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WORK PLANS

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PHASE I SOIL AND GROUND-WATER ASSESSMENT PLAN FOR ROSWELL COMPRESSOR STATION SURFACE IMPOUNDMENTS

Prepared for
ENRON Environmental Affairs
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LIST OF ACRONYMS AND ABBREVIATIONS

B&C	Brown and Caldwell
B&R	Brown & Root Environmental
bgs	Below ground surface
BLM	Bureau of Land Management
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CES	Cypress Engineering Services
DBS&A	Daniel B. Stephens & Associates, Inc.
DO	Dissolved oxygen
DQOs	Data quality objectives
EDAC	Earth Data Analysis Center
EPA	Environmental Protection Agency
FID	Flame ionization detector
Halliburton	Halliburton NUS Environmental Corporation
HLA	Harding Lawson Associates
mL	Milliliter
MS/MSD	Matrix spike/matrix spike duplicate
NMED	New Mexico Environment Department
NMSHTD	New Mexico State Highway and Transportation Department
OCD	New Mexico Oil Conservation Division
OVA	Organic vapor analyzer
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PID	Photoionization detector
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
PPE	Personal protective equipment
PSH	Phase-separated hydrocarbons
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RPD	Relative percent difference
SCT	Salinity-conductivity-temperature meter
SEO	State Engineer Office
TCA	1,1,1-trichloroethane
TCLP	Toxicity characteristic leaching procedure
TDS	Total dissolved solids
TPH	Total petroleum hydrocarbons
Transwestern	Transwestern Pipeline Company
USGS	United States Geological Survey
VOCs	Volatile organic compounds

1. INTRODUCTION

At the request of Transwestern Pipeline Company (Transwestern), a wholly owned subsidiary of ENRON Operations Corporation, Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this Phase I Assessment Plan for investigation of several former surface impoundments located at Transwestern's Compressor Station No. 9 (Roswell compressor station) near Roswell, New Mexico (Figure 1-1). Sections 1.1 and 1.2 provide information on the scope of work and objectives of this investigation.

1.1 Scope of Work

This Phase I Assessment Plan addresses proposed activities for investigation and cleanup of several former surface impoundments located at the Roswell compressor station. The former surface impoundments were located in the northeastern corner of the compressor station. Initial operation began in approximately 1960 and may have continued until 1984, although the last impoundment was not backfilled until June 1986. Two impoundments are known to have existed at this location, and a third is suspected to have been present. No surface expression of the former impoundments is now visible at the site.

The impoundments served primarily to contain pipeline condensate, a hydrocarbon liquid that accumulates within natural gas pipelines. Small quantities of spent halogenated solvents were also inadvertently released into the impoundments, along with miscellaneous non-hazardous solid wastes such as filters, engine parts, and office trash (Campbell, 1993). This Phase I Assessment Plan is intended to provide the basis for a voluntary subsurface investigation to determine the nature and extent of soil and ground-water contamination resulting from past use of the impoundments.

1.2 Phase I Assessment Plan Objectives and Organization

The objective of Phase I activities is to characterize the nature of the subsurface wastes that remain immediately beneath and adjacent to the former impoundments. Thus the Phase I soil and ground-water investigations described here are confined to a relatively small area near the suspected contaminant sources. Following completion of Phase I, a Phase II investigation will be conducted to determine the lateral and vertical extent of impacted soil and ground water. Subsequent phases will address corrective actions that may be required to meet soil and ground-water cleanup criteria.

This Phase I plan is organized in the following manner. The site background and regulatory status of the former impoundments are described first in Section 2 to provide a basis for the proposed activities. The results of all previous subsurface environmental investigations are then summarized in Section 3. The proposed Phase I soil and ground-water investigations are outlined in Sections 4 and 5, respectively. A quality assurance project plan is included in Section 6 to ensure that the data generated are of sufficient quality to support subsequent decisions. Finally, the proposed project schedule is included in Section 7.

2. SITE BACKGROUND

The Roswell compressor station is located approximately 9 miles north of the city center of Roswell, New Mexico along the east side of U.S. Highway 285 (Figure 1-1). Sections 2.1 through 2.5 provide background information regarding the facility layout and operation, history of the former surface impoundments that are the subject of closure under this plan, as well as the regional geographic, geologic, and hydrologic setting.

2.1 Facility Description

The Roswell compressor station is situated on approximately 80 acres of land in Sections 21 and 28, Chaves County, New Mexico (Figure 1-1). The property is privately owned by Transwestern Pipeline Company, while the remainder of Sections 21 and Section 28 are State Trust Land (Glenn, 1993). Site access is via U.S. Highway 285, and the entire property is secured by a chain link fence. The following is a list of pertinent information regarding the facility:

Facility name	Transwestern Pipeline Company Compressor Station No. 9
Facility address	Transwestern Pipeline Company 6381 North Main Street P.O. Box 1717 Roswell, New Mexico 88202-1717
Telephone number	(505) 625-8022
EPA I.D. number	NMD 986676955
County and state	Chaves County, New Mexico
Property legal description	SW¼ of the SW¼ of Section 21, T. 9S. R. 24E. NW¼ of the NW¼ of Section 28, T. 9S. R. 24E.
Latitude/longitude of former impoundments	Pit 1: N33°30'54" / W104°30'55" Pit 2: N33°30'55" / W104°30'55" Pit 3: N33°30'55" / W104°30'56"
Site elevation	Approximately 3610 feet above sea level

The Roswell compressor station is one of numerous similar facilities located along the Transwestern natural gas pipeline that extends from Texas to California. Natural gas is received from the east through two 24-inch pipelines, the West Texas Lateral and the Panhandle Lateral, and leaves to the northwest through two 30-inch pipelines. The primary function of the compressor station is to boost the pressure of the natural gas stream by means of piston compressors powered by natural gas internal combustion engines. The facility also includes the district offices for Transwestern's New Mexico operations, along with other ancillary buildings including a warehouse and a repair shop (Figure 2-1). The compressor station has been in operation at this location since August 9, 1960. The only environmental permit currently in force is Discharge Plan GW-52 with the New Mexico Oil Conservation Division (OCD).

2.2 History and Operation of Former Surface Impoundments

Little information exists about the operational history of the surface impoundments. Much of what is known is based on the recollection of present or former Transwestern employees. The following discussion summarizes the available information regarding the locations, sizes, and periods of operation of the former surface impoundments.

As mentioned in Section 1, the primary function of the former impoundments was to contain pipeline condensate, a hydrocarbon liquid that accumulates during the periodic cleaning of the natural gas pipelines. Natural gas is composed mostly of alkane compounds, with methane being the most abundant (Eiceman, 1986; GRI, 1995). In addition, natural gas contains variable concentrations of heavier molecular weight hydrocarbons (C4+), which may condense due to changes in temperature and pressure within the pipelines. Besides the higher molecular weight hydrocarbons derived from the natural gas itself, pipeline condensate may also contain lube oil blow-by derived from upstream reciprocating engine gas compressors located at other compressor stations. The lube oil blow-by consists of crankcase lubricating oil that bypasses the compressor piston rings and enters the natural gas pipeline.

Pipeline condensate is periodically removed from the pipeline through "pigging" operations, which make use of a cylindrical piston-like device known as a "pig." The pig cleans the condensate from the interior pipeline wall by scraping and brushing as it is carried through the pipeline by the pressurized gas stream. The pig and the accumulated liquid condensate are removed from the pipeline at the "pig receiver" (Figure 2-1). Currently, all condensate is collected and stored in aboveground tanks. The condensate is then sold for use as fuel. Formerly, the condensate was stored in one or more unlined surface impoundments that are the subject of this Phase I Assessment Plan. The impoundments have been variously referred to as the "disposal pit" or the "burn pits." The latter term refers to the reported practice of periodically burning the hydrocarbon liquids in the impoundment to reduce their volume (Campbell, 1993).

The first reported use of a surface impoundment at this location was in August of 1960, shortly following construction of the compressor station in 1960 (Campbell, 1993). However, no records are currently available showing the exact location or size of this surface impoundment or others that may have been used subsequently until the last remaining surface impoundment was backfilled in 1986. Correspondence among Transwestern, New Mexico Environment Department (NMED), and OCD has generally referred to a single impoundment as "the disposal pit" (Campbell, 1992) or "the burn pit." However, the General Plan map for the Roswell compressor station (Transwestern, 1959) showed two surface impoundments located in the northeast corner of the facility, in the NE¼ of the SW¼ of the SW¼ of Section 21, T. 9S. R. 24E. The locations of the two former burn pits as previously shown on the General Plan were found to be incorrect, as discussed below.

Figure 3 of a report prepared by Metric Corporation (1991) indicated the possibility that three pits had existed in the northeast corner of the facility. This was reportedly based on discussions with a former compressor station supervisor who was able to recall the approximate locations of three former surface impoundments (Campbell, 1994). The three pits are designated in the Metric report (1991) as Pit 1 (southernmost), Pit 2 (northeast), and Pit 3 (northwest). The employee was said to have pointed out the approximate former locations of the pits to the Metric field staff. For the sake of consistency, these designations will be retained through this Phase I Assessment Plan. However, it should be noted that the existence of Pit 3 is less certain than Pits 1 and 2, as described below.

Prior to the preparation of this Phase I Assessment Plan, the location and number of former surface impoundments was not known precisely. In order to clarify the number and exact locations of the former impoundments, DBS&A obtained historical aerial photographs showing the compressor station. The following sources were contacted during this effort: the Earth Data

Analysis Center (EDAC, Albuquerque), the Bureau of Land Management (BLM, Albuquerque), the New Mexico State Highway and Transportation Department (NMSHTD, Santa Fe), IntraSearch (Denver), and the United States Geological Survey (USGS) Earth Science Information Center (Denver). Several aerial photographs showing the compressor station were located, and contact prints were obtained for five different photographs taken on the following dates:

Date Flown	Approximate Scale	Source
07/28/61	1:23,000	EDAC-Albuquerque
10/10/72	1:25,000	NMSHTD-Santa Fe
06/21/73	1:32,000	BLM-Albuquerque
04/19/81	1:26,000	BLM-Albuquerque
08/05/82	1:19,000	NMSHTD-Santa Fe

The 1961 aerial photograph shows a single feature that appears to be a surface impoundment in the extreme northeast corner of the property. This impoundment corresponds to Pit 2 on Figure 2-1. This appears to be the first surface impoundment constructed at the compressor station.

The 1972 and 1973 photographs reveal two features that appear to be surface impoundments. In order to more clearly see these features, enlargements were made of the 1973 and 1981 BLM photographs to scales of 1:5340 and 1:4330, respectively. Examination of the 1973 photograph shows two surface impoundments (Pit 1 and Pit 2 on Figure 2-1), with a third feature that may represent a backfilled impoundment (Pit 3 on Figure 2-1). However, the existence of Pit 3 is by no means certain, and it is quite possible that no impoundment ever existed at this location.

In the 1981 and 1982 photographs, only Pit 1 remains visible (Figure 2-1). Pit 2 appears to have been backfilled prior to the April 19, 1981 flight, and the feature labeled as Pit 3 is no longer visible.

Pit 1 was reportedly taken out of service no later than 1984 and backfilled in June of 1986 (Campbell, 1993). No wastes of any type were received after that date. Based on the aerial photographs, the dimensions and approximate periods of operation of the three former surface impoundments were as follows:

Impoundment	Approximate Dimensions	Date Constructed	Date Backfilled
Pit 1	40' x 70' (rectangular)	After 7/61, before 10/72	6/86
Pit 2	70' diameter (circular)	Before 7/61	Before 4/81
Pit 3	50' diameter (circular)	After 7/61, before 10/72	Before 4/81

It is estimated that the impoundments were at most 10 feet deep. Therefore, the maximum volumes of Pits 1, 2, and 3 during their operational lifetimes were approximately 1000, 1400, and 700 cubic yards, respectively.

In addition to the pipeline condensate, trace quantities of chlorinated solvent wastes were inadvertently released into the impoundments. The solvents were primarily used as degreasers to remove oily deposits on engine parts during maintenance of the compressor engines. The quantity of solvents and the exact type of solvents used is unknown as no records that might indicate the quantity or type of solvent materials purchased are known to exist at the site or at any other Transwestern facility. In addition, most of the Transwestern employees who were employed during the period of operation of the surface impoundments have retired.

Discussions with the few remaining personnel who were employed during the period in question indicate that the most common solvent used was known by the trade name "TK-1." This solvent product reportedly contained 1,1,1-TCA. The primary degradation product of 1,1,1-TCA is 1,1-DCA. Therefore, the presence of these two compounds in soil and ground water are most likely the result of the use of the "TK-1" solvent product. The source of PCE and PCA compounds that were also detected in soil samples collected from the surface impoundment area is unknown.

Discussions with the same Transwestern personnel further indicate that the last surface impoundment in use (Pit 1) did not receive any waste materials after mid-1984. This information is supported by examination of facility drawings which indicate that considerable facility piping, upgrades, and installations were made during the latter half of 1983.

2.3 Geographic Setting

The Roswell compressor station is located approximately 6 miles west of the Pecos River within the Pecos Valley drainage basin. The entire area west of the Pecos River is generally referred to as the west Pecos slope (Kelley, 1971), which rises westward from elevations of about 3,300 feet at the Pecos River to over 10,000 feet in the Capitan Mountains some 50 miles to the west. Tributary surface streams drain west to east toward the Pecos River. Local topography is generally of low relief. The mean annual precipitation as measured at the Roswell Municipal Airport for a 23-year period was 9.82 inches. The majority of the precipitation occurs in July and August during frequent summer thunderstorms.

2.4 Regional Hydrogeology

The Roswell compressor station lies within the northernmost portion of the Roswell hydrologic basin. The basin is structurally controlled by eastward-dipping carbonate and evaporite sequences of Permian age which were uplifted during the Tertiary period during the development of the Sacramento and Guadalupe Mountains along the western margin of the basin (Kelley, 1971). Eastward flowing tributaries originating in the western highlands have deposited Quaternary alluvium over the Permian age rocks west of the Pecos River.

Because the average dip of the Permian rocks is greater than the slope of the land surface, progressively younger units are encountered eastward toward the Pecos River. Several prominent northeast trending ridges and hills interrupt the gently sloping plains near the site. These structures are narrow fault zones referred to as the Border Hills, Six-Mile Hill, and the Y-O faulted anticlines.

The stratigraphic units of importance with regard to water resources are, in ascending order, the San Andres Formation (Permian), the Artesia Group (Permian), and the undifferentiated Quaternary valley fill alluvium. Figure 2-2 shows the generalized stratigraphy in the vicinity of the site. Ground water is produced from both a shallow water-table aquifer (alluvium) and a deeper artesian aquifer that includes the two bedrock units (Welder, 1983). The deep bedrock aquifer is commonly known as the Roswell artesian aquifer. According to the State Engineer Office

(SEO), approximately 400,000 acre-feet of water are pumped annually from the two aquifers of the Roswell hydrologic basin (DBS&A, 1992). The two aquifers are separated by a semi-confining layer, but are connected where the carbonate aquifer rises structurally to meet the shallow aquifer. Both aquifers are recharged along surface exposures on the slopes to the west and are believed to discharge to the Pecos River at the eastern margin of the basin.

The following subsections describe each of the hydrostratigraphic units in the Roswell basin in detail.

2.4.1 San Andres Formation

The San Andres Formation consists primarily of a thick sequence of limestones, dolomitic limestones, and dolomites, with increasing quantities of interbedded anhydrite and gypsum to the north (Kelley, 1971). The formation is divided into three members, in ascending order: the Rio Bonito, the Bonney Canyon, and the Fourmile Draw members (Figure 2-2; Kelley, 1971). The average thickness of the formation is about 1,000 feet in the Roswell basin (Bean, 1949).

The Fourmile Draw member is the principal water-bearing unit within the San Andres Formation. High permeability has resulted from an irregular network of collapsed breccias, cavities, caves, and other interconnected open structures which were formed by dissolution of evaporite and carbonate beds. Gypsum beds become much more abundant in the Fourmile Draw member from Roswell northward (Kelley, 1971), and a well-developed karst surface is exposed where the unit is not covered by alluvium. In the northern portion of the basin the water-bearing zones of the San Andres Formation are approximately 400 to 600 feet thick and ground-water flow is primarily to the east-southeast toward the Pecos River.

In general, the lower boundary of the Roswell artesian aquifer, in general, is defined by low permeability zones that commonly occur within the Bonney Canyon member, which lies approximately 450 feet below the surface in the vicinity of the Roswell compressor station (Figure 2-2). SEO well records for wells near the site indicate that the upper boundary of the San Andres is approximately 92 feet below ground surface (bgs) in this area.

2.4.2 Artesia Group

The Artesia Group includes the following formations, in ascending order: the Grayburg, Queen, Seven Rivers, Yates, and Tansill Formations. In the vicinity of the Roswell compressor station, only the first three formations are present. The Artesia Group consists primarily of dolomite, sandstone, and gypsum units of Permian age. The sedimentary sequence represents a rapid lateral change in depositional environments from the southern massive reef complexes near Carlsbad to the northern clastic and evaporitic sequences representative of back reef and shelf environments (Kelley, 1971).

The Grayburg Formation unconformably overlies the San Andres Formation and ranges in thickness from 140 to 360 feet. The bottom of the Grayburg Formation provides a leaky confining bed that allows artesian ground water to move upward through the Artesia Group into the shallow alluvial aquifer. The thickness of this confining bed varies from 0 to 1,000 feet across the basin.

Drillers logs in the Roswell area indicate that discontinuous permeable units in the upper Artesia Group act as water-bearing zones (Welder, 1983). Fractures and cracks between fragments of collapsed breccia and solution-enlarged bedding planes and joints constitute the principal sources of permeability. These water-bearing zones generally occur in the upper quarter of the confining unit and may yield water to wells that tap both the upper Artesia Group and the shallow alluvium.

In most areas the Artesia Group is covered by a veneer of Quaternary alluvium west of the Pecos River. In the northwest portion of the basin, the bedrock confining unit is thin or absent, and the clay beds within the valley fill act as the confining bed for the lower confined carbonate aquifer. Historically, the lower carbonate aquifer discharged upward into the alluvium, but within the past 50 years, the vertical gradient across the confining bed has reversed because of ground-water pumping from the deep aquifer. This reversal has resulted in a downward gradient, causing ground water in the shallow aquifer to discharge to the deeper carbonate aquifer in some areas (DBS&A, 1992).

2.4.3 Quaternary Valley Fill

The Quaternary valley fill in the Roswell area was deposited by shifting streams flowing from the west toward the Pecos River. The valley fill consists of poorly to moderately consolidated deposits of gravel, sand, and clay which mantle the underlying Permian rocks. The thickness of alluvial sediments varies considerably from one locality to another because of the irregular bedrock erosional surface upon which the alluvium was deposited. In some areas the alluvial fill is moderately well cemented.

The thickness of the shallow alluvial aquifer is shown on Figure 2-3 for the northern portion of the Roswell Basin. Lyford (1973) developed the thickness (isopach) map after examination of drill cuttings from 225 wells penetrating the valley fill. Lyford's map indicates that the alluvium near the site is generally less than 50 feet thick. In other areas, however, the thickness can exceed 250 feet thick where the alluvium fills depressions in the underlying bedrock surface. Recent SEO well records indicate that the alluvium near the site is approximately 70 feet thick (DBS&A, 1992).

Lyford (1973) described three distinct units in the valley fill of the Roswell Basin. These units were termed the quartzose, clay, and carbonate gravels. The quartzose unit consists of sandstone, quartzite, quartz, chert, and igneous and carbonate fragments with varying degrees of calcium carbonate cementation. The quartzose unit in the vicinity of the Pecos River consists primarily of medium to coarse, uncemented quartz grains (Welder, 1983). Silt and clay deposits occur as lenses overlying the quartzose unit. These lenses were deposited in small ponds and lakes that resulted from the dissolution and collapse of the underlying carbonate rocks. The carbonate-gravel unit overlies the other valley fill deposits and generally consists of coarse carbonate gravel with intermixed silts and caliche.

The alluvial sediments underlying the compressor station, as observed in borings drilled during several investigations (Section 3), consist predominantly of interbedded cobbles, gravel, sand, silt, and clay. The finer-grained zones form lenticular beds which appear to be discontinuous across the site. Some of the alluvial deposits are firmly cemented in some places. These lithologic descriptions are consistent with Lyford's descriptions of the valley fill.

The principal water-bearing zones of sands and gravels are separated by less permeable lenses of silt and clay. According to Welder (1983), one to five water-bearing zones exist within the valley fill, and in many areas the alluvium is hydraulically connected to the upper bedrock units of the Artesia Group. The perimeter of the shallow alluvial aquifer is generally bounded by a margin of less permeable alluvium.

Figure 2-4 shows the approximate elevation of the water table in the shallow alluvium, as determined from measurements of water levels in wells completed in the alluvium (DBS&A, 1992). The map indicates that the station lies slightly outside the mapped extent of the shallow alluvial aquifer and that ground-water flow is toward the Pecos River. Although a thin layer of saturated alluvium exists as far north as Arroyo del Macho, Welder (1983) did not include this area within the extent of the shallow alluvial aquifer as defined by him, primarily because the ground-water quality in this area is too poor to be used for water supply purposes (DBS&A, 1992). The poor water quality in the shallow alluvial aquifer from slightly south of the Roswell compressor station northward is due to the presence of gypsum beds of the Fourmile Draw member at the base of the alluvium.

Because of the poor water quality and the low yields, most wells completed in the shallow alluvium are used primarily as livestock water supplies. In general, the chloride content of water in the shallow aquifer increases from west to east and ranges from 20 mg/L to 3700 mg/L (Welder, 1983). The presence of gypsum beds results in objectionably high calcium and sulfate concentrations in the shallow alluvial aquifer in the vicinity of the Roswell compressor station and northward. Sulfate concentrations are typically in the range of 2,000 to 3,000 mg/L, which is approximately equal to the equilibrium saturation concentration for ground water in direct contact with gypsum ($CaSO_4 \cdot 2H_2O$). Thus, background sulfate concentrations in this area are four to five times above the New Mexico Water Quality Control Commission ground-water standard for sulfate of 600 mg/L. The poor water quality in the alluvium is consistent with the high total dissolved solids concentrations reported for ground water from the on-site monitor wells, as discussed further in Section 3.

2.5 Water Well Inventory

A survey was conducted to locate water supply wells within 2 miles of the Roswell compressor station. This survey was accomplished by searching a water well database created by DBS&A that is based on the USGS Ground-Water Sites Inventory database. The database contains the locations of all known water wells plus additional information regarding well construction, well use, and aquifer penetrated. The water well database was compiled by DBS&A for a ground-water modeling project conducted for the SEO.

A review of the database revealed that there are 18 wells within about 2 miles of the compressor station. Table 2-1 details the location, total depth, depth to water, use, and completion aquifer for each of these 18 wells, along with their distance from the compressor station, and Figure 2-5 shows the locations of the wells relative to the site.

On December 2 and 3, 1994 a field reconnaissance of the off-site wells was conducted, and the wells were accurately located using a Magellan GPS satellite navigator. In addition, the condition and current use of each well was noted. The results of the well inventory and field reconnaissance are described below.

The closest off-site well to the former surface impoundments is a shallow livestock well completed in alluvium to a depth of 58 feet (well 3 on Figure 2-5). This well, which is no longer in use, is located about a half mile due east of the impoundments in the direction that would presumably be downgradient. The well is completed with 8⅝-inch casing, and the depth to water measured in 1937 reportedly was 15 feet. The well is presently plugged and abandoned, and may have gone dry because of declining water levels in the Roswell area.

The next nearest well is a 352-foot-deep well (TW-1) located in the southwestern portion of the compressor station property (well 2 on Figure 2-5). This well was reportedly drilled in 1969 for use as a water supply well for the compressor station (Campbell, 1994). Following connection of the facility to the City of Roswell water distribution system, however, use of the well was turned over to the Pecos Valley Artesian Conservancy District for monitoring water levels in the Roswell bedrock aquifer. Based on comparison of the driller's log with the local stratigraphy, the well is completed in limestone of the San Andres Formation. The well is cased with 9⅝-inch steel casing from the surface to a depth of 240 feet, and is open from 240 feet to the total depth of 352 feet. The depth to water as measured in December 1994 was 65 feet.

Several active and inactive irrigation and livestock wells are located between 1 and 2 miles east of the site (Figure 2-5). All of these wells are completed in the San Andres limestone aquifer. Given the distance to the downgradient wells and the presence of the aquitard between the alluvium and the bedrock aquifer, it is very unlikely that ground water from the compressor station could impact any of the active water supply wells.

3. PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Several hydrogeologic investigations have been completed at the Roswell compressor station to characterize the extent of subsurface impacts near the former surface impoundments. The investigations have included (1) a comprehensive soil vapor survey and soil coring program by HLA, (2) a drilling and soil sampling program by Metric Corporation, (3) installation of a monitor well by Halliburton NUS Environmental Corporation (Halliburton), (4) installation of a product recovery pump in monitor well MW-1 by Cypress Engineering Services (CES), (5) a drilling and soil sampling program by Brown & Root Environmental (B&R), and (6) system operation and optimization by Brown & Caldwell.

The above investigations and the interim corrective action program have been undertaken in phases beginning in the spring of 1990 and continuing to the present. During this period extensive data have been collected regarding subsurface soils and ground-water conditions at the site.

Sections 3.1 through 3.5 provide an accounting of each of the field investigations conducted to date, and Section 3.6 summarizes the extent of subsurface impacts resulting from past surface impoundment operations. Table 3-1 provides a summary of the soil borings and monitor wells installed during each investigation. Analytical summaries of hydrocarbon compounds detected in soil and ground water are provided in Tables 3-2 through 3-6.

3.1 Harding Lawson Associates Shallow Subsurface Investigation (1990)

During the spring of 1990, a soil investigation was performed by HLA to investigate the presence of VOCs in the shallow subsurface in the vicinity of the former surface impoundments (HLA, 1991a). The HLA investigation included an extensive soil gas survey and a soil coring and sampling program.

During the soil gas survey, HLA collected a total of 812 soil vapor samples from the locations shown on Figure 3-1. Soil gas samples were collected from depths ranging from 2 feet to 36 feet by driving a soil vapor probe several feet ahead of the hollow-stem auger bit. Soil vapor samples were analyzed in a mobile laboratory by subcontractor Fahrenthold & Associates using a gas chromatograph equipped with an electron capture detector. Five target purgeable halocarbons were quantified, including 1,1,1-TCA, trichloroethene, perchloroethene, chloroform, and carbon tetrachloride.

The highest VOC concentrations were measured near the surface impoundments located in the northeast portion of the facility. The most frequently detected compound was 1,1,1-TCA, which was also detected at the highest concentrations (up to 372 ppmv). The areal distribution of 1,1,1-TCA at the 10-foot depth, as determined by HLA, is illustrated in Figure 3-2. The mass of vapor phase 1,1,1-TCA within the plume is estimated to be approximately 18 kg, assuming that the concentrations at the 10 foot depth apply to all soils from the surface to the water table at a depth of about 60 feet. This is equivalent to a volume of liquid 1,1,1-TCA of only about 3.5 gallons.

Following completion of the soil gas survey, HLA undertook a program of continuous coring and soil sampling in order to validate the soil vapor survey results. A total of 11 borings were drilled to depths of up to 65 feet. Continuous 5-foot-long soil cores were collected using a hollow-stem auger drill rig. Figure 3-3 shows the location of each boring drilled by HLA. The soil samples were analyzed in the laboratory for a suite of selected VOCs, semivolatile organic compounds, total petroleum hydrocarbons (TPH), and toxicity characteristic leaching procedure (TCLP) metals. The results of these analyses are summarized in Tables 3-2 and 3-3.

