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HYDROGEOLOGIC REPORT
ENVIROCARE WASTE DISPOSAL FACILITY
SOUTH CLIVE, UTAH

Prepared for
ENVIROCARE OF UTAH
215 South State Street, Suite 1160
Salt Lake City, Utah

Prepared by
BINGHAM ENVIRONMENTAL
5160 Wiley Post Way
Salt Lake City, Utah 84116

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HYDROGEOLOGIC REPORT

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SECTION 1

INTRODUCTION

Envirocare of Utah (Envirocare) has applied for an Amendment to their Radioactive Material License to permit the handling and disposal of Low Activity Radioactive Wastes (LARW) at their South Clive Facility located in Section 32, T1S, R11W in Tooele County, Utah. As part of the permitting process Envirocare has also applied for a Groundwater Quality Discharge Permit for the proposed LARW Disposal Area. The Groundwater Quality Discharge Permit has been granted contingent on Envirocare satisfying certain compliance requirements, one of which is the preparation and submittal of a site specific Hydrogeologic Report.

This Hydrogeologic Report has been prepared to satisfy the requirements of the permit and in addition, provide detailed hydrogeologic information for all of Section 32. Envirocare proposes applying this Permit to the area identified on Figure 1, Site Map, as the LARW Disposal Cell and Future Disposal Cell Areas all located in the south part of Section 32. These two areas are defined as the Permit Area in this report.

The site is particularly suited for LARW landfills due to its remote location, relatively small amount of annual precipitation (6-inches), relatively high potential for evapotranspiration, the thick layer of low permeability clay immediately below the site, the moderate depth to groundwater and the relatively poor quality (Class IV) saline groundwater. Much of this report includes information and analyses supporting the suitability of the site.

A significant amount of hydrogeologic information is available for the site and surrounding area, and this has been supplemented with field and laboratory data collected as part of this study. The U.S. Department of Energy (DOE) collected hydrogeologic information to locate and dispose of the Vitro uranium tailing which have been placed in a disposal cell in the north central part of Section 32 as shown on Figure 1. Dames & Moore and Jacobs Engineering Group collected information for the DOE between 1982 and 1984 and most of this data is summarized in the *Disposal Site Characterization Report (1985)*. Delta

Geotechnical Consultants collected hydrogeologic information for Envirocare between 1988 and 1990 as part of the permitting process and the majority of this data is summarized in report titled *Hydrogeologic Study, Mixed Waste Landfill Cell (1989).*

In addition to the hydrogeologic information collected in Section 32, significant data has also been collected from the sections located directly west and northwest of Section 32. Aptus has performed field investigations and laboratory testing for Sections 30 and 31. Aptus kindly provided hydrogeologic information for Sections 30 and 31 to Envirocare as part of an information exchange agreement and this data has been utilized in evaluating the hydrogeology of the general area. Although the data for Section 36, which is located west of Section 30, was not requested, some of the hydrogeologic data was obtained from the Division of Solid and Hazardous Waste files.

The Hydrogeologic Report primarily addresses the hydrogeology of Section 32 and then provides detailed conclusions regarding the Permit Area. Appendix A, B and C provide field and laboratory data and Appendix D provides a summary of a contaminant transport assessment performed for the facility. A separate Report on Groundwater Modeling has been prepared which summarizes the results of unsaturated and saturated flow modeling performed as part of the permitting.

SECTION 2

GEOLOGY

2.1 REGIONAL GEOLOGY

The Envirocare Facility is located in the extreme eastern margin of the Great Salt Lake Desert which is part of the Basin and Range Province of North America. The Basin and Range topography is typified by block-faulted (normal faults) mountain ranges that generally trend north to south. This predominant geologic structural feature with its alluvial filled basins are discontinuous and were created by extensional normal faulting. The basins consist mainly of sediments originating from Quaternary lacustrine Lake Bonneville deposits and Quaternary and Tertiary colluvial and alluvial materials eroded from adjacent mountains (Stephens, 1974). The unconsolidated to semi-consolidated valley fill is generally about 800 to 1000 feet thick throughout the central portions of the valleys in the Great Salt Lake Desert (Dames & Moore, 1987).

The block faulted mountains mainly consist of Paleozoic limestones, dolomites, shales, quartzites, and sandstones. Tertiary extrusive igneous rocks of basaltic lava flows and pyroclastics are also found in isolated areas of the Great Salt Lake Desert (Stephens 1974). The valley sediments are composed of alluvial fans, evaporites and unconsolidated and semi-consolidated valley fill (Stephens, 1974).

Unconsolidated and semi-consolidated materials comprise the valley fill. These sediments consist of intercalated colluvium, alluvium, lacustrine, and fluvial deposits with some basalt flows, pyroclastics and deposits of eolian material. Generally, the colluvial and coarse alluvial deposits are near the mountain ranges where they contain a wide range of grain sizes, varying from boulders to clay. Extending to the center of the valleys the deposits grade into well sorted beds of sand and gravel interlayered with alluvial and lacustrine silt and clay. Thick beds of clay interfingered with permeable beds of sand and gravel are found at the edge of alluvial fans, which

generally fringe the mountains ranges. The alluvial fans grade laterally into fine-grained alluvium and thin toward the center of the valleys where it is present as a veneer overlying and adjacent to fine-grained Lake Bonneville lakebed deposits (Dames and Moore, 1987).

2.2 SITE GEOLOGY

The Site rests on Quaternary lakebed deposits of Lake Bonneville (Stephens, 1974) as shown on Figure 2, Geologic Map. Subsurface logs from monitor well SC-1, located in the center of Section 32, indicate that lacustrine deposits extend to at least 250 feet underneath the Site. The underlying Tertiary and Quaternary age valley fill is composed of semi-consolidated clays, sands, and gravel where it comes in contact with bedrock. Because of the lack of detailed subsurface data concerning the bedrock, the exact depth to and relationships of various bedrock units are unknown, however, the presence of nearby outcrops and the regional block-faulted basins suggest that the valley-fill deposits are relatively thin within the area of the Site. Estimated down-dip projections from a bedrock outcrop on the southwest corner of Section 31 and bedrock found at depth in monitor well MW-106 suggests that the contact may dip to the east at about three (3) degrees. A conceptual geologic cross section has been prepared as Figure 3 and reflects this projection.

The Site is located in, and is bounded by the Great Salt Lake Desert to the west at approximate elevations of 4250 to 4300 feet. Also to the west low lying hills rise 50 to 100 feet from the desert floor. To the north the Grayback Hills rise to an elevation of 4800 feet. To the east and southeast the site is bounded by the north-south trending Lone Mountains which rise to a height of 5362 feet. At the base of the Lone Mountains alluvial fans slope gently toward the west at a gradient of approximately 40 feet per mile. The Site has topographic relief of approximately 11 feet, sloping in a south-west direction at a gradient of approximately 0.0019.

To the north of the Site are the Grayback Hills, composed of Tertiary volcanic rocks, consisting mainly of basalt lava flows and pyroclastics (Stephens, 1974). To the east

and southeast is Lone Mountain which consists of Paleozoic limestones, dolomite and shale (Stephens, 1974). The mountain differs from other uplifts in the area since it is a reverse-faulted, asymmetric anticline of Laramide age (DOE 1983). These well-indurated sedimentary beds strike N12E and dip steeply 70 to 74 degrees to the west. West of the site, low hills also contain outcrops of Paleozoic limestones and dolomite (Stephens 1974).

No active Holocene faults are known to have occurred in the vicinity of the Site, (Buchnam, 1977), and (Barnard, 1988). The nearest Holocene faulting is located 18 miles north in the northwest Puddle Valley, east of the Grassy Mountains. In addition, a prominent scarp is located on the west side of the Stansbury Mountains, estimated to be 15,000 years old or greater. Most of the faulting occurred between 1 million and 25 million years ago (DOE 1983). Little active faulting occurs in the area since much of the seismic activity occurs along the Wasatch Mountain Range located over 70 miles east of the Great Salt Lake Desert. Recent seismic activity is believed to be the result of rebound from the de-watering of ancient Lake Bonneville over 15,000 years ago (Machette, 1987).

Although the Site is classified as prospectively valuable for oil and gas, no active or pending mining claims or minerals leases are located on the Site. No oil, coal, or other economic minerals are extracted here. In addition, it is unlikely that paleontological sites would occur in the area.

SECTION 3

HYDROGEOLOGY

3.1 GENERAL

The Envirocare Facility is located in the west semi-arid desert of Utah. Precipitation at the site is estimated to average six (6) inches a year based on Utah Department of Natural Resources Technical Publication No. 71 (1981) and available precipitation data in the general area. Pan evaporation at South Clive is estimated to exceed 60 inches based on information included in the Disposal Site Characterization Report. The evapotranspiration potential is therefore significantly higher than the average precipitation at the Site.

Alluvial and lacustrine sediments that fill the valley floor are estimated to extend to depths of greater than 600 feet with unconsolidated sediments ranging from 300 to over 500 feet thick below Section 32 as projected on Figure 3. North-south trending mountains and outcrops define the hydrogeologic boundaries for the aquifer system. Lone Mountain located two miles east of the Site, rises approximately 950 feet above the valley floor, the Grayback Hills located to the north and outcropping features to the west rise 500 feet and 230 feet respectively above the valley floor.

The aquifer system investigated as part of this hydrogeologic study consists of a shallow unconfined aquifer that extends through the upper 60 to 70 feet of lacustrine deposits. A confined aquifer begins around 70 to 80 foot below the ground surface and continues through the valley fill. Due to the low precipitation and relatively high evapotranspiration little or no precipitation reaches the upper unconfined aquifer as direct vertical infiltration. Groundwater recharge is primarily due to infiltration at bedrock and alluvial fan deposits which then travels laterally through the unconfined and confined aquifers. Groundwater flow in this area is generally directed northerly. Groundwater discharges by evaporation where the water table lies within a few feet

of the ground surface (near the Bonneville Salt Flats, 30 miles west of the South Clive Site). Fresh water from the recharge zones along the mountain slopes develops progressively poorer chemical quality in response to dissolution of evaporite minerals during its travel through the regional-scale flow systems and through concentration by evaporation at the points of discharge. The groundwater quality in the unconfined aquifer at the Envirocare Facility is considered saline with concentrations of several chemical species (sulfate, chloride, total dissolved solids, iron, and manganese) significantly exceeding the EPA secondary drinking water standards. The deeper confined aquifer exhibits slightly better water quality, however, it is still saline with TDS on the order of 20,000. The groundwater aquifer classification system established in the State of Utah Groundwater Quality Protection Regulations designates both the shallow and deeper aquifers as Class IV aquifers, based on TDS above 10,000 mg/l.

Four hydrostratigraphic units have been delineated in the unsaturated zone and shallow aquifer at the Envirocare Facility and they consist of an upper silty clay/clayey silt (Unit 4), an upper silty sand (Unit 3), a middle silty clay (Unit 2), and a lower sand/silty sand (Unit 1). Figures 4 through 9 are hydrogeologic cross sections that illustrate the distribution of these units beneath Sections 30, 31 and 32. Cross section locations are shown on Figure 10, Exploration Location Map. The cross sections are based on lithologies logged in monitoring wells and piezometers drilled between 1981 and 1991. It should be noted that the geologic/soil logs included on the cross sections were selected based on the perceived accuracy of the sampling and logging. Drill hole logs and monitor well completion details of recent drilling and monitor well installation, performed by Bingham Environmental, are found in Appendix A. All other previous drill hole and well completion data can be found in Delta Geotechnical's report, *Hydrogeological Study, Mixed Waste Landfill Cell* (1989) and Envirocare of Utah, *Submittal of Monitoring Well Completion Reports* (March, 1991).

3.2 UNSATURATED ZONE

Hydrostratigraphic Units 3 and 4 make up the unsaturated zone that underlies the Envirocare Facility. As shown on Figures 4 through 9, Unit 4 consists of 8 to 15 feet of relatively continuous finer grained low permeable silty clay and clay silt. Figure 11 provides an Isopach Map of Unit 4 for Section 32. Unit 3 consists of silty sand with occasional silty to sandy clay lenses. The shallow groundwater is generally encountered in Unit 3 below the western part of the Site and in Unit 2 below the eastern part of Section 32. Figure 12 provides a structural contour map for the top of Unit 2 and review of this map indicates that the top of Unit 2 slopes down from east to west. Unit 2 is above the shallow groundwater level east of the intercept line shown on Figure 12.

In order to determine the hydraulic behavior of the layered soil profile, testing for physical and unsaturated hydraulic properties were performed. Selected soil samples from Units 3 and 4 were tested for field bulk density, field water content, porosity, water retention characteristics including wetting and drying to obtain hysteresis curves and unsaturated hydraulic conductivity. Tests were preformed by Colorado State University's porous media laboratory and by Bingham's Materials Testing Laboratory. Test results along with the appropriate tables and figures are provided in Appendix B. The water retention data indicate more hysteresis for the sandy material than the clay. Coarser materials typically show a greater percentage of hysteresis than finer materials.

The curves derived from the unsaturated hydraulic conductivity tests appear to be representative of the material types tested. The clayey material exhibits a saturated hydraulic conductivity on the order of 1.9×10^{-7} cm/sec and the sandy material's saturated hydraulic conductivity was on the order of 3.5×10^{-5} to 5.6×10^{-5} cm/sec.

Soil moisture content data available from this and previous investigations was compiled on Table 6 and plotted with depth on Figure 13. Different symbols were used for each respective hydrostratigraphic unit. Unit 4 typically has moisture

contents ranging from 20 to 44 percent. Note that the silty sand (Unit 3) immediately below the upper clay has very low moisture contents, on the order of 5 to 15 percent which is an indicator that little or no moisture is infiltrating vertically from the surface. The moisture content of Unit 3 increases near and just above the groundwater table which is generally near the bottom of Unit 3.

3.3 SATURATED ZONES

The shallow saturated zone is encountered near the bottom of Unit 3 on the west side of Section 32, however, the shallow aquifer primarily consists of Unit 1 which mainly consists of a silty sand layer which is overlain by a discontinuous silty clay (Unit 2). Based on water level measurements the Unit 2 clays do not significantly influence potentiometric levels when comparing screened intervals above or below the unit. Unit 1 begins at around 60 feet below the ground surface and extends to depths of at least 150 feet with occasional silty clay layers. The hydraulic conductivity of the shallow saturated zone averages 1×10^{-4} cm/sec.

Deeper saturated zones, encountered below approximately 60 feet, exhibit higher potentiometric levels than the shallower saturated zone. This upward vertical gradient appears to occur below all of Section 32.

SECTION 4

GROUNDWATER CONDITIONS

4.1 INTRODUCTION

This section describes the existing groundwater conditions at the Envirocare Facility. The groundwater conditions are based on previously collected detailed subsurface information available for Section 32, additional hydrogeologic information collected in Section 32 as part of this study, hydrogeologic information provided by Aptus for Sections 30 and 31 and other data obtained from Utah Department of Water Resources and Department of Environmental Quality files. These data have been used to estimate rates and directions of groundwater flow in the vicinity of the Envirocare Facility.

4.2 AQUIFER SYSTEM

4.2.1 GENERAL

The aquifer system investigated in the area of the Envirocare Facility consists of unconsolidated basin-fill and alluvial-fan aquifers which extend to depths on the order of 500 feet below Section 32. The lacustrine deposits, which comprise the majority of the aquifer system below the Envirocare Facility, are somewhat variable in depth and thickness and this makes the exact delineation of aquifers and aquitards difficult. Characterization of the aquifer system as a whole is based on subsurface stratigraphy and potentiometric data. A shallow, unconfined, aquifer has been identified in the upper 20 to 70 feet separated from a deeper, confined aquifer by layers of primarily silty clay material occurring below 70 feet. Both the aquifers and aquitards are characterized by low vertical hydraulic conductivity but the aquifers have relatively high horizontal hydraulic conductivity in relation to the aquitard.

4.2.2 SHALLOW UNCONFINED AQUIFER

The shallow, unconfined aquifer consists of the upper 60 to 70 feet of lacustrine deposits. Detailed stratigraphy is provided on the hydrogeologic cross sections, Figure 4 through 9. The groundwater surface ranges from 18 to 35 feet below the ground surface and extends to depths on the order of 60 to 70 feet. The unsaturated zone consists of an upper 8 to 15 foot thick silty clay and clayey silt (Unit 4) which over lies a 10 to 20 foot thick silty sand layer (Unit 3). Below this silty sand layer the exploratory holes typically encountered a silty clay deposit (Unit 2) at variable depth and thickness. It appears that this silty clay layer is discontinuous based on the variable elevations at which it was encountered in the exploratory holes and the similar piezometric levels for wells screened above and below this silty clay layer. Unit 1, which consists of a relatively thick silty sand layer, was encountered below the silty clay unit and extends below depths ranging from 60 to 85 feet below the ground surface. Piezometric levels for wells screened in Unit 3 and the upper part of Unit 1 were similar indicating hydraulic connection between them.

The shallow aquifer contains saline water with TDS concentrations ranging from 20,000 to 60,000 mg/l which is typically classified as Class IV groundwater based on the criteria of TDS greater than 10,000 mg/l of the Utah Groundwater Quality Protection Regulations. The saline water typically exhibits a specific gravity of 1.035.

The majority of the recharge to the shallow aquifer appears to occur as vertical leakage from the deeper confined aquifer. In addition, a small amount of vertical infiltration from the surface and some lateral movement of water from the recharge zone to the east probably occurs. Movement from the shallow aquifer is primarily laterally to the north.

4.2.3 CONFINED AQUIFER

The confined aquifer consists primarily of lacustrine deposits which occur below a depth of 70 to 80 feet. This deeper aquifer primarily consists of silty sand deposits with occasional silty clay layers and is overlain by one or more silty clay layers. Wells completed with screened intervals located at least 70 to 100 feet below the ground surface have static water levels ranging from 3 to 18 inches above wells screened in the shallow unconfined aquifer.

This deeper, confined aquifer also contains saline water with TDS concentrations on the order of 20,000 mg/l which is typically classified as Class IV groundwater, however, it is generally better quality than the shallow groundwater. The deeper saline groundwater typically exhibits a specific gravity on the order of 1.019.

Recharge to the deeper confined aquifer probably occurs south and east of Section 32 in the coarser alluvial deposits adjacent to Lone Mountain.

4.3 GROUNDWATER FLOW REGIME

4.3.1 GENERAL

The groundwater flow regime at the Envirocare Facility has been evaluated and defined based on information collected from water level measurements, the aquifer hydraulic properties calculated from slug injection tests and laboratory testing and isotope dating of groundwater. Water levels obtained from the majority of the wells on three different dates in 1991 were used to develop contour maps to define the direction of groundwater flow and hydraulic gradients within the aquifers. These data were then combined with measured hydraulic conductivities to develop estimates of groundwater velocities.

The saline water exhibited specific gravities which ranged from 1.017 to 1.041 which is significantly higher than fresh water and varies considerably with depth. As indicated in a previous section of this report, the shallow groundwater exhibits an average specific gravity of 1.035 while the deeper confined groundwater exhibited a specific gravity of 1.019. Analyses indicated that density variations could result in gradients of as much as 0.2 feet from the shallow to deeper aquifer. However, fluid densities within a specific aquifer were relatively similar so no adjustments were made for specific gravity in a particular aquifer.

4.3.2 GROUNDWATER LEVELS

4.3.2.1 Shallow Monitor Well Water Levels

Characterization of the groundwater surface was based on three sets of groundwater levels measured on February 26, May 10 and October 7, 1991. The groundwater levels, which are summarized in Appendix A, were measured in the majority of the wells located in Section 32 by Bingham Environmental and in Sections 30 and 31 by Aptus personnel. Appendix A also provides tabular and graphic summaries of the recent and previous water level measurements for the shallow and deeper monitor wells. The water level measurement data was difficult to summarize due to the different datums and reference points. Review of the groundwater levels indicates that maximum water level fluctuations are on the order of 2 to 3 feet over the past 10 years. The recent wells installed by Envirocare indicate groundwater fluctuations on the order of one-half to one foot over the past one to two and one-half years. Groundwater contours for the shallow monitor wells are plotted on Figure 14 based on the February 26, 1991 measurements and on Figure 15 based on the May 10, 1991 measurements. The groundwater surface is relatively flat with elevations varying about 2 feet per mile at Section 32. In general, groundwater flows toward the

north with flows moving toward the northwest in Section 30 and toward the northeast in Section 32.

Groundwater conditions directly below the LARW Disposal Cell and the Future Disposal Cells vary slightly. The apparent direction of flow below the LARW Disposal Cell is from the southwest corner toward the northeast corner. Water levels below the Future Disposal Cells range from south to north on the east side and from south to northwest in the central and west sides. Water levels are relatively flat in the area of the Future Disposal Cell.

4.3.2.2 Deeper Monitor Well Water Levels

Figure 16 presents the piezometric surface interpreted from water levels obtained from the deeper monitor wells on February 26, 1991 and Figure 17 provides groundwater contours for the deeper confined aquifer based on measurement performed on May 10, 1991. In general, groundwater flows toward the north with flows toward the northwest in Section 30 and toward the northeast in Section 32. The greatest difference between water levels in deep and shallow monitor wells clustered at a location occurred at GW-19A and GW-19B on February 26, 1991 in which the measured elevation difference was 1.5 feet. Approximately 0.15 feet is attributed to groundwater density variations but that still results in a level 1.35 feet higher in the confined aquifer. The other clustered monitor wells exhibited lower piezometric differences compared to GW-19A and GW-19B on February 26, but this may be due to the deeper completions being partially above the confining layers and/or vertical leakage along the well bore due to a poor seal in the monitor wells or fluctuations in recharge to the confined aquifer.

4.3.3 GROUNDWATER GRADIENTS

4.3.3.1 Horizontal Hydraulic Gradients

Horizontal hydraulic gradients, expressed as a dimensionless ratio, were calculated from the groundwater contour maps by dividing the linear distance by the vertical change in water level. The horizontal hydraulic gradient ranges from 0.0001 to 0.0005 in the shallow aquifer with the average horizontal hydraulic gradient approximately 0.0003.

4.3.3.2 Vertical Hydraulic Gradients

Vertical gradients were calculated between the shallow and deeper-screened intervals in the monitor well clusters by dividing the difference in groundwater elevation by the distance between the center of the shallow well screen and the center of the deeper well screen. The results are expressed as a dimensionless ratio. Prior to calculating the vertical gradient the water levels were normalized to adjust for variations in fluid density. The normalized difference in groundwater elevation ranged from 0.25 to 0.38 feet on October 7, 1991 and the distance between screened intervals ranged from 27 to 65 feet. The vertical hydraulic gradient was calculated to range from 0.021 to 0.0038 for the monitor wells which appear to be established in the deeper confined aquifer, specifically the GW-19 wells, the I-1 wells, the I-3 wells and the MW-105 wells.

4.3.4 GROUNDWATER VELOCITY

4.3.4.1 Horizontal Velocity

The velocity and volume of groundwater flow can be estimated using Darcy's Law and the velocity equation of hydraulics.

$Q = kiA$ (Darcy's Law)

$v = Q/A = Ki$ (velocity equation)

where:

Q = rate of flow per unit time (gpd)

K = hydraulic conductivity (gpd/ft^2)

A = cross sectional area perpendicular to the flow direction (ft^2)

i = hydraulic gradient

v = velocity (ft/yr)

n = porosity

The velocity equation must be adjusted for porosity which results in:

$$v = \frac{ki}{n}$$

Horizontal groundwater velocities were calculated for all monitor wells for which slug injection tests were performed. A summary of these results is listed in Table 1.

TABLE 1

SUMMARY OF GROUNDWATER HORIZONTAL VELOCITY ESTIMATES

Monitor Well ID	Hydraulic Conductivity (cm/sec)	Porosity	Estimated Gradient	Velocity (ft/yr)
GW-3	1.75×10^{-2}	0.35	0.0005	25.9
GW-5	1.46×10^{-3}	0.35	0.00029	1.3
GW-16	8.4×10^{-4}	0.35	0.00037	0.9
GW-17A	1.75×10^{-3}	0.35	0.00029	1.5
GW-18	4.4×10^{-3}	0.35	0.00028	3.6
GW-19A	3.5×10^{-4}	0.35	0.00020	0.2
GW-19B	2.9×10^{-3}	0.35	0.00025	2.1
GW-21	2.93×10^{-3}	0.35	0.00048	4.2

Horizontal velocity calculations indicate that the velocity of the groundwater ranges from less than 1 ft/year to about 26 ft/year with the average horizontal velocities being on the order of 2 ft/year. However, it should be noted that these estimates are based on data collected from slug tests from wells with only 10 foot screened intervals which may not be representative of the overall aquifer.

4.3.4.2 Vertical Groundwater Velocities

Vertical hydraulic gradients can be used to calculate vertical groundwater velocities using the velocity equation. Using the data at GW-19A and GW-19B and assuming vertical hydraulic conductivities ranging from 4×10^{-5} to 5×10^{-7} cm/sec the vertical groundwater

velocities range from 0.7 ft/yr to 0.009 ft/yr in the saturated aquifer zones.

4.4 GROUNDWATER QUALITY

4.4.1 GENERAL

A significant amount of water quality data has been collected for groundwater from Section 32 over the past 10 years. This includes inorganic and radionuclide constituents. In addition, Envirocare currently samples and analyzes groundwater from at least seven (7) monitor wells on a quarterly basis as part of existing permits. Bingham Environmental installed six (6) new wells as part of this study and sampled those six and four existing monitor wells to further characterize the groundwater quality of the shallow and deeper confined aquifers.

Details of the groundwater sampling performed during this study is summarized in Appendix A and the groundwater quality results are provided in Appendix C. The most recent groundwater quality data is summarized first in Appendix C. The previous data which was collected by the DOE as part of the Vitro Disposal, Envirocare and Delta Geotechnical Consultants is included in summary tables and selected parameters have been plotted. Plots of TDS, Conductivity, Radium 226, Total Uranium, Gross Alpha and Gross Beta are provided in Appendix C for this previous data. It should be noted that there are some QA/QC questions that could not be answered regarding the previous data and that some of the data appears to exhibit field or laboratory errors.

Review of the water quality data indicates that the groundwater is relatively poor quality below the Site. The TDS ranges from 20,000 to 75,000 mg/l with significant seasonal and longer term fluctuations. The Conductivity values also are relatively variable, however it appears that some of this variability is due to QA/QC problems. The inorganic parameters analyzed previously indicates

that many of the concentrations are above maximum concentration limits (MCL) for groundwater. Many of the protection levels proposed in the Ground Water Quality Discharge Permit No. UGW450005 are below the concentrations previously identified in groundwater samples.

Selected radionuclides have been plotted in Appendix C. Specifically, Radium-226, Total Uranium, Gross Alpha and Gross Beta are plotted. Review of these plots indicate that the radioactivity at the Site is significantly above normal background levels. GW-3 in particular has Radium-226 and Total Uranium levels which appear to be significantly above normal, however, more detailed review indicates that the relatively high Radium-226 in November 1990 and March 1991 are approximately the same levels as that measured in October 1988. Subsequent analyses performed in May 1991 indicate that the levels are back below 5 pCi/l. Additional sampling and analysis with appropriate QA/QC oversight will provide information regarding whether the previous values were normal fluctuations, groundwater contamination or due to field and/or laboratory errors. Review of available data does not point to groundwater contamination, however the radionuclides should be carefully evaluated in the future.

4.4.2 ANALYSIS OF SOLUTE AND ISOTOPIC GEOCHEMISTRY

4.4.2.1 Introduction

Selected solute and stable and unstable isotopic data were analyzed to characterize groundwater recharge sources, groundwater flow directions and the groundwater geochemical evolution. For analytical purposes solute data were converted from mg/l to meq/l (Table 2). PCO_2, selected molar ratios, and saturation indices (SI) were calculated by means of the computer code WATEQ (Plummer and others, 1976). WATEQ results are listed in Table 3.

Stable isotopes used in this investigation include: $\delta^{2}H$ ($^{2}H/^{1}H$), $\delta^{18}0$ ($^{18}o/^{16}o$), $\delta^{13}C$ ($^{13}C/^{12}C$) and $\delta^{34}S$ ($^{34}S/^{32}S$). The reporting standards are SMOW for $\delta^{2}H$ and $\delta^{18}0$, PDB for $\delta^{13}C$ and CD for $\delta^{34}S$ as summarized on Table 4. The isotopic composition of each standard is, by convention, 0 o/oo. The radioactive isotopes ^{3}H and ^{14}C were also collected at selected sites. Isotopic data are listed in Table 5. Laboratory results of solute analyses are reported as absolute abundances per volume of liquid (i.e. mg/l). Determination of the absolute isotopic abundances of stable isotopes in water is however, extremely difficult. In hydrology it is conventional, and just as useful to determine the relative isotopic composition of a sample with respect to a standard of known composition. Concentrations are therefore not expressed as absolute abundance ratios, R, but rather as relative δ (delta) units defined as

$$\delta = \left(\frac{R_{sample}}{R_{standard}} - 1\right) \times 10^{3}$$

where R is the ratio of the number of heavy isotope nuclides to the number of light isotope nuclides (e.g. $^{2}H/^{1}H$). The delta unit expresses the difference in isotopic composition in parts per thousand (per *mil* or 0 o/oo) between the sample and the standard. Because analytical results are not reported as absolute abundances it is not uncommon for laboratory results to have negative values. For example, $\delta^{13}C$ = - 13.0 o/oo means that the sample has less ^{13}C relative to ^{12}C than does the standard and the sample may be referred to as being depleted in ^{13}C or enriched in ^{12}C. The absolute abundance of carbon (i.e. how much carbon is actually in the sample) is determined by the solute analysis and reported in units such as mg/l.

4.4.2.2 Groundwater Origin and Recharge

The δ^2H and $\delta^{18}O$ isotopic compositions of the water molecules have been plotted on Figure 14 with respect to the meteoric water line (MWL). The MWL, has been defined by Craig (1961) and Dansgaard (1964) as:

$$\delta^2H = 8\ \delta^{18}O + 10\ (o/oo)$$

It is important to note that the MWL is only valid for average annual modern meteoric water (i.e. precipitation) with respect to worldwide reporting stations. Adjustments, usually empirical, must be made for regional and local conditions and for paleoground water. Precipitation falling at higher elevations or during cooler paleoclimatic conditions has more negative isotopic compositions than does warmer precipitation. Such cool precipitation plots in the more negative regions of the MWL. Surface water which has been subjected to excessive surface evaporation tends to plot along an evaporation trajectory with a positive slope of 3 to 5 with respect to the MWL.

Although not meteoric most of the isotopic compositions plot about the MWL suggesting a meteoric recharge history. The data from the shallow unconfined aquifer along the south central, southwestern and west central perimeter of Section 32 (sites GW-3, GW-18, GW-19A) plot along an apparent evaporation trajectory and appear to have been subjected to excessive evaporation prior to recharge. Three mechanisms could be responsible for the observed apparent higher evaporation:

1. Incorporation of connate (Lake Bonneville) water in the aquifer at the time of sediment deposition or at some subsequent time prior to the retreat of Lake Bonneville,

2. Vertical infiltration of overland recharge of either surface ponded water or evaporated water in the soil profile at the site, and

3. Recharge of evaporated surface water away from the site.

It is unlikely that the groundwater is connate because only 3 of the 7 unconfined groundwater analyses fall along the evaporation trajectory. Although the present water table gradient under the site is small (Figures 14 and 15) there has been ample time since the retreat of Lake Bonneville for a complete flushing of connate water from the groundwater system. Complete flushing is further suggested because all groundwaters have similar percentages of major ions (Table 2) but have dissimilar TDS concentrations and δ^{2H} and $\delta^{18}O$ compositions (Table 5). Solute compositions may be readily explained by dissolution reactions accompanying rock/water interactions.

On site vertical infiltration of partially evaporated surface water is also an unlikely possibility due to the combined effects of low site precipitation, high evapotranspiration, low vertical hydraulic conductivity and the absence of a closed topographic contour.

Recharge of evaporated surface water at some location away from the site is the most likely cause of the evaporation trajectory. This mechanism requires either different recharge locations or different recharge times for the sources of evaporated and non-evaporated recharge waters. It is possible that the site is the confluence of two shallow groundwater flow systems, however the potentiometric map of the shallow unconfined aquifer (Figures 14 and 15) does not support this idea and upgradient water table data do not exist in sufficient detail to verify this hypothesis. A more plausible explanation is different recharge times. The idea of different recharge times is supported by: 1) GW-3, GW-18 and GW-19A being generally upgradient of the other sampling locations, and 2) a flatter water table gradient existing in the vicinity of GW-3, GW-19A and GW-18 than exists elsewhere in Section 32. A flatter gradient would permit slower horizontal flow.

The two deep groundwater samples (GW-19B and I-1-100) do not plot along the evaporation trajectory or along the MWL near the cluster of shallow unconfined groundwater data. I-1-100 plots in the most negative position along the MWL. This negative position may indicate recharge during cooler paleoclimatic conditions. The isotopic composition of GW-19B is not readily explicable.

4.4.2.3 Groundwater Age

The concept of groundwater age is a confusing one. A volume of water in an aquifer is the product of the mixture of many waters of possible diverse origins and histories. The water has no unique age, except in the unusual occurrence of pure piston flow. The age of a groundwater sample,or more correctly the integrated mean residence time, can often be estimated by means of radioactive isotopes. Both tritium (^{3}H) and carbon-14 (^{14}C) were used to estimate groundwater ages.

Prior to atmospheric thermonuclear weapons testing most tritium found in the atmosphere and groundwater was naturally produced in the atmosphere and groundwater was naturally produced i the upper atmosphere. Natural atmospheric tritium concentrations in precipitation appear to range from 4 to 25 TU depending upon location (Nir and others, 1966). Since 1952 massive injections of tritium were introduced into the atmosphere and hydrologic cycle by nuclear weapons. Because tritium has a short half life, 12.7 years, groundwater tritium levels of less than 10 TU generally indicate that the groundwater recharged prior or 1953. Measured tritium contents of 4.9 to 1.8 TU (Table 5) indicate pre-1953 recharge. It is not possible to estimate absolute groundwater ages using tritium because of the short tritium half life and the uncertainty in the natural tritium content of the recharge wastes. Groundwater wastes ages greater than 40 years could not be verified by ^{14}C methods because existing radiocarbon

groundwater dating models do not account for the dissolved carbon evolution pathway which occurs at the site. Carbon-14 dating models are based on the idea that groundwater acquires carbon in the soil zone and aquifer by predictable mechanisms and that about 50% of the carbon is from soil zone $CO_2(g)$ and 50% is from the dissolution of carbonate materials in the soil zone and aquifer skeleton. This carbon acquisition mechanism is verified by the $\delta^{13}C$ content of the groundwater. To use radiocarbon dating techniques the $\delta^{13}C$ content of groundwater should normally fall in the range of -14 to -8 o/oo. Unfortunately the $\delta^{13}C$ contents of site groundwater are considerably more positive (Table 5). Possible carbon evolutionary pathways are described latter.

4.4.2.4 Groundwater Geochemical Evolution

Solute compositions have been plotted as Stiff (1951) diagrams (Figure 19) and a trilinear diagram (Figure 20) for visual inspection. Solute and isotopic compositions may be attributed to the dissolution of soluble minerals in the aquifer. All groundwater have similar gross solute chemistries suggesting similar rock/water interactions. The groundwaters have elevated TDS and are of the Na^+ and Cl^- type. Na^+ and Cl^- ions account for approximately 90% of the total solute load (Table 2) and are likely due to the dissolution of NaCl in the lake bed deposits of the aquifer skeleton.

Lower TDS concentrations for the few confined aquifer samples suggest that the unconfined and confined aquifers may be chemically as well as hydraulically distinct groundwater systems. The Na^+ and Cl^- contents of both aquifers suggest slow horizontal flow rates because all groundwaters are undersaturated with respect to halite (Table 3) yet they have very high Na^+ and Cl^- concentrations (Table 2). Groundwater saturation, reported as the Saturation Index (SI), is a

measure of the thermodynamic tendency of a groundwater to either dissolve or precipitate a mineral. A positive log SI means the water is supersaturated and would like to precipitate the mineral and a negative log SI means the water is undersaturated and would like to dissolve the mineral. Saturation is defined as log SI = 0.0 + 0.1. Fast flow rates combined with the high solubility of halite would rapidly dissolve most of the halite from the aquifer and would result in much lower Na^+ and Cl^- concentrations.

Complex dissolution and precipitation reactions involving calcite ($CaCo_3$), dolomite $CaMg(CO^3)^2$), gypsum ($CaSO_4$), anhydrite ($CaSO_4.H_2O$) and other low solubility carbonate and sulfate minerals appear to be responsible for the distribution of major ions other than Na^+ and Cl^-. Such reactions are consistent with minerals commonly found in fine-grained Lake Bonneville sediments. Because the specific reaction pathways are not significant to the permitting process they will not be developed in detail here.

The carbon evolution is worthy of note because of the difficulty with the radiocarbon dating. The $\delta^{13}C$ contents are generally more positive than anticipated and the HCO_3 concentrations are greater than anticipated for typical soil zone/aquifer reactions. The positive isotopic compositions and the HCO_3 contents suggest excessive contributions of dissolved mineral carbonate. However, the groundwater are supersaturated with respect to common carbonate bearing mineral species, calcite and dolomite (Table 3). In other words the groundwaters should be precipitating rather than dissolving extra carbon. The excess carbon and positive carbon isotopic content is probably due to complex reactions involving the common ion effect (dissolution reactions involving common ions such as Ca^{2+} which lead to the precipitation of another Ca^{2+} containing mineral), the ionic strength effect (as salinity increased due to the dissolution of NaCl

additional carbonate and sulfate bearing minerals will dissolve) and the ion exchange of Na^+ for Ca^{2+} and Mg^{2+}.

4.4.2.5 Vertical Groundwater Movement

Although the deep confined aquifer data are limited existing solute and isotopic data suggest there is minimal or no downward vertical movement from the shallow unconfined aquifer to the deeper confined aquifer. At site GW-19A and GW-19B the idea of no vertical downward movement is supported by the decreasing Na^+ and Cl^- contents with depth, the absence of evaporated water in GW-19B, and differences between the $\delta^{34}S$ content of GW-19A and GW-19B. A relatively low TDS content is also observed in the confined aquifer sample I-1-100. No downward movement is also suggested by the hydraulic head differences between the unconfined and confined systems. Solute and isotopic compositions do not preclude upward vertical movement from the confined aquifer to the unconfined aquifer.

SECTION 5

CONTAMINANT MIGRATION ASSESSMENT

Rogers & Associates Engineering Corporation (Rogers) utilized the PATHRAE model in 1990 as part of a risk assessment of the Envirocare Facility. The PATHRAE model was developed by Rogers for the EPA to assist in evaluating the risk of contaminated Low Level Radioactive Wastes (LLRW) migrating from the disposal site. The PATHRAE model allows the user to simulate the movement of leachate from the bottom of the landfill cell through the unsaturated zone to the groundwater surface. PATHRAE then estimates the contaminant concentrations in the groundwater and simulates the contaminant transport in the direction of groundwater flow.

Groundwater concentrations of radionuclides predicted by PATHRAE have been compared to predictions utilizing alternative subsurface transport models and to groundwater quality data available for several waste sites. Results of these comparisons indicate that PATHRAE is a good model for predicting potential contamination pathways for a LLRW site. The model tends to predict higher groundwater contamination than a more detailed contaminant transport model would compute, therefore, PATHRAE is a more conservative approach.

Bingham Environmental and Rogers provided additional documentation, which has been included in Appendix D, for the PATHRAE model and the computer runs performed in 1990 for the Envirocare LARW site. Based on this information and the wastes Envirocare proposes to dispose the Groundwater Quality Discharge Permit was granted and the Radioactive Materials License Amended on March 21, 1991 to include selected low activity radioactive wastes.

SECTION 6

GROUNDWATER MONITOR WELL NETWORK

Based on the results of the field and laboratory investigations, the groundwater modeling and the Permit requirements the following groundwater modeling well network is proposed. Figure 21 provides a map of Section 32 with existing monitor wells, the Permit Area and the proposed future monitor wells.

The proposed groundwater monitor well network would monitor water quality of the upper shallow aquifer upgradient and downgradient of the disposal cells. Travel times vertically in the unsaturated zone and horizontally in the saturated zone are on the order of hundreds to thousands of years which reduces the importance of monitor wells for rapid detection of groundwater contamination. However, several monitor wells are still proposed to detect any unusual migration of contamination.

I-1-30 is proposed as the upgradient monitor well for the LARW Disposal Cell with existing wells I-2-30 and GW-16 and the proposed wells identified as GW-20, GW-22, GW-23 and GW-24 proposed as the downgradient compliance wells. All the proposed monitor wells are screened in the upper part of the shallow unconfined aquifer (Unit 2 and/or Unit 3) and should detect any contamination migrating from the LARW Disposal Cell.

GW-19A is proposed as the upgradient monitor well for the Future Disposal Area with GW-20, GW-24, GW-25, GW-26, GW-27 and GW-28 proposed as the downgradient compliance wells. It is proposed that filling of the Future Disposal Cells start on the east side and move toward the west. All monitor wells are proposed to be screened in the upper 15 feet of the shallow aquifer, specifically screening Unit 3 on the west side of Section 32, screening Units 2 and 3 in the center of Section 32 and screening Unit 2 on the east side of Section 32. Care will be taken that all monitor wells are completed above Unit 1. Each monitor well shall be constructed in conformance with the criteria found in the EPA RCRA TEGD (EPA, 1986).

Envirocare proposes that compliance monitor wells GW-20, GW-22, GW-23 and GW-24 be installed immediately. Monitor wells GW-25, GW-26, GW-27 and GW-28 are proposed to be installed prior to disposal of waste in the Future Disposal Cells. Envirocare proposes to perform accelerated background sampling on monitor wells I-1-30 and GW-19A. Quarterly sampling is proposed for the two upgradient and all the downgradient compliance wells. The chemical analyses will consist of the proposed Indicator Radionuclides and the Inorganics (Table 1A) outlined in the Permit.

In addition, Envirocare proposes to periodically measure water levels and collect and analyze groundwater samples from GW-17A to monitor performance of the Vitro Disposal Cell and I-1-100 and GW-19B to obtain upgradient data for the deeper aquifer.

In addition to collecting and analyzing groundwater samples from the selected monitor wells, Envirocare proposes to obtain water level measurements prior to each sampling event and quarterly in all Section 32 wells. In particular water levels in GW-19A and GW-19B, I-1-30 and I-1-100 and I-3-30 and I-3-100 will be obtained and compared to determine if a vertical upward gradient still exists. If groundwater contamination is identified in any of the shallow compliance monitor wells and the vertical gradient is measured to be downward Envirocare will meet with the Division of Water Quality to discuss the construction of a deeper monitor well adjacent the shallow well which indicates evidence of contamination.

Compliance of the groundwater monitoring wells with the protection levels developed in the Permit shall be determined by use of the Normal Distribution Method outlined in Section 6 of the EPA document *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance (EPA, 1989).*

SECTION 7

CONCLUSIONS

The hydrogeologic and meteorological information indicates that Section 32 is well suited to site LARW disposal facilities due to favorable climatic and subsurface soil and groundwater conditions. The relatively low precipitation at the site coupled with the high evapotranspiration potential and low permeability upper clay soil result in a very low potential for infiltration in the upper soils and migration to the groundwater table. Based on the unsaturated flow modeling travel times through the unsaturated zone ranges from 1100 to 2500 years with annual infiltration less than 0.03 of an inch. Therefore, potential leachate volumes are very low and travel times are also very low.

The aquifer system investigated at Section 32 consists of a shallow unconfined aquifer in the upper 40 to 70 feet and a deeper confined aquifer below approximately 70 feet. Both aquifers are Class IV consisting of saline groundwater. Groundwater levels in the shallow aquifer range from 18 to 35 feet below the ground surface with the deeper aquifer exhibiting slightly higher potentiometric levels than the shallow aquifer. This upward vertical gradient and the low vertical permeability should also protect the deeper aquifer from contamination migration from the shallow groundwater in the event contamination reaches the groundwater system.

Groundwater flow directions for the shallow and deeper aquifer generally are from south to north below Section 32. Horizontal velocities were estimated to be on the order of 1 to 5 ft/yr. A few monitor wells strategically placed in the shallow aquifer are considered appropriate to monitor compliance of the LARW with groundwater quality protection standards. This report proposes both upgradient and downgradient monitor wells adjacent to the permit area as shown on Figure 21.

SECTION 8

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TABLE 2

ENVIROCARE OF UTAH

SOLUTE DATA

(meq/l)

Sample I.D.	GW-3	GW-5	GW-16	GW-17A	GW-18	GW-19A	GW-19B	GW-21	I-1-100	Ocean
PARAMETER										
Calcium (Ca)	34.93	24.95	13.97	34.43	27.94	37.43	14.47	0.05	10.48	19.96
Magnesium (Mg)	49.36	37.84	15.63	33.73	46.89	78.97	31.26	30.44	18.92	111.05
Sodium (Na)	696.00	696.00	352.35	395.85	565.50	870.00	356.70	652.50	317.55	456.75
Potassium (k)	16.88	18.41	9.21	14.57	14.83	11.25	0.03	0.03	6.39	9.72
Na + K	712.88	714.41	361.56	410.42	580.33	881.25	356.73	652.53	323.94	466.47
% Ca	0.04	0.03	0.04	0.07	0.04	0.04	0.04	0.00	0.03	0.03
% Mg	0.06	0.05	0.04	0.07	0.07	0.08	0.08	0.04	0.05	0.19
% Na + K	0.89	0.92	0.92	0.86	0.89	0.88	0.89	0.96	0.92	0.78
Bicarbonate (HCO_3)	4.02	5.24	3.28	9.83	11.47	5.08	4.10	7.70	9.83	2.33
Sulfate (SO_4)	93.69	47.89	16.66	47.89	58.30	104.10	36.66	37.48	12.49	56.21
Chloride (Cl)	648.83	677.04	366.73	451.36	535.99	733.46	338.52	592.41	310.31	535.99
% HCO_3	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.03	0.00
% SO_4	0.13	0.07	0.04	0.09	0.10	0.12	0.10	0.06	0.04	0.09
%Cl	0.87	0.93	0.95	0.89	0.88	0.87	0.89	0.93	0.93	0.90
SUMMARY										
Cations	797.16	777.20	391.16	478.58	655.16	997.65	402.46	683.02	353.34	597.48
Anions	746.54	730.17	386.66	509.08	605.76	842.64	379.28	637.59	332.64	594.53
Total	1543.7	1507.37	777.82	987.66	2220.06	9670.29	3992.03	7467.03	685.98	685.98
% Error	3.3	3.1	0.6	-3.1	3.9	8.4	3.0	3.4	3.0	0.2

TABLE 3

ENVIROCARE OF UTAH

MINERALOGY DATA

(SI) *

Sample I.D.	GW-3	GW-5	GW-16	GW-17A	GW-18	GW-19A	GW-19B	GW-21	I-1-100
MINERAL									
Partial Pressure of CO_2	-2.42	-2.29	-2.64	-2.09	-2.26	-2.34	-2.46	-2.12	-2.27
Calcium/Sodium	0.93	0.97	1.04	1.14	0.95	0.84	0.95	0.91	0.98
Anhydrite	-0.48	-0.88	-1.38	-0.64	-0.74	-0.46	-1.18	-1.32	-1.60
Aragonite	0.25	0.26	0.09	0.80	0.91	0.36	0.08	0.07	0.55
Calcite	0.40	0.41	0.25	0.95	1.06	0.52	0.23	0.22	0.70
Dolomite	1.00	1.05	0.55	1.94	2.37	1.42	0.81	1.08	1.65
Flourite	0.85	0.17	-0.56	0.26	0.61	0.89	-0.26	-0.48	-0.51
Gypsum	-0.15	-0.55	-1.03	-0.32	-0.39	-0.13	-0.84	-0.98	-1.25
Halite	-2.23	-2.21	-2.75	-2.63	-2.40	-2.07	-2.78	-2.29	-2.86
Magnesite	0.27	0.30	-0.02	0.66	0.98	0.57	0.25	0.53	0.63
Mirabilite	-1.36	-1.64	-2.45	-0.26	-1.63	-1.20	-2.24	-1.72	-2.60

* Saturation Index

Saturation equals log SI = 0.0 ± 0.1

TABLE 4

ENVIROCARE OF UTAH

ISOTOPIC STANDARDS FOR ENVIRONMENTAL ISOTOPICS

ISOTOPICS	STANDARDS	ABBREVIATION
$\delta^{2}H$	Standard Mean Ocean Water	SMOW
$\delta^{18}O$	Standard Mean Ocean Water	SMOW
^{13}C	Pee Dee Blemnite	PDB
$\delta^{34}S$	Canyon Diablo Meteorite	CDM
^{14}C	Percent Modern Carbon	PMC
Tritium	Tritium Units	TU

TABLE 5

ENVIROCARE OF UTAH

ISOTOPIC DATA

Sample ID	$\delta^{2}H$ (o/oo)	$\delta^{18}O$ (o/oo)	$\delta^{13}C$ (o/oo)	$\delta^{34}S$ (o/oo)	TU	^{14}C (PMC)
GW-3	-104	-10.5	-2.7	-	-	-
GW-5	-115	-12.8	-1.8	-	-	-
GW-16	-114	-13.5	-6.9	-	-	-
GW-17A	-114	-13.1	-1.9	-	-	-
GW-18	-112	-11.9	-2.7	-	-	-
GW-19A	-103	-10.5	-0.3	-5.7	1.8	10.0
GW-19B	-107	-13.0	-1.3	0.4	2.8	5.2
GW-21	-113	-13.4	-5.4	-2.9	4.9	36.4
I-1-100	-121	-13.8	-5.2	10.4	-	-

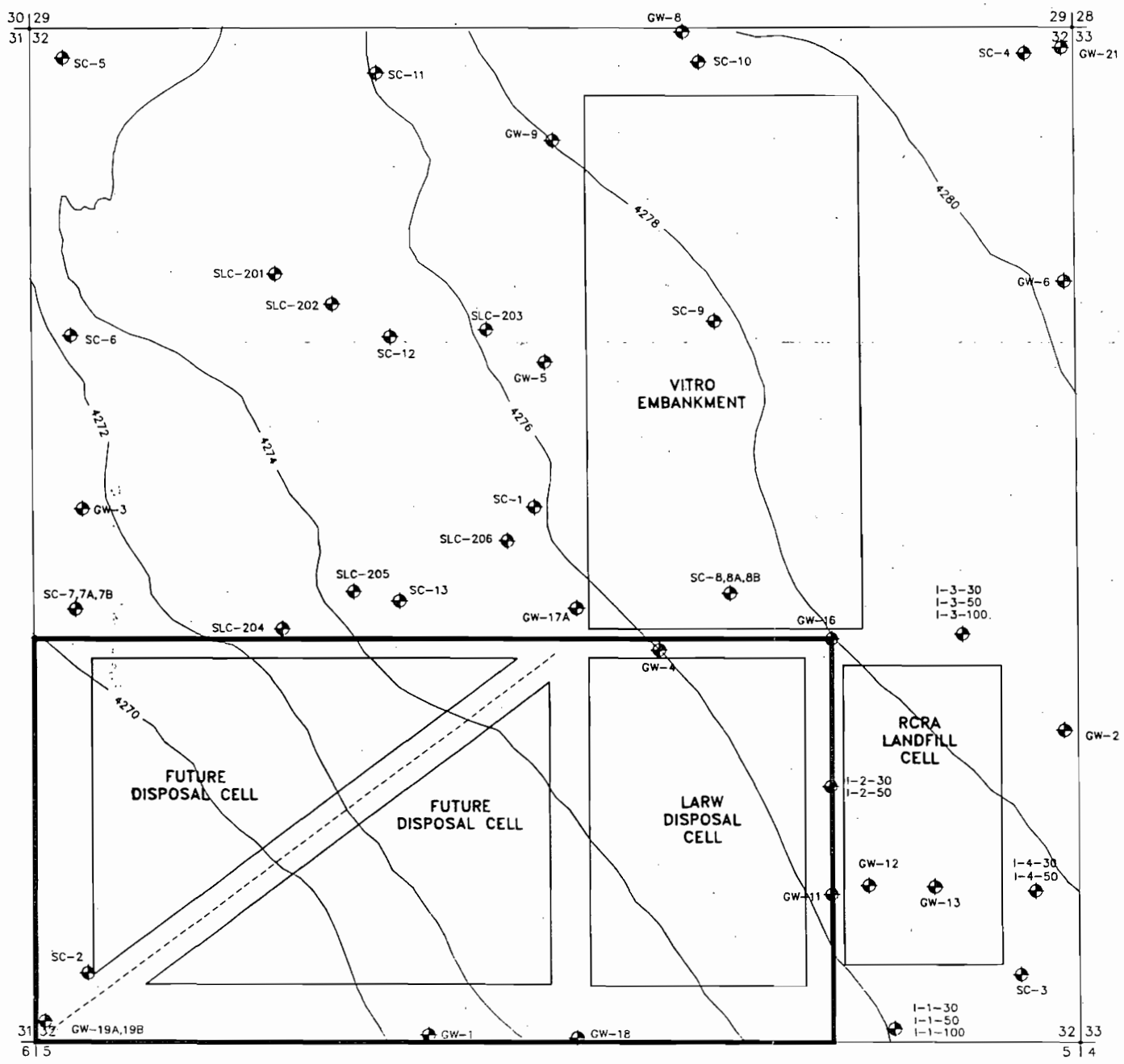
TU values +/- 2.2 TU
14C values +/- 2 PMC

TABLE 6
SUMMARY OF AVAILABLE
MOISTURE CONTENT DATA

Drill Hole ID	Sample ID	Depth (ft)	Soil Type	Unit	Moisture Content By % Weight
GW-16	S-1	3.0	Silty Clay	4	5.3
GW-16	B-1	9.5	Silty Clay	4	10.9
GW-16	B-3	14.5	Silty Sand	3	13.5
GW-16	B-4	19.5	Silty Sand	3	26.0
GW-17A	L-1	2.0	Silty Clay	4	27.8
GW-17A	L-2	7.0	Silty Clay	4	32.5
GW-17A	L-3	9.5	Silty Clay	4	39.6
GW-17A	L-4	14.5	Silty Sand	3	15.3
GW-17A	L-5	19.5	Silty Sand	3	10.7
GW-17A	L-6	27.0	Silty Sand	3	19.7
GW-17A	L-7	32.0	Silty Clay	2	49.5
GW-19B	L-1	2.0	Silty Clay	4	17.5
GW-19B	L-2	7.0	Silty Clay	4	35.2
GW-19B	L-3	12.0	Silty Clay	4	44.1
GW-19B	L-4	17.0	Silty Sand	3	13.9
GW-19B	L-5	22.0	Silty Sand	3	17.8
SC-1	NA	30.0	Silty Clay	2	39.2
SC-1	NA	40.0	Silty Clay	2	32.3
SC-1	NA	69.0	Silty Sand	1	22.5
SC-2	NA	33.0	Silty Clay	2	29.2
SC-3	NA	29.2	Silty Clay	2	29.8
SC-4	NA	40.0	Silty Clay	2	28.3
SC-5	NA	40.0	Silty Clay	2	30.9
SC-6	NA	3.0	Silty Clay	4	37.5
SC-6	NA	8.0	Silty Clay	4	4.1
SC-6	NA	18.5	Silty Sand	3	20.2
SC-6	NA	43.0	Silty Clay	2	25.7
SC-7	NA	5.0	Silty Clay	4	33.8
SC-7	NA	25.0	Silty Sand	3	23.9
SC-7	NA	35.0	Silty Clay	2	37.8
SC-8	NA	9.0	Silty Clay	4	40.2
SC-8	NA	14.0	Silty Sand	3	10.5
SC-8	NA	19.0	Silty Sand	3	13.0
SC-8	NA	24.0	Silty Sand	3	26.6

TABLE 6 contd.
SUMMARY OF AVAILABLE
MOISTURE CONTENT DATA

Drill Hole ID	Sample ID	Depth (ft)	Soil Type	Unit	Moisture Content By % Weight
SC-8	NA	29.0	Silty Clay	2	67.4
SC-9	NA	8.0	Silty Clay	4	40.4
SC-9	NA	28.0	Silty Clay	2	52.3
SC-10	NA	5.0	Silty Clay	4	34.2
SC-10	NA	10.0	Silty Clay	3	43.7
SC-10	NA	15.0	Silty Sand	3	18.3
SC-11	NA	14.0	Silty Sand	3	10.5
SC-11	NA	34.0	Silty Clay	2	29.0
SC-12	NA	10.0	Silty Sand	3	5.1
SC-12	NA	15.0	Silty Sand	3	9.6
SC-12	NA	30.0	Silty Clay	2	66.1
SC-12	NA	40.0	Silty Clay	2	22.4
SC-13	NA	8.0	Silty Clay	4	35.2
SC-13	NA	13.0	Silty Sand	3	10.3
SC-13	NA	18.0	Silty Sand	3	13.0
SC-13	NA	23.0	Silty Sand	3	12.3
SC-13	NA	32.0	Silty Clay	2	33.3
SC-16	NA	13.0	Silty Sand	3	11.3
SLC-201	NA	4.0	Silty Clay	4	20.5
SLC-201	NA	8.5	Silty Clay	4	36.9
SLC-201	NA	9.0	Silty Clay	4	36.9
SLC-201	NA	13.0	Silty Clay	4	16.2
SLC-202	NA	6.0	Silty Clay	4	39.7
SLC-202	NA	11.0	Silty Sand	3	7.4
SLC-203	NA	2.0	Silty Clay	4	21.7
SLC-203	NA	6.0	Silty Clay	4	35.6
SLC-203	NA	11.0	Silty Clay	4	16.4
SLC-204	NA	2.0	Silty Clay	4	15.3
SLC-204	NA	6.0	Silty Clay	4	28.4
SLC-204	NA	11.0	Silty Clay	4	12.1
SLC-205	NA	2.0	Silty Clay	4	20.7
SLC-205	NA	6.0	Silty Clay	4	24.8
SLC-205	NA	11.0	Silty Clay	4	9.4
SLC-206	NA	2.0	Silty Clay	4	19.6
SLC-206	NA	6.0	Silty Clay	4	30.9
SLC-206	NA	11.0	Silty Clay	4	17.4



400 0 200 400 800 1600

(IN FEET)

SLBM, SEC. 32, T. 1 S., R. 11 W.

