15.4 - 16.4	1	1.1	110
2	18 - 24.5	6.5	0.8	12.3
3	24.5 - 28.35	3.85	1	26
4	28.35- 31.5	3.15	0.5	15.9
5	31.5 - 34.35	2.85	2.85	100
6	34.35- 37.35	3	1.9	63.3
7	37.35- 40.35	3	1.5	50
8	40.35- 43.6	3.25	0.8	24.6
9	43.6 - 46.6	3	2.5	83.3
10	46.6 - 49.6	3	0.4	13.3
11	49.6 - 51.5	1.9	0	0
12	51.5 - 54.5	3	1.9	63.3
13	54.5 - 57.2	2.7	2.7	100
14	57.2 - 60.2	3	3	100
15	60.2 - 63.2	3	1.8	60
16	63.2 - 68.2	5	0	0
17	68.2 - 72.4	4.2	1.6	38
18	72.4 - 76	3.6	1.9	52.8
19	76 - 79	3	2.3	76.7
20	79 - 82	3	0	0
21	82 - 85	3	0	0
22	85 - 88	3	2.8	93.3
23	88 - 91.5	3.5	2.9	82.9
24	91.5 - 94.5	3	2.5	83.3
25	94.5 - 97.5	3	2.3	76.7
26	97.5 -100.5	3	3	100
27	100.5 -105.5	5	5	100
28	105.5 -111.5	6	5.5	91.7
29	111.5 -121.5	10	10	100
30	121.5 -131.5	10	10	100
31	131.5 -138	6.5	6.5	100
32	138 -145	7	6.9	98.6
33	145 -151.5	6.5	6.6	100
34	151.5 -158.2	6.7	6.7	100
35	158.2 -165	6.8	5.5	80.9
36	165 -171.5	6.5	5.5	84.6
37	171.5 -177.5	6	7.3	121.7
38	177.5 -184.5	7	7.1	101.4
39	184.5 -191.5	7	6.7	95.7
40	191.5 -197.5	6	6.6	110
41	197.5 -204.5	7	6.7	95.7
42	204.5 -211.5	7	7	100
43	211.5 -217.5	6	6.3	105
44	217.5 -224.5	7	6.7	95.7
45	224.5 -231.5	7	6.9	98.6
46	231.5 -237.5	6	6.2	103.3
47	237.5 -244.5	7	3.75	53.6

CORE RECORD (Cont'd.)

CORE NO.	INTERVAL CORED-FT.	FEET CORED	FEET RECOVERED	% RECOVERY
48	244.5 - 251.5	7	10.1	144.3
49	251.5 - 257.5	6	6.3	105
50	257.5 - 264.5	7	6.8	97.1
51	264.5 - 271.5	7	6.8	97.1
52	271.5 - 277.5	6	6.5	108.3
53	277.5 - 284.5	7	6.6	94.3
54	284.5 - 291.5	7	7	100
55	291.5 - 297.5	6	5.5	91.7
56	297.5 - 304.5	7	7.7	110
57	304.5 - 313.5	9	8.7	96.7
58	313.5 - 322.5	9	8.8	97.8
59	322.5 - 331.5	9	9.3	103.3
60	331.5 - 340.5	9	9.1	101.1
61	340.5 - 349.5	9	9	100
62	349.5 - 358.5	9	8.8	97.8
63	358.5 - 367.5	9	9.3	103.3
64	367.5 - 376.5	9	4	44.4
65	376.5 - 381.5	5	9.5	190
66	381.5 - 390.7	9.2	9.7	105.4
67	390.7 - 399.5	8.8	8.8	100
68	399.5 - 408.5	9	8.9	98.9
69	408.5 - 417.5	9	8.9	98.9
70	417.5 - 426.5	9	9	100
71	426.5 - 435.5	9	9.8	108.9
72	435.5 - 444.5	9	8.9	98.9
73	444.5 - 453.5	9	9.6	106.7
74	453.5 - 463.4	9.9	9.1	91.9
75	463.4 - 471.5	8.1	8.1	100
76	471.5 - 480.5	9	9	100
77	480.5 - 485.5	5	4.8	96
78	485.5 - 494.5	9	8.8	97.8
79	494.5 - 503.5	9	9.1	101.0
80	503.5 - 511.5	8	8.3	103.5
81	511.5 - 520.5	9	9.1	101.1
82	520.5 - 529.5	9	8.7	96.7
83	529.5 - 538.5	9	9	100
84	538.5 - 545.5	7	7	100
85	545.5 - 554.5	9	9	100
86	554.5 - 563.5	9	8.9	98.9
87	563.5 - 571.8	8.3	7.3	87.9
88	571.8 - 580.8	9	9.7	107.7
89	580.8 - 589.8	9	9.4	104.4
90	589.8 - 599	9.2	9.1	98.9
91	599 - 608	9	9	100
92	608 - 618	10	10	100
93	618 - 626.8	8.8	8.7	98.8