Only a few of the HLA soil samples contained detectable concentrations of the target purgeable halocarbons. A soil sample collected from 35 to 37 feet deep in boring SB-9-07 near the surface impoundments contained the highest concentration of 1,1,1-TCA (2 mg/kg). This boring also contained somewhat higher concentrations of Freon-113, ethylbenzene, xylenes, and TPH.

In 4 of the 11 borings, HLA encountered perched water on top of a clay lens at approximately 30 feet bgs. The boreholes that contained water were near the utility garage and engine room (Figure 2-1). HLA postulated that the clay formed an aquitard with an undulating surface, thus allowing the water to pond within depressions in the upper surface of the clay. Water samples collected from these borings contained concentrations of 1,1,1-TCA below EPA drinking water maximum contaminant levels (MCLs).

3.2 Metric Corporation Shallow Subsurface Investigation (1991)

During July and November 1991, Metric Corporation drilled 20 additional soil borings to delineate the areal and vertical extent of the VOCs identified by HLA near the surface impoundments (Metric, 1991). The locations of borings drilled by Metric are shown on Figure 3-4. Soil borings were generally advanced to approximately 30 to 40 feet bgs in order to characterize soil type and to determine if VOCs were present above the uppermost clay unit. Only four soil borings were drilled to depths greater than 50 feet bgs (Table 3-1).

Metric collected soil samples using a continuous tube sampler, and each core was screened for the presence of VOCs using an organic vapor analyzer (OVA). Within a given soil core, the material with the highest concentration of organic vapors was submitted to the laboratory for analysis of the following constituents: TPH, benzene, toluene, ethylbenzene, and xylenes (BTEX); and purgeable halocarbons by EPA Methods 418.1, 8010, and 8020, respectively. The results of these laboratory analyses are summarized in Tables 3-2 and 3-4. Several of the borings contained VOC concentrations above the soil cleanup standards enforced by NMED and OCD.

Based on the analytical results, Metric estimated that the areal and vertical extent of VOC impacts extended approximately 240 feet east and approximately 100 feet north of the northeast property corner. The investigation further established that purgeable halocarbons are present to depths of at least 30 feet bgs near surface impoundments 1 and 2 (soil borings "Pit 1" and "Pit 2") and along the eastern fence line (soil boring SG 86). In addition, some soil samples contained TPH concentrations of 100 mg/kg, or greater, to depths exceeding 27 feet in soil borings "Pit 1," "Pit 2," SG 86, and OS BH-9.

Most borings drilled previously by HLA and Metric had penetrated a clay layer at approximately 30 feet bgs. However, clay was not encountered in soil boring "Pit 2" above about 68 feet bgs. This prompted Metric to conclude that a natural clay basin existed beneath the surface impoundments, with the sides sloping from the 30 to 40 foot depth around the perimeter, to approximately 70 feet bgs near the basin bottom.

However, subsequent drilling programs verified that the upper clay is, in fact, present at the 35 to 40 foot depth near the "Pit 2" soil boring, but is thinner and contains coarser sediments. The upper clay unit appears to grade laterally into a coarser zone of sandy clays near soil boring "Pit 2." Further, the clay unit identified at 67.9 feet bgs by Metric is actually part of the lower clay unit that underlies the entire site. This lower clay may lie near the contact between the valley-fill alluvium and the underlying Artesia Group Permian bedrock units (see Figure 2-2, Section 2.5).

Ground water was encountered at depths ranging from 37 to 57 feet bgs in 6 of the 20 borings drilled by Metric. Soil borings "Pit 2" and SG 361 (Figure 3-4) contained thin perched water zones (1 to 6 feet thick) above fine-grained sandy clays which correspond to the upper clay unit. Approximately 1-foot of water was measured at the bottom of soil borings OS BH-8 and OS BH-9 (Figure 3-4) at approximately 49 feet bgs. The water measured at the 49-foot depth may have migrated down the boreholes from the top of the upper clay unit. Finally, the ground water encountered at depths of about 55 feet bgs likely represents the water table of the uppermost aquifer, as these depths to water were generally reported in borings drilled to depths of approximately 70 feet bgs.

3.3 Halliburton NUS Corporation Monitor Well Installation (1992)

During July 1992, Halliburton installed one monitor well within the natural clay basin determined by Metric (Section 3.2) (Halliburton, 1992). The boring was drilled to a depth of 60 feet prior to sampling, at which point continuous samples were collected with a split-spoon sampler until a red clay layer containing very hard sulfate lenses was encountered at 68 feet bgs. Monitor well MW-1 was installed at the location depicted on Figure 3-5.

Following installation of MW-1, the well was developed by bailing and subsequently sampled for 8240 volatile and 8270 semivolatile organics, TPH, and total metals. The analytical results indicated that the ground water within monitor well MW-1 contained aromatic and halogenated hydrocarbons, as well as several semivolatile organic compounds. These results are summarized in Table 3-4.

3.4 Brown & Root Environmental Ground-Water Assessment (1993)

In April 1993, B&R, a division of Halliburton, completed a limited assessment of ground-water impacts resulting from disposal activities at the former surface impoundments (B&R, 1993). The investigation was undertaken to determine if two separate saturated zones existed within the alluvium and to establish ground-water quality beneath the former impoundments.

As part of their investigation, seven soil borings were drilled, and four of these were completed as monitor wells. Figure 3-5 shows the locations of soil borings and monitor wells installed by B&R. Soil samples were collected from each boring using a split-spoon sampler or continuous core barrel. The samples were screened for the presence of VOCs using an OVA. Unfortunately, the OVA was not functioning during the drilling of soil borings SB-4, SB-5, and SB-1C. Soil samples were collected above the two saturated zones and analyzed for TPH using EPA Method 418.1; the results are summarized in Table 3-4.

Perched water was not encountered above the upper clay unit during drilling of soil borings SB-1B, SB-2, SB-3, and SB-5 (Figure 3-5). However, phase-separated hydrocarbons (PSH) and water were encountered in soil boring SB-1A immediately above the upper clay layer at approximately 40 feet bgs. This boring was subsequently plugged and abandoned by B&R. Soil boring SB-4 encountered a small saturated zone in fractured limestone at approximately 47 feet bgs. This boring is located approximately 250 feet east of the property boundary, and the limestone probably corresponds to the top of the Artesia Group (Section 2.5).

B&R installed four monitor wells in the uppermost aquifer within soil borings SB-1B, SB-2, SB-3, and SB-5. The monitor wells, identified as MW-1B, MW-2, MW-3, and MW-5, were set at total depths ranging from 65 to 70 feet bgs (Table 3-1). The newly installed wells were then checked for the presence of PSH, developed, and sampled.

Approximately 4 feet of PSH was present on top of the water table in monitor wells MW-1B and MW-2. Ground-water samples were collected from the two monitor wells without PSH (MW-3 and MW-5) and analyzed for TPH (EPA Method 418.1), volatile organics (EPA Method 624 and 8240), and total dissolved solids (EPA Method 160.1). The results of these analyses are summarized in Tables 3-4 and 3-5.

B&R concluded that two water bearing zones were present in the alluvium and that both were impacted by VOCs. The two zones included (1) the upper thin zone of perched water on the upper clay unit (approximately 40 feet bgs) and (2) a deeper zone of saturated silty sand and sand at depths ranging from 55 to 65 feet bgs. During the drilling of soil borings SB-1B and SB-2, B&R identified zones of residual saturation and PSH above the upper clay unit. Following construction of monitor wells MW-1B and MW-2 in the uppermost aquifer, approximately 4 feet of PSH was measured in each well.

In June 1993 B&R returned to the site to install PSH recovery wells in the upper water-bearing zone above the upper clay unit. An additional seven borings were drilled near the surface impoundments, designated RB-1 through RB-7 (Figure 3-5). Only one of the seven additional borings contained perched liquids. The one boring which contained liquid (RB-7) was completed as recovery well RW-1 near monitor well MW-1 (Figure 3-5). Approximately 1.4 feet of PSH was measured in recovery well RW-1 following its construction.

On March 23, 1994, CES removed an inoperative recovery pump from MW-1 and collected ground-water samples from monitor wells MW-3 and MW-5. On April 15, 1994, B&R installed a pneumatic product recovery pump and skimmer in monitor well MW-1. At that time B&R measured the following depths to PSH and to ground water in the four wells containing free hydrocarbon product:

Well	Date	Total Depth of Well (feet)	Depth to PSH[1] (feet)	Depth to Water[1] (feet)	PSH Thickness (feet)
MW-1	04-15-94	68.0	53.30	61.54	8.24
MW-1B	04-15-94	65.5	58.42	61.30	2.88
MW-2	04-15-94	65.0	58.68	61.50	2.82
RW-1[2]	04-15-94	42.5	38.70	39.00	0.30

[1] Depth in feet below top of casing.
[2] Recovery well RW-1 is completed in the perched water zone.

3.5 Interim PSH Removal Program

On May 21, 1993, a recovery pump was installed in MW-1 by CES. During July 1993, B&R installed PSH recovery pumps in monitor wells MW-1B, MW-2, and RW-1. Since that time, PSH and water have been pumped from these wells and routed to an aboveground storage tank. Rollins Environmental Services then periodically transports the waste hydrocarbon liquid to Deer Park, Texas for incineration.

During the fall of 1993, Brown and Caldwell (B&C) installed skimmers on each recovery pump to reduce the volume of water recovered. Prior to the installation of the skimmers, B&C measured PSH levels and ground-water levels of approximately 58. 5 and 62 feet bgs in monitor wells MW-1B and MW-2, respectively. The depth to water was approximately 38.6 feet bgs in recovery well RW-1, which contained approximately 0.06 feet of PSH at the time of measurement. As of January 1995, the interim PSH recovery system had successfully removed approximately 7300 gallons of PSH and 5800 gallons of ground water. The system is currently being maintained by a local contractor.

3.6 Daniel B. Stephens & Associates, Inc. Subsurface Investigation (1994)

During November and December 1994, upgradient monitor well MW-6 was installed by DBS&A approximately 500 feet southwest of the location of the former surface impoundments (Figure 2-1). The MW-6 boring was drilled using a hollow-stem auger to a depth of 80 feet, and the well is screened from 60 to 75 feet bgs. Soil samples were collected at 5-foot intervals during drilling, and field headspace measurements using a PID did not detect the presence of VOCs in any of the soil samples.

The alluvial sediments penetrated during drilling of MW-6 were generally consistent with those observed in previous borings; that is, they consisted predominantly of sandy gravel and sand from the surface to a depth of 60 feet and silty clay and clayey sand from 60 to 75 feet. A gravelly sand of unknown thickness was penetrated at the 79-foot depth in this boring; however, the red plastic clay reported in previous borings was not encountered.

A ground-water sample from MW-6 and a soil sample from the same boring collected from a depth corresponding to the water table were submitted for laboratory analysis of VOCs and TPH. Both the soil and the ground-water sample exhibited no detectable concentrations of 8010/8020 VOCs or TPH determined by method 418.1.

In order to allow a better estimate of the ground-water flow direction and gradient within the shallow alluvium, the elevations and coordinates of all on-site monitor wells were resurveyed on December 1, 1994. The well locations and elevations based on this survey are provided in Table 3-6.

Depths to water were measured in on-site monitor wells MW-3, MW-5, and MW-6 on December 4, 1994 and again on December 22; these data are also shown in Table 3-6. The ground-water flow direction was calculated as N44E for both measurement dates, indicating that ground water in the shallow alluvium flows to the northeast in the vicinity of the former impoundments (Figure 2-1). The dimensionless ground-water gradient calculated using the December 22 data is 0.012, which is typical of relatively permeable alluvial sediments of the type encountered during drilling.

In addition to the sampling and analysis of MW-6, ground-water samples were also collected from on-site deep well TW-1 (Figure 2-1) and off-site deep well #5 (Figure 2-5). Well #5 was selected as representative of background upgradient water quality within the San Andres bedrock aquifer. The ground-water samples from these two wells were analyzed for a modified Appendix IX suite of constituents.

These results indicate that both deep wells yield very hard ground water of relatively high salinity. Well #5 contains high concentrations of sulfate (768 mg/L), chloride (750 mg/L), and total dissolved solids (TDS) (2420 mg/L). These values significantly exceed the New Mexico ground-water standards for sulfate (600 mg/L), chloride (250 mg/L), and TDS (1000 mg/L). The ground-water sample collected from Transwestern well TW-1, although of somewhat lower salinity, still exceeds the New Mexico standards for chloride and TDS, with reported concentrations of 631 mg/L and 1290 mg/L, respectively. In addition, deep well TW-1 also contained elevated concentrations of iron (4.22 mg/L) and manganese (0.39 mg/L), which exceed the New Mexico ground-water standards for these elements of 1.0 mg/L and 0.2 mg/L, respectively.

The high salinity of the ground water from TW-1 and Well #5 is almost certainly natural and probably results from dissolution of soluble evaporite minerals within the upper Fourmile Draw Member of the San Andres Formation, as discussed in Section 2.5. The high salinity of the ground water in the bedrock aquifer in this vicinity may also account for the fact that many of the production wells are no longer in use.

Analyses of ground-water samples collected from the two deep wells for RCRA Appendix IX VOCs revealed no detectable concentrations of any of these compounds. In addition, the sample from TW-1 was analyzed for Appendix IX SVOCs, and the only compound detected was bis(2-ethylhexyl)phthalate (18 μg/L). The phthalate esters are well-known laboratory contaminants used as plasticizers in most flexible plastic products, such as the plastic beakers and tubing used in many laboratory applications. EPA has acknowledged this compound as a common laboratory contaminant (U.S. EPA, 1988, 1991). Therefore, we conclude that the reported detection of this compound is probably the result of laboratory handling of the sample; it is almost certainly not present in the ground water, as no other organic compounds were detected in the sample.

3.7 Extent of Soil and Ground-Water Contamination

The investigations completed to date and described in Sections 3.1 through 3.5 have been conducted to characterize the subsurface hydrogeology and the distribution of VOCs in the soils and ground water beneath the former surface impoundments. Figure 3-6 shows the locations of all borings and monitor wells installed to date. The contaminants detected consist primarily of petroleum hydrocarbons that are typical components of pipeline condensate, which was formerly held in the surface impoundments. Tables 3-2 through 3-5 provide summaries of the organic and inorganic constituents detected in soils and ground water during each of the previous investigations.

Sections 3.7.1 through 3.7.3 summarize the findings of the investigations discussed above and provide an overview of the subsurface distribution of constituents as inferred from existing information.

3.7.1 Site Hydrogeology

The Quaternary sediments beneath the impoundments consist of interbedded cobbles, gravel, sand, silt, and clay to depths of approximately 70 feet bgs. The lithology of the alluvium is consistent with the descriptions provided by Lyford (1973). A generalized hydrogeologic cross section of the sediments underlying the impoundments constructed along a north-south line (Figure 3-6) is provided in Figure 3-7. Soil types in Figure 3-7 are defined using the Unified Soil Classification System. The hydrogeology underlying the site is as follows:

- From the ground surface to depths of approximately 30 to 35 feet bgs, brown gravelly sands and clays are present. Perched water is often encountered within the bottom few feet of this interval.

- At depths of approximately 35 to 60 feet, light brown to reddish-colored interbedded silts, sands, and clays are encountered. The fine-grained clay lenses serve as perching layers for the downward moving fluids and likely represent interfingering deposits of limited lateral extent.

- At depths of approximately 60 to 70 feet, saturated silty sands and sands are present. This zone is referred to as the uppermost aquifer.

- At approximately 70 feet, a red plastic clay of unknown thickness is present. This unit probably represents the transition from the Quaternary alluvium to the Permian-age bedrock of the Artesia Group.

- As discussed in Section 2.5, the background water quality in the shallow alluvial aquifer is very poor in the vicinity of the site due to the presence of gypsum beds beneath the alluvium. TDS concentrations exceed 3000 mg/L in on-site monitor wells MW-3 and MW-5 (Table 3-5). These two wells do not appear to be impacted by site activities; rather, the elevated TDS concentrations in these wells simply reflect the poor background quality of ground water in the region.

- The ground-water flow direction in the alluvium underlying the former impoundments is northeast, and the dimensionless head gradient is approximately 0.012.

3.7.2 Soil Impacts

Based on field OVA measurements and analytical chemistry results, elevated VOC concentrations in soil appear to encompass an area of approximately 600 feet by 400 feet centered between the three former surface impoundments. Figure 3-8 shows the estimated areal extent of impacted soil, in excess of 100 mg/kg TPH.

Near the former surface impoundments, the vertical extent of impacted soils extends from approximately land surface to the uppermost aquifer at approximately 60 feet. The vertical extent of impacted soil decreases as one moves laterally away from the surface impoundments. Due to local soil heterogeneities, it appears that VOCs have spread out along preferential pathways on top of the clay lenses at the 30- to 40-foot depth, prior to continued downward migration to the uppermost aquifer.

A generalized cross-sectional profile of impacted soils is shown in Figure 3-9; Figure 3-6 shows the location of the cross section. The estimated distribution of impacted soils is based both on field organic vapor analyzer readings and soil TPH concentrations as determined in the laboratory.

The extent of 1,1,1,-TCA detected in soil samples is limited to the area immediately below the former surface impoundments. However, elevated 1,1,1-TCA soil vapor concentrations are present throughout the estimated area of actionable soils (Figure 3-8).

3.7.3 Ground-Water Impacts

The estimated extent of actionable VOCs in ground water is difficult to ascertain at present due to the limited number of existing monitor wells. However, the lateral extent of VOCs is bounded on-site by monitor wells MW-3, MW-5, and MW-6. The ground-water plume most likely extends downgradient beyond the estimated extent of actionable soil contamination. The direction of ground-water flow is to the northeast in this area.

PSH is present in on-site monitor wells MW-1, MW-2, and MW-1B completed in the uppermost aquifer at 55 to 70 feet bgs, and in recovery well RW-1, completed in the limited perched zone from 35 to 42 feet bgs. The extent of PSH off-site, if any, remains to be defined.

4. SOIL ASSESSMENT PLAN

A phased approach will be used to assess the nature and extent of soil impacts resulting from past usage of the former surface impoundments. Phase I will consist of precisely locating the former impoundments and characterizing residual wastes through laboratory analyses. Phase II will attempt to define the lateral and vertical extents of impacts to soils underlying and adjacent to the former surface impoundments. Sections 4.1 through 4.6 describe Phase I soil sampling strategy and procedures, while Section 4.7 provides a brief description of Phase II objectives.

4.1 Phase I Soil Sampling Strategy

The sampling strategy described herein is based on information collected from previous investigations at the facility (Section 3) and examination of historical aerial photographs (Section 2.2). The goal of the Phase I soil assessment is to characterize any wastes that may remain within the former impoundments with respect to hazardous constituents. Waste characterization will include collection of soil samples from two locations directly beneath each of the two known surface impoundments (Pits 1 and 2). The four soil samples from the two potential source areas (Pit 1 and Pit 2) will be analyzed in the laboratory for VOCs, SVOCs, PCBs, metals, cyanide, and sulfide, as described in detail in Section 4.4.

From 1960 until about 1984, liquid hydrocarbon consisting primarily of pipeline condensate was placed in the impoundments. Later, the impoundments backfilled with clean soil, and the surface was restored to approximately original grade. At each impoundment location, this history has resulted in clean backfill overlying subsoils that are potentially impacted by seepage of liquids from the former impoundments. The Phase I soil assessment is intended to permit collection of subsoil samples from the most highly impacted horizon immediately beneath the clean backfill. Based on prior experience, the clean soil backfill is generally visually quite distinct from the underlying impacted subsoil, due to staining of the latter by hydrocarbon liquids. The soil sampling rationale for each suspected source area is described in the following paragraphs, and detailed soil sampling procedures are provided in Section 4.2.

The soil sampling rationale for Pits 1 and 2 is as follows. Because the former locations of Pit 1 and Pit 2 (Figure 2-1) are known with relative certainty from examination of aerial photographs, two soil borings will be drilled at each of these two areas at the approximate locations shown on Figure 4-1. In order to chemically characterize the wastes, a single sample of the most highly impacted soil will be selected from each boring at Pits 1 and 2 for laboratory analysis. The most highly impacted sample from each of the borings will be selected based on visual examination and field headspace screening with the PID. Each boring will then be plugged as described in Section 4.3 to prevent downward migration of fluids.

The overall purpose of the Phase I soil assessment is to characterize residual subsurface wastes with respect to hazardous constituents such that a list of "target analytes" may be developed and the extent of subsurface impacts can be further defined during Phase II. Laboratory analysis of the soil samples collected during Phase I will permit identification of those constituents that represent contaminants of concern at this site. Those constituents that are presently believed to constitute potential contaminants of concern are highlighted in Section 6.

4.2 Soil Sampling Procedures

Phase I soil sampling will be performed by continuous drive sampling through the clean soil backfill and into the underlying impacted subsoil below. By retrieving successive continuous soil samples, the maximum stratigraphic information will be obtained from each boring, with a minimum of soil cuttings that require disposal being generated. Based on reasonable assumptions regarding the depths of the former impoundments, it is estimated that the contact between the clean soil backfill and the underlying impacted subsoils will be encountered between 10 and 20 feet below grade.

Drive samples will be obtained using a 24-inch-long split-barrel sampler in accordance with DBS&A Standard Operating Procedure (SOP) 13.3.2. The split-barrel sampler will be driven into the soil using the rig-mounted drive hammer with uniform drive-pressure/drop-height. Blow counts will be recorded for all split-barrel drives. Following retrieval from the borehole, the split-barrel sampler will be placed on a table covered with a clean plastic sheet. The split-barrel sampler will then be opened and the soil material described according to DBS&A SOP 13.3.2. A subsample of the material will be placed in a ziplock plastic bag for field headspace screening for VOCs using a PID.

When the base of the clean backfill is encountered, a clean split-barrel sampler equipped with 6-inch-long brass liner rings will be used to collect a sample of the hydrocarbon-impacted subsoil below. The split-barrel sampler will be driven in the same manner as described above. Upon opening the split-barrel, however, the center two liner rings to be submitted for laboratory analysis will immediately be sealed with Teflon® membranes, plastic end caps, and solvent-free tape to minimize loss of VOCs from the soil samples due to volatilization.

All sample containers will be labeled using waterproof ink. Label information will include the sampling location, depth interval, sampling date and time, type of analysis requested, project number, and the initials of the sampler. The containers will be sealed and placed in clear plastic bags. The sealed containers will be put into coolers on bags of ice or frozen ice packs. Plastic bubble pack or other suitable packing material will be used to protect the samples during shipping. Chain-of-custody forms will be completed in triplicate for each sample shipment as described in Section 6.5.

Field personnel will ship the sample coolers to the laboratory using an overnight courier service. The fastest possible shipping method will be used, and all sample shipments will be carefully tracked to ensure that samples arrive intact and that all holding times are met.

4.3 Borehole Abandonment Procedures

The approximately 15 foot-deep, 3-inch-diameter boreholes created by continuous drive sampling of the soil will be abandoned by plugging them with a bentonite slurry poured slowly down the borehole using a funnel. The approximate volume of each borehole will be determined to estimate the volume of bentonite slurry required, and the quantity of slurry actually emplaced will be recorded. Borings drilled using a hollow-stem auger will be plugged in a similar manner, except that a cement-bentonite grout will be emplaced using a tremie pipe.

4.4 Laboratory Analysis of Soil Samples

As detailed in Section 6, four soil samples will be submitted to the laboratory for analysis of VOCs, SVOCs, PCBs, metals, cyanide, and sulfide. These will include one soil sample collected from the uppermost portion of the impacted soil horizon in each of two borings drilled at Pit 1 and Pit 2, as discussed in Section 4.1. Chemical analysis of the soil samples will be performed using standard laboratory protocols in *Test Methods for Evaluating Solid Waste* (U.S. EPA, 1986). The analytical methods and data quality objectives are discussed in greater detail in Section 6 of this Phase I Assessment Plan.

4.5 Decontamination Procedures

All non-disposable field equipment that may potentially come in contact with any soil sample will be decontaminated in accordance with DBS&A SOP 13.5.2, Decontamination of Field Equipment, in order to minimize the potential for cross-contamination between sampling locations. Clean latex or plastic gloves will be worn during all decontamination operations. The following sequence of decontamination procedures will be followed prior to each sampling event:

1. Wash all down-hole equipment in a solution of non-phosphate detergent (Liquinox®) and distilled/deionized water. All surfaces that may come into direct contact with the soil sample will be washed. Use a clean Nalgene® tub to contain the wash solution and a scrub brush to mechanically remove loose particles.

2. Rinse the equipment twice with distilled/deionized water.

3. Allow the equipment to air dry prior to the next use.

The drill rig and all down-hole equipment will be steam-cleaned and allowed to air dry between borings. A decontamination area lined with plastic sheeting will be set up to contain all wash water associated with the steam-cleaning operation. Liquid wastes produced during equipment decontamination will be contained in 55-gallon drums at a designated on-site drum storage area. Pending the results of laboratory analyses, all liquids will be handled as potentially hazardous wastes, as described in Section 4.6.

4.6 Management of Investigation-Derived Wastes

All soil cuttings, decontamination fluids, and used personal protective equipment (PPE) will be stored in 55-gallon drums and labeled to identify contents, date of generation, and amount of material generated. All wastes, with the exception of PPE, will be handled as potentially hazardous wastes, pending results of laboratory analyses for associated samples.

Liquid wastes generated during decontamination of drilling and sampling equipment will be stored pending results of associated soil sample laboratory results. For example, the disposition of wash water associated with a particular boring will be determined from the analytical results of soil samples collected from that particular boring. If the water is determined to be hazardous, it will be filtered through an activated carbon filtration system as described in Section 5.7.

Soil cuttings generated during the soil assessment will be stored in 55-gallon drums pending analytical results for soil samples collected from associated soil borings. Hydrocarbon-contaminated soils, as determined by field headspace screening, will be segregated from clean soils. Clean soils will be disposed of on-site by spreading soil cuttings on the ground surface, and contaminated soils will be shipped for off-site disposal at a permitted disposal facility. PPE and dry waste associated with these materials will be disposed of in a sanitary landfill.

4.7 Phase II Soil Assessment

The detailed scope of work for the Phase II soil assessment cannot be determined until the Phase I investigation is completed. The Phase II soil assessment scope of work, along with that for the Phase II ground-water assessment, will therefore be submitted later as an amendment to this Phase I Assessment Plan. Nevertheless, the overall objectives for the Phase II assessment may be defined at this time.

Following its completion, the results of the Phase I soil assessment will be summarized in a report. The report will include a proposed list of target analytes to direct subsequent Phase II investigations. For hazardous metals, the selection of target analytes will be based on comparison of the observed concentrations of each element with its expected background concentration in soils, as reported in existing literature. Statistical techniques for determining whether a particular constituent is present above background levels will follow EPA guidance (U.S. EPA, 1989).

Briefly, the Phase II soil assessment will consist of delineating the lateral and vertical extent of impacted soils beneath and adjacent to the former impoundments. This delineation will necessitate an iterative approach to soil sampling. Following review and approval of the Phase II scope of work, additional soil borings will be drilled outward along a grid centered on the location of each source area identified during Phase I.

