Hydrogeologic Characterization of the Floodplain that Lies Below the Uranium Mill Tailings Remedial Action Site at Shiprock, New Mexico

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Thesis

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In Memory of Lydia (1905-1992) and Clyde Bekis Begay (1903-1994)

As I complete my thesis, I reflect on the influences my grandparents had on my life and the career I have chosen. Their lives were harsh, moving livestock from their winter to their summer home every year. As a young child, the long extended visits to Tocito and Beautiful Mountain were limited during school breaks. Even now, it is hard to imagine that we were still hauling our drinking water in the early 1980's. Sometimes our trips to the water hole would be as far as 30 miles away from camp. We would take the old Chevy truck or the horse and wagon; filling at least four 55 gallon containers for our weekly drinking water. The horseback rides in the mountains with my grandparents are my fondest memories. My sister and I would sit behind my grandfather and grandmother holding onto their shirt/skirt observing, even at that early age, that as elevation changed, the types of vegetation and rock types also changed. It wasn't until years later that I would learn that those plants were able to survive on limited water in this desert climate and those rocks were of sedimentary and volcanic origin. On Beautiful Mountain, another source of water was from a nearby pond. One of our daily chores was to bring two buckets of pond water for washing dishes and hands. We were taught at a young age to respect water, not to waste or play with it, since we had to physically bring water into our home. My grandparents taught their children and grandchildren the importance of preserving the land and, most importantly, water.

Abstract

A study was undertaken at the US Department of Energy's UMTRA site at Shiprock, New Mexico, to determine the behavior of the NO_3^- and SO_4^{2-} contaminant plume within an unconfined aquifer in the floodplain. To characterize the aquifer, data were obtained from monitoring well logs, water-level measurements, electrical conductivity, refraction seismic data, and water chemical analyses. Lithologies from monitoring well logs and seismic refraction were used to define the floodplain stratigraphy and possible fractures in Mancos Shale. The fractures provide conduits for contaminants to be transported from the terrace onto the floodplain aquifer and eventually into the San Juan River. The stratigraphy consists of alluvial gravels overlying coarser outwash gravels that were deposited on a strath terrace cut into the Mancos Shale. Ancestral channels are identified by variation in the thickness of stratigraphic units from the monitoring well logs, seismic refraction data and isopachs for the surface of the Mancos Shale the outwash gravels and the more recent alluvium. The ancestral channels and a thicker outwash gravel bed may be major factors controlling the groundwater and contaminant flow directions in the floodplain aquifer. The outwash gravels contain larger pore space than the alluvium providing a preferential flow path. The finer grained alluvium may inhibit groundwater movement and retard contaminant flow directions. However during high river flows the retardation effect decreases as water-levels increase in the aquifer. Water-level measurements were collected on a monthly basis, to determine the interaction between the flow in the San Juan River onto the floodplain aquifer. Discharge from Bob Lee Wash, is recharging the unconfined floodplain aquifer throughout the year. Electrical conductivity surveys on the floodplain identified the vertical and horizontal extent of a contaminant plume. Movement of the contaminant plume was difficult to determine from chemical water analyses in abandoned and existing monitoring wells since they were sampled inconsistently over the last eleven years. Futhermore, the density of wells was insufficient to adequately characterize the contaminant plume over the entire floodplain. Comparison of chemical analyses and electrical conductivity readings were used to determine if movement of the plume varies with flows in the San Juan River. Correlations of all four results indicates the general direction of groundwater flow and how lithology influences the groundwater and contaminant movements withing the floodplain. The groundwater flow direction is controlled by the lithological changes from the smaller grain size alluvium to the larger size gravels and by the ancestral channels in the Mancos Shale beneath the floodplain. The contaminant plume has a similar flow direction as the groundwater.

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List of Abbreviations

bgs	below ground surface
BIA	Bureau of Indian Affairs
BOR	US Bureau of Reclamation
CeRAM	Center for Radioactive Waste Management
DOE	US Department of Energy
EM	Electromagnetic
EPA	US Environmental Protection Agency
GPS	Global Positioning System
IHS	Indian Health Service
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
UMT	Universal Transverse Mercator
UNM	University of New Mexico
USGS	US Geological Survey
NCC	Navajo Community College
NDWR	National Drinking Water Regulations
NECA	Navajo Engineering & Construction Authority
NMT	New Mexico Institute of Mining and Technology
NTUA	Navajo Tribal Utility Authority
MW	Monitoring well
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
WERC	Waste-management Education & Research Consortium

1.0 INTRODUCTION

The Shiprock uranium mill in northwestern New Mexico ended operations 29 years ago on the Navajo Nation (Figure 1). Shiprock is a small town of approximately 8,000 people (Bekis-Begay, pers. comm., 1995) situated on the banks of the San Juan River. Milling operations dissolved the uraniferous minerals from the ore using sulfuric acid (H_2SO_4) followed by an ammonia (NH_4) solution to neutralize the acid so that the uranium could be precipitated (Department of Interior (DOI), 1980). Tailings and chemical by-products, (SO_4^{2-} and NO_3^-), of the milling process were deposited on a terrace surface and the lower floodplain of the San Juan River. As a result of the milling operations high concentrations of sulfate (SO_4^{2-}), nitrate (NO_3^-) and uranium (U) have been found on the terrace and the floodplain (DOI, 1980, and 1984). These chemicals are in the form of aqueous solutions beneath the tailings pile and measurements indicate high SO_4^{2-} and NO_3^- concentrations along seepages on the escarpment, and in the floodplain aquifer (Public Heath Service (PHS), 1960, Department of Energy (DOE), 1984, 1985-1996, 1989a, and 1989b). The mill ceased operation in 1968 and the tailings pile was capped in 1986 with a 2.1 meter clay layer (DOE, 1984). Recently DOE observed groundwater contamination in the shallow aquifer underlying the floodplain adjacent to the San Juan River. The floodplain aquifer is recharged by the San Juan River flows and contamination of the aquifer may also move into the San Juan River.

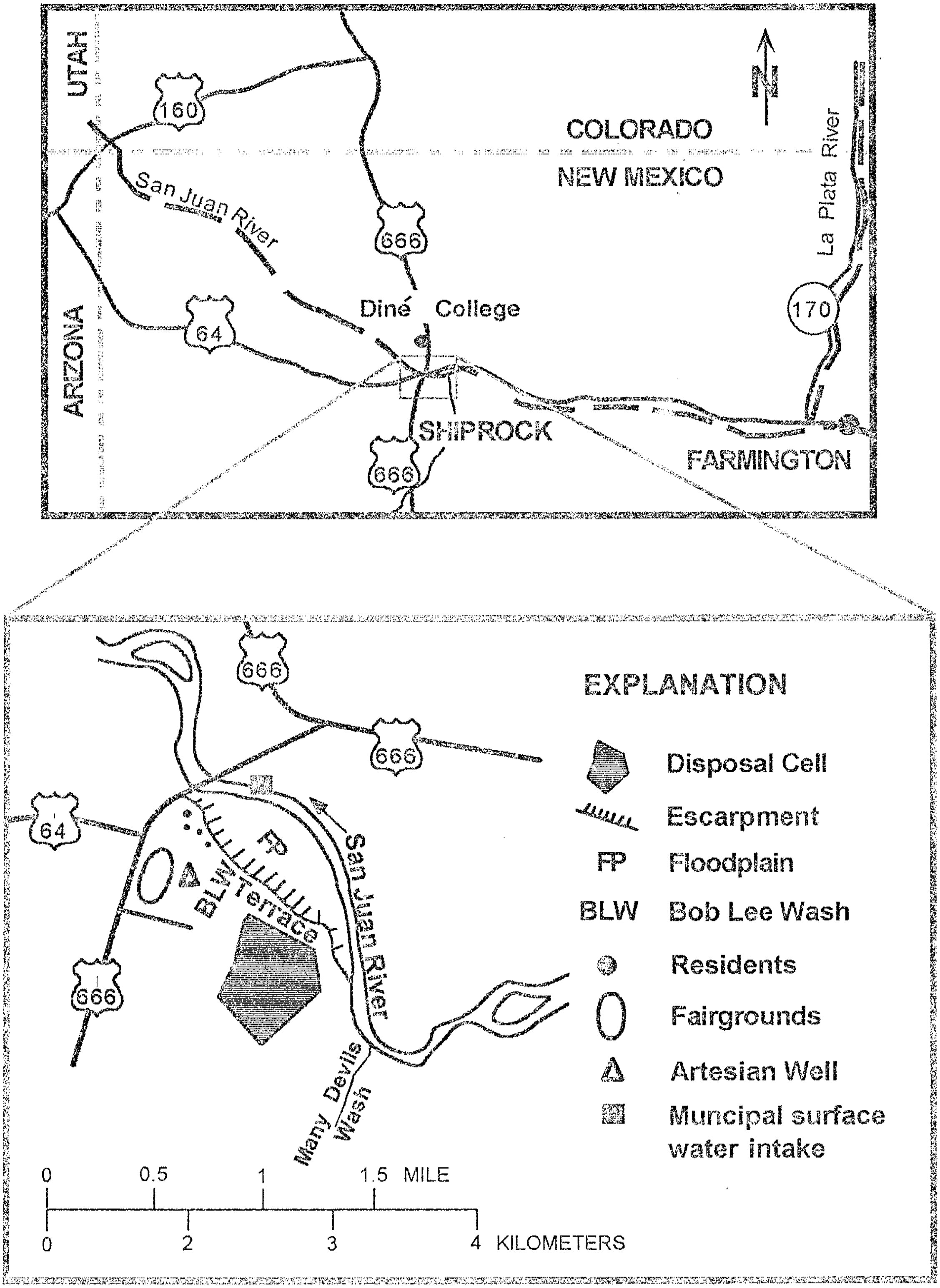


Figure 1. Study area location map (modified after DOE, 1992).

The drinking water supply for Shiprock comes from the river beginning in October through April (Atcitty, pers. comm., 1996) and a surface intake system is located 78 meters across the northwestern section of the study area. In light of concerns (DOE, 1994a) that leachate from the mill site was contaminating the floodplain aquifer, the Center for Radioactive Waste Management (CeRAM) was funded by DOE to evaluate strategies for remediation of the shallow aquifer. One of the possibilities considered was to place a permeable barrier in the floodplain and allow the contaminant plume to pass through it (CeRAM, 1995). Such an approach requires an understanding of the structural and lithological controls on the movement of groundwater and contaminant plume in the floodplain. Existing DOE data on the floodplain did not identify temporal or spatial changes in groundwater water flow directions. Determining the lithological and structural controls on groundwater flow directions, was one of the objectives of this study.

1.1 Research Objectives

The objectives of the research was to characterize the floodplain stratigraphy, the behavior of the unconfined aquifer and the contaminant plume within the floodplain below the Shiprock UMTRA site. The structural and lithological controls were investigated to determine how they influence groundwater flows in the floodplain aquifer. The influence of recharge from the San Juan River and from the Bob Lee Wash, which drains onto the floodplain near its downstream end, were studied to determine if these flows affected the direction of groundwater movement or caused a dilution of the contaminant plume. The last objective was to define the vertical and horizontal extent of the plume.

1.2 Mining and Mill Site Operation History

Shiprock is located approximately 42 kilometers southeast of the Four Corners area and in the northeastern section of the Navajo Nation (Figure 2). The former uranium mill site is located on a terrace approximately 21 meters above the San Juan River, east of the fairgrounds at Shiprock. In the 1940's vanadium and uranium ores were mined in the Four Corners area and in the Carrizo Mountains. The uraniferous minerals were disseminated in fluvial sandstones and conglomerates. In 1954, a uranium mill was constructed at Shiprock by Kerr-McGee, who operated the mill until 1963. In 1963 the operation was taken over by the Vanadium Corporation of America, who later merged with Foote Mineral Company and operated the mill until 1968 (Chenoweth, 1977). Navajo miners brought 1.5 million short tons (DOE, 1989, 1984; and Chenoweth, 1977) of uranium ore to the Shiprock mill for processing over a period of 14 years.

The milling operation involved dissolving the uraniferous minerals from the ore using sulfuric acid (H_2SO_4) in leach circuits to form complex uranyl sulfate anions

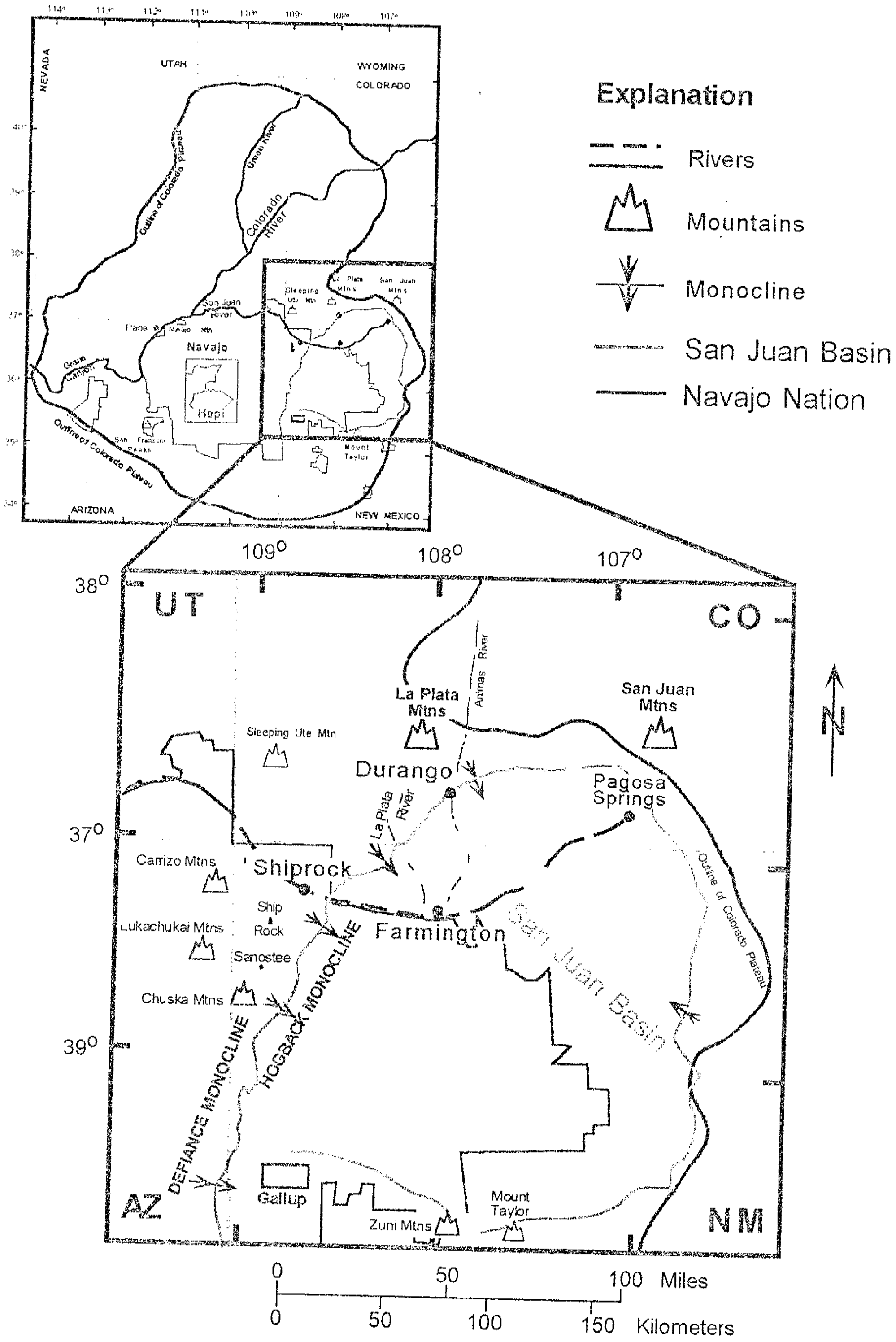
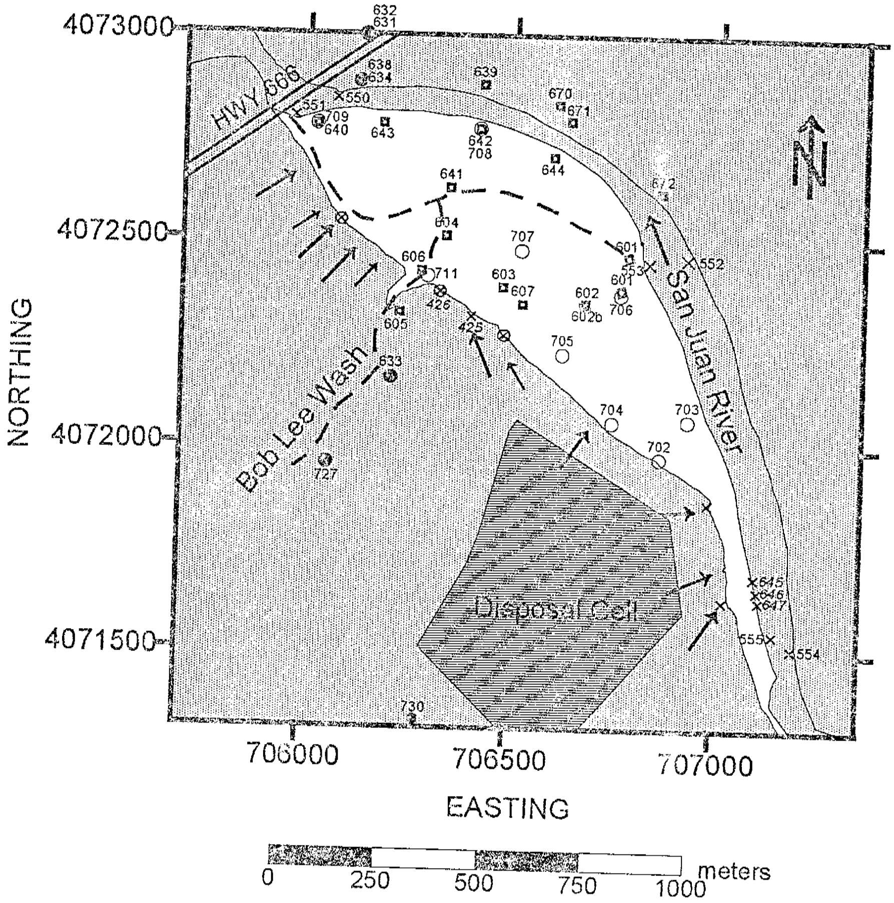


Figure 2. Generalized physiographic map showing outline of Colorado Plateau and Navajo Reservation (modified after Peterson and Turner-Peterson, 1989: and Woodward, and Callender, 1977).

such as $UO_2(SO_4)_2^{-2}$ and $UO_2(SO_4)_3^{-4}$. With the uranium in solution the remaining waste rock was deposited into an unlined waste pile (tailings). The liquid waste not removed from the tailings was transported to raffinate ponds and discharged onto the floodplain (DOI, 1980; DOE, 1984). In the final processing stages, an ammonia (NH_4) solution was added to neutralize the acidic solvent for precipitating of the uranium yellowcake (DOI, 1980). After processing, high concentrations of sulfate (SO_4^{2-}) and nitrate (NO_3^-) were left in the unlined raffinate ponds and waste rock.

1.3 Historical Development of Shiprock UMTRA Site Remediation

In 1978, the Uranium Mill Tailings Radiation Control Act (UMTRCA) provided funding for the stabilization of abandoned uranium mill tailings. Remedial action at the Shiprock site began in September 1984 and the tailings were stabilized permanently by being covered by a clay cap in September 1986. The clay cap decreases radon exposure to local residents by inhibit the release of airborne particles from the uncovered tailings pile. In 1978, the US Environmental Protection Agency (EPA) required that sites operating under UMTRCA, adopt health and environmental protection standards for groundwater contamination (40 CFR Part 192, Subpart A-C) (Nuclear Regulatory Commission (NRC), 1990). In the mid-1980's DOE began to install the required well points and monitoring wells on the floodplain and terrace (Figures 3 and 4) (DOE, 1986, 1994a) to



Explanation

X US Public Health Service (1960) and DOE (1989) sampling locations for seep and surface water in the San Juan River.

⊗ Observed seeps along the escarpment in 1996.

↑ Aerial photographs show gullies (SCS, 1935, and US Army 1954).

▣ DOE well point locations (1985-1996).

○ DOE test pits and bore hole locations (1985-1996).

● DOE abandon monitoring well locations (1985-1996).

Figure 3. Location map showing locations of the Public Health Service (1962) and the Department of Energy's (1985-1996) abandon wells/well points and surface sampling locations on the floodplain. Surface and seep sample locations are indicated by X's.

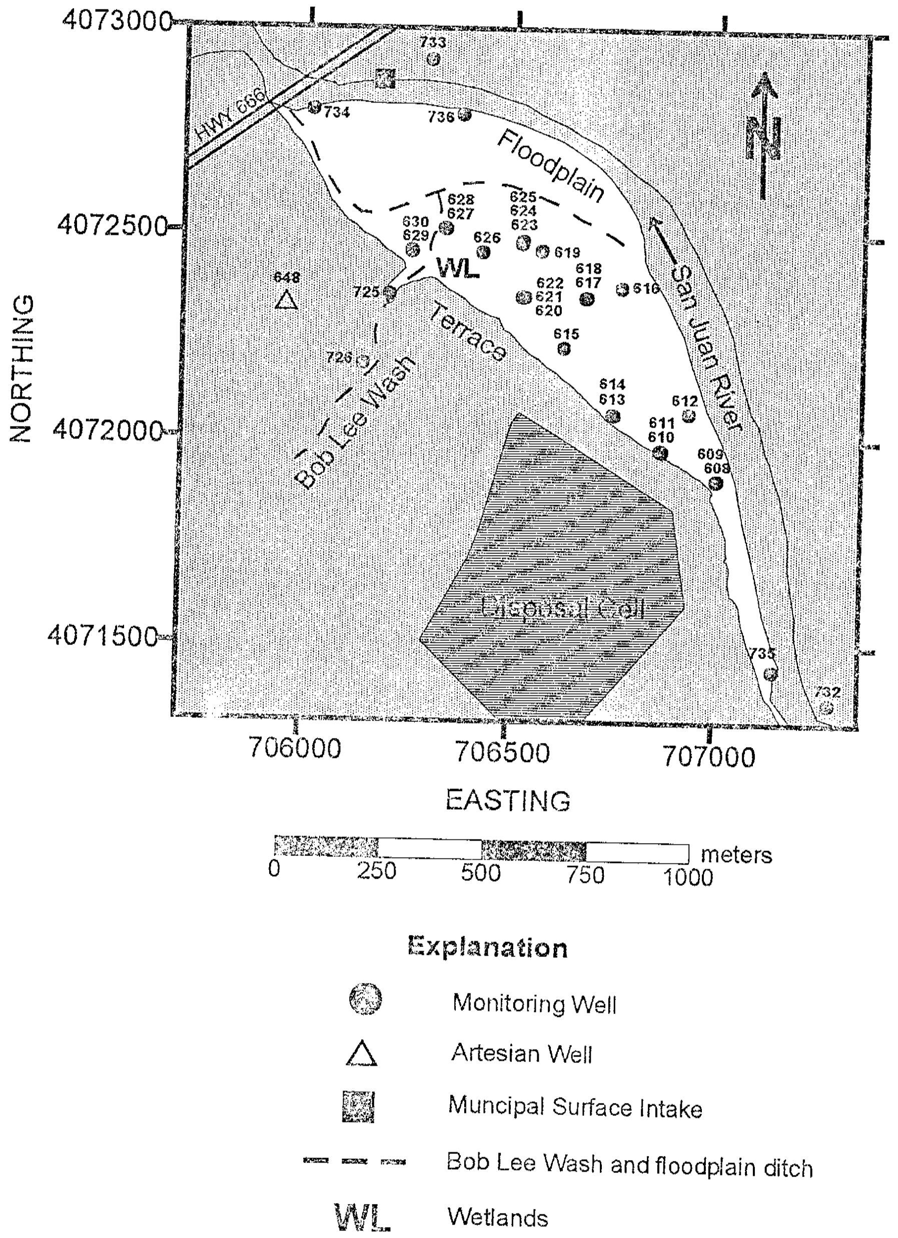


Figure 4. Thirty monitoring wells were used for determining water levels on the floodplain. Water-level measurements were taken from March 1995 to July 1996 by Diné College students.

determine the extent of groundwater contamination (DOE, 1990). In 1985 and 1986 twelve well points (638-647, and 670-672), thirty-two monitoring wells (601-607, and 608-632), and six surface stations (550-555) adjacent to the San Juan River were also sampled for water quality parameters (Appendix A). Ground and surface water quality data indicated high concentrations of arsenic, molybdenum, nitrate, sulfate, selenium, and uranium which are common by-products of the uranium extraction processes (DOE, 1984).

Gross alpha activities in the San Juan River were found in the to be less than background levels (Ra-226 0.07-0.08 pico curies per liter (pCi/l), uranium (U) (total) 2.90-8.49 micrograms per liter (µg/l) and the EPA suggested that any discharge from the tailings was not affecting the water quality of the river (DOE, 1984). By 1984, DOE completed background water quality analysis for the terrace and determined that the groundwater quality of the shallow aquifer on the terrace was poor and it was not a viable aquifer for the local area. They assumed the nearest usable aquifer was in the Dakota Sandstone 607 meters beneath the Mancos Shale, which acts as an aquiclude. Hence contamination of the Dakota aquifer by the UMTRA site was considered unlikely and that is why contamination was thought unlikely at the site (DOE, 1984, and 1994). The last time DOE installed monitoring wells was in 1993 and they continue to sample yearly for water quality analysis.

However, by 1994, DOE began to be concerned about the contamination of the shallow aquifer of the floodplain. Two groundwater studies by DOE (1995a) and Henry (1995), respectively, used MODFLOW to characterize the behavior of the alluvial aquifer below the UMTRA site. The models indicate that the San Juan River was the only external influence on flow directions in the floodplain aquifer. The contaminant plume appears to be moving in a northwest direction and encompass a large area of the floodplain (DOE, 1994b and 1995b). Because of the large distance between monitoring wells, the DOE qualitative analysis does not reflect the complex relationship between the geologic and hydrologic controls on the floodplain.

In 1994 CeRAM submitted a groundwater remediation research proposal to DOE for the Shiprock UMTRA site. The goal of the study was to evaluate the feasibility of installing a permeable barrier within the floodplain for remediation purposes. Bedrock occurs 7.5 meters below ground surface on the floodplain making it makes it technically possible to trench the floodplain and place a permeable barrier across the groundwater flow direction. The pilot model for testing the permeable barrier would allow the contaminated groundwater to flow through while sorbing sulfate (SO_4^{2-}), nitrate (NO_3^-), and metal constituents. The proposed barrier would have at least three different filter types: microorganisms consisting of sulfate reducing-bacteria that would destroy the sulfates and immobilize the metal constituents (Henry, 1995), zero valence material that modified zeolite that would immobilize sulfates and nitrates by sorption (Bowman et al., 1996). The sorbed materials and the immobilized metals could be removed from the barrier and then be disposed of.

1.4 Environmental Concerns of Contamination of the Floodplain Aquifer

In the early 1980's, three seeps were identified along the eastern terrace in gullies, which were covered to prevent further erosion of the terrace (DOE, 1984). Black and white aerial photographs from 1935 (Soil Conservation Survey (SCS) and 1954 (US Army)) show gullies eroding along the terrace edge (Figure 5 and 6), but after 1978 (U.S. Geological Survey (USGS)) the gullies were difficult to identify (Figure 7). In 1991, DOE identified two seeps (#425 and #426, Figure 3) which occur along the edge of the terrace. Seep #425 is 9 meters long and discharges one to two l/min. Water quality analyses in 1991 showed SO_4^{2-} at 4800 mg/l, NO_3^- at 290 mg/l, and total dissolved solids at 8,020 mg/l. Analyses from Seep #426 indicate concentration values for SO_4^{2-} at 5,670 mg/l at NO_3^- at 328 mg/l, total dissolved solids at 9,540 mg/l. Both seeps show that NO_3^-, SO_4^{2-} and U are now moving from the base of the UMTRA pile into the floodplain aquifer (DOE, 1991 and 1984).

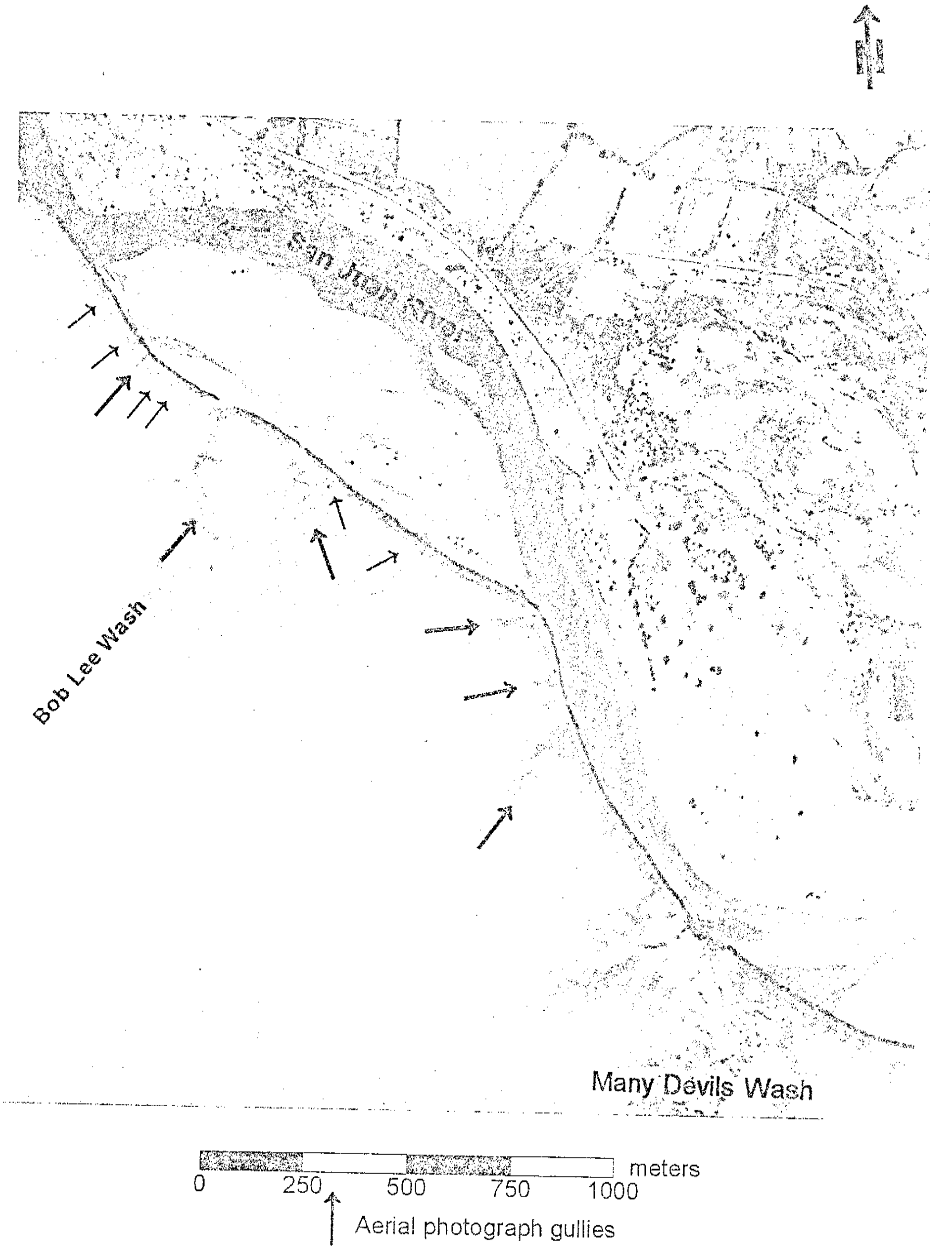


Figure 5. Soil Conservation Survey aerial photograph (1935) showing the Shiprock UMTRA site before operations began. Fracture induced gullies are indicated by the arrows. The lighter colored areas on the floodplain are former channels of the San Juan River.

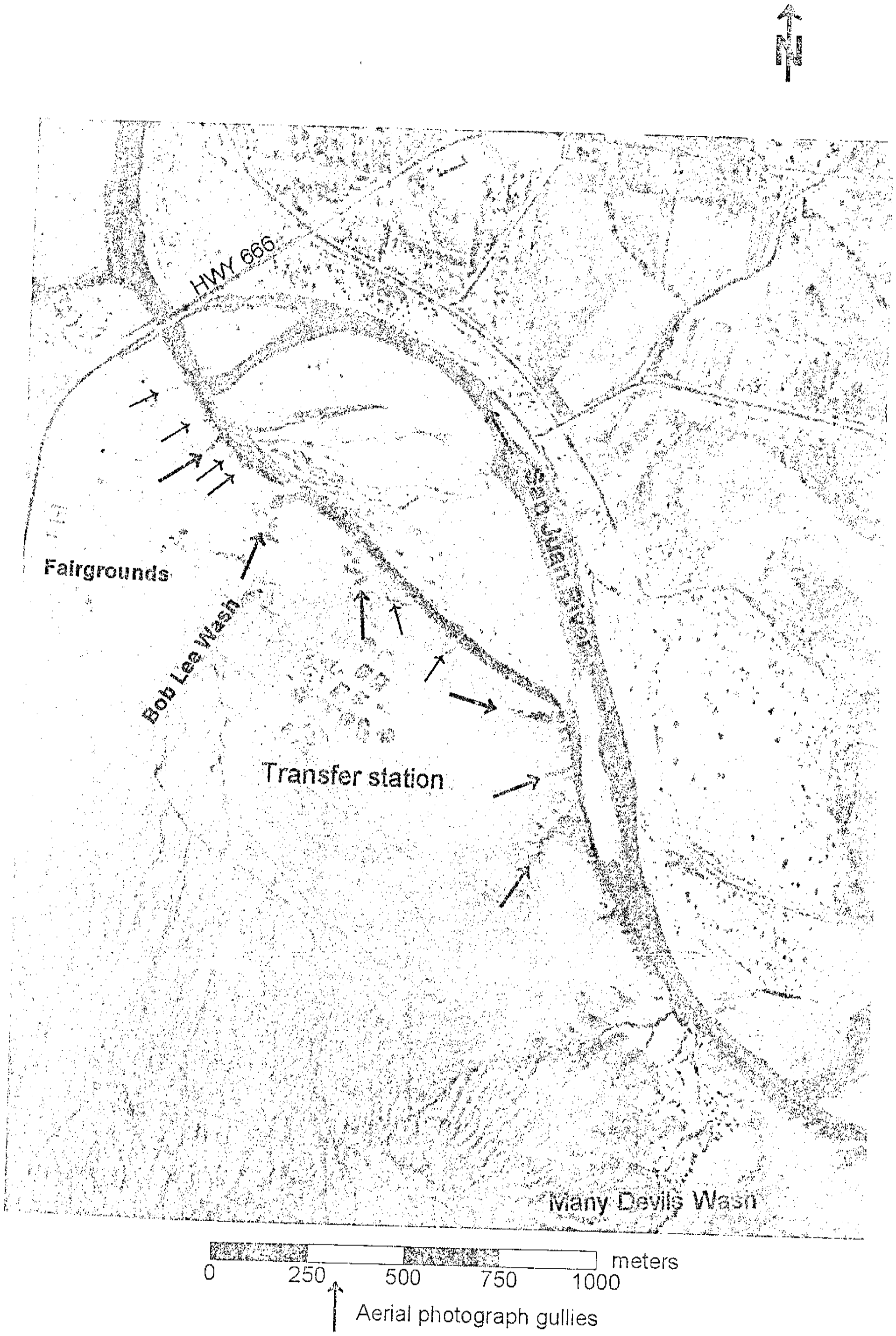


Figure 6. US Army aerial photograph (1954) showing the Shiprock uranium transfer station activities east of Bob Lee Wash. Fracture induced gullies are indicated by the arrows. Lighter colored areas on the floodplain represent former channels. Vegetation is beginning to grow along the escarpment below the Bob Lee Wash.

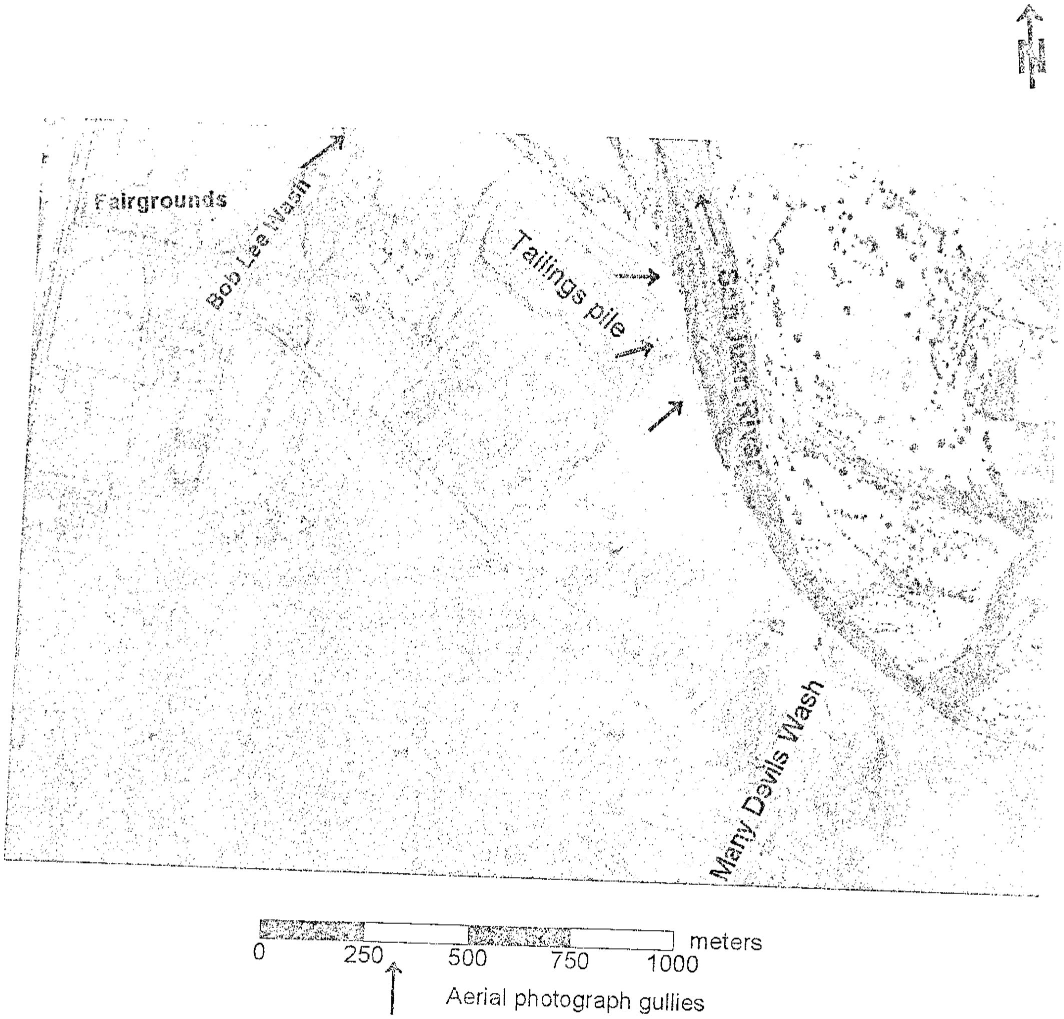
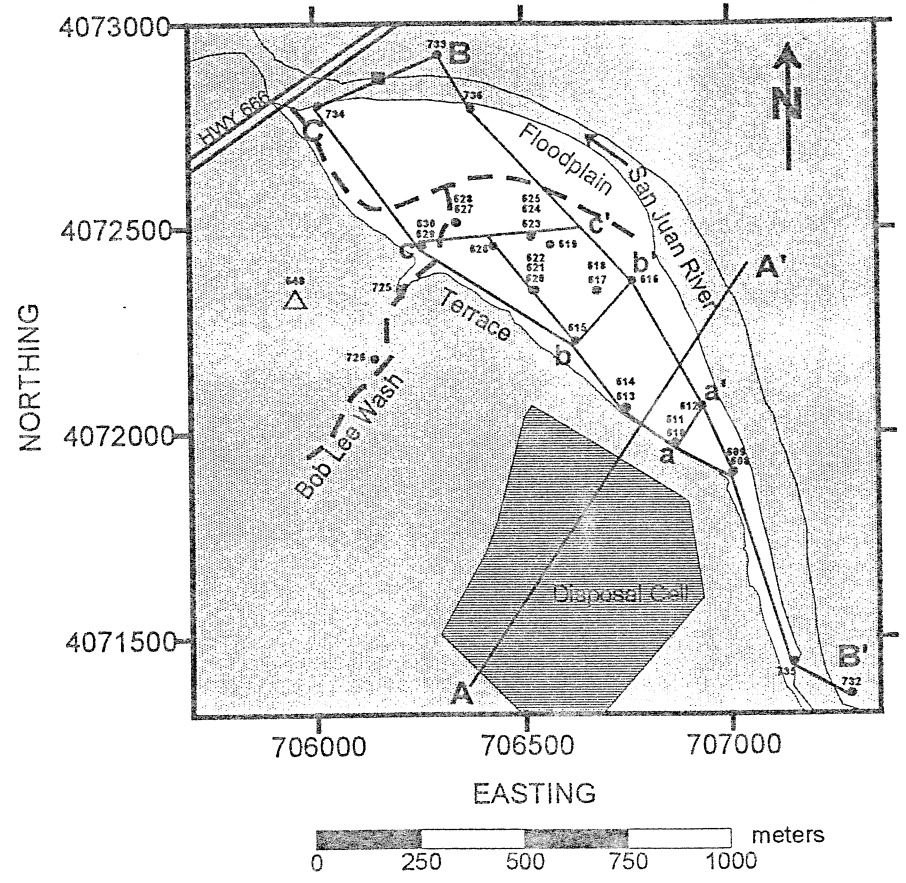


Figure 7. US Geological Survey aerial photograph (1975) showing the southeastern edge of the floodplain. The uranium mill tailings piles remains exposed and gullies have been covered to stabilize erosion northeast of the tailings piles.

In 1996, DOE sampled eighteen of the thirty floodplain monitoring wells and the water analyses showed that these wells are highly contaminated with NO_3^- from 1 to 3320 mg/ℓ, SO_4^{2-} from 593 to 17,100 mg/l, and U from 0.019 to 2.47 pCi/l (DOE, 1984-1996). High SO_4^{2-} and NO_3^- concentrations are known health hazards when found in municipal drinking water systems. The US Environmental Protection Agency's National Drinking Water Regulations (40 CFR-Part 141) 1994 proposed maximum contaminant levels (MCL) for sulfate of 500 mg/l and final MCL for 10 of mg/l nitrate (as nitrogen)(1991). Sulfates above 1,200 mg/l in public water supplies can cause osmotic diarrhea (EPA, 1994) and nitrates above 45 mg/l in public water supplies can have potential toxic effects on infants and can cause methemoglobinemia (EPA., 1991, and Driscoll, 1986).

2.0 PHYSIOGRAPHY OF THE UTMRA SITE

The UMTRA site lies approximately 21 meters above the San Juan River on a terrace cut into the highly weathered Mancos Shale (DOE, 1983; and Sergent et al., 1983). Both the floodplain and strath terrace consist of alluvium and gravels overlying the shale deposit (Figures 8a to 8e). The tailings pile lies approximately 9 meters (USGS, 1966) above the strath terrace, and the study area is located on the floodplain approximately 21 meters below the terrace (Department of Energy (DOE), 1983).



Explanation

● Monitoring Well (MW)

△ Artesian Well

■ Muncipal Surface Intake

– – · Bob Lee Wash and floodplain ditch

Figure 8a. Cross-section locations on the Shiprock UMTRA site floodplain. Interpretations were based on DOE's lithological information.

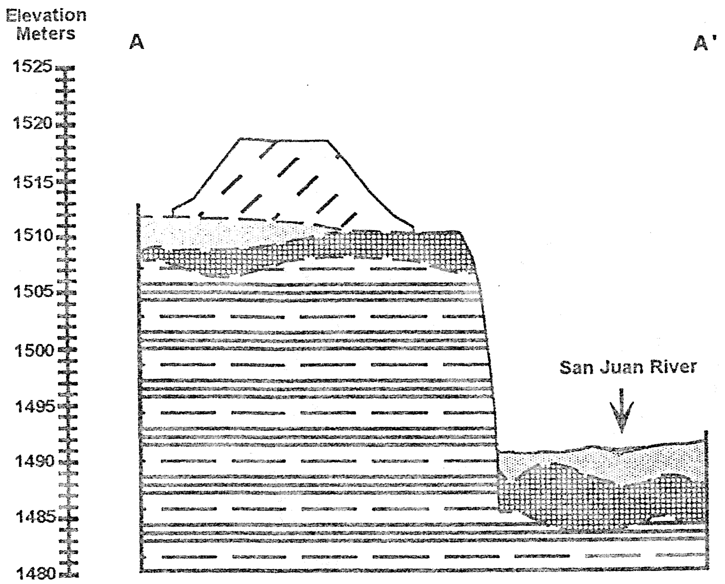


Figure 8b. Cross-section A-A' showing the UMTRA disposal cell and floodplain.

KEY

░ Alluvium:
fine to coarse-grained sand and clays with occasional gravels

▒ Outwash Gravels:
gravels and boulders

☰ Mancos Shale:
fine grained clay

▨ Disposal Cell
fine grained clay covering the tailings pile

500X vertical exaggeration

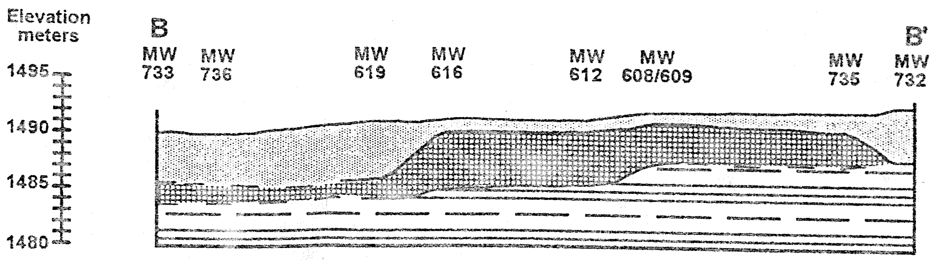


Figure 8c. Northern cross-section map from B to B'

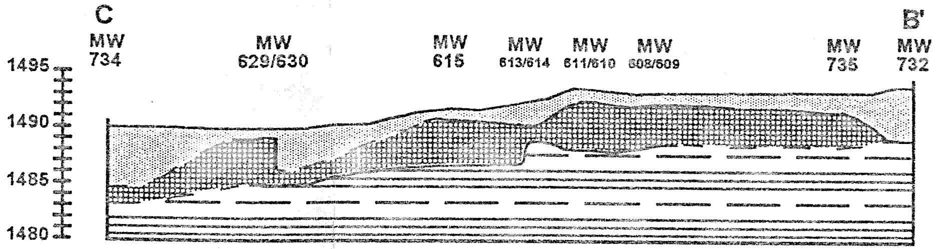


Figure 8d. Southern cross-section map from C to B'

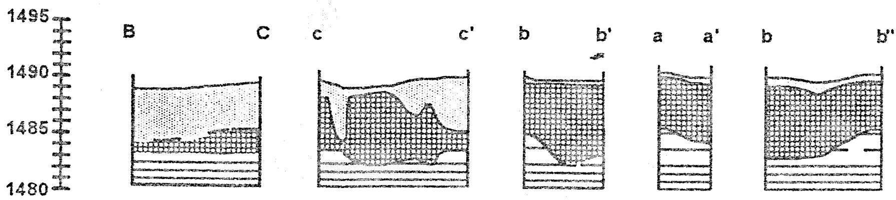


Figure 8e. Central floodplain cross-sections.

Shiprock is located on the Four Corners platform within the physiographic boundaries of the Defiance Uplift and west of the San Juan Basin. A Hogback monocline, approximately 24 kilometers east of the study area, is formed by drape folding layers over a single fault at depth (Woodward and Callender, 1977). Faults and/or fractures along the Hogback west ridge formed in the Mancos Shale during Laramide deformation during the late Cretaceous period (Woodward and Callender, 1977). Several interpretations of lineaments have been completed within the Four Corners area using Landsat data and these show trends in a northeasterly direction (O'Driscoll, 1981; and Knepper, 1982).

2.1 Fluvial Deposits in the Study Area

Three types of deposits occur in the study area. The lithology consists of fine grained Holocene alluvium overlying Pleistocene outwash gravels and Cretaceous marine shales. The migration of Tethyan sea waters during the Cretaceous deposited the marine shales which consist of clays and silty clays (Fassett, et al., 1977). Regressive and transgressive transitions resulted in the many facies changes throughout the formation (Peterson and Kirk, 1977). Below the Shiprock UMTRA site, the Mancos Shale formation has a thickness of approximately 239 meters (Johnson, M. S., pers. comm., 1997). The outwash gravels and boulders overlie strath terraces on the north and south sides of the San Juan River and can be observed from Farmington to Shiprock.

Metamorphic and volcanic rocks are common in the deposits, and do not occur locally. The thickness of the outwash deposits on the floodplain ranges from 6 to 9 meters. The presence of well rounded gravels, cobbles, and boulders reflect long distances of fluvial transport during glacial melting.

2.2 Moraine and Terrace Sequences from Durango to Farmington

Terraces along the Animas River from Durango, Colorado, to Farmington, New Mexico, areas have been interpreted to have formed intermittently from the late Pliocene to the late Pleistocene. Three glacial moraines --Durango (330,000 to 240,000 years BP (Gillam et al., 1984; and Love and Gillam, 1991)), Spring Creek, (140,000 years to 150,000 years (Gillam et al., 1984)), and Animas City (70,000 to 60,000 years BP and 40,000 to 30,000 years BP (Gillam et al., 1984)) -- have been identified near Durango, Colorado. A set of outwash terraces was formed after each of the glacial events (Gillam et al., 1984; and Love and Gillam, 1991).

2.3 Ages for the Terraces and Floodplain in the Shiprock Area

Published maps had not identified the ages of the terraces and floodplain in the study area. Therefore terraces were mapped and correlated with the surfaces identified by Love & Gillam (1991). Along the San Juan River from Farmington to Shiprock Ward's (1990) surficial deposits map and Gillam's unpublished (Gillam, pers. comm., 1996) maps were used as a basis for determining the terrace ages in the study area. The terrace elevations from south of Farmington to northwest of Shiprock were plotted against the length of the San Juan River to determine the terrace ages from Farmington to Shiprock (Figure 9). The Shiprock UMTRA site is located on a strath terrace which is estimated to have formed between 88,000 to 150,000 (late-middle Pleistocene) years BP from the Spring Creek glacial waters. The floodplain outwash gravels were estimated to have been deposited from 16,000 to 70,000 years BP (late Pleistocene) from the Animas City glacial waters and lie approximately 1.3 meters above the San Juan River.

3.0 HYDROLOGY

The San Juan hydrologic basin lies within the Colorado River Basin. The basin was formed by uplifts which control the direction of groundwater movement toward the San Juan River, which joins downstream with the Colorado River in southeastern Utah (Figure 2). In the Colorado River Basin (Cooley, 1969, Lyford, 1979; and Stone, 1984), groundwater flows toward the tributaries of the Colorado River. The perennial flows of the San Juan and La Plata Rivers (Figure 2) are the largest tributaries in the Colorado River Basin (Cooley, 1969;

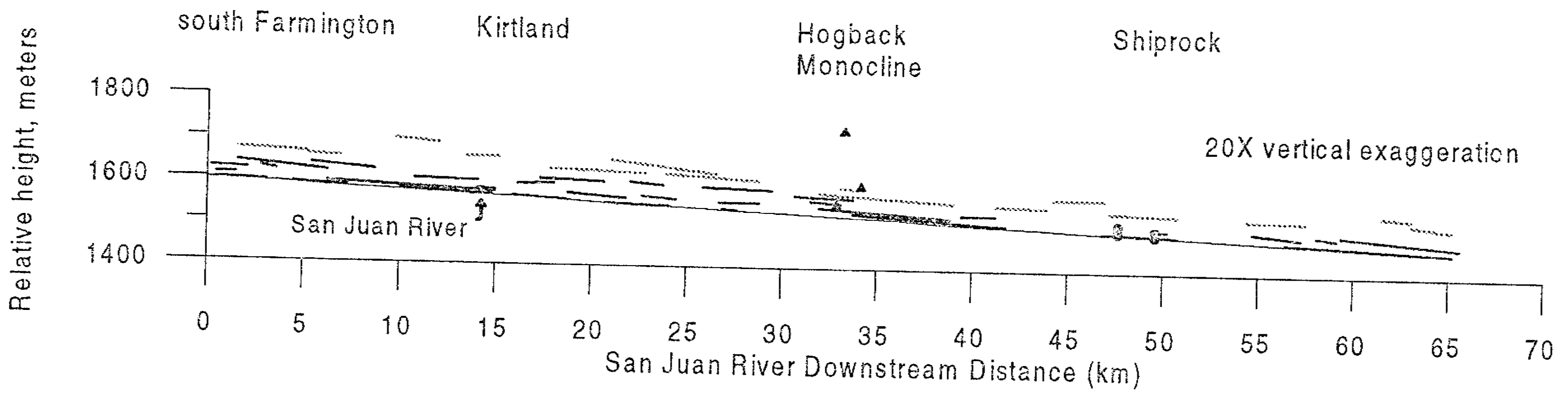


Figure 9. Estimated ages of gravel terraces along the San Juan River from Farmington, NM, to Shiprock, NM. Zero begins at junction of Animas and San Juan Rivers in south Farmington.

and Stone, 1984). The principal aquifers are of Jurassic and Cretaceous age and are shown in a generalized stratigraphic section in Figure 10.

3.1 Regional Hydrology

Cooley (1969), Stone and others (1984), and Kernodle (1996) have described the recharge areas for the confined aquifers in the San Juan hydrologic basin. In the Chuska Mountains of northwestern New Mexico, outcrops of Tertiary Chuska Sandstone overlie and recharge the Jurassic Morrison Formation. This groundwater also is the source for springs and local wells along the Chuska Mountains (Cooley, 1969; and Lyford, 1979). The recharge area for the Morrison Formation aquifer extends as far north as Colorado, and is exposed along the flanks of the San Juan Mountains.

Aquifers in the San Juan hydrologic basin are located stratigraphically above, within and below the Cretaceous Mancos Shale. Upper Cretaceous units of Mesa Verde group lies above the confining layers whereas the Gallup Sandstone is within in the Mancos Shale and the Morrison Formation, San Rafael group, and Glen Canyon Group are below the confining Mancos Shale layers. The shale consists of siltstone and mudstone ranging in thickness from 76 meters to as much as 701 meters regionally (Fassett, 1977). According to

QUATERNARY		Alluvium	**11 meters** *12-31 meters*
		Pleistocene Outwash Gravels	**8 meters** *4-20 meters*
TERTIARY		Chuska Sandstone	*212-549 meters*
Upper CRETACEOUS		Mesa Verde	*0-242 meters*
CRETACEOUS	Mancos Shale	Mancos Shale	**238 meters** *244-701 meters*
		Gallup Sandstone	**25 meters** *27-212 meters*
		Graneros Shale Member	**37 meters** *18-91 meters*
		Dakota Sandstone	**50 meters** *15-610 meters*
Late JURASSIC	San Rafael	Bluff Sandstone Summerville Formation Todilto Limestone Entrada Sandstone Carmel Formation	*0-107 meters*
JURASSIC	Morrison Formation	Brushy Basin Member Westwater Canyon Member Recapture Member Salt Wash Member	**177 meters** *37-151 meters*
Upper TRIASSIC	Glen Canyon	Navajo Sandstone Kayenta Formation Moenave Sandstone Wingate Sandstone	*0-549 meters*

Figure 10. Generalized stratigraphic section. Deposits at the Shiprock UMTRA site is shown in black (bold) and regional in italicized (modified after Fassett et al., 1987, Frenzel and Lyford, 1982, and Stone et al., 1983).

well records, artesian well #648, located on the western terrace above the study site, is screened in the Morrison Formation (Johnson, M. S., pers. comm., 1997).

3.2 Local Hydrology

The study area lies within the Middle San Juan watershed, the boundaries of which are formed by the Defiance monocline to the southwest, the Hogback monocline to the east, the Lukachukai and Carrizo mountains to the west, and the San Juan mountains to the north (Figure 11). The San Juan River tributaries affecting the study area include the ephemeral flows from the Canon Largo, Gallegos Canyon, and Chaco River and the perennial flows from the La Plata River (Cooley, 1969, and Stone, 1984).

The headwaters of the San Juan River are located north of Pagosa Springs, Colorado. The San Juan River joins the Colorado River north of Page, Arizona in Utah. Prior to joining the Colorado River, the San Juan River is fed by two major tributaries, the La Plata and Animas Rivers, within the study area. The headwaters of the La Plata River are located north of Silverton, Colorado, and the headwaters of the Animas River are located north of Hesperus, Colorado. The Animas joins the San Juan in central Farmington whereas the La Plata comes in west of the city (Figure 11).

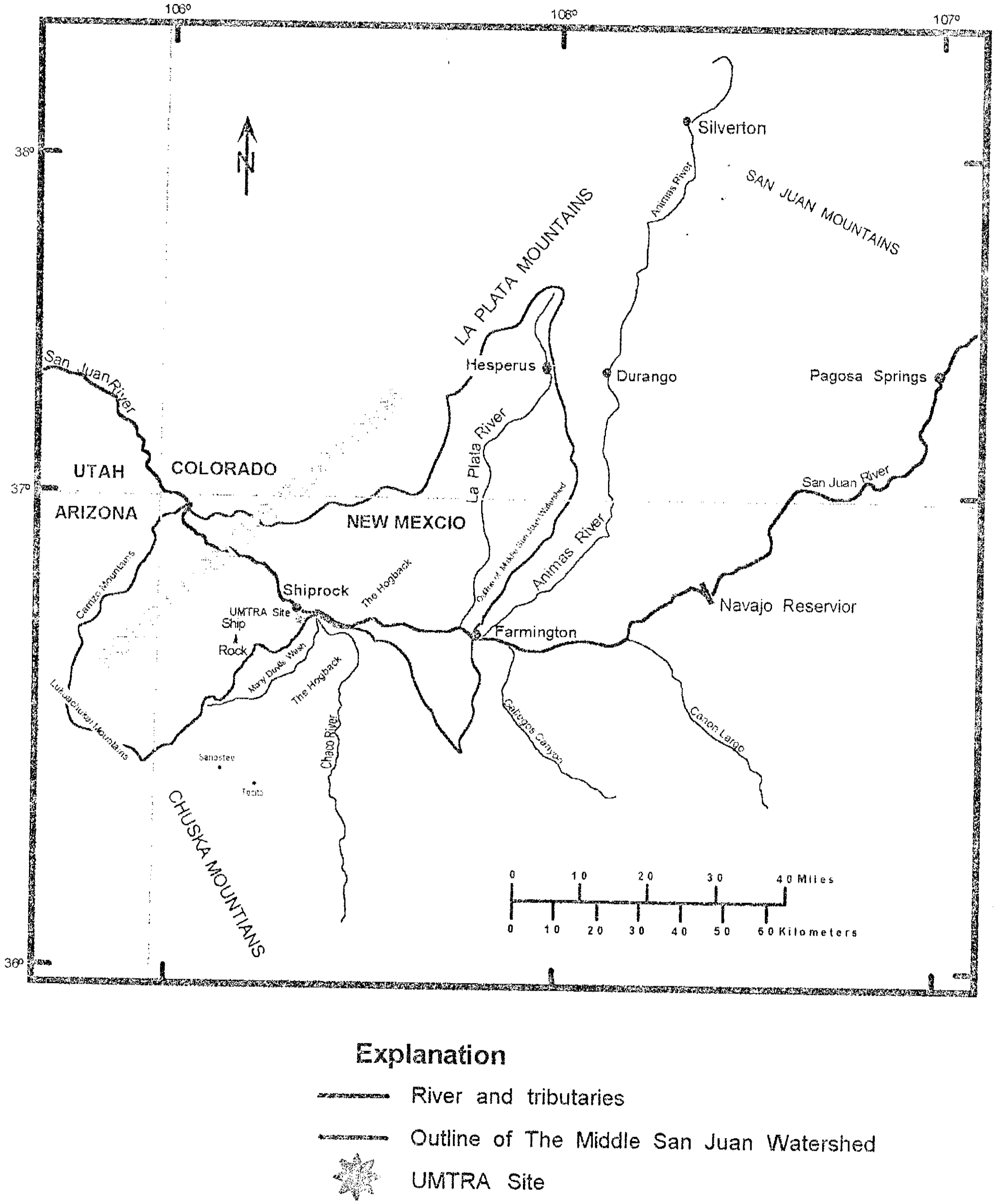


Figure 11. Middle San Juan Watershed showing major surface water drainages (modified after USGS, 1974 Hydrologic Unit Maps).

The Quaternary-aged unconfined aquifers along the San Juan and La Plata Rivers consist of valley fill deposits ranging from 4 meters to 20 meters thick (Cooley, 1969; Stone et al., 1983; and DOE, 1985-1996). Since 1963 the San Juan River flow volumes at Shiprock have depended on releases from the Navajo Reservoir, located approximately 100 kilometers upstream from Shiprock. The flow from the Navajo Reservoir to San Juan River affects recharges to the unconfined aquifer system below the reservoir, therefore affecting high and low water levels along the river.

3.3 Climate

In Shiprock the mean annual temperature is 52.8°F (Kunkel, 1984). The mean annual precipitation is 20.3 cms per year (Kernodle, 1996). The highest precipitation occurs during summer months as localized thunderstorms. The precipitation is approximately 9 cms per year from both snow and spring runoff (Kernodle, 1996). In the Shiprock area the potential mean annual evaporation rate is 1.47 meters per year (Kernodle, 1996).

Since the potential mean annual evaporation rate exceeds the mean annual precipitation rate, recharge by precipitation to the floodplain aquifer may be negligible. The exception may be strong storm events in which precipitation exceeds evaporation for short periods of time. The local floodplain aquifer within the study area is recharged predominantly thorough discharges by the artesian well #648, and from the San Juan River. Piezometric levels in the floodplain aquifer are highest at the mouth of Bob Lee Wash. These high water levels have created a wetland environment at the base of the wash.

4.0 RESEARCH METHODS

This study was conducted to determine the behavior of the unconfined aquifer within the floodplain that lies below the site of the DOE's UMTRA project at Shiprock, New Mexico. Following methods were used: a) Universal Transverse Mercator (UMT) coordinates for all sampling locations were determined to provide a consistent database for the diverse sources of data from the DOE consultants; b) Well logs from the existing and abandoned wells were collected and analyzed to develop cross-sections of the floodplain stratigraphy. c) Seismic refraction data were used to identify fractures and/or offsets, and to determine the depths to gravel and shale contacts and fluctuations of the gravel and alluvium interface; d) Depths to groundwater were recorded for monitoring wells; e) Electrical conductivity data were collected using the electromagnetic (EM) 38 and 31 during the low- and high-water flows from the San Juan River to determine the vertical and horizontal extent of the salt contaminant plume; f) Eleven years of DOE water data were compared to high and low flow of the San

Juan River to determine if the San Juan River flows influence uranium, nitrate and sulphate concentrations in the floodplain aquifer.

4.1 Universal Transverse Mercator Locations

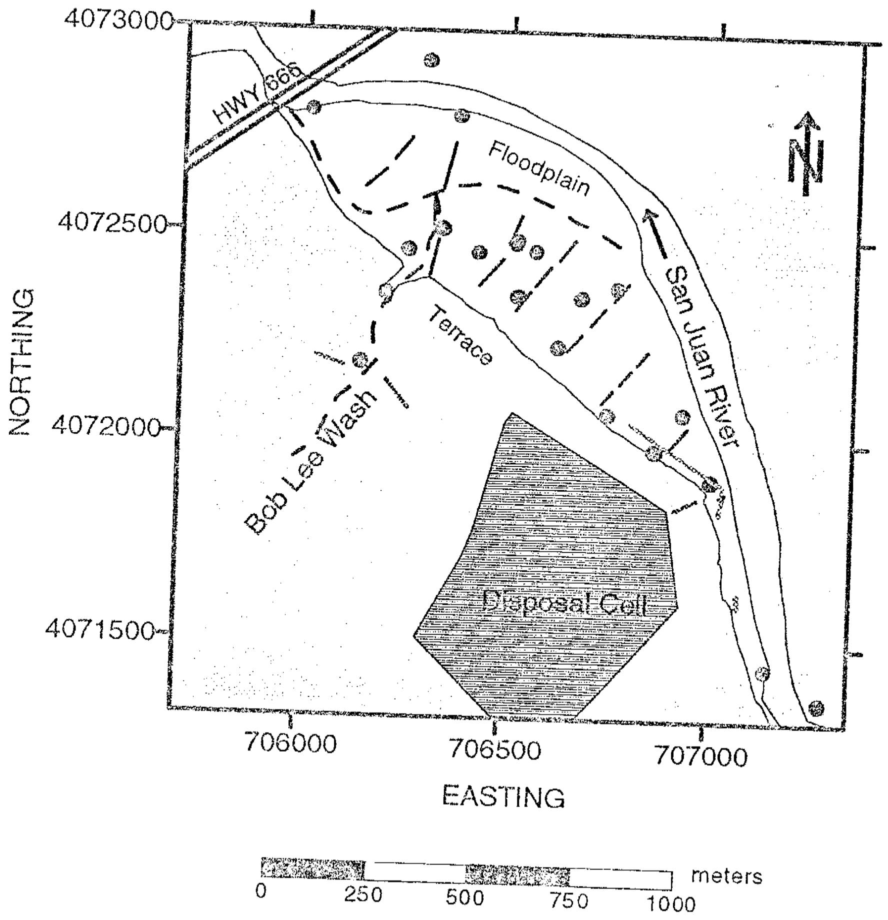
A unified coordinate system was required to enable comparison of previous and current sampling data. In the past, all sampling locations were given a Navajo Engineering & Construction Authority (NECA) easting and northing coordinate and this did not reflect any state plane coordinate system. All available coordinates in the DOE database were used to manipulate and calculate Universal Transverse Mercator (UTM) coordinates to compare previously collected data with the data collected in 1996 and 1997. In February 1996, Geraghty & Miller (Newlin, pers. comm. 1996) used the global positioning system (GPS) to find the UTM coordinates for two monitoring wells and nine electromagnetic sampling points. Personnel from the Navajo Nation Water Resources Program calculated UTM coordinates (Appendix B) for all the existing and abandoned monitoring wells and the 189 sampling points for electromagnetic survey (Largo, G., pers. comm., 1996).

4.2 Stratigraphy

The DOE reports published prior to 1989 identify 82 well logs from monitoring wells, well points and boreholes and of these, 52 have been abandoned. The 82 well logs were used to establish the subsurface stratigraphy and to produce the cross-sections and isopach maps. Seismic refraction surveys were performed on the floodplain to identify any possible fractures and/or offsets, gravel contacts within the shale, and topographical high and lows in the shale. The first seismic refraction test line was conducted on the floodplain in June 1995 (Figure 12). A second seismic test was conducted on February 1996, by Geraghty and Miller in the non-vegetative sections of the floodplain. The gravels and shale contacts were determined from the lithologic information of monitoring well logs (Figures 3 and 4). The shale elevation (Figure 13a) and isopach maps (Figure 13b and 13c) were constructed using the 1993-1994, Surfer contouring program by Golden Software, Inc. Version 5.0, using the data from 56 lithological logs existing and abandon monitoring wells, well points, and test pits locations (Appendixes C and D).

4.3 Water Level Measurements

A schedule of water level measurements was established by the Dine' College students for 30 monitoring wells located on the floodplain (Figure 4). During



Explanation

NMT siesmic line (June 1995)

DOE siesmic line (February 1995)

Fractures in shale (Schule, 1995 and DOE, 1996)

Bob Lee Wash and floodplain ditch

● Monitoring wells

Figure 12. Location of seismic lines on the floodplain.

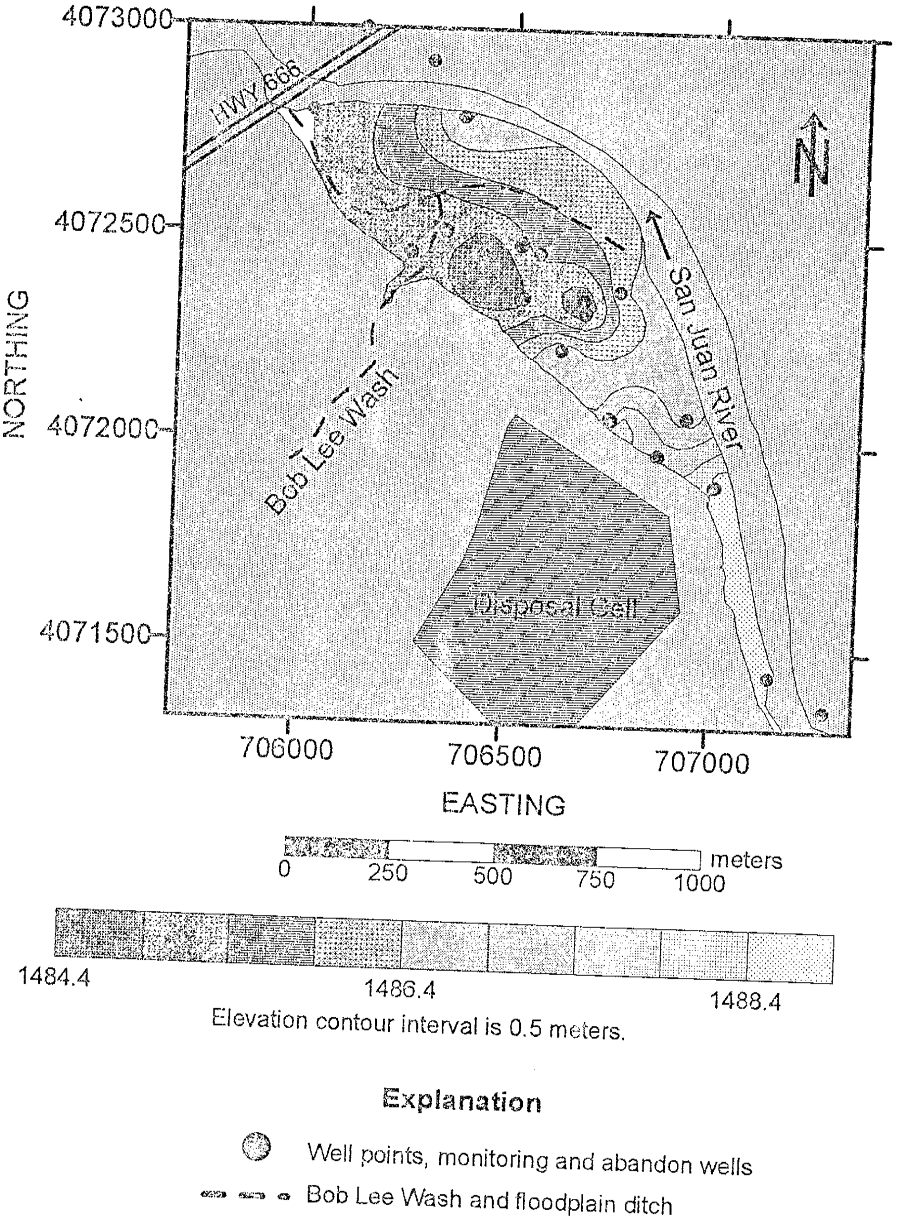
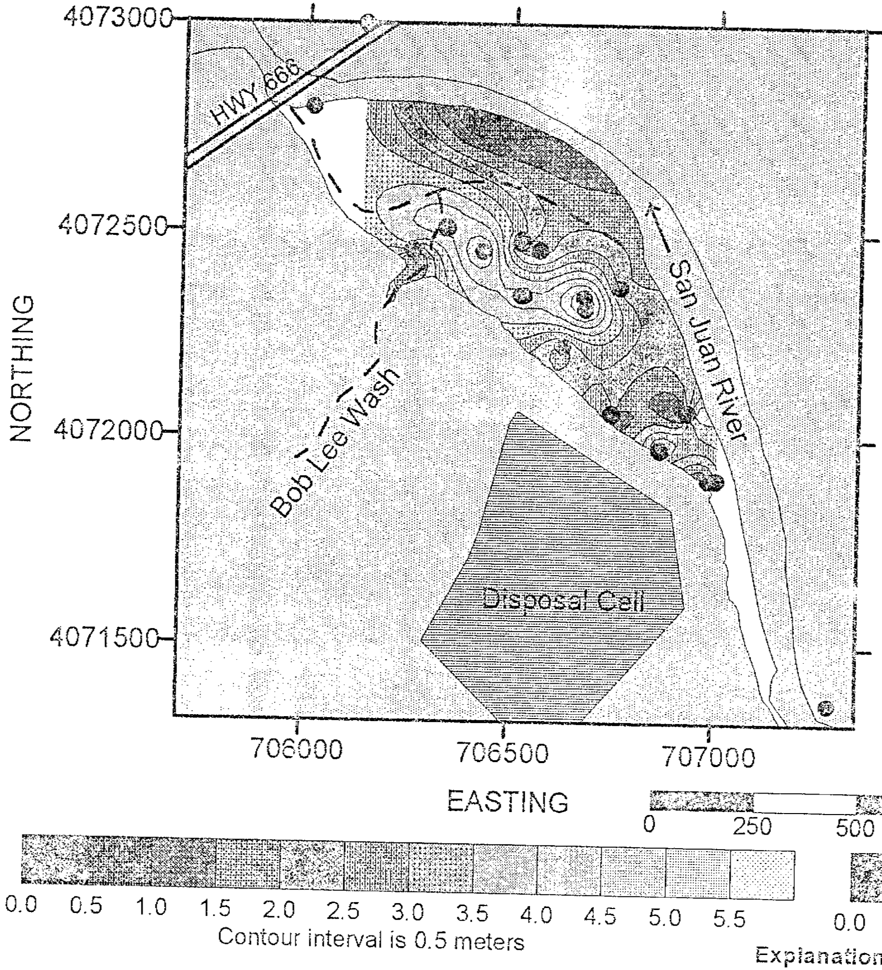
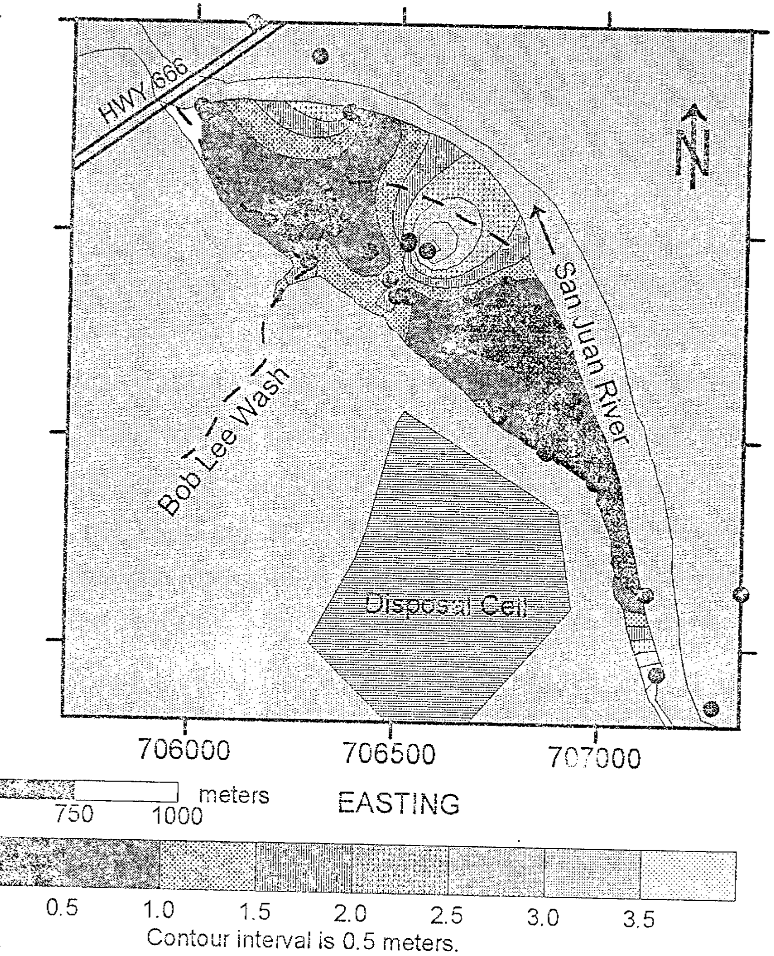


Figure 13a. Shale surface elevation map. Surface elevation is highest on the eastern floodplain and begins to decrease toward the center of the floodplain. Minimum elevation is 1484.41 meters and maximum elevation is 1488.76 meters.





Explanation

● Well points, test pits, and monitoring wells

— — Bob Lee Wash and flooplain ditch

Figure 13b. Gravel isopach map show greatest thickness in the central section of the floodplain between the ditch and terrace. Minimum thickness is 0.32 meters and maximum thickness is 5.57 meters.

Figure 13c. Alluvium isopach map shows greatest thickness near the eastern floodplain ditch. Minimum thickness is 0.15 meters and maximum thickness is 3.7 meters.

data collection period, January 1995 to mid-November 1995, an electric sounder made by Jacobs Engineering Group (JEG) was used to measure the depth to groundwater. Subsequently a Solinst sounder Model 101 was used from mid-November 1995 to July 1996. During periods of low river flows, from April to May, 1995, and September 1995 to August 1996, water-levels on the floodplain were measured each week. When the San Juan River experienced high flow rates and/or anticipated variability in water-levels from the Navajo Dam releases, more frequent water-level measurements were required to evaluate possible interactions between the floodplain aquifer and the San Juan River. Water elevation contour maps were mechanically drawn and based on depth-to-water level measurements for the highest and lowest water levels and for monthly averages from April 1995 to July, 1996 (Appendix E).

4.4 Electromagnetic Surveys

A 50 by 50 meter grid consisting of 189 sampling points (Figure 14) was established on the floodplain for repeated surveys of groundwater salinity using the electromagnetic (EM) to collect electrical conductivity values. The direction of the north/south line is 60° and the east/west line is 150°. Four electromagnetic surveys were conducted at the site during different high and low discharge seasons of the San Juan River. The ground conductivity meters by Geonics Limited (Ontario, Canada) used were models EM-38 and EM-31. The

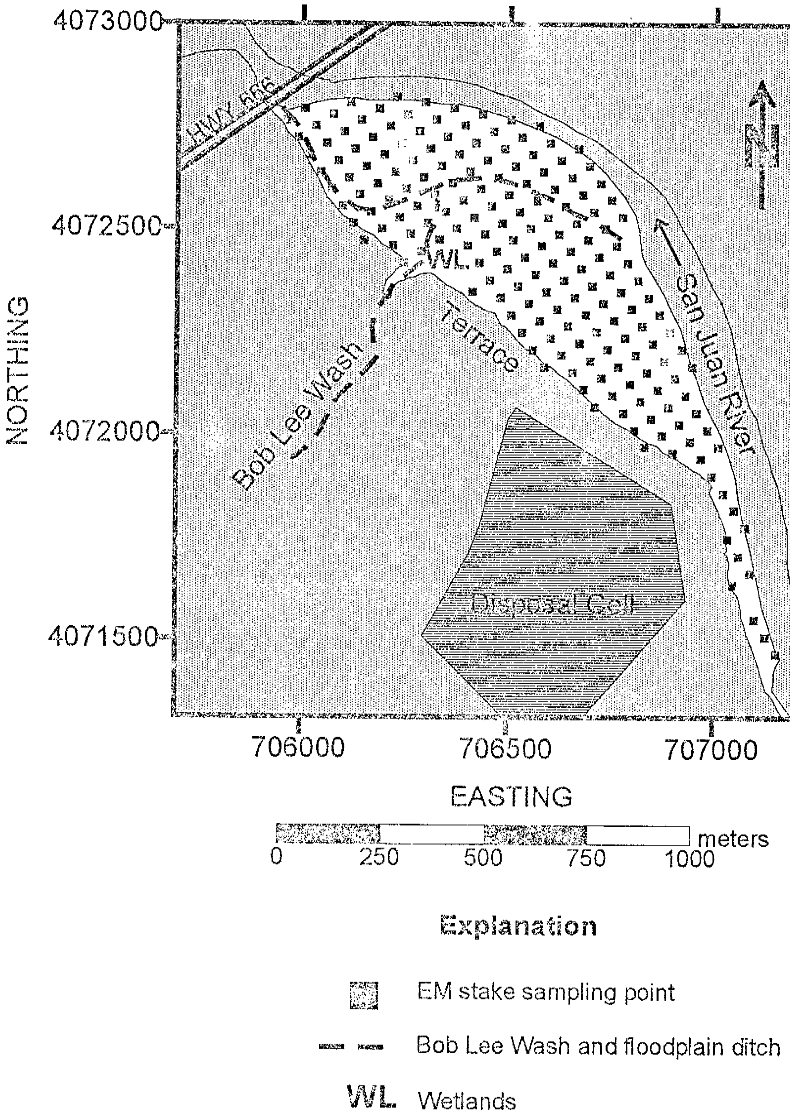


Figure 14. Electrical conductivity sampling locations. Collected in 1995 and 1996 with EM-8 and EM-31.

electromagnetic values provide an integrated conductivity of the soil and water. Depth of signal penetration for the EM-38 is approximately 0.75 meters in the horizontal mode and 1.5 meters in the vertical mode. Depth of signal penetration for the EM-31 is approximately 3 meters in the horizontal mode and 6 meters in the vertical mode.

The EM-38 and EM-31 instruments generate an electromagnetic field which induces a small current in the ground. The magnetic field strength is determined by terrain electrical conductivity measurements (McNeil, 1992). The EM instruments measure the electrical conductivity over a given interval depth below ground surface. The electrical conductivity responds to both the total salt content and water content in the soil. The EM conductivity technique provides an integrated electrical conductivity profile of the subsurface soil and can show changes attributable to salinity variations. Locally high electrical conductivity values on the floodplain indicate the possible presence of contaminants, in the form of total salt content moving with groundwater. The EM-38 and EM-38 contour maps were constructed using the 1993-1994, Surfer contouring program by Golden Software, Inc. Version 5.0 using the electrical conductivity data from the EM-38 and EM-31 surveys (Appendix F).

4.5 Geochemical Analyses

San Juan River flow measurements from the USGS (1985-1996) Shiprock discharge gaging station were compared with eleven years (1985-1996) of DOE's water analyses for NO_3^- and SO_4^{2-}, and U (Appendix A). The evaluation was used to determine whether or not the contaminants were being diluted by the flows from the San Juan River. The results from the water quality analysis were contoured using Surfer program by Golden Software, Inc. Version 5.0 and divided into the Log concentration ranges.

5.0 DISCUSSION OF RESULTS

One way of evaluating the influence of the San Juan River on the unconfined aquifer is to compare floodplain lithology, water flow directions, and the vertical and horizontal extent of the contaminant salt plume. By overlaying the water elevation and isopach maps, the groundwater flow directions on the floodplain aquifer show recharge from both the San Juan River and the Bob Lee Wash. Comparing the lithologic, water elevation, and electrical conductivity contour maps will allow identification of recharge areas in the floodplain aquifer.

Groundwater and contaminant flow directions are influenced by many factors. Monitoring well elevations were incorrect and initially gave inaccurate water level data. The EM-38 and EM-31 data allowed delineation of the contaminant plume on the floodplain. Finally, comparison of previous DOE water analyses and electrical conductivity contour data maps allowed for interpretation of the plume source.

5.1 Re-measurement of Monitoring Wells Elevations

In winter, 1995, the calculated water levels below ground surface indicated that saturated areas existed on the floodplain, however no water was observed on the floodplain in December, 1995. Earlier in the year the floodplain was saturated from mid-June to mid-July 1995 (Figures 15a to 15d) when large releases from Navajo Dam were timed to mimic unimpeded runoff from snowmelt. The monitoring well elevation of 28 of 30 monitoring wells on the Shiprock UMTRA site floodplain were remeasured and the elevations on 26 monitoring wells were found to be incorrect. The monitoring wells were remeasured and the corrected values were used for the water elevation and lithological contour maps.

5.2 Floodplain Stratigraphy

The DOE data from 56 lithologic logs were (Figure 3) used to produce cross-sections and isopach maps (Figures 8a-8e and 13a-13c) to identify variation in

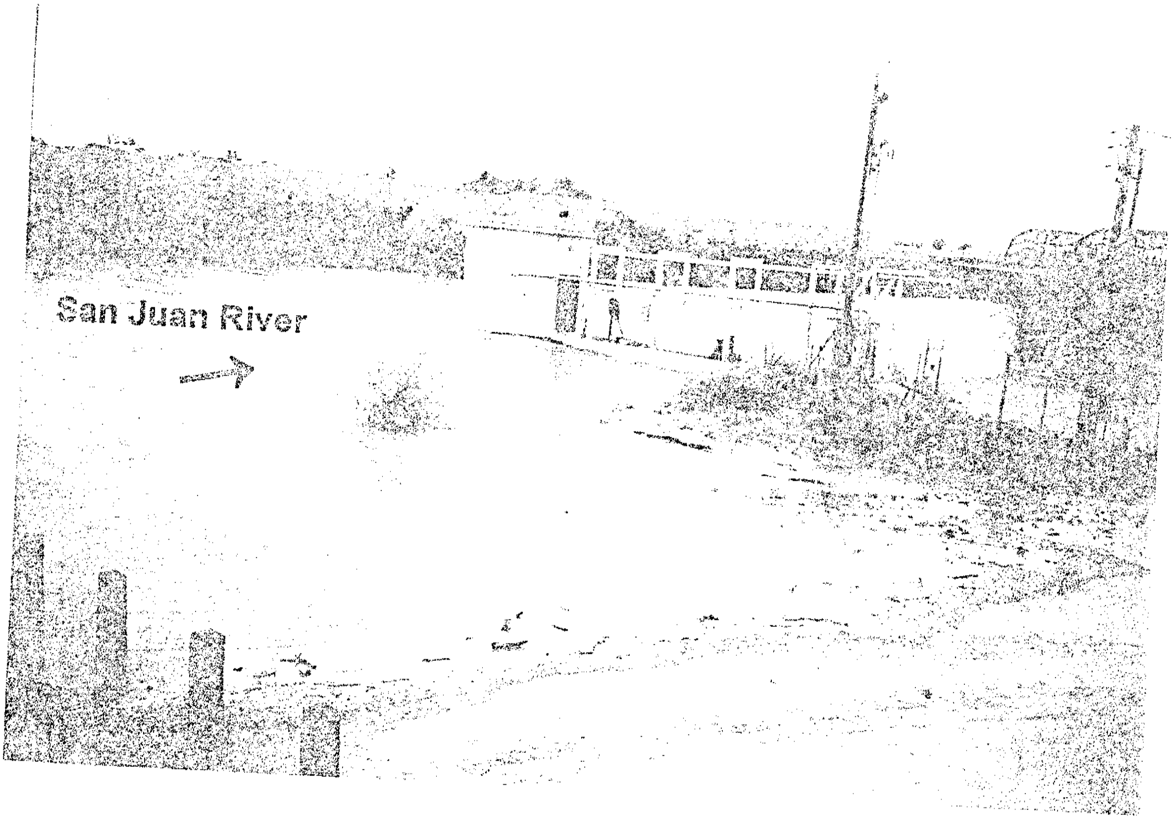


Figure 15a. Photograph of the San Juan River floodplain in June 1995. View is to the southeast looking at the Navajo Tribal Utility Authority's intake public water system building. Residents, in background, are currently inhabiting the upper western terrace of the floodplain (Photo by SC Semken, 1995).

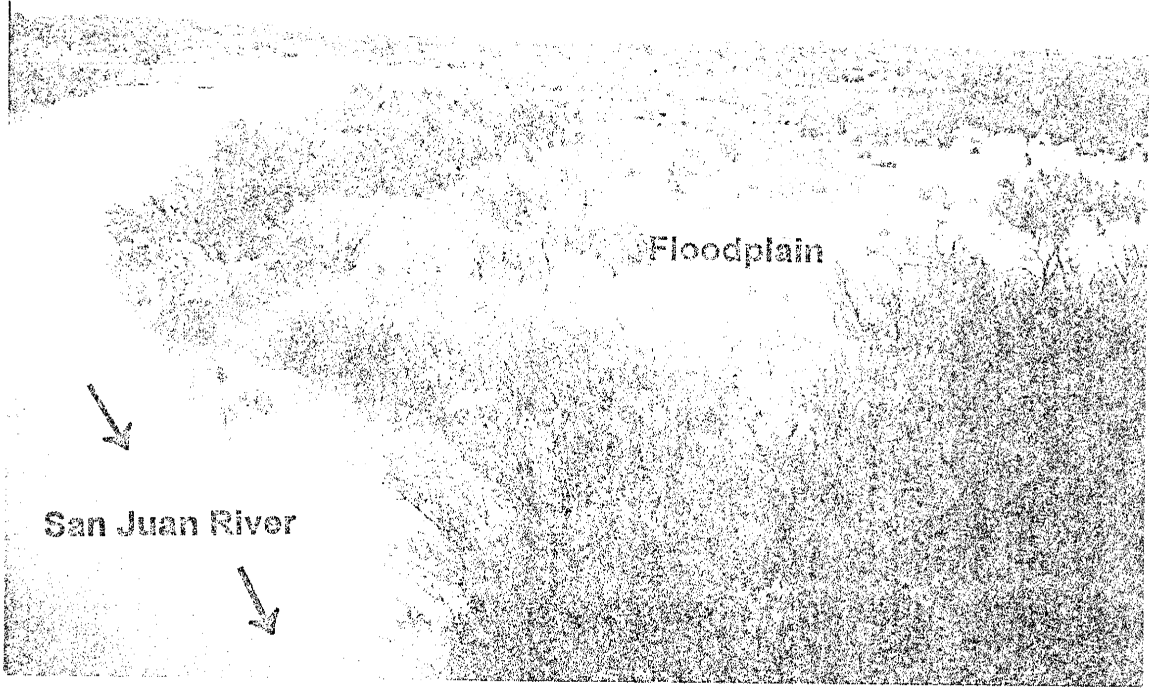


Figure 15b. Photograph showing the San Juan River flow in min-June 1995. View is looking to the east, northeast of the municipal surface water intake system building. The study area is off the photograph to the left and the San Juan River on the right-side (Photo by SC Semken, 1995).

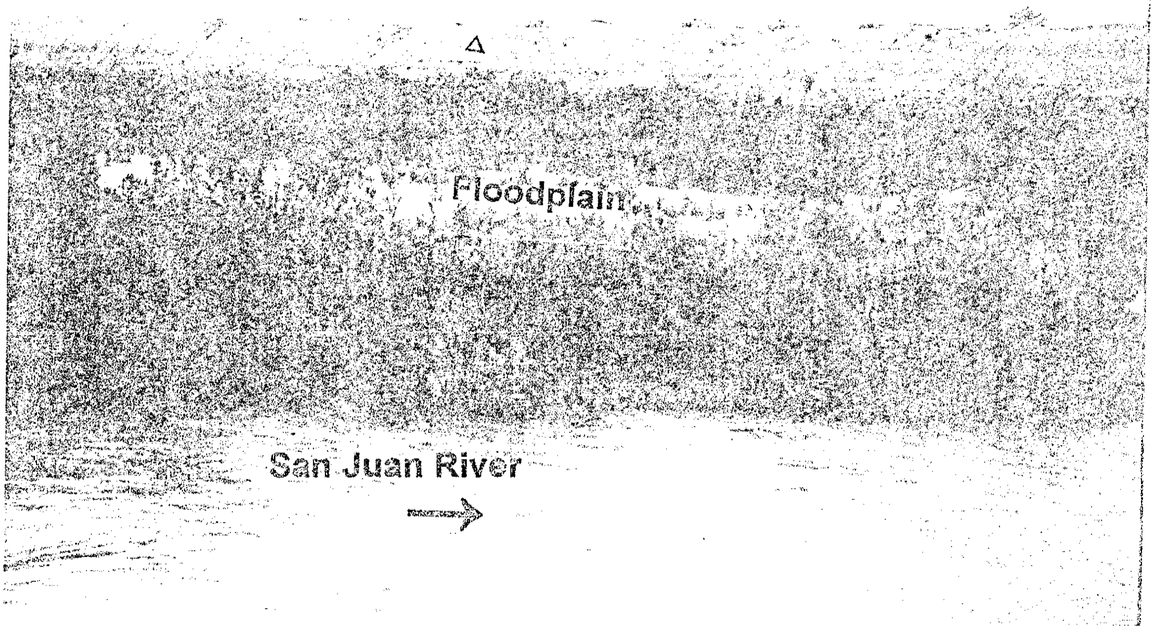


Figure 15c. Photograph of the San Juan River during high-flow in mid-June 1995. View is to the south and escarpment can be seen in the background. Open triangle indicates approximately where salt encrustation was observed and which coincides with higher EM conductivity values (Photo by SC Semken, 1995).