LEGEND

GW-16 Through GW-21:	Bingham Environmental (1991)
I and other GW's:	Delta Geotechnical Consultants (1988,1990)
SLC-	Jacobs Engineering Group, Inc. (1984)
SC-	Dames & Moore (1981,1982)
4247	Original Topography Prior to Construction
	Groundwater Quality Discharge Permit Area

ENVIROCARE OF UTAH

SITE MAP

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 1

Rev.	By	Date	Remarks	Date SEPT. 1991	Proj. # 1416-010	T.M.
1	SLP	9/30/91	REVISE-PERMIT AREA			

EXPLANATION

GEOLOGY

QUATERNARY	Qa	ALLUVIUM & COLLUVIUM	SAND, GRAVEL, BOULDERS
	Ql	LACUSTRINE	MOSTLY CLAY & SILT
	Qt	LAKESHORE & NEARSHORE DEPOSITS	SAND, GRAVEL BARS, SPITS & TERRACES
MIDDLE CAMBRAIN TO PERMIAN	Pzu	SEDIMENTARY ROCK UNDIVIDED	CHIEFLY LIMESTONE, DOLOMITE, SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES
			APPROXIMATE CONTACT

GEOLOGY BASED FROM STEPHENS (1974), AND U.S. DEPARTMENT OF ENERGY (1983)

0 2000 4000 6000
Scale in Feet

CONTOUR INTERVAL 100'
DASHED LINES REPRESENT 10' CONTOURS

REFERENCE U.S.G.S. QUADRANGLE MAPS ARAGONITE NW AND ARAGONITE, UTAH 1973

Rev.	By	Date	Remarks
1	SLP	9/30/91	REVISE GEOLOGY

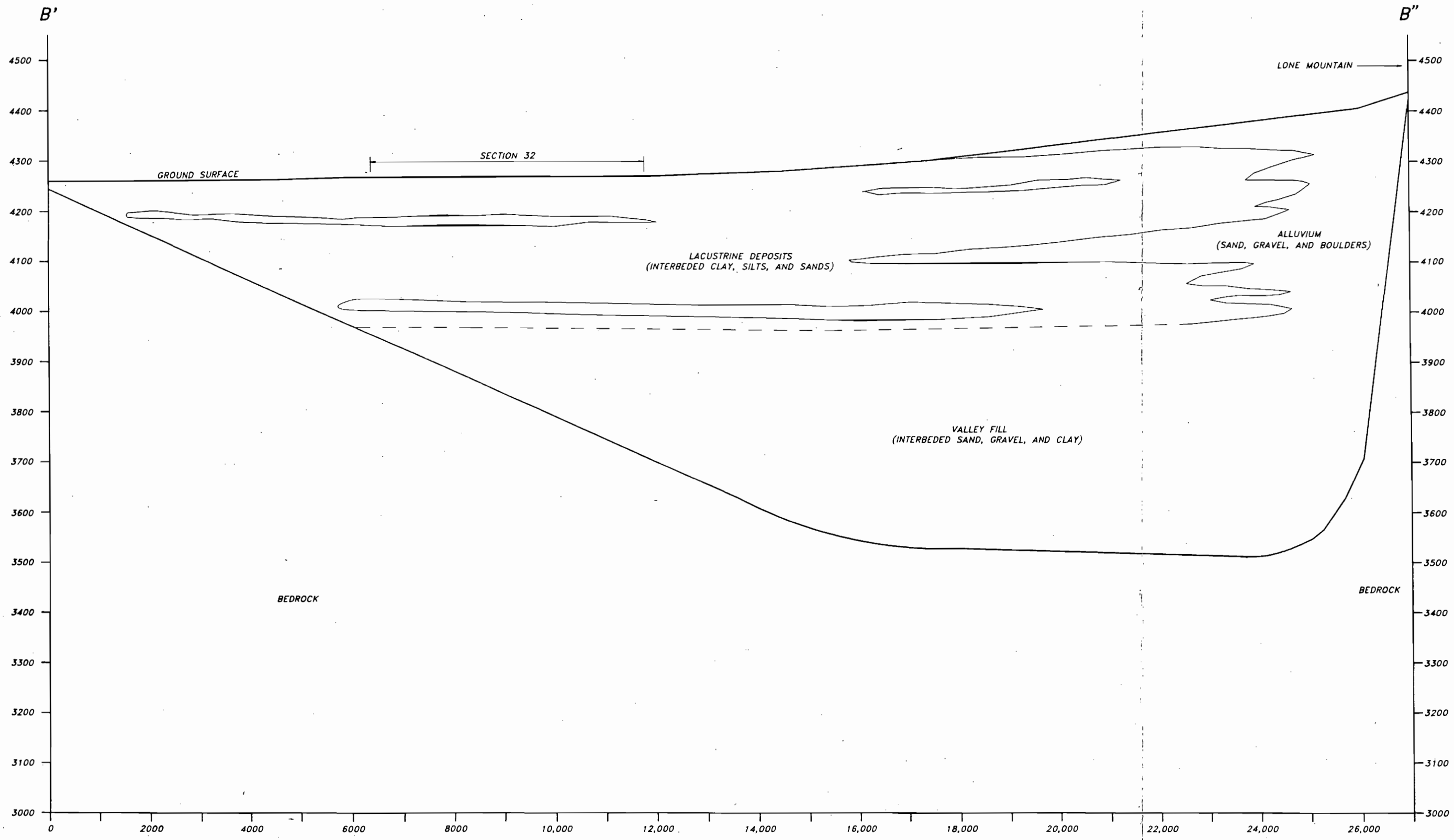
ENVIROCARE OF UTAH

GEOLOGIC MAP

BINGHAM ENVIRONMENTAL
SALT LAKE CITY – (801) 532-2230

FIGURE 2

Date SEPT. 1991 | Proj. # 1416-010 | T.M. | EV



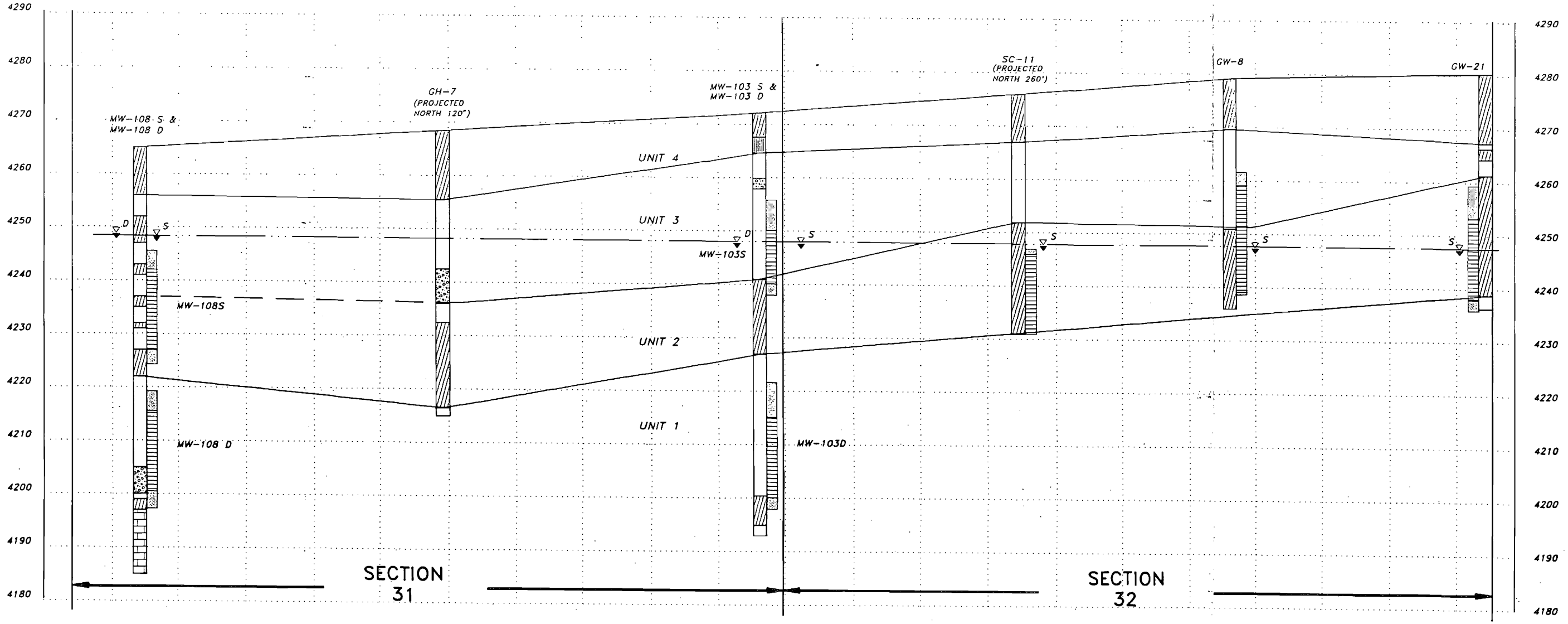
ENVIROCARE OF UTAH

CONCEPTUAL
GEOLOGIC CROSS SECTIO

BINGHAM ENVIRONMENTAL
SALT LAKE CITY – (801) 532-2230

FIGURE 3

Rev.	By	Date	Remarks	Date MAY 1991	Proj. # 1416-010	RJC	NE
1	SLP	9/31/91	REVISE CROSS SECTION				



LEGEND

- SILTY CLAY
- CLAYEY SILT
- SILTY SAND
- GRAVELLY SAND
- BEDROCK → PALEOZOIC LIMESTONE, DOLOMITE & SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES.
- SILICA SAND
- WELL SCREEN
- GROUNDWATER LEVEL MEASURED ON FEBRUARY 26, 1991

GROUNDWATER LEVELS MEASURED ON FEBRUARY 26, 1991

0 400 800 1200
Scale in Feet
HORIZONTAL SCALE

0 10 20 30
Scale in Feet
VERTICAL SCALE

No.	By	Date	Remarks
1	SLP	9/30/91	REVISE WELL SCREEN

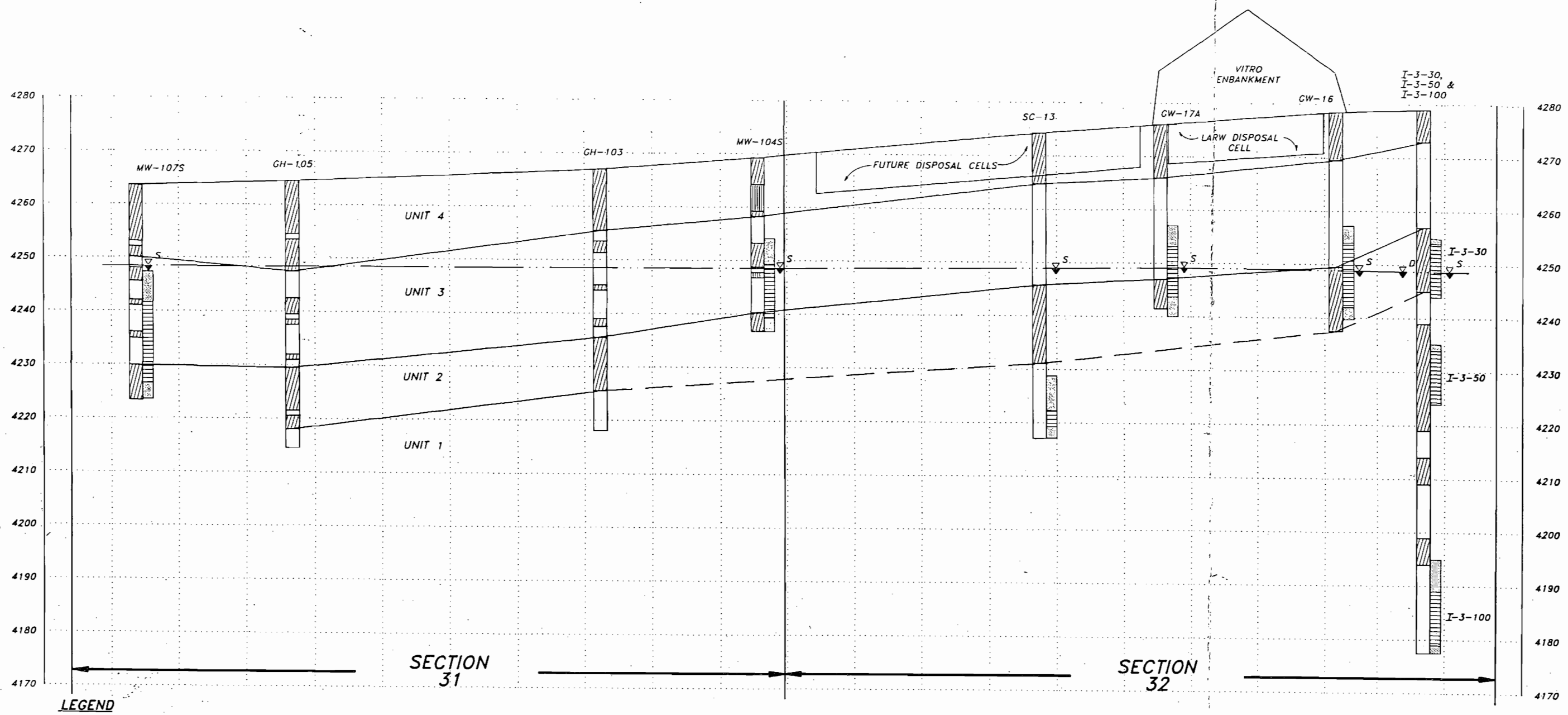
ENVIROCARE OF UTAH

HYDROGEOLOGIC CROSS SECTION A–A'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY – (801) 532-2230

FIGURE 4

Date MARCH 1991 | Proj. # 1416-010 | T.M. EVS



LEGEND

- SILTY CLAY
- CLAYEY SILT
- SILTY SAND
- GRAVELLY SAND
- BEDROCK → PALEOZOIC LIMESTONE, DOLOMITE & SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES.
- SILICA SAND
- WELL SCREEN
- ▽ GROUNDWATER LEVEL MEASURED ON FEBRUARY 26, 1991

0 400 800 1200
Scale in Feet
HORIZONTAL SCALE

0 10 20 30
Scale in Feet
VERTICAL SCALE

Rev.	By	Date	Remarks
1	SLP	9/31/91	REVISE WELL SCREEN

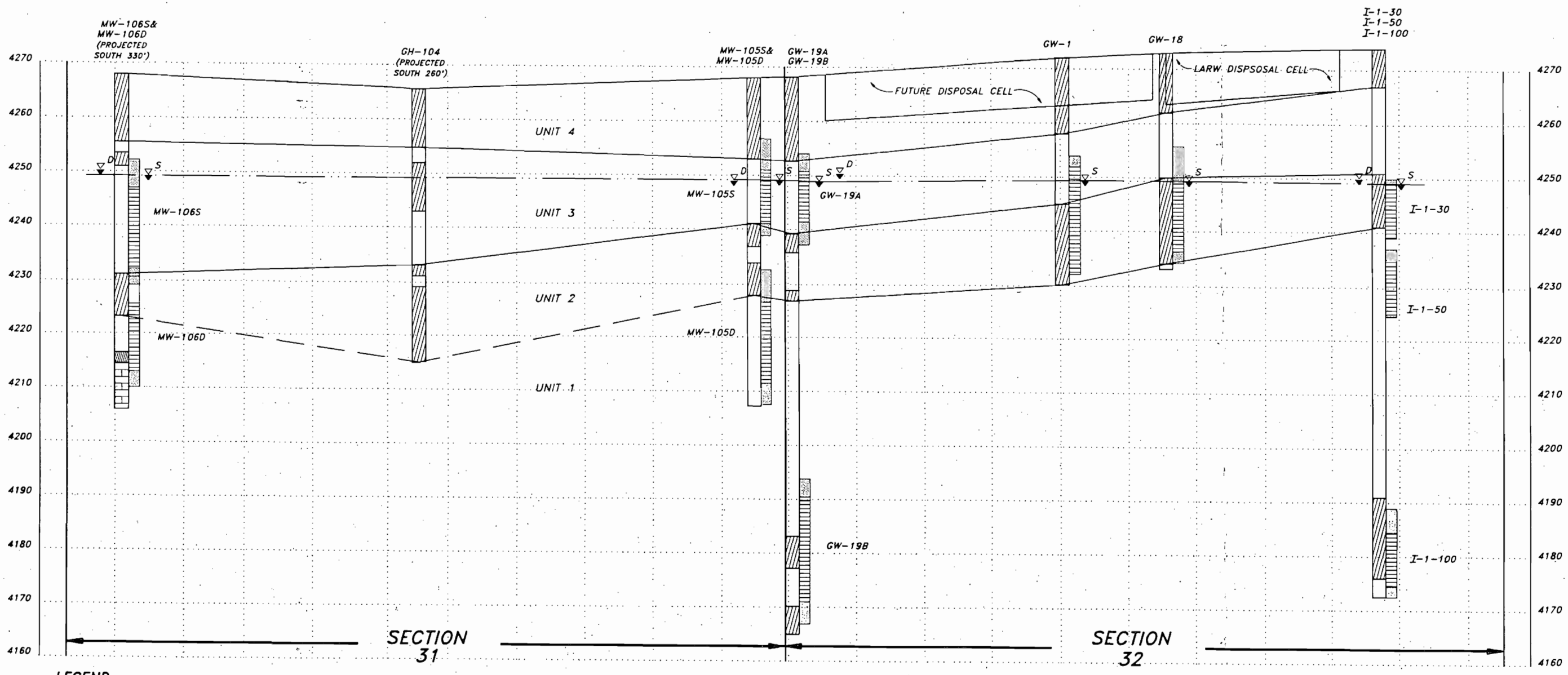
ENVIROCARE OF UTAH

HYDROGEOLOGIC CROSS SECTION B-B'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 5

Date MARCH 1991 | Proj. # 1416-010 | D.M. | EVS



LEGEND

- SILTY CLAY
- CLAYEY SILT
- SILTY SAND
- GRAVELLY SAND
- BEDROCK → PALEOZOIC LIMESTONE, DOLOMITE & SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES.
- SILICA SAND
- WELL SCREEN
- GROUNDWATER LEVEL MEASURED ON FEBRUARY 26, 1991

0 400 800 1200
Scale in Feet
HORIZONTAL SCALE

0 10 20 30
Scale in Feet
VERTICAL SCALE

Rev.	By	Date	Remarks
1	SLP	9/31/91	REVISE WELL SCREEN

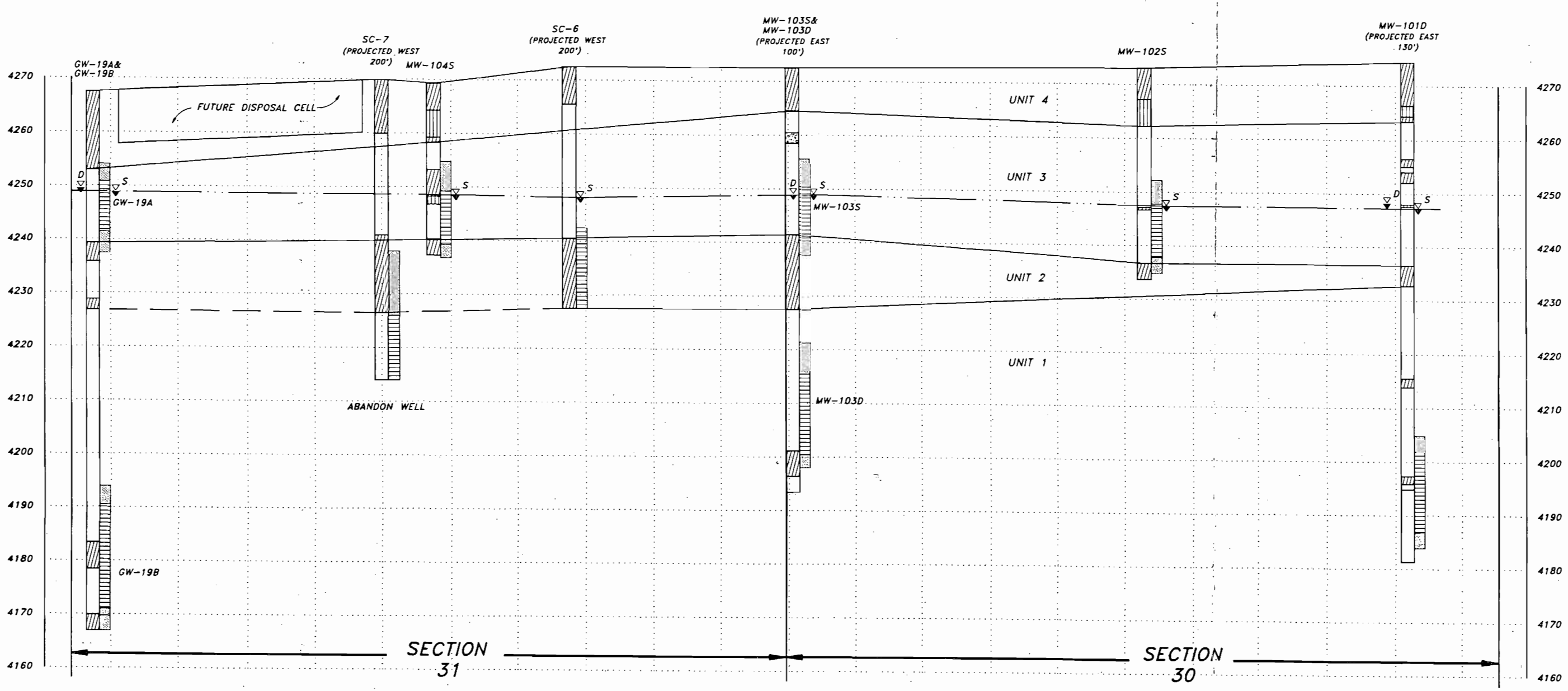
ENVIROCARE OF UTAH

HYDROGEOLOGIC CROSS SECTION C-C'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 6

Date MARCH 1991 | Proj. # 1416-010 | T.M. EVS



LEGEND

- SILTY CLAY
- CLAYEY SILT
- SILTY SAND
- GRAVELLY SAND
- BEDROCK → PALEOZOIC LIMESTONE, DOLOMITE & SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES.
- SILICA SAND
- WELL SCREEN
- GROUNDWATER LEVEL MEASURED ON FEBRUARY 26, 1991

0 400 800 1200
Scale in Feet
HORIZONTAL SCALE

0 10 20 30
Scale in Feet
VERTICAL SCALE

ENVIROCARE OF UTAH

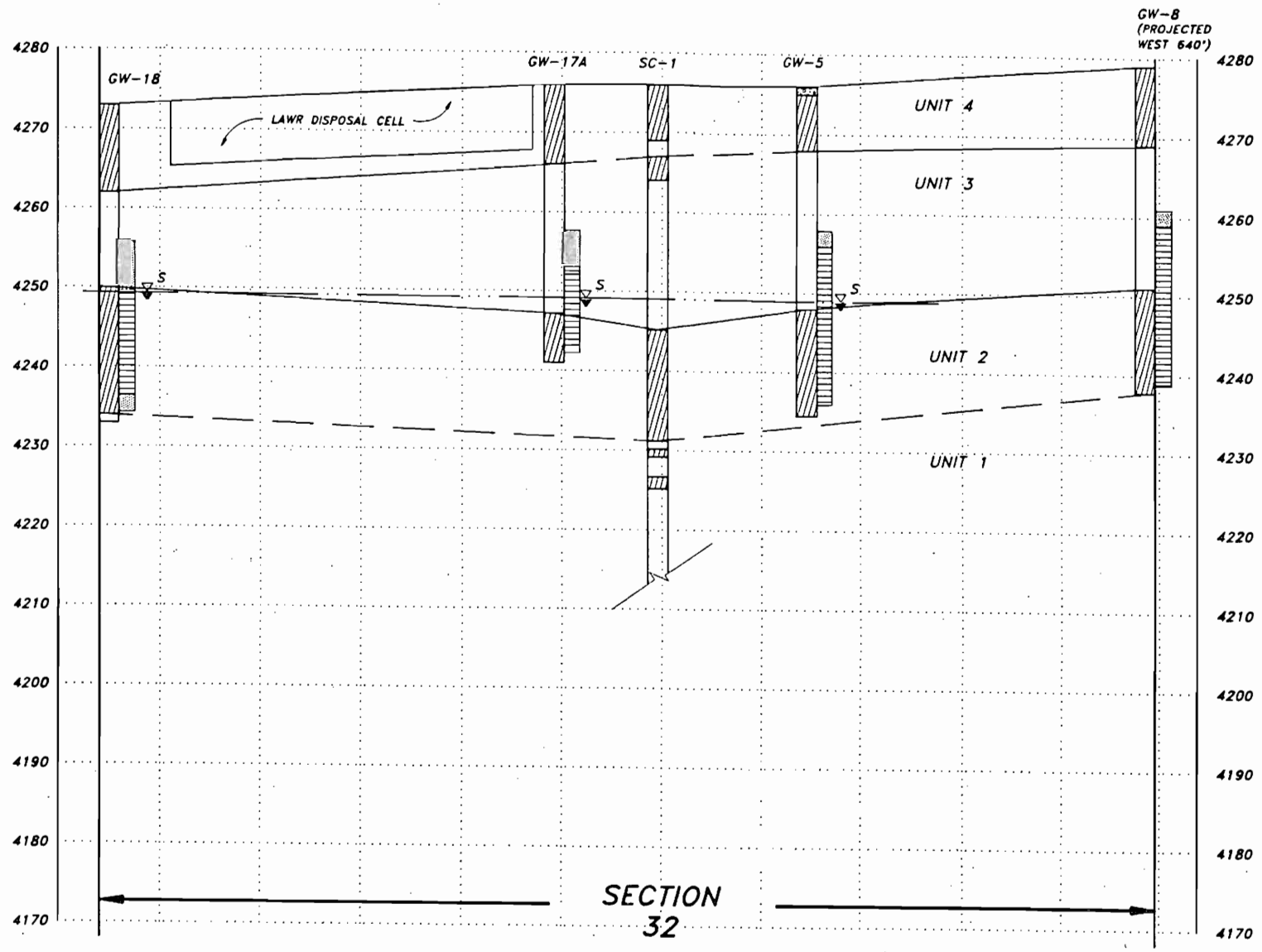
HYDROGEOLOGIC CROSS SECTION D-D'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 7

Rev.	By	Date	Remarks
1	SLP	9/30/91	REVISE WELL SCREEN

Date MARCH 1991 | Proj. # 1418-010 | T.M.



LEGEND

- SILTY CLAY
- CLAYEY SILT
- SILTY SAND
- GRAVELLY SAND
- BEDROCK — PALEOZOIC LIMESTONE, DOLOMITE & SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES.
- SILICA SAND
- WELL SCREEN
- GROUNDWATER LEVEL MEASURED ON FEBURARY 26, 1991

0 400 800 1200
Scale in Feet
HORIZONTAL SCALE

0 10 20 30
Scale in Feet
VERTICAL SCALE

Rev.	By	Date	Remarks
1	SLP	9/31/91	REVISE WELL SCREEN

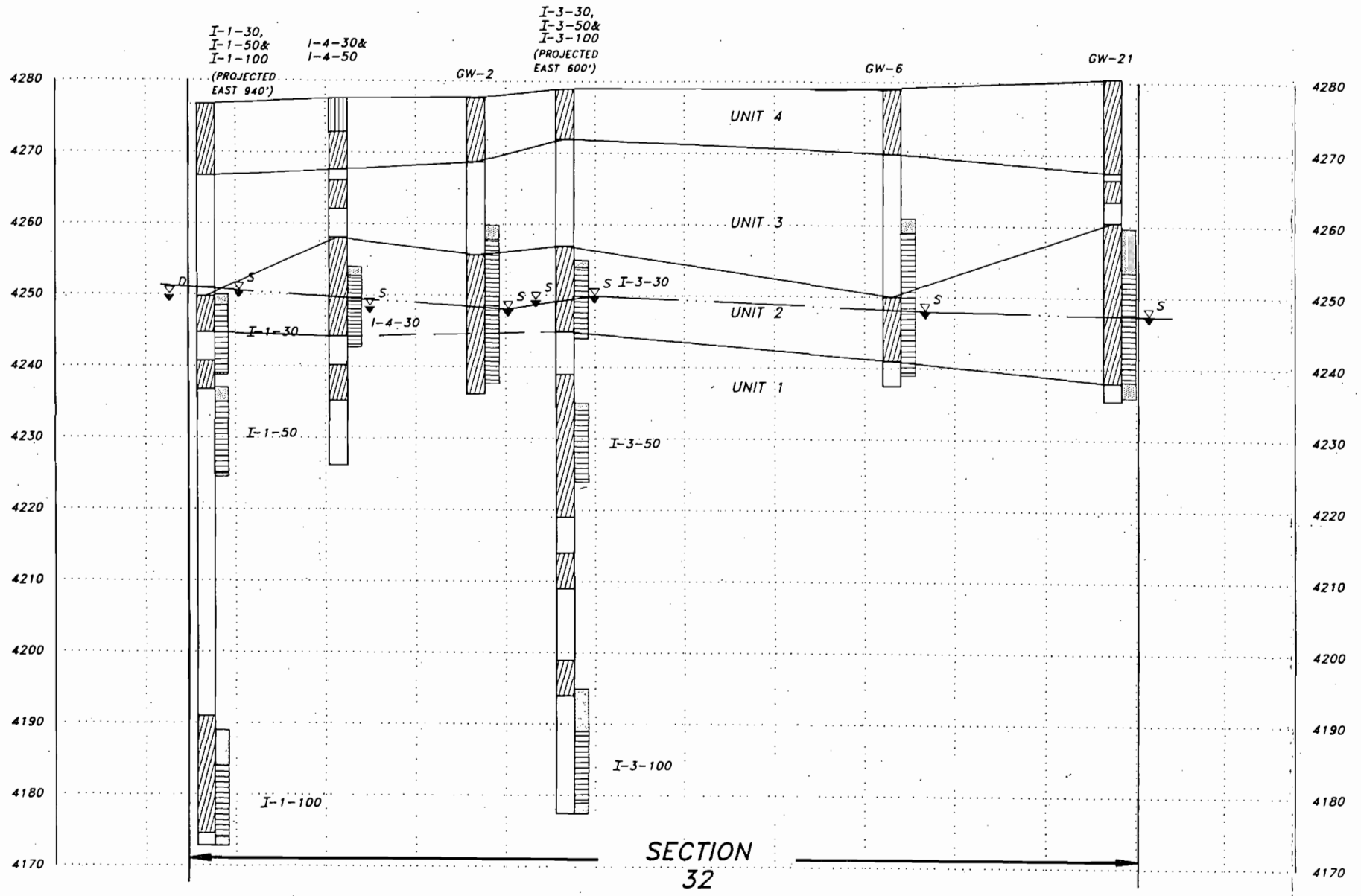
ENVIROCARE OF UTAH

HYDROGEOLOGIC CROSS SECTION E-E'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 8

Date MARCH 1991 | Proj. # 1416-010 | T.M. EVSECE-1



LEGEND

- SILTY CLAY
- CLAYEY SILT
- SILTY SAND
- GRAVELLY SAND
- BEDROCK → PALEOZOIC LIMESTONE, DOLOMITE & SHALE; LOCALLY INCLUDE SANDSTONE, QUARTZITE & EVAPORITES.
- SILICA SAND
- WELL SCREEN
- GROUNDWATER LEVEL MEASURED ON FEBRUARY 26, 1991

0 400 800 1200
Scale in Feet
HORIZONTAL SCALE

0 10 20 30
Scale in Feet
VERTICAL SCALE

Rev.	By	Date	Remarks
1	SLP	9/31/91	REVISE WELL SCREEN

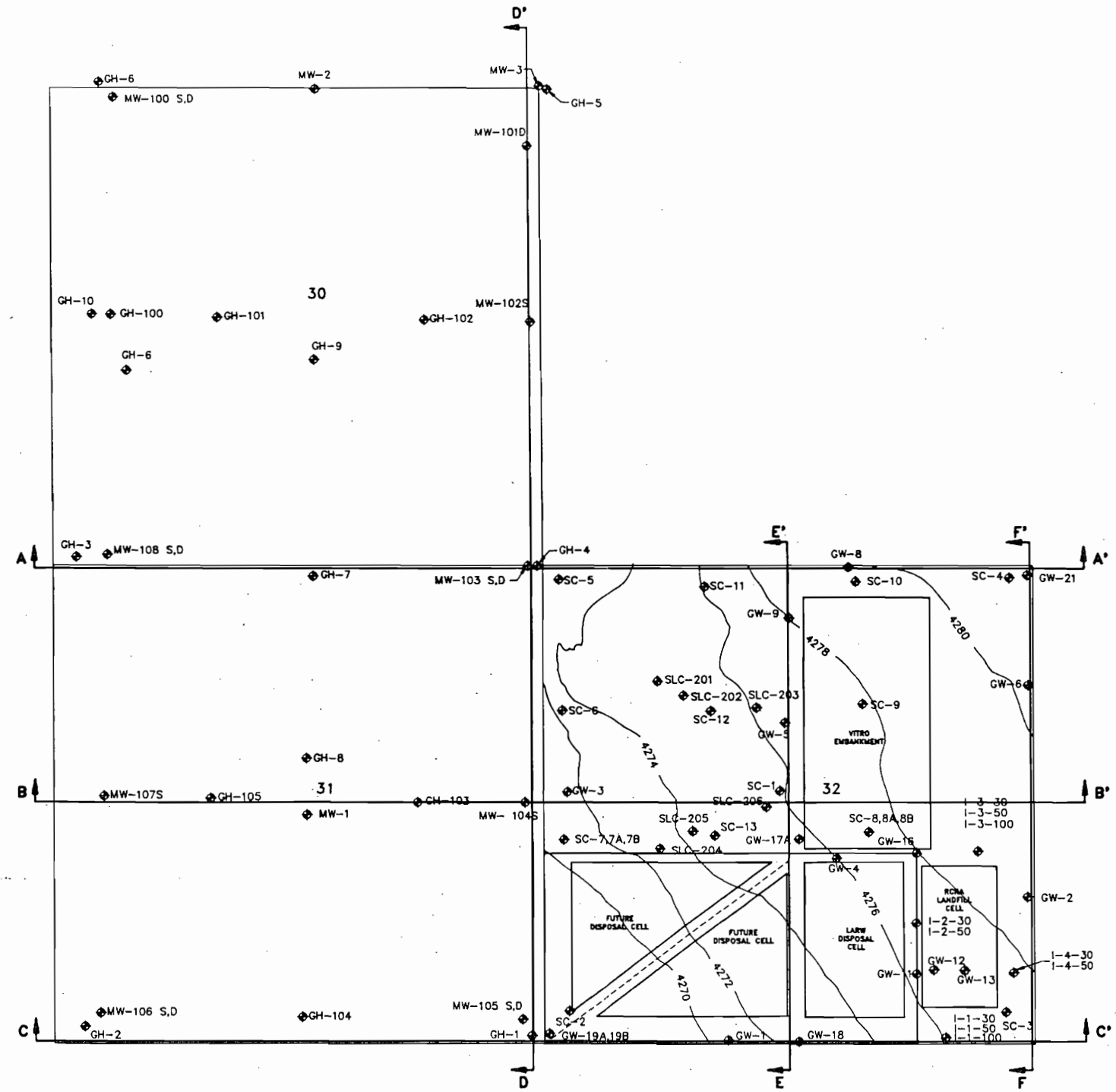
ENVIROCARE OF UTAH

HYDROGEOLOGIC CROSS SECTION F-F'

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 9

Date MARCH 1991 | Proj. # 1416-010 | T.M. EVSECF-F



800 0 400 800 1600 3200

(IN FEET)

LEGEND

GW-16 Through GW-21:	Bingham Environmental (1991)
I and other GW's:	Delta Geotechnical Consultants (1988,1990)
MW and GH-	Aptus (1988,1990)
SLC-	Jacobs Engineering Group, Inc. (1984)
4278	Topographic Contour Elevation

NOTE: ALL GH DESIGNATES EXPLORATORY DRILL HOLES, WHICH WERE NOT COMPLETED AS MONITOR WELLS.

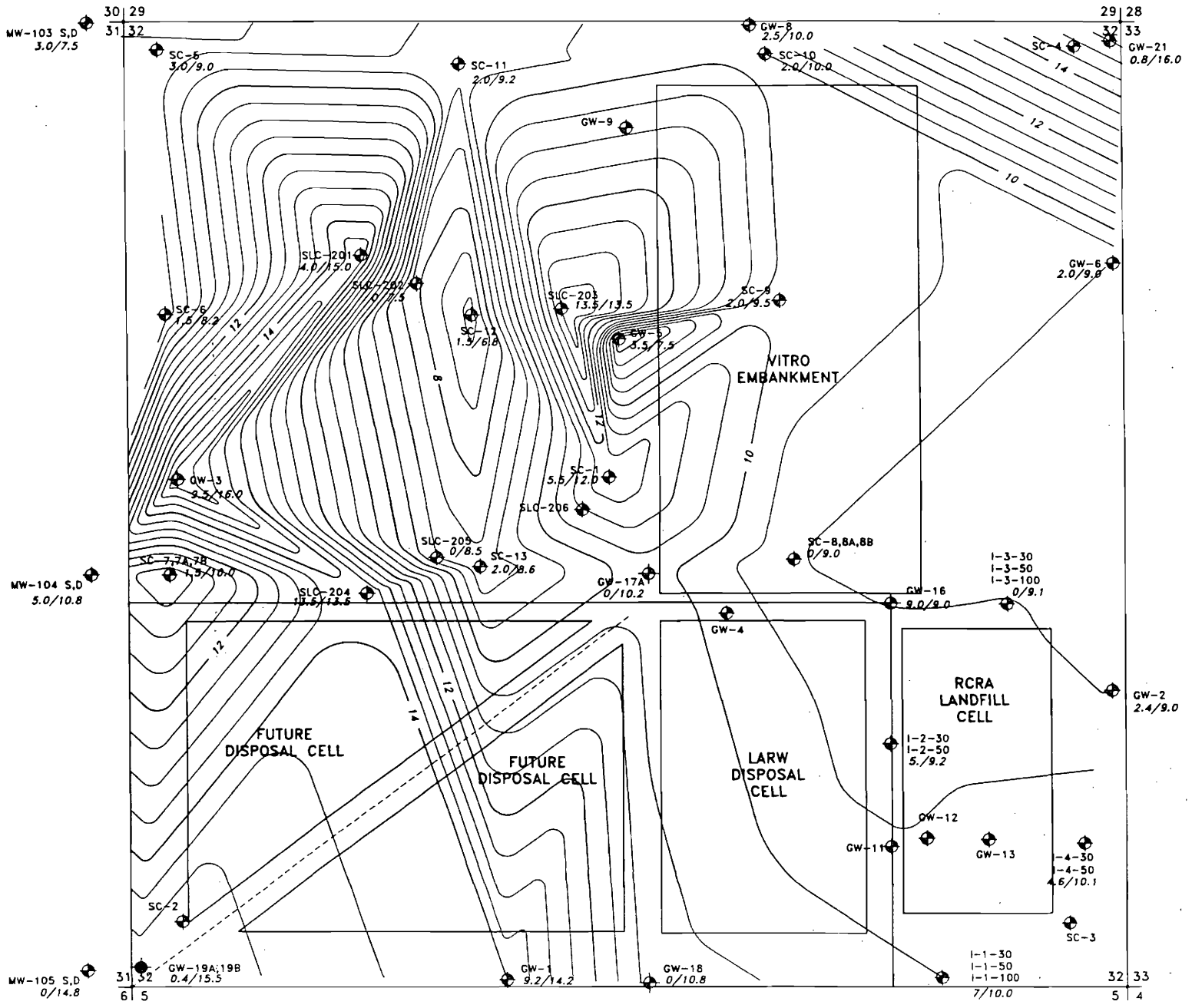
ENVIROCARE OF UTAH

EXPLORATION LOCATION MAP

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 10

Rev.	By	Date	Remarks	Date MAY 1991	Proj. # 1416-010	T.M.	ENV
1	SLP	9/30/91	REVISE CELLS AND NOTES				



LEGEND

- GW-16 Through GW-21: Bingham Environmental (1991)
- I and other GW's: Delta Geotechnical Consultants (1988,1990)
- SLC- Jacobs Engineering Group, Inc. (1984)
- SC- Dames & Moore (1981,1982)
- 11.0 — Unit 4 Thickness Contours
- 2.4/9.0 — Total Thickness of Unit 4 (in feet) / Non-CL Soil Thickness (in feet)

SLBM, SEC. 32, T. 1 S., R. 11 W.

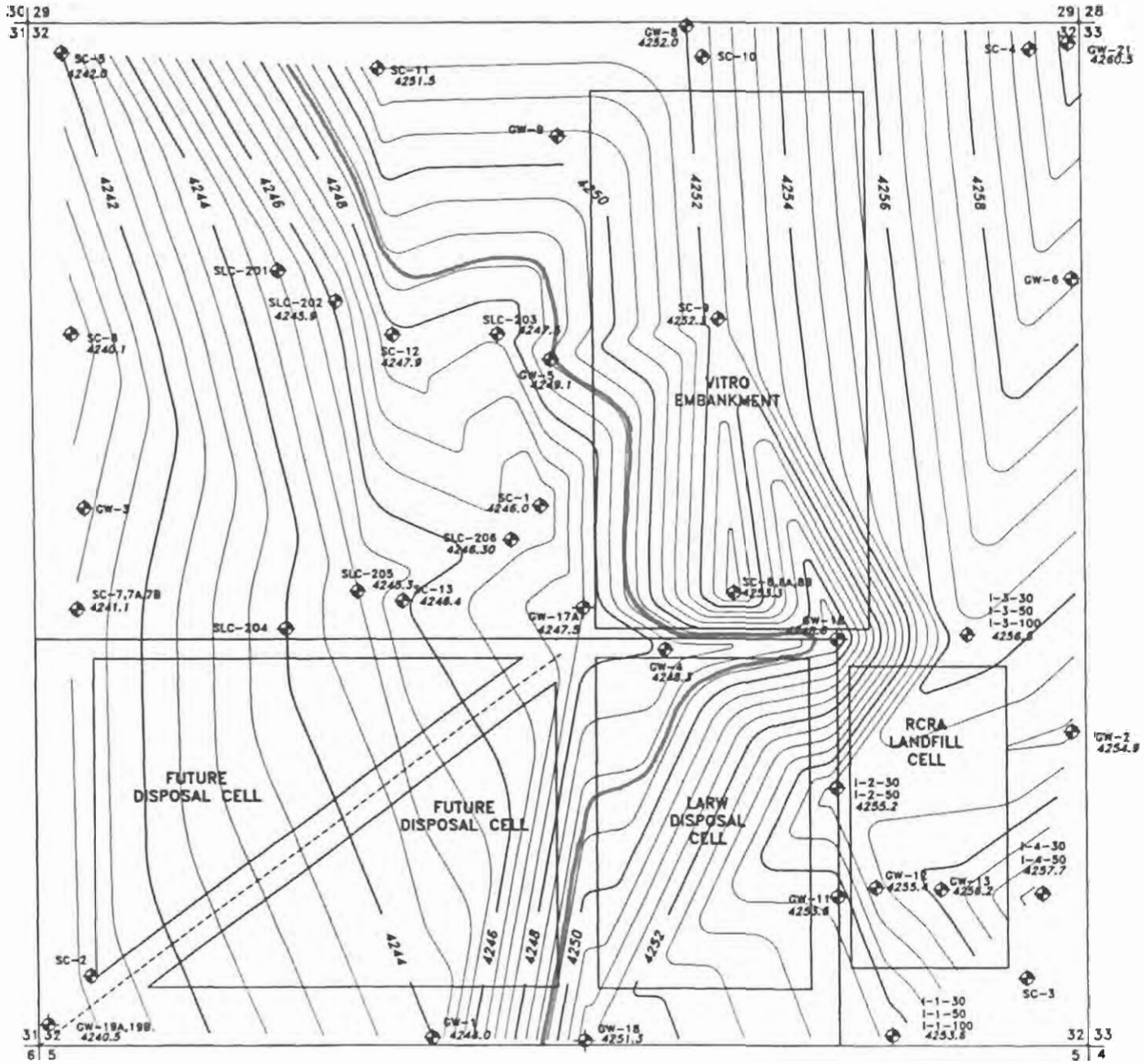
ENVIROCARE OF UTAH

ISOPACH MAP OF UNIT 4 CLAY

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 11

Rev.	By	Date	Remarks	Date SEP. 1991	Proj. # 1416-018	T.M.



LEGEND

GW-16 Through GW-21:	Bingham Environmental (1991)
I and other GW's:	Delta Geotechnical Consultants (1988,1990)
SLC-	Jacobs Engineering Group, Inc. (1984)
SC-	Dames & Moore (1981,1982)
4258	Top of Unit 2 Elevation Contours, Top of Unit 2 Elevations Included Adjacent to Well
	Intercept of Water Table with Top of Unit 2 Clay

400 0 200 400 800 1600

(IN FEET)

SLBM, SEC. 32, T. 1 S., R. 11 W.

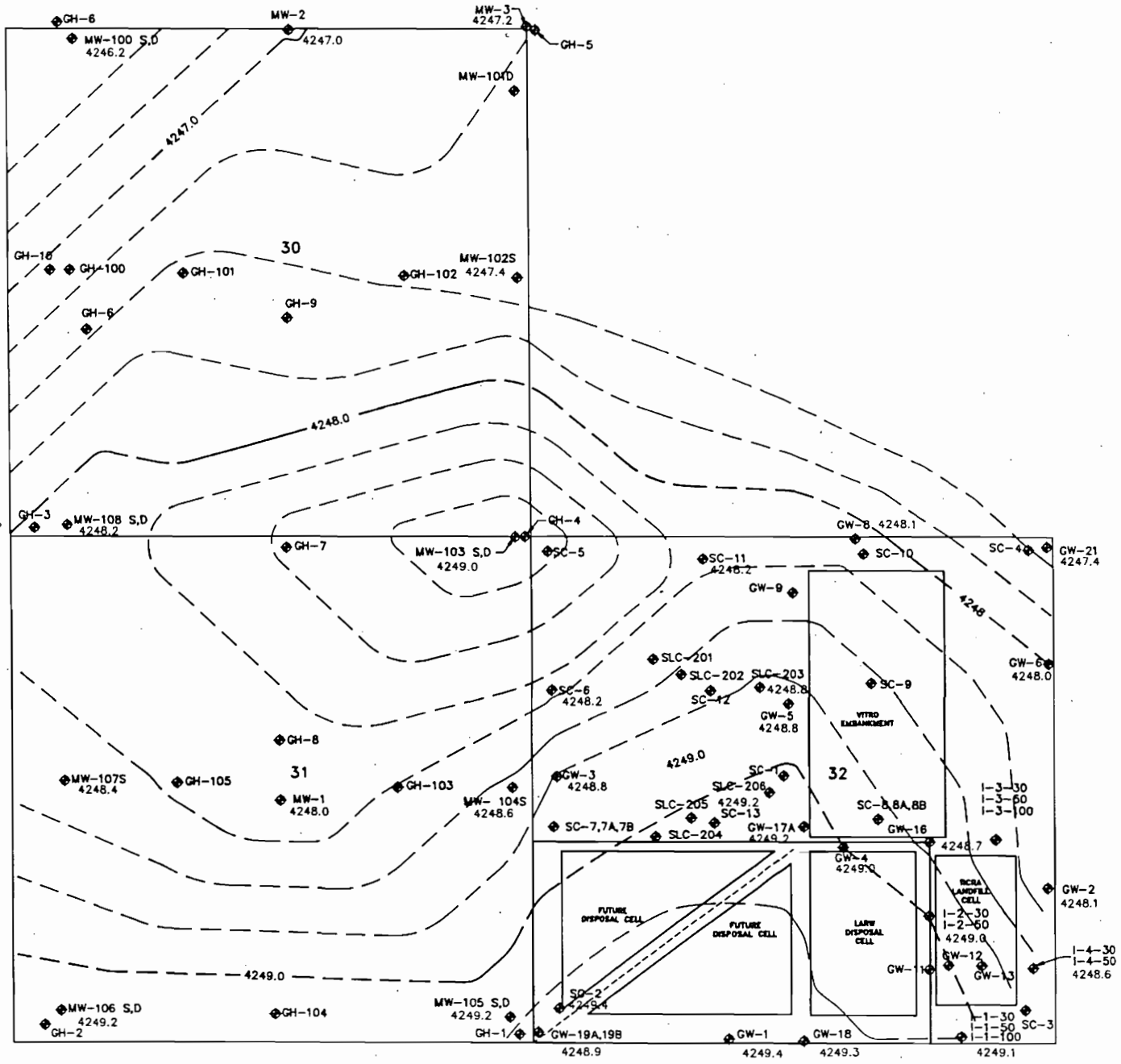
ENVIROCARE OF UTAH

STRUCTURAL CONTOUR MA
TOP OF UNIT 2

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 12

Rev.	By	Date	Remarks	Date SEPT. 1991	Proj. # 1416-018	T.M.



800 0 400 800 1600 3200

(IN FEET)

LEGEND

——— 4247.50 ——— Potentiometric Level (February 26, 1991)

Groundwater Elevation Included Adjacent to Well I.D.

- ◆ GW-16 Through GW-21: Bingham Environmental (1991)
- ◆ I and other GW's: Delta Geotechnical Consultants (1988,1990)
- ◆ MW and GH- Aptus (1988,1990)
- ◆ SLC- Jacobs Engineering Group, Inc. (1984)

ENVIROCARE OF UTAH

POTENTIOMETRIC MAP

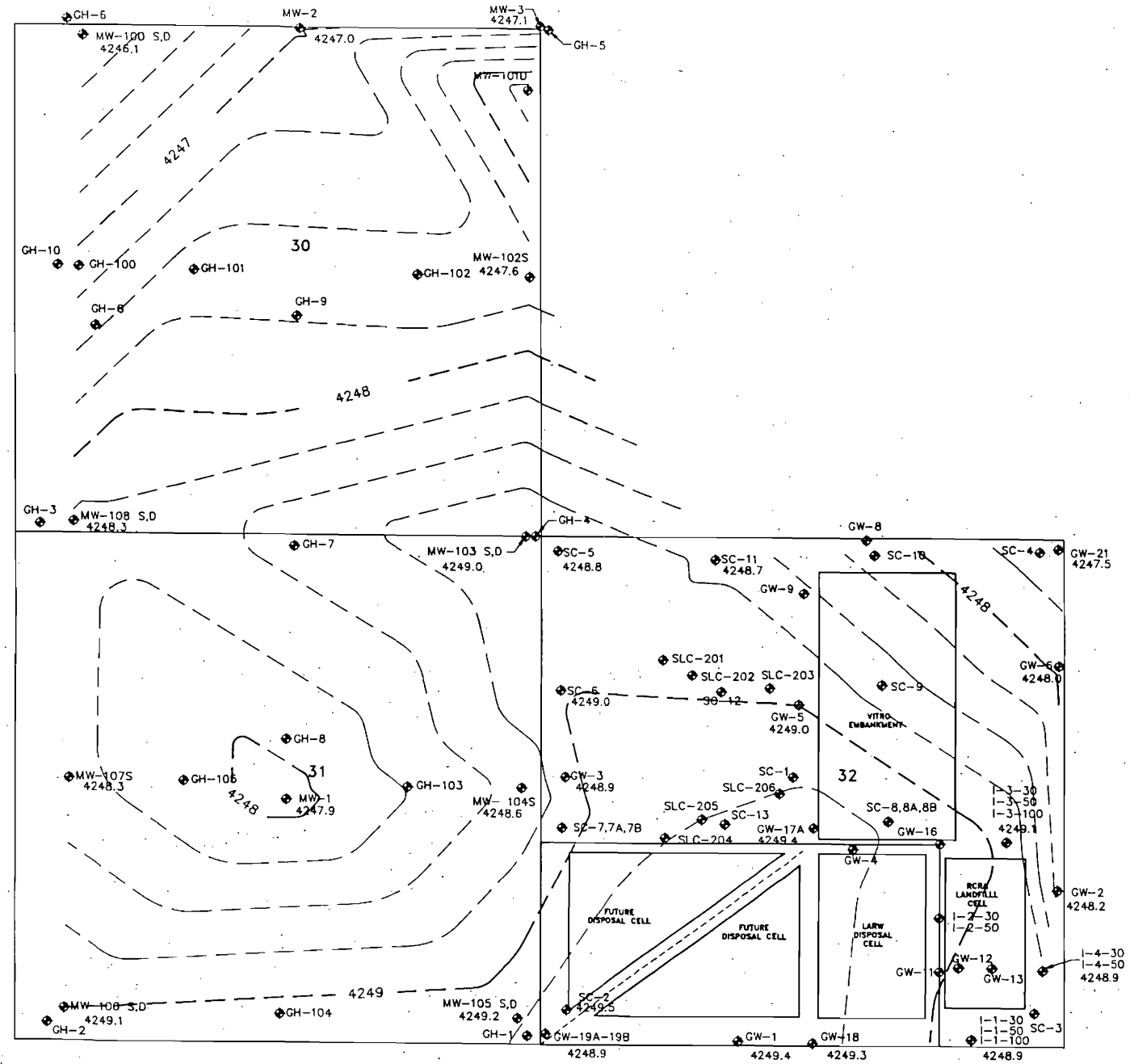
SHALLOW UNCONFINED AQUIFER

(February 1991)

BINGHAM ENVIRONMENTAL
SALT LAKE CITY – (801) 532-2230

FIGURE 14

Rev.	By	Date	Remarks	Date	Proj. #	T.M.
1	SLP	9/30/91	REVISE CONTOURS	MAY 1991	1416-010	



800 0 400 800 1600 3200

(IN FEET)

LEGEND

——— 4247.5 ——— Potentiometric Level (May 10, 1991)

Groundwater Elevation Included Adjacent to Well I.D.

- GW-16 Through GW-21: Bingham Environmental (1991)
- I and other GW's: Delta Geotechnical Consultants (1988,1990)
- MW and GH- Aptus (1988,1990)
- SLC- Jacobs Engineering Group, Inc. (1984)

ENVIROCARE OF UTAH

POTENTIOMETRIC MAI

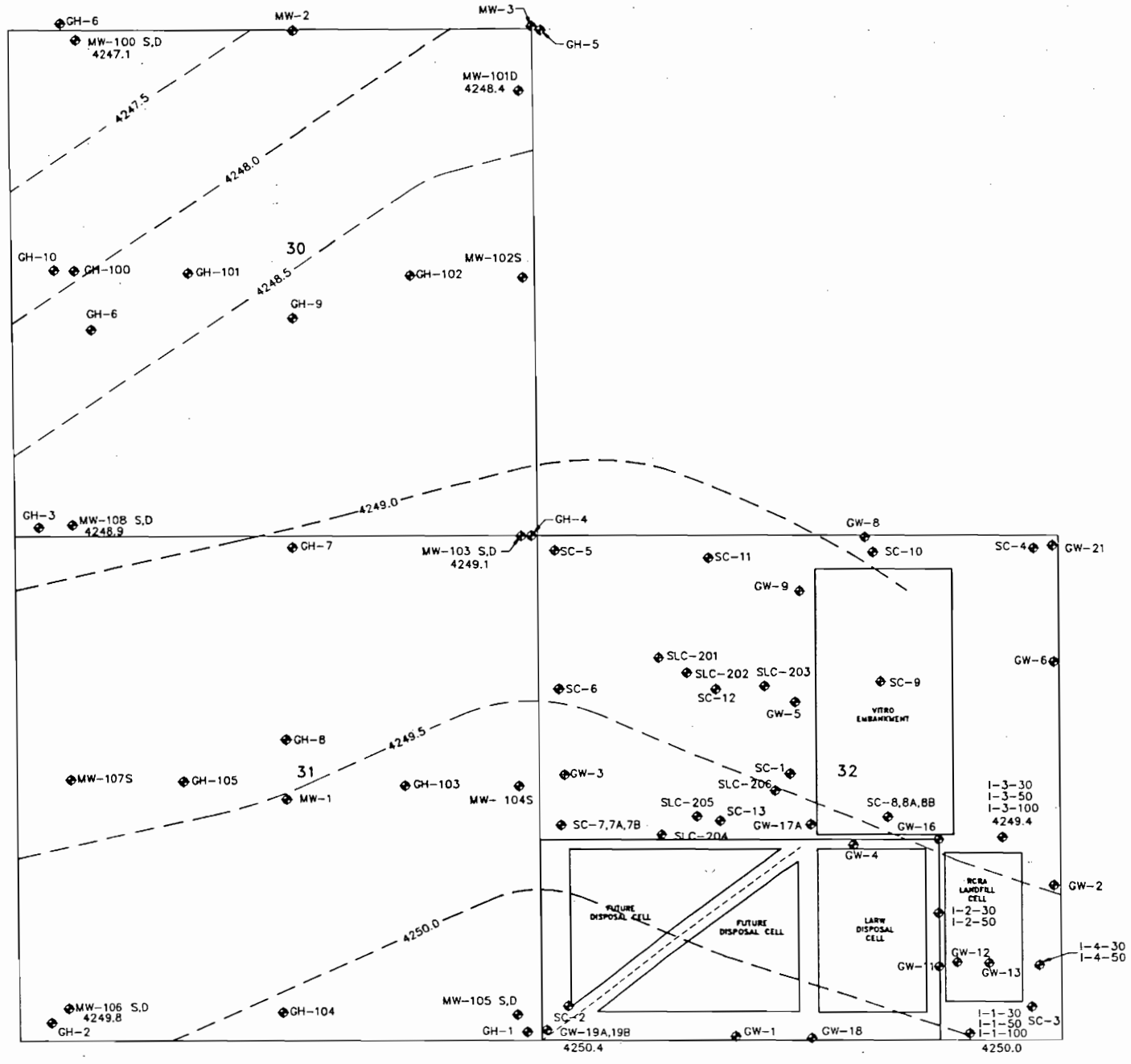
SHALLOW UNCONFINED AQUIFER

(May 1991)

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 15

Rev.	By	Date	Remarks	Date SEP. 1991	Proj. # 1416-018	T.M.



800 0 400 800 1600 3200

(IN FEET)

LEGEND

— — 4247.5 — — Potentiometric Level (February 26, 1991)

Groundwater Elevation Included Adjacent to Well I.D.

- GW-16 Through GW-21: Bingham Environmental (1991)
- I and other GW's: Delta Geotechnical Consultants (1988,1990)
- MW and GH- Aptus (1988,1990)
- SLC- Jacobs Engineering Group, Inc. (1984)

ENVIROCARE OF UTAH

POTENTIOMETRIC MAP

DEEPER CONFINED AQUIFER

(February 1991)

BINGHAM ENVIRONMENTAL
SALT LAKE CITY - (801) 532-2230

FIGURE 1

Rev.	By	Date	Remarks
1	SLP	9/30/91	REVISE CONTOURS

Date MAY 1991 | Proj. # 1416-010 | T.M.