CORE RECORD (Cont'd.)

CORE NO.	INTERVAL CORED-FT.	FEET CORED	FEET RECOVERED	% RECOVERY
94	626.8 - 636	9.2	9.2	100
95	636 - 645	9	9	100
96	645 - 654.2	9.2	9.1	98.9
97	654.2 - 663.2	9	9	100
98	663.2 - 672.2	9	9	100
99	672.2 - 681.2	9	8.5	94
100	920 - 929	9	8.9	98.8
101	929 - 938	9	9.1	101.1
102	938 - 939	1	1	100
103	939 - 948	9	9.4	104.4
104	948 - 957	9	8.6	95.5

PROPOSED DRILL HOLE LOCATION

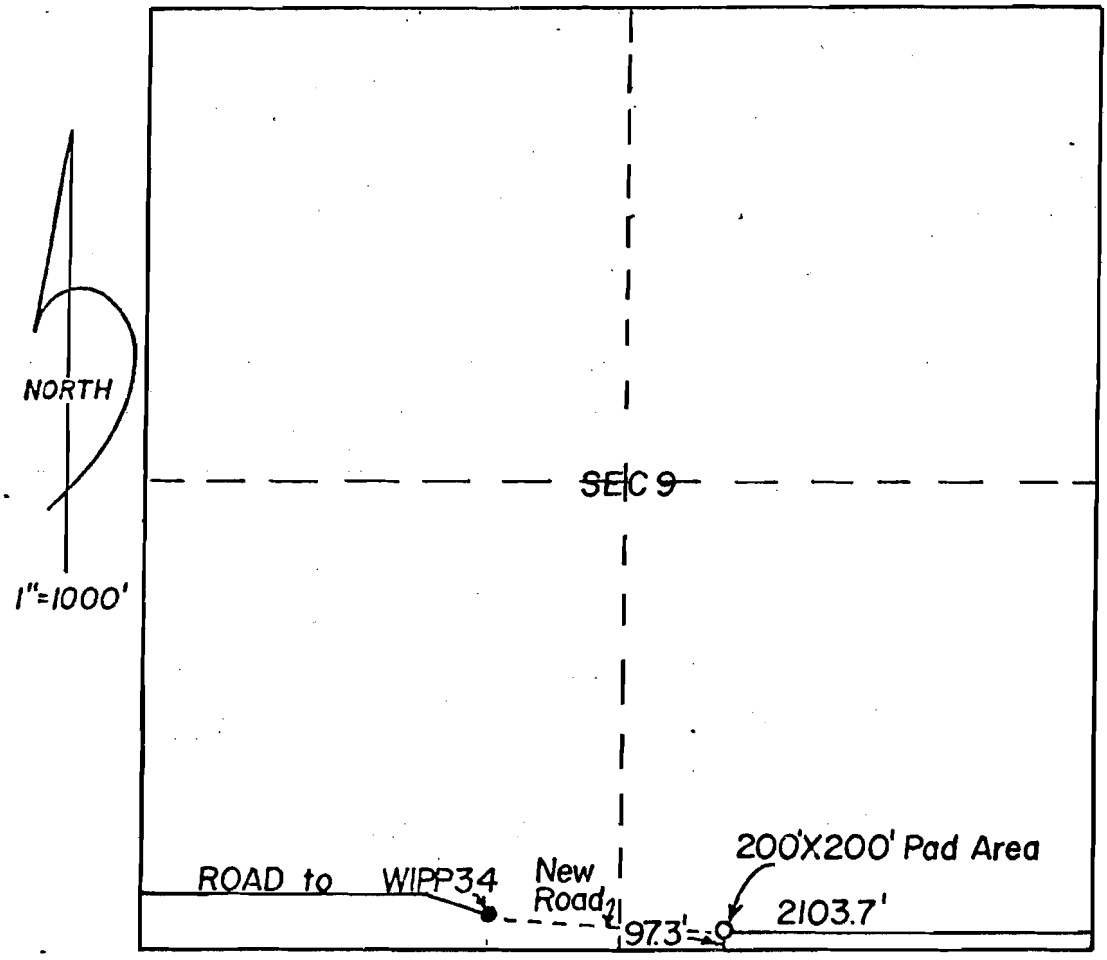
WIPP 14

SECTION 9, TOWNSHIP 22 S, RANGE 31 E N.M.P.M.

EDDY COUNTY, NEW MEXICO

ELEVATION: 3429'

97.3' FSL & 2103.7' FEL



This is to certify that the foregoing plat was made from field notes of a bonafide survey made by me and is true and correct to the best of my knowledge and belief.