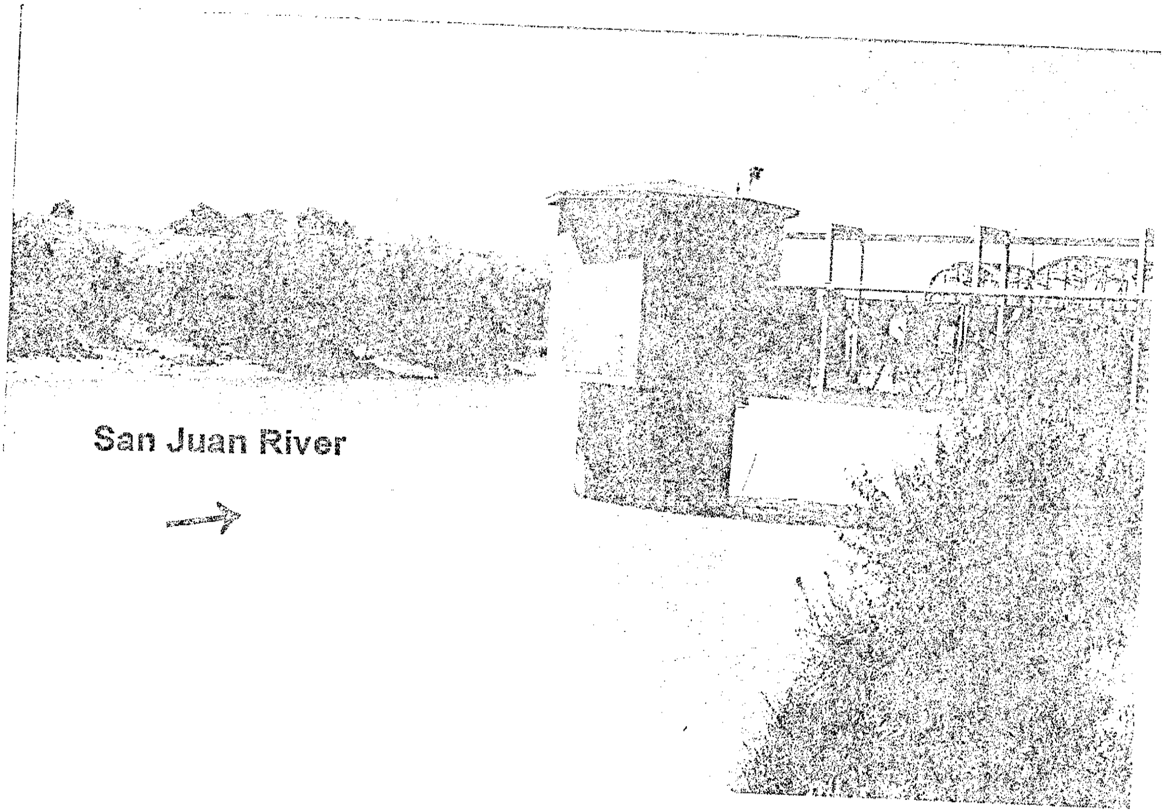


Figure 15d. Photograph showing the San Juan River flow in mid-August 1995. The mid-ground structure is the Navajo Tribal Utility Authority's intake for the public water system building. View is looking towards floodplain in a southwesterly direction (Photo by SC Semken, 1995).

lithologic thickness on the floodplain. Former alluvial channels on the floodplain were identified from aerial photographs (Figures 5 and 6). The outwash-gravels contain larger pore space than the alluvium. The ancestral channels may presently control the groundwater and contaminant flow directions. Restricted fluid movement would occur through the finer grained alluvium around channels. East of Bob Lee Wash, higher electrical conductivity values indicate that the locally finer-grained alluvium may be inhibiting the movement of contaminants and groundwater flow from the disposal pile into the river. The alluvial channel branching east of Bob Lee Wash may be restricting the flow of the contaminant plume as it moves towards the San Juan River. Variations in the lithologies within the stratigraphic sequence will influence fluids as they cross the boundary from a more permeable material (outwash gravels) to less permeable material (fine-grained alluvium).

The cross-section line B-B' on the map in Figure 8c shows that the alluvium and outwash gravels have a consistent thickness in the center of the floodplain. However, the alluvium becomes thicker on the northwestern sections of the floodplain, may be part of/or near a former point bar, where higher rates of sedimentation by the San Juan River would be expected. In mid-cross-section line B-B', the Mancos Shale topographical surface is relatively flat from erosion by the river. Cross-section C to B' shows that alluvium and gravel thicknesses vary as much as three meters along the edge of the terrace but the upper surface of the Mancos Shale shows relatively little topographic variation, except near MW 613, and MW 614, where a resistant shale knob exists (Figure 8d).

In the southeastern and central sections of the floodplain, the isopach maps and cross-sections show the depth to the gravel/shale contact varying from 0.3 to 3.7 meters (Figures 8a-8e, 13a, and 13b). The shale surface elevation map (Figure 13a) and southern and central cross-sections C-B' and c-c' (Figures 8d and 8e) show a depression at the base of the Bob Lee Wash. This depression within the Mancos Shale may represent ancestral channeling in the floodplain and is perhaps a major factor in controlling the groundwater and contaminate flow directions. The channeling can be seen in the elevation changes in shale and the alluvium thickness. A contour map, of the shale surface along the terrace edge and below Bob Lee Wash, shows ancestral channels that have been filled by alluvium and gravels (Figures 8e, 13b and 13c).

The variation in alluvium and gravel thicknesses suggest a later stage of channeling on the floodplain. It is probable that channeling occurred when the shale was first eroded, when gravels were deposited, and when the alluvium was deposited. Aerial photographs prior to 1954 show patterns of the former alluvial channels on the floodplain (Figures 5 and 6).

The seismic refraction survey for the central non-vegetated part of the floodplain shows the Mancos Shale bedrock topography (DOE, 1996) ranging in depth from 5.5 to 10 meters below ground surface (DOE, 1996). The greatest depth to shale is 10 meters bgs within the floodplain at the mouth and east of Bob Lee Wash (DOE, 1996). The elevation gradient of the Mancos Shale is approximately 0.0037 to 0.0044 meter per meter trending in the northwest direction whereas the regional dip is 1° to 5° to the northeast (Nowels, 1929). The southeastern floodplain refraction survey results agree with the local, stratigraphy determined from the monitoring well logs. The refraction results indicate that the top of shale surface and the alluvium/gravel thickness are within one meter of monitoring well records.

5.3 Structural Setting of the Mancos Shale

Aerial photographs from 1935 (SCS) and 1954 (US Army) show erosional patterns indicated by gullies along the terrace edge of the UMTRA site. These gullies trend to the northeast (Figures 5 and 6). After 1975, the gullies are difficult to distinguish in aerial photographs as they are covered by the uranium mill tailings (Figures 7 and 16). Regional structural features, including lineaments and anticlines, within six kilometers of the study area (O'Driscoll, 1981; and Knepper, 1982) trend NE. The orientation of the gullies in the Mancos Shale is consistent with the regional fracture patterns. Gullies along

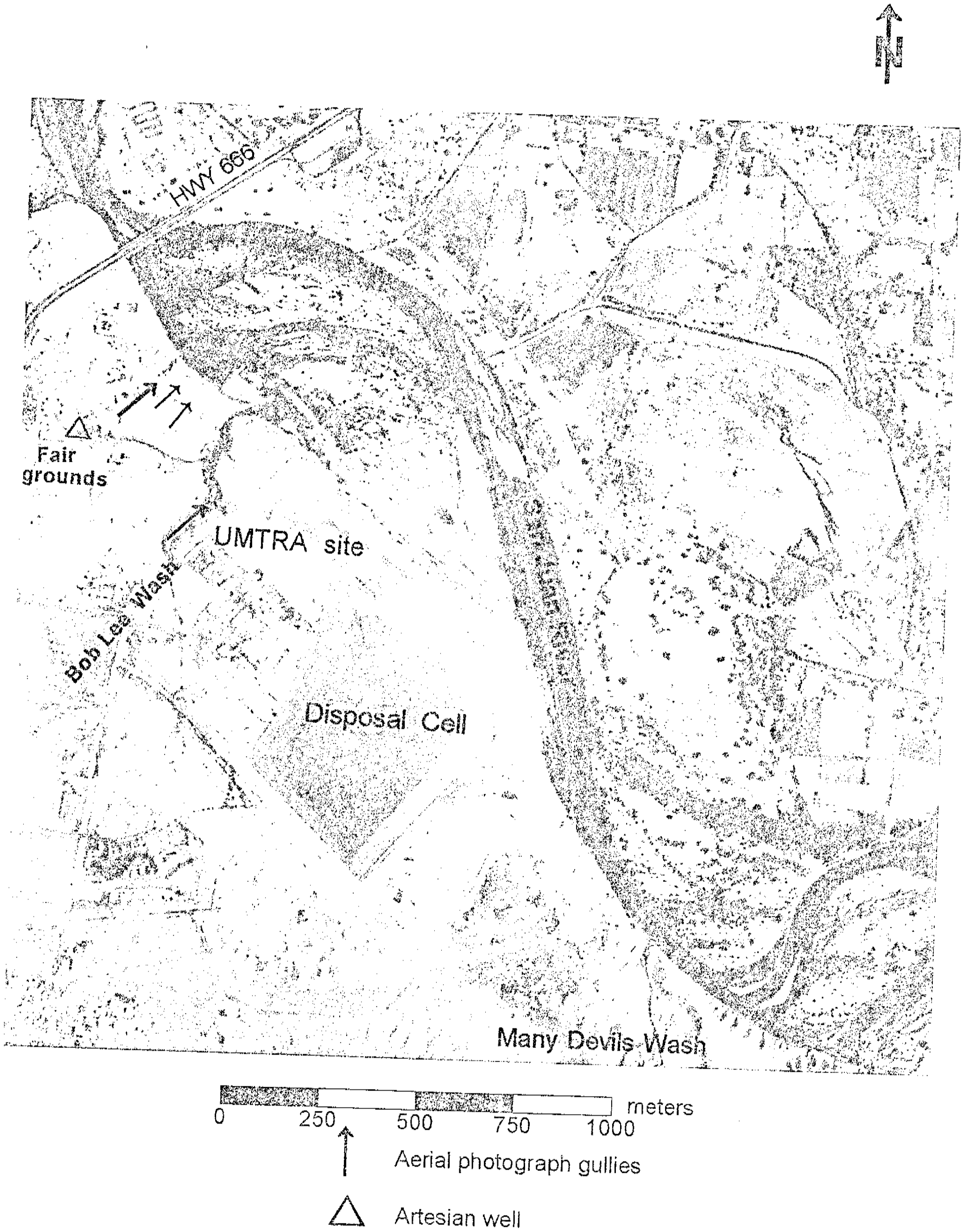


Figure 16. US Geological Survey aerial photograph (1991) showing how much vegetative growth has occurred in the floodplain since 1935 (Figure 4).

terrace edges parallel fractures within the Mancos Shale and have enhanced weathering profiles.

Above the northwestern floodplain, salt deposits and seepages were found along the escarpment which coincide with abandoned gullies observed in aerial photographs. A fracture and/or offset (Schlue, pers. comm., 1995) was identified from a refraction survey of the floodplain (Figure 12) and coincides with a gully on the terrace (Figures 5, 6 and 16). The presence of salt deposits and seepages along the escarpment (Figure 3, 15c), the occurrence of erosional gullies, and the notably higher electrical conductivity values in adjacent areas of the floodplain suggests that fractures exist within the Mancos Shale. These fractures appear to be controlling the direction of contamination plume on the floodplain.

5.4 The Influence of Floodplain Sediment Variation on Groundwater Flow Direction

A DOE (1994b) water elevation contour map has been interpreted to show that groundwater flow directions are not affected by recharge influences from the San Juan River on the eastern floodplain and only slightly affected by the recharges from the Bob Lee Wash on the western floodplain aquifer (Figure 17). The DOE's contour map suggests on the eastern floodplain there is a constant

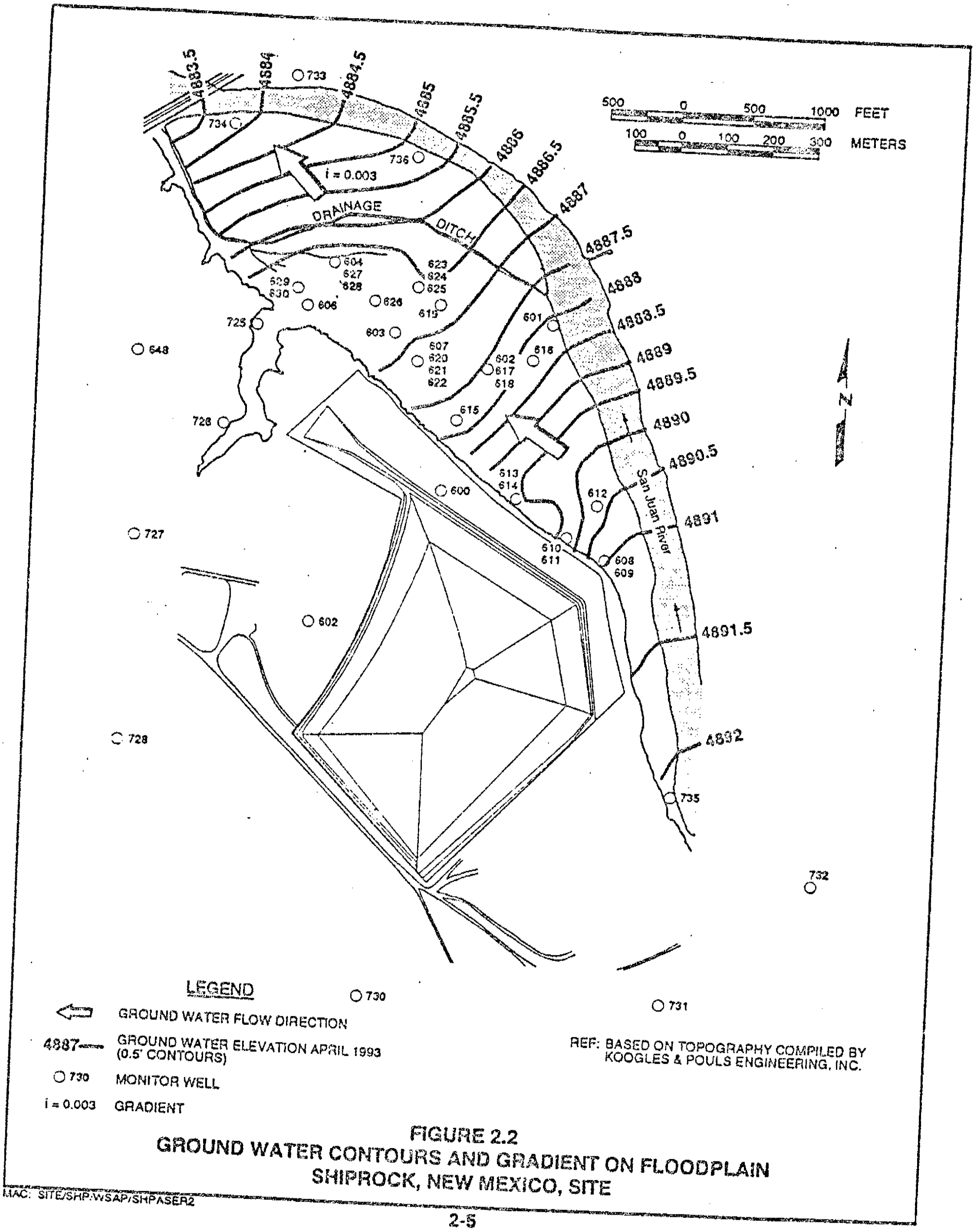
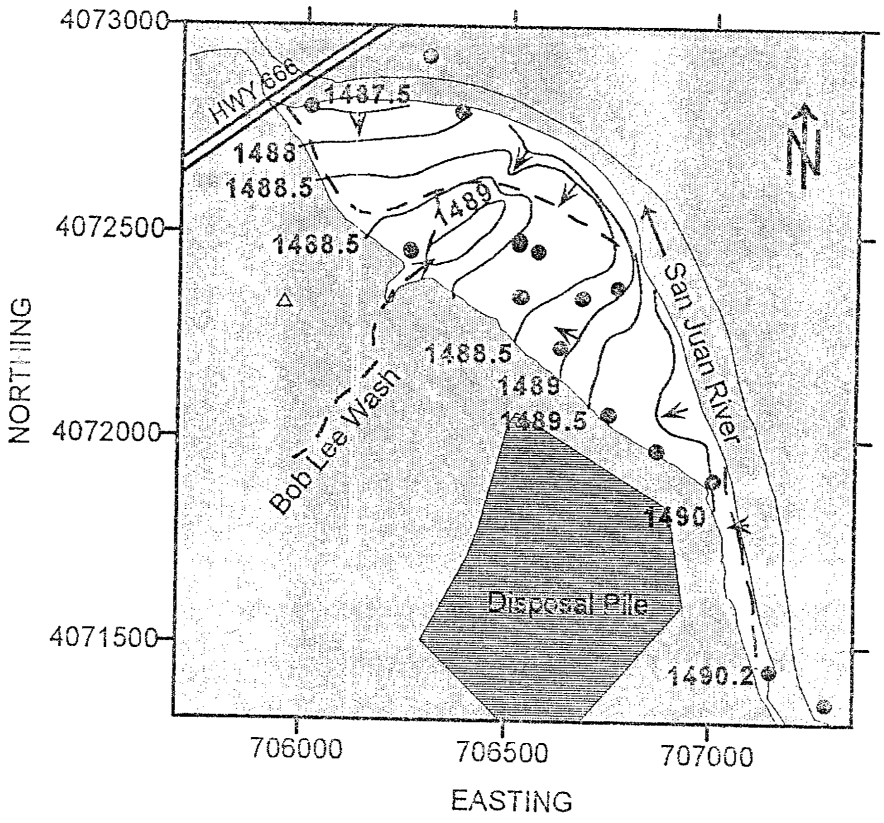


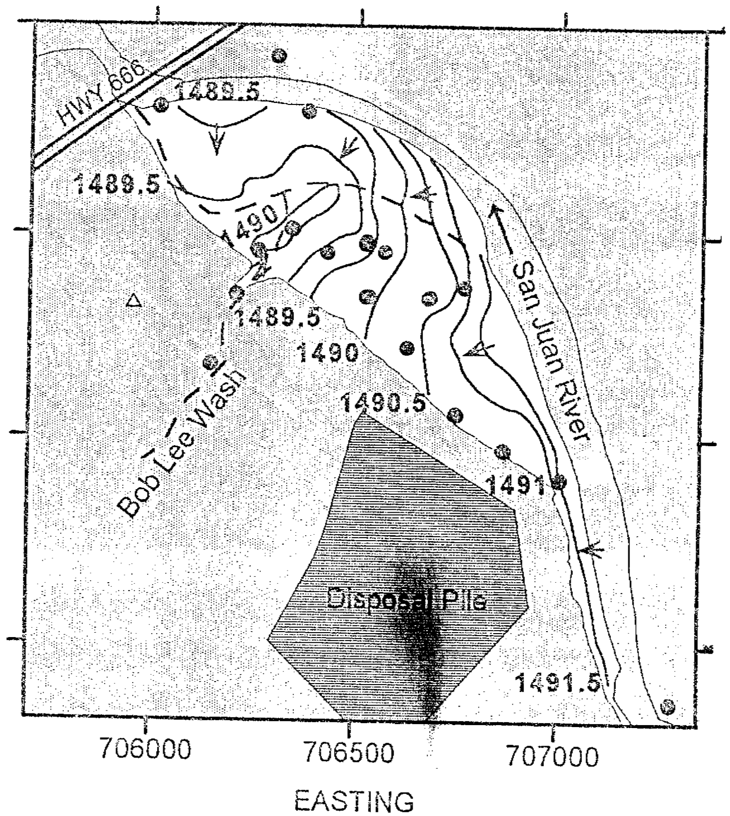
Figure 17. The 1994 DOE interpretation of groundwater flow directions on the UMTRA site floodplain

groundwater recharge from the floodplain aquifer to the San Juan River and on the western floodplain the recharge from the Bob Lee Wash is significantly recharging the San Juan River (Figure 17). However, this DOE study did not consider the effects of flow directions in the alluvium, outwash gravels, and along Mancos Shale elevation surfaces. Furthermore, the depth to the groundwater was based on erroneous monitoring well elevations. As a result, the DOE study may have incorrectly assessed influences of the San Juan River and Bob Lee Wash on the floodplain aquifer.

During the lowest water levels on the floodplain aquifer, the water elevation contour map in the eastern floodplain ditch shows water elevation decreasing sharply as the San Juan River water enters the floodplain (Figure 18a). It is possible that finer-grained alluvium in this area acts as a barrier to water flow, preventing flow of water from the San Juan River into the floodplain aquifer. During high water levels the elevation gradient is reduced (Figure 18b) and it increases during low water levels (Figure 18a). However, it is possible that when alluvium is saturated it no longer acts as a barrier to water flow from the San Juan River (Figures 13, and 18b).

Irrespective of the flow conditions in the San Juan River, where thicker gravel beds exist water flow directions are towards the gravels. The groundwater may





0 250 500 750 1000 meters

Contour interval is 0.5 meters.

Figure 18a. Water elevation contour map at the Shiprock UMTRA site floodplain. The lowest water levels occurred on January 24-25, 1996. Minimum water elevation was 1484.5 meters and maximum water elevation was 1497.1 meters. The groundwater flow directions show that alluvium near the eastern ditch is affecting the recharge to the floodplain.

Explanation

△ Artesian well

● Monitoring wells

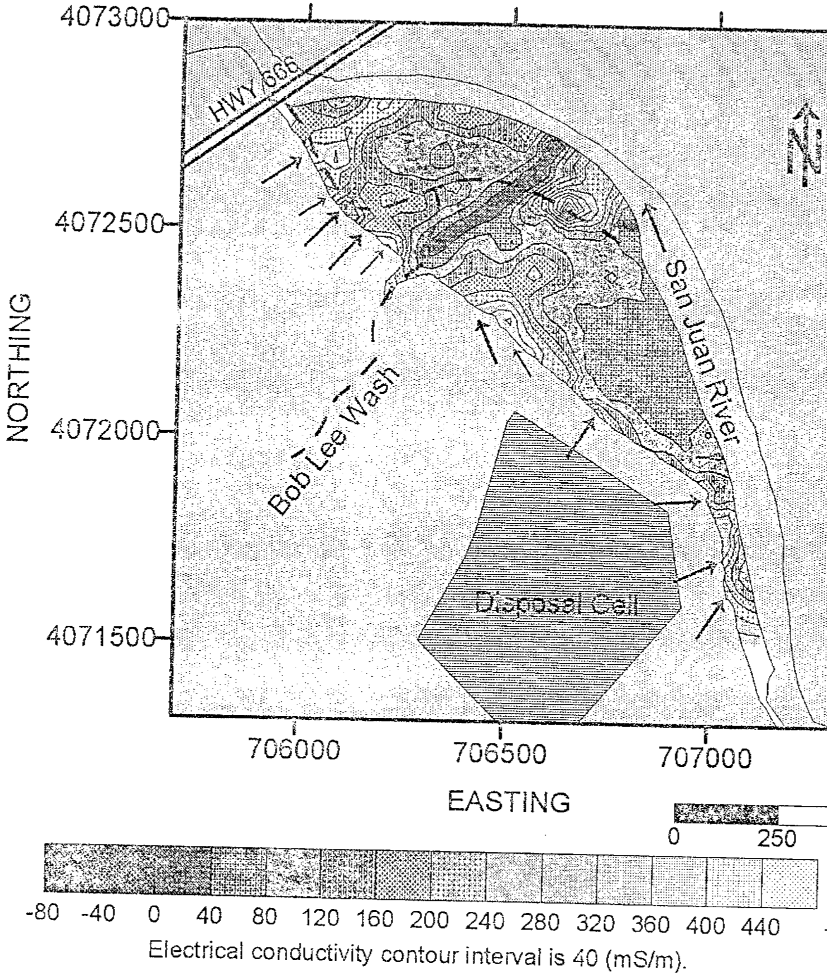
↑ Groundwater flow directions

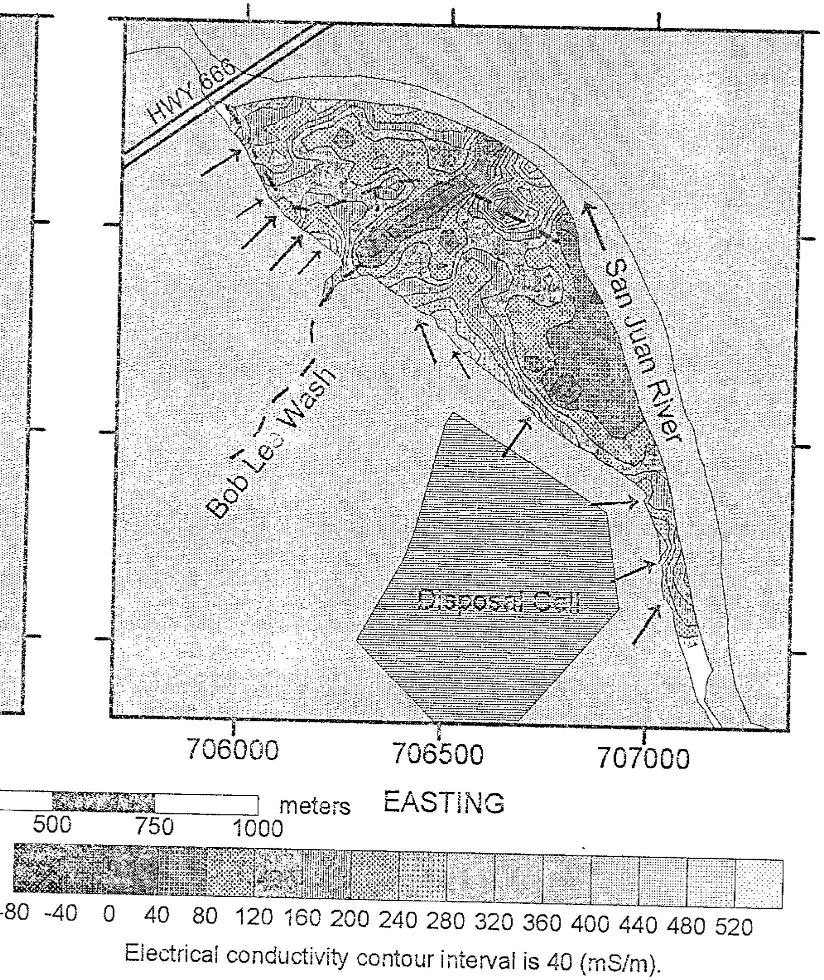
Figure 18b. Water elevation contour map at the Shiprock UMTRA site floodplain. The highest water levels occurred on June 18, 1995. Minimum water elevation was 1489.1 meters and maximum water elevation was 1497.1 meters. The groundwater flow directions show that alluvium near the eastern ditch has is not affecting the recharge to the floodplain.

also flow from the higher topographical shale areas and towards the lower topographic areas near the base of Bob Lee Wash and away from the alluvium. The groundwater flow directions on the southeastern part of the floodplain are perpendicular to the San Juan River flow direction (Figures 18a and 18b). This perpendicular flow pattern may be due to the San Juan River losing its water to the floodplain (Larkin and Sharp, 1996).

5.4.1 Characterize Recharge Areas from Bob Lee Wash and San Juan River Within the Floodplain Through the EM Surveys

Artesian well #648 provides continuous discharge from formation waters of the Morrison Formation (Johnson, M. S., pers. comm., 1995), and onto the floodplain through Bob Lee Wash (Figure 1). During times of low flow discharges from the San Juan River, and Bob Lee Wash, a prominent freshwater divide occurs in the floodplain aquifer. This can observed in the lower electrical conductivity values and increased water elevations at the base of the Bob Lee Wash (Figures 18a, and 19a-b). Alternatively, it is possible that this fresh water divide could also be the result of a contribution of fresh water through a major fracture within the Mancos Shale. The freshwater could be flowing along a fracture pathway, increasing local fresh water flow from Bob Lee Wash and the San Juan River during low-flow seasons. The freshwater divide creates a hydraulic barrier and





↑ Aerial photograph gullies (SCS, 1935; U. S. Army 1954, and USGS, 1991)

Figure 19a. Horizontal EM-31 anomaly map for the Shipock UMTRA site floodplain. The electrical conductivity differences were taken from January and June 1996. Areas of higher conductivity values are strongest below the terraces and areas of dense vegetation. The lower conductivity values trend in known recharge areas.

Figure 19b. Vertical EM-31 anomaly map for the Shipock UMTRA site floodplain. The electrical conductivity differences were taken from January and June 1996. Trends in both higher and lower electrical conductivities are similar to EM-31 horizontal mode.

separates the floodplain aquifer into eastern and western sections (Figure 19a-b) between the Bob Lee Wash and the San Juan River.

The southeastern floodplain along the edge of the San Juan River has the lowest electrical conductivity values (Figures 19a-b, and 20a-b). This is probably the influence of the San Juan River freshwater recharge into the floodplain aquifer (Figures 19a-b, and 20b). Flow lines show that groundwater flow directions are into the floodplain (Figures 18a-b) which coincides with lower electrical conductivity values on the floodplain (Figures 19a-b). Below the eastern disposal cell near its east end the contaminant plume is pushed toward the west against the fresh water divide of the Bob Lee Wash. This may be a result of infiltration from the losing stream from the San Juan River. This suggests that the lithologic type is influencing variation of flow rates on the floodplain. The San Juan River's discharges into the unconfined aquifer system may change the flow regime of the groundwater and contaminant plume in this area.

5.5 Delineating the Vertical Contaminant Plume Through EM Surveys

The different depths over which the two EM instruments operate provides a basis for identifying for vertical variations in salinity concentrations. For EM-38 and EM-31, the lower electrial conductivity in the horizontal mode (0.75 and 3

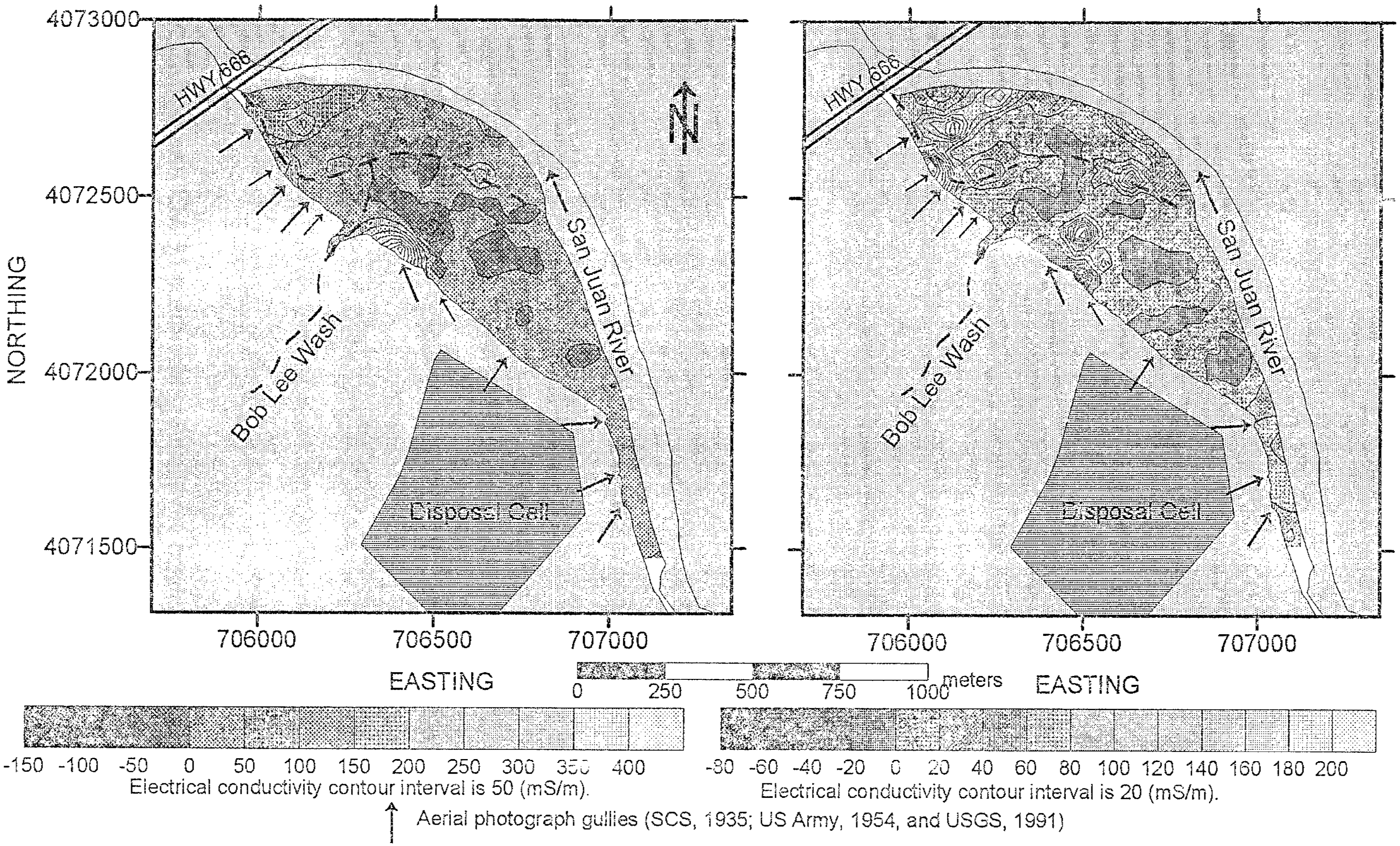


Figure 20a. Horizontal EM-38 anomaly map for the Shiprock UMTRA site floodplain. The electrical conductivity differences were taken from January and June 1996. Because conductivity differences are much larger than the EM-38 vertical and EM-31 surveys, no comparison could be made. The contours reflect no apparent trends and could be due to the vegetation influences.

Figure 20b. Vertical EM-38 anomaly map for the Shipock UMTRA site floodplain. The electrical conductivity differences were taken from January and June 1996. On the western floodplain the higher conductivity trends may reflect influences from septic and animal waste on the terrace. In the center floodplain, high conductivity area coincides with dense vegetation whereas the anomaly near the terrace may reflect contamination from the disposal pile.

meters) suggests the presence of contaminants in the form of salts near the ground surface, whereas the higher electrical conductivity noted in vertical mode (3 and 6 meters) suggests that salinity is increasing with depth below ground surface (Figures 19a-b, and 20b).

The EM-31 vertical contour map indicates that the salt contaminant plume is concentrated in the lower portion of the aquifer (Figure 19b). During low-flow seasons, the overall electrical conductivity values are generally higher for both EM-38 and EM-31 (Figures 19a-b). This can be attributed to the lower water content in the floodplain aquifer. Lower water-levels could cause the contaminated water to be more concentrated resulting in higher electrical conductivity values. During higher river flow, the electrical conductivity values are lower thus allowing the best representation of the salt contaminant plume. This overall lower electrial conductivity value is due to the water and soil contact which has increased and distributed over a larger area throughout the unconfined aquifer. This occurs when the unconfined aquifer water levels are increasing from the high discharge rates of the San Juan River.

5.6 Identifying the Extent of the Contaminant Plume with EM Surveys

The EM-38 and EM-31 electrical conductivity contour maps show three areas of high salinity values which are consistent throughout the four separate sampling periods. The first high electrical conductivity area indicate the highest salinity is near the surface. This may be the result of the dense vegetation. The second area is below the UTMRA disposal pile. Finally, the third area of high electrical conductivity is located below the western terrace.

5.6.1 Areas of High Electrical Conductivity Related to Surface Salinity on Floodplain and Vegetation Effects

High electrical conductivity values are found in highly vegetated areas along the floodplain ditch and banks of the San Juan River and probably represent the accumulated salts along evaporative margins of the floodplain (Figures 19a-b, 20a-b, and 21). The EM-38 horizontal mode readings suggest that the higher electrial conductivity values were probably generated by the presence of near-surface salts. The greater salt concentrations at the ground surface may be the result of capillary action in the vadose zone that bring salts to the surface. In areas where the groundwater depth was less than 1.5 meters bgs, vertical mode EM-38 measurements are probably influenced by vegetation, including: tamarisks (salt cedar bushes), cottonwoods and Russian olive trees. Salt cedar trees are known to have high evapotranspiration rates which increases the uptake of water and lowers the water-table (Blaney, 1958), therefore increasing the concentration of salts below the vegetated areas. Phreatophytes, such as

Figure 21. On vegetated areas along the floodplain ditch during an EM-31 survey, M. Mitchell (right) and W. Pierce (left) are taking measurements in August 1995 (Photo by SC Semken).

cottonwoods and salt cedar, have high transpiration rates (Blaney, 1958) and probably cause increased salt concentrations near the surface.

5.6.2 High Electrial Conductivity Areas Below the UMTRA Disposal Pile

A second area of high electrical conductivity is located below the UMTRA site near the terrace edge (Figures 19a-b) and is believed to have originated at the tailings site (DOE, 1991). This area has the lowest shale eleveations and the concentration of salts increases with depth. The location of the salts is related to fractures draining from the base of the disposal pile.

When the 1995 and 1996 DOE water analyses contour maps (Figures 22a-b, and 23a-b) were compared with EM conductivity maps (Figure 19a-b), the results indicate that the higher NO_3^- and SO_4^{2-} concentrations are located at the below the disposal pile within the floodplain aquifer. In February 1996, Geraghty & Miller (DOE) electrial conductivity survey found high concentrations above and beneath the escarpment immediately north and northwest of the disposal cell and monitoring well water analsis inidcate it is high contaminated with NO_3^-, SO_4^{2-} and U. Gullies identified in aerial photographs (Figures 5 and 6) coincide with higher concentrations in monitoring wells (Figures 22a-b, and 23a-b), escarpment seeps (Figure 3), and higher EM conductivity values (Figures 19a-b).

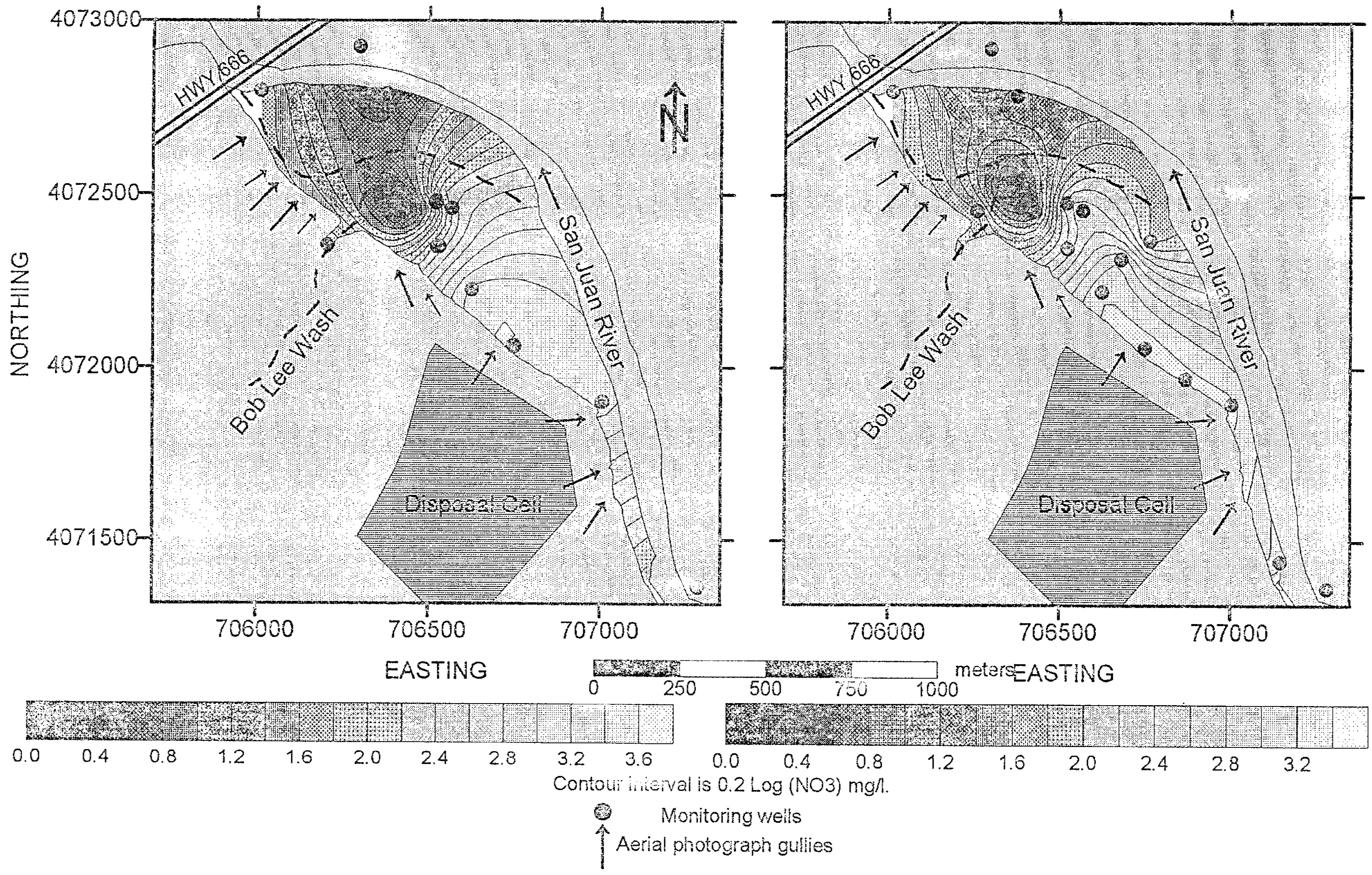
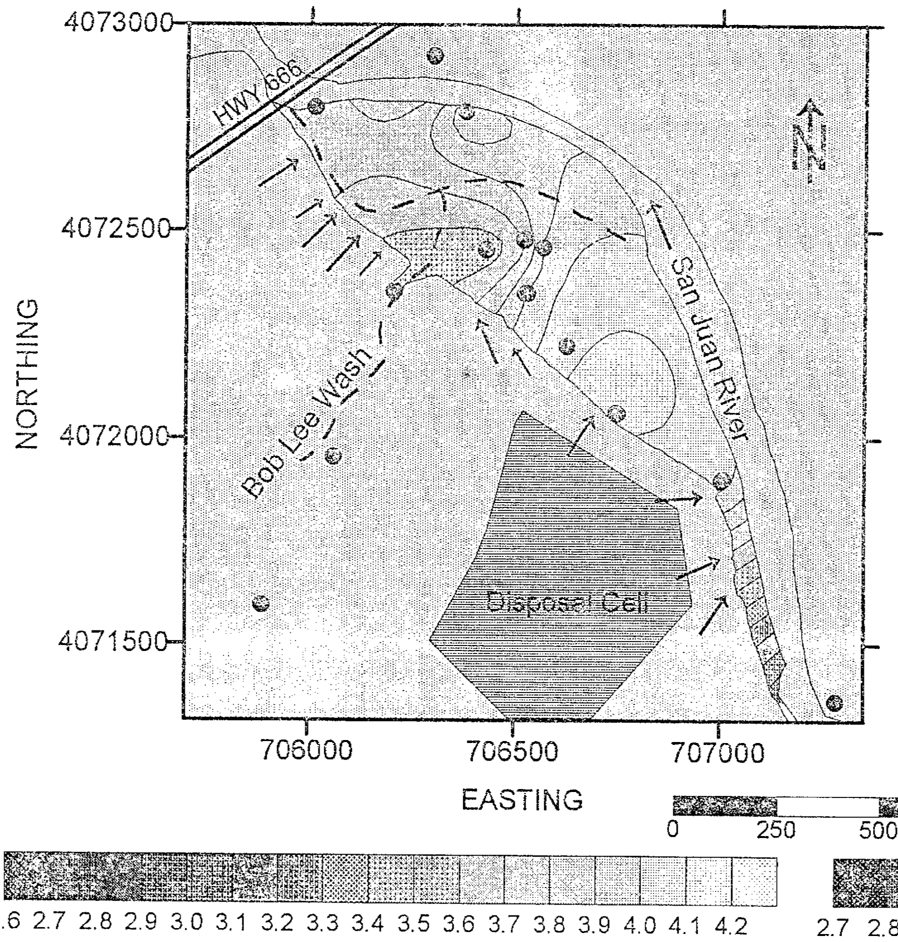
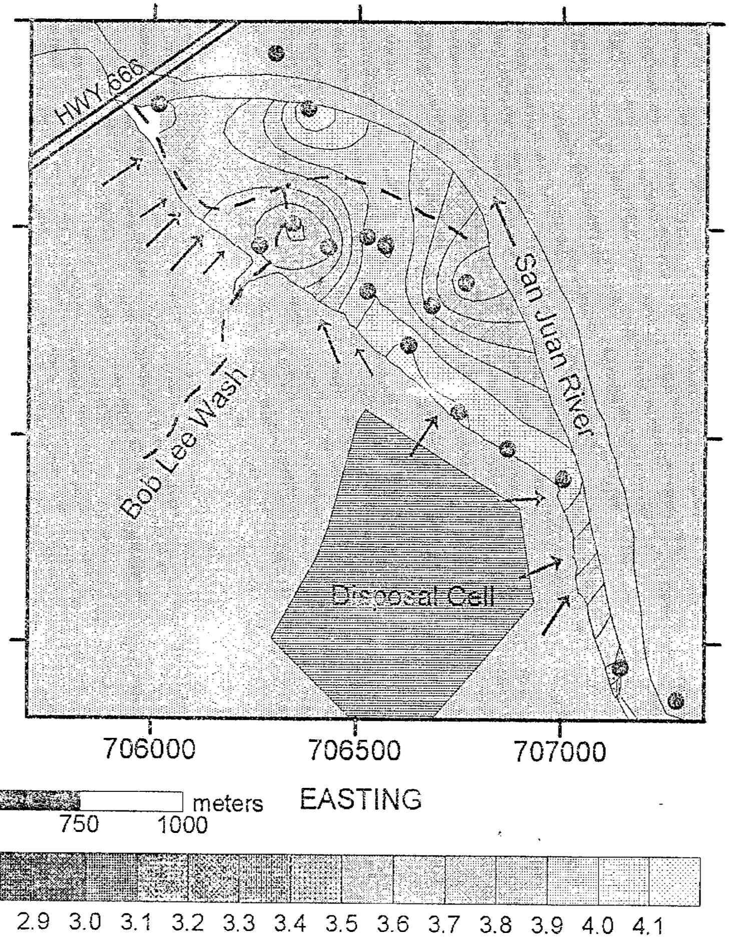


Figure 22a. The DOE 1995 nitrate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Sixteen monitoring wells were sampled on the floodplain. Minimum concentration was 1 mg/l and the maximum concentration was 4530 mg/l.

Figure 22b. The DOE 1996 nitrate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Sixteen monitoring wells were sampled on the floodplain. Minimum concentration was 1 mg/l and the maximum concentration was 3320 mg/l.





Contour interval is 0.1 Log (SO4) mg/l.

● Monitoring wells

↑ Aerial photograph gullies.

Figure 23a. The DOE 1995 sulfate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Eighteen monitoring wells were sampled on the floodplain. Minimum concentration was 465 mg/l and the maximum concentration was 16800 mg/l.

Figure 23b. The DOE 1996 sulfate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Sixteen monitoring wells were sampled on the floodplain. Minimum concentration was 593 mg/l and the maximum concentration was 17100 mg/l.

5.6.3 High Electrical Conductivity Areas West of Bob Lee Wash

A third area of high salt concentration is located on the western floodplain near the escarpment. This zone is probably the result of sewage seepage flowing along a fracture pathway in the shale from homes on the terrace west of the UMTRA site (Figures 19a-b, and 20b). Along the escarpment edge approximately 2 meters below the terrace, salt encrustations were found. Located on terrace above the salt encrustation was a septic tank. A gully identified in aerial photos (Figures 5 and 6) leads from the septic tank to the seep.

Since the Bob Lee Wash discharges has produced a fresh water divide, the hydrologic barrier separates the unconfined aquifer into the eastern and western sections. As result the contaminant plume on the west is not associated with the UMTRA site contaminants. Some high levels of NO_3^- and SO_4^{2-} do exist on the western side of the floodplain aquifer, but the source for the high NO_3^- on the western side is probably not from the tailings pile but from residential septic tanks and animal waste. This is based on the NO_3^- and SO_4^{2-} concentrations in monitoring wells as shown in Table 1. Monitoring wells located below the UMTRA site indicate the highest concentrations of NO_3^- and SO_4^{2-}, whereas the western floodplain had intermediate concentration levels. At present residents along the western terrace are not connected to the NTUA's sewage system

(Atcitty, pers. comm., 1996) and they have created a septic-leach field on the floodplain. In agricultural lagoons NO_3^- concentrations range from 7.4 to 92.2 mg/l (Department of Agriculture, 1992) and NO_3^- concentrations below the terrace are within the agricultural septic ranges. These septic tanks and animal waste therefore provide continuous source of NO_3^-, on the western floodplain, and are the likely cause of high electrical conductivity values from the terrace to the San Juan River throughout each sampling period (Figures 19a-b, and 20b).

Table 1. Monitoring well NO_3^- and SO_4^{2-} concentrations in 1995 and 1996.

	1995		1996	
Monitoring Well	NO_3^- (mg/l)	SO_4^{2-} (mg/l)	NO_3^- (mg/l)	SO_4^{2-} (mg/l)
610*	3400	10900	2910	10900
614*	2940	13000	3320	13300
734**	66.1	6070	155	6560
733***	1	2220	1	3270

* MWs below the tailings pile

** MW on western floodplain

*** Background MW

5.7 Dilution Effects Identified on the Floodplain

The discharge recorded at the Shiprock USGS discharge gaging station along the San Juan River was compared with DOE's monitoring well concentrations to determine the possibility of dilution or a concentration was occurring over time. Variations in lithology were analyzed to determine whether they were influencing the directions of contaminant movement within the floodplain aquifer

In 1995 and 1996 the NO_3^- and SO_4^{2-} concentrations follow similar northwestern flow plume directions with an average San Juan River discharge of 932 cfs and 804 cfs (Figures 22a-b and 23a-b). Concentrations nearest to the tailings pile and near fracture areas showed little to no dilution effects from the San Juan River (Appendix G). Whereas the wells nearest to the river showed lower concentrations in the floodplain when the San Juan River flow was high and higher NO_3^- and SO_4^{2-} concentrations when San Juan River flow was low (Figures 22a-b, and 23a-b). At the base of Bob Lee Wash and along the eastern fresh divide, discharges from Bob Lee Wash dilutes the high salinity concentrations as the contaminants move within the ancestral channel filled with outwash gravels.

5.8 Lithology Affecting High Electrical Conductivity

By comparing lithological cross-sections and isopach maps with EM conductivity contour maps and DOE's monitoring well data, a prediction of the groundwater and contaminant flow directions can be made. In such a scenario we would expect to see lower concentrations in the thicker gravel areas and higher concentrations in the thicker alluvium areas; this is because gravels tend to have higher hydraulic conductivity than the finer grained alluvium and affect flow through the porus media (Freeze and Cherry, 1979).

The depth below the ground surface to the gravel/shale contact varies from 0.3048 to 3.7 meters near the base of Bob Lee Wash. The lower concentration areas may also be influenced by the thicker alluvium areas whereas east of the Bob Lee Wash the finer-grained alluvium coincides with the high EM conductivity values (Figures 19a-b). Whereas contaminant movement is inhibited by the channel remnants which are branching outward east of Bob Lee Wash. East of the finer-grained alluvium coincides with high values EM (Figures 16 and 18a-b). East of Bob Lee Wash, higher conductivity values indicate that the locally finer-grained alluvium may be inhibiting the movement of contaminants and groundwater flow from the tailing pile into the river. The alluvium is restricting the flow of the salt contaminant plume as it moves towards the San Juan River.

5.9 Comparison of Geochemical Analyses and Electromagnetic Survey Data

Validation of the EM method for defining the plume requires a comparison between EM data and groundwater quality data. Over the past 11 years the number of monitoring wells sampled each year ranged from three to fifteen wells per year which provided an inconsistent database of groundwater quality analysis. The monitoring wells the floodplain were not consistently sampled and were located as far as 415 meters apart. SO_4^{2-} and NO_3^- concentrations could only be estimated for large areas of the floodplain (Figures 22a-23b) resulting in a non-representative sampling of the floodplain aquifer. Whereas the EM sampling points were located 50 meters apart and provided a representative sampling values within the floodplain. A comparison of the EM map with a map of the contanimant plume derived from monitoring wells, indicates the need for additional wells to adequately characterize the SO_4^{2-} and NO_3^- plumes (Figures 22a-23b).

6.0 CONCLUSIONS

The ages of the two Shiprock UMTRA site terraces were based on correlation from the terrace surfaces describe by Gillam. The floodplain at the Shiprock UMTRA site was formed by glacial waters from the Animas City moraines (late Pleistocene approximately 16,000 years to 70,000 years BP) and the strath terrace was formed by glacial waters that produced the Spring Creek moraines (late-middle Pleistocene approximately 88,000 years to 150,000 years BP).

The floodplain stratigraphy consists of three lithologies, fine-grained alluvium, outwash gravels, and the Mancos Shale. Lithologic cross-sections and isopach maps for the Shiprock UMTRA site floodplain indicate that ancestral channeling occurred in the Mancos Shale and is a major factor influencing the contaminated salt plume movement in the subsurface. The channeling can be seen by elevation changes in lithology and the variation in thickness of the outwash gravels and alluvium. Grain size also appears to be a factor in controlling the groundwater and contaminated flow directions. Preferential flow patterns within the study area are in the outwash gravel, whereas the finer-grained alluvium tends to redirect groundwater flow directions and concentrate the contaminants.

The unconfined aquifer is influenced by both the San Juan River and the Bob Lee Wash discharges. The San Juan River is a losing stream to the unconfined aquifer system on the floodplain and is changing the flow regime of the contaminant plume. In the southeastern floodplain the San Juan River is diluting the contaminants in monitoring wells located along the floodplain edge near the San Juan River or redirecting the contaminant flow direction into the ancestral channels east of Bob Lee Wash. In the central floodplain area, Bob Lee Wash is recharging the alluvial aquifer on the floodplain and creating a freshwater divide throughout the year. During the San Juan River low flow discharges, the river is contributing to the freshwater divide on the floodplain. Water level contour maps show an abrupt elevation change on the eastern floodplain ditch during low flows. This is interpreted to be the result of finer-grained alluvium inhibiting the movement of water flow and contaminant direction from the disposal pile into the river itself.

The contaminant plume from the disposal site is following an ancestral channel east of the Bob Lee Wash. This area has the lowest shale surface elevation and high EM conductivity values. The fine-grained alluvium is containing the contaminant within the lower shale depression area. With combination of the lower shale elevation, fine-grained alluvium and fractures provides an area for a salt plume to exist without dilution. Freshwater divide near the base of Bob Lee Wash is diluting the contaminant plume on its western side and separating the contaminant plumes on the floodplain.

Fractures in the Mancos Shale were identified from aerial photographs and seismic refraction survey results. Aerial photographs from 1935 and 1954 show erosional gullies along the terrace edge. Refraction results indicate offsets/fractures in the shale on the eastern floodplain and there coincide with high electrical conductivity values on the floodplain. The fractured induced gullies in the Mancos Shale represent preferred groundwater conduits which

The horizontal extent of a contaminant salt plume was defined through EM surveys and analysis of DOE monitoring well 1994-1995 water analysis for NO_3^- and SO_4^{2-}. However, not all areas of high conductivity values represent contamination from the uranium mill tailing waste. The high NO_3^- but relatively low SO_4^{2-} concentrations and the high EM electrical conductivity values on western floodplain, downstream of the Bob Lee Wash, suggest that other influences may be affecting the higher salinity in this area. All the residents living on the western terrace have septic tanks and salt encrustations have been found along the escarpment. This suggests the contaminant is transported from the septic tanks through the fractures and onto the floodplain.

The high salinity areas along the floodplain ditch and near the San Juan River are reflected most in the EM 38 horizontal mode data indicating that they are primarily a surface phenomena. They are probably related to the dense phreatophyte vegetation in this area. Phreatophytes have high transpiration rates and the ability to bring salts to the surface and to concentrate them in the leaves. This results in high salt concentrations in the litter and in the upper parts of the soil and the ground surface. Thus the only areas of high salinity directly attributable to the tailings pile are those near the base of the Western terrace.

This study at the Shiprock UMTRA site suggest that many factors are affecting the contaminant flow directions in the floodplain aquifer. Local factors include changes in thickness of gravels and fractures in the Mancos Shale.

The vertical and horizontal extent of the contaminant plume and its direction of movement can be identified by comparing the maps of EM data, floodplain lithology and water-levels. A multi-disciplinary approach is necessary to be able to identify and understand the lithological controls on the contaminant plume and groundwater flow paths.

7.0 RECOMMENDATIONS FOR FUTURE WORK

- The four electrical conductivity maps provide a base line for future EM surveys and may be used to compare the differences in the contaminant plume direction. The results from future EM surveys will demonstrate the extent of the salinity and how the shape of the plume is changing through time. EM surveys should continue during the San Juan River high discharges flow periods. If the San Juan River discharges are expected to saturate the floodplain then surveys can be conducted before or after the peak discharge season. Additional surveys should be planned for high San Juan River discharges.

- Upcoming surveys should continue along an established 50 X 50 meter grid system. This grid was established on the floodplain in preparation for the EM survey during the study and for future surveys. This provides EM survey sampling to occur on known UMT coordinates and compare electrical conductivity with previous surveys.

- Conduct a detailed geophysical refraction survey parallel to the terrace escarpment. The survey will identify fractures and topographical high and low within Mancos Shale and the thickness in the outwash gravels and alluvium. The seismic survey should begin on the southeastern end and finish on the western floodplain near the San Juan River. The data from future test pits, piezometers, and well points should be used in conjunction with the seismic refraction survey and the EM surveys.

- Test pits, piezometer, and/or well points should be placed where the EM survey data identified plumes on the western floodplain. There are no monitoring wells or abandoned sampling locations west of Bob Lee Wash on the floodplain. A detailed lithologic cross-section should be created for this area.

- Sampling the existing wells for water chemistry analyses, and continuing depth-to- groundwater water measurements, and EM surveys should be a priority. Sampling should be co-ordinated to flow conditions in the San Juan River so that meaningful comparisons can be made. A longer data record will help answer questions about the rate of dilution of the contaminant plume and the direction and rate of movement of the plume.

- Artesian well #648 on the terrace should be recapped so that the discharges can be eliminated or controlled from Bob Lee Wash. This would allow the fresh water divide in the floodplain aquifer to be eliminated and re-direct the contaminant plume through the ancestral channel below the Bob Lee Wash.

- Proposed sampling areas on the western floodplain should include NO_3^- and SO_4^{2-} concentrations to confirm whether the contamination is the result of septic waste or disposal pile activities. Nitrate:sulfate ratios can be compared with background levels on the eastern floodplain where recharge areas were identified. Another constituent to sample are the biological parameters; if organisms characteristic of human and/or animal sewage exist in the sample, then this should confirm whether or not the origin of NO_3^- is from septic waste.

- Finally, the proposed permeable barrier should be installed on the east side of the base of Bob Lee Wash. This area represents the lowest surface shale elevation caused by ancestral channels and would allow the contaminant plume to pass through the permeable barrier once the artesian well discharges are stopped. When the discharges are stopped then the contaminant would continue to flow within the ancestral channels; permitting scavenging of contaminant from the tailings/disposal site.

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APPENDIXES

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0601	09/19/86	219	3	181	0.0048	0.27				
0602	09/18/87	231	110	2880	0.348	0.07				
0602	10/01/85	302	180	4940	0.789	0.2				
0603	04/06/89	749	5.3	16000	2.33	0.13				
0603	06/04/90	310	106	15000	0.017	0.18				
0603	09/03/87	1791	120	23300	3.93	0.17				
0603	10/02/85	185	4	1780	0.22	0.3				
0604	09/03/87	339	95	5096	0.411	0.07				
0604	10/03/85	460	200	7220	0.789	0.01				
0606	10/03/85	296	180	4850	0.814	0.6				
0607	09/01/87	1660	840	12800	1.96	0.15				
0607	09/19/86	620	840	8660	0.834	0.21				
0607	10/02/85	1291	460	14300	2.5	0.49				
0608	01/05/96	1084		9940	2.21					
0608	01/30/95	1100			2.5		3180			
0608	02/21/93	1075			2.41		14100		2.72	
0608	04/03/89	1138	3900	13400	3.73	0.16				
0608	04/24/93	1127			2.22	0.1	14900	2860	2.6	0.05
0608	05/14/91	1292	2510	12900	2.54	0.05				
0608	06/01/90	1178	3460	12100	3.25	0.01				
0608	09/17/92	1144	4900	14000	2.4					
0608	09/18/86	845	410	9650	1.72	0.21				
0608	09/22/87	1001	365	15400	3.3	0.17				
0608	09/28/85	560	1800	6570	1.78	0.4				
0608	10/07/90	1199	3110	14300	2.71	0.02				
0609	01/30/95	1001		11400	2.26					
0609	09/17/86	820	410	8980	2.17	0.23				
0609	09/21/87	1039	4000	13400	3.04	0.2				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0609	09/29/85	595	1600	4850	1.4	0.3				
0610	01/04/96	578	2910	10900	1.7					
0610	02/21/93	643			1.87		9840		2	
0610	04/03/89	624	2700	7800	1.92	0.11				
0610	05/14/91	756	1820	9600	1.65	0.01				
0610	06/01/90	675	2270	9960	1.88	0.01				
0610	09/17/92	494	2100	8400	0.92					
0610	09/18/86	318	410	6800	1.03	0.2				
0610	09/21/87	471	1770	7070	0.92	0.17				
0610	09/29/85	380	3600	4660	1.52	0.3				
0610	10/07/90	674	1740	8740	1.57	0.01				
0611	09/19/87	591	1110	6950	0.719	0.1				
0611	09/29/85	287	2000	5130	0.704	0.4				
0612	02/25/93	333			0.411				0.435	
0612	04/03/89	201	51	746	0.263	0.02				
0612	09/17/86	291	160	1160	0.192	0.23				
0612	09/19/87	273	0.1	1150	0.165	0.04				
0612	09/29/85	213	4	809	0.14	0.4				
0613	01/26/95	636	3400	10900	4.06		4530			
0613	09/18/86	548	320	8040	1.8	0.16				
0613	09/18/87	440	1060	6930	0.801	0.13				
0613	09/30/85	390	300	7110	1.44	0.6				
0614	01/04/96	668	3320	13300	2.28					
0614	01/26/95	614		16800	2.54		2940			
0614	02/21/93	638			2.2		10300		2.52	
0614	04/03/89	406	1200	6630	1.3	0.1				
0614	05/14/91	525	611	8880	1.61	0.01				
0614	06/01/90	493	1600	7500	1.37	0.01				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0614	09/17/92	668	2800	10000	1.8					
0614	09/18/87	426	886	6690	0.83	0.12				
0614	09/30/85	561	1200	9190	1.78	0.5				
0614	10/07/90	565	1490	8620	1.61	0.01				
0614	10/11/88	406	1120	7230	1.24	0.11				
0615	01/04/96	701	2430	13100	2.47					
0615	01/31/95	623		13000	2.68		2940			
0615	02/21/93	638	2960	12000	2.64		12400		2.89	
0615	04/03/89	768	3300	6230	4.07	0.16				
0615	05/14/91	754	4010	14600	2.8	0.05				
0615	06/01/90	695	400	15000	3	0.01				
0615	09/17/92	568	5300	13000	2.1	0.34				
0615	09/18/87	489	1570	9930	1.64	0.14				
0615	10/01/85	473	1100	12100	1.52	0.6				
0615	10/09/90	728	4220	15600	2.93	0.16				
0616	01/04/96	253	52.4	3170	0.346					
0616	02/25/93	353			0.589		4020		0.577	
0616	04/04/89	295	1.8	2880	0.305	0.06				
0616	05/13/91	319	76.1	3430	0.56	0.01				
0616	06/01/90	287	8	2870	0.274	0.01				
0616	09/15/86	247	160	1400	0.184	0.16				
0616	09/17/92	312	110	3300	0.34					
0616	09/18/87	318	25.7	2250	0.433	0.07				
0616	10/01/85	216	9	887	0.112	0.6				
0616	10/09/90	323	21	3230	0.348	0.01				
0617	01/04/96	365	1620	5510	0.785					
0617	02/22/93	466			0.832		7120	1320	0.849	
0617	04/04/89	387	50	4140	0.373	0.07				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0617	05/13/91	463	1420	6250	1.53	0.01				
0617	06/01/90	352	7	4150	0.327	0.01				
0617	09/16/92	524	2700	7300	1.07					
0617	09/18/87	407	25.7	4650	0.355	0.12				
0617	10/01/85	423	88	4700	0.509	0.4				
0617	10/09/90	390	213	4820	0.466	0.01				
0618	09/18/87	344	42	4270	0.415	0.16				
0618	10/01/85	400	75	5030	0.548	0.5				
0618	10/11/88	340	27	3960	0.424	0.07				
0619	01/04/96	880	327	11000	1.5					
0619	01/31/95	724		11400	1.33		213			
0619	02/23/93	643			1.08		9840	200	1.2	
0619	04/05/89	1210	1600	15000	3.14	0.16				
0619	05/13/91	861	377	12200	1.95	0.01				
0619	06/01/90	1141	10	15800	2.31	0.01				
0619	09/16/92	690	320	11000	0.9					
0619	09/19/87	778	1550	12100	2.34	0.27				
0619	10/02/85	950	790	19200	3.05	0.6				
0619	10/09/90	1060	389	12300	1.99	0.01				
0620	01/05/96	900	183	9990	1.1					
0620	01/30/95	901		8420	1		203			
0620	02/21/93	789			1.09		8110		0.976	
0620	04/05/89	1168	330	10500	1.6	0.12				
0620	04/24/93	885	222	10600	1.1	0.05			1.07	0.02
0620	05/13/91	727	110	6950	0.89	0.01				
0620	06/01/90	939	216	8010	1.11	0.01				
0620	08/30/87	1405	12	14500	2.11	0.16				
0620	09/16/86	1172	840	14300	2.34	0.23				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0620	09/17/92	807	230	8000	0.73					
0620	10/02/85	1160	700	10600	1.71	0.4				
0621	09/01/87	1370	1200	14700	2.19	0.16				
0621	09/15/86	1299	2100	13500	2.39	0.26				
0621	10/02/85	837	700	8700	1.31	0.47				
0622	01/30/95	855		7740	1		178			
0622	09/01/87	1666	660	14900	3.07	0.17				
0622	09/16/86	1466	2400	10600	2.5	0.24				
0622	10/02/85	964	810	10900	1.7	0.5				
0623	09/01/87	995	1770	12400	1.67	0.15				
0623	10/03/85	739	940	10600	1.44	0.8				
0624	01/04/96	662	255	9010	1.1					
0624	01/31/95	550		8460	0.761		149			
0624	04/04/89	1374	950	13400	2.57	0.14				
0624	05/13/91	495	77	6860	0.589	0.01				
0624	09/01/87	960	2220	12700	1.84	0.15				
0624	09/16/92	436	110	6000	0.47					
0624	09/18/86	879	2500	10600	1.34	0.26				
0624	10/03/85	840	1200	11500	1.56	0.5				
0624	10/09/90	723	283	8870	1.02	0.01				
0625	01/31/95	396		5490	0.39		17.2			
0625	09/03/87	1091	1620	12300	2.11	0.15				
0625	10/03/85	726	890	10100	1.44	0.5				
0626	01/05/96	400	3.8	3410	0.165					
0626	01/29/95	365		4130	0.225		1			
0626	02/22/93	321			0.175		3150		0.174	
0626	04/05/89	403	23	5520	0.56	0.08				
0626	05/12/91	425	3.1	5480	0.522	0.01				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0626	06/04/90	320	2	4290	0.227	0.02				
0626	09/01/87	829	190	8690	1.22	0.11				
0626	09/19/92	280	0.68	2900	0.15					
0626	10/03/85	874	10	11300	1.61	0.5				
0626	10/11/90	301	1	3980	0.264	0.01				
0627	09/16/87	330	75	5480	0.388	0.08				
0627	10/03/85	459	180	6310	0.67	0.39				
0628	01/05/96	296	1	2910	0.04					
0628	02/23/93	381			0.188		4280	1	0.182	
0628	04/05/89	277	38	4460	0.314	0.06				
0628	05/12/91	446	6.1	5310	0.322	0.01				
0628	06/04/90	243	6	4050	0.196	0.02				
0628	09/16/87	399	105	6260	0.405	0.08				
0628	09/16/92	211	1.5	2600	0.056					
0628	10/04/85	422	160	5810	0.526	0.6				
0628	10/11/90	293	4	4450	0.229	0.01				
0629	04/05/89	116	60	3240	0.0299	0.05				
0629	08/30/87	125	86.8	3300	0.0316	0.08				
0629	10/03/85	324	180	5550	0.551	0.4				
0630	01/05/96	344	47.1	3940	0.191					
0630	02/20/93	499			0.538		4770		0.557	
0630	04/23/93	412	93	4860	0.337	0.02			0.287	0.02
0630	05/12/91	194	265	2580	0.076	0.01				
0630	06/04/90	130	51	3220	0.037	0.03				
0630	08/30/87	124	97.5	3320	0.0307	0.12				
0630	09/15/86	170	160	3710	0.184	0.2				
0630	09/18/92	518	100	4000	0.36	0.18				
0630	10/04/85	303	180	5390	0.5	0.5				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0630	10/10/90	218	31	3030	0.093	0.02				
0631	08/30/87	447	8.9	3360	0.01	0.19				
0631	09/20/86	486	1	3460	0.0185	0.2				
0631	09/30/85	422	4	3040	0.0159	0.4				
0632	09/01/87	428	7.5	3290	0.0093	0.07				
0632	09/20/86	406	1	3390	0.0157	0.11				
0632	09/29/85	376	3	2750	0.017	0.41				
0632	11/12/87	469	0.4	3040	0.0167	0.07				
0633	04/19/89	108	1.5	2420	0.026	0.03				
0633	10/04/85	940	240	7670	7.21	0.3				
0638	03/19/87	578	0.1	2160	0.0139	0.1				
0638	04/20/89	250	0.7	714	0.0016	0.02				
0638	05/14/87	521	0.4	1390	0.0085	0.02				
0638	09/25/87	254	0.1	235	0.0024	0.02				
0638	10/09/88	180	1	402	0.0023	0.01				
0639	03/19/87	604	0.1	3900	0.037	0.1				
0639	04/20/89	422	0.1	3440	0.0156	0.07				
0639	05/14/87	350	5.7	1880	0.0109	0.05				
0639	09/25/87	538	0.1	3170	0.0191	0.07				
0639	10/09/88	488	1	3500	0.0366	0.07				
0640	03/19/87	823	4	7770	0.0153	0.1				
0640	04/19/89	548	39	6900	0.089	0.07				
0640	09/24/87	742	3.5	8190	0.182	0.09				
0641	03/18/87	1853	2.6	18000	1.79	0.1				
0641	04/18/89	1042	1	12400	1.31	0.1				
0641	05/14/87	1564	0.1	14100	0.487	0.11				
0641	09/24/87	1561	0.1	14400	1.59	0.13				
0641	10/09/88	2325	1	21000	2.34	0.16				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0642	03/19/87	842	1110	9470	0.726	0.1				
0642	04/18/89	859	2000	13200	1.7	0.14				
0642	05/20/87	521	930	5270	0.194	0.06				
0642	09/23/87	959	2520	14800	1.32	0.16				
0643	03/19/87	1727	709	36900	4.32	0.1				
0643	04/18/89	1276	130	10600	1.82	0.12				
0643	09/24/87	1418	151	30200	3.07	0.18				
0644	03/18/87	749	1240	16000	1.63	0.1				
0644	04/18/89	528	2200	10800	1.14	0.13				
0644	05/20/87	865	1200	21100	0.785	0.2				
0644	09/23/87	857	5320	21300	1.41	0.2				
0644	10/09/88	617	3450	13300	1.13	0.15				
0645	03/17/87	197	0.1	373	0.0153	0.1				
0645	04/02/89	217	270	1480	0.0663	0.03				
0645	05/16/87	219	2.2	269	0.0143	0.02				
0645	09/23/87	185	7.1	165	0.0113	0.02				
0646	03/18/87	286	8.8	914	0.0848	0.1				
0646	04/02/89	183	21	388	0.0323	0.01				
0646	05/16/87	247	11.5	818	0.0875	0.03				
0646	09/22/87	184	11.1	558	0.0438	0.03				
0647	03/18/87	320	182	1740	0.245	0.2				
0647	04/02/89	218	380	1610	0.125	0.03				
0647	05/17/87	185	9.8	286	0.252	0.01				
0647	09/20/87	112	8	114	0.0135	0.01				
0648	03/17/87	81	0.1	2050	0.0003	0.2				
0648	04/25/93	60	1	2340	0.001	0.01			0.001	0.01
0648	05/16/87	65	0.4	2100	0.0003	0.01				
0648	09/20/87	66	0.1	1960	0.0003	0.02				

Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0670	01/20/88	377	1.2	1310	0.0207	0.05				
0670	03/31/88		1.1	1140	0.0237	0.05				
0670	04/21/89	338	0.4	880	0.0018	0.03				
0670	05/17/88	366	2.3	916	0.0093	0.01				
0670	10/09/88	347	1	625	0.0064	0.03				
0671	01/20/88	379	141	2750	0.0671	0.07				
0671	03/31/88		1.7	2530	0.0287	0.06				
0671	04/21/89	554	0.7	1260	0.0115	0.04				
0671	05/17/88	565	2	1300	0.0215	0.01				
0671	10/09/88	470	1	613	0.0154	0.02				
0672	01/20/88	404	4.9	1970	0.0597	0.05				
0672	03/31/88		1.7	607	0.0151	0.03				
0672	04/22/89	345	0.7	482	0.0079	0.03				
0672	05/17/88	416	0.5	649	0.0122	0.01				
0672	10/09/88	322	1	413	0.0074	0.02				
0725	01/13/94	308	114	3420	0.339	0.01				
0725	01/28/95	295		9890	0.368					
0725	04/22/93	250	197	4810	0.496	0.02			0.503	0.03
0725	09/01/93	328					3080	46	0.162	0.03
0726	01/13/94		46	5840	0.024	0.02			0.028	0.04
0726	04/26/93	376	26	6840	0.022	0.01			0.024	0.05
0726	08/31/93	473					6520	86	0.029	0.02
0727	01/28/95		123	3280	0.474					
0728	01/28/95			12000	0.801					
0732	01/04/96	217	20.8	593	0.019					
0732	01/13/94	236	38	660	0.009	0.01			0.009	0.01
0732	01/28/95	188		3490	0.008		32.8			
0732	04/22/93	234	310	1630	0.015	0.01			0.018	0.01

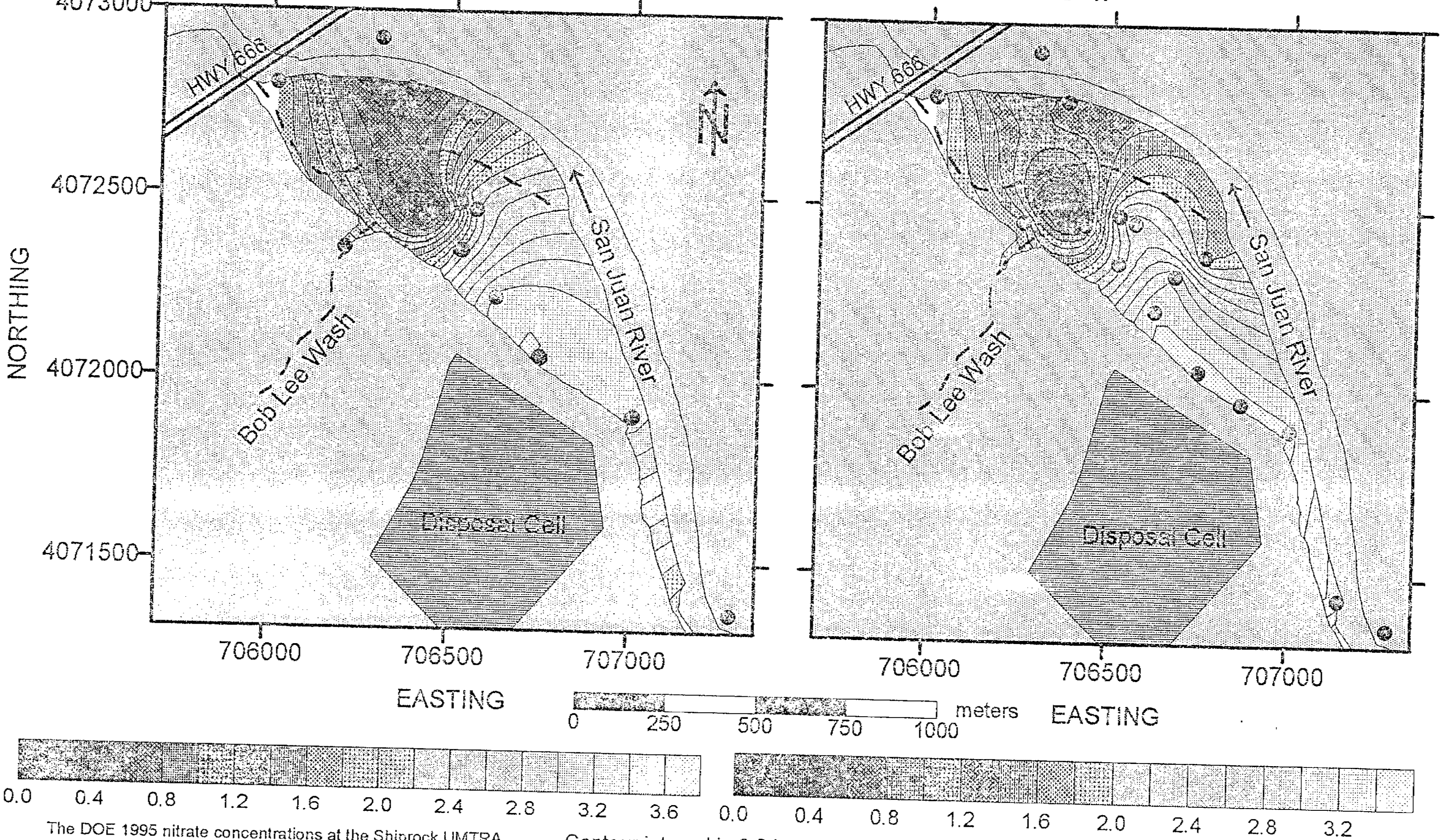
Appendix A: 1985-1996 US Department of Energy water analysis for Nitrate, Sulfate, Uranium and Vanadium

WELL	DATE	ALKALINITY CaCO3 (MG/L)	NITRATE (MG/L)	SULFATE (MG/L)	URANIUM (MG/L)	VANADIUM (MG/L)	SULFATE (TOTAL) (MG/L)	NITRATE (TOTAL) (MG/L)	URANIUM (TOTAL) (MG/L)	VANADIUM (TOTAL) (MG/L)
0733	01/05/96	431	1	3270	0.009					
0733	01/12/94	420			0.026	0.01			0.025	0.01
0733	01/13/94		1	2930						
0733	01/28/95	386		465	0.024		1			
0733	04/24/93				0.01					
0733	04/27/93	448	1	3420	0.023				0.027	0.01
0734	01/05/96	621	155	6560	0.097					
0734	01/12/94	525	1	6920	0.077	0.02			0.081	
0734	01/28/95	537		2220	0.116		66.1			
0734	04/23/93	406	1	3900	0.152	0.1			0.52	0.01
0734	01/05/96	621	155	6560	0.097					
0735	01/04/96	374	886	2970	0.071					
0735	01/12/94	438	1360	4330	0.112	0.02			0.115	0.01
0735	04/24/93		2360	7610	0.138	0.05			0.146	0.02
0736	01/05/96	833	26.4	17100	1					
0736	01/12/94	1029	5450	16200	1.6	0.05			1.46	0.01
0736	01/28/95	667		6070	0.697		2.6			
0736	04/23/93	881	175	20800	1.33	0.1			1.41	0.05

Appendix A.1: 1995-1996 Nitrate, Sulfate and Uranium Concentrations

WELL	DATE	NITRATE (MG/L)	log(NO3)	NITRATE (TOTAL) (MG/L)	log(NO3T)	SULFAT (MG/L)	log(SO4)	URANIUM (MG/L)
0608	01/30/95			**3180**	3.50	11400	4.06	2.5
0608	01/05/96	2850	3.45			12200	4.09	2.210
0609	01/30/95	3400	3.53			10900	4.04	2.260
0610	01/04/96	2910	3.46			10900	4.04	1.700
0613	01/26/95			**4530**	3.66	16800	4.23	4.060
0614	01/26/95			**2940**	3.47	13000	4.11	2.540
0614	01/04/96	3320	3.52			13300	4.12	2.280
0615	01/31/95			**2940**	3.47	11400	4.06	2.680
0615	01/04/96	2430	3.39			13100	4.12	2.470
0616	01/04/96	52.4	1.72			3170	3.50	0.346
0617	01/04/96	1620	3.21			5510	3.74	0.785
0619	01/31/95			**213**	2.33	8420	3.93	1.330
0619	01/04/96	327	2.51			11000	4.04	1.500
0620	01/30/95			**203**	2.31	7740	3.89	1.000
0622	01/30/95			**178**	2.25	8460	3.93	1.000
0624	01/31/95			**149**	2.17	5490	3.74	0.761
0624	01/04/96	255	2.41			9010	3.95	1.100
0625	01/31/95			**17.2**	1.24	4130	3.62	0.390
0626	01/29/95			**1**	0.00	3490	3.54	0.225
0626	01/05/96	3.8	0.58			3410	3.53	0.165
0628	01/05/96	1	0.00			2910	3.46	0.040
0630	01/05/96	47.1	1.67			3940	3.60	0.191
0732	01/28/95			**32.8**	1.52	465	2.67	0.008
0732	01/04/96	20.8	1.32			593	2.77	0.019
0733	01/28/95			**1**	0.00	2220	3.35	0.024
0733	01/05/96	1	0.00			3270	3.51	0.009
0734	01/28/95			**66.1**	1.82	6070	3.78	0.116
0734	01/05/96	155	2.19			6560	3.82	0.097
0735	01/04/96	886	2.95			2970	3.47	0.071
0736	01/28/95			**2.6**	0.41	9890	4.00	0.697
0736	01/05/96	26.4	1.42			17100	4.23	1.000
0725	01/28/95	123	2.09			3280	3.52	0.368
0727	01/28/95					12000	4.08	0.474
0728	01/28/95					9940	4.00	0.801

Appendix A.1.a: 1995-1996 contour maps for Log (nitrate mg/l))



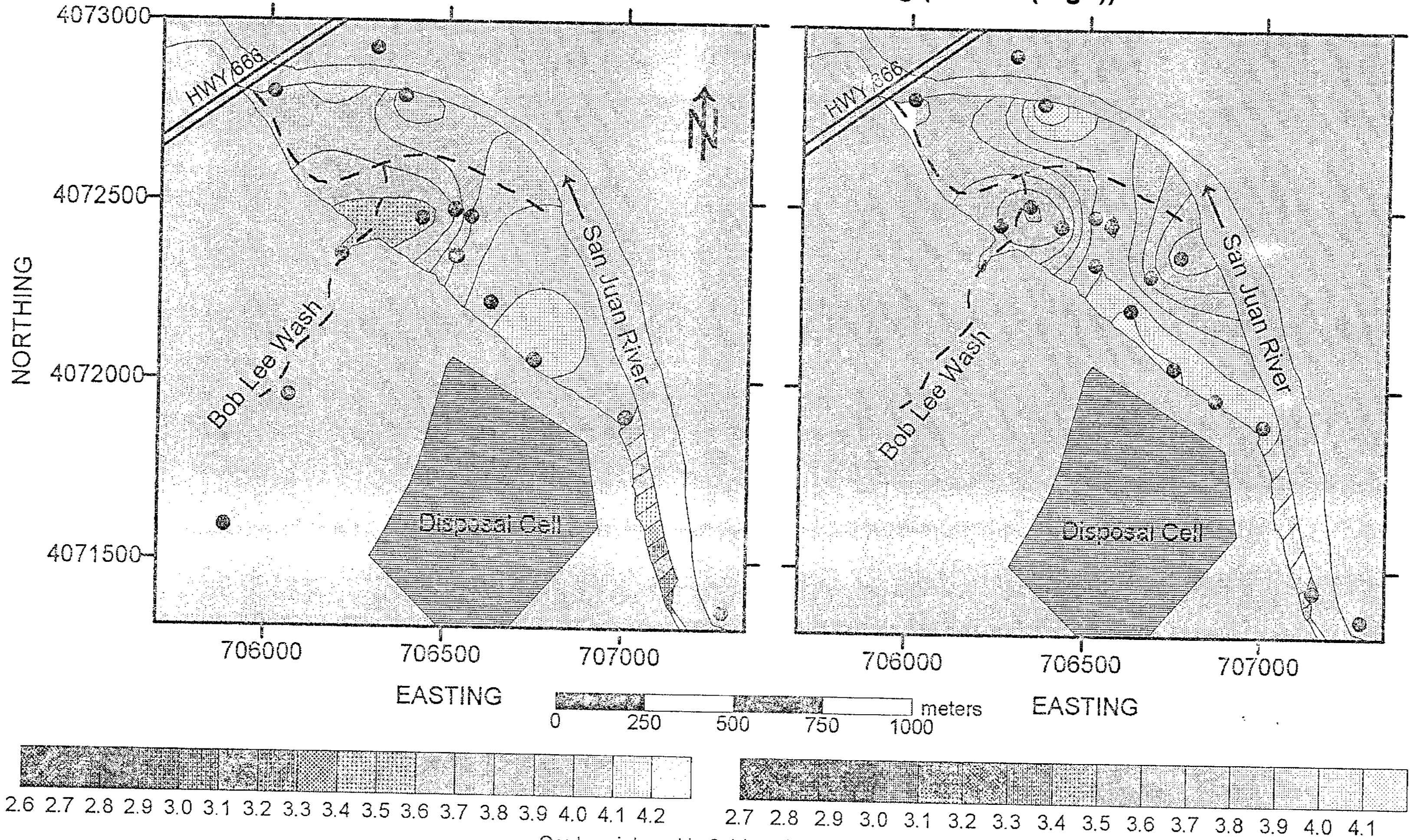
The DOE 1995 nitrate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Sixteen monitoring wells were sampled on the floodplain. Minimum concentration was 1 mg/l and the maximum concentration was 4530 mg/l.

Contour interval is 0.2 Log (NO3) mg/l.

● Monitoring wells

The DOE 1996 nitrate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Thirteen monitoring wells were sampled on the floodplain. Minimum concentration was 1 mg/l and the maximum concentration was 3320 mg/l.

Appendix A.1.b: 1995-1996 contour maps for Log (sulfate (mg/l))



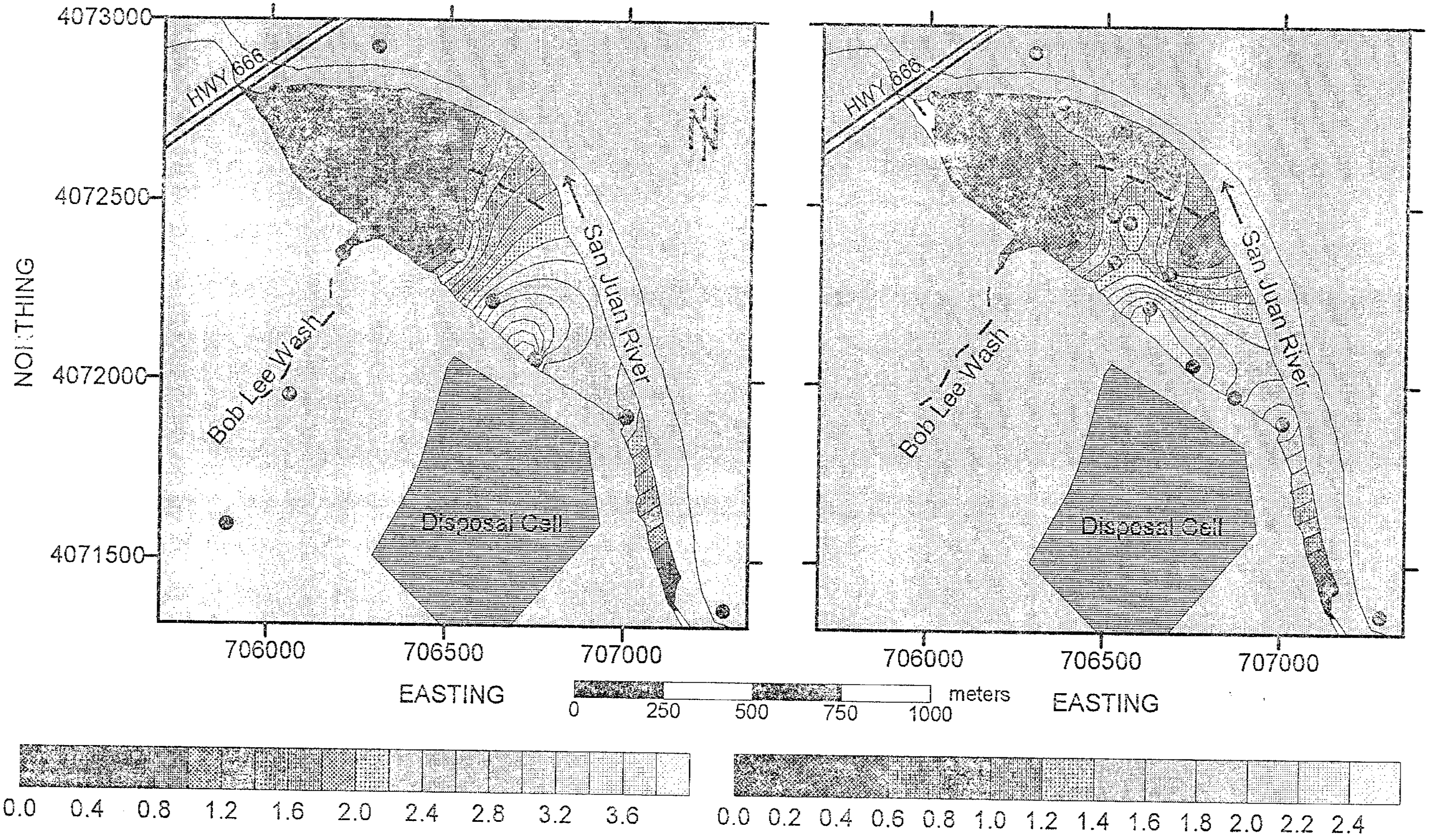
Contour interval is 0.1 Log (SO4) mg/l

● Monitoring wells

The DOE 1995 sulfate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Eighteen monitoring wells were sampled on the floodplain. Minimum concentration was 465 mg/l and the maximum concentration was 16800 mg/l.

The DOE 1996 sulfate concentrations at the Shiprock UMTRA site floodplain monitoring wells. Sixteen monitoring wells were sampled on the floodplain. Minimum concentration was 593 mg/l and the maximum concentration was 17100 mg/l.

Appendix A.1.c: 1995-1996 contour maps for Log (uranium (mg/l))



Contour interval is uranium 0.2 mg/l

● Monitoring wells sampled

The DOE 1995 uranium concentrations at the Shiprock UMTRA site floodplain monitoring wells. Eighteen monitoring wells were sampled on the floodplain. Minimum concentration was 0.008 mg/l and the maximum concentration was 4.06 mg/l.

The DOE 1996 uranium concentrations at the Shiprock UMTRA site floodplain monitoring wells. Sixteen monitoring wells were sampled on the floodplain. Minimum concentration was 0.009 mg/l and the maximum concentration was 2.47 mg/l.

Appendix: B Universal Transverse Mercator sampling locations

The DOE has used the coordinates developed by NECA to locate all sampling locations at the UTMRA site. The coordinate system could not be correlated to state plane coordinates. In February 1996, Geraghty & Miller used the global position system to determine the UTM locations for two monitoring wells and nine 50 X 50 meter grid coordinates during their geophysical assignment at the UMTRA site.

Geraghty & Miller 1996 GPS Locations

MW/stake	Easting	Northing
625	4072674	706442
736	4072986	706298
14, 1	4072488	706787
13, -1	4072366	706689
17, -4	4072451	706455
21, -4	4072619	706341
23, -4	4072695	706290
23, 1	4072843	706502
28, -3	4072939	706203
28, -7	4072825	706036
21, -2	4072674	706433

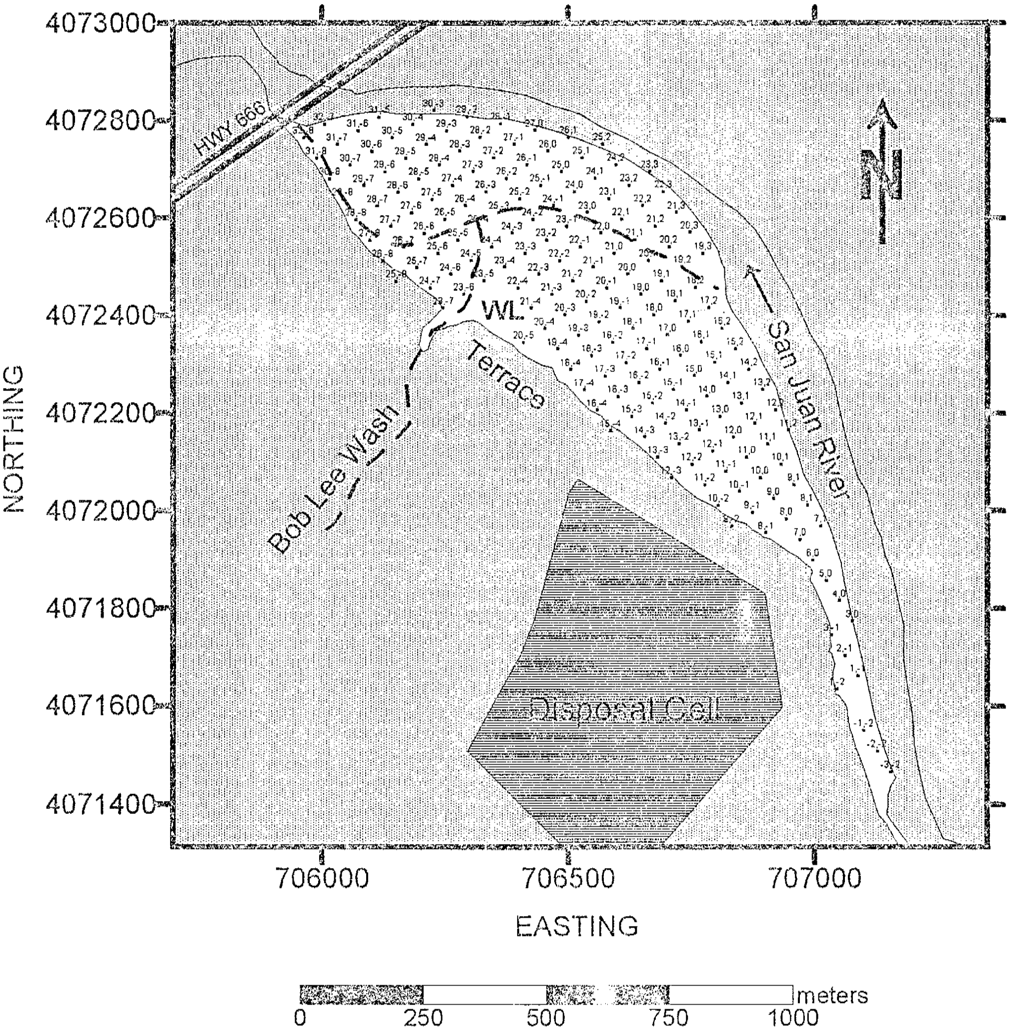
The Navajo Nation Water Resources overlain the eleven UTM coordinates with established NECA easting and northing coordinates to calculate the remaining and nonexisting wells UTM coordinates. The UTM coordinates have allowed the development of a unifying coordinate system for all wells and 50 X 50 meter grid system on the floodplain. Maps for cross-sections, water elevations, and electrical conductivities were also constructed using the UTM coordinates. Now the salt contaminant directions can be accurately located on the floodplain by comparing the water-levels with electrical conductivities and historical water quality results.