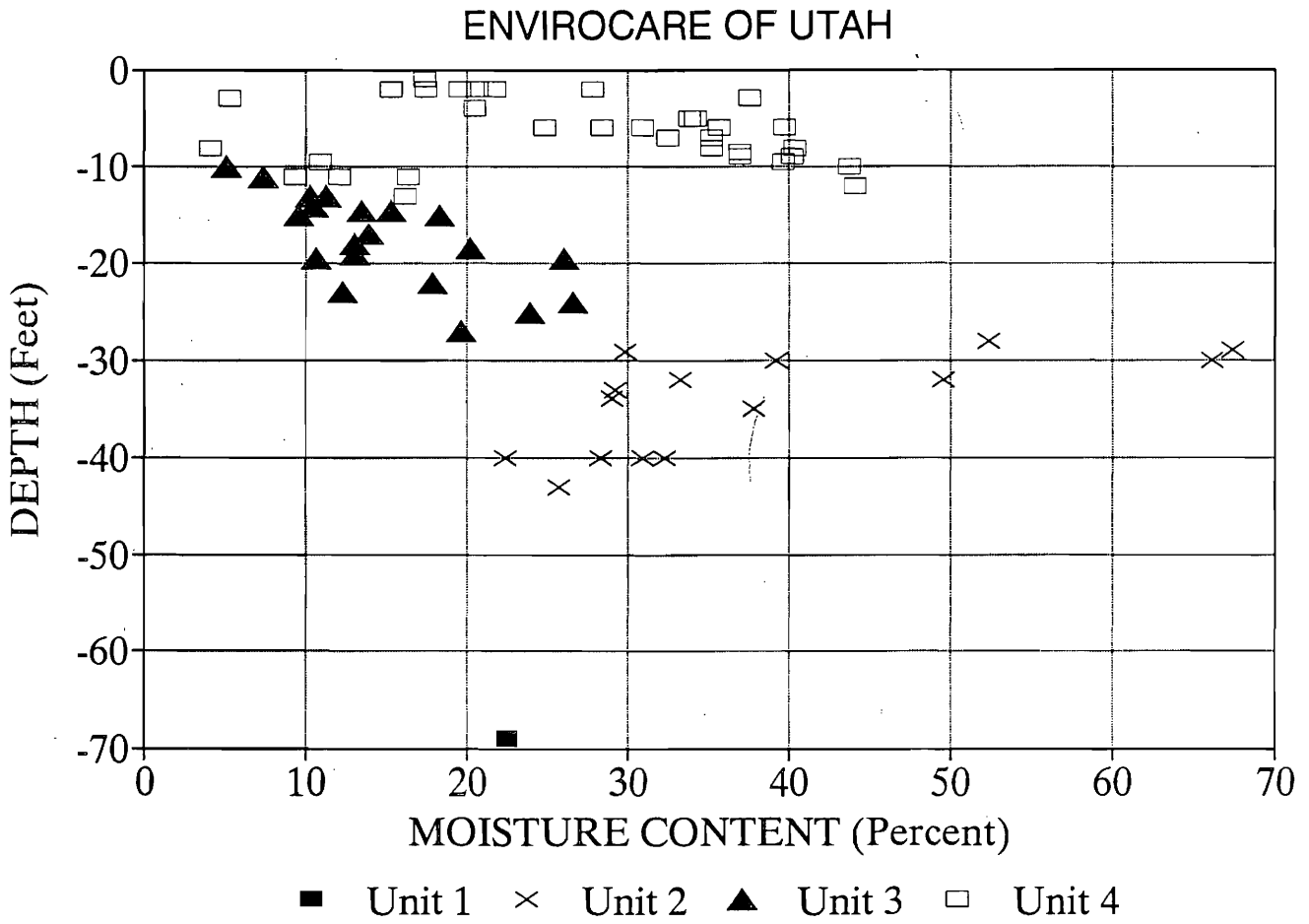


FIGURE 13 - MOISTURE vs. DEPTH

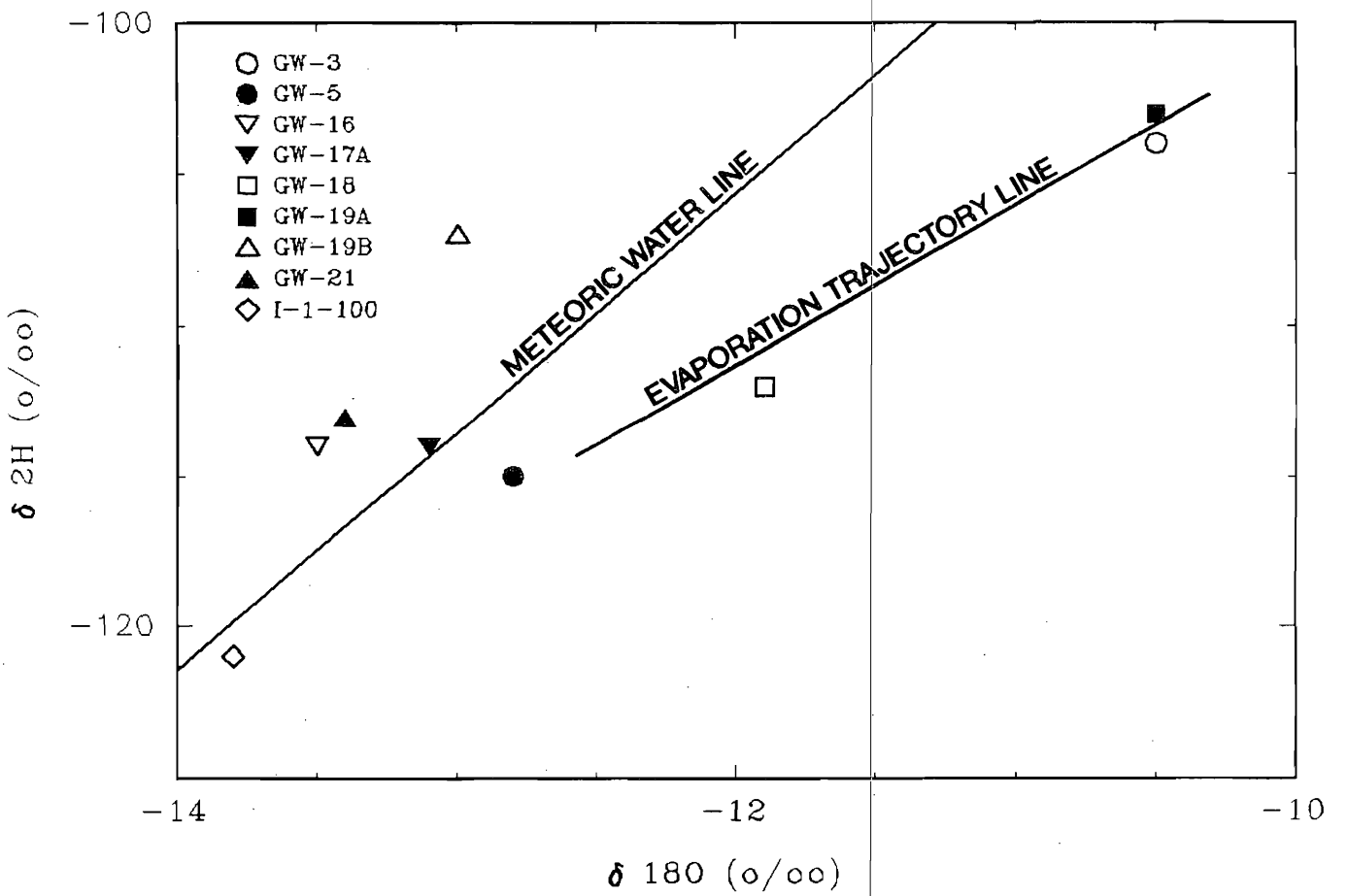
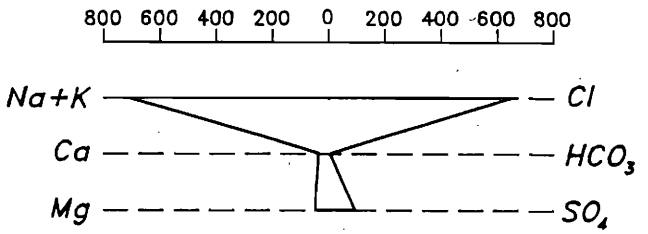
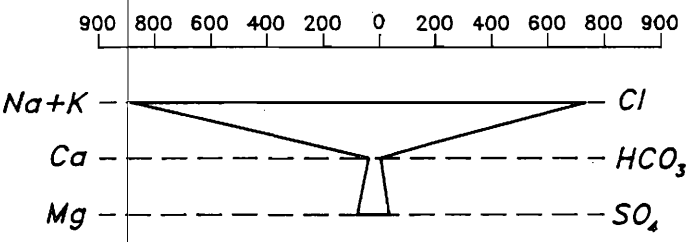


FIGURE 18 - ISOTOPIC COMPOSITION OF WATER

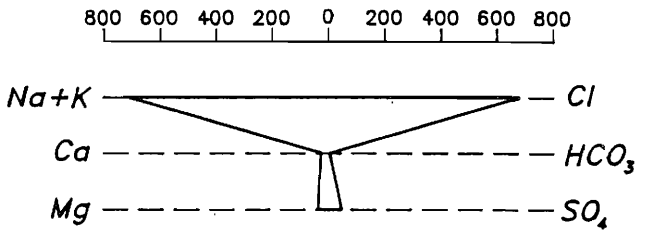
GW-3



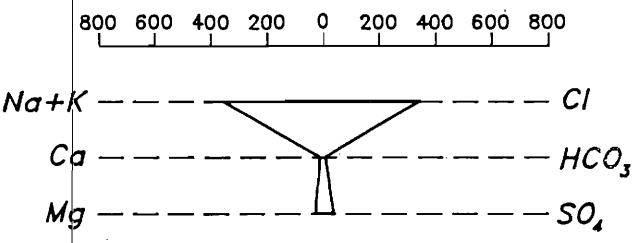
GW-19A



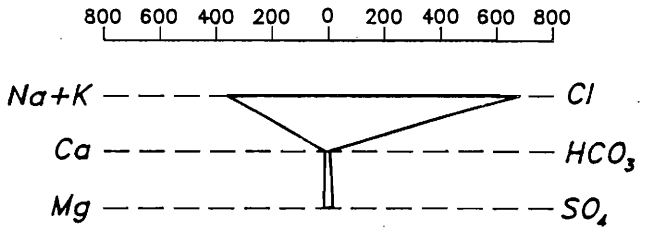
GW-5



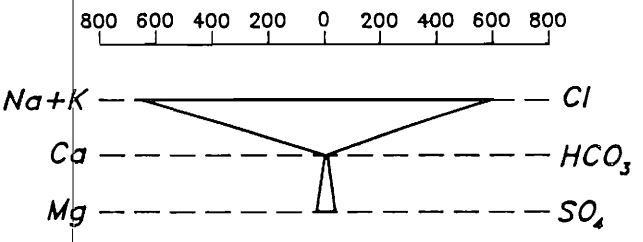
GW-19B



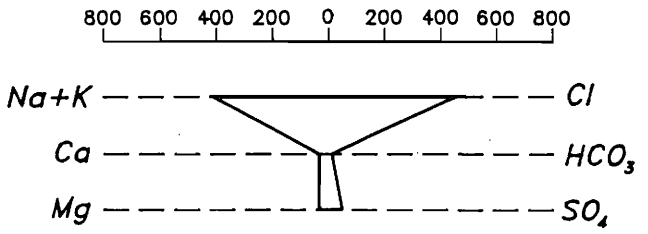
GW-16



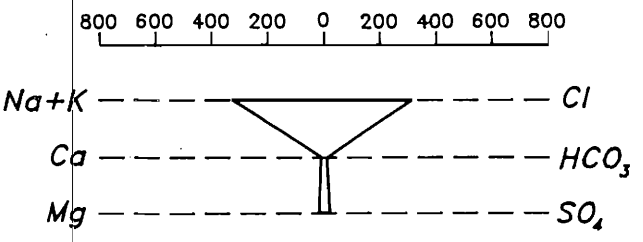
GW-21



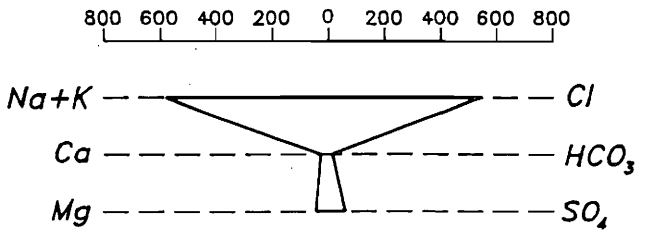
GW-17A



I-1-100



GW-18



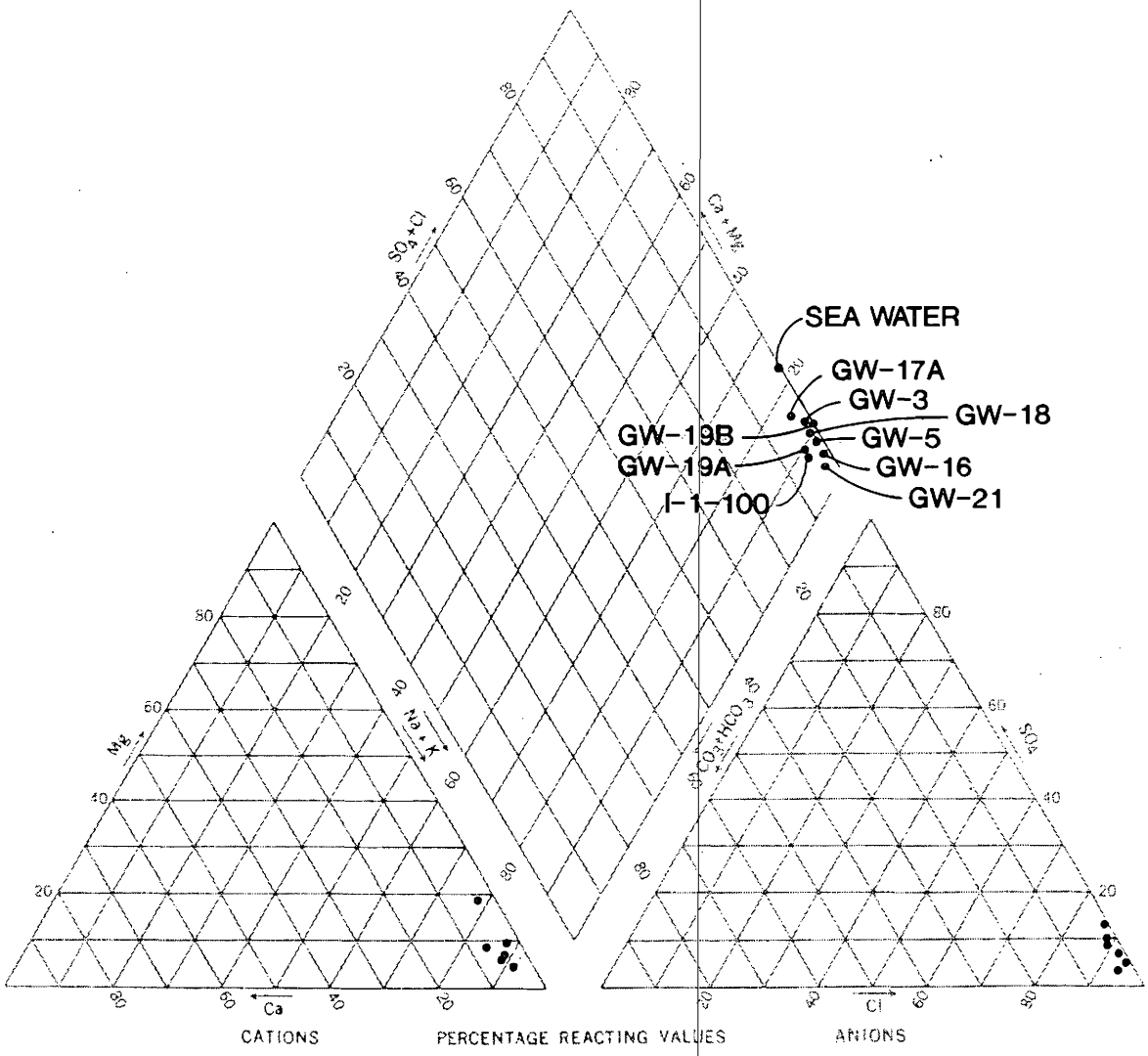
ENVIROCARE OF UTAH

STIFF DIAGRAM

BINGHAM ENVIRONMENTAL
Salt Lake City, Utah
(801) 532-2230

FIGURE 19

Date	Proj. #	T.M.
10/3/91	1416-018	1416CHRT



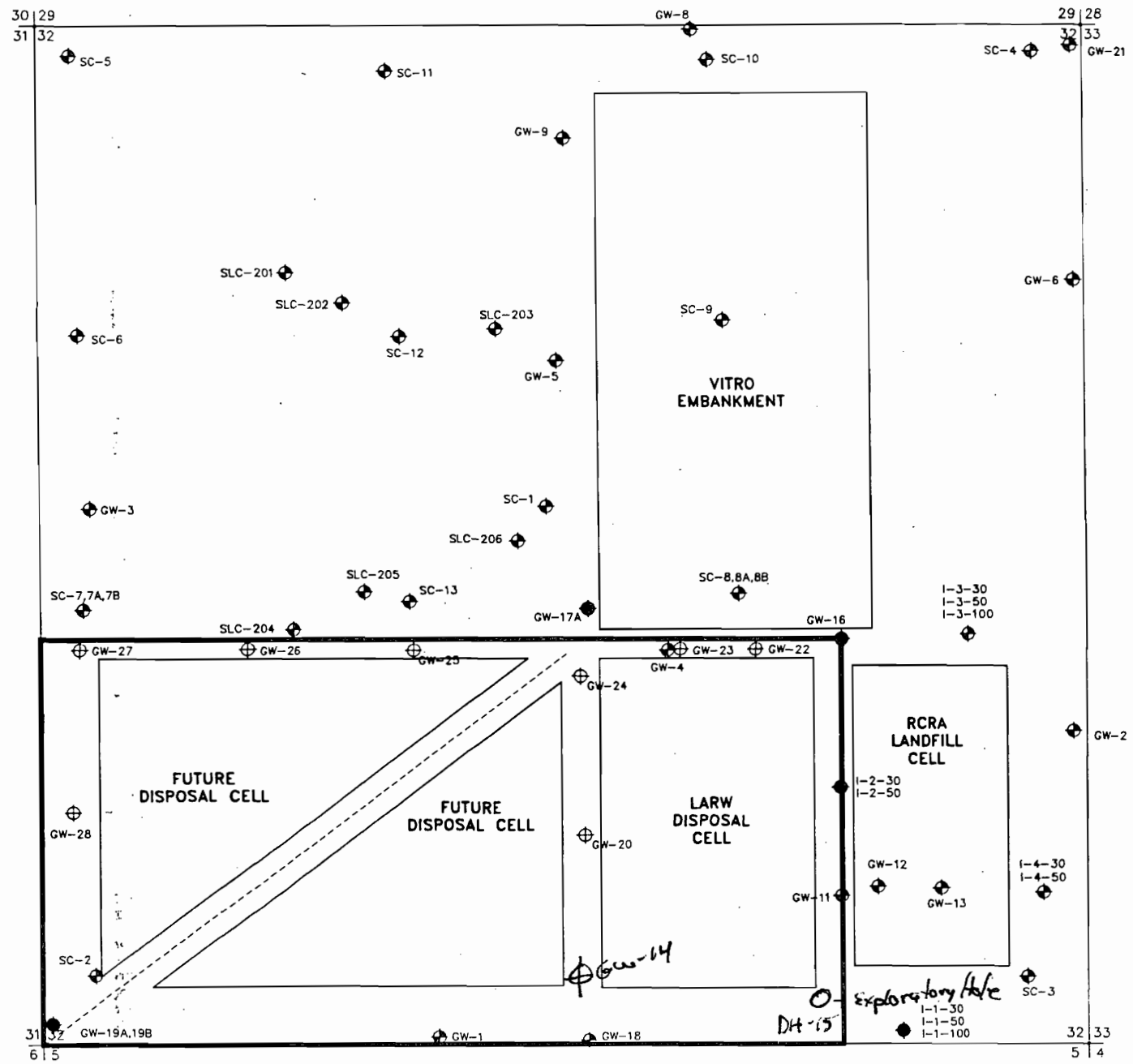
ENVIROCARE OF UTAH

TRILINEAR DIAGRAM

BINGHAM ENVIRONMENTAL
Salt Lake City, Utah
(801) 532-2230

FIGURE 20

Date 5/14/91 | Proj. # 1416-010



400 0 200 400 800 1600

(IN FEET)

SLBM, SEC. 32, T. 1 S., R. 11 W.

LEGEND

GW-16 Through GW-21:	Bingham Environmental (1991)
I and other GW's:	Delta Geotechnical Consultants (1988,1990)
SLC-	Jacobs Engineering Group, Inc. (1984)
SC-	Dames & Moore (1981,1982)
⊕	Proposed Compliance Monitor Wells
◆	Monitor Wells To Be Included in Network
▭	Groundwater Quality Discharge Permit Area

PROPOSED COMPLIANCE MONITOR WELLS

UPGRADIENT MONITOR WELLS:

GW-19A
I-1-30

DOWN GRADIENT COMPLIANCE MONITOR WELLS

LARW:

I-2-30
GW-16
GW-20
GW-22
GW-23
GW-24

FUTURE DISPOSAL CELLS

GW-20
GW-24
GW-25
GW-26
GW-27
GW-28

NOTES

1. GW-17A TO MONITOR PERFORMANCE OF VITRO DISPOSAL CELL. THIS IS NOT PROPOSED TO BE A COMPLIANCE MONITOR WELL.
2. PROPOSE THAT COMPLIANCE MONITOR WELLS GW-20, GW-22, GW-23, AND GW-24 BE INSTALLED IMMEDIATELY.
3. PROPOSED MONITOR WELLS GW-25, GW-26, GW-27 AND GW-28 TO BE INSTALLED PRIOR TO DISPOSAL OF WASTE IN THE FUTURE DISPOSAL CELLS.

Rev.	By	Date	Remarks
1	SLP	9/30/91	REVISE MONITOR WELL NETWORK

ENVIROCARE OF UTAH

MONITOR WELL NETWORK

BINGHAM ENVIRONMENTAL
SALT LAKE CITY – (801) 532-2230

FIGURE 2

Date SEPT. 1991 | Proj. # 1416-010 | T.M.

APPENDIX A

FIELD PROGRAM

APPENDIX A

FIELD PROGRAM

GENERAL

This appendix includes information developed as part of the hydrogeologic studies performed at the Envirocare of Utah site, South Clive, Utah.

We have included all pertinent field data in one single appendix that includes the following:

1. Hydrogeologic drill hole logs
2. Monitor well completion details
3. Water level measurements
4. Slug test results
5. Groundwater sampling
6. Survey information

The majority of the field program was performed between February and April, 1991. Bingham Environmental (Bingham) geologists and/or engineers supervised the field activities. The locations of all monitor wells and groundwater sampling performed as part of this study and from previous studies are shown on Figure 1, Site Map.

MONITOR WELLS

The Work Plan prepared by Bingham Environmental (Bingham) for permitting assistance to Envirocare of Utah's Low Activity Radioactive Waste Disposal Site, dated January 14, 1991, originally proposed drilling nine (9) to twelve (12) exploratory holes at six (6) to nine (9) locations. At the time the Work Plan was being developed, Bingham was not aware

of recent hydrogeologic investigation being performed by Aptus on the adjacent Sections 30 and 31. An informal agreement was established between Envirocare and Aptus to share the hydrogeologic data being generated from both sites. Based on the additional data from Aptus the field activity scope of work was modified to the drilling and installation of six (6) monitor wells at five (5) locations. The monitor wells identified as GW-16, GW-17A, GW-18, GW-19A, GW-19B and GW-21 were drilled and constructed starting on February 4, 1991 through February 13, 1991. The drilling program was conducted using an all-terrain-vehicle (ATV) CME 750 drill rig operated by Overland Drilling. The drill holes were advanced using 8 3/4-inch diameter hollow stem augers.

A Bingham hydrogeologist and/or engineer supervised the drilling operations during the duration of the drilling program. They located the holes, logged the subsurface soil and groundwater profile and obtained both undisturbed and disturbed samples. The majority of the samples were obtained by driving a standard penetration sampler (SPT) either 18 or 24 inches. Relatively undisturbed samples were obtained using thin walled steel samplers (Shelby tubes) or using the CME continuous sampler with lucite tubes. All samples were recorded on the logs which are included in this appendix along with a legend to and in interpreting the logs. Depending on the sample type they were either sent to Bingham Engineering's Materials Laboratory or forwarded to Colorado State University's Porous Media Laboratory. During drilling operations all equipment was cleaned with high pressure hot potable water to minimize the potential for well contamination.

MONITOR WELL COMPLETION DETAILS

Monitor well completion was accomplished with the installation of two-inch diameter flush-coupled schedule 40 PVC pipe with .010-inch and .020-inch machine slotted screen in the bottom 10 to 20 feet. The annulus was backfilled with #10-20 or #16-40 Colorado silica sand to a minimum height of 2 feet above the screened interval. A bentonite pellet plug 2 feet in thickness was placed over the sand filter. The remaining annulus was backfilled with a cement-bentonite slurry. A protective concrete pad and locking steel casing were placed at the surface of the monitor wells. Illustrations of monitor well completion details

are presented as part of this appendix.

The monitor wells were allowed to stabilize for a 24-hour period prior to development. The wells were developed by removing several well volumes of water with a 2-inch diameter PVC bailer. Bailing was continued until the water was relatively clear of sand and other sediments. Bailing revealed that the wells were recharging at medium to high rates.

WATER LEVEL MEASUREMENTS

Water levels have been measured in the existing and new monitor wells throughout the field program. This includes measurements performed during the drilling of each boring and on February 26, 1991, May 10, 1991 and October 7, 1991. Water levels measurements were determined using an electronic well probe. Each measurement is referenced to the top of casing (TOC) which was surveyed so that elevations could be determined. The monitor well water level elevations are tabulated in this appendix along with summary tables of previous measurements.

SLUG TESTS

Slug injection tests were performed on eight (8) monitor wells identified as GW-3, GW-5, GW-16, GW-18, GW-19A and GW-19B on April 10, 1991 and GW-17A and GW-21 on May 10, 1991. Each test consisted of injecting a known volume of previously bailed water back into the monitor well as rapidly as possible and then measuring the depth to water as the water level dropped back to its original static level.

The tests were performed using automatic water level monitoring and logging equipment which provided accurate water level measurements during the recovery phase. Results of the tests have been tabulated and plotted and are included in this appendix.

The data was analyzed using methods developed by Hvorslev (1951), Bouwer (1972),

Cooper, et al (1967) and Ferris and Knowles (1963). Wells GW-3, GW-5, GW-16 and GW-17A were screened over multiple hydrostratigraphic units (Units 2 and 3) and may best represent the coarser grained soil. Wells GW-18 and GW-21 were screened in hydrostratigraphic units with fine grained soil such as unit 2 (silty clay and clay) and may show higher than typical hydraulic conductivity values for clay due to silty sand and sandy clay lenses found in those wells. A summary of the hydraulic conductivity values estimated from the slug tests is provided in the appendix along with the hydrostratigraphic unit the well is screened over and the analysis method(s) used to evaluate the slug test data.

GROUNDWATER SAMPLING

Groundwater samples were obtained from GW-19A, GW-19B and GW-21 on April 3, 1991; from GW-3, GW-5, GW-16 and GW-17A on April 5, 1991; and from GW-18 and I-1-100 on April 8, 1991 and analyzed for selected chemical constituents.

Prior to sampling and testing, the water level was measured and at least three casing volumes of water removed from each well. Water was removed from the monitor wells using a PVC bailer. Once the three casing volumes had been removed, additional water was removed and monitored until the pH and specific conductance stabilized, at which point samples were obtained.

Field measurements performed during groundwater sampling are on file. All sampling and testing equipment was cleaned with Alconox, a non-phosphate detergent, and triple-rinsed with distilled water between samples.

Samples were obtained from the monitor wells using the PVC bailer. Once the pH, specific conductance, temperature and dissolved oxygen were determined the water sample was placed in sample bottles. Chain-of-custody forms were filled out for each well, sample labels were filled out and attached to the sample bottles and the samples were stored on ice in coolers. All samples were sent to the laboratory for analysis within 24 hours.

SURVEYING

Bingham performed surveying on all existing wells at the Site, as part of the field program, because several discrepancies were found in previous survey data. An initial survey was conducted on February 15, 1991 with a follow-up survey performed on March 4, 1991. The surveying included determining the horizontal and vertical locations of all existing monitor wells, piezometers and miscellaneous features at the Envirocare Site. All data was reported based on USGS and State Plane coordinance datums located at the southwest corner of Section 32, which was also used by Aptus as their benchmark. A table included in the appendix provides a summary of the monitor well locations and elevations.

REFERENCES

Cooper,H.H., Jr., Bredehoeft, J.D., and Papadopulos, I.S., 1967, Response of a Finite Diameter Well to an Instantaneous Charge of Water: Water Resources Research, v. 3, No. 1, p. 263-269.

Ferris, J. G., and Knowles, D.B., 1962, The Slug Injection Test for Estimating the Coefficient of Transmissibility of an Aquifer; in Methods of Determining Permeability, Transmissibility and Drawdown: U.S. Geological Survey Water Supply Paper 1536-I, p. 299-304.

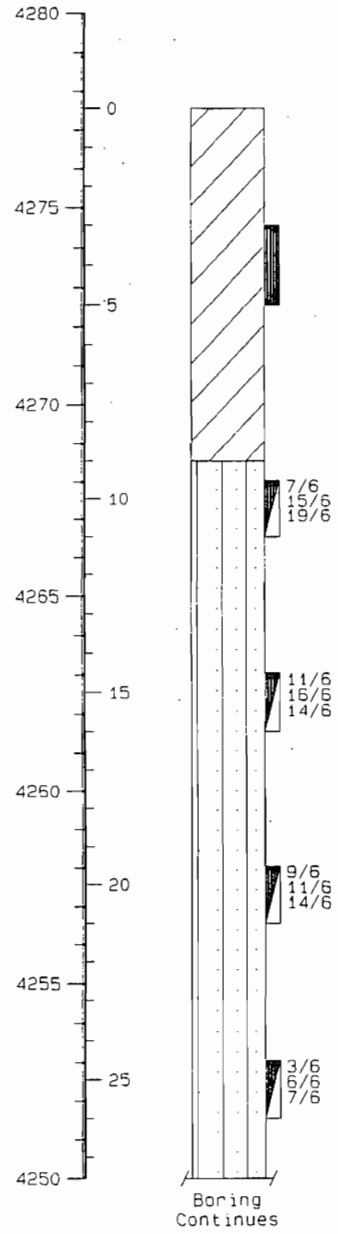
MONITOR WELL LOGS

DRILL HOLE LOG

DRILL HOLE NO.: GW-16

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: NE Corner of LARW Cell
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 29 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/12/91
TOC ELEV.: 4279.36
GS ELEV.: 4277.56
LOGGED BY: MT
HOLE NO.: GW-16



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Tan, sandy, stiff, moist.			
			... grades to tanish gray, silty, iron oxide staining, medium stiff, moist.	S-1	3.0-5.0	2.0/2.0
		SM	SILTY SAND: Tan, silty, fine, dense, slightly moist.	B-2	9.5-11	1.5/1.5
			... trace of gravel			
				B-3	14.5-16	1.3/1.5
			... grades to reddish tan sand, clayey, with occasional sandy clay lenses, medium dense, slightly moist.	B-4	19.5-21	1.5/1.5
				B-5	24.5-26	1.5/1.5

Total depth 41 feet. Completed as shown on separate sheet.

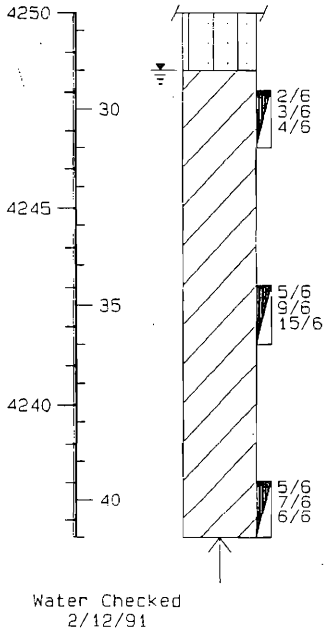
Figure No. 1

DRILL HOLE LOG

DRILL HOLE NO.: GW-16

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: NE Corner of LARW Cell
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 29 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/12/91
TOC ELEV.: 4279.36
GS ELEV.: 4277.56
LOGGED BY: MT
HOLE NO.: GW-16



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Light gray, silty, medium soft, very moist.	B-6	29.5-31	1.5/1.5
			... grades to light gray sandy clay, stiff, wet.	B-7	34.5-36	1.5/1.5
			... grades to tan clay, sandy silty, stiff, moist.	B-8	39.5-41	1.5/1.5

Total depth 41 feet. Completed as shown on separate sheet.

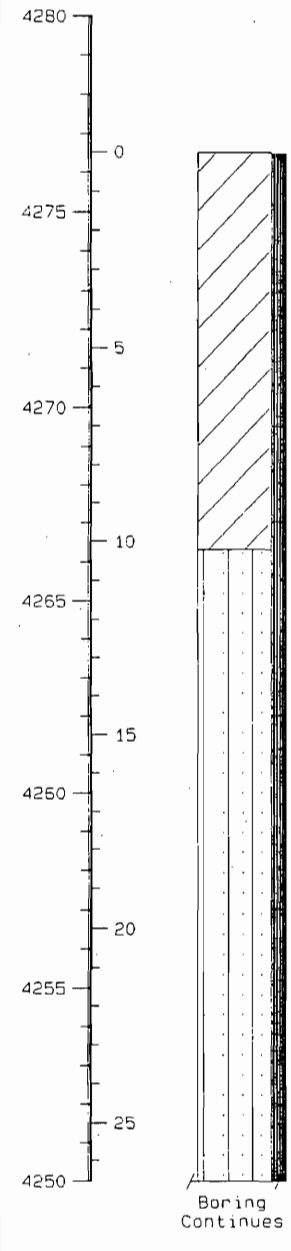
Figure No. 2

DRILL HOLE LOG

DRILL HOLE NO.: GW-17 A

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: NW Corner of LARW cell
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 27.5 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/8/91
TOC ELEV.: 4278.22
GS ELEV.: 4276.53
LOGGED BY: MT
HOLE NO.: GW-17 A



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Light brown grades to tanish gray, slighlty silty and sandy iron oxide staining, soft, moist.	L-1	2.0-4.5	4.0/4.5
			... grades to light gray clay, with silt lenses, iron oxide staining, very moist.	L-2	7.0-9.5	4.0/5.0
		SM	SILTY SAND: Tan, very silty, fine, medium dense, moist.	L-3	9.5-12.5	2.0/5.0
			... trace of gravel	L-4	14.5-17.5	1.2/5.0
			... grades to reddish tan sand, medium dense, moist.	L-5	19.5-22	2.5/5.0

Total Depth 34.5 feet. Completed as shown on separate sheet.

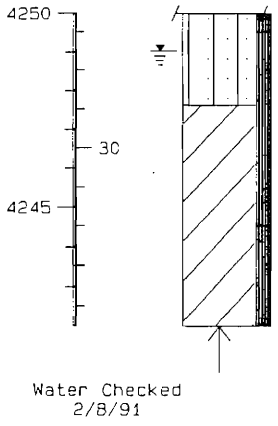
Figure No. 3

DRILL HOLE LOG

DRILL HOLE NO.: GW-17 A

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: NW Corner of LARW cell
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 27.5 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/8/91
TOC ELEV.: 4278.22
GS ELEV.: 4276.53
LOGGED BY: MT
HOLE NO.: GW-17 A



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
			... Sand and clay interbedding.	L-6	27-29.5	3.3/5.0
		CL	SILTY CLAY. Tan, silty sandy, stiff, moist.			
			... grades to greenish gray clay, stiff, very moist.	L-7	32-34.5	5.0/5.0

Total Depth 34.5 feet. Completed as shown on separate sheet.

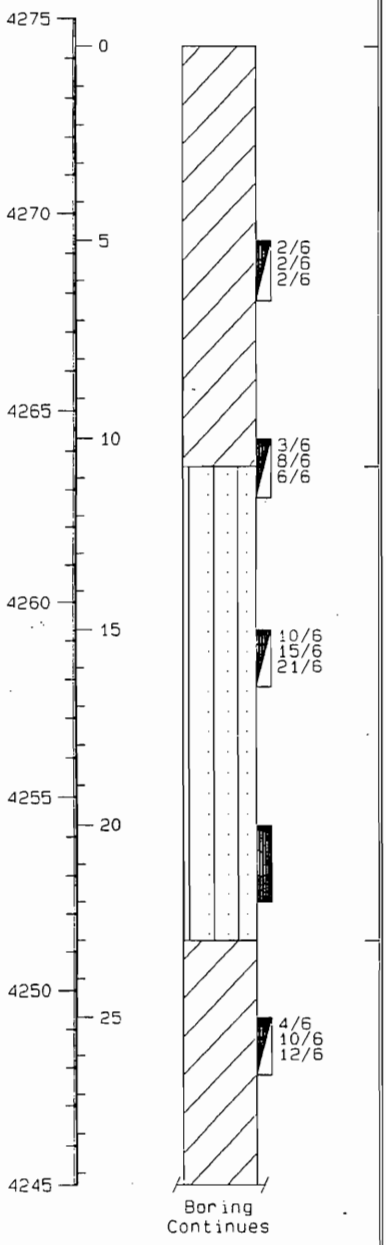
Figure No. 4

DRILL HOLE LOG

DRILL HOLE NO.: GW-18

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: Near SW Corner of LARW Cell
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 31' HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/9/91
TOC ELEV.: 4276.17
GS ELEV.: 4274.31
LOGGED BY: MT
HOLE NO.: GW-18



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Light brown grades to tanish gray, slighlty silty and sandy iron oxide staining, soft, moist.			
			... grades to tan gray clay, with iron oxide staining, moist.	B-1	5.0-6.5	1.5/1.5
				B-2	10-11.5	1.5/1.5
		SM	SILTY SAND: Tanish gray, clayey, silty with occasional clay lenses, medium dense, slightly moist.			
				B-3	15-16.5	1.4/1.5
				S-4	20-22.0	2.0/2.0
		CL	SILTY CLAY: Reddish tan, very sandy, with sand lenses, stiff, slightly wet, mostly wet in the sand lenses.			
				B-5	25-26.5	1.5/1.5

Total depth of hole 40 feet. Completed as shown on separate sheet.

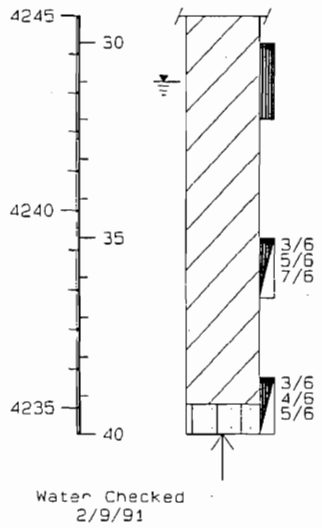
Figure No. 5

DRILL HOLE LOG

DRILL HOLE NO.: GW-18

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: Near SW Corner of LARW Cell
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 31' HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/9/91
TOC ELEV.: 4276.17
GS ELEV.: 4274.31
LOGGED BY: MT
HOLE NO.: GW-18



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
				S-6	30-32.0	2.0/2.0
			... grades to white to light gray clay with silty lenses, defined bedding, soft, wet.			
			... grades to light greenish gray clay, with clayey sand lenses, very moist.	B-7	35-36.5	1.5/1.5
				B-8	38.5-40	1.5/1.5
		SM	SILTY SAND: Greenish gray, clayey, medium dense, moist.			
			NOTE: Placed bentonite in bottom of hole to plug off SPT sample that penetrated the sand at 39.2 feet.			

Total depth of hole 40 feet. Completed as shown on separate sheet.

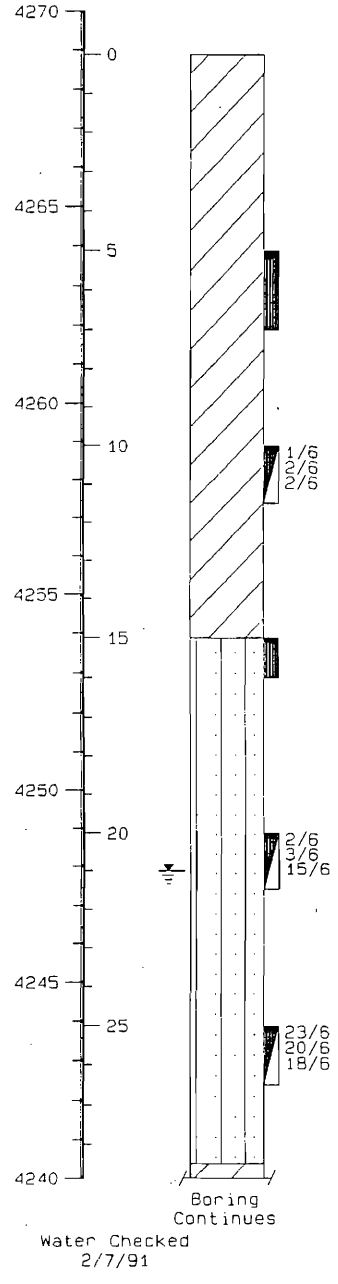
Figure No. 6

DRILL HOLE LOG

DRILL HOLE NO.: GW-19 A

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: SW Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 21 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/7/91
TOC ELEV.: 4270.41
GS ELEV.: 4268.89
LOGGED BY: MT
HOLE NO.: GW-19 A



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILT CLAY: Light brown, silty sandy, dry.			
			... grades to light gray clay, with silt lenses, soft, moist.	S-1	5-7	2.0/2.0
				B-2	10-11.5	1.5/1.5
		SM	SILTY SAND: Tan, silty, dense, moist.	S-3	15-16*	1/1
			* Shelby sample S-3 refused after 12-inches.			
			... grades to gray silty sand, medium dense, wet.	B-4	20-21.5	1.5/1.5
			... grades to tan silty sand, with occasional sandy clay lenses, dense, wet.	B-5	25-26.5	1.5/1.5
		CL	SILTY CLAY: Greenish gray, slightly silty, medium stiff, very moist.			

Total depth of 31.5 feet. Completed as shown on separate sheet.

Figure No. 7

DRILL HOLE LOG

DRILL HOLE NO.: GW-19 A

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: SW Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 21 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/7/91
TOC ELEV.: 4270.41
GS ELEV.: 4268.89
LOGGED BY: MT
HOLE NO.: GW-19 A

ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
4240 / 30	2/6 2/6 3/6			B-6	30-31.5	1.5/1.5

Total depth of 31.5 feet. Completed as shown on separate sheet.

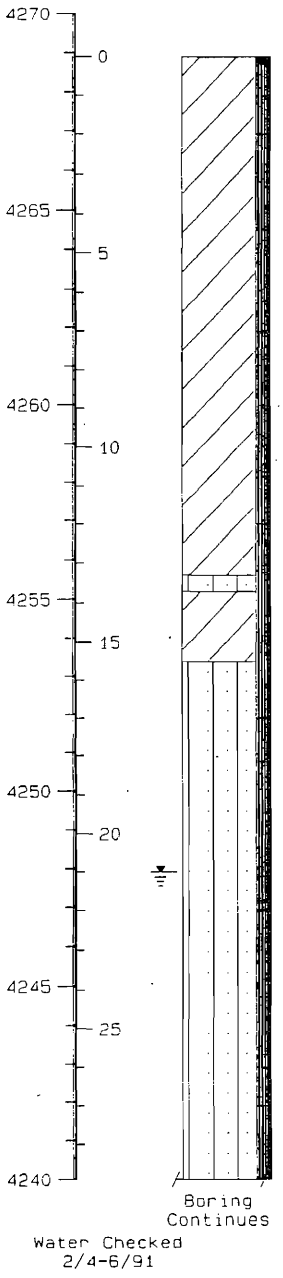
Figure No. 8

DRILL HOLE LOG

DRILL HOLE NO.: GW-19 B

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: SW Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 21'

PROJECT NO.: 1416-005
DATE: 2/4-6/91
TOC ELEV.: 4270.43
GS ELEV.: 4268.91
LOGGED BY: MT
HOLE DIAMETER: 7 3/4"
HOLE NO.: GW-19 B



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Light brown grades to light gray, slighlty silty and sandy, gypsum crystals, moist.	L-1	2.0-4.5	3.1/3.5
			... grades to light gray clay with occasional sand lenses, gypsum crystals, moist.	L-2	7.0-9.5	4.9/5.0
				L-3	12-14.5	5.0/5.0
		SM	SILTY SAND: Tan, silty, loose, moist.			
		CL	SILTY CLAY: Light gray, silty lenses, bedding, moist.			
		SM	SILTY SAND: Tan, silty, occasional silt lenses, fine to medium course, loose, moist.	L-4	17-19.5	3.5/5.0
			... grades to brownish gray sand, wet	L-5	22-24.5	4.8/5.0
				L-6	27-29.5	4.2/5.0

Total depth 102 feet. Completed as shown on separate sheet.

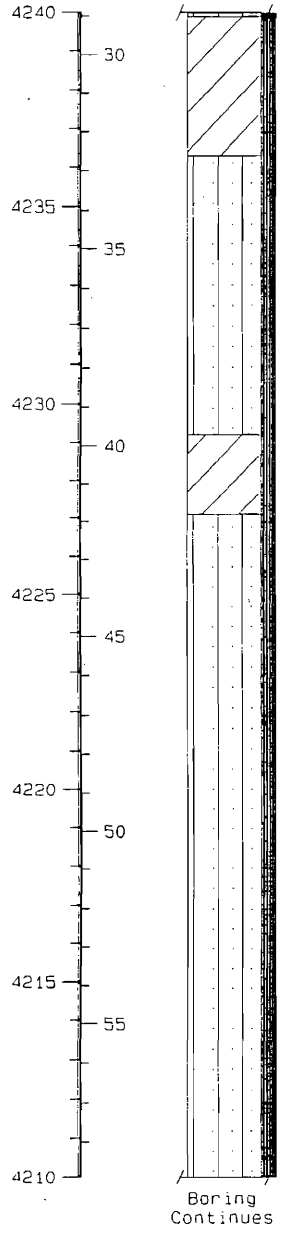
Figure No. 9

DRILL HOLE LOG

DRILL HOLE NO.: GW-19 B

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: SW Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 21'

PROJECT NO.: 1416-005
DATE: 2/4-6/91
TOC ELEV.: 4270.43
GS ELEV.: 4268.91
LOGGED BY: MT
HOLE DIAMETER: 7 3/4"
HOLE NO.: GW-19 B



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Greenish gray, silty, stiff, moist.			
		SM	SILTY SAND: Light greenish gray, fine to medium course, medium dense, wet.	L-7	32-34.5	4.7/5.0
				L-8	37-39.5	5.0/5.0
		CL	SILTY CLAY: Light gray, slightly silty, with occatsional sand lenses, very moist, stiff.			
		SM	SILTY SAND: Greenish gray, silty, fine, medium dense, wet. ... grades to tan sand, wet	L-9	42-44.5	5.0/5.0
			... hard drilling between 47.0' and 49.5' (cemented sands)	L-10	47-49.5	2.9/5.0
				B-11	52-54.5	5.0/5.0
				B-12	57-59.5	4.5/5.0

Total depth 102 feet. Completed as shown on separate sheet.

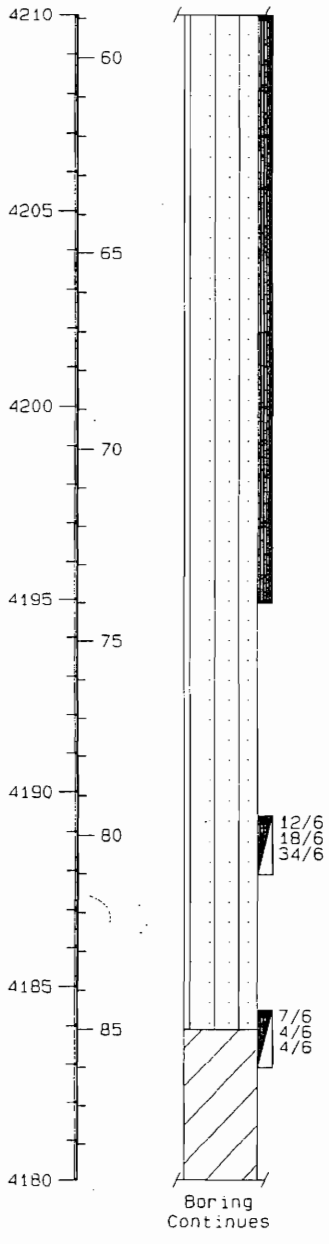
Figure No. 10

DRILL HOLE LOG

DRILL HOLE NO.: GW-19 B

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: SW Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 21' HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/4-6/91
TOC ELEV.: 4270.43
GS ELEV.: 4268.91
LOGGED BY: MT
HOLE NO.: GW-19 B



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
				L-13	62-64.5	3.4/5.0
				L-14	67-69.5	5.0/5.0
			... grades to a greenish gray sand with cemented silty clay lenses, wet.			
			... grades to a tan sand, silty, cemented lenses, dense, wet. ... very hard drilling between 73.0' and 79.0', out of the cemented sand lenses at 79.0'.	L-15	72-74.5	4.0/5.0
				B-16	79.5-81	1.4/1.5
		CL	SILTY CLAY: Light gray, slightly silty, stiff, plastic, very moist.	B-17	84.5-86	0.2/1.5

Total depth 102 feet. Completed as shown on separate sheet.

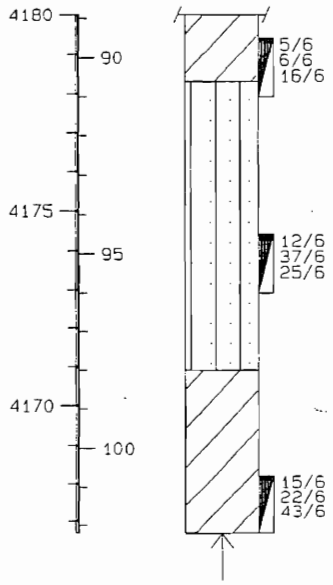
Figure No. 11

DRILL HOLE LOG

DRILL HOLE NO.: GW-19 B

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: SW Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 21' HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/4-6/91
TOC ELEV.: 4270.43
GS ELEV.: 4268.91
LOGGED BY: MT
HOLE NO.: GW-19 B



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
				B-18	89.5-91	1.5/1.5
		SM	SILTY SAND: Tan, silty, fine, dense, wet.			
				B-19	94.5-96	1.5/1.5
		CL	SILTY CLAY: Light tan, very silty, slightly sandy, very stiff, cemented lenses, very moist.			
				B-20	100.7-102.2	1.5/1.5

Total depth 102 feet. Completed as shown on separate sheet.

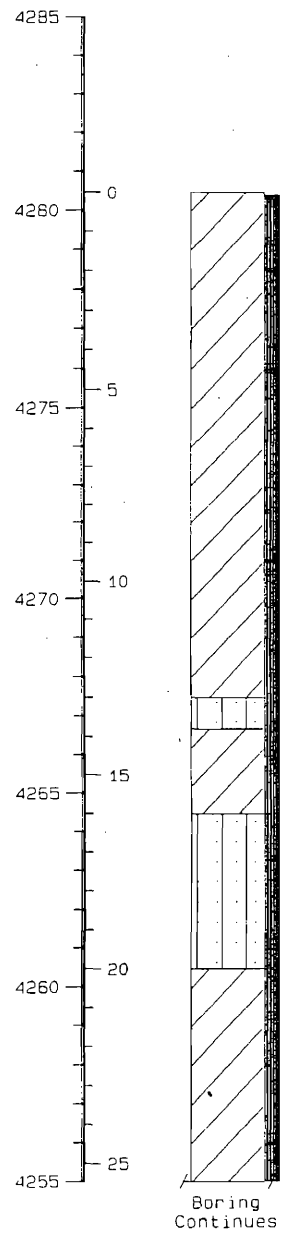
Figure No. 12

DRILL HOLE LOG

DRILL HOLE NO.: GW-21

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: NE Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 33 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/13/91
TOC ELEV.: 4282.80
GS ELEV.: 4280.47
LOGGED BY: MT
HOLE NO.: GW-21



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
		CL	SILTY CLAY: Light brown, sandy, slightly moist.	L-1	0-4.5	4.0/4.5
			... grades to tanish gray clay, very silty, dry.	L-2	4.5-9.5	5.0/5.0
			... grades to light gray clay, horizontal bedding, very silty, iron oxide staining, moist.	L-3	9.5-14.5	3.2/5.0
		SM	SILTY SAND: Tan, silty, loose, slighly moist.			
		CL	SILTY CLAY: Tan gray, iron oxide staining, moist.	L-4	14.5-19.5	4.6/5.0
		SM	SILTY SAND: Tan, silty, loose, fine, loose, with occasional clay lenses, slightly moist.			
		CL	SILTY CLAY: Reddish tan, sandy, stiff, moist.	L-5	19.5-24.5	5.0/5.0
				L-6	24.5-29.5	5.0/5.0

Total depth of 41.5 feet. Completed as shown on separate sheet.

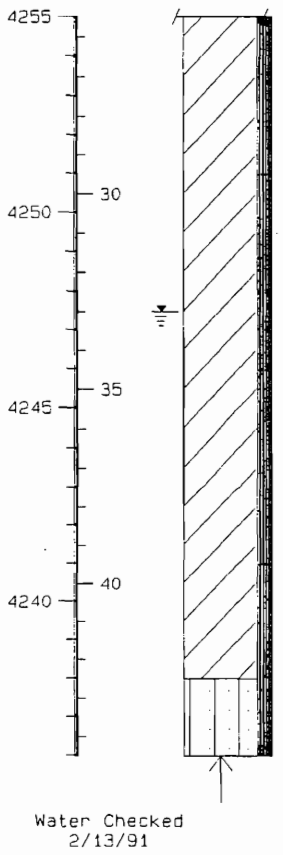
Figure No. 13

DRILL HOLE LOG

DRILL HOLE NO.: GW-21

PROJECT: Hydrogeologic Study
CLIENT/OWNER: Envirocare of Utah
HOLE LOCATION: NE Corner of Section 32
DRILLER: Overland Drilling Company
DRILL RIG: CME 750
DEPTH TO WATER: 33 HOLE DIAMETER: 7 3/4"

PROJECT NO.: 1416-005
DATE: 2/13/91
TOC ELEV.: 4282.80
GS ELEV.: 4280.47
LOGGED BY: MT
HOLE NO.: GW-21

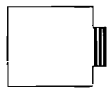
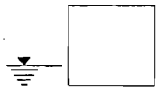
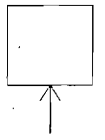


ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample Number	Sample Depth	Recovery ft/ft
			... grades to light gray clay, cemented lenses, very moist.			
				L-7	29.5-34.5	3.8/5.0
			... occasional sand lenses.			
				L-8	34.5-39.5	3.2/5.0
				L-9	39.5-44.5	5.0/5.0
		SM	SILTY SAND: Light brown, silty, fine, loose, moist.			

Total depth of 41.5 feet. Completed as shown on separate sheet.

Figure No. 14

Legend:

Symbol:	Description:	Symbol:	Description:
	SILTY CLAY: Tan, sandy, stiff, moist.		
	SILTY SAND: Tan, silty, fine, dense, slightly moist.		
	SPT1 2" O.D. sampler, 140 lb. hammer, 30" drop		Shelby Tube Sample & CME Continuous Sampler
	Groundwater Level		Hole Completion Depth

Notes:

1. Monitor wells were drilled and installed on February 4 through February 13, 1991 using a CME 750 drill rig and 7 3/4-inch OD diameter continuous hollow stem augers.
2. Soil samples for soil identification and laboratory analysis were collected using a standard split spoon sampler (SPT), CME continuous sampler, and shelby tubes.
3. All drill holes were surveyed to determine horizontal coordinates and vertical elevations, based on State Plane and USGS datums located at the SW Section corner of Section 32.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.