The Phase II soil assessment will also investigate two additional on-site areas: "Pit 3" and former soil gas sampling location "SG 86" (Figure 3-6). The location of Pit 3, if indeed it ever existed, is not known with any degree of certainty (Figure 2-1). Likewise, the location of a possible hydrocarbon source area in the vicinity of Metric Corporation boring SG 86 is poorly known (Figure 3-4). Therefore, in order to determine whether subsurface wastes exist at these two suspect areas, an exploratory soil sampling program will be undertaken at these locations. This program will begin with the collection of a continuous soil core at the center of each suspected location (Figure 4-1). If hydrocarbon-impacted soils are not found, up to four additional soil borings will then be drilled at 50-foot centers on a grid centered about the initial soil sampling location, as shown in Figure 4-1. One of the Pit 3 borings will be drilled to the top of the bedrock, at approximately 75 feet, in order to allow stratigraphic correlation between the monitor wells.

The presence of any hydrocarbon wastes at these sites is expected to be obvious, based upon visual examination of soil cores and field headspace screening of soil samples using a PID. If wastes are found at the locations of Pit 3 and SG 86, a single soil sample from the two most highly impacted borings at each of the two locations (Pit 3 and SG 86) will be selected for laboratory analysis of hazardous constituents. If no evidence of hydrocarbon impacts are noted in any of the five borings at Pit 3 or at SG 86, as determined by field screening with the PID, then a single soil sample from the center boring will be submitted for laboratory analysis, as discussed in Section 6.

5. GROUND-WATER ASSESSMENT PLAN

In parallel with the soil assessment plan, a phased approach will be used to assess ground-water impacts resulting from the former impoundments. Phase I will consist of characterization of the target analytes present in ground water both on- and off-site, and Phase II will define the downgradient extent of a potential off-site ground-water contaminant plume. If necessary, a deep monitor well may also be installed to define the vertical extent of impacts. As described in Section 4.7, the detailed scope of work for Phase II activities will be submitted at a later date as an amendment to this Phase I Assessment Plan.

The Phase I ground-water assessment will include the following tasks: (1) installation and development of three additional monitor wells downgradient of the former impoundments, (2) redevelopment of existing monitor wells MW-3, MW-5, and MW-6, (3) installation of dedicated sampling pumps in each monitor well, (4) sampling of all new and existing monitor wells, and (5) additional water level measurements in the new and existing monitor wells to allow refinement of the ground-water flow direction and gradient. The procedures for the Phase I ground-water assessment are described in Sections 5.1 through 5.7.

5.1 Phase I Monitor Well Installation

Three monitor wells will be installed within the uppermost aquifer downgradient of the former impoundments using hollow-stem auger drilling techniques. The proposed locations for the downgradient monitor wells are shown in Figure 5-1. Prior to well installation, pilot soil borings will be drilled to the total depth at each location with minimum 6-inch augers. Soil samples will be collected at 10-foot intervals during the drilling of the pilot hole using the procedures described in Section 4, and field headspace screening will be performed using a PID meter, as described in Section 4. Soil grab samples will also be collected periodically during drilling to better define the geologic conditions at the site. All soil samples will be collected in accordance with DBS&A SOP 13.3.2, Soils Logging, Sampling, Handling, and Shipping for Geotechnical and Chemical Analyses.

The shallow monitor wells will be installed within the hollow-stem augers following the completion of the pilot soil boring. Immediately prior to well construction, the total depth of the borehole will be determined using a clean, weighted steel tape or tag line. The monitor wells will be constructed of 2-inch-diameter Schedule 40 PVC pipe and will include, in ascending order, a 6-inch flush-threaded silt trap (sump) at the bottom, 10 to 25 feet of flush-threaded 0.01-inch machine-slotted PVC screen, and blank casing from the top of the screen to approximately 2 feet above ground surface. No more than 15 feet of screen will be installed below the water table. If high VOC concentrations are detected, however, up to 10 feet of screen may extend above the water table in the vadose zone, to allow subsequent use of the well for soil vapor extraction.

Once the well casing has been lowered to the bottom of the borehole, a sandpack consisting of #20-40 mesh silica sand will be poured down the annulus of the auger in 3-foot lifts. After each 3-foot interval is filled, the augers will be pulled up approximately the same distance. This procedure will be repeated until the sand pack level is approximately 2 feet above the top of the screened section. The annular space above the sand pack will then be filled with a minimum 2-foot-thick pelletized bentonite seal, which will be hydrated with distilled water. The remaining annular space will be filled with a cement/bentonite slurry grout consisting of approximately 3 percent bentonite by weight. The top of the well casing will be protected by a PVC cap, and the exposed casing will be protected by a locking steel shroud. A 6-inch-thick concrete pad will then be constructed around the shroud. Generalized monitor well construction details are shown in Figure 5-2.

Immediately following their installation, the three new downgradient monitor wells will be checked for the presence of PSH. If any of the three wells are found to contain PSH, one additional monitor well will be installed approximately 100 feet downgradient from that well. This procedure will permit the subsequent conversion of the well with free product to a soil vapor extraction well, while still satisfying the recommendation for three downgradient monitor wells.

5.2 Monitor Well Development Procedures

The newly installed downgradient monitor wells and existing wells MW-3, MW-5, and MW-6 will be developed by a sequence of surging and pumping and/or bailing in accordance with DBS&A

SOP 13.4.3, Well Development. Initially, the wells will be surged with a surge block to dislodge any smeared material on the borehole wall that would otherwise inhibit ground-water flow and to remove fine particles from the formation. The suspended sediments will be removed by bailing, pumping, or air lifting. During well development, pH, temperature, specific conductance, and turbidity will be monitored periodically to determine when the wells have been sufficiently developed. Development will be considered complete when the water becomes relatively clear and water quality parameters have stabilized to within ± 5 percent over three consecutive measurements.

5.3 Ground-Water Sampling Procedures

Ground-water samples will be collected on a quarterly basis for the first year and on an annual basis thereafter. Ground-water samples will be collected from existing monitor wells MW-3, MW-5, and MW-6 and from all of the new downgradient monitor wells (Figure 5-1), except those found to contain PSH. All ground-water samples will be collected in accordance with DBS&A SOP 13.5, Water Sampling. Dedicated bladder pumps will be installed in all new and existing monitor wells that do not contain PSH, to allow purging and collection of representative ground-water samples using low flow rates.

Prior to ground-water sample collection, the following preparations will be made:

1. The area around the wellhead will be inspected for integrity, cleanliness, and signs of possible contamination.

2. A clean plastic sheet will be spread over the ground around the wellhead.

3. The cap on the wellhead will be removed and a flame ionization detector (FID) or photoionization detector (PID) will be used to determine if VOC vapors are present. Any obvious odors will be noted in the field logbook.

4. The static water level will be measured to the nearest 0.01 foot using an electrical water level sounder. The presence of any obvious contamination on the water level sounder

will be noted in the field logbook. The sounder will be decontaminated between wells, as described in Section 5.6, in order to prevent cross contamination.

5. Prior to purging the wells, a clear bailer or interface probe will be used to check for the presence of PSH. The presence or absence of PSH will be recorded in the field logbook, as well as the thickness of PSH, if any.

6. The well will then be purged to remove standing/stagnant water in order to ensure the collection of representative ground-water samples. Purging will be accomplished using the dedicated bladder pump at a rate equal to or greater than the anticipated sample collection flow rate. The field parameters pH, electric conductivity, dissolved oxygen, and temperature will be measured throughout the purging process at a frequency of at least once per casing volume. These parameters will be measured at the pump outlet within a clean container or a closed flow-through cell. Purging will continue for a minimum of three casing volumes and until the field parameters remain stable to within ±5 percent over at least one casing volume, except if the well is a very poor producer. In this case, the well will be purged dry once prior to sample collection. All fluids produced during purging will be contained for later disposal as described in Section 5.7.

Following purging, unfiltered ground-water samples will be collected as soon as possible using the dedicated bladder pump. Under no circumstances will the well be allowed to stand for more than three hours after well purging before collecting samples. The only exception is for very low-yield wells that are pumped dry under normal purging and sampling rates. In this case, the well will be pumped dry and allowed to recover until sufficient water is present in the well to allow a sample to be collected.

The samples will be collected in order of decreasing volatility, with samples for VOC analysis being collected first. The pumping rate during sample collection of VOC samples will be maintained at 100 milliliters (mL) per minute or less to minimize volatilization. All samples will be collected in precooled, acidified, certified-clean 40-mL glass vials with septum caps supplied by the laboratory. Following collection of the VOC samples, the SVOC, metals, and other samples will be collected in appropriate containers, as described in greater detail in Section 6.

Sample labeling, packaging, and chain-of custody procedures will be performed as described in Section 6.5. The sample coolers with the associated chain-of-custody forms will be shipped to the laboratory using an overnight commercial carrier. The fastest possible shipping method will be used, and all sample shipments will be carefully tracked to ensure that samples arrive intact and that all holding times are met.

5.4 Laboratory Analysis of Ground-Water Samples

During the first sampling event, ground-water samples from each well will be analyzed for VOCs, SVOCs, PCBs, metals, cyanide, and sulfide. In addition, the major cations and anions will be determined, along with TDS and TPH. Chemical analyses will be performed in accordance with procedures set forth in *Test Methods for Evaluating Solid Waste* (U.S. EPA, 1986). Section 6 provides a list of target analytes, along with data quality objectives and quality assurance procedures applicable to the ground-water assessment.

5.5 Aquifer Testing

Aquifer slug tests will be performed on existing monitor wells MW-3, MW-5, and MW-6, and on each of the newly installed shallow wells (Figure 5-1). Data collected from the individual slug tests will be used to estimate the hydraulic conductivity of both the uppermost aquifer and deep bedrock aquifer. All slug tests will be performed in accordance with the procedures described in DBS&A SOP 13.6.2, Slug Testing.

Slug tests are performed by causing a sudden change in the water level in the well and then measuring the water level recovery rate. Both rising head and falling head tests are possible. Displacement of the water level in the well is achieved through the use of a solid cylinder immersed in the water. The cylinder is then suddenly removed and the rate of water level recovery monitored until it is complete. The recovery rate is proportional to the hydraulic conductivity of the water-bearing zone.

Water levels will be measured immediately prior to the aquifer test and throughout the recovery period until water levels have recovered to within approximately 95 percent of the static water level. Water levels will be recorded using a downhole pressure transducer and electronic data logger. The transducer will be calibrated prior to the test using standard procedures required by the manufacturer. In addition, periodic manual water level measurements will be made using an electric water level indicator for comparison with the data recorded by the data logger.

Standard aquifer testing equations will be used to estimate the hydraulic conductivity of both the uppermost aquifer and deep bedrock aquifer. Appropriate analytical procedures are presented in *Groundwater and Wells* (Driscoll, 1986) and *Analysis and Evaluation of Pumping Test Data* (Kruseman and de Ridder, 1992).

5.6 Decontamination Procedures

All non-disposable field equipment that may potentially come in contact with contaminated ground water or soils will be decontaminated in accordance with DBS&A SOP 13.5.2, Decontamination of Field Equipment, in order to minimize the potential for cross-contamination between sampling locations. Clean latex or plastic gloves will be worn during all decontamination operations. The following sequence of decontamination procedures will be followed prior to each sampling and/or testing event:

1. Wash the equipment in a solution of non-phosphate detergent (Liquinox®) and distilled/deionized water. Use a clean Nalgene® tub to contain the wash solution and a scrub brush to mechanically remove loose particles.

2. Rinse the equipment twice with distilled/deionized water.

3. Allow the equipment to air dry before the next use.

All wash water generated during equipment decontamination will be contained in 55-gallon drums for proper disposal. All liquids will be assumed to be contaminated and properly labeled as described in Section 5.7. Decontamination water will remain on-site pending the results of laboratory analysis of the associated ground-water samples. The laboratory results for the ground-water samples will be used to determine the method of disposal for the drummed wash water, as described in Section 5.7. All drilling equipment will be decontaminated as described in Section 4.5.

5.7 Management of Investigation-Derived Wastes

A variety of wastes will be generated during the implementation of the ground-water assessment plan. These wastes include soil cuttings, decontamination fluids, used PPE, and ground water produced during well development and purging. All wastes, with the exception of PPE, will be handled as potentially hazardous wastes.

All waste materials will be drummed and labeled to identify the contents, date of generation, and amount of material generated. Waste material will be stored in 55-gallon drums. All waste containers generated during the ground-water assessment will be stored in a designated drum storage area within the facility.

For those wastes that are associated with a particular sample collected during the ground-water assessment (e.g., soil cuttings collected during the drilling of a well with soil samples collected for chemical analyses at 10-foot intervals, or purged ground water from a well that was subsequently sampled and analyzed), the analytical results will be used to determine if the drummed materials constitute hazardous waste. All contaminated water and water that is potentially contaminated but cannot be associated with a particular sample or set of samples will be passed through an activated carbon filtration system to remove all organic constituents. A sample of the clean filtered water will then be collected for laboratory analysis of VOCs. Upon verification that the water is clean, it will be released to the ground surface on-site. The carbon filter will be disposed of at a licensed hazardous waste disposal facility such as the Rollins facility in Deer Park, Texas that is currently receiving PSH product from the recovery well system. PPE and dry refuse associated with these materials will be disposed of in a sanitary landfill.

5.8 Phase II Ground-Water Assessment

As with the soil assessment plan, the Phase II ground-water assessment cannot be fully scoped until the Phase I results are available. However, the objective of the Phase II ground-water investigation will be to define the downgradient extent of impacted ground water. Thus an iterative approach will be required. In general, additional downgradient monitor wells may be installed in the alluvium to track the dissolved-phase plume that may exist to the northeast of the former impoundments. Drilling, well installation, and well development procedures will be similar to those described in Section 5.1. The number of monitor wells that will be required to define the downgradient plume remains unknown at this time.

In addition to the installation of additional monitor wells in the shallow alluvium, one downgradient deep monitor well will be installed into the San Andres bedrock aquifer. The purpose of the deep well is to determine whether the bedrock aquifer has been impacted by the former impoundments. The location of the deep bedrock monitor well will be determined based on the results of the Phase I ground-water assessment. Drilling and well installation procedures will be provided in the Phase I Assessment Plan amendment that details the scope of work for Phase II activities.

6. QUALITY ASSURANCE PROJECT PLAN

This section describes the procedures that will be followed to ensure that the data obtained during this investigation will be adequate for the project objectives. The Quality Assurance Project Plan (QAPP) presented herein describes the laboratory analyses to be performed, data quality objectives, and quality assurance/quality control (QA/QC) procedures to be used to ensure that project objectives are met. Sections 6.1 through 6.12 have been prepared in accordance with the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (U.S. EPA, 1983), and are those elements required for consideration in any QAPP, according to EPA.

6.1 Analytical Parameters and Methods

Based on previous investigations, petroleum hydrocarbons and the chlorinated solvent 1,1,1-TCA are recognized as the principal threats to ground water in the study area. However, in order to ensure that other constituents are not present, additional analyses will be specified for soil and ground-water samples collected during Phase I. Accordingly, soil and ground-water samples collected as described in Sections 4.1 and 5.1 of this Phase I Assessment Plan will be analyzed for the suite of target analytes listed in Table 6-1.

The suite of analytes specified in Table 6-1 includes 8240 VOCs, 8270 SVOCs, 8080 pesticides/PCBs, metals, cyanide, and sulfide. In addition, ground-water samples will be analyzed for major cations and anions and total dissolved solids in order to characterize the overall water quality. TPH will also be determined on both soil and ground-water samples. Analytical methods for all parameters will follow standard RCRA procedures specified in *Test Methods for Evaluating Solid Waste* (U.S. EPA, 1986). Table 6-2 highlights those constituents that are believed to constitute potential contaminants of concern at this facility.

6.2 Data Quality Objectives

Data quality objectives (DQOs) are the qualitative and quantitative objectives established to ensure that the data generated meet the needs of the project. Therefore DQOs are project-specific and depend largely on the ultimate use for which the data are intended. DQOs have been established for this project in accordance with EPA guidance documents, particularly *Data Quality Objectives for Remedial Response Activities* (U.S. EPA, 1987), and *RCRA Ground-Water Monitoring: Draft Technical Guidance* (U.S. EPA, 1992). The parameters used to quantify data quality include precision, accuracy, representativeness, completeness, and comparability (PARCC).

Objectives or goals for the so-called PARCC parameters (U.S. EPA, 1987) constitute the project-specific DQOs for a particular investigation. Each PARCC parameter is described below, along with the proposed DQO for this Phase I Assessment Plan, where applicable. The proposed DQOs for this investigation are summarized in Table 6-1.

- **Precision** is a quantitative measure of the reproducibility (or variability) of the analytical results. Precision will be calculated by determining the relative percent difference (RPD) between the concentrations reported for field duplicate samples collected from the same location. Methods for collecting duplicate field samples are discussed in Section 5.3. The proposed RPD precision objective is 20 or less.

- **Accuracy** is defined as the degree to which the reported analytical result approaches the "true" value. Accuracy will be estimated through the analysis of matrix spikes (MS). The percent recovery of the "true" spike concentration will be calculated for each MS. The accuracy objective is within the range of 80 to 120 percent recovery of the matrix spike.

- **Representativeness** refers to how well the analytical data reflect subsurface contaminant concentrations. Due to numerous site-specific factors, such as the degree of heterogeneity in the subsurface, representativeness is difficult to define and even more difficult to quantify. For this project, representative data will be attained through the use of consistent and approved sampling and analytical procedures and through a well defined sampling plan that specifies adequate investigation of all areas of concern.

- **Completeness** is the percentage of samples collected that meet or exceed the DQOs for precision, accuracy, and representativeness, as estimated from the analysis of QA/QC samples described above. The completeness objective for this project is 90%.

- **Comparability** is an assessment of the relative consistency of the data. No quantitative method exists for evaluating comparability; hence, professional judgment must be relied upon. Internal comparability of the soil and ground-water data set will be achieved by the use of consistent sampling and analysis procedures throughout the project. Likewise, by using identical analytical methods to those employed during previous investigations, the data generated during this investigation will be comparable with existing data.

6.3 Quality Assurance/Quality Control Samples

QA/QC samples include matrix spikes/matrix spike duplicates (MS/MSD), field duplicates, trip blanks, and equipment blanks. EPA guidance recommends that QA/QC samples be collected at a minimum 5-percent frequency (U.S. EPA, 1987). For this project, both soil and ground-water QA/QC samples will be analyzed at this frequency.

Equipment blank samples are collected in order to determine if any of the analytes detected in environmental samples may be attributable to improper and/or incomplete decontamination of field sampling equipment. Equipment blanks will be collected in the following manner. After the sampling device has been decontaminated in accordance with DBS&A SOP 13.5.2, Decontamination of Field Equipment, it will be rinsed with deionized water. The rinsate will be collected and sent to the laboratory as an equipment blank.

Field duplicate samples will be collected to provide a measure of precision for the analytical results. VOC soil duplicates will be collected by submitting two adjacent brass liner rings from the same split-barrel sample. The ground-water duplicate samples will be collected by filling sample containers in an alternating manner following the sampling protocol described in Section 5.3 of this Phase I Assessment Plan.

One VOC trip blank will accompany each shipment to the laboratory. VOC trip blanks are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage, or other site-specific conditions. VOC trip blanks will consist of deionized, organic-free water added to a clean 40-mL glass septum vial.

In addition to the above QA/QC samples, MS/MSD analyses will be performed in the laboratory by spiking the soil or water samples with a known quantity of the analyte of interest. MS/MSD analyses are performed to determine laboratory accuracy and precision and to determine if any matrix interferences exist. MS/MSD analysis will be specified on the chain-of custody form for at least 5 percent of the samples collected.

6.4 Sampling Procedures

The soil and ground-water sampling procedures described in Sections 4 and 5 will be performed in accordance with DBS&A SOPs 13.3.2 and 13.5, respectively. A summary of the analytical methods, required sample volumes, containers, and sample preservation is provided in Table 6-3. All sample containers will be acquired from the laboratory and will be certified clean.

Adhesive labels will be applied to the sample containers, and a waterproof marking pen will be used to complete the labels. Information will include the date and time of sample collection, type of analysis to be performed, preservative used (if any), depth of sample (for soils), and the initials of sampling personnel. The containers will be sealed and placed in clear plastic bags. The sealed containers will be put in coolers on bags of ice or frozen ice packs. Plastic bubble pack or other suitable packing material will be used to prevent breakage.

The field personnel will ship the sample coolers to the laboratory using an overnight courier service. The fastest possible shipping method will be used, and all sample shipments will be carefully tracked to ensure that samples arrive intact and that all holding times are met.

6.5 Chain of Custody Procedures

For analytical data to be valid, samples must be traceable from the time of collection through chemical analysis and final disposition. Chain-of-custody forms have been developed for this purpose. The necessary blank documents will be obtained from the laboratory, including chain-of-custody forms and seals.

Chain-of-custody forms will be completed in triplicate. The original form and one copy will be placed inside each cooler, and one copy will be retained by field personnel. The chain-of-custody forms accompanying each cooler will be sealed in a plastic bag and taped to the inside of the cooler lid. Each cooler will have a clearly visible return address. The cooler lids will be secured with shipping tape that encircles the cooler ends. A chain-of-custody seal will be placed at the front left and rear right sides of the cooler so that opening the lid will break the chain-of-custody seals.

Field activities and sample collection will be documented in a bound logbook dedicated to the project. For each sample, the location, time, monitor well/boring number, sample depth, sample volumes and preservation, and other pertinent field observations will be recorded. Each page of the logbook will be dated, numbered, and signed by those individuals making entries.

6.6 Equipment Calibration Procedures and Frequency

Numerous instruments will be used in the field and the laboratory during this investigation. In order for reliable data to be generated, it is important that these instruments be routinely calibrated. Calibration of analytical instruments within the laboratory will be the responsibility of the contracted laboratory. Although the details of the laboratory calibration procedures are beyond the scope of this QAPP, the frequency of initial and continuing calibrations will adhere to established EPA protocols, as described in the analytical method (U.S. EPA, 1986). In addition, the laboratory's QA manual will be available for review upon request.

During this investigation, DBS&A anticipates using the following field equipment:

- PID (Thermo Environmental 580B or equivalent)
- FID type OVA (Foxboro 108 or equivalent)
- Salinity-conductivity-temperature (SCT) meter (YSI Model 33 or equivalent)
- pH meter (Orion Model 250A or equivalent)
- Dissolved oxygen (DO) meter (YSI Model 57 or equivalent)
- Water level indicator (Solinst or equivalent)
- PSH interface meter (Solinst or equivalent)

Calibration and maintenance procedures for each of these instruments are described in the following paragraphs. Documentation of daily calibration for each of these instruments will be recorded in the field logbook, along with any required maintenance procedures performed.

A PID and/or FID will be used to screen soil samples for volatile organic compounds using the headspace method. The PID or FID will also serve for health and safety monitoring of the work area for organic vapors. Background VOC concentrations will be recorded daily in the logbook. The PID and/or FID will be calibrated daily with standard isobutylene (PID) or standard methane (FID). Recalibration of the PID and/or FID can occur during the work day at the discretion of the site health and safety officer in the event of suspect readings. Care will be taken to ensure that the PID and/or FID remains free of sand and dirt. The battery will be charged on a daily basis.

The SCT meter calibration will be checked initially with a standard potassium chloride solution and mercury thermometer, and a battery check will be performed daily prior to beginning field work. In the event of erratic measurements, the instrument calibration will be checked in the field. When not in use, the electrode will be kept immersed in deionized water to keep the platinum black surfaces fully hydrated, in accordance with manufacturers' instructions.

Prior to use each day, the pH meter will be calibrated using two pH buffers. The buffer solutions will be chosen to bracket the expected ground-water pH range. Calibration of the instrument will be periodically checked throughout the day using the pH buffers to ensure accurate readings. In the event of instrument drift, the pH meter will be recalibrated. The electrode will be rinsed with deionized water following each measurement and placed in the appropriate potassium chloride storage solution.

The DO meter will be calibrated in air by adjusting the calibration control until the oxygen concentration reads the correct value for the elevation and temperature at the site. The DO meter calibration will be checked periodically during the day and recalibrated if necessary.

The water level indicator will be initially calibrated against a steel tape, prior to commencement of field activities. The battery and electrical connections will be periodically checked to ensure proper functioning of the instrument. The indicator probe and tape will be rinsed clean following each measurement. The PSH interface meter will be calibrated in a similar manner following manufacturer's instructions.

6.7 Data Reduction and Reporting

Data reduction will be performed by the laboratory in accordance with EPA protocols for the respective analytical method. Data from the analytical laboratory will be reviewed following the laboratory's internal QA/QC plan. All EPA required elements will be provided with the data package. If the analytical data do not meet the minimum data quality objectives, the laboratory will implement the corrective actions described in Section 6.10. All data falling outside the quality control limits defined in this QAPP will be flagged by the laboratory, as required by EPA protocol. Any discrepancies noted in the laboratory QA review will be noted in the case summaries included with the data packages.

Following the field investigation phase of the project, the degree to which the data quality objectives have been met will be examined by comparing the actual results for the QA/QC samples with the objectives listed in Table 6-1. The results of this comparison will be tabulated in the final report, along with detailed descriptions of any deviations from the protocols proposed in this Phase I Assessment Plan.

6.8 Internal Quality Control Checks

The specific quality control checks to be used are included with the individual analytical methods specified for each parameter. The quality control criteria for VOCs and TPH (gasoline) are described in *Test Methods for Evaluating Solid Wastes* (U.S. EPA, 1986).

6.9 Performance and System Audits

Performance and system audits are the practices followed by analytical laboratories to evaluate quality control procedures and laboratory performance (U.S. EPA, 1983). System audits are performed in order to assess whether a new analytical system is functioning properly. Performance audits rate the ongoing performance of the laboratory in terms of the accuracy and precision of the analytical data generated. Examples of performance audits include the analysis of performance evaluation samples, such as standard reference materials obtained from the National Institute of Standards and Technology or EPA, or participation in interlaboratory performance evaluation studies using "round-robin" samples. Each participating laboratory is graded and ranked based on the results. The performance and system audits of the laboratory contracted for this Phase I Assessment Plan will be provided and available for review.

6.10 Corrective Actions

If QA activities reveal apparent problems or deficiencies with the analytical data, corrective actions must be applied. The type of corrective action depends on the specific problem that occurs, but a general sequence of corrective actions will be followed. If the data do not fall within the prescribed data quality objectives, the affected samples will be re-analyzed by the laboratory until the objectives are met. Any data falling outside QC limits will be flagged and qualified to explain the nature of the data quality problem.

6.11 Routine Data Assessment Procedures

Routine procedures to assess the precision, accuracy, and completeness of the analyses include RPD for field duplicates and MS/MSD samples, as well as percent recovery for MS samples. The specific statistical techniques to be used are described with the appropriate analytical method (U.S. EPA, 1986). Any problems or deficiencies will be reported to the NMED in the quarterly progress reports, or by telephone, if warranted by the nature and urgency of the problem.

6.12 Quality Assurance Reports to Management

Periodic assessment of data accuracy, precision, and completeness will be performed by the QA manager of the contracted laboratory. The results of these assessments, as well as the results of laboratory performance and system audits, will be available upon request. The laboratory QA manager will also review the case narratives and accompanying analytical data package to ensure that all data quality objectives are met. In the event that objectives are not met, the QA manager will consult with the laboratory manager to correct the problem.

7. PROJECT SCHEDULE

The proposed Phase I project schedule is shown in Figure 7-1. The Phase I soil assessment (Section 4) and Phase-I ground-water assessment (Section 5) are tentatively scheduled to begin July 17, 1995. The Phase I drilling and monitor well installation program is expected to require approximately two weeks to complete. Monitor well development, ground-water sampling, and aquifer testing will require an additional week. Preparation of a report summarizing Phase I activities will require 6 weeks following receipt of the laboratory data.