When the calculated UTM coordinates for the EM-grid was overlaid with the digitized study area map, the points were off by 77.06 in the easting and -199.68 in the northing. All the UTM coordinates calcluated by Navajo Nation Water Resources were shifted for 77.06 meters in the east and -199.68 meters in the north directions to fit within the study area.

Appendix B.1: Grid on Floodplain

The grid was established on the floodplain in preparation for the EM and seismic surveys. A 50 X 50 meter grid system on the floodplain was constructed using a Brunton compass and a 100 meter tape where the direction of the north/south line is 60° and the east/west line is 150°. Each point was given a column and row number for a classification and interpreting purposes. Students from Diné College and New Mexico Tech participated in field work under the Navajo UMTRA program. Major obstacles in constructing the grid system included clearing a pathway through dense vegetation, and saturated surface soils associated with the high San Juan Mountains snow melt discharges.

Appendix B.1.a: 1995-1996 electrical conductivity sampling locations



Explanation

▨ EM stake sampling point

– – – – Wash and floodplain ditch

WL Wetlands

Appendix B.1.b: Electromagnetic UTM sampling locations

Stake	Easting (E-W)	Northing (N-S)
-3,-2	707151.4	4071467
-2,-2	707124.6	4071509
-1,-2	707097.8	4071551
1,-2	707044.2	4071635
1,-1	707086.3	4071663
2,-1	707059.4	4071705
3,-1	707032.7	4071747
3,0	707074.7	4071775
4,0	707047.9	4071817
5,0	707021.1	4071858
6,0	706994.4	4071900
7,0	706967.4	4071942
7,1	707009.6	4071970
8,-1	706898.7	4071956
8,0	706940.7	4071984
8,1	706982.8	4072012
9,-2	706829.9	4071970
9,-1	706871.9	4071998
9,0	706913.9	4072026
9,1	706955.9	4072054
10,-2	706802.9	4072012
10,-1	706845.1	4072040
10,0	706887.2	4072068
10,1	706929.2	4072096
11,-2	706776.2	4072054
11,-1	706818.3	4072082
11,0	706860.4	4072110
11,1	706902.4	4072138
11,2	706944.4	4072166
12,-3	706707.4	4072068
12,-2	706749.4	4072096
12,-1	706791.4	4072124
12,0	706833.4	4072152
12,1	706875.6	4072180
12,2	706917.7	4072208
13,-3	706680.6	4072110
13,-2	706722.7	4072138
13,-1	706764.7	4072166
13,0	706806.8	4072194
13,1	706848.8	4072222
13,2	706890.9	4072250
14,-3	706653.8	4072152
14,-2	706695.9	4072180
14,-1	706737.9	4072208
14,0	706779.9	4072236
14,1	706821.9	4072264
14,2	706864.1	4072292
15,-4	706584.9	4072165
15,-3	706626.9	4072194
15,-2	706669.1	4072222
15,-1	706711.1	4072250
15,0	706753.2	4072278
15,1	706795.2	4072306
15,2	706837.3	4072334
16,-4	706558.2	4072207
16,-3	706600.2	4072235
16,-2	706642.3	4072264
16,-1	706684.4	4072292
16,0	706726.4	4072320
16,1	706768.4	4072348
16,2	706810.4	4072376
17,-4	706531.4	4072249
17,-3	706573.4	4072277
17,-2	706615.4	4072305
17,-1	706657.4	4072334
17,0	706699.6	4072362
17,1	706741.7	4072390
17,2	706783.7	4072418
18,-4	706504.6	4072291
18,-3	706546.6	4072319
18,-2	706588.7	4072347
18,-1	706630.7	4072375
18,0	706672.8	4072403
18,1	706714.9	4072432
18,2	706756.9	4072460
19,-4	706477.8	4072333
19,-3	706519.9	4072361
19,-2	706561.9	4072389
19,-1	706603.9	4072417
19,0	706645.9	4072445
19,1	706687.9	4072473
19,2	706730.1	4072502
19,3	706772.2	4072530
20,-5	706772.2	4072530
20,-4	706450.9	4072375
20,-3	706492.9	4072403
20,-2	706535.1	4072431
20,-1	706577.2	4072459
20,0	706619.2	4072487
20,1	706661.2	4072515
20,2	706703.3	4072543
20,3	706745.4	4072572
21,-4	706424.2	4072417
21,-3	706466.2	4072445
21,-2	706508.3	4072473
21,-1	706550.4	4072501
21,0	706592.4	4072529
21,1	706634.4	4072557
21,2	706676.4	4072585
21,3	706718.4	4072613
22,-4	706397.4	4072459
22,-3	706439.4	4072487
22,-2	706481.4	4072515
22,-1	706523.4	4072543
22,0	706565.6	4072571
22,1	706607.7	4072599
22,2	706649.7	4072627
22,3	706691.8	4072655
23,-7	706244.4	4072417
23,-6	706286.4	4072445
23,-5	706328.4	4072473
23,-4	706370.6	4072501
23,-3	706412.7	4072529
23,-2	706454.7	4072557
23,-1	706496.8	4072585
23,0	706538.8	4072613
23,1	706580.9	4072641
23,2	706622.9	4072669
23,3	706664.9	4072697
24,-7	706217.7	4072459
24,-6	706259.7	4072487
24,-5	706301.7	4072515
24,-4	706343.8	4072543
24,-3	706385.9	4072571
24,-2	706427.9	4072599
24,-1	706469.9	4072627
24,0	706511.9	4072655
24,1	706553.9	4072683
24,2	706596.1	4072711
25,-8	706148.8	4072472
25,-7	706190.9	4072500
25,-6	706232.9	4072529
25,-5	706274.9	4072557
25,-4	706316.9	4072585
25,-3	706358.9	4072613
25,-2	706401.1	4072641
25,-1	706443.2	4072669
25,0	706485.2	4072697
25,1	706527.3	4072725
25,2	706569.4	4072753
26,-8	706121.9	4072514
26,-7	706163.9	4072542
26,-6	706206.1	4072570
26,-5	706248.2	4072599
26,-4	706290.2	4072627
26,-3	706332.3	4072655
26,-2	706374.3	4072683
26,-1	706416.4	4072711
26,0	706458.4	4072739
26,1	706500.4	4072767
27,-8	706095.2	4072556
27,-7	706137.3	4072584
27,-6	706179.3	4072612
27,-5	706221.4	4072640
27,-4	706263.4	4072669
27,-3	706305.4	4072697
27,-2	706347.4	4072725
27,-1	706389.6	4072753
27,0	706431.6	4072781
28,-8	706068.4	4072598
28,-7	706110.4	4072626
28,-6	706152.4	4072654
28,-5	706194.6	4072682
28,-4	706236.6	4072710
28,-3	706278.7	4072739
28,-2	706320.7	4072767
28,-1	706362.8	4072795
29,-8	706041.6	4072640
29,-7	706083.7	4072668
29,-6	706125.7	4072696
29,-5	706167.8	4072724
29,-4	706209.9	4072752
29,-3	706251.9	4072780
29,-2	706293.9	4072809
30,-8	706014.9	4072682
30,-7	706056.9	4072710
30,-6	706098.9	4072738
30,-5	706140.9	4072766
30,-4	706182.9	4072794
30,-3	706225.1	4072822
31,-8	705987.9	4072724
31,-7	706030.1	4072752
31,-6	706072.2	4072780
31,-5	706114.2	4072808
32,-8	705961.2	4072766
32,-7	706003.3	4072794

Appendix B.2: UMT locations for DOE abandon and existing monitoring wells

Eight-two lithologic logs from previous well-points, bore holes, test pits and monitoring wells were found in the DOE library and/or data base. The 52 pits have been filled or abandon. The lithologic locations have used to produce cross-section and isopach maps on the floodplain stratigraphy.

Abandoned wells

Well	Easting	Northing
631	706134.7	4073002
632	706136.7	4072998
633	706211.4	4072165
634	706121.7	4072886
727	706059.8	4071956
728	705808.3	4071795
730	706255	4071170
731	706841.1	4071141

Test Pit	Easting	Northing
700	707115.9	4071636
701	706983.7	4071901
702	706866.6	4071973
703	706932.1	4072066
704	706747.9	4072060
705	706624.4	4072224
706	706763.6	4072371
707	706519.9	4072477
708	706413.3	4072773
709	706019.9	4072782
710	707349.9	4071643
711	706294.7	4072413

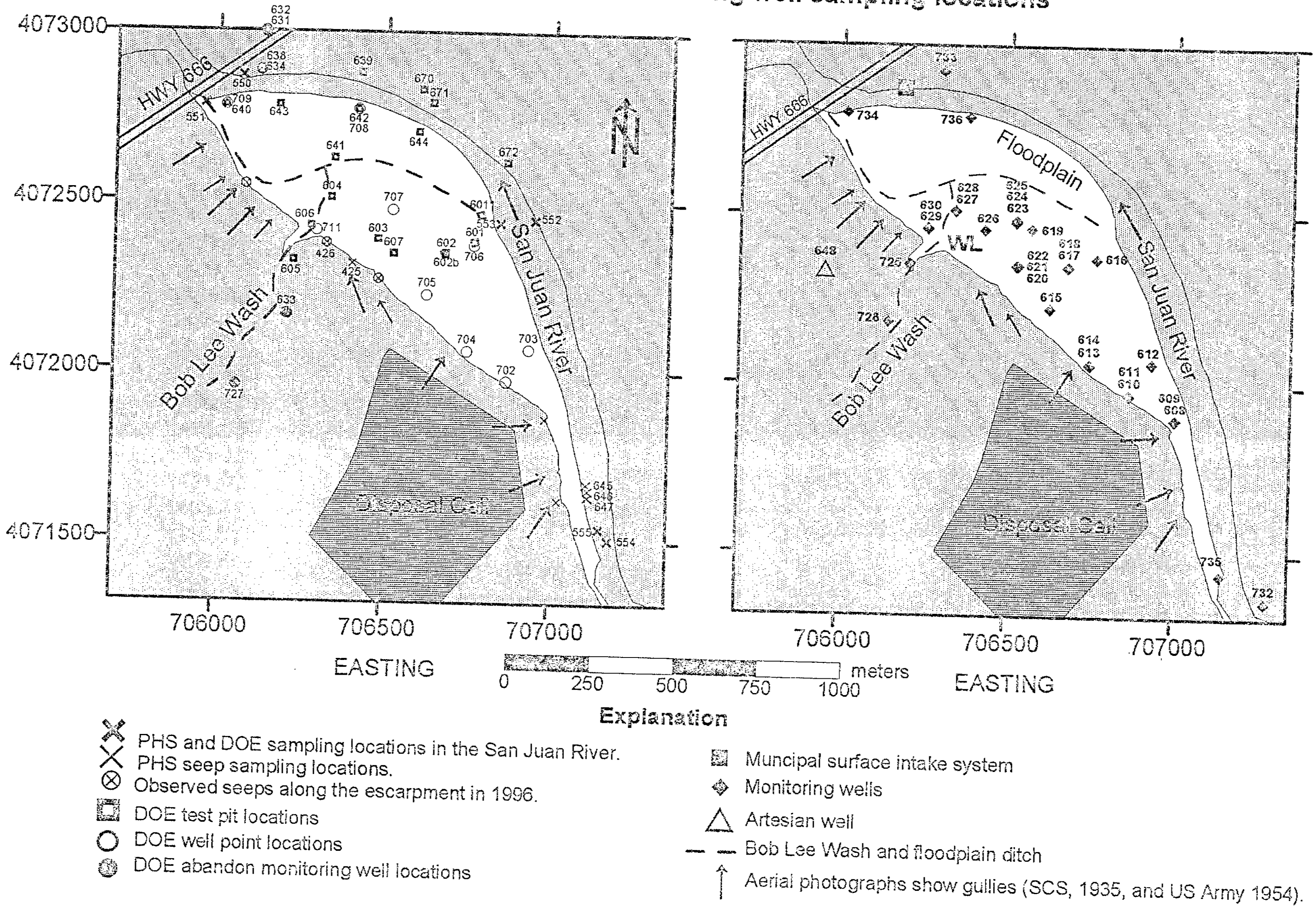
Abandoned wells

Well point	Easting	Northing
601	706765.9	4072382
601*	706782.8	4072464
602	706676.1	4072346
602b	706678.7	4072350
603	706477.4	4072388
604	706337.2	4072512
605	706227.7	4072325
606	706279.3	4072427
607	706524.3	4072347
638	706121.7	4072886
639	706419.9	4072881
640	706019.9	4072782
641	706344.9	4072630
642	706413.3	4072773
643	706179.2	4072785
644	706593.8	4072707
645	707110.6	4071673
646	707115.3	4071655
647	707116.1	4071636
670	706602.1	4072833
671	706634.3	4072794
672	706859.9	4072622

Existing monitoring wells

Well	Northing	Easting
608	707002.1	4071901
609	707005.1	4071903
610	706866.7	4071973
611	706863.3	4071975
612	706932.2	4072066
613	706744.8	4072062
614	706747.9	4072060
615	706624.4	4072224
616	706763.6	4072371
617	706679.9	4072346
618	706675.9	4072345
619	706566.9	4072459
620	706522.4	4072348
621	706525.4	4072348
622	706528.8	4072348
623	706521.9	4072484
624	706520.9	4072480
625	706519.9	4072477
626	706427.2	4072455
627	706336.9	4072513
628	706339.9	4072511
629	706256.2	4072460
630	706257.7	4072457
725	706203.2	4072352
726	706142.4	4072181
732	707281.4	4071362
733	706296.7	4072924
734	706010.7	4072799
735	707145.4	4071442
736	706375.3	4072789

Appendix B.3: Abandon and monitoring well sampling locations



Appendix C: Table of lithological elevations and thickness

WELL	Ground Surface Elevation (m)	Top of Alluvium Elevation (m)	Top of Gravel Elevation (m)	Top of Shale Elevation (m)	Alluvium Thickness (m)	Gravel Thickness (m)	Total Depth (ft)	Well Type
601	1490.47	1490.47	1489.38		1.09		al TD 1.09	wp
602	1490.47	1490.47	1489.38		1.09		al TD 1.09	wp
602b	1490.43	1490.43	1489.34		1.09		al TD 1.09	wp
603	1489.86	1489.86	1488.77		1.09		al TD 1.09	wp
604	1489.86	1489.86	1488.77		1.09		al TD 1.09	wp
605	1493.15	1493.15	1491.99		1.16		al TD 1.16	wp
606	1489.76	1489.76	1488.15		1.62		al TD 1.62	wp
607	1489.86	1489.86	1487.85		2.01		al TD 2.01	wp
608	1491.31	1491.31	1491.00	1488.26	0.30	2.74	5.79	mw
609	1491.26	1491.26	1490.96	1488.62	0.30	2.13	4.27	mw
610	1491.68	1491.68	1491.37	1487.71	0.30	3.66	4.57	mw
611	1491.71	1491.71	1491.40	1487.74	0.30	3.66	6.71	mw
612	1491.05	1491.05	1490.44	1486.63	0.61	3.81	4.57	mw
613	1491.05	1491.05	1489.83	1486.78	1.22	3.05	4.57	mw
614	1491.03	1491.03	1489.81	1488.29	1.22	1.52	5.79	mw
615	1490.77	1490.77	1490.16	1486.80	0.61	3.35	4.27	mw
616	1490.71	1490.71	1490.41		0.30	3.96	gr TD 4.27	mw
617	1490.58	1490.58	1490.12	1484.56	0.46	5.56	6.10	mw
618	1490.51	1490.51	1490.05	1484.42	0.46	5.64	6.40	mw
619	1490.78	1490.78	1486.82	1485.30	3.96	1.52	6.10	mw
620	1489.97	1489.97	1489.06	1484.79	0.91	4.27	6.10	mw
621	1490.02	1490.02	1489.41	1484.99	0.61	4.42	5.79	mw
622	1490.08	1490.08	1489.47		0.61	4.27	gr TD 4.88	mw
623	1490.43	1490.43	1487.99	1485.25	2.44	2.74	7.01	mw
624	1490.34	1490.34	1487.89	1484.85	2.45	3.05	7.32	mw
625	1490.44	1490.44	1488.00		2.44	2.74	gr TD 5.17	mw
626	1490.09	1490.09	1489.64	1484.30	0.46	5.33	6.10	mw
627	1489.81	1489.81	1489.36	1484.63	0.46	4.72	6.10	mw
628	1489.98	1489.98	1489.37		0.61	3.96	gr TD 4.56	mw

mw = monitoring well, bh = bore hole, tp = test pit, al = alluvium, gr = gravel, TD = total depth

Appendix C: Table of lithological elevations and thickness

WELL	Ground Surface Elevation (m)	Top of Alluvium Elevation (m)	Top of Gravel Elevation (m)	Top of Shale Elevation (m)	Alluvium Thickness (m)	Gravel Thickness (m)	Total Depth (ft)	Well Type
629	1489.31	1489.31	1489.00	1485.35	0.30	3.66	6.10	mw
630	1489.33	1489.33	1486.28	1485.36	3.05	0.91	4.57	mw
631	1490.34	1490.34	1487.29	1484.24	3.05	3.05	7.01	mw
632	1490.34	1490.34	1488.20	1484.55	2.13	3.66	6.10	mw
633	1498.39	1498.39	1497.35		1.04		al TD 1.04	bh
700	1492.92	1492.92	1492.61	1492.61	0.30		0.30	tp
701	1491.31	1491.31	1491.00	1490.55	0.30	0.46	0.76	tp
702	1491.68			1491.22		0.46	0.46	tp
703	1491.36	1491.36	1491.05	1490.90	0.30	0.15	0.46	tp
704	1491.03	1491.03	1490.83	1490.60	0.20	0.22	0.43	tp
705	1490.77	1490.77	1490.31	1490.31	0.46		0.46	tp
706	1490.69	1490.69	1490.54	1490.27	0.15	0.27	0.43	tp
707	1490.44	1490.44	1489.98	1489.98	0.46	0.00	0.46	tp
708	1488.60	1488.60	1488.30	1487.99	0.30	0.30	0.61	tp
709	1487.84	1487.84	1487.23	1487.23	0.61		0.61	tp
710	1492.92	1492.92	1492.31	1492.31	0.61		0.61	tp
711	1492.91			1492.91			0.15	tp
725	1495.47	1495.47	1491.20	1490.59	4.27	0.61	6.10	mw
726	1505.10	1505.10	1502.35	1502.35	2.74	0.00	12.18 no gr	mw
727	1505.34	1505.34	1504.73	1503.44	0.61	1.30	19.00	mw
728	1512.94	1512.94	1509.58	1505.93	3.35	3.66	30.00	mw
730	1517.23	1517.23	1508.08	1508.08	9.14		12.18 no gr	mw
731	1514.82	1514.82	1507.81	1507.81	7.01		8.84 no gr	mw
732	1492.26	1492.26	1488.60	1488.60	3.66		5.78 no gr	mw
733	1489.94	1489.94	1486.58		3.35	1.22	gr TD 4.57	mw
734	1489.32	1489.32	1486.88		2.44		al TD 2.44	mw
735	1491.79	1491.79	1488.28		3.51		al TD 3.51	mw
736	1489.75	1489.75	1487.31		2.44		al TD 2.44	mw

mw = monitoring well, bh = bore hole, tp = test pit, al = alluvium, gr = gravel, TD = total depth

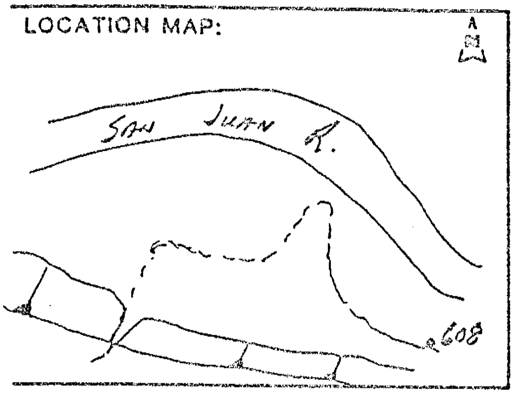
Appendix D: DOE and Navajo Nation well logs

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

BOREHOLE LOG (SOIL)

Page 1 of 1

LOCATION MAP:



SITE ID: SHL-01 LOCATION ID: 608
APPROX. SITE COORDINATES (ft.):
N ____ E ____
GROUND ELEVATION (ft. MSL): ____
DRILLING METHOD: Rotary
DRILLER: Kissner Drilling
DATE STARTED: 8/28/85
DATE COMPLETED: 8/28/85
FIELD REP.: R. Crockett

GROUNDWATER LEVELS		
DATE	TIME	DEPTH (ft.)

LOCATION DESCRIPTION S.E. Cor. Floodplain
SITE CONDITION Floodplain, Flat, Grasses & Brush

DEPTH	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	TYPE	ID	BLOWS PER 6 In.	N VALUE	USCS	VISUAL CLASSIFICATION
								SP	Sandy Some Silt, Occ. Gravel, Pred Med, N.P., Tan
2.0									
								GP	Sandy Gravel & Cobbles, Poorly Graded, N.P., Brn-Gray
13.0								Sh	Shale, Soft, Gray
									Stopped Drilling @ 12.0' Note: Drill w/ Air. Hole caved to 9'. ∴ Abandoned Hole Redrilled @ 608B

COMMENTS: ____

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D. 1.38" I.D. drive sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

JEG-AL-ENG-2S (3/84)

Page 1 of 1

LOG OF WELL BORING NO. 608

PROJECT SHIPROCK SITE, NM

JOB NO. SHF01. DATE 08/29/85

SURFACE ELEVATION 4892.74

TOP OF FILTER PACK 5.00

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

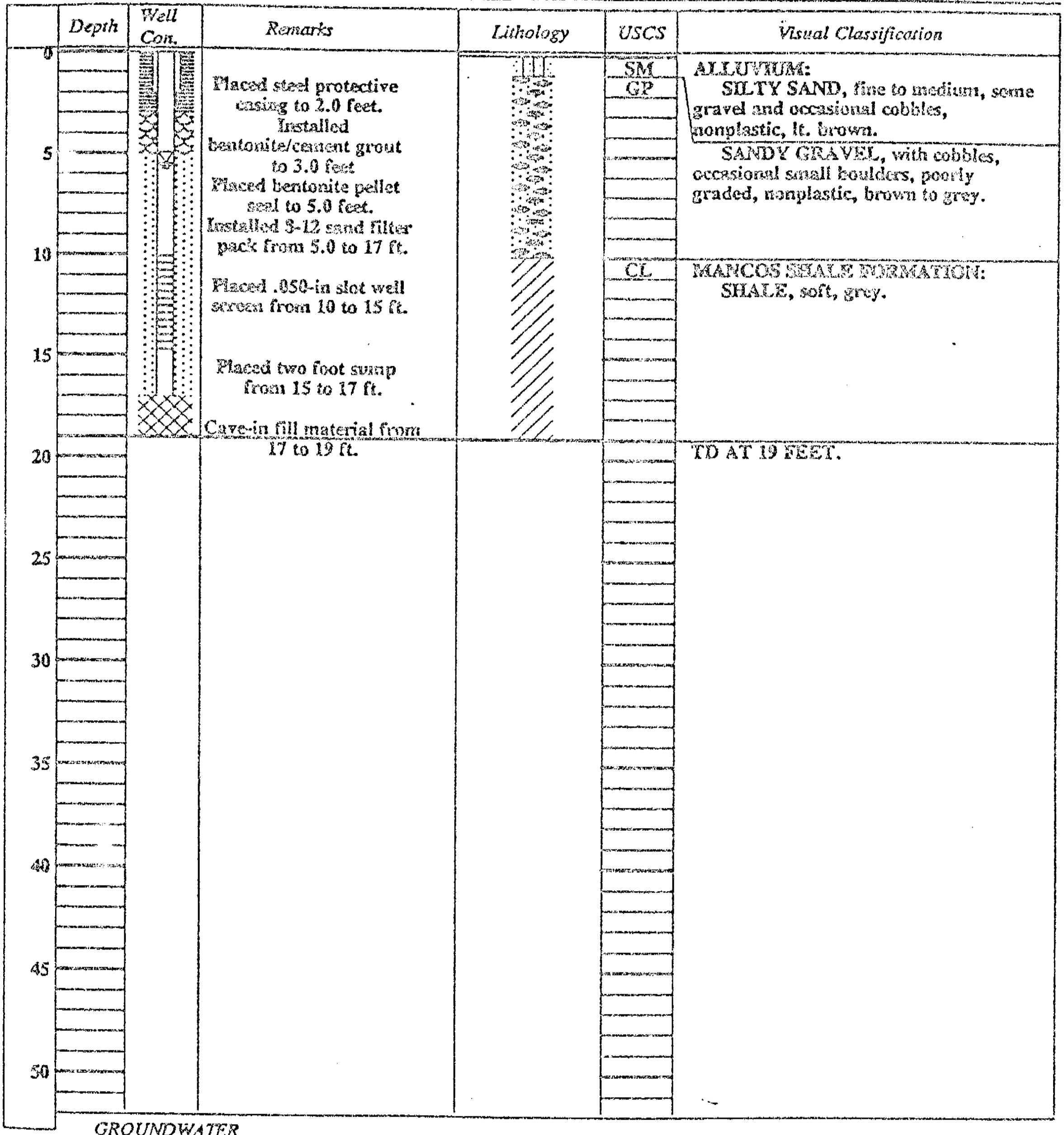
TOTAL DEPTH 19.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 8642.03 E 11819.14

DATUM MSL



Remarks:

Placed steel protective casing to 2.0 feet.

Installed bentonite/cement grout to 3.0 feet

Placed bentonite pellet seal to 5.0 feet.

Installed 8-12 sand filter pack from 5.0 to 17 ft.

Placed .050-in slot well screen from 10 to 15 ft.

Placed two foot sump from 15 to 17 ft.

Cave-in fill material from 17 to 19 ft.

Visual Classification:

ALLUVIUM:

SILTY SAND, fine to medium, some gravel and occasional cobbles, nonplastic, lt. brown.

SANDY GRAVEL, with cobbles, occasional small boulders, poorly graded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:

SHALE, soft, grey.

TD AT 19 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	5.5	16:20	09-28-85
▽			

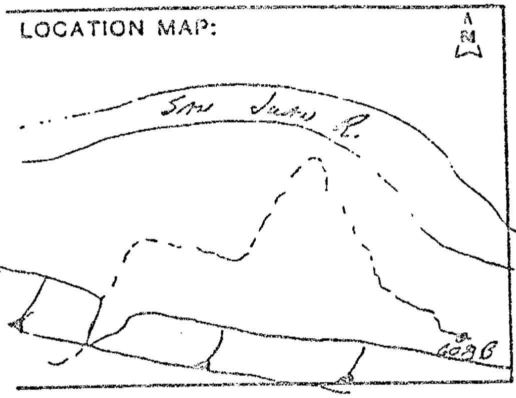
JEG TAC TEAM

JE JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

BOREHOLE LOG (SOIL)

Page 1 of 1

LOCATION MAP:



SITE ID: SHL-01 LOCATION ID: 6098
APPROX. SITE COORDINATES (ft.):
N 9662.03 E 11819.14
GROUND ELEVATION (ft. MSL): 4897.74
DRILLING METHOD: Rotary
DRILLER: Kissner Drilling
DATE STARTED: 8/29/86
DATE COMPLETED: 8/29/86
FIELD REP.: A. Crockell

GROUNDWATER LEVELS

DATE	TIME	DEPTH (ft.)

LOCATION DESCRIPTION SE Corner Floodplain
SITE CONDITION Floodplain, Flat, Grasses & Brush

DEPTH	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	TYPE	ID	BLOWS PER 6 in.	N VALUE	USCS	VISUAL CLASSIFICATION
								SP	Sand, Some Silt, occ. Gravel & Cobbles, Pred. Fine-Med, N.P., Lt Brn
1.0								GP	Sandy Gravel & Cobbles, occ. Boulder, Poorly Graded, N.P., Subround, Brn-Gray
10.0								Sh	Shale, Soft, Gray
									Stopped Drilling @ 19.0'

COMMENTS:

SAMPLE TYPE
A – Auger cuttings
S – 2" O.D. 1.38" I.D. drive sample
U – 3" O.D. 2.42" I.D. tube sample
T – 3" O.D. thin-walled Shelby tube

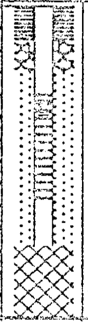
JEG-AL-ENG-2S (3/84)

PROJECT [illegible]

LOG OF WELL BORING NO. 609

JOB NO. SHP01, DATE 08/30/85
SURFACE ELEVATION 4892.59
TOP OF FILTER PACK 3.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 14.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 8656.57 E 11812.42
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 1.5 feet Placed bentonite pellet seal to 3.0 feet. Installed 8-12 sand filter pack from 3.0 to 10.8 ft. Placed .050-in slot well screen from 3.8 to 8.8 ft.		SP GP CL	ALLUVIUM: SAND, little silt, fine to medium, occasional gravel and cobbles, nonplastic, light brown. SANDY GRAVEL, with cobbles, poorly graded, occasonal boulders, subrounded, nonplastic, brown to grey. MANCOS SHALE FORMATION: SHALE, soft, grey.
5					
10					
15		Placed two foot sump from 8.8 to 10.8 ft. Cave-in fill material from 10.8 to 14 ft.			TD AT 14 FEET.
20					
25					
30					
35					
40					
45					
50					

GROUNDWATER

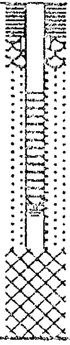
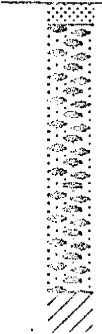
	DEPTH	HOUR	DATE
∇	4.8	10:20	09-29-85
∇			

JEG TAC TEAM

Page 1 of 1

LOG OF WELL BORING NO. 610

PROJECT SHIPROCK SITE, NM
JOB NO. SHP01, DATE 09/03/85
SURFACE ELEVATION 4893.95
TOP OF FILTER PACK 3.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM
TOTAL DEPTH 15.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 8892.95 E 11440.63
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 1.5 feet Placed bentonite pellet seal to 3.0 feet. Installed 8-12 sand filter pack from 3.0 to 11 ft. Placed .050-in slot well screen from 4 to 9 ft. Placed two foot sump from 9 to 11 ft. Cave-in fill material from 11 to 15 ft.		SP	ALLUVIUM: SAND, little silt, fine to medium, occasional gravel, nonplastic, lt. brown.
				GP	SANDY GRAVEL with cobbles, poorly graded, occasional boulders, subrounded, nonplastic, brown to grey.
5					
10					
				CL	MANCOS SHALE FORMATION: SHALE, soft, grey.
15					TD AT 15 FEET.
20					
25					
30					
35					
40					
45					
50					

GROUNDWATER

DEPTH	HOUR	DATE
9.2	12:35	09-29-85

JEG TAC TEAM

Page of

LOG OF WELL BORING NO. 611

PROJECT *SHIPROCK SITE, NM*

JOB NO. *SHP01* DATE *09/03/85*

SURFACE ELEVATION *4894.05*

TOP OF FILTER PACK *7.00*

WELL CASING TYPE *4.0-IN.SCHED. 40 PVC*

COMPLETION *ALLUVIUM*

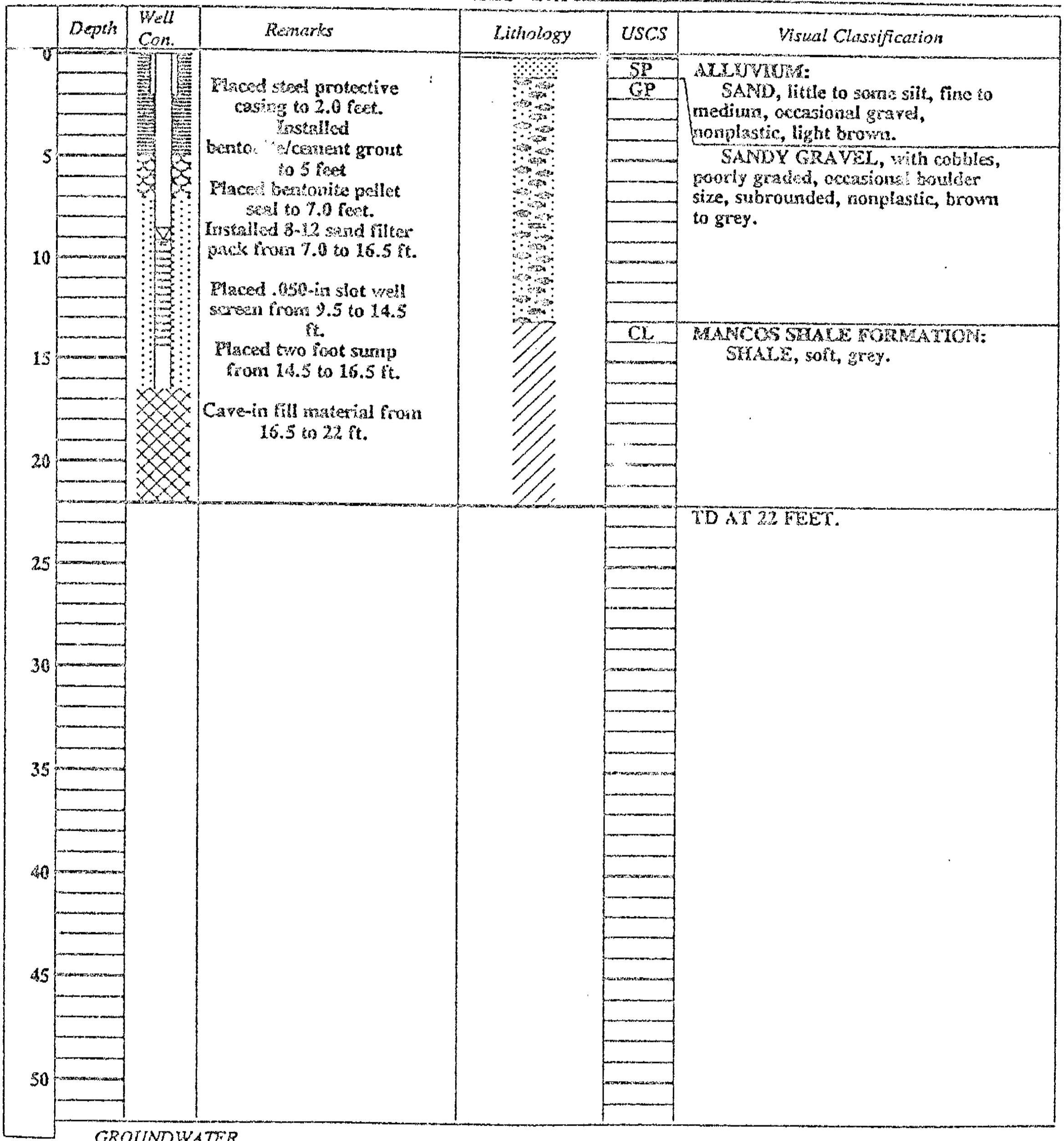
TOTAL DEPTH *22.0 feet*

RIG TYPE *GARDNER-DENVER*

BORING TYPE *ROTARY MUD*

LOCATION *N 8899.15 E 11429.74*

DATUM *MSL*



Remarks

Placed steel protective casing to 2.0 feet.

Installed bentonite/cement grout to 5 feet

Placed bentonite pellet seal to 7.0 feet.

Installed 8-12 sand filter pack from 7.0 to 16.5 ft.

Placed .050-in slot well screen from 9.5 to 14.5 ft.

Placed two foot sump from 14.5 to 16.5 ft.

Cave-in fill material from 16.5 to 22 ft.

Visual Classification

ALLUVIUM:

SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:

SHALE, soft, grey.

TD AT 22 FEET.

GROUNDWATER

	DEPTH	*HOUR*	*DATE*
∇	*9.1*	*15:50*	*09-29-85*

JEG TAC TEAM

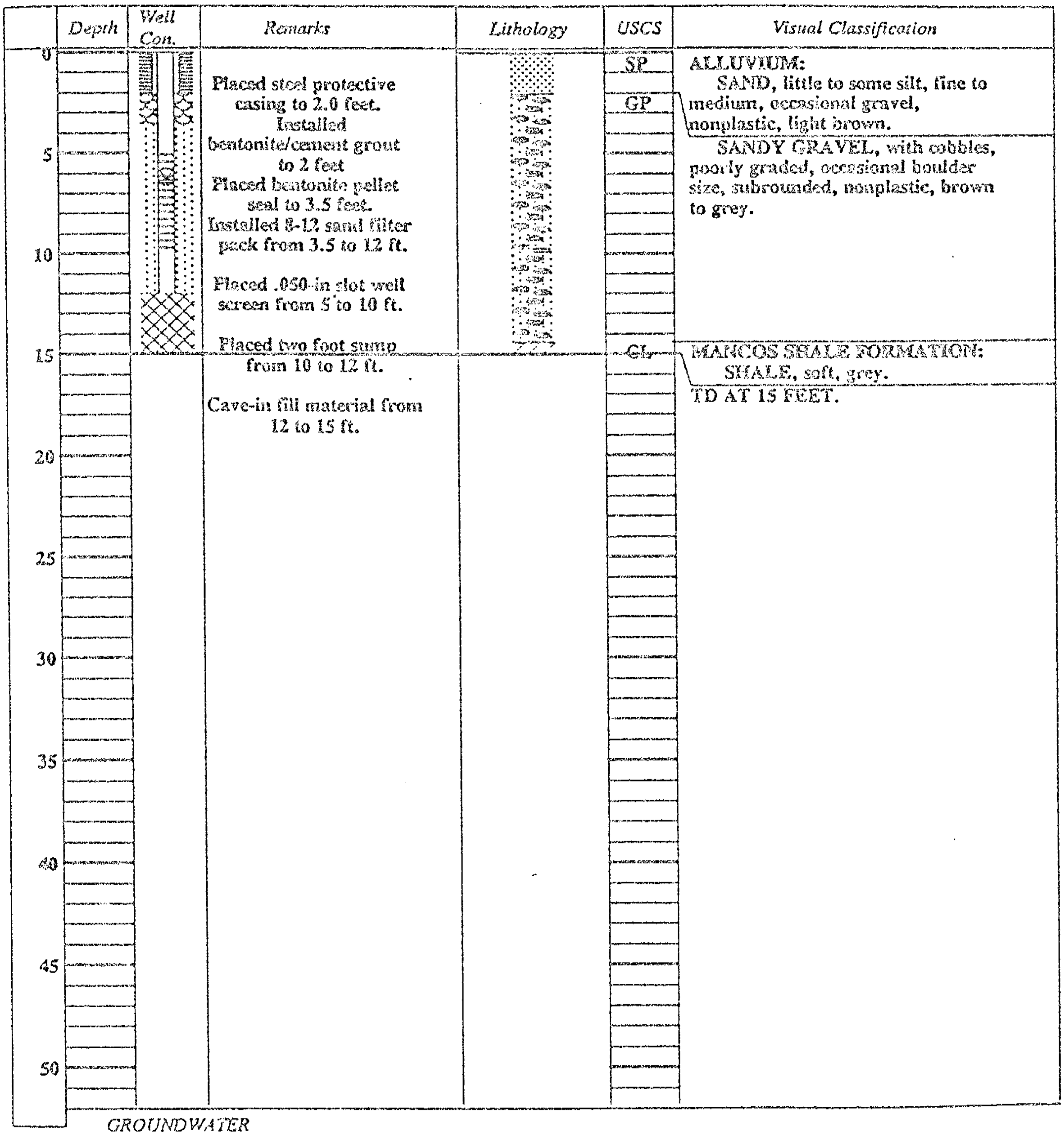
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 612

JOB NO. SHP01, DATE 09/04/85
SURFACE ELEVATION 4892.89
TOP OF FILTER PACK 3.50
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 15.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 9192.09 E 11655.72
DATUM MSL



Placed steel protective casing to 2.0 feet.
Installed bentonite/cement grout to 2 feet
Placed bentonite pellet seal to 3.5 feet.
Installed 8-12 sand filter pack from 3.5 to 12 ft.

Placed .050-in slot well screen from 5 to 10 ft.

Placed two foot sump from 10 to 12 ft.

Cave-in fill material from 12 to 15 ft.

ALLUVIUM:
SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:
SHALE, soft, grey.
TD AT 15 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	6.3	13:56	09-29-85
▽			

JEG TAC TEAM

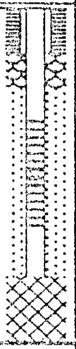
Page 1 of 1

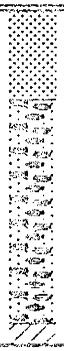
PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 613

JOB NO. SHP01, DATE 09/04/85
SURFACE ELEVATION 4891.83
TOP OF FILTER PACK 3.50
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 15.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 9196.28 E 11047.87
DATUM MSL





Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 2 feet		SP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
5		Placed bentonite pellet seal to 3.5 feet. Installed 8-12 sand filter pack from 3.5 to 12 ft.		GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
10		Placed .050-in slot well screen from 5 to 10 ft.			
15		Placed two foot sump from 10 to 12 ft. Cave-in fill material from 12 to 15 ft.		CL	MANCOS SHALE FORMATION: SHALE, soft, grey. TD AT 15 FEET.
20					
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽	7.7	10:55	09-30-85
▽			

JEG TAC TEAM

PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 614

JOB NO. SHP01, DATE 09/04/85

SURFACE ELEVATION 4891.83

TOP OF FILTER PACK 8.00

WELL CASING TYPE 4.0-IN. SCHED. 40 PVC

COMPLETION ALLUVIUM

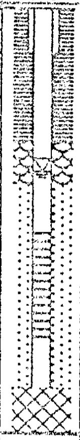
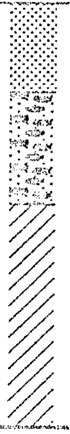
TOTAL DEPTH 19.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 9189.42 E 11057.99

DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 6 feet		SP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
5		Placed bentonite pellet seal to 8 feet. Installed 8-12 sand filter pack from 8 to 17 ft.		GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
10		Placed .050-in slot well screen from 10 to 15 ft.		CL	MANCOS SHALE FORMATION: SHALE, soft, grey.
15		Placed two foot sump from 15 to 17 ft. Cave-in fill material from 17 to 19 ft.			
20					TD AT 19 FEET.
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽	7.3	15:30	09-30-85
▽			

JEG TAC TEAM

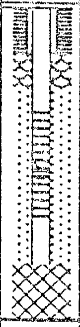
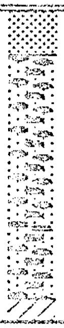
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 615

JOB NO. SHP01, DATE 09/06/85
SURFACE ELEVATION 4890.96
TOP OF FILTER PACK 3.50
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 14.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 9744.74 E 10667.33
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 2 feet Placed bentonite pellet seal to 3.5 feet. Installed 8-12 sand filter pack from 3.5 to 11.5 ft. Placed .050-in slot well screen from 4.5 to 9.5 ft.		SP	**ALLUVIUM:** SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
5				GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
10					
				CL	**MANCOS SHALE FORMATION:** SHALE, soft, grey. TD AT 14 FEET.
15		Placed two foot sump from 9.5 to 11.5 ft. Cave-in fill material from 11.5 to 14 ft.			
20					
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽	7.4	09:45	10-01-85
▽			

JEG TAC TEAM

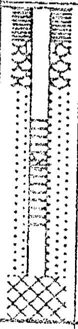
PROJECT *SHIPROCK SITE, NM*

Page 1 of 1

LOG OF WELL BORING NO. 616

JOB NO. *SHP01,* DATE *09/05/85*
SURFACE ELEVATION *4890.78*
TOP OF FILTER PACK *3.50*
WELL CASING TYPE *4.0-IN.SCHED. 40 PVC*
COMPLETION *ALLUVIUM*

TOTAL DEPTH *14.0 feet*
RIG TYPE *GARDNER-DENVER*
BORING TYPE *ROTARY MUD*
LOCATION *N 10213.54 E 11140.82*
DATUM *MSL*

Depth	*Well Con.*	*Remarks*	*Lithology*	*USCS*	*Visual Classification*
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 1.5 feet Placed bentonite pellet seal to 3.5 feet. Installed 8-12 sand filter pack from 3.5 to 12 ft. Placed .050-in slot well screen from 5 to 10 ft.		SP GP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown. SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
5					
10					
15		Placed two foot sump from 10 to 12 ft. Cave-in fill material from 12 to 14 ft.			TD AT 14 FEET.
20					
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	*HOUR*	*DATE*
▽	*7.1*	*13:55*	*10-01-85*
▽			

JEG TAC TEAM

Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 617

JOB NO. SHP01, DATE 09/05/85

SURFACE ELEVATION 4890.35

TOP OF FILTER PACK 3.50

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

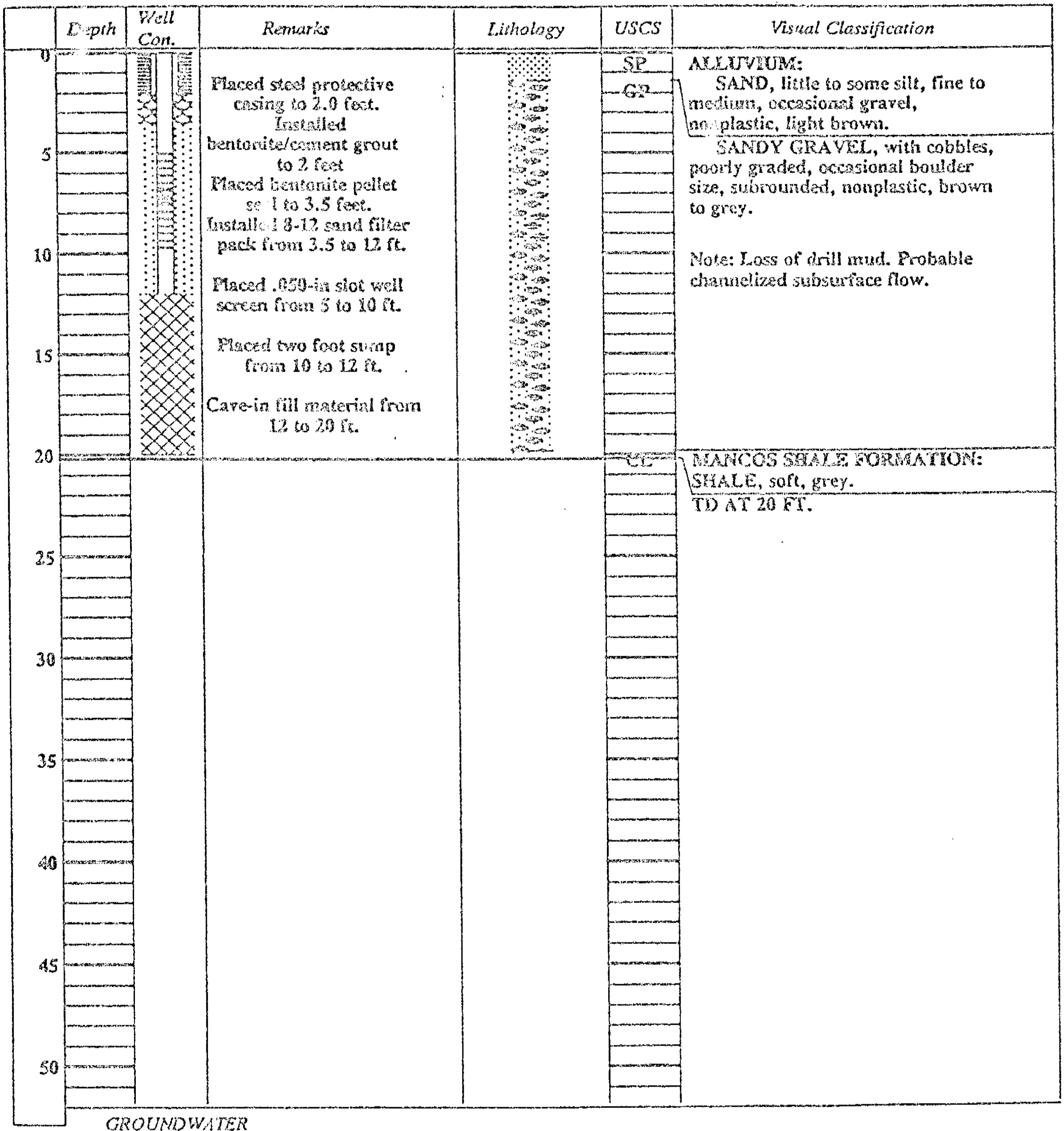
TOTAL DEPTH 20.3 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 10140.59 E 10862.37

DATUM MSL



Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 2 feet

Placed bentonite pellet seal 1 to 3.5 feet.

Installed 8-12 sand filter pack from 3.5 to 12 ft.

Placed .050-in slot well screen from 5 to 10 ft.

Placed two foot sump from 10 to 12 ft.

Cave-in fill material from 12 to 20 ft.

ALLUVIUM:

SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

Note: Loss of drill mud. Probable channelized subsurface flow.

MANCOS SHALE FORMATION:

SHALE, soft, grey.

TD AT 20 FT.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	7.3	14:20	10-01-85
▽			

JEG TAC TEAM

Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 618

JOB NO. SHF01, DATE 09/05/85

SURFACE ELEVATION 4890.13

TOP OF FILTER PACK 9.00

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

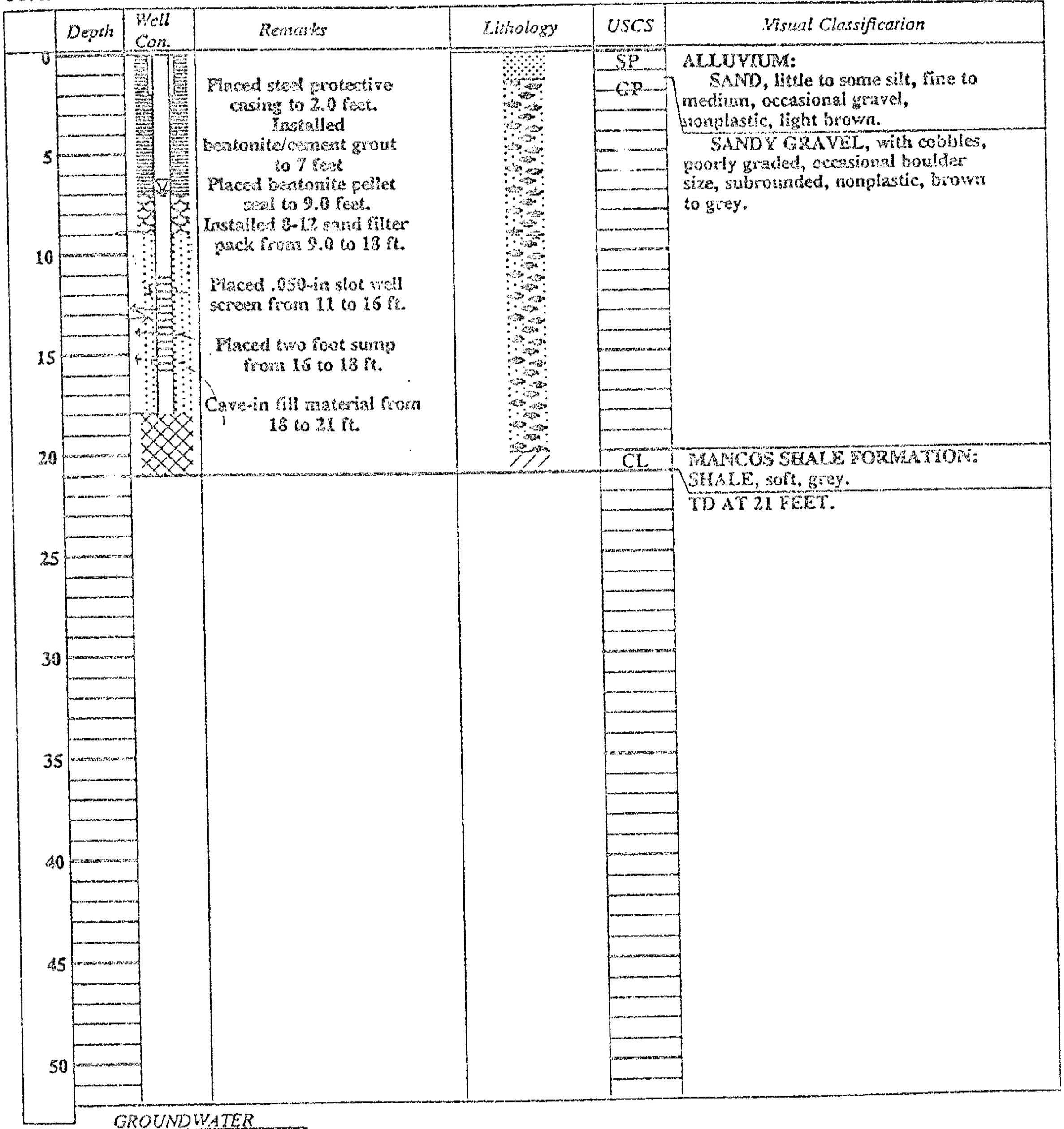
TOTAL DEPTH 21.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 10138.05 E 10849.30

DATUM MSL



Remarks:

Placed steel protective casing to 2.0 feet.

Installed bentonite/cement grout to 7 feet

Placed bentonite pellet seal to 9.0 feet.

Installed 8-12 sand filter pack from 9.0 to 18 ft.

Placed .050-in slot well screen from 11 to 16 ft.

Placed two foot sump from 16 to 18 ft.

Cave-in fill material from 18 to 21 ft.

Visual Classification:

ALLUVIUM:

SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:

SHALE, soft, grey.

TD AT 21 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	6.8	10:30	10-01-85
▼			

JEG TAC TEAM

Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 619

JOB NO. SHP01, DATE 09/06/85

SURFACE ELEVATION 4891.02

TOP OF FILTER PACK 6.00

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

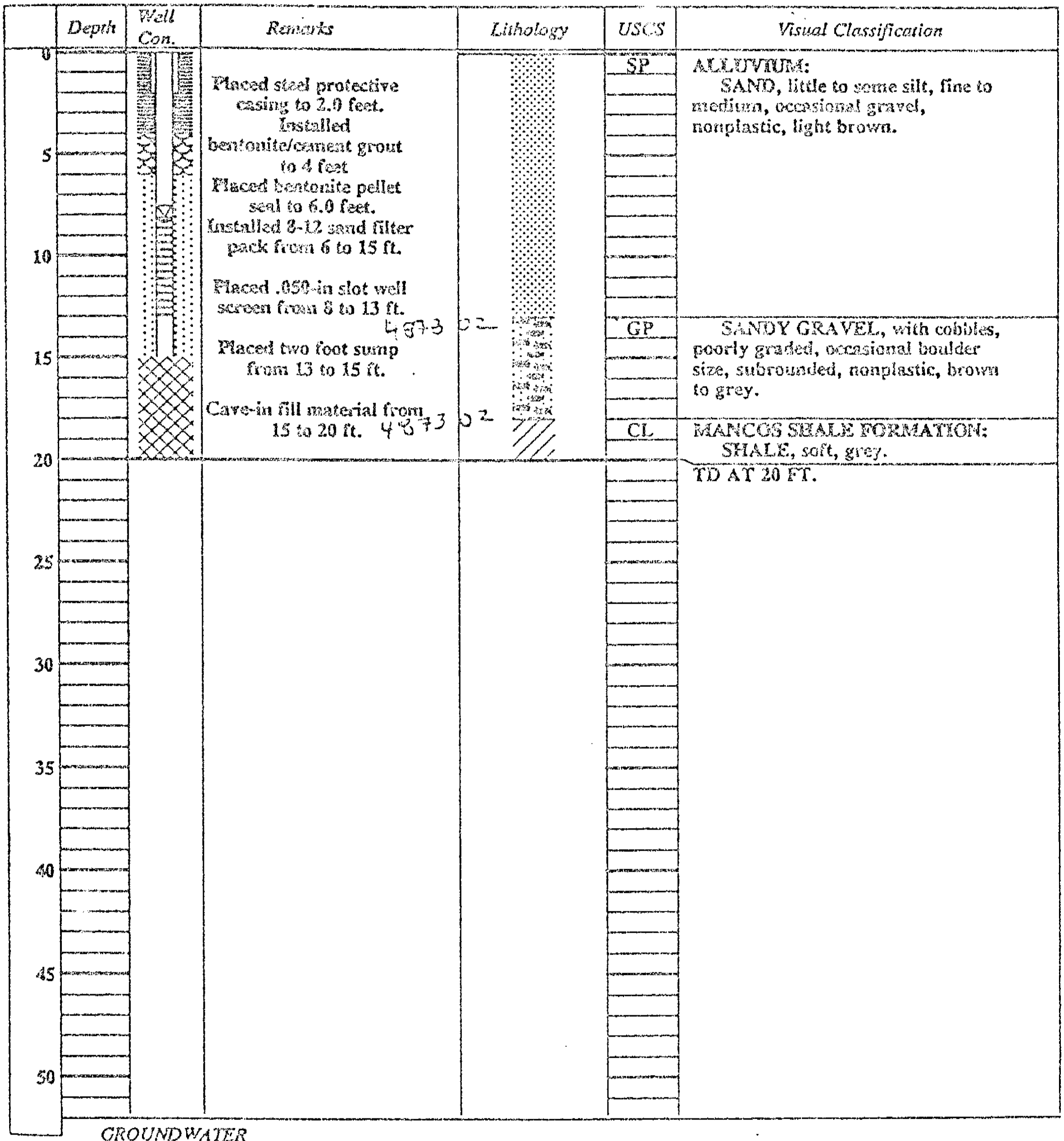
TOTAL DEPTH 20.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 10524.13 E 10501.47

DATUM MSL



Depth	Remarks	USCS	Visual Classification
0	Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 4 feet Placed bentonite pellet seal to 6.0 feet. Installed 8-12 sand filter pack from 6 to 15 ft. Placed .050-in slot well screen from 8 to 13 ft.	SP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
13	4873 02 Placed two foot sump from 13 to 15 ft.	GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
18	Cave-in fill material from 15 to 20 ft. 4873 02	CL	MANCOS SHALE FORMATION: SHALE, soft, grey.
20			TD AT 20 FT.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	8.1	10:50	10-02-85
▼			

JEG TAC TEAM

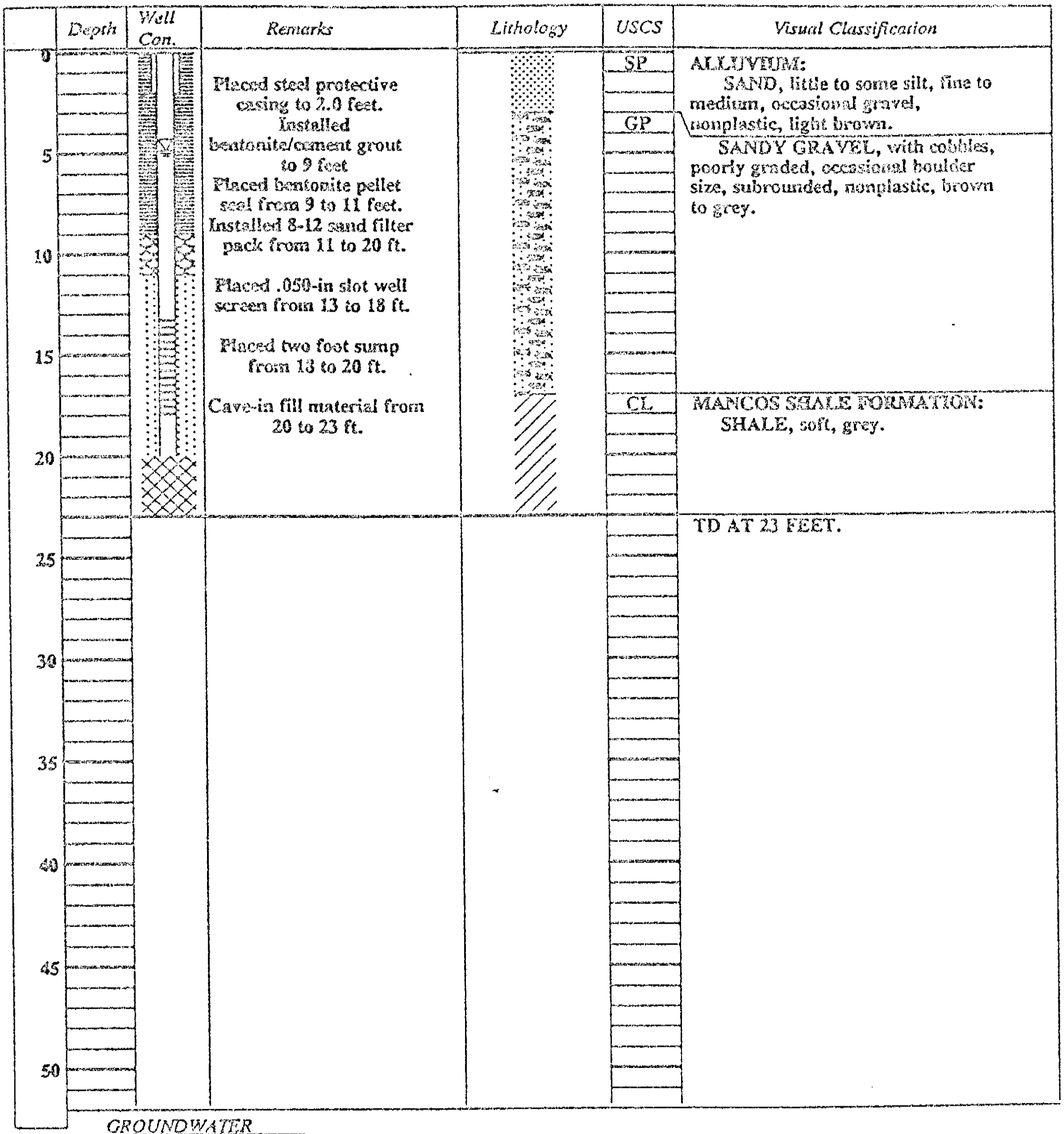
Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 620

JOB NO. SHP01. DATE 08/27/85
SURFACE ELEVATION 4888.36
TOP OF FILTER PACK 11.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 23.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 10162.22 E 10344.01
DATUM MSL



Placed steel protective casing to 2.0 feet.
Installed bentonite/cement grout to 9 feet
Placed bentonite pellet seal from 9 to 11 feet.
Installed 8-12 sand filter pack from 11 to 20 ft.

Placed .050-in slot well screen from 13 to 18 ft.

Placed two foot sump from 18 to 20 ft.

Cave-in fill material from 20 to 23 ft.

ALLUVIUM:
SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:
SHALE, soft, grey.

TD AT 23 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	4.9	13:35	10-02-85
▼			

JEG TAC TEAM

Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 621

JOB NO. SHP01, DATE 08/28/85

SURFACE ELEVATION 4888.50

TOP OF FILTER PACK 8.00

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

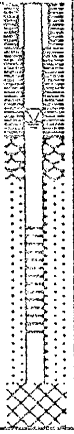
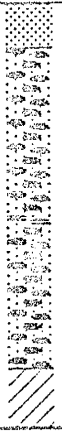
TOTAL DEPTH 19.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 10161.72 E 10353.91

DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 6 feet Placed bentonite pellet seal from 6 to 8 feet. Installed 8-12 sand filter pack from 8 to 17 ft. Placed .050-in slot well screen from 10 to 15 ft. Placed two foot sump from 15 to 17 ft. Cave-in fill material from 17 to 19 ft.		SP	**ALLUVIUM:** SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
				GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
5					
10					
15					
				CL	**MANCOS SHALE FORMATION:** SHALE, soft, grey.
20					TD AT 19 FEET.
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
∇	5.3	16:35	10-02-85

JEG TAC TEAM

PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 622

JOB NO. SHP01 DATE 08/28/85

SURFACE ELEVATION 4888.70

TOP OF FILTER PACK 3.50

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

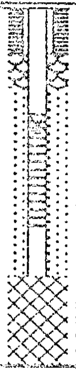
TOTAL DEPTH 16.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 10160.52 E 10364.80

DATUM MSL

	Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0 5 10 15			Placed steel protective casing to 1.5 feet. Installed bentonite/cement grout to 1.5 feet Placed bentonite pellet seal from 1.5 to 3.5 feet. Installed 8-12 sand filter pack from 3.5 to 12 ft. Placed .050-in slot well screen from 5 to 10 ft. Placed two foot sump from 10 to 15 ft.		SP GP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown. SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
20 25 30 35 40 45 50			Cave-in fill material from 15 to 16 ft.			TD AT 16 FEET.

GROUNDWATER

DEPTH	HOUR	DATE
5.3	17:00	10-02-85

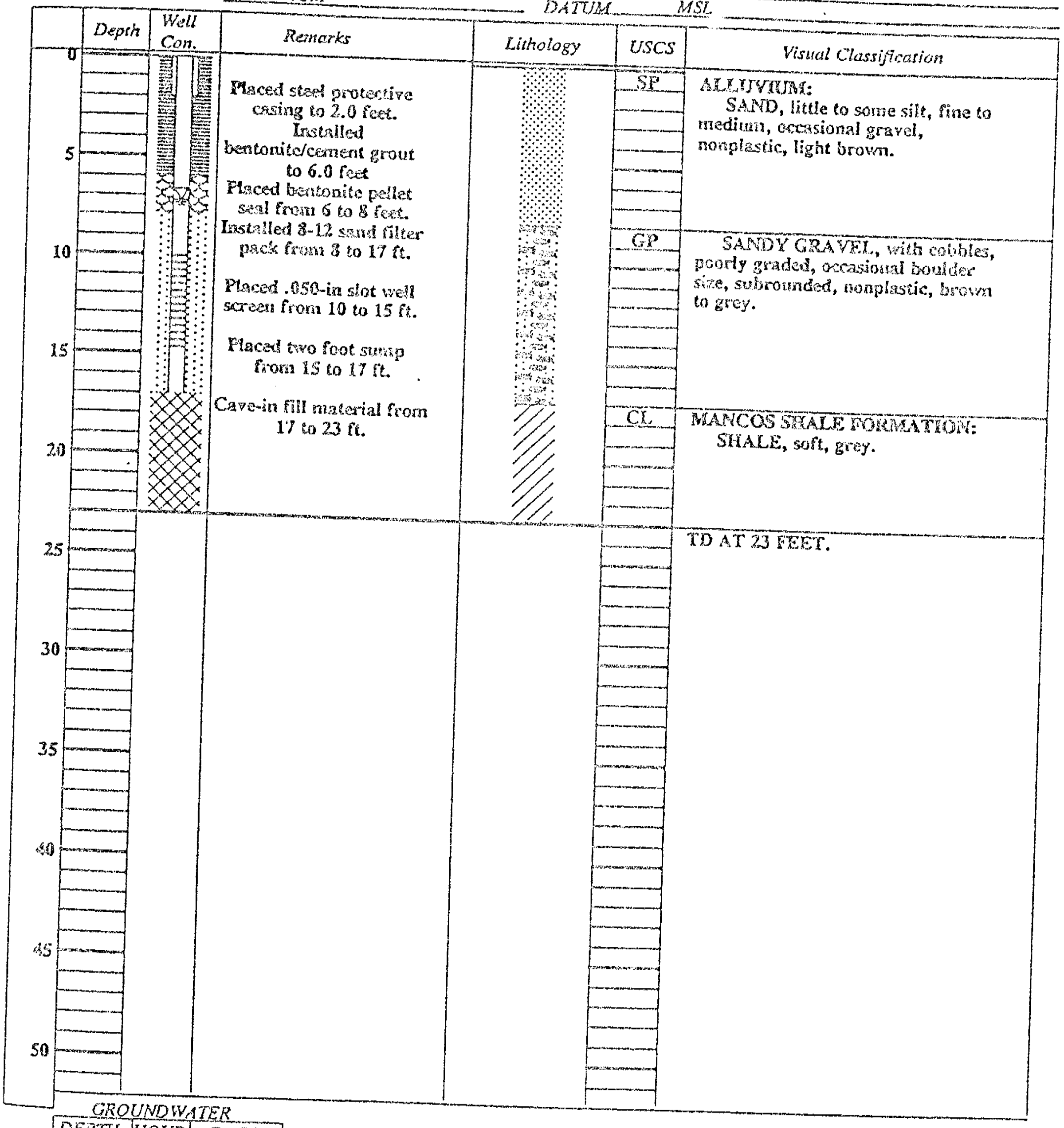
JEG TAC TEAM

PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 623

JOB NO. SHP01 DATE 09/07/85
SURFACE ELEVATION 4889.86
TOP OF FILTER PACK 8.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM
TOTAL DEPTH 23.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 10610.77 E 10355.84
DATUM MSL



Remarks

Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 6.0 feet

Placed bentonite pellet seal from 6 to 8 feet.

Installed 8-12 sand filter pack from 8 to 17 ft.

Placed .050-in slot well screen from 10 to 15 ft.

Placed two foot sump from 15 to 17 ft.

Cave-in fill material from 17 to 23 ft.

USCS / Visual Classification

SP ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

GP SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

CL MANCOS SHALE FORMATION: SHALE, soft, grey.

TD AT 23 FEET.

GROUNDWATER

DEPTH	HOUR	DATE
7.2	10:30	10-03-85

JEG TAC TEAM

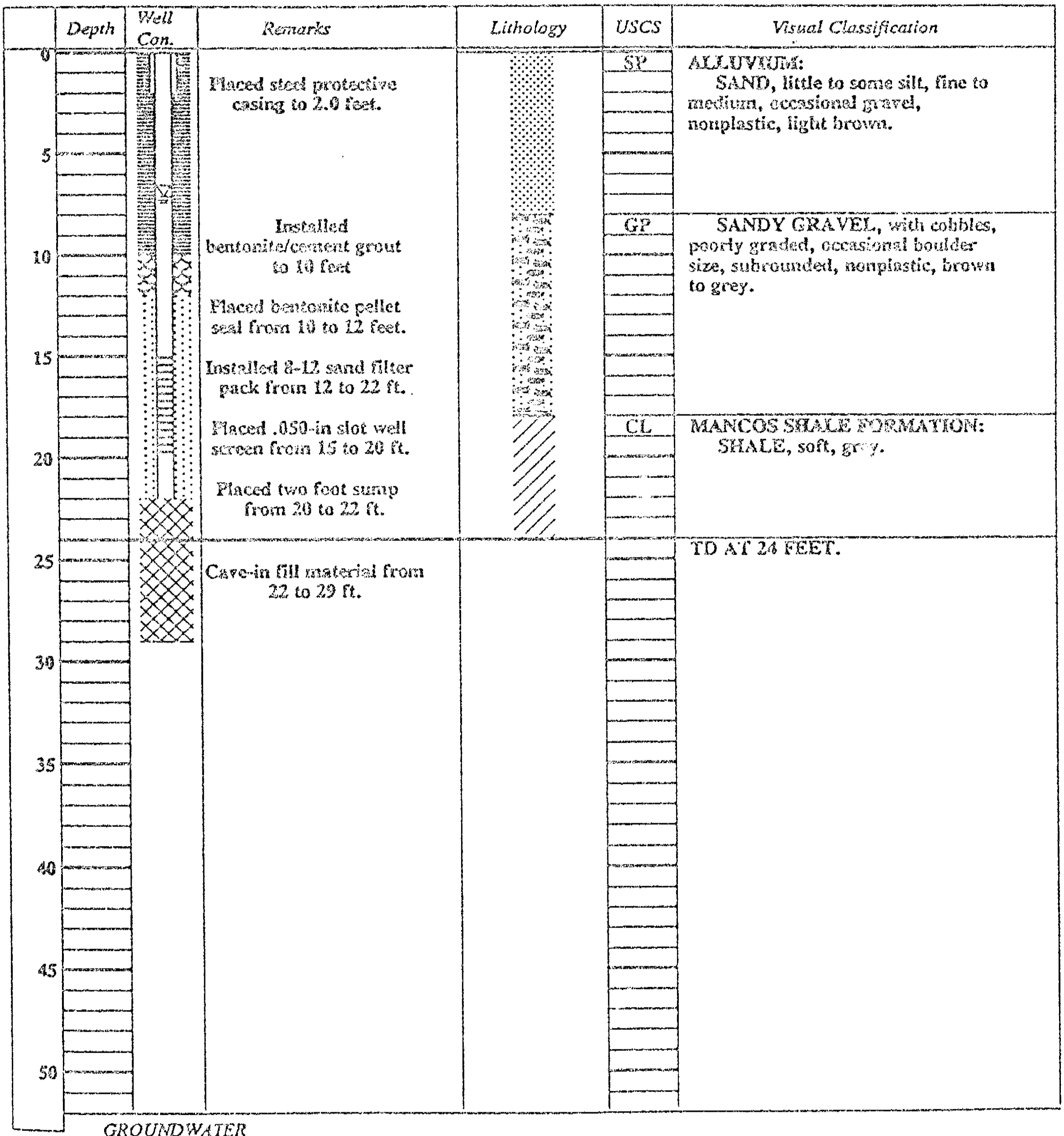
Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 624

JOB NO. SHP01, DATE 09/07/85
SURFACE ELEVATION 4889.57
TOP OF FILTER PACK 12.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 29.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 10598.41 E 10352.08
DATUM MSL



Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet.		SP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
5					
		Installed bentonite/cement grout to 10 feet		GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
10		Placed bentonite pellet seal from 10 to 12 feet.			
15		Installed 8-12 sand filter pack from 12 to 22 ft.			
		Placed .050-in slot well screen from 15 to 20 ft.		CL	MANCOS SHALE FORMATION: SHALE, soft, grey.
20		Placed two foot sump from 20 to 22 ft.			
					TD AT 24 FEET.
25		Cave-in fill material from 22 to 29 ft.			
30					
35					
40					
45					
50					

GROUNDWATER

DEPTH	HOUR	DATE
7.1	12:30	10-03-85

JEG TAC TEAM

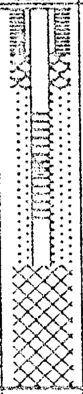
Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 625

JOB NO. SHP01. DATE 09/07/85
SURFACE ELEVATION 4889.89
TOP OF FILTER PACK 3.50
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 17.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 10586.48 E 10348.87
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 2.0 feet Placed bentonite pellet seal from 2 to 3.5 feet. Installed 8-12 sand filter pack from 3.5 to 11.5 ft. Placed .050-in slot well screen from 4.5 to 9.5 ft. Placed two foot sump from 9.5 to 11.5 ft.		SP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
5					
				GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
10					
15					
		Cave-in fill material from 11.5 to 17 ft.			TD AT 17 FEET.
20					
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽	7.1	11:00	10-03-85
▽			

JEG TAC TEAM

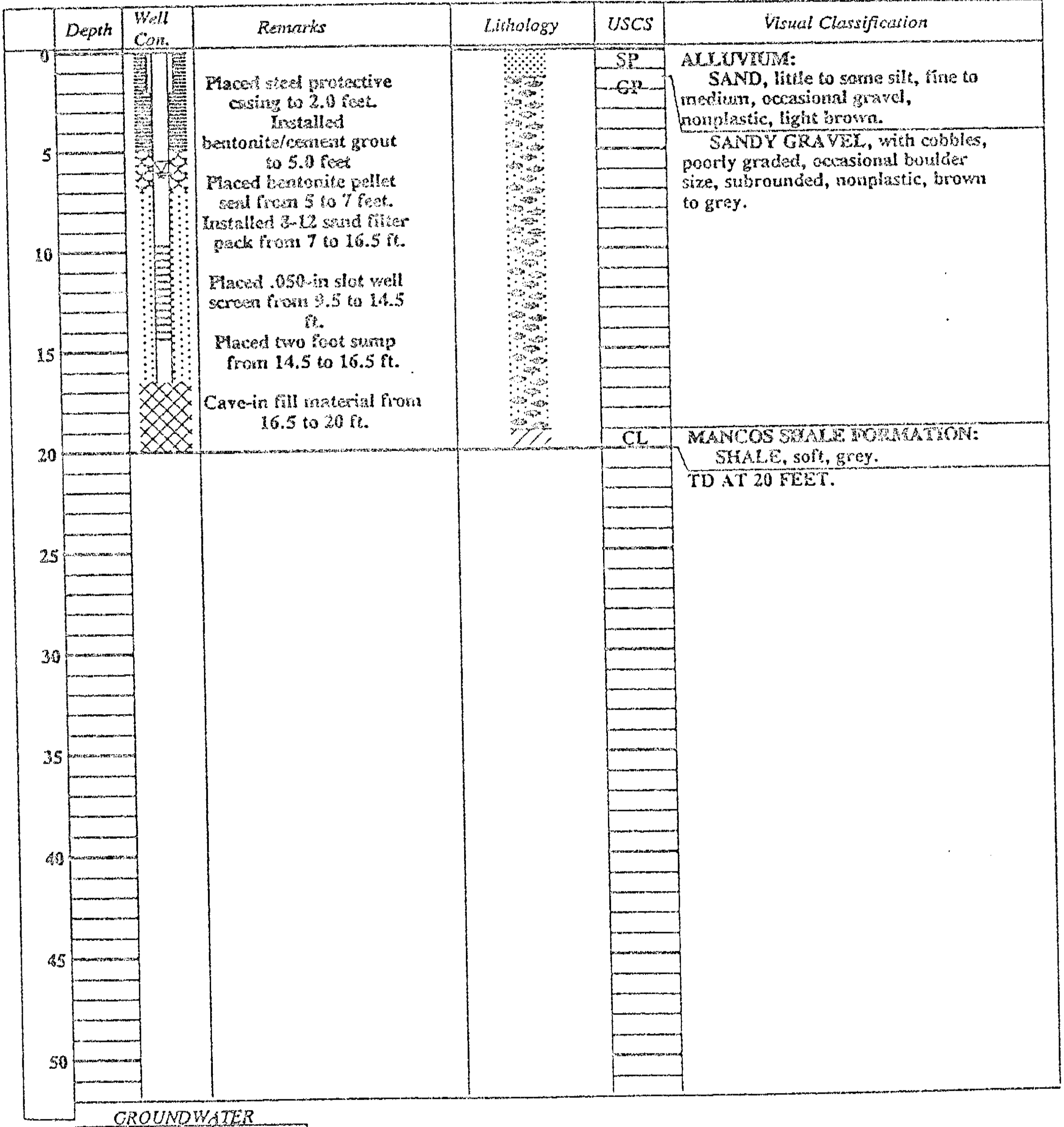
Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 626

JOB NO. SHP01, DATE 09/08/85
SURFACE ELEVATION 4888.76
TOP OF FILTER PACK 7.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 20.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 10524.93 E 10040.71
DATUM MSL



Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 5.0 feet. Placed bentonite pellet seal from 5 to 7 feet. Installed 8-12 sand filter pack from 7 to 16.5 ft.

Placed .050-in slot well screen from 9.5 to 14.5 ft. Placed two foot sump from 14.5 to 16.5 ft.

Cave-in fill material from 16.5 to 20 ft.

ALLUVIUM:
SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:
SHALE, soft, grey.
TD AT 20 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
∇	6.0	15:30	10-03-85
∇			

JEG TAC TEAM

PROJECT *SHIPROCK SITE, NM*

Page *1* of *1*

LOG OF WELL BORING NO. *627*

JOB NO. *SHP01* DATE *09/08/85*

SURFACE ELEVATION *4887.84*

TOP OF FILTER PACK *6.00*

WELL CASING TYPE *4.0-IN.SCHED. 40 PVC*

COMPLETION *ALLUVIUM*

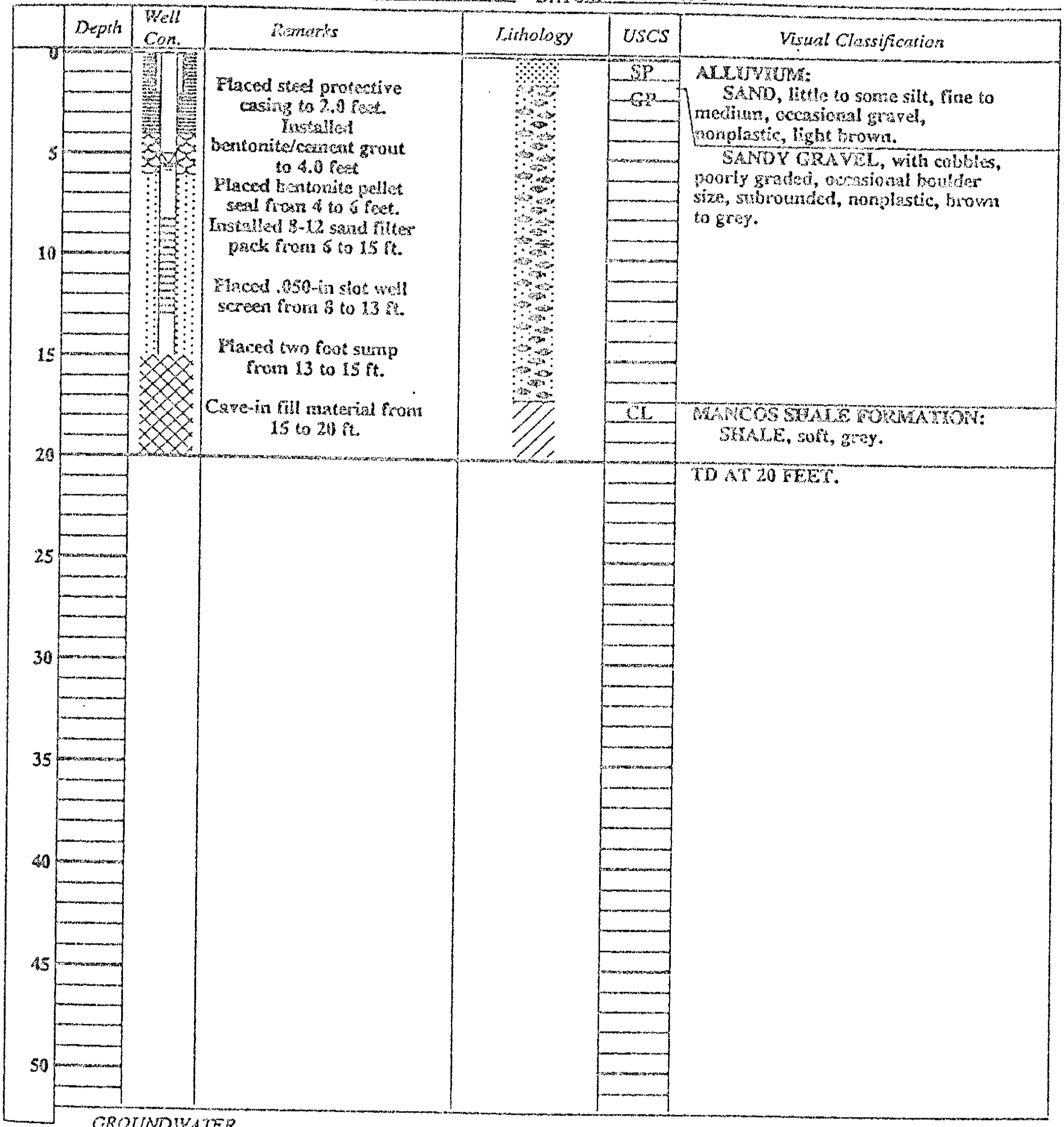
TOTAL DEPTH *20.0 feet*

RIG TYPE *GARDNER-DENVER*

BORING TYPE *ROTARY MUD*

LOCATION *N 10725.88 E 9749.24*

DATUM *MSL*



Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 4.0 feet

Placed bentonite pellet seal from 4 to 6 feet.

Installed 8-12 sand filter pack from 6 to 15 ft.

Placed .050-in slot well screen from 8 to 13 ft.

Placed two foot sump from 13 to 15 ft.

Cave-in fill material from 15 to 20 ft.

ALLUVIUM:

SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:

SHALE, soft, grey.

TD AT 20 FEET.

GROUNDWATER

	DEPTH	*HOUR*	*DATE*
▽	*5.5*	*17:05*	*10-03-85*
▽			

JEG TAC TEAM

PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 628

JOB NO. SHP01. DATE 09/09/85

SURFACE ELEVATION 4888.37

TOP OF FILTER PACK 3.50

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

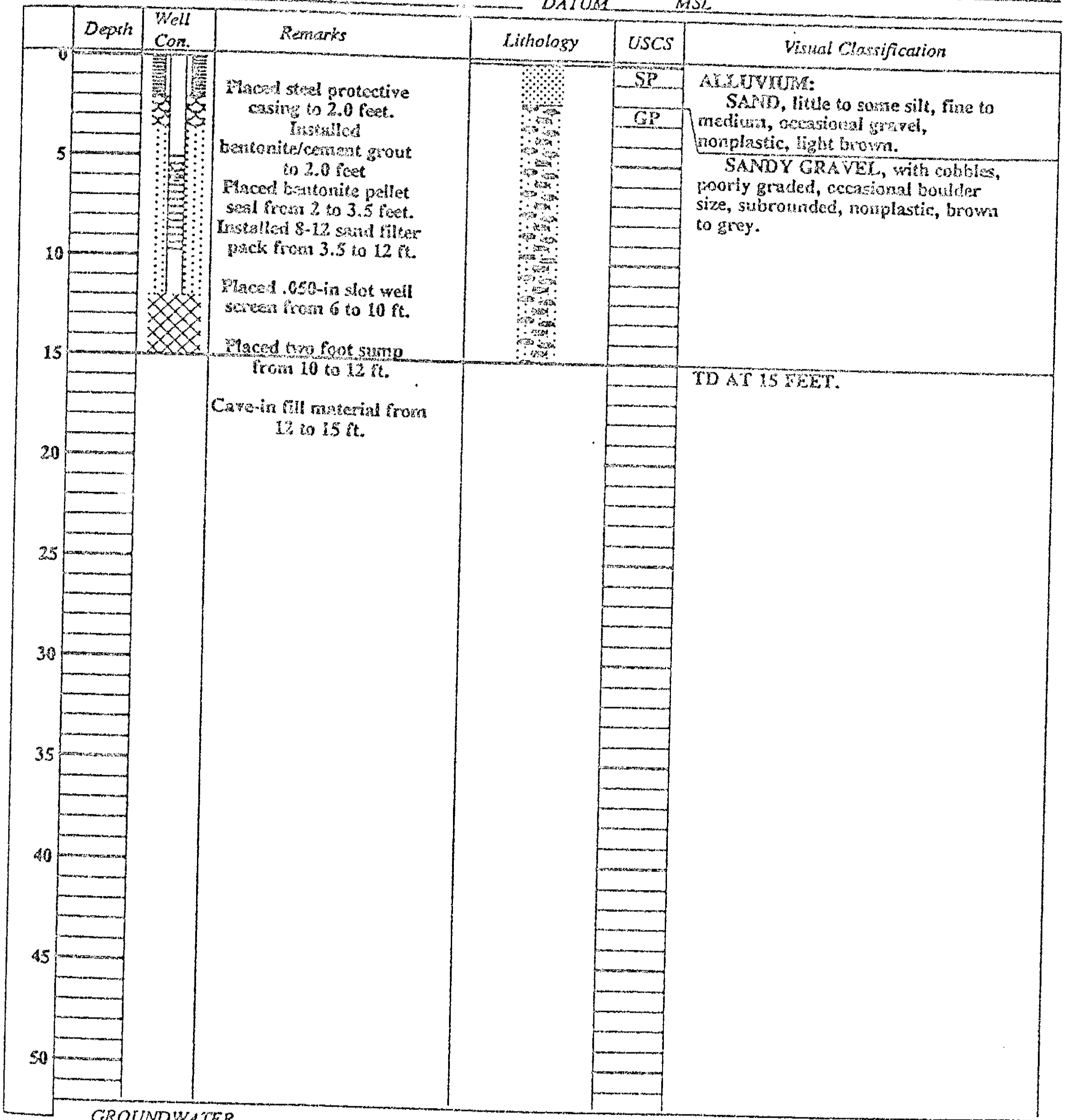
TOTAL DEPTH 15.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 10716.54 E 9758.94

DATUM MSL



Remarks:

Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 2.0 feet

Placed bentonite pellet seal from 2 to 3.5 feet.

Installed 8-12 sand filter pack from 3.5 to 12 ft.

Placed .050-in slot well screen from 6 to 10 ft.

Placed two foot sump from 10 to 12 ft.

Cave-in fill material from 12 to 15 ft.

Visual Classification:

ALLUVIUM:

SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

TD AT 15 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	6.0	11:35	10-04-85
▽			

JEG TAC TEAM

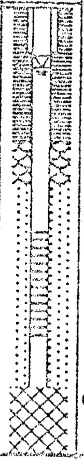
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 629

JOB NO. SHP01, DATE 09/09/85
SURFACE ELEVATION 4836.18
TOP OF FILTER PACK 8.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 20.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 10558.80 E 9477.73
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 6.0 feet Placed bentonite pellet seal from 6 to 8 feet. Installed 8-12 sand filter pack from 8 to 15 ft. Placed .050-in slot well screen from 10 to 15 ft. Placed two foot sump from 15 to 17 ft. Cave-in fill material from 17 to 20 ft.		SP GP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown. SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
5					
10					
15				CL	MANCOS SHALE FORMATION: SHALE, soft, grey.
20					TD AT 20 FEET.
25					
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽	2.7	18:35	10-03-85
▼			

JEG TAC TEAM

PROJECT *SHIPROCK SITE, NM*

Page *1* of *1*

LOG OF WELL BORING NO. 630

JOB NO. *SHP01.* DATE *09/09/85*

SURFACE ELEVATION *4886.24*

TOP OF FILTER PACK *3.50*

WELL CASING TYPE *4.0-IN.SCHED. 40 PVC*

COMPLETION *ALLUVIUM*

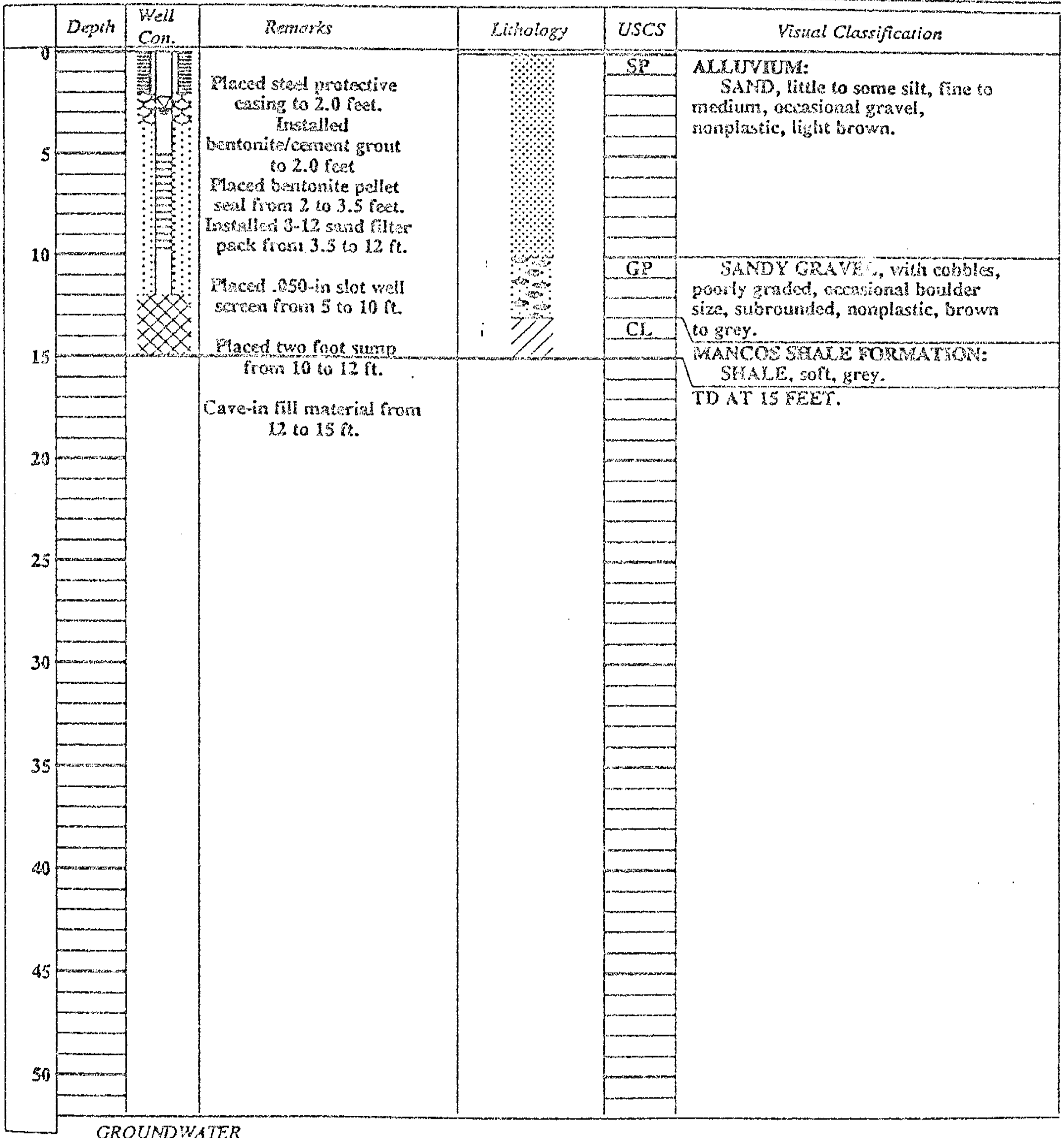
TOTAL DEPTH *15.0 feet*

RIG TYPE *GARDNER-DENVER*

BORING TYPE *ROTARY MUD*

LOCATION *N 10547.53 E 9482.50*

DATUM *MSL*



Remarks:

Placed steel protective casing to 2.0 feet.
Installed bentonite/cement grout to 2.0 feet
Placed bentonite pellet seal from 2 to 3.5 feet.
Installed 8-12 sand filter pack from 3.5 to 12 ft.