MONITOR WELL COMPLETION DETAILS

MONITOR WELL INSTALLATION REPORT

PROJECT ENVIROCARE HYDROGEOLOGIC STUDY

LOCATION CLIVE, UTAH

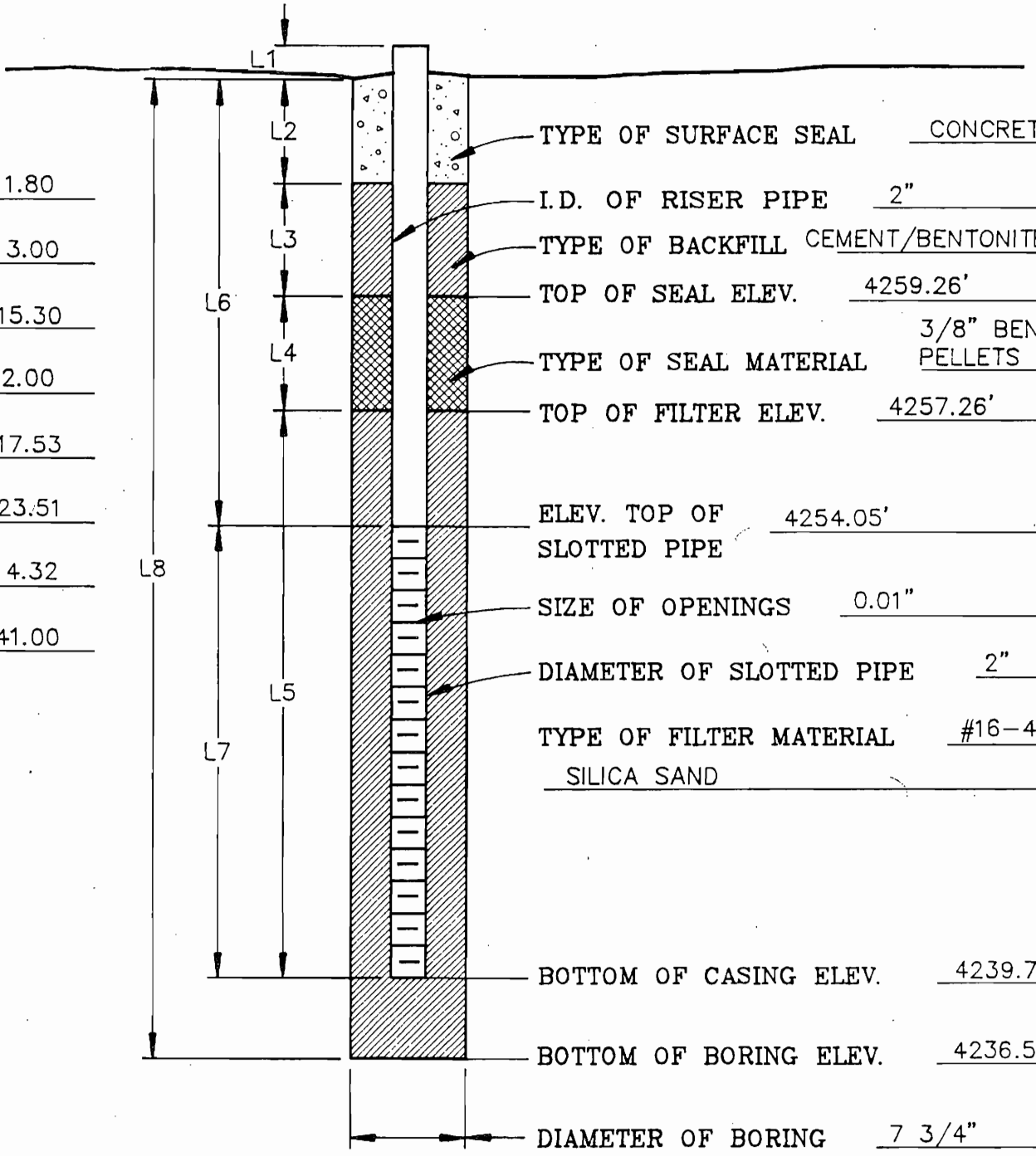
MONITOR WELL NO. GW-16

ELEVATION - TOP OF PROTECTIVE CASING

ELEVATION - TOP OF PVC CASING 4279.36'

GROUND SURFACE ELEVATION 4277.56'

TYPE OF PIPE PVC SCHEDULE 40



L1	1.80
L2	3.00
L3	15.30
L4	2.00
L5	17.53
L6	23.51
L7	14.32
L8	41.00

TYPE OF SURFACE SEAL CONCRETE

I.D. OF RISER PIPE 2"

TYPE OF BACKFILL CEMENT/BENTONITE GROUT

TOP OF SEAL ELEV. 4259.26'

TYPE OF SEAL MATERIAL 3/8" BENTONITE PELLETS

TOP OF FILTER ELEV. 4257.26'

ELEV. TOP OF SLOTTED PIPE 4254.05'

SIZE OF OPENINGS 0.01"

DIAMETER OF SLOTTED PIPE 2"

TYPE OF FILTER MATERIAL #16-40 SILICA SAND

BOTTOM OF CASING ELEV. 4239.73'

BOTTOM OF BORING ELEV. 4236.56'

DIAMETER OF BORING 7 3/4"

BINGHAM ENVIRONMENTAL

MONITOR WELL INSTALLATION REPORT

PROJECT ENVIROCARE HYDROGEOLOGIC STUDY

LOCATION CLIVE, UTAH

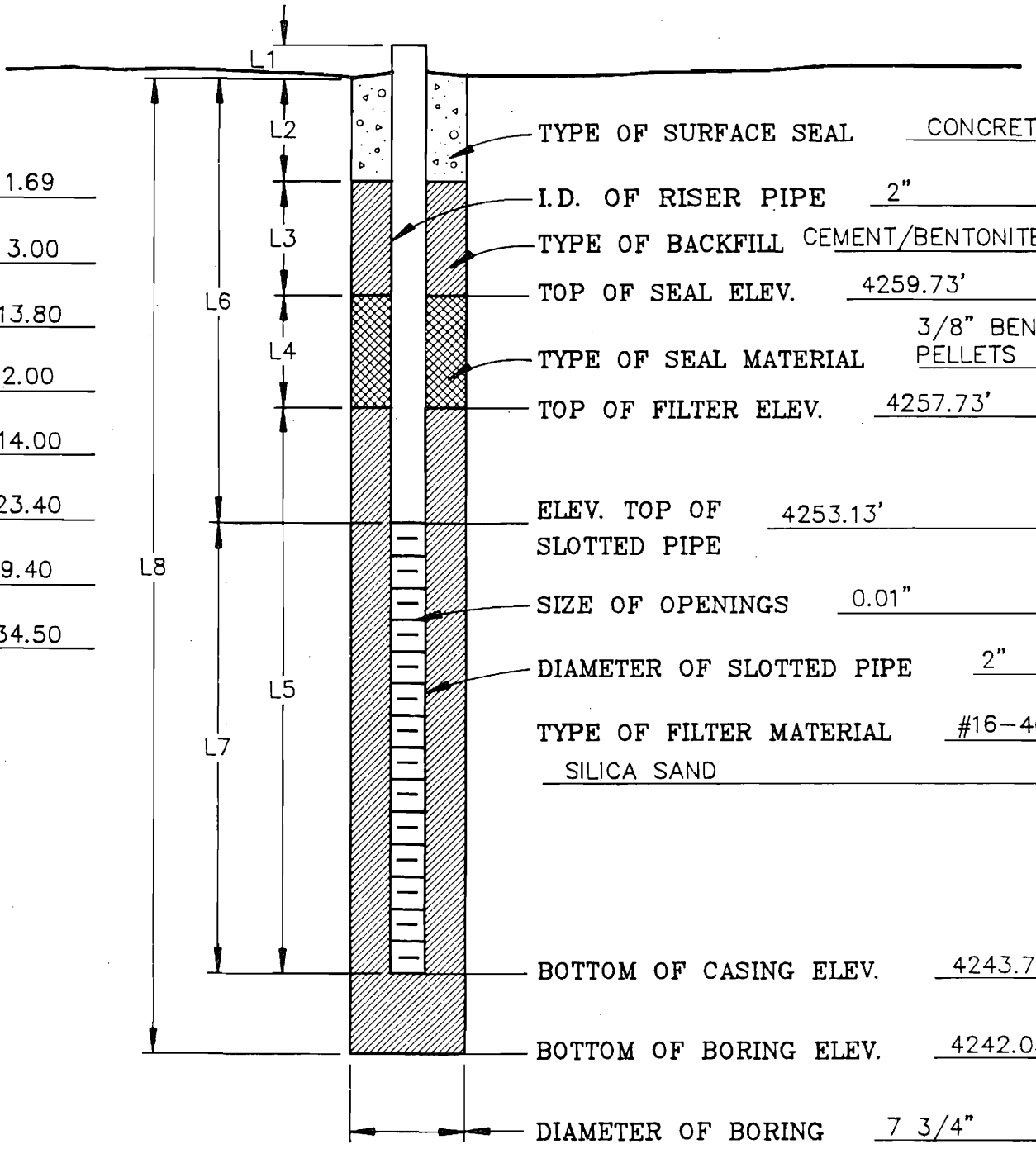
MONITOR WELL NO. GW-17A

ELEVATION - TOP OF PROTECTIVE CASING

ELEVATION - TOP OF PVC CASING 4278.22'

GROUND SURFACE ELEVATION 4276.53'

TYPE OF PIPE PVC SCHEDULE 40



L1	1.69
L2	3.00
L3	13.80
L4	2.00
L5	14.00
L6	23.40
L7	9.40
L8	34.50

TYPE OF SURFACE SEAL CONCRETE

I.D. OF RISER PIPE 2"

TYPE OF BACKFILL CEMENT/BENTONITE GROUT

TOP OF SEAL ELEV. 4259.73'

TYPE OF SEAL MATERIAL 3/8" BENTONITE PELLETS

TOP OF FILTER ELEV. 4257.73'

ELEV. TOP OF SLOTTED PIPE 4253.13'

SIZE OF OPENINGS 0.01"

DIAMETER OF SLOTTED PIPE 2"

TYPE OF FILTER MATERIAL #16-40 SILICA SAND

BOTTOM OF CASING ELEV. 4243.73'

BOTTOM OF BORING ELEV. 4242.03'

DIAMETER OF BORING 7 3/4"

MONITOR WELL INSTALLATION REPORT

PROJECT ENVIROCARE HYDROGEOLOGIC STUDY

LOCATION CLIVE, UTAH

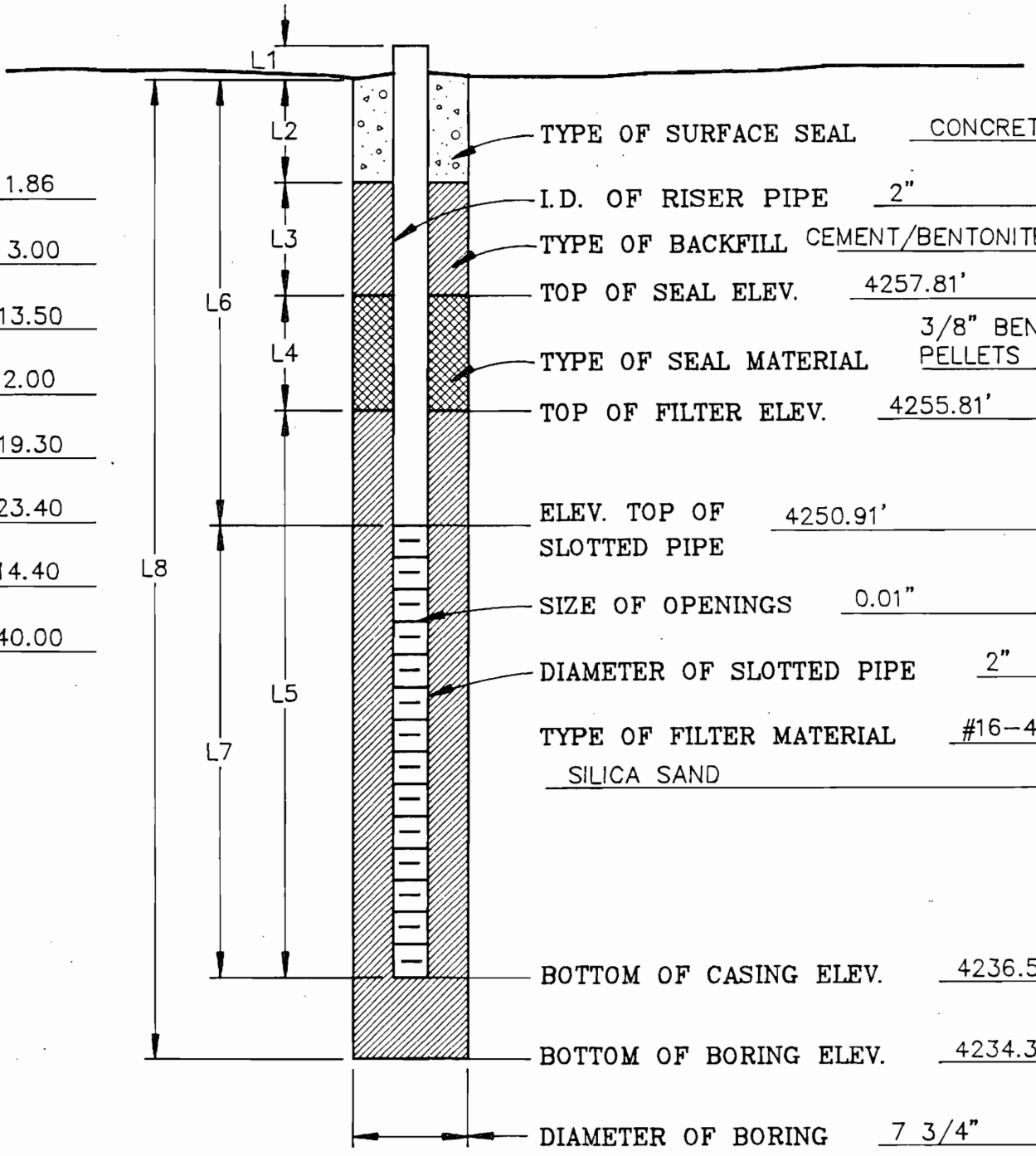
MONITOR WELL NO. GW-18

ELEVATION - TOP OF PROTECTIVE CASING

ELEVATION - TOP OF PVC CASING 4276.17'

GROUND SURFACE ELEVATION 4274.31'

TYPE OF PIPE PVC SCHEDULE 40



L1	1.86
L2	3.00
L3	13.50
L4	2.00
L5	19.30
L6	23.40
L7	14.40
L8	40.00

TYPE OF SURFACE SEAL CONCRETE

I.D. OF RISER PIPE 2"

TYPE OF BACKFILL CEMENT/BENTONITE GROUT

TOP OF SEAL ELEV. 4257.81'

TYPE OF SEAL MATERIAL 3/8" BENTONITE PELLETS

TOP OF FILTER ELEV. 4255.81'

ELEV. TOP OF SLOTTED PIPE 4250.91'

SIZE OF OPENINGS 0.01"

DIAMETER OF SLOTTED PIPE 2"

TYPE OF FILTER MATERIAL #16-40 SILICA SAND

BOTTOM OF CASING ELEV. 4236.51'

BOTTOM OF BORING ELEV. 4234.31'

DIAMETER OF BORING 7 3/4"

MONITOR WELL INSTALLATION REPORT

PROJECT ENVIROCARE HYDROGEOLOGIC STUDY

LOCATION CLIVE, UTAH

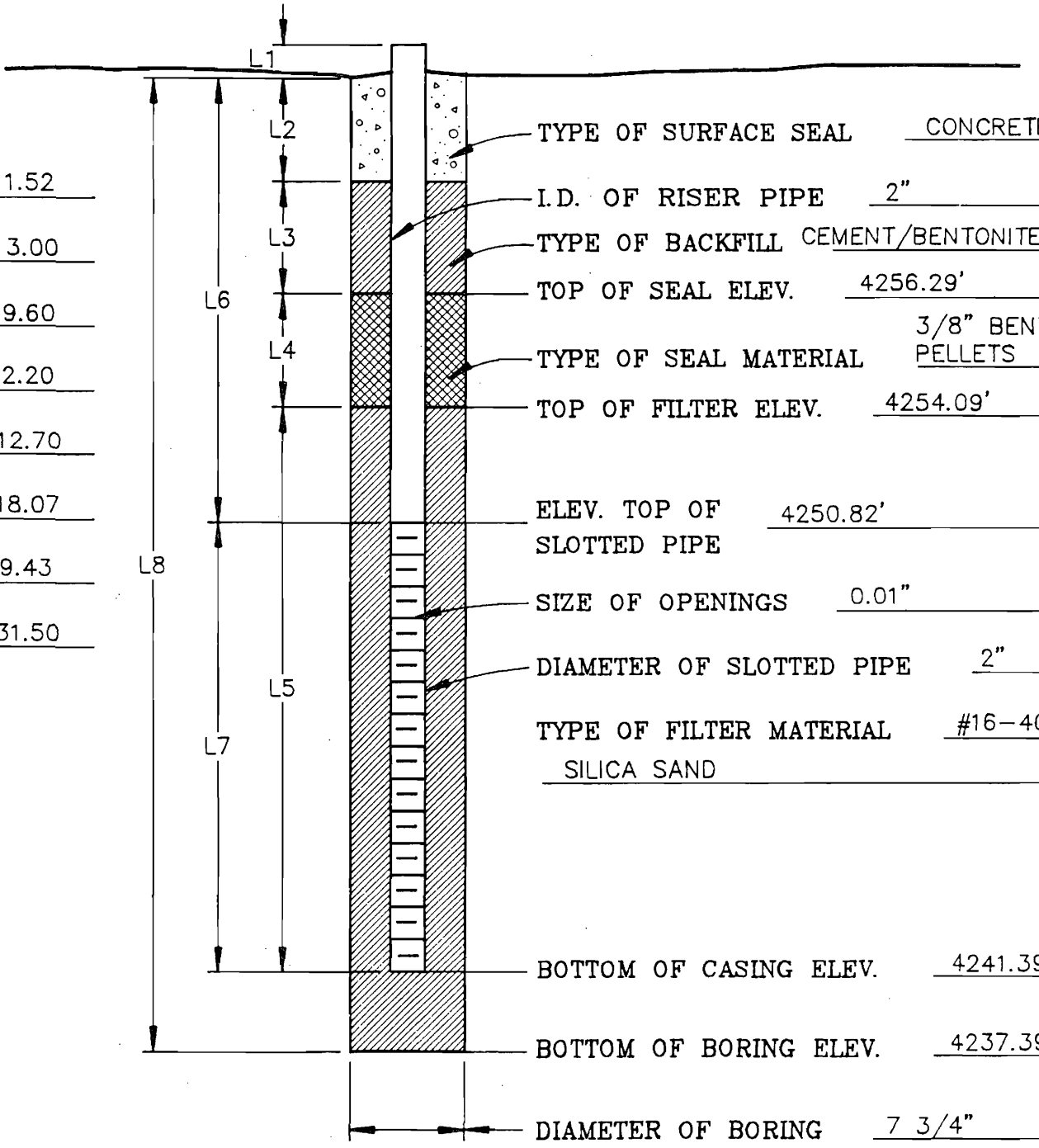
MONITOR WELL NO. GW-19A

ELEVATION - TOP OF PROTECTIVE CASING _____

ELEVATION - TOP OF PVC CASING 4270.41'

GROUND SURFACE ELEVATION 4268.89'

TYPE OF PIPE PVC SCHEDULE 40



L1	1.52
L2	3.00
L3	9.60
L4	2.20
L5	12.70
L6	18.07
L7	9.43
L8	31.50

TYPE OF SURFACE SEAL CONCRETE

I.D. OF RISER PIPE 2"

TYPE OF BACKFILL CEMENT/BENTONITE GROUT

TOP OF SEAL ELEV. 4256.29'

TYPE OF SEAL MATERIAL 3/8" BENTONITE PELLETS

TOP OF FILTER ELEV. 4254.09'

ELEV. TOP OF SLOTTED PIPE 4250.82'

SIZE OF OPENINGS 0.01"

DIAMETER OF SLOTTED PIPE 2"

TYPE OF FILTER MATERIAL #16-40 SILICA SAND

BOTTOM OF CASING ELEV. 4241.39'

BOTTOM OF BORING ELEV. 4237.39'

DIAMETER OF BORING 7 3/4"

MONITOR WELL INSTALLATION REPORT

PROJECT ENVIROCARE HYDROGEOLOGIC STUDY

LOCATION CLIVE, UTAH

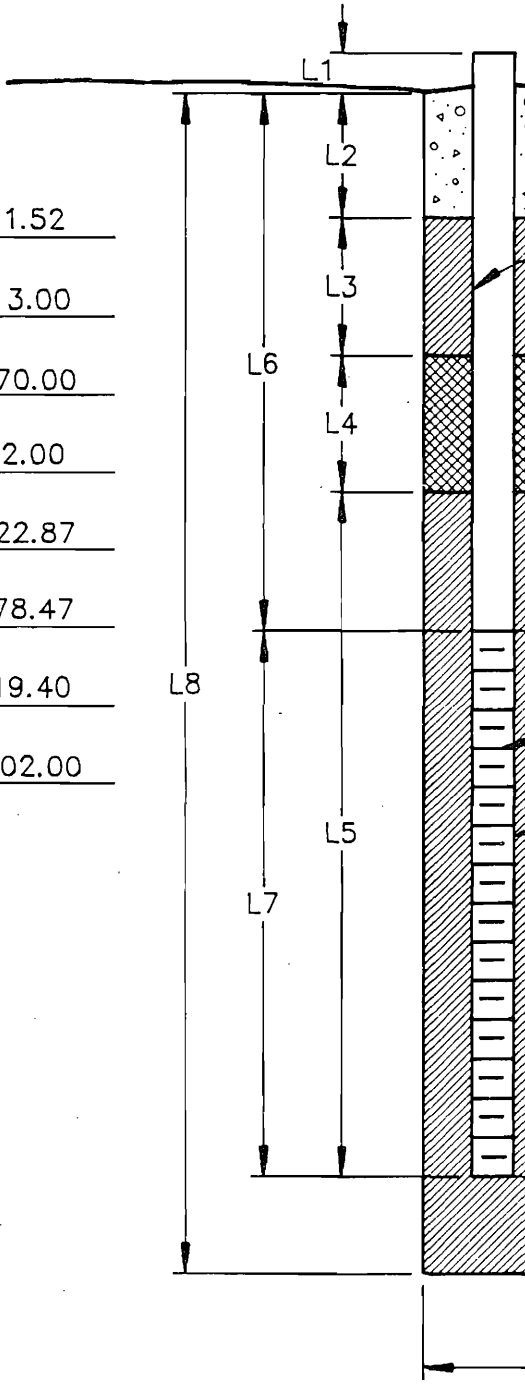
MONITOR WELL NO. GW-19B

ELEVATION - TOP OF PROTECTIVE CASING _____

ELEVATION - TOP OF PVC CASING 4270.43'

GROUND SURFACE ELEVATION 4268.91'

TYPE OF PIPE PVC SCHEDULE 40



L1	1.52
L2	3.00
L3	70.00
L4	2.00
L5	22.87
L6	78.47
L7	19.40
L8	102.00

TYPE OF SURFACE SEAL CONCRETE

I.D. OF RISER PIPE 2"

TYPE OF BACKFILL CEMENT/BENTONITE GROUT

TOP OF SEAL ELEV. 4195.91'

TYPE OF SEAL MATERIAL 3/8" BENTONITE PELLETS

TOP OF FILTER ELEV. 4193.91'

ELEV. TOP OF SLOTTED PIPE 4190.44'

SIZE OF OPENINGS 0.02"

DIAMETER OF SLOTTED PIPE 2"

TYPE OF FILTER MATERIAL #10-20 SILICA SAND

BOTTOM OF CASING ELEV. 4171.04'

BOTTOM OF BORING ELEV. 4166.91'

DIAMETER OF BORING 7 3/4"

MONITOR WELL INSTALLATION REPORT

PROJECT ENVIROCARE HYDROGEOLOGIC STUDY

LOCATION CLIVE, UTAH

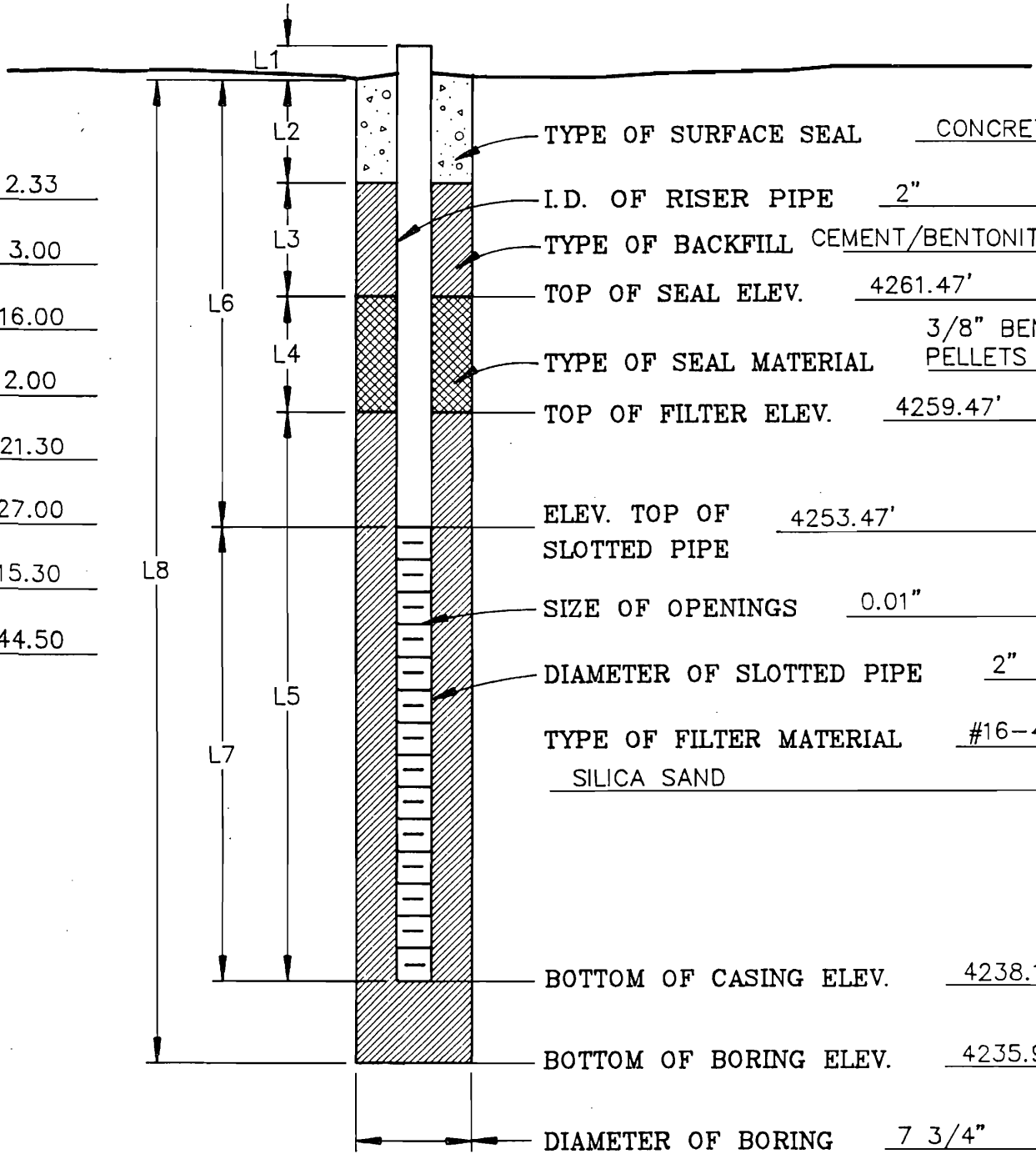
MONITOR WELL NO. GW-21

ELEVATION - TOP OF PROTECTIVE CASING _____

ELEVATION - TOP OF PVC CASING 4282.80'

GROUND SURFACE ELEVATION 4280.47'

TYPE OF PIPE PVC SCHEDULE 40



L1	2.33
L2	3.00
L3	16.00
L4	2.00
L5	21.30
L6	27.00
L7	15.30
L8	44.50

TYPE OF SURFACE SEAL CONCRETE

I.D. OF RISER PIPE 2"

TYPE OF BACKFILL CEMENT/BENTONITE GROUT

TOP OF SEAL ELEV. 4261.47'

TYPE OF SEAL MATERIAL 3/8" BENTONITE PELLETS

TOP OF FILTER ELEV. 4259.47'

ELEV. TOP OF SLOTTED PIPE 4253.47'

SIZE OF OPENINGS 0.01"

DIAMETER OF SLOTTED PIPE 2"

TYPE OF FILTER MATERIAL #16-40 SILICA SAND

BOTTOM OF CASING ELEV. 4238.17'

BOTTOM OF BORING ELEV. 4235.97'

DIAMETER OF BORING 7 3/4"

SLUG TESTS

ENVIROCARE OF UTAH

SLUG INJECTION TESTS

Well I.D.	Casing Diameter (inches)	Aquifer Length (feet)	Unit Screened	Volume of Water (gallons)	Ho (feet)	Hydraulic Conductivity (cm/sec)	Analysis Method
GW-3	2.0	17.0	2, 3	4.5	27.6	1.75×10^{-2}	3
GW-5	2.0	12.0	2, 3	4.5	27.6	1.46×10^{-3}	2
GW-16	2.0	9.5	2, 3	4.6	28.2	8.41×10^{-4}	2
GW-17A	2.0	3.5	2, 3	5.0	30.6	1.75×10^{-3}	2
GW-18	2.0	7.0	2	4.7	28.8	3.6×10^{-4}	4
GW-19A	2.0	7.0	3	4.0	24.5	1.4×10^{-5}	1
GW-19B	2.0	14.0	1	4.6	28.19	2.93×10^{-3}	4
GW-21	2.0	9.5	2	5.0	30.6	2.13×10^{-3}	2

Method

1. Hvorslev
2. Cooper, Bredehoeft and Papadopulos
3. ~~Ferris and Knowles~~
4. Bouwer

ENVIROCARE OF UTAH

GW-3 Page 1

WELL # GW-3

WELL DIAMETER= 6.50 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 4.50 GALLONS
LENGTH OF AQUIFER TESTED= 17.00 FEET
VALUE OF H0= 27.58 FEET
STATIC WATER LEVEL= 5.18 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.00	6.38	1.20	.044	********
.08	5.92	.74	.027	11.992
.17	5.38	.20	.007	5.998
.25	5.32	.14	.005	3.999
.33	5.28	.10	.004	2.999
.42	5.25	.07	.003	2.400
.50	5.24	.06	.002	2.000
.58	5.23	.05	.002	1.714
.67	5.22	.04	.001	1.500
.75	5.22	.04	.001	1.333
.83	5.22	.04	.001	1.200
.92	5.22	.04	.001	1.091
1.00	5.22	.04	.001	1.000
1.08	5.22	.04	.001	.923
1.17	5.21	.03	.001	.857
1.25	5.21	.03	.001	.800
1.33	5.21	.03	.001	.750
1.42	5.21	.03	.001	.706
1.50	5.21	.03	.001	.667
1.58	5.21	.03	.001	.632
1.67	5.21	.03	.001	.600
1.75	5.21	.03	.001	.571
1.83	5.20	.02	.001	.545
1.92	5.21	.03	.001	.522
2.00	5.20	.02	.001	.500
2.08	5.20	.02	.001	.480
2.17	5.20	.02	.001	.462
2.25	5.20	.02	.001	.444
2.33	5.20	.02	.001	.429
2.42	5.20	.02	.001	.414
2.50	5.20	.02	.001	.400
2.58	5.20	.02	.001	.387
2.67	5.20	.02	.001	.375
2.75	5.20	.02	.001	.364
2.83	5.20	.02	.001	.353
2.92	5.19	.01	.000	.343
3.00	5.19	.01	.000	.333
3.08	5.20	.02	.001	.324
3.17	5.19	.01	.000	.316
3.33	5.19	.01	.000	.300
3.42	5.19	.01	.000	.293
3.50	5.19	.01	.000	.286
3.58	5.19	.01	.000	.279
3.67	5.19	.01	.000	.273

GW-3 Page 1

3.75	5.19	.01	.000	.267
3.83	5.19	.01	.000	.261
3.92	5.19	.01	.000	.255
4.00	5.19	.01	.000	.250
4.08	5.19	.01	.000	.245
4.17	5.19	.01	.000	.240
4.25	5.19	.01	.000	.235
4.33	5.19	.01	.000	.231
4.42	5.19	.01	.000	.226
4.50	5.19	.01	.000	.222
4.58	5.18	.00	.000	.218
4.67	5.18	.00	.000	.214
4.75	5.19	.01	.000	.211
4.83	5.18	.00	.000	.207
4.92	5.19	.01	.000	.203
5.00	5.19	.01	.000	.200
5.08	5.19	.01	.000	.197
5.17	5.19	.01	.000	.194
5.25	5.19	.01	.000	.190
5.33	5.19	.01	.000	.187
5.42	5.19	.01	.000	.185
5.50	5.18	.00	.000	.182
5.58	5.19	.01	.000	.179
5.67	5.19	.01	.000	.176
5.75	5.18	.00	.000	.174
5.83	5.18	.00	.000	.171
5.92	5.19	.01	.000	.169
6.00	5.18	.00	.000	.167
6.08	5.19	.01	.000	.164
6.17	5.18	.00	.000	.162
6.25	5.18	.00	.000	.160
6.33	5.19	.01	.000	.158
6.42	5.18	.00	.000	.156
6.50	5.19	.01	.000	.154
6.58	5.18	.00	.000	.152
6.67	5.18	.00	.000	.150
6.75	5.18	.00	.000	.148
6.83	5.18	.00	.000	.146
6.92	5.18	.00	.000	.145
7.00	5.19	.01	.000	.143
7.08	5.18	.00	.000	.141
7.17	5.18	.00	.000	.140
7.25	5.18	.00	.000	.138
7.33	5.18	.00	.000	.136
7.50	5.18	.00	.000	.133
7.58	5.18	.00	.000	.132
7.67	5.18	.00	.000	.130
7.75	5.18	.00	.000	.129
7.83	5.18	.00	.000	.128
7.92	5.18	.00	.000	.126
8.00	5.18	.00	.000	.125
8.08	5.18	.00	.000	.124
8.17	5.18	.00	.000	.122
8.25	5.18	.00	.000	.121
8.33	5.18	.00	.000	.120
8.42	5.18	.00	.000	.119
8.50	5.18	.00	.000	.118
8.58	5.18	.00	.000	.117
8.67	5.18	.00	.000	.115
8.75	5.18	.00	.000	.114
8.83	5.18	.00	.000	.113
8.92	5.18	.00	.000	.112

9.00	5.18	.00	.000	.111
9.08	5.18	.00	.000	.110
9.17	5.18	.00	.000	.109
9.25	5.18	.00	.000	.108
9.33	5.18	.00	.000	.107
9.42	5.18	.00	.000	.106
9.50	5.18	.00	.000	.105
9.58	5.18	.00	.000	.104
9.67	5.18	.00	.000	.103
9.75	5.18	.00	.000	.103
9.83	5.18	.00	.000	.102
9.92	5.18	.00	.000	.101
10.00	5.18	.00	.000	.100
10.08	5.18	.00	.000	.099
10.17	5.18	.00	.000	.098
10.25	5.18	.00	.000	.098
10.33	5.18	.00	.000	.097
10.42	5.18	.00	.000	.096
10.50	5.18	.00	.000	.095
10.58	5.18	.00	.000	.094
10.67	5.18	.00	.000	.094
10.75	5.18	.00	.000	.093
10.83	5.18	.00	.000	.092

ENVIROCARE OF UTAH

GW-5 Page 1

WELL # GW-5

WELL DIAMETER= 6.50 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 4.50 GALLONS
LENGTH OF AQUIFER TESTED= 12.00 FEET
VALUE OF H0= 27.58 FEET
STATIC WATER LEVEL= 5.01 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.08	9.62	4.61	.167	11.999
.17	7.87	2.86	.104	6.000
.25	7.64	2.63	.095	4.000
.33	7.58	2.57	.093	3.000
.42	7.52	2.51	.091	2.400
.50	7.45	2.44	.088	2.000
.58	7.39	2.38	.086	1.714
.67	7.33	2.32	.084	1.500
.75	7.28	2.27	.082	1.333
.83	7.22	2.21	.080	1.200
.92	7.16	2.15	.078	1.091
1.00	7.11	2.10	.076	1.000
1.08	7.07	2.06	.075	.923
1.17	7.01	2.00	.073	.857
1.25	6.96	1.95	.071	.800
1.33	6.92	1.91	.069	.750
1.42	6.86	1.85	.067	.706
1.50	6.81	1.80	.065	.667
1.58	6.77	1.76	.064	.632
1.67	6.73	1.72	.062	.600
1.75	6.69	1.68	.061	.571
1.83	6.64	1.63	.059	.545
1.92	6.61	1.60	.058	.522
2.00	6.56	1.55	.056	.500
2.08	6.53	1.52	.055	.480
2.17	6.47	1.46	.053	.462
2.25	6.44	1.43	.052	.444
2.33	6.40	1.39	.050	.429
2.42	6.35	1.34	.049	.414
2.50	6.24	1.23	.045	.400
2.58	6.15	1.14	.041	.387
2.67	6.08	1.07	.039	.375
2.75	6.02	1.01	.037	.364
2.83	5.95	.94	.034	.353
2.92	5.89	.88	.032	.343
3.00	5.84	.83	.030	.333
3.08	5.78	.77	.028	.324
3.17	5.73	.72	.026	.316
3.25	5.69	.68	.025	.308
3.42	5.60	.59	.021	.293
3.50	5.56	.55	.020	.286
3.58	5.53	.52	.019	.279
3.67	5.49	.48	.017	.273
3.75	5.46	.45	.016	.267

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3.83	5.43	.42	.015	.261
3.92	5.40	.39	.014	.255
4.00	5.38	.37	.013	.250
4.08	5.35	.34	.012	.245
4.17	5.33	.32	.012	.240
4.25	5.31	.30	.011	.235
4.33	5.28	.27	.010	.231
4.42	5.26	.25	.009	.226
4.50	5.24	.23	.008	.222
4.58	5.23	.22	.008	.218
4.67	5.21	.20	.007	.214
4.75	5.19	.18	.007	.211
4.83	5.18	.17	.006	.207
4.92	5.17	.16	.006	.203
5.00	5.15	.14	.005	.200
5.08	5.15	.14	.005	.197
5.17	5.14	.13	.005	.194
5.25	5.13	.12	.004	.190
5.33	5.12	.11	.004	.187
5.42	5.11	.10	.004	.185
5.50	5.10	.09	.003	.182
5.58	5.10	.09	.003	.179
5.67	5.09	.08	.003	.176
5.75	5.09	.08	.003	.174
5.83	5.08	.07	.003	.171
5.92	5.07	.06	.002	.169
6.00	5.06	.05	.002	.167
6.08	5.06	.05	.002	.164
6.17	5.06	.05	.002	.162
6.25	5.05	.04	.001	.160
6.33	5.04	.03	.001	.158
6.42	5.04	.03	.001	.156
6.50	5.03	.02	.001	.154
6.58	5.03	.02	.001	.152
6.67	5.02	.01	.000	.150
6.75	5.03	.02	.001	.148
6.83	5.02	.01	.000	.146
6.92	5.02	.01	.000	.145
7.00	5.01	.00	.000	.143
7.08	5.01	.00	.000	.141
7.17	5.01	.00	.000	.140
7.25	5.01	.00	.000	.138

ENVIROCARE OF UTAH

WELL # GW-16

WELL DIAMETER= 7.75 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 4.60 GALLONS
LENGTH OF AQUIFER TESTED= 9.50 FEET
VALUE OF H0= 28.19 FEET
STATIC WATER LEVEL= 4.47 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.08	9.82	5.35	.190	11.996
.17	8.65	4.18	.148	5.999
.25	7.75	3.28	.116	4.000
.33	7.26	2.79	.099	3.000
.42	7.02	2.55	.090	2.400
.50	6.87	2.40	.085	2.000
.58	6.77	2.30	.082	1.714
.67	6.72	2.25	.080	1.500
.75	6.68	2.21	.078	1.333
.83	6.64	2.17	.077	1.200
.92	6.58	2.11	.075	1.091
1.00	6.53	2.06	.073	1.000
1.08	6.49	2.02	.072	.923
1.17	6.45	1.98	.070	.857
1.25	6.41	1.94	.069	.800
1.33	6.37	1.90	.067	.750
1.42	6.32	1.85	.066	.706
1.50	6.29	1.82	.065	.667
1.58	6.25	1.78	.063	.632
1.67	6.20	1.73	.061	.600
1.75	6.17	1.70	.060	.571
1.83	6.13	1.66	.059	.545
1.92	6.10	1.63	.058	.522
2.00	6.09	1.62	.057	.500
2.08	6.07	1.60	.057	.480
2.17	6.05	1.58	.056	.462
2.25	6.05	1.58	.056	.444
2.33	6.08	1.61	.057	.429
2.42	6.08	1.61	.057	.414
2.50	6.10	1.63	.058	.400
2.58	6.11	1.64	.058	.387
2.67	6.17	1.70	.060	.375
2.75	6.17	1.70	.060	.364
2.83	6.18	1.71	.061	.353
2.92	6.19	1.72	.061	.343
3.00	6.19	1.72	.061	.333
3.08	6.20	1.73	.061	.324
3.17	6.20	1.73	.061	.316
3.25	6.20	1.73	.061	.308
3.33	6.19	1.72	.061	.300
3.42	6.19	1.72	.061	.293
3.50	6.18	1.71	.061	.286
3.58	6.18	1.71	.061	.279
3.67	6.17	1.70	.060	.273

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3.75	6.21	1.74	.062	.267
3.83	6.20	1.73	.061	.261
3.92	6.21	1.74	.062	.255
4.00	6.21	1.74	.062	.250
4.08	6.20	1.73	.061	.245
4.17	6.19	1.72	.061	.240
4.25	6.19	1.72	.061	.235
4.33	6.18	1.71	.061	.231
4.42	6.17	1.70	.060	.226
4.50	6.16	1.69	.060	.222
4.58	6.16	1.69	.060	.218
4.67	6.15	1.68	.060	.214
4.75	6.13	1.66	.059	.211
4.83	6.11	1.64	.058	.207
4.92	6.10	1.63	.058	.203
5.00	6.07	1.60	.057	.200
5.08	6.04	1.57	.056	.197
5.17	5.98	1.51	.054	.194
5.25	5.92	1.45	.051	.190
5.33	5.87	1.40	.050	.187
5.42	5.82	1.35	.048	.185
5.50	5.79	1.32	.047	.182
5.58	5.75	1.28	.045	.179
5.67	5.72	1.25	.044	.176
5.75	5.69	1.22	.043	.174
5.83	5.66	1.19	.042	.171
5.92	5.63	1.16	.041	.169
6.00	5.61	1.14	.040	.167
6.08	5.59	1.12	.040	.164
6.17	5.57	1.10	.039	.162
6.25	5.55	1.08	.038	.160
6.33	5.53	1.06	.038	.158
6.42	5.51	1.04	.037	.156
6.50	5.49	1.02	.036	.154
6.58	5.47	1.00	.035	.152
6.67	5.46	.99	.035	.150
6.75	5.43	.96	.034	.148
6.83	5.41	.94	.033	.146
6.92	5.40	.93	.033	.145
7.00	5.37	.90	.032	.143
7.08	5.36	.89	.032	.141
7.17	5.34	.87	.031	.140
7.25	5.33	.86	.031	.138
7.33	5.31	.84	.030	.136
7.42	5.29	.82	.029	.135
7.50	5.27	.80	.028	.133
7.58	5.26	.79	.028	.132
7.67	5.24	.77	.027	.130
7.75	5.23	.76	.027	.129
7.83	5.21	.74	.026	.128
7.92	5.20	.73	.026	.126
8.00	5.18	.71	.025	.125
8.08	5.17	.70	.025	.124
8.17	5.16	.69	.024	.122
8.25	5.15	.68	.024	.121
8.33	5.13	.66	.023	.120
8.42	5.12	.65	.023	.119
8.50	5.11	.64	.023	.118
8.58	5.10	.63	.022	.117
8.67	5.09	.62	.022	.115
8.75	5.08	.61	.022	.114
8.83	5.06	.59	.021	.113

8.92	5.06	.59	.021	.112
9.00	5.05	.58	.021	.111
9.08	5.04	.57	.020	.110
9.17	5.03	.56	.020	.109
9.25	5.01	.54	.019	.108
9.33	5.01	.54	.019	.107
9.42	5.00	.53	.019	.106
9.50	4.99	.52	.018	.105
9.58	4.98	.51	.018	.104
9.67	4.98	.51	.018	.103
9.75	4.97	.50	.018	.103
9.83	4.96	.49	.017	.102
9.92	4.94	.47	.017	.101
10.00	4.92	.45	.016	.100
10.08	4.92	.45	.016	.099
10.17	4.91	.44	.016	.098
10.25	4.90	.43	.015	.098
10.33	4.88	.41	.015	.097
10.42	4.87	.40	.014	.096
10.50	4.86	.39	.014	.095
10.58	4.86	.39	.014	.094
10.67	4.84	.37	.013	.094
10.75	4.83	.36	.013	.093
10.83	4.82	.35	.012	.092
10.92	4.81	.34	.012	.092
11.00	4.81	.34	.012	.091
11.08	4.79	.32	.011	.090
11.17	4.78	.31	.011	.090
11.25	4.77	.30	.011	.089
11.33	4.76	.29	.010	.088
11.42	4.75	.28	.010	.088
11.50	4.75	.28	.010	.087
11.58	4.73	.26	.009	.086
11.67	4.72	.25	.009	.086
11.75	4.72	.25	.009	.085
11.83	4.70	.23	.008	.085
11.92	4.70	.23	.008	.084
12.00	4.69	.22	.008	.083
12.08	4.69	.22	.008	.083
12.17	4.68	.21	.007	.082
12.25	4.68	.21	.007	.082
12.33	4.67	.20	.007	.081
12.42	4.66	.19	.007	.081
12.50	4.65	.18	.006	.080
12.58	4.64	.17	.006	.079
12.67	4.64	.17	.006	.079
12.75	4.63	.16	.006	.078
12.83	4.62	.15	.005	.078
12.92	4.62	.15	.005	.077
13.00	4.61	.14	.005	.077
13.08	4.60	.13	.005	.076
13.17	4.59	.12	.004	.076
13.25	4.59	.12	.004	.075
13.33	4.58	.11	.004	.075
13.42	4.57	.10	.004	.075
13.50	4.57	.10	.004	.074
13.58	4.56	.09	.003	.074
13.67	4.56	.09	.003	.073
13.75	4.56	.09	.003	.073
13.83	4.56	.09	.003	.072
14.08	4.55	.08	.003	.071
14.17	4.54	.07	.002	.071

14.25	4.54	.07	.002	.070
14.33	4.53	.06	.002	.070
14.42	4.53	.06	.002	.069
14.50	4.52	.05	.002	.069
14.58	4.52	.05	.002	.069
14.67	4.51	.04	.001	.068
14.75	4.51	.04	.001	.068
14.83	4.50	.03	.001	.067
14.92	4.50	.03	.001	.067
15.00	4.50	.03	.001	.067
15.08	4.48	.01	.000	.066
15.17	4.48	.01	.000	.066
15.25	4.47	.00	.000	.066
15.33	4.47	.00	.000	.065
15.25	4.47	.00	.000	.066
15.17	4.46	.01	.000	.066
15.17	4.46	.01	.000	.066

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WELL # GW-17A

WELL DIAMETER= 7.75 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 5.00 GALLONS
LENGTH OF AQUIFER TESTED= 3.50 FEET
VALUE OF H0= 30.64 FEET
STATIC WATER LEVEL= 3.90 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.17	14.79	10.89	.355	5.999
.33	13.02	9.12	.298	3.000
.50	11.89	7.99	.261	2.000
.67	10.98	7.08	.231	1.500
.83	9.90	6.00	.196	1.200
1.00	9.51	5.61	.183	1.000
1.17	9.00	5.10	.166	.857
1.33	8.47	4.57	.149	.750
1.50	8.12	4.22	.138	.667
1.67	7.77	3.87	.126	.600
1.83	7.24	3.34	.109	.545
2.00	7.00	3.10	.101	.500
2.17	6.68	2.78	.091	.462
2.33	6.88	2.98	.097	.429
2.50	6.74	2.84	.093	.400
2.67	6.59	2.69	.088	.375
2.83	6.48	2.58	.084	.353
3.00	6.35	2.45	.080	.333
3.17	6.24	2.34	.076	.316
3.33	6.16	2.26	.074	.300
3.50	6.07	2.17	.071	.286
3.67	5.99	2.09	.068	.273
3.83	5.93	2.03	.066	.261
4.00	5.85	1.95	.064	.250
4.17	5.80	1.90	.062	.240
4.33	5.74	1.84	.060	.231
4.50	5.62	1.72	.056	.222
4.67	5.60	1.70	.055	.214
4.83	5.56	1.66	.054	.207
5.00	5.52	1.62	.053	.200
5.17	5.47	1.57	.051	.194
5.33	5.43	1.53	.050	.187
5.50	5.38	1.48	.048	.182
5.67	5.32	1.42	.046	.176
5.83	5.27	1.37	.045	.171
6.00	5.23	1.33	.043	.167
6.17	5.18	1.28	.042	.162
6.33	5.14	1.24	.040	.158
6.50	5.09	1.19	.039	.154
6.67	5.05	1.15	.038	.150
6.83	5.02	1.12	.037	.146
7.00	4.99	1.09	.036	.143
7.17	4.94	1.04	.034	.140
7.33	4.92	1.02	.033	.136

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7.50	4.88	.98	.032	.133
7.67	4.85	.95	.031	.130
7.83	4.80	.90	.029	.128
8.00	4.77	.87	.028	.125
8.17	4.74	.84	.027	.122
8.33	4.71	.81	.026	.120
8.50	4.68	.78	.025	.118
8.67	4.65	.75	.024	.115
8.83	4.62	.72	.023	.113
9.00	4.59	.69	.023	.111
9.17	4.57	.67	.022	.109
9.33	4.54	.64	.021	.107
9.50	4.51	.61	.020	.105
9.67	4.48	.58	.019	.103
9.83	4.46	.56	.018	.102
10.00	4.44	.54	.018	.100
10.17	4.41	.51	.017	.098
10.33	4.38	.48	.016	.097
10.50	4.36	.46	.015	.095
10.67	4.34	.44	.014	.094
10.83	4.31	.41	.013	.092
11.00	4.09	.19	.006	.091
11.17	4.13	.23	.008	.090
11.33	4.09	.19	.006	.088
11.50	4.07	.17	.006	.087
11.67	4.07	.17	.006	.086
11.83	4.06	.16	.005	.085
12.00	4.05	.15	.005	.083
12.17	4.04	.14	.005	.082
12.33	4.04	.14	.005	.081
12.50	4.03	.13	.004	.080
12.67	4.01	.11	.004	.079
12.83	3.95	.05	.002	.078
13.00	3.99	.09	.003	.077
13.17	3.94	.04	.001	.076
13.33	3.93	.03	.001	.075
13.50	3.96	.06	.002	.074
13.67	3.91	.01	.000	.073
13.83	3.91	.01	.000	.072
14.00	3.91	.01	.000	.071
14.17	3.91	.01	.000	.071
14.33	3.91	.01	.000	.070
14.50	3.91	.01	.000	.069

ENVIROCARE OF UTAH

WELL # GW-18

WELL DIAMETER= 7.75 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 4.70 GALLONS
LENGTH OF AQUIFER TESTED= 7.00 FEET
VALUE OF H0= 28.80 FEET
STATIC WATER LEVEL= 5.02 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.08	19.49	14.47	.502	12.005
.17	17.37	12.35	.429	6.001
.25	15.54	10.52	.365	4.001
.33	14.13	9.11	.316	3.000
.42	12.92	7.90	.274	2.400
.50	11.92	6.90	.240	2.000
.58	11.04	6.02	.209	1.714
.67	10.27	5.25	.182	1.500
.75	9.66	4.64	.161	1.333
.83	9.08	4.06	.141	1.200
.92	8.63	3.61	.125	1.091
1.00	8.22	3.20	.111	1.000
1.08	7.87	2.85	.099	.923
1.17	7.56	2.54	.088	.857
1.25	7.29	2.27	.079	.800
1.33	7.06	2.04	.071	.750
1.42	6.86	1.84	.064	.706
1.50	6.70	1.68	.058	.667
1.58	6.54	1.52	.053	.632
1.67	6.42	1.40	.049	.600
1.75	6.30	1.28	.044	.571
1.83	6.20	1.18	.041	.545
1.92	6.12	1.10	.038	.522
2.00	6.05	1.03	.036	.500
2.08	5.97	.95	.033	.480
2.17	5.91	.89	.031	.462
2.25	5.85	.83	.029	.444
2.33	5.80	.78	.027	.429
2.42	5.75	.73	.025	.414
2.50	5.71	.69	.024	.400
2.58	5.68	.66	.023	.387
2.75	5.62	.60	.021	.364
2.83	5.60	.58	.020	.353
2.92	5.58	.56	.019	.343
3.00	5.56	.54	.019	.333
3.08	5.55	.53	.018	.324
3.17	5.53	.51	.018	.316
3.25	5.52	.50	.017	.308
3.33	5.50	.48	.017	.300
3.42	5.49	.47	.016	.293
3.50	5.48	.46	.016	.286
3.58	5.47	.45	.016	.279
3.67	5.46	.44	.015	.273
3.75	5.46	.44	.015	.267

3.83	5.45	.43	.015	.261
3.92	5.45	.43	.015	.255
4.00	5.43	.41	.014	.250
4.08	5.43	.41	.014	.245
4.17	5.42	.40	.014	.240
4.25	5.41	.39	.014	.235
4.33	5.41	.39	.014	.231
4.42	5.40	.38	.013	.226
4.50	5.40	.38	.013	.222
4.58	5.39	.37	.013	.218
4.67	5.39	.37	.013	.214
4.75	5.37	.35	.012	.211
4.83	5.37	.35	.012	.207
4.92	5.37	.35	.012	.203
5.00	5.36	.34	.012	.200
5.08	5.35	.33	.011	.197
5.17	5.34	.32	.011	.194
5.25	5.34	.32	.011	.190
5.33	5.34	.32	.011	.188
5.42	5.33	.31	.011	.185
5.50	5.32	.30	.010	.182
5.58	5.33	.31	.011	.179
5.67	5.31	.29	.010	.176
5.75	5.31	.29	.010	.174
5.83	5.31	.29	.010	.171
5.92	5.30	.28	.010	.169
6.00	5.29	.27	.009	.167
6.08	5.28	.26	.009	.164
6.17	5.27	.25	.009	.162
6.25	5.27	.25	.009	.160
6.33	5.27	.25	.009	.158
6.42	5.26	.24	.008	.156
6.50	5.25	.23	.008	.154
6.58	5.24	.22	.008	.152
6.67	5.24	.22	.008	.150
6.75	5.24	.22	.008	.148
6.83	5.23	.21	.007	.146
6.92	5.23	.21	.007	.145
7.00	5.21	.19	.007	.143
7.08	5.21	.19	.007	.141
7.17	5.21	.19	.007	.140
7.25	5.20	.18	.006	.138
7.33	5.19	.17	.006	.136
7.42	5.19	.17	.006	.135
7.50	5.18	.16	.006	.133
7.58	5.18	.16	.006	.132
7.67	5.18	.16	.006	.130
7.75	5.17	.15	.005	.129
7.83	5.17	.15	.005	.128
7.92	5.16	.14	.005	.126
8.00	5.16	.14	.005	.125
8.08	5.15	.13	.005	.124
8.17	5.15	.13	.005	.122
8.25	5.15	.13	.005	.121
8.33	5.14	.12	.004	.120
8.42	5.13	.11	.004	.119
8.50	5.13	.11	.004	.118
8.58	5.13	.11	.004	.117
8.67	5.12	.10	.003	.115
8.75	5.12	.10	.003	.114
8.83	5.12	.10	.003	.113
8.92	5.12	.10	.003	.112

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9.00	5.12	.10	.003	.111
9.08	5.11	.09	.003	.110
9.17	5.11	.09	.003	.109
9.25	5.10	.08	.003	.108
9.33	5.10	.08	.003	.107
9.42	5.10	.08	.003	.106
9.50	5.10	.08	.003	.105
9.58	5.09	.07	.002	.104
9.67	5.09	.07	.002	.103
9.75	5.09	.07	.002	.103
9.83	5.07	.05	.002	.102
9.92	5.08	.06	.002	.101
10.00	5.07	.05	.002	.100
10.08	5.06	.04	.001	.099
10.17	5.07	.05	.002	.098
10.25	5.06	.04	.001	.098
10.33	5.06	.04	.001	.097
10.42	5.06	.04	.001	.096
10.50	5.06	.04	.001	.095
10.58	5.05	.03	.001	.094
10.67	5.06	.04	.001	.094

ENVIROCARE OF UTAH

WELL # GW-19A

WELL DIAMETER= 7.75 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 4.00 GALLONS
LENGTH OF AQUIFER TESTED= 7.00 FEET
VALUE OF H0= 24.51 FEET
STATIC WATER LEVEL= 9.64 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.08	15.58	5.94	.242	12.001
.17	14.23	4.59	.187	6.000
.25	13.26	3.62	.148	4.000
.33	12.55	2.91	.119	3.000
.42	11.96	2.32	.095	2.400
.50	11.51	1.87	.076	2.000
.58	11.12	1.48	.060	1.714
.67	10.78	1.14	.047	1.500
.75	10.48	.84	.034	1.333
.83	10.26	.62	.025	1.200
.92	10.01	.37	.015	1.091
1.00	9.81	.17	.007	1.000
1.08	9.67	.03	.001	.923
1.17	9.52	.12	.005	.857
1.25	9.38	.26	.011	.800
1.33	9.25	.39	.016	.750
1.42	9.14	.50	.020	.706
1.50	9.04	.60	.024	.667
1.58	8.94	.70	.029	.632
1.67	8.85	.79	.032	.600
1.75	8.77	.87	.035	.571
1.83	8.69	.95	.039	.545
1.92	8.63	1.01	.041	.522
2.00	8.56	1.08	.044	.500
2.08	8.51	1.13	.046	.480
2.17	8.46	1.18	.048	.462
2.25	8.40	1.24	.051	.444
2.33	8.36	1.28	.052	.429
2.42	8.31	1.33	.054	.414
2.50	8.28	1.36	.055	.400
2.58	8.25	1.39	.057	.387
2.67	8.21	1.43	.058	.375
2.75	8.18	1.46	.060	.364
2.83	8.15	1.49	.061	.353
2.92	8.13	1.51	.062	.343
3.00	8.10	1.54	.063	.333
3.08	8.07	1.57	.064	.324
3.17	8.06	1.58	.064	.316
3.25	8.04	1.60	.065	.308
3.33	8.01	1.63	.066	.300
3.42	7.99	1.65	.067	.293
3.50	7.98	1.66	.068	.286
3.58	7.96	1.68	.069	.279
3.67	7.94	1.70	.069	.273

3.75	7.93	1.71	.070	.267
3.83	7.91	1.73	.071	.261
3.92	7.90	1.74	.071	.255
4.00	7.88	1.76	.072	.250
4.08	7.86	1.78	.073	.245
4.17	7.85	1.79	.073	.240
4.25	7.83	1.81	.074	.235
4.33	7.81	1.83	.075	.231
4.42	7.80	1.84	.075	.226
4.50	7.78	1.86	.076	.222
4.58	7.76	1.88	.077	.218
4.67	7.75	1.89	.077	.214
4.75	7.74	1.90	.078	.211
4.83	7.73	1.91	.078	.207
4.92	7.71	1.93	.079	.203
5.00	7.70	1.94	.079	.200
5.08	7.69	1.95	.080	.197
5.17	7.68	1.96	.080	.194
5.25	7.68	1.96	.080	.190
5.33	7.66	1.98	.081	.188
5.42	7.65	1.99	.081	.185
5.50	7.63	2.01	.082	.182
5.58	7.62	2.02	.082	.179
5.67	7.61	2.03	.083	.176
5.75	7.60	2.04	.083	.174
5.83	7.59	2.05	.084	.171
5.92	7.58	2.06	.084	.169
6.00	7.57	2.07	.084	.167
6.08	7.56	2.08	.085	.164
6.17	7.54	2.10	.086	.162
6.25	7.54	2.10	.086	.160
6.33	7.53	2.11	.086	.158
6.42	7.52	2.12	.086	.156
6.50	7.50	2.14	.087	.154
6.58	7.50	2.14	.087	.152
6.67	7.47	2.17	.089	.150
6.75	7.46	2.18	.089	.148
6.83	7.45	2.19	.089	.146
6.92	7.44	2.20	.090	.145
7.00	7.43	2.21	.090	.143
7.08	7.42	2.22	.091	.141
7.17	7.41	2.23	.091	.140
7.25	7.41	2.23	.091	.138
7.33	7.39	2.25	.092	.136
7.42	7.38	2.26	.092	.135
7.50	7.37	2.27	.093	.133
7.58	7.36	2.28	.093	.132
7.67	7.35	2.29	.093	.130
7.75	7.35	2.29	.093	.129
7.83	7.34	2.30	.094	.128
7.92	7.33	2.31	.094	.126
8.00	7.31	2.33	.095	.125
8.08	7.30	2.34	.095	.124
8.17	7.29	2.35	.096	.122
8.25	7.29	2.35	.096	.121
8.33	7.27	2.37	.097	.120
8.42	7.26	2.38	.097	.119
8.50	7.26	2.38	.097	.118
8.58	7.24	2.40	.098	.117
8.67	7.24	2.40	.098	.115
8.75	7.23	2.41	.098	.114
8.83	7.22	2.42	.099	.113