All remaining activities will be addressed in subsequent phases following completion of the Phase I report. These include establishing cleanup criteria, developing soil and ground-water corrective action plans, and establishing the schedule for corrective action activities. The tentative project schedule for these activities is shown in Figure 7-1. Transwestern is committed to achieving cleanup of impacted soil and ground water as efficiently and rapidly as possible and believes that the phased approach proposed here will attain that objective.

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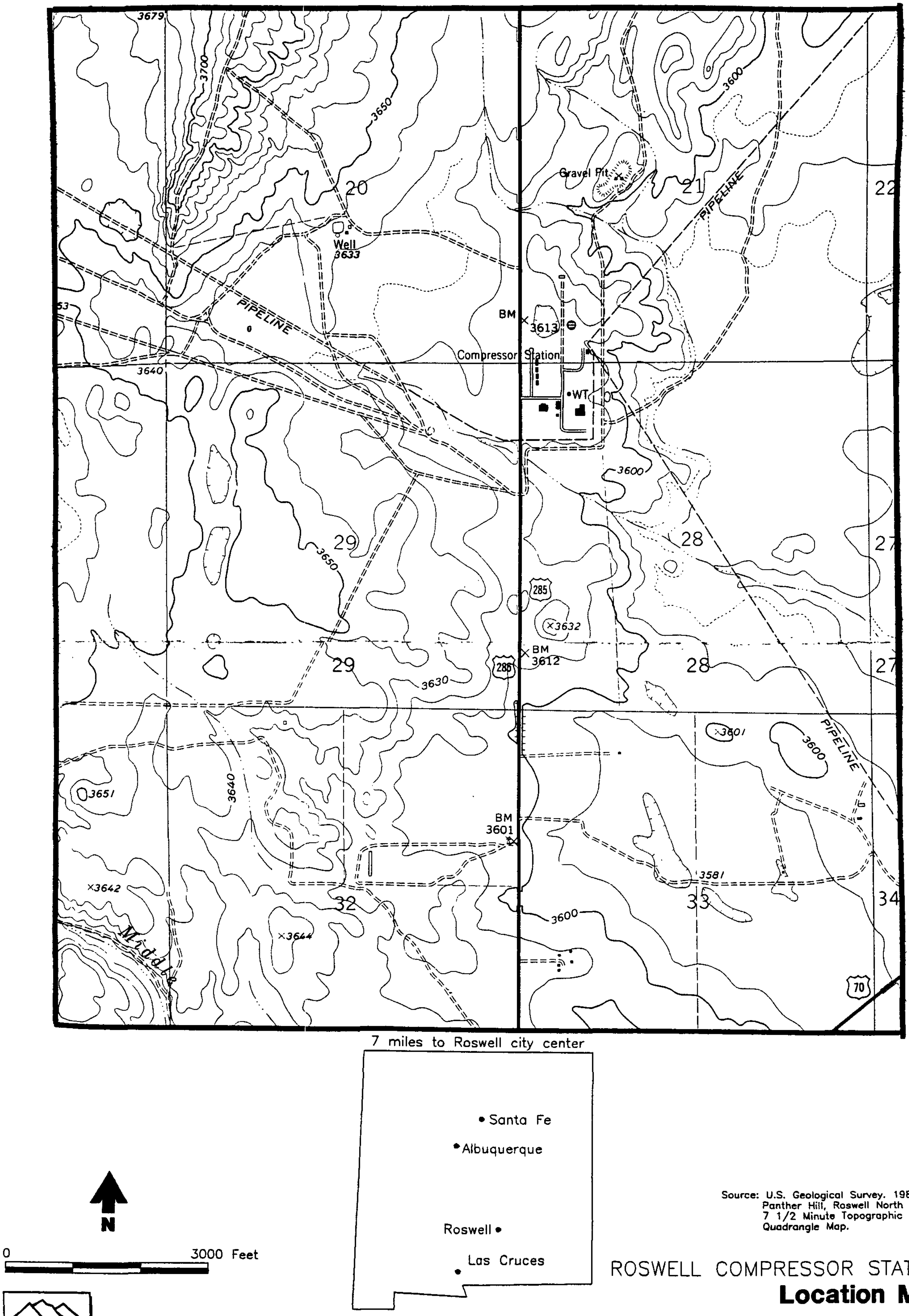
FIGURES



Source: U.S. Geological Survey. 1982
Panther Hill, Roswell North
7 1/2 Minute Topographic
Quadrangle Map.

ROSWELL COMPRESSOR STATION
Location Map

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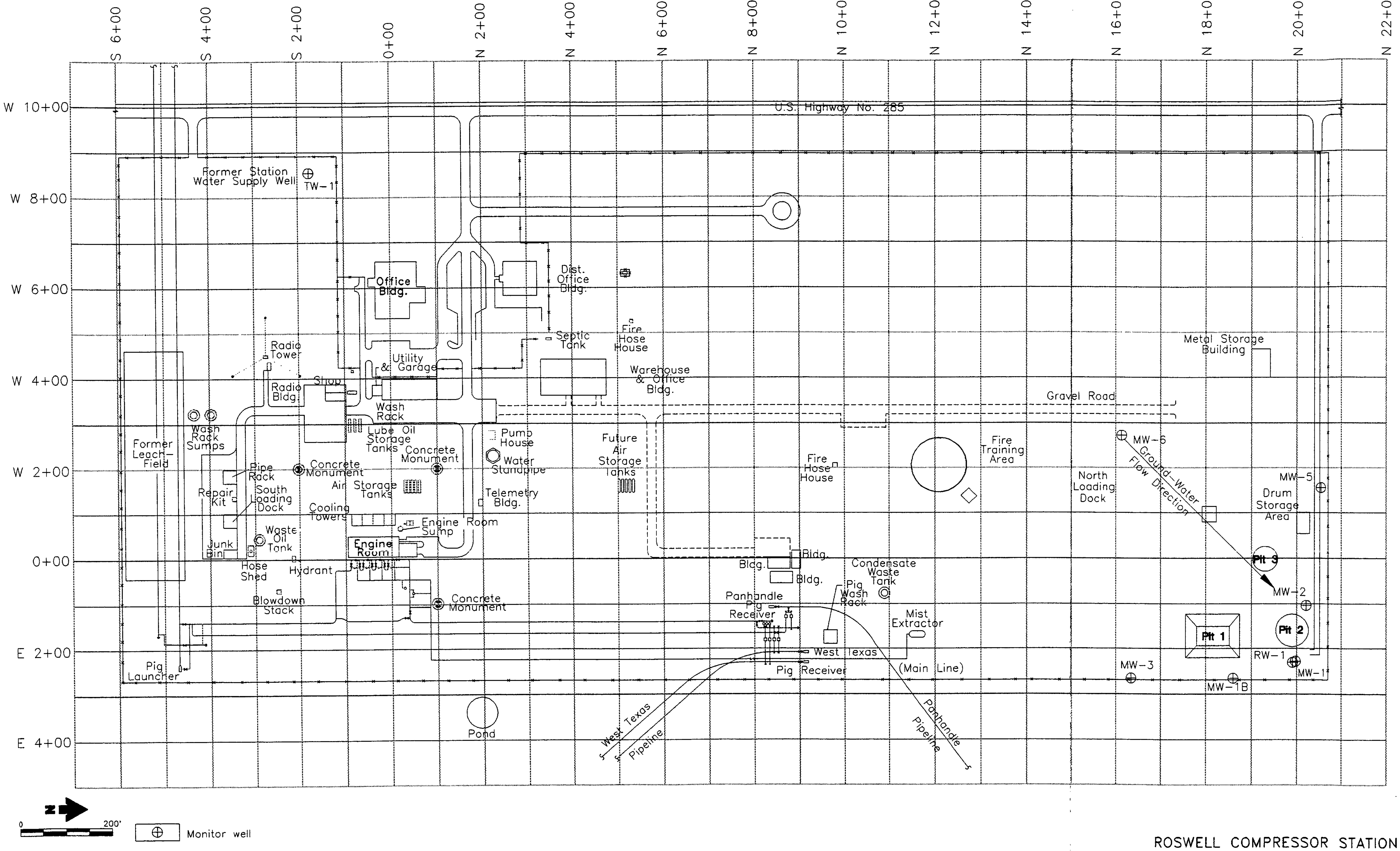
5-94
JN 4115

Figure 1-1



D:\4115\1-2SP.DWG

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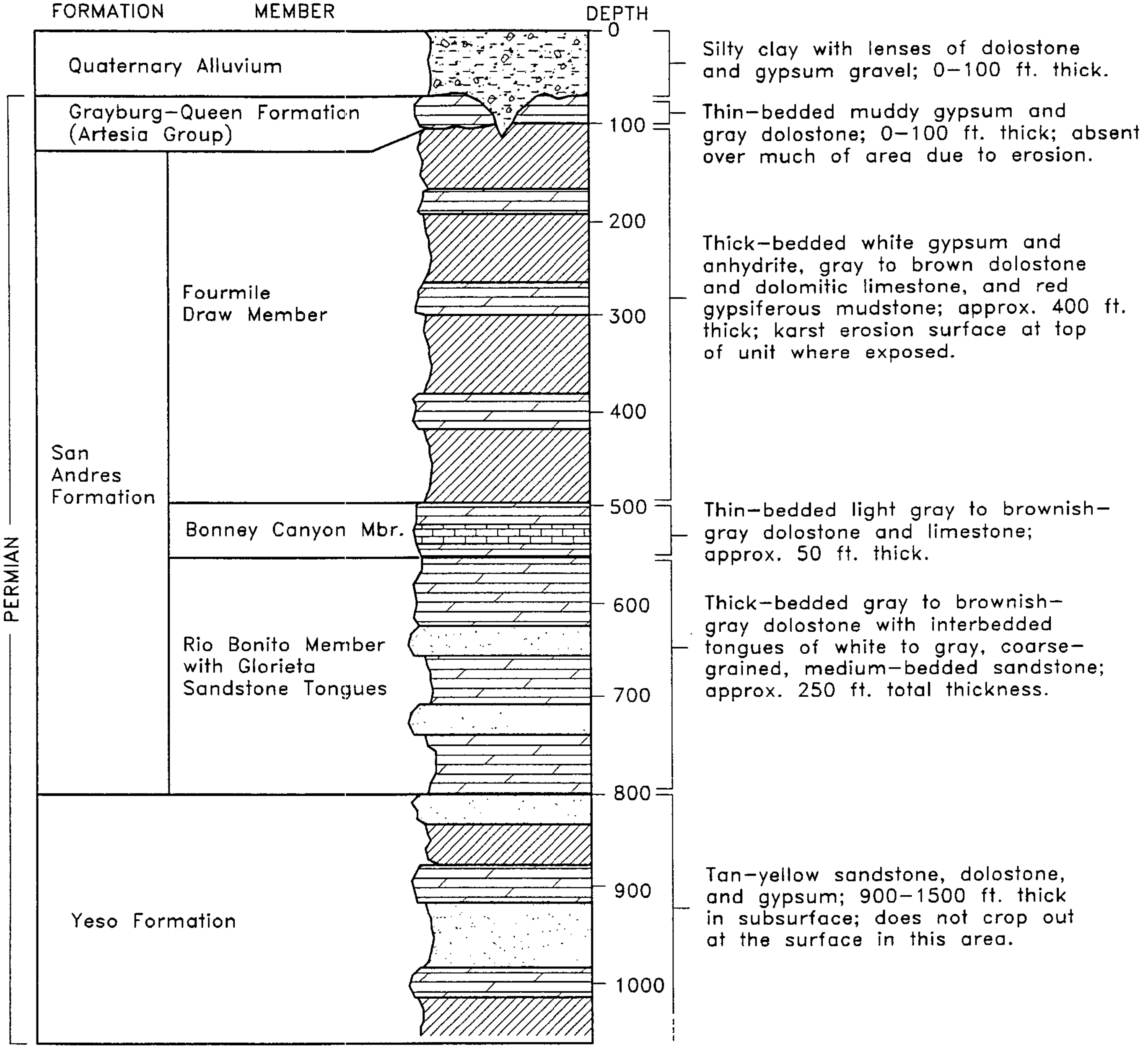
ROSWELL COMPRESSOR STATION
Site Plan

Figure 2-1



Silty clay with lenses of dolostone and gypsum gravel; 0–100 ft. thick.

Thin-bedded muddy gypsum and gray dolostone; 0–100 ft. thick; absent over much of area due to erosion.

Thick-bedded white gypsum and anhydrite, gray to brown dolostone and dolomitic limestone, and red gypsiferous mudstone; approx. 400 ft. thick; karst erosion surface at top of unit where exposed.

Thin-bedded light gray to brownish-gray dolostone and limestone; approx. 50 ft. thick.

Thick-bedded gray to brownish-gray dolostone with interbedded tongues of white to gray, coarse-grained, medium-bedded sandstone; approx. 250 ft. total thickness.

Tan-yellow sandstone, dolostone, and gypsum; 900–1500 ft. thick in subsurface; does not crop out at the surface in this area.

Information Source: Kelley, 1971

Explanation

▤	Unconsolidated Alluvium	☰	Dolomite
☐	Sandstone	▨	Gypsum
▦	Limestone		

ROSWELL COMPRESSOR STATION

Generalized Stratigraphic Section Near Roswell Compressor Station

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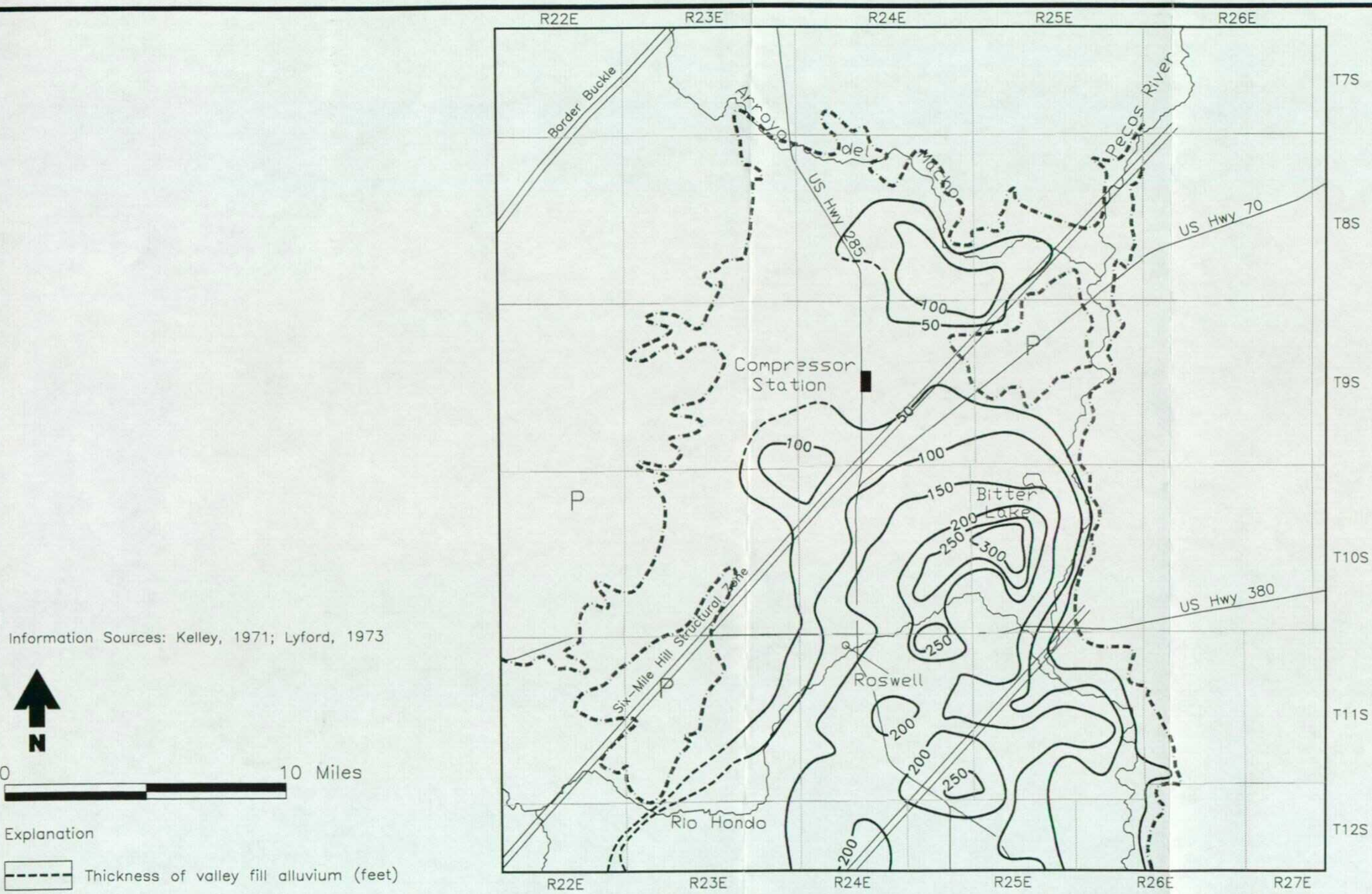
Figure 2-2

D/4115/2-2GSS.DWG



Information Sources: Kelley, 1971; Lyford, 1973

Explanation

- - - - -	Thickness of valley fill alluvium (feet)
-·-·-·-·-	Approx. surface contact between Permian rocks and valley fill alluvium
P	Outcrop area of Permian rocks

D:\4115\2-1TSAA

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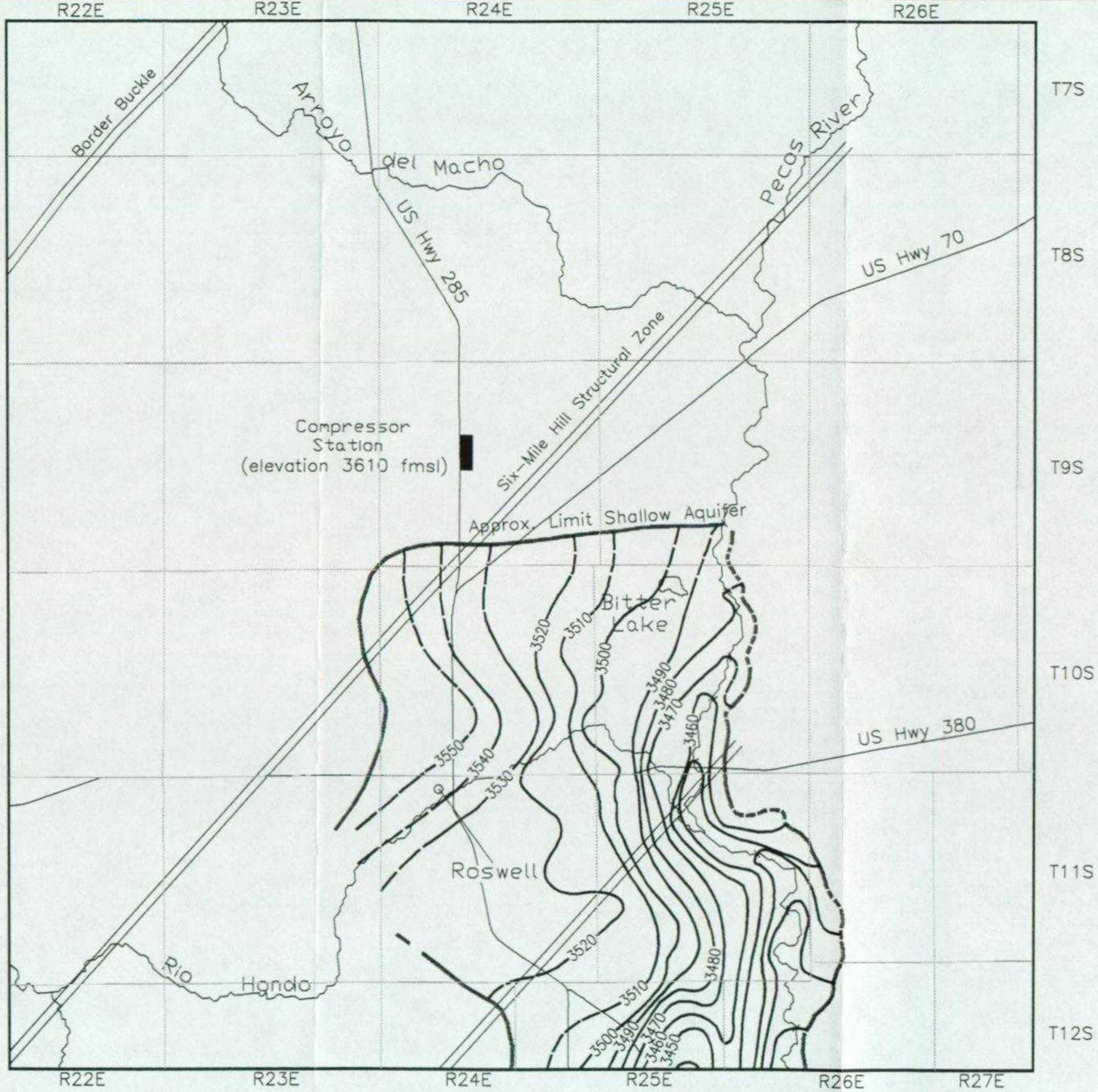
ROSWELL COMPRESSOR STATION

Approximate Thickness of Shallow Alluvial Aquifer

Figure 2-3



Information Source: Welder, 1983

N

0 10 Miles

Explanation

3350	Water level contour (feet above mean sea level [fmsl])
— —	Approximate extent of shallow alluvial aquifer
▨	Structural zone (Maddox, 1968; Kelley, 1971)

D\4115\2-2WL

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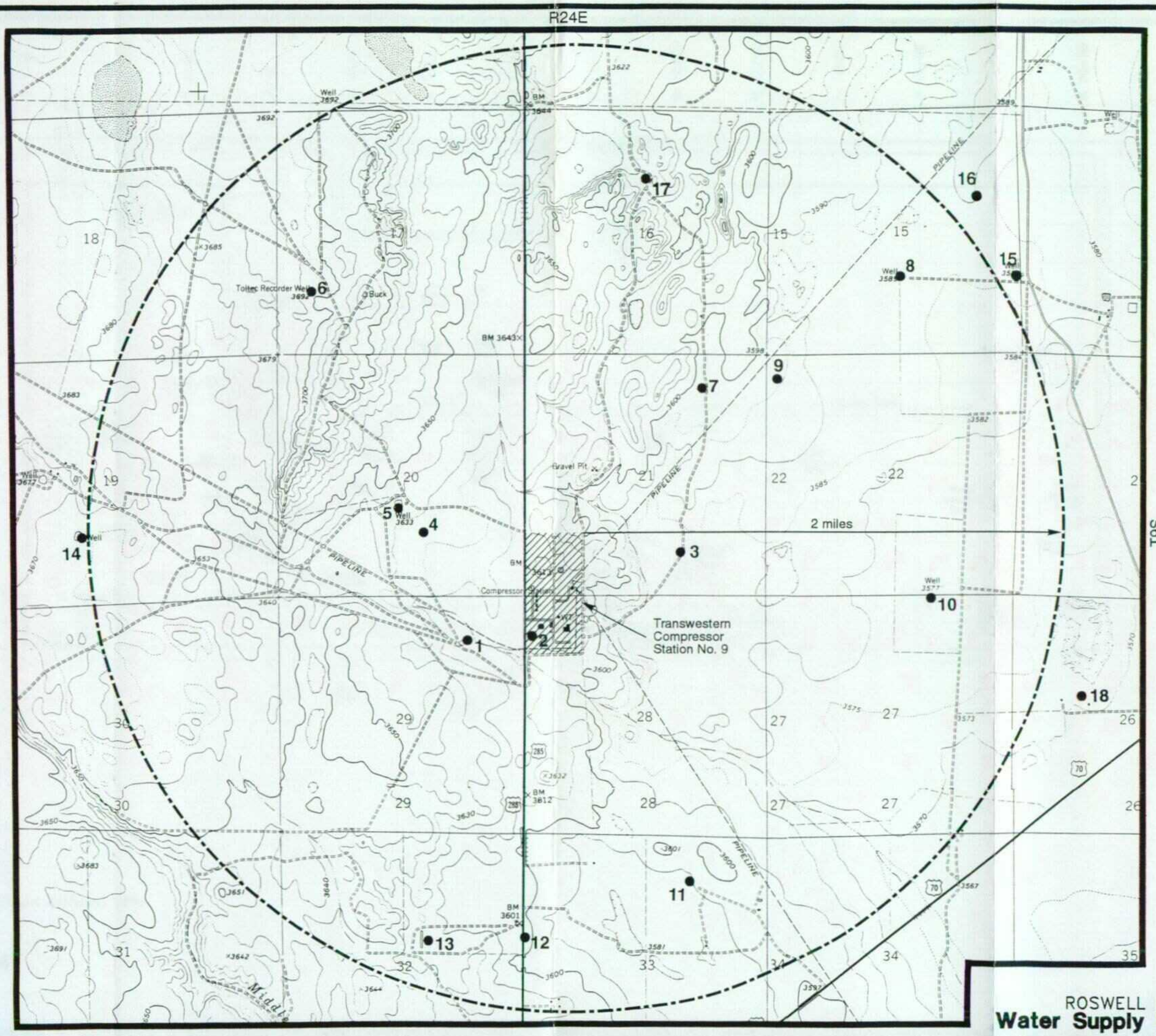
ROSWELL COMPRESSOR STATION
Water Levels in Shallow Alluvial Aquifer, January 1984

Figure 2-4



Note: Well numbers refer to wells listed on Table 2-1.