Placed .050-in slot well screen from 5 to 10 ft.

Placed two foot sump from 10 to 12 ft.

Cave-in fill material from 12 to 15 ft.

Visual Classification:

ALLUVIUM:
SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:
SHALE, soft, grey.

TD AT 15 FEET.

GROUNDWATER

	DEPTH	*HOUR*	*DATE*
∇	*2.8*	*09:55*	*10-04-85*
∇			

JEG TAC TEAM

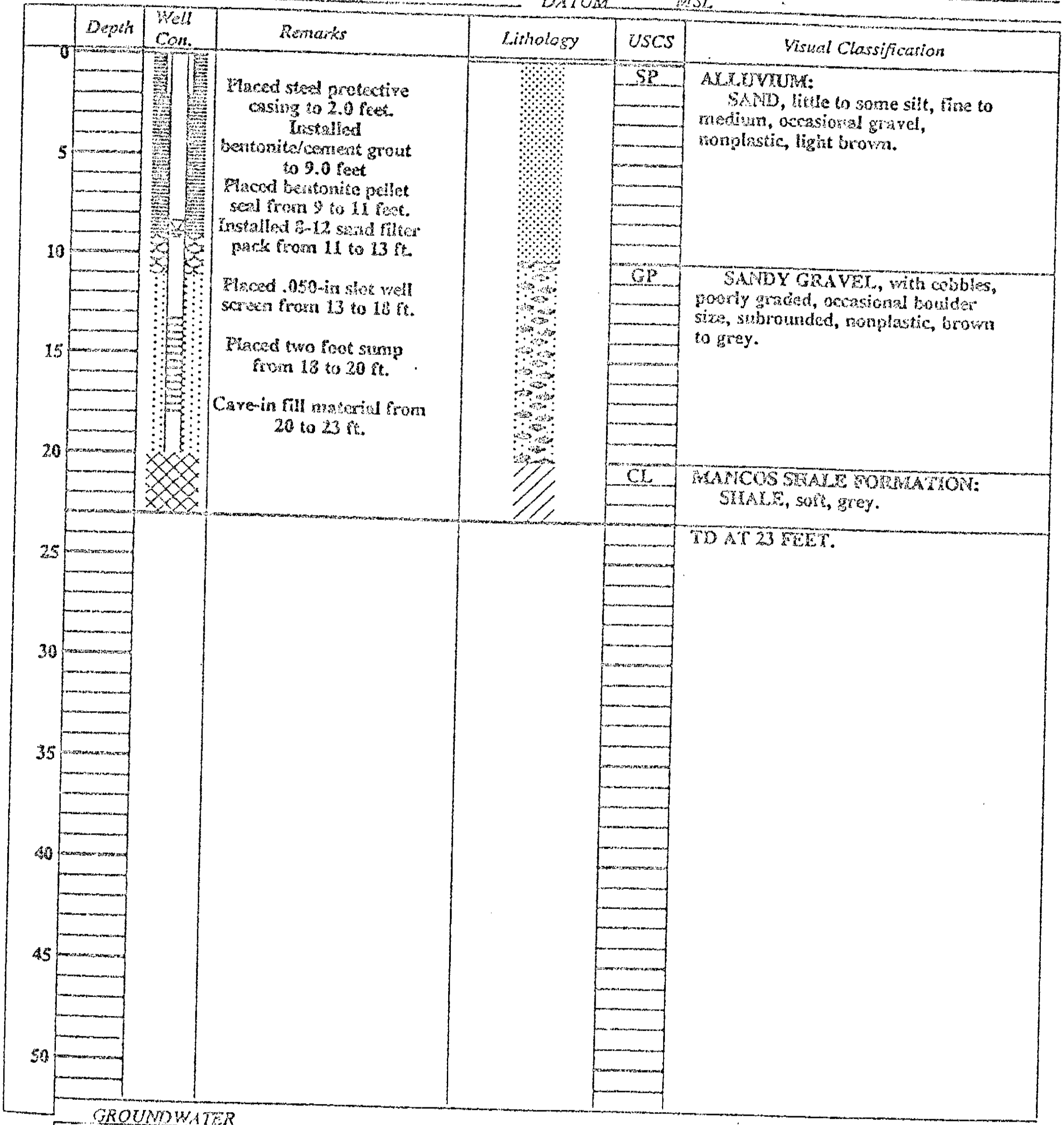
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 631

JOB NO. SHP01, DATE 09/11/85
SURFACE ELEVATION 4889.55
TOP OF FILTER PACK 11.00
WELL CASING TYPE 4.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM

TOTAL DEPTH 23.0 feet
RIG TYPE GARDNER-DENVER
BORING TYPE ROTARY MUD
LOCATION N 12355.10 E 9131.70
DATUM MSL



Remarks

Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 9.0 feet Placed bentonite pellet seal from 9 to 11 feet. Installed 8-12 sand filter pack from 11 to 13 ft.

Placed .050-in slot well screen from 13 to 18 ft.

Placed two foot sump from 18 to 20 ft.

Cave-in fill material from 20 to 23 ft.

Visual Classification

ALLUVIUM:
SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.

SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.

MANCOS SHALE FORMATION:
SHALE, soft, grey.

TD AT 23 FEET.

GROUNDWATER		
DEPTH	HOUR	DATE
8.9	10:30	9-30-85

JEG TAC TEAM

PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 632

JOB NO. SHP01, DATE 09/11/85

SURFACE ELEVATION 4889.56

TOP OF FILTER PACK 6.00

WELL CASING TYPE 4.0-IN.SCHED. 40 PVC

COMPLETION ALLUVIUM

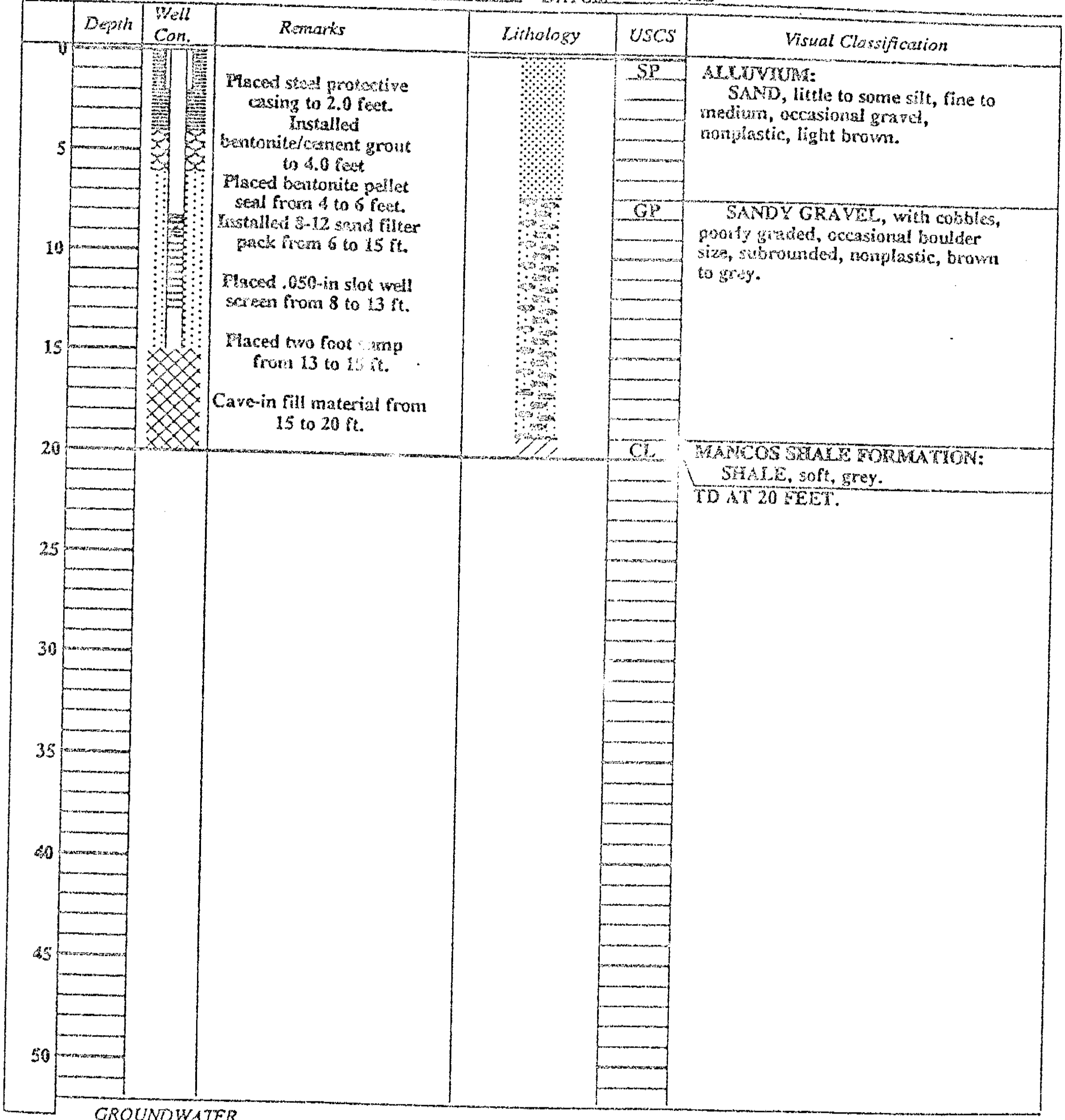
TOTAL DEPTH 20.0 feet

RIG TYPE GARDNER-DENVER

BORING TYPE ROTARY MUD

LOCATION N 12343.88 E 9137.67

DATUM MSL



Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Placed steel protective casing to 2.0 feet. Installed bentonite/cement grout to 4.0 feet Placed bentonite pellet seal from 4 to 6 feet. Installed 8-12 sand filter pack from 6 to 15 ft. Placed .050-in slot well screen from 8 to 13 ft. Placed two foot sump from 13 to 15 ft. Cave-in fill material from 15 to 20 ft.		SP	ALLUVIUM: SAND, little to some silt, fine to medium, occasional gravel, nonplastic, light brown.
				GP	SANDY GRAVEL, with cobbles, poorly graded, occasional boulder size, subrounded, nonplastic, brown to grey.
20				CL	MANCOS SHALE FORMATION: SHALE, soft, grey. TD AT 20 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	9.0	16:30	09-29-85
▽			

JEG TAC TEAM

JACOBS SYSTEMS COMPANY
A DIVISION OF JACOBS ENGINEERING GROUP INC.

BOREHOLE AND TEST PIT SUMMARY

DEC 1 0 1985

SHP01
CATION ID: 633
OCATION COORDINATES:
N 9589.47
E 9300.89
GROUND ELEVATION (FT. MSL): 4915.99

BH-BOREHOLE/TP-TEST PIT: BH
DRILLER EXCAVATOR: SHB
COMPLETION DATE: 851004
BOREHOLE DIAMETER (IN): 1.25 ✓
TOTAL DEPTH (FT.): 3.42

WELL SUMMARY

WELL OWNER: DOE
INSTALLER: SHB
INSTALLATION DATE: 85/004
CASING ELEV. (FT. MSL): 4918.24
CASING LENGTH (FT.): ~~6.0~~ 6.42
CASING DIA. (IN.): 1.25
SEAL (END) DEPTH (FT.): N/A

FILTER PACK LENGTH (FT.): N/A
FORMATION OF COMPLETION: AL
STRATIGRAPHIC ORDER: UNK
OPEN SCREEN DEPTH (FT.): 3.0
OPEN SCREEN LENGTH (FT.): 3.0
OPEN SCREEN AREA (IN.2/FT.): UNK
*FLOW RELATIONSHIP: D

LITHOLOGICAL SUMMARY

SOIL/ROCK PROFILE				STD. PENETRATION TEST			
DEPTH (FT.)	UNIFIED SOIL/ROCK CLASS	STRAT. ORDER	VISUAL DESCRIPTION	SAMPLE ID	DEPTH INTERVAL (FT.)	SAMPLE METHOD	N VALUE
3.42	ML	1	Alluvium				

*FLOW RELATIONSHIP:
J-Upgradient
D-Downgradient
C-Cross Gradient
O-On Site
N-Not Known

SAMPLE METHODS.
A-Auger Cuttings
S-2"O.D. 1.38"I.D. drive sample
U-3"O.D. 2.42"I.D. tube sample
T-3" O.D. thin-walled Shelby tube
H-8 1/2 Hollow Stem Auger
C-4 1/2 Continuous Flight Auger
GB-Gear Bit
NX-NX Rock Coring
NQ-NQ Wireline Rock Coring
B-Undisturbed Block Sample
D-Disturbed Bulk Sample

JEG-AL-ENG-4 (6/85)

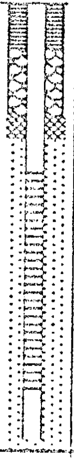
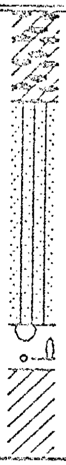
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 725

JOB NO. SHP01 DATE 03/28/93
SURFACE ELEVATION 4906.40
TOP OF FILTER PACK 6.00
WELL CASING TYPE 2.0-IN. SCHED. 40 PVC
COMPLETION ALLUVIUM.

TOTAL DEPTH 20.0 feet
RIG TYPE ODEX, IR, TH-60
BORING TYPE ODEX ROTARY AIR
LOCATION N 10207.42 E 9292.16
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Installed 2-in. PVC well to 19.5 ft. Steel casing set to 3 feet. Grout seal placed to 2 feet. Bentonite chip seal placed from 2 to 6 feet. Prepacked well screen, .050-in. slot, set from 7.5 to 17.5 ft. Filter pack placed from 6 to 20 feet.		GC	ALLUVIUM: CLAYEY SAND AND GRAVEL, gravel poorly graded to 1-in., occasional cobbles, low to medium plasticity, brown.
5				SM	SILTY SAND, very fine, some fine gravel, nonplastic, brown. Note: occ. seams of sandy silt.
10					
					▽ 13.4?
15				GM	SILTY GRAVEL AND COBBLES, poorly graded with cobbles to 6-in., subrounded, nonplastic, brown.
		Two ft. sump placed from 17.5 to 19.5 ft.		CL	MANCOS SHALE FM.: SHALE, soft, weathered, brown to grey.
20					TD AT 20 FEET.
25		Well developed with pump to 4 NTU.			
30					
35					
40					
45					
50					

GROUNDWATER

DEPTH	HOUR	DATE

JEG TAC TEAM

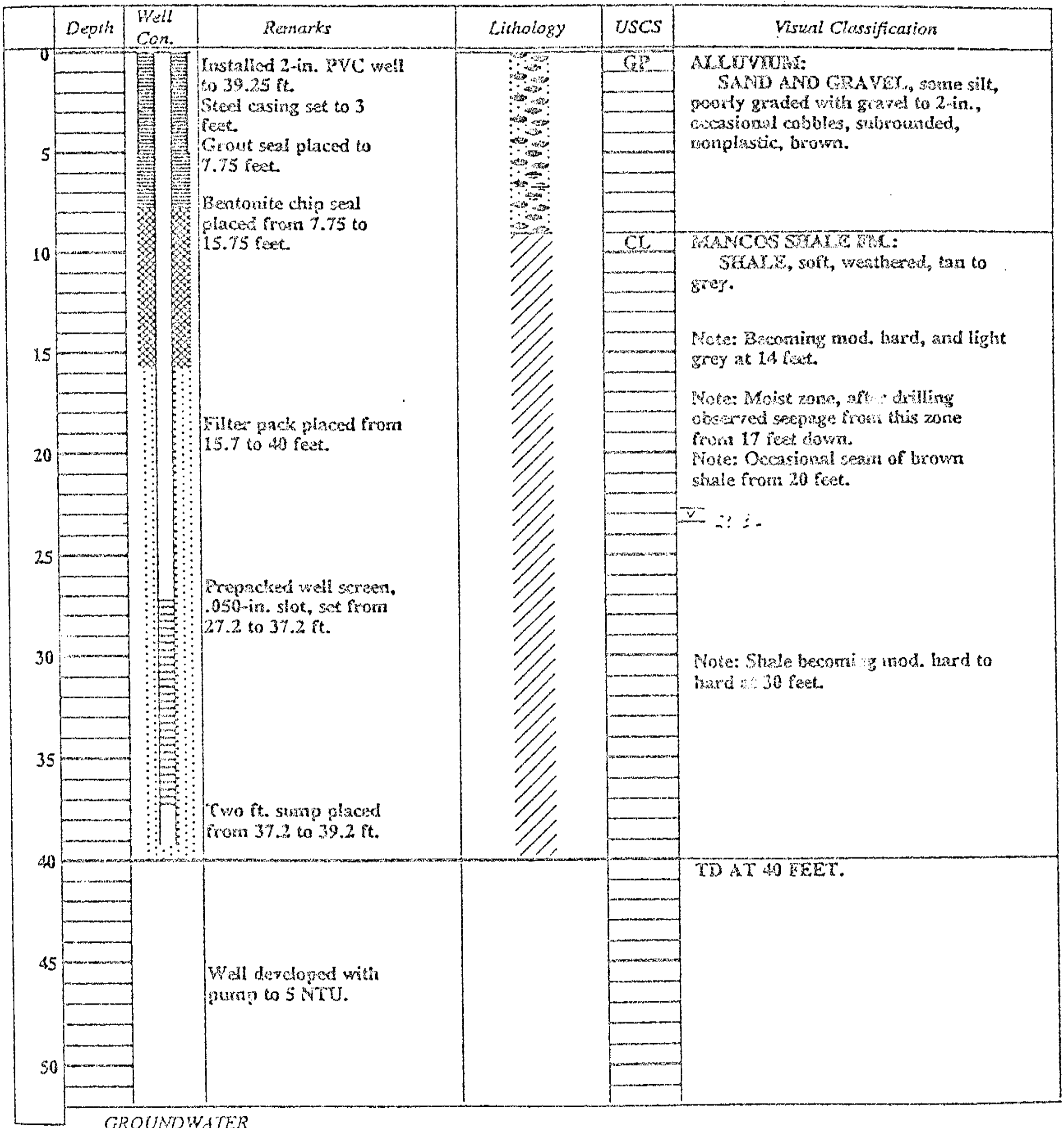
Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 726

JOB NO. SHP01, DATE 03/28/93
SURFACE ELEVATION 4937.98
TOP OF FILTER PACK 15.75
WELL CASING TYPE 2.0-IN. SCHED. 40 PVC
COMPLETION ALLUVIUM.

TOTAL DEPTH 40.0 feet
RIG TYPE ODEX, IR, TH-60
BORING TYPE ODEX ROTARY AIR
LOCATION N 9648.97 E 9075.03
DATUM MSL



Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Installed 2-in. PVC well to 39.25 ft. Steel casing set to 3 feet. Grout seal placed to 7.75 feet.		GP	ALLUVIUM: SAND AND GRAVEL, some silt, poorly graded with gravel to 2-in., occasional cobbles, subrounded, nonplastic, brown.
5		Bentonite chip seal placed from 7.75 to 15.75 feet.			
10				CL	MANCOS SHALE FM.: SHALE, soft, weathered, tan to grey.
15					Note: Becoming mod. hard, and light grey at 14 feet. Note: Moist zone, after drilling observed seepage from this zone from 17 feet down.
20		Filter pack placed from 15.7 to 40 feet.			Note: Occasional seam of brown shale from 20 feet. ▽ 22.1
25		Prepacked well screen, .050-in. slot, set from 27.2 to 37.2 ft.			
30					Note: Shale becoming mod. hard to hard at 30 feet.
35		Two ft. sump placed from 37.2 to 39.2 ft.			
40					TD AT 40 FEET.
45		Well developed with pump to 5 NTU.			
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			

JEG TAC TEAM

PROJECT *SHIPROCK SITE, NM*

Page *1* of *1*

LOG OF WELL BORING NO. *727*

JOB NO. *SHP01* DATE *03/27/93*

SURFACE ELEVATION *4938.79*

TOP OF FILTER PACK *5.50*

WELL CASING TYPE *2.0-IN. SCHED. 40 PVC*

COMPLETION *ALLUVIUM.*

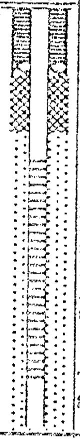
TOTAL DEPTH *19.0 feet*

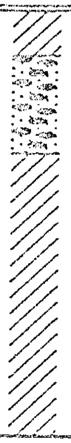
RIG TYPE *ODEX, IR, TH-60*

BORING TYPE *ODEX ROTARY AIR*

LOCATION *N 8915.41 E 8780.14*

DATUM *MSL*





Depth	*Well Con.*	*Remarks*	*Lithology*	*USCS*	*Visual Classification*
0		Installed 2-in. PVC well to 18.7 ft. Steel casing set to 3 feet.		CL GP	ALLUVIUM: SILTY CLAY, medium plasticity, tan. SAND, GRAVEL AND COBBLES, poorly graded, cobbles size to 8-in. some silt, subrounded, nonplastic, tan.
5		Grout seal placed to 2.5 feet. Bentonite chip seal placed from 2.5 to 5.5 feet.		CL	MANCOS SHALE FM.: SHALE, soft, weathered, tan to grey.
10		Filter pack placed from 5.5 to 19 feet. Prepacked well screen, .050-in. slot, set from 6.7 to 16.7 ft.			
15		Two ft. sump placed from 16.7 to 18.7 ft.			Note: Becoming slightly weathered, mod. soft, and light grey at 15 feet. Note: No moist conditions observed during drilling. Perched zone may be very thin.
20					TD AT 19 FEET.
25		Well developed with pump to 5 NTU.			
30					
35					
40					
45					
50					

GROUNDWATER

DEPTH	*HOUR*	*DATE*

JEG TAC TEAM

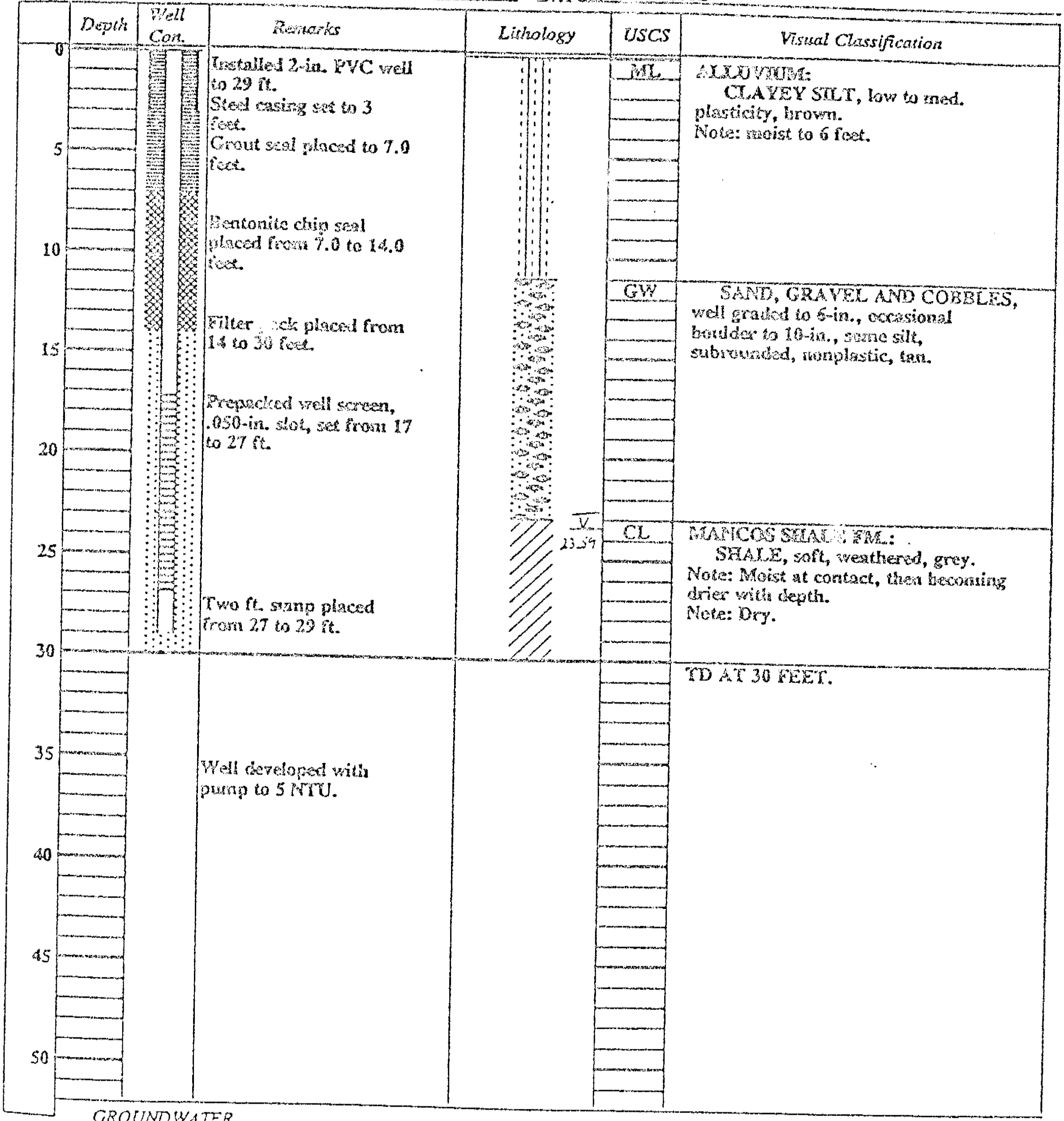
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 728

JOB NO. SHP01, DATE 03/26/93
SURFACE ELEVATION 4963.70
TOP OF FILTER PACK 14.00
WELL CASING TYPE 2.0-IN.SCHED.40 PVC
COMPLETION ALLUVIUM.

TOTAL DEPTH 30.0 feet
RIG TYPE ODEX,IR,TH-60
BORING TYPE ODEX ROTARY AIR
LOCATION N 7736.95 E 8466.14
DATUM MSL



Installed 2-in. PVC well to 29 ft.
Steel casing set to 3 feet.
Grout seal placed to 7.0 feet.

Bentonite chip seal placed from 7.0 to 14.0 feet.

Filter pack placed from 14 to 30 feet.

Prepacked well screen, .050-in. slot, set from 17 to 27 ft.

Two ft. sump placed from 27 to 29 ft.

Well developed with pump to 5 NTU.

ML — ALLUVIUM:
CLAYEY SILT, low to med. plasticity, brown.
Note: moist to 6 feet.

GW — SAND, GRAVEL AND COBBLES, well graded to 6-in., occasional boulder to 10-in., some silt, subrounded, nonplastic, tan.

CL — MANCOS SHALE FM.:
SHALE, soft, weathered, grey.
Note: Moist at contact, then becoming drier with depth.
Note: Dry.

TD AT 30 FEET.

GROUNDWATER

DEPTH	HOUR	DATE

JEG TAC TEAM

Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 730

JOB NO. SHP01, DATE 03/26/93

SURFACE ELEVATION 4977.78

TOP OF FILTER PACK 25.00

WELL CASING TYPE 2.0-IN.SCHED.40 PVC

COMPLETION ALLUVIUM.

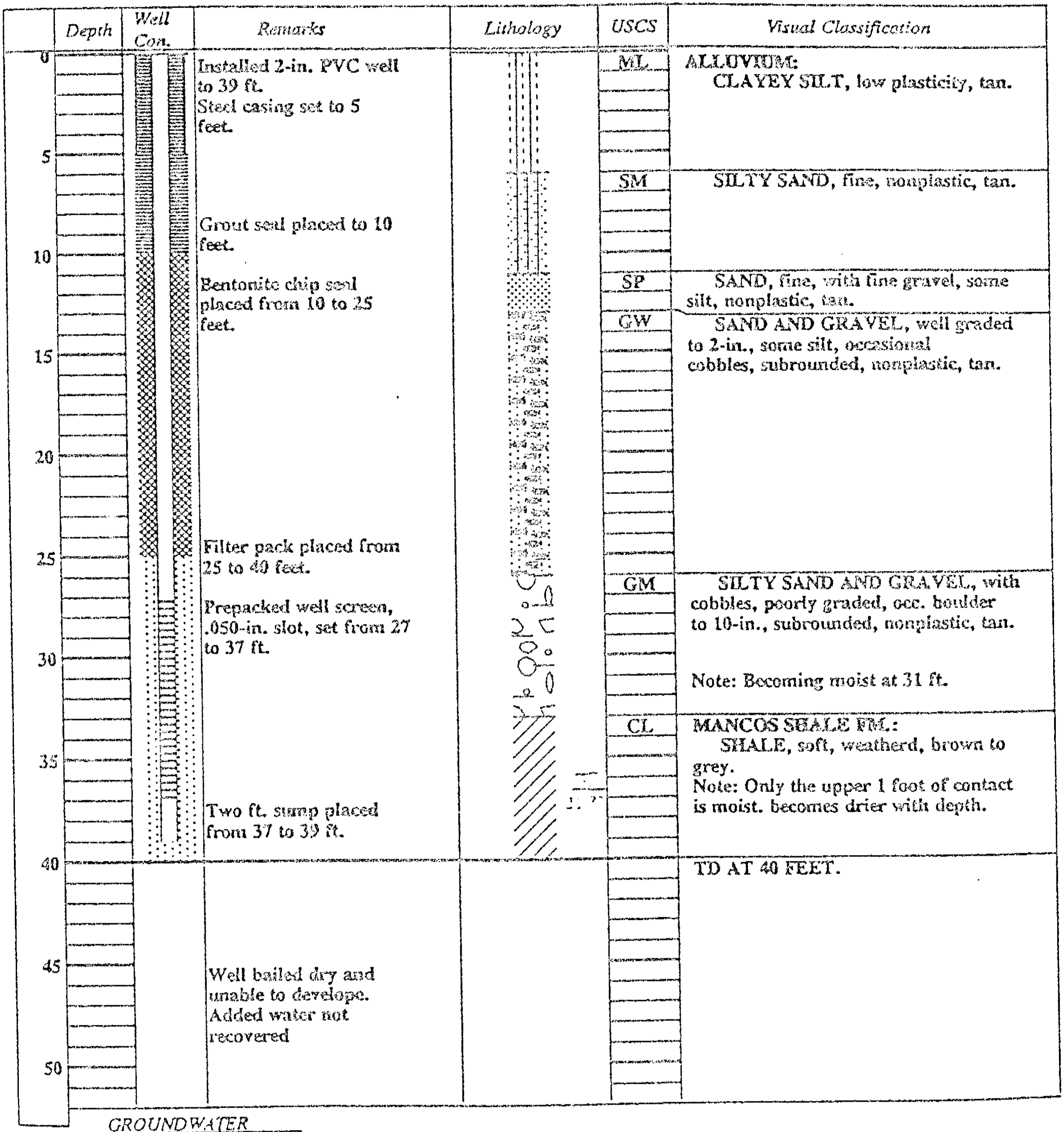
TOTAL DEPTH 40.0 feet

RIG TYPE ODEX,IR,TH-60

BORING TYPE ODEX ROTARY AIR

LOCATION N 6629.21 E 9608.98

DATUM MSL



Depth	Remarks	USCS	Visual Classification
0	Installed 2-in. PVC well to 39 ft. Steel casing set to 5 feet.	ML	ALLUVIUM: CLAYEY SILT, low plasticity, tan.
6		SM	SILTY SAND, fine, nonplastic, tan.
8	Grout seal placed to 10 feet.		
11	Bentonite chip seal placed from 10 to 25 feet.	SP	SAND, fine, with fine gravel, some silt, nonplastic, tan.
13		GW	SAND AND GRAVEL, well graded to 2-in., some silt, occasional cobbles, subrounded, nonplastic, tan.
25	Filter pack placed from 25 to 40 feet. Prepacked well screen, .050-in. slot, set from 27 to 37 ft.	GM	SILTY SAND AND GRAVEL, with cobbles, poorly graded, occ. boulder to 10-in., subrounded, nonplastic, tan. Note: Becoming moist at 31 ft.
33	Two ft. sump placed from 37 to 39 ft.	CL	MANCOS SHALE FM.: SHALE, soft, weatherd, brown to grey. Note: Only the upper 1 foot of contact is moist. becomes drier with depth.
40	Well bailed dry and unable to develope. Added water not recovered		TD AT 40 FEET.

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			

JEG TAC TEAM

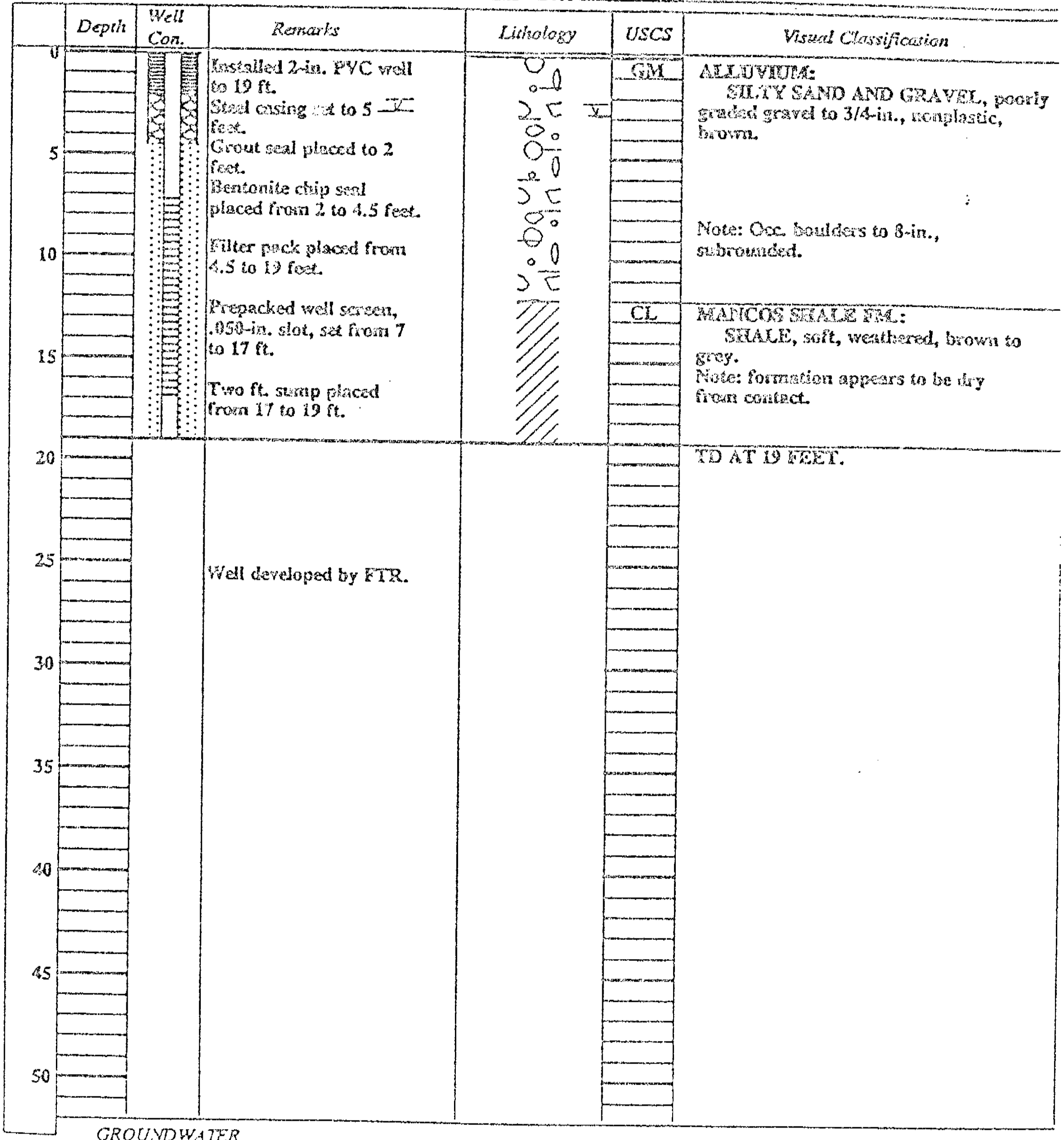
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 732

JOB NO. SHP01, DATE 03/29/93
SURFACE ELEVATION 4897.31
TOP OF FILTER PACK 4.50
WELL CASING TYPE 2.0-IN. SCHED. 40 PVC
COMPLETION ALLUVIUM.

TOTAL DEPTH 19.0 feet
RIG TYPE ODEX, IR, TH-60
BORING TYPE ODEX ROTARY AIR
LOCATION N 6837.70 E 12746.52
DATUM MSL



Depth	Remarks	USCS	Visual Classification
0	Installed 2-in. PVC well to 19 ft. Steel casing set to 5 feet.	GM	**ALLUVIUM:** SILTY SAND AND GRAVEL, poorly graded gravel to 3/4-in., nonplastic, brown.
5	Grout seal placed to 2 feet. Bentonite chip seal placed from 2 to 4.5 feet.		
10	Filter pack placed from 4.5 to 19 feet.		Note: Occ. boulders to 8-in., subrounded.
	Prepacked well screen, .050-in. slot, set from 7 to 17 ft.	CL	**MANCOS SHALE FM.:** SHALE, soft, weathered, brown to grey.
15	Two ft. sump placed from 17 to 19 ft.		Note: formation appears to be dry from contact.
20			TD AT 19 FEET.
25	Well developed by FTR.		
30			
35			
40			
45			
50			

GROUNDWATER

DEPTH	HOUR	DATE

JEG TAC TEAM

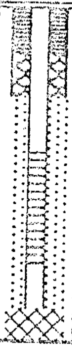
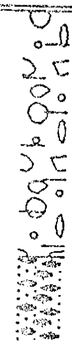
PROJECT SHIPROCK SITE, NM

Page 1 of 1

LOG OF WELL BORING NO. 733

JOB NO. SHP01, DATE 03/25/93
SURFACE ELEVATION 4888.24
TOP OF FILTER PACK 4.00
WELL CASING TYPE 2.0-IN.SCHED. 40 PVC
COMPLETION ALLUVIUM.

TOTAL DEPTH 15.0 feet
RIG TYPE ODEX,IR,TH-60
BORING TYPE ODEX ROTARY AIR
LOCATION N 12084.40 E 9657.68
DATUM MSL

Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0		Installed 2-in. PVC well to 13.5 ft. Steel casing set to 3 feet. Grout seal placed to 2 feet. Bentonite chip seal placed from 2 to 4.0 feet. Filter pack placed from 4.0 to 13.5 feet. Prepacked well screen, .050-in. slot, set from 6.5 to 11.5 ft.		GM	ALLUVIUM: SILTY SAND AND GRAVEL, poorly graded to 1-in., nonplastic, subrounded, brown.
5					
10				GP	~~SILTY~~ GRAVEL, with cobbles, poorly graded, nonplastic, brown.
15		Two ft. sump placed from 11.5 to 13.5 ft.			TD AT 15 FEET. Note: severe caving from 11 feet.
20		Cave-in fill from 13.5 to 15 feet.			
25		Well developed to 3 NTU.			
30					
35					
40					
45					
50					

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼			

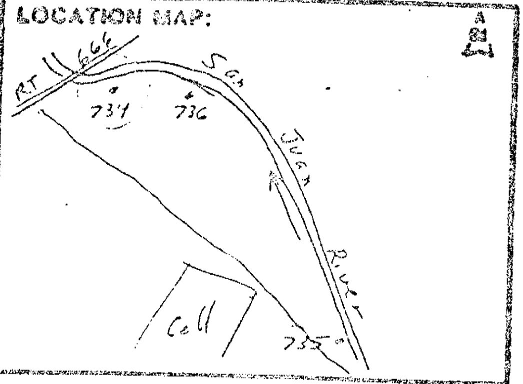
JEG TAC TEAM

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

BOREHOLE LOG (SOIL)

Page 1 of 1

LOCATION MAP:



SITE ID: SHP 01 LOCATION ID: 734
SITE COORDINATES (ft.):
N 11 700.20 E 8 702.66
GROUND ELEVATION (ft. MSL): 4896.22
DRILLING METHOD: Driven Well Point
DRILLING CONTR.: NECA Backhoe
DATE STARTED: 3/25/93
DATE COMPLETED: 3/25/93
FIELD REP.: D Tachan

GROUNDWATER LEVELS

DATE	TIME	DEPTH (ft.)
3/25/93		4'

LOCATION DESCRIPTION
SITE CONDITION

	DEPTH	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	TYPE	ID	BLOWS PER 6 in.	N VALUE	USCS	VISUAL CLASSIFICATION
0	2" —	—	—	—	—	—	— —	—	SM	Light brown medium to fine SAND – Little Silt, Roots
1										
2									SP	Light brown medium to fine SAND trace Silt
3										
4										(see comment)
5										
6										Alluvium
7							(7) 4893.22			
8										End of Well Point
9										
10										

COMMENTS: [illegible]

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D. 1.38" I.D. drive sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

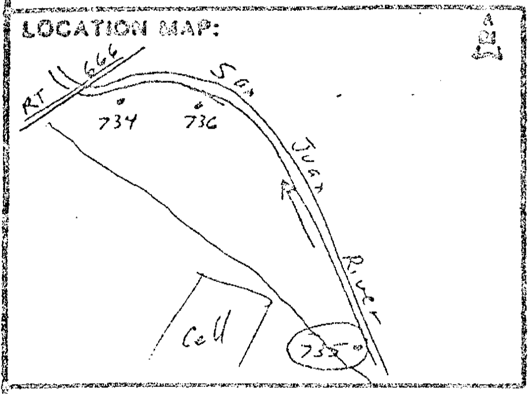
JEG-AL-SMO-28 (4/88)

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

BOREHOLE LOG (SOIL)

Page __ of __

LOCATION MAP:



SITE ID: SHP 01 LOCATION ID: 735
SITE COORDINATES (ft.):
N 2113.72 E 12,306.33
GROUND ELEVATION (ft, MSL): 4894.33
DRILLING METHOD: Test pit and driven
DRILLING CONTR.: NECA Backhoe
DATE STARTED: 3/26/93
DATE COMPLETED: 3/26/93
FIELD REP.: D. Jackson

GROUNDWATER LEVELS		
DATE	TIME	DEPTH (ft.)
3/26/93		4'

LOCATION DESCRIPTION
SITE CONDITION

DEPTH	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	TYPE	ID	BLOWS PER 6 in.	N VALUE	USCS	VISUAL CLASSIFICATION
0									
1								SP	Light brown medium to fine SAND, little(-) Silt
2									
3						4893.33			Alluvium.
4									
5									
6								GW	Brown coarse to fine GRAVEL, little coarse to fine Sand, trace Silt. Frequent cobbles and boulders (up to 2')
7									
8									
9						4903.33 (5')			
10									End of test pit

COMMENTS:

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D 1.38" I.D split spoon
U - 3" O.D 2.42" I.D tube sample
T - 3" O.D thin-walled Shelby tube

Page 1 of 1

PROJECT SHIPROCK SITE, NM

LOG OF WELL BORING NO. 735

JOB NO. SHF01, DATE 03/26/93

SURFACE ELEVATION 4894.32

TOP OF FILTER PACK

WELL CASING TYPE 2-IN.STAINLESS,.

COMPLETION FLOOD PLAIN

TOTAL DEPTH 6.0 feet

RIG TYPE

BORING TYPE DRIVEN WELL POINT

LOCATION N 7113.77 E 12306.33

DATUM MSL.

	Depth	Well Con.	Remarks	Lithology	USCS	Visual Classification
0			DRAFT	? ? ? ? ? ?		ALLUVIUM: UNKNOWN DESCRIPTION.
5						
						EST. TD AT ~~6.0~~ 9. according to David Tarbox all grave
10						
15						
20						
25						
30						
35						
40						
45						
50						

GROUNDWATER

	DEPTH	HOUR	DATE
∇			
∇			

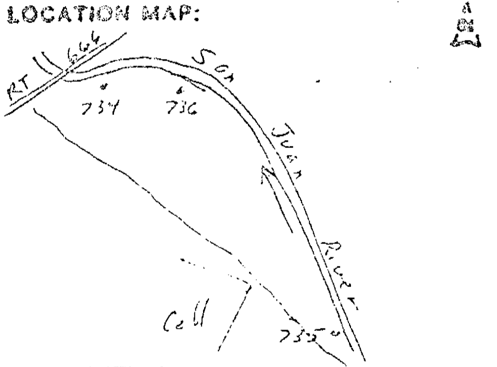
JEG TAC TEAM

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

BOREHOLE LOG (SOIL)

Page 1 of 2

LOCATION MAP:



SITE ID: SHP 01 LOCATION ID: 736
SITE COORDINATES (ft.):
N 11,620.69 E 9,902.76
GROUND ELEVATION (ft. MSL): 4887.63
DRILLING METHOD: Driven well point
DRILLING CONTR.: NECA Backhoe
DATE STARTED: 3/24/93
DATE COMPLETED: 3/24/93
FIELD REP.: D Tarbox

GROUNDWATER LEVELS

DATE	TIME	DEPTH (ft.)
3/24/93		3'

LOCATION DESCRIPTION
SITE CONDITION

DEPTH	SAMPLE INTERVAL	SAMPLE RECOVERY	SAMPLE RETAINED	TYPE	ID	BLOWS PER 6 In.	N VALUE	USCS	VISUAL CLASSIFICATION
0									
1								SP	Light brown medium to fine SAND, trace silt (see comment)
2									
3									
4									
5									
6									
7									End of well point
8									
9									
10									

COMMENTS: Upper 2' were excavated with backhoe and visually inspected. Remainder of formation thought to be same to 7" because point smoothly driven without hitting gravel.

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D 1.38" I.D drive sampler
U - 3" O.D 2.42" I.D tube sampler
T - 3" O.D thin-walled Shelby tube

JEG-AL-ENG-28 (4/85)