8.92	7.22	2.42	.099	.112
9.00	7.21	2.43	.099	.111
9.08	7.20	2.44	.100	.110
9.17	7.19	2.45	.100	.109
9.25	7.19	2.45	.100	.108
9.33	7.18	2.46	.100	.107
9.42	7.17	2.47	.101	.106
9.50	7.16	2.48	.101	.105
9.58	7.16	2.48	.101	.104
9.67	7.15	2.49	.102	.103
9.75	6.94	2.70	.110	.103
9.83	7.13	2.51	.102	.102
9.92	7.13	2.51	.102	.101
10.00	7.12	2.52	.103	.100
10.08	7.12	2.52	.103	.099
10.17	7.11	2.53	.103	.098
10.25	7.10	2.54	.104	.098
10.33	7.09	2.55	.104	.097
10.42	7.09	2.55	.104	.096
10.50	7.07	2.57	.105	.095
10.58	7.07	2.57	.105	.094
10.67	7.06	2.58	.105	.094
10.75	7.05	2.59	.106	.093
10.83	7.05	2.59	.106	.092
10.92	7.04	2.60	.106	.092
11.00	7.03	2.61	.106	.091
11.08	7.03	2.61	.106	.090
11.17	7.02	2.62	.107	.090
11.25	7.01	2.63	.107	.089
11.33	7.01	2.63	.107	.088
11.42	7.01	2.63	.107	.088
11.50	6.98	2.66	.109	.087
11.58	6.98	2.66	.109	.086
11.67	6.98	2.66	.109	.086
11.75	6.96	2.68	.109	.085
11.83	6.96	2.68	.109	.085
11.92	6.96	2.68	.109	.084
12.00	6.95	2.69	.110	.083
12.08	6.95	2.69	.110	.083
12.17	6.94	2.70	.110	.082
12.25	6.94	2.70	.110	.082
12.33	6.94	2.70	.110	.081
12.42	6.93	2.71	.111	.081
12.50	6.93	2.71	.111	.080
12.58	6.92	2.72	.111	.079
12.67	6.92	2.72	.111	.079
12.75	6.92	2.72	.111	.078
12.83	6.92	2.72	.111	.078
12.92	6.91	2.73	.111	.077
13.00	6.90	2.74	.112	.077
13.08	6.89	2.75	.112	.076
13.17	6.88	2.76	.113	.076
13.25	6.88	2.76	.113	.075
13.33	6.87	2.77	.113	.075
13.42	6.86	2.78	.113	.075
13.50	6.85	2.79	.114	.074
13.58	6.85	2.79	.114	.074
13.67	6.84	2.80	.114	.073
13.75	6.84	2.80	.114	.073
13.83	6.84	2.80	.114	.072
13.92	6.83	2.81	.115	.072
14.00	6.83	2.81	.115	.071

14.08	6.83	2.81	.115	.071
14.17	6.82	2.82	.115	.071
14.25	6.81	2.83	.115	.070
14.33	6.80	2.84	.116	.070
14.42	6.80	2.84	.116	.069
14.50	6.79	2.85	.116	.069
14.58	6.79	2.85	.116	.069
14.67	6.79	2.85	.116	.068
14.75	6.79	2.85	.116	.068
14.83	6.78	2.86	.117	.067
14.92	6.77	2.87	.117	.067
15.00	6.77	2.87	.117	.067
22.58	6.43	3.21	.131	.044
22.67	6.43	3.21	.131	.044
22.75	6.42	3.22	.131	.044
22.83	6.43	3.21	.131	.044
22.92	6.43	3.21	.131	.044
23.00	6.42	3.22	.131	.043
23.08	6.42	3.22	.131	.043
23.17	6.42	3.22	.131	.043
23.25	6.41	3.23	.132	.043
23.33	6.41	3.23	.132	.043
23.42	6.40	3.24	.132	.043
23.50	6.40	3.24	.132	.043
23.58	6.39	3.25	.133	.042
23.67	6.39	3.25	.133	.042
23.75	6.39	3.25	.133	.042
23.83	6.38	3.26	.133	.042
23.92	6.38	3.26	.133	.042
24.00	6.38	3.26	.133	.042
24.08	6.37	3.27	.133	.042
24.17	6.37	3.27	.133	.041
24.25	6.36	3.28	.134	.041
24.33	6.37	3.27	.133	.041
24.42	6.36	3.28	.134	.041
24.50	6.36	3.28	.134	.041
24.58	6.36	3.28	.134	.041
24.67	6.36	3.28	.134	.041
24.75	6.36	3.28	.134	.040
24.83	6.36	3.28	.134	.040
24.92	6.36	3.28	.134	.040
25.00	6.36	3.28	.134	.040
25.08	6.36	3.28	.134	.040
25.17	6.36	3.28	.134	.040
25.25	6.36	3.28	.134	.040
25.33	6.35	3.29	.134	.039
25.42	6.35	3.29	.134	.039
25.50	6.35	3.29	.134	.039
25.58	6.34	3.30	.135	.039
25.67	6.34	3.30	.135	.039
25.75	6.34	3.30	.135	.039
25.83	6.33	3.31	.135	.039
25.92	6.33	3.31	.135	.039
26.00	6.32	3.32	.135	.038
26.08	6.32	3.32	.135	.038
26.17	6.32	3.32	.135	.038
26.25	6.32	3.32	.135	.038
26.33	6.31	3.33	.136	.038
26.42	6.31	3.33	.136	.038
26.50	6.31	3.33	.136	.038
26.58	6.31	3.33	.136	.038
26.67	6.31	3.33	.136	.038

26.75	6.31	3.33	.136	.037
26.83	6.31	3.33	.136	.037
26.92	6.30	3.34	.136	.037
27.00	6.30	3.34	.136	.037
27.08	6.30	3.34	.136	.037
27.17	6.30	3.34	.136	.037
27.25	6.29	3.35	.137	.037
27.33	6.29	3.35	.137	.037
27.42	6.28	3.36	.137	.036
27.50	6.28	3.36	.137	.036
27.58	6.28	3.36	.137	.036
27.67	6.28	3.36	.137	.036
27.75	6.28	3.36	.137	.036
27.83	6.27	3.37	.137	.036
27.92	6.27	3.37	.137	.036
28.00	6.27	3.37	.137	.036
28.08	6.27	3.37	.137	.036
28.17	6.27	3.37	.137	.036
28.25	6.27	3.37	.137	.035
28.33	6.27	3.37	.137	.035
28.42	6.27	3.37	.137	.035
28.50	6.27	3.37	.137	.035
28.58	6.27	3.37	.137	.035
28.67	6.27	3.37	.137	.035
28.75	6.27	3.37	.137	.035
28.83	6.26	3.38	.138	.035
28.92	6.25	3.39	.138	.035
29.00	6.25	3.39	.138	.034
29.08	6.24	3.40	.139	.034
29.17	6.24	3.40	.139	.034
29.25	6.24	3.40	.139	.034
29.33	6.24	3.40	.139	.034
29.42	6.24	3.40	.139	.034
29.50	6.23	3.41	.139	.034
29.58	6.24	3.40	.139	.034
29.67	6.23	3.41	.139	.034
29.75	6.23	3.41	.139	.034
29.83	6.23	3.41	.139	.034
29.92	6.23	3.41	.139	.033
30.00	6.23	3.41	.139	.033
30.08	6.23	3.41	.139	.033
30.17	6.23	3.41	.139	.033
30.25	6.23	3.41	.139	.033
30.33	6.22	3.42	.140	.033
30.42	6.22	3.42	.140	.033
30.50	6.22	3.42	.140	.033
30.58	6.22	3.42	.140	.033
30.67	6.22	3.42	.140	.033
30.75	6.22	3.42	.140	.033
30.83	6.21	3.43	.140	.032
30.92	6.21	3.43	.140	.032
31.00	6.20	3.44	.140	.032
31.08	6.20	3.44	.140	.032
31.17	6.20	3.44	.140	.032
31.25	6.20	3.44	.140	.032
31.33	6.20	3.44	.140	.032
31.42	6.20	3.44	.140	.032
31.50	6.20	3.44	.140	.032
31.58	6.20	3.44	.140	.032
31.67	6.20	3.44	.140	.032
31.75	6.20	3.44	.140	.031
31.83	6.20	3.44	.140	.031

31.92	6.20	3.44	.140	.031
32.00	6.19	3.45	.141	.031
32.08	6.20	3.44	.140	.031
32.17	6.19	3.45	.141	.031
32.25	6.20	3.44	.140	.031
32.33	6.19	3.45	.141	.031

ENVIROCARE OF UTAH

GW-19B Page 1

WELL # GW-19B

WELL DIAMETER= 7.75 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 4.60 GALLONS
LENGTH OF AQUIFER TESTED= 14.00 FEET
VALUE OF H0= 28.19 FEET
STATIC WATER LEVEL= 9.64 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.08	23.68	14.04	.498	12.001
.17	21.64	12.00	.426	6.000
.25	19.67	10.03	.356	4.000
.33	18.02	8.38	.297	3.000
.42	16.58	6.94	.246	2.400
.50	15.43	5.79	.205	2.000
.58	14.41	4.77	.169	1.714
.67	13.61	3.97	.141	1.500
.75	12.85	3.21	.114	1.333
.83	12.30	2.66	.094	1.200
.92	11.81	2.17	.077	1.091
1.00	11.40	1.76	.062	1.000
1.08	11.06	1.42	.050	.923
1.17	10.77	1.13	.040	.857
1.25	10.56	.92	.033	.800
1.33	10.33	.69	.024	.750
1.42	10.20	.56	.020	.706
1.50	10.09	.45	.016	.667
1.58	9.99	.35	.012	.632
1.67	9.92	.28	.010	.600
1.75	9.86	.22	.008	.571
1.83	9.81	.17	.006	.545
1.92	9.78	.14	.005	.522
2.00	9.76	.12	.004	.500
2.08	9.73	.09	.003	.480
2.17	9.73	.09	.003	.462
2.25	9.71	.07	.002	.444
2.33	9.72	.08	.003	.429
2.42	9.70	.06	.002	.414
2.50	9.70	.06	.002	.400
2.58	9.70	.06	.002	.387
2.67	9.69	.05	.002	.375
2.75	9.70	.06	.002	.364
2.83	9.68	.04	.001	.353
2.92	9.69	.05	.002	.343
3.00	9.68	.04	.001	.333
3.08	9.67	.03	.001	.324
3.17	9.68	.04	.001	.316
3.25	9.68	.04	.001	.308
3.33	9.67	.03	.001	.300
3.42	9.66	.02	.001	.293
3.50	9.67	.03	.001	.286
3.58	9.67	.03	.001	.279
3.67	9.68	.04	.001	.273

GW-19B Page 1

3.75	9.67	.03	.001	.267
3.83	9.67	.03	.001	.261
3.92	9.67	.03	.001	.255
4.00	9.68	.04	.001	.250
4.08	9.67	.03	.001	.245
4.17	9.67	.03	.001	.240
4.25	9.67	.03	.001	.235
4.33	9.67	.03	.001	.231
4.42	9.67	.03	.001	.226
4.50	9.67	.03	.001	.222
4.58	9.66	.02	.001	.218
4.67	9.66	.02	.001	.214
4.75	9.67	.03	.001	.211
4.83	9.66	.02	.001	.207
4.92	9.66	.02	.001	.203
5.00	9.66	.02	.001	.200
5.08	9.66	.02	.001	.197
5.17	9.66	.02	.001	.194
5.25	9.66	.02	.001	.190
5.33	9.66	.02	.001	.188
5.42	9.67	.03	.001	.185
5.50	9.67	.03	.001	.182
5.58	9.66	.02	.001	.179
5.67	9.65	.01	.000	.176
5.75	9.65	.01	.000	.174
5.83	9.65	.01	.000	.171
5.92	9.65	.01	.000	.169
6.00	9.65	.01	.000	.167
6.08	9.65	.01	.000	.164
6.17	9.65	.01	.000	.162
6.25	9.66	.02	.001	.160
6.33	9.65	.01	.000	.158
6.42	9.65	.01	.000	.156
6.50	9.66	.02	.001	.154
6.58	9.65	.01	.000	.152
6.67	9.66	.02	.001	.150
6.75	9.66	.02	.001	.148
6.83	9.66	.02	.001	.146
6.92	9.66	.02	.001	.145
7.00	9.66	.02	.001	.143
7.08	9.66	.02	.001	.141
7.17	9.66	.02	.001	.140
7.25	9.66	.02	.001	.138
7.33	9.65	.01	.000	.136
7.42	9.66	.02	.001	.135
7.50	9.66	.02	.001	.133
7.58	9.65	.01	.000	.132
7.67	9.65	.01	.000	.130
7.75	9.65	.01	.000	.129
7.83	9.66	.02	.001	.128
7.92	9.65	.01	.000	.126
8.00	9.65	.01	.000	.125
8.08	9.65	.01	.000	.124
8.17	9.65	.01	.000	.122
8.25	9.65	.01	.000	.121
8.33	9.65	.01	.000	.120
8.42	9.65	.01	.000	.119
8.50	9.65	.01	.000	.118
8.58	9.65	.01	.000	.117
8.67	9.65	.01	.000	.115
8.75	9.64	.00	.000	.114
8.83	9.64	.00	.000	.113

8.92	9.64	.00	.000	.112
9.00	9.65	.01	.000	.111
9.08	9.64	.00	.000	.110
9.17	9.65	.01	.000	.109
9.25	9.64	.00	.000	.108
9.33	9.64	.00	.000	.107
9.42	9.64	.00	.000	.106
9.50	9.64	.00	.000	.105
9.58	9.64	.00	.000	.104
9.67	9.64	.00	.000	.103
9.75	9.65	.01	.000	.103
9.83	9.64	.00	.000	.102
9.92	9.64	.00	.000	.101
10.00	9.64	.00	.000	.100
10.08	9.64	.00	.000	.099
10.17	9.64	.00	.000	.098

GW-21 Page 1

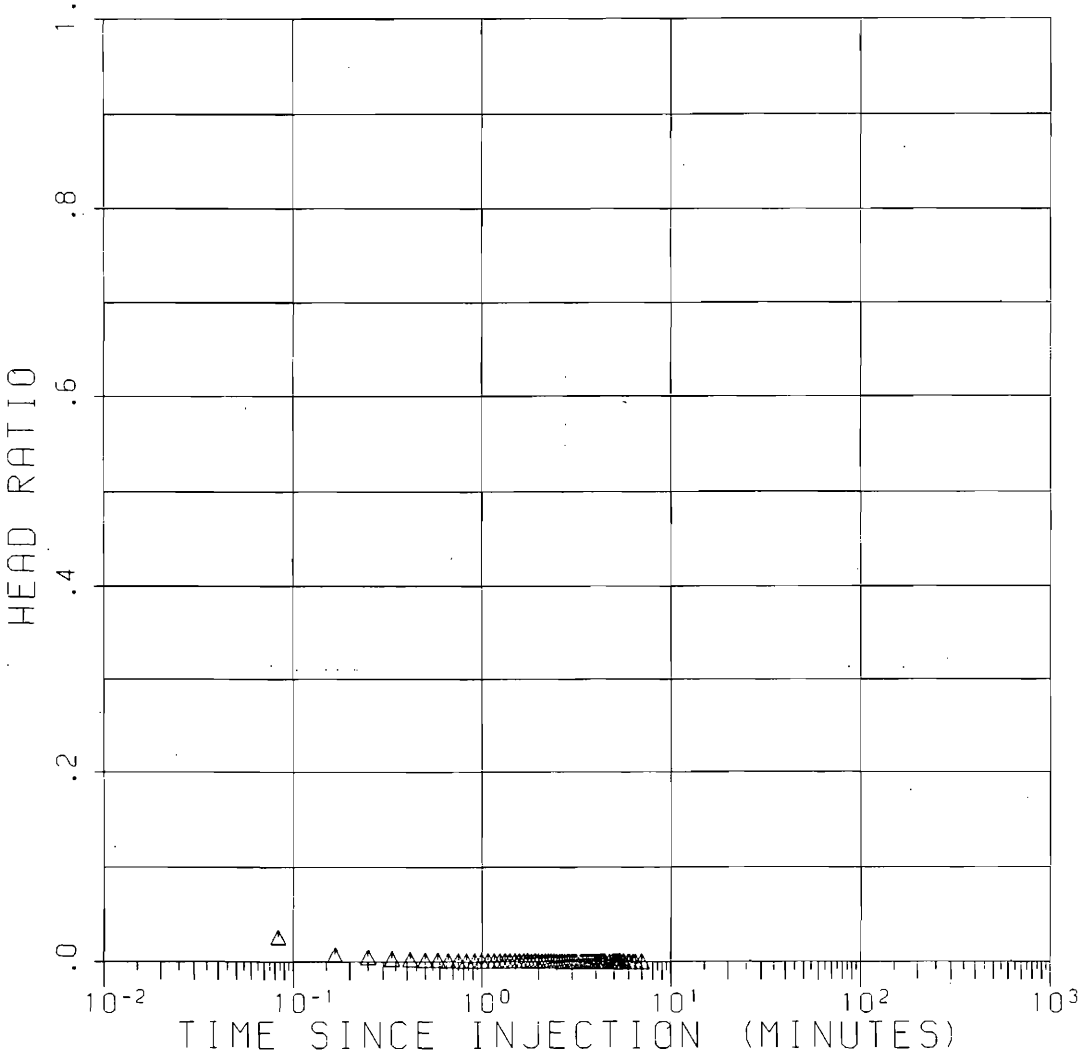
WELL # GW-21

WELL DIAMETER= 7.75 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 5.00 GALLONS
LENGTH OF AQUIFER TESTED= 9.50 FEET
VALUE OF H0= 30.64 FEET
STATIC WATER LEVEL= 6.51 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.17	9.98	3.47	.113	6.001
.33	9.36	2.85	.093	3.000
.50	9.23	2.72	.089	2.000
.67	9.11	2.60	.085	1.500
.83	8.82	2.31	.075	1.200
1.00	8.59	2.08	.068	1.000
1.17	8.38	1.87	.061	.857
1.33	8.23	1.72	.056	.750
1.50	7.95	1.44	.047	.667
1.67	7.80	1.29	.042	.600
1.83	7.78	1.27	.041	.545
2.00	7.68	1.17	.038	.500
2.17	7.59	1.08	.035	.462
2.33	7.53	1.02	.033	.429
2.50	7.44	.93	.030	.400
2.67	7.40	.89	.029	.375
2.83	7.35	.84	.027	.353
3.00	7.28	.77	.025	.333
3.17	7.23	.72	.023	.316
3.33	7.20	.69	.023	.300
3.50	7.18	.67	.022	.286
3.67	7.14	.63	.021	.273
3.83	7.09	.58	.019	.261
4.00	7.05	.54	.018	.250
4.17	7.01	.50	.016	.240
4.33	6.98	.47	.015	.231
4.50	6.94	.43	.014	.222
4.67	6.91	.40	.013	.214
4.83	6.87	.36	.012	.207
5.00	6.84	.33	.011	.200
5.17	6.81	.30	.010	.194
5.33	6.78	.27	.009	.188
5.50	6.76	.25	.008	.182
5.67	6.73	.22	.007	.176
5.83	6.70	.19	.006	.171
6.00	6.70	.19	.006	.167
6.17	6.68	.17	.006	.162
6.33	6.68	.17	.006	.158
6.50	6.67	.16	.005	.154
6.67	6.65	.14	.005	.150
6.83	6.64	.13	.004	.146
7.00	6.64	.13	.004	.143
7.17	6.63	.12	.004	.140
7.33	6.62	.11	.004	.136

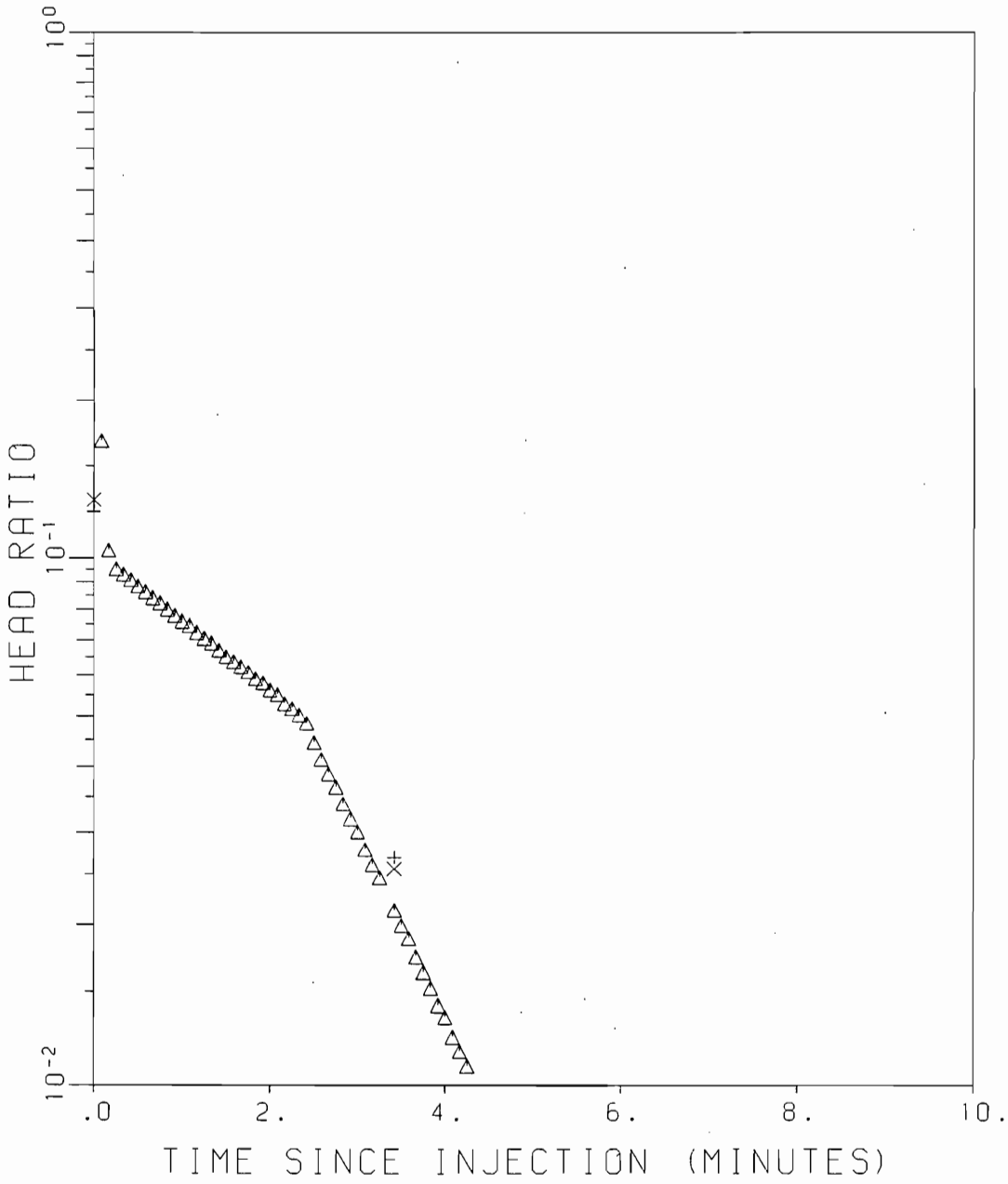
7.50	6.61	.10	.003	.133
7.67	6.61	.10	.003	.130
7.83	6.59	.08	.003	.128
8.00	6.58	.07	.002	.125
8.17	6.57	.06	.002	.122
8.33	6.56	.05	.002	.120
8.50	6.54	.03	.001	.118
8.67	6.54	.03	.001	.115
8.83	6.54	.03	.001	.113
9.00	6.54	.03	.001	.111
9.17	6.53	.02	.001	.109
9.33	6.53	.02	.001	.107
9.50	6.52	.01	.000	.105
9.67	6.52	.01	.000	.103