N

0 2000'

D:\4115\2-3WSW.DWG

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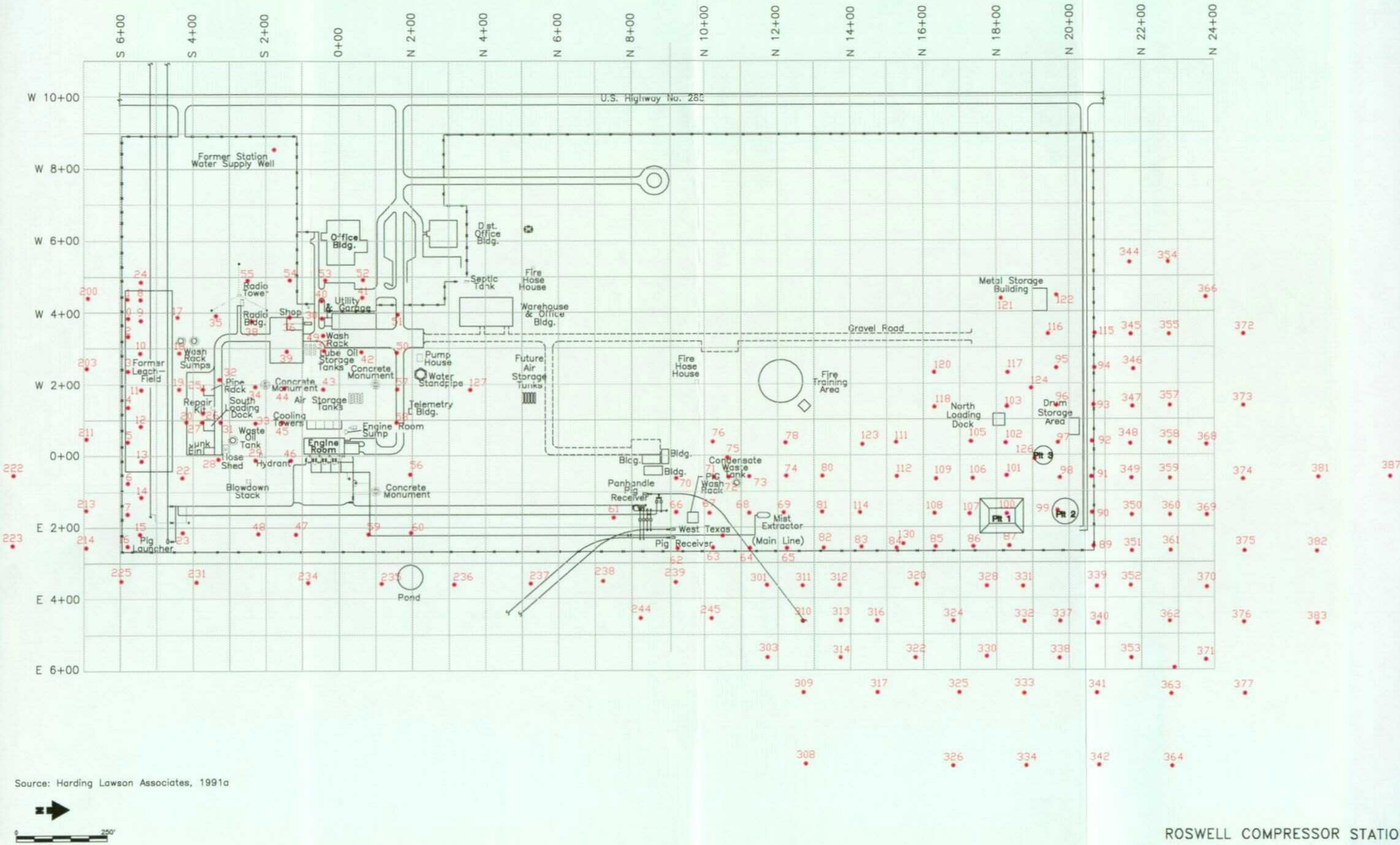
ROSWELL COMPRESSOR STATION
Water Supply Well Location Map

Figure 2-5



Source: Harding Lawson Associates, 1991a

D/4115/4-1SV.DWG

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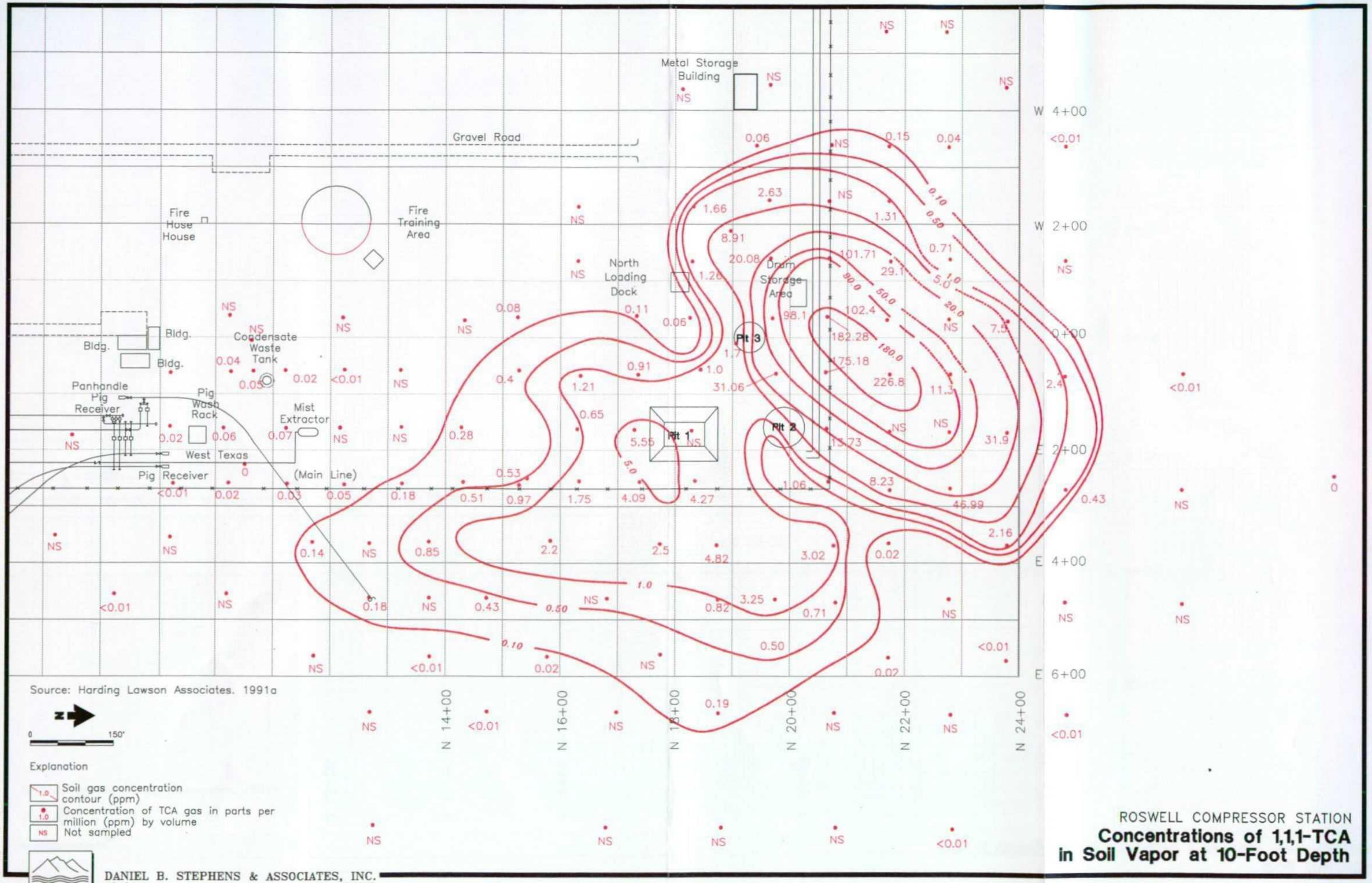
ROSWELL COMPRESSOR STATION
Harding Lawson Associates
Soil Vapor Sample Locations

Figure 3-1



Source: Harding Lawson Associates. 1991a

0 150'

Explanation

1.0	Soil gas concentration contour (ppm)
• 1.0	Concentration of TCA gas in parts per million (ppm) by volume
NS	Not sampled

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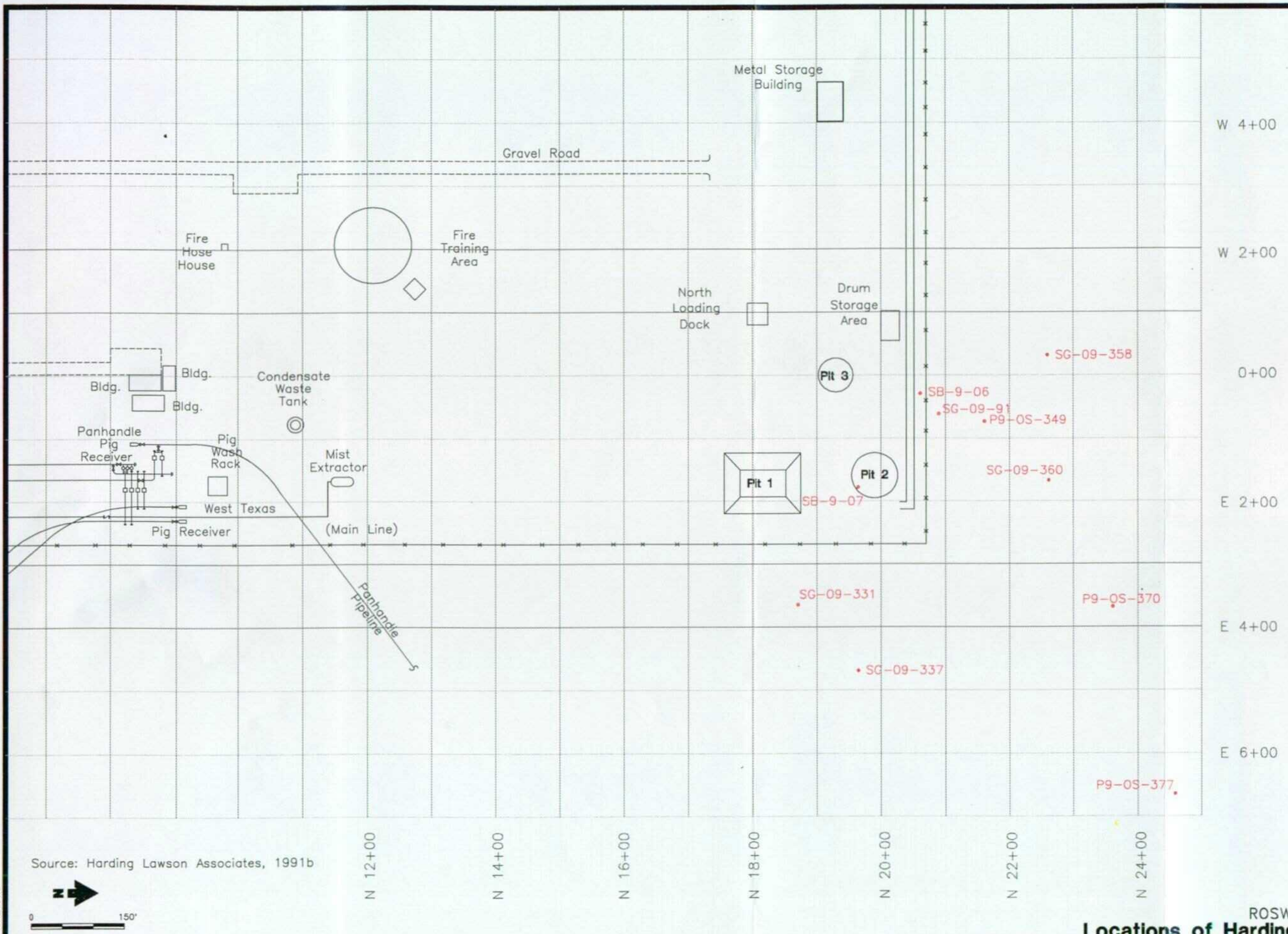
D/4115/4-2TCA2.DWG

ROSWELL COMPRESSOR STATION

Concentrations of 1,1,1-TCA in Soil Vapor at 10-Foot Depth

Figure 3-2



Source: Harding Lawson Associates, 1991b

ROSWELL COMPRESSOR STATION

Locations of Harding Lawson Associates Soil Borings

D\4115\4-3HLA.DWG

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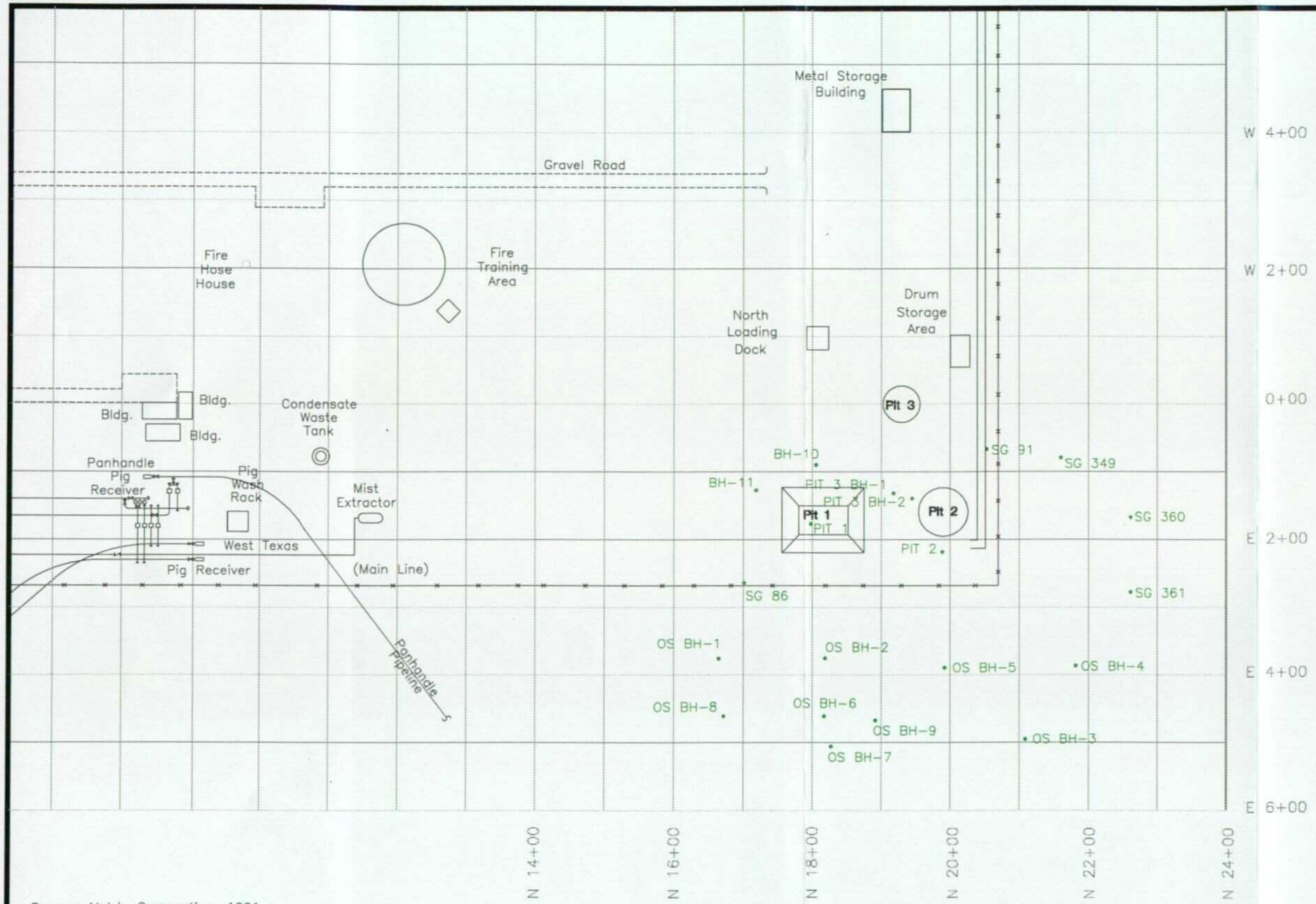
Figure 3-3



Source: Metric Corporation, 1991

0 150'

D:\4115\4-4MC.DWG

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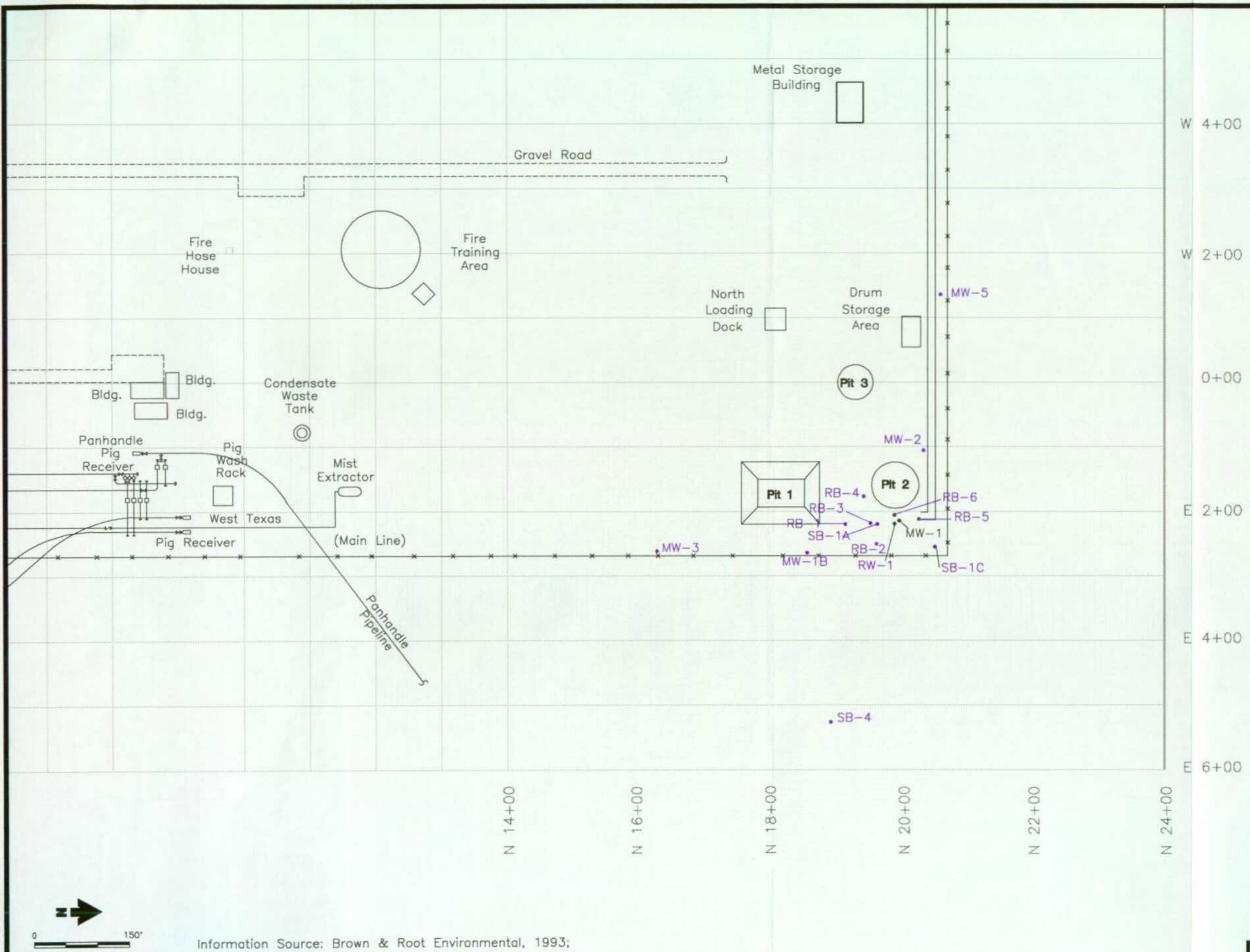
ROSWELL COMPRESSOR STATION

Locations of Metric Corporation Soil Borings

Figure 3-4



Information Source: Brown & Root Environmental, 1993;
Halliburton-NUS Environmental Corp., 1992

ROSWELL COMPRESSOR STATION

Locations of Halliburton and Brown & Root Soil Borings

D:\4115\4-5HBR.DWG

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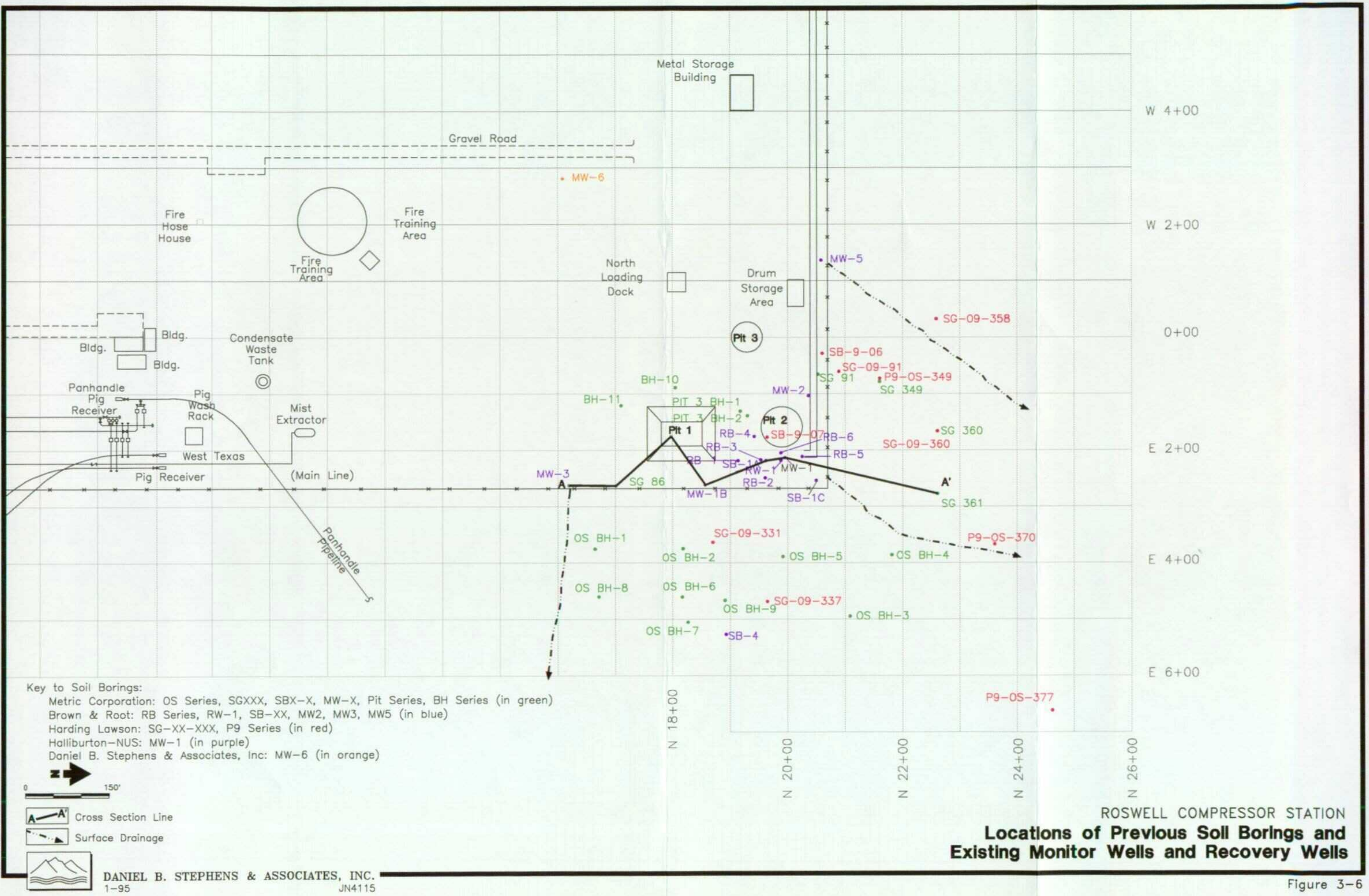
Figure 3-5



Key to Soil Borings:
Metric Corporation: OS Series, SGXXX, SBX-X, MW-X, Pit Series, BH Series (in green)
Brown & Root: RB Series, RW-1, SB-XX, MW2, MW3, MW5 (in blue)
Harding Lawson: SG-XX-XXX, P9 Series (in red)
Halliburton-NUS: MW-1 (in purple)
Daniel B. Stephens & Associates, Inc: MW-6 (in orange)

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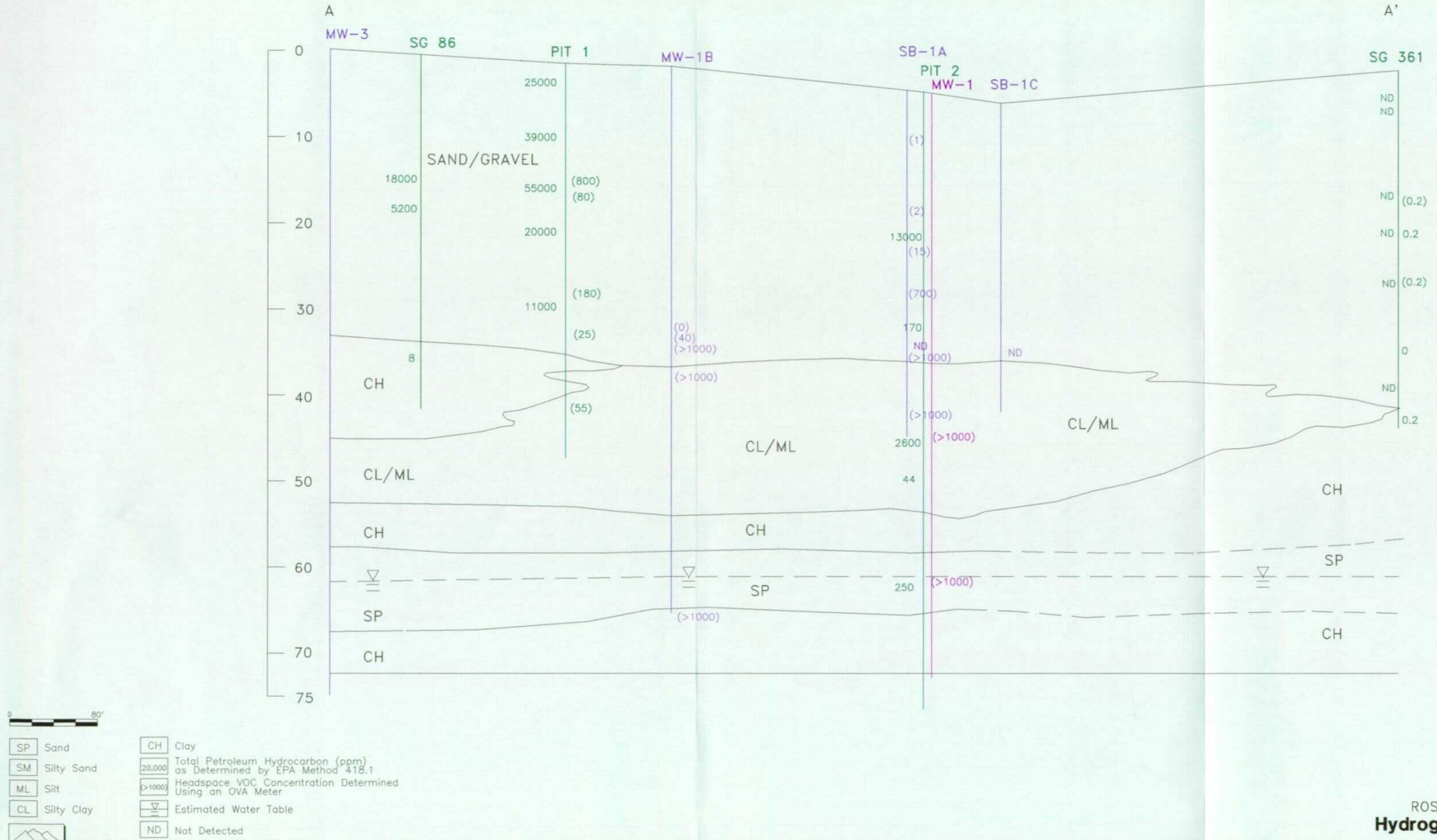
ROSWELL COMPRESSOR STATION

Locations of Previous Soil Borings and Existing Monitor Wells and Recovery Wells

Figure 3-6

D:\4115\4-7HCS.DWG



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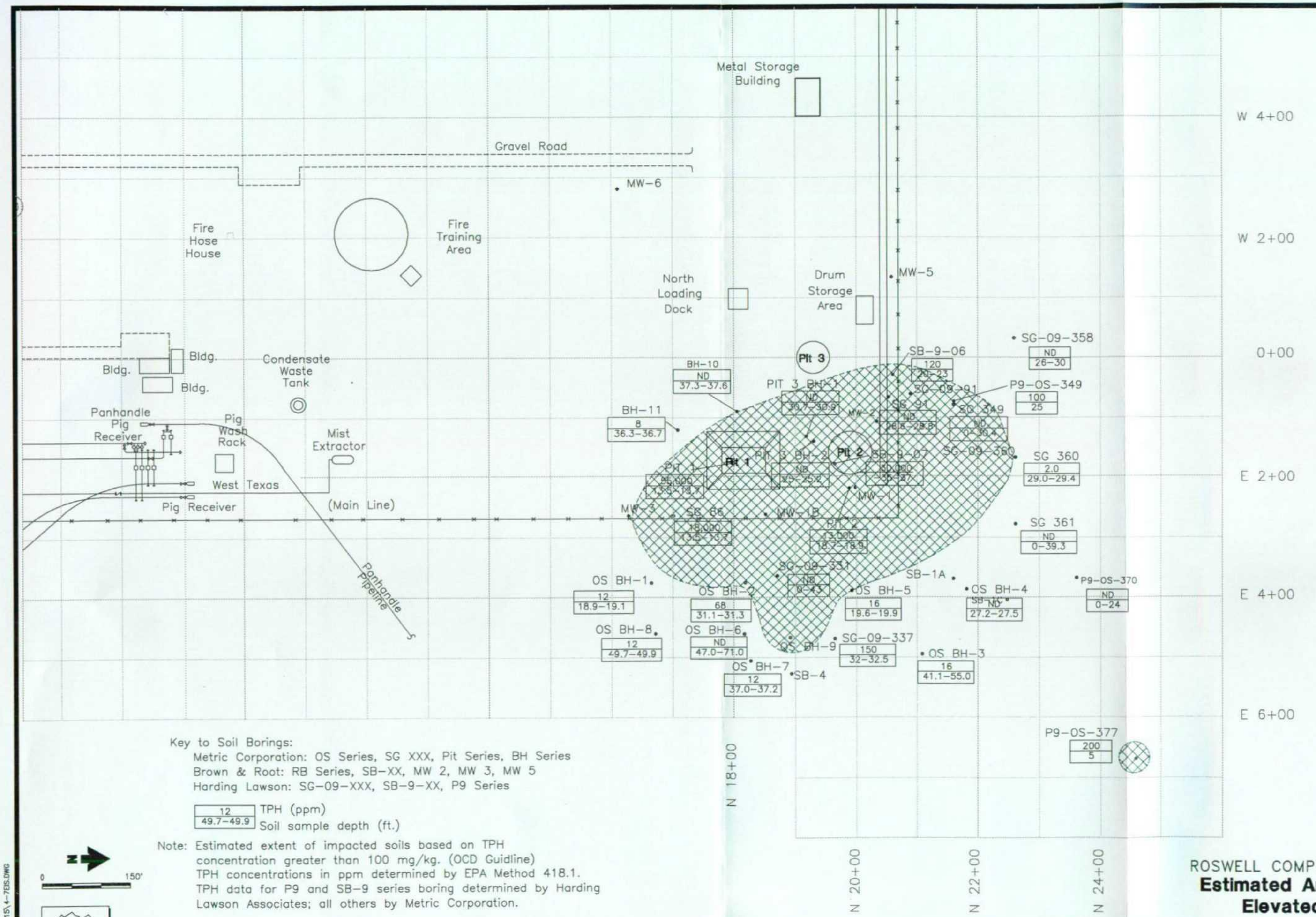
ROSWELL COMPRESSOR STATION
Hydrogeologic Cross Section

Figure 3-7



Key to Soil Borings:
Metric Corporation: OS Series, SG XXX, Pit Series, BH Series
Brown & Root: RB Series, SB-XX, MW 2, MW 3, MW 5
Harding Lawson: SG-09-XXX, SB-9-XX, P9 Series

12 49.7-49.9	TPH (ppm) Soil sample depth (ft.)