Dan R. Reddy

N.M.P.E. & L.S # 5412

DAN R. REDDY NEW MEXICO 5412 REGISTERED PROFESSIONAL ENGINEER LAND SURVEYOR

PROPOSED DRILL HOLE LOCATION

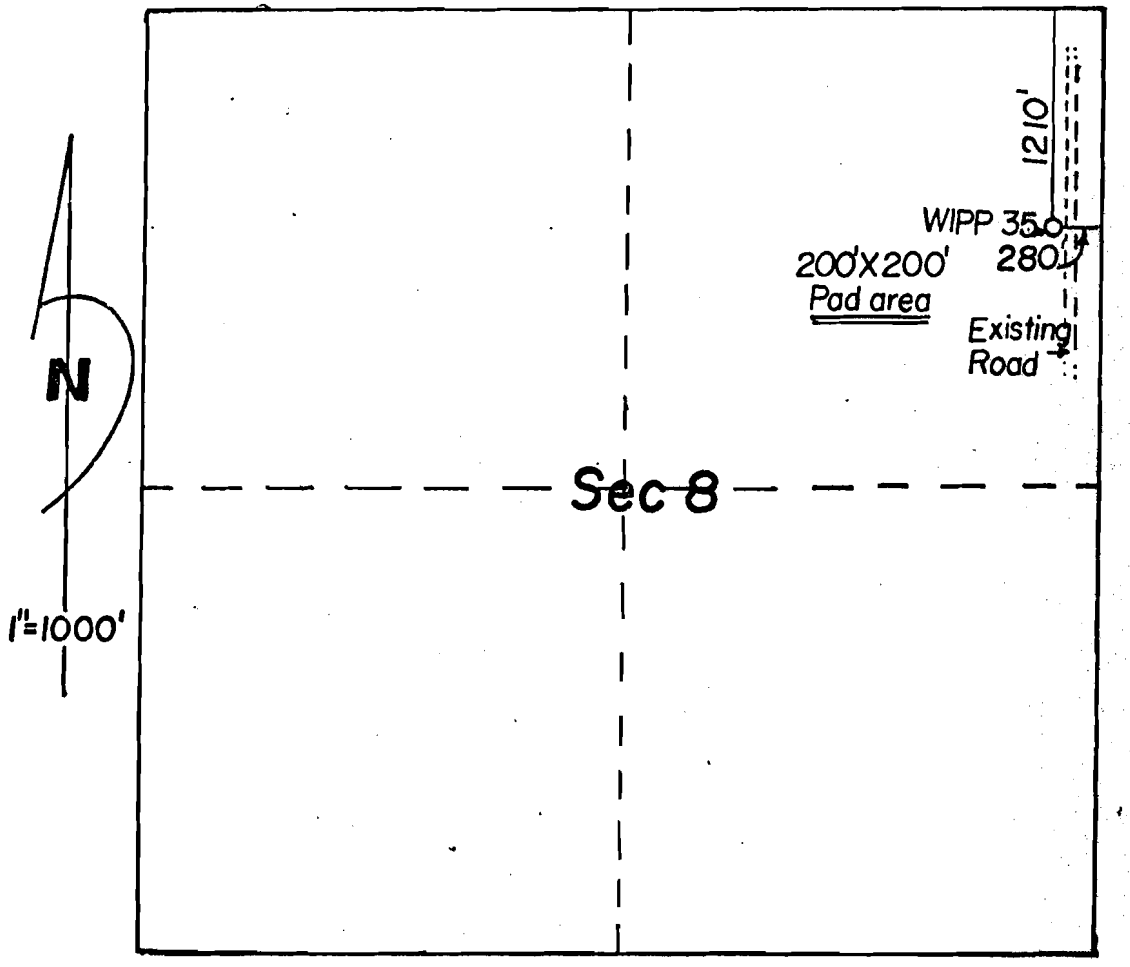
WIPP 35

SECTION 8, TOWNSHIP 22 S, RANGE 31 E N.M.P.M.

EDDY COUNTY, NEW MEXICO

ELEVATION: 3417'

1210' FNL & 280' FEL



This is to certify that the foregoing plat was made from field notes of a bonafide survey made by me and is true and correct to the best of my knowledge and belief.

Dan R. Reddy

Dan R. Reddy

N.M.P.E. & L.S. # 5412

DAN R. REDDY NEW MEXICO 5412 REGISTERED PROFESSIONAL ENGINEER LAND SURVEYOR

APPENDIX D

LOGS

compiled by

S-E. Shaffer
Division 9731
Sandia National Laboratories

WIPP 14 Logs[1]

Log	Company	ELSI#[2]	Top of Logged Interval[3] (feet)	Bottom Logged Interval (feet)	Date
Compensated Density with Gamma Ray and Caliper	Dresser	-	Surface	996	6-5-81
Gamma Ray Neutron and Density	U.S.G.S.	-	Surface	1000	6-5-81

[1]Original data is retained in Sandia WIPP Central File, Division 9772, Sandia National Laboratories, Albuquerque, NM 87185
[2]Order number for logs available through West Texas Electric Log Service, Inc. (ELSI), 105 West Wall Ave., Midland, TX.
[3]Depths measured from ground surface; elevation officially 3429' above MSL.

DISTRIBUTION