SLUG TEST OF WELL GW-3

HEAD RATIO VS LOG TIME

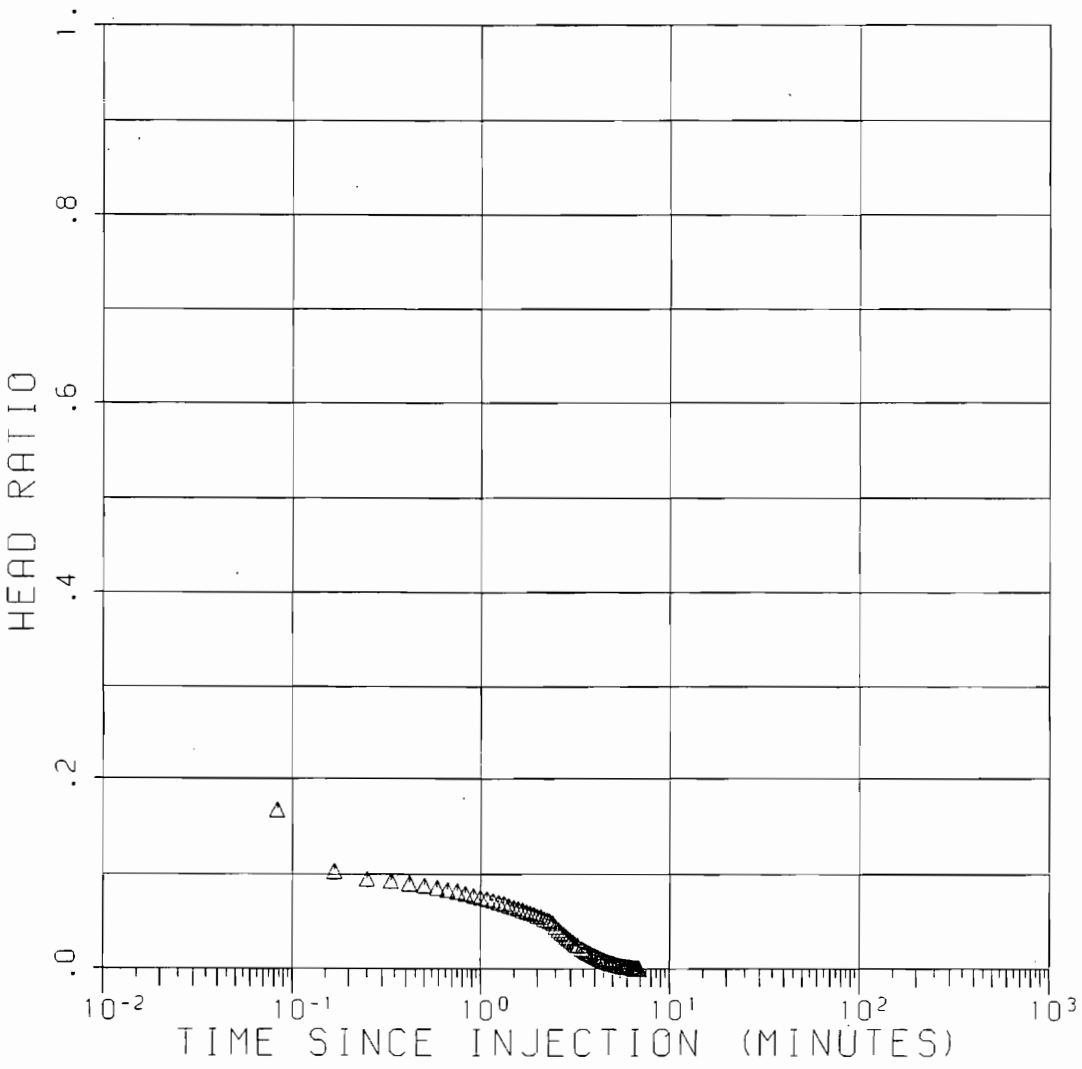
ENVIROCARE OF UTAH



SLUG TEST OF WELL GW-5

LOG HEAD RATIO VS TIME

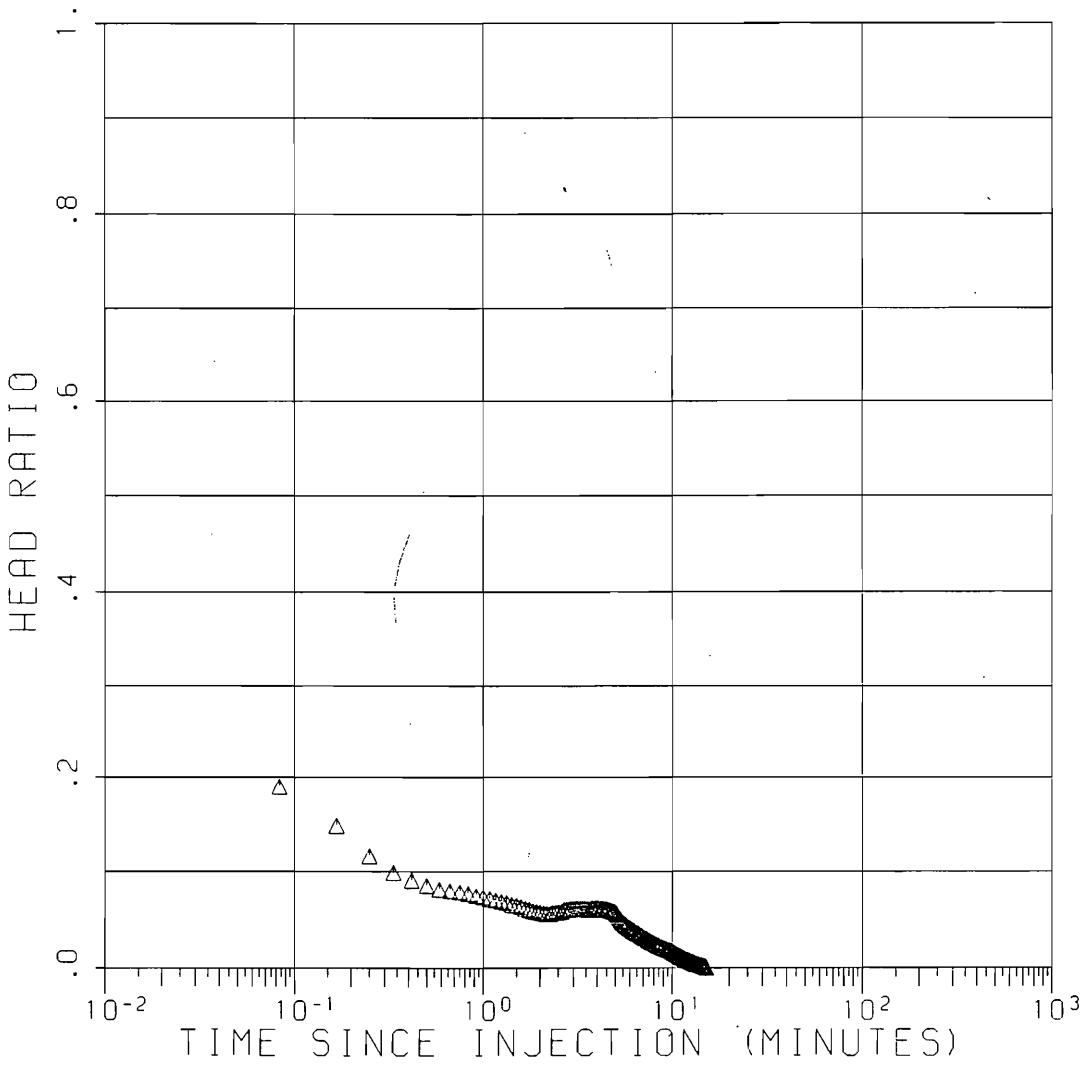
ENVIROCARE OF UTAH



ENVIROCARE OF UTAH

SLUG TEST OF WELL GW-5

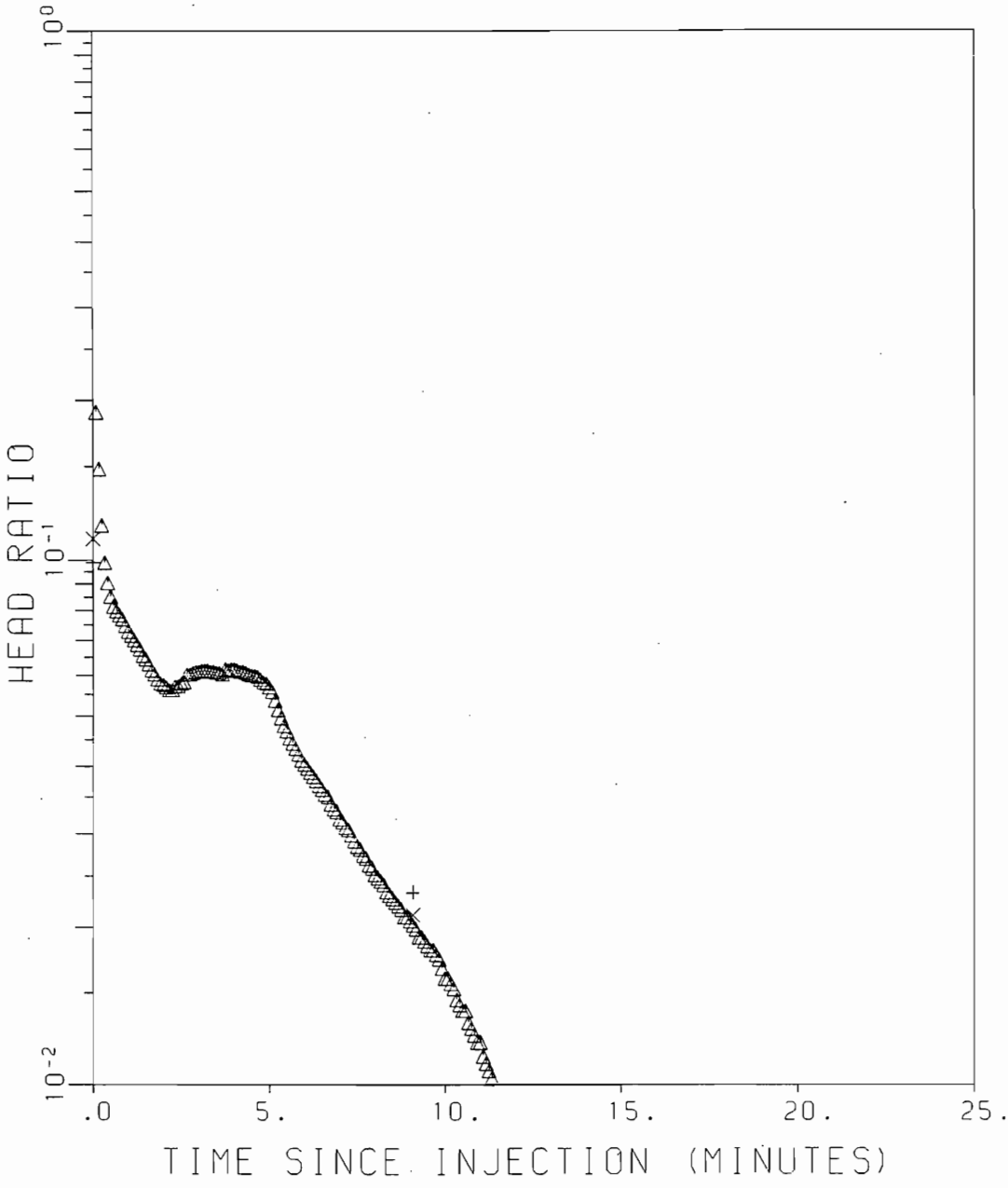
HEAD RATIO VS LOG TIME



SLUG TEST OF WELL GW-16

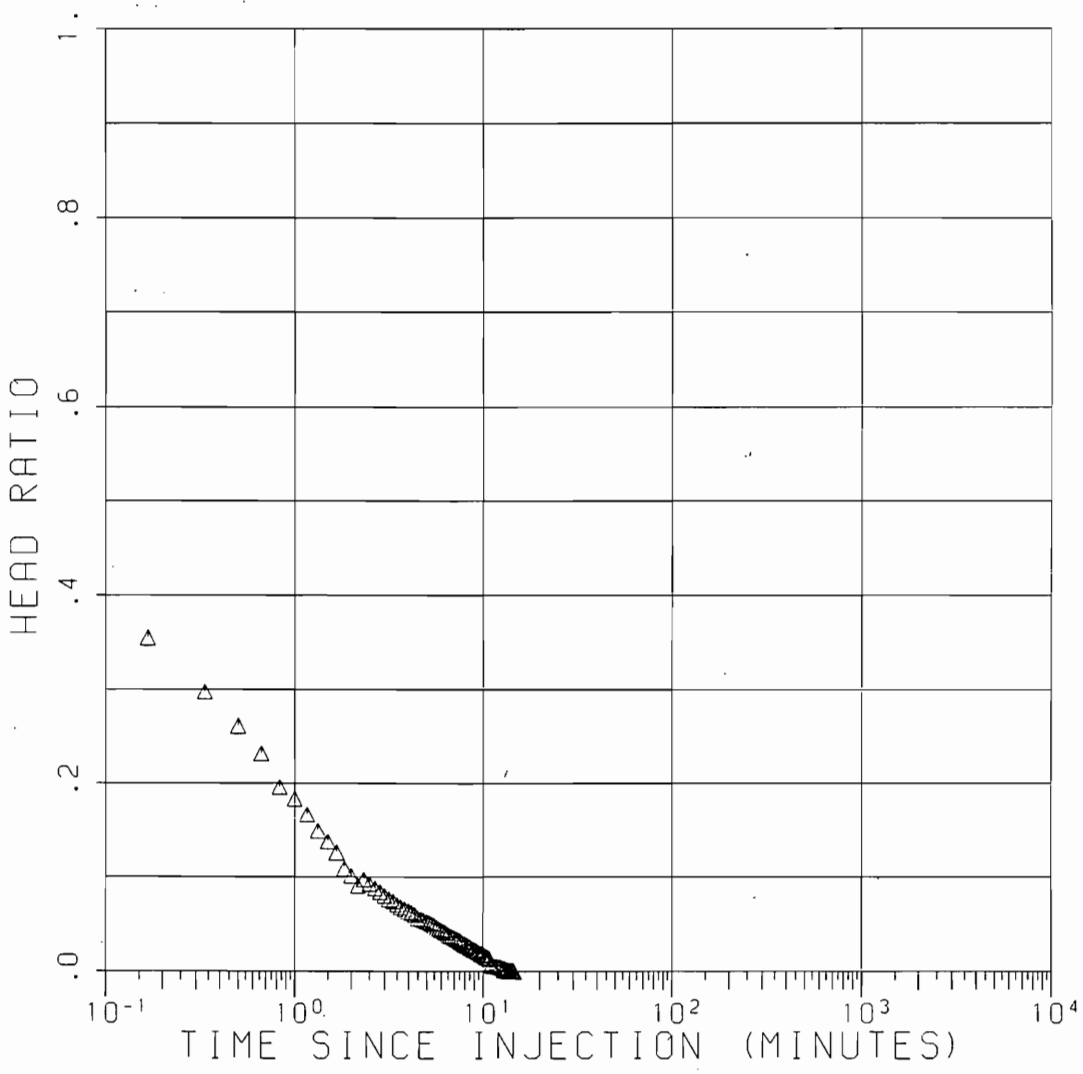
HEAD RATIO VS LOG TIME

ENVIROCARE OF UTAH



SLUG TEST OF WELL GW-16
LOG HEAD RATIO VS TIME

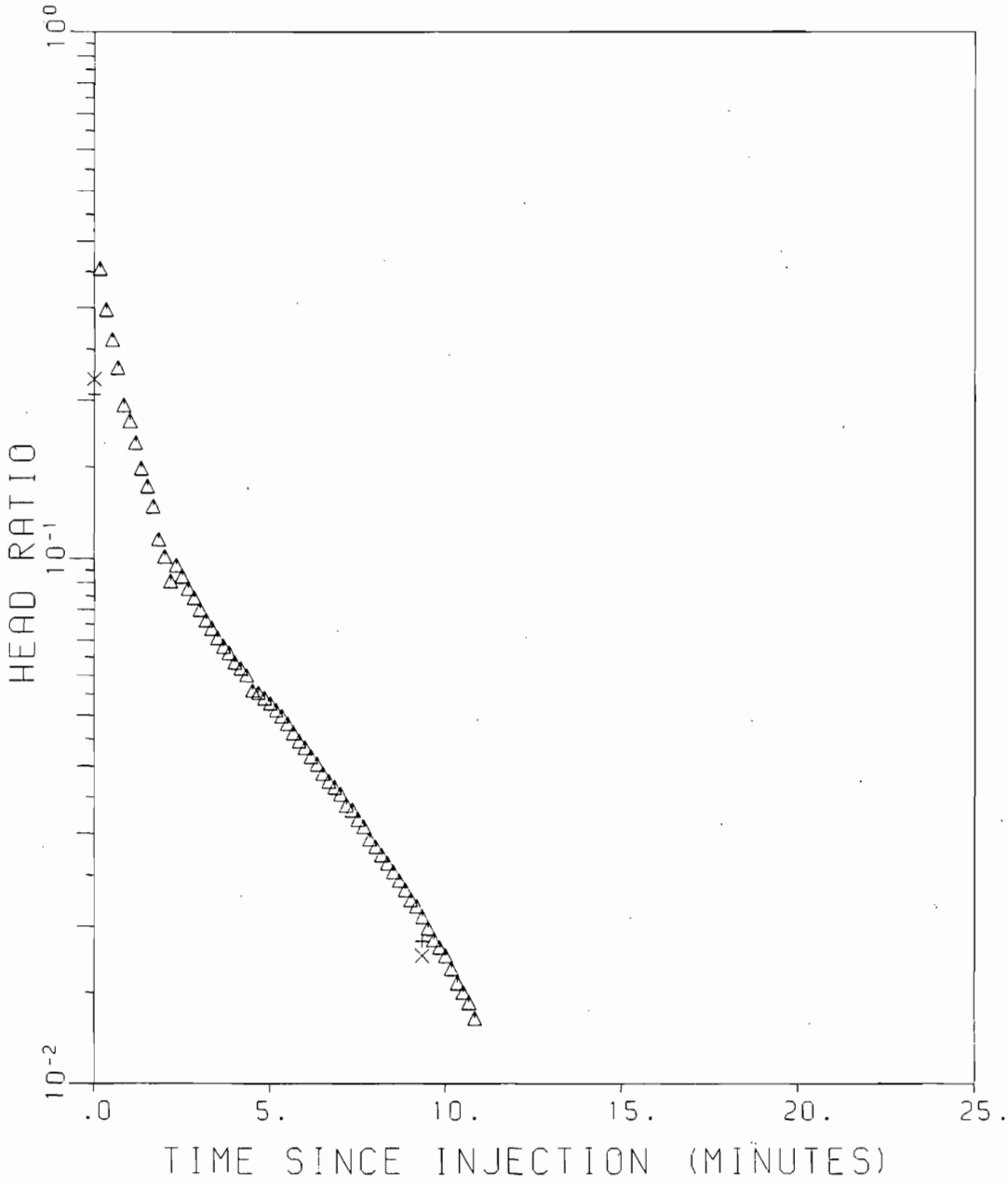
ENVIROCARE OF UTAH



ENVIROCARE OF UTAH

SLUG TEST OF WELL GW-17A

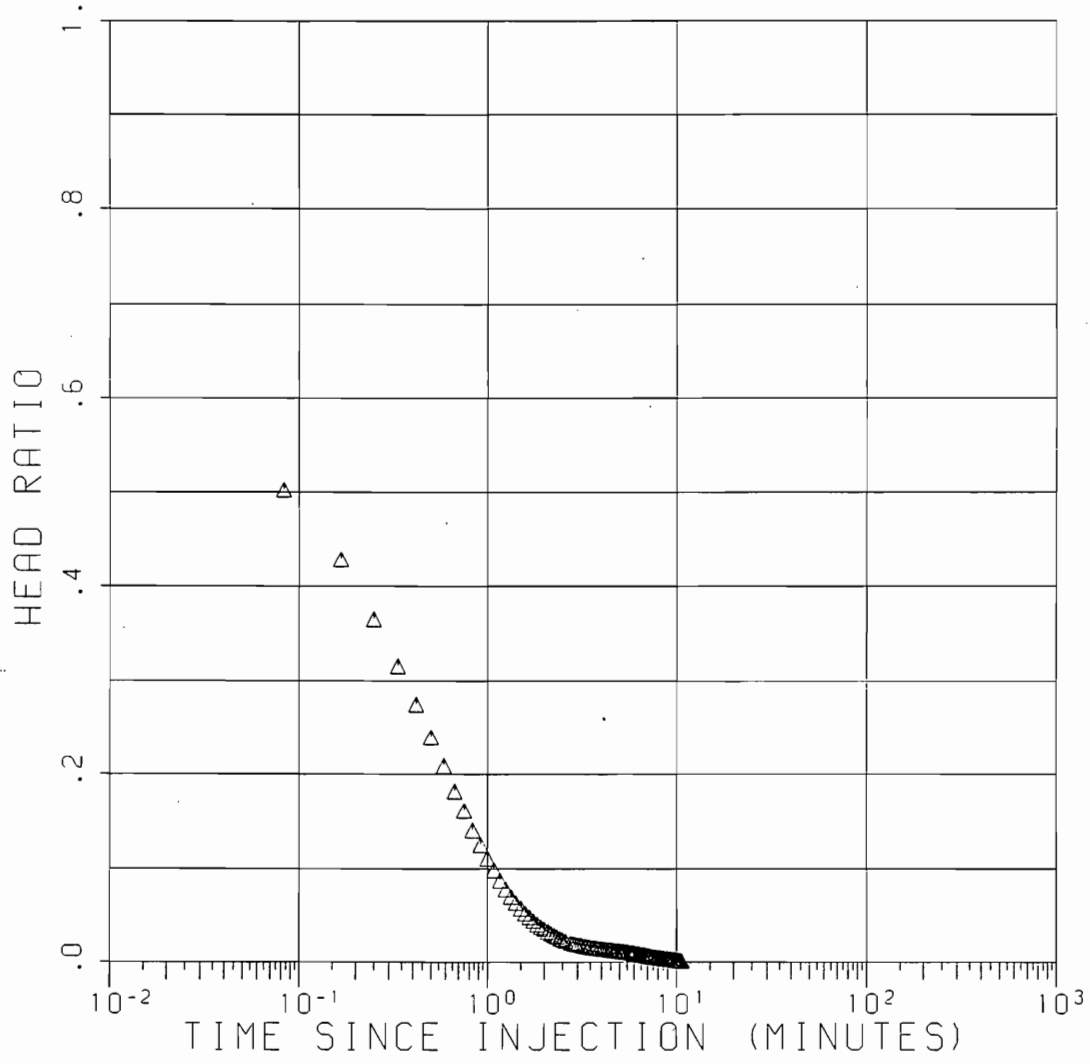
HEAD RATIO VS LOG TIME



SLUG TEST OF WELL GW-17A

LOG HEAD RATIO VS TIME

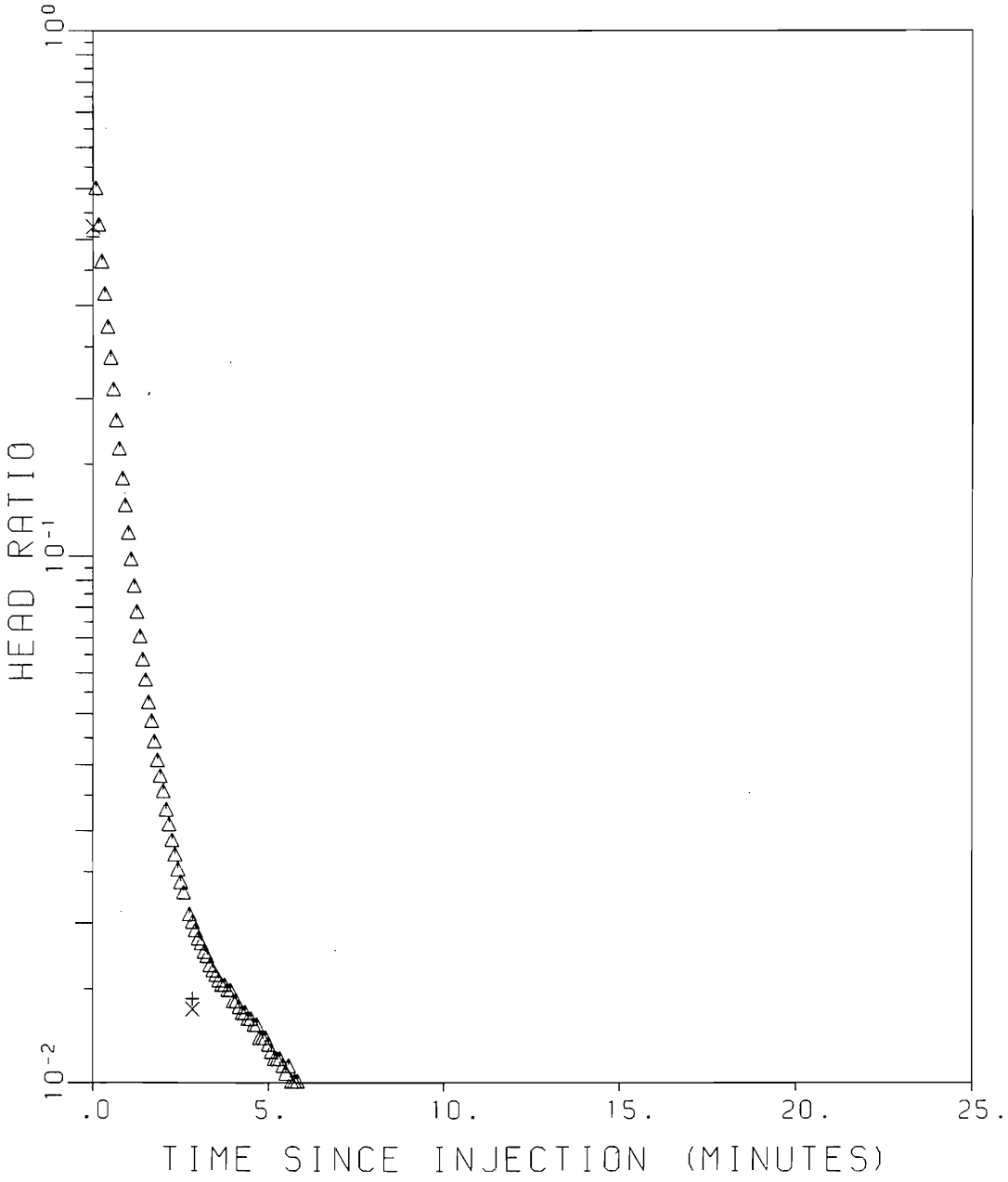
ENVIROCARE OF UTAH



ENVIROCARE OF UTAH

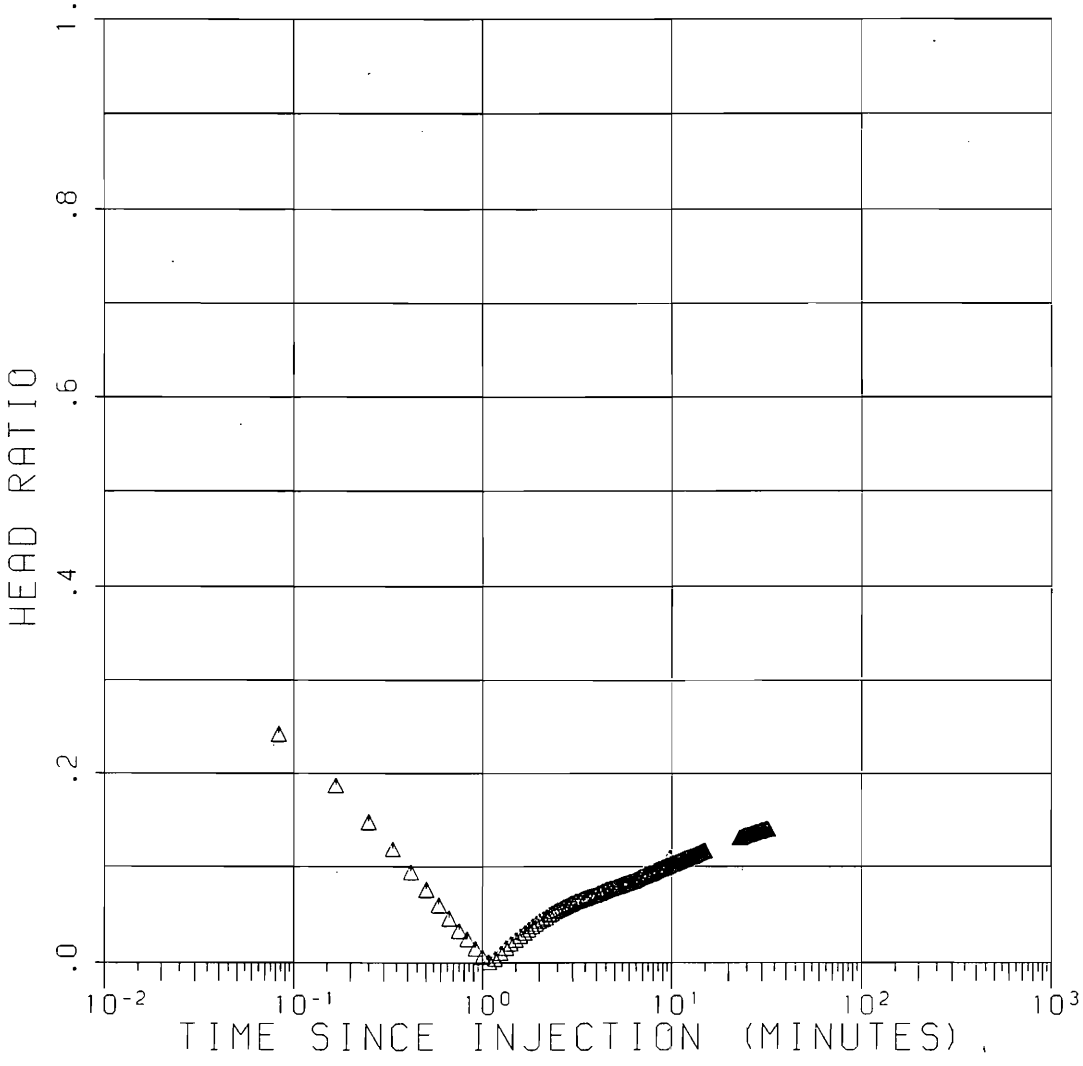
SLUG TEST OF WELL GW-18

HEAD RATIO VS LOG TIME



SLUG TEST OF WELL GW-18
LOG HEAD RATIO VS TIME

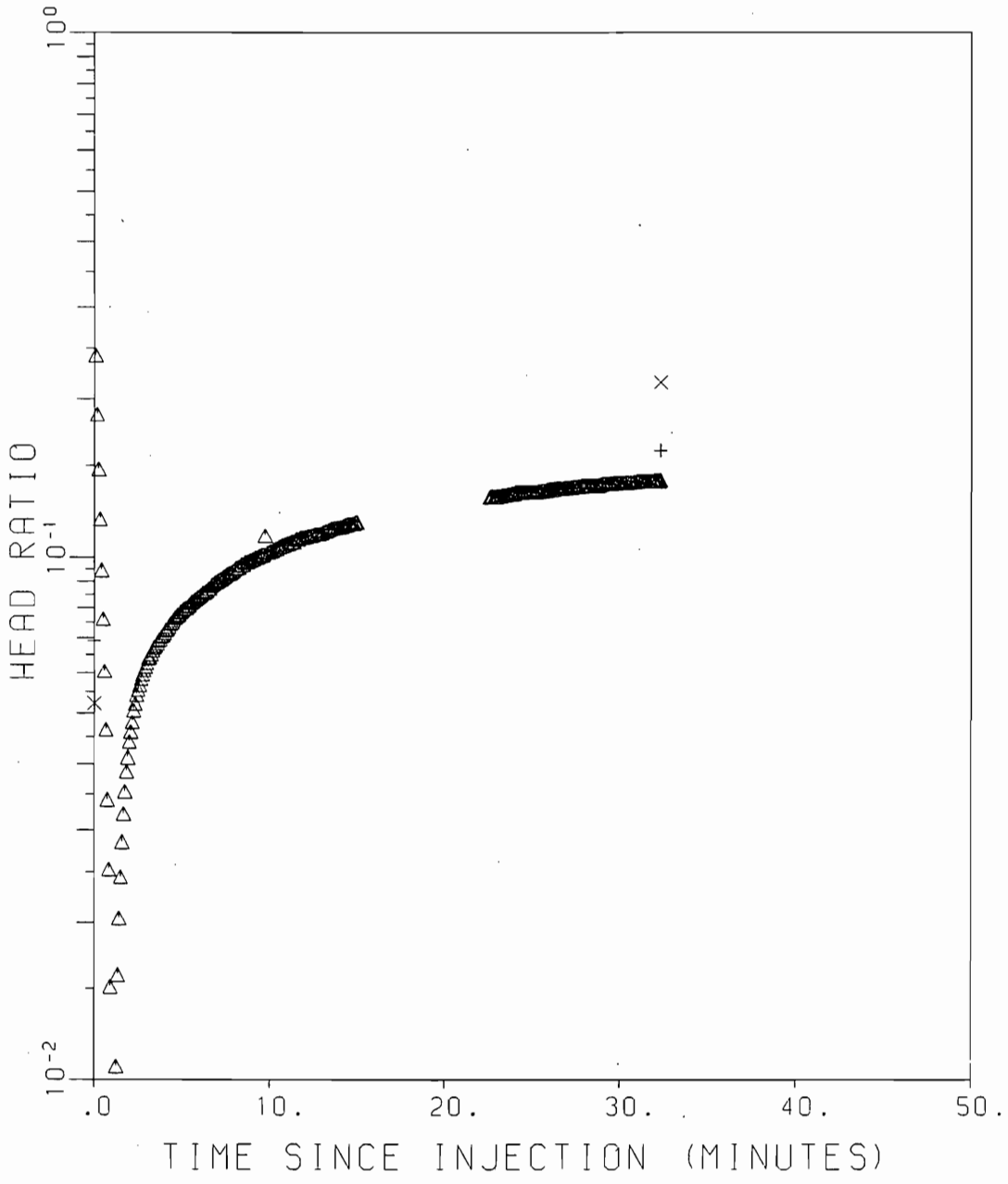
ENVIROCARE OF UTAH



SLUG TEST OF WELL GW-19A

HEAD RATIO VS LOG TIME

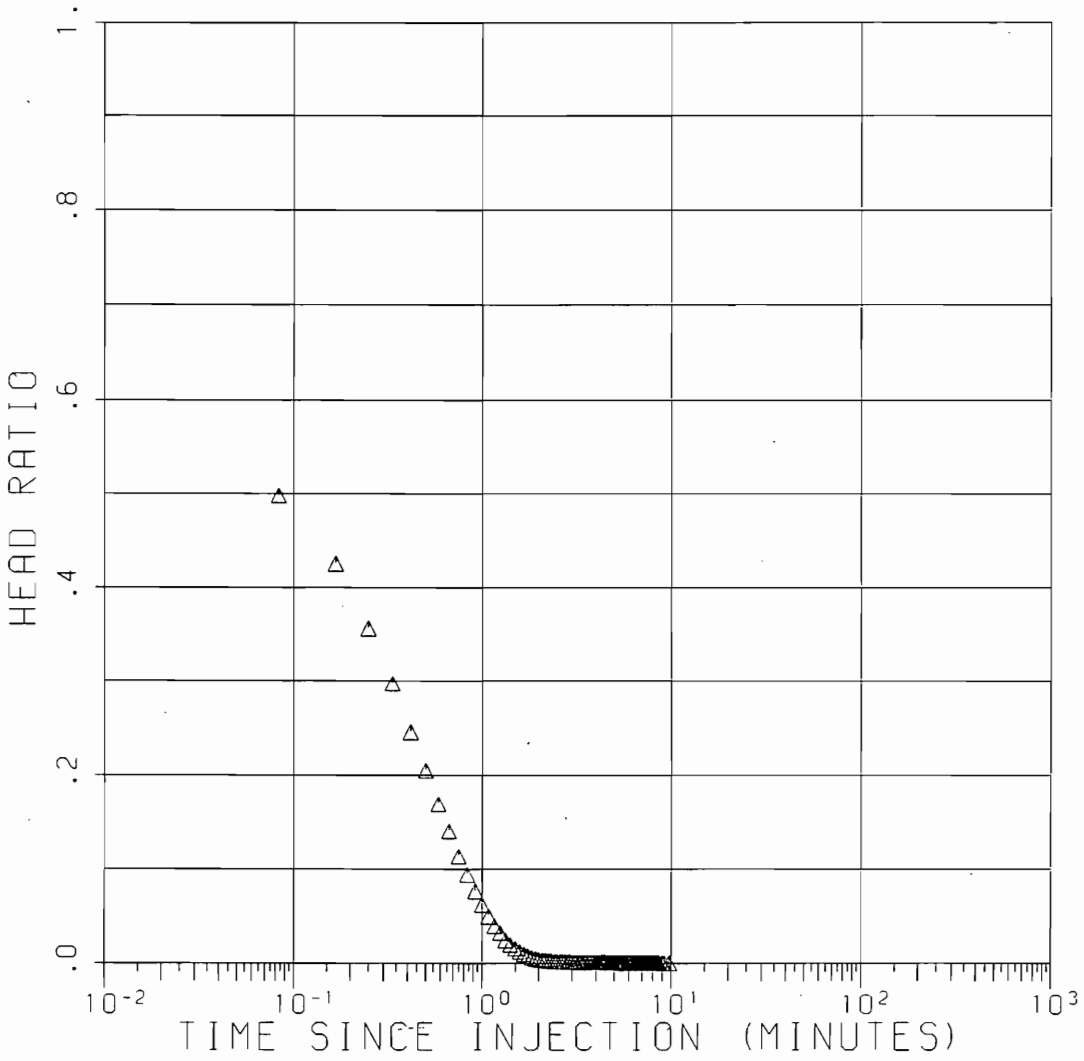
ENVIROCARE OF UTAH



SLUG TEST OF WELL GW-19A

LOG HEAD RATIO VS TIME

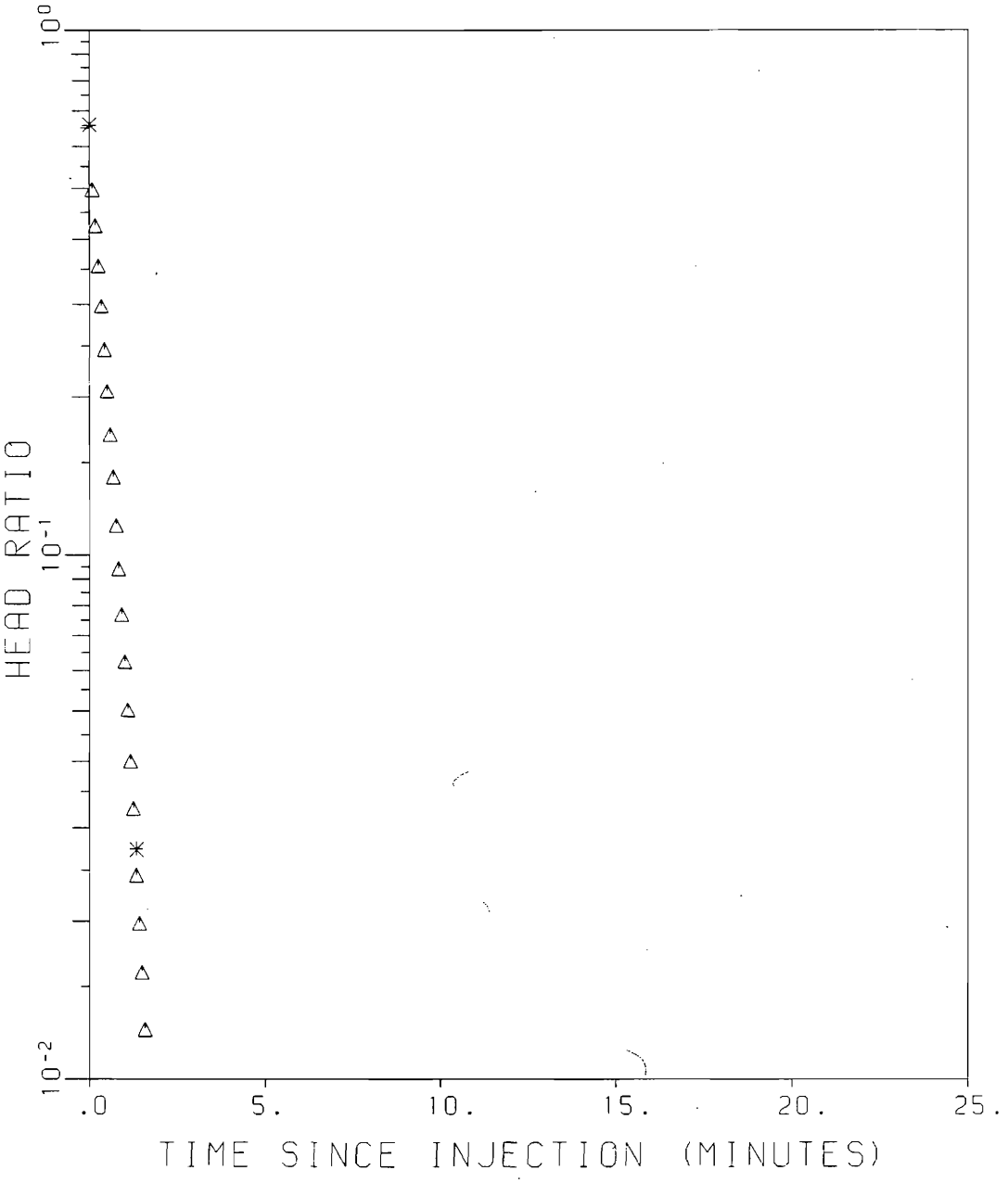
ENVIROCARE OF UTAH



ENVIROCARE OF UTAH

SLUG TEST OF WELL GW-19B

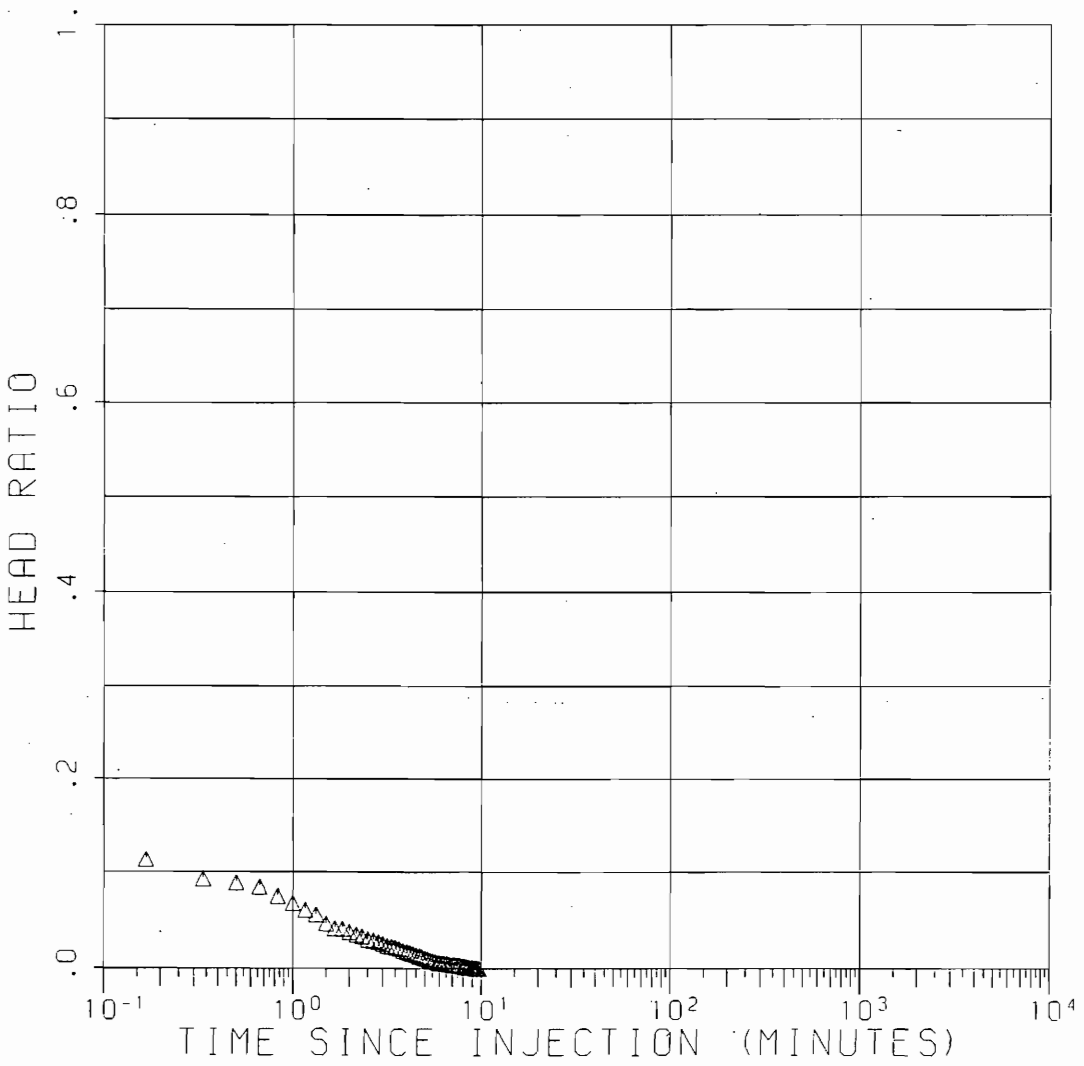
HEAD RATIO VS LOG TIME



SLUG TEST OF WELL GW-19B

LOG HEAD RATIO VS TIME

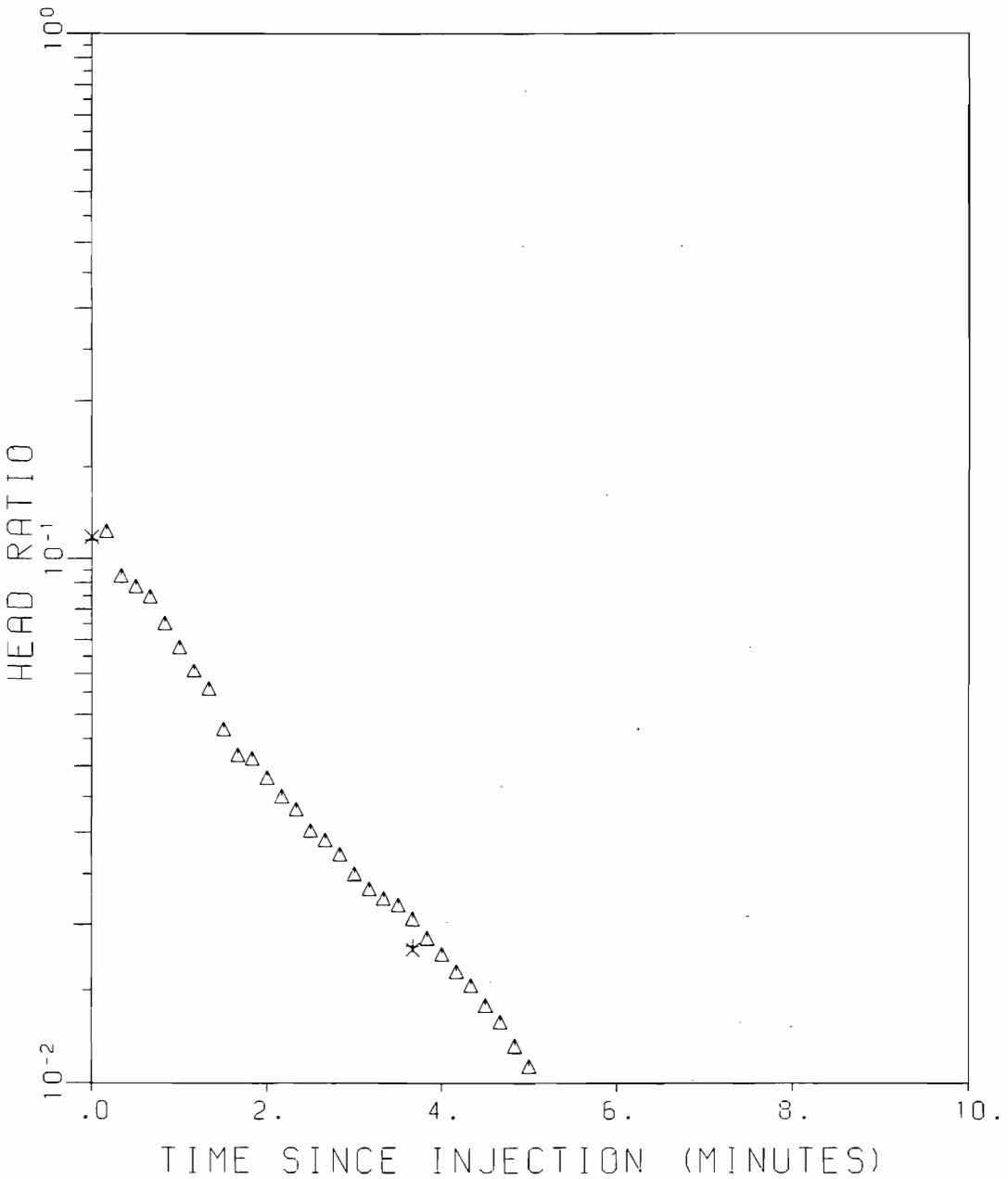
ENVIROCARE OF UTAH



SLUG TEST OF WELL GW-21

HEAD RATIO VS LOG TIME

ENVIROCARE OF UTAH



SLUG TEST OF WELL GW-21

LOG HEAD RATIO VS TIME

ENVIROCARE OF UTAH

WATER LEVEL MEASUREMENTS

TABLE

WATER LEVEL SUMMARY
CLIVE SITE
FEB., MAY & OCT. 1991

WELL ID #	ELEVATION GROUND SURFACE (feet)	ELEV. TOP OF PVC WITHOUT (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)
			February 26		May 10		October 7	
SC-1	4275.4	4278.88	30.30	4248.58	NA	NA	29.79	4249.09
SC-2	4268.7	4271.46	22.05	4249.41	21.99	4249.47	22.14	4249.32
SC-3	4277.1	4279.73	30.91	4248.82	30.80	4248.93	31.06	4248.67
SC-4	4280.5	4284.52	36.99	4247.53	36.86	4247.66	36.98	4247.54
SC-5	4273.5	4275.53	27.30	4248.23	26.72	4248.81	26.77	4248.76
SC-6	4272.5	4276.24	28.04	4248.20	27.21	4249.03	27.26	4248.98
SC-9	4278.8*	NA	NA	NA	NA	NA	NA	NA
SC-10	4279.8	4283.72	NA	NA	NA	NA	35.66	4248.06
SC-11	4275.8	4280.50	32.29	4248.21	31.82	4248.68	31.97	4248.53
SC-12	4274.9*	NA	NA	NA	NA	NA	NA	NA
SC-13	4274.1	4276.82	NA	NA	NA	NA	NA	NA
SLC-201	4274.0	4275.65	NA	NA	NA	NA	26.86	4248.79
SLC-202	4274.4	4275.78	28.86	4246.92	NA	NA	26.90	4248.88
SLC-203	4276.0	4277.39	28.57	4248.82	NA	NA	28.56	4248.83
SLC-204	4271.8	4273.18	24.01	4249.17	NA	NA	23.99	4249.19
SLC-205	4273.8	4275.44	NA	NA	28.46	4246.98	26.26	4249.18
SLC-206	4274.8	4275.95	26.71	4249.24	NA	NA	26.78	4249.17
GW-1	4273.0	4274.91	25.49	4249.42	25.48	4249.43	25.46	4249.45
GW-2	4277.9	4279.88	31.77	4248.11	31.19	4248.69	31.96	4247.92
GW-3	4271.0	4272.97	24.20	4248.77	24.12	4248.85	23.88	4249.09
GW-4/10	4274.3	4276.46	27.49	4248.97	NA	NA	27.48	4248.98
GW-5	4276.6	4278.48	29.64	4248.84	29.50	4248.98	29.39	4249.09
GW-6	4279.8	4281.91	33.95	4247.96	33.88	4248.03	33.95	4247.96
GW-8	4280.0	4281.93	33.80	4248.13	NA	NA	33.76	4248.17
GW-9	4278.8	4280.82	NA	NA	NA	NA	NA	NA

TABLE

WELL ID #	ELEVATION GROUND SURFACE (feet)	ELEV. TOP OF PVC WITHOUT (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)
			February 26		May 10		October 7	
GW-11	4276.6	4279.54	30.25	4249.29	NA	NA	30.36	4249.18
GW-12	4276.9	4279.33	30.12	4249.21	NA	NA	30.23	4249.10
GW-13	4277.2	4279.48	30.30	4249.18	NA	NA	30.44	4249.04
GW-16	4277.6	4279.36	30.69	4248.67	NA	NA	30.76	4248.60
GW-17A	4276.5	4278.22	29.06	4249.16	28.80	4249.42	28.88	4249.34
GW-18	4274.3	4276.17	26.83	4249.34	26.83	4249.34	26.92	4249.25
GW-19A	4268.9	4270.41	21.49	4248.92	21.52	4248.89	21.50	4248.91
GW-19B	4268.9	4270.43	20.00	4250.43	20.79	4249.64	20.98	4249.45
GW-21	4280.5	4282.80	35.43	4247.37	35.30	4247.50	35.65	4247.15
I-1-30 (NE)	4276.7	4278.82	29.69	4249.13	29.90	4248.92	29.79	4249.03
I-1-50 (NW)	4276.9	4278.60	29.39	4249.21	29.26	4249.34	29.50	4249.10
I-1-100 (S)	4276.6	4278.72	28.75	4249.97	29.06	4249.66	29.29	4249.43
I-2-30 (S)	4277.2	4279.30	30.28	4249.02	NA	NA	30.42	4248.88
I-2-50 (N)	4277.2	4279.24	30.19	4249.05	NA	NA	30.25	4248.99
I-3-30 (SW)	4278.8	4281.18	32.11	4249.07	32.09	4249.09	32.34	4248.84
I-3-50 (SE)	4278.8	4281.24	32.25	4248.99	32.01	4249.23	32.34	4248.90
I-3-100 (N)	4278.8	4281.32	31.95	4249.37	31.84	4249.48	32.12	4249.20
I-4-30 (E)	4277.6	4280.03	31.41	4248.62	31.34	4248.69	31.90	4248.13
I-4-50 (W)	4277.7	4280.09	31.29	4248.80	31.19	4248.90	31.48	4248.61
MW-1	4265.9	4267.40	19.38	4248.02	19.50	4247.90	NA	NA
MW-2	4266.9	4267.80	20.82	4246.98	20.82	4246.98	NA	NA
MW-3	4275.4	4277.70	30.46	4247.24	30.56	4247.14	NA	NA
MW-100S	4262.4	4264.30	18.08	4246.22	18.20	4246.10	NA	NA
MW-100D	4262.3	4265.10	18.04	4247.06	18.78	4246.32	NA	NA
MW-101D	4274.3	4276.70	28.32	4248.38	28.58	4248.12	NA	NA
MW-102S	4273.1	4275.80	28.38	4247.42	28.24	4247.56	NA	NA
MW-103S	4272.5	4275.20	26.20	4249.00	26.24	4248.96	26.32	4248.88
MW-103D	4272.5	4275.40	26.34	4249.06	26.50	4248.90	26.69	4248.71
MW-104S	4269.3	4271.30	22.74	4248.56	22.70	4248.60	22.86	4248.44
MW-105S	4268.1	4270.80	21.62	4249.18	21.64	4249.16	21.76	4249.04
MW-105D	4267.9	4270.80	21.06	4249.74	21.08	4249.72	21.20	4249.60

TABLE

WELL ID #	ELEVATION GROUND SURFACE (feet)	ELEV. TOP OF PVC WITHOUT (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)	DEPTH TO WATER FROM TOP OF PVC (feet)	ELEVATION GROUND-WATER (feet)
			February 26		May 10		October 7	
MW-106S	4268.8	4271.00	21.78	4249.22	21.88	4249.12	NA	NA
MW-106D	4268.2	4271.30	21.52	4249.78	21.60	4249.70	NA	NA
MW-107S	4263.6	4266.40	17.98	4248.42	18.06	4248.34	NA	NA
MW-108S	4264.4	4267.20	19.02	4248.18	18.92	4248.28	NA	NA
MW-108D	4264.4	4266.90	18.03	4248.87	17.92	4248.98	NA	NA

* Based on previous surveys.

NA - Not available or applicable.

MW - Aptus monitor wells, data provided by Aptus. Aptus does not warrant any data provided nor does it accept responsibility for its use.

TABLE A-
SUMMARY OF WATER LEVEL MEASUREMENTS
CLIVE SITE

ELEVATION OF GROUNDWATER SURFACE (feet)

Measurement Date	Envirocare Well Number									
	GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-8	GW-11	GW-12	GW-13
02-Oct-89	NA	4248.17	NA	NA	4248.97	NA	NA	NA	NA	NA
09-Oct-89	4249.56	4247.96	NA	4249.47	NA	4247.64	NA	NA	NA	NA
23-Oct-89	4249.56	4247.98	4248.97	NA	4249.14	4247.84	4248.53	NA	NA	NA
26-Oct-89	NA	NA	4248.89	NA	NA	NA	NA	NA	NA	NA
27-Oct-89	NA	NA	4248.90	NA	NA	NA	NA	NA	NA	NA
07-Nov-89	4249.55	NA	4249.00	4249.35	4249.18	4247.99	4249.32	NA	NA	NA
13-Nov-89	NA	4248.32	NA	NA	NA	NA	4248.43	NA	NA	NA
23-Feb-90	4249.59	4248.18	4248.83	4249.28	4249.04	4248.01	4248.21	NA	NA	NA
26-Mar-90	4249.54	4248.15	4248.91	4249.41	4248.96	4247.98	4248.20	NA	NA	NA
20-May-90	4249.57	4248.11	4248.84	NA	4249.00	4247.96	4248.19	NA	NA	NA
28-Jun-90	4249.57	4248.14	4248.80	NA	4248.93	4247.68	4248.03	NA	NA	NA
29-Jun-90	NA	NA	NA	4249.12	NA	NA	NA	4249.11	4249.04	4248.94
17-Sep-90	NA	NA	NA	4249.01	NA	NA	NA	4249.07	4249.04	NA
18-Sep-90	4249.62	4247.97	4249.03	4249.01	4249.02	4247.80	4247.96	NA	NA	NA
19-Sep-90	NA	4247.85	4248.95	4249.00	4249.23	4247.70	4248.00	NA	NA	NA
29-Oct-90	4249.58	4248.05	4248.89	NA	NA	4247.89	4248.16	NA	NA	NA
30-Oct-90	NA	NA	NA	NA	4248.79	NA	NA	NA	NA	NA
28-Nov-90	4249.61	4248.12	4248.90	NA	4248.97	4247.83	NA	NA	NA	NA
13-Dec-90	4249.13	4248.24	4249.01	4249.11	4249.02	4248.03	4248.25	4249.44	4249.35	4249.30
28-Dec-90	NA	4248.12	NA	NA	NA	NA	NA	NA	NA	NA
02-Jan-91	4249.58	4248.18	4249.00	NA	4249.05	4247.94	NA	4249.51	4249.27	4249.27
18-Jan-91	4249.60	4248.18	NA	NA	NA	4247.97	NA	4249.29	4249.24	4249.17
21-Jan-91	NA	NA	4248.96	NA	4249.03	NA	4248.16	NA	NA	NA
28-Jan-91	NA	NA	NA	4249.12	NA	NA	NA	NA	NA	NA
13-Dec-90	4249.30	4248.36	4248.69	NA	NA	4247.60	NA	NA	NA	NA
26-Feb-91	4249.42	4248.11	4248.77	4248.97	4248.84	4247.96	4248.13	4249.29	4249.21	4249.18
10-May-91	4249.23	4248.19	4248.85	NA	4248.98	4248.03	NA	NA	NA	NA
07-Oct-91	4249.45	4247.92	4249.09	4248.98	4249.09	4247.96	4248.17	4249.19	4249.1	4249.04

TABLE A-
SUMMARY OF WATER LEVEL MEASUREMENTS
CLIVE SITE

ELEVATION OF GROUNDWATER SURFACE (feet)

MEASUREMENT DATE	Envirocare Well Number					
	GW-16	GW-17A	GW-18	GW-19A	GW-19B	GW-21
13-Feb-91	4248.81	4249.21	4249.37	4249.01	4250.62	4247.47
26-Feb-91	4248.67	4249.16	4249.34	4248.92	4250.43	4247.37
10-May-91	NA	4249.42	4249.34	4248.89	4249.64	4247.50
07-Oct-91	4248.60	4249.34	4249.25	4248.91	4249.45	4247.15

TABLE A-
SUMMARY OF WATER LEVEL MEASUREMENTS
CLIVE SITE

ELEVATION OF GROUNDWATER SURFACE (feet)

MEASUREMENT DATE	Envirocare Well Number									
	I-1-30	I-1-50	I-1-100	I-2-30	I-2-50	I-3-30	I-3-50	I-3-100	I-4-30	I-4-50
26-Jul-90	NA	4249.08	4249.75	4248.83	4249.32	4248.78	4248.85	4249.09	4248.58	4248.83
12-Sep-90	NA	NA	NA	NA	NA	NA	4248.77	4249.07	NA	NA
13-Sep-90	4248.93	4249.04	4249.81	NA	NA	NA	NA	NA	4248.5	4248.49
17-Sep-90	NA	NA	NA	4248.83	4248.92	NA	NA	NA	NA	NA
24-Sep-90	NA	NA	NA	NA	NA	NA	NA	NA	4248.54	NA
25-Oct-90	4249.02	4249.05	4249.83	4248.86	4248.94	4248.87	4248.91	4249.17	4248.53	4248.59
13-Dec-90	4249.21	4249.17	4250.07	4249.11	4249.24	4249.16	4249.17	4250.22	4248.85	4248.92
02-Jan-91	4249.15	4249.22	4249.99	NA	NA	4249.02	4249.08	4249.30	4248.75	4248.76
18-Jan-91	4249.15	4249.22	4249.99	NA	NA	4249.03	4249.09	4249.32	4248.76	4248.78
06-Feb-91	4249.14	NA	NA	NA	NA	NA	NA	NA	NA	NA
13-Feb-91	4249.23	NA	NA	NA	NA	NA	NA	NA	NA	NA
26-Feb-91	4249.13	4249.21	4249.97	4249.02	4249.14	4249.07	4248.99	4249.37	4248.62	4248.80
10-May-91	4248.92	4249.34	4249.66	NA	NA	4249.09	4249.23	4249.48	4248.69	4248.90
07-Oct-91	4249.03	4249.10	4249.43	4248.88	4248.99	4248.84	4248.90	4249.20	4248.13	4248.61

TABLE A-
SUMMARY OF WATER LEVEL MEASUREMENTS
CLIVE SITE

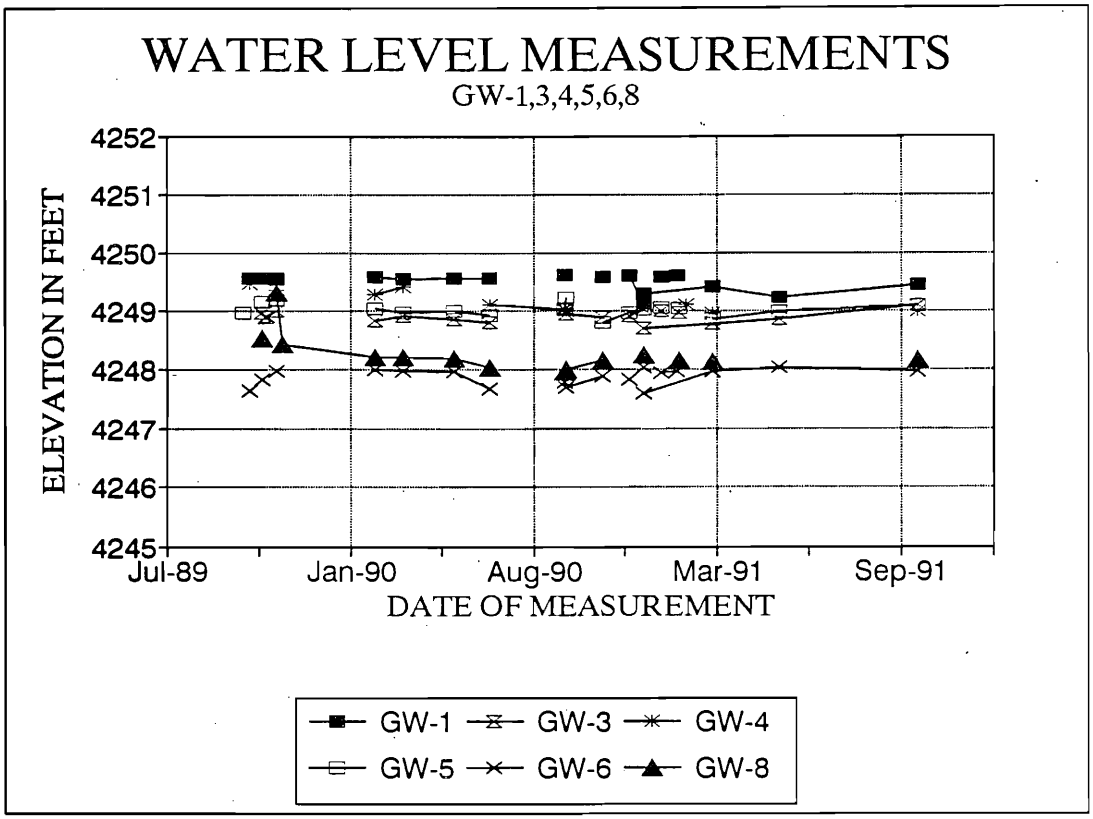
ELEVATION OF GROUNDWATER SURFACE (feet)

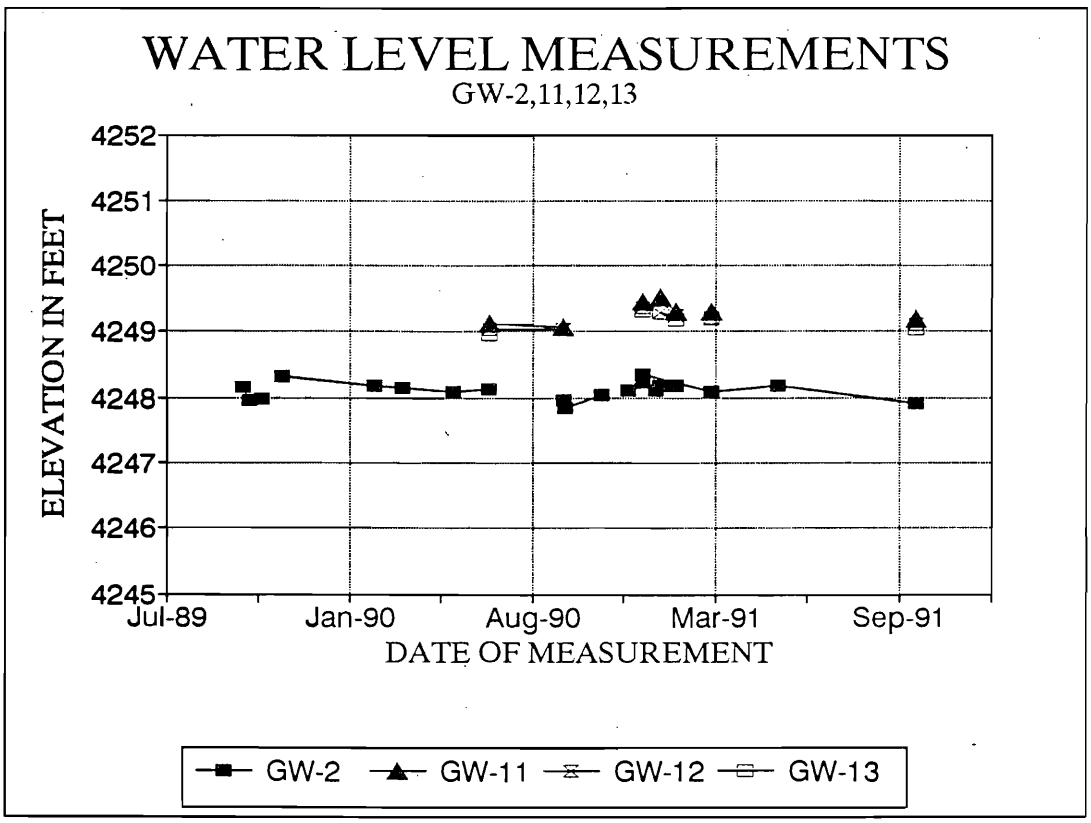
MEASUREMENT DATE	DOE/UDH Well Number								
	SC-1	SC-2	SC-3	SC-4	SC-5	SC-6	SC-10	SC-11	SC-13
22-Sep-81	NA	4248.38	NA	NA	NA	NA	NA	NA	NA
23-Sep-81	NA	NA	NA	NA	4247.2	NA	NA	NA	NA
24-Sep-81	NA	NA	4247.85	NA	4247.3	NA	NA	NA	NA
29-Sep-81	NA	NA	NA	4246.33	NA	NA	NA	NA	NA
30-Sep-81	4249.58	NA	NA	NA	NA	NA	NA	NA	NA
12-Feb-82	4246.68	4248.38	4247.65	4245.53	4247.30	NA	NA	NA	NA
26-Feb-82	4247.78	4249.08	4247.85	4246.33	4247.20	4248.46	4247.71	4247.61	4248.50
08-Mar-82	4247.68	4248.58	4247.85	4246.33	4247.20	4248.26	4247.91	4247.51	NA
17-Mar-82	4247.98	4248.58	4247.95	4245.73	4247.60	4248.56	4247.91	4247.11	4248.60
02-Apr-82	4248.08	4248.58	4247.85	4246.53	4247.70	4248.46	4247.91	4247.71	4248.80
14-Jul-82	4247.78	NA	4247.05	4246.13	4247.4	4248.46	4247.51	4247.21	NA
26-Sep-83	NA	4248.18	NA	NA	4246.80	NA	4248.31	NA	NA
13-Oct-83	4248.08	4248.18	4248.15	4246.43	4247.80	4249.06	4248.31	4248.01	4249.40
18-Jan-84	NA	4250.18	NA	NA	4248.3	4248.06	NA	NA	NA
29-Feb-84	NA	4248.82	NA	NA	4247.65	4248.31	NA	NA	NA
20-Jun-84	4248.48	4249.98	4248.45	4246.63	4247.9	4248.56	4248.11	4248.01	NA
02-Oct-89	4249.21	4249.55	4248.71	NA	NA	NA	NA	4248.68	NA
09-Oct-89	4249.16	4249.27	4248.83	4247.52	NA	4248.85	NA	4248.81	NA
23-Oct-89	NA	4248.97	4248.85	NA	NA	NA	NA	NA	NA
26-Oct-89	NA	4249.64	NA	NA	NA	NA	NA	NA	NA
27-Oct-89	NA	4249.58	NA	NA	4248.85	4248.92	NA	4248.61	NA
07-Nov-89	4249.35	4249.64	4248.95	NA	4249.02	4249.08	4248.33	4248.63	NA
13-Nov-89	NA	NA	NA	4247.43	NA	NA	NA	NA	4249.2
23-Feb-90	4249.28	4249.54	4248.85	NA	4248.85	4249	4247.53	NA	4249.73
26-Mar-90	4249.34	4249.59	4248.92	4247.58	4249.06	4249	4248.36	NA	4249.95
20-May-90	4249.32	4249.65	4248.94	4247.52	4248.69	4249.01	NA	NA	NA
28-Jun-90	4249.17	4249.38	4248.79	4247.31	NA	4248.97	NA	4248.57	NA
29-Jun-90	NA	NA	NA	NA	4248.72	NA	4248.10	NA	NA
12-Sep-90	NA	NA	NA	4247.17	NA	NA	NA	NA	NA
19-Sep-90	4249.08	4249.29	4248.56	4247.31	4248.68	4248.97	4248.04	4248.48	NA
29-Oct-90	4249.16	NA	4248.67	4247.35	4248.77	4248.98	NA	4248.52	NA
19-Dec-90	NA	NA	NA	NA	NA	NA	NA	NA	NA
28-Dec-90	NA	NA	NA	NA	NA	NA	NA	NA	4249.56
02-Jan-91	NA	4249.32	4248.76	NA	4248.72	4248.99	NA	NA	NA
18-Jan-91	NA	NA	4248.79	4247.51	NA	NA	NA	NA	NA
21-Jan-91	4249.18	4249.35	NA	NA	4248.71	NA	NA	4248.79	4249.66
25-Jan-91	NA	NA	NA	NA	NA	NA	4248.32	NA	NA
26-Feb-91	4248.58	4249.41	4248.82	4247.53	4248.23	4248.20	NA	4248.21	NA
10-May-91	NA	4249.47	4248.93	4247.66	4248.81	4249.03	NA	4248.68	NA
07-Oct-91	4249.09	4249.32	4248.67	4247.54	4248.76	4248.98	4248.06	4248.53	

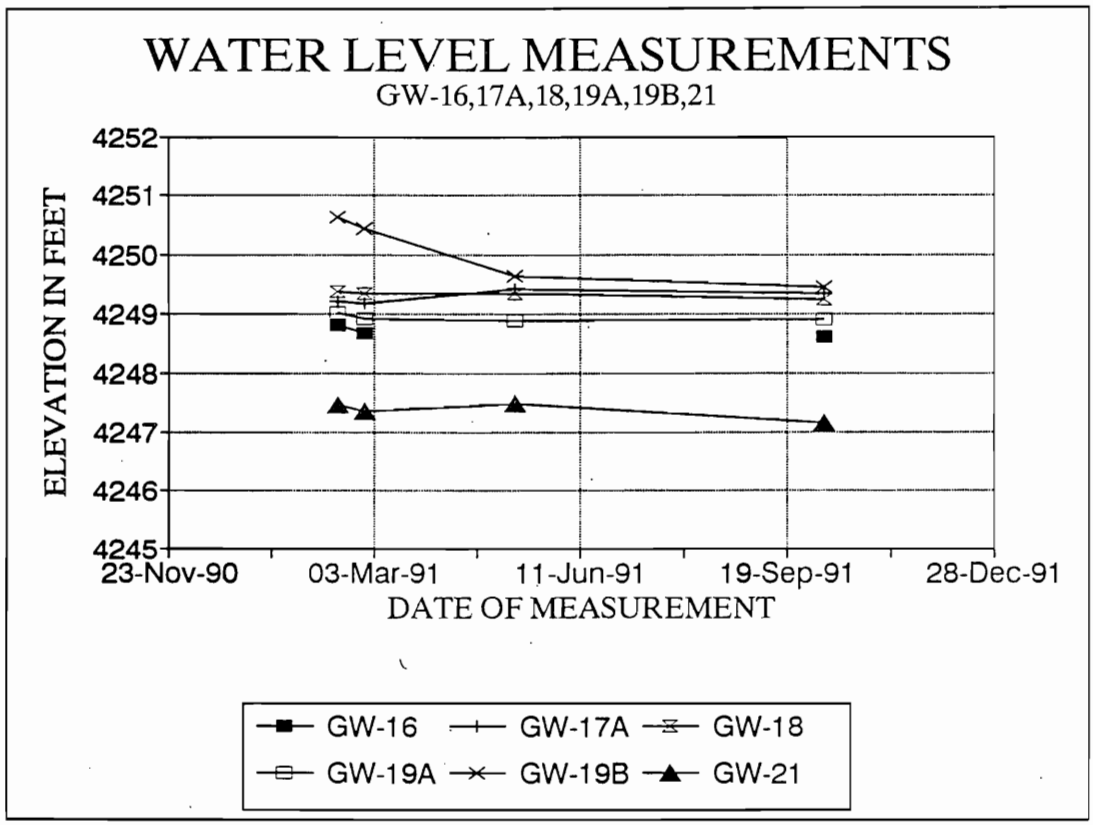
TABLE A-
SUMMARY OF WATER LEVEL MEASUREMENTS
CLIVE SITE

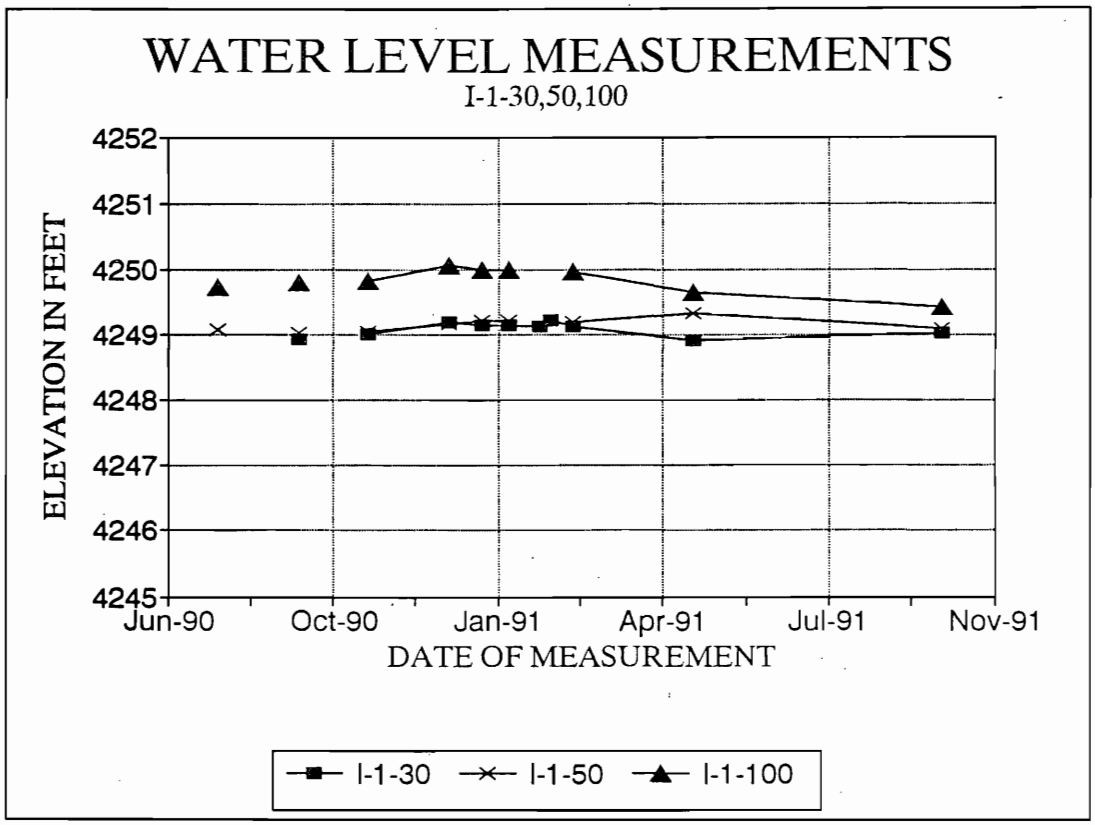
ELEVATION OF GROUNDWATER SURFACE (feet)

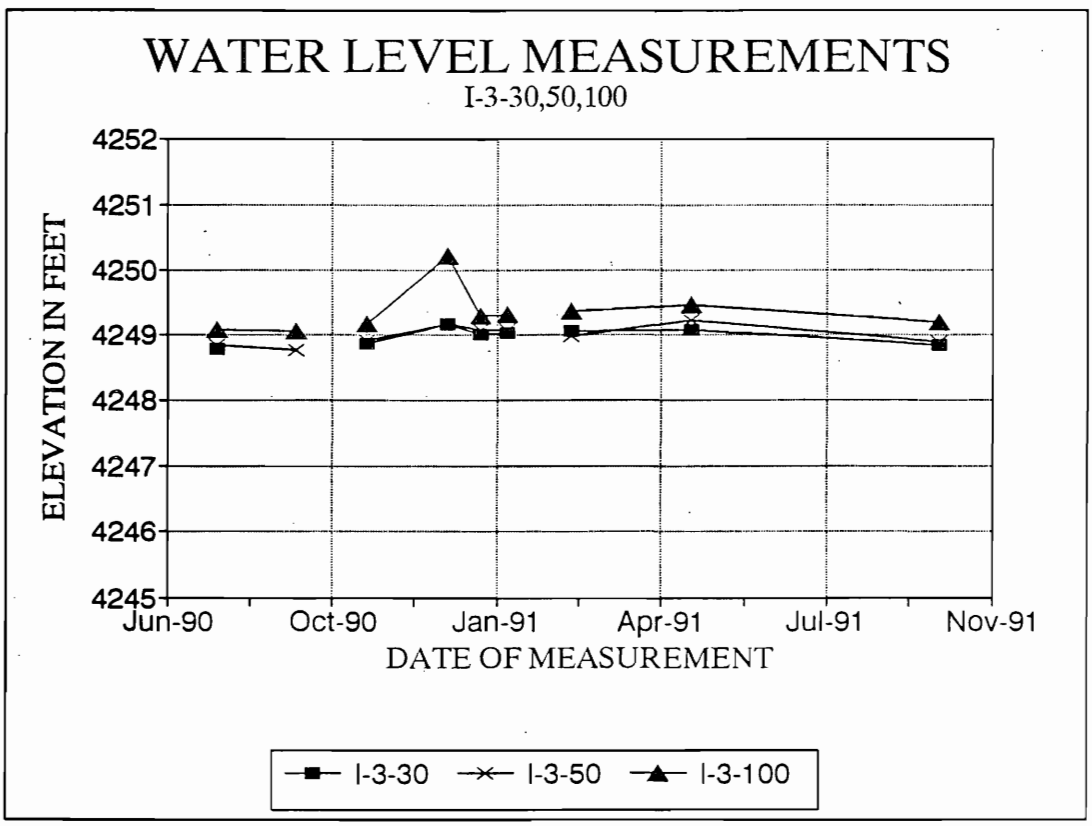
Measurement Date	APTUS Well Number				
	MW-103S	MW-103D	MW-104S	MW-105S	MW-105D
20-Aug-90	NA	NA	4248.5	NA	NA
22-Aug-90	NA	NA	4248.2	NA	NA
27-Aug-90	NA	NA	4248.15	NA	NA
28-Aug-90	NA	NA	4248.2	NA	NA
31-Aug-90	NA	NA	4248.29	4248.88	4249.88
04-Sep-90	NA	NA	4248.35	NA	4249.75
05-Sep-90	NA	NA	4248.2	NA	NA
06-Sep-90	NA	NA	NA	4248.7	4249.85
07-Sep-90	NA	NA	NA	4248.7	4249.25
10-Sep-90	4248.45	4248.95	4248.7	4248.7	4249.25
11-Sep-90	4248.55	4248.25	NA	4248.8	NA
13-Sep-90	4248.49	4248.52	4248.2	4248.71	4249.22
14-Sep-90	4248.49	4248.58	4248.24	NA	NA
18-Sep-90	4248.49	4248.57	4248.21	NA	NA
19-Sep-90	NA	NA	4248.2	4248.7	4249.3
20-Sep-90	4248.48	4248.57	NA	NA	NA
24-Sep-90	4248.5	4248.5	4248.3	4248.7	4249.25
15-Oct-90	4248.11	4248.36	4248.22	4248.73	4249.14
25-Oct-90	4248.55	4248.62	4249.21	4248.8	4249.09
30-Oct-90	4248.9	4248.93	4248.53	4249.17	4249.07
26-Feb-91	4249	4249.06	4248.56	4249.18	4249.74
10-May-91	4248.96	4248.9	4248.6	4249.16	4249.72
07-Oct-91	4248.88	4248.71	4248.44	4249.04	4249.6

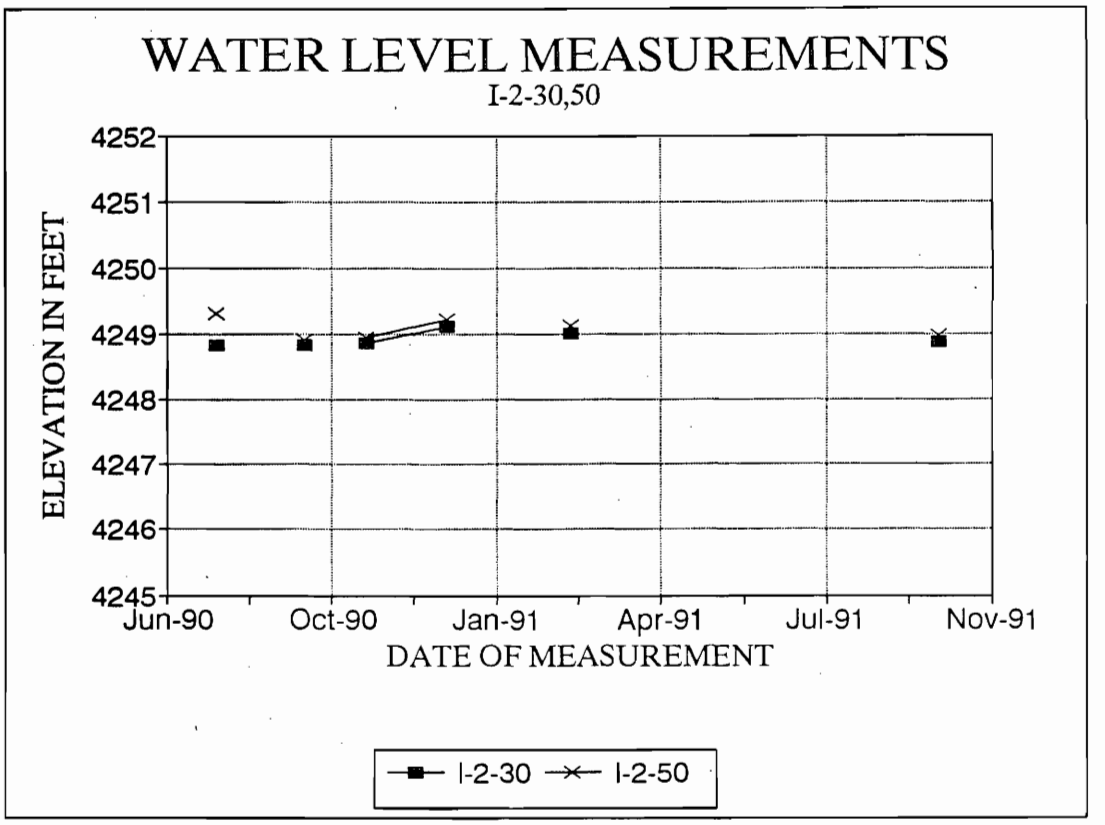

WATER LEVEL MEASUREMENTS
GW-1,3,4,5,6,8
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Jul-89
Jan-90
Aug-90
Mar-91
Sep-91
DATE OF MEASUREMENT
GW-1
GW-3
GW-4
GW-5
GW-6
GW-8

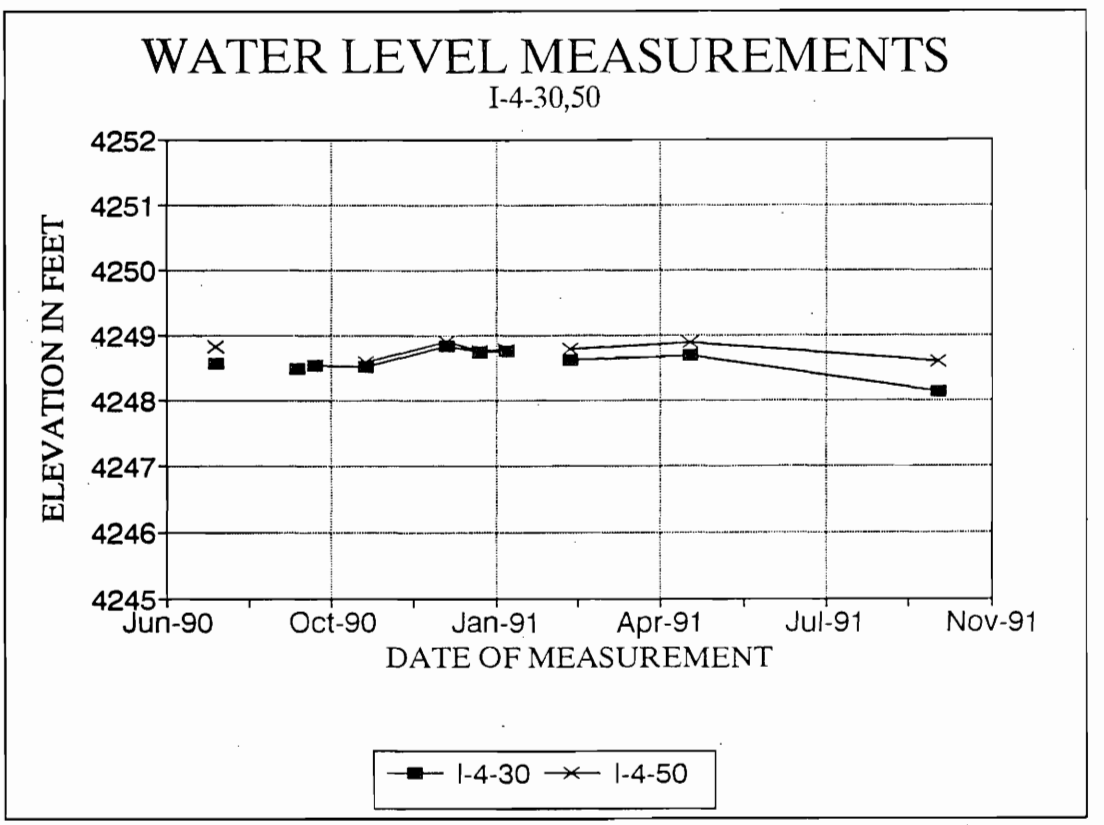

WATER LEVEL MEASUREMENTS
GW-2,11,12,13
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Jul-89
Jan-90
Aug-90
Mar-91
Sep-91
DATE OF MEASUREMENT
GW-2
GW-11
GW-12
GW-13

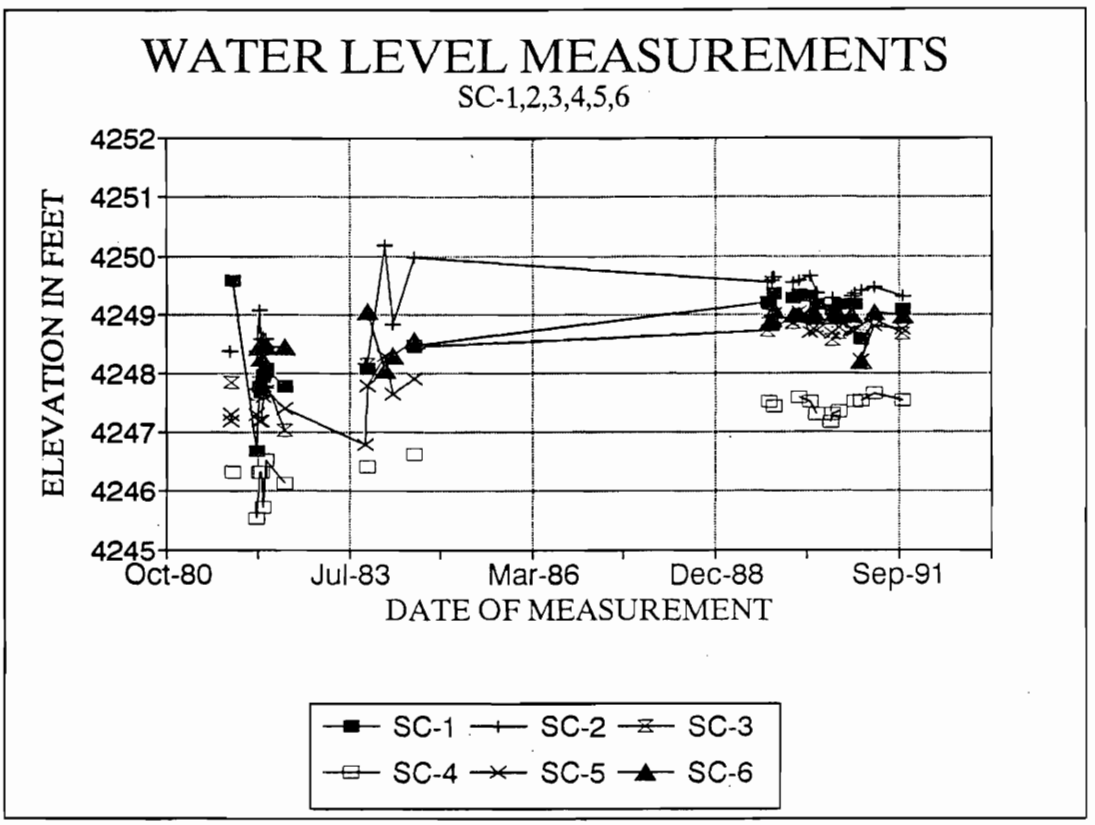

WATER LEVEL MEASUREMENTS
GW-16,17A,18,19A,19B,21
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
23-Nov-90
03-Mar-91
11-Jun-91
19-Sep-91
28-Dec-91
DATE OF MEASUREMENT
GW-16
GW-17A
GW-18
GW-19A
GW-19B
GW-21