Note: Estimated extent of impacted soils based on TPH concentration greater than 100 mg/kg. (OCD Guidline) TPH concentrations in ppm determined by EPA Method 418.1. TPH data for P9 and SB-9 series boring determined by Harding Lawson Associates; all others by Metric Corporation.

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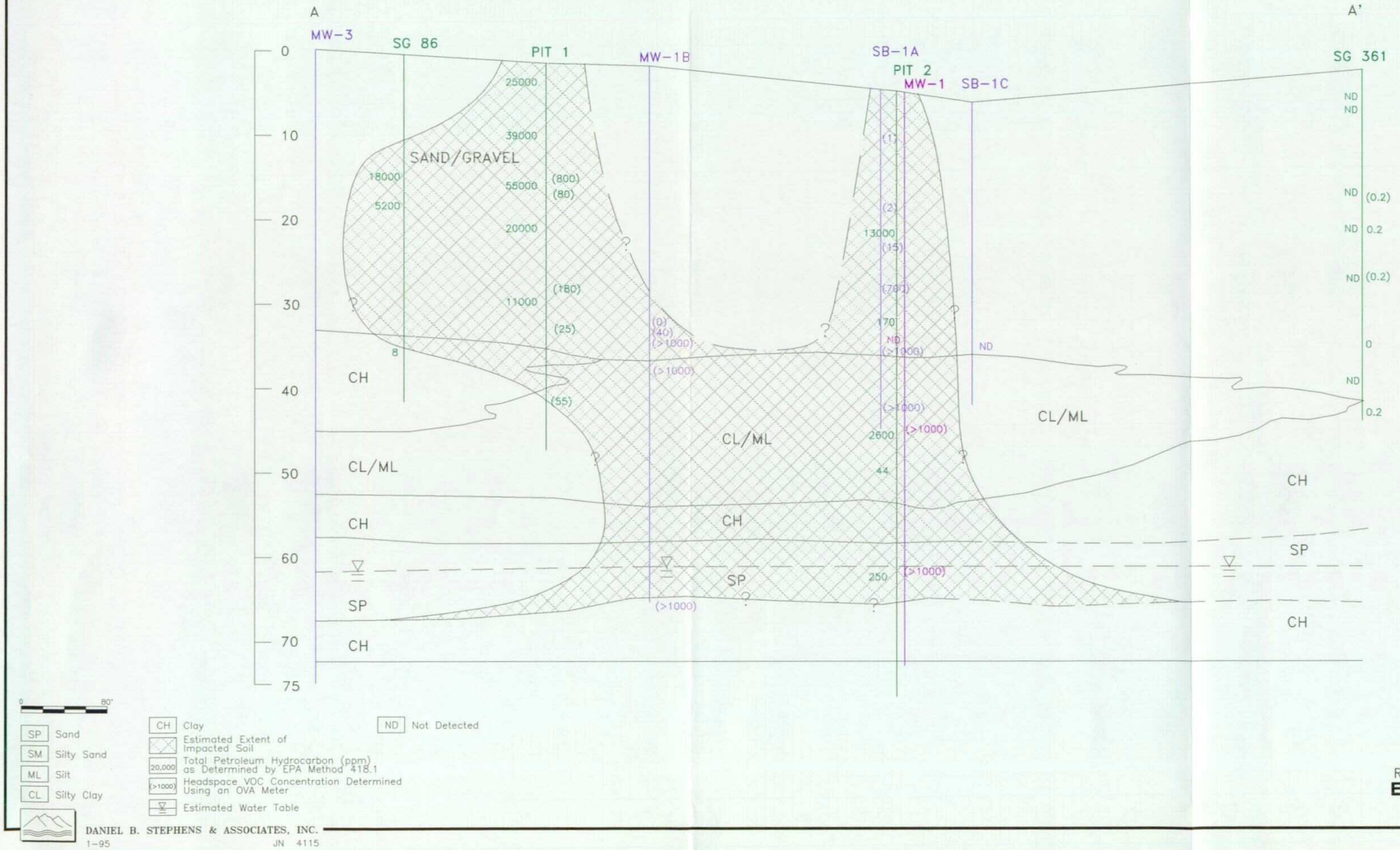
ROSWELL COMPRESSOR STATION

Estimated Areal Extent of Elevated TPH in Soils

Figure 3-8

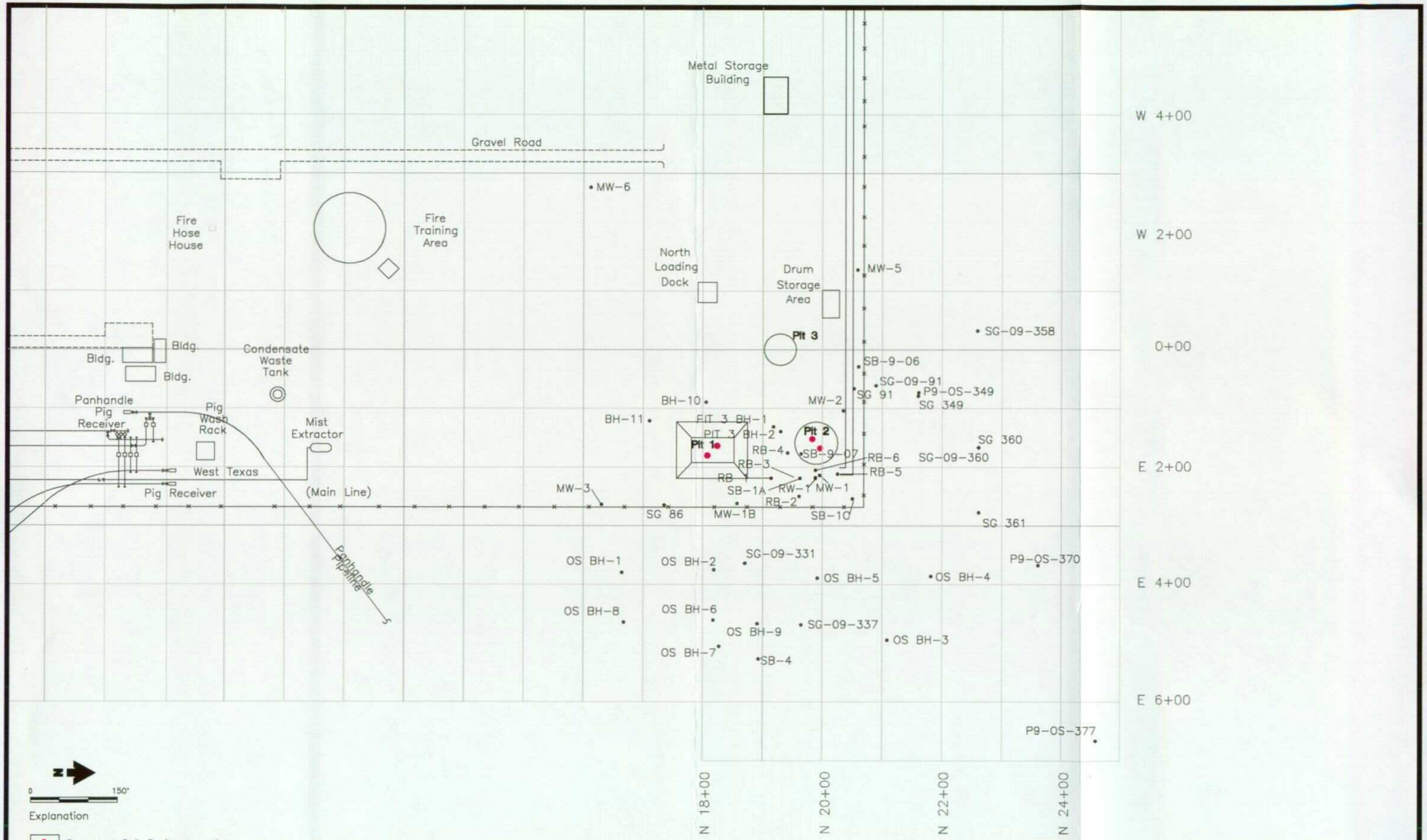
D:\4115\4-9EAS.DWG



ROSWELL COMPRESSOR STATION

Estimated Vertical Extent of Elevated TPH in Soil

Figure 3-9



Explanation

- ● Proposed Soil Boring Locations
- • Previous Soil Boring Locations

D\4115\5-1SBL.DWG

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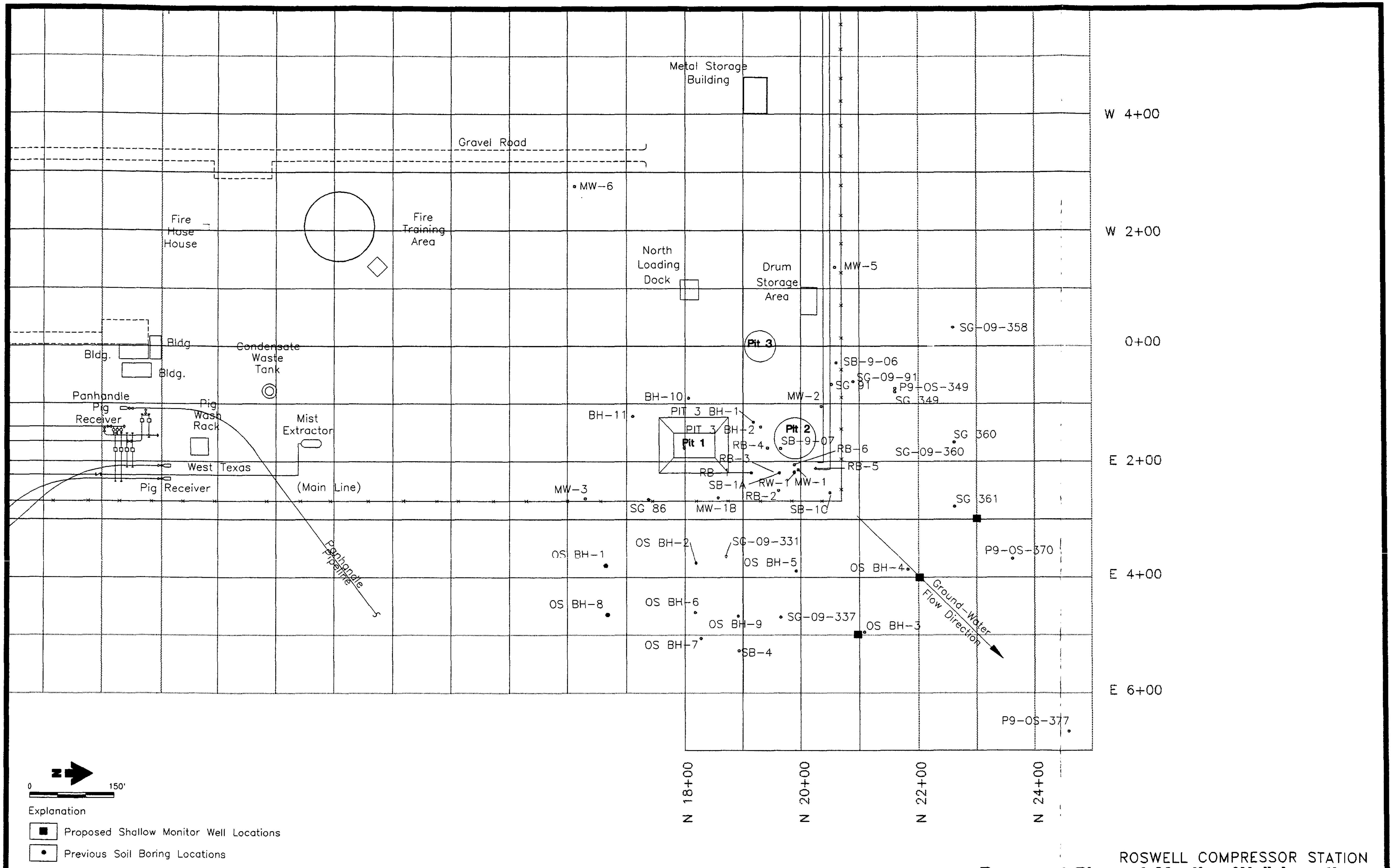
ROSWELL COMPRESSOR STATION

Proposed Phase I Soil Boring Locations

Figure 4-1



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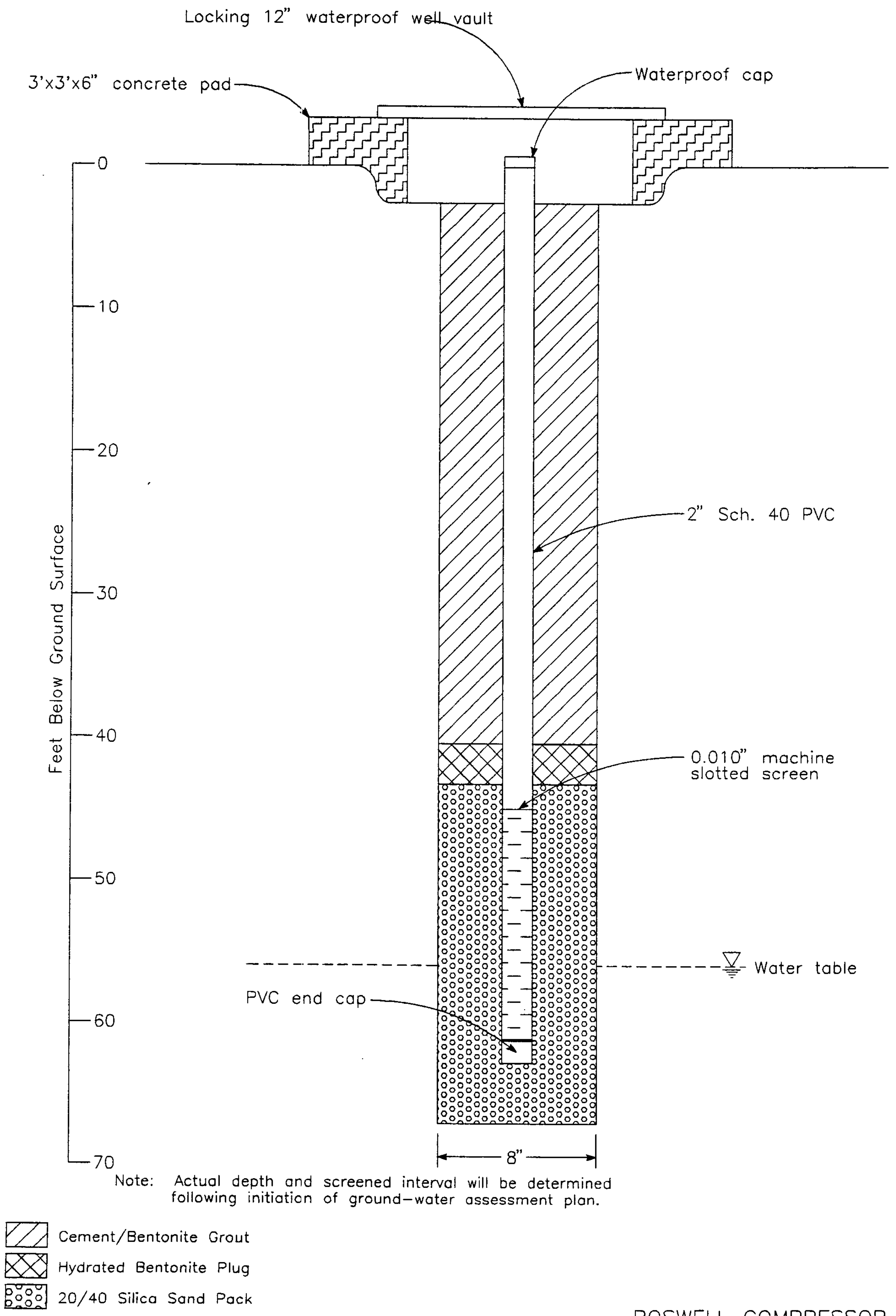
D\4115\411501F.DWG

ROSWELL COMPRESSOR STATION

Proposed Phase I Monitor Well Locations

Figure 5-1



Note: Actual depth and screened interval will be determined following initiation of ground-water assessment plan.

Not to Scale

ROSWELL COMPRESSOR STATION

Monitor Well Schematic

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Figure 5-2

D\4115\6-2MWS.DWG

ROSWELL COMPRESSOR STATION

Proposed Schedule for Soil and Ground-Water Assessment Activities

TASK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Weeks following implementation of Phase I activities																							
PSH product recovery	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase I soil and ground-water sampling		■	■	■	■																			
Laboratory analysis of soil and ground-water samples			■	■	■	■																		
Phase I report preparation					■	■	■	■	■	■														
Develop constituent monitoring list					■	■	■	■	■	■														
Phase I report submitted										◆														
	Weeks following approval of Phase I report																							
Implement Phase II assessment plan					■	■	■	■																
Laboratory analysis of soil and ground-water samples							■	■	■	■	■													
Phase II report preparation							■	■	■	■	■	■	■											
Phase II report submitted													◆											
	Weeks following approval of Phase II report																							
Corrective measures proposal preparation			■	■	■	■	■	■	■	■	■	■												
Corrective measures proposal submitted								◆																
	Months following approval of corrective measures proposal																							
Implement corrective action			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	...?		
Quarterly ground-water sampling and analysis		◆			◆			◆			◆			◆			◆			◆		...?		
	Months following approval of Phase I corrective action report																							
Semiannual summaries submitted to NMOCD								◆						◆						◆				
	Weeks following attainment of cleanup standards																							
Perform confirmation sampling					■																			
Laboratory analysis of confirmation samples						■	■	■	■															
Corrective action summary report preparation								■	■	■	■	■	■											
Corrective action summary report submitted to NMOCD													◆											

D4115411503F.CDR

Figure 7-1

DANIEL B. STEPHENS & ASSOCIATES, INC.

Project 4115

TABLES

Table 2-1. Water Supply Wells Located Within 2 Miles of Roswell Compressor Station No. 9

Well Number[1]	Latitude	Longitude	Well ID	Well Depth (ft)	Depth to Water (ft) / Year	Aquifer	Distance From Site (miles)	Date Drilled	Use	Status
1	333028	1043119	09S.24E.29.223313	NA	63 / 1961	San Andres Fm	0.66	NA	Livestock	Abandoned; plugged
2	333031	1043103	09S.24E.28.113132	352	65 / 1994	San Andres Fm	0.49	09/17/69	Observation	Abandoned; open
3	333050	1043025	09S.24E.21.43213	58	15 / 1937	Alluvial Fill	0.45	NA	Livestock	Abandoned; plugged
4	333053	1043134	09S.24E.20.413	NA	NA	San Andres Fm	0.63	NA	NA	Abandoned; not found
5	333059	1043135	09S.24E.20.32422	370	63 / 1948	San Andres Fm	0.73	NA	Industrial	In use
6	333145	1043159	09S.24E.17.331222	208	119 / 1948	Artesia Group	1.54	NA	Observation	NA
7	333128	1043022	09S.24E.21.2124	NA	NA	NA	0.83	NA	Livestock	Abandoned; plugged
8	333149	1042931	09S.24E.15.41313	425	47 / 1961	San Andres Fm	1.72	03/18/59	Irrigation	In use
9	333128	1043004	09S.24E.22.1113	386	281 / 1968	San Andres Fm	1.06	NA	Livestock	Abandoned; open
10	333041	1042924	09S.24E.27.21212	NA	NA	NA	1.50	NA	Irrigation	Not in use
11	332934	1043021	09S.24E.33.21443	510	53 / 1965	San Andres Fm	1.60	NA	Irrigation	NA
12	332927	1043106	09S.24E.32.242443	NA	43 / 1961	Artesia Group	1.66	NA	Livestock	Abandoned
13	332921	1043134	09S.24E.32.233324	116	72 / 1960	San Andres Fm	1.86	NA	Livestock	NA
14	333055	1043236	09S.24E.19.41331	550	126 / 1962	San Andres Fm	2.01	NA	Irrigation	NA
15	333151	1042903	09S.24E.15.42442	375	55 / 1959	San Andres Fm	2.08	12/15/58	Domestic	Abandoned; open
16	333207	1042914	09S.24E.15.24321	365	66 / 1966	San Andres Fm	2.12	11/15/65	Irrigation	Abandoned; has pump
17	333211	1043037	09S.24E.16.1422	NA	NA	NA	1.53	NA	Irrig/Stock	In use
18	333021	1042845	09S.24E.26.1431	NA	NA	NA	2.15	NA	Domestic	In use

Sources: USGS Ground-Water Site Inventory; field verification by Transwestern using GPS.

[1] Well numbers correspond to well locations shown on Figure 2-5.