U.S. Department of Energy, Headquarters
Office of Nuclear Waste Management
Washington, DC 20545
Larry Harmon, Program Manager (WIPP)
Wade Ballard, Director, Div. of Waste Isolation (2)

U.S. Department of Energy, Headquarters
Office of Defense Waste & By-Products
Washington, DC 20545
Dr. Goetz Oertel, Director (NE-320)

U.S. Department of Energy, Albuquerque Operations
P.O. Box 5400
Albuquerque, NM 87185
J. M. McGough, Manager, WIPP Project Office (2)
D. Jackson, Director, Public Affairs Division

U.S. Department of Energy
Carlsbad WIPP Project Office
Room 113, Federal Building
Carlsbad, NM 88220

U.S. Department of Energy
c/o Battelle Office of Nuclear
Waste Isolation
505 King Avenue
Columbus, OH 43201
Jeff O. Neff

Battelle Memorial Institute
Office of Nuclear Waste Isolation
505 King Avenue
Columbus, OH 43201
S. Goldsmith, Manager
ONWI Library

Battelle Memorial Institute
Project Management Division
505 King Avenue
Columbus, OH 43201
Neal Carter, General Manager

D'Appolonia Consulting Engineers
2340 Alamo, S.E.
Albuquerque, NM 87106
Dev Shukla (10)

Westinghouse Electric Corporation
P.O. Box 40039
Albuquerque, NM 87196
R. K. Brown
R. Jones (TSC)

Bechtel National, Inc.
Fifty Beale Street
P. O. Box 3965
San Francisco, CA 94119
D. L. Ledbetter
Dale Roberts