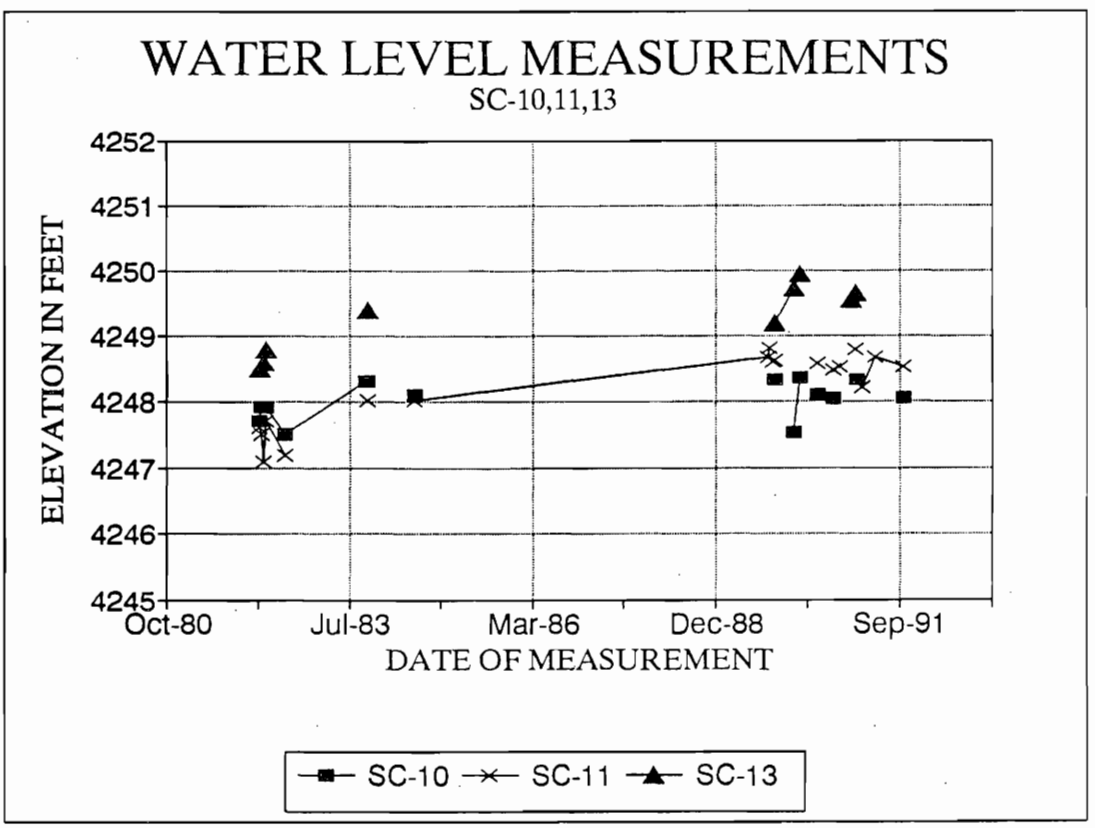

WATER LEVEL MEASUREMENTS
I-1-30,50,100
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Jun-90
Oct-90
Jan-91
Apr-91
Jul-91
Nov-91
DATE OF MEASUREMENT
I-1-30
I-1-50
I-1-100

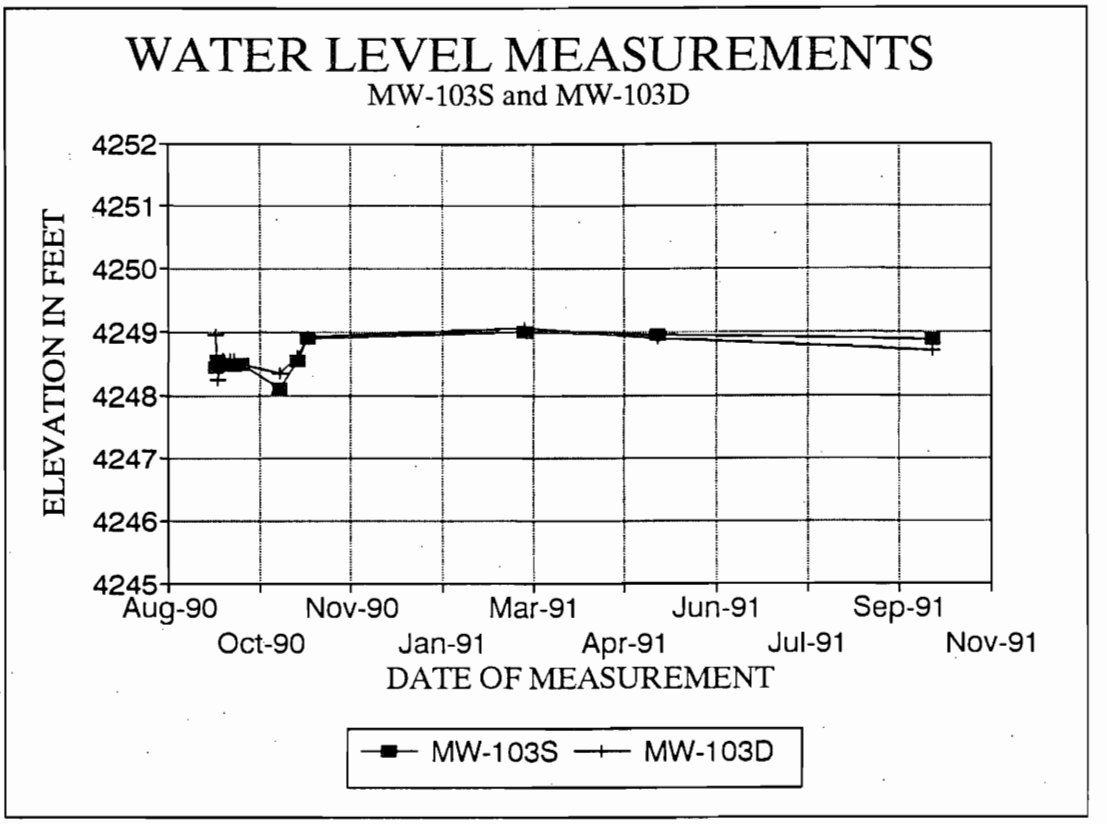

WATER LEVEL MEASUREMENTS
I-3-30,50,100
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Jun-90
Oct-90
Jan-91
Apr-91
Jul-91
Nov-91
DATE OF MEASUREMENT
I-3-30
I-3-50
I-3-100

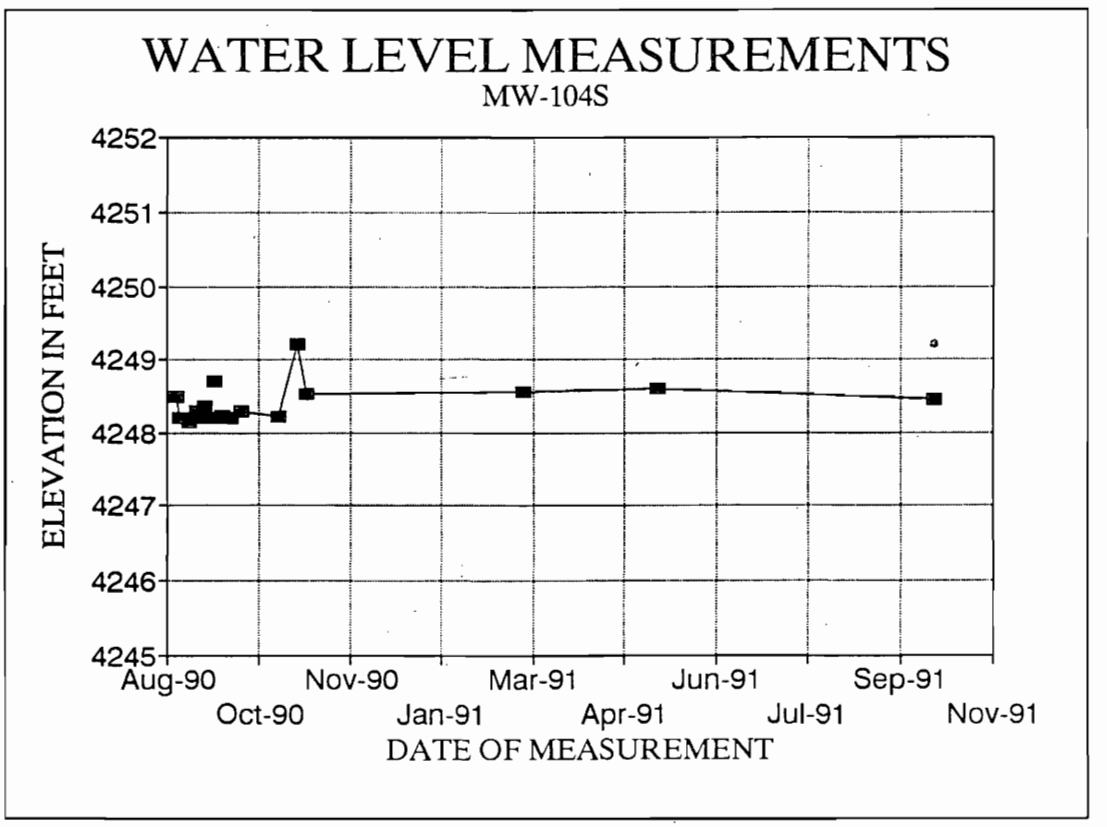

WATER LEVEL MEASUREMENTS
I-2-30,50
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Jun-90
Oct-90
Jan-91
Apr-91
Jul-91
Nov-91
DATE OF MEASUREMENT
I-2-30
I-2-50

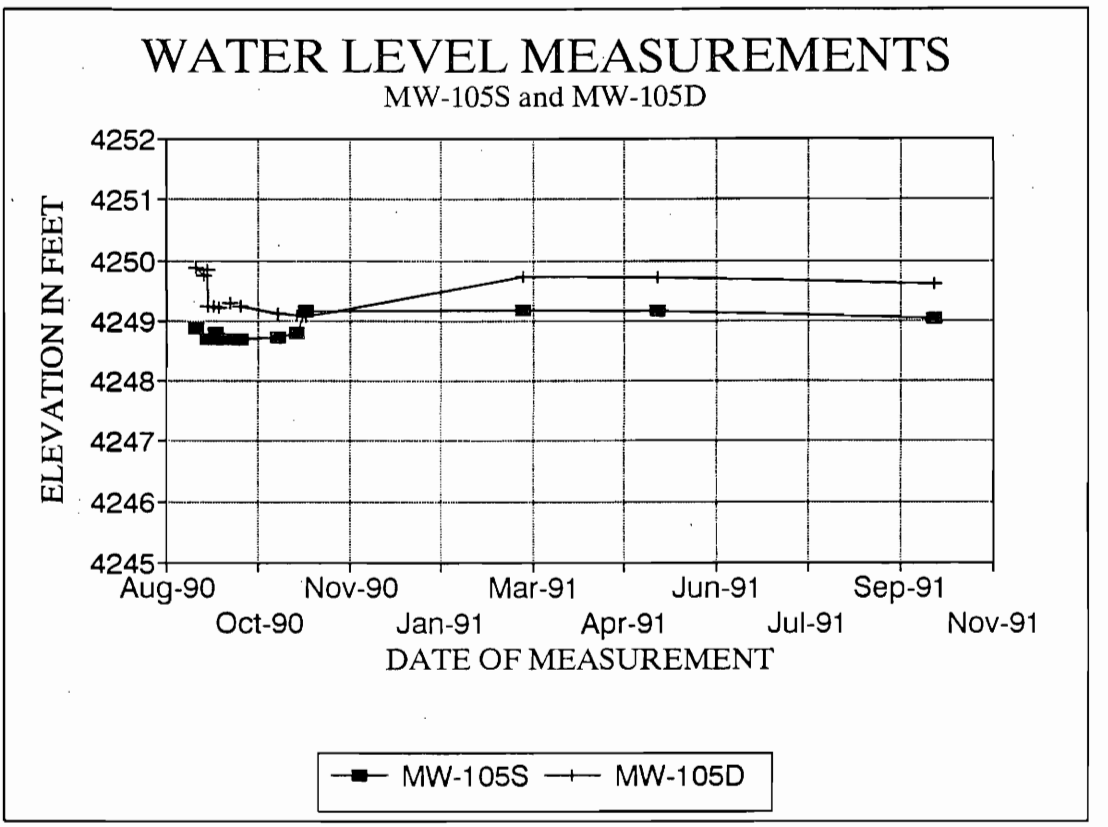

WATER LEVEL MEASUREMENTS
I-4-30,50
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Jun-90
Oct-90
Jan-91
Apr-91
Jul-91
Nov-91
DATE OF MEASUREMENT
I-4-30
I-4-50


WATER LEVEL MEASUREMENTS
SC-1,2,3,4,5,6
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Oct-80
Jul-83
Mar-86
Dec-88
Sep-91
DATE OF MEASUREMENT
SC-1
SC-2
SC-3
SC-4
SC-5
SC-6


WATER LEVEL MEASUREMENTS
SC-10,11,13
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Oct-80
Jul-83
Mar-86
Dec-88
Sep-91
DATE OF MEASUREMENT
SC-10
SC-11
SC-13


WATER LEVEL MEASUREMENTS
MW-103S and MW-103D
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Aug-90
Oct-90
Nov-90
Jan-91
Mar-91
Apr-91
Jun-91
Jul-91
Sep-91
Nov-91
DATE OF MEASUREMENT
MW-103S
MW-103D


WATER LEVEL MEASUREMENTS
MW-104S
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Aug-90
Oct-90
Nov-90
Jan-91
Mar-91
Apr-91
Jun-91
Jul-91
Sep-91
Nov-91
DATE OF MEASUREMENT


WATER LEVEL MEASUREMENTS
MW-105S and MW-105D
ELEVATION IN FEET
4252
4251
4250
4249
4248
4247
4246
4245
Aug-90
Oct-90
Nov-90
Jan-91
Mar-91
Apr-91
Jun-91
Jul-91
Sep-91
Nov-91
DATE OF MEASUREMENT
MW-105S
MW-105D

SURVEYING

SUMMARY OF WELL LOCATIONS AND ELEVATIONS (1991 SURVEY)

WELL ID#	STATE PLANE COORDINATES Northing (feet)	Easting (feet)	ELEV. GROUND SURFACE (feet)	ELEV. TOP PROTECTIVE CASING W/O LID (feet)	ELEV. TOP OF PVC W/O CAP (feet)	ELEV. OF MARKER CAP (feet)
SC-1	862,034.2	1,552,216.9	4275.4	4278.88	4276.69	NA
SC-2	859,618.4	1,549,908.3	4268.7	4272.08	4271.46	NA
SC-3	859,607.7	1,554,682.0	4277.1	4280.35	4279.73	NA
SC-4	864,377.2	1,554,736.2	4280.5	4284.53	4284.52	NA
SC-5	864,357.8	1,549,810.4	4273.5	4276.10	4275.53	NA
SC-6	862,919.1	1,549,841.6	4272.5	4276.96	4276.24	NA
SC-9	862,992.0	1,553,137.1	4278.8*	4283.20*	NA	NA
SC-10	864,334.8	1,553,067.7	4279.8	4284.41	4283.72	NA
SC-11	864,278.4	1,551,419.8	4275.8	4280.81	4280.50	NA
SC-12	862,912.7	1,551,480.3	4274.9*	4277.50*	NA	NA
SC-13	861,449.1	1,551,546.7	4274.1	4277.05	4276.82	NA
SLC-201	863,094.7	1,550,650.2	4274.0	4275.69	4275.65	NA
SLC-202	863,032.6	1,551,125.5	4274.4	4275.81	4275.78	NA
SLC-203	862,914.0	1,552,014.8	4276.0	4277.42	4277.39	NA
SLC-204	861,565.2	1,550,447.4	4271.8	4273.21	4273.18	NA
SLC-205	861,560.7	1,551,051.1	4273.8	4275.45	4275.44	NA
SLC-206	861,655.2	1,551,988.8	4274.8	4275.94	4275.95	NA
GW-1	859,299.5	1,551,653.0	4273.0	4275.06	4274.91	NA
GW-2	860,874.8	1,554,916.1	4277.9	4279.98	4279.88	NA
GW-3	862,024.3	1,549,894.7	4271.0	4273.14	4272.97	NA
GW-4/10	861,292.9	1,552,841.8	4274.3	4276.57	4276.46	NA
GW-5	862,783.3	1,552,275.2	4276.6	4278.64	4278.48	NA
GW-6	863,198.6	1,554,934.6	4279.8	4282.01	4281.91	NA
GW-8	864,490.8	1,552,985.1	4280.0	4282.03	4281.93	NA
GW-9	864,027.5	1,552,466.3	4278.8	4281.47	4280.82	NA
GW-11	860,026.0	1,553,723.6	4276.6	4280.17	4279.54	4277.17
GW-12	860,072.3	1,553,912.8	4276.9	4279.95	4279.33	4277.25
GW-13	860,064.4	1,554,244.2	4277.2	4280.11	4279.48	4277.61
GW-16	861,349.8	1,553,727.4	4277.6	NA	4279.36	NA
GW-17A	861,507.2	1,552,426.1	4276.5	NA	4278.22	NA
GW-18	859,283.1	1,552,418.2	4274.3	NA	4276.17	NA
GW-19A	859,343.7	1,549,663.7	4268.9	NA	4270.41	NA
GW-19B	859,335.9	1,549,663.2	4268.9	NA	4270.43	NA

WELL ID#	STATE PLANE COORDINATES Northing (feet)	Easting (feet)	ELEV. GROUND SURFACE (feet)	ELEV. TOP PROTECTIVE CASING W/O LID (feet)	ELEV. TOP OF PVC W/O CAP (feet)	ELEV. OF MARKER CAP (feet)
GW-21	864,463.3	1,555,001.0	4280.5	NA	4282.80	NA
I-1-30 (NE)	859,260.9	1,549,636.5	4276.7	4279.44	4278.82	4277.26
I-1-50 (NW)	859,260.9	1,549,636.5	4276.9	4279.19	4278.60	4277.15
I-1-100 (S)	859,260.9	1,549,636.5	4276.6	4279.33	4278.72	4277.25
I-2-30 (S)	859,260.9	1,549,636.5	4277.2	4279.93	4279.30	4277.72
I-2-50 (N)	859,260.9	1,549,636.5	4277.2	4279.87	4279.24	4277.72
I-3-30 (SW)	859,260.9	1,549,636.5	4278.8	4281.82	4281.18	4278.86
I-3-50 (SE)	859,260.9	1,549,636.5	4278.8	4281.86	4281.24	4278.98
I-3-100 (N)	859,260.9	1,549,636.5	4278.8	4281.95	4281.32	4279.10
I-4-30 (E)	859,260.9	1,549,636.5	4277.6	4280.67	4280.03	4278.10
I-4-50 (W)	859,260.9	1,549,636.5	4277.7	4280.72	4280.09	4278.15
MW-1	861,773.9	1,547,042.0	4265.9	4267.80	4267.40	NA
MW-2	869,750.9	1,547,186.6	4266.9	4268.40	4267.80	NA
MW-3	869,789.9	1,549,637.3	4275.4	4278.00	4277.70	NA
MW-100S	869,671.8	1,544,977.3	4262.4	4264.90	4264.30	NA
MW-100D	869,659.8	1,544,978.5	4262.3	4265.30	4265.10	NA
MW-101D	869,126.2	1,549,501.4	4274.3	4276.90	4276.70	NA
MW-102S	867,189.3	1,549,519.5	4273.1	4276.00	4275.80	NA
MW-103S	864,554.0	1,549,470.7	4272.5	4275.40	4275.20	NA
MW-103D	864,547.8	1,549,477.8	4272.5	4275.60	4275.40	NA
MW-104S	861,906.1	1,549,430.7	4269.3	4271.40	4271.30	NA
MW-105S	859,528.5	1,549,389.7	4268.1	4271.10	4270.80	NA
MW-105D	859,519.0	1,549,389.8	4267.9	4271.00	4270.80	NA
MW-106S	859,606.1	1,544,798.5	4268.8	4271.40	4271.00	NA
MW-106D	859,598.0	1,544,791.3	4268.2	4271.50	4271.30	NA
MW-107S	861,980.6	1,544,837.4	4263.6	4266.60	4266.40	NA
MW-108S	864,642.4	1,544,878.8	4264.4	4267.40	4267.20	NA
MW-108D	864,632.8	1,844,881.1	4264.4	4267.30	4266.90	NA

* Based on previous survey.

NA - Not available or applicable.

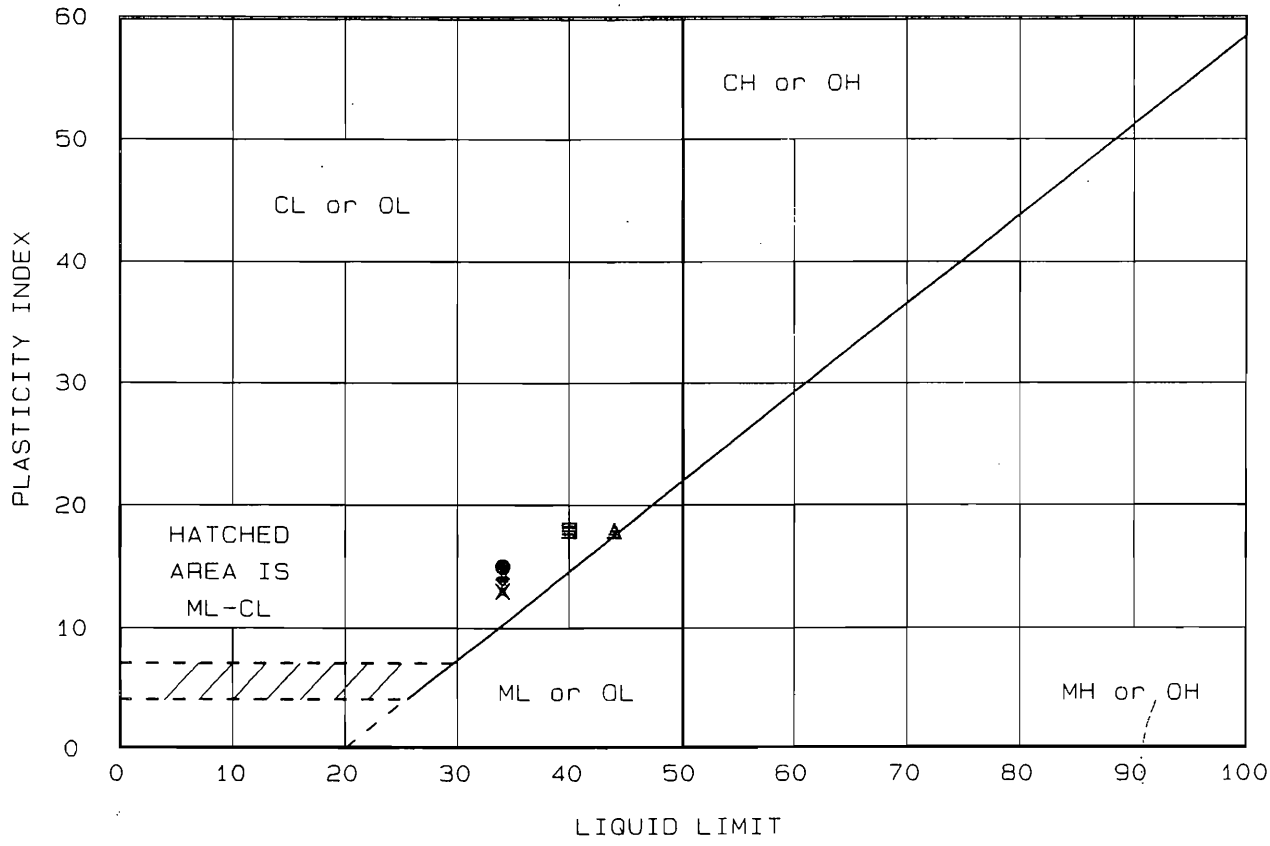
MW - Aptus monitor wells, data provided by Aptus. Aptus does not warrant any data provided nor does it accept responsibility for its use.

APPENDIX B

PHYSICAL LABORATORY TESTING

ATTERBERG LIMITS

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-85
●	GW-16 S-1 Depth: 3'-5' Brown Silty Clay (CL)	34	19	15		
▲	GW-19A S-1 Depth: 5'-7' Brown Silty Clay (CL)	44	26	18		
■	GW-18 S-6 Depth: 30'-32' Brown Silty Clay (CL)	40	22	18		
◆	GW-17A L-2 Depth: 7'-9.5' Brown Silty Clay (CL)	34	20	14		
✕	GW-18 B-1 Depth: 5'-6.5' Brown Silty Clay (CL)	34	21	13		

Project No.: 1416-007
Project: Hydrogeologic Study

Client: Envirocare of Utah
Location: South Clive Facility

Date: 03-07-91

Remarks:

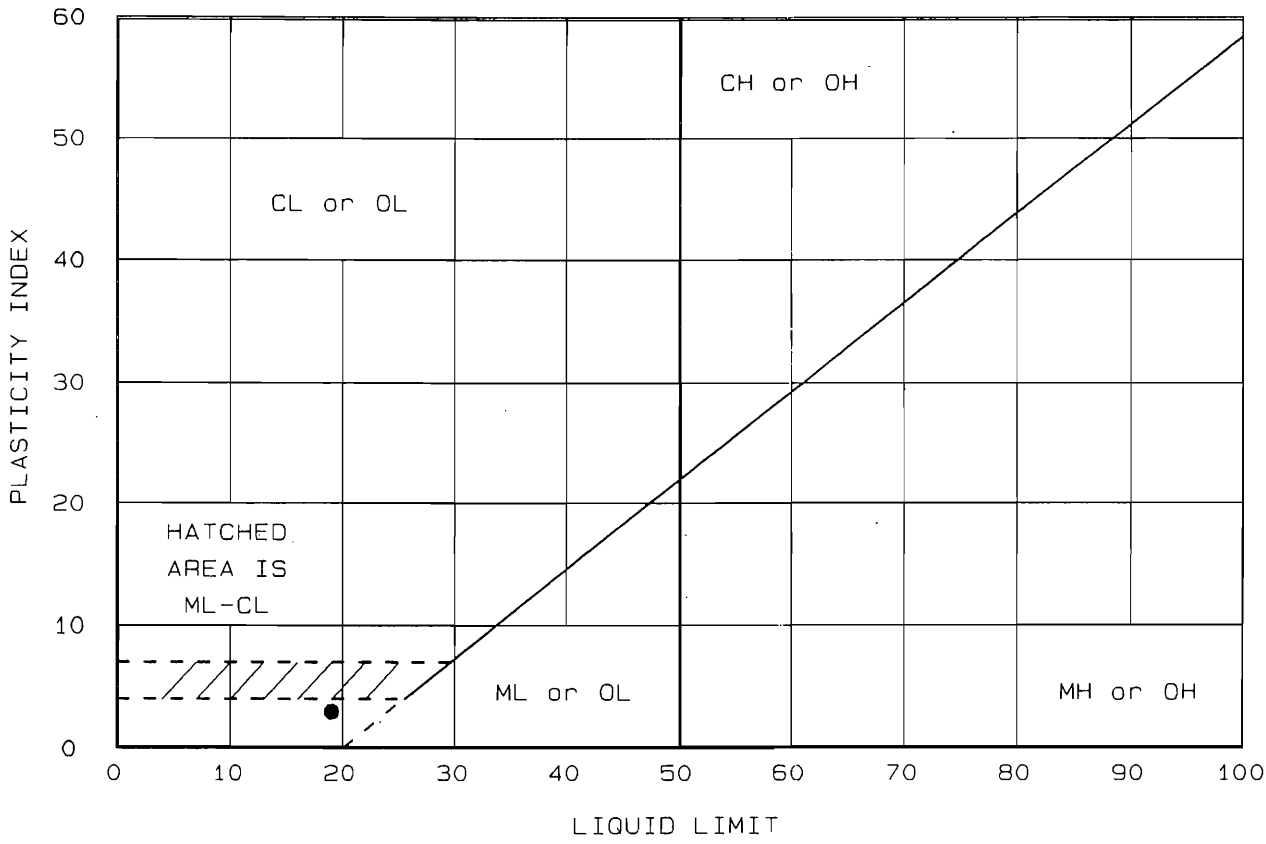
Tested By: Dave Anderson

LIQUID AND PLASTIC LIMITS TEST REPORT

Bingham Engineering B-2

Fig. No.

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-85
●	GW-16 B-7 Depth 34.5-36' Light Brown Fine Sandy Silt (ML)	19	16	3		

Project No.: 1416-007
Project: Hydrogeologic Study

Client: Envirocare of Utah
Location: South Clive Facility

Date: 04-11-91

Remarks:

Tested By: JD

LIQUID AND PLASTIC LIMITS TEST REPORT

Bingham Engineering B-3

Fig. No.

BULK DENSITY AND POROSITY

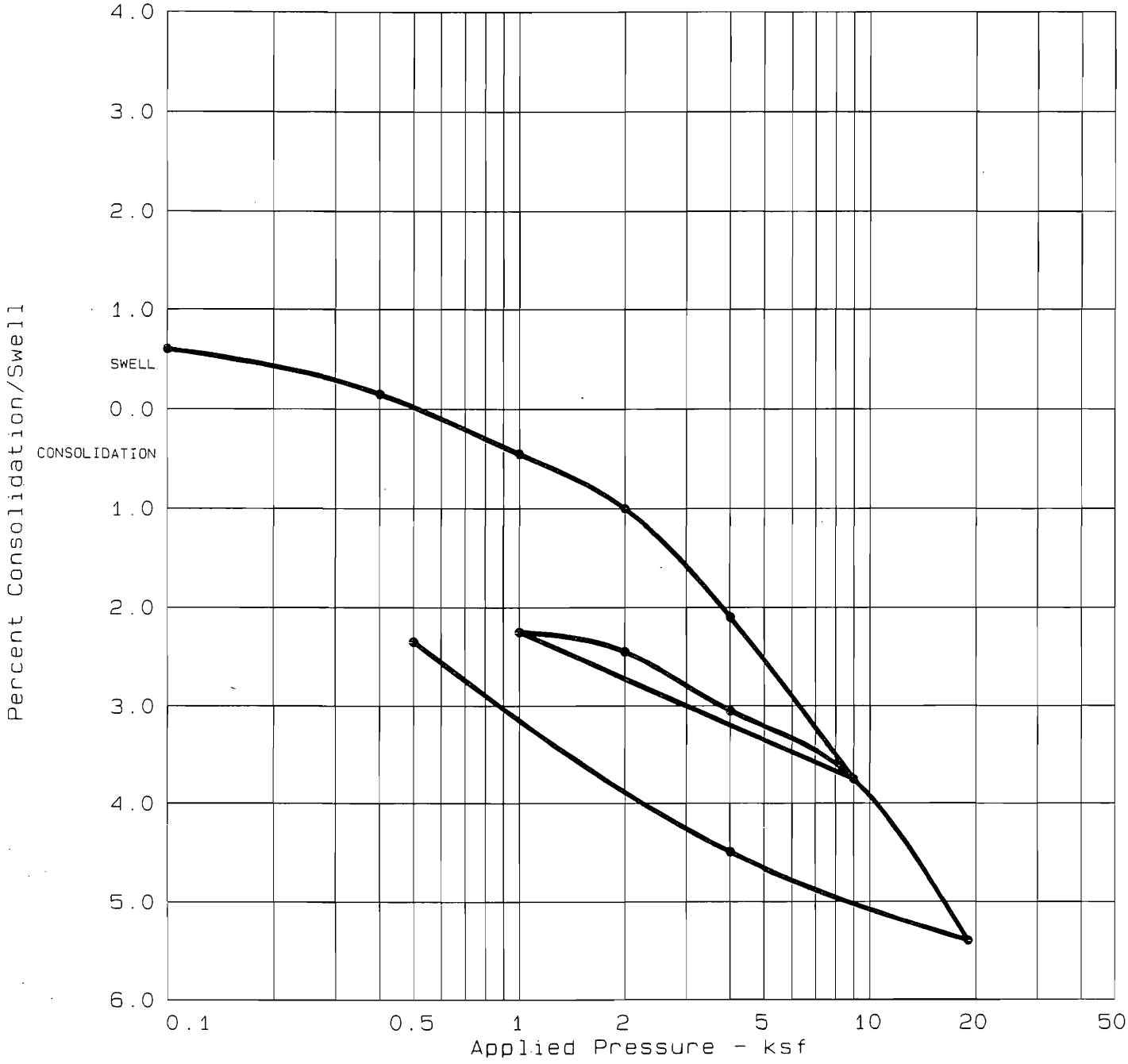
ENVIROCARE OF UTAH

PHYSICAL PROPERTIES

Sample I.D.	Depth (ft)	Soil Type	Unit	Average Field Water Content (% by weight)	Average Porosity (cc/cc)	Average Field Density Summary (g/cc)
GW-16, S-1	3-5	Silty Clay	2 4	0.36	0.38	1.66
GW-16, B-7	34.5-36	Silty Clay	2	0.38	0.38	1.66
GW-17A, L-2	7-9.5	Silty Clay	4	0.50	0.50	1.37
GW-17A, L-5	19.5-22	Silty Sand	3	0.16	0.37	1.67
GW-17A, L-7	27-29.5	Silty Clay	2	0.49	0.51	1.32
GW-18, S-4	20-22	Silty Sand	3	0.23	0.42	1.55
GW-19A, S-1	5-7	Silty Clay	4	0.45	0.51	1.32
GW-19B, L-5	22-24.5	Silty Sand	3	0.33	0.32	1.79

CONSOLIDATION

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	98.7 %	20.8	106.2	34	15	2.65	0.5576

TEST RESULTS

C_v at 19.00 ksf applied = 0.18 sq. feet/day

MATERIAL DESCRIPTION

Brown Silty Clay with Fine Sand

Class: CL

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
Location: GW-16 S-1 Depth 3.0' to 5.0'
South Clive Facility
Date: 03-18-91

Remarks:

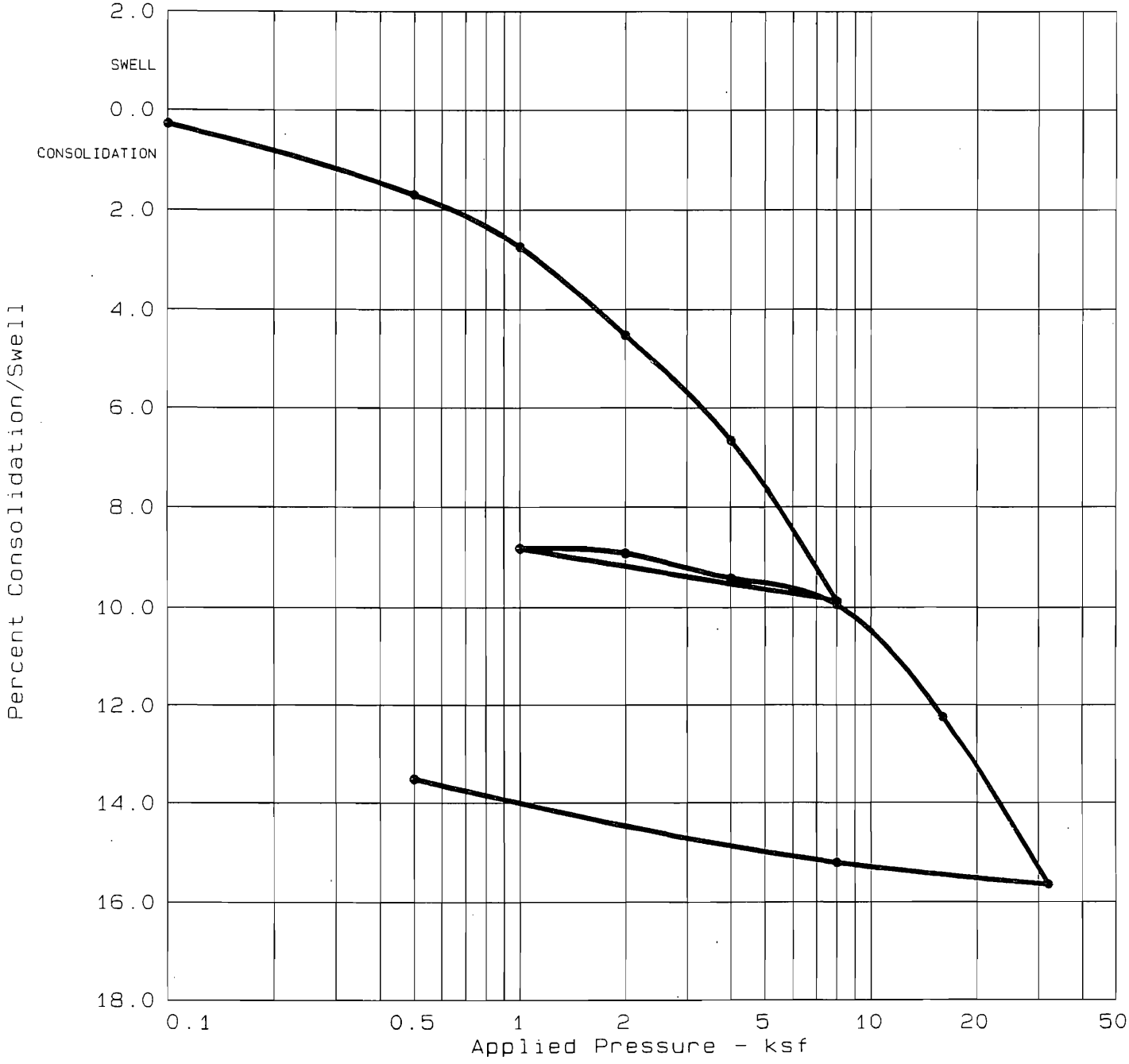
Tested By: DA

CONSOLIDATION TEST REPORT

BINGHAM ENGINEERING B-7

Fig. No.

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	101.3 %	34.3	87.2	34	14	2.65	0.8963

TEST RESULTS

C_v at 8.00 ksf applied = 0.14 sq. feet/day

MATERIAL DESCRIPTION

Brown Silty Clay

Class: CL

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
Location: GW-17A L-2 Depth 7.0' to 9.5'
South Clive Facility
Date: 03-18-91

Remarks:

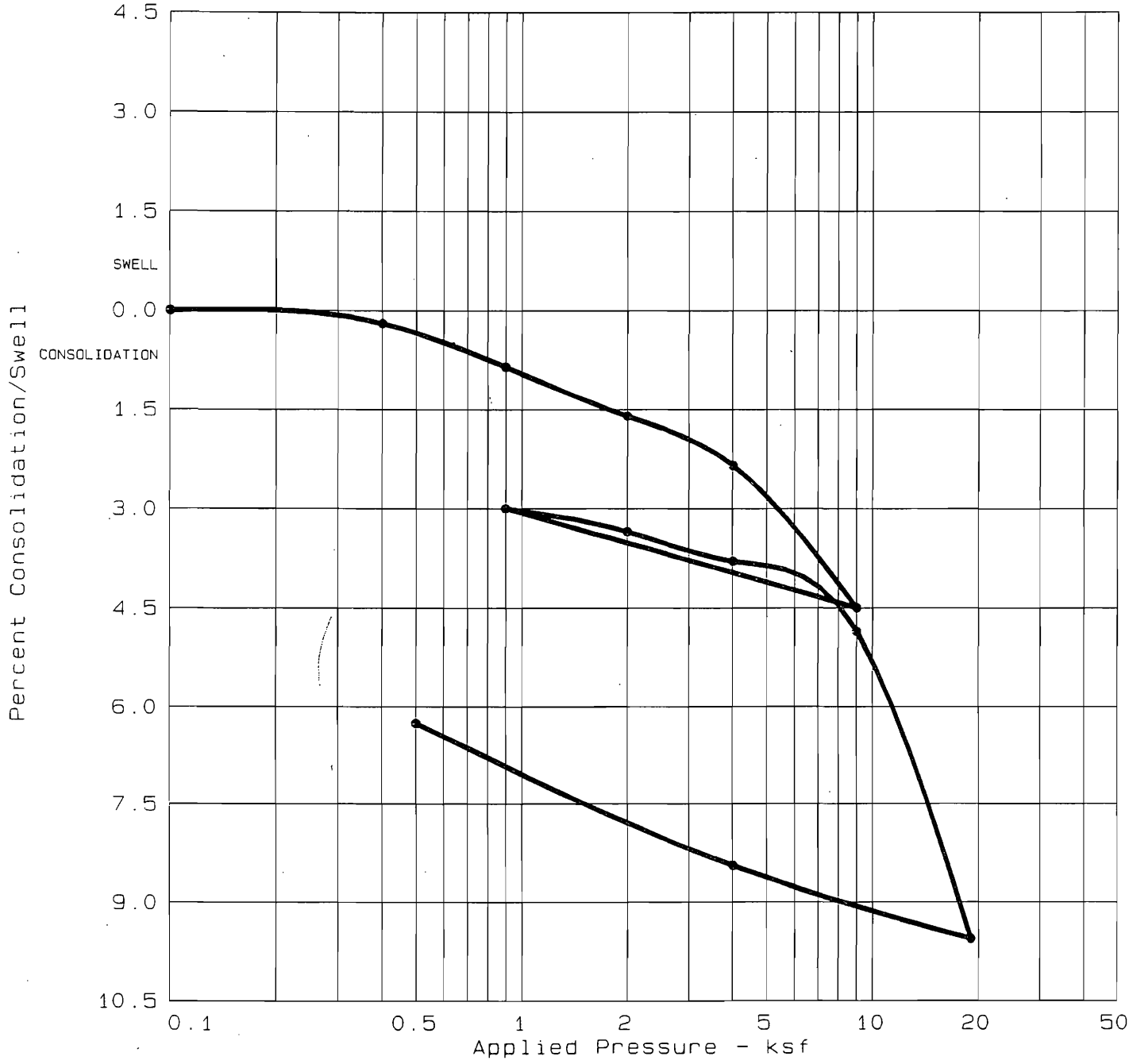
Tested By: DA

CONSOLIDATION TEST REPORT

BINGHAM ENGINEERING B-8

Fig. No.

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	110.0 %	45.5	79.0	40	18	2.65	1.0952

TEST RESULTS

C_v at 9.00 ksf applied = 0.11 sq. feet/day

MATERIAL DESCRIPTION

Brown Silty Clay

Class: CL

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
Location: GW-18 S-6 Depth: 30'-32'
South Clive Facility
Date: 03-18-91

Remarks:

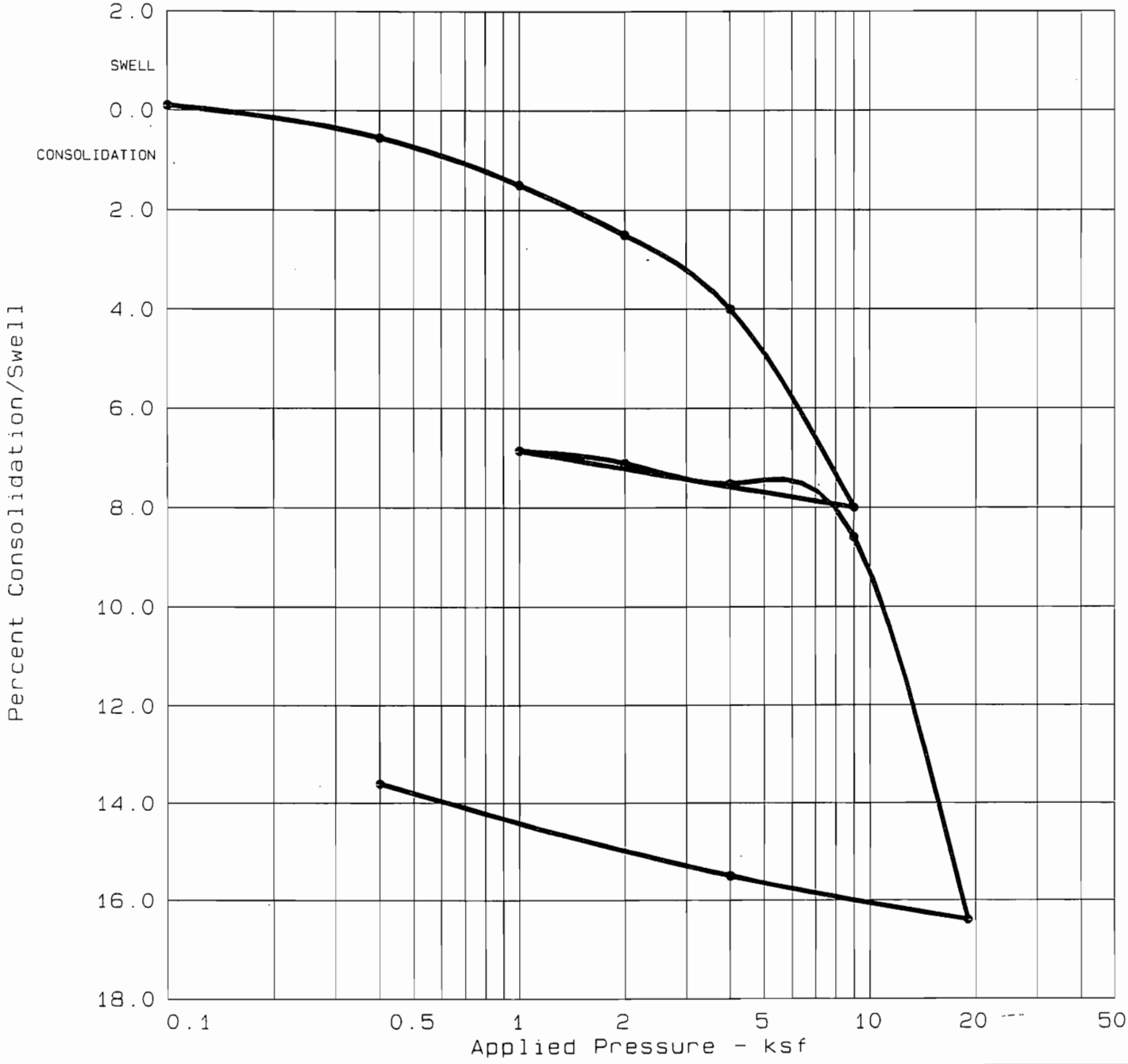
Tested By: DA

CONSOLIDATION TEST REPORT

BINGHAM ENGINEERING B-9

Fig. No.

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	93.8 %	44.6	73.2	44	18	2.65	1.2598

TEST RESULTS

C_v at 19.00 ksf applied = 0.44 sq. feet/day

MATERIAL DESCRIPTION

Brown Silty Clay

Class: CL

Project No.: 1416-007
Project: Envirocare Hydrogeological Study
Location: GW-19A S-1 Depth 5.0' to 7.0'
South Clive Facility
Date: 03-18-91

Remarks:

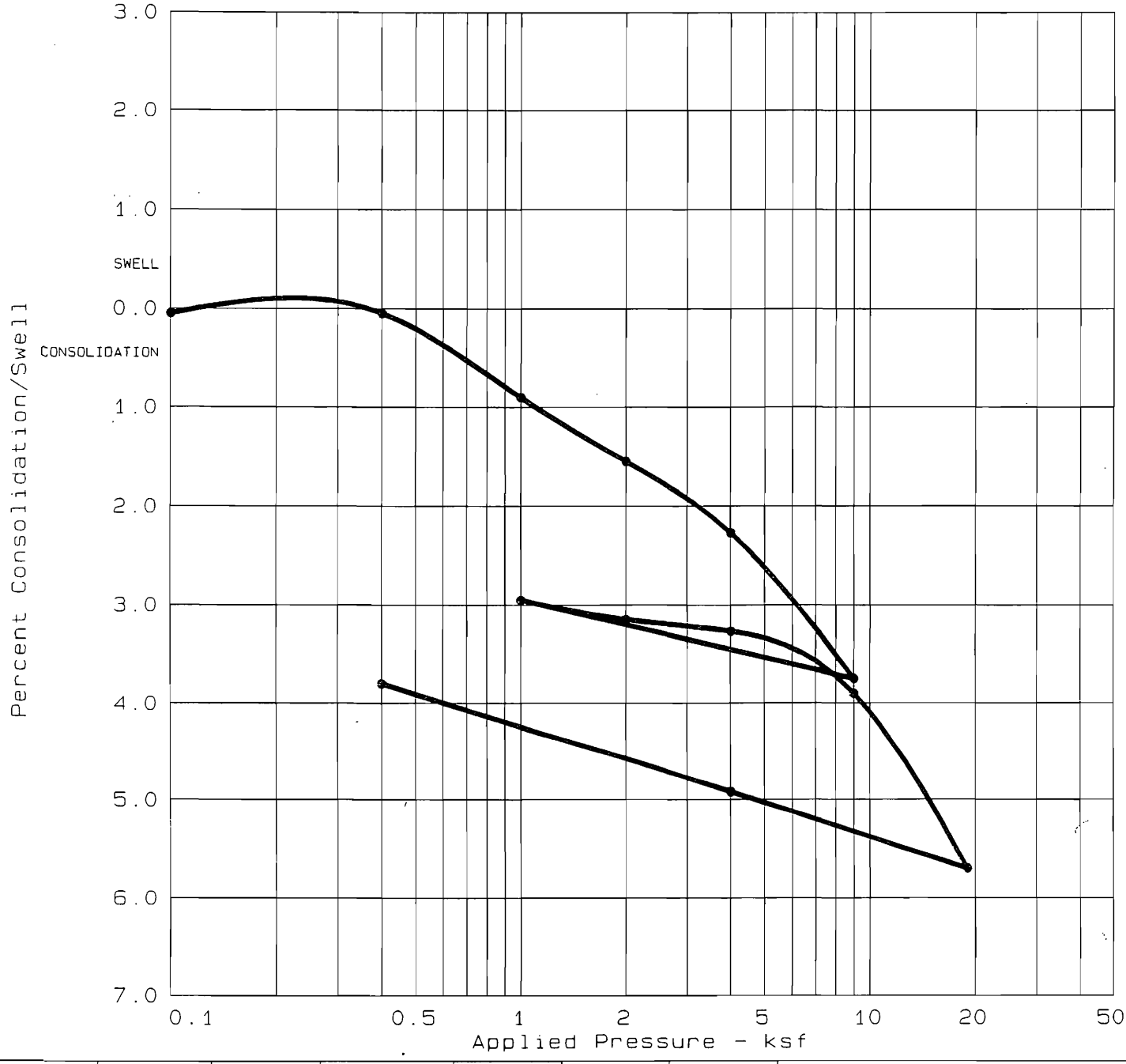
Tested By: DA

CONSOLIDATION TEST REPORT

BINGHAM ENGINEERING B-10

0
Fig. No.

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Initial void ratio
	89.3 %	16.1	111.9	N/A	N/A	2.65	0.4779

TEST RESULTS

C_v at 19.00 ksf applied = 1.94 sq. feet/day

MATERIAL DESCRIPTION

Brown Silty Fine Sand

Class: SM

Project No.: 1416-007
Project: Envirocare Hydrogeological Study
Location: GW-19A B-3 Depth 15.0' to 16.0'
South Clive Facility
Date: 03-18-91

Remarks:

Tested By: DA

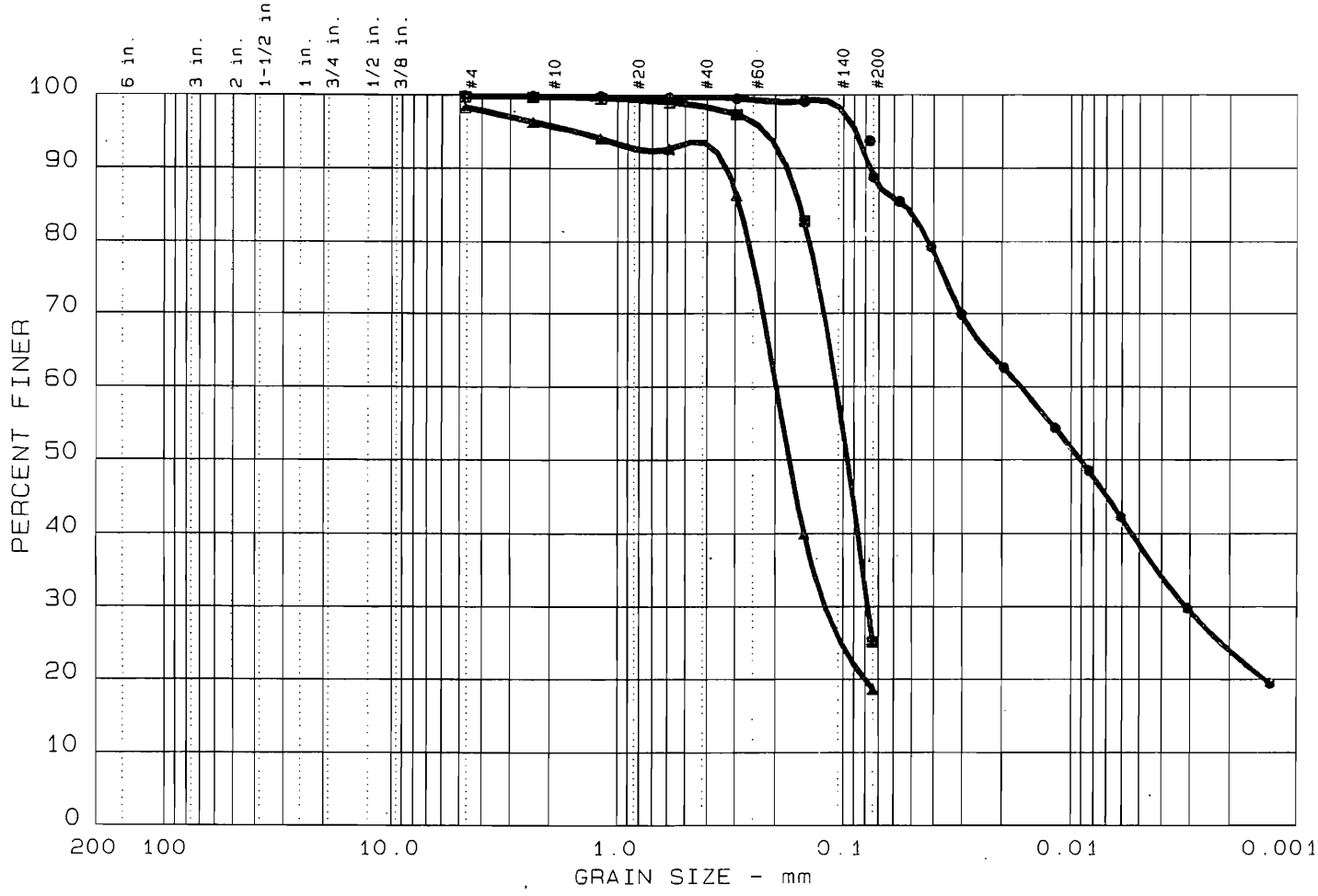
CONSOLIDATION TEST REPORT

BINGHAM ENGINEERING B-11

0
Fig. No.

GRAIN SIZE ANALYSES

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	0.1	11.2	50.3	38.4
▲	2	0.0	1.6	79.8	18.6	
■	3	0.0	0.2	74.7	25.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	34	15			0.01	0.003				
▲	N/A	N/A	0.29	0.20	0.17	0.120				
■	N/A	N/A	0.16	0.11	0.10	0.078				

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Silty Clay with Trace Fine Sand	CL	A-6
▲ Tan Silty Fine Sand	SM	UNCLASSIFIE
■ Tan Silty Fine Sand	SM	UNCLASSIFIE

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
● Location: GW-16 S-1 Depth: 3'-5'
▲ Location: GW-16 B-2 Depth: 9.5'-11'
■ Location: GW-16 B-3 Depth: 14.5'-16'
Date: 03-07-91

Remarks:

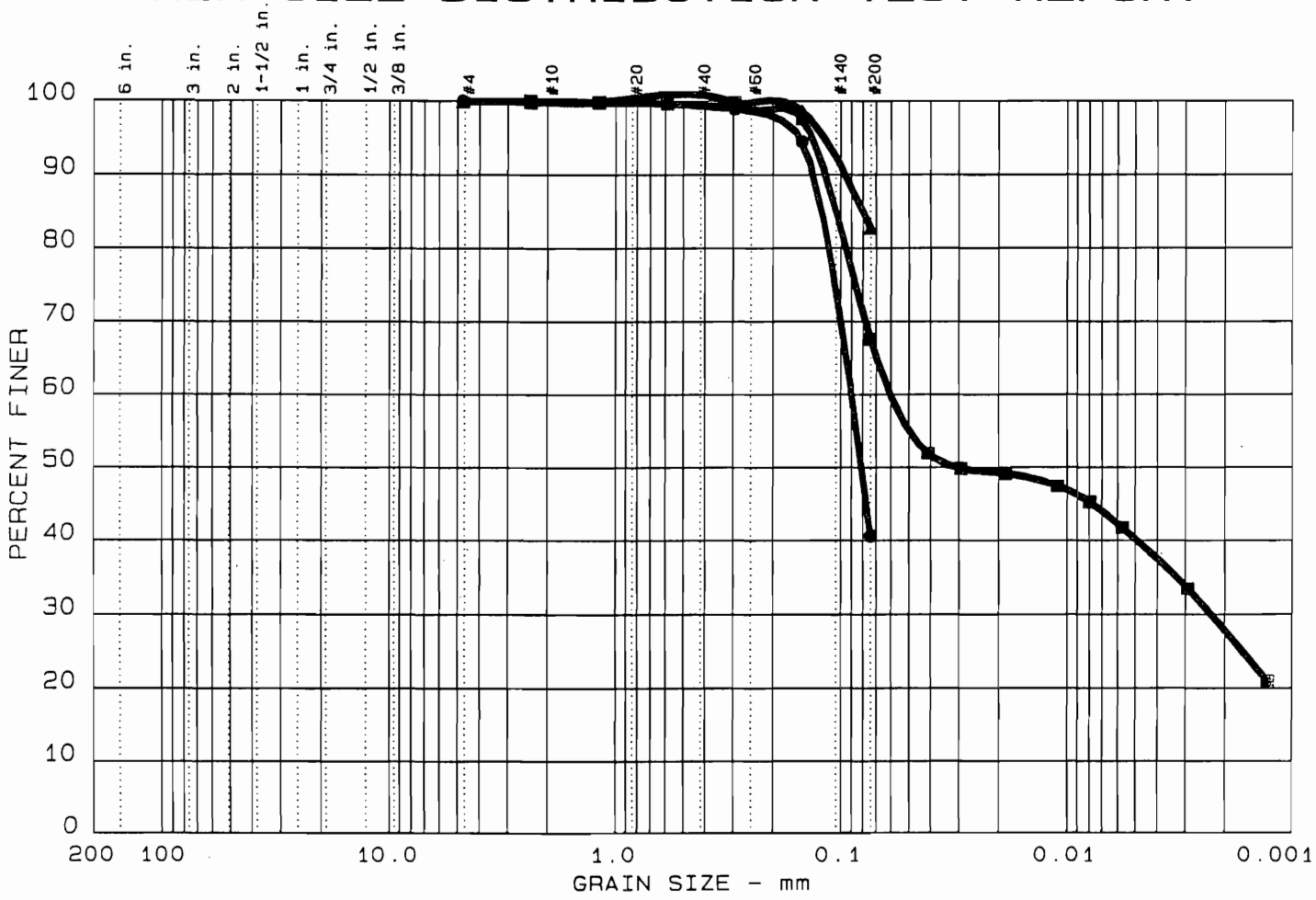
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering B-13