NA = Not available

Table 3-1. Summary of Previous Soil Borings and Monitor Wells
Roswell Compressor Station No. 9
Page 1 of 3

Boring No.	Source[1]	Boring Type[2]	Date of Completion	Location		Ground Surface Elevation	Total Depth (feet bgs)	Casing Diameter (inches)	Screened Interval (feet bgs)	Top of Sand Pack (feet bgs)	Top of Upper Clay[3] (feet bgs)
				North	East						
SB-9-06	HLA	ASB	04/03/90	NA	NA	NA	29.0	N/A	N/A	N/A	28.0
SB-9-07	HLA	ASB	04/03/90	NA	NA	NA	38.5	N/A	N/A	N/A	38.0
P9-OS-349	HLA	ASB	05/02/90	NA	NA	NA	40.0	N/A	N/A	N/A	34.0
P9-OS-377	HLA	ASB	05/02/90	NA	NA	NA	30.0	N/A	N/A	N/A	12.0
SG-09-91	HLA	ASB	05/15/90	NA	NA	NA	33.0	N/A	N/A	N/A	31.0
SG-09-331	HLA	ASB	05/16/90	NA	NA	NA	43.0	N/A	N/A	N/A	38.0
SG-09-337	HLA	ASB	05/17/90	NA	NA	NA	33.0	N/A	N/A	N/A	28.0
SG-09-358	HLA	ASB	05/17/90	NA	NA	NA	30.0	N/A	N/A	N/A	21.0
SG-09-360	HLA	ASB	05/16/90	NA	NA	NA	34.5	N/A	N/A	N/A	30.0
SG-09-370	HLA	ASB	05/16/90	NA	NA	NA	24.0	N/A	N/A	N/A	12.0
Pit 1	Metric	ASB	07/16/91	1798	176.6	3615.72	47.8	N/A	N/A	N/A	30.6
Pit 2	Metric	ASB	07/17/91	1995	216.6	3615.72	71.6	N/A	N/A	N/A	10.1
Pit 3 (BH-1)	Metric	ASB	07/18/91	1918	131.5	3615.71	32.8	N/A	N/A	N/A	ND
Pit 3 (BH-2)	Metric	ASB	07/18/91	1948	138.5	3615.68	29.5	N/A	N/A	N/A	ND
SG 86	Metric	ASB	07/22/91	1710	268.2	3613.52	40.7	N/A	N/A	N/A	33.6

[1] HLA = Harding Lawson Associates, 1991
Metric = Metric Corporation, 1991
Hall-NUS = Halliburton NUS, 1992
B&R = Brown & Root Environmental, 1993

[2] ASB = Abandoned soil boring
MW = Monitor well
RW = Product recovery well

[3] Depth below ground surface (feet) to uppermost clay reported on boring log

bgs = Below ground surface
NA = Not available
N/A = Not applicable
ND = Not detected

Table 3-1. Summary of Previous Soil Borings and Monitor Wells
Roswell Compressor Station No. 9
Page 2 of 3

Boring No.	Source[1]	Boring Type[2]	Date of Completion	Location North	Location East	Ground Surface Elevation	Total Depth (feet bgs)	Casing Diameter (inches)	Screened Interval (feet bgs)	Top of Sand Pack (feet bgs)	Top of Upper Clay[3] (feet bgs)
SG 91	Metric	ASB	07/22/91	2053.2	66.5	3612.28	33.0	N/A	N/A	N/A	28.2
SG 349	Metric	ASB	07/25/91	2160.2	79.0	3615.56	30.4	N/A	N/A	N/A	29.7
SG 360	Metric	ASB	07/25/91	2261.5	166.8	3610.83	29.4	N/A	N/A	N/A	28.9
SG 361	Metric	ASB	07/25/91	2261.5	277.8	3610.15	41.3	N/A	N/A	N/A	38.9
OS BH-1	Metric	ASB	07/22/91	1664.9	375.9	3622.30	35.7	N/A	N/A	N/A	34.5
OS BH-2	Metric	ASB	07/24/91	1826.0	379.0	3618.39	70.6	N/A	N/A	N/A	22.1
OS BH-3	Metric	ASB	07/26/91	2108.7	495.1	3607.04	55.0	N/A	N/A	N/A	10.2
OS BH-4	Metric	ASB	07/29/91	2181.6	386.6	3604.95	31.0	N/A	N/A	N/A	24.4
OS BH-5	Metric	ASB	07/30/91	1992.0	389.5	3611.12	24.8	N/A	N/A	N/A	19.9
OS BH-6	Metric	ASB	07/30/91	1817.5	460.9	3619.15	72.6	N/A	N/A	N/A	ND
OS BH-7	Metric	ASB	07/31/91	1827.6	505.7	3616.69	40.3	N/A	N/A	N/A	22.0
OS BH-8	Metric	ASB	07/31/91	1671.9	460.8	3620.04	49.9	N/A	N/A	N/A	33.9
OS BH-9	Metric	ASB	08/01/91	1891.6	467.2	3614.77	49.7	N/A	N/A	N/A	31.0
BH-10	Metric	ASB	11/15/91	NA	NA	3617.33	37.8	N/A	N/A	N/A	27.8
BH-11	Metric	ASB	11/15/91	NA	NA	3617.60	37.8	N/A	N/A	N/A	28.9

[1] HLA = Harding Lawson Associates, 1991
Metric = Metric Corporation, 1991
Hall-NUS = Halliburton NUS, 1992
B&R = Brown & Root Environmental, 1993

[2] ASB = Abandoned soil boring
MW = Monitor well
RW = Product recovery well

[3] Depth below ground surface (feet) to uppermost clay reported on boring log

bgs = Below ground surface
NA = Not available
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Table 3-1. Summary of Previous Soil Borings and Monitor Wells
Roswell Compressor Station No. 9
Page 3 of 3

Boring No.	Source[1]	Boring Type[2]	Date of Completion	Location		Ground Surface Elevation	Total Depth (feet bgs)	Casing Diameter (inches)	Screened Interval (feet bgs)	Top of Sand Pack (feet bgs)	Top of Upper Clay[3] (feet bgs)
				North	East						
MW-1	Hall-NUS	MW/RW	7/21/92	2001.4	217.6	NA	68	4	28-68	25.2	NA
MW-1B	B&R	MW/RW	04/21/93	1854.0	265.5	3609.96[4]	65.5	2	55-65	53	34.5
MW-2	B&R	MW/RW	04/21/93	2034.3	102.4	3611.76[4]	65.0	2	55-65	53	30
MW-3	B&R	MW	04/26/93	1629.8	265.3	3614.88[4]	72.5	2	60-70	58	32
MW-5	B&R	MW	04/28/93	2049.7	−151.0	3612.76[4]	70	2	60-70	58	19.5
SB-1A	B&R	ASB	04/20/93	NA	NA	3613.48[4]	41.5	N/A	N/A	N/A	ND
SB-1C	B&R	ASB	04/29/93	NA	NA	3606.08[4]	36.0	N/A	N/A	N/A	30
SB-4	B&R	ASB	04/25/93	NA	NA	3604.78[4]	75	N/A	N/A	N/A	18
RB-1	B&R	ASB	6/13/93	1914	222	3613.22[4]	36.3	N/A	N/A	N/A	36.0
RB-2	B&R	ASB	6/12/93	1962	254	3611.11[4]	34.5	N/A	N/A	N/A	34.30
RB-3	B&R	ASB	6/12/93	1953	220	3612.76[4]	42	N/A	N/A	N/A	41.25
RB-4	B&R	ASB	6/13/93	1943	175	3614.41[4]	39	N/A	N/A	N/A	37.75
RB-5	B&R	ASB	6/13/93	2027	213	3608.61[4]	32	N/A	N/A	N/A	31.50
RB-6	B&R	ASB	NA	1989	206	3613.36[4]	38.5	N/A	N/A	N/A	38.5
RW-1 (RB-7)	B&R	RW	6/13/93	1987	222	3612.32[4]	42.5	4	36.8-41.7	34.8	41.5
MW-6	DBS&A	MW	12/1/94	1607.4	−266.2	3618.62	79	2	59.9-74.9	57.1	35.5

[1] HLA = Harding Lawson Associates, 1991
Metric = Metric Corporation, 1991
Hall-NUS = Halliburton NUS, 1992
B&R = Brown & Root Environmental, 1993
DBS&A = Daniel B. Stephens & Associates, Inc., 1994

[2] ASB = Abandoned soil boring
MW = Monitor well
RW = Product recovery well

[3] Depth below ground surface (feet) to uppermost clay reported on boring log

bgs = Below ground surface
NA = Not available
N/A = Not applicable
ND = Not detected

[4] Original survey to arbitrary datum corrected to elevations above sea level by referencing boring elevations to the surveyed elevation of MW-3 (3614.88 asl).

Table 3-2. Summary of Organic Compounds Detected in Soil Samples
Roswell Compressor Station No. 9
Page 1 of 6

Sample ID	Source[2]	Concentration[1]													
		1,1,1-TCA	1,1-DCA	Acetone	Chloro-benzene	Chloro-form	PCA	PCE	Freon-113	Methylene chloride	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH (mg/kg)
SB9-6 @ 8-11'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20
SB9-6 @ 18-20'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20
SB9-6 @ 20-23'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	120
SB9-6 @ 26-28'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20
SB9-6 @ 26-28' Tube #5	HLA	<5	ND	<10	<5	ND	<5	ND	6	16	ND	ND	<5	<5	<20
SB9-6 @ 26-28' Tube #6	HLA	<7	ND	<14	<7	ND	<7	ND	23*	9*	ND	ND	<7	<7	<20
SB9-7 @ 9-12'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1100
SB9-7 @ 21.5-24'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2000
SB9-7 @ 25.5-28'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2500
SB9-7 @ 29-32'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11000
SB9-7 @ 29-32' Tube #7	HLA	<1300	ND	<2600	<1300	ND	<1300	ND	5100	<1300	ND	ND	720	1800	5000
SB9-7 @ 35-37'	HLA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4600
SB9-7 @ 35-37' Tube #8	HLA	<640	ND	<1300	<640	ND	<640	ND	<640	<640	ND	ND	1800	4200	13000
SB9-7 @ 35-37' Tube #9	HLA	2000	ND	<1300	<670	ND	2100	ND	<670	<670	ND	ND	2800	6500	30000
P9-OS-349 @ 5'	HLA	<5	ND	<11	<5	ND	<5	ND	26*	6*	ND	ND	<5	<5	<20
P9-OS-349 @ 10'	HLA	<6	ND	<11	<6	ND	<6	ND	18	9	ND	ND	<6	<6	100
P9-OS-349 @ 20'	HLA	<5	ND	<11	<5	ND	<5	ND	45*	<5*	ND	ND	<5	<5	<20
P9-OS-349 @ 25'	HLA	<5	ND	<11	<5	ND	<5	ND	21	10	ND	ND	<5	<5	100

[1] Concentrations are in µg/kg unless otherwise noted

[2] HLA = Harding Lawson Associates (1991a)
Metric = Metric Corporation (1991)
B&R = Brown and Root Environmental (1993)
Note: All HLA analyses performed in on-site mobile laboratory

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
PCA = Tetrachloroethane
PCE = Tetrachloroethene
Freon-113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
TPH = Total petroleum hydrocarbons

NA = Not analyzed
ND = Not detected
* = Compound was also detected in the QC blanks

Table 3-2. Summary of Organic Compounds Detected in Soil Samples
Roswell Compressor Station No. 9
Page 2 of 6

Sample ID	Source[2]	Concentration[1]													
		1,1,1-TCA	1,1-DCA	Acetone	Chloro-benzene	Chloro-form	PCA	PCE	Freon-113	Methylene chloride	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH (mg/kg)
P9-OS-349 @ 30'	HLA	<7	ND	<14	<7	ND	<7	ND	45*	<7	ND	ND	<7	<7	<20
P9-OS-349 @ 35'	HLA	<7	ND	<14	<7	ND	<7	ND	39	15	ND	ND	<7	<7	<20
P9-OS-349 @ 40'	HLA	<5	ND	<10	<5	ND	<5	ND	40	8	ND	ND	<5	<5	<20
P9-OS-377 @ 5'	HLA	<6	ND	34*	<6	ND	<6	ND	<6	<6	ND	ND	<6	<6	200
P9-OS-377 @ 10'	HLA	<6	ND	27*	<6	ND	<6	ND	<6	<6	ND	ND	<6	<6	<20
P9-OS-377 @ 15'	HLA	<6	ND	27*	<6	ND	<6	ND	<6	11	ND	ND	<6	<6	<20
P9-OS-377 @ 20'	HLA	<7	ND	37*	<7	ND	<7	ND	<7	7	ND	ND	<7	<7	<20
P9-OS-377 @ 25'	HLA	<6	ND	<12	<6	ND	<6	ND	46	36	ND	ND	<6	<6	<20
P9-OS-377 @ 30'	HLA	<7	ND	<13	<7	ND	<7	ND	69	23	ND	ND	<7	<7	<20
Pit 1 @ 2.8-3.0'	Metric	3200	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	25000
Pit 1 @ 9.2-9.4'	Metric	19000	ND	NA	ND	ND	ND	260	NA	ND	NA	NA	NA	NA	39000
Pit 1 @ 13.5-13.7'	Metric	18000	590	NA	ND	200	ND	330	NA	ND	NA	NA	NA	NA	55000
Pit 1 @ 18.8-19.0'	Metric	330	ND	NA	ND	ND	ND	870	NA	ND	NA	NA	NA	NA	20000
Pit 1 @ 26.8-27.0'	Metric	ND	ND	NA	ND	ND	ND	160	NA	ND	NA	NA	NA	NA	11000
Pit 1 @ 30.6-30.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	16
Pit 1 @ 41.6-41.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	16
Pit 1 @ 43.5-43.7'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	56

[1] Concentrations are in µg/kg unless otherwise noted

[2] HLA = Harding Lawson Associates (1991a)
Metric = Metric Corporation (1991)
B&R = Brown and Root Environmental (1993)
Note: All HLA analyses performed in on-site mobile laboratory

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
PCA = Tetrachloroethane
PCE = Tetrachloroethene
Freon-113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
TPH = Total petroleum hydrocarbons

NA = Not analyzed
ND = Not detected
* = Compound was also detected in the QC blanks

Table 3-2. Summary of Organic Compounds Detected in Soil Samples
Roswell Compressor Station No. 9
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Sample ID	Source[2]	Concentration[1]													
		1,1,1-TCA	1,1-DCA	Acetone	Chloro-benzene	Chloro-form	PCA	PCE	Freon-113	Methylene chloride	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH (mg/kg)
Pit 2 #1 @ 18.7-18.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
Pit 2 #2 @ 18.7-18.9'	Metric	370	ND	NA	ND	ND	ND	650	NA	ND	NA	NA	NA	NA	13000
Pit 2 @ 26.0-26.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	170
Pit 2 @ 29.1-29.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
Pit 2 @ 39.8-39.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	2600
Pit 2 @ 44.1-44.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	44
Pit 2 @ 57.5-57.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	250
Pit 2 @ 69.9-70.1'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
Pit 3 BH-1 @ 30.7-30.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
Pit 3 BH-2 @ 25.0-25.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
SG 86 @ 13.5-13.7'	Metric	240	ND	NA	ND	ND	ND	1900	NA	ND	NA	NA	NA	NA	18000
SG 86 @ 18.7-18.9'	Metric	ND	ND	NA	ND	ND	ND	230	NA	ND	NA	NA	NA	NA	5200
SG 86 @ 24.9-25.1'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 86 @ 35.0-35.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	8.0
SG 86 @ 40.5-40.7'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
SG 91 @ 28.6-28.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
SG 349 @ 0.0-1.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 349 @ 2.9-4.6'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND

[1] Concentrations are in µg/kg unless otherwise noted

[2] HLA = Harding Lawson Associates (1991a)
Metric = Metric Corporation (1991)
B&R = Brown and Root Environmental (1993)
Note: All HLA analyses performed in on-site mobile laboratory

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
PCA = Tetrachloroethane
PCE = Tetrachloroethene
Freon-113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
TPH = Total petroleum hydrocarbons

NA = Not analyzed
ND = Not detected
* = Compound was also detected in the QC blanks

Table 3-2. Summary of Organic Compounds Detected in Soil Samples
Roswell Compressor Station No. 9
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Sample ID	Source[2]	Concentration[1]													
		1,1,1-TCA	1,1-DCA	Acetone	Chloro-benzene	Chloro-form	PCA	PCE	Freon-113	Methylene chloride	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH (mg/kg)
SG 349 @ 9.0-10.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 349 @ 14.0-14.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 349 @ 20.3-21.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 349 @ 5.3-26.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 349 @ 29.7-30.4'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
SG 360 @ 0.0-2.5'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 360 @ 4.0-5.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 360 @ 9.0-9.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 360 @ 14.0-14.7'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 360 @ 19.0-20.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 360 @ 24.0-25.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 360 @ 29.0-29.4'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	2.0
SG 361 @ 0.0-2.5'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 361 @ 4.0-5.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 361 @ 9.0-10.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 361 @ 16.0-16.4'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 361 @ 19.5-19.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
SG 361 @ 24.0-25.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND

[1] Concentrations are in µg/kg unless otherwise noted

[2] HLA = Harding Lawson Associates (1991a)
Metric = Metric Corporation (1991)
B&R = Brown and Root Environmental (1993)
Note: All HLA analyses performed in on-site mobile laboratory

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
PCA = Tetrachloroethane
PCE = Tetrachloroethene
Freon-113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
TPH = Total petroleum hydrocarbons

NA = Not analyzed
ND = Not detected
* = Compound was also detected in the QC blanks

Table 3-2. Summary of Organic Compounds Detected in Soil Samples
Roswell Compressor Station No. 9
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Sample ID	Source[2]	Concentration[1]													
		1,1,1-TCA	1,1-DCA	Acetone	Chloro-benzene	Chloro-form	PCA	PCE	Freon-113	Methylene chloride	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH (mg/kg)
SG 361 @ 38.0-39.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-1 @ 18.9-19.1'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	12
OS BH-1 @ 34.3-34.5'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-2 @ 9.9-10.1'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-2 @ 22.5-22.6'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-2 @ 31.1-31.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	68
OS BH-2 @ 41.8-42.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	24
OS BH-2 @ 55.2-55.4'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	16
OS BH-2 @ 69.0-69.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	16
OS BH-3 @ 21.0-21.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
OS BH-3 @ 44.1-44.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	16
OS BH-3 @ 54.7-55.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	16
OS BH-4 @ 27.5-27.7'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
OS BH-5 @ 14.0-14.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-5 @ 19.6-19.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	16
OS BH-5 @ 23.4-23.6'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	12
OS BH-6 @ 13.6-13.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	12
OS BH-6 @ 47.0-47.2'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND

[1] Concentrations are in µg/kg unless otherwise noted

[2] HLA = Harding Lawson Associates (1991a)
Metric = Metric Corporation (1991)
B&R = Brown and Root Environmental (1993)
Note: All HLA analyses performed in on-site mobile laboratory

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
PCA = Tetrachloroethane
PCE = Tetrachloroethene
Freon-113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
TPH = Total petroleum hydrocarbons

NA = Not analyzed
ND = Not detected
* = Compound was also detected in the QC blanks

Table 3-2. Summary of Organic Compounds Detected in Soil Samples
Roswell Compressor Station No. 9
Page 6 of 6

Sample ID	Source[2]	Concentration[1]													
		1,1,1-TCA	1,1-DCA	Acetone	Chloro-benzene	Chloro-form	PCA	PCE	Freon-113	Methylene chloride	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH (mg/kg)
OS BH-6 @ 52.6-52.8'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-6 @ 70.0-71.0'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
OS BH-7 @ 22.1-22.3'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND
OS BH-7 @ 33.5-33.7'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	ND
OS BH-7 @ 37.0-37.2'	Metric	ND	ND	NA	ND	ND	ND	170	NA	ND	ND	ND	190	440	12
OS BH-8 @ 4.6-4.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	12
OS BH-8 @ 33.9-34.1'	Metric	ND	ND	NA	120	ND	ND	160	NA	ND	NA	NA	NA	NA	ND
OS BH-8 @ 49.7-49.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	140	300	12
OS BH-9 @ 4.5-4.9'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	8
OS BH-9 @ 32.0-32.5'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	150
OS BH-9 @ 49.5-49.7'	Metric	ND	ND	NA	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND	8
BH-10 @ 37.3-37.6'	Metric	NA	NA	NA	ND	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND
BH-11 @ 36.3-36.7'	Metric	NA	NA	NA	ND	NA	NA	NA	NA	NA	ND	ND	ND	ND	8
SB-1C @ 25-26'	B&R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20
SB-5 @ 19-21'	B&R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20
SB-5 @ 64-66'	B&R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<20

[1] Concentrations are in µg/kg unless otherwise noted

[2] HLA = Harding Lawson Associates (1991a)
Metric = Metric Corporation (1991)
B&R = Brown and Root Environmental (1993)
Note: All HLA analyses performed in on-site mobile laboratory

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
PCA = Tetrachloroethane
PCE = Tetrachloroethene
Freon-113 = 1,1,2-Trichloro-1,2,2-trifluoroethane
TPH = Total petroleum hydrocarbons

NA = Not analyzed
ND = Not detected
* = Compound was also detected in the QC blanks

Table 3-3. Summary of TCLP Inorganic Constituents Detected in Soil Samples
Roswell Compressor Station No. 9
Page 1 of 2

		Concentration (mg/L)							
Sample ID	Source[1]	Arsenic (TCLP Extract)	Barium (TCLP Extract)	Cadmium (TCLP Extract)	Chromium (TCLP Extract)	Lead (TCLP Extract)	Mercury (TCLP Extract)	Selenium (TCLP Extract)	Silver (TCLP Extract)
TCLP Limit	---	***5.0***	***100.0***	***1.0***	***5.0***	***5.0***	***0.2***	***1.0***	***5.0***
SB9-6 @ 8-11'	HLA	0.004	0.63	0.0010	<0.006	<0.002	<0.0002	<0.003	<0.0005
SB9-6 @ 18-20'	HLA	<0.003	1.21	<0.0005	<0.006	<0.002	<0.0002	<0.003	<0.0005
SB9-6 @ 20-23'	HLA	<0.003	0.7	<0.0005	0.011	<0.002	<0.0002	<0.003	0.0026
SB9-6 @ 26-28'	HLA	<0.003	1.22	0.0006	0.006	0.008	<0.0002	<0.003	<0.0005
SB9-6 @ 26-28' Tube #5	HLA	<0.003	1.3	0.0012	0.007	0.002	<0.0002	<0.003	<0.0005
SB9-6 @ 26-28' Tube #6	HLA	0.009	0.010	0.0008	0.011	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 9-12'	HLA	<0.003	0.75	0.0005	0.007	0.003	<0.0002	<0.003	<0.0005
SB9-7 @ 21.5-24'	HLA	0.004	2.22	0.0010	<0.006	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 25.5-28'	HLA	<0.003	1.81	<0.0005	0.009	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 29-32'	HLA	0.008	3.59	0.0011	0.009	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 29-32' Tube #7	HLA	0.008	1.81	0.0012	0.006	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 35-37'	HLA	0.008	1.72	0.0007	0.007	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 35-37' Tube #8	HLA	0.005	1.84	0.0006	<0.006	<0.002	<0.0002	<0.003	<0.0005
SB9-7 @ 35-37' Tube #9	HLA	0.004	3.12	0.0006	0.01	<0.002	<0.0002	<0.003	<0.0005
P9-OS-349 @ 5'	HLA	0.007	1.21	0.0009	0.012	0.012	<0.0002	<0.003	<0.0006
P9-OS-349 @ 10'	HLA	0.005	0.4	<0.0006	0.013	0.011	<0.0002	<0.01	<0.0006
P9-OS-349 @ 20'	HLA	<0.003	0.77	<0.0006	0.009	0.004	<0.0002	<0.003	<0.0006

[1] HLA = Harding Lawson Associates (1991a)

Table 3-3. Summary of TCLP Inorganic Constituents Detected in Soil Samples
Roswell Compressor Station No. 9
Page 2 of 2

Sample ID	Source[1]	Concentration (mg/L)							
		Arsenic (TCLP Extract)	Barium (TCLP Extract)	Cadmium (TCLP Extract)	Chromium (TCLP Extract)	Lead (TCLP Extract)	Mercury (TCLP Extract)	Selenium (TCLP Extract)	Silver (TCLP Extract)
TCLP Limit	---	***5.0***	***100.0***	***1.0***	***5.0***	***5.0***	***0.2***	***1.0***	***5.0***
P9-OS-349 @ 30'	HLA	<0.003	1.48	<0.0006	0.009	0.007	<0.0002	<0.003	<0.0006
P9-OS-349 @ 35'	HLA	<0.003	1.36	<0.0006	0.011	0.005	<0.0002	<0.003	<0.0006
P9-OS-349 @ 40'	HLA	0.005	0.23	0.0013	<0.007	<0.002	<0.0002	<0.003	<0.0006
P9-OS-377 @ 5'	HLA	0.004	1.05	<0.0006	0.009	0.003	<0.0002	<0.003	<0.0006
P9-OS-377 @ 10'	HLA	0.01	0.19	0.0018	0.007	0.004	<0.0002	<0.01	<0.0006
P9-OS-377 @ 15'	HLA	<0.003	0.15	0.003	0.011	0.009	<0.0002	<0.003	<0.0006
P9-OS-377 @ 20'	HLA	0.003	0.16	0.0010	0.011	0.003	<0.0002	<0.01	<0.0006
P9-OS-377 @ 25'	HLA	0.006	0.06	0.0009	<0.007	<0.002	<0.0002	<0.02	<0.0006
P9-OS-377 @ 30'	HLA	0.011	0.32	<0.0006	<0.007	<0.002	<0.0002	<0.003	<0.0006

[1] HLA = Harding Lawson Associates (1991a)

Table 3-4. Summary of Organic Compounds Detected in Ground-Water Samples
Roswell Compressor Station No. 9

Sample ID	Source[2]	Date	Concentration[1]											
			Benzene	Toluene	Ethyl-benzene	o-Xylene	p-Xylene, m-Xylene	1,1,1-TCA	1,1-DCA	2-Butanone (MEK)	Naphthalene	2-Methyl-naphthalene	4-Methyl-phenol	Petroleum Hydrocarbons (mg/L)
NMWQCC Ground-Water Standard			10	750	750	620[3]		60	NS	NS	NS	30[4]	NS	NS
MW-1	HB	09/21/92	370	61	110	120	820	180	560	220	34	51	250	37
MW-2	B&R	10/09/93	6,500	15,000	2,100	13,000[3]		<300	<300	NA	NA	NA	NA	NA
MW-3	B&R	04/30/93	<5	<5	<5	NA	NA	<5	<5	NA	NA	NA	NA	<0.2
MW-5	B&R	04/30/93	<5	<5	<5	NA	NA	<5	<5	NA	NA	NA	NA	<0.2
MW-6	DBS&A	12/02/94	<0.5	<0.5	<0.5	<0.5[3]		<0.2	<0.2	NA	NA	NA	NA	<2.5
TW-1	DBS&A	12/22/94	<1	<5	<5	<5		<5	<5	<100	<10	<10	<10	NA
Well #5[5]	DBS&A	12/22/94	<1	<5	<5	<5		<5	<5	<100	NA	NA	NA	NA

[1] Concentrations are in μg/L unless otherwise noted

[2] HB = Halliburton NUS Environmental Corp. (1992)
B&R = Brown and Root Environmental (1993)
DBS&A = Daniel B. Stephens & Associates, Inc. (1994)

[3] Total xylenes

[4] Sum of naphthalene and methylnaphthalene

[5] Off-site water supply well; see Figure 2-5 for location

1,1,1-TCA = 1,1,1-Trichloroethane
1,1-DCA = 1,1-Dichloroethane
MEK = Methyl ethyl ketone

NA = Not analyzed
ND = Not detected
NS = No standard

Table 3-5. Summary of Inorganic Constituents Detected in Ground-Water Samples Roswell Compressor Station No. 9

			Concentration (mg/L)																	
			Arsenic		Barium		Cadmium		Chromium		Lead		Mercury		Selenium		Silver		
Sample ID	Source[1]	Date	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	TDS
NMWQCC Ground-Water Standards			NS	0.1	NS	1.0	NS	0.01	NS	0.05	NS	0.05	0.002	NS	NS	0.05	NS	0.05	1000
MW-1	HB	09/21/92	0.19	NA	4.4	NA	<0.005	NA	0.01	NA	<0.05	NA	<0.0002	NA	<0.003	NA	<0.01	NA	NA
MW-3	B&R	04/30/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3,400
	CES	03/23/94	<0.03	<0.03	0.09	0.02	<0.01	<0.01	<0.01	<0.01	0.04	<0.03	<0.0002	<0.0002	<0.04	<0.04	<0.01	<0.01	NA
MW-5	B&R	04/30/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3,800
	CES	03/23/94	<0.03	<0.03	0.38	0.01	<0.01	<0.01	0.03	<0.01	0.04	<0.03	<0.0002	<0.0002	<0.04	<0.04	<0.01	<0.01	NA
TW-1	DBS&A	12/22/94	<0.05	NA	0.14	NA	<0.005	NA	<0.01	NA	0.06	NA	<0.0002	NA	<0.1	NA	<0.01	NA	1,290
Well #5[2]	DBS&A	12/22/94	<0.05	NA	0.02	NA	<0.005	NA	<0.01	NA	<0.05	NA	<0.0002	NA	<0.1	NA	<0.01	NA	2,420

[1] HB = Halliburton NUS Environmental Corp. (1992)
B&R = Brown and Root Environmental (1993)
CES = Cypress Engineering Services (1994)
DBS&A = Daniel B. Stephens & Associates, Inc. (1994)

[2] Off-site water supply well; see Figure 2-5 for location.

TDS = Total dissolved solids
T = Total metals concentrations determined on unfiltered samples
D = Dissolved metals concentrations determined on samples filtered in the laboratory prior to analysis
NA = Not analyzed
NS = Not standard

Note: New Mexico Water Quality Control Commission (NMWQCC) ground-water standards pertain to dissolved constituents, except mercury; the mercury standard applies to the total (unfiltered) mercury concentration.

Table 3-6. Well Coordinates and Depth to Water for Existing Monitor Wells

Monitor Well	Location[1]	RP Elevation[2] (feet asl)	DTW[3] (feet)	Ground-Water Elevation (feet asl)	Date/Time Measured
RW-1	N1999.1 E224.4	3612.03	NA	NA	NA
MW-1	N2001.4 E217.6	3612.95	NA	NA	NA
MW-1B	N1854.0 E265.5	3610.44	NA	NA	NA
MW-2	N2034.3 E102.4	3612.83	NA	NA	NA
MW-3	N1629.8 E265.3	3614.88	64.6 64.58	3550.28 3550.30	12/04/94 1145 12/22/94 1721
MW-5	N2049.7 W151.0	3612.78	62.55 62.64	3550.23 3550.14	12/04/94 1140 12/22/94 1728
MW-6	N1607.4 W266.2	3618.62	65.5 63.59	3553.12 3555.03	12/04/94 1155 12/22/94 1715

Note: Well coordinates surveyed December 1, 1994 by Atkins Engineering Associates, Inc. (Roswell)

[1] Horizontal coordinates relative to station datum (see Figure 2-1).
[2] Reference point elevation (feet above sea level) for each monitor well determined relative to station datum.
[3] Depth to water (DTW) below RP on top of casing.
[4] Ground-water elevation determined as RP elevation minus DTW

Boring logs, if available, are provided in Appendix G.