TRIBAL WELL NO >12T-520 (DOE 648) PWSID > ******* STATE NUMBER

WELL NAME/OTHER NO >NR017.1085X1545

WELL TYPE >WA WELL STATUS ACT WELL USE >DOM

QUAD NO > MILES WEST > 0.00 MILES SOUTH > 0.00

10 ACRE > 40 ACRE > 160 ACRE >NW SECT >36 TWNSHP >T30.0N RANGE >R18.0W

APPROXIMATE LOCATION >20 YDS NE OF FAIR GROUNDS

UTM COORD: X(EAST) >705856 Y(NORTH) >4072361 ZONE >12 OPERATOR >TRIBE O&M

WATERSHED CODE >14080105000 STATE >NM COUNTY >SA CHAPTER CODE >SHIP

GRAZING DISTRICT >12 LOCATION DATA SOURCE >WELL FILES/FLD CHKD 1/95

FIELD CHECKED BY >LNOTAH/BTSOSIE

WELLNO 12T-520 STARTED 10/29/1960 COMPLETED 2/ 7/1961

ELEVATION 4,941.0 FT DEPTH 1,850.0 FT DEPTH MEASURED / /

DEPTH IS R WELL DIA 18.00 IN

1 CASING DIA 16.00 IN FROM -1.0 FT TO 46.0 FT MATL STL

2 CASING DIA 12.00 IN FROM -1.0 FT TO 530.0 FT MATL STL

3 CASING DIA 9.62 IN FROM -3.0 FT TO 1,339.0 FT MATL STL

4 CASING DIA 7.00 IN FROM 844.0 FT TO 1,482.0 FT MATL STL

WELL NO= 12T-520

1 CASING PERFORATED FROM 1,482.0 FT TO 1,777.0 FT OPENING TYPE X

2 CASING PERFORATED FROM FT TO FT OPENING TYPE

3 CASING PERFORATED FROM FT TO FT OPENING TYPE

4 CASING PERFORATED FROM FT TO FT OPENING TYPE

5 CASING PERFORATED FROM FT TO FT OPENING TYPE

DATE WELL TURNED OVER TO TRIBE / /

FUNDED BY CONTRACTOR O.C. ROBINSON

```
SITE IMPROVEMENTS WP              TYPE OF LIFT         ENERGY SOURCE

PUMP HP    0        ON SITE STORAGE CAPACITY       0
STRUCTURE DATA SOURCE  WELL FILES

   TRIBAL WELL NO >12T-520      <    USGS AQUIFER CODE >221MRSN <

THICKNESS >  0.0<   NOMINAL YIELD > 150.0<    DATE YIELD MEASURED >03/13/1961

ENTER BT OR PT >  <    GPM > 350.0<  HOURS > 46.0<    TEST DATE >03/13/1961

DRAWDOWN >  380.0< OBSERVATION WELL DATA AVAILABLE (ENTER Y OR N) >N<

HORIZONTAL CONDUCTIVITY >  0.000<   SPECIFIC CAPACITY >0.92<

VERTICAL CONDUCTIVITY >  0.000<    STORAGE COEFFICIENT >.0000000

COEFFICIENT OF TRANSMISSIVITY >       0.0<

 * AVAILABILITY OF TEST DATA *          * LOGS AVAILABLE * (ENTER DL OR EL)
>N< MULTIPLE RATE DRAWDOWN TEST
>Y< SINGLE RATE DRAWDOWN TEST           >DL< DRILLERS LOG    >EL< ELECTRIC LOG
>N< MULTIPLE RATE/RECOVERY TEST .
>Y< RECOVERY TEST                        DATA SOURCE >                        <


 $RECNO    WELLNO             SWL DATE
  14657    12T-520            0.0  6/25/1985
  14658    12T-520            0.0  3/10/1961
                5442
 WELLNO              =12T-520
 GEOHYDRO-SEQ-NO  =  1
 GEOHYDRO-TOP     =     0.00
 GEOHYDRO-BOTTOM  =    30.00
 GEOHYDRO-UNIT    =110ALVM
 LITHOLOGY        =SDGL
 LITH-MODIFIER    =
 GEOHYDRO-C-UNIT  =N
                5443
 WELLNO              =12T-520
 GEOHYDRO-SEQ-NO  =  2
 GEOHYDRO-TOP     =    30.00
 GEOHYDRO-BOTTOM  =   248.00
 GEOHYDRO-UNIT    =210MNCS
 LITHOLOGY        =SHLE
 LITH-MODIFIER    =
 GEOHYDRO-C-UNIT  =N
                5444
 WELLNO              =12T-520
 GEOHYDRO-SEQ-NO  =  3
 GEOHYDRO-TOP     =   248.00
 GEOHYDRO-BOTTOM  =   330.00
 GEOHYDRO-UNIT    =211GLLP
 LITHOLOGY        =SDGL
 LITH-MODIFIER    =
 GEOHYDRO-C-UNIT  =N
                5445
 WELLNO              =12T-520
 GEOHYDRO-SEQ-NO  =  4
```

```
GEOHYDRO-TOP      =  330.00
GEOHYDRO-BOTTOM =  895.00
GEOHYDRO-UNIT    =210MNCS
LITHOLOGY         =SHLE
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =N
            5446
WELLNO            =12T-520
GEOHYDRO-SEQ-NO =  5
GEOHYDRO-TOP      =  895.00
GEOHYDRO-BOTTOM =1,015.00
GEOHYDRO-UNIT    =211GRRS
LITHOLOGY         =SHLE
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =N
            5447
WELLNO            =12T-520
GEOHYDRO-SEQ-NO =  6
GEOHYDRO-TOP      =1,015.00
GEOHYDRO-BOTTOM =1,180.00
GEOHYDRO-UNIT    =211DKOT
LITHOLOGY         =SDSL
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =N
            5448
WELLNO            =12T-520
GEOHYDRO-SEQ-NO =  7
GEOHYDRO-TOP      =1,180.00
GEOHYDRO-BOTTOM =1,342.00
GEOHYDRO-UNIT    =221BRSB
LITHOLOGY         =MDSN
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =N
            5449
WELLNO            =12T-520
GEOHYDRO-SEQ-NO =  8
GEOHYDRO-TOP      =1,342.00
GEOHYDRO-BOTTOM =1,485.00
GEOHYDRO-UNIT    =221WSRC
LITHOLOGY         =SNDS
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =S
            5450
WELLNO            =12T-520
GEOHYDRO-SEQ-NO =  9
GEOHYDRO-TOP      =1,485.00
GEOHYDRO-BOTTOM =1,610.00
GEOHYDRO-UNIT    =221RCPR
LITHOLOGY         =SNDS
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =S
            5451
WELLNO            =12T-520
GEOHYDRO-SEQ-NO = 10
GEOHYDRO-TOP      =1,610.00
GEOHYDRO-BOTTOM =1,760.00
GEOHYDRO-UNIT    =221SLWS
LITHOLOGY         =SNDS
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =P
            5452
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```
WELLNO           =12T-520
GEOHYDRO-SEQ-NO = 11
GEOHYDRO-TOP     =1,760.00
GEOHYDRO-BOTTOM =1,795.00
GEOHYDRO-UNIT    =221BLFF
LITHOLOGY        =SNDS
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =U
            5453
WELLNO           =12T-520
GEOHYDRO-SEQ-NO = 12
GEOHYDRO-TOP     =1,795.00
GEOHYDRO-BOTTOM =
GEOHYDRO-UNIT    =221SMVL
LITHOLOGY        =SDSL
LITH-MODIFIER    =
GEOHYDRO-C-UNIT =N
$RECNO   WELLNO        FWQ-SAMPLE-DATE FWQ-GEO-UNIT FWQ-MEASUREMENT FWQ-PARAM-DE
  2910   12T-520        3/10/61         221MRSN           30.0         temperature-
  2911   12T-520        6/25/85         221MRSN           32.5         temperature-
  2912   12T-520        3/10/61         221MRSN        3,000.0         specific cor
  2913   12T-520        6/25/85         221MRSN        3,900.0         specific cor
WELL FLOWED 155 GPM BEFORE IT WAS          << USGS COMMENT
PLUGGED BACK TO 1777 FT.         .         << USGS COMMENT
WELL CONFIRMED-UPDATED PER * O&M SURVEY OF FALL 91 *
FLOWING WELL NEAR FAIR GROUNDS AT SHIPROCK.  THE ORIGINAL
TOTAL DEPTH WAS 1850' PLUGGED BACK TO 1777'.  REPORTED FLOW-
ING WELL 155 GPM.  DETAILED BOREHOLE/CASING HISTORY IN WELL
FILE.  USGS WELL SCHEDULE WITH LITHOLOGIC AND STRATIGRAPHIC
LOGS IN FILE.  GEOHYDROLOGIC UNITS FROM USGS STRATIGRAPHIC
LOG.  WELL PRODUCES FROM AT LEAST 3 MEMBERS OF THE MORRISON
FM (221MRSN).  WATER QUALITY DATA AVAILABLE IN WELL FILE.
LOCATION COORDINATES MEASURED WITH GPS DEVICE 6 SATELLITES
VISIBLE.                      G. KINSEL/M.S. JOHNSON  3/21/95
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Appendix E: Diné College water level measurements

A schedule of water level measurements was established for the 30 monitoring wells located on the floodplain. An electric sounder made by JEG was used in measuring depth to water for each monitoring well from January 1995 to mid-November 1995. A Solinst sounder model 101, George-town, Ontario, Solinst-Canada Ltd. was used in from mid-November 1995 to July 1996. Frequent water-level measurements were required to evaluate possible interactions between the floodplain aquifer and the San Juan River. Water-levels were measured each week from April to May, 1995, and from September 1995 to August 1996. During the 1995 summer months, when San Juan River flowed high due to high snow melt and Navajo dam high release times (BOR, 1996), water level measurements were taken bi-weekly from June to August, 1995, and from June to July, 1996. Frequent data collection was crucial during the high flow and release at Navajo Dam upstream. Water-level elevation contour maps were made to observe the seasonal effects on the unconfined aquifer (Appendix E.4:) from the San Juan River. These frequent measurements allowed the observation of the effects on the alluvial aquifer from the water flow of the San Juan River.

Appendix E.1: 1995-1996 Weekly water-level measurements from top of casing

WELL	3/13/95 TOC (feet)	4/20/95 TOC (feet)	03-04/95 Ave. TOC (feet)	05/10/95 TOC (feet)	05/21/95 TOC (feet)	05/25/95 TOC (feet)	05/31/95 TOC (feet)	05/95 Ave. TOC (feet)	06/04/95 TOC (feet)	06/07/95 TOC (feet)	06/11/95 TOC (feet)	06/18/95 TOC (feet)	06/20/95 TOC (feet)
608		4.75	4.75		4.05	3.84	3.97	3.95	3.82	3.39	3.43	2.13	2.42
609		3.85	3.85		3.18	3.00	3.09	3.09	2.97	2.54	2.62	1.44	1.56
610		8.04	8.04		7.51	7.48	7.43	7.47	7.30	7.32	7.22	3.22	5.22
611		8.00	8.00		7.42	7.38	7.29	7.36	7.38	7.25	7.18	3.15	5.18
612													
613		6.20	6.20		5.83	5.72	5.69	5.75	5.68	5.68	5.65	3.02	3.78
614		6.20	6.20		5.41	5.41	5.31	5.38	5.28	5.30	5.91	2.07	3.49
615		6.20	6.20		5.95	5.94	5.84	5.91	5.82	5.82	5.83	1.87	3.03
616		6.21	6.21		5.40	5.31	5.20	5.30	5.13	4.98	4.92	2.72	2.88
617		6.22	6.22		5.86	5.76	5.67	5.76	5.65	5.66	5.67	3.00	3.25
618		5.32	5.32		5.35	5.30	5.22	5.29	5.21	5.21	5.17	2.37	2.78
619		7.00	7.00		6.83	6.79	6.74	6.79	6.80	6.81	6.78	5.67	5.44
620		3.93	3.93						4.08	4.06	4.12	1.57	1.57
621		4.51	4.51		4.38	4.45	4.55	4.46	4.48	4.53	4.56	1.87	1.87
622		4.21	4.21		4.21	4.28	4.25	4.25	4.32	4.41	4.44	1.50	1.5
623				5.91	5.95	5.96	5.93	5.94	5.97	5.96	5.95	4.43	4.37
624				6.14	6.18	6.22	6.08	6.16	6.21	6.16	6.23	4.20	4.53
625				5.93	5.91	5.93	5.94	5.93	5.96	5.96	5.98	4.52	4.35
626				5.22	4.94	4.97	5.02	5.04	5.04	5.07	5.09	1.01*	4.32
627	3.80		3.80	3.91	3.98	4.09	4.17	4.04	4.19	4.13	4.07	0.54*	3.22
628	4.26		4.26	5.62	4.53	4.58	4.64	4.84	4.10	4.57	4.55	1.40*	3.55
629	1.58		1.58	0.61	0.91	1.02	1.08	0.96	0.96	0.96	0.95	1.13	1.00
630	1.58		1.58	0.53*	0.95	1.02	1.15	1.04	1.01	1.57	1.02	1.14	1.00
725													
726													
732						4.20	4.37	4.29	3.87	3.53	3.61	1.51	1.51
733												1.90	1.9
734	4.85		4.85	6.40*	4.21	4.25	4.56	4.34	3.82	3.30	3.56	0.03	2.70
735		4.53	4.53		3.08	3.09	3.29	3.15	2.68	2.44	2.44	1.44	1.44
736	3.68		3.68	5.62	5.18	5.07	5.20	5.27	4.91	4.60	4.62	0.95	3.84
DATA BY	SBSMMM BTSS	SRMM		SRSM	SMMMBB	SMMMBB	SMMMBB		MMBB	MMBB	BBMM	SRBB	SRBB
NOTES					#620 cap stuck truck stuck in mud at #734				#620 cap came free		FP seismic survey 06/10	much of FP under water most wells inaccessible	some areas of FP still muddy

month/day/year
saturated areas used stick-up measurements
* deleted water-level values

TOC top of casing
bgs below groundsurface
WL water-level

BB Bernina Blackwater
CB Collette Brown
SB Stephanie Begay

TL Terri Lansman
SM Suzette Martin
MM Murrell Mitchell

BT Bernadette Tsosie
SS Steve Semken
SY Sonya Yazzie

SR Sheba Russell
WP Wendy Pierce

Appendix E.1: 1995-1996 Weekly water-level measurements from top of casing

WELL	06/26/95 TOC (feet)	06/29/95 TOC (feet)	06/95 Ave. TOC (feet)	07/02/95 TOC (feet)	07/06/95 TOC (feet)	07/09/95 TOC (feet)	07/13/95 TOC (feet)	07/16/95 TOC (feet)	07/19/95 TOC (feet)	07/23/95 TOC (feet)	07/26/95 TOC (feet)	07/95 Ave. TOC (feet)	08/02/95 TOC (feet)	08/09/95 TOC (feet)
608	2.57	2.72	2.93	2.91	3.34	3.74	4.07	4.35	4.50	4.82	5.13	4.11	5.53	5.85
609	1.71	1.86	2.10	2.02	2.57	2.85	3.20	3.53	3.66	3.92	4.20	3.24	4.63	4.98
610	5.60	5.78	5.95	6.00	6.33	6.54	6.76	6.96	7.14	7.32	7.51	6.82	7.92	8.23
611	5.57	5.72	5.92	5.91	6.65	6.45	6.76	6.86	7.06	7.23	7.40	6.79	7.80	8.11
612														
613	3.93	4.04	4.55	4.09	4.30	4.39	4.64	4.80	4.96	5.21	5.38	4.72	5.68	6.00
614	3.65	3.71	4.20	3.75	3.94	4.02	4.25	4.48	4.64	4.82	4.99	4.36	5.36	5.63
615	3.25	3.43	4.15	3.65	3.99	4.14	4.44	4.68	4.85	5.05	5.29	4.51	5.58	5.83
616	3.09	3.35	3.67	3.55	4.04	4.26	4.55	4.90	5.11	5.41	5.67	4.69	6.16	6.57
617	3.48	3.56	4.32	3.77	4.05	4.30	4.51	4.71	4.88	5.11	5.34	4.58	5.73	6.07
618	3.03	3.16	3.85	3.31	3.63	3.82	4.08	4.72	4.40	4.66	4.87	4.19	5.24	5.68
619	5.36	5.46	6.05	5.58	5.74	5.88	6.05	6.16	6.25	6.42	6.59	6.08	6.90	7.26
620	2.11	2.30	2.83	2.52	2.82	2.96	3.15	3.29	3.41	3.69	3.77	3.20	4.01	4.26
621	2.49	2.66	3.21	2.86	3.20	3.39	3.58	4.71	4.85	4.05	4.21	3.86	4.49	4.71
622	2.24	2.43	2.98	2.66	3.06	3.27	3.44	3.54	3.72	3.89	4.04	3.45	4.34	4.58
623	4.59	4.74	5.14	4.83	5.03	5.15	5.35	5.46	5.51	5.72	5.78	5.35	6.10	6.38
624	4.86	4.99	5.31	5.12	5.31	5.14	5.62	5.69	5.76	5.95	6.05	5.58	6.32	6.60
625	4.62	4.73	5.16	4.83	4.97	5.14	5.34	5.47	5.48	6.36	5.79	5.42	6.09	6.39
626	3.90	3.99	4.57	4.11	4.33	4.45	4.74	4.69	4.78	4.87	5.02	4.62	5.25	6.54
627	3.45	3.50	3.76	3.58	3.78	3.86	3.89	4.39	3.96*	4.14	4.20	3.98	4.45	4.67
628	3.89	3.94	4.10	4.03	4.20	4.31	4.32	4.39	4.40	4.60	5.67	4.49	4.91	5.13
629	1.37	1.42	1.11	1.54	1.74	1.88	1.88	1.92	1.96	2.12	2.20	1.91	2.41	2.55
630	1.44	1.50	1.24	1.60	1.77	1.93	1.96	2.02	2.03	2.22	2.28	1.98	2.43	2.61
725						14.80	14.79	14.75	14.78	14.72	14.77	14.77	14.57	14.45
726						26.59	26.64	26.64	26.67	26.66	26.68	26.65	26.69	26.64
732	1.51	3.49	2.72	3.64	3.46	4.32	4.70	5.27	6.52	6.86	6.23	5.13	6.67	7.09
733	1.9		1.90		5.66	5.71	5.94	6.33	6.62	6.87	7.14	6.32	7.52	7.88
734	3.30	3.82	2.93	3.64	3.55	4.62	5.07	5.50	5.75	6.09	6.44	5.11	6.79	7.14
735	1.44	2.57	2.06	2.54	3.56	3.49	3.76	4.31	4.60	5.11	5.45	4.10	6.93	6.34
736	4.18	4.35	3.92	4.40	5.09	5.16	5.41	5.82	6.04	6.32	6.56	5.60	7.02	7.39
DATA BY	MMBB	BBMM		BBMM	MMBBSRBT	BBMM	BBMM	BBWPMM	?	?	BBMM		?	BBWPMM
NOTES	FP gradually drying out	took photos			Bema here					#623 conn. and cap loose; needs check w/compass	Bema here FP survey began 07/25		FP survey continuing	

Appendix E.1: 1995-1996 Weekly water-level measurements from top of casing

WELL	03/16/95	08/95	10/16/95	10/18/95	10/23/95	10/25/95	10/30/95	10/95	11/01/95	11/06/95	11/08/95	11/13/95	11/27/95	11/95
	TOC (feet)	Ave. TOC (feet)	TOC (feet)	TOC (feet)	TOC (feet)	TOC (feet)	TOC (feet)	Ave. TOC (feet)	TOC (feet)	TOC (feet)	TOC (feet)	TOC (feet)	TOC (feet)	Ave. TOC (feet)
608	5.98	5.79		6.31		6.15		6.23	6.02		5.90		5.87	5.93
609	5.09	4.90		5.42		5.31		5.37	5.15		5.05		5.04	5.08
610	8.54	8.23		9.54		4.94		7.24	9.46		9.35		9.30	9.37
611	8.42	8.11		9.56		9.33		9.45	9.34		9.25		9.31	9.30
612														
613	7.73	6.47		7.54		7.52		7.53	7.55		7.45		7.42	7.47
614		5.50		7.10		7.09		7.10	7.10		7.06		7.06	7.07
615		5.71		7.32		7.29		7.31	7.32		7.24		7.25	7.27
616	6.82	6.52		7.68	7.64		7.50	7.61		7.52		7.43	7.41	7.45
617	6.38	6.06	4.76		4.76		7.36	5.63		7.38		7.32	7.33	7.34
618	6.85	5.92	6.93		6.93		6.85	6.90		6.84		6.78	6.77	6.80
619		7.08	8.26		8.23		8.05	8.18		8.05		7.98	8.02	8.02
620	4.47	4.25	5.02		4.85		4.74	4.87		4.80		4.72	4.78	4.77
621	4.92	4.71	5.00		5.47		5.24	5.24		5.28		5.21	5.29	5.26
622	5.81	4.91	5.32		5.30		5.19	5.27		5.17		5.12	5.19	5.16
623		6.24	7.18		7.17		6.70	7.02		6.98		6.90	6.92	6.93
624		6.46	7.32		7.26		7.17	7.25		7.14		7.09	7.08	7.10
625		6.24	7.90		7.40		6.98	7.43		6.93		6.83	6.79	6.85
626		5.90	5.81		5.74		5.65	5.73		5.60		5.58	5.58	5.59
627	4.62	4.58	4.63		4.54		4.49	4.55		4.47		4.43	4.53	4.48
628	5.12	5.05	5.70		5.05		4.96	5.24		4.95		4.88	4.93	4.92
629	2.46	2.47	1.84		1.83		1.79	1.82		1.75		1.78	1.80	1.78
630	2.49	2.51	1.95		1.93		1.85	1.91		1.86		1.87	1.88	1.87
725	14.20	14.41	14.44		14.44		14.18	14.35		13.97		13.42	13.34	13.58
726	27.00	26.78	26.09		26.79		27.40*	26.74		26.86		26.84	26.92	26.87
732	7.21	6.99		7.57		7.45		7.51		7.35	7.34		7.31	7.33
733	8.05	7.82		8.54		8.44		6.49		8.39	8.33		8.32	8.35
734	7.29	7.07	7.30		7.22		7.12	7.21		7.11		7.10	7.12	7.11
735	6.36	6.54		6.66		6.46		6.56	6.40		6.26		6.24	6.31
736	7.63	7.35	7.99		7.92		7.82	7.91		7.80		7.75	7.72	7.76
DATA BY	BBWPMM		WPMMCBSS	WPMMCB	WPMMCB	WPMMCB	WPCBMM		WPCBMM	WPCBMM	WPMM	MMWP	MMWPCB	
NOTES	UNM/Jacobs GW sampling and Berna's EM survey on 08/14-15	more EM on 08/02 Jacobs sounder down	in Sept.									first use of new Solinst sounder		

Appendix E.1: 1995-1996 Weekly water-level measurements from top of casing

WELL	12/04/95 TOC (feet)	12/07/95 TOC (feet)	12/13/95 TOC (feet)	12/95 Ave. TOC (feet)	01/04-05/96 DOE TOC (feet)	01/24/96 TOC (feet)	01/25/96 TOC (feet)	01/96 DOE + NCC Ave. TOC (feet)	02/26/96 TOC (feet)	02/29/96 TOC (feet)	03/04/96 TOC (feet)	02-03/96 Ave. TOC (feet)	05/09/96 TOC (feet)
608	5.90			5.90	5.90		6.12	6.01		6.05		6.05	5.98
609	5.00			5.00	5.05		5.32	5.19		5.19		5.19	5.19
610	6.28*				9.21		9.33	9.27		9.31		9.31	9.55
611	9.15			9.15	9.08		9.21	9.15		9.24		9.24	9.37
612													
613	7.51			7.51	7.28		7.39	7.34		7.42		7.42	7.61
614	7.11			7.11	6.91		7.01	6.96		8.51		8.51	8.80
615	7.19			7.19	7.14		7.28	7.21		7.20		7.20	7.41
616		7.40		7.40	7.45		7.69	7.57		7.59		7.59	7.46
617		7.24		7.24	7.20		7.41	7.31		7.32		7.32	7.42
618		6.78		6.78	6.67		6.88	6.78		6.79		6.79	6.94
619		8.40		8.40	7.78		7.97	7.88		7.90		7.90	8.18
620		4.81		4.81	4.58		4.91	4.75		4.77		4.77	4.99
621		5.22		5.22	5.09		5.30	5.20		5.30		5.30	5.41
622		5.07		5.07	5.05		5.15	5.10		5.07		5.07	5.37
623		6.91		6.91	7.71		6.89	7.30		6.81		6.81	7.11
624		7.13		7.13	6.89		7.12	7.01		6.98		6.98	7.23
625		6.82		6.82	6.63		6.83	6.73					7.00
626					5.38		5.93	5.66		5.51		5.51	5.83
627		4.56		4.56	4.14		4.53	4.34		4.39	4.47	4.43	4.89
628		5.40		5.40	4.60		5.30	4.95		4.83	4.91	4.87	5.35
629	1.89	5.61*		1.89	1.73		1.99	1.86		1.94	2.07	2.01	2.33
630	2.00			2.00	1.84		2.08	1.96		1.97	2.18	2.08	2.41
725	13.29			13.29		13.44		13.44	13.71		14.19	13.95	14.22
726	26.91		26.98	26.95		27.17		27.17	27.52		27.69	27.61	26.69
732	7.33			7.33	7.56	7.91		7.75	7.66			7.66	6.72
733	8.31			8.31		8.74		8.74	8.61			8.61	8.01
734	7.15			7.15	6.21		7.63	6.92		7.53	8.80	8.17	6.68
735	7.15		8.34	7.75			6.81*			7.48		7.48	6.04
736	7.69			7.69	6.22		8.07	7.15		8.02		8.02	7.53
DATA BY	CBWPMM	CBWPMM	MMWP			CBWP	CBWPMM		WPCB	WPMM	WPCBBT		MMWPCB
NOTES			Rain; FP too muddy for access		DOE Contractors annual water sampling.				snow in AM		Berna here; casings measured	average includes wells done 02/29	UNM soil samples on FP 05/15

Appendix E.1: 1995-1996 Weekly water-level measurements from top of casing

WELL	05/23/96 TOC (feet)	05/96 Ave. TOC (feet)	06/06/96 TOC (feet)	06/13/96 TOC (feet)	06/20/96 TOC (feet)	06/30/96 TOC (feet)	06/96 Ave. TOC (feet)	07/01/96 TOC (feet)	07/08/96 TOC (feet)	07/11/96 TOC (feet)	07/96 Ave. TOC (feet)
608	5.74	5.86	5.85	5.79	5.88		5.84	6.04	6.64	6.75	6.48
609	4.91	5.05	4.99	6.04	5.00		5.34	5.15	5.70	5.91	5.59
610	9.27	9.41	9.46	9.44			9.45	9.35	9.58	9.68	9.54
611	9.12	9.25	9.35	9.19			9.27	9.24	9.50	9.77	9.50
612								6.77	7.24	7.57	7.19
613	7.50	7.56	7.67	7.65			7.66	7.69	7.79	8.38	7.95
614	7.50	8.15	7.24	7.18			7.21	7.18		7.40	7.29
615	7.25	7.33	7.38	7.36			7.37	7.44	5.03*	7.65	7.55
616	7.06	7.26	7.13	7.17			7.15	7.45	7.85	7.97	7.76
617	7.25	7.34	7.04	7.38			7.21	7.51	7.75	7.80	7.69
618	6.74	6.84	6.82	6.63			6.73	7.04	7.16	7.25	7.15
619	8.17	8.18	8.04				8.04	8.66	8.77	8.99	8.81
620	5.05	5.02	5.29				5.29	5.42	5.63	5.70	5.58
621	5.53	5.47	5.76				5.76	5.93	6.06	6.25	6.09
622	5.37	5.37	5.64				5.64	6.00	6.00	6.06	6.02
623	7.17	7.14	7.04				7.04	7.64	7.74	7.86	7.75
624	7.35	7.29	7.69				7.69	7.84	8.00	8.08	7.97
625	7.11	7.06	7.36				7.36	7.57	7.80	7.80	7.72
626	5.95	5.89	6.22				6.22	6.41	6.74	5.83	6.33
627	4.95	4.92	5.94				5.94	5.41	5.66	6.15	5.74
628	5.45	5.40	5.97				5.97	5.84	6.51	6.71	6.35
629	2.41	2.37	2.98	3.40	3.64		3.34	3.14	3.97	3.82	3.64
630	2.50	2.46	3.07	3.52	3.67		3.42	3.27	3.82	4.03	3.71
725	14.13	14.18	14.45	14.90	14.80	14.35	14.63		14.78	14.92	14.85
726	27.37	27.03	27.45	27.40	27.41	27.33	27.40		27.29	27.35	27.32
732	6.47	6.60	6.09			7.02	6.56		7.93	7.90	7.92
733	7.93	7.97	7.35			7.88	7.62		8.57	8.65	8.61
734	8.42	7.55	6.01	6.15	6.19		6.12	7.00	6.76	6.74	6.83
735	5.63	5.84	5.04	5.46	5.46		5.33	7.21	6.66	6.98	6.95
736	7.14	7.34	7.14	7.08	7.29		7.17	8.62	6.59*	8.00	8.31
DATA BY	WPMM		WPMM	MMSYTL	MMTLSY	MMSYTL		MMSYTL	TLSYMM	TLMMSY	
NOTES	measured stake positions			Bema here; EM surveys on 6/14,17; Bronco back window broken	Bronco stuck badly near #612; rain; bad day cut short			casing dim measured	GPS readings on FP by Isely team	More GPS on 7/19; Bronco not running well	

Appendix E.2: 1995-1996 Monthly averages for below ground surface water-level measurements

WELL	Ground surface Elevation (meters)	Casing Stick-up (meters)	03-04/95 Average BGS (meters)	05/95 Average BGS (meters)	06/95 Average BGS (meters)	07/95 Average BGS (meters)	08/95 Average BGS (meters)	09/95 Average BGS (meters) estimated	10/95 Average BGS (meters)	11/95 Average BGS (meters)	12/95 Average BGS (meters)	01/96 Average BGS (meter
608	1491.31	0.65	0.80	0.55	0.24	0.60	1.11	1.19	1.25	1.16	1.15	1.18
609	1491.26	0.44	0.74	0.50	0.20	0.55	1.06	1.14	1.20	1.11	1.09	1.14
610	1491.68	0.98	1.47	1.30	0.84	1.10	1.53	1.70	1.23	1.88		1.85
611	1491.71	0.96	1.48	1.28	0.84	1.11	1.51	1.69	1.92	1.87	1.83	1.83
612	1491.05	0.43										
613	1491.05	0.92	0.97	0.83	0.46	0.52	1.05	1.24	1.37	1.35	1.37	1.31
614	1491.03	0.63	1.26	1.01	0.65	0.70	1.04	1.31	1.53	1.52	1.54	1.49
615	1490.77	0.57	1.32	1.23	0.70	0.81	1.17	1.44	1.66	1.65	1.62	1.63
616	1490.71	0.50	1.39	1.11	0.67	0.92	1.48	1.64	1.81	1.77	1.75	1.80
617	1490.58	0.55	1.34	1.20	0.77	0.84	1.29	1.20	1.16	1.69	1.65	1.67
618	1490.51	0.50	1.12	1.11	0.67	0.77	1.30	1.48	1.60	1.57	1.56	1.56
619	1490.78	0.53	1.60	1.54	1.31	1.32	1.62	1.83	1.96	1.91	2.03	1.87
620	1489.97	0.48	0.72		0.39	0.50	0.82	0.92	1.01	0.98	0.99	0.97
621	1490.02	0.57	0.81	0.79	0.41	0.61	0.87	0.92	1.03	1.03	1.02	1.02
622	1490.08	0.47	0.82	0.83	0.44	0.59	1.03	1.13	1.14	1.11	1.08	1.09
623	1490.43	0.58		1.23	0.99	1.05	1.32	1.49	1.56	1.54	1.53	1.65
624	1490.34	0.68		1.20	0.94	1.02	1.29	1.44	1.53	1.49	1.49	1.46
625	1490.44	0.58		1.22	0.99	1.07	1.32	1.59	1.68	1.50	1.49	1.47
626	1490.09	0.61		0.93	0.79	0.80	1.19	1.28	1.14	1.10		1.12
627	1489.81	0.61	0.55	0.62	0.54	0.60	0.79	0.80	0.78	0.75	0.78	0.71
628	1489.98	0.62	0.68	0.86	0.63	0.75	0.92	1.00	0.98	0.88	1.03	0.89
629	1489.31	0.10	0.39	0.20	0.24	0.49	0.66	0.60	0.46	0.45	0.48	0.47
630	1489.33	0.02	0.46	0.30	0.36	0.56	0.75	0.70	0.56	0.55	0.59	0.58
725	1495.47	0.68	0.00			3.82	3.71	3.70	3.69	3.46	3.37	3.41
726	1505.10	0.63				7.50	7.54	7.54	7.52	7.57	7.59	7.66
732	1492.26	0.46		0.84	0.37	1.10	1.67	1.76	1.83	1.77	1.77	1.90
733	1489.94	0.58				1.34	1.80	1.90	2.00	1.96	1.95	2.08
734	1489.32	0.01	1.47	1.31	0.88	1.55	2.15	2.20	2.19	2.16	2.17	2.10
735	1491.79	0.44	0.94	0.52	0.19	0.81	1.56	1.53	1.56	1.48	1.92	
736	1489.75	0.29	0.83	1.32	0.91	1.42	1.95	2.05	2.12	2.08	2.05	1.89

Appendix E.2: 1995-1996 Monthly averages for below ground surface water-level measurements

WELL	02-03/96 Average BGS (meters)	05/96 Average BGS (meters)	06/96 Average BGS (meters)	07/96 Average BGS (meters)
608	1.19	1.14	1.13	1.32
609	1.14	1.10	1.19	1.26
610	1.86	1.89	1.90	1.93
611	1.85	1.86	1.86	1.93
612				1.77
613	1.34	1.38	1.41	1.50
614	1.96	1.85	1.57	1.59
615	1.63	1.67	1.68	1.73
616	1.81	1.71	1.67	1.86
617	1.68	1.68	1.65	1.79
618	1.57	1.58	1.55	1.68
619	1.87	1.96	1.92	2.15
620	0.98	1.05	1.14	1.23
621	1.05	1.10	1.19	1.29
622	1.08	1.17	1.25	1.37
623	1.50	1.60	1.57	1.78
624	1.45	1.54	1.66	1.75
625		1.57	1.66	1.77
626	1.07	1.19	1.29	1.32
627	0.74	0.89	1.20	1.14
628	0.87	1.03	1.20	1.32
629	0.52	0.63	0.92	1.02
630	0.61	0.73	1.02	1.11
725	3.57	3.64	3.78	3.84
726	7.79	7.61	7.73	7.70
732	1.87	1.55	1.53	1.95
733	2.04	1.85	1.74	2.04
734	2.48	2.29	1.85	2.07
735	1.84	1.34	1.19	1.68
736	2.16	1.95	1.90	2.07

Appendix E.3: 1995-1996 Monthly averages for groundwater elevations

WELL	Ground surface Elevation (meters)	03-04/95 Average Elevation (m)	05/95 Average Elevation (m)	06/95 Average Elevation (m)	07/95 Average Elevation (m)	08/95 Average Elevation (m)	09/95 Average WL Elevation (m) estimated	10/95 Average Elevation (m)	11/95 Average Elevation (m)	12/95 Average Elevation (m)
608	1491.31	1490.51	1490.75	1491.07	1490.71	1490.19	1490.11	1490.06	1490.15	1490.16
609	1491.26	1490.53	1490.76	1491.06	1490.71	1490.21	1490.13	1490.06	1490.15	1490.17
610	1491.68	1490.20	1490.38	1490.84	1490.58	1490.15	1489.98	1490.45	1489.80	
611	1491.71	1490.23	1490.42	1490.86	1490.60	1490.20	1490.02	1489.79	1489.83	1489.88
612	1491.05									
613	1491.05	1490.08	1490.22	1490.58	1490.53	1490.00	1489.81	1489.67	1489.69	1489.68
614	1491.03	1489.77	1490.02	1490.38	1490.33	1489.99	1489.72	1489.50	1489.51	1489.49
615	1490.77	1489.44	1489.53	1490.07	1489.96	1489.59	1489.33	1489.11	1489.12	1489.14
616	1490.71	1489.32	1489.60	1490.04	1489.79	1489.23	1489.07	1488.90	1488.94	1488.96
617	1490.58	1489.24	1489.37	1489.81	1489.73	1489.28	1489.38	1489.42	1488.89	1488.92
618	1490.51	1489.39	1489.40	1489.84	1489.74	1489.21	1489.04	1488.91	1488.94	1488.95
619	1490.78	1489.18	1489.25	1489.47	1489.46	1489.16	1488.95	1488.82	1488.87	1488.76
620	1489.97	1489.25		1489.59	1489.47	1489.15	1489.05	1488.96	1489.00	1488.98
621	1490.02	1489.21	1489.22	1489.61	1489.41	1489.15	1489.10	1488.99	1488.98	1488.99
622	1490.08	1489.26	1489.25	1489.64	1489.49	1489.05	1488.95	1488.94	1488.97	1489.00
623	1490.43		1489.20	1489.44	1489.38	1489.10	1488.94	1488.87	1488.89	1488.90
624	1490.34		1489.14	1489.40	1489.32	1489.05	1488.90	1488.81	1488.86	1488.85
625	1490.44		1489.22	1489.45	1489.37	1489.12	1488.84	1488.76	1488.93	1488.94
626	1490.09		1489.16	1489.31	1489.29	1488.90	1488.82	1488.95	1489.00	
627	1489.81	1489.27	1489.19	1489.28	1489.21	1489.03	1489.01	1489.04	1489.06	1489.03
628	1489.98	1489.30	1489.12	1489.34	1489.23	1489.05	1488.97	1489.00	1489.09	1488.95
629	1489.31	1488.92	1489.11	1489.06	1488.82	1488.65	1488.71	1488.85	1488.86	1488.83
630	1489.33	1488.86	1489.03	1488.97	1488.74	1488.58	1488.63	1488.76	1488.78	1488.74
725	1495.47				1491.65	1491.76	1491.78	1491.78	1492.02	1492.10
726	1505.10				1497.60	1497.56	1497.56	1497.57	1497.53	1497.51
732	1492.26		1491.42	1491.89	1491.16	1490.59	1490.50	1490.43	1490.49	1490.49
733	1489.94			1489.94	1488.59	1488.14	1488.03	1487.93	1487.98	1487.99
734	1489.32	1487.85	1488.01	1488.44	1487.77	1487.17	1487.12	1487.13	1487.16	1487.15
735	1491.79	1490.85	1491.27	1491.60	1490.98	1490.23	1490.26	1490.23	1490.30	1489.87
736	1489.75	1488.92	1488.43	1488.84	1488.33	1487.80	1487.70	1487.63	1487.67	1487.69

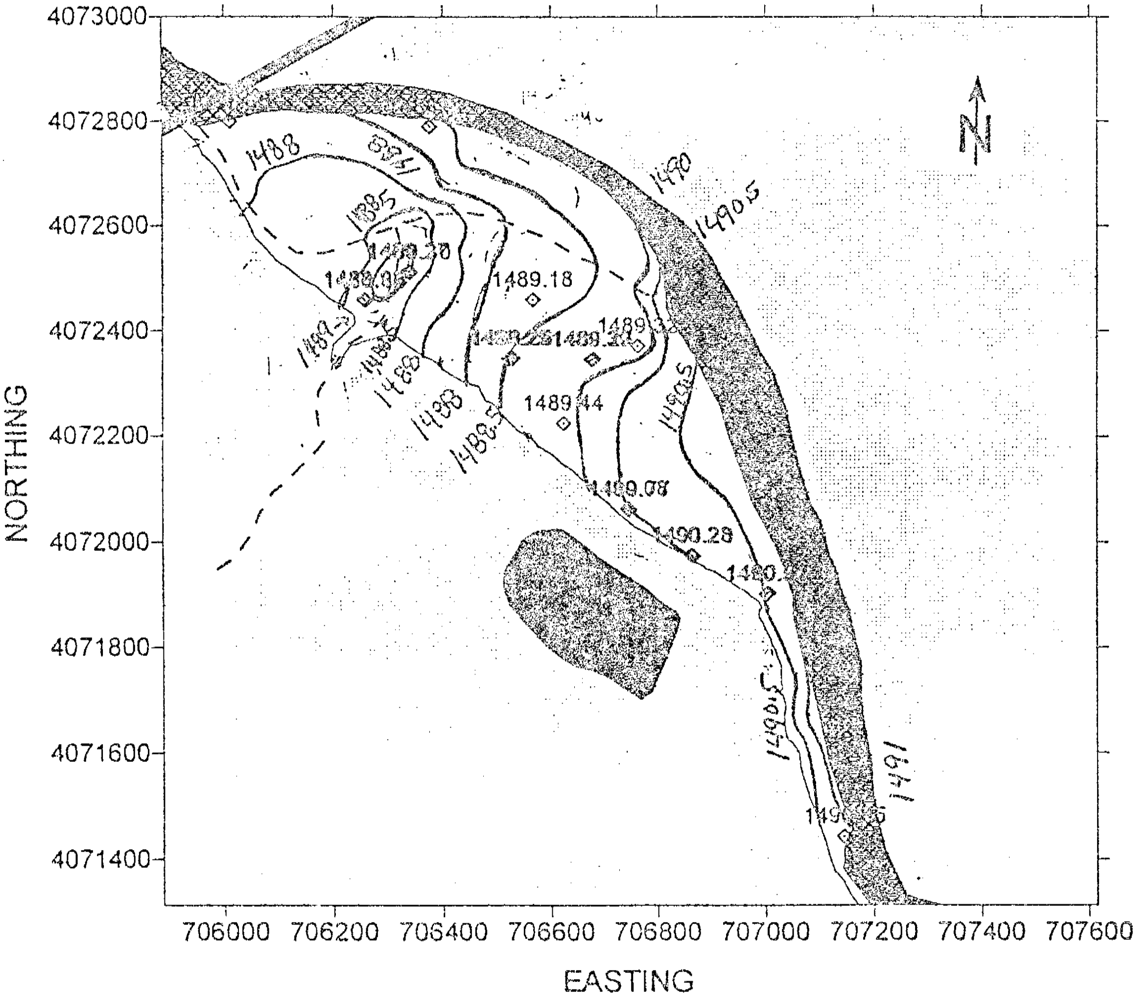
Appendix E.3: 1995-1996 Monthly averages for groundwater elevations

01/96 Average Elevation (m)	02-03/96 Average Elevation (m)	05/96 Average Elevation (m)	06/96 Average Elevation (m)	07/96 Average Elevation (m)
1490.13	1490.11	1490.17	1490.18	1489.98
1490.12	1490.12	1490.16	1490.07	1490.00
1489.83	1489.82	1489.79	1489.77	1489.75
1489.88	1489.85	1489.85	1489.84	1489.77
				1489.28
1489.73	1489.71	1489.67	1489.63	1489.54
1489.54	1489.07	1489.18	1489.46	1489.44
1489.14	1489.14	1489.10	1489.09	1489.03
1488.91	1488.90	1489.00	1489.04	1488.85
1488.90	1488.90	1488.90	1488.93	1488.79
1488.95	1488.94	1488.93	1488.96	1488.83
1488.92	1488.91	1488.82	1488.87	1488.63
1489.00	1488.99	1488.92	1488.84	1488.75
1489.00	1488.97	1488.92	1488.83	1488.73
1488.99	1489.00	1488.91	1488.82	1488.71
1488.78	1488.93	1488.83	1488.86	1488.65
1488.88	1488.89	1488.80	1488.68	1488.59
1488.97		1488.87	1488.78	1488.67
1488.98	1489.02	1488.91	1488.80	1488.77
1489.10	1489.07	1488.92	1488.61	1488.67
1489.09	1489.11	1488.95	1488.77	1488.66
1488.84	1488.79	1488.68	1488.39	1488.29
1488.75	1488.71	1488.60	1488.30	1488.22
1492.06	1491.90	1491.83	1491.70	1491.63
1497.44	1497.31	1497.48	1497.37	1497.39
1490.36	1490.39	1490.71	1490.72	1490.31
1487.86	1487.90	1488.09	1488.20	1487.90
1487.22	1486.84	1487.03	1487.47	1487.25
	1489.95	1490.45	1490.60	1490.11
1487.86	1487.59	1487.80	1487.85	1487.68

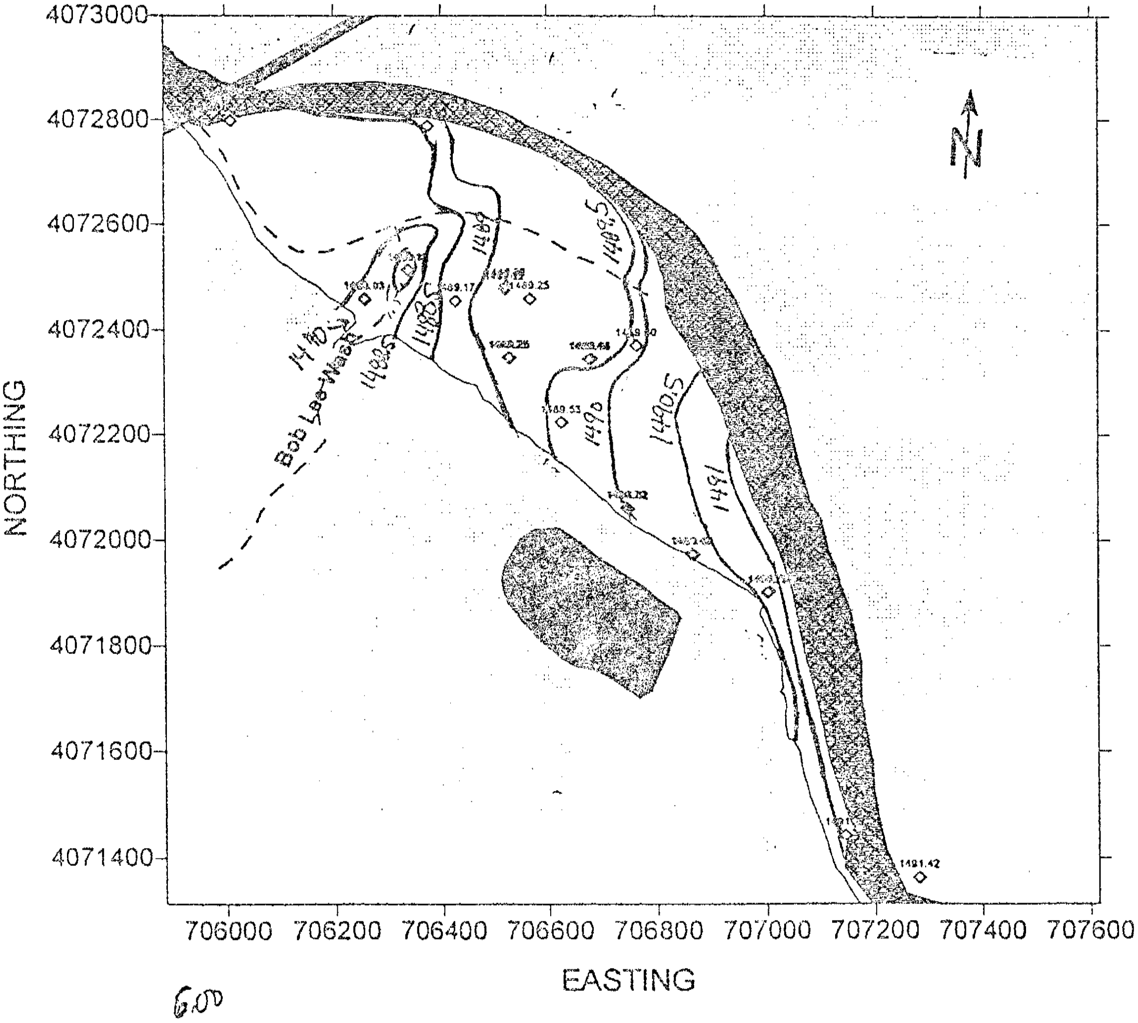
Appendix E.4: Monthly groundwater elevation contour maps for the unconfined aquifer.

Piezometric surface contour maps were mechanically drawn from the averages of monthly water-level measurements for each month from April 1995 to June, 1996.

March-April 1995
Water Elevation (meters)

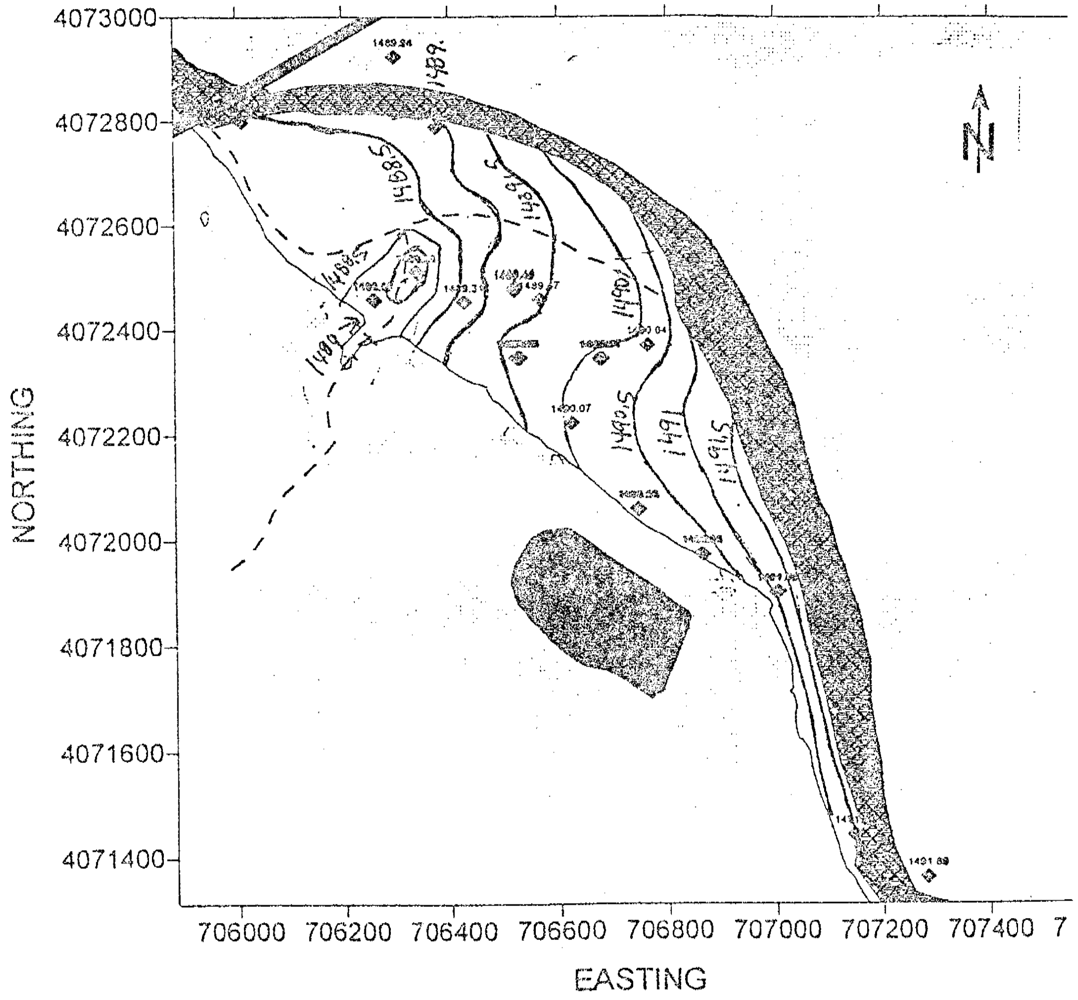


May 1995
Water Elevation (meters)

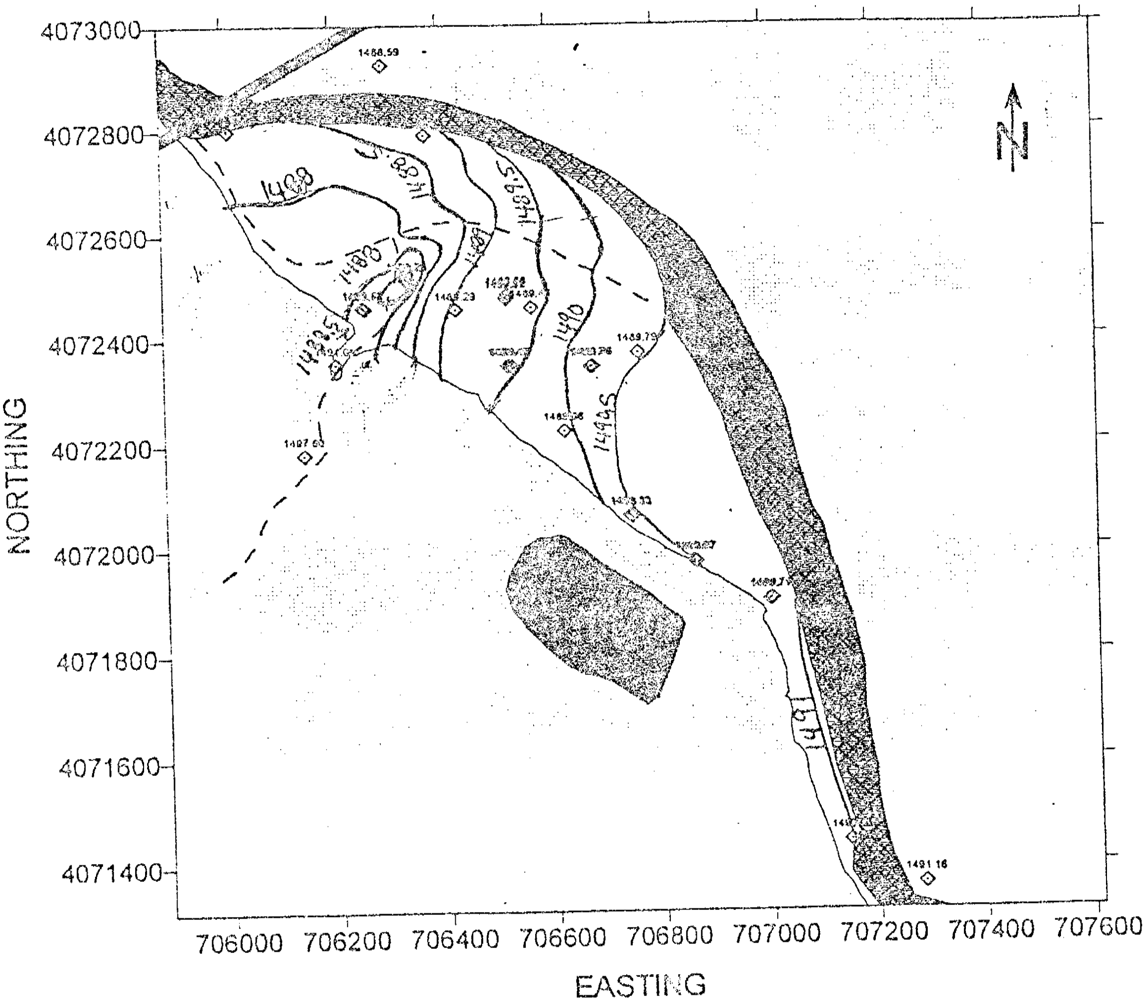


6.00

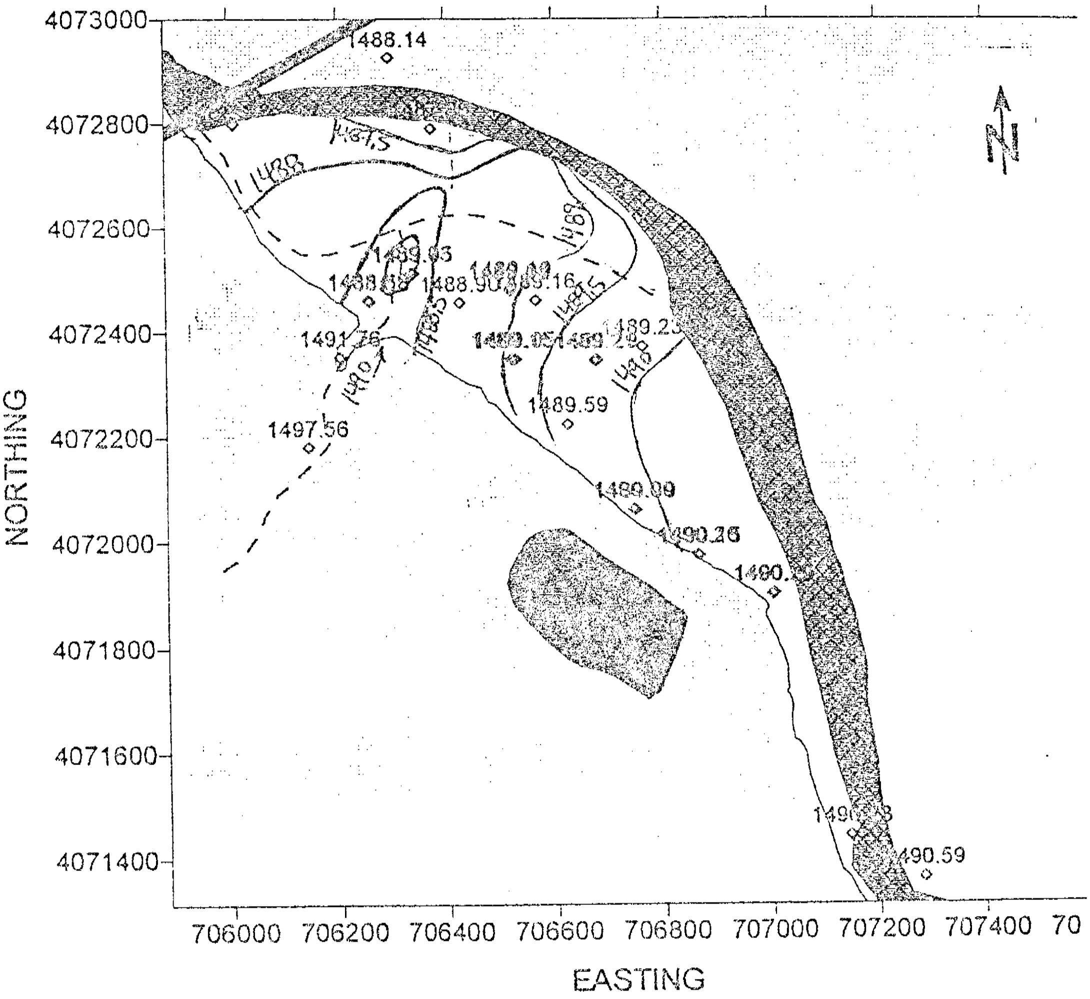
June 1995
Water Elevation (meters)



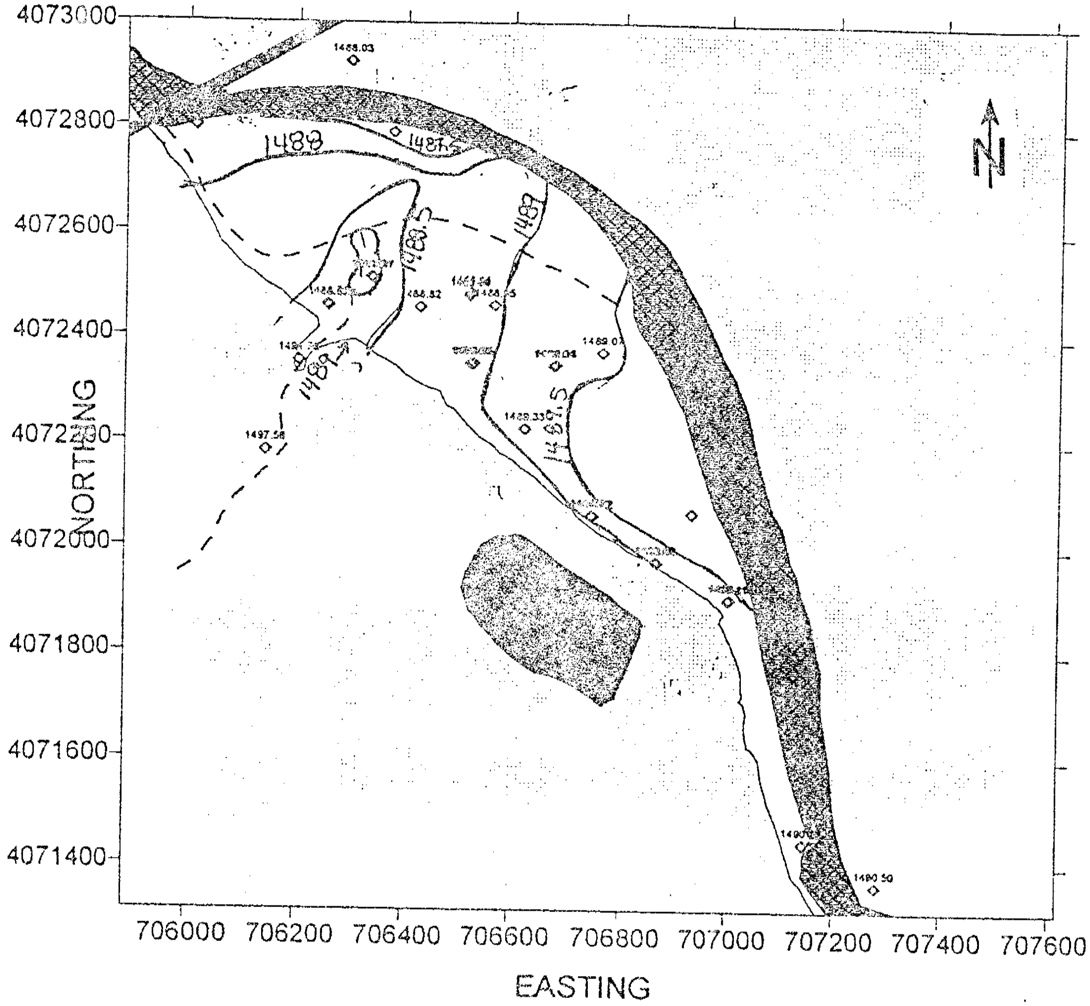
July 1995
Water Elevation (meters)

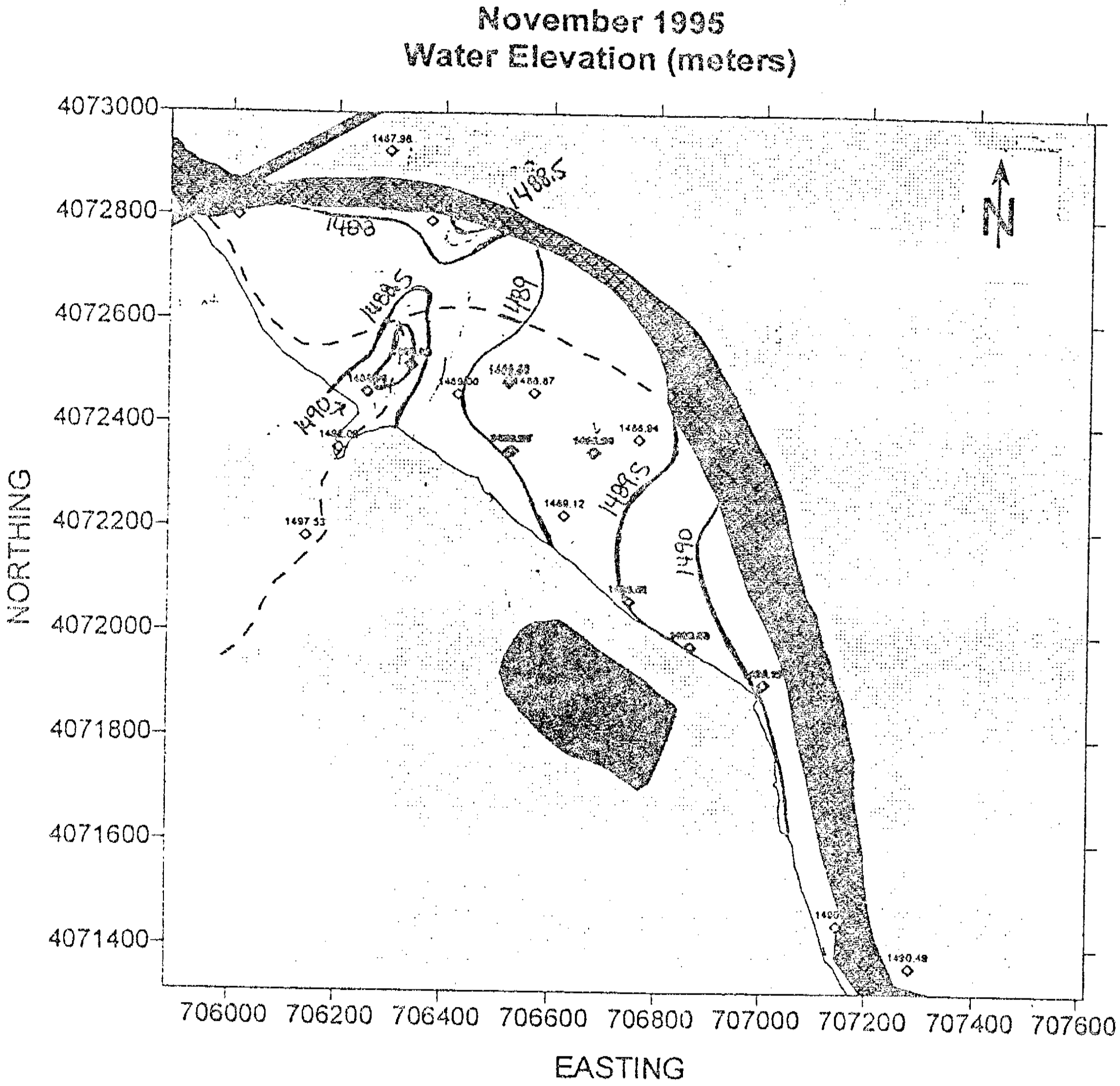


August 1995
Water Elevation (meters)



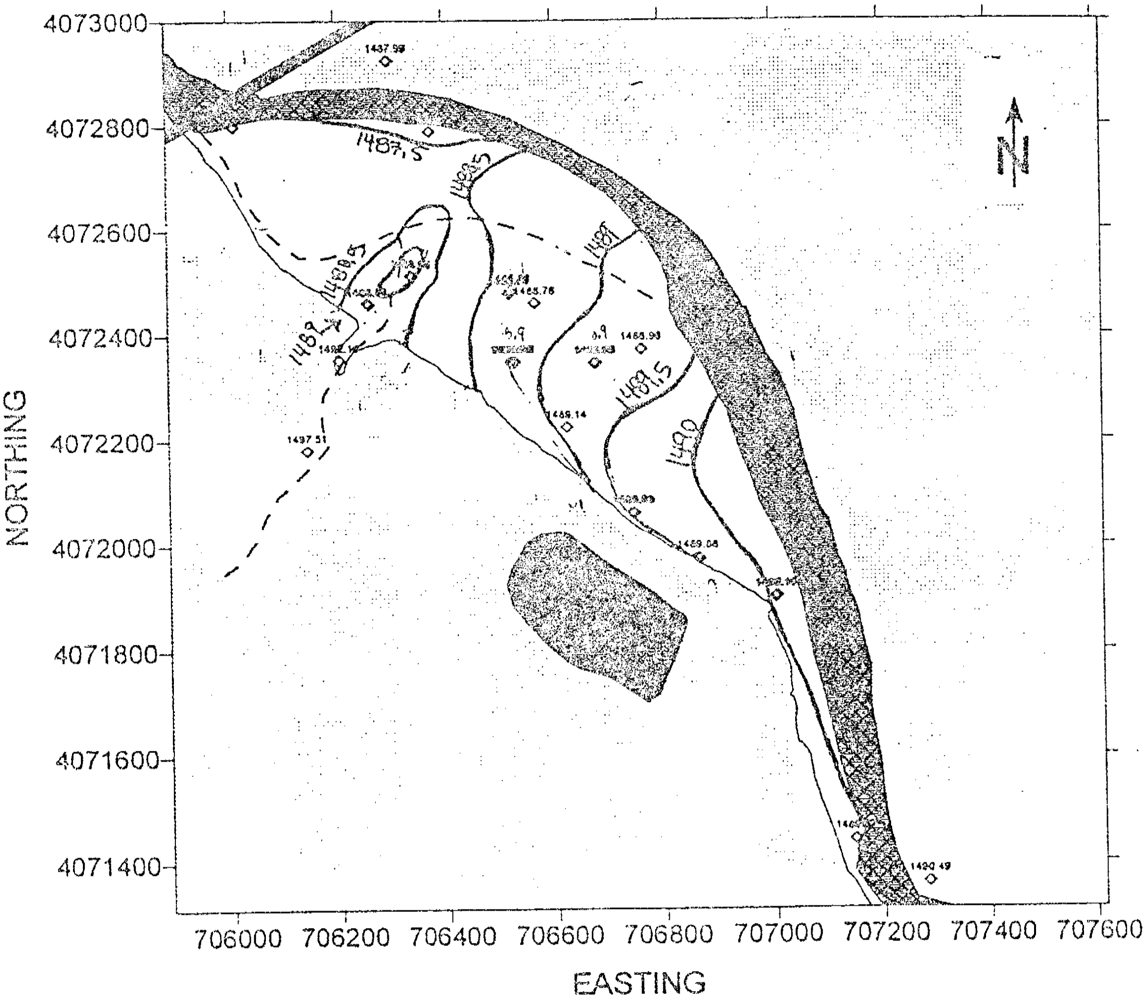
October 1995
Water Elevation (meters)



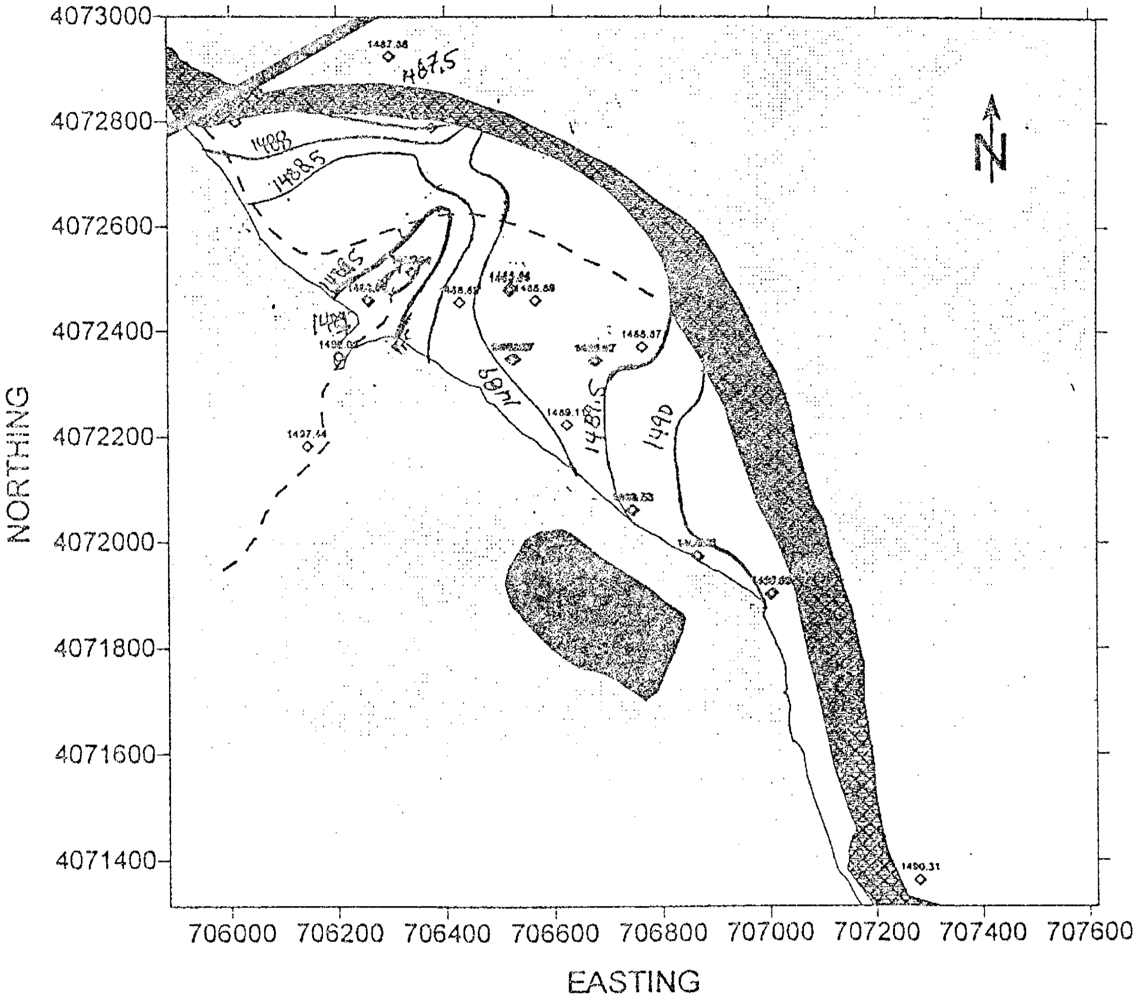

November 1995
Water Elevation (meters)

Contour interval 0.5 meters

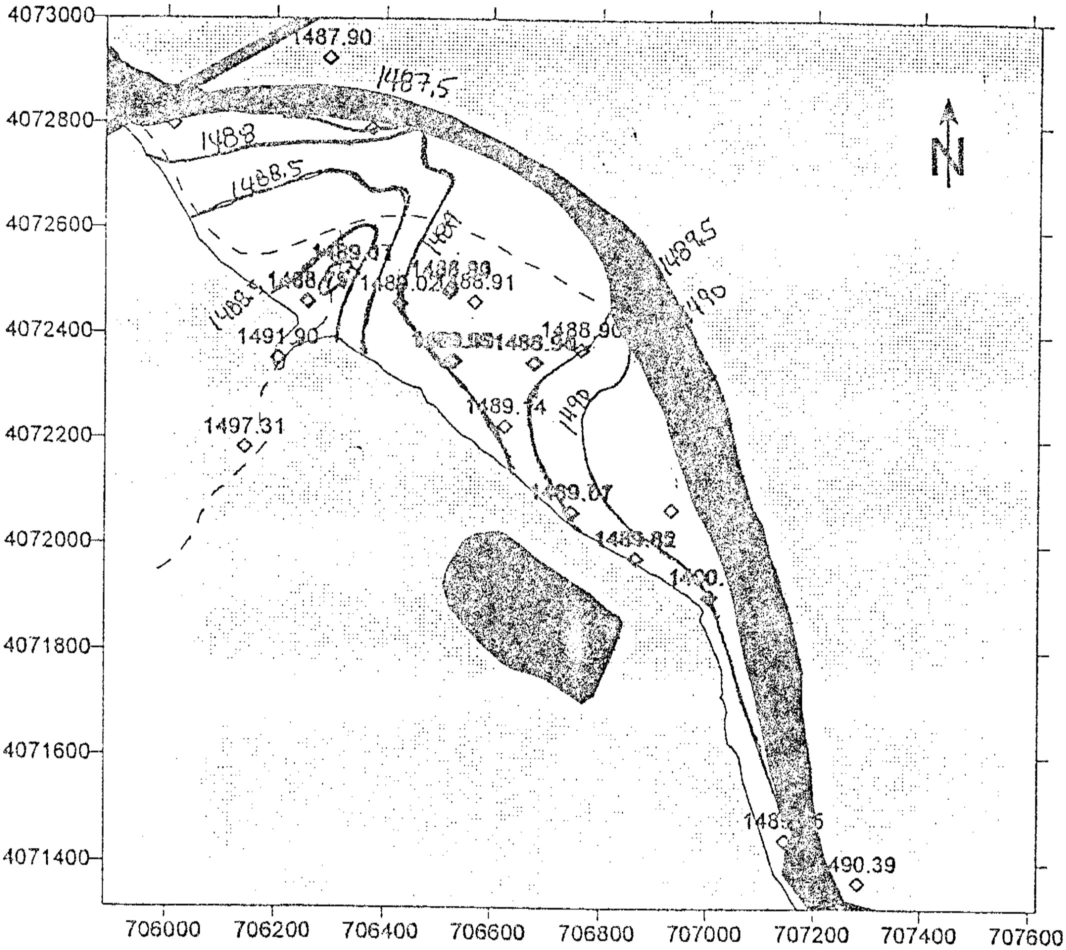
December 1995
Water Elevation (meters)



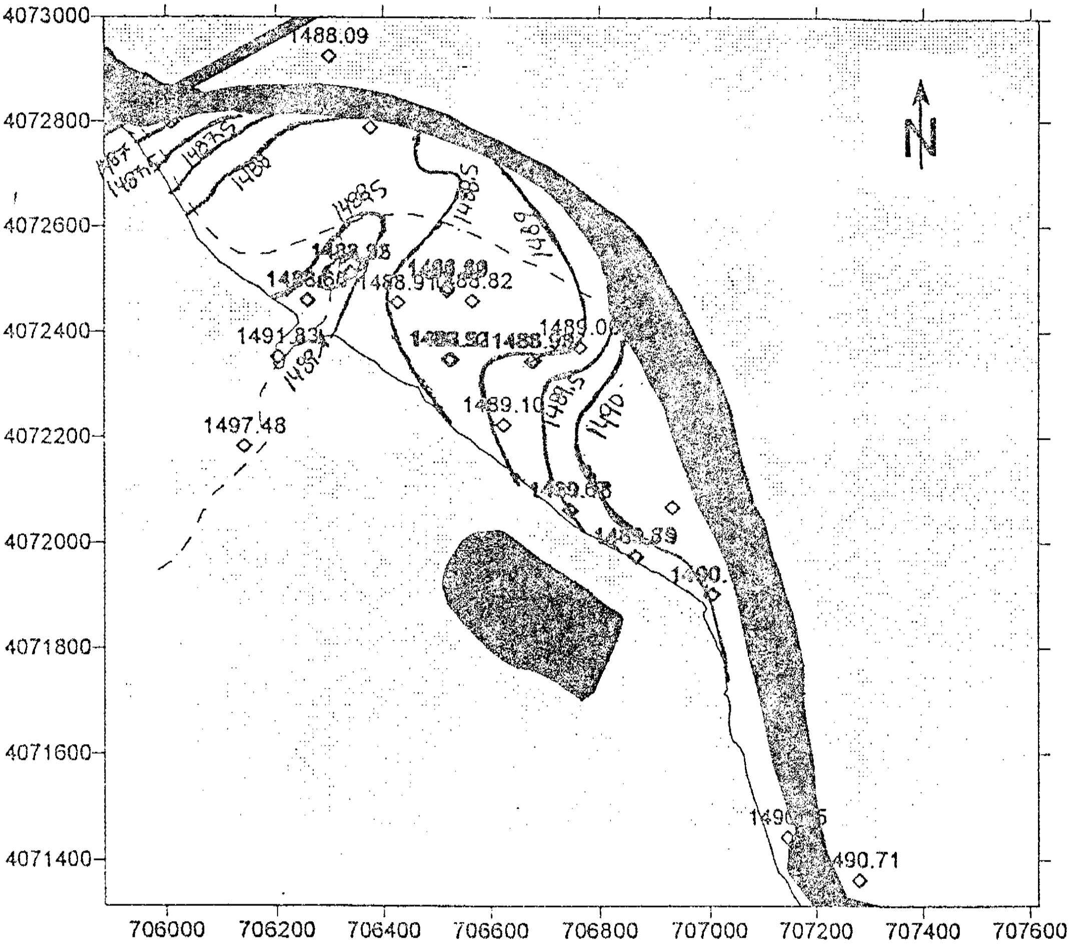
January 1996
Water Elevation (meters)



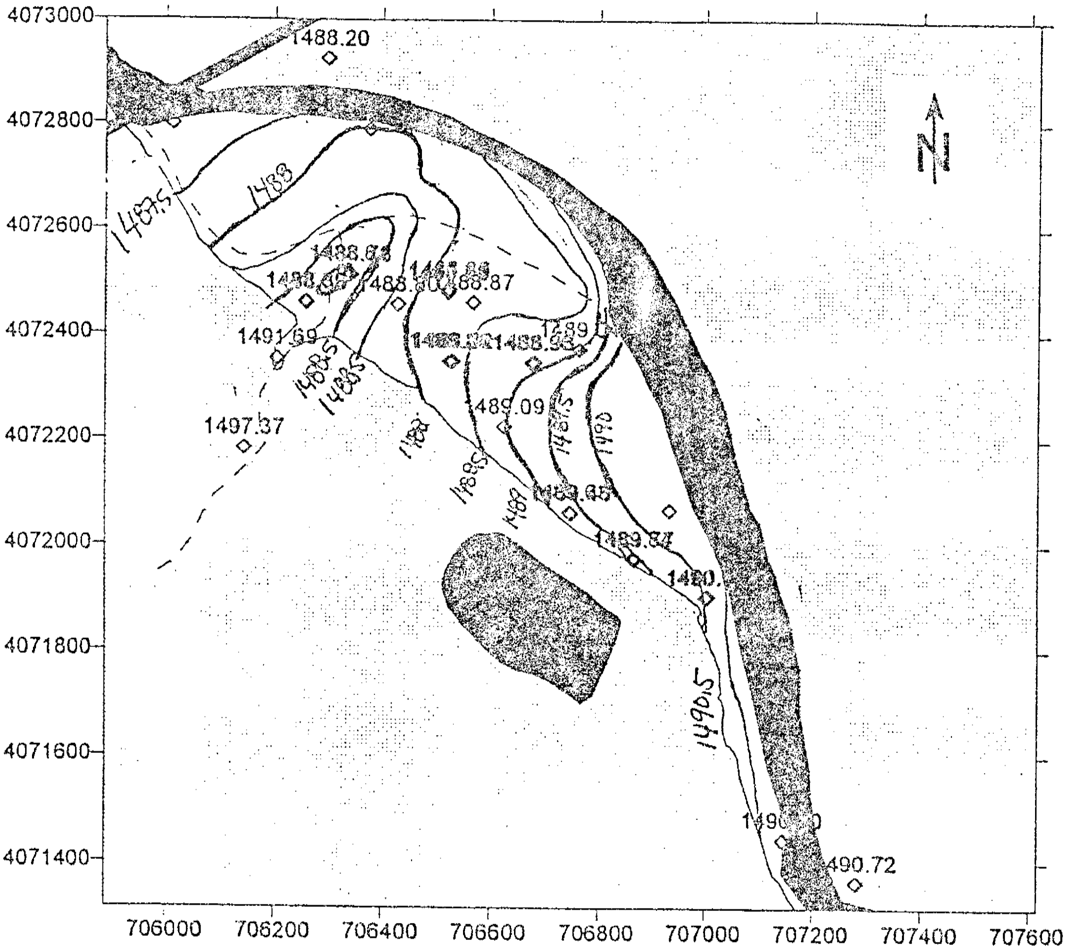
February - March 1996
Water Elevation (meters)



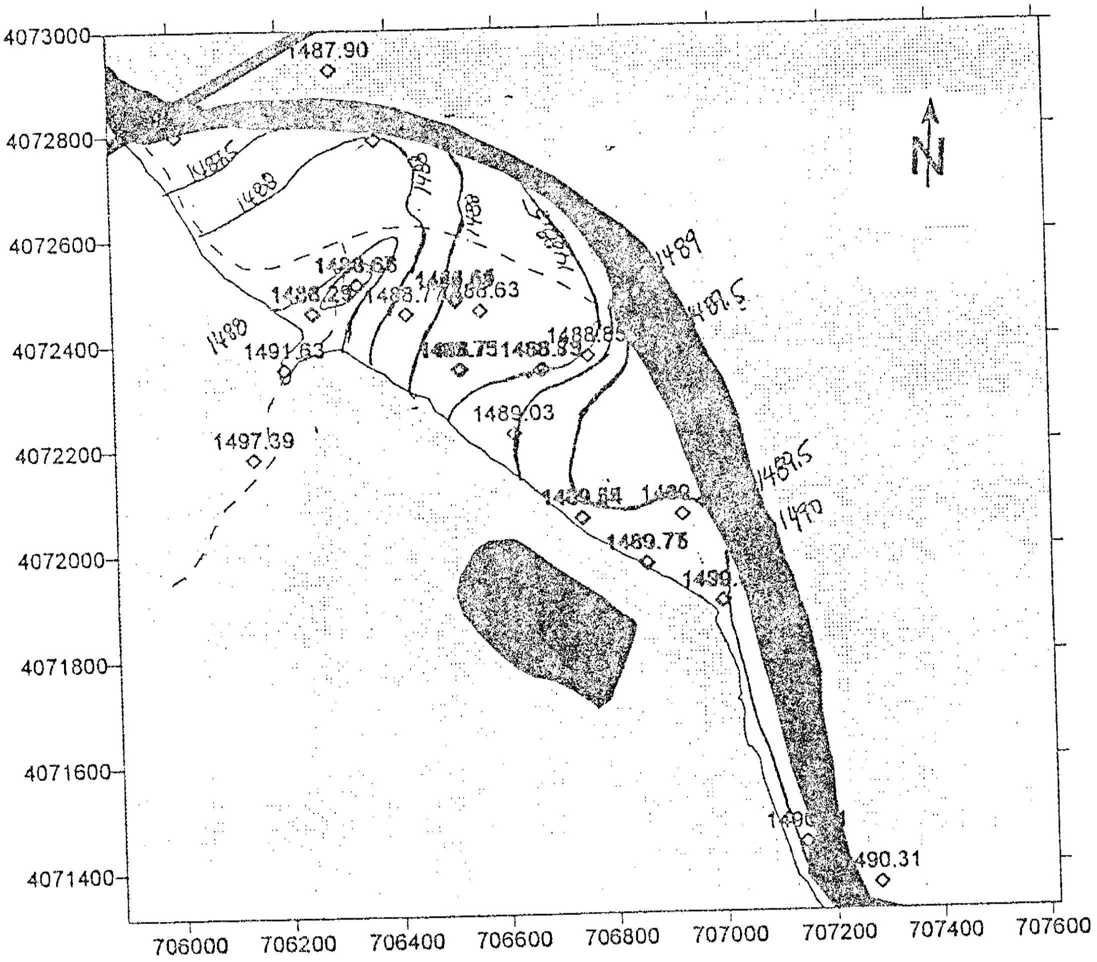
May 1996
Water Elevation (meters)



June 1996
Water Elevation (meters)



July 1996
Water Elevation (meters)



Appendix E.5: Diné College vs DOE monitoring well elevations

In conjunction with Diné College and NMT, we re-measured the existing well casings on the Shiprock UMTRA site floodplain. According to the DOE monitoring well logs, the monitoring well elevations for #630 and #629 had been recorded as 76 and 86 centimeters above the ground-surface. Based on field observations and the bgs water-level contour maps, the monitoring elevations should have been less than the DOE surveyed lengths. Using the DOE monitoring well elevations, the winter 1995, water-level contour maps showed saturated areas on the floodplain, when the floodplain was not saturated. From mid-June to mid-July 1995 sections of floodplain was the only time the floodplain was saturated. As shown below the stick-up length ranges from 0.09 to 84 centimeters from the DOE survey casing and hand measured casing.

WELL	Ground Surface Elevation (m)	NCC Top of Casing (m)	NCC Stick-up (m)	DOE Top of Casing (m)	DOE Stick-up (m)	Differance in Stick-up (cm)
608	1491.31	1491.96	0.65	1492.01	0.71	-5.63
609	1491.26	1491.70	0.44	1491.87	0.61	-17.15
610	1491.68	1492.65	0.98	1492.39	0.72	26.16
611	1491.71	1492.67	0.96	1492.39	0.68	27.93
612	1491.35	1491.78	0.43	1491.95	0.60	-17.20
613	1491.05	1491.97	0.92	1491.88	0.84	8.57
614	1491.03	1491.66	0.63	1492.01	0.98	-34.35
615	1490.77	1491.33	0.57	1491.44	0.67	-10.53
616	1490.71	1491.21	0.50	1491.44	0.73	-22.36
617	1490.58	1491.13	0.55	1491.29	0.71	-15.47
618	1490.51	1491.01	0.50	1491.25	0.74	-23.60
619	1490.78	1491.32	0.53	1491.38	0.60	-6.71
620	1489.97	1490.45	0.48	1490.59	0.62	-14.55
621	1490.02	1490.58	0.57	1490.74	0.72	-15.41
622	1490.08	1490.54	0.47	1490.85	0.77	-30.75
623	1490.43	1491.01	0.58	1491.11	0.68	-10.19
624	1490.34	1491.02	0.68	1491.19	0.84	-16.48
625	1490.44	1491.02	0.58	1491.19	0.75	-16.87
626	1490.09	1490.70	0.61	1490.83	0.74	-13.13
627	1489.81	1490.42	0.61	1490.57	0.75	-14.33
628	1489.98	1490.59	0.62	1490.89	0.91	-29.53
629	1489.31	1489.40	0.10	1490.07	0.76	-66.68
630	1489.33	1489.35	0.02	1490.19	0.86	-84.35
725	1495.47	1496.15	0.68	1496.18	0.70	-2.15
726	1505.10	1505.72	0.63	1505.71	0.62	0.98
732	1492.26	1492.72	0.46	1492.70	0.44	2.16
733	1489.94	1490.52	0.58	1490.52	0.58	0.51
734	1489.32	1489.33	0.01	1489.44	0.12	-11.22
735	1491.79	1492.23	0.44	1492.17	0.38	5.41
736	1489.75	1490.04	0.29	1489.97	0.22	6.95

Appendix E.5.a: Saturated Floodplain Using DOE's Well Elevations

Monitoring Well	DOE Stick-up (m)	03-04/95 Average TOC (m)	05/95 Average TOC (m)	06/95 Average TOC (m)	07/95 Average TOC (m)	08/95 Average TOC (m)	10/95 Average TOC (m)	11/95 Average TOC (m)	12/95 Average TOC (m)	01/96 Average TOC (m)	02-03/96 Average TOC (m)	05/96 Average TOC (m)	06/96 Average TOC (m)	07/96 Average TOC (m)
608	0.71	0.74	0.50	0.18	0.54	1.06	1.19	1.10	1.09	1.12	1.14	1.08	1.07	1.27
609	0.61	0.56	0.33	0.03	0.38	0.88	1.03	0.94	0.91	0.97	0.97	0.93	1.02	1.09
610	0.72	1.73	1.56	1.10	1.36	1.79	1.49	2.14	-0.72	2.11	2.12	2.15	2.16	2.19
611	0.68	1.76	1.56	1.12	1.39	1.79	2.20	2.15	2.11	2.10	2.13	2.14	2.14	2.21
612	0.60													1.60
613	0.84	1.05	0.91	0.55	0.60	1.13	1.46	1.44	1.45	1.40	1.42	1.46	1.50	1.59
614	0.98	0.91	0.66	0.31	0.35	0.70	1.19	1.18	1.19	1.15	1.62	1.51	1.22	1.25
615	0.67	1.22	1.13	0.59	0.70	1.07	1.55	1.54	1.52	1.52	1.52	1.56	1.57	1.63
616	0.73	1.16	0.89	0.45	0.70	1.26	1.59	1.54	1.53	1.58	1.58	1.48	1.45	1.64
617	0.71	1.19	1.05	0.61	0.69	1.14	1.01	1.53	1.50	1.52	1.52	1.53	1.49	1.64
618	0.74	0.88	0.87	0.43	0.54	1.07	1.37	1.33	1.33	1.33	1.33	1.35	1.31	1.44
619	0.60	1.53	1.47	1.24	1.25	1.56	1.89	1.84	1.96	1.80	1.81	1.89	1.85	2.08
620	0.62	0.58		0.24	0.35	0.67	0.86	0.83	0.84	0.82	0.83	0.91	0.99	1.08
621	0.72	0.65	0.64	0.26	0.45	0.71	0.87	0.88	0.87	0.86	0.89	0.94	1.03	1.13
622	0.77	0.51	0.52	0.13	0.28	0.72	0.83	0.80	0.77	0.78	0.77	0.86	0.94	1.06
623	0.68		1.13	0.89	0.95	1.22	1.46	1.43	1.43	1.55	1.40	1.50	1.47	1.68
624	0.84		1.03	0.77	0.86	1.12	1.37	1.32	1.33	1.29	1.28	1.38	1.50	1.59
625	0.75		1.05	0.82	0.90	1.15	1.51	1.34	1.33	1.30		1.40	1.49	1.60
626	0.74		0.80	0.65	0.67	1.06	1.01	0.97		0.99	0.94	1.06	1.16	1.19
627	0.75	0.41	0.48	0.39	0.46	0.64	0.64	0.61	0.64	0.57	0.60	0.75	1.06	1.00
628	0.91	0.38	0.56	0.34	0.45	0.63	0.68	0.59	0.73	0.59	0.57	0.73	0.91	1.02
629	0.76	-0.28	-0.47	-0.42	-0.18	-0.01	-0.21	-0.22	-0.19	-0.20	-0.15	-0.04	0.26	0.35
630	0.86	-0.38	-0.55	-0.48	-0.26	-0.10	-0.28	-0.29	-0.25	-0.27	-0.23	-0.11	0.18	0.27
725	0.70				3.80	3.69	3.67	3.43	3.35	3.39	3.55	3.62	3.75	3.82
726	0.62				7.51	7.55	7.53	7.58	7.60	7.67	7.80	7.62	7.74	7.71
732	0.44		0.86	0.39	1.12	1.69	1.85	1.79	1.79	1.92	1.89	1.57	1.56	1.97
733	0.58			0.00	1.35	1.80	2.01	1.96	1.95	2.08	2.05	1.85	1.74	2.05
734	0.12	1.36	1.20	0.77	1.43	2.03	2.08	2.05	2.06	1.99	2.37	2.18	1.74	1.96
735	0.38	1.00	0.58	0.25	0.87	1.61	1.62	1.54	1.98		1.90	1.39	1.24	1.73
736	0.22	0.90	1.39	0.98	1.49	2.02	2.19	2.14	2.12	1.96	2.23	2.02	1.97	2.14

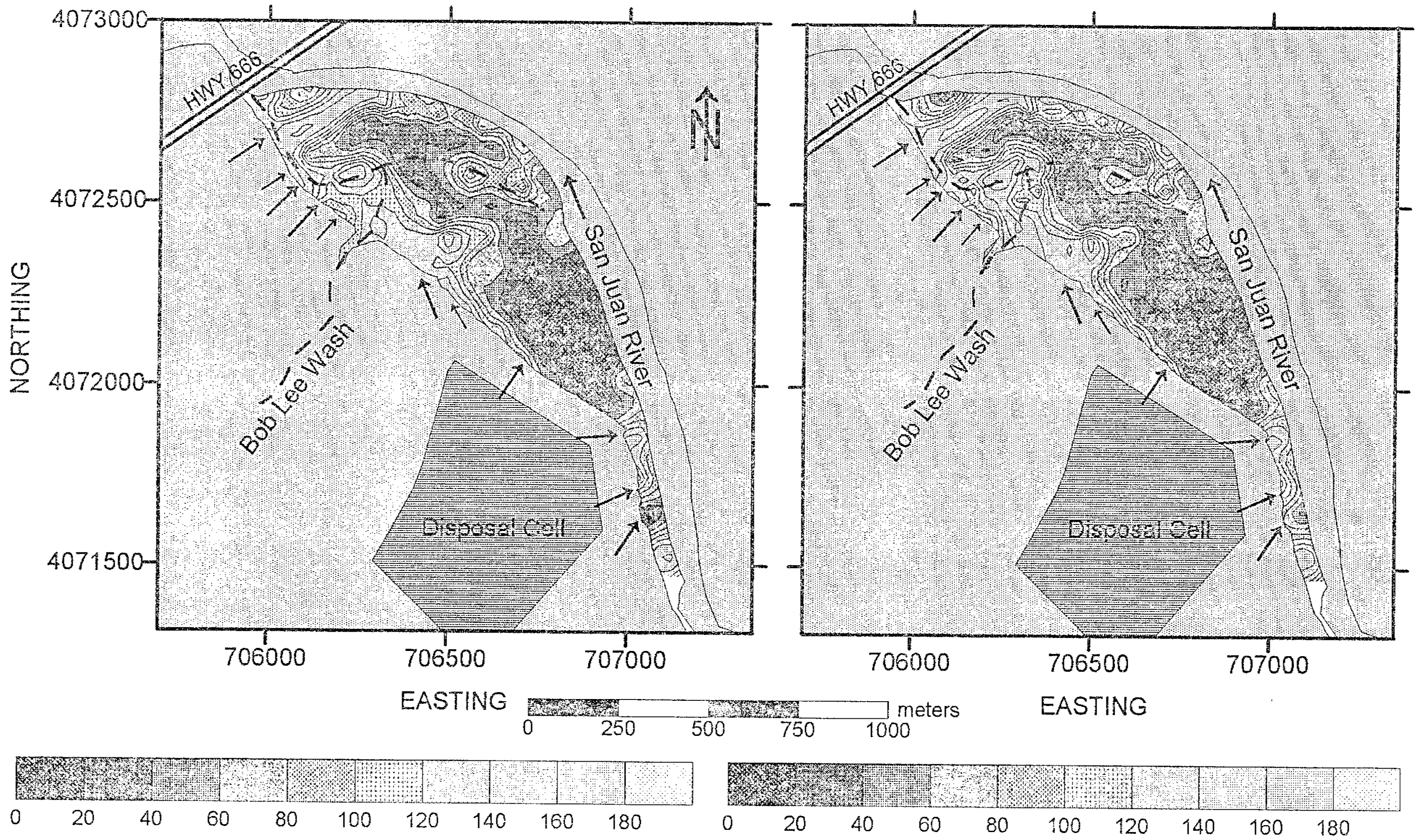
Appendix: F EM-38 and EM-31

The EM instruments allow the measurement of soil salinity as it responds to both the conductive soils and water. The EM values provide a integrated conductivity of the soil and the small variations by the measurements over the approximate depth of exploration. The ground conductivity meters by Geonics Limited, Ontario, Canada, we used were the EM-38 and EM-31. Depth of signal penetration for the EM-38 has a penetration depth of 0.75 meters horizontal mode and 1.5 meters in the vertical mode, whereas the EM-31 is 3 meters in the horizontal mode and 6 meters in the vertical mode. These instruments generate an electromagnetic field which induces a small current in the ground. The magnetic field strength is determined by terrain conductivity (McNeil, 1992). The EM measurement was conducted along an established 50 X 50 meter grid system as discussed above in section 4.3.

The readings for the EM-38 were taken in both the horizontal and vertical modes by placing the instrument directly on the ground on each grid point. Reading for the EM-31 were taken in both the horizonal and vertical modes by carrying the instrument one meter above the ground on a sling strap while walking to each sampling point. Vertical and horizontal contour maps of electrical conductivity have been produced for both EM-38 and EM-31.

Four electromagnetic surveys were conducted on the floodplain during different seasons in August 1995, December 1995, January 1996, and June 1996. The 1996 EM surveys sample locations was approximately 10 meters apart in the north/south directions. These four electrical conductivity maps provide a base line for future EM surveys. Comparing the results from the two instruments will allow an estimation of the variation in conductivity with depth, which can then be correlated with horizontal and vertical variation of the salt contaminant plume.

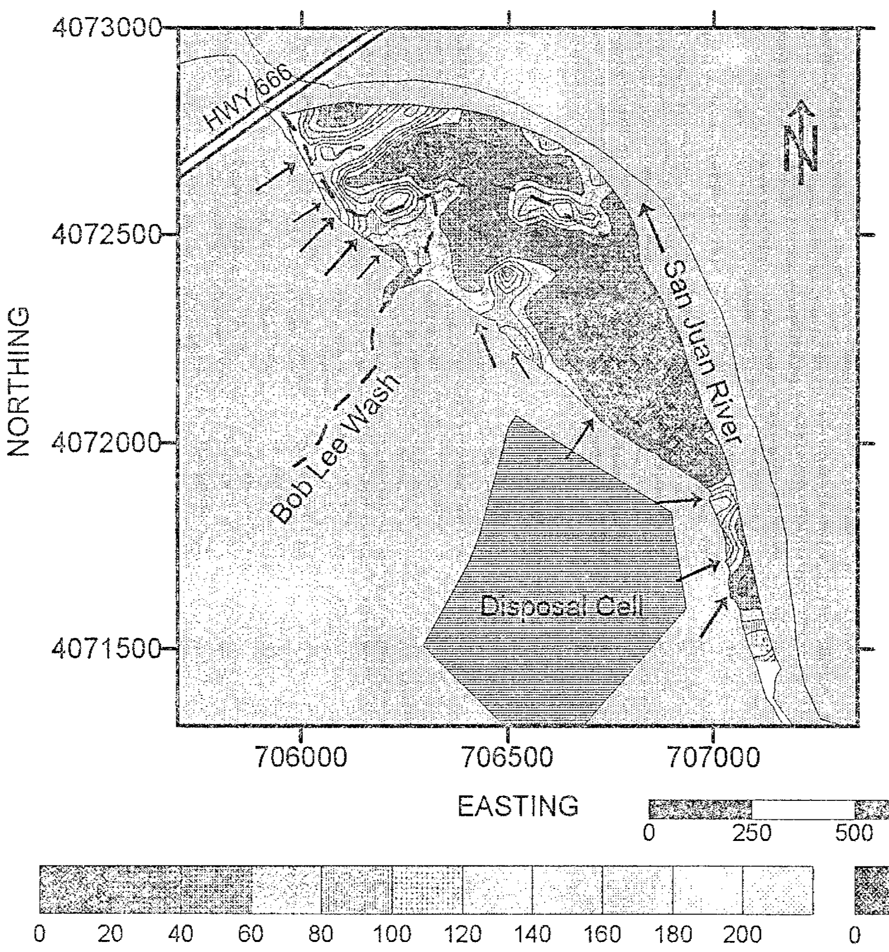
Appendix F.1: Late August - Early September 1995, EM-38 electrical conductivity contour maps



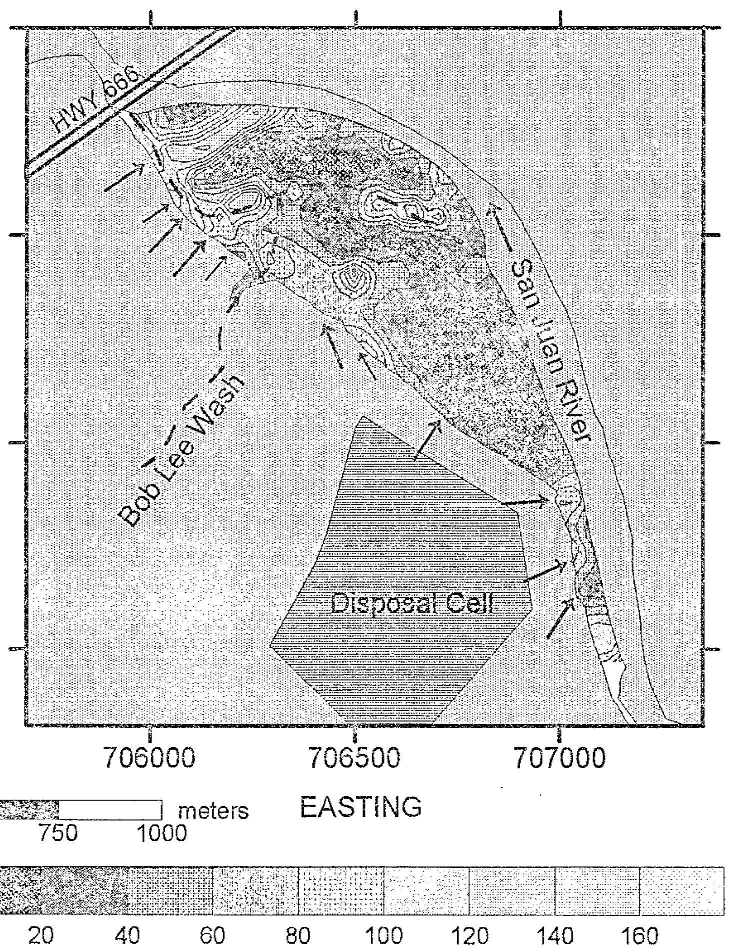
Horizontal EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 10 meter intervals on the grid covering the study area. The contour interval is 20 mS/m.

Horizontal EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 20 mS/m.

Appendix F.2: January 1996, EM-38 electrical conductivity contour maps

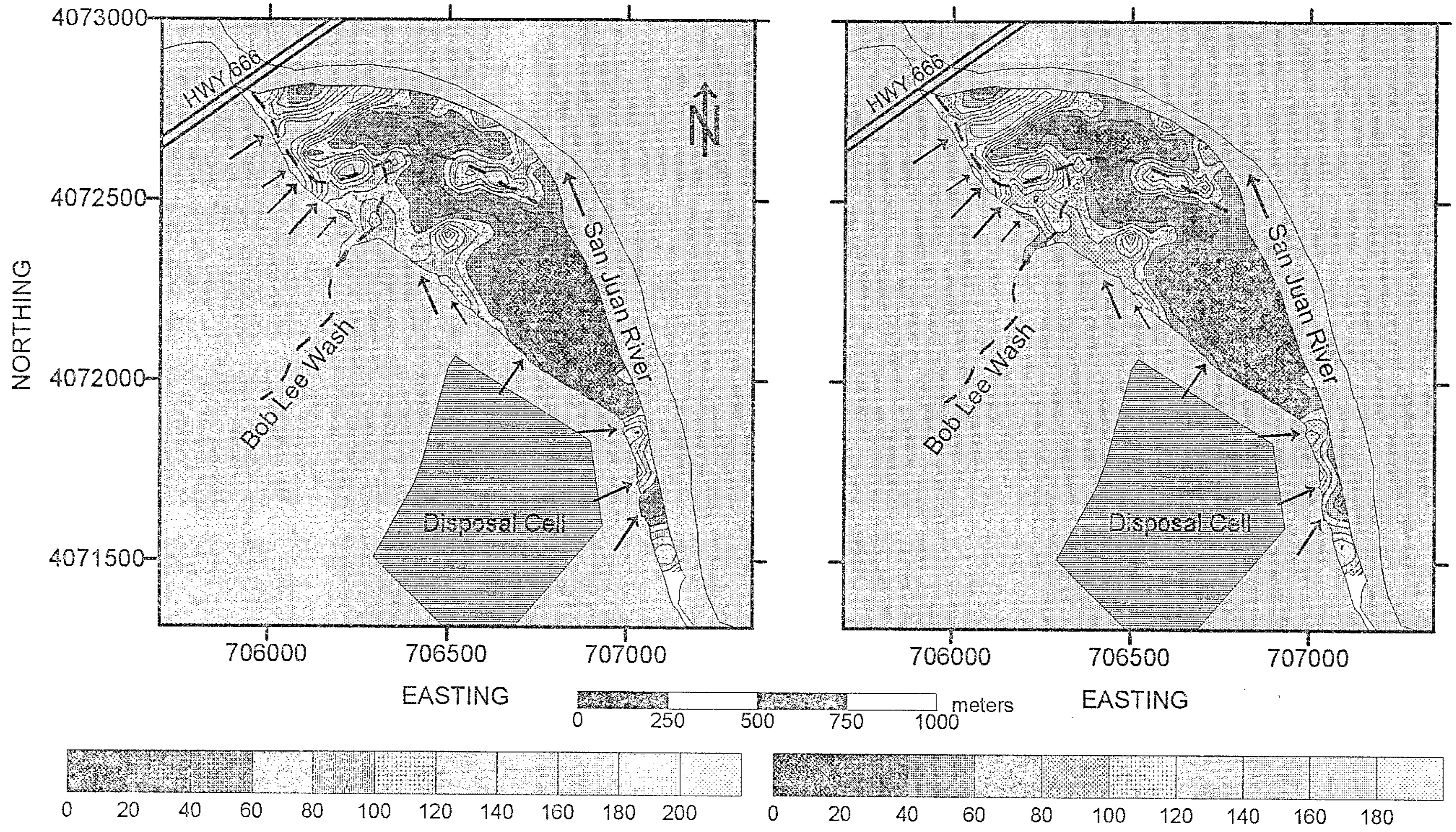


Vertical EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 20 mS/m.



Horizontal EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 20 mS/m.

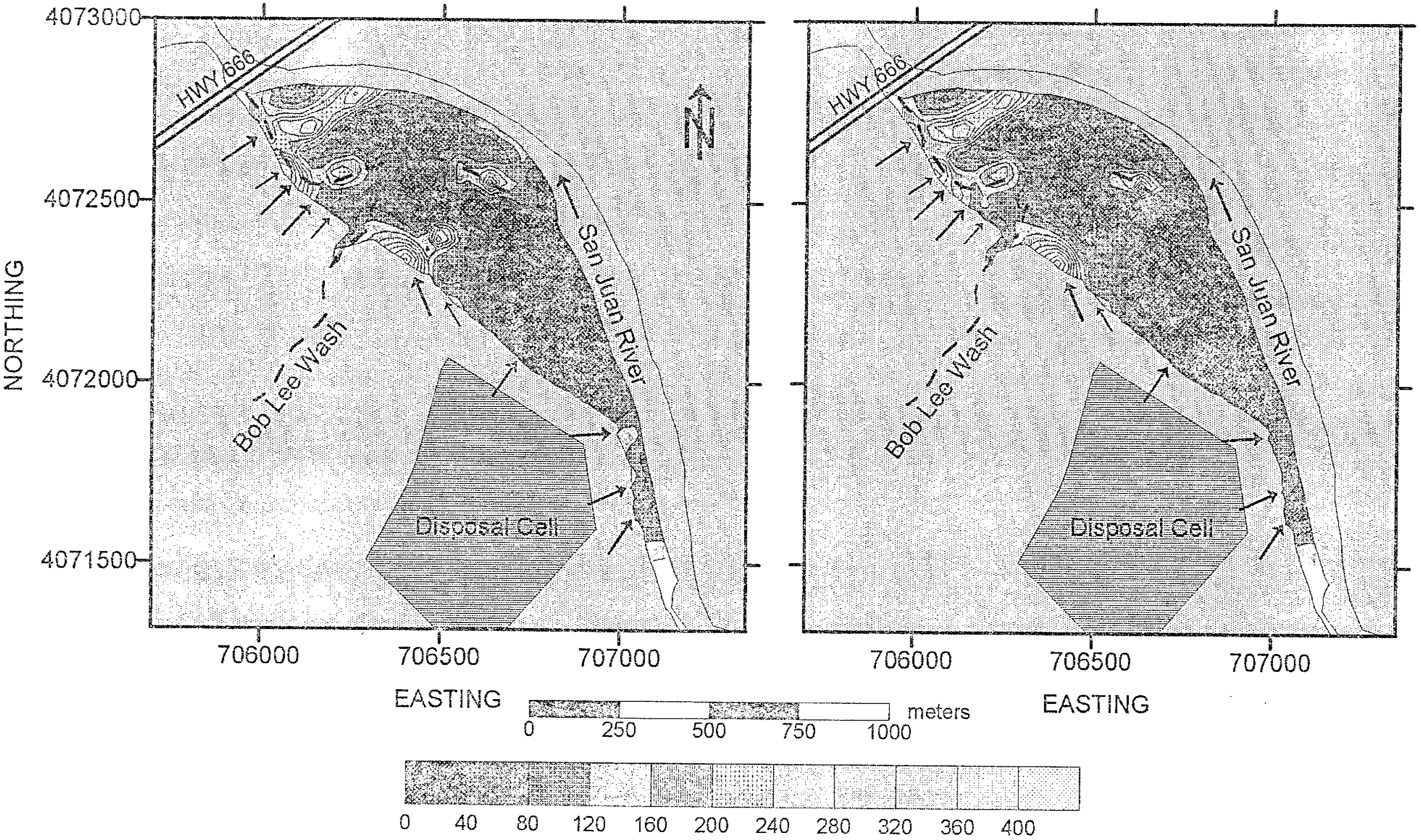
Appendix F.3: February 1996, EM-38 electrical conductivity contour maps



Vertical EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 40 mS/m.

Vertical EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 40 mS/m.

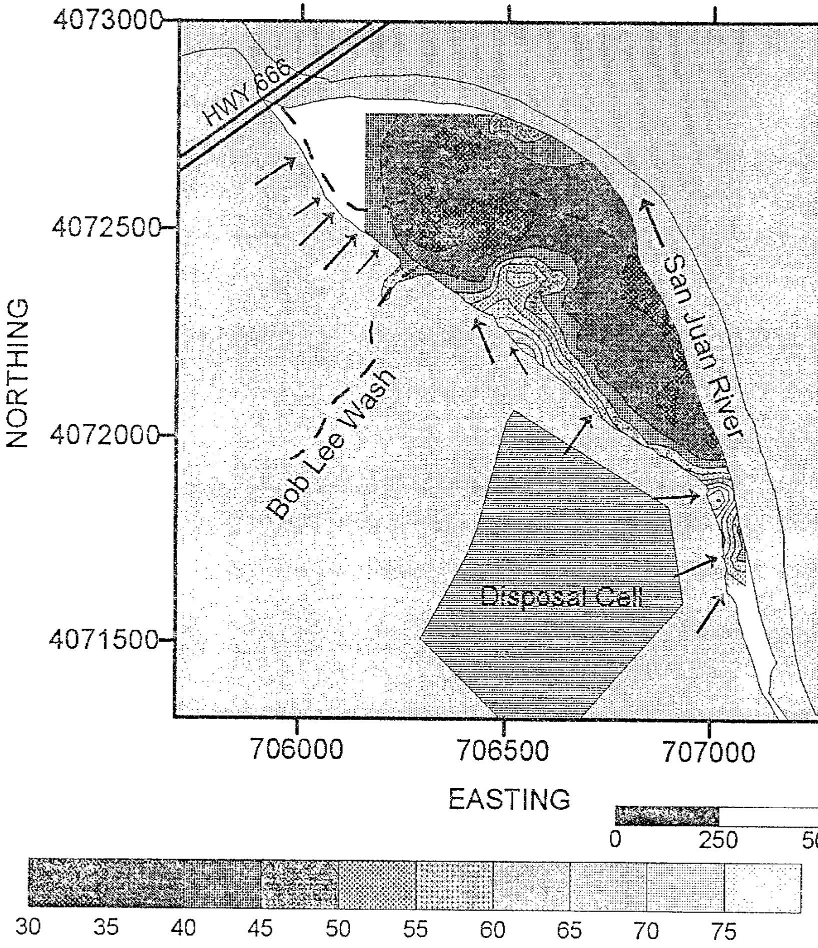
Appendix F.4: June 1996, EM-38 electrical conductivity contour maps



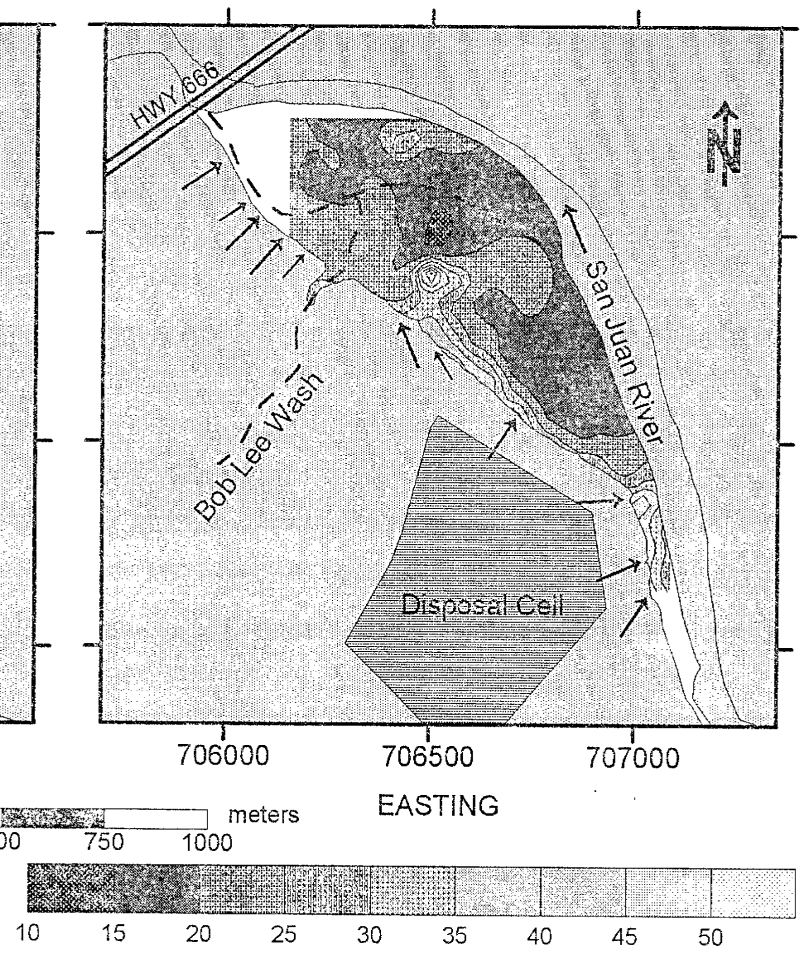
Vertical EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 40 mS/m.

Horizontal EM-38 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken at 50 meter intervals on the grid covering the study area. The contour interval is 40 mS/m.

Appendix F.5: August 1995, EM-31 electrical conductivity contour maps

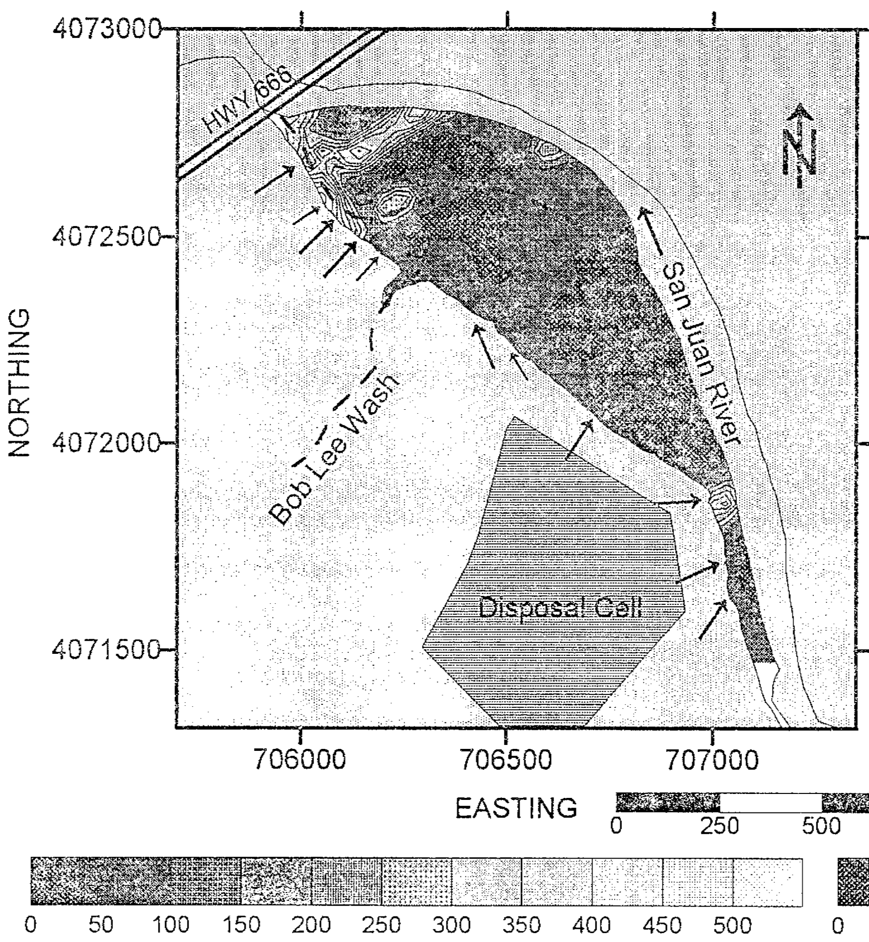


Vertical EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. The contour interval is 5 mS/m.

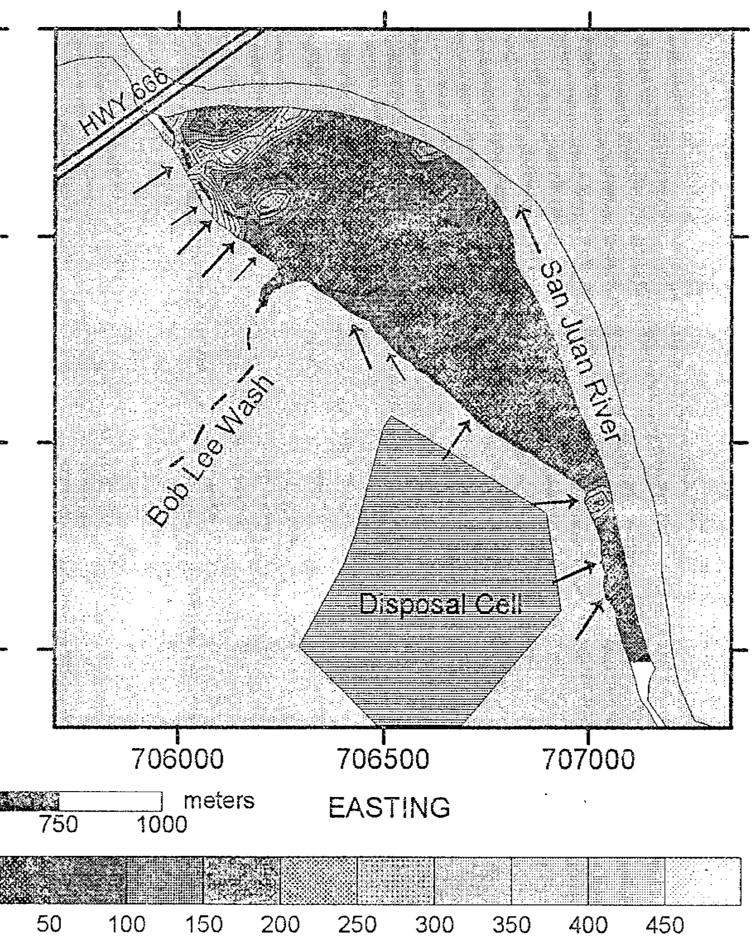


Horizontal EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. The contour interval is 5 mS/m.

Appendix F.6: January 1996, EM-31 electrical conductivity contour map

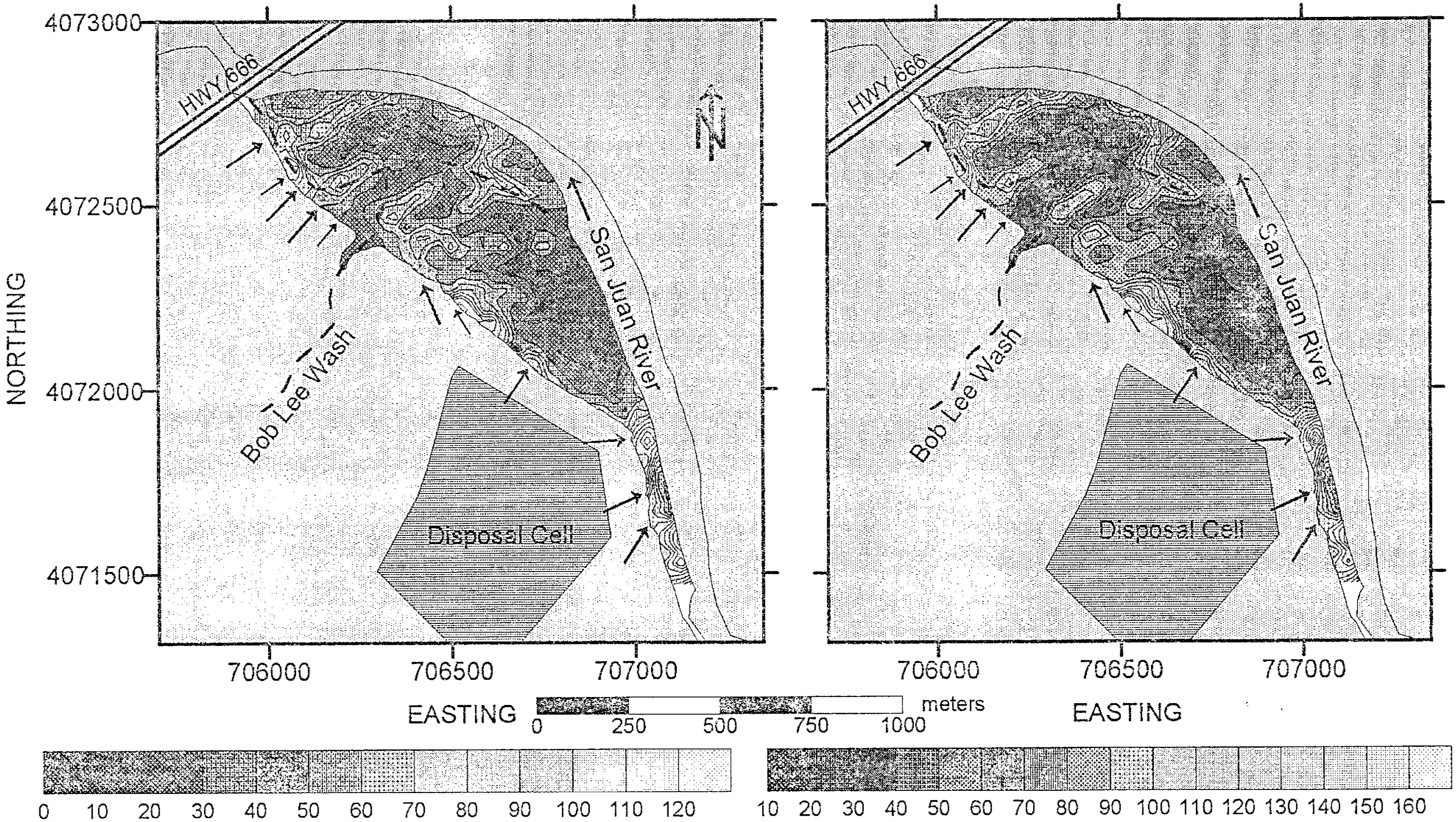


Vertical EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. The contour interval is 50 mS/m.



Horizontal EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. The contour interval is 50 mS/m.

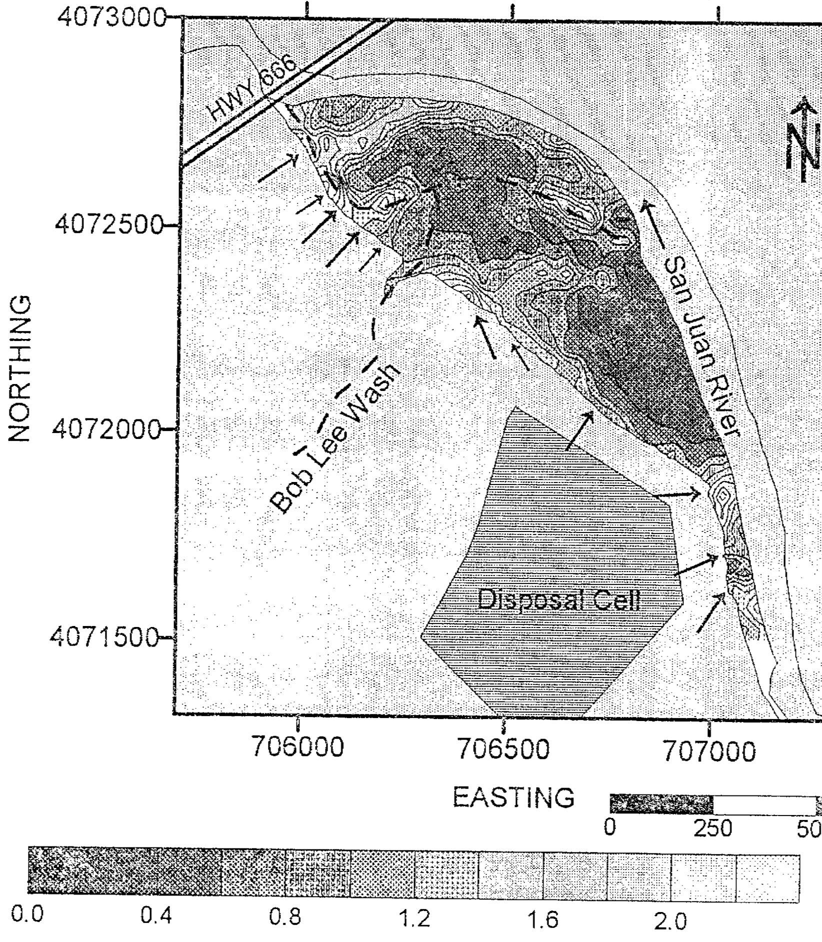
Appendix F.7: February 1996, EM-31 electrical conductivity contour map



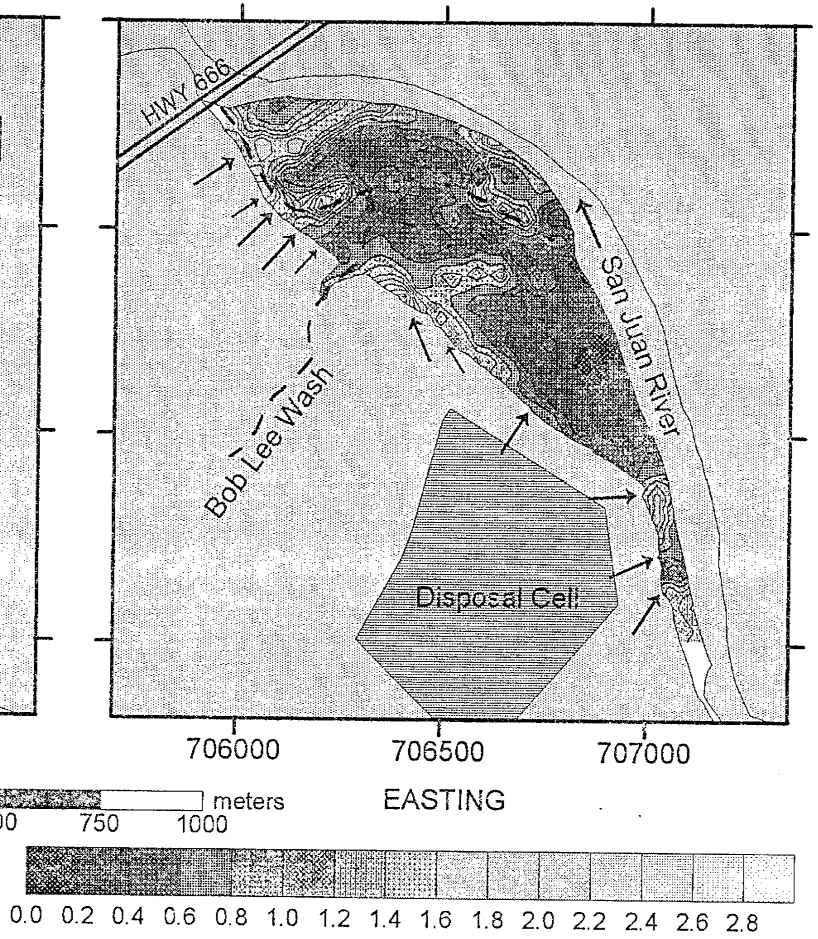
Vertical EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken approximately 10 meter intervals in north/south and at 10 meter intervals in east/west on the grid covering the study area. The contour interval is 5 mS/m.

Horizontal EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken approximately 10 meter intervals in north/south and at 50 meter intervals in east/west on the grid covering the study area. The contour interval is 10 mS/m.

Appendix F.8: June 1996, EM-31 electrical conductivity contour map



Vertical EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken approximately 10 meter intervals in north/south and at 50 meter intervals in east/west on the grid covering the study area. The contour interval is 0.2 mS/m.



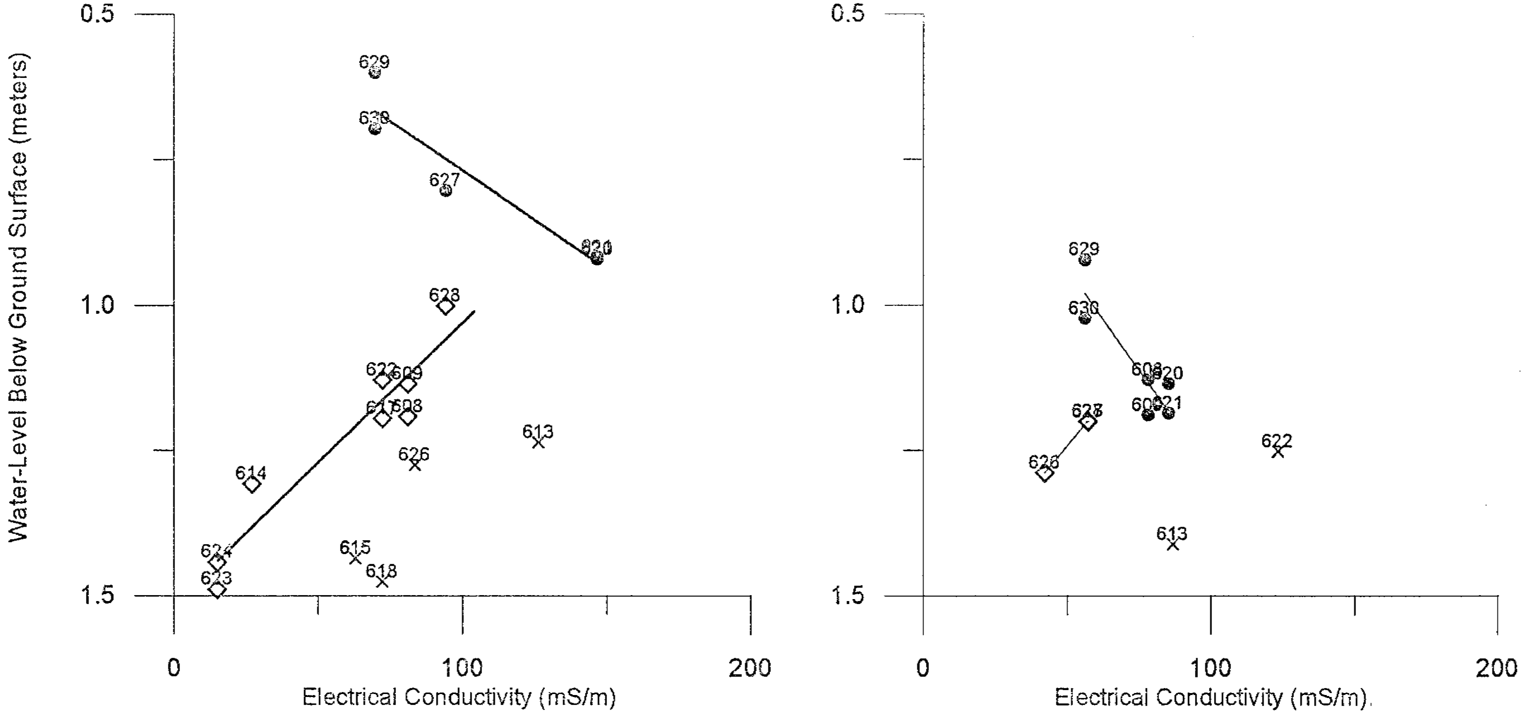
Horizontal EM-31 electrical conductivity anomaly map of the Shiprock UMTRA site floodplain. Readings are taken approximately 10 meter intervals in north/south and at 50 meter intervals in east/west on the grid covering the study area. The contour interval is 0.2 mS/m.

Appendix: F.9: Comparison of electrical conductivity values with water levels

An attempt to define the vertical salt contaminant plume was made by comparing bgs water-level measurements with electrical conductivity values. Water-levels from weekly measurements were from dates closest to the EM survey and conductivity values used the nearest sampling location near the monitoring well. In August 1995, January and February 1996, water-levels did not reach 0.75 meters bgs, as result no graphs were produced using the EM-38 conductivity values in the horizontal mode. Because the vertical mode has a deeper penetration depth, the EM-38 vertical mode was used instead. Conductivity values from EM-31 used both the horizontal and vertical modes to produce graphs. The following graphs are some crude estimates of where the salt plume may be concentrated within the floodplain aquifer. Monitoring wells in the graphs were grouped according to location and distance from each other. Those wells closest in distance were grouped as one section. In the table below indicates from August 1995 through February 1996, electrical conductivity tends to follow similar patterns of increasing conductivity with decreasing water levels. Whereasin June 1996, the upper 1.3 m shows that electrical conductivity may begining to decrease at the surface. Perhasp these trends might be indicating during low water-levels as electrical conductivity increase at the water surface and during the high water-levels the electrical conductivity decrease below the water surface.

<table>
<tr><th colspan="5">EM-38 and EM-31</th></tr>
<tr><th>EM</th><th>Augus 95</th><th>January 96</th><th>February 96</th><th>June 96</th></tr>
<tr><td>EM-38 vert (1.5m)</td><td>EC↓ WL↓</td><td>EC↓ WL↓</td><td>EC↓ WL↓</td><td>EC↓ WL↓</td></tr>
<tr><td>1.2 m</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td></tr>
<tr><td>1.2 - 1.4 m</td><td></td><td></td><td></td><td></td></tr>
<tr><td>EM-31 horz (3m)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0.6-1.0 m</td><td>EC↑ WL↓</td><td>No Correlation</td><td>EC↑ WL↓</td><td>EC↓ WL↓</td></tr>
<tr><td>1.0-1.2 m</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td></tr>
<tr><td>1.3-1.6 m</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td></tr>
<tr><td>EM-31 vert (6m)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0.6-1.0 m</td><td>EC↑ WL↓</td><td>No Correlation</td><td>EC↑ WL↓</td><td>EC↓ WL↓</td></tr>
<tr><td>1.0-1.2 m</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td></tr>
<tr><td>1.3-1.6 m</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td><td>EC↑ WL↓</td></tr>
</table>

Appendix: F.9.a: Late August/Early Septemeber 1995 and June 1996, EM-38 Electrical Conductivity vs Water Levels



Linear, Y=B*X+A ●
Equation:
Y = 0.00338722 * X + 0.431801
Number of data points used = 5
Average X = 105.24, Average Y = 0.788272
Regression sum of squares = 0.0696601
Residual sum of squares = 0.00846593
Coef of determination, R-squared = 0.891638

Linear, Y=B*X+A ◇
Equation:
Y = -0.00482356 * X + 1.51185
Number of data points used = 8
Average X = 57.05, Average Y = 1.23667
Regression sum of squares = 0.17305
Residual sum of squares = 0.0184228
Coef of determination, R-squared = 0.903784

Linear, Y=B*X+A ●
Equation:
Y = -0.0059245 * X + 1.53839
Number of data points used = 3
Average X = 52, Average Y = 1.23031
Regression sum of squares = 0.00526496
Residual sum of squares = 7.25778E-008
Coef of determination, R-squared = 0.999986

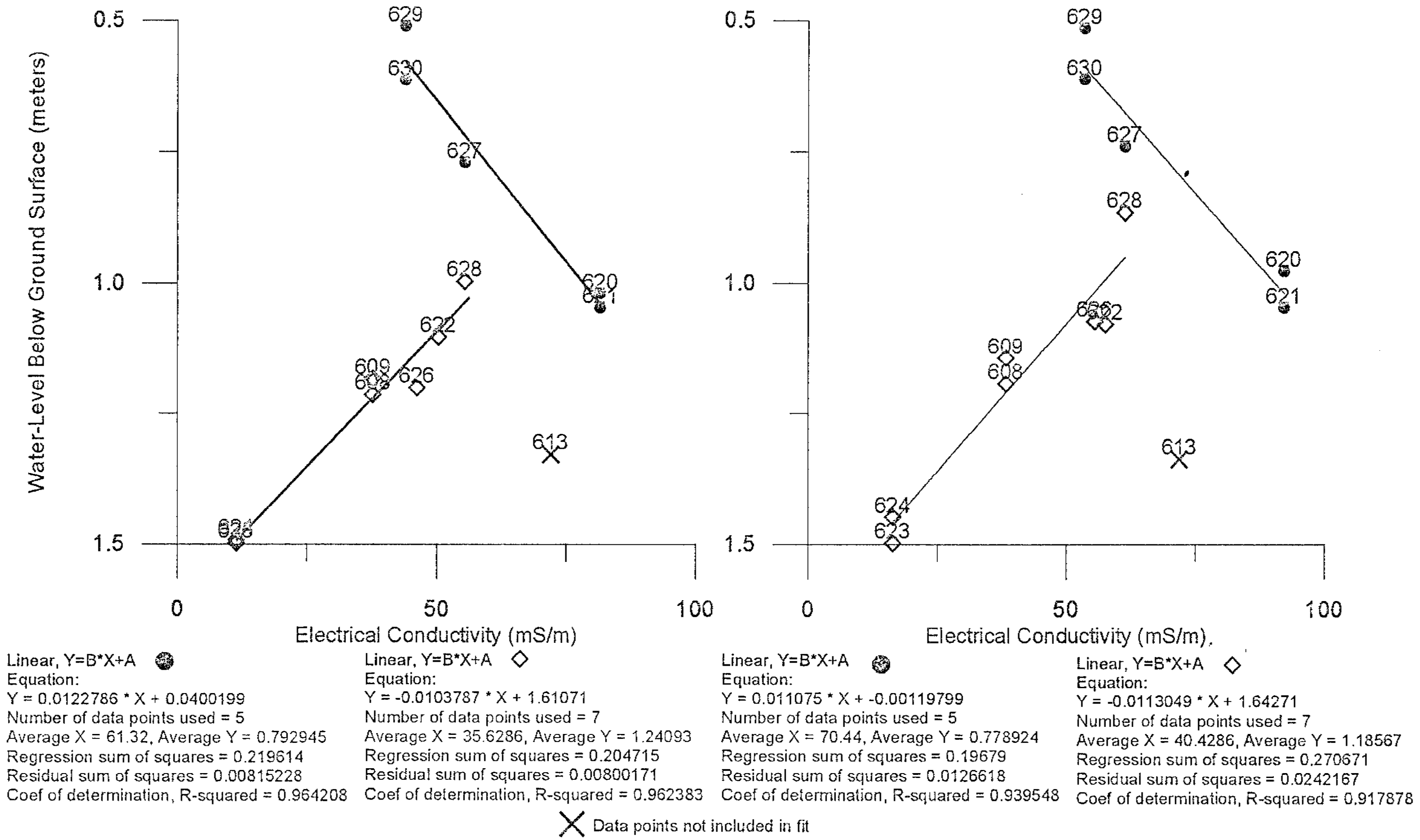
Linear, Y=B*X+A ◇
Equation:
Y = 0.00698096 * X + 0.588583
Number of data points used = 6
Average X = 73, Average Y = 1.09819
Regression sum of squares = 0.0446401
Residual sum of squares = 0.0105804
Coef of determination, R-squared = 0.808397

× Data not used in fit

Late August/Early September 1995
vertical conductivity versus bgs

June 1996, vertical conductivity versus bgs

Appendix F.9.b: January and February 1996, EM-38 Electrical Conductivity vs Water-Levels



Linear, Y=B*X+A ●
Equation:
Y = 0.0122786 * X + 0.0400199
Number of data points used = 5
Average X = 61.32, Average Y = 0.792945
Regression sum of squares = 0.219614
Residual sum of squares = 0.00815228
Coef of determination, R-squared = 0.964208

Linear, Y=B*X+A ◇
Equation:
Y = -0.0103787 * X + 1.61071
Number of data points used = 7
Average X = 35.6286, Average Y = 1.24093
Regression sum of squares = 0.204715
Residual sum of squares = 0.00800171
Coef of determination, R-squared = 0.962383

Linear, Y=B*X+A ●
Equation:
Y = 0.011075 * X + -0.00119799
Number of data points used = 5
Average X = 70.44, Average Y = 0.778924
Regression sum of squares = 0.19679
Residual sum of squares = 0.0126618
Coef of determination, R-squared = 0.939548

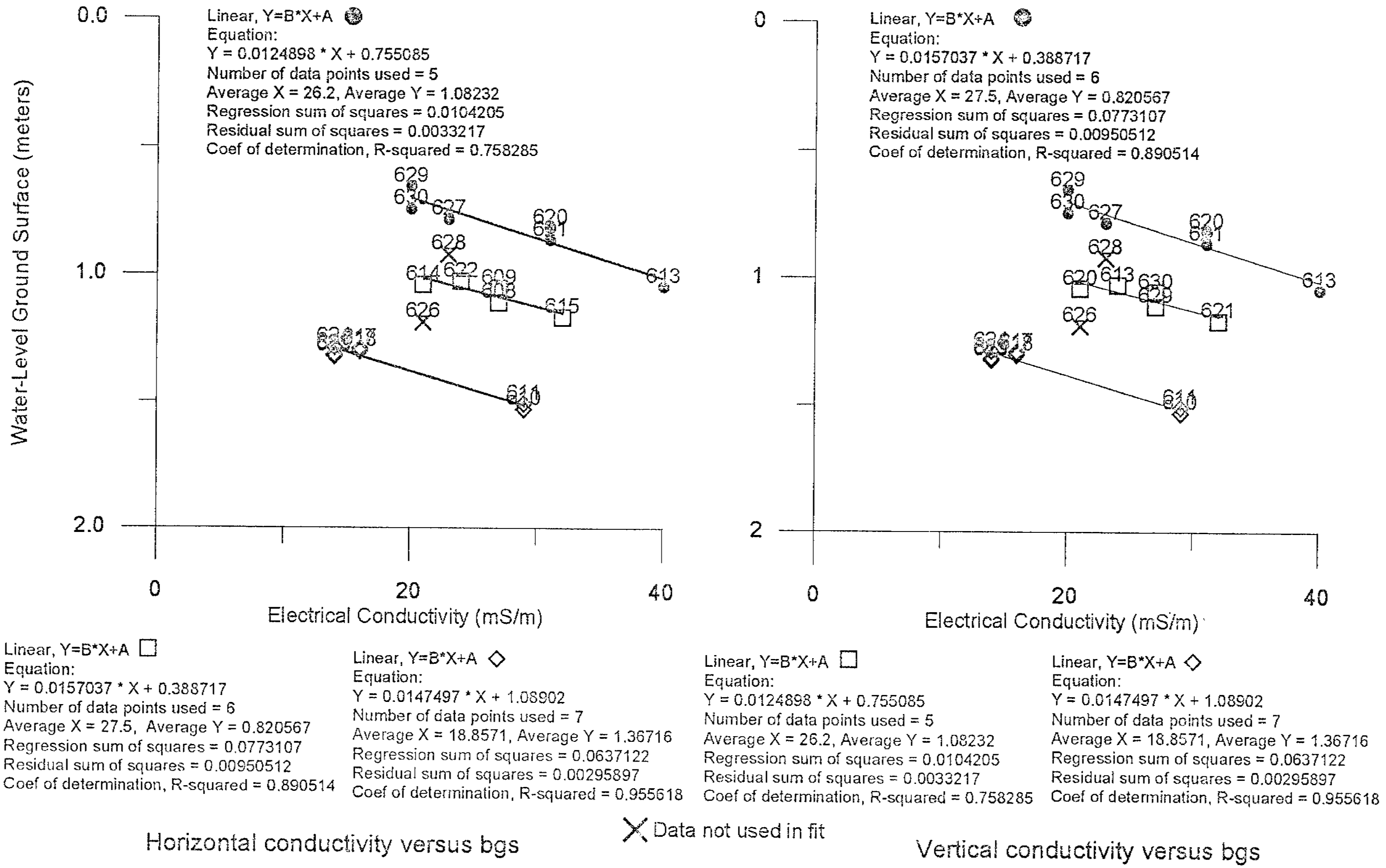
Linear, Y=B*X+A ◇
Equation:
Y = -0.0113049 * X + 1.64271
Number of data points used = 7
Average X = 40.4286, Average Y = 1.18567
Regression sum of squares = 0.270671
Residual sum of squares = 0.0242167
Coef of determination, R-squared = 0.917878

✕ Data points not included in fit

January 1996, vertical conductivity versus bgs

February 1996, vertical conductivity versus bgs

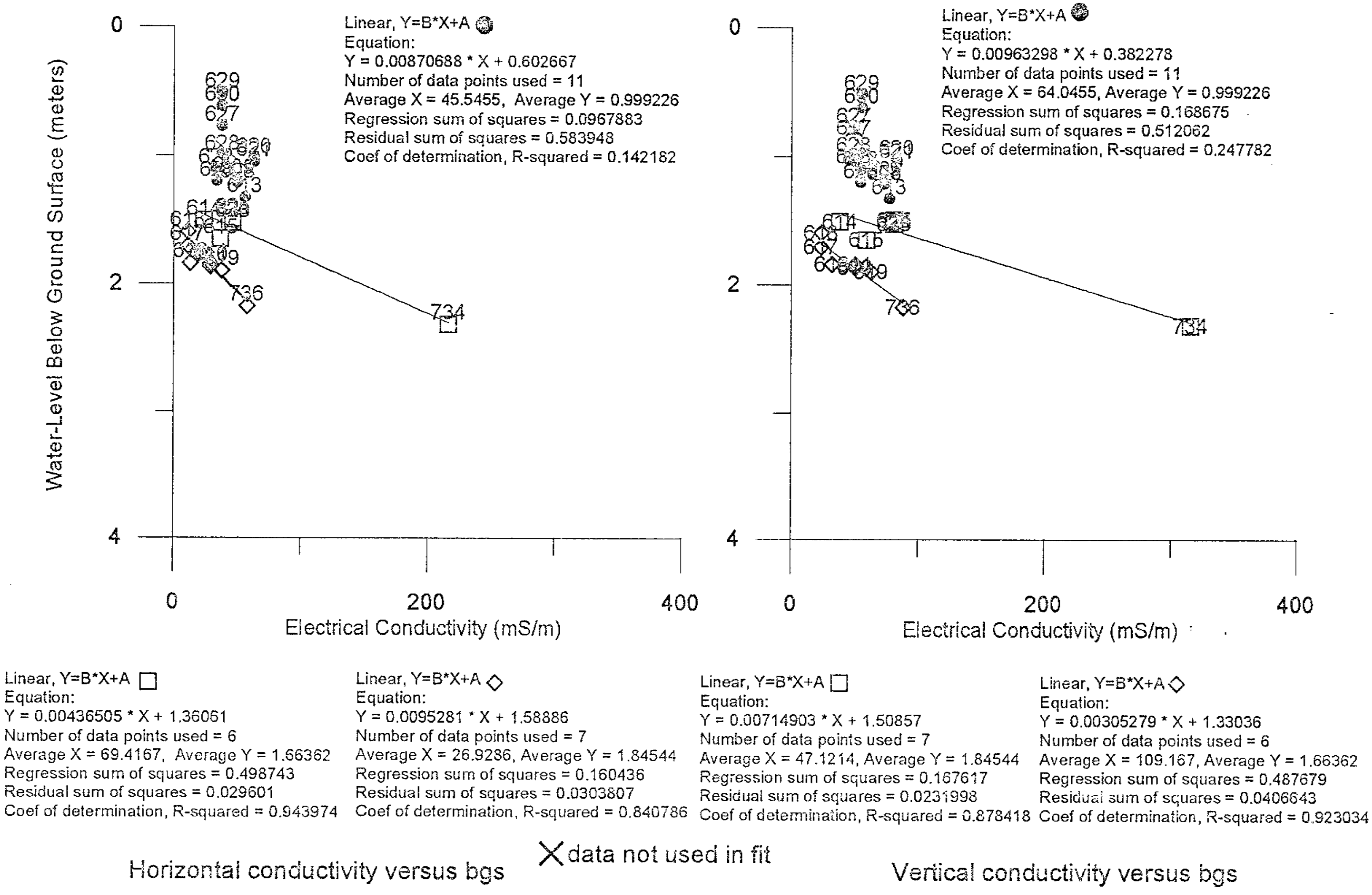
Appendix: F.9.c: Late August 1995, EM-31 Electrical Conductivity vs Water-Levels



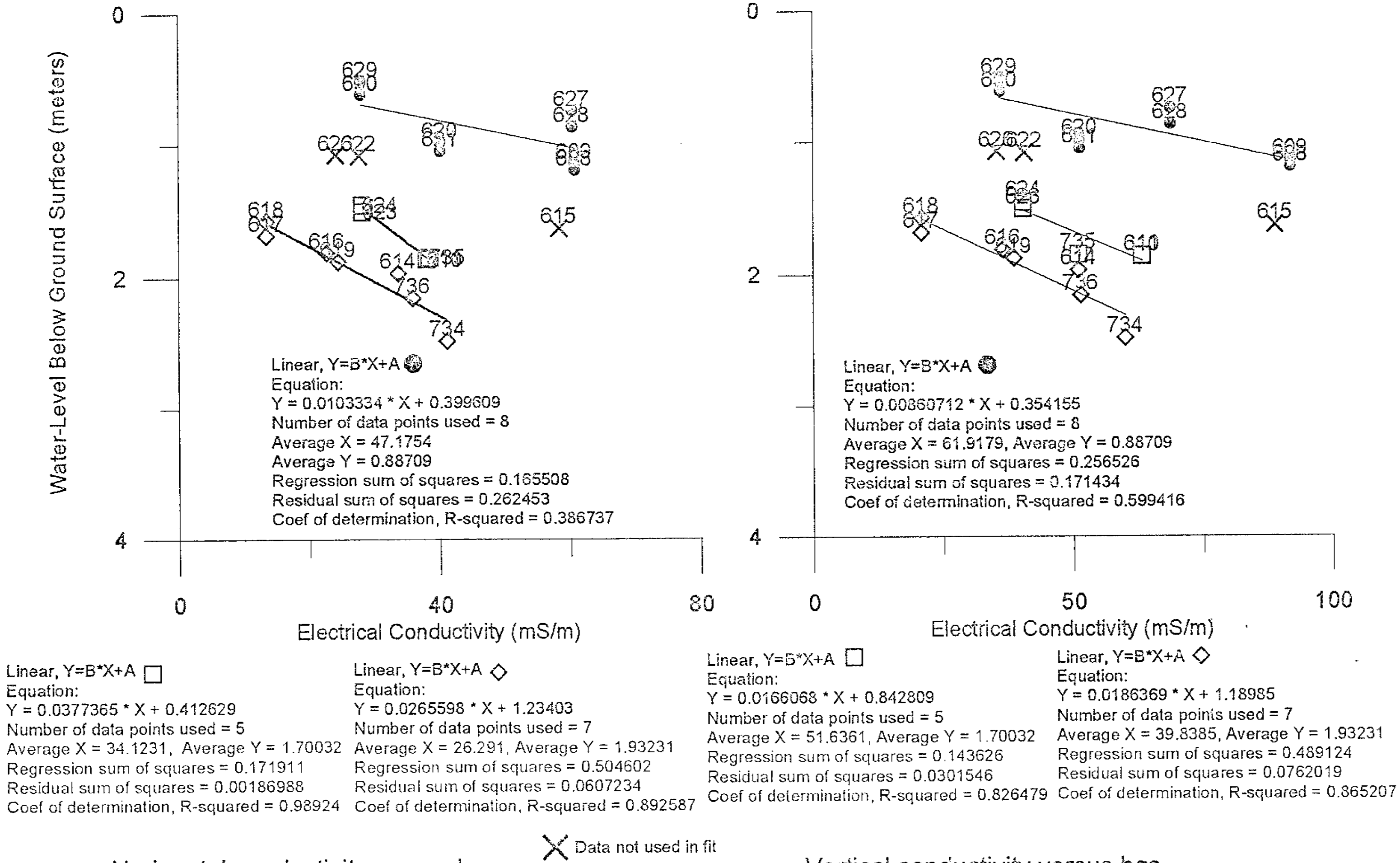
Horizontal conductivity versus bgs

Vertical conductivity versus bgs

Appendix F.9.d: January 1996, EM-31 Electrical Conductivity vs Water-Levels



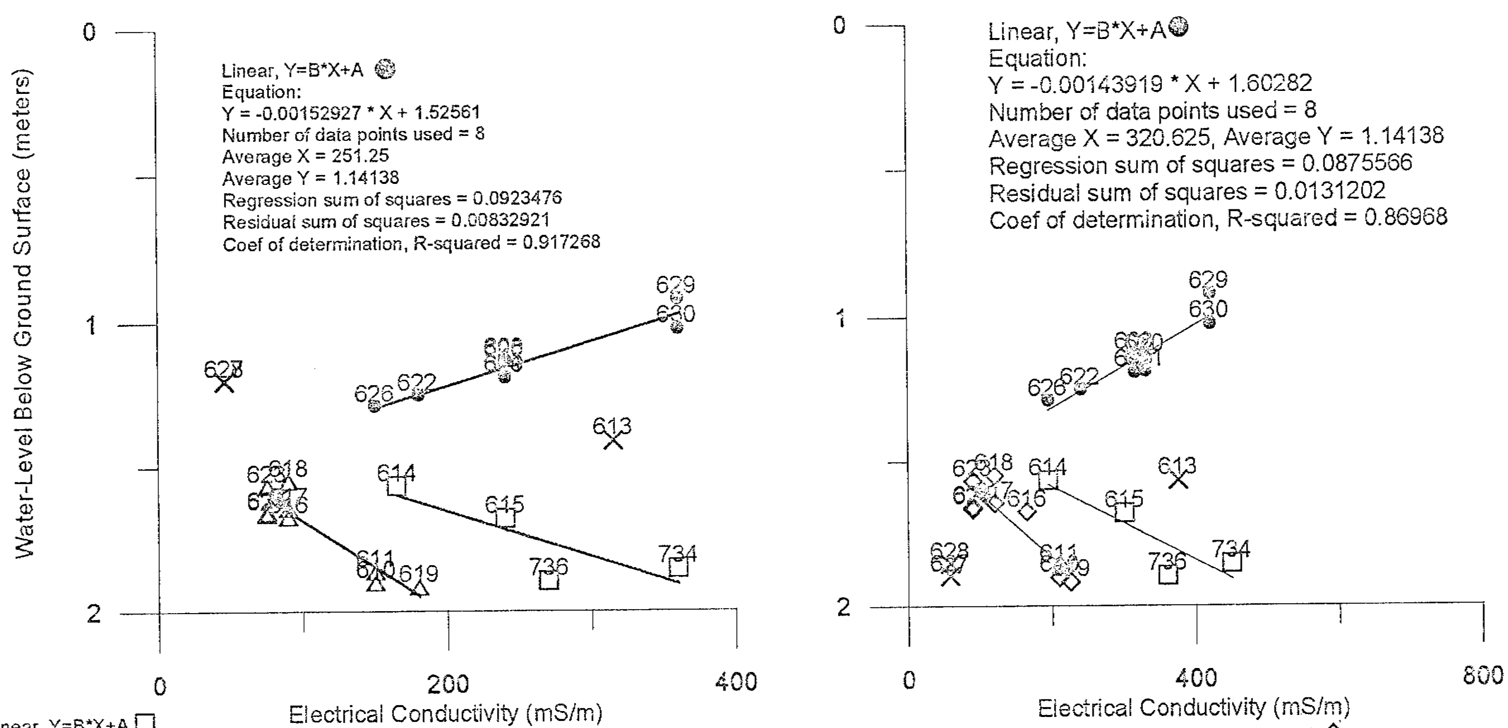
Appendix: F.9.e: February 1996, EM-31 Electrical Conductivity vs Water-Level



Horizontal conductivity versus bgs

Vertical conductivity versus bgs

Appendix: F.9.f: June 1996 EM-31 Electrical Conductivity vs Water-Levels



Linear, Y=B*X+A ●
Equation:
Y = -0.00152927 * X + 1.52561
Number of data points used = 8
Average X = 251.25
Average Y = 1.14138
Regression sum of squares = 0.0923476
Residual sum of squares = 0.00832921
Coef of determination, R-squared = 0.917268

Linear, Y=B*X+A ●
Equation:
Y = -0.00143919 * X + 1.60282
Number of data points used = 8
Average X = 320.625, Average Y = 1.14138
Regression sum of squares = 0.0875566
Residual sum of squares = 0.0131202
Coef of determination, R-squared = 0.86968

Linear, Y=B*X+A ☐
Equation:
Y = 0.00158127 * X + 1.33957
Number of data points used = 4
Average X = 258.75
Average Y = 1.74872
Regression sum of squares = 0.0488053
Residual sum of squares = 0.0227184
Coef of determination, R-squared = 0.682366

Linear, Y=B*X+A ◇
Equation:
Y = 0.00324458 * X + 1.3643
Number of data points used = 9
Average X = 108.333, Average Y = 1.71579
Regression sum of squares = 0.136329
Residual sum of squares = 0.0233844
Coef of determination, R-squared = 0.853585

Linear, Y=B*X+A ☐
Equation:
Y = 0.00127917 * X + 1.33139
Number of data points used = 4
Average X = 326.25, Average Y = 1.74872
Regression sum of squares = 0.0562367
Residual sum of squares = 0.0152869
Coef of determination, R-squared = 0.786268

Linear, Y=B*X+A ◇
Equation:
Y = 0.00223267 * X + 1.38834
Number of data points used = 9
Average X = 146.667, Average Y = 1.71579
Regression sum of squares = 0.127363
Residual sum of squares = 0.0323506
Coef of determination, R-squared = 0.797445

Horizontal conductivity versus bgs

✕ Data not used in fit

Vertical conductivity versus bgs

Appendix F.10: EM - 38 Electrical Conductivity Values

Stake	Easting (E-W)	Northing (N-S)	Horz 9/95 (mS/m)	Vert 9/95 (mS/m)	Horz 1/96 (mS/m)	Vert 1/96 (mS/m)	Horz 2/96 (mS/m)	Vert 2/96 (mS/m)	Horz 6/96 (mS/m)	Vert 6/96 (mS/m)
-3,-2	707151.4	4071467	66.50	83.20	30.10	41.30	37.20	43.30	no reading	no reading
-2,-2	707124.6	4071509	167.40	171.90	123.20	135.90	127.30	148.40	150.10	166.10
-1,-2	707097.8	4071551	181.30	158.40	117.50	95.10	145.80	121.80	150.40	140.30
1,-2	707044.2	4071635	68.80	-4.10	35.20	39.10	65.50	19.70	33.10	61.30
1,-1	707086.3	4071663	24.10	30.60	12.30	23.40	12.50	17.80	13.80	19.00
2,-1	707059.4	4071705	115.00	91.90	64.70	64.00	69.40	61.90	84.20	79.90
3,-1	707032.7	4071747	170.80	173.90	99.40	136.30	137.40	144.40	105.30	147.00
3,0	707074.7	4071775	70.50	72.80	21.60	30.10	44.20	52.10	53.10	55.00
4,0	707047.9	4071817	83.80	98.40	47.70	51.60	47.00	64.20	74.40	76.30
5,0	707021.1	4071858	159.20	169.20	115.40	166.80	116.30	168.20	132.80	167.70
6,0	706994.4	4071900	124.30	80.80	69.50	37.60	81.00	38.20	88.10	78.00
7,0	706967.4	4071942	16.20	21.20	11.10	17.70	9.90	14.50	13.50	19.40
7,1	707009.6	4071970	72.60	53.10	43.00	39.40	43.20	37.10	40.50	65.40
8,-1	706898.7	4071956	25.20	38.20	15.90	29.80	18.20	26.40	21.80	35.40
8,0	706940.7	4071984	9.00	9.00	5.10	10.00	6.50	7.90	6.90	8.20
8,1	706982.8	4072012	97.20	106.00	78.40	85.60	87.40	91.60	90.70	86.90
9,-2	706829.9	4071970	17.10	27.20	11.30	23.50	12.40	21.60	14.30	21.30
9,-1	706871.9	4071998	no reading	no reading	11.30	19.60	13.00	18.00	12.80	19.50
9,0	706913.9	4072026	12.70	13.40	5.40	10.00	7.60	8.50	4.60	6.10
9,1	706955.9	4072054	16.40	16.20	9.30	9.60	6.80	5.70	3.50	4.50
10,-2	706802.9	4072012	34.80	53.20	24.20	42.10	24.70	41.70	31.50	51.10
10,-1	706845.1	4072040	13.30	17.50	7.50	13.80	7.70	11.10	8.80	13.00
10,0	706887.2	4072068	12.60	10.70	7.80	8.30	9.60	7.10	7.50	9.30
10,1	706929.2	4072096	4.80	5.90	3.30	7.40	4.80	3.00	5.30	3.90
11,-2	706776.2	4072054	17.90	26.80	12.90	23.30	13.70	20.90	16.20	25.80
11,-1	706818.3	4072082	10.50	14.20	5.30	9.30	5.50	6.80	7.10	9.40
11,0	706860.4	4072110	9.20	11.80	5.10	7.40	5.80	6.20	8.00	8.70
11,1	706902.4	4072138	5.20	6.30	3.60	7.90	2.80	5.20	4.90	7.80
11,2	706944.4	4072166	59.10	60.20	38.90	40.80	39.40	38.90	53.00	52.10
12,-3	706707.4	4072068	126.70	126.30	69.80	72.00	73.20	71.80	75.70	86.60
12,-2	706749.4	4072096	13.30	19.90	9.10	16.30	9.80	13.80	11.60	16.60
12,-1	706791.4	4072124	10.60	12.50	6.70	9.90	7.00	7.80	9.30	11.00
12,0	706833.4	4072152	10.50	11.80	4.60	9.60	6.20	6.70	10.90	9.50
12,1	706875.6	4072180	7.00	9.90	2.30	8.40	4.60	5.40	7.40	9.30
12,2	706917.7	4072208	7.70	7.00	3.20	6.40	6.10	3.60	6.70	7.60
13,-3	706680.6	4072110	61.40	79.20	38.90	63.70	36.60	52.60	41.50	66.60
13,-2	706722.7	4072138	14.00	21.20	9.30	14.90	7.80	11.50	10.10	13.80
13,-1	706764.7	4072166	10.90	14.90	7.10	11.50	6.30	8.10	4.50	10.10
13,0	706806.8	4072194	10.30	10.90	6.30	9.20	5.70	6.10	8.00	9.10
13,1	706848.8	4072222	8.40	10.10	2.80	7.90	2.90	4.70	6.00	7.10
13,2	706890.9	4072250	4.60	2.90	2.60	5.50	2.00	1.50	5.00	4.50
14,-3	706653.8	4072152	87.50	113.20	47.60	69.30	47.70	68.60	86.70	59.50
14,-2	706695.9	4072180	10.90	17.40	9.30	16.20	8.80	12.40	12.00	18.00
14,-1	706737.9	4072208	8.60	13.70	6.30	10.80	6.70	7.00	8.90	11.30
14,0	706779.9	4072236	8.30	10.10	5.70	9.60	4.80	6.50	8.60	11.20
14,1	706821.9	4072264	15.70	21.20	9.80	15.30	11.80	14.20	17.70	22.40
14,2	706864.1	4072292	5.70	6.50	3.10	6.00	4.20	5.20	7.00	7.10
15,-4	706584.9	4072165	152.50	132.20	69.20	76.90	76.20	73.90	79.00	85.70
15,-3	706626.9	4072194	39.20	63.00	29.60	51.00	30.50	50.00	40.50	67.30
15,-2	706669.1	4072222	12.10	13.80	6.40	14.10	8.20	11.20	10.70	14.40
15,-1	706711.1	4072250	16.10	23.60	9.10	15.00	10.20	13.80	13.60	18.70
15,0	706753.2	4072278	7.70	10.40	5.40	13.00	4.20	5.40	8.00	10.90
15,1	706795.2	4072306	28.20	40.40	15.30	23.00	14.80	20.20	8.20	11.10
15,2	706837.3	4072334	7.00	16.30	-3.20	19.90	7.20	11.60	7.70	28.20
16,-4	706558.2	4072207	149.00	152.00	104.70	107.80	105.20	111.50	115.00	131.00
16,-3	706600.2	4072235	35.90	59.00	26.70	47.50	29.20	46.50	31.00	54.00
16,-2	706642.3	4072264	54.30	54.30	25.50	36.50	28.60	34.60	26.00	35.00
16,-1	706684.4	4072292	9.60	12.30	5.30	13.90	9.60	11.00	4.00	7.00
16,0	706726.4	4072320	11.30	16.90	7.60	15.60	8.90	13.20	5.00	10.00
16,1	706768.4	4072348	22.70	32.80	12.00	21.10	14.00	18.90	10.00	20.00
16,2	706810.4	4072376	92.20	62.10	41.10	32.10	48.10	38.20	43.00	37.00
17,-4	706531.4	4072249	124.30	133.60	99.90	118.60	97.90	110.50	138.00	122.00

Appendix F.10: EM - 38 Electrical Conductivity Values

Stake	Easting (E-W)	Northing (N-S)	Horz 9/95 (mS/m)	Vert 9/95 (mS/m)	Horz 1/96 (mS/m)	Vert 1/96 (mS/m)	Horz 2/96 (mS/m)	Vert 2/96 (mS/m)	Horz 6/96 (mS/m)	Vert 6/96 (mS/m)
17,-3	706573.4	4072277	37.20	58.60	23.30	46.80	25.90	43.90	23.00	44.00
17,-2	706615.4	4072305	43.30	72.20	28.60	56.90	29.80	53.10	29.00	56.00
17,-1	706657.4	4072334	49.30	72.20	12.90	18.60	20.30	19.50	6.00	13.00
17,0	706699.6	4072362	15.20	17.20	16.30	27.40	20.70	28.00	12.00	23.00
17,1	706741.7	4072390	21.40	31.90	43.40	55.80	59.70	64.10	52.00	68.00
17,2	706783.7	4072418	77.20	87.50	50.50	38.50	54.80	39.90	56.00	48.00
18,-4	706504.6	4072291	117.50	145.90	75.10	97.10	85.30	99.30	11.00	17.00
18,-3	706546.6	4072319	49.30	72.20	31.80	50.20	43.00	57.40	89.00	123.00
18,-2	706588.7	4072347	57.30	57.20	34.00	44.70	39.60	38.10	30.00	47.00
18,-1	706630.7	4072375	34.00	58.50	37.10	47.80	29.60	46.90	27.00	36.00
18,0	706672.8	4072403	16.40	31.10	23.30	34.50	25.30	33.40	23.00	42.00
18,1	706714.9	4072432	17.50	18.30	16.30	24.20	19.30	21.90	16.00	27.00
18,2	706756.9	4072460	60.40	38.80	29.50	27.10	41.10	33.40	16.00	24.00
19,-4	706477.8	4072333	127.80	104.50	62.00	80.60	86.50	92.70	87.00	102.00
19,-3	706519.9	4072361	148.50	146.50	85.20	81.50	98.30	92.10	78.00	85.00
19,-2	706561.9	4072389	73.50	115.60	41.80	73.50	55.10	83.90	51.00	84.00
19,-1	706603.9	4072417	126.70	120.70	65.80	71.30	103.80	82.50	126.00	95.00
19,0	706645.9	4072445	29.40	45.60	16.60	33.20	26.90	38.40	17.00	32.00
19,1	706687.9	4072473	13.70	21.50	13.10	20.20	20.50	25.90	14.00	23.00
19,2	706730.1	4072502	58.60	79.00	50.90	75.30	66.20	84.50	78.00	105.00
19,3	706772.2	4072530	no reading	no reading	no reading	no reading	no reading	no reading	9.00	9.00
20,-5	706772.2	4072530	no reading	no reading	no reading	no reading	no reading	no reading	464.00	444.00
20,-4	706450.9	4072375	106.20	120.00	60.90	58.90	81.40	63.90	69.00	65.00
20,-3	706492.9	4072403	192.60	193.90	191.50	193.50	192.20	198.30	28.00	427.00
20,-2	706535.1	4072431	74.20	115.50	47.60	75.20	53.00	84.50	48.00	88.00
20,-1	706577.2	4072459	30.20	50.00	20.20	36.60	26.80	42.50	16.00	33.00
20,0	706619.2	4072487	21.50	34.40	15.20	25.00	15.90	28.00	8.00	20.00
20,1	706661.2	4072515	46.30	72.30	31.90	52.80	35.90	56.70	25.00	50.00
20,2	706703.3	4072543	166.70	167.10	114.80	113.00	135.70	129.00	145.00	152.00
20,3	706745.4	4072572	30.50	34.20	19.30	28.50	28.30	37.00	23.00	45.00
21,-4	706424.2	4072417	133.20	128.30	73.20	48.30	76.80	55.20	68.00	62.00
21,-3	706466.2	4072445	18.00	28.30	12.90	20.70	18.20	26.40	14.00	23.00
21,-2	706508.3	4072473	9.60	14.80	7.20	11.30	12.90	16.30	8.00	13.00
21,-1	706550.4	4072501	no reading	no reading	15.1	31.90	23.30	38.30	19.00	44.00
21,0	706592.4	4072529	48.80	56.10	26.00	34.1	33.10	37.90	24.00	39.00
21,1	706634.4	4072557	no reading	no reading	191.30	189.7	196.40	195.80	388.00	357.00
21,2	706676.4	4072585	no reading	no reading	30.70	49.3	34.90	49.30	32.00	55.00
21,3	706718.4	4072613	no reading	no reading	94.90	93.60	104.10	106.80	124.00	136.00
22,-4	706397.4	4072459	67.70	83.30	59.00	46.10	46.60	55.40	36.00	42.00
22,-3	706439.4	4072487	59.80	77.40	37.20	50.50	37.80	52.10	36.00	51.00
22,-2	706481.4	4072515	17.00	28.90	9.50	22.60	13.50	24.00	9.00	18.00
22,-1	706523.4	4072543	no reading	no reading	77.20	104.00	85.70	115.70	96.00	133.00
22,0	706565.6	4072571	108.80	172.90	136.90	116.70	161.30	131.80	184.00	140.00
22,1	706607.7	4072599	58.30	86.60	46.60	71.10	56.50	76.50	70.00	94.00
22,2	706649.7	4072627	23.40	44.60	20.20	31.50	24.60	34.90	24.00	38.00
22,3	706691.8	4072655	167.10	151.60	81.50	83.00	103.00	92.50	98.00	119.00
23,-7	706244.4	4072417	no reading	no reading	24.40	43.80	39.60	62.40	33.00	51.00
23,-6	706286.4	4072445	172.90	152.50	121.00	95.10	130.20	119.70	140.00	130.00
23,-5	706328.4	4072473	147.90	131.50	74.50	69.30	96.90	85.90	78.00	77.00
23,-4	706370.6	4072501	87.20	94.00	44.10	55.30	60.50	68.00	41.00	51.00
23,-3	706412.7	4072529	27.80	44.60	13.10	32.60	24.60	39.80	20.00	37.00
23,-2	706454.7	4072557	19.10	26.20	11.70	19.80	19.20	25.70	10.00	17.00
23,-1	706496.8	4072585	no reading	no reading	48.70	55.10	66.60	73.70	30.00	45.00
23,0	706538.8	4072613	74.10	104.50	76.50	97.90	80.80	105.80	95.00	129.00
23,1	706580.9	4072641	24.80	42.20	16.70	32.30	19.40	35.50	20.00	38.00
23,2	706622.9	4072669	20.40	30.50	13.40	23.30	16.10	25.80	20.00	34.00
23,3	706664.9	4072697	no reading	no reading	45.40	72.30	49.20	75.30	177.00	191.00
24,-7	706217.7	4072459	56.10	69.60	27.80	43.80	44.30	53.40	42.00	56.00
24,-6	706259.7	4072487	164.60	122.50	80.10	69.70	114.60	82.00	117.00	67.00
24,-5	706301.7	4072515	60.00	90.20	39.40	65.70	47.00	68.80	38.00	60.00
24,-4	706343.8	4072543	161.50	103.60	60.50	56.00	89.30	61.20	52.00	57.00
24,-3	706385.9	4072571	27.3	28.7	15.50	25.90	26.20	35.00	21.00	31.00

Appendix F.10: EM - 38 Electrical Conductivity Values

Stake	Easting (E-W)	Northing (N-S)	Horz 9/95 (mS/m)	Vert 9/95 (mS/m)	Horz 1/96 (mS/m)	Vert 1/96 (mS/m)	Horz 2/96 (mS/m)	Vert 2/96 (mS/m)	Horz 6/96 (mS/m)	Vert 6/96 (mS/m)
24,-2	706427.9	4072599	34.50	43.90	19.60	33.30	29.20	39.40	32.00	40.00
24,-1	706469.9	4072627	30.60	51.70	17.70	42.20	23.90	42.00	16.00	38.00
24,0	706511.9	4072655	16.50	27.80	11.80	20.70	15.50	23.10	12.00	22.00
24,1	706553.9	4072683	21.40	37.00	14.30	28.10	16.40	29.00	15.00	30.00
24,2	706596.1	4072711	184.10	173.10	109.90	104.40	135.30	117.00	128.00	149.00
25,-8	706148.8	4072472	38.40	52.30	30.60	42.40	33.60	54.10	38.00	58.00
25,-7	706190.9	4072500	139.40	110.20	112.30	92.00	104.00	84.50	146.00	89.00
25,-6	706232.9	4072529	143.10	117.80	50.40	67.50	66.80	69.50	70.00	80.00
25,-5	706274.9	4072557	161.30	150.90	99.10	88.50	120.90	105.10	135.00	129.00
25,-4	706316.9	4072585	70.60	113.80	41.90	65.70	52.30	83.40	55.00	87.00
25,-3	706358.9	4072613	153.90	16.60	104.30	115.60	126.60	140.10	118.00	150.00
25,-2	706401.1	4072641	15.30	26.30	8.90	15.50	15.50	18.50	7.00	13.00
25,-1	706443.2	4072669	18.20	46.50	9.60	24.90	15.30	24.60	11.00	20.00
25,0	706485.2	4072697	11.50	14.80	11.80	21.40	14.50	23.30	13.00	26.00
25,1	706527.3	4072725	130.50	93.90	44.80	53.40	49.90	52.50	52.00	72.00
25,2	706569.4	4072753	54.80	78.40	52.90	75.70	61.70	87.80	66.00	95.00
26,-8	706121.9	4072514	173.10	170.60	153.30	157.80	178.30	169.70	202.00	200.00
26,-7	706163.9	4072542	72.50	101.20	59.50	74.20	74.60	85.00	69.00	87.00
26,-6	706206.1	4072570	188.20	185.50	176.00	178.50	194.80	194.40	240.00	281.00
26,-5	706248.2	4072599	185.90	182.50	181.20	173.70	195.10	185.50	248.00	221.00
26,-4	706290.2	4072627	169.50	84.10	42.00	37.10	65.40	44.40	68.00	65.00
26,-3	706332.3	4072655	no reading	no reading	6.00	11.90	12.30	17.10	8.00	14.00
26,-2	706374.3	4072683	20.10	28.90	6.80	23.60	18.10	27.60	13.00	26.00
26,-1	706416.4	4072711	11.30	17.90	4.30	14.00	12.50	17.30	6.00	13.00
26,0	706458.4	4072739	116.80	120.10	47.20	71.00	58.80	83.10	49.00	79.00
26,1	706500.4	4072767	87.50	69.40	42.80	50.80	53.80	63.10	32.00	48.00
27,-8	706095.2	4072556	116.70	185.10	134.50	189.70	173.40	194.80	192.00	333.00
27,-7	706137.3	4072584	166.80	145.30	112.90	93.60	136.40	104.50	153.00	125.00
27,-6	706179.3	4072612	95.60	96.50	61.90	78.60	100.60	92.40	105.00	105.00
27,-5	706221.4	4072640	32.60	41.10	19.00	29.30	24.70	33.40	37.00	43.00
27,-4	706263.4	4072669	97.80	38.30	47.30	47.70	72.80	61.10	69.00	71.00
27,-3	706305.4	4072697	31.40	39.80	12.60	24.10	33.00	29.20	28.00	37.00
27,-2	706347.4	4072725	19.80	30.40	11.00	21.60	18.30	26.80	24.00	36.00
27,-1	706389.6	4072753	169.90	115.80	86.60	64.40	104.00	74.50	122.00	101.00
27,0	706431.6	4072781	85.80	64.10	25.50	33.20	34.30	27.00	56.00	81.00
28,-8	706068.4	4072598	187.30	187.30	190.30	193.30	195.70	195.30	348.00	429.00
28,-7	706110.4	4072626	31.50	55.00	16.90	34.80	24.20	38.60	23.00	38.00
28,-6	706152.4	4072654	40.50	62.90	27.90	48.40	33.80	53.70	32.00	54.00
28,-5	706194.6	4072682	50.30	64.30	19.50	41.10	30.20	48.60	28.00	47.00
28,-4	706236.6	4072710	11.20	13.70	4.70	8.60	10.80	13.30	7.00	11.00
28,-3	706278.7	4072739	12.80	24.80	13.70	18.00	17.80	22.10	8.00	16.00
28,-2	706320.7	4072767	172.80	149.30	64.30	66.60	83.90	78.20	78.00	84.00
28,-1	706362.8	4072795	59.70	79.30	43.80	66.40	52.70	69.20	51.00	87.00
29,-8	706041.6	4072640	165.70	177.80	122.50	168.00	139.90	175.80	156.00	220.00
29,-7	706083.7	4072668	175.30	175.10	129.40	146.00	154.20	158.60	179.00	197.00
29,-6	706125.7	4072696	185.70	185.20	191.70	191.10	194.10	193.20	406.00	394.00
29,-5	706167.8	4072724	182.40	180.70	173.70	177.40	184.40	179.20	254.00	250.00
29,-4	706209.9	4072752	181.40	180.00	176.50	167.20	187.50	176.00	269.00	240.00
29,-3	706251.9	4072780	185.40	184.00	185.20	188.60	192.10	191.00	309.00	327.00
29,-2	706293.9	4072809	177.80	177.40	151.20	169.30	166.60	177.90	220.00	260.00
30,-8	706014.9	4072682	156.30	164.50	97.50	117.70	115.00	126.50	143.00	147.00
30,-7	706056.9	4072710	181.10	181.70	177.00	184.30	185.50	188.90	282.00	308.00
30,-6	706098.9	4072738	157.80	157.30	90.70	87.80	113.60	105.50	146.00	132.00
30,-5	706140.9	4072766	171.50	139.40	82.10	71.80	110.90	86.00	135.00	117.00
30,-4	706182.9	4072794	159.30	143.30	68.60	78.90	86.80	98.90	103.00	131.00
30,-3	706225.1	4072822	156.80	140.00	84.30	93.60	99.20	105.90	116.00	143.00
31,-8	705987.9	4072724	141.50	153.80	138.30	146.10	112.40	129.30	224.00	211.00
31,-7	706030.1	4072752	86.80	79.50	41.00	43.10	49.50	50.90	65.00	85.00
31,-6	706072.2	4072780	36.00	60.40	17.90	30.40	27.90	37.60	24.00	41.00
31,-5	706114.2	4072808	18.90	42.80	10.80	21.90	16.90	23.40	14.00	25.00
32,-8	705961.2	4072766	137.20	156.60	120.20	142.90	104.20	122.60	157.00	179.00
32,-7	706003.3	4072794	119.8	169.7	73.50	126.10	91.00	143.60	117.00	172.00

Appendix F.11: EM-31 Electrical Conductivity Values

Stake	Easting (E-W)	Northing (N-S)	Vert 8/95 (mS/m)	Horz 8/95 (mS/m)	Vert 1/96 (mS/m)	Horz 1/96 (mS/m)	Vert 2/96 (mS/m)	Horz 2/96 (mS/m)	Vert 6/96 (mS/m)	Horz 6/96 (mS/m)
-3,-2	707151.4	4071467	no reading	no reading	38.00	25.00	51.00	38.40	no reading	no reading
-2,-2	707124.6	4071509	no reading	no reading	91.00	70.00	108.60	103.20	390.00	390.00
-1,-2	707097.8	4071551	no reading	no reading	68.00	54.00	79.20	73.80	270.00	315.00
1,-2	707044.2	4071635	61.00	38.00	68.00	43.00	85.80	57.00	300.00	270.00
1,-1	707086.3	4071663	53.00	25.00	39.00	21.00	48.60	28.80	150.00	105.00
2,-1	707059.4	4071705	44.00	31.00	52.00	35.00	64.20	51.00	210.00	180.00
3,-1	707032.7	4071747	64.00	40.00	89.00	67.00	113.40	105.60	435.00	375.00
3,0	707074.7	4071775	40.00	28.00	35.00	21.00	55.80	39.60	180.00	150.00
4,0	707047.9	4071817	51.00	32.00	76.00	50.00	90.00	60.60	330.00	330.00
5,0	707021.1	4071858	80.00	46.00	450.00	330.00	179.40	130.80	600.00	465.00
6,0	706994.4	4071900	54.00	27.00	73.00	50.00	91.80	60.60	315.00	240.00
7,0	706967.4	4071942	42.00	22.00	34.00	20.00	42.60	24.00	150.00	105.00
7,1	707009.6	4071970	34.00	24.00	24.00	24.00	33.60	34.20	150.00	90.00
8,-1	706898.7	4071956	51.00	28.00	50.00	31.00	64.20	44.60	195.00	180.00
8,0	706940.7	4071984	38.00	22.00	20.00	12.00	27.20	15.80	105.00	75.00
8,1	706982.8	4072012	no reading	no reading	38.00	38.00	50.40	46.80	165.00	180.00
9,-2	706829.9	4071970	46.00	29.00	50.00	29.00	63.20	38.00	210.00	150.00
9,-1	706871.9	4071998	43.00	21.00	34.00	20.00	42.00	25.40	150.00	120.00
9,0	706913.9	4072026	34.00	20.00	20.00	11.00	27.20	16.00	90.00	75.00
9,1	706955.9	4072054	40.00	18.00	16.00	10.00	23.80	15.80	75.00	60.00
10,-2	706802.9	4072012	49.00	26.00	60.00	38.00	73.20	45.40	255.00	180.00
10,-1	706845.1	4072040	40.00	18.00	28.00	15.00	35.80	23.80	120.00	90.00
10,0	706887.2	4072068	34.00	17.00	15.00	8.00	23.00	15.20	90.00	60.00
10,1	706929.2	4072096	no reading	no reading	14.00	7.00	20.60	13.40	75.00	75.00
11,-2	706776.2	4072054	44.00	21.00	38.00	24.00	51.00	33.60	195.00	165.00
11,-1	706818.3	4072082	38.00	17.00	20.00	10.00	30.00	19.80	105.00	75.00
11,0	706860.4	4072110	35.00	16.00	15.00	8.00	22.60	13.80	90.00	60.00
11,1	706902.4	4072138	no reading	no reading	14.00	8.00	22.40	12.60	75.00	60.00
11,2	706944.4	4072166	no reading	no reading	18.00	18.00	27.40	24.20	90.00	105.00
12,-3	706707.4	4072068	61.00	40.00	77.00	56.00	95.40	79.80	375.00	315.00
12,-2	706749.4	4072096	44.00	22.00	30.00	16.00	40.60	26.20	135.00	90.00
12,-1	706791.4	4072124	39.00	17.00	185.00	10.00	29.40	16.40	105.00	75.00
12,0	706833.4	4072152	38.00	18.00	14.50	8.50	23.60	14.20	90.00	60.00
12,1	706875.6	4072180	no reading	no reading	14.00	6.50	21.50	12.80	75.00	60.00
12,2	706917.7	4072208	no reading	no reading	10.00	6.00	19.00	11.20	75.00	60.00
13,-3	706680.6	4072110	60.00	29.00	72.00	48.00	7.80	3.60	285.00	105.00
13,-2	706722.7	4072138	40.00	20.00	24.50	12.00	39.60	24.00	120.00	90.00
13,-1	706764.7	4072166	39.00	19.00	20.00	15.00	34.20	21.00	105.00	60.00
13,0	706806.8	4072194	38.00	18.00	16.00	8.00	24.80	14.80	90.00	60.00
13,1	706848.8	4072222	no reading	no reading	10.00	6.00	19.40	11.40	60.00	60.00
13,2	706890.9	4072250	no reading	no reading	10.00	6.00	17.64	9.00	60.00	60.00
14,-3	706653.8	4072152	58.00	37.00	67.00	41.00	91.20	63.60	330.00	270.00
14,-2	706695.9	4072180	42.00	18.00	78.00	40.50	38.40	22.20	135.00	90.00
14,-1	706737.9	4072208	37.00	18.00	54.00	25.50	29.00	16.60	150.00	105.00
14,0	706779.9	4072236	39.00	17.00	52.50	25.50	27.40	16.20	105.00	75.00
14,1	706821.9	4072264	no reading	no reading	63.00	34.50	32.20	20.80	120.00	90.00
14,2	706864.1	4072292	no reading	no reading	43.50	19.50	23.22	13.86	105.00	75.00
15,-4	706584.9	4072165	66.00	42.00	73.00	51.00	107.40	81.00	315.00	270.00
15,-3	706626.9	4072194	53.00	32.00	59.00	37.00	88.80	58.20	300.00	240.00
15,-2	706669.1	4072222	39.00	19.00	22.00	11.00	40.80	25.80	120.00	90.00
15,-1	706711.1	4072250	40.00	18.00	22.00	12.00	36.80	56.60	120.00	90.00
15,0	706753.2	4072278	36.00	19.00	15.00	7.00	27.00	17.80	90.00	60.00
15,1	706795.2	4072306	no reading	no reading	20.00	11.00	34.40	21.20	120.00	90.00
15,2	706837.3	4072334	no reading	no reading	70.00	8.50	31.80	18.80	105.00	90.00
16,-4	706558.2	4072207	74.00	42.00	87.00	62.00	124.20	100.80	420.00	360.00
16,-3	706600.2	4072235	56.00	24.00	58.00	34.00	85.00	57.00	285.00	210.00
16,-2	706642.3	4072264	43.00	23.00	40.00	22.00	59.00	40.40	195.00	135.00
16,-1	706684.4	4072292	40.00	17.00	18.00	8.50	34.20	26.00	105.00	75.00
16,0	706726.4	4072320	36.00	21.00	19.00	9.00	32.40	18.60	135.00	90.00
16,1	706768.4	4072348	no reading	no reading	32.00	13.00	36.40	22.60	165.00	90.00
16,2	706810.4	4072376	no reading	no reading	16.00	10.00	16.89	12.75	90.00	90.00
17,-4	706531.4	4072249	67.00	37.00	91.00	62.00	127.20	90.00	360.00	330.00

Appendix F.11: EM-31 Electrical Conductivity Values

Stake	Easting (E-W)	Northing (N-S)	Vert 8/95 (mS/m)	Horz 8/95 (mS/m)	Vert 1/96 (mS/m)	Horz 1/96 (mS/m)	Vert 2/96 (mS/m)	Horz 2/96 (mS/m)	Vert 6/96 (mS/m)	Horz 6/96 (mS/m)
17,-3	706573.4	4072277	53.00	26.00	59.00	34.00	87.00	53.90	270.00	180.00
17,-2	706615.4	4072305	fence	fence	fence	fence	fence	fence	fence	fence
17,-1	706657.4	4072334	35.00	16.00	23.50	11.00	20.75	13.34	120.00	90.00
17,0	706699.6	4072362	37.00	22.00	34.00	18.00	27.27	17.49	165.00	120.00
17,1	706741.7	4072390	no reading	no reading	56.00	40.00	43.27	28.45	240.00	180.00
17,2	706783.7	4072418	no reading	no reading	19.00	16.00	36.14	42.04	105.00	120.00
18,-4	706504.6	4072291	60.00	38.00	70.00	60.00	57.21	44.16	390.00	390.00
18,-3	706546.6	4072319	48.00	24.00	54.00	33.00	40.61	27.57	240.00	180.00
18,-2	706588.7	4072347	44.00	21.00	59.00	38.00	35.27	23.71	210.00	150.00
18,-1	706630.7	4072375	51.00	21.00	69.00	46.00	42.68	26.08	270.00	180.00
18,0	706672.8	4072403	40.00	22.00	50.00	32.00	32.31	19.27	195.00	135.00
18,1	706714.9	4072432	no reading	no reading	31.00	20.00	21.34	13.63	120.00	90.00
18,2	706756.9	4072460	no reading	no reading	35.00	25.00	23.12	17.78	135.00	105.00
19,-4	706477.8	4072333	55.00	31.00	82.00	61.00	50.68	34.09	330.00	300.00
19,-3	706519.9	4072361	55.00	31.00	82.50	63.00	51.28	40.01	330.00	240.00
19,-2	706561.9	4072389	59.00	34.00	91.50	60.00	54.83	37.94	360.00	285.00