National Academy of Sciences, WIPP Panel:

Frank L. Parker, Chairman
Department of Environmental and
Water Resources Engineering
Vanderbilt University
Nashville, TN 37235

Konrad B. Krauskopf, Vice Chairman
Department of Geology
Stanford University
Stanford, CA 94305

Karl P. Cohen, Member
Consultant
928 N. California Avenue
Palo Alto, CA 94303

Neville G. W. Cook, Member
Dept. of Material Sciences and Engineering
University of California at Berkeley
Hearst Mining Building, #320
Berkeley, CA 94720

Fred M. Ernsberger, Member
250 Old Mill Road
Pittsburgh, PA 15238

Harold L. James, Member
1617 Washington St.
Port Townsend, WA 98368

Richard R. Parizek, Member
Department of Hydrogeology
Pennsylvania State University
University Park, PA 16802

D'Arcy A. Shock, Member
233 Virginia
Ponca City, OK 74601

John W. Winchester, Member
Department of Oceanography
Florida State University
Tallahassee, FL 32306

John T. Holloway
Senior Staff Officer
2101 Constitution Avenue, NW
Washington, DC 20418

WIPP Public Reading Room
Atomic Museum, Kirtland East AFB
Albuquerque, NM 87185
Attn: Ms. Gwynn Schreiner

WIPP Public Reading Room
Carlsbad Municipal Library
101 S. Hallagueno St.
Carlsbad, NM 88220
Attn: Lee Hubbard, Head Librarian

Thomas Brannigan Library
106 W. Hadley St.
Las Cruces, NM 88001
Attn: Don Dresp, Head Librarian

Roswell Public Library
301 N. Pennsylvania Avenue
Roswell, NM 88201
Attn: Ms. Nancy Langston

Hobbs Public Library
509 N. Ship St.
Hobbs, NM 88248
Ms. Marcia Lewis, Librarian

State of New Mexico
Environmental Evaluation Group
320 Marcy Street
P.O. Box 968
Santa Fe, NM 87503
Robert H. Neill, Director (2)

NM Department of Energy & Minerals
P.O. Box 2770
Santa Fe, NM 87501
Larry Kehoe, Secretary
Kasey LaPlante, Librarian

New Mexico State Geologist
P. O. Box 2860
Santa Fe, NM 87501
Emery C. Arnold

New Mexico State Library
P.O. Box 1629
Santa Fe, NM 87503
Ms. Ingrid Vollenhofer

New Mexico Tech
Martin Speer Memorial Library
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USGS, Conservation Division
P. O. Box 1857
Roswell, NM 88201
W. Melton

USGS, Special Projects Branch
Federal Center, Bldg. 25
Denver, CO 80225
R. P. Snyder (2)

New Mexico Bureau of Mines and Mineral Resources
Socorro, NM 87801
F. E. Kottlowski, Director (2)

Klaus Kuhn
Gesellschaft fuer Strahlen-und
Umweltforschung MBH Muenchen
Institut fuer Tieflagerung
Berliner Strasse 2
3392 Clausthal-Zellerfeld
Federal Republic of Germany

Klaus Eckart Maass
Hahn-Meitner-Institut fuer Kernforschung
Glienicker Strasse 100
1000 Berlin 39
Federal Republic of Germany

Michael Langer
Bundesanstalt fuer Geowissenschaften
und Rohstoffe
Postfach 510 153
3000 Hannover 51
Federal Republic of Germany

Helmut Rothemeyer
Physikalisch-Technische
Bundesanstalt
Bundesalle 100
3300 Braunschweig
Federal Republic of Germany

Rolf-Peter Randl
Bundesministerium fuer Forschung
und Technologie
Postfach 200 706
5300 Bonn 2
Federal Republic of Germany

Fenix & Scisson, Inc.
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Attn: J. A. Cross

Gayle Pawloski, L-222
Geologist CSDP
Lawrence Livermore Laboratory
Livermore, CA 94550

U.S. Nuclear Regulatory Commission (3)
Division of Waste Management
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