Table 6-1. Analytical Parameters, Methods, and Data Quality Objectives

Analyte Class	EPA Method[1]	Precision Objective (RPD)[2]	Accuracy Objective (%R)[3]	Completeness Objective (%)
Soils and Ground Water				
VOCs	8240	20	80 to 120	90
SVOCs	8270	30	60 to 140	90
PCBs	8080	30	60 to 140	90
Total metals[4]	6010/7000	20	80 - 120	90
Total cyanide	9012	20	80 to 120	90
Total sulfide	9030	20	80 to 120	90
Total petroleum hydrocarbons	418.1[6]/8015[7]	20	NA	90
Ground Water Only				
Major cations[5]	6010	20	NA	90
Total alkalinity	310.1	20	NA	90
Chloride	9250	20	NA	90
Sulfate	9038	20	NA	90
Nitrate and nitrite	9200	20	NA	90
TDS	160.1	20	NA	90

[1] U.S. EPA, 1986.
[2] Relative percent difference between duplicates.
[3] Percent recovery of matrix spike.
[4] Includes Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V, Zn.
[5] Includes Ca, K, Mg, Na, Fe, Mn.
[6] Soil samples only
[7] Ground-water samples only

Table 6-2. Analyte List for Waste Characterization
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	Laboratory Preparation Method[a]					Potential Contaminant of Concern[d]	
Analtye	Liquid Samples	Solid Samples	Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Ground Water	Soils
Volatile Organic Compounds							
Acetone	3520	3550	8240	2-14	324		
Acetonitrile	3520	3550	8240[e]	2-13	324		
Acrolein (Propenal)	3520	3550	8240[e]	2-13, 2-14	324		
Acrylonitrile	3520	3550	8240	2-13, 2-14	324		
Allyl chloride	3520	3550	8240		324		
Benzene	3520	3550	8240	2-12,2-14	324	X	X
Benzyl chloride	3520	3550	8240	2-10			
Bromobenzene	3520	3550	8240	2-10			
Bromochloromethane	3520	3550	8240[f]	2-14			
Bromodichloromethane	3520	3550	8240	2-10,2-14	325		
4-Bromofluorobenzene	3520	3550	8240[g]	2-14			
Bromoform (tribromomethane)	3520	3550	8240	2-10,2-14	325		
Bromomethane	3520	3550	8240	2-10,2-14	328		
2-Butanone (MEK)	3520	3550	8240	2-14	328	X	X
Carbon disulfide	3520	3550	8240	2-14	325		
Carbon tetrachloride	3520	3550	8240	2-10,2-14	325	X	X
Chlorobenzene	3520	3550	8240	2-10,2-12,2-14	325	X	
Chloroethane	3520	3550	8240	2-10,2-14	325	X	
2-Chloroethyl vinyl ether	3520	3550	8240	2-10,2-14			
Chloroform (trichloromethane)	3520	3550	8240	2-10,2-14	325	X	
Chloromethane (methyl chloride)	3520	3550	8240	2-10,2-14	328	X	

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[a] U.S. EPA. 1994. SW 846 Test Methods for Evaluating Solid Waste, Revision 2, September 1994

[b] Interim Final RCRA Facility Investigation Guidance, Volume I of IV, Appendix B - Monitoring Constituents and Indicator Parameters, List 4 - Industry-Specific Monitoring Constituents, Table 2-X or List 1 - Indicator Parameters

[c] 40 CFR, Part 264, Appendix IX, Ground-Water Monitoring List, July 1, 1992 edition, page number listed

[d] These compounds are potential constituents of concern based on ENRON's experience at similar gas transmission facilities

[e] Compound not on 1994 8240 list, but can be quantified by this method

[f] Compound used as internal standard

[g] Compound used as surrogate

Table 6-2. Analyte List for Waste Characterization
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Analtye	Laboratory Preparation Method[a]		Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Potential Contaminant of Concern[d]	
	Liquid Samples	Solid Samples				Ground Water	Soils
Chloroprene	3520	3550	8240		325		
Dibromochloromethane (chlorodibromomethane)	3520	3550	8240	2-10	325		
1,2-Dibromo-3-chloropropane (DBCP)	3520	3550	8240		325		
1,2-Dibromoethane (ethylene dibromide)	3520	3550	8240		326		
Dibromomethane (methylene bromide)	3520	3550	8240	2-10,2-14	328		
1,4-Dichloro-2-butene	3520	3550	8240		326		
Dichlorodifluoromethane (Freon 12)	3520	3550	8240	2-10,2-14	326		
1,1-Dichloroethane (1,1-DCA)	3520	3550	8240	2-10,2-14	326	X	X
1,2-Dichloroethane (ethylene chloride)	3520	3550	8240	2-10,2-14	326	X	
1,1-Dichloroethylene (vinylidene chloride)	3520	3550	8240	2-10,2-14	326	X	
cis-1,2-dichloroethene	3520	3550	8240	2-10,2-14	326	X	
trans-1,2-Dichloroethylene	3520	3550	8240	2-10,2-14	326	X	
1,2-Dichloropropane (propylene chloride)	3520	3550	8240	2-10	326		
cis-1,3-Dichloropropylene	3520	3550	8240	2-14	326		
trans-1,3-Dichloropropylene	3520	3550	8240	2-14	326		
1,4-Difluorobenzene	3520	3550	8240[g]	2-14			
Ethylbenzene	3520	3550	8240	2-12,2-14	327	X	X
Ethyl methacrylate	3520	3550	8240	2-14	327		
2-Hexanone	3520	3550	8240	2-14	327		
Iodomethane	3520	3550	8240	2-14			
Isobutyl alcohol	3520	3550	8240		327		
Methacrylonitrile	3520	3550	8240		327		
Methylene chloride (dichloromethane)	3520	3550	8240	2-14	328	X	

[a] U.S. EPA. 1994. SW 846 Test Methods for Evaluating Solid Waste, Revision 2, September 1994
[b] Interim Final RCRA Facility Investigation Guidance, Volume I of IV, Appendix B - Monitoring Constituents and Indicator Parameters, List 4 - Industry-Specific Monitoring Constituents, Table 2-X or List 1 - Indicator Parameters
[c] 40 CFR, Part 264, Appendix IX, Ground-Water Monitoring List, July 1, 1992 edition, page number listed
[d] These compounds are potential constituents of concern based on ENRON's experience at similar gas transmission facilities
[g] Compound used as surrogate

Table 6-2. Analyte List for Waste Characterization
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	Laboratory Preparation Method[a]					Potential Contaminant of Concern[d]	
Analtye	Liquid Samples	Solid Samples	Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Ground Water	Soils
Methyl iodide	3520	3550	8240		328		
Methyl methacrylate	3520	3550	8240	2-6	328		
4-Methyl-2-pentanone (MIBK)	3520	3550	8240	2-14	328		
Pentachloroethane	3520	3550	8240		328		
Propionitrile	3520	3550	8240		329		
Styrene	3520	3550	8240	2-14	329		
1,1,1,2-Tetrachloroethane (1,1,1,2-PCA)	3520	3550	8240	2-10	329	X	X
1,1,2,2-Tetrachloroethane (1,1,2,2-PCA)	3520	3550	8240	2-10,2-14	329	X	X
Tetrachloroethylene (PCE)	3520	3550	8240	2-10	329	X	X
Toluene	3520	3550	8240	2-12,2-14	329	X	X
1,1,1-Trichloroethane (1,1,1-TCA)	3520	3550	8240	2-10,2-14	329	X	X
1,1,2-Trichloroethane	3520	3550	8240	2-10,2-14	329	X	X
Trichloroethylene (TCE)	3520	3550	8240	2-10,2-14	329	X	X
Trichlorofluoromethane (Freon 11)	3520	3550	8240[e]	2-10,2-14	329		
1,2,3-Trichloropropane	3520	3550	8240	2-14	329		
Vinyl acetate	3520	3550	8240	2-14	329		
Vinyl chloride	3520	3550	8240	2-10,2-14	330	X	
Xylene(s)	3520	3550	8240	2-12,2-14	330	X	X
Semivolatile Organic Compounds							
Acenaphthene	3520	3550	8270	2-4,2-6	324	X	X
Acenaphthylene	3520	3550	8270	2-4,2-6	324		
Acetophenone (methyl phenyl ketone)	3520	3550	8270	2-6	324		
4-Aminobiphenyl	3520	3550	8270	2-6	324		

[a] U.S. EPA. 1994. SW 846 Test Methods for Evaluating Solid Waste, Revision 2, September 1994

[b] Interim Final RCRA Facility Investigation Guidance, Volume I of IV, Appendix B - Monitoring Constituents and Indicator Parameters, List 4 - Industry-Specific Monitoring Constituents, Table 2-X or List 1 - Indicator Parameters

[c] 40 CFR, Part 264, Appendix IX, Ground-Water Monitoring List, July 1, 1992 edition, page number listed

[d] These compounds are potential constituents of concern based on ENRON's experience at similar gas transmission facilities

[e] Compound not on 1994 8240 list, but can be quantified by this method

Table 6-2. Analyte List for Waste Characterization
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Analtye	Laboratory Preparation Method[a]		Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Potential Contaminant of Concern[d]	
	Liquid Samples	Solid Samples				Ground Water	Soils
Aniline	3520	3550	8270[e]	2-6	324		
Anthracene	3520	3550	8270	2-4,2-6	324		
Benzidine	3520	3550	8270[e]	2-6			
Benzoic acid	3520	3550	8270	2-1			
Benzo(a) anthracene	3520	3550	8270	2-4,2-6	324		
Benzo(b)fluoranthene	3520	3550	8270	2-4,2-6	324		
Benzo(j)fluoranthene	3520	3550	8270[e]	2-4			
Benzo(k)fluoranthene	3520	3550	8270	2-4,2-6	324		
Benzo(g,h,i)perylene	3520	3550	8270	2-4,2-6	324		
Benzo(a)pyrene	3520	3550	8270	2-4,2-6	324		
Benzyl alcohol (phenyl methanol)	3520	3550	8270	2-1	324		
Bis(2-chloroethoxy)methane	3520	3550	8270	2-6,2-10	324		
Bis(2-chloroethyl)ether	3520	3550	8270	2-6	324		
Bis(2-chloroisopropyl)ether	3520	3550	8270	2-6,2-10			
Bis(2-ethylhexyl)phthalate	3520	3550	8270	2-2,2-6	325		
4-Bromophenyl phenyl ether	3520	3550	8270	2-6	325		
Butyl benzyl phthalate	3520	3550	8270	2-2,2-6	325		
4-Chloroaniline	3520	3550	8270	2-6	325		
Chlorobenzilate	3520	3550	8270		325		
1-Chloronaphthalene	3520	3550	8270[e]	2-6			
2-Chloronaphthalene	3520	3550	8270	2-6	325		
4-Chloro-3-methylphenol	3520	3550	8270	2-1	325		
2-Chlorophenol	3520	3550	8270	2-6	325		

[a] U.S. EPA. 1994. SW 846 Test Methods for Evaluating Solid Waste, Revision 2, September 1994

[b] Interim Final RCRA Facility Investigation Guidance, Volume I of IV, Appendix B - Monitoring Constituents and Indicator Parameters, List 4 - Industry-Specific Monitoring Constituents, Table 2-X or List 1 - Indicator Parameters

[c] 40 CFR, Part 264, Appendix IX, Ground-Water Monitoring List, July 1, 1992 edition, page number listed

[d] These compounds are potential constituents of concern based on ENRON's experience at similar gas transmission facilities

[e] Compound not on 1994 8240 list, but can be quantified by this method

Table 6-2. Analyte List for Waste Characterization
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	Laboratory Preparation Method[a]					Potential Contaminant of Concern[d]	
Analtye	Liquid Samples	Solid Samples	Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Ground Water	Soils
4-Chlorophenyl phenyl ether	3520	3550	8270		325		
Chrysene	3520	3550	8270	2-4,2-6	325		
Diallate	3520	3550	8270		325		
Dibenz(a,h)acridine	3520	3550	8270[e]	2-4			
Dibenz(a,j)acridine	3520	3550	8270	2-4,2-6			
Dibenz(a,h)anthracene	3520	3550	8270	2-4,2-6	325		
Dibenzo(a,e)pyrene	3520	3550	8270	2-4			
Dibenzo(a,h)pyrene	3520	3550	8270[e]	2-4			
Dibenzo(a,i)pyrene	3520	3550	8270[e]	2-4			
Dibenzofuran	3520	3550	8270	2-6	325		
Di-n-butyl phthalate	3520	3550	8270	2-2,2-6	326		
1,2-Dichlorobenzene	3520	3550	8270	2-10,2-12	326	X	X
1,3-Dichlorobenzene	3520	3550	8270	2-10,2-12	326	X	X
1,4-Dichlorobenzene	3520	3550	8270	2-10,2-12	326	X	X
3,3'-Dichlorobenzidine	3520	3550	8270	2-6	326		
2,4-Dichlorophenol	3520	3550	8270	2-1	326		
2,6-Dichlorophenol	3520	3550	8270	2-1	326		
Diethyl phthalate	3520	3550	8270	2-2,2-6	326		
p-(Dimethylamino)azobenzene	3520	3550	8270	2-6	326		
Phosphorodithionic acid (Dimethoate)	3520	3550	8270	2-7	326		
7,12-Dimethylbenz(a)anthracene	3520	3550	8270	2-6	326		
α-,α-Dimethylphenethylamine	3520	3550	8270	2-6	326		
2,4-Dimethylphenol	3520	3550	8270	2-1	326		

[a] U.S. EPA. 1994. SW 846 Test Methods for Evaluating Solid Waste, Revision 2, September 1994

[b] Interim Final RCRA Facility Investigation Guidance, Volume I of IV, Appendix B - Monitoring Constituents and Indicator Parameters, List 4 - Industry-Specific Monitoring Constituents, Table 2-X or List 1 - Indicator Parameters

[c] 40 CFR, Part 264, Appendix IX, Ground-Water Monitoring List, July 1, 1992 edition, page number listed

[d] These compounds are potential constituents of concern based on ENRON's experience at similar gas transmission facilities

[e] Compound not on 1994 8240 list, but can be quantified by this method

Table 6-2. Analyte List for Waste Characterization
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Analtye	Laboratory Preparation Method[a]		Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Potential Contaminant of Concern[d]	
	Liquid Samples	Solid Samples				Ground Water	Soils
Dimethyl phthalate	3520	3550	8270	2-2,2-6	326		
4,6-Dinitro-2-methylphenol	3520	3550	8270	2-1	326		
2,4-Dinitrophenol	3520	3550	8270	2-1	326		
2,4-Dinitrotoluene	3520	3550	8270	2-6	326		
2,6-Dinitrotoluene	3520	3550	8270	2-6	326		
Dinoseb (DNBP)	3520	3550	8270	2-1, 2-9	326		
Di-n-octyl phthalate	3520	3550	8270	2-2, 2-6	326		
Diphenylamine	3520	3550	8270[e]	2-6	327		
1,2-Diphenylhydrazine	3520	3550	8270[e]	2-6			
Disulfoton	3520	3550	8270	2-7	327		
Ethyl methanesulfonate	3520	3550	8270	2-6	327		
Fluoranthene	3520	3550	8270	2-4,2-6	327		
Fluorene	3520	3550	8270	2-4,2-6	327	X	X
2-Fluorobiphenyl	3520	3550	8270[e,f]	2-6			
Hexachlorobenzene	3520	3550	8270	2-5, 2-6	327		
Hexachlorobutadiene	3520	3550	8270	2-5, 2-6	327		
Hexachlorocyclopentadiene	3520	3550	8270	2-5, 2-6	327		
Hexachloroethane (perchloroethane)	3520	3550	8270	2-5, 2-6	327		
Hexachlorophene	3520	3550	8270		327		
Hexachloropropene	3520	3550	8270		327		
Indeno(1,2,3-cd)pyrene	3520	3550	8270	2-4,2-6	327		
Isodrin	3520	3550	8270		327		
Isophorone	3520	3550	8270	2-6	327		

[a] SW 846 Test Methods for Evaluating Solid Waste, Revision 2, September 1994

[b] Interim Final RCRA Facility Investigation Guidance, Volume I of IV, Appendix B - Monitoring Constituents and Indicator Parameters, List 4 - Industry-Specific Monitoring Constituents, Table 2-X or List 1 - Indicator Parameters

[c] 40 CFR, Part 264, Appendix IX, Ground-Water Monitoring List, July 1, 1992 edition, page number listed

[d] These compounds are potential constituents of concern based on Enron's experience at similar gas transmission facilities

[e] Compound not on 1994 8270 list, but can be quantified by this method

[f] Compound used as internal standard

Table 6-2. Analyte List for Waste Characterization
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Analtye	Laboratory Preparation Method[a]		Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Potential Contaminant of Concern[d]	
	Liquid Samples	Solid Samples				Ground Water	Soils
Isosafrole	3520	3550	8270		327		
Methapyrilene	3520	3550	8270		327		
3-Methylcholanthrene	3520	3550	8270	2-4,2-6	328		
Methyl methanesulfonate	3520	3550	8270		328		
2-Methylnaphthalene	3520	3550	8270	2-6	328	X	X
3-Methylphenol (m-cresol)	3520	3550	8270		325		
2-Methylphenol (o-cresol)	3520	3550	8270	2-1	325		
4-Methylphenol (p-cresol)	3520	3550	8270	2-1	325	X	
Naphthalene	3520	3550	8270	2-4,2-6	328	X	X
1,4-Naphthoquinone	3520	3550	8270		328		
1-Naphthylamine	3520	3550	8270	2-6	328		
2-Naphthylamine	3520	3550	8270	2-6	328		
2-Nitroaniline (o-Nitroaniline)	3520	3550	8270	2-6	328		
3-Nitroaniline (m-Nitroaniline)	3520	3550	8270	2-6	328		
4-Nitroaniline (p-Nitroaniline)	3520	3550	8270	2-6	328		
Nitrobenzene	3520	3550	8270	2-6	328		
2-Nitrophenol	3520	3550	8270	2-1	328		
4-Nitrophenol	3520	3550	8270	2-1	328		
4-Nitroquinoline 1-oxide	3520	3550	8270		328		
N-Nitrosodi-n-butylamine	3520	3550	8270	2-6	328		
N-Nitrosodiethylamine	3520	3550	8270		328		
N-Nitrosomethylethylamine	3520	3550	8270[e]		328		
N-Nitrosomorpholine	3520	3550	8270[e]		328		

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Table 6-2. Analyte List for Waste Characterization
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	Laboratory Preparation Method[a]					Potential Contaminant of Concern[d]	
Analtye	Liquid Samples	Solid Samples	Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Ground Water	Soils
N-Nitrosodimethylamine	3520	3550	8270[e]	2-6	328		
N-Nitrosodiphenylamine	3520	3550	8270	2-6	328		
N-Nitrosodi-n-propylamine	3520	3550	8270	2-6	328		
N-Nitrosopiperidine	3520	3550	8270	2-6	328		
N-Nitrosopyrrolidine	3520	3550	8270		328		
5-Nitro-o-toluidine	3520	3550	8270		328		
Parathion	3520	3550	8270	2-7	328		
Pentachlorobenzene	3520	3550	8270	2-6	328		
Pentachloronitrobenzene	3520	3550	8270	2-6	328		
Pentachlorophenol	3520	3550	8270	2-1	328		
Phenacetin	3520	3550	8270	2-6	328		
Phenanthrene	3520	3550	8270	2-4,2-6	328		
Phenol (carbolic acid)	3520	3550	8270	2-1	329		
p-Phenylenediamine	3520	3550	8270		329		
Phorate	3520	3550	8270		329		
2-Picoline	3520	3550	8270	2-6	329		
Pronamide	3520	3550	8270	2-6	329		
Pyridine (azabenzene)	3520	3550	8270		329		
Pyrene	3520	3550	8270	2-4,2-6	329	X	X
Safrole	3520	3550	8270		329		
Terphenyl	3520	3550	8270[e,f]		329		
1,2,4,5-Tetrachlorobenzene	3520	3550	8270	2-6	329		
2,3,4,6-Tetrachlorophenol	3520	3550	8270	2-1	329		

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Table 6-2. Analyte List for Waste Characterization
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	Laboratory Preparation Method[a]					Potential Contaminant of Concern[d]	
Analtye	Liquid Samples	Solid Samples	Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Ground Water	Soils
o-Toluidine	3520	3550	8270		329		
1,2,4-Trichlorobenzene	3520	3550	8270	2-6	329		
2,4,5-Trichlorophenol	3520	3550	8270	2-1	329		
2,4,6-Trichlorophenol	3520	3550	8270	2-1	329		
0,0,0-Triethyl phosphorothioate	3520	3550	8270		329		
sym-Trinitrobenzene	3520	3550	8270		329		
Organochlorine Pesticides/PCBs							
Aldrin	3520	3550	8080	2-6,2-8	324		
α-BHC (benzene hexachloride)	3520	3550	8080	2-6,2-8	324		
β-BHC (benzene hexachloride)	3520	3550	8080	2-6,2-8	324		
δ-BHC (benzene hexachloride)	3520	3550	8080	2-6,2-8	324		
γ-BHC (benzene hexachloride)(Lindane)	3520	3550	8080	2-6,2-8	324		
Chlordane	3520	3550	8080	2-6,2-8	325		
4,4'-DDD	3520	3550	8080	2-6,2-8	325		
4,4'-DDE	3520	3550	8080	2-6,2-8	325		
4,4'-DDT	3520	3550	8080	2-6,2-8	325		
Dieldrin	3520	3550	8080	2-6,2-8	325		
Endosulfan I	3520	3550	8080	2-6,2-8	326		
Endosulfan II	3520	3550	8080	2-6,2-8	327		
Endosulfan sulfate	3520	3550	8080	2-6,2-8	327		
Endrin	3520	3550	8080	2-6,2-8	327		
Endrin aldehyde	3520	3550	8080	2-6,2-8	327		
Endrin ketone	3520	3550	8080[e]	2-6			

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Table 6-2. Analyte List for Waste Characterization
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Analtye	Laboratory Preparation Method[a] Liquid Samples	Laboratory Preparation Method[a] Solid Samples	Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Potential Contaminant of Concern[d] Ground Water	Potential Contaminant of Concern[d] Soils
Heptachlor	3520	3550	8080	2-6,2-8	327		
Heptachlor epoxide	3520	3550	8080	2-6,2-8	327		
Kepone	3520	3550	8080[e]	2-8	327		
Methoxychlor	3520	3550	8080	2-6,2-8	328		
Toxaphene	3520	3550	8080	2-6,2-8	329		
PCB-1016 (Aroclor-1016)	3520	3550	8080	2-6,2-8	328	X	X
PCB-1221 (Aroclor-1221)	3520	3550	8080	2-6,2-8	328	X	X
PCB-1232 (Aroclor-1232)	3520	3550	8080	2-6,2-8	328	X	X
PCB-1242 (Aroclor-1242)	3520	3550	8080	2-6,2-8	328	X	X
PCB-1248 (Aroclor-1248)	3520	3550	8080	2-6,2-8	328	X	X
PCB-1254 (Aroclor-1254)	3520	3550	8080	2-6,2-8	328	X	X
PCB-1260 (Aroclor-1260)	3520	3550	8080	2-6,2-8	328	X	X
Metals							
Aluminum (Al)	3010	3050	6010	2-15			
Antimony (Sb)	3010	3050	6010	2-15	324		
Arsenic (As)	3010	3050	6010	2-15	324	X	X
Barium (Ba)	3010	3050	6010	2-15	324	X	X
Beryllium (Be)	3010	3050	6010	2-15	324		
Cadmium (Cd)	3010	3050	6010	2-15	325		
Chromium (Cr)	3010	3050	6010	2-15	325	X	X
Cobalt (Co)	3010	3050	6010	2-15	325		
Copper (Cu)	3010	3050	6010	2-15	325		
Lead (Pb)	3010	3050	6010	2-15	327		

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Table 6-2. Analyte List for Waste Characterization
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Analtye	Laboratory Preparation Method[a]		Analysis Method[a]	RFI Guidance[b]	Appendix IX[c]	Potential Contaminant of Concern[d]	
	Liquid Samples	Solid Samples				Ground Water	Soils
Mercury (Hg)	3020	3050	7000	2-15	327	X	X
Nickel (Ni)	3010	3050	6010	2-15	328		
Selenium (Se)	3010	3050	6010	2-15	329		
Silver (Ag)	3010	3050	6010	2-15	329		
Thallium (Tl)	3010	3050	6010	2-15	329		
Tin (Sn)	3020	3050	7000		329		
Vanadium (V)	3010	3050	6010	2-15	329		
Zinc (Zn)	3010	3050	6010	2-15	330		
Miscellaneous							
Total cyanide			9012		325		
Total sulfide			9030		329		
Total petroleum hydrocarbons			418.1			X	X
Indicator Parameters (Ground Water Only)							
Calcium (Ca)	3010		6010	List 1			
Chloride	None		9250	List 1, 2-15		X	
Iron (Fe)	3010		6010	List 1, 2-15			
Magnesium (Mg)	3010		6010	List 1, 2-15			
Manganese (Mn)	3010		6010	List 1, 2-15			
Nitrate and nitrite	None		9200	List 1			
Potassium (K)	3010		6010	2-15			
Sodium (Na)	3010		6010	2-15			
Sulfate	None		9038	List 1			
Total alkalinity	None		310.1	List 1			
TDS	None		160.1			X	

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Table 6-3. Sample Collection Protocol

Analyte	EPA Method	Sample Volume/Container	Sample Preservation	Holding Time
Soil Matrix				
VOCs	8010/8020	2.5" x 6" brass ring	Chill to 4°C	14 days
SVOCs	8270	2.5" x 6" brass ring	Chill to 4°C	14/40 days
PCBs	8080	2.5" x 6" brass ring	Chill to 4°C	14/40 days
Total metals[1]	6010/7000	2.5" x 6" brass ring	Chill to 4°C	6 months
Total cyanide	9010	2.5" x 6" brass ring	Chill to 4°C	14 days
Total sulfide	9030	2.5" x 6" brass ring	Chill to 4°C	7 days
TPH	418.1	2.5" x 6" brass ring	Chill to 4°C	28 days
Ground-Water Matrix				
VOCs	8240	Two 40-mL septum vials	HCl to pH<2; chill to 4°C	14 days
SVOCs	8270	1 L glass	Chill to 4°C	7/40 days
Pests/PCBs	8080	1 L glass	Chill to 4°C	7/40 days
Phosphorus pesticides	8140	1 L glass	Chill to 4°C	7/40 days
Chlorinated herbicides	8150	1 L glass	Chill to 4°C	7/40 days
Total metals[1]	6010/7000	1 L glass	Chill to 4°C	6 months
Total cyanide	9010	1 L glass	NaOH to pH>12	14 days
Total sulfide	9030	1 L glass	ZnAc + NaOH to pH>12	7 days
TPH (gasoline)	8015 Mod.	Two 40-mL septum vials	HCl to pH<2; chill to 4°C	28 days
Major cations[2]	3010/6010	500-mL plastic	HNO_3 to pH<2	6 months
Bicarbonate (total)	310.1	500-mL plastic	Chill to 4°C	14 days
Chloride (total)	9250	500-mL plastic	Chill to 4°C	28 days
Nitrate (total)	9200	500-mL plastic	H_2SO_4 to pH<2; chill to 4°C	28 days
Sulfate (total)	9038	500-mL plastic	Chill to 4°C	28 days
TDS	160.1	500-mL plastic	Cihll to 4°C	7 days

Note: All laboratory analyses to be performed on unfiltered ground-water samples.

[1] Includes Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V, Zn.
[2] Includes Ca, K, Mg, Na, Fe, Mn.