19,-1	706603.9	4072417	42.00	22.00	62.00	48.00	39.42	30.23	240.00	225.00
19,0	706645.9	4072445	40.00	22.00	56.00	35.00	35.57	22.82	210.00	150.00
19,1	706687.9	4072473	no reading	no reading	41.00	24.00	26.97	16.60	165.00	120.00
19,2	706730.1	4072502	no reading	no reading	58.00	41.00	35.57	27.57	225.00	195.00
19,3	706772.2	4072530	no reading	no reading	55.50	36.00	no reading	no reading	75.00	60.00
20,-5	706772.2	4072530	no reading	no reading	no reading	no reading	53.35	50.39	630.00	705.00
20,-4	706450.9	4072375	39.00	21.00	51.50	41.00	34.38	28.16	210.00	210.00
20,-3	706492.9	4072403	57.00	58.00	36.00	36.00	48.31	119.15	54.00	180.00
20,-2	706535.1	4072431	46.00	23.00	72.50	51.00	46.83	32.01	300.00	240.00
20,-1	706577.2	4072459	no reading	no reading	62.85	38.00	38.53	24.30	225.00	180.00
20,0	706619.2	4072487	no reading	no reading	47.00	29.00	29.64	18.67	165.00	120.00
20,1	706661.2	4072515	no reading	no reading	89.50	56.00	53.06	34.38	330.00	225.00
20,2	706703.3	4072543	no reading	no reading	89.50	69.00	55.43	48.91	375.00	345.00
20,3	706745.4	4072572	no reading	no reading	51.00	30.00	34.98	26.38	270.00	180.00
21,-4	706424.2	4072417	36.00	20.00	54.00	40.00	79.84	59.52	210.00	195.00
21,-3	706466.2	4072445	33.00	15.00	32.00	19.00	47.95	35.19	150.00	105.00
21,-2	706508.3	4072473	32.00	14.00	81.00	46.50	40.39	28.11	90.00	75.00
21,-1	706550.4	4072501	no reading	no reading	54.00	32.00	76.77	55.27	195.00	135.00
21,0	706592.4	4072529	no reading	no reading	57.00	39.00	75.58	53.15	180.00	150.00
21,1	706634.4	4072557	no reading	no reading	56.00	45.00	100.78	95.14	690.00	585.00
21,2	706676.4	4072585	no reading	no reading	76.50	49.00	43.67	30.83	210.00	285.00
21,3	706718.4	4072613	no reading	no reading	78.00	60.00	45.35	38.53	315.00	309.00
22,-4	706397.4	4072459	36.00	21.00	54.50	34.00	35.27	24.01	195.00	150.00
22,-3	706439.4	4072487	32.00	20.00	47.00	32.00	31.71	25.79	165.00	135.00
22,-2	706481.4	4072515	no reading	no reading	42.00	26.00	26.68	18.97	135.00	90.00
22,-1	706523.4	4072543	no reading	no reading	57.50	53.50	34.09	33.79	210.00	210.00
22,0	706565.6	4072571	no reading	no reading	85.00	75.00	49.20	44.46	300.00	300.00
22,1	706607.7	4072599	no reading	no reading	95.50	60.00	56.32	44.16	360.00	270.00
22,2	706649.7	4072627	no reading	no reading	62.00	38.00	37.35	27.27	225.00	165.00
22,3	706691.8	4072655	no reading	no reading	75.50	56.00	45.35	39.12	450.00	300.00
23,-7	706244.4	4072417	44.00	24.00	60.00	39.00	38.53	27.86	228.00	168.00
23,-6	706286.4	4072445	36.00	22.00	49.00	48.00	29.34	32.31	68.00	72.00
23,-5	706328.4	4072473	33.00	20.00	55.00	44.00	82.67	67.79	72.00	62.00
23,-4	706370.6	4072501	34.00	23.00	49.00	38.00	68.73	60.23	58.00	46.00
23,-3	706412.7	4072529	33.00	20.00	45.50	29.00	65.43	49.84	58.00	42.00
23,-2	706454.7	4072557	no reading	no reading	34.00	21.00	51.49	38.26	44.00	30.00
23,-1	706496.8	4072585	no reading	no reading	54.50	42.00	34.98	29.94	64.00	45.00
23,0	706538.8	4072613	no reading	no reading	80.00	68.00	48.91	43.57	64.00	45.00
23,1	706580.9	4072641	no reading	no reading	63.00	39.00	87.87	51.49	30.00	33.00
23,2	706622.9	4072669	no reading	no reading	49.20	29.00	66.84	48.89	258.00	180.00
23,3	706664.9	4072697	no reading	no reading	no reading	no reading	56.91	39.72	210.00	150.00
24,-7	706217.7	4072459	44.00	20.00	55.00	38.00	35.86	27.86	420.00	360.00
24,-6	706259.7	4072487	34.00	21.00	51.00	43.00	31.71	29.34	195.00	150.00
24,-5	706301.7	4072515	no reading	no reading	49.00	38.00	32.31	25.49	195.00	150.00
24,-4	706343.8	4072543	no reading	no reading	no reading	no reading	25.19	24.01	180.00	150.00
24,-3	706385.9	4072571	no reading	no reading	33.50	22.50	24.30	17.78	150.00	150.00

Appendix F.11: EM-31 Electrical Conductivity Values

Stake	Easting (E-W)	Northing (N-S)	Vert 8/95 (mS/m)	Horz 8/95 (mS/m)	Vert 1/96 (mS/m)	Horz 1/96 (mS/m)	Vert 2/96 (mS/m)	Horz 2/96 (mS/m)	Vert 6/96 (mS/m)	Horz 6/96 (mS/m)
24,-2	706427.9	4072599	no reading	no reading	45.00	29.00	29.05	22.53	150.00	120.00
24,-1	706469.9	4072627	no reading	no reading	63.50	38.00	40.61	23.71	165.00	135.00
24,0	706511.9	4072655	no reading	no reading	44.00	25.00	27.57	21.64	225.00	120.00
24,1	706553.9	4072683	no reading	no reading	53.50	32.00	32.31	23.12	150.00	120.00
24,2	706596.1	4072711	no reading	no reading	315.00	240.00	62.54	52.76	195.00	150.00
25,-8	706148.8	4072472	no reading	no reading	80.00	49.00	no reading	no reading	435.00	360.00
25,-7	706190.9	4072500	no reading	no reading	90.00	65.00	51.87	36.75	330.00	210.00
25,-6	706232.9	4072529	39.00	24.00	51.00	42.00	33.49	28.16	225.00	180.00
25,-5	706274.9	4072557	37.00	21.00	59.50	49.00	35.86	34.38	240.00	240.00
25,-4	706316.9	4072585	32.00	20.00	56.50	36.00	38.24	29.34	210.00	180.00
25,-3	706358.9	4072613	41.00	27.00	71.00	65.00	47.42	46.83	330.00	270.00
25,-2	706401.1	4072641	34.00	16.00	33.50	18.00	23.42	14.52	120.00	90.00
25,-1	706443.2	4072669	44.00	17.00	52.00	29.00	32.31	20.45	180.00	135.00
25,0	706485.2	4072697	30.00	17.00	40.20	25.00	26.68	19.86	150.00	120.00
25,1	706527.3	4072725	48.00	23.00	66.00	49.00	39.42	33.49	270.00	240.00
25,2	706569.4	4072753	no reading	no reading	65.00	55.00	45.94	40.31	240.00	210.00
26,-8	706121.9	4072514	no reading	no reading	342.00	300.00	no reading	no reading	420.00	345.00
26,-7	706163.9	4072542	no reading	no reading	72.00	57.50	46.53	43.27	330.00	240.00
26,-6	706206.1	4072570	no reading	no reading	363.00	315.00	75.58	73.80	540.00	555.00
26,-5	706248.2	4072599	no reading	no reading	324.00	276.00	66.39	56.61	450.00	420.00
26,-4	706290.2	4072627	32.00	15.00	32.00	26.00	43.70	42.04	120.00	135.00
26,-3	706332.3	4072655	no reading	no reading	84.00	49.50	43.22	29.53	120.00	90.00
26,-2	706374.3	4072683	30.00	14.00	37.00	24.00	53.62	34.72	150.00	120.00
26,-1	706416.4	4072711	30.00	30.00	31.00	18.00	20.75	13.04	120.00	90.00
26,0	706458.4	4072739	48.00	27.00	77.00	52.00	44.16	29.34	285.00	210.00
26,1	706500.4	4072767	no reading	no reading	65.00	45.00	96.61	70.86	270.00	180.00
27,-8	706095.2	4072556	no reading	no reading	360.00	360.00	66.39	65.50	450.00	390.00
27,-7	706137.3	4072584	no reading	no reading	66.00	56.00	41.20	39.42	225.00	255.00
27,-6	706179.3	4072612	no reading	no reading	45.50	39.00	26.38	27.27	150.00	180.00
27,-5	706221.4	4072640	39.00	17.00	44.50	27.50	28.45	18.67	180.00	135.00
27,-4	706263.4	4072669	36.00	22.00	48.50	34.00	29.94	23.12	180.00	150.00
27,-3	706305.4	4072697	41.00	17.00	35.00	22.50	21.64	13.93	150.00	105.00
27,-2	706347.4	4072725	30.00	19.00	35.50	20.50	21.93	14.23	135.00	105.00
27,-1	706389.6	4072753	40.00	21.00	59.50	47.00	35.57	34.09	240.00	240.00
27,0	706431.6	4072781	40.00	19.00	56.00	35.00	34.68	22.23	285.00	210.00
28,-8	706068.4	4072598	no reading	no reading	555.00	480.00	103.44	93.66	720.00	720.00
28,-7	706110.4	4072626	no reading	no reading	52.20	33.00	32.90	22.82	210.00	150.00
28,-6	706152.4	4072654	41.00	21.00	70.00	42.00	44.16	26.97	255.00	180.00
28,-5	706194.6	4072682	no reading	no reading	57.80	38.00	33.49	24.08	240.00	150.00
28,-4	706236.6	4072710	no reading	no reading	62.40	35.40	14.19	8.57	90.00	105.00
28,-3	706278.7	4072739	no reading	no reading	30.00	18.00	19.81	14.48	150.00	105.00
28,-2	706320.7	4072767	no reading	no reading	71.20	49.00	45.23	32.52	300.00	225.00
28,-1	706362.8	4072795	no reading	no reading	88.00	57.50	51.43	35.77	360.00	270.00
29,-8	706041.6	4072640	no reading	no reading	426.00	342.00	88.09	66.51	585.00	510.00
29,-7	706083.7	4072668	no reading	no reading	98.00	77.80	60.01	53.50	420.00	420.00
29,-6	706125.7	4072696	no reading	no reading	504.00	486.00	85.13	82.47	585.00	645.00
29,-5	706167.8	4072724	no reading	no reading	414.00	348.00	72.42	65.33	480.00	450.00
29,-4	706209.9	4072752	no reading	no reading	360.00	294.00	70.35	61.78	480.00	450.00
29,-3	706251.9	4072780	no reading	no reading	420.00	360.00	73.90	70.35	510.00	510.00
29,-2	706293.9	4072809	no reading	no reading	540.00	390.00	109.08	67.10	720.00	495.00
30,-8	706014.9	4072682	no reading	no reading	85.50	69.00	56.16	53.50	330.00	375.00
30,-7	706056.9	4072710	no reading	no reading	420.00	360.00	85.72	74.79	585.00	570.00
30,-6	706098.9	4072738	no reading	no reading	71.80	58.00	44.93	42.57	330.00	315.00
30,-5	706140.9	4072766	no reading	no reading	66.00	48.00	45.23	37.84	300.00	300.00
30,-4	706182.9	4072794	no reading	no reading	85.00	55.00	48.48	39.99	375.00	315.00
30,-3	706225.1	4072822	no reading	no reading	78.50	55.00	42.27	45.23	360.00	300.00
31,-8	705987.9	4072724	no reading	no reading	300.60	222.00	57.35	51.14	375.00	375.00
31,-7	706030.1	4072752	no reading	no reading	65.00	40.00	40.79	27.79	285.00	240.00
31,-6	706072.2	4072780	no reading	no reading	50.00	35.00	20.69	31.33	210.00	150.00
31,-5	706114.2	4072808	no reading	no reading	42.80	21.80	33.70	23.06	180.00	120.00
32,-8	705961.2	4072766	no reading	no reading	300.00	225.00	66.21	55.87	480.00	450.00
32,-7	706003.3	4072794	no reading	no reading	315.00	216.00	60.01	41.09	450.00	360.00

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
-3,-2	707151.4	4071467	51.00	38.40
	707145.4	4071471	59.40	40.20
	707139.4	4071475	66.00	43.80
	707133.4	4071479	69.60	53.40
	707127.4	4071483	96.00	81.60
	707121.4	4071487	85.20	66.60
	707115.4	4071491	91.20	66.00
-2,-2	707124.6	4071509	108.60	103.20
	707118.6	4071513	127.20	121.20
	707112.6	4071517	135.6	134.4
-1,-2	707097.8	4071551	79.20	73.80
	707100.9	4071558	96.00	75.00
	707104.2	4071566	108.60	96.60
	707107.4	4071573	119.40	113.40
	707110.4	4071580	137.40	129.00
	707113.7	4071587	148.80	132.00
	707116.9	4071595	144.60	123.60
	707119.9	4071602	133.80	117.60
	707123.2	4071609	138.60	133.20
	707126.4	4071617	138.00	124.80
	707129.6	4071624	129.60	115.20
	707132.8	4071631	136.20	145.80
	707135.9	4071638	121.20	112.20
	707139.2	4071646	97.80	79.80
735	707142.4	4071653	106.20	83.40
	707037.2	4071630	84.00	63.00
1,-2	707044.2	4071635	85.80	57.00
	707051.2	4071640	94.80	58.20
	707058.2	4071644	106.20	73.80
	707065.3	4071649	72.60	67.20
	707072.3	4071654	66.00	44.40
	707079.3	4071658	60.00	36.60
1,-1	707086.3	4071663	48.60	28.80
	707093.4	4071668	43.20	25.20
	707038.4	4071691	91.80	63.60
	707045.4	4071696	108.60	91.20
	707052.4	4071700	98.40	88.20
2,-1	707059.4	4071705	64.20	51.00
	707066.4	4071710	54.60	36.00
	707073.4	4071714	37.20	22.20
	707080.4	4071719	34.20	21.60
	707026.7	4071743	133.80	103.80
3,-1	707032.7	4071747	113.40	105.60
	707038.7	4071751	107.40	75.60
	707044.7	4071755	67.20	58.80
	707050.7	4071759	58.20	36.00
	707056.7	4071763	52.80	36.60
	707062.7	4071767	49.20	33.00
	707068.7	4071771	45.60	30.60
3,0	707074.7	4071775	55.80	39.60
	707014.2	4071795	135.60	126.00
	707022.7	4071800	150.00	118.80
	707030.9	4071806	119.40	109.20
	707039.4	4071812	95.40	81.00
4,0	707047.9	4071817	90.00	60.60
	707056.4	4071823	85.20	73.80
	707004.3	4071847	99.00	76.20
	707012.7	4071853	131.40	118.20
5,0	707021.1	4071858	179.40	130.80
	706969.2	4071883	71.40	51.60
	706977.4	4071889	62.40	43.20
	706985.9	4071895	70.80	49.20
6,0	706994.4	4071900	91.80	60.60
	706937.4	4071922	63.60	41.40
	706943.4	4071926	64.20	45.00
	706949.4	4071930	67.20	48.60
	706955.4	4071934	54.00	36.60
	706961.4	4071938	47.40	30.60
7,0	706967.4	4071942	42.60	24.00
	706973.4	4071946	41.40	28.20
	706979.4	4071950	45.00	25.80
	706985.4	4071954	48.00	55.20
	706991.6	4071958	63.00	68.40
	706997.6	4071962	43.80	44.40
	707003.6	4071966	43.80	36.60
7,1	707009.6	4071970	33.60	34.20
	706881.9	4071945	69.80	48.80
	706890.3	4071951	62.40	38.40
8,-1	706898.7	4071956	64.20	44.60
	706906.9	4071962	64.00	42.60
	706915.4	4071967	56.80	36.60
	706923.9	4071973	48.00	30.20
	706932.3	4071979	32.80	22.20
8,0	706940.7	4071984	27.20	15.80
	706947.7	4071989	27.00	15.20
	706954.7	4071993	25.00	15.60
	706961.8	4071998	26.20	15.20
	706968.8	4072003	30.00	22.20
	706975.8	4072007	65.40	55.20
8,1	706982.8	4072012	50.40	46.80
9,-2	706829.9	4071970	63.20	38.00
	706838.2	4071976	56.60	40.20
	706846.7	4071981	57.60	35.00
	706854.9	4071987	45.40	28.00
	706863.4	4071993	43.00	25.00
9,-1	706871.9	4071998	42.00	25.40
	706880.4	4072004	40.40	24.60
	706888.7	4072009	38.60	23.20
	706897.2	4072015	35.00	23.00
	706905.6	4072021	31.60	26.20
9,0	706913.9	4072026	27.20	16.00
	706920.9	4072031	24.40	13.80
	706927.9	4072035	22.00	13.00
	706934.9	4072040	22.20	13.00
	706942.1	4072045	21.80	14.40
	706949.1	4072049	22.60	15.00
9,1	706955.9	4072054	23.80	15.80
	706788.9	4072003	71.60	48.20
	706795.9	4072007	72.00	49.20
10,-2	706802.9	4072012	73.20	45.40
	706809.9	4072017	54.60	37.40
	706816.9	4072021	43.20	27.60
	706823.9	4072026	46.20	28.40
	706831.1	4072031	42.40	26.40
	706838.1	4072035	35.20	26.20
10,-1	706845.1	4072040	35.80	23.80
	706853.4	4072046	35.00	21.80
	706861.9	4072051	34.40	24.00
	706870.4	4072057	31.20	18.60
	706878.8	4072063	26.40	20.00

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
10,0	706887.2	4072068	23.00	15.20
	706894.2	4072073	21.20	15.40
	706901.2	4072077	19.00	11.40
	706908.3	4072082	19.20	13.00
	706915.3	4072087	20.00	12.60
	706922.3	4072091	21.40	14.00
10,1	706929.2	4072096	20.60	13.40
	706936.2	4072101	17.80	12.60
	706943.2	4072105	22.80	13.80
	706950.3	4072110	27.20	24.40
	706741.1	4072031	96.00	70.80
	706748.1	4072035	85.80	61.80
	706755.2	4072040	74.40	45.00
	706762.2	4072045	64.80	43.80
	706769.2	4072049	58.20	37.20
11,-2	706776.2	4072054	51.00	33.60
	706783.2	4072059	42.60	27.00
	706790.2	4072063	40.20	27.60
	706797.3	4072068	45.60	31.20
	706804.3	4072073	36.60	22.20
	706811.3	4072077	30.00	21.00
11,-1	706818.3	4072082	30.00	19.80
	706825.4	4072087	28.20	18.60
	706832.4	4072091	28.20	18.60
	706839.4	4072096	25.40	16.80
	706846.4	4072101	25.40	17.00
	706853.4	4072105	23.20	16.00
11,0	706860.4	4072110	22.60	13.80
	706867.4	4072115	21.80	15.00
	706874.4	4072119	20.40	12.60
	706881.4	4072124	19.20	11.60
	706888.4	4072129	18.20	10.80
	706895.4	4072133	18.80	11.60
11,1	706902.4	4072138	22.40	12.60
	706909.4	4072143	22.40	12.40
	706916.4	4072147	21.40	14.00
	706923.4	4072152	20.20	12.40
	706930.4	4072157	23.80	18.80
	706937.4	4072161	32.20	21.30
11,2	706944.4	4072166	27.40	24.20
	706698.9	4072063	96.60	73.20
12,-3	706707.4	4072068	95.40	79.80
	706715.9	4072074	99.00	78.60
	706724.2	4072079	96.00	98.40
	706732.7	4072085	74.00	54.80
	706741.1	4072091	48.60	30.40
12,-2	706749.4	4072096	40.60	26.20
	706756.4	4072101	40.60	28.40
	706763.4	4072105	42.40	25.20
	706770.4	4072110	38.20	26.20
	706777.6	4072115	31.40	17.40
	706784.6	4072119	28.00	15.80
12,-1	706791.4	4072124	29.40	16.40
	706799.9	4072130	31.00	21.40
	706808.2	4072135	27.60	21.80
	706816.7	4072141	26.60	18.60
	706825.1	4072147	21.40	13.80
12,0	706833.4	4072152	23.60	14.20
	706841.9	4072158	25.40	15.40
	706850.4	4072163	24.80	14.80
	706858.8	4072169	24.80	18.00
	706867.2	4072175	22.40	14.60
12,1	706875.6	4072180	21.50	12.80
	706882.6	4072185	12.60	13.00
	706889.7	4072189	12.60	22.00
	706896.7	4072194	12.40	21.00
	706903.7	4072199	17.60	20.20
	706910.7	4072203	20.20	11.00
12,2	706917.7	4072208	19.00	11.20
	706924.7	4072213	19.20	12.40
	706931.7	4072217	18.40	11.80
	706663.8	4072099	30.60	3.00
	706672.2	4072105	12.60	7.20
13,-3	706680.6	4072110	7.80	3.60
	706688.9	4072116	82.20	57.00
	706697.4	4072121	46.80	33.00
	706705.9	4072127	43.20	28.20
	706714.3	4072133	41.40	31.20
13,-2	706722.7	4072138	39.60	24.00
	706730.9	4072144	39.60	25.20
	706739.4	4072149	40.80	29.40
	706747.9	4072155	38.40	26.40
	706756.3	4072161	37.80	25.20
13,-1	706764.7	4072166	34.20	21.00
	706771.7	4072171	34.80	25.20
	706778.7	4072175	36.60	27.00
	706785.8	4072180	34.80	24.00
	706792.8	4072185	30.60	19.80
	706799.8	4072189	24.20	14.60
13,0	706806.8	4072194	24.80	14.80
	706813.9	4072199	24.00	15.80
	706820.9	4072203	22.20	15.00
	706827.9	4072208	21.80	14.60
	706834.9	4072213	24.40	17.00
	706841.9	4072217	21.10	12.40
13,1	706848.8	4072222	19.40	11.40
	706855.9	4072227	19.20	13.80
	706862.9	4072231	18.80	11.00
	706869.9	4072236	18.60	14.00
	706876.9	4072241	18.60	10.80
	706883.9	4072245	18.78	10.08
13,2	706890.9	4072250	17.64	9.00
	706897.9	4072255	19.44	11.28
	706617.3	4072128	109.80	72.60
	706624.4	4072133	100.20	64.20
	706631.4	4072137	105.00	77.40
	706638.4	4072142	102.60	69.00
	706645.4	4072147	97.20	62.70
14,-3	706653.8	4072152	91.20	63.60
	706662.2	4072158	66.20	46.60
	706670.7	4072163	50.20	31.60
	706678.9	4072169	41.80	24.80
	706687.4	4072175	40.40	24.60
14,-2	706695.9	4072180	38.40	22.20
	706704.2	4072186	32.40	18.40
	706712.7	4072191	26.60	15.60
	706720.9	4072197	26.20	14.40
	706729.4	4072203	30.40	19.40
14,-1	706737.9	4072208	29.00	16.60
	706744.9	4072213	28.00	17.20

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
	706751.9	4072217	29.80	18.00
	706758.9	4072222	30.40	17.20
	706765.9	4072227	24.00	14.40
	706772.9	4072231	24.40	14.60
14,0	706779.9	4072236	27.40	16.20
	706786.9	4072241	28.80	17.00
	706793.9	4072245	25.80	14.40
	706800.9	4072250	27.40	17.80
	706808.1	4072255	29.80	20.00
	706815.1	4072259	28.40	18.40
14,1	706821.9	4072264	32.20	20.80
	706828.9	4072269	34.00	18.40
	706835.9	4072273	29.00	21.00
	706842.9	4072278	20.94	13.08
	706850.1	4072283	22.20	13.68
	706857.1	4072287	23.58	14.15
14,2	706864.1	4072292	23.22	13.86
	706871.1	4072297	22.32	12.24
	706878.2	4072301	21.30	11.52
15,-4	706584.9	4072165	107.40	81.00
	706593.4	4072172	102.60	78.60
	706601.7	4072177	113.40	83.40
	706610.2	4072183	106.20	100.20
	706618.6	4072189	115.80	95.40
15,-3	706626.9	4072194	88.80	58.20
	706635.4	4072200	73.80	54.00
	706643.9	4072205	55.80	35.40
	706652.3	4072211	46.80	28.80
	706660.7	4072217	44.40	27.60
15,-2	706669.1	4072222	40.80	25.80
	706676.1	4072227	40.20	27.60
	706683.2	4072231	45.00	28.80
	706690.2	4072236	42.20	25.20
	706697.2	4072241	39.60	24.20
	706704.2	4072245	40.20	25.80
15,-1	706711.1	4072250	36.80	56.60
	706719.4	4072256	29.20	16.40
	706727.9	4072261	26.20	16.40
	706736.4	4072267	24.20	14.00
	706744.8	4072273	24.20	14.20
15,0	706753.2	4072278	27.00	17.80
	706761.4	4072284	26.20	16.80
	706769.9	4072289	26.00	18.20
	706778.4	4072295	26.00	14.60
	706786.8	4072301	27.20	16.20
15,1	706795.2	4072306	34.40	21.20
	706802.2	4072311	39.00	24.20
	706809.2	4072315	35.20	22.80
	706816.3	4072320	28.40	19.60
	706823.3	4072325	27.40	18.60
	706830.3	4072329	27.20	19.60
15,2	706837.3	4072334	31.80	18.80
	706844.4	4072339	25.40	15.80
	706851.4	4072343	21.60	14.40
	706551.2	4072202	106.20	90.00
16,-4	706558.2	4072207	124.20	100.80
	706565.2	4072212	136.50	103.80
	706572.2	4072216	131.40	131.60
	706579.3	4072221	87.60	54.80
	706586.3	4072226	84.60	46.60
	706593.3	4072230	73.20	48.20
16,-3	706600.2	4072235	85.00	57.00
	706607.2	4072240	69.60	45.60
	706614.2	4072244	65.00	43.80
	706621.3	4072249	60.40	34.80
	706628.3	4072254	57.00	43.00
	706635.3	4072258	59.00	38.40
16,-2	706642.3	4072264	59.00	40.40
	706650.7	4072270	55.80	48.20
	706659.2	4072275	58.00	38.00
	706667.4	4072281	48.00	31.40
	706675.9	4072287	42.80	29.40
16,-1	706684.4	4072292	34.20	26.00
	706691.4	4072297	31.50	20.00
	706698.4	4072301	29.80	20.60
	706705.4	4072306	34.00	18.80
	706712.4	4072311	33.20	23.60
	706719.4	4072315	34.20	20.20
16,0	706726.4	4072320	32.40	18.60
	706734.7	4072326	33.60	21.00
	706743.2	4072331	33.60	20.60
	706751.4	4072337	31.60	20.20
	706759.9	4072343	33.60	22.20
16,1	706768.4	4072348	36.40	22.60
	706776.9	4072354	48.80	23.40
	706793.7	4072365	25.19	27.86
	706802.1	4072371	26.68	16.30
16,2	706810.4	4072376	16.89	12.75
	706818.9	4072382	13.04	10.37
	706827.4	4072387	12.15	8.60
	706835.8	4072393	10.37	7.71
	706506.2	4072232	138.00	115.20
	706514.4	4072238	114.00	81.60
	706522.9	4072244	134.40	107.40
17,-4	706531.4	4072249	127.20	90.00
	706539.7	4072255	106.80	76.80
	706548.2	4072260	95.40	61.20
	706556.4	4072266	91.20	67.20
	706564.9	4072272	87.00	59.00
17,-3	706573.4	4072277	87.00	53.90
	706581.9	4072283	82.20	54.00
17,-2	706615.4	4072305		
	706623.9	4072311	23.12	16.01
17,-1	706657.4	4072334	20.75	13.34
	706665.9	4072340	22.53	14.23
	706674.4	4072345	24.30	15.12
	706682.8	4072351	26.08	16.30
	706691.2	4072357	26.68	16.60
17,0	706699.6	4072362	27.27	17.49
	706707.9	4072368	34.68	19.86
	706716.4	4072373	32.60	18.08
	706724.9	4072379	43.57	29.94
	706733.3	4072385	41.50	47.72
17,1	706741.7	4072390	43.27	28.45
	706749.9	4072396	57.40	64.01
	706758.4	4072401	73.22	51.02
	706766.9	4072407	63.07	38.03
	706775.3	4072413	39.68	27.87
17,2	706783.7	4072418	36.14	42.04
	706792.1	4072424	32.12	19.84

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
	706800.4	4072429	29.76	17.24
	706808.9	4072435	58.58	30.23
	706817.4	4072441	52.91	27.64
	706490.4	4072282	48.61	28.75
	706497.6	4072286	52.46	31.71
18,-4	706504.6	4072291	57.21	44.16
	706511.6	4072296	62.84	44.16
	706518.7	4072300	54.24	44.16
	706525.7	4072305	46.83	40.90
	706532.7	4072310	44.46	32.60
	706539.7	4072314	41.50	28.45
18,-3	706546.6	4072319	40.61	27.57
	706553.6	4072324	41.79	24.01
	706560.7	4072328	42.39	28.16
	706567.7	4072333	39.42	26.97
	706574.7	4072338	38.53	28.16
	706581.7	4072342	38.83	26.97
18,-2	706588.7	4072347	35.27	23.71
	706595.7	4072352	38.53	24.60
	706602.7	4072356	41.50	29.94
	706609.8	4072361	48.61	29.05
	706616.8	4072366	46.53	26.68
	706623.8	4072370	45.35	27.86
18,-1	706630.7	4072375	42.68	26.08
	706639.1	4072381	49.20	38.53
	706647.4	4072386	64.32	53.35
	706655.9	4072392	59.28	39.12
	706664.4	4072398	41.50	26.97
18,0	706672.8	4072403	32.31	19.27
	706681.2	4072410	28.16	17.49
	706689.7	4072415	21.04	13.34
	706697.9	4072421	18.97	13.63
	706706.4	4072427	17.19	12.45
18,1	706714.9	4072432	21.34	13.63
	706721.9	4072437	23.71	15.41
	706728.9	4072441	22.23	23.42
	706735.9	4072446	32.60	29.94
	706742.9	4072451	21.93	19.56
	706749.9	4072455	26.38	16.30
18,2	706756.9	4072460	23.12	17.78
	706763.9	4072465	21.04	19.56
	706444.1	4072311	64.02	46.83
	706452.4	4072316	58.98	39.12
	706460.9	4072322	58.39	32.90
	706469.4	4072328	58.69	41.20
19,-4	706477.8	4072333	50.68	34.09
	706486.2	4072339	53.35	36.75
	706494.7	4072344	55.72	45.65
	706502.9	4072350		37.35
	706511.4	4072356	50.39	31.42
19,-3	706519.9	4072361	51.28	40.01
	706528.2	4072367	60.76	47.72
	706536.7	4072372	55.72	50.39
	706544.9	4072378	58.98	42.09
	706553.4	4072384	54.24	40.61
19,-2	706561.9	4072389	54.83	37.94
	706568.9	4072394	58.39	48.02
	706575.9	4072398	71.14	44.76
	706582.9	4072403	67.28	41.79
	706589.9	4072408	56.61	45.65
	706596.9	4072412	54.54	39.12
19,-1	706603.9	4072417	39.42	30.23
	706612.4	4072423	38.24	29.34
	706620.7	4072428	47.72	29.05
	706629.2	4072434	49.20	31.71
	706637.6	4072440	45.65	29.94
19,0	706645.9	4072445	35.57	22.82
	706654.4	4072451	28.45	17.49
	706662.7	4072456	23.42	14.52
	706671.2	4072462	23.12	15.41
	706679.6	4072468	22.82	13.93
19,1	706687.9	4072473	26.97	16.60
	706694.9	4072478	29.64	18.67
	706701.9	4072482	36.16	24.01
	706708.9	4072487	39.42	24.01
	706716.1	4072492	33.20	26.68
	706723.1	4072496	30.23	21.64
19,2	706730.1	4072502	35.57	27.57
	706737.1	4072507	54.24	46.83
19,3	706772.2	4072530		
	706401.9	4072342	46.53	37.94
20,-5	706408.9	4072347	53.35	50.39
	706415.9	4072352	55.72	53.94
	706422.9	4072356	19.56	57.50
	706429.9	4072361	44.16	37.05
	706436.9	4072366	35.86	26.68
	706443.9	4072370	25.49	31.71
20,-4	706450.9	4072375	34.38	28.16
	706456.9	4072379	37.64	40.61
	706462.9	4072383	43.87	37.35
	706468.9	4072387	52.17	29.34
	706474.9	4072391	53.65	30.53
	706480.9	4072395	75.88	67.88
	706486.9	4072399	76.17	81.21
20,-3	706492.9	4072403	48.31	119.15
	706501.4	4072409	40.31	40.31
	706509.9	4072414	40.90	32.60
	706518.3	4072420	37.35	22.82
	706526.7	4072426	36.75	24.01
20,-2	706535.1	4072431	46.83	32.01
	706543.4	4072437	27.27	21.93
	706551.9	4072442	25.79	18.97
	706560.4	4072448	33.49	26.08
	706568.8	4072454	35.27	21.64
20,-1	706577.2	4072459	38.53	24.30
	706585.4	4072465	41.20	23.71
	706593.9	4072470	35.27	24.01
	706602.4	4072476	28.45	16.89
	706610.8	4072482	24.60	15.71
20,0	706619.2	4072487	29.64	18.67
	706627.4	4072493	33.20	19.86
	706635.9	4072498	33.20	21.04
	706644.4	4072504	42.68	27.86
	706652.8	4072510	49.50	30.23
20,1	706661.2	4072515	53.06	34.38
	706667.2	4072519	54.54	38.24
	706673.2	4072523	61.06	37.94
	706679.2	4072527	61.95	46.53
	706685.2	4072531	72.62	54.54
	706691.2	4072535	94.26	83.58

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
	706697.2	4072539	73.21	62.24
20,2	706703.3	4072543	55.43	48.91
	706710.4	4072548	40.61	33.79
	706717.4	4072552	37.35	29.64
	706724.4	4072557	39.12	28.75
	706731.4	4072562	45.35	34.38
	706738.4	4072566	42.68	30.53
20,3	706745.4	4072572	34.98	26.38
	706752.4	4072577	30.53	22.53
	706759.4	4072581		28.75
	706410.2	4072408	82.67	67.32
	706417.2	4072412	85.03	60.94
21,-4	706424.2	4072417	79.84	59.52
	706431.2	4072422	87.39	75.11
	706438.2	4072426	82.91	62.12
	706445.3	4072431	64.72	49.13
	706452.3	4072436	53.85	39.99
	706459.3	4072440	54.09	41.10
21,-3	706466.2	4072445	47.95	35.19
	706474.6	4072451	43.93	34.72
	706482.9	4072456	45.11	30.00
	706491.4	4072462	44.88	33.54
	706499.9	4072468	42.52	30.71
21,-2	706508.3	4072473	40.39	28.11
	706516.7	4072479	52.44	34.49
	706525.2	4072484	64.01	49.37
	706533.4	4072490	70.39	54.09
	706541.9	4072496	75.11	54.56
21,-1	706550.4	4072501	76.77	55.27
	706558.7	4072507	69.92	48.89
	706567.2	4072512	59.29	44.17
	706575.4	4072518	59.29	46.06
	706583.9	4072524	67.79	53.85
21,0	706592.4	4072529	75.58	53.15
	706599.4	4072534	75.82	63.54
	706606.4	4072538	45.65	28.45
	706613.4	4072543	49.80	37.94
	706620.4	4072548	60.17	43.27
	706627.4	4072552	70.54	53.65
21,1	706634.4	4072557	100.78	95.14
	706641.4	4072562	68.47	64.91
	706648.4	4072566	61.35	50.68
	706655.4	4072571	48.61	39.72
	706662.6	4072576	47.42	32.01
	706669.6	4072580	45.35	34.68
21,2	706676.4	4072585	43.87	30.83
	706684.9	4072591	48.91	36.46
	706693.2	4072596	46.24	35.86
	706701.7	4072602	37.94	26.68
	706710.1	4072608	37.35	26.08
21,3	706718.4	4072613	45.35	38.53
	706726.9	4072619	43.57	32.60
	706735.4	4072624	40.31	26.68
	706376.4	4072445	24.90	23.12
	706383.4	4072450	32.90	28.16
	706390.4	4072454	37.05	27.57
22,-4	706397.4	4072459	35.27	24.01
	706404.4	4072464	33.20	25.49
	706411.4	4072468	32.31	26.38
	706418.4	4072473	30.23	26.38
	706425.4	4072478	30.23	25.49
	706432.4	4072482	32.01	28.45
22,-3	706439.4	4072487	31.71	25.79
	706447.9	4072493	23.71	17.19
	706456.2	4072498	22.82	15.41
	706464.7	4072504	23.71	14.52
	706473.1	4072510	24.60	18.38
22,-2	706481.4	4072515	26.68	18.97
	706489.9	4072521	25.79	18.38
	706498.2	4072526	25.49	18.97
	706506.7	4072532	27.86	21.04
	706515.1	4072538	24.90	13.93
22,-1	706523.4	4072543	34.09	33.79
	706529.4	4072547	38.53	31.12
	706535.4	4072551	30.23	22.82
	706541.4	4072555	31.12	19.27
	706547.4	4072559	31.12	31.12
	706553.4	4072563	32.01	24.90
	706559.4	4072567	41.50	33.20
22,0	706565.6	4072571	49.20	44.46
	706571.6	4072575	61.95	55.43
	706577.6	4072579	74.99	70.54
	706583.6	4072583	73.21	66.99
	706589.7	4072587	105.81	83.29
	706595.7	4072591	104.63	106.11
	706601.7	4072595	68.47	68.17
22,1	706607.7	4072599	56.32	44.16
	706615.9	4072605	41.20	36.16
	706624.4	4072610	38.83	29.05
	706632.9	4072616	40.31	26.97
	706641.3	4072622	39.42	32.01
22,2	706649.7	4072627	37.35	27.27
	706658.1	4072633	34.98	21.34
	706666.4	4072638	32.60	23.71
	706674.9	4072644	33.79	25.19
	706683.4	4072650	38.53	31.71
22,3	706691.8	4072655	45.35	39.12
	706700.2	4072661	48.02	37.05
23,-7	706244.4	4072417	38.53	27.86
	706251.4	4072422	37.05	23.42
	706258.4	4072426	38.24	26.08
	706265.4	4072431	33.79	23.71
	706272.6	4072436	32.90	21.93
	706279.6	4072440	34.38	24.60
23,-6	706286.4	4072445	29.34	32.31
	706293.4	4072450	32.604	26.76
	706317.9	4072466	63.54	57.87
23,-5	706328.4	4072473	82.67	67.79
	706338.9	4072480	79.13	94.48
	706349.4	4072487	76.29	53.15
	706360.1	4072494	67.08	49.13
23,-4	706370.6	4072501	68.73	60.23
	706377.6	4072506	69.68	50.07
	706384.7	4072510	69.91	49.13
	706391.7	4072515	67.79	48.89
	706398.7	4072520	68.26	54.33
	706405.7	4072524	70.86	55.27
23,-3	706412.7	4072529	65.43	49.84
	706419.7	4072534	76.53	62.83
	706426.7	4072538	70.39	49.37

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
	706433.8	4072543	74.40	53.38
	706440.8	4072548	56.92	50.55
	706447.8	4072552	55.27	43.22
23,-2	706454.7	4072557	51.49	38.26
	706463.1	4072563	49.60	34.96
	706471.4	4072568	53.38	41.81
	706479.9	4072574	26.38	18.67
	706488.4	4072580	25.79	23.71
23,-1	706496.8	4072585	34.98	29.94
	706505.2	4072591	40.31	36.16
23,0	706538.8	4072613	48.91	43.57
	706547.2	4072619	66.61	54.09
	706555.7	4072624	56.45	37.56
	706563.9	4072630	57.40	35.43
	706572.4	4072636	69.51	48.89
23,1	706580.9	4072641	87.87	51.49
	706587.9	4072646	72.51	55.27
	706594.9	4072650	76.06	51.96
	706601.9	4072655	77.24	58.81
	706608.9	4072660	77.47	59.29
	706615.9	4072664	69.91	55.51
23,2	706622.9	4072669	66.84	48.89
	706629.9	4072674	73.69	55.98
	706636.9	4072678	80.07	56.45
	706643.9	4072683	95.66	86.21
	706650.9	4072688	51.57	39.42
	706657.9	4072692	56.91	42.68
23,3	706664.9	4072697	56.91	39.72
	706210.7	4072454	37.05	23.42
24,-7	706217.7	4072459	35.86	27.86
	706224.7	4072464	35.57	28.45
	706231.7	4072468	30.83	24.90
	706238.8	4072473	30.83	30.23
	706245.8	4072478	39.12	33.49
	706252.8	4072482	34.38	31.71
24,-6	706259.7	4072487	31.71	29.34
	706266.7	4072492	30.53	29.05
	706273.7	4072496	35.57	30.23
	706280.8	4072501	39.12	34.38
	706287.8	4072506	37.64	33.20
	706294.8	4072510	32.31	25.19
24,-5	706301.7	4072515	32.31	25.49
	706329.8	4072534	28.16	23.12
	706336.8	4072538	23.12	19.86
24,-4	706343.8	4072543	25.19	24.01
	706350.9	4072548	25.19	23.12
	706357.9	4072552	21.93	19.56
	706364.9	4072557	21.93	16.89
	706371.9	4072562	23.71	18.38
	706378.9	4072566	27.27	22.53
	706385.9	4072571	27.57	22.23
24,-3	706385.9	4072571	24.30	17.78
	706392.9	4072576	22.30	16.89
	706399.9	4072580	22.82	18.38
	706406.9	4072585	25.79	19.86
	706413.9	4072590	26.67	20.45
	706420.9	4072594	32.01	19.86
24,-2	706427.9	4072599	29.05	22.53
	706434.9	4072604	31.12	23.42
	706441.9	4072608	32.01	29.94
24,-1	706469.9	4072627	40.61	23.71
	706478.4	4072633	28.75	18.67
	706486.7	4072638	31.12	22.23
	706495.2	4072644	31.71	23.71
	706503.6	4072650	29.94	19.27
24,0	706511.9	4072655	27.57	21.64
	706518.9	4072660	26.38	20.16
	706525.9	4072664	24.60	17.78
	706532.9	4072669	24.90	17.49
	706540.1	4072674	24.90	19.27
	706547.1	4072678	3.85	16.30
24,1	706553.9	4072683	32.31	23.12
	706560.9	4072688	31.42	23.42
	706567.9	4072692	31.42	21.04
	706574.9	4072697	42.98	33.49
	706582.1	4072702	53.65	39.42
	706589.1	4072706	62.84	49.50
24,2	706596.1	4072711	62.54	52.76
	706603.1	4072716	79.14	64.91
25,-8	706148.8	4072472		
25,-7	706190.9	4072500	51.87	36.75
25,-6	706232.9	4072529	33.49	28.16
	706239.9	4072534	33.20	26.38
	706246.9	4072538	32.90	28.16
	706253.9	4072543	36.75	27.27
	706260.9	4072548	35.57	31.71
	706267.9	4072552	36.75	32.31
25,-5	706274.9	4072557	35.86	34.38
	706281.9	4072562	35.27	33.79
	706288.9	4072566	35.57	33.20
	706295.9	4072571	32.90	32.01
	706303.1	4072576	32.01	30.53
	706310.1	4072580	33.79	30.83
25,-4	706316.9	4072585	38.24	29.34
	706323.9	4072590	24.90	26.68
	706330.9	4072594	29.64	22.53
	706337.9	4072599	29.05	30.23
	706345.1	4072604	30.23	35.57
	706352.1	4072608	33.20	34.09
25,-3	706358.9	4072613	47.42	46.83
	706367.4	4072619	51.28	38.24
	706375.9	4072624	29.94	25.19
	706384.3	4072630	29.64	24.60
	706392.7	4072636	26.08	17.19
25,-2	706401.1	4072641	23.42	14.52
	706409.4	4072647	23.71	16.89
	706417.9	4072652	24.30	15.41
	706426.4	4072658	26.08	18.38
	706434.8	4072664	30.23	21.34
25,-1	706443.2	4072669	32.31	20.45
	706451.4	4072675	29.34	20.16
	706459.9	4072680	23.71	18.97
	706468.4	4072686	24.30	17.78
	706476.8	4072692	24.90	19.27
25,0	706485.2	4072697	26.68	19.86
	706492.2	4072702	27.57	21.93
	706499.2	4072706	32.01	20.45
	706506.3	4072711	33.79	24.90
	706513.3	4072716	34.98	24.60
	706520.3	4072720	33.49	26.97

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
25,1	706527.3	4072725	39.42	33.49
	706535.7	4072731	46.53	38.53
	706544.2	4072736	52.17	40.31
	706552.4	4072742	48.91	41.79
	706560.9	4072748	56.02	35.57
25,2	706569.4	4072753	45.94	40.31
26,-8	706121.9	4072514		
26,-7	706163.9	4072542	46.53	43.27
	706170.9	4072547	66.69	61.95
	706177.9	4072551	75.88	72.62
	706184.9	4072556	79.44	69.06
	706192.1	4072561	78.55	84.77
	706199.1	4072565	84.18	87.44
26,-6	706206.1	4072570	75.58	73.80
	706213.1	4072575	65.50	65.80
	706220.2	4072579	56.91	64.91
	706227.2	4072584	61.95	54.54
	706234.2	4072589	56.61	62.84
	706241.2	4072593	60.47	56.32
26,-5	706248.2	4072599	66.39	56.61
	706256.4	4072605	53.85	57.16
	706264.9	4072610	66.14	53.62
	706273.4	4072616	65.19	61.18
	706281.8	4072622	66.61	49.37
26,-4	706290.2	4072627	43.70	42.04
	706298.6	4072633	37.56	24.80
	706306.9	4072638	38.74	22.68
	706315.4	4072644	43.22	28.11
	706323.9	4072650	42.75	31.65
26,-3	706332.3	4072655	43.22	29.53
	706340.6	4072661	35.90	22.20
	706348.9	4072666	37.32	25.98
	706357.4	4072672	42.52	29.53
	706365.9	4072678	46.30	29.76
26,-2	706374.3	4072683	53.62	34.72
	706382.7	4072689	43.93	34.01
	706391.2	4072694	42.75	28.58
	706399.4	4072700	41.10	25.04
	706407.9	4072706	19.27	11.86
26,-1	706416.4	4072711	20.75	13.04
	706424.7	4072717	24.30	16.60
	706433.2	4072722	27.57	21.93
	706441.4	4072728	26.97	17.78
	706449.9	4072734	29.64	18.97
26,0	706458.4	4072739	44.16	29.34
	706465.4	4072744	48.02	38.53
	706472.4	4072748	47.13	32.90
	706479.4	4072753	45.65	32.60
	706486.4	4072758	50.09	33.79
	706493.4	4072762	48.31	32.60
26,1	706500.4	4072767	96.61	70.86
27,-8	706095.2	4072556	66.39	65.50
	706102.2	4072561	71.14	82.98
	706109.2	4072565	68.47	72.91
	706116.3	4072570	50.09	52.17
	706123.3	4072575	43.27	39.72
	706130.3	4072579	40.61	37.94
27,-7	706137.3	4072584	41.20	39.42
	706144.4	4072589	42.09	38.83
	706151.4	4072593	37.35	38.24
	706158.4	4072598	44.76	37.64
	706165.4	4072603	42.98	25.19
	706172.4	4072607	37.35	29.34
27,-6	706179.3	4072612	26.38	27.27
	706187.7	4072618	28.45	17.49
	706196.2	4072623	21.93	16.01
	706204.4	4072629	24.01	16.89
	706212.9	4072635	25.19	14.82
27,-5	706221.4	4072640	28.45	18.67
	706229.7	4072647	28.45	21.64
	706238.2	4072652	29.64	18.67
	706246.4	4072658	30.53	21.04
	706254.9	4072664	30.23	22.82
27,-4	706263.4	4072669	29.94	23.12
	706271.9	4072675	21.64	14.82
	706280.2	4072680	17.78	12.15
	706288.7	4072686	16.30	11.26
	706297.1	4072692	16.89	12.15
27,-3	706305.4	4072697	21.64	13.93
	706313.9	4072703	22.82	14.82
	706322.2	4072708	25.19	18.38
	706330.7	4072714	22.23	13.34
	706339.1	4072720	21.04	12.75
27,-2	706347.4	4072725	21.93	14.23
	706355.9	4072731	23.42	14.82
	706364.4	4072736	24.60	14.82
	706372.8	4072742	27.27	16.60
	706381.2	4072748	28.75	19.27
27,-1	706389.6	4072753	35.57	34.09
	706397.9	4072759	35.27	26.68
	706406.4	4072764	48.31	35.86
	706414.8	4072770	57.50	41.20
	706423.2	4072776	47.13	30.83
27,0	706431.6	4072781	34.68	22.23
28,-8	706068.4	4072598	103.44	93.66
	706074.4	4072602	104.63	98.11
	706080.4	4072606	93.96	99.00
	706086.4	4072610	81.81	73.80
	706092.4	4072614	63.43	52.76
	706098.4	4072618	39.12	26.97
	706104.4	4072622	33.20	22.23
28,-7	706110.4	4072626	32.90	22.82
	706117.4	4072631	33.20	24.30
	706124.4	4072635	33.20	24.30
	706131.4	4072640	37.35	24.30
	706138.6	4072645	40.61	30.23
	706145.6	4072649	44.16	36.46
28,-6	706152.4	4072654	44.16	26.97
	706159.4	4072659	40.01	28.16
	706166.4	4072663	35.27	22.82
	706173.4	4072668	34.68	25.79
	706180.6	4072673	35.86	25.19
	706187.6	4072677	29.64	22.53
28,-5	706194.6	4072682	33.49	24.08
	706201.6	4072687	41.50	32.90
	706208.7	4072691	35.27	29.34
	706215.7	4072696	26.38	20.16
	706222.7	4072701	18.67	13.04
	706229.7	4072705	16.30	10.37
28,-4	706236.6	4072710	14.19	8.57

Appendix F.11.a: EM-31 Electrical Conductivity Values for February 26-29, 1996

Stake	Easting (E-W)	Northing (N-S)	Horizontal (mS/m)	Vertical (mS/m)
	706243.6	4072715	16.85	10.64
	706250.7	4072719	17.44	11.23
	706257.7	4072724	23.35	20.10
	706264.7	4072729	25.72	20.69
	706271.7	4072733	20.40	12.42
28,-3	706278.7	4072739	19.81	14.48
	706286.9	4072745	25.13	18.92
	706295.4	4072750	35.47	24.24
	706303.9	4072756	33.70	26.90
	706312.3	4072762	40.20	33.40
28,-2	706320.7	4072767	45.23	32.52
	706329.1	4072773	48.77	32.81
	706337.4	4072778	60.60	40.20
	706345.9	4072784	65.33	55.28
	706354.4	4072790	56.76	35.77
28,-1	706362.8	4072795	51.43	35.77
29,-8	706041.6	4072640	88.09	66.51
	706048.6	4072645	97.84	95.77
	706055.7	4072649	78.63	73.60
	706062.7	4072654	65.03	58.82
	706069.7	4072659	59.42	52.03
	706076.7	4072663	57.64	49.37
29,-7	706083.7	4072668	60.01	53.50
	706091.9	4072674	63.85	52.32
	706100.4	4072679	68.58	56.16
	706108.9	4072685	67.10	56.76
	706117.3	4072691	75.97	60.30
29,-6	706125.7	4072696	85.13	82.47
	706134.1	4072702	86.09	80.99
	706142.4	4072707	88.09	75.67
	706150.9	4072713	83.65	69.76
	706159.4	4072719	74.20	67.40
29,-5	706167.8	4072724	72.42	65.33
	706174.9	4072729	73.60	58.82
	706181.9	4072733	72.72	58.53
	706188.9	4072738	70.65	57.64
	706195.9	4072743	61.12	58.23
	706202.9	4072747	60.89	71.54
29,-4	706209.9	4072752	70.35	61.78
	706216.9	4072757	67.10	70.65
	706223.9	4072761	72.42	65.03
	706230.9	4072766	74.49	67.10
	706237.9	4072771	80.40	84.25
	706244.9	4072775	82.47	82.47
29,-3	706251.9	4072780	73.90	70.35
	706258.9	4072785	66.81	46.41
	706265.9	4072789	62.67	47.30
	706272.9	4072794	67.99	53.21
	706279.9	4072799	81.88	64.15
	706286.9	4072803	99.03	83.06
29,-2	706293.9	4072809	109.08	67.10
30,-8	706014.9	4072682	56.16	53.50
	706021.9	4072687	70.94	59.42
	706028.9	4072691	71.83	63.26
	706035.9	4072696	78.63	77.74
	706042.9	4072701	78.33	78.04
	706049.9	4072705	83.65	75.08
30,-7	706056.9	4072710	85.72	74.79
	706063.9	4072715	80.11	75.38
	706070.9	4072719	65.03	68.87
	706077.9	4072724	52.62	40.50
	706084.9	4072729	46.11	37.25
	706091.9	4072733	45.82	39.31
30,-6	706098.9	4072738	44.93	42.57
	706105.9	4072743	42.27	41.09
	706112.9	4072747	46.70	30.15
	706119.9	4072752	44.04	36.06
	706126.9	4072757	48.48	36.36
	706133.9	4072761	49.37	28.38
30,-5	706140.9	4072766	45.23	37.84
	706147.9	4072771	45.52	30.45
	706154.9	4072775	49.07	31.92
	706161.9	4072780	55.87	40.79
	706169.1	4072785	50.25	38.72
	706176.1	4072789	53.50	35.47
30,-4	706182.9	4072794	48.48	39.99
	706191.4	4072800	41.38	35.18
	706199.9	4072805	44.93	26.60
	706208.3	4072811	32.52	19.81
	706216.7	4072817	41.98	31.33
30,-3	706225.1	4072822	42.27	45.23
	706233.4	4072828	44.93	34.29
31,-8	705987.9	4072724	57.35	51.14
	705996.4	4072730	71.24	57.94
	706004.9	4072735	57.05	55.87
	706013.3	4072741	47.89	31.63
	706021.7	4072747	33.11	41.98
31,-7	706030.1	4072752	40.79	27.79
	706038.4	4072758	40.20	27.20
	706046.9	4072763	39.02	26.01
	706055.4	4072769	20.40	33.40
	706063.8	4072775	30.45	21.28
31,-6	706072.2	4072780	20.69	31.33
	706080.4	4072786	33.99	21.28
	706088.9	4072791	29.56	17.14
	706097.4	4072797	31.92	22.17
	706105.8	4072803	39.31	23.65
31,-5	706114.2	4072808	33.70	23.06
32,-8	705961.2	4072766	66.21	55.87
	705969.6	4072772	83.65	75.67
	705977.9	4072777	74.79	64.74
	705986.4	4072783	41.38	54.98
	705994.9	4072789	50.55	35.47
32,-7	706003.3	4072794	60.01	41.09

Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
-3,-2	707151.4	4071467		
-2,-2	707124.6	4071509	390	390
-1,-2	707097.8	4071551	270	315
	707101.9	4071560	390	300
	707105.9	4071570	480	420
	707109.9	4071579	510	480
	707113.9	4071588	525	435
	707117.9	4071597	525	405
	707122.1	4071607	390	420
	707126.2	4071616	510	450
	707130.2	4071625	510	450
	707134.2	4071634	480	420
	707138.3	4071644	480	450
736	707142.3	4071653	420	360
1,-2	707044.2	4071635	300	270
	707052.6	4071641	375	300
	707060.9	4071646	375	345
	707069.4	4071652	255	180
	707077.9	4071658	195	150
1,-1	707086.3	4071663	150	105
	707094.7	4071669	120	105
	707034.2	4071688	105	90
	707042.7	4071694	105	105
	707051.1	4071700	105	75
2,-1	707059.4	4071705	210	180
	707067.9	4071711	300	225
	707024.3	4071742	360	315
3,-1	707032.7	4071747	435	375
	707041.1	4071753	360	300
	707049.4	4071758	375	345
	707057.9	4071764	195	150
	707066.4	4071770	135	120
3,0	707074.7	4071775	180	150
	707022.7	4071800	465	450
	707030.9	4071806	540	510
	707039.4	4071812	420	450
4,0	707047.9	4071817	330	330
	707056.4	4071823	300	210
	706995.9	4071841	330	240
	707004.3	4071847	465	450
	707012.7	4071853	510	585
5,0	707021.1	4071858	600	465
	706969.2	4071883	285	180
	706977.4	4071839	210	165
	706985.9	4071895	270	210
6,0	706994.4	4071900	315	240
	706933.9	4071920	240	180
	706942.2	4071925	180	150
	706950.7	4071931	180	120
	706959.1	4071937	150	105
7,0	706967.4	4071942	150	105
	706975.9	4071948	150	165
	706984.4	4071953	240	285
	706992.8	4071959	150	120
	707001.2	4071965	135	120
7,1	707009.6	4071970	150	90
	706890.3	4071951	240	180
8,-1	706898.7	4071956	195	180
	706907.1	4071962	270	180
	706915.4	4071967	180	150
	706923.9	4071973	180	135
	706932.4	4071979	135	105
8,0	706940.7	4071984	105	75
	706949.1	4071990	90	60
	706957.4	4071995	90	60
8,1	706982.8	4072012	165	180
	706991.2	4072018	45	120
	706819.4	4071963	210	150
9,-2	706829.9	4071970	210	150
	706840.3	4071977	195	150
	706850.9	4071984	150	120
	706861.4	4071991	150	105
9,-1	706871.9	4071998	150	120
	706880.4	4072004	135	105
	706888.7	4072009	135	150
	706897.2	4072015	120	105
	706905.6	4072021	120	90
9,0	706913.9	4072026	90	75
	706922.4	4072032	90	60
	706930.7	4072037	75	60
	706939.2	4072043	75	60
	706947.6	4072049	75	60
9,1	706955.9	4072054	75	60
	706964.4	4072060	90	90
	706972.9	4072065	90	75
	706981.3	4072071	75	75
	706794.6	4072007	270	210
10,-2	706802.9	4072012	255	180
	706811.4	4072018	150	120
	706819.9	4072023	150	105
	706828.3	4072029	150	105
	706836.7	4072035	90	90
10,-1	706845.1	4072040	120	90
	706853.4	4072046	120	90
	706861.9	4072051	120	90
	706870.4	4072057	90	75
	706878.8	4072063	90	75
10,0	706887.2	4072068	90	60
	706895.4	4072074	75	60
	706903.9	4072079	75	60
	706912.4	4072085	75	60
	706920.8	4072091	75	60
10,1	706929.2	4072096	75	75
	706937.6	4072102	75	75
	706945.9	4072107	60	60
	706954.4	4072113	75	60
	706962.9	4072119	60	60
	706750.9	4072037	165	120
	706759.4	4072043	300	270
	706767.8	4072049	255	180
11,-2	706776.2	4072054	195	165
	706784.6	4072060	150	105
	706792.9	4072065	135	90
	706801.4	4072071	120	90
	706809.9	4072077	120	90
11,-1	706818.3	4072082	105	75
	706826.7	4072088	90	105
	706835.2	4072093	90	60
	706843.4	4072099	90	90
	706851.9	4072105	90	75

Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
11,0	706860.4	4072110	90	60
	706868.7	4072116	75	60
	706877.2	4072121	75	60
	706885.4	4072127	75	60
	706893.9	4072133	75	60
11,1	706902.4	4072138	75	60
	706910.9	4072144	90	60
	706919.2	4072149	90	60
	706927.7	4072155	90	60
	706936.1	4072161	105	75
11,2	706944.4	4072166	90	105
	706696.9	4072061	300	240
12,-3	706707.4	4072068	375	315
	706717.9	4072075	300	270
	706728.4	4072082	195	150
	706738.9	4072089	135	90
12,-2	706749.4	4072096	135	90
	706757.9	4072102	150	105
	706766.2	4072107	150	90
	706774.7	4072113	120	90
	706783.1	4072119	105	75
12,-1	706791.4	4072124	105	75
	706816.7	4072141	96	60
	706825.1	4072147	90	60
12,0	706833.4	4072152	90	60
	706841.9	4072158	90	60
	706850.4	4072163	90	60
	706858.8	4072169	75	60
	706867.2	4072175	75	60
12,1	706875.6	4072180	75	60
	706883.9	4072186	75	60
	706892.4	4072191	75	60
	706900.9	4072197	60	60
	706909.3	4072203	60	45
12,2	706917.7	4072208	75	60
	706670.1	4072103	300	240
13,-3	706680.6	4072110	285	105
	706691.1	4072117	135	105
	706701.7	4072124	240	180
	706712.2	4072131	150	120
13,-2	706722.7	4072138	120	90
	706730.9	4072144	120	90
	706739.4	4072149	120	90
	706747.9	4072155	120	90
	706756.3	4072161	120	90
13,-1	706764.7	4072166	105	60
	706773.1	4072172	120	90
	706781.4	4072177	120	90
	706789.9	4072183	105	90
	706798.4	4072189	90	75
13,0	706806.8	4072194	90	60
	706815.1	4072200	90	60
	706823.4	4072205	75	60
	706831.9	4072211	90	60
	706840.4	4072217	60	60
13,1	706848.8	4072222	60	60
	706857.2	4072228	60	60
	706865.7	4072233	60	60
	706873.9	4072239	60	45
	706882.4	4072245	60	60
13,2	706890.9	4072250	60	60
	706899.4	4072256	75	60
14,-3	706653.8	4072152	330	270
	706664.4	4072159	345	255
	706674.9	4072166	315	240
14,-2	706695.9	4072180	135	90
	706704.2	4072186	90	75
	706712.7	4072191	90	60
	706720.9	4072197	150	90
	706729.4	4072203	75	75
14,-1	706737.9	4072208	150	105
	706748.4	4072215	150	120
	706758.9	4072222	210	150
	706769.4	4072229	240	225
14,0	706779.9	4072236	105	75
	706788.4	4072242	90	75
	706796.7	4072247	105	75
	706805.2	4072253	105	90
	706813.6	4072259	105	90
14,1	706821.9	4072264	120	90
	706830.4	4072270	90	60
	706838.9	4072275	90	60
	706847.3	4072281	105	75
	706855.7	4072287	90	75
14,2	706864.1	4072292	105	75
	706872.4	4072298	75	60
	706880.9	4072303	90	60
	706889.4	4072309	90	60
15,-4	706584.9	4072165	315	270
	706595.4	4072172	330	270
	706605.9	4072179	420	330
	706616.6	4072186	390	390
15,-3	706626.9	4072194	300	240
	706637.4	4072201	150	210
	706647.9	4072208	150	120
	706658.6	4072215	135	105
15,-2	706669.1	4072222	120	90
	706679.6	4072229	120	90
	706690.2	4072236	150	105
	706700.7	4072243	120	90
15,-1	706711.1	4072250	120	90
	706719.4	4072256	90	75
	706727.9	4072261	90	60
	706736.4	4072267	90	60
	706744.8	4072273	90	60
15,0	706753.2	4072278	90	60
	706761.6	4072284	90	60
	706769.9	4072289	90	60
	706778.4	4072295	90	60
	706786.9	4072301	105	105
15,1	706795.2	4072306	120	90
	706803.6	4072312	120	90
	706811.9	4072317	120	90
	706820.4	4072323	105	75
	706828.9	4072329	90	75
15,2	706837.3	4072334	105	90
	706845.7	4072340	90	60
	706854.2	4072345	75	60
	706862.4	4072351	90	60
	706870.9	4072357	105	60

Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
16,-4	706558.2	4072207	420	360
	706568.7	4072214	480	390
	706579.3	4072221	300	210
	706589.8	4072228	270	180
16,-3	706600.2	4072235	285	210
	706610.7	4072242	210	150
	706621.3	4072249	195	150
	706631.8	4072256	180	135
16,-2	706642.3	4072264	195	135
	706652.9	4072271	180	150
	706663.4	4072278	150	105
	706673.9	4072285	105	90
16,-1	706684.4	4072292	105	75
	706694.9	4072299	105	75
	706705.4	4072306	105	75
	706715.9	4072313	105	90
16,0	706726.4	4072320	135	90
	706736.9	4072327	105	90
	706747.4	4072334	120	90
	706757.9	4072341	120	90
16,1	706768.4	4072348	165	90
16,2	706810.4	4072376	90	90
	706820.9	4072383	75	60
	706831.4	4072390	60	60
	706510.4	4072235	405	330
	706520.9	4072242	390	345
17,-4	706531.4	4072249	360	330
	706541.9	4072256	330	525
	706552.4	4072263	300	210
	706562.9	4072270	270	180
17,-3	706573.4	4072277	270	180
	706583.9	4072284	255	195
17,-2	706615.4	4072305		
	706640.8	4072322	180	150
	706649.2	4072328	135	105
17,-1	706657.4	4072334	120	90
	706667.9	4072341	120	105
	706678.4	4072348	150	90
	706689.1	4072355	150	105
17,0	706699.6	4072362	165	120
	706710.1	4072369	225	150
	706720.7	4072376	450	225
	706731.2	4072383	300	375
17,1	706741.7	4072390	240	180
	706752.2	4072397	195	135
	706762.8	4072404	180	120
	706773.3	4072411	120	120
17,2	706783.7	4072418	105	120
	706794.2	4072425	60	60
	706804.8	4072432	60	45
	706815.3	4072439	60	30
	706472.9	4072270	435	315
	706483.4	4072277	360	300
	706494.1	4072284	330	255
18,-4	706504.6	4072291	390	390
	706515.1	4072298	360	315
	706525.7	4072305	285	240
	706536.2	4072312	240	195
18,-3	706546.6	4072319	240	180
	706557.1	4072326	225	180
	706567.7	4072333	225	165
	706578.2	4072340	225	180
18,-2	706588.7	4072347	210	150
	706599.2	4072354	210	165
	706609.8	4072361	270	225
	706620.3	4072368	255	210
18,-1	706630.7	4072375	270	180
	706641.2	4072382	450	510
	706651.8	4072389	450	450
	706662.3	4072396	270	210
18,0	706672.8	4072403	195	135
	706683.4	4072410	150	105
	706693.9	4072417	120	90
	706704.4	4072424	120	90
18,1	706714.9	4072432	120	90
	706725.4	4072439	165	120
	706735.9	4072446	210	225
	706746.4	4072453	165	120
18,2	706756.9	4072460	135	105
	706767.4	4072467	390	300
	706777.9	4072474	330	270
19,-4	706477.8	4072333	330	300
	706486.2	4072339	360	300
	706494.7	4072344	315	255
	706502.9	4072350	285	210
	706511.4	4072356	330	240
19,-3	706519.9	4072361	330	240
	706530.4	4072368	390	450
	706540.9	4072375	345	270
	706551.4	4072382	345	300
19,-2	706561.9	4072389	360	285
	706572.4	4072396	360	390
	706582.9	4072403	450	345
	706593.4	4072410	345	345
19,-1	706603.9	4072417	240	225
	706614.4	4072424	240	225
	706624.9	4072431	270	240
	706635.4	4072438	270	195
19,0	706645.9	4072445	210	150
	706656.4	4072452	150	105
	706666.9	4072459	135	90
	706677.6	4072466	150	105
19,1	706687.9	4072473	165	120
	706698.4	4072480	195	150
	706708.9	4072487	270	180
	706719.6	4072494	210	150
19,2	706730.1	4072502	225	195
	706761.7	4072523	90	60
19,3	706772.2	4072530	75	60
20,-5	706408.9	4072347	630	705
	706419.4	4072354	330	270
	706429.9	4072361	255	225
	706440.4	4072368	210	150
20,-4	706450.9	4072375	210	210
	706461.4	4072382	225	240
	706471.9	4072389	315	210
	706482.6	4072396	450	420
20,-3	706492.9	4072403	54	180
	706503.4	4072410	270	300
	706513.9	4072417	270	300

Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
	706524.6	4072424	240	165
20,-2	706535.1	4072431	300	240
	706545.6	4072438	165	120
	706556.2	4072445	150	150
	706566.7	4072452	180	135
20,-1	706577.2	4072459	225	180
	706587.7	4072466	210	180
	706598.3	4072473	150	120
	706608.8	4072480	150	90
20,0	706619.2	4072487	165	120
	706629.7	4072494	180	120
	706640.3	4072501	210	135
	706650.8	4072508	285	210
20,1	706661.2	4072515	330	225
	706671.7	4072522	330	240
	706682.3	4072529	540	435
	706692.8	4072536	630	585
20,2	706703.3	4072543	375	345
	706713.9	4072550	240	180
	706724.4	4072557	240	180
	706734.9	4072564	285	195
20,3	706745.4	4072572	270	180
	706755.9	4072579	270	195
	706413.7	4072410	210	195
21,-4	706424.2	4072417	210	195
	706434.7	4072424	150	180
	706445.3	4072431	180	135
	706455.8	4072438	150	120
21,-3	706466.2	4072445	150	105
	706476.7	4072452	105	90
	706487.3	4072459	120	90
	706497.8	4072466	120	90
21,-2	706508.3	4072473	90	75
	706518.9	4072480	150	120
	706529.4	4072487	150	120
	706539.9	4072494	180	135
21,-1	706550.4	4072501	195	135
	706560.9	4072508	135	120
	706571.4	4072515	135	105
	706581.9	4072522	180	120
21,0	706592.4	4072529	180	150
	706602.9	4072536	225	165
	706613.4	4072543	255	195
	706623.9	4072550	375	270
21,1	706634.4	4072557	690	585
	706644.9	4072564	405	390
	706655.4	4072571	330	255
	706666.1	4072578	300	210
21,2	706676.4	4072585	210	285
	706686.9	4072592	300	225
	706697.4	4072599	285	210
	706708.1	4072606	270	195
21,3	706718.4	4072613	315	309
	706386.9	4072452	210	180
22,-4	706397.4	4072459	195	150
	706407.9	4072466	195	135
	706418.4	4072473	165	150
	706428.9	4072480	165	150
22,-3	706439.4	4072487	165	135
	706449.9	4072494	135	90
	706460.4	4072501	120	90
	706471.1	4072508	120	90
22,-2	706481.4	4072515	135	90
	706491.9	4072522	120	90
	706502.4	4072529	450	420
22,-1	706523.4	4072543	210	210
	706533.9	4072550	150	120
	706544.4	4072557	150	105
	706555.1	4072564	210	165
22,0	706565.6	4072571	300	300
	706576.1	4072578	420	390
	706586.7	4072585	480	450
	706597.2	4072592	480	480
22,1	706607.7	4072599	360	270
	706618.2	4072606	240	195
	706628.8	4072613	255	180
	706639.3	4072620	210	150
22,2	706649.7	4072627	225	165
	706660.2	4072634	225	150
	706670.8	4072641	225	150
	706681.3	4072648	240	180
22,3	706691.8	4072655	450	300
23,-7	706244.4	4072417	76	56
	706252.9	4072423	80	56
	706261.4	4072428	74	54
	706269.8	4072434	76	52
	706278.2	4072440	88	26
23,-6	706286.4	4072445	68	72
	706296.9	4072452	64	58
	706307.4	4072459	56	68
	706318.1	4072466	58	56
23,-5	706328.4	4072473	72	62
	706338.9	4072480	62	96
	706349.4	4072487	62	48
	706360.1	4072494	60	42
23,-4	706370.6	4072501	58	46
	706378.9	4072507	56	38
	706387.4	4072512	56	38
	706395.9	4072518	58	40
	706404.3	4072524	53	38
23,-3	706412.7	4072529	58	42
23,-2	706454.7	4072557	44	30
	706465.2	4072564	48	38
	706475.8	4072571	48	30
	706486.3	4072578	55	39
23,-1	706496.8	4072585	64	45
	706507.4	4072592	84	58
	706517.9	4072599	82	70
	706528.4	4072606	84	74
23,0	706538.8	4072613	30	33
	706547.2	4072619	195	135
	706555.7	4072624	150	105
	706563.9	4072630	180	120
	706572.4	4072636	210	150
23,1	706580.9	4072641	240	1800
	706589.4	4072647	210	150
	706597.7	4072652	210	150
	706606.2	4072658	210	165
	706614.6	4072664	210	150
23,2	706622.9	4072669	210	150

Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
	706633.4	4072676	30	225
	706643.9	4072683	345	330
	706654.4	4072690	450	390
23,3	706664.9	4072697	420	360
	706207.2	4072452	255	165
24,-7	706217.7	4072459	240	150
	706228.2	4072466	195	135
	706238.8	4072473	225	180
	706249.3	4072480	240	210
24,-6	706259.7	4072487	195	150
	706270.2	4072494	180	180
	706280.8	4072501	240	150
	706291.3	4072508	195	180
24,-5	706301.7	4072515	180	150
	706312.2	4072522	180	180
	706322.8	4072529	120	135
	706333.3	4072536	150	150
24,-4	706343.8	4072543	150	150
	706352.2	4072549	120	105
	706360.7	4072554	120	105
	706368.9	4072560	135	120
	706377.4	4072566	150	120
24,-3	706385.9	4072571	150	120
	706396.4	4072578	120	105
	706406.9	4072585	135	120
	706417.4	4072592	150	120
24,-2	706427.9	4072599	165	135
	706438.4	4072606	180	150
	706448.9	4072613	135	33
	706459.4	4072620	42	42
24,-1	706469.9	4072627	225	120
	706480.4	4072634	150	120
	706490.9	4072641	180	120
	706501.6	4072648	180	120
24,0	706511.9	4072655	150	120
	706520.4	4072661	150	90
	706528.9	4072666	135	105
	706537.3	4072672	150	135
	706545.7	4072678	150	105
24,1	706553.9	4072683	195	150
	706562.4	4072689	195	135
	706570.9	4072694	255	210
	706579.3	4072700	330	270
	706587.7	4072706	390	360
24,2	706596.1	4072711	435	360
	706604.4	4072717	525	480
	706612.9	4072722	510	510
25,-8	706148.8	4072472	300	180
25,-7	706190.9	4072500	330	210
25,-6	706232.9	4072529	225	180
	706241.4	4072535	240	180
	706249.7	4072540	180	180
	706258.2	4072546	210	180
	706266.6	4072552	210	210
25,-5	706274.9	4072557	240	240
	706283.4	4072563	240	240
	706291.9	4072568	210	240
	706300.3	4072574	195	180
	706308.7	4072580	210	150
25,-4	706316.9	4072585	210	180

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
	706325.4	4072591	165	120
	706333.9	4072596	120	90
	706342.3	4072602	150	90
	706350.7	4072608	180	240
25,-3	706358.9	4072613	330	270
	706367.4	4072619	390	360
	706375.9	4072624	120	195
	706384.3	4072630	150	150
	706392.7	4072636	150	90
25,-2	706401.1	4072641	120	90
	706409.4	4072647	150	120
	706417.9	4072652	150	120
	706426.4	4072658	165	120
	706434.8	4072664	180	135
25,-1	706443.2	4072669	180	135
	706451.6	4072675	165	165
	706459.9	4072680	135	90
	706468.4	4072686	135	90
	706476.9	4072692	135	90
25,0	706485.2	4072697	150	120
	706493.6	4072703	150	120
	706501.9	4072708	150	120
	706510.4	4072714	210	150
	706518.9	4072720	240	180
25,1	706527.3	4072725	270	240
	706535.7	4072731	330	270
	706544.2	4072736	330	300
	706552.4	4072742	360	300
	706560.9	4072748	360	270
25,2	706569.4	4072753	240	210
26,-8	706121.9	4072514	420	345
26,-7	706163.9	4072542	330	240
	706172.4	4072548	510	510
	706180.9	4072553	540	480
	706189.3	4072559	570	630
	706197.7	4072565	585	735
26,-6	706206.1	4072570	540	555
	706214.4	4072576	450	510
	706222.9	4072581	390	495
	706231.4	4072587	420	450
	706239.8	4072593	450	510
26,-5	706248.2	4072599	450	420
	706256.6	4072605	285	465
	706264.9	4072610	195	165
	706273.4	4072616	150	180
	706281.9	4072622	180	120
26,-4	706290.2	4072627	120	135
	706298.6	4072633	120	90
	706306.9	4072638	105	75
	706315.4	4072644	120	90
	706323.9	4072650	120	90
26,-3	706332.3	4072655	120	90
	706340.7	4072661	105	90
	706349.2	4072666	90	90
	706357.4	4072672	120	90
	706365.9	4072678	120	105
26,-2	706374.3	4072683	150	120
	706382.7	4072689	150	105
	706391.2	4072694	120	105
	706399.4	4072700	120	90

Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
	706407.9	4072706	120	90
26,-1	706416.4	4072711	120	90
	706424.9	4072717	135	120
	706433.2	4072722	180	120
	706441.7	4072728	165	120
	706450.1	4072734	180	135
26,0	706458.4	4072739	285	210
	706466.9	4072745	330	270
	706475.2	4072750	330	255
	706483.7	4072756	345	270
	706492.1	4072762	315	210
26,1	706500.4	4072767	270	180
27,-8	706095.2	4072556	450	390
	706105.7	4072563	480	600
	706116.3	4072570	390	450
	706126.8	4072577	270	255
27,-7	706137.3	4072584	225	255
	706147.9	4072591	240	255
	706158.4	4072598	240	180
	706168.9	4072605	180	165
27,-6	706179.3	4072612	150	180
	706189.9	4072619	150	120
	706200.4	4072626	150	120
	706210.9	4072633	150	120
27,-5	706221.4	4072640	180	135
	706231.9	4072647	165	135
	706242.4	4072654	150	120
	706252.9	4072661	180	120
27,-4	706263.4	4072669	180	150
	706273.9	4072676	120	90
	706284.4	4072683	105	90
	706294.9	4072690	120	75
27,-3	706305.4	4072697	150	105
	706315.9	4072704	120	120
	706326.4	4072711	150	105
	706337.1	4072718	120	90
27,-2	706347.4	4072725	135	105
	706357.9	4072732	150	105
	706368.4	4072739	165	120
	706379.1	4072746	180	120
27,-1	706389.6	4072753	240	240
	706400.1	4072760	285	255
	706410.7	4072767	375	285
	706421.2	4072774	360	270
27,0	706431.6	4072781	285	210
	706442.[illegible]	4072788	300	210
28,-8	706068.4	4072598	720	720
	706078.9	4072605	675	660
	706089.4	4072612	45	45
	706099.9	4072619	225	150
28,-7	706110.4	4072626	210	150
	706120.9	4072633	195	135
	706131.4	4072640	210	165
	706142.1	4072647	240	210
28,-6	706152.4	4072654	255	180
	706162.9	4072661	210	165
	706173.4	4072668	165	150
	706184.1	4072675	165	135
28,-5	706194.6	4072682	240	150
	706205.1	4072689	195	165
	706215.7	4072696	120	90
	706226.2	4072703	105	105
28,-4	706236.6	4072710	90	105
	706247.1	4072717	105	90
	706257.7	4072724	150	135
	706268.2	4072731	150	120
28,-3	706278.7	4072739	150	105
	706289.2	4072746	180	150
	706299.8	4072753	225	165
	706310.3	4072760	270	210
28,-2	706320.7	4072767	300	225
	706331.2	4072774	330	270
	706341.8	4072781	420	390
	706352.3	4072788	450	420
28,-1	706362.8	4072795	360	270
	706373.4	4072802	360	315
29,-8	706041.6	4072640	585	510
29,-7	706083.7	4072668	420	420
	706094.2	4072675	450	405
	706104.8	4072682	435	435
	706115.3	4072689	480	510
29,-6	706125.7	4072696	585	645
	706136.2	4072703	600	705
	706146.8	4072710	405	390
	706157.3	4072717	525	510
29,-5	706167.8	4072724	480	450
	706178.4	4072731	525	510
	706188.9	4072738	435	450
	706199.4	4072745	390	450
29,-4	706209.9	4072752	480	450
	706220.4	4072759	465	510
29,-3	706251.9	4072780	510	510
	706262.4	4072787	420	420
	706272.9	4072794	450	360
	706283.4	4072801	540	495
29,-2	706293.9	4072809	720	495
30,-8	706014.9	4072682	330	375
	706025.4	4072689	435	420
	706035.9	4072696	540	570
	706046.4	4072703	600	540
30,-7	706056.9	4072710	585	570
	706067.4	4072717	540	600
	706077.9	4072724	360	330
	706088.4	4072731	315	300
30,-6	706098.9	4072738	330	315
	706109.4	4072745	300	225
	706119.9	4072752	330	240
	706130.4	4072759	300	315
30,-5	706140.9	4072766	300	300
	706151.4	4072773	330	255
	706161.9	4072780	360	270
30,-4	706182.9	4072794	375	315
	706193.4	4072801	315	300
	706203.9	4072808	270	180
	706214.6	4072815	300	240
30,-3	706225.1	4072822	360	300
31,-8	705987.9	4072724	375	375
	705998.4	4072731	450	450
	706008.9	4072738	405	450
	706019.6	4072745	300	270

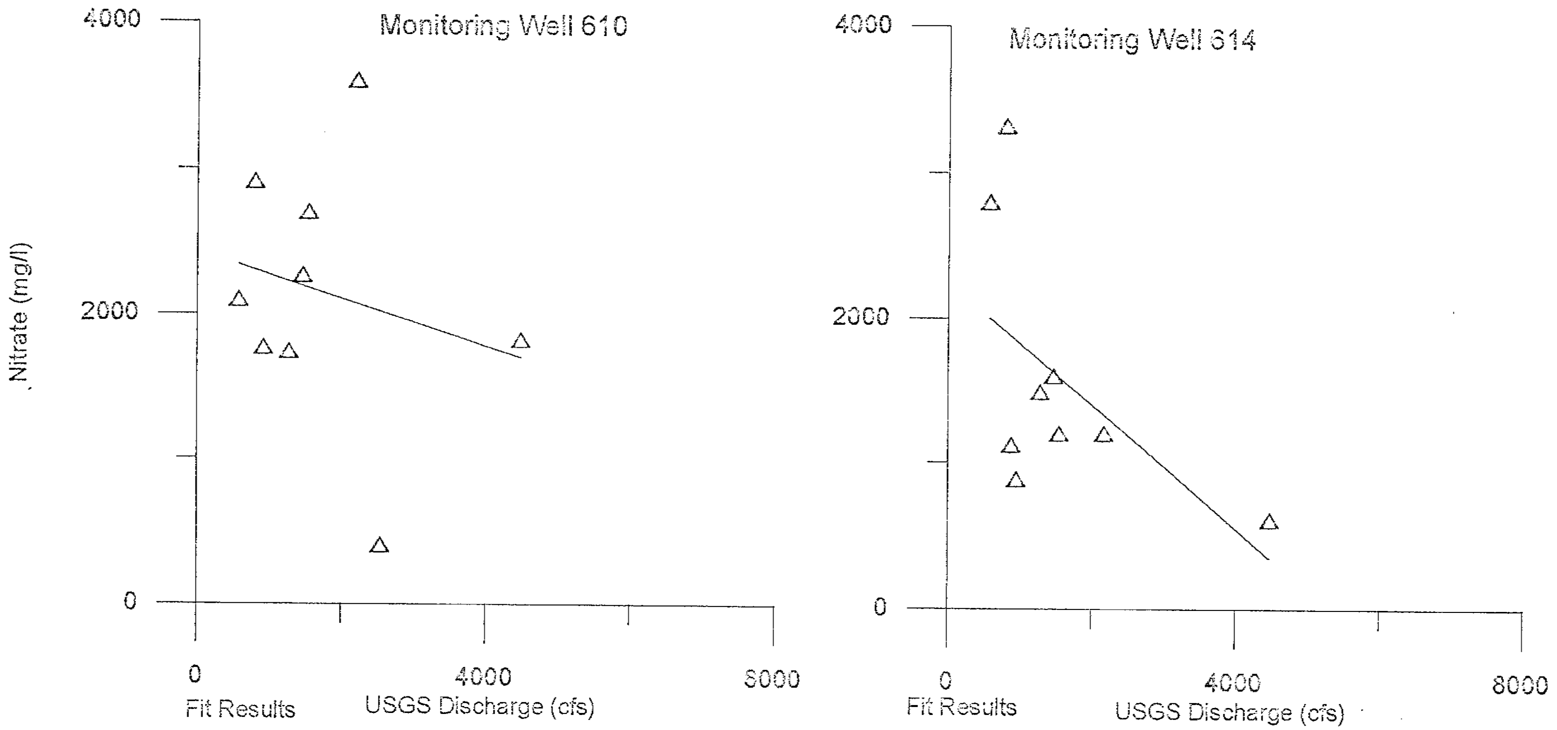
Appendix F.11.b: EM-31 Electrical Conductivity Values for June 14-17, 1996

Stake	Easting (E-W)	Northing (N-S)	Vertical (mS/m)	Horizontal (mS/m)
31,-7	706030.1	4072752	285	240
	706040.6	4072759	300	240
	706051.2	4072766	240	210
	706061.7	4072773	210	150
31,-6	706072.2	4072780	210	150
	706082.7	4072787	210	180
	706093.3	4072794	210	150
	706103.8	4072801	240	195
31,-5	706114.2	4072808	180	120
32,-8	705961.2	4072766	480	450
	705969.6	4072772	600	570
	705977.9	4072777	585	540
	705986.4	4072783	405	330
	705994.9	4072789	360	300
32,-7	706003.3	4072794	450	360

Appendix: G US Department of Energy water analysis versus US Geological Survey Shiprock Discharge Gaging Station

Nitrate and sulfate concentrations from DOE's yearly water analyses were compared with discharges at USGS Shiprock gaging station to determine whether a dilution effect was occurring on the floodplain. Since not all test pits, well points and monitoring wells were not consistently sampled only six sampling locations were utilized. Two monitoring wells, 610 and 614, located nearest to the terrace and near fractures did not correlate to discharges. Whereas those test pits, 642 and 644, located near the San Juan River tend to decrease in concentration as river discharges increased. Finally, monitoring wells, 628 and 624, located on the east of Bob Lee Wash the concentrations had no correlation with river discharges.

Appendix G.1: Discharge vs Nitrate for wells located near terrace



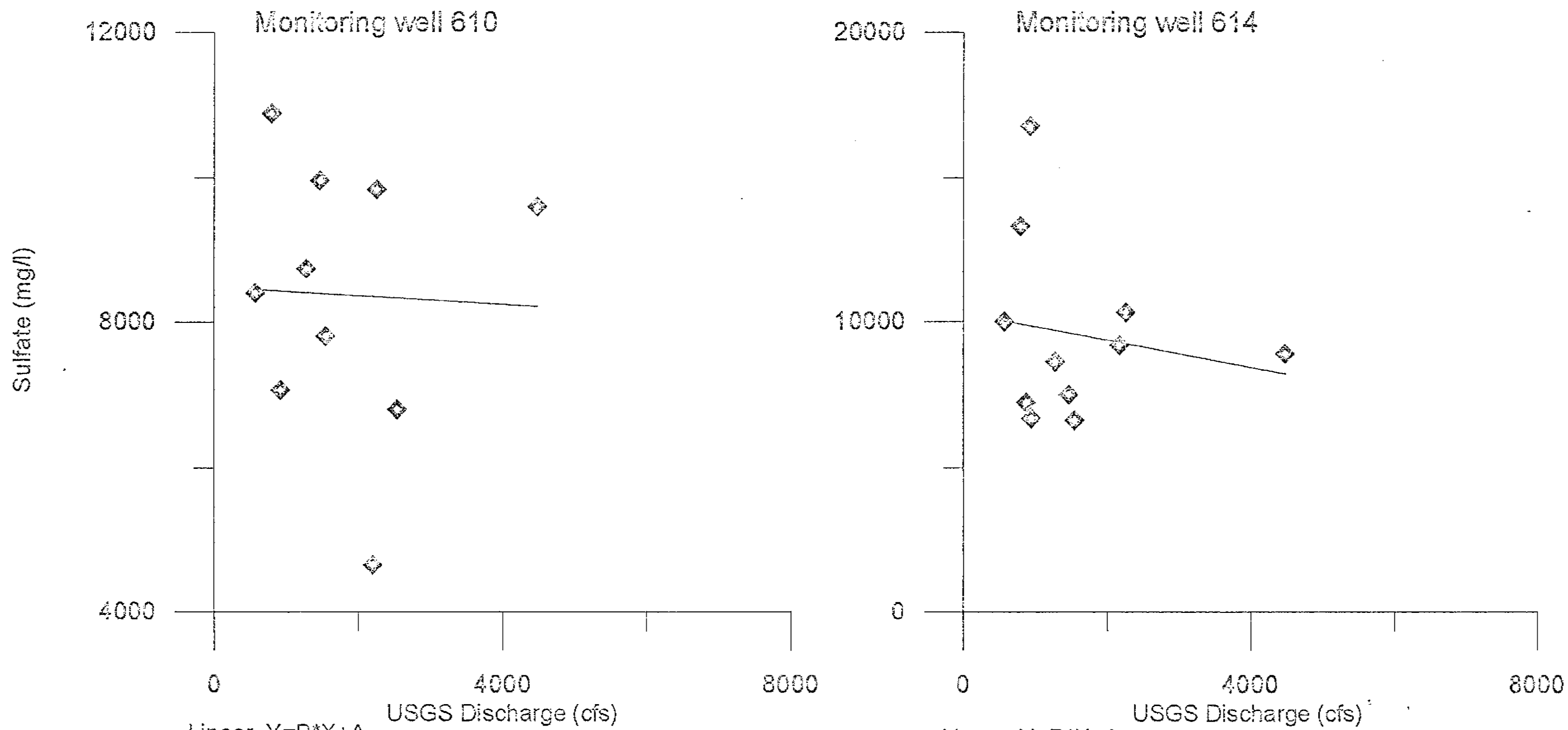
Fit Results

Fit 1: Linear, Y=B*X+A
Equation:
Y = -0.165271 * X + 2435.91
Number of data points used = 9
Average X = 1750.11, Average Y = 2146.67
Regression sum of squares = 315975
Residual sum of squares = 6.13243E+006
Coef of determination, R-squared = 0.0490005
Residual mean square, sigma-hat-sq'd = 876061

Fit Results

Fit 2: Linear, Y=B*X+A
Equation:
Y = -0.424125 * X + 2243.87
Number of data points used = 9
Average X = 1563.44, Average Y = 1580.78
Regression sum of squares = 2.0423E+006
Residual sum of squares = 4.40319E+006
Coef of determination, R-squared = 0.316858
Residual mean square, sigma-hat-sq'd = 629027

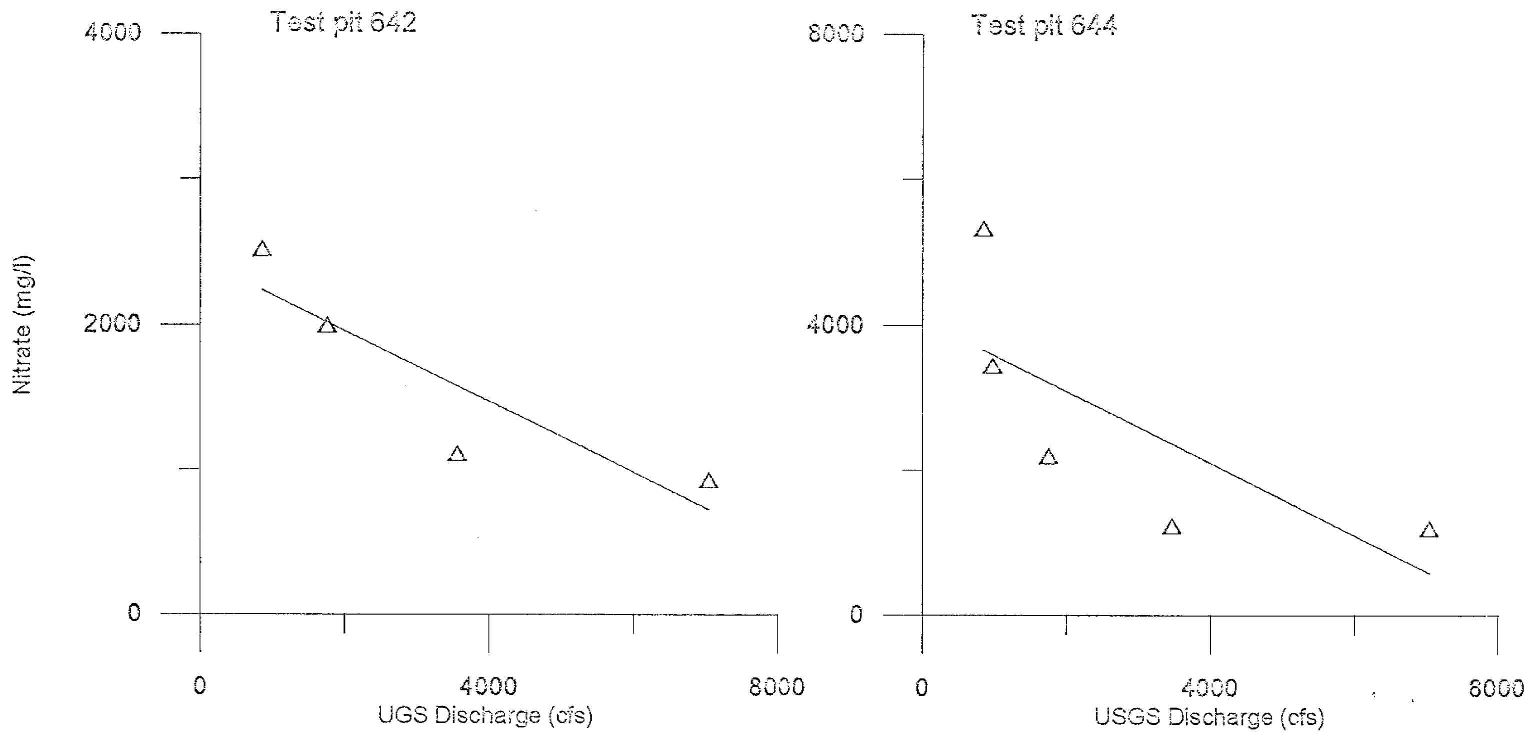
Appendix G.1.a: Discharge vs Sulfate for wells located near terrace



Linear, Y=B*X+A
Equation:
Y = -0.0613655 * X + 8487.46
Number of data points used = 10
Average X = 1800.1, Average Y = 8377
Regression sum of squares = 44408.8
Residual sum of squares = 3.09396E+007
Coef of determination, R-squared = 0.00143328
Residual mean square, sigma-hat-sq'd = 3.86745E+006

Linear, Y=B*X+A
Equation:
Y = -0.465001 * X + 10287.2
Number of data points used = 11
Average X = 1567.73, Average Y = 9558.18
Regression sum of squares = 2.64522E+006
Residual sum of squares = 9.24783E+007
Coef of determination, R-squared = 0.0278083
Residual mean square, sigma-hat-sq'd = 1.02754E+007

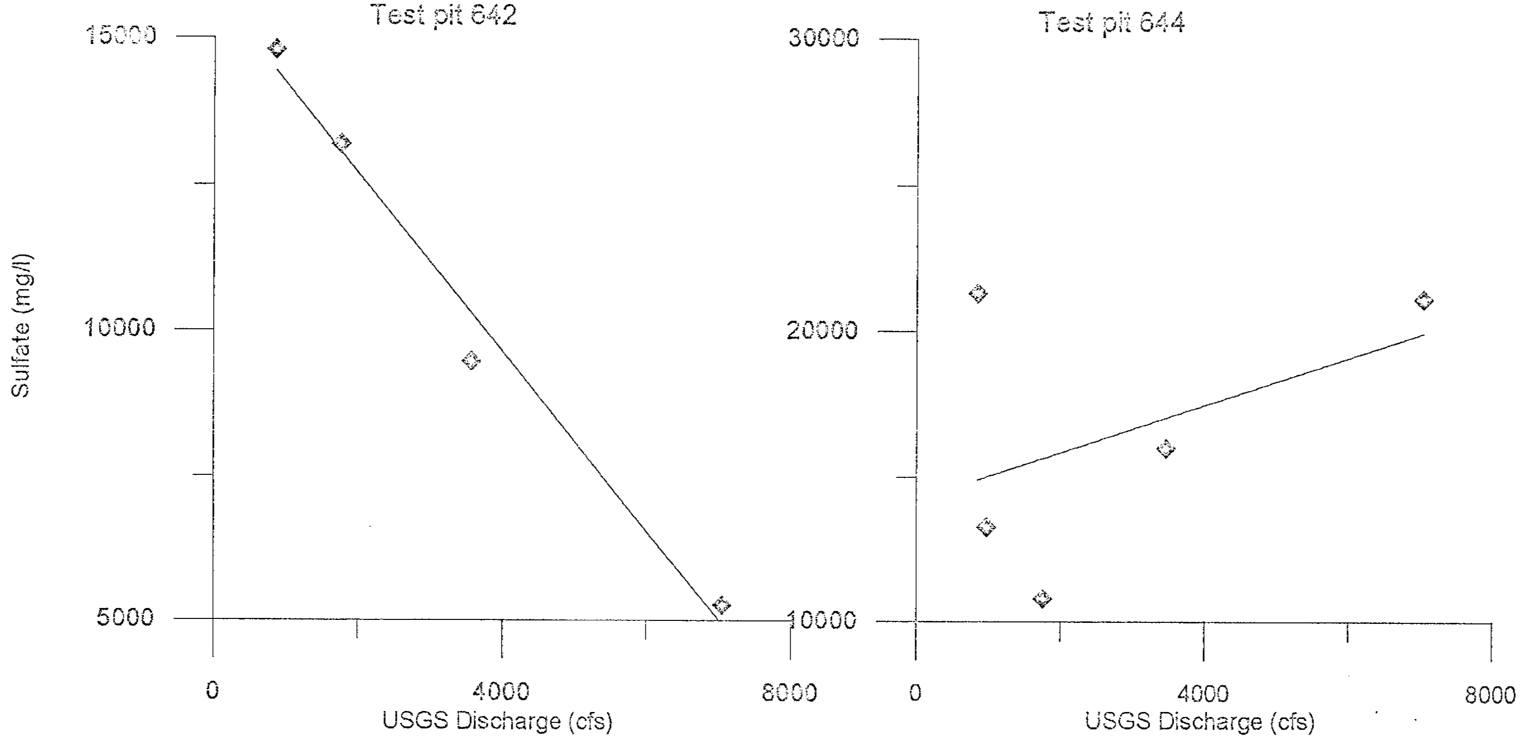
G.2: Discharge vs Nitrate for test pits located near San Juan River



Linear, Y=B*X+A
Equation:
Y = -0.245018 * X + 2447.95
Number of data points used = 4
Average X = 3297.5, Average Y = 1640
Regression sum of squares = 1.34807E+006
Residual sum of squares = 340935
Coef of determination, R-squared = 0.798144
Residual mean square, sigma-hat-sq'd = 170467

Linear, Y=B*X+A
Equation:
Y = -0.497806 * X + 4082.43
Number of data points used = 5
Average X = 2813.2, Average Y = 2682
Regression sum of squares = 6.61182E+006
Residual sum of squares = 5.44506E+006
Coef of determination, R-squared = 0.548386
Residual mean square, sigma-hat-sq'd = 1.81502E+006

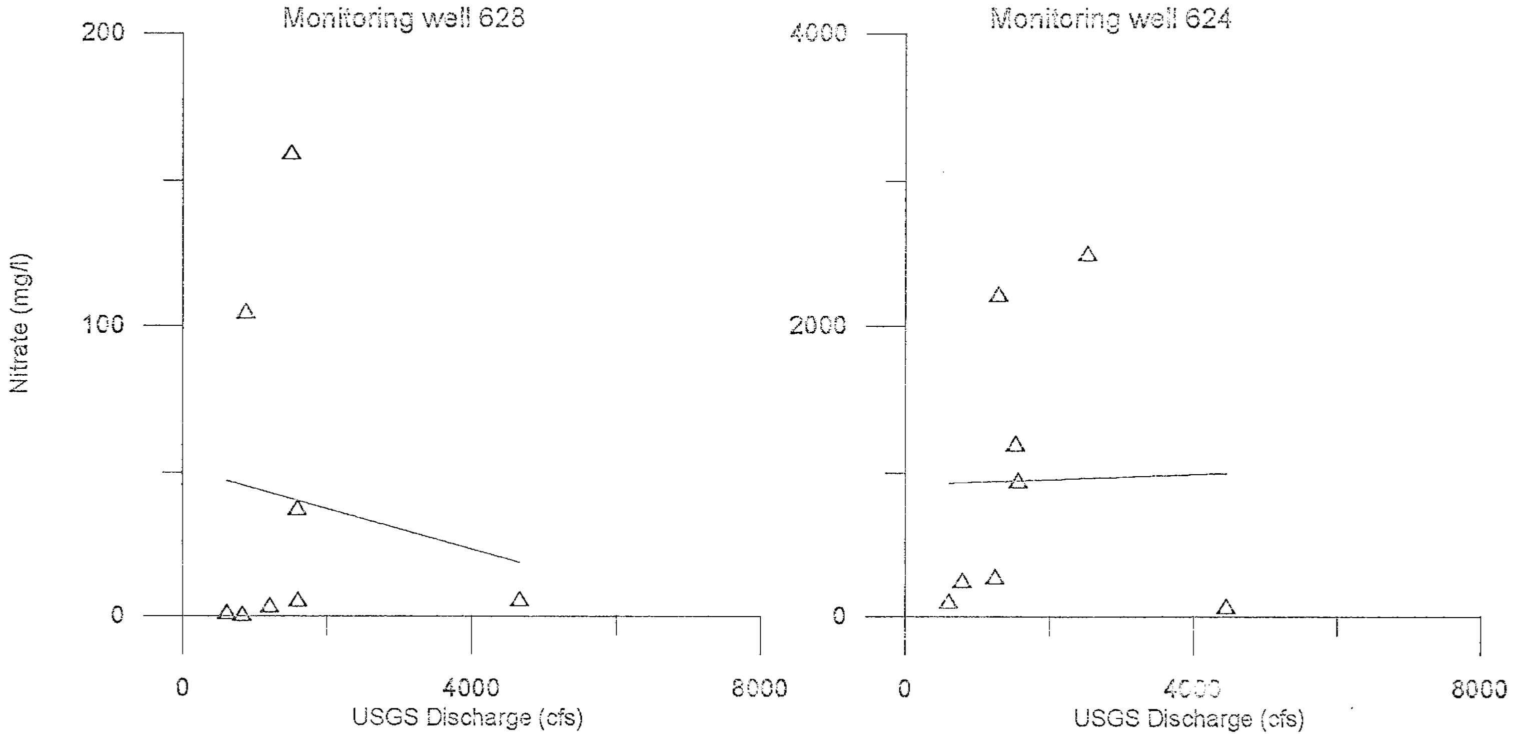
Appendix G.2.a: Discharge vs Sulfate for test pits located near San Juan River



Linear, Y=B*X+A
Equation:
Y = -1.538 * X + 15756.5
Number of data points used = 4
Average X = 3297.5, Average Y = 10685
Regression sum of squares = 5.31161E+007
Residual sum of squares = 940848
Coef of determination, R-squared = 0.982595
Residual mean square, sigma-hat-sq'd = 470424

Linear, Y=B*X+A
Equation:
Y = 0.812109 * X + 14215.4
Number of data points used = 5
Average X = 2813.2, Average Y = 16500
Regression sum of squares = 1.75966E+007
Residual sum of squares = 6.95834E+007
Coef of determination, R-squared = 0.201842
Residual mean square, sigma-hat-sq'd = 2.31945E+007

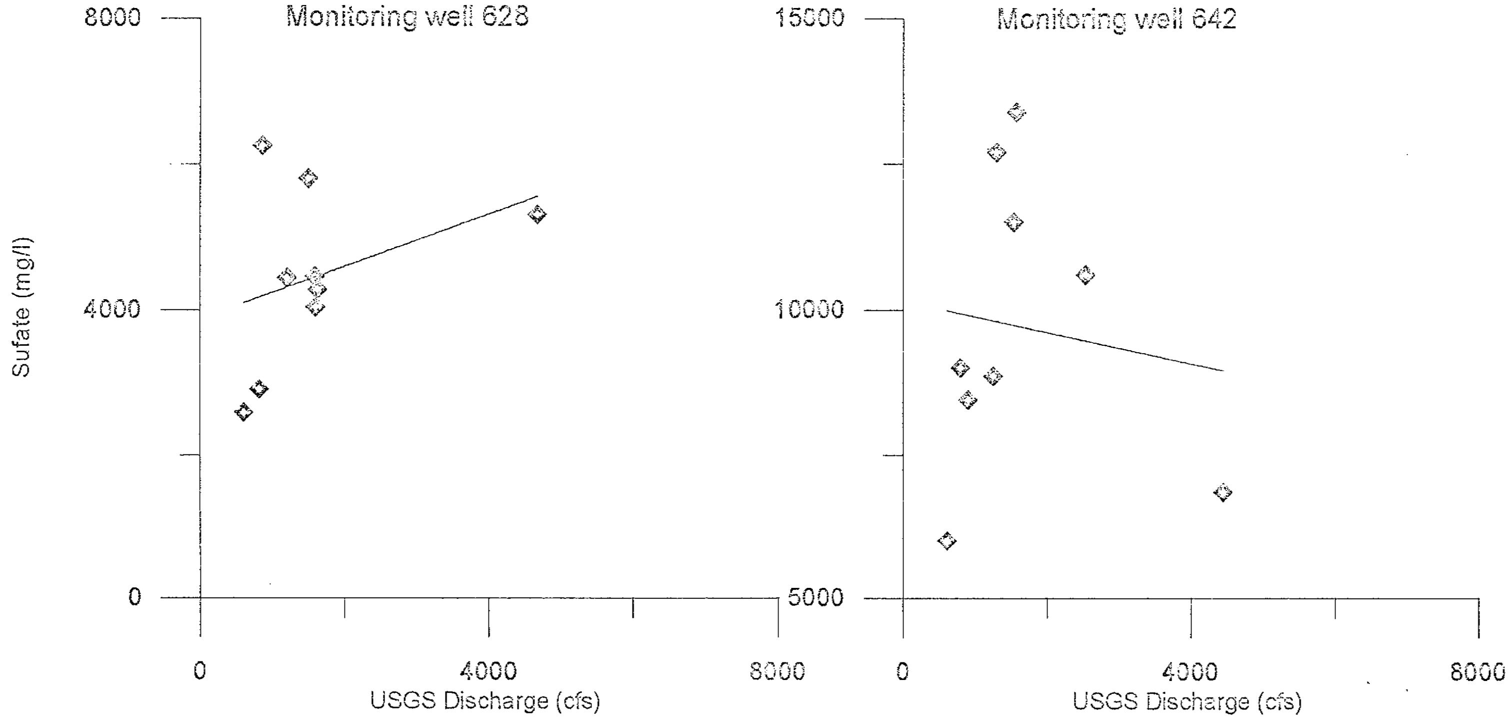
Appendix G.3: Discharge vs Nitrate for well located east of Bob Lee Wash



Linear, Y=B*X+A
Equation:
Y = -0.00696548 * X + 51.3465
Number of data points used = 8
Average X = 1600.25, Average Y = 40.2
Regression sum of squares = 567.066
Residual sum of squares = 24666.1
Coef of determination, R-squared = 0.0224731
Residual mean square, sigma-hat-sq'd = 4111.01

Linear, Y=B*X+A
Equation:
Y = 0.0175263 * X + 918.721
Number of data points used = 8
Average X = 1749, Average Y = 949.375
Regression sum of squares = 3265.16
Residual sum of squares = 6.47027E+006
Coef of determination, R-squared = 0.000504385
Residual mean square, sigma-hat-sq'd = 1.07838E+006

Appendix G.3.a: Discharge vs Sulfate for wells located east of Bob Lee Wash



Linear, Y=B*X+A
Equation:
Y = 0.358483 * X + 3884.44
Number of data points used = 9
Average X = 1602.44, Average Y = 4458.89
Regression sum of squares = 1.50204E+006
Residual sum of squares = 1.03456E+007
Coef of determination, R-squared = 0.126779
Residual mean square, sigma-hat-sq'd = 1.47795E+006

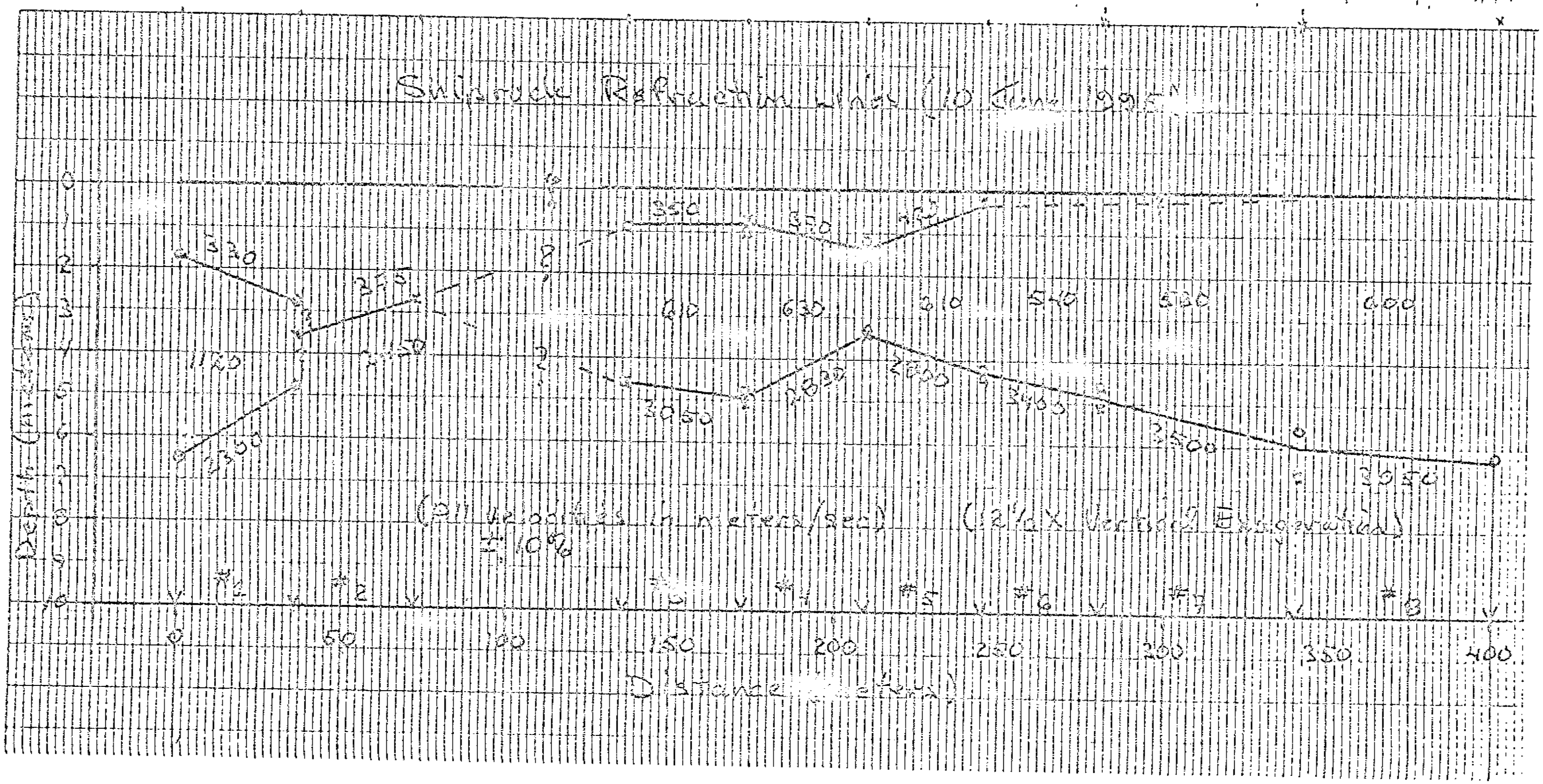
Linear, Y=B*X+A
Equation:
Y = -0.268205 * X + 10154.8
Number of data points used = 9
Average X = 1654.11, Average Y = 9711.11
Regression sum of squares = 811273
Residual sum of squares = 5.03858E+007
Coef of determination, R-squared = 0.0158461
Residual mean square, sigma-hat-sq'd = 7.19797E+006

Appendix: H Seismic refraction survey on the eastern floodplain

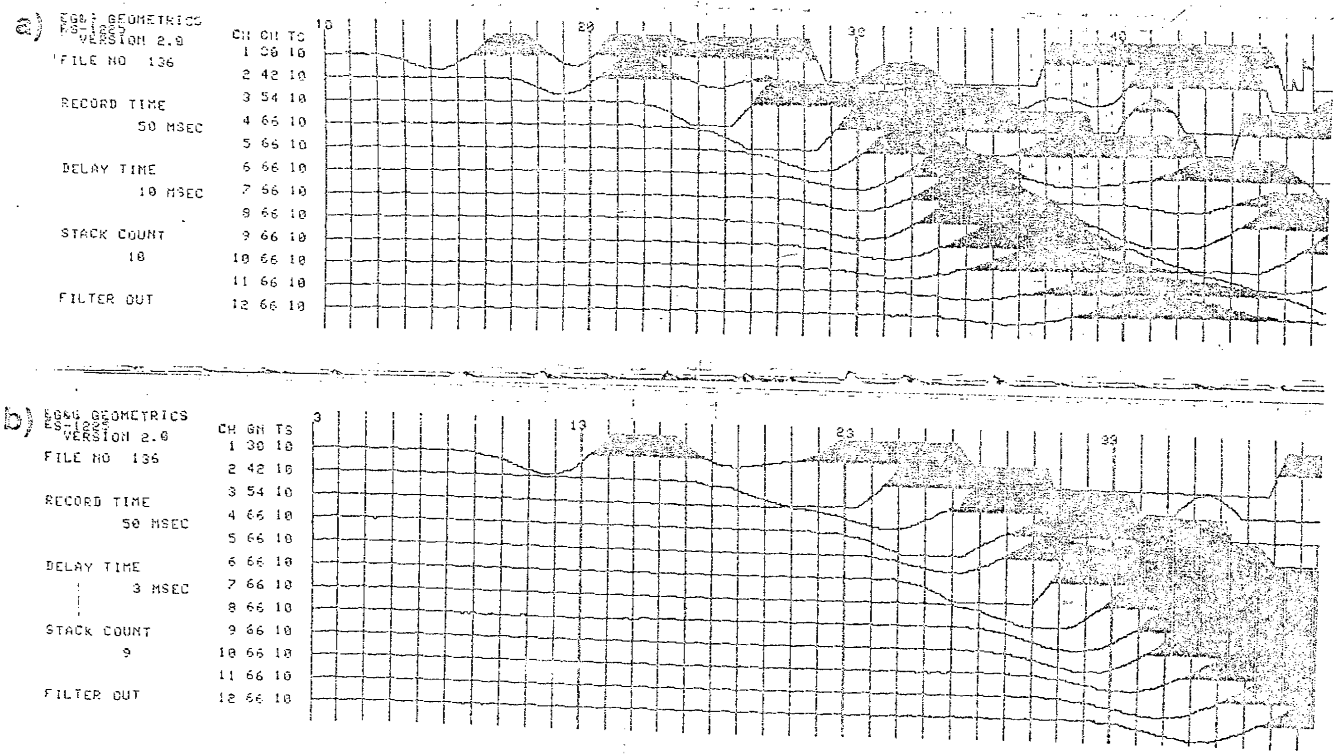
Although some of the well logs provide some information on lithology and stratigraphy, a better understanding of the floodplain stratigraphy is needed. This can be best accomplished through a shallow seismic survey. A seismic refraction test line was emplaced on the floodplain in June 10, 1995, from grid points (0,1) to (8,-2). The seismic refraction survey was coordinated with the NMT Geophysics department, Diné College students and the Navajo UMTRA program. Some problems were encountered in completing the remainder of the shallow seismic refraction survey so less than 10% of the site was surveyed..

The seismic refraction test line was emplaced on the floodplain in June 10, 1995, used the multichannel signal enhancement seismograph, model ES-1225 by EG & G Geometrics, in Sunnyvale, California. The seismograph produced the seismogram trace. The seismic line was placed 36 meters apart for one to six lines and 60 meters apart for the seven to eight lines. The energy source was a hammer banging on metal plate. Measurements of the first arrivals times from the seismogram traces were recorded. The measurements were plotted as arrival times (t) with the corresponding seismic line distances (x). On the graph, the slopes from the above plotted points were measured from the straight lines and the velocities were calculated from the reciprocals. From the velocities the lithology thickness was calculated. A rough cross-section, by Dr. J. Shule, illustrates the thickness in lithology of the alluvium, gravel and shale on the floodplain.

Appendix H.1: Seismic profile on the eastern floodplain



Appendix H.2: Seismograph traces for the eastern floodplain



a)

```
EG&G GEOMETRICS
ES-1225
  VERSION 2.9
FILE NO  136

RECORD TIME
        50 MSEC

DELAY TIME
        10 MSEC

STACK COUNT
      10

FILTER OUT
```

```
CH GN TS
 1 36 10
 2 42 10
 3 54 10
 4 66 10
 5 66 10
 6 66 10
 7 56 10
 8 66 10
 9 66 10
10 66 10
11 66 10
12 66 10
```

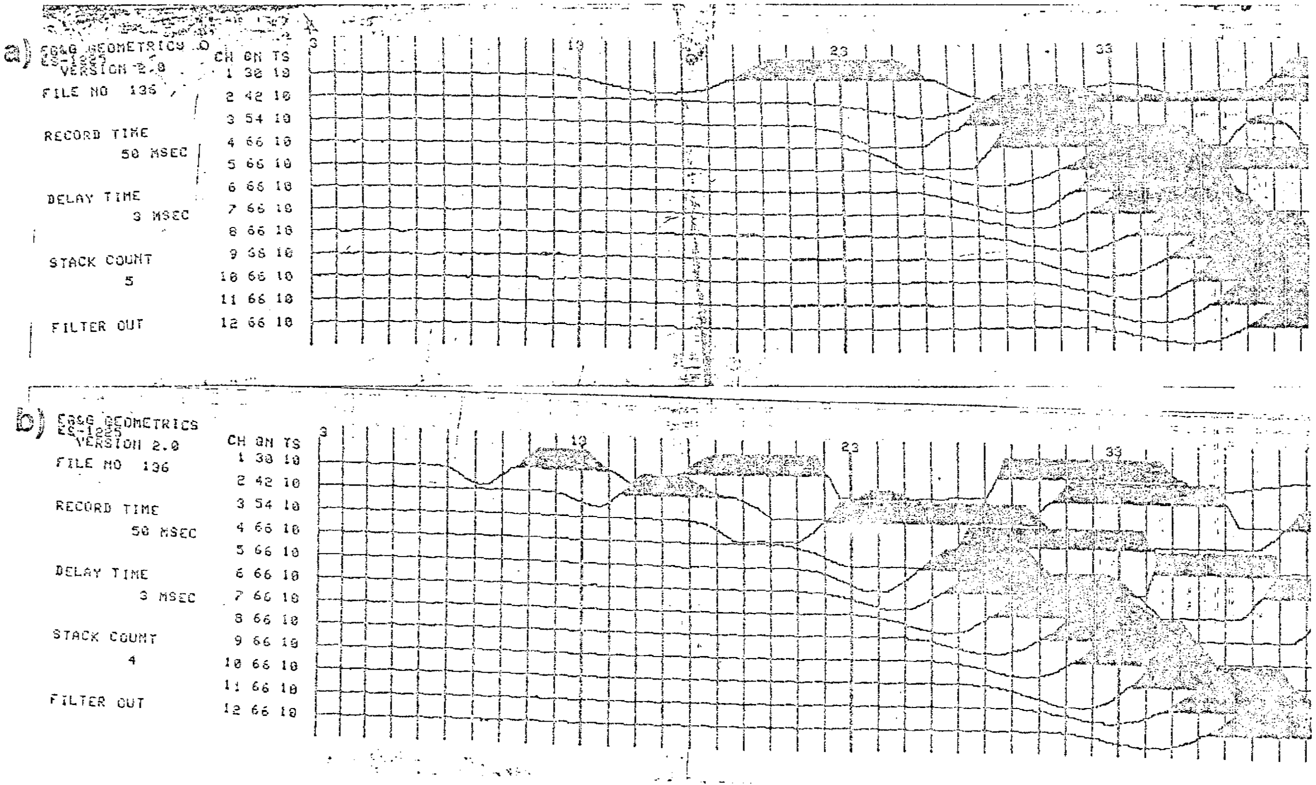
b)

```
EG&G GEOMETRICS
ES-1225
  VERSION 2.0
FILE NO  136

RECORD TIME
        50 MSEC

DELAY TIME
         3 MSEC

STACK COUNT
      9

FILTER OUT
```

```
CH GN TS
 1 30 10
 2 42 10
 3 54 10
 4 66 10
 5 66 10
 6 66 10
 7 66 10
 8 66 10
 9 66 10
10 66 10
11 66 10
12 66 10
```

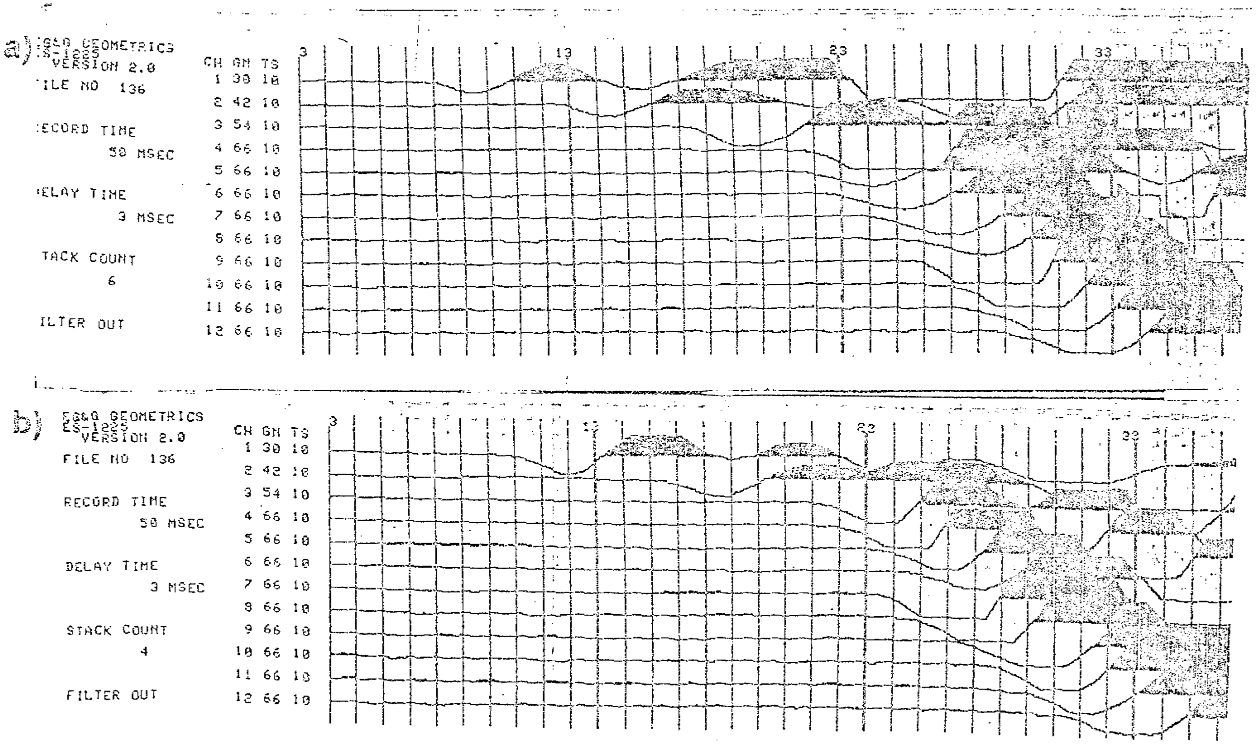
a) First forward shot in northwest (343°) direction with geophone spacing at 3 meters apart beginning with striker plate. Began line near the eastern fence. Time: 9:30 a.m. on 09/10/95. b) First reverse shot in southeast direction with geophone spacing at 3 meters. Geophone #12 becomes striker plate and geophone #11 becomes geophone #1. Time: 9:50 a.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



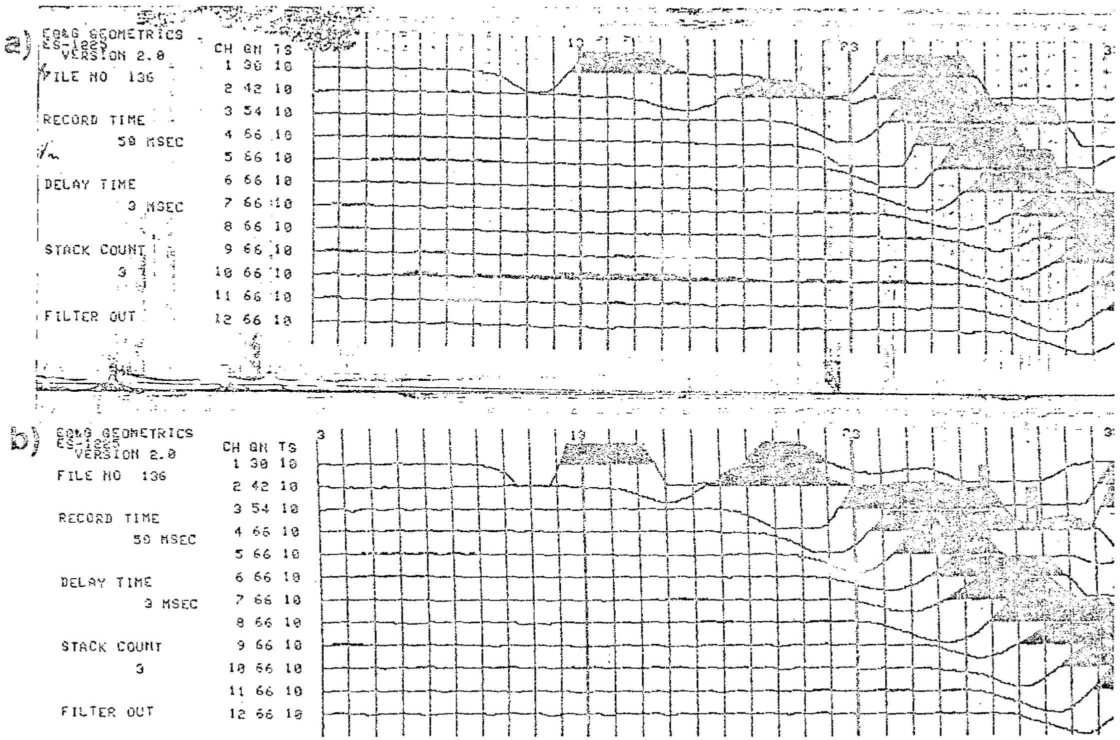
a) Second forward shot in northwest (326°) direction with geophone spacing at 3 meters apart. Moved line approximately 170 meters to the northwest. End of shot line is located 21.5 meters southeast from monitoring well 608. Time: 10:20 a.m. on 09/10/95. b) Second reverse shot in southeast direction with geophone spacing at 3 meters. Geophone #12 becomes striker plate and geophone #11 becomes geophone #. Time: 10:30 a.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



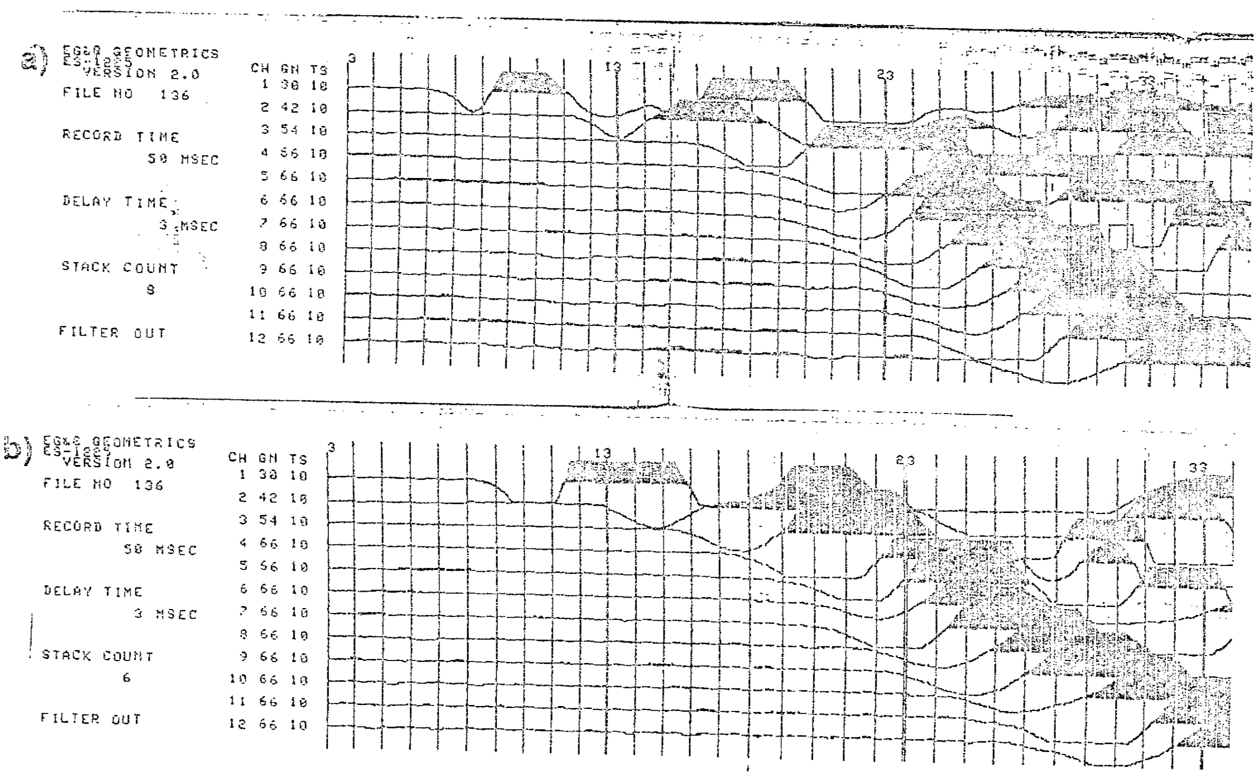
a) Third forward shot in northwest (333°) direction with geophone spacing at 3 meters apart. End of shot line is located 35 meters from monitoring well 609. Time: 10:43 a.m. on 09/10/95. b) Third reverse shot in southeast direction with geophone spacing at 3 meters. Geophone #12 becomes striker plate and geophone #11 becomes geophone #1. End of shot line is located 27.5 meters from monitoring well 608. Time: 10:50 a.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



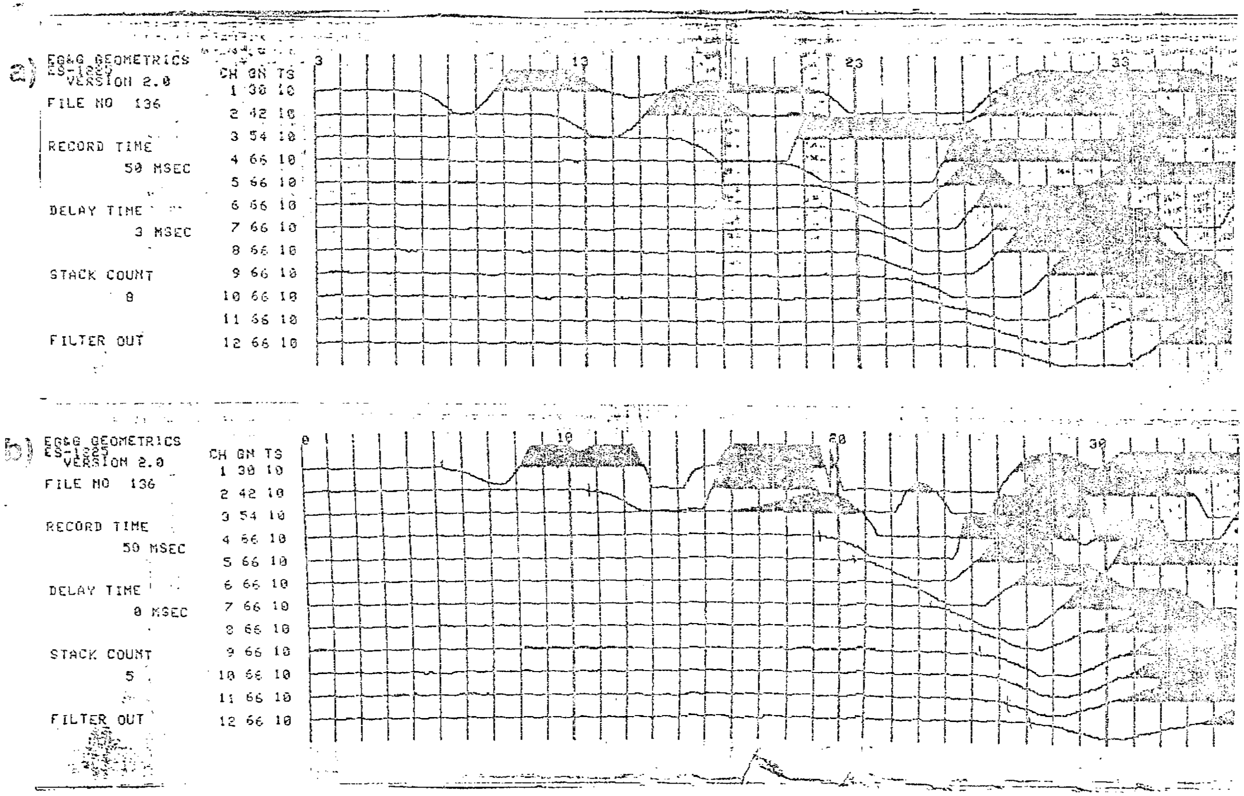
a) Fourth forward shot in northwest (303°) direction with geophone spacing at 3 meters apart. Time: 11:07 a.m. on 09/10/95. b) Fourth reverse shot in southeast direction with geophone spacing at 3 meters. Geophone #12 becomes striker plate and geophone #11 becomes geophone #1. Time: 11:38 a.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



a) Fifth forward shot in northwest (306°) direction with geophone spacing at 3 meters apart. Time: 12:20 a.m. on 09/10/95. b) Fifth reverse shot in southeast direction with geophone spacing at 3 meters. Geophone #12 becomes geophone #1. Time: 12:32 a.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



a)

EG&G GEOMETRICS
ES-1225
VERSION 2.0
FILE NO 136
RECORD TIME
50 MSEC
DELAY TIME
3 MSEC
STACK COUNT
8
FILTER OUT

CH	GN	TS
1	30	10
2	42	10
3	54	10
4	66	10
5	66	10
6	66	10
7	66	10
8	66	10
9	66	10
10	66	10
11	66	10
12	66	10

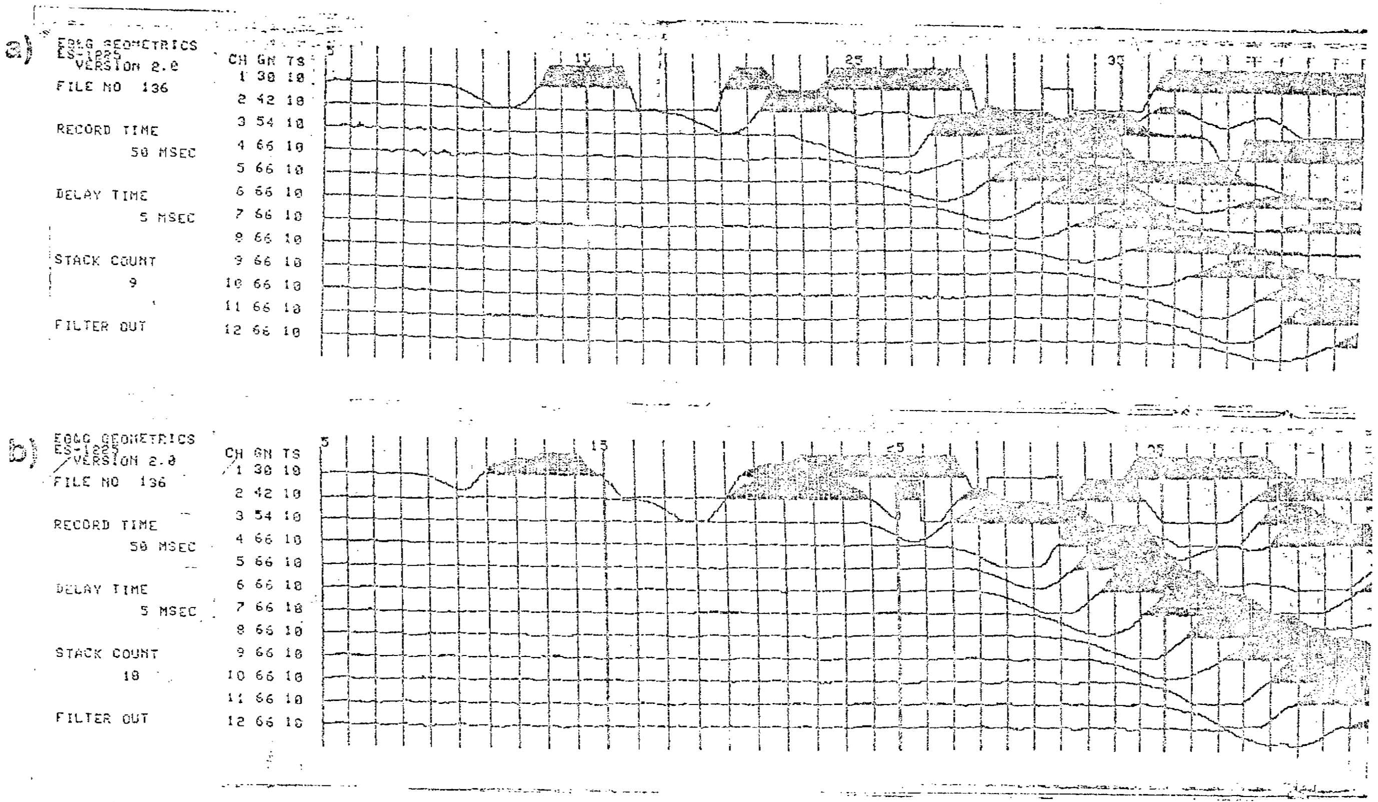
b)

EG&G GEOMETRICS
ES-1225
VERSION 2.0
FILE NO 136
RECORD TIME
50 MSEC
DELAY TIME
0 MSEC
STACK COUNT
5
FILTER OUT

CH	GN	TS
1	30	10
2	42	10
3	54	10
4	66	10
5	66	10
6	66	10
7	66	10
8	66	10
9	66	10
10	66	10
11	66	10
12	66	10

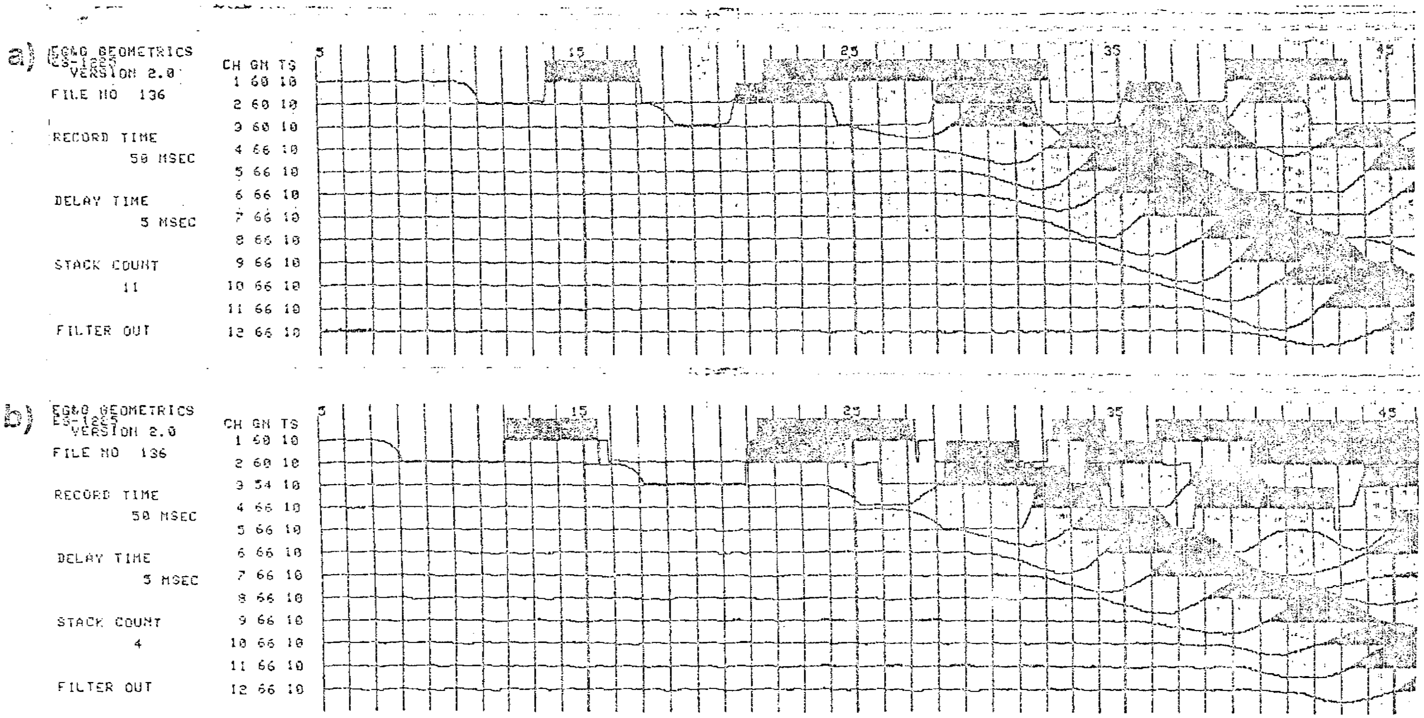
a) Sixth forward shot in northwest (306°) direction with geophone spacing at 3 meters apart. Time: 12:50 a.m. on 09/10/95. b) Sixth reverse shot in southeast direction with geophone spacing at 3 meters. Geophone #12 becomes geophone #1. Time: 01:00 p.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



a) Seventh forward shot in northwest (305°) direction with geophone spacing at 5 meters apart. Sixth geophone is 28 meters from the center of monitoring wells 611 and 610. Time: 02:25 p.m. on 09/10/95.
b) Seventh reverse shot in southeast direction with geophone spacing at 5 meters. Geophone #12 becomes geophone #1. Time: 03:08 p.m. on 09/10/95.

Appendix H.2: Seismograph traces for the eastern floodplain



a) Eighth forward shot in northwest (304°) direction with geophone spacing at 5 meters apart. Time: 03:28 p.m. on 09/10/95. b) Eighth reverse shot in southeast direction with geophone spacing at 5 meters. Geophone #12 becomes geophone #1. Time: 03:40 p.m. on 09/10/95.

Appendix I: Terrace elevations vs the San Juan River Distance from Farmington to Shiprock, New Mexico

San Juan River Dis. (m)	Terrace Elevation (m)
1a x dis	1a y elev
5.11	1658.11
6.29	1655.06
6.89	1655.06
1b x dis	1b y elev
9.80	1697.74
10.58	1697.74
12.04	1688.59
1 x dis	1 y elev
1.59	1670.30
1.89	1670.30
2.77	1670.30
4.57	1664.21
5.23	1664.21
2 x dis	2 y elev
1.54	1639.82
5.11	1624.58
6.22	1618.49
2a x dis	2a y elev
2.77	1627.63
3.05	1621.54
3.55	1621.54
3 x dis	3 y elev
0.19	1627.63
0.41	1621.54
2.05	1621.54
4 x dis	4 y elev
0.45	1609.34
1.44	1609.34
5 x dis	5 y elev
0.45	1597.15
1.44	1597.15
2.77	1594.10
3.05	1594.10

San Juan River Dis. (m)	Terrace Elevation (m)
6 x dis	6 y elev
4.45	1591.06
5.28	1588.01
7.24	1584.96
7 x dis	7 y elev
6.22	1594.10
10.58	1584.96
13.23	1578.86
13.51	1575.82
14.98	1575.82
8 x dis	8 y elev
5.42	1636.78
8.31	1624.58
8.68	1624.58
9 x dis	9 y elev
13.51	1658.11
15.17	1658.11
15.19	1658.11
10 x dis	10 y elev
10.79	1603.25
12.42	1603.25
13.06	1600.20
14.08	1600.20
11 x dis	11 y elev
10.03	1578.86
11.36	1575.82
12.04	1575.82
13.23	1569.72
14.62	1566.67
14.81	1566.67
12 x dis	12 y elev
14.08	1581.91
14.62	1581.91
14.98	1578.86

San Juan River Dis. (m)	Terrace Elevation (m)
13 x dis	13 y elev
17.89	1630.68
18.93	1627.63
21.39	1627.63
21.65	1627.63
22.27	1621.54
22.83	1621.54
14 x dis	14 y elev
17.32	1609.34
17.89	1606.30
18.43	1606.30
18.67	1603.25
18.98	1603.25
19.08	1603.25
19.64	1600.20
20.37	1603.25
20.67	1603.25
14a x dis	14a y elev
22.03	1603.25
22.83	1597.15
23.38	1594.10
23.78	1597.15
15a x dis	15a y elev
22.64	1566.67
22.83	1566.67
22.83	1569.72
24.44	1560.58
15 x dis	15 y elev
16.18	1597.15
17.32	1588.01
18.03	1600.20
16 x dis	16 y elev
15.92	1566.67
16.40	1563.62
17.32	1560.58
18.79	1557.53

Zero begins at junction of Animas and San Juan River in South Farmington.

Appendix I: Terrace elevations vs the San Juan River Distance from Farmington to Shiprock, New Mexico

San Juan River Dis. (m)	Terrace Elevation (m)
17 x dis	17 y elev
18.79	1572.77
19.08	1572.77
21.65	1560.58
21.79	1563.62
18 x dis	18 y elev
20.67	1551.43
21.39	1548.38
21.79	1548.38
23.78	1545.34
24.04	1545.34
19 x dis	19 y elev
21.08	1652.02
21.63	1652.02
25.74	1630.68
25.83	1624.58
26.10	1624.58
26.52	1624.58
20 x dis	20 y elev
23.95	1621.54
24.04	1621.54
24.30	1621.54
24.44	1621.54
28.80	1609.34
27.05	1612.39
26.79	1612.39
21 x dis	21 y elev
25.83	1594.10
26.10	1591.06
26.52	1591.06
26.79	1588.01
26.86	1591.06
27.65	1591.06
28.51	1591.06
27.19	1584.96
27.31	1584.96
29.48	1584.96

San Juan River Dis. (m	Terrace Elevation (m)
22 x dis	22 y elev
26.69	1554.48
27.05	1554.48
27.31	1554.48
28.80	1554.48
26.79	1554.48
23 x dis	23 y elev
27.65	1536.19
26.86	1539.24
27.19	1539.24
27.31	1539.24
24 x dis	24 y elev
33.10	1591.06
33.74	1591.06
33.22	1597.15
25 x dis	25 y elev
31.97	1578.36
35.21	1572.77
36.58	1566.67
39.02	1560.58
37.74	1560.58
26 x dis	26 y elev
30.67	1572.77
33.74	1566.67
27 x dis	27 y elev
31.52	1560.58
33.10	1554.48
28 x dis	28 y elev
31.97	1542.29
33.51	1542.29
33.74	1542.29
33.79	1536.19
34.69	1536.19
35.21	1536.19
36.00	1536.19
36.34	1517.90
36.58	1530.10
37.43	1530.10
38.83	1524.00

San Juan River Dis. (m)	Terrace Elevation (m)
29 x dis	29 y elev
33.74	1524.00
36.34	1536.19
37.43	1517.90
39.02	1511.81
41.21	1505.71
41.79	1505.71
30 x dis	30 y elev
41.21	1554.48
41.36	1554.48
42.35	1554.48
43.47	1548.38
43.98	1554.48
31 dis x	31 elev y
39.42	1530.10
41.21	1530.10
32 dis x	32 elev y
44.25	1572.77
46.93	1572.77
33 dis x	33 elev y
44.84	1517.90
47.65	1511.81
50.09	1505.71
50.73	1499.62
50.90	1505.71

Appendix I: Terrace elevations vs the San Juan River Distance from Farmington to Shiprock, New Mexico

San Juan River Dis. (m)	Terrace Elevation (m)
34 dis x	34 elev y
49.52	1499.62
50.21	1499.62
35 dis x	35 elev y
46.80	1493.52
50.47	1487.42
50.75	1487.42
36 dis x	36 elev y
47.18	1542.29
50.21	1536.19
50.75	1536.19
37 dis x	37 elev y
54.39	1527.05
55.62	1530.10
57.46	1524.00
38 dis x	38 elev y
59.36	1499.62
59.85	1499.62
60.54	1493.52
61.30	1466.09
62.11	1487.42
63.05	1481.33
63.73	1475.23
65.60	1475.23
39 dis x	39 elev y
58.08	1493.52
59.12	1487.42

San Juan River Dis. (m)	Terrace Elevation (m)
40 dis x	40 elev y
54.69	1499.62
55.81	1493.52
57.23	1487.42
41 dis x	41 elev y
56.45	1475.23
59.85	1469.14
61.30	1466.09
62.11	1463.04
63.66	1459.99
65.20	1456.94
42 dis x	42 elev y
61.46	1542.29
62.11	1542.29
63.05	1536.19
43 dis x	43 elev y
63.05	1524.00
64.21	1517.90
65.20	1511.81
X HB dis	y HB Elev
32.89	1554.48
33.27	1732.48
34.17	1699.59
X site dis	y site Elev
47.65	1511.81
47.65	1493.52
49.60	1499.62
49.60	1487.42
X NCC dis	Y NCC Elev
52.95	1524.00

San Juan River Dis. (km)	River Elevation (m)
0.00	1597.15
1.89	1594.10
3.81	1591.06
5.44	1584.96
6.55	1581.91
8.57	1578.86
10.10	1575.82
11.33	1572.77
12.85	1569.72
13.49	1566.67
15.90	1563.62
16.97	1560.58
18.43	1557.53
19.31	1554.48
20.42	1551.43
21.22	1548.38
23.40	1545.34
24.73	1542.29
26.00	1539.24
27.10	1536.19
29.52	1533.14
33.46	1524.00
36.16	1517.90
37.98	1511.81
40.63	1505.71
43.49	1499.62
46.57	1493.52
50.28	1487.42
53.19	1481.33
56.11	1475.23
59.26	1469.14
60.68	1466.09
62.10	1463.04
63.57	1459.99
65.11	1456.94

Zero begins at junction of Animas and San Juan River in South Farmington.

Appendix: J USGS Shiprock gaging station discharges

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/23/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Day	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2670	1330	1500	1510	2360	2730	2090	2250	6440	3200	1800	2300
1	2670	1330	1500	1510	2360	2730	2090	2250	6440	3200	1800	2300
2	3540	1060	1520	1500	2350	2700	2160	2090	5870	2890	1550	3030
2	3540	1060	1520	1500	2350	2700	2160	2090	5870	2890	1550	3030
3	2720	756	1550	1420	2340	2720	2150	2110	5100	2970	1420	2030
3	2720	756	1550	1420	2340	2720						
4	2310	741	1550	1450	2370	2850	2100	2090	4670	2940	1330	1630
5	2000	739	1550	1520	2390	2820	2100	2150	4100	2710	1230	1420
6	1880	739	1500	1790	2400	2730	2030	2280	3970	2500	1950	1250
7	1760	739	1440	2120	2610	2810	2090	2340	3220	2280	2620	1030
8	1700	920	1440	2270	2640	2550	2170	2390	3070	2130	2060	983
9	1700	1400	1450	2300	2640	2390	2230	2340	2810	2130	1530	924
10	1680	1450	1480	2310	2660	2440	2440	2690	2600	2270	1370	844
11	1670	1400	1490	2360	2690	2610	2420	3290	2540	2320	1230	886
12	1670	1340	1500	2340	2680	2750	2340	4120	2570	2310	1060	1040
13	1760	1390	1490	2410	2650	2650	2340	5170	2860	2030	1360	1120
14	1790	1350	1490	2470	2610	2660	2310	5300	3380	2400	1130	1020
15	1700	1280	1500	2480	2660	2710	2380	5570	3820	2220	1210	1010
16	1720	1330	1510	2440	2610	2430	2500	6380	3870	2170	1370	1040
17	1690	1330	1470	2430	2650	2190	2710	5890	3990	2210	3050	1230
18	1630	1500	1490	2390	2720	2130	2920	5530	3580	1920	3490	1360
19	1620	1490	1490	2330	2700	2140	3250	5340	3390	1700	2360	1260

20	1600	1510	1490	2380	2660	2100	3480	4990	3080	1530	2010	1190
21	1580	1540	1480	2370	2670	2130	3190	5710	3180	1530	2140	1170
22	1570	1630	1470	2390	2650	2210	2720	6500	3470	1480	1750	1160
23	1570	1550	1450	2380	2650	2360	2490	7410	3640	1530	3110	1150
24	1500	1500	1490	2430	2620	2260	2320	8420	3410	1540	3590	1110
25	1420	1520	1520	2410	2630	2210	2190	9380	3190	1430	2690	1130
26	1450	1550	1750	2420	2780	2280	2410	9880	3310	1600	2530	1320
27	1420	1520	2010	2400	2760	2360	2360	9670	3680	1610	2340	1450
28	1390	1450	2510	2390	2650	2240	2290	9030	3750	1550	1850	1460
29	1390	1420	2120	2390	2680	2140	2300	8130	3380	1650	1530	1420
30	1400	1480	1560	2370	---	2120	2260	7420	3190	2100	1380	1340
31	1390	---	1510	2330	---	2140	---	6950	---	2000	1320	---
TOTAL	54890	38954	48770	68550	75460	75560	72740	162810	109230	64850	59610	39327
MEAN	1771	1298	1573	2211	2602	2437	2425	5252	3641	2092	1923	1311
MAX	3540	1630	2510	2480	2780	2850	3480	9880	6440	3200	3590	3030
MIN	1390	739	1440	1420	2340	2100	2030	2090	2540	1430	1060	844
AC-FT	108900	77270	96740	136000	149700	149900	144300	322900	216700	128600	118200	78010

CAL YR 1983 TOTAL 964683 MEAN 2643 MAX 8020 MIN 739 AC-FT 1913000

WTR YR 1984 TOTAL 870751 MEAN 2379 MAX 9880 MIN 739 AC-FT 1727000

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1240	1410	2200	2090	2290	1500	3580	6150	8440	4950	2310	1180
2	1180	1920	2190	2000	2240	1630	3670	6410	7430	4310	2200	1180
3	1470	2010	2230	1870	2250	1770	3710	6840	7630	3660	2440	1170
4	1960	2000	2260	1940	2300	1790	3930	7940	8050	3590	2730	1200

5	2360	2030	2230	1930	2360	2190	4460	9490	7970	3630	2090	1230			
6	2130	2050	2210	1950	2620	2560	4700	10300	8160	3320	1570	1250			
7	2090	2030	2180	1980	2660	2640	5140	10100	9310	3120	1130	1330			
8	1890	1980	2170	1540	2720	2650	5550	9730	11100	2940	1050	1390			
9	1650	1990	2210	1370	2710	2760	5770	10000	12000	2710	920	1450			
10	1810	1930	2200	1310	2670	2930	5970	9860	12600	2640	920	1430			
11	1990	1920	2190	1280	2670	3660	6010	9550	11600	2650	930	1440			
12	2220	1920	2270	1210	2730	4340	6060	8480	10900	2710	940	3370			
13	2340	1890	2320	1140	2730	4790	6270	7440	10300	2690	950	2620			
14	2340	2040	2370	1120	2730	3490	6610	6990	9770	2880	950	2310			
15	2340	2220	2240	1850	2740	3120	6860	6410	9660	2780	940	2020			
16	2370	2320	2180	2370	2780	3240	7280	8190	9520	2620	930	2040			
17	2470	2320	2130	2400	3070	3300	7210	6450	9960	2470	925	2370			
18	2730	2330	2110	2400	3780	3170	6890	6640	9070	2380	920	2430			
19	2540	2300	2120	2370	4090	3780	6620	6650	8590	2650	920	3820			
20	2430	2330	2130	2390	3740	4380	6210	6790	8280	3150	1080	4700			
21	2320	2270	2150	2410	4030	4240	5710	6620	8060	3070	1380	3970			
22	2400	2240	2120	2390	3250	3930	5460	6370	8150	3000	1300	3410			
23	2310	2250	2090	2430	2050	3750	5140	6190	8070	3390	1220	3230			
24	2400	2310	2080	2460	1590	3560	5010	6080	7660	2740	1180	2910			
25	2260	2370	2120	2460	1510	3640	4750	6380	7440	2270	1170	2630			
26	2180	2380	2090	2450	1490	3630	4740	7060	7720	2040	1250	2500			
27	2200	2310	2100	2440	1420	3730	4860	7910	6970	1970	1200	2360			
28	2140	2210	2390	2410	1450	3790	5250	9020	6300	1900	1300	2250			
29	2130	2200	2600	2440	---	3810	8630	9560	5710	1950	1510	2200			
30	1560	2200	2340	2430	---	3760	7520	9680	5200	2690	1200	2180			
31	979	---	2170	2380	---	3660	---	9550	---	2520	1160	---			
TOTAL	64429	83680	68390	63210	72670	101190	169590	243030	261620	89390	40715	67580			
MEAN	2078	2123	2206	2039	2595	3264	5653	7840	8721	2884	1313	2253			
MAX	2730	2380	2600	2460	4090	4790	8630	10300	12600	4950	2730	4700			
MIN	979	1410	2080	1120	1420	1500	3580	6080	5200	1900	920	1170			

AC-FT 127600 126300 135700 125400 144100 200700 336400 482000 518900 177300 80760 134000

CAL YR 1984 TOTAL 924636 MEAN 2526 MAX 9860 MIN 844 AC-FT 1834000
WTR YR 1985 TOTAL 1305494 MEAN 3577 MAX 12600 MIN 920 AC-FT 2589000

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS
LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045
from isco flow meter
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1860	2950	2800	3200	3130	1970	2560	2970	4260	7010	3650	2850
2	1560	2910	2800	3170	3140	1960	3880	3700	4360	6410	3630	2730
3	1530	2900	2800	3140	3090	1940	4400	4470	4190	5460	3570	2650
4	1490	2900	2830	3140	3060	2110	3450	5830	4970	5490	3500	2550
5	1410	2880	2840	3120	3060	2260	2950	6240	5700	5680	3400	2500
6	1400	2880	2830	3130	3060	2360	2750	5480	6100	6160	3300	2400
7	1450	2830	2850	3170	3110	2390	2860	4570	6420	5910	3230	2310
8	1460	2900	2850	3150	3070	2350	3080	3700	7100	5650	3230	2370
9	1520	2900	2800	3090	3050	2420	3190	3150	6590	5460	3160	3170
10	1550	2870	2850	3110	3080	2440	3290	2840	5630	6440	3200	3930
11	1710	2900	2850	3140	2410	2470	3170	2510	4430	6330	3160	5690
12	1900	2900	2900	3140	1460	2450	3190	2450	4090	5760	2400	3920
13	1910	2900	3000	3120	1470	2440	3080	2370	4570	5420	1860	3350
14	1900	2900	3000	3130	1540	2260	2980	2480	5180	5020	1960	2910
15	1880	2900	3000	3080	1590	2340	2860	2640	5530	5080	1920	2620
16	1860	2900	3000	3090	1710	2220	2720	2700	5500	5340	1640	[illegible]
17	1790	2900	3000	3070	1710	2220	2740	2740	5440	5150	1610	2540
18	1970	2900	3000	3060	1660	2230	2840	2650	5080	3840	1600	2530
19	1870	2900	2930	3060	1730	2210	2750	2490	5390	3810	1580	2480
20	1740	2900	2700	3030	1880	2160	2580	2710	5950	7200	1510	2470

21	1710	2900	3000	3000	2040	2100	2480	3560	5920	5240	1550	2460
22	1650	2900	3200	3040	1900	2150	2160	4270	5940	6480	1640	2440
23	1610	2900	3200	3020	1800	2200	2370	4280	5780	9190	1800	2500
24	1610	2900	3200	2970	1750	2250	3000	4460	5570	9280	2690	3640
25	1640	2900	3150	2990	1740	2300	3050	4330	5420	5780	3840	4000
26	1570	2900	3100	3070	1800	2200	3040	3960	5790	4650	3990	4030
27	1610	2900	3100	3090	1860	1980	2850	4790	7050	4320	3550	3800
28	1560	2850	3210	3080	1910	2030	2610	5160	7920	4240	2700	3410
29	1530	2850	3210	3110	---	2180	2370	5330	7360	4210	3150	3240
30	2300	2850	3200	3100	---	2320	2500	5300	7260	4080	5200	3270
31	2930	---	3220	3090	---	2360	---	4640	---	3810	3120	---
TOTAL	53480	86770	92420	95900	62850	69270	87750	118750	170490	173930	87140	91570
MEAN	1725	2892	2981	3094	2245	2235	2925	3831	5683	5611	2811	3052
MAX	2930	2950	3220	3200	3140	2470	4400	6240	7920	9280	5200	5890
MIN	1400	2830	2700	2970	1460	1940	2160	2370	4090	3810	1510	2310
AC-FT	106100	172100	183300	190200	124700	137400	174100	235500	338200	345000	172800	181600

CAL YR 1985 TOTAL 1341665 MEAN 3676 MAX 12800 MIN 920 AC-FT 2661000

WTR YR 1986 TOTAL 1190320 MEAN 3261 MAX 9280 MIN 1400 AC-FT 2361000

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3210	3370	3510	3070	3400	1390	4460	8420	3070	6870	1600	1290
2	3150	7810	3450	3060	3470	1380	4480	8700	4660	6800	1530	1190
3	3180	5700	3460	3090	3530	1780	4660	8660	6080	6660	1520	1120
4	3170	5150	3470	3100	3570	3190	4800	7700	7100	6460	1510	1080
5	3110	5910	3510	3080	3780	4000	4930	6710	8390	6260	1490	1050

6	3650	4180	3780	3090	3790	4810	4950	6480	8730	5950	1600	1070
7	2490	4520	4050	3070	3710	5430	4810	6570	9360	5730	1720	1100
8	1950	3630	3920	3020	3730	5230	4780	6730	9830	5530	1580	1130
9	1770	3470	3680	3050	3810	5020	4960	7030	9680	5300	1490	989
10	2010	3270	3520	3040	3710	4500	5100	7330	10300	5220	1480	900
11	3800	3250	3340	3050	3770	4040	5240	7340	10400	5200	1390	840
12	5490	3290	3300	3040	3910	3700	5440	7480	10000	5190	1300	880
13	4650	3640	3310	3120	4020	3470	5560	8040	9740	5220	1110	860
14	3640	3670	3340	3060	4040	3420	5320	7760	9940	5170	1030	890
15	3150	3740	3350	3120	4210	3410	5130	8060	10300	5140	980	870
16	3030	3750	3350	3160	3720	3420	5210	8860	10700	5290	920	860
17	3030	3730	3300	3080	3600	3490	5700	9110	10600	5340	690	960
18	3110	3710	3370	3130	3460	3460	6330	9100	9690	5440	820	940
19	3170	3910	3340	3080	3380	3550	6750	8860	9240	5520	785	930
20	3210	4020	3330	3110	3410	3620	6750	7040	9090	5240	710	980
21	3190	3750	3270	3140	3440	3630	6400	5000	8780	4860	800	920
22	3130	3680	3260	3140	3420	3720	6200	4510	8230	4230	750	880
23	2990	3640	3230	3090	3380	3730	6220	4410	8010	2710	900	850
24	2950	3600	3220	3110	2310	4270	6470	4480	8200	2150	1700	800
25	2790	3560	3190	3200	1580	4420	6800	4310	8210	1930	2190	820
26	2150	3710	3160	3190	1590	4530	7360	4020	8280	1890	2400	840
27	2120	3670	3130	3200	1530	4390	7310	3900	8140	1810	2040	890
28	2090	3560	3100	3260	1510	4290	7630	3460	7800	1820	1390	900
29	2570	3510	3110	[illegible]	---	4170	7920	3260	7270	1880	1700	920
30	2970	3500	3110	3320	---	4110	7850	3180	7160	1690	1500	940
31	2930	---	3070	3300	---	4400	---	3110	---	1680	1410	---
TOTAL	93850	119900	104510	96850	92780	117970	175520	[illegible]	256980	140380	42535	26689
MEAN	3027	3997	3371	3124	3314	3805	5851	6440	8566	4528	1372	956
MAX	5490	7810	4050	3320	4210	5430	7920	9110	10700	6870	2400	1290
MIN	1770	3250	3070	3020	1510	1330	4460	3110	3070	1680	710	800
AC-FT	186200	237800	207300	192100	184000	234000	348100	396000	509700	278400	84370	56900

CAL YR 1986 TOTAL 1275910 MEAN 3496 MAX 9280 MIN 1460 AC-FT 2531000
WTR YR 1987 TOTAL 1469604 MEAN 4026 MAX 10700 MIN 710 AC-FT 2915000

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS
LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045
from isco flow meter
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1050	1300	1020	973	970	1220	1220	978	1730	3940	1210	2730
2	1040	1910	1010	922	1030	1320	1080	1230	1500	2500	1150	3160
3	1050	1830	990	950	1000	1280	1030	1230	1290	1900	1300	3300
4	1030	1500	986	1030	990	1200	1010	1030	1480	1810	1400	2800
5	1020	1310	1010	1020	960	1250	1050	878	2570	1700	1120	1550
6	975	1820	1010	1100	990	1220	1100	833	2790	1500	1500	1300
7	870	2080	1000	1100	1000	1200	1120	890	2820	1350	3500	1100
8	790	1910	992	1060	1020	1150	1090	806	3030	1250	3300	1000
9	780	1600	1020	1030	1050	1100	1260	786	2990	1130	2300	950
10	770	1380	1010	1010	1040	1050	1300	766	2850	1120	1600	906
11	775	1320	1000	1050	1070	1060	1210	668	2890	1090	1200	861
12	800	1290	1000	1020	1050	1050	1090	695	3620	920	1000	851
13	825	1210	1060	996	1050	1000	1010	1080	2650	780	1100	950
14	920	1200	1050	978	1060	970	1110	1610	2420	680	1000	1150
15	1100	1330	1010	939	1050	960	1180	1770	1890	630	890	1270
16	1110	1260	1000	1020	1040	970	1230	2230	1640	620	730	1330
17	1080	1110	1010	1080	1100	990	1510	2530	1510	625	1100	1350
18	990	1090	1060	1080	1080	958	1490	2660	1710	610	1900	1200
19	980	1080	1110	1070	1050	965	1290	2660	1730	520	2500	1160
20	1000	1030	1100	1000	1080	930	1170	2370	1750	540	1900	1070

21	1010	1050	1040	979	1100	888	1120	1970	1820	660	1500	1090
22	1050	1060	993	984	1150	912	1280	1640	1800	640	1300	1250
23	980	1080	1000	961	1170	948	1410	1390	1650	620	1150	1420
24	950	1060	1020	979	1160	1020	1290	1220	1730	610	2550	1450
25	960	1030	1060	1020	1100	1010	1230	1300	2060	615	2800	1500
26	957	1050	1060	1020	1160	1000	1080	1590	2220	620	3100	1450
27	972	1050	1050	1020	1150	1030	1040	1510	2040	620	2950	1360
28	995	1020	1000	1070	1140	1020	989	1610	3000	615	2900	1310
29	996	1000	1020	1040	1160	1190	953	1940	4070	590	2850	1200
30	1220	1030	1010	982	---	1210	915	2350	4120	600	2500	1150
31	1250	---	947	1030	---	1150	---	2250	---	1390	2400	---
TOTAL	30295	38990	31648	31513	30990	33221	34857	46470	69380	32795	57700	43163
MEAN	977	1300	1021	1017	1089	1072	1162	1499	2313	1058	1861	1439
MAX	1250	2080	1110	1100	1170	1320	1510	2660	4120	3940	3500	3300
MIN	770	1000	947	922	970	888	915	663	1290	520	730	851
AC-FT	60090	77340	62770	62510	61470	65890	69140	92170	137600	65050	114400	85620

CAL YR 1987 TOTAL 1252277 MEAN 3431 MAX 10700 MIN 710 AC-FT 2484000

WTR YR 1988 TOTAL 481027 MEAN 1314 MAX 4120 MIN 520 AC-FT 954100

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e1050	924	795	e900	e1030	e1130	e1550	e1280	1600	743	e2050	278
2	e1000	926	835	e910	e1030	e1120	e1500	e1100	1400	714	e2500	252
3	e980	e930	851	e920	e1100	e1100	e1540	e1100	1360	658	e1750	254
4	e960	e920	827	e920	e1130	e1130	e1560	e1100	1270	629	e1500	251
5	e890	e910	811	e950	e1100	e1120	1580	e1090	1240	584	1380	274

6	e850	e880	756	e980	e1080	e1110	1500	e1140	1240	582	1170	367
7	828	e850	787	e1000	e970	e1100	1420	e1230	1310	518	1010	350
8	999	e840	866	e1010	e920	e1100	1530	e1450	1300	524	650	323
9	966	e810	827	e1000	e980	e1140	e1660	e1750	1430	463	490	324
10	926	e800	771	e980	e1000	e1200	e1650	e2150	1360	446	479	315
11	870	e830	749	e940	e1080	e1500	e1870	e2210	1290	432	481	317
12	843	e880	792	e920	e1100	e1550	e1800	e2120	1250	404	519	317
13	786	e900	e830	e930	e1090	e1600	e1780	e1900	1310	454	412	361
14	772	e910	e880	e980	e1080	e1600	e1650	e1630	1230	487	403	297
15	821	e930	e880	e990	e1070	e1620	e1500	e1500	1170	458	349	316
16	[illegible]	e920	e900	e990	e1060	e1620	e1520	e1420	1090	396	[illegible]	339
17	806	e950	e920	e1000	e1030	e1500	e1650	1200	1230	366	343	341
18	783	960	e900	e1010	e1010	e1550	e1750	1100	1440	381	350	330
19	793	764	e910	e1010	e1000	e1460	e1800	1030	1350	357	606	311
20	881	733	e920	e1020	e1000	e1470	e1860	1150	1360	e352	572	431
21	894	811	e910	e1020	e1000	e1450	e1950	1390	1290	e325	706	682
22	841	749	e910	e1010	e1000	e1400	e2150	2010	1190	e320	642	744
23	808	726	e900	e1000	e1000	e1400	e2280	1990	1010	e390	798	672
24	787	703	e920	e1010	e1000	e1380	e2200	2140	793	e720	768	641
25	869	787	e910	e1010	e1020	e1420	e2150	2080	711	e1000	674	648
26	922	803	e920	e1010	e1100	e1500	e2000	1910	741	e1450	579	609
27	851	756	e930	e1010	e1120	e1580	e1880	1700	804	e1700	476	530
28	891	771	e930	e1010	e1160	e1570	1680	1670	779	e1550	420	525
29	952	780	e940	e1020	---	e1550	1440	2170	796	e1680	407	511
30	963	741	e930	e1020	---	e1550	1400	2300	765	e1400	350	493
31	969	---	e910	e1020	---	e1550	---	2070	---	e1380	340	---
TOTAL	27391	25194	26919	30500	29290	43090	52000	50080	35129	21863	23523	12403
MEAN	884	840	868	984	1046	1390	1733	1615	1171	705	759	413
MAX	1050	960	940	1020	1160	1620	2280	2300	1600	1700	2500	744
MIN	772	703	749	900	920	1100	1400	1030	711	320	340	251
AC-FT	54330	49970	53390	60500	58100	85470	103100	99330	69680	43370	46660	24600

CAL YR 1988 TOTAL 459598 MEAN 1256 MAX 4120 MIN 520 AC-FT 911600
WTR YR 1989 TOTAL 377382 MEAN 1034 MAX 2500 MIN 251 AC-FT 748500

e Estimated

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS
LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045
from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	471	820	841	720	741	856	649	851	1460	661	183	e335	
2	480	868	891	712	783	876	634	1450	1540	639	154	e320	
3	485	921	882	690	740	803	534	e2320	1370	668	144	367	
4	551	892	809	693	741	783	496	e1290	1590	798	e139	406	
5	765	906	828	760	749	786	478	e1090	2780	939	e133	381	
6	966	892	828	725	690	849	480	e1190	3480	1460	e123	386	
7	975	962	861	713	707	818	528	e1290	3550	2050	128	526	
8	908	949	865	762	689	681	490	e1480	3420	2120	133	489	
9	853	969	830	715	689	668	574	1790	3290	1780	161	539	
10	832	993	841	716	690	650	549	1680	3250	1720	154	541	
11	869	1010	941	674	698	693	459	1600	3870	1430	119	481	
12	789	969	879	680	710	710	486	1450	3830	1280	109	440	
13	711	931	850	682	720	717	389	1270	3170	1120	115	445	
14	672	925	842	703	705	675	395	1170	2620	995	321	394	
15	680	908	796	680	703	634	390	1140	2280	1060	1380	382	
16	733	907	685	661	663	635	398	1340	2030	1110	1660	407	
17	738	914	679	727	677	635	396	1310	1690	891	1880	e1090	
18	728	914	704	731	788	650	449	1200	1600	710	1620	e1150	
19	763	899	701	764	781	678	687	1220	1480	510	1130	1230	
20	747	898	705	784	811	689	778	1290	1520	e445	1190	1220	

21	735	839	748	810	820	712	715	1300	1420	e395	3600	1210
22	747	775	764	785	817	671	634	1490	1300	e367	1650	1270
23	735	898	724	729	830	683	740	2000	1200	e295	1370	1150
24	740	860	733	730	805	654	847	2480	1130	287	1090	1090
25	776	878	747	724	773	693	972	3060	1070	283	955	1030
26	820	864	741	738	775	668	877	2620	976	249	794	966
27	729	867	726	728	743	699	760	2410	887	241	652	930
28	770	877	779	742	831	721	793	2190	762	e214	553	1060
29	813	865	707	757	---	680	711	2360	694	e206	e454	2850
30	795	851	701	759	---	695	731	2370	669	e198	e400	2250
31	808	---	694	738	---	673	---	1720	---	192	e350	---
TOTAL	23184	27024	24322	22532	20869	22035	18039	51341	59928	25271	22854	25295
MEAN	748	901	785	727	745	711	601	1656	1998	815	737	843
MAX	975	1010	941	810	831	876	972	3060	3870	2120	3600	2850
MIN	471	775	679	661	663	634	389	851	669	192	109	320
AC-FT	45990	53600	48240	44690	41390	43710	35780	101800	118900	50130	45330	50170

CAL YR 1989 TOTAL 372408 MEAN 1020 MAX 2500 MIN 251 AC-FT 738700

WTR YR 1990 TOTAL 342694 MEAN 939 MAX 3870 MIN 109 AC-FT 679700

e Estimated

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1820	1070	1060	966	764	1010	935	2080	3340	1360	434	275
2	1610	1150	1130	978	792	e1220	993	2890	2910	1310	e398	283
3	1610	1500	1150	1040	811	1090	1060	2610	2680	1080	e409	273

4	1700	1440	1100	1150	811	1050	1180	2190	2510	949	500	273				
5	1580	1210	1090	1360	826	1030	1290	1930	2380	878	766	392				
6	1450	1090	1090	1260	858	1270	1420	1740	2260	863	719	840				
7	1270	1100	1050	1360	962	1260	1900	2570	2450	845	961	2300				
8	1320	1190	1050	1360	1130	1000	2250	3520	2750	743	1150	2380				
9	1250	1140	1070	1220	1250	963	e2110	3830	2950	751	730	2390				
10	1250	1070	1070	1180	1130	915	e1920	4620	3310	957	457	1980				
11	1200	1040	1060	1120	1160	903	e1640	4560	2890	928	465	2520				
12	1160	1090	992	1070	1320	906	1690	4660	2910	730	669	3890				
13	1250	1130	1080	1070	1520	948	1550	4440	3070	674	623	3350				
14	1270	1140	1070	1040	1980	962	1350	4470	3110	592	512	2890				
15	1240	1170	1030	1040	2300	978	1270	4720	3100	610	e429	2110				
16	1230	1150	1050	1070	2090	1040	1520	4560	2700	594	e349	1840				
17	1190	1150	1010	1040	1970	1070	1560	3830	2600	597	e316	1570				
18	1120	1180	996	1060	1880	1010	1570	3340	2580	678	e313	1330				
19	1110	1170	1010	1060	e1420	1000	1810	3620	2480	693	e409	1190				
20	2000	1090	1080	1060	e1150	1020	2160	4270	2450	647	e307	942				
21	2570	1070	1070	1090	e1030	1060	2150	4210	2280	553	e298	870				
22	1430	1060	1030	1020	e1030	1000	2320	4390	2280	539	279	844				
23	1250	1110	868	976	e1050	991	2470	3610	2230	557	258	e795				
24	1180	1040	744	944	e1000	997	2440	3280	1990	573	265	e749				
25	1230	1030	784	931	e952	1030	2180	2970	1830	911	279	e684				
26	1060	1050	803	944	926	1000	2060	2690	1580	852	287	e711				
27	1070	1100	882	942	902	1060	2030	2910	1530	944	275	e634				
28	1060	1060	969	962	967	1080	1910	3390	1400	828	302	e590				
29	1050	1080	1100	996	---	1070	1840	3690	1330	635	328	e564				
30	1040	1090	1090	1020	---	1010	1920	3560	1410	515	309	e601				
31	1040	---	1010	e951	---	964	---	3630	---	483	277	---				
TOTAL	41610	33960	31588	33300	34031	31907	52498	108980	73290	23869	14073	40060				
MEAN	1342	1132	1019	1074	1215	1029	1750	3515	2443	770	454	1335				
MAX	2570	1500	1150	1380	2300	1270	2470	4720	3340	1360	1150	3890				

MIN	1040	1030	744	931	764	903	935	1740	1330	483	253	273
AC-FT	62530	67360	62650	66050	67500	63290	104100	216200	145400	47340	27910	79460

CAL YR 1990 TOTAL 375322 MEAN 1028 MAX 3370 MIN 109 AC-FT 744500
WTR YR 1991 TOTAL 519166 MEAN 1422 MAX 4720 MIN 258 AC-FT 1030000

e Estimated

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS
LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4846.68 STATE 35 COUNTY 045
from isco flow meter
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	711	1020	1060	1050	1180	1060	1930	5130	7240	2380	867	1570
2	667	1050	1050	963	1240	1110	2190	5370	6950	2100	697	1160
3	604	1000	1080	845	1540	1170	1940	5300	6640	1750	703	1010
4	588	985	1110	821	1630	1560	1780	5240	6480	1600	594	991
5	532	1010	1080	910	1640	1420	1770	5080	6400	1470	579	924
6	553	1120	1090	929	1370	1420	1860	5200	6910	1440	566	821
7	625	1200	1070	1050	1340	1340	2020	5630	7060	1370	595	808
8	659	1130	1110	891	1260	1290	2280	5760	7020	1360	557	723
9	621	1350	1100	888	1210	1350	2390	5710	6720	1400	564	670
10	592	1350	1090	806	1310	1190	2460	6950	6120	1500	540	521
11	601	1500	1200	788	1450	1150	2560	6030	5540	1480	514	565
12	608	1860	1520	780	1490	1060	2580	5700	5070	1620	515	537
13	651	1620	2100	809	1470	1070	2650	5510	4800	2840	525	523
14	660	1420	1550	856	1660	1130	2880	5540	5020	2370	506	597
15	633	1640	1310	854	1790	1220	3060	5730	4870	1760	479	596
16	606	2510	1040	812	1390	1260	3350	5700	4190	1210	494	603
17	580	2730	956	819	1260	1260	3940	5540	3620	1020	472	572

18	596	2680	1090	866	1160	1260	4640	5560	3480	773	436	558
19	625	2670	1290	925	1050	1260	5120	5590	3490	655	378	963
20	632	2250	1420	903	1050	1150	4970	5730	3600	648	348	1890
21	629	1780	1300	901	972	1270	4770	7100	3580	585	328	1960
22	610	1170	1240	881	883	1250	4620	7900	3540	505	326	1590
23	626	1070	1070	856	1220	1290	4620	7330	3440	548	363	1330
24	673	1050	967	892	1290	1200	4490	7020	3240	685	1140	1060
25	755	1050	900	849	1120	1150	3870	7390	3150	1210	3300	1000
26	752	1000	868	867	1020	1090	3760	7570	3060	3090	2970	884
27	733	1000	868	957	990	1190	3860	8190	3010	2860	2530	925
28	894	1010	857	994	971	1310	4070	9290	2970	2330	2120	916
29	1050	958	870	952	1040	1470	4490	8970	2800	1730	1660	934
30	1060	1010	992	1040	---	1480	4950	8130	2690	1430	1240	756
31	1060	---	1040	1120	---	1580	---	7590	---	1020	1360	---
TOTAL	21186	43253	35280	27894	36996	39010	99870	198480	142700	46739	28256	28057
MEAN	683	1442	1138	900	1276	1258	3329	6403	4757	1508	911	935
MAX	1060	2730	2100	1120	1790	1580	5120	9290	7240	3090	3300	1960
MIN	532	958	857	780	883	1060	1770	5080	2690	505	326	523
AC-FT	42020	85790	69990	55330	73380	77380	198100	393700	283000	92710	56050	55650

CAL YR 1991 TOTAL 511735 MEAN 1402 MAX 4720 MIN 258 AC-FT 1015000

WTR YR 1992 TOTAL 747729 MEAN 2043 MAX 9290 MIN 326 AC-FT 1483000

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

from isco flow meter

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	781	1120	907	e875	897	3500	5450	7510	6340	4130	632	3410
2	759	1100	918	e895	902	3740	5450	7130	9300	3870	596	2050

3	741	1030	965	e920	873	4030	5580	6720	9470	3390	544	1660			
4	709	1010	969	945	815	4210	5660	6650	9130	3220	544	1320			
5	687	974	1000	911	812	4290	5730	6750	7780	2880	485	1210			
6	658	949	971	863	822	4400	5890	6490	6870	2290	465	1120			
7	654	888	939	969	778	4490	5840	6160	6660	2120	484	990			
8	634	904	922	1780	900	4570	5720	5950	6410	2120	474	903			
9	616	907	953	3040	1110	4590	5610	5770	6120	2180	480	821			
10	704	918	929	1810	1230	4670	5590	5480	5830	2060	501	700			
11	684	993	911	1030	1170	4940	5690	4910	5770	1940	515	683			
12	687	951	911	1100	1130	5300	5880	4620	5850	1810	526	619			
13	708	879	938	957	1070	5200	5910	4780	6440	1640	581	1150			
14	644	860	990	897	1040	4900	5820	5060	7690	1520	1290	2200			
15	604	844	959	846	978	4720	5720	5630	8820	1400	1530	1680			
16	713	855	956	888	990	4960	5740	6130	9200	1300	1240	1270			
17	788	855	894	1120	991	5280	5800	6400	9550	1230	687	1170			
18	785	857	e884	1690	932	5240	5780	6360	9130	1100	752	1090			
19	767	874	e875	2450	938	5650	5910	5650	6620	1050	673	1000			
20	770	921	e840	2300	1160	5480	5920	5570	5570	948	662	972			
21	760	943	e810	1620	2250	5350	5600	5650	5900	819	760	842			
22	794	930	e790	1340	1650	5450	5880	6280	6580	798	1330	746			
23	803	974	e810	1150	1620	5540	6120	6590	6520	725	1350	706			
24	765	947	e800	1040	2150	5580	6480	6010	5940	695	956	643			
25	740	931	e820	946	2740	5780	6560	5810	5440	685	718	632			
26	814	877	e825	883	3060	5990	6340	6100	5060	758	603	660			
27	881	849	e870	813	3320	6330	6320	6930	4980	717	795	606			
28	896	887	e930	822	3450	6460	6620	8860	4890	669	2040	581			
29	950	879	e960	835	---	6100	6930	9830	4590	614	4010	606			
30	1070	869	e965	856	---	5760	7350	8390	4230	637	3510	620			
31	1090	---	e900	863	---	5560	---	7810	---	628	2690	---			
TOTAL	23656	27775	28111	37759	40028	158060	179090	198000	204480	49943	32823	32663			
MEAN	763	926	907	1218	1430	5099	5970	6387	6816	1611	1059	1089			

MAX	1090	1120	1000	3040	3450	6460	7350	9830	9550	4130	4010	5410
MIN	604	844	790	813	778	3500	5450	4620	4230	614	465	581
AC-FT	46920	55090	55760	74890	79400	313500	355200	392700	405600	99060	65100	64790

CAL YR 1992 TOTAL 727544 MEAN 1988 MAX 9290 MIN 326 AC-FT 1443000
WTR YR 1993 TOTAL 1012388 MEAN 2774 MAX 9830 MIN 465 AC-FT 2008000

e Estimated

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS
LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4843.68 STATE 35 COUNTY 045
from isco flow meter
DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1993 TO SEPTEMBER 1994
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	642	951	1180	1140	816	1310	578	1270	8170	3990	e340	e350
2	614	934	1170	1170	e840	1250	561	1230	8240	3860	e310	e450
3	577	908	1160	1220	e860	1160	571	1570	8460	3820	e280	e680
4	589	1070	1130	1180	920	1160	568	2170	8630	3760	e280	e1700
5	593	1180	1110	1160	994	1120	596	2330	9160	3730	e300	e1500
6	648	1180	1130	1130	970	1070	590	2870	8750	3560	e340	e1300
7	859	1140	1130	1150	936	1020	556	3660	8330	3330	e400	e1000
8	1210	1160	1140	1120	921	969	514	3830	7940	2650	e500	e800
9	1140	1240	1140	1130	949	965	604	3810	7560	2530	e520	e720
10	1120	1220	1140	1140	895	856	661	3880	7400	2410	e500	e680
11	1090	1250	1170	1130	870	804	617	3640	7280	2410	e440	e640
12	1120	1610	1190	1130	873	797	561	4120	7060	2220	e420	e620
13	1220	1390	1170	1130	856	781	553	4680	6540	2390	e580	e600
14	1250	1460	1160	1160	827	769	524	5010	6470	2220	e470	e1300
15	1240	1420	1190	1110	782	756	503	5080	6510	1920	e580	e1900
16	1130	1350	1190	1100	736	754	521	5520	6320	1790	e1200	e1600

17	1000	1340	1160	1100	751	741	525	5640	6070	e1600	e1000	e1200
18	1160	1300	1130	1090	766	757	547	6000	5970	e1450	e800	e1100
19	1070	1270	1160	1060	934	800	774	5960	5910	e1400	e600	e1020
20	1050	1240	1150	1080	883	832	968	5860	5910	e1400	e640	e1000
21	1010	1240	1120	1090	799	867	1110	5800	5550	e1300	e560	e960
22	1010	1230	1120	1100	769	878	1120	5490	5700	e1200	e490	e960
23	1010	1230	1110	1170	732	806	1350	5610	5970	e1100	e480	e1000
24	971	1270	1120	1190	766	820	1510	6020	5400	e1000	e450	e900
25	945	1190	1090	1000	803	817	1580	6770	5060	e930	e420	e820
26	952	1150	e1110	819	750	842	1640	7270	4820	e910	e400	e760
27	999	1120	e1120	854	842	829	1570	5810	4640	e820	e390	e720
28	1030	1240	e1140	867	1090	914	1460	5810	4490	e720	e370	e700
29	933	1220	e1150	837	---	811	1410	6330	4320	e630	e360	e720
30	946	1180	e1140	823	---	720	1390	7050	4270	e540	e360	e600
31	966	---	e1140	771	---	592	---	7850	---	e460	e350	---
TOTAL	30094	36683	35460	33171	23930	27467	26052	148140	196900	62250	15130	28700
MEAN	971	1223	1144	1070	855	886	868	4779	6563	2008	488	957
MAX	1250	1610	1190	1220	1090	1310	1640	7850	9120	3990	1200	1900
MIN	577	908	1090	771	732	592	503	1230	4270	460	280	350
AC-FT	59690	72760	70330	65790	47470	54480	51670	293800	390600	123500	30010	56930

CAL YR 1993 TOTAL 1035063 MEAN 2836 MAX 9830 MIN 465 AC-FT 2053000

WTR YR 1994 TOTAL 663977 MEAN 1819 MAX 9160 MIN 280 AC-FT 1317000

e Estimated

1 UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 01/29/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS

LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045

PROVISIONAL DATA from isco flow meter SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1994 TO SEPTEMBER 1995

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP

1	1070	993	861	989	867	e1210	2620	4140	6190	7270	1690	1480				
2	1040	906	871	939	872	1450	2570	4250	6310	7870	1610	1310				
3	1020	923	884	916	904	1620	2550	4220	7070	7690	1540	1170				
4	836	1090	868	854	898	1750	2870	4530	7540	7210	1470	1100				
5	774	1020	860	954	937	2670	3040	4660	7780	6240	1380	972				
6	859	950	1190	995	976	4300	3120	4990	6110	5330	1420	885				
7	877	916	1460	933	1010	6510	3290	5180	6980	5410	1340	849				
8	854	876	1150	909	1040	2020	3370	5380	9170	5840	1290	821				
9	792	887	1070	944	1020	1410	3490	5460	8420	5670	1150	2500				
10	822	866	910	936	968	2270	3680	5650	7980	6000	1120	2270				
11	816	843	855	913	962	2450	3480	5860	7890	6140	1140	2010				
12	791	1260	886	950	914	2590	3250	5930	8310	5630	1230	1450				
13	732	2330	904	969	888	2880	3120	5850	9310	5190	1300	1360				
14	752	1360	894	912	907	2830	3070	5690	10300	4780	1370	1260				
15	1430	1140	926	867	1100	2830	3160	5510	10800	4170	1280	1080				
16	1490	1060	918	882	1810	2870	3250	5670	11200	3490	1110	1060				
17	1390	999	851	886	1420	3000	3220	6280	11700	3510	1010	1110				
18	1530	963	868	882	1140	3110	3250	6650	11100	3490	981	983				
19	1250	958	891	838	1070	3140	3250	6480	11700	3160	969	890				
20	1050	933	895	798	1040	3240	3330	6510	10200	3320	1140	810				
21	974	926	888	320	1040	3220	3690	6640	10200	3360	1320	819				
22	954	931	891	851	1080	3210	4050	7140	10300	3020	1460	789				
23	1000	896	910	845	e1090	3300	4070	7600	10100	2750	1610	803				
24	1030	876	942	781	e1100	3220	3820	7820	9780	2560	1650	821				
25	1070	848	940	807	e1140	3150	3830	7290	9280	2230	1800	838				
26	1060	861	994	924 √	e1160	3040	3930	6800	9380	2090	1820	817				
27	1020	868	982	1000	e1180	2940	3880	6430	9090	2030	1880	819				
28	1000	849	959	979 √	e1180	2840	3970	6330	8740	2000	2190	870				
29	960	853	949	943 √	---	2630	4050	6370	7520	1930	2550	979				
30	953	884	976	917 √	---	2720	4030	6520	7410	1870	2270	1110				
31	974	---	986	895 √	---	2680	---	6420	---	1340	1710	---				

TOTAL	31170	30085	29449	28008	29693	87300	102300	184250	271860	133090	45800	34035
MEAN	1005	1003	950	903	1060	2816	3410	5944	9062	4293	1477	1134
MAX	1530	2330	1480	1000	1810	6510	4070	7820	11700	7870	2550	2500
MIN	732	843	851	781	867	1210	2550	4140	6190	1840	969	789
AC-FT	61830	59670	58410	55550	58900	173200	202900	365500	539200	264000	90840	67510

CAL YR 1994 TOTAL 652444 MEAN 1788 MAX 9160 MIN 280 AC-FT 1294000

WTR YR 1995 TOTAL 1007040 MEAN 2759 MAX 11700 MIN 732 AC-FT 1997000

e Estimated

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - NEW MEXICO 08/14/96

STATION NUMBER 09368000 SAN JUAN RIVER AT SHIPROCK, NM STREAM SOURCE AGENCY USGS
LATITUDE 364732 LONGITUDE 1084354 DRAINAGE AREA 12900.00 DATUM 4848.68 STATE 35 COUNTY 045
PROVISIONAL DATA FROM DCP SUBJECT TO REVISION

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1995 TO SEPTEMBER 1996
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1240	1030	1100	810	869	707	477	666	e2100	3380	e172	---
2	1230	975	1070	806	901	754	478	745	e2590	3370	e143	---
3	1130	969	1060	775	823	754	402	810	e2710	1990	208	---
4	1030	968	1050	754	774	788	401	969	e2800	959	212	---
5	1100	970	1040	780	759	782	474	1150	e3100	825	---	---
6	1150	983	1040	864	770	740	514	1440	e3140	726	to 1000 ---	---
7	1110	1050	1110	863	763	754	503	1780	e3080	663	---	---
8	1050	1040	1080	844	771	722	516	1990	e3140	638	173	---
9	1010	1050	1070	834	804	712	544	1900	e3320	556	180	---
10	876	1050	1060	835	803	701	429	2080	e3210	566	272	---
11	871	1080	1040	768	813	712	586	1800	e3080	600	264	---
12	852	1080	1050	598	806	716	822	1890	e2930	592	225	---
13	816	1050	1020	581	801	696	741	2490	e3100	502	187	---
14	810	1040	1030	588	794	719	733	2840	e2830	519	---	---
15	821	1040	1080	591	783	773	678	2730	e3040	552	---	---
16	924	1050	1070	586	784	771	571	2840	e3080	425	---	---
17	896	1030	1010	537	789	764	404	3110	e2780	496	---	---
18	846	1040	1050	646	785	794	382	3270	e2650	745	---	---
19	847	1090	1040	611	790	765	377	3120	e2690	746	---	---
20	842	1120	1080	547	811	713	374	2970	e2540	634	---	---
21	808	1120	1110	522	736	709	357	2890	e2790	474	---	---
22	797	1100	1060	507	777	712	290	2450	e2730	411	---	---
23	932	1080	1040	520	779	683	273	2360	e2920	369	---	---
24	967	1090	1020	555	757	668	277	1760	e2950	326	---	---
25	989	1090	1020	577	724	674	256	1420	e2910	213	---	---
26	986	1090	1010	591	690	657	314	1180	e2270	187	---	---
27	1080	1090	979	801	703	638	709	1020	e2100	178	---	---
28	1050	1120	851	840	703	584	949	860	e2250	168	---	---
29	1020	1100	752	862	701	552	1080	1270	e1900	e171	---	---
30	1020	1090	759	866	---	499	877	1610	e1590	e153	---	---
31	1020	---	795	875	---	486	---	1950	---	e180	---	---
TOTAL	30120	31675	31545	21734	22563	21699	15788	59360	82320	22314	---	---
MEAN	972	1056	1018	701	778	700	526	1915	2744	720	---	---
MAX	1240	1120	1110	875	901	794	1080	3270	3320	3380	---	---
MIN	797	968	752	507	690	486	256	666	1590	153	---	---
AC-FT	59740	62830	62570	43110	44750	43040	31320	117700	163300	44260	---	---

CAL YR 1995 TOTAL 1009676 MEAN 2766 MAX 11700 MIN 752 AC-FT 2003000

e Estimated

Appendix: K US Bureau of Reclamation discharges for Navajo Reservoir

11/19/96

Berndette,

I was told that you are looking for Navajo Reservoir releases for the period January 1995 to the present. Attached is a hard copy of those values. Please note that periodically we review our data and modify these number. This has not been done yet for the period of January 1995 to the present. Thus, these numbers should be considered provisional.

I can get you this data in electonic format if you need it. The best way is for me to Email it to you. I could also send you a disk, however.

Tom

Email tom@ucsun1.uc.usbr.gov
Phone 801-524-3732
Fax 801-524-5499
address Tom Ryan UC-294
Bureau of Reclamation
125 S. State Street
Salt Lake City, Ut.
84105

Navajo Reservoir Releases

01-jan-1995	504	Navajo Daily Release (CFS)
02-jan-1995	504	Navajo Daily Release (CFS)
03-jan-1995	504	Navajo Daily Release (CFS)
04-jan-1995	504	Navajo Daily Release (CFS)
05-jan-1995	504	Navajo Daily Release (CFS)
06-jan-1995	504	Navajo Daily Release (CFS)
07-jan-1995	504	Navajo Daily Release (CFS)
08-jan-1995	504	Navajo Daily Release (CFS)
09-jan-1995	504	Navajo Daily Release (CFS)
10-jan-1995	504	Navajo Daily Release (CFS)
11-jan-1995	504	Navajo Daily Release (CFS)
12-jan-1995	504	Navajo Daily Release (CFS)
13-jan-1995	504	Navajo Daily Release (CFS)
14-jan-1995	504	Navajo Daily Release (CFS)
15-jan-1995	504	Navajo Daily Release (CFS)
16-jan-1995	504	Navajo Daily Release (CFS)
17-jan-1995	504	Navajo Daily Release (CFS)
18-jan-1995	504	Navajo Daily Release (CFS)
19-jan-1995	504	Navajo Daily Release (CFS)
20-jan-1995	504	Navajo Daily Release (CFS)
21-jan-1995	504	Navajo Daily Release (CFS)
22-jan-1995	504	Navajo Daily Release (CFS)
23-jan-1995	504	Navajo Daily Release (CFS)
24-jan-1995	504	Navajo Daily Release (CFS)
25-jan-1995	504	Navajo Daily Release (CFS)
26-jan-1995	504	Navajo Daily Release (CFS)
27-jan-1995	504	Navajo Daily Release (CFS)
28-jan-1995	504	Navajo Daily Release (CFS)
29-jan-1995	504	Navajo Daily Release (CFS)
30-jan-1995	504	Navajo Daily Release (CFS)
31-jan-1995	504	Navajo Daily Release (CFS)
01-feb-1995	504	Navajo Daily Release (CFS)
02-feb-1995	504	Navajo Daily Release (CFS)
03-feb-1995	504	Navajo Daily Release (CFS)
04-feb-1995	504	Navajo Daily Release (CFS)
05-feb-1995	504	Navajo Daily Release (CFS)
06-feb-1995	504	Navajo Daily Release (CFS)
07-feb-1995	504	Navajo Daily Release (CFS)
08-feb-1995	504	Navajo Daily Release (CFS)
09-feb-1995	504	Navajo Daily Release (CFS)
10-feb-1995	504	Navajo Daily Release (CFS)
11-feb-1995	504	Navajo Daily Release (CFS)
12-feb-1995	504	Navajo Daily Release (CFS)
13-feb-1995	504	Navajo Daily Release (CFS)
14-feb-1995	504	Navajo Daily Release (CFS)
15-feb-1995	504	Navajo Daily Release (CFS)
16-feb-1995	504	Navajo Daily Release (CFS)
17-feb-1995	504	Navajo Daily Release (CFS)
18-feb-1995	504	Navajo Daily Release (CFS)
19-feb-1995	504	Navajo Daily Release (CFS)
20-feb-1995	504	Navajo Daily Release (CFS)
21-feb-1995	504	Navajo Daily Release (CFS)
22-feb-1995	504	Navajo Daily Release (CFS)
23-feb-1995	504	Navajo Daily Release (CFS)
24-feb-1995	504	Navajo Daily Release (CFS)
25-feb-1995	504	Navajo Daily Release (CFS)
26-feb-1995	504	Navajo Daily Release (CFS)
27-feb-1995	504	Navajo Daily Release (CFS)

28-feb-1995	504	Navajo Daily Release (CFS)
01-mar-1995	504	Navajo Daily Release (CFS)
02-mar-1995	504	Navajo Daily Release (CFS)
03-mar-1995	504	Navajo Daily Release (CFS)
04-mar-1995	504	Navajo Daily Release (CFS)
05-mar-1995	504	Navajo Daily Release (CFS)
06-mar-1995	504	Navajo Daily Release (CFS)
07-mar-1995	504	Navajo Daily Release (CFS)
08-mar-1995	810	Navajo Daily Release (CFS)
09-mar-1995	1596	Navajo Daily Release (CFS)
10-mar-1995	1999	Navajo Daily Release (CFS)
11-mar-1995	2016	Navajo Daily Release (CFS)
12-mar-1995	2016	Navajo Daily Release (CFS)
13-mar-1995	2016	Navajo Daily Release (CFS)
14-mar-1995	2016	Navajo Daily Release (CFS)
15-mar-1995	2016	Navajo Daily Release (CFS)
16-mar-1995	2016	Navajo Daily Release (CFS)
17-mar-1995	2016	Navajo Daily Release (CFS)
18-mar-1995	2016	Navajo Daily Release (CFS)
19-mar-1995	2016	Navajo Daily Release (CFS)
20-mar-1995	2016	Navajo Daily Release (CFS)
21-mar-1995	2016	Navajo Daily Release (CFS)
22-mar-1995	2016	Navajo Daily Release (CFS)
23-mar-1995	2016	Navajo Daily Release (CFS)
24-mar-1995	2016	Navajo Daily Release (CFS)
25-mar-1995	2016	Navajo Daily Release (CFS)
26-mar-1995	2016	Navajo Daily Release (CFS)
27-mar-1995	2016	Navajo Daily Release (CFS)
28-mar-1995	2016	Navajo Daily Release (CFS)
29-mar-1995	2016	Navajo Daily Release (CFS)
30-mar-1995	2016	Navajo Daily Release (CFS)
31-mar-1995	2016	Navajo Daily Release (CFS)
01-apr-1995	2016	Navajo Daily Release (CFS)
02-apr-1995	2016	Navajo Daily Release (CFS)
03-apr-1995	2487	Navajo Daily Release (CFS)
04-apr-1995	2520	Navajo Daily Release (CFS)
05-apr-1995	2520	Navajo Daily Release (CFS)
06-apr-1995	2520	Navajo Daily Release (CFS)
07-apr-1995	2520	Navajo Daily Release (CFS)
08-apr-1995	2520	Navajo Daily Release (CFS)
09-apr-1995	2520	Navajo Daily Release (CFS)
10-apr-1995	2520	Navajo Daily Release (CFS)
11-apr-1995	2520	Navajo Daily Release (CFS)
12-apr-1995	2520	Navajo Daily Release (CFS)
13-apr-1995	2520	Navajo Daily Release (CFS)
14-apr-1995	2520	Navajo Daily Release (CFS)
15-apr-1995	2520	Navajo Daily Release (CFS)
16-apr-1995	2520	Navajo Daily Release (CFS)
17-apr-1995	2520	Navajo Daily Release (CFS)
18-apr-1995	2520	Navajo Daily Release (CFS)
19-apr-1995	2520	Navajo Daily Release (CFS)
20-apr-1995	3021	Navajo Daily Release (CFS)
21-apr-1995	3024	Navajo Daily Release (CFS)
22-apr-1995	3024	Navajo Daily Release (CFS)
23-apr-1995	3024	Navajo Daily Release (CFS)
24-apr-1995	3495	Navajo Daily Release (CFS)
25-apr-1995	3529	Navajo Daily Release (CFS)
26-apr-1995	3529	Navajo Daily Release (CFS)
27-apr-1995	3529	Navajo Daily Release (CFS)
28-apr-1995	3529	Navajo Daily Release (CFS)

29-apr-1995	3529	Navajo Daily Release (CFS)
30-apr-1995	3529	Navajo Daily Release (CFS)
01-may-1995	3529	Navajo Daily Release (CFS)
02-may-1995	3629	Navajo Daily Release (CFS)
03-may-1995	3730	Navajo Daily Release (CFS)
04-may-1995	3831	Navajo Daily Release (CFS)
05-may-1995	3932	Navajo Daily Release (CFS)
06-may-1995	3932	Navajo Daily Release (CFS)
07-may-1995	3932	Navajo Daily Release (CFS)
08-may-1995	4033	Navajo Daily Release (CFS)
09-may-1995	4134	Navajo Daily Release (CFS)
10-may-1995	4234	Navajo Daily Release (CFS)
11-may-1995	4335	Navajo Daily Release (CFS)
12-may-1995	4436	Navajo Daily Release (CFS)
13-may-1995	4436	Navajo Daily Release (CFS)
14-may-1995	4436	Navajo Daily Release (CFS)
15-may-1995	4537	Navajo Daily Release (CFS)
16-may-1995	4638	Navajo Daily Release (CFS)
17-may-1995	4739	Navajo Daily Release (CFS)
18-may-1995	4839	Navajo Daily Release (CFS)
19-may-1995	4940	Navajo Daily Release (CFS)
20-may-1995	4940	Navajo Daily Release (CFS)
21-may-1995	4940	Navajo Daily Release (CFS)
22-may-1995	5041	Navajo Daily Release (CFS)
23-may-1995	5041	Navajo Daily Release (CFS)
24-may-1995	5041	Navajo Daily Release (CFS)
25-may-1995	5041	Navajo Daily Release (CFS)
26-may-1995	5041	Navajo Daily Release (CFS)
27-may-1995	5041	Navajo Daily Release (CFS)
28-may-1995	5041	Navajo Daily Release (CFS)
29-may-1995	5041	Navajo Daily Release (CFS)
30-may-1995	5041	Navajo Daily Release (CFS)
31-may-1995	5041	Navajo Daily Release (CFS)
01-jun-1995	5041	Navajo Daily Release (CFS)
02-jun-1995	5041	Navajo Daily Release (CFS)
03-jun-1995	5041	Navajo Daily Release (CFS)
04-jun-1995	5041	Navajo Daily Release (CFS)
05-jun-1995	5041	Navajo Daily Release (CFS)
06-jun-1995	5041	Navajo Daily Release (CFS)
07-jun-1995	5041	Navajo Daily Release (CFS)
08-jun-1995	5041	Navajo Daily Release (CFS)
09-jun-1995	5041	Navajo Daily Release (CFS)
10-jun-1995	5041	Navajo Daily Release (CFS)
11-jun-1995	5041	Navajo Daily Release (CFS)
12-jun-1995	5041	Navajo Daily Release (CFS)
13-jun-1995	5041	Navajo Daily Release (CFS)
14-jun-1995	4940	Navajo Daily Release (CFS)
15-jun-1995	4839	Navajo Daily Release (CFS)
16-jun-1995	4739	Navajo Daily Release (CFS)
17-jun-1995	4739	Navajo Daily Release (CFS)
18-jun-1995	4739	Navajo Daily Release (CFS)
19-jun-1995	4537	Navajo Daily Release (CFS)
20-jun-1995	4436	Navajo Daily Release (CFS)
21-jun-1995	4335	Navajo Daily Release (CFS)
22-jun-1995	4134	Navajo Daily Release (CFS)
23-jun-1995	4033	Navajo Daily Release (CFS)
24-jun-1995	4033	Navajo Daily Release (CFS)
25-jun-1995	4033	Navajo Daily Release (CFS)
26-jun-1995	3562	Navajo Daily Release (CFS)
27-jun-1995	3226	Navajo Daily Release (CFS)

28-jun-1995	3024	Navajo Daily Release (CFS)
29-jun-1995	2823	Navajo Daily Release (CFS)
30-jun-1995	2419	Navajo Daily Release (CFS)
01-jul-1995	2419	Navajo Daily Release (CFS)
02-jul-1995	2419	Navajo Daily Release (CFS)
03-jul-1995	2419	Navajo Daily Release (CFS)
04-jul-1995	2419	Navajo Daily Release (CFS)
05-jul-1995	2218	Navajo Daily Release (CFS)
06-jul-1995	1923	Navajo Daily Release (CFS)
07-jul-1995	1529	Navajo Daily Release (CFS)
08-jul-1995	1209	Navajo Daily Release (CFS)
09-jul-1995	1209	Navajo Daily Release (CFS)
10-jul-1995	1109	Navajo Daily Release (CFS)
11-jul-1995	1008	Navajo Daily Release (CFS)
12-jul-1995	907	Navajo Daily Release (CFS)
13-jul-1995	806	Navajo Daily Release (CFS)
14-jul-1995	806	Navajo Daily Release (CFS)
15-jul-1995	806	Navajo Daily Release (CFS)
16-jul-1995	806	Navajo Daily Release (CFS)
17-jul-1995	806	Navajo Daily Release (CFS)
18-jul-1995	806	Navajo Daily Release (CFS)
19-jul-1995	806	Navajo Daily Release (CFS)
20-jul-1995	806	Navajo Daily Release (CFS)
21-jul-1995	806	Navajo Daily Release (CFS)
22-jul-1995	806	Navajo Daily Release (CFS)
23-jul-1995	806	Navajo Daily Release (CFS)
24-jul-1995	806	Navajo Daily Release (CFS)
25-jul-1995	806	Navajo Daily Release (CFS)
26-jul-1995	806	Navajo Daily Release (CFS)
27-jul-1995	806	Navajo Daily Release (CFS)
28-jul-1995	806	Navajo Daily Release (CFS)
29-jul-1995	806	Navajo Daily Release (CFS)
30-jul-1995	806	Navajo Daily Release (CFS)
31-jul-1995	806	Navajo Daily Release (CFS)
01-aug-1995	806	Navajo Daily Release (CFS)
02-aug-1995	806	Navajo Daily Release (CFS)
03-aug-1995	806	Navajo Daily Release (CFS)
04-aug-1995	806	Navajo Daily Release (CFS)
05-aug-1995	806	Navajo Daily Release (CFS)
06-aug-1995	806	Navajo Daily Release (CFS)
07-aug-1995	806	Navajo Daily Release (CFS)
08-aug-1995	806	Navajo Daily Release (CFS)
09-aug-1995	806	Navajo Daily Release (CFS)
10-aug-1995	806	Navajo Daily Release (CFS)
11-aug-1995	806	Navajo Daily Release (CFS)
12-aug-1995	806	Navajo Daily Release (CFS)
13-aug-1995	806	Navajo Daily Release (CFS)
14-aug-1995	806	Navajo Daily Release (CFS)
15-aug-1995	806	Navajo Daily Release (CFS)
16-aug-1995	806	Navajo Daily Release (CFS)
17-aug-1995	806	Navajo Daily Release (CFS)
18-aug-1995	806	Navajo Daily Release (CFS)
19-aug-1995	806	Navajo Daily Release (CFS)
20-aug-1995	806	Navajo Daily Release (CFS)
21-aug-1995	806	Navajo Daily Release (CFS)
22-aug-1995	806	Navajo Daily Release (CFS)
23-aug-1995	806	Navajo Daily Release (CFS)
24-aug-1995	806	Navajo Daily Release (CFS)
25-aug-1995	806	Navajo Daily Release (CFS)
26-aug-1995	806	Navajo Daily Release (CFS)

27-aug-1995	806	Navajo Daily Release (CFS)
28-aug-1995	806	Navajo Daily Release (CFS)
29-aug-1995	806	Navajo Daily Release (CFS)
30-aug-1995	806	Navajo Daily Release (CFS)
31-aug-1995	806	Navajo Daily Release (CFS)
01-sep-1995	806	Navajo Daily Release (CFS)
02-sep-1995	806	Navajo Daily Release (CFS)
03-sep-1995	806	Navajo Daily Release (CFS)
04-sep-1995	806	Navajo Daily Release (CFS)
05-sep-1995	806	Navajo Daily Release (CFS)
06-sep-1995	806	Navajo Daily Release (CFS)
07-sep-1995	806	Navajo Daily Release (CFS)
08-sep-1995	806	Navajo Daily Release (CFS)
09-sep-1995	806	Navajo Daily Release (CFS)
10-sep-1995	806	Navajo Daily Release (CFS)
11-sep-1995	806	Navajo Daily Release (CFS)
12-sep-1995	806	Navajo Daily Release (CFS)
13-sep-1995	806	Navajo Daily Release (CFS)
14-sep-1995	806	Navajo Daily Release (CFS)
15-sep-1995	806	Navajo Daily Release (CFS)
16-sep-1995	806	Navajo Daily Release (CFS)
17-sep-1995	806	Navajo Daily Release (CFS)
18-sep-1995	806	Navajo Daily Release (CFS)
19-sep-1995	806	Navajo Daily Release (CFS)
20-sep-1995	806	Navajo Daily Release (CFS)
21-sep-1995	806	Navajo Daily Release (CFS)
22-sep-1995	806	Navajo Daily Release (CFS)
23-sep-1995	806	Navajo Daily Release (CFS)
24-sep-1995	806	Navajo Daily Release (CFS)
25-sep-1995	806	Navajo Daily Release (CFS)
26-sep-1995	806	Navajo Daily Release (CFS)
27-sep-1995	806	Navajo Daily Release (CFS)
28-sep-1995	806	Navajo Daily Release (CFS)
29-sep-1995	806	Navajo Daily Release (CFS)
30-sep-1995	806	Navajo Daily Release (CFS)
01-oct-1995	806	Navajo Daily Release (CFS)
02-oct-1995	806	Navajo Daily Release (CFS)
03-oct-1995	806	Navajo Daily Release (CFS)
04-oct-1995	806	Navajo Daily Release (CFS)
05-oct-1995	806	Navajo Daily Release (CFS)
06-oct-1995	806	Navajo Daily Release (CFS)
07-oct-1995	806	Navajo Daily Release (CFS)
08-oct-1995	806	Navajo Daily Release (CFS)
09-oct-1995	806	Navajo Daily Release (CFS)
10-oct-1995	806	Navajo Daily Release (CFS)
11-oct-1995	806	Navajo Daily Release (CFS)
12-oct-1995	806	Navajo Daily Release (CFS)
13-oct-1995	806	Navajo Daily Release (CFS)
14-oct-1995	806	Navajo Daily Release (CFS)
15-oct-1995	806	Navajo Daily Release (CFS)
16-oct-1995	806	Navajo Daily Release (CFS)
17-oct-1995	806	Navajo Daily Release (CFS)
18-oct-1995	806	Navajo Daily Release (CFS)
19-oct-1995	806	Navajo Daily Release (CFS)
20-oct-1995	806	Navajo Daily Release (CFS)
21-oct-1995	806	Navajo Daily Release (CFS)
22-oct-1995	806	Navajo Daily Release (CFS)
23-oct-1995	806	Navajo Daily Release (CFS)
24-oct-1995	806	Navajo Daily Release (CFS)
25-oct-1995	806	Navajo Daily Release (CFS)

26-oct-1995	806	Navajo Daily Release (CFS)
27-oct-1995	806	Navajo Daily Release (CFS)
28-oct-1995	806	Navajo Daily Release (CFS)
29-oct-1995	806	Navajo Daily Release (CFS)
30-oct-1995	806	Navajo Daily Release (CFS)
31-oct-1995	806	Navajo Daily Release (CFS)
01-nov-1995	806	Navajo Daily Release (CFS)
02-nov-1995	806	Navajo Daily Release (CFS)
03-nov-1995	806	Navajo Daily Release (CFS)
04-nov-1995	806	Navajo Daily Release (CFS)
05-nov-1995	806	Navajo Daily Release (CFS)
06-nov-1995	806	Navajo Daily Release (CFS)
07-nov-1995	806	Navajo Daily Release (CFS)
08-nov-1995	806	Navajo Daily Release (CFS)
09-nov-1995	806	Navajo Daily Release (CFS)
10-nov-1995	806	Navajo Daily Release (CFS)
11-nov-1995	806	Navajo Daily Release (CFS)
12-nov-1995	806	Navajo Daily Release (CFS)
13-nov-1995	806	Navajo Daily Release (CFS)
14-nov-1995	806	Navajo Daily Release (CFS)
15-nov-1995	806	Navajo Daily Release (CFS)
16-nov-1995	806	Navajo Daily Release (CFS)
17-nov-1995	806	Navajo Daily Release (CFS)
18-nov-1995	806	Navajo Daily Release (CFS)
19-nov-1995	806	Navajo Daily Release (CFS)
20-nov-1995	806	Navajo Daily Release (CFS)
21-nov-1995	806	Navajo Daily Release (CFS)
22-nov-1995	806	Navajo Daily Release (CFS)
23-nov-1995	806	Navajo Daily Release (CFS)
24-nov-1995	806	Navajo Daily Release (CFS)
25-nov-1995	806	Navajo Daily Release (CFS)
26-nov-1995	806	Navajo Daily Release (CFS)
27-nov-1995	806	Navajo Daily Release (CFS)
28-nov-1995	806	Navajo Daily Release (CFS)
29-nov-1995	806	Navajo Daily Release (CFS)
30-nov-1995	806	Navajo Daily Release (CFS)
01-dec-1995	806	Navajo Daily Release (CFS)
02-dec-1995	806	Navajo Daily Release (CFS)
03-dec-1995	806	Navajo Daily Release (CFS)
04-dec-1995	806	Navajo Daily Release (CFS)
05-dec-1995	806	Navajo Daily Release (CFS)
06-dec-1995	806	Navajo Daily Release (CFS)
07-dec-1995	806	Navajo Daily Release (CFS)
08-dec-1995	806	Navajo Daily Release (CFS)
09-dec-1995	806	Navajo Daily Release (CFS)
10-dec-1995	806	Navajo Daily Release (CFS)
11-dec-1995	806	Navajo Daily Release (CFS)
12-dec-1995	806	Navajo Daily Release (CFS)
13-dec-1995	806	Navajo Daily Release (CFS)
14-dec-1995	806	Navajo Daily Release (CFS)
15-dec-1995	806	Navajo Daily Release (CFS)
16-dec-1995	806	Navajo Daily Release (CFS)
17-dec-1995	806	Navajo Daily Release (CFS)
18-dec-1995	806	Navajo Daily Release (CFS)
19-dec-1995	806	Navajo Daily Release (CFS)
20-dec-1995	806	Navajo Daily Release (CFS)
21-dec-1995	806	Navajo Daily Release (CFS)
22-dec-1995	806	Navajo Daily Release (CFS)
23-dec-1995	806	Navajo Daily Release (CFS)
24-dec-1995	806	Navajo Daily Release (CFS)

25-dec-1995	806	Navajo Daily Release (CFS)
26-dec-1995	504	Navajo Daily Release (CFS)
27-dec-1995	504	Navajo Daily Release (CFS)
28-dec-1995	504	Navajo Daily Release (CFS)
29-dec-1995	504	Navajo Daily Release (CFS)
30-dec-1995	504	Navajo Daily Release (CFS)
31-dec-1995	504	Navajo Daily Release (CFS)
01-jan-1996	504	Navajo Daily Release (CFS)
02-jan-1996	504	Navajo Daily Release (CFS)
03-jan-1996	504	Navajo Daily Release (CFS)
04-jan-1996	504	Navajo Daily Release (CFS)
05-jan-1996	504	Navajo Daily Release (CFS)
06-jan-1996	504	Navajo Daily Release (CFS)
07-jan-1996	504	Navajo Daily Release (CFS)
08-jan-1996	504	Navajo Daily Release (CFS)
09-jan-1996	504	Navajo Daily Release (CFS)
10-jan-1996	275	Navajo Daily Release (CFS)
11-jan-1996	252	Navajo Daily Release (CFS)
12-jan-1996	252	Navajo Daily Release (CFS)
13-jan-1996	252	Navajo Daily Release (CFS)
14-jan-1996	252	Navajo Daily Release (CFS)
15-jan-1996	252	Navajo Daily Release (CFS)
16-jan-1996	252	Navajo Daily Release (CFS)
17-jan-1996	252	Navajo Daily Release (CFS)
18-jan-1996	252	Navajo Daily Release (CFS)
19-jan-1996	252	Navajo Daily Release (CFS)
20-jan-1996	252	Navajo Daily Release (CFS)
21-jan-1996	252	Navajo Daily Release (CFS)
22-jan-1996	252	Navajo Daily Release (CFS)
23-jan-1996	252	Navajo Daily Release (CFS)
24-jan-1996	252	Navajo Daily Release (CFS)
25-jan-1996	494	Navajo Daily Release (CFS)
26-jan-1996	504	Navajo Daily Release (CFS)
27-jan-1996	504	Navajo Daily Release (CFS)
28-jan-1996	504	Navajo Daily Release (CFS)
29-jan-1996	504	Navajo Daily Release (CFS)
30-jan-1996	504	Navajo Daily Release (CFS)
31-jan-1996	504	Navajo Daily Release (CFS)
01-feb-1996	504	Navajo Daily Release (CFS)
02-feb-1996	504	Navajo Daily Release (CFS)
03-feb-1996	504	Navajo Daily Release (CFS)
04-feb-1996	504	Navajo Daily Release (CFS)
05-feb-1996	504	Navajo Daily Release (CFS)
06-feb-1996	504	Navajo Daily Release (CFS)
07-feb-1996	504	Navajo Daily Release (CFS)
08-feb-1996	504	Navajo Daily Release (CFS)
09-feb-1996	504	Navajo Daily Release (CFS)
10-feb-1996	504	Navajo Daily Release (CFS)
11-feb-1996	504	Navajo Daily Release (CFS)
12-feb-1996	504	Navajo Daily Release (CFS)
13-feb-1996	504	Navajo Daily Release (CFS)
14-feb-1996	504	Navajo Daily Release (CFS)
15-feb-1996	504	Navajo Daily Release (CFS)
16-feb-1996	504	Navajo Daily Release (CFS)
17-feb-1996	504	Navajo Daily Release (CFS)
18-feb-1996	504	Navajo Daily Release (CFS)
19-feb-1996	504	Navajo Daily Release (CFS)
20-feb-1996	504	Navajo Daily Release (CFS)
21-feb-1996	504	Navajo Daily Release (CFS)
22-feb-1996	504	Navajo Daily Release (CFS)

23-feb-1996	504	Navajo Daily Release (CFS)
24-feb-1996	504	Navajo Daily Release (CFS)
25-feb-1996	504	Navajo Daily Release (CFS)
26-feb-1996	504	Navajo Daily Release (CFS)
27-feb-1996	504	Navajo Daily Release (CFS)
28-feb-1996	504	Navajo Daily Release (CFS)
29-feb-1996	504	Navajo Daily Release (CFS)
01-mar-1996	504	Navajo Daily Release (CFS)
02-mar-1996	504	Navajo Daily Release (CFS)
03-mar-1996	504	Navajo Daily Release (CFS)
04-mar-1996	504	Navajo Daily Release (CFS)
05-mar-1996	504	Navajo Daily Release (CFS)
06-mar-1996	504	Navajo Daily Release (CFS)
07-mar-1996	504	Navajo Daily Release (CFS)
08-mar-1996	504	Navajo Daily Release (CFS)
09-mar-1996	504	Navajo Daily Release (CFS)
10-mar-1996	504	Navajo Daily Release (CFS)
11-mar-1996	504	Navajo Daily Release (CFS)
12-mar-1996	504	Navajo Daily Release (CFS)
13-mar-1996	504	Navajo Daily Release (CFS)
14-mar-1996	504	Navajo Daily Release (CFS)
15-mar-1996	504	Navajo Daily Release (CFS)
16-mar-1996	504	Navajo Daily Release (CFS)
17-mar-1996	504	Navajo Daily Release (CFS)
18-mar-1996	504	Navajo Daily Release (CFS)
19-mar-1996	504	Navajo Daily Release (CFS)
20-mar-1996	504	Navajo Daily Release (CFS)
21-mar-1996	504	Navajo Daily Release (CFS)
22-mar-1996	504	Navajo Daily Release (CFS)
23-mar-1996	504	Navajo Daily Release (CFS)
24-mar-1996	504	Navajo Daily Release (CFS)
25-mar-1996	504	Navajo Daily Release (CFS)
26-mar-1996	504	Navajo Daily Release (CFS)
27-mar-1996	504	Navajo Daily Release (CFS)
28-mar-1996	504	Navajo Daily Release (CFS)
29-mar-1996	504	Navajo Daily Release (CFS)
30-mar-1996	504	Navajo Daily Release (CFS)
31-mar-1996	504	Navajo Daily Release (CFS)
01-apr-1996	504	Navajo Daily Release (CFS)
02-apr-1996	504	Navajo Daily Release (CFS)
03-apr-1996	504	Navajo Daily Release (CFS)
04-apr-1996	504	Navajo Daily Release (CFS)
05-apr-1996	504	Navajo Daily Release (CFS)
06-apr-1996	504	Navajo Daily Release (CFS)
07-apr-1996	504	Navajo Daily Release (CFS)
08-apr-1996	504	Navajo Daily Release (CFS)
09-apr-1996	504	Navajo Daily Release (CFS)
10-apr-1996	504	Navajo Daily Release (CFS)
11-apr-1996	504	Navajo Daily Release (CFS)
12-apr-1996	504	Navajo Daily Release (CFS)
13-apr-1996	504	Navajo Daily Release (CFS)
14-apr-1996	504	Navajo Daily Release (CFS)
15-apr-1996	504	Navajo Daily Release (CFS)
16-apr-1996	504	Navajo Daily Release (CFS)
17-apr-1996	504	Navajo Daily Release (CFS)
18-apr-1996	504	Navajo Daily Release (CFS)
19-apr-1996	504	Navajo Daily Release (CFS)
20-apr-1996	504	Navajo Daily Release (CFS)
21-apr-1996	504	Navajo Daily Release (CFS)
22-apr-1996	504	Navajo Daily Release (CFS)

23-apr-1996	504	Navajo Daily Release (CFS)
24-apr-1996	504	Navajo Daily Release (CFS)
25-apr-1996	504	Navajo Daily Release (CFS)
26-apr-1996	504	Navajo Daily Release (CFS)
27-apr-1996	504	Navajo Daily Release (CFS)
28-apr-1996	504	Navajo Daily Release (CFS)
29-apr-1996	504	Navajo Daily Release (CFS)
30-apr-1996	504	Navajo Daily Release (CFS)
01-may-1996	504	Navajo Daily Release (CFS)
02-may-1996	504	Navajo Daily Release (CFS)
03-may-1996	504	Navajo Daily Release (CFS)
04-may-1996	504	Navajo Daily Release (CFS)
05-may-1996	504	Navajo Daily Release (CFS)
06-may-1996	504	Navajo Daily Release (CFS)
07-may-1996	504	Navajo Daily Release (CFS)
08-may-1996	504	Navajo Daily Release (CFS)
09-may-1996	504	Navajo Daily Release (CFS)
10-may-1996	504	Navajo Daily Release (CFS)
11-may-1996	504	Navajo Daily Release (CFS)
12-may-1996	504	Navajo Daily Release (CFS)
13-may-1996	504	Navajo Daily Release (CFS)
14-may-1996	504	Navajo Daily Release (CFS)
15-may-1996	504	Navajo Daily Release (CFS)
16-may-1996	504	Navajo Daily Release (CFS)
17-may-1996	504	Navajo Daily Release (CFS)
18-may-1996	504	Navajo Daily Release (CFS)
19-may-1996	504	Navajo Daily Release (CFS)
20-may-1996	504	Navajo Daily Release (CFS)
21-may-1996	504	Navajo Daily Release (CFS)
22-may-1996	504	Navajo Daily Release (CFS)
23-may-1996	504	Navajo Daily Release (CFS)
24-may-1996	504	Navajo Daily Release (CFS)
25-may-1996	504	Navajo Daily Release (CFS)
26-may-1996	504	Navajo Daily Release (CFS)
27-may-1996	504	Navajo Daily Release (CFS)
28-may-1996	974	Navajo Daily Release (CFS)
29-may-1996	1478	Navajo Daily Release (CFS)
30-may-1996	1982	Navajo Daily Release (CFS)
31-may-1996	2487	Navajo Daily Release (CFS)
01-jun-1996	2520	Navajo Daily Release (CFS)
02-jun-1996	2520	Navajo Daily Release (CFS)
03-jun-1996	2520	Navajo Daily Release (CFS)
04-jun-1996	2520	Navajo Daily Release (CFS)
05-jun-1996	2520	Navajo Daily Release (CFS)
06-jun-1996	2520	Navajo Daily Release (CFS)
07-jun-1996	2520	Navajo Daily Release (CFS)
08-jun-1996	2520	Navajo Daily Release (CFS)
09-jun-1996	2520	Navajo Daily Release (CFS)
10-jun-1996	2520	Navajo Daily Release (CFS)
11-jun-1996	2520	Navajo Daily Release (CFS)
12-jun-1996	2520	Navajo Daily Release (CFS)
13-jun-1996	2520	Navajo Daily Release (CFS)
14-jun-1996	2520	Navajo Daily Release (CFS)
15-jun-1996	2520	Navajo Daily Release (CFS)
16-jun-1996	2520	Navajo Daily Release (CFS)
17-jun-1996	2520	Navajo Daily Release (CFS)
18-jun-1996	2520	Navajo Daily Release (CFS)
19-jun-1996	2520	Navajo Daily Release (CFS)
20-jun-1996	2520	Navajo Daily Release (CFS)
21-jun-1996	2520	Navajo Daily Release (CFS)

22-jun-1996	2520	Navajo Daily Release (CFS)
23-jun-1996	2520	Navajo Daily Release (CFS)
24-jun-1996	2134	Navajo Daily Release (CFS)
25-jun-1996	1731	Navajo Daily Release (CFS)
26-jun-1996	1327	Navajo Daily Release (CFS)
27-jun-1996	924	Navajo Daily Release (CFS)
28-jun-1996	604	Navajo Daily Release (CFS)
29-jun-1996	604	Navajo Daily Release (CFS)
30-jun-1996	604	Navajo Daily Release (CFS)
01-jul-1996	604	Navajo Daily Release (CFS)
02-jul-1996	604	Navajo Daily Release (CFS)
03-jul-1996	604	Navajo Daily Release (CFS)
04-jul-1996	604	Navajo Daily Release (CFS)
05-jul-1996	604	Navajo Daily Release (CFS)
06-jul-1996	604	Navajo Daily Release (CFS)
07-jul-1996	604	Navajo Daily Release (CFS)
08-jul-1996	604	Navajo Daily Release (CFS)
09-jul-1996	604	Navajo Daily Release (CFS)
10-jul-1996	604	Navajo Daily Release (CFS)
11-jul-1996	604	Navajo Daily Release (CFS)
12-jul-1996	604	Navajo Daily Release (CFS)
13-jul-1996	604	Navajo Daily Release (CFS)
14-jul-1996	604	Navajo Daily Release (CFS)
15-jul-1996	604	Navajo Daily Release (CFS)
16-jul-1996	604	Navajo Daily Release (CFS)
17-jul-1996	604	Navajo Daily Release (CFS)
18-jul-1996	604	Navajo Daily Release (CFS)
19-jul-1996	604	Navajo Daily Release (CFS)
20-jul-1996	604	Navajo Daily Release (CFS)
21-jul-1996	604	Navajo Daily Release (CFS)
22-jul-1996	604	Navajo Daily Release (CFS)
23-jul-1996	604	Navajo Daily Release (CFS)
24-jul-1996	604	Navajo Daily Release (CFS)
25-jul-1996	604	Navajo Daily Release (CFS)
26-jul-1996	604	Navajo Daily Release (CFS)
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16-nov-1996	302	Navajo Daily Release (CFS)
17-nov-1996	302	Navajo Daily Release (CFS)
18-nov-1996	256	Navajo Daily Release (CFS)

All data is provisional and subject to review and modification

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William X. Chavez, Jr. 11 September, 1997

Steven C

9 · 24 · 97
Date

I release this document to the New Mexico Institute of Mining and Technology.

Bernadette B Tsosie 9-10-97
Student's Signature Date