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	59.4	40.6	
▲	7	0.0	0.0	17.3	82.7	
■	1	0.0	0.0	32.4	27.4	40.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/A	N/A	0.12	0.09	0.08					
▲	N/A	N/A	0.08							
■	19	3	0.11		0.03	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan Silty Fine Sand	SM	A-4
▲ Brown Fine Sandy Silt/Clay	ML/CL	A-4
■ Light Brown Fine Sandy Clayish Silt	ML	A-4 (0.0)

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
● Location: GW-16 B-4 Depth: 19.5'-21'
▲ Location: GW-16 B-5 Depth: 24.5'
■ Location: GW-16 B-7 Depth: 34.5'-36'
Date: 02-25-90

Remarks:

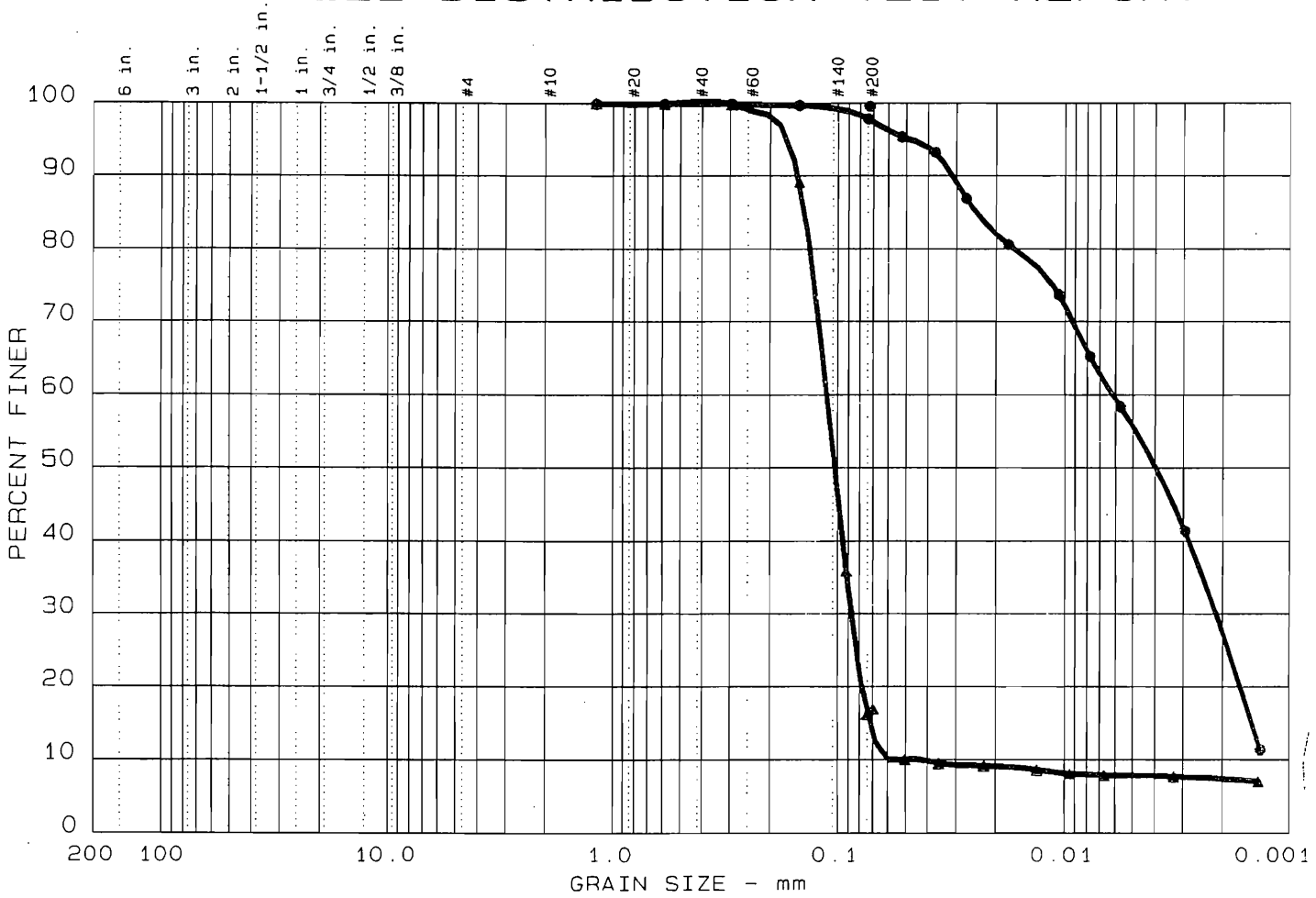
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering B-14

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	8	0.0	0.0	2.1	42.3	55.6
▲	13	0.0	0.0	83.8	8.4	7.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	34	14			0.00	0.002	0.0015			
▲	N/A	N/A	0.14	0.11	0.10	0.087	0.0724	0.0575	1.18	1.9

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Silty Clay with Trace Fine Sand	CL	A-6
▲ Brown Silty Fine Sand with Trace Clay	SM	UNCLASSIFIE

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
● Location: GW-17A L-2 Depth: 7'-9.5'
▲ Location: GW-17A L-5 Depth: 19.5'-22'

Date: 03-07-91

Remarks:

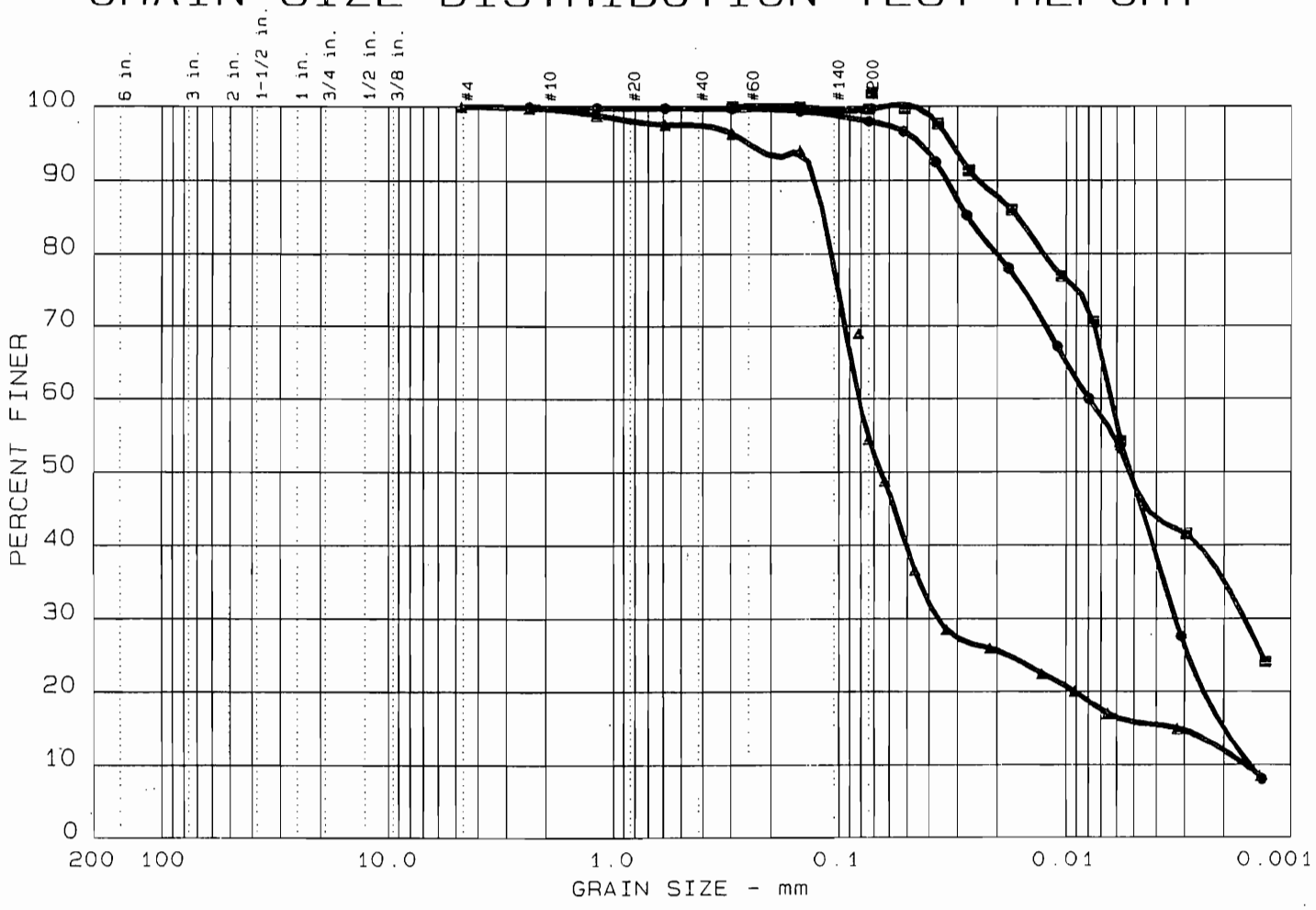
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering B-15

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	0.0	2.0	49.9	48.1
▲	14	0.0	0.0	45.5	38.7	15.8
■	11	0.0	0.0	0.4	51.6	48.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	34	13			0.01	0.003	0.0020	0.0015	0.90	5.2
▲	N/A	N/A	0.12	0.08	0.06	0.036	0.0033	0.0016	10.12	50.7
■	40	18			0.01	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Silty Clay with Trace Fine Sand	CL	A-6
▲ Brown Silty Fine Sand with Some Clay	SM	A-4
■ Brown Silty Clay with Trace Fine Sand	CL	A-6

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
● Location: GW-18 B-1 Depth: 5'-6.5'
▲ Location: GW-18 S-4 Depth: 20'-22'
■ Location: GW-18 S-6 Depth: 30'-32'
Date: 03-07-91

Remarks:

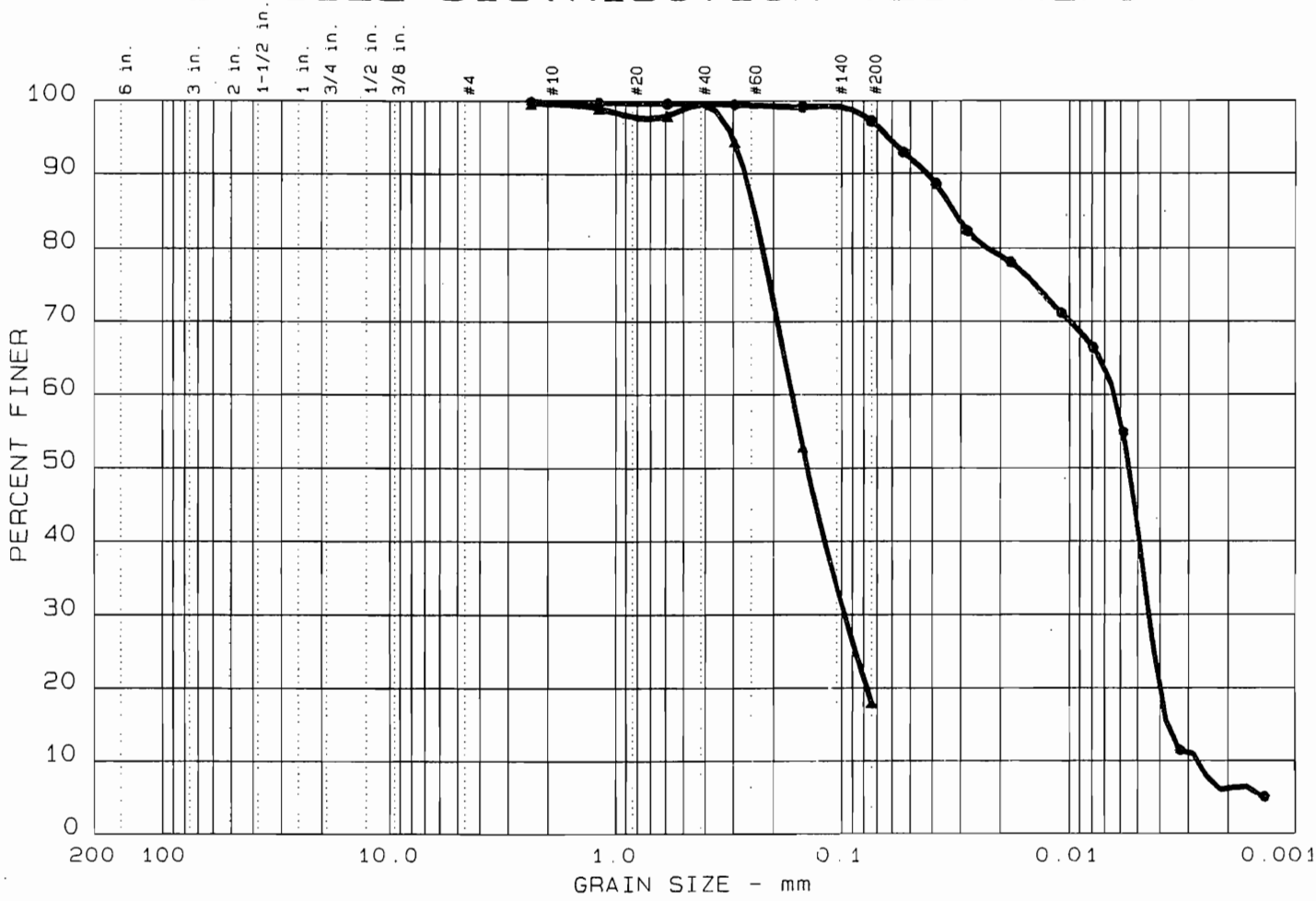
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering B-16

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	12	0.0	0.0	2.8	56.2	41.0
▲	9	0.0	0.0	82.0	18.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	44	18			0.01	0.004	0.0037	0.0027	1.16	2.3
▲	N/A	N/A	0.24	0.17	0.14	0.097				

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Silty Clay with Trace Fine Sand	CL	A-7-6
▲ Brown Silty Fine Sand	SM	UNCLASSIFIE

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
● Location: GW-19A S-1 Depth: 5'-7'
▲ Location: GW-19a S-3 Depth: 15'-16'

Date: 03-07-91

Remarks:

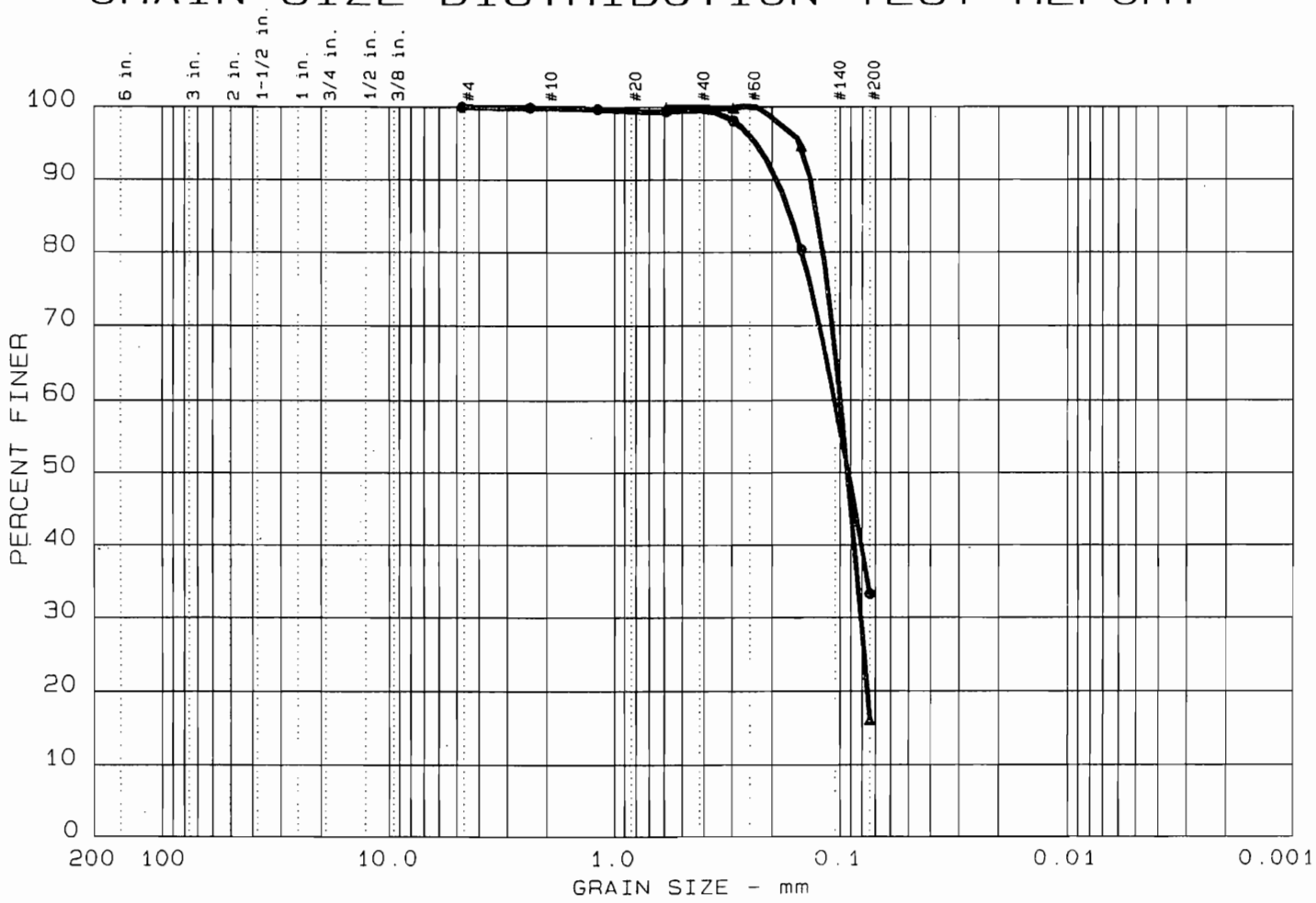
Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering B-17

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	0.0	66.7	33.3	
▲	6	0.0	0.0	83.8	16.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/A	N/A	0.17	0.11	0.09					
▲	N/A	N/A	0.13	0.10	0.09	0.081				

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan Silty Fine Sand	SM	A-2-4
▲ Tan Silty Fine Sand	SM	UNCLASSIFIE

Project No.: 1416-007
Project: Envirocare: Hydrogeological Study
● Location: GW-19B L-4 Depth: 17'-19'
▲ Location: GW-19B L-5 Depth: 22'-24.5'

Date: 02-25-90

Remarks:

Tested By: DA

GRAIN SIZE DISTRIBUTION TEST REPORT

Bingham Engineering B-18

Figure No.

SOIL MOISTURE CHARACTERISTIC CURVES

Water Retention Data and Wetting Curve Fit Parameters

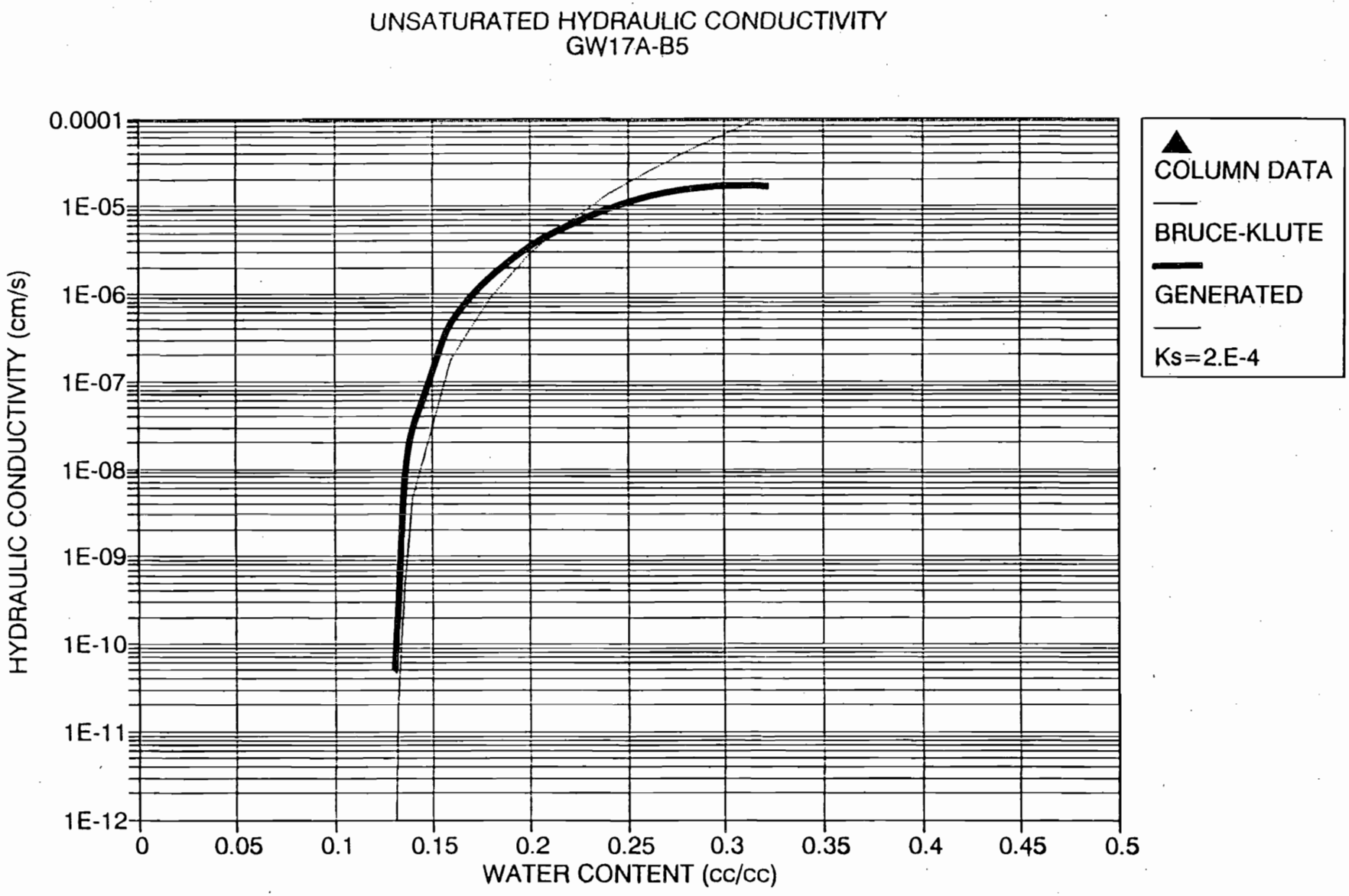
	GW18-B4		GW19A-B1		GW17A-B5		GW17A-B2	
	WATER CONTENT	MATRIC PRESSURE (cm)	WATER CONTENT	MATRIC PRESSURE (cm)	WATER CONTENT	MATRIC PRESSURE (cm)	WATER CONTENT	MATRIC PRESSURE (cm)
DRYING CYCLE	0.409	0	0.442	0	0.377	0	0.505	0
	0.409	6	0.438	383	0.376	19	0.505	49
	0.404	24	0.426	468	0.319	60	0.485	455
	0.362	94	0.405	683	0.207	274	0.466	954
	0.321	131	0.370	1074	0.188	569	0.453	1947
	0.262	171	0.344	2029			0.429	2563
	0.213	230	0.337	3025			0.397	4815
	0.180	349	0.316	4921				
	0.144	664						
	0.132	828						
WETTING CYCLE	0.117	932	0.316	4211	0.1279	946	0.395	4030
	0.119	852	0.317	3961	0.128	807	0.396	3537
	0.122	817	0.317	3736	0.128	578	0.399	3092
	0.126	683	0.322	3465	0.130	403	0.403	2545
	0.129	633	0.323	3265	0.134	282	0.407	2045
	0.135	491	0.327	3010	0.148	204	0.410	1524
	0.142	417	0.332	2774	0.186	88	0.413	1005
	0.156	314	0.335	2540	0.254	53	0.417	504
	0.171	262	0.343	2284	0.307	49	0.422	211
	0.180	221	0.345	2054	0.316	34	0.426	60
	0.220	110	0.352	1804				
	0.302	36	0.357	1534				
	0.327	9	0.365	1300				
			0.369	1079				
			0.373	845				
			0.383	625				
			0.396	391				
			0.397	300				
			0.432	0				
BULK DENSITY	1.567		1.397		1.673		1.326	
POROSITY	0.409		0.473		0.320		0.505	
WETTING CYCLE FIT PARAMETERS								
θ_s	0.380		0.432		0.345		0.429	
θ_s	0.0		0.0		0.130		0.172	
α	0.05222		0.00295		0.0177		0.0012	
n	1.3068		1.1202		3.6477		1.1000	
m	0.2347		0.1073		0.7259		0.0909	

Test Results from Colorado State University

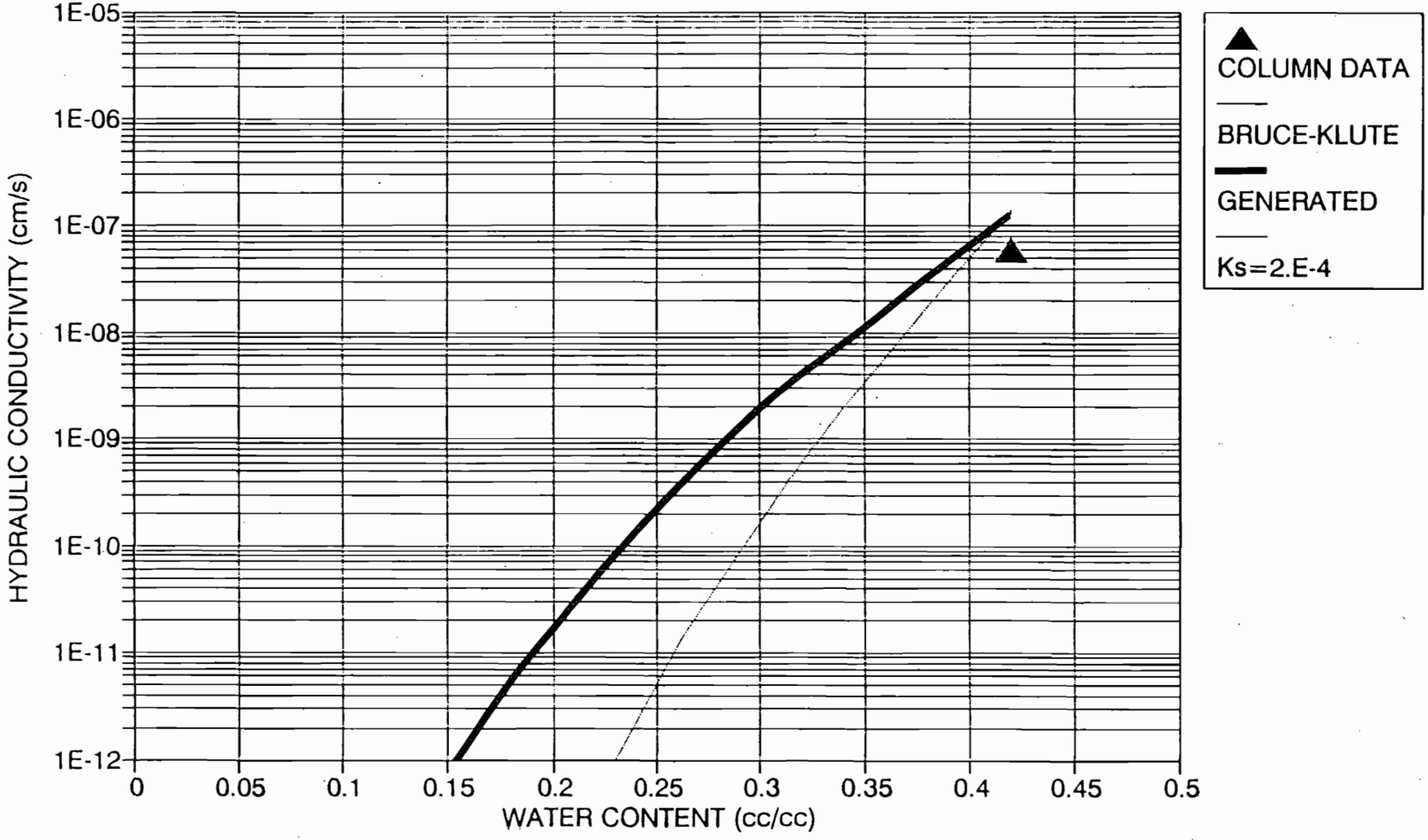
Hydraulic Conductivity Data

	GW18-B4		GW19A-B1		GW17A-B5	
	WATER CONTENT	D(θ) (cm^2/s)	WATER CONTENT	D(θ) (cm^2/s)	WATER CONTENT	D(θ) (cm^2/s)
DIFFUSIVITY DATA	0.380	0.005559	0.430	0.004502	0.345	0.005559
	0.360	0.010385	0.420	0.004024	0.340	0.012307
	0.340	0.008981	0.400	0.003327	0.320	0.008794
	0.320	0.008246	0.380	0.002838	0.300	0.007767
	0.300	0.007759	0.360	0.002471	0.280	0.007184
	0.280	0.007401	0.340	0.002184	0.260	0.006785
	0.260	0.007119	0.320	0.001952	0.240	0.006485
	0.240	0.006889	0.315	0.001900	0.220	0.006247
	0.220	0.006696	0.312	0.001870	0.200	0.006051
	0.200	0.006529	0.262	0.001468	0.180	0.005885
	0.180	0.006383	0.212	0.001186	0.160	0.005742
	0.160	0.006254	0.162	0.000974	0.140	0.005616
	0.140	0.006138	0.112	0.000809	0.135	0.005586
	0.120	0.006034			0.132	0.005569
	0.100	0.005938			0.1308	0.005563
	0.080	0.005850			0.1305	0.005561
	0.060	0.005770				
	0.040	0.005695				
	0.020	0.005625				
	0.010	0.005591				
CONDUCTIVITY DATA	0.380	3.38E-5	0.430	1.89E-7	0.345	5.59E-5
	0.360	3.28E-5	0.420	1.33E-7	0.340	9.60E-6
	0.340	2.42E-5	0.400	6.74E-8	0.320	1.72E-5
	0.320	1.74E-5	0.380	3.41E-8	0.300	1.76E-5
	0.300	1.22E-5	0.360	1.71E-8	0.280	1.55E-5
	0.280	8.39E-6	0.340	8.38E-9	0.260	1.25E-5
	0.260	5.59E-6	0.320	4.01E-9	0.240	9.16E-6
	0.240	3.61E-6	0.315	3.32E-9	0.220	6.09E-6
	0.220	2.25E-6	0.312	2.96E-9	0.200	3.53E-6
	0.200	1.34E-6	0.262	3.84E-10	0.180	1.65E-6
	0.180	7.56E-7	0.212	3.49E-10	0.160	5.01E-7
	0.160	4.00E-7	0.162	1.79E-12	0.140	3.62E-8
	0.140	1.95E-7	0.112	3.28E-14	0.135	6.65E-9
	0.120	8.54E-8			0.132	6.45E-10
	0.100	3.22E-8			0.1308	4.73E-11
	0.080	9.83E-9			0.1305	9.10E-12
	0.060	2.14E-9				
	0.040	2.50E-10				
	0.020	6.44E-12				
	0.010	1.67E-13				
FIT PARAMETER Ks	4.4E-3		2.00E-4		2.00E-4	

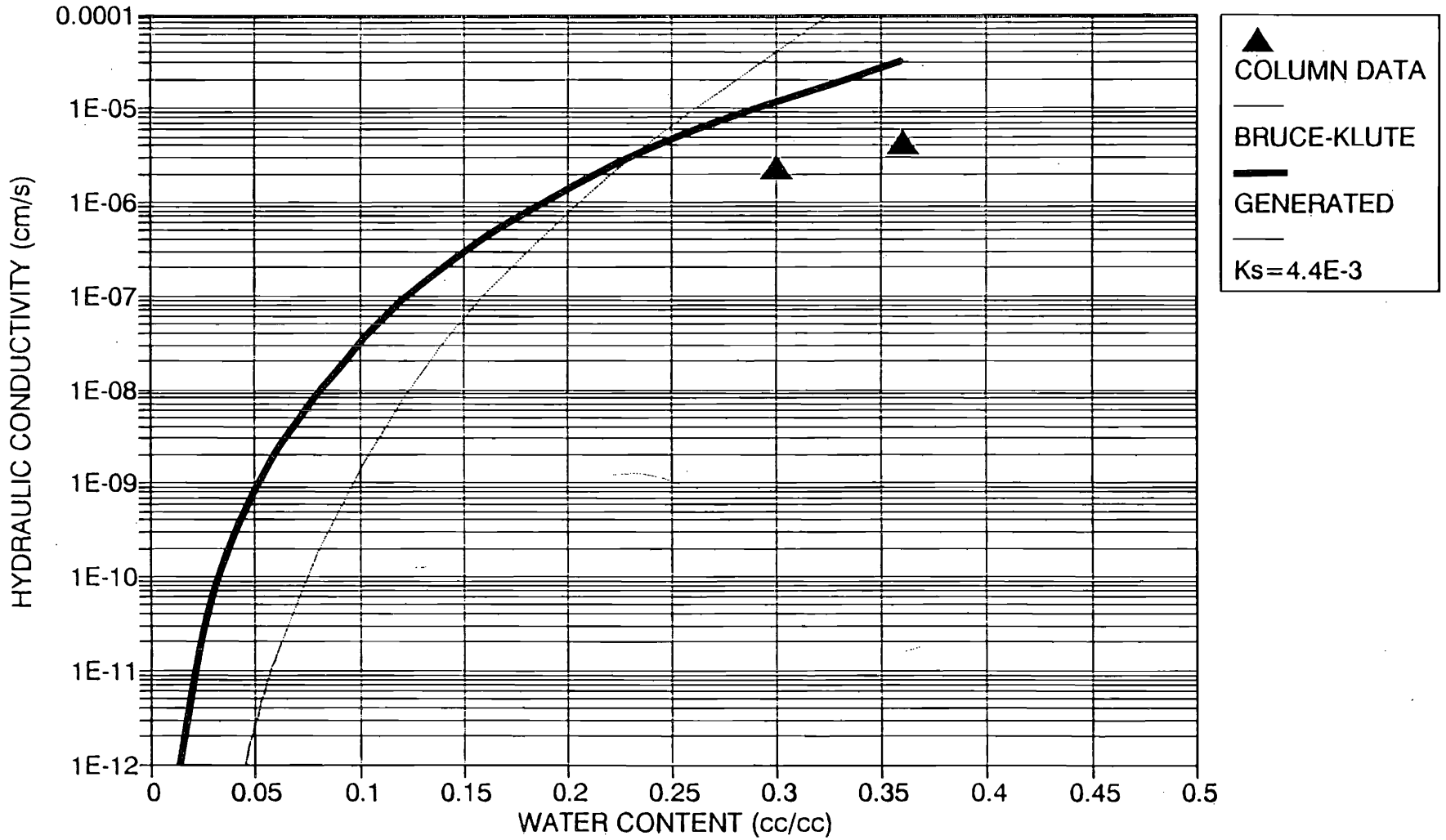
Test Results from Colorado State University

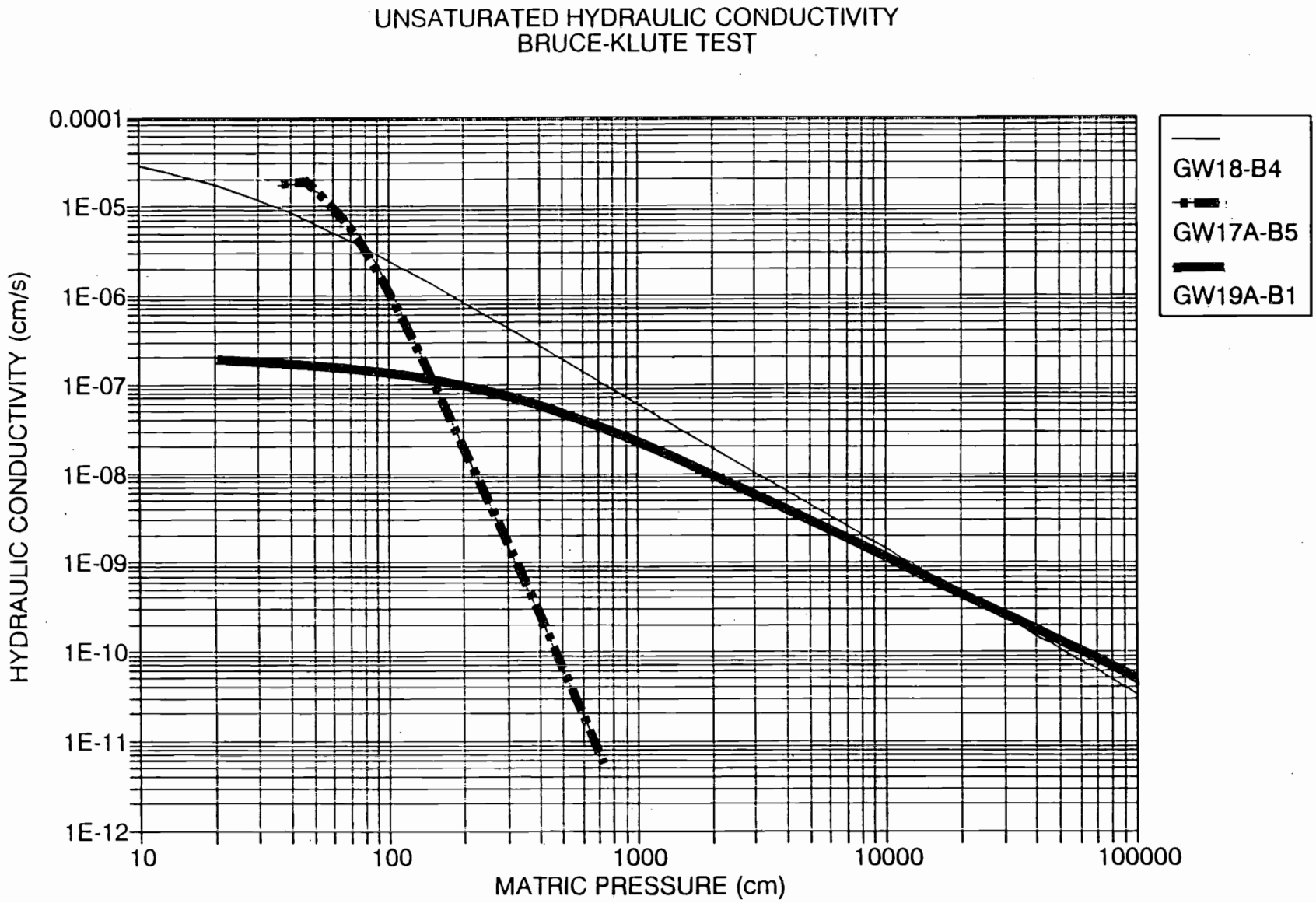

UNSATURATED HYDRAULIC CONDUCTIVITY
GW17A-B5
HYDRAULIC CONDUCTIVITY (cm/s)
0.0001
1E-05
1E-06
1E-07
1E-08
1E-09
1E-10
1E-11
1E-12
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
WATER CONTENT (cc/cc)
COLUMN DATA
BRUCE-KLUTE
GENERATED
Ks=2.E-4

UNSATURATED HYDRAULIC CONDUCTIVITY
GW19A-B1



UNSATURATED HYDRAULIC CONDUCTIVITY
GW18-B4




UNSATURATED HYDRAULIC CONDUCTIVITY
BRUCE-KLUTE TEST
HYDRAULIC CONDUCTIVITY (cm/s)
0.0001
1E-05
1E-06
1E-07
1E-08
1E-09
1E-10
1E-11
1E-12
10
100
1000
10000
100000
MATRIC PRESSURE (cm)
GW18-B4
GW17A-B5
GW19A-B1

ENVIROCARE OF UTAH

SATURATED HYDRAULIC CONDUCTIVITY

Sample ID	Depth (feet)	Description	Unit	Hydraulic Conductivity (cm/sec)
GW-17A, L-1	2-4.5	Brown Silty Clay	4	1.9E-07
GW-17A, L-7	32-34.5	Tan Silty Clay With Trace Sand	2	6.0E-08
GW-18, B-1	5-6.5	Brown Silty Clay	4	1.2E-06*
GW-19B, L-5	22-24.5	Brown Silty Fine Sand	3	1.6E-04

* May be lower due to leaking around sample in tube

MOISTURE - DENSITY DETERMINATIONS

ENVIROCARE OF UTAH

MOISTURE CONTENT AND UNIT WEIGHTS

Sample ID	Sample Depth (feet)	Description	Unit	Moisture Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)
GW-16, S-1	3-5'	Tan Silty Clay	4	20.77	113.16	93.7
GW-16, B-2	9.5-11	Tan Silty Clay	4	5.18	NA	NA
GW-16, B-3	14.5-16	Tan Silty Clay	4	10.89	NA	NA
GW-16, B-4	19.5-21	Tan Silty Sand	4	13.51	NA	NA
GW-16, B-5	24.5-26	Tan Silty Fine Sand	3	26.02	NA	NA
GW-16, B-7	34.5-36	Lt. Gray Fine Sandy Silt	2	38.0	103.6	75.1
GW-17A, L-1	2-4.5	Brown Silty Clay	4	27.8	NA	NA
GW-17A, L-2	7-9.5	Brown Silty Clay	4	34.27	120.13	89.5
GW-17A, L-3	9.5-12.5	Brown Silty Clay	4	39.62	NA	NA
GW-17A, L-4	14.5-17.5	Tan Silty Fine Sand	3	5.21	108.04	102.70
GW-17A, L-5	19.5-22	Tan Fine Silty Sand, Trace Clay	3	5.43	111.19	105.5
GW-17A, L-6	27-29.5	Tan Silty Fine Sand	3	19.66	NA	NA
GW-17A, L-7	32-34.5	Tan Silty Clay, Trace Sand	2	36.00	116.66	85.78
GW-18, B-1	5-6.5	Brown Silty Clay	4	32.81	NA	NA
GW-18, S-4	20.22	Gray Silty Fine Sand, Trace Clay	3	22.94	87.97	71.6
GW-18, S-6	30.32	Tan Silty Clay	2	45.46	100.93	69.4
GW-19A, S-1	5-7	Brown Silty Clay	4	44.62	100.55	69.5
GW-19A, S-3	15-16	Tan Silty Fine Sand	3	16.10	116.01	99.9
GW-19B, L-1	2-4.5	Brown Silty Clay	4	17.51	NA	NA
GW-19B, L-2	7-9.5	Brown Silty Clay	4	35.22	NA	NA
GW-19B, L-3	12-14.5	Brown Silty Clay	4	44.11	NA	NA
GW-19B, L-4	17-19.5	Brown Silty Fine Sand	3	13.94	NA	NA
GW-19B, L-5	22-24.5	Brown Silty Fine Sand	3	21.06	115.05	128.08

Moisture Contents and Unit Weights by Bingham Material Testing Facility and Colorado State University Porous Media Laboratory.

NA = Not Analyzed

SPECIFIC GRAVITY

ENVIROCARE OF UTAH

SPECIFIC GRAVITY OF SOIL

Sample ID	Depth (feet)	Unit	Soil Description	Specific Gravity
GW-17A, L-7	32-34.5	2	Tan Silty Clay, Trace Sand	2.68
GW-19B, L-5	22-24.5	3	Brown Silty Fine Sand	2.61

Testing Conducted at Bingham Material Testing Facility

ENVIROCARE OF UTAH

GROUNDWATER SPECIFIC GRAVITY

April 8, 1991

Monitor Well I.D. No.	Screened Unit	Specific Gravity
GW-3	2, 3	1.038
GW-5	2	1.037
GW-16	2	1.021
GW-17A	2, 3	1.030
GW-18	2	1.031
GW-19A	3	1.041
GW-19B	1	1.021
GW-21	2	1.033
I-1-100	1	1.017

APPENDIX C

GROUNDWATER QUALITY ANALYSES

LABORATORY RESULTS

INORGANIC CHEMISTRY

AMERICAN
WEST
ANALYTICAL
LABORATORIES

63 West 3600 South
Salt Lake City, Utah
84115

(801) 263-8686
Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-01 **R**
Field Sample ID: Envirocare of Utah GW-3

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**23,000.**
Fluoride	340.1	0.1	**3.8**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**0.85**
pH	150.1	0.1	**7.5**
Specific Conductance	120.1	NA	**60,000.**
Sulfate	375.2	5.0	**4,500.**
TDS	160.3	1.0	**39,000.**
TOC	415.1	1.0	**66.**

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Report Date 10/7/91

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Salt Lake City, Utah
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INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-01 **R**
Field Sample ID: Envirocare of Utah GW-3

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Arsenic	7060	0.01	**0.24**
Barium	6010	0.005	**3.5**
Calcium	6010	1.0	**700.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Copper	6010	0.005	<0.005
Iron	6010	0.01	<0.01
Lead	6010	0.05	<0.05
Magnesium	6010	1.0	**600.**
Mercury	7471	0.001	<0.001
Potassium	6010	1.0	**660.**
Selenium	7740	0.005	**0.01**
Sodium	6010	1.0	**16,000.**
Zinc	6010	0.01	<0.01

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INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-02 **R**
Field Sample ID: Envirocare of Utah GW-5

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**24,000.**
Fluoride	340.1	0.1	**1.9**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**0.09**
pH	150.1	0.1	**7.5**
Specific Conductance	120.1	NA	**62,000.**
Sulfate	375.2	5.0	**2,300.**
TDS	160.3	1.0	**43,000.**
TOC	415.1	1.0	**56.**

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-02 **R**
Field Sample ID: Envirocare of Utah GW-5

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Arsenic	7060	0.01	**0.03**
Barium	6010	0.005	**0.07**
Calcium	6010	1.0	**500.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Copper	6010	0.005	<0.005
Iron	6010	0.01	<0.01
Lead	6010	0.05	<0.05
Magnesium	6010	1.0	**460.**
Mercury	7471	0.001	<0.001
Potassium	6010	1.0	**720.**
Selenium	7740	0.005	<0.005
Sodium	6010	1.0	**16,000.**
Zinc	6010	0.01	<0.01

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INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-03 **R**
Field Sample ID: Envirocare of Utah GW-16

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**13,000.**
Fluoride	340.1	0.1	**1.1**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**2.8**
pH	150.1	0.1	**7.7**
Specific Conductance	120.1	NA	**37,000.**
Sulfate	375.2	5.0	**800.**
TDS	160.3	1.0	**24,000.**
TOC	415.1	1.0	**43.**

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INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-03 **R**
Field Sample ID: Envirocare of Utah GW-16

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Arsenic	7060	0.01	<0.01
Barium	6010	0.005	**0.06**
Calcium	6010	1.0	**280.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Copper	6010	0.005	<0.005
Iron	6010	0.01	<0.01
Lead	6010	0.05	<0.05
Magnesium	6010	1.0	**190.**
Mercury	7471	0.001	<0.001
Potassium	6010	1.0	**360.**
Selenium	7740	0.005	<0.005
Sodium	6010	1.0	**8,100.**
Zinc	6010	0.01	<0.01

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Salt Lake City, Utah
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INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-04 **R**
Field Sample ID: Envirocare of Utah GW-17A

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**16,000.**
Fluoride	340.1	0.1	**1.9**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**0.19**
pH	150.1	0.1	**7.6**
Specific Conductance	120.1	NA	**53,000.**
Sulfate	375.2	5.0	**2,300.**
TDS	160.3	1.0	**36,000.**
TOC	415.1	1.0	**57.**

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84115

(801) 263-8686
Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 5, 1991
Lab Sample ID Number: 5648-04 **R**
Field Sample ID: Envirocare of Utah GW-17A

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Arsenic	7060	0.01	**0.01**
Barium	6010	0.005	**0.26**
Calcium	6010	1.0	**690.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Copper	6010	0.005	<0.005
Iron	6010	0.01	<0.01
Lead	6010	0.05	<0.05
Magnesium	6010	1.0	**410.**
Mercury	7471	0.001	<0.001
Potassium	6010	1.0	**570.**
Selenium	7740	0.005	<0.005
Sodium	6010	1.0	**9,100.**
Zinc	6010	0.01	<0.01

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 9, 1991
Lab Sample ID Number: 5664-01
Field Sample ID: Envirocare of Utah GW-18

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**19,000.**
Fluoride	340.1	0.1	**3.2**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	<0.01
pH	150.1	0.1	**7.8**
Specific Conductance	120.1	NA	**53,000.**
Sulfate	375.2	5.0	**2,800.**
TDS	160.3	1.0	**34,000.**
TOC	415.1	1.0	**63.**

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Report Date 5/14/91

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 9, 1991
Lab Sample ID Number: 5664-01
Field Sample ID: Envirocare of Utah GW-18

Contact: Gordon Miner
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Arsenic	7060	0.01	**0.03**
Barium	6010	0.005	**0.075**
Calcium	6010	1.0	**560.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Copper	6010	0.005	<0.005
Iron	6010	0.01	**9.1**
Lead	6010	0.05	<0.05
Magnesium	6010	1.0	**570.**
Mercury	7471	0.001	<0.001
Potassium	6010	1.0	**580.**
Selenium	7740	0.005	<0.005
Sodium	6010	1.0	**13,000.**
Zinc	6010	0.01	**0.52**

Released by: _____
Laboratory Supervisor

Report Date 5/13/91

AMERICAN
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463 West 3600 South
Salt Lake City, Utah
84115

(801) 263-8686
Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 4, 1991
Lab Sample ID Number: 5633-01
Field Sample ID: Envirocare of Utah GW-19-A @ 30'

Contact: Mark Taggart
Received By: Steve Getz

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bicarbonate	403.0	10.	**310.**
Bromide	405.0	0.1	<0.05
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**27,000.**
Cyanide	335.3	0.005	<0.005
Fluoride	340.1	0.1	**4.3**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	<0.01
pH	150.1	0.1	**7.5**
Specific Conductance	120.1	NA	**68,000.**
Sulfate	375.2	5.0	**5,300.**
TDS	160.3	1.0	**45,000.**
TOC	415.1	1.0	**49.**

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Report Date 5/16/91

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84115

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 4, 1991
Lab Sample ID Number: 5633-01
Field Sample ID: Envirocare of Utah GW-19-A @ 30'

Contact: Mark Taggart
Received By: Steve Getz

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Aluminum	6010	0.1	<0.1
Arsenic	7060	0.01	<0.01
Barium	6010	0.005	<0.005
Boron	6010	0.1	**2.5**
Calcium	6010	1.0	**750.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Cobalt	6010	0.05	<0.05
Copper	6010	0.005	<0.005
Iron	6010	0.01	**81.**
Lead	6010	0.05	<0.05
Lithium	6010	0.1	**4.8**
Magnesium	6010	1.0	**1,300.**
Manganese	6010	0.01	**1.8**
Mercury	7471	0.001	<0.001
Molybdenum	6010	1.0	<1.0
Nickel	6010	0.010	<0.010
Potassium	6010	1.0	**440.**
Selenium	7740	0.005	<0.005
Silicon	6010	0.05	**15.**
Silver	6010	0.01	<0.01
Sodium	6010	1.0	**19,000.**
Vanadium	6010	0.005	<0.005
Zinc	6010	0.01	**15.**

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Laboratory Supervisor

Report Date 5/16/91

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 4, 1991
Lab Sample ID Number: 5633-02
Field Sample ID: Envirocare of Utah GW-19-B @ 100'

Contact: Mark Taggart
Received By: Steve Getz

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bicarbonate	403.0	10.	**250.**
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**12,000.**
Cyanide	335.3	0.005	<0.005
Fluoride	340.1	0.1	**1.5**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**0.02**
pH	150.1	0.1	**7.6**
Specific Conductance	120.1	NA	**35,000.**
Sulfate	375.2	5.0	**1,300.**
TDS	160.3	1.0	**23,000.**
TOC	415.1	1.0	**50.**

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Laboratory Supervisor

Report Date 5/16/91

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 4, 1991
Lab Sample ID Number: 5633-02
Field Sample ID: Envirocare of Utah GW-19-B @ 100'

Contact: Mark Taggart
Received By: Steve Getz

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Aluminum	6010	0.1	<0.1
Arsenic	7060	0.01	<0.01
Barium	6010	0.005	<0.005
Boron	6010	0.1	<0.1
Calcium	6010	1.0	**290.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Cobalt	6010	0.05	<0.05
Copper	6010	0.005	<0.005
Iron	6010	0.01	**28.**
Lead	6010	0.05	<0.05
Lithium	6010	0.1	**3.1**
Magnesium	6010	1.0	**380.**
Manganese	6010	0.01	<0.01
Mercury	7471	0.001	<0.001
Molybdenum	6010	1.0	<1.0
Nickel	6010	0.010	<0.010
Potassium	6010	1.0	**170.**
Selenium	7740	0.005	<0.005
Silicon	6010	0.05	<0.05
Silver	6010	0.01	<0.01
Sodium	6010	1.0	**8,200.**
Vanadium	6010	0.005	<0.005
Zinc	6010	0.01	**5.3**

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Laboratory Supervisor

Report Date 5/16/91

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INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 4, 1991
Lab Sample ID Number: 5633-03
Field Sample ID: Envirocare of Utah GW-21

Contact: Mark Taggart
Received By: Steve Getz

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bicarbonate	403.0	10.	**470.**
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**21,000.**
Cyanide	335.3	0.005	<0.005
Fluoride	340.1	0.1	**1.4**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**0.07**
pH	150.1	0.1	**7.5**
Specific Conductance	120.1	NA	**59,000.**
Sulfate	375.2	5.0	**1,800.**
TDS	160.3	1.0	**40,000.**
TOC	415.1	1.0	**78.**

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Laboratory Supervisor

Report Date 5/16/91

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463 West 3600 South
Salt Lake City, Utah
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(801) 263-8686
Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 4, 1991
Lab Sample ID Number: 5633-03
Field Sample ID: Envirocare of Utah GW-21

Contact: Mark Taggart
Received By: Steve Getz

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Aluminum	6010	0.1	<0.1
Arsenic	7060	0.01	<0.01
Barium	6010	0.005	<0.005
Boron	6010	0.1	<0.1
Calcium	6010	1.0	**220.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Cobalt	6010	0.05	<0.05
Copper	6010	0.005	<0.005
Iron	6010	0.01	0.01
Lead	6010	0.05	<0.05
Lithium	6010	0.1	**5.2**
Magnesium	6010	1.0	**540.**
Manganese	6010	0.01	<0.01
Mercury	7471	0.001	<0.001
Molybdenum	6010	1.0	<1.0
Nickel	6010	0.010	<0.010
Potassium	6010	1.0	**520.**
Selenium	7740	0.005	<0.005
Silicon	6010	0.05	<0.05
Silver	6010	0.01	<0.01
Sodium	6010	1.0	**15,000.**
Vanadium	6010	0.005	<0.005
Zinc	6010	0.01	<0.01

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Report Date 5/16/91

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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 9, 1991
Lab Sample ID Number: 5664-02
Field Sample ID: Envirocare of Utah I-1-100

Contact: Mark Taggart
Received By: Elona Hayward

Analytical Results

	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Bromide	405.0	0.1	<0.1
Carbonate	403.0	10.	<10.
Chloride	325.2	0.5	**11,000.**
Fluoride	340.1	0.1	**1.2**
Iodine	414.0	0.1	<0.1
Nitrate	353.2	0.01	**0.03**
pH	150.1	0.1	**7.8**
Specific Conductance	120.1	NA	**52,000.**
Sulfate	375.2	5.0	**600.**
TDS	160.3	1.0	**21,000.**
TOC	415.1	1.0	**44.**

Released by: _____
Laboratory Supervisor

Report Date 5/14/91

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463 West 3600 South
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Fax (801) 263-8687

INORGANIC ANALYSIS REPORT

Client: Bingham Environmental
Date Received: April 9, 1991
Lab Sample ID Number: 5664-02
Field Sample ID: Envirocare of Utah I-1-100

Contact: Gordon Miner
Received By: Elona Hayward

Analytical Results

DISSOLVED METALS	Method Used:	Detection Limit: mg/L	Amount Detected: mg/L
Arsenic	7060	0.01	<0.01
Barium	6010	0.005	**0.026**
Calcium	6010	1.0	**210.**
Cadmium	6010	0.005	<0.005
Chromium	6010	0.01	<0.01
Copper	6010	0.005	<0.005
Iron	6010	0.01	<0.01
Lead	6010	0.05	<0.05
Magnesium	6010	1.0	**230.**
Mercury	7471	0.001	<0.001
Potassium	6010	1.0	**250.**
Selenium	7740	0.005	<0.005
Sodium	6010	1.0	**7,300.**
Zinc	6010	0.01	<0.01

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Laboratory Supervisor

Report Date 5/13/91

LABORATORY RESULTS

RADIOLOGICAL ANALYSES

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300, Ggolden, COLORADO 80401 PHONE (303) 277-1687

10-May-91

BINGHAM ENGINEERING COMPANY
5160 Wiley Post Way
Salt Lake City, UT 84116

Page: 1
Copy: 2 of 2
Set : 1

Attn:
Project: Envirocare of Utah PO #:

Received: 9-Apr-91 09:40

Job: 91675E Status: Final

Sample Type: Water

Sample	Gross Alpha Total pCi/l	Error 2σ	Gross Beta Total pCi/l	Error 2σ	Pb-210 Total pCi/l	Error 2σ
GW-19A	0	±230	510	±190	3.2	±1.2
GW-19B	120	±210	260	±190	3.6	±1.2
GW-21	110	±240	490	±190	2.9	±1.2
GW-3	200	±330	490	±190	NR	NR
GW-5	150	±310	550	±190	NR	NR
GW-16	0	±140	310	±100	NR	NR
GW-17A	110	±220	470	±140	NR	NR

Sample	Po-210 Total pCi/l	Error 2σ	Ra-226 Total pCi/l	Error 2σ	Ra-228 Total pCi/l	Error 2σ
GW-19A	2.2	±0.8	1.3	±1.7	1.1	±3.2
GW-19B	8.6	±1.2	3.0	±2.4	4.6	±3.4
GW-21	2.7	±1.0	3.7	±2.4	9.9	±3.7
GW-3	NR	NR	NR	NR	NR	NR
GW-5	NR	NR	NR	NR	NR	NR
GW-16	NR	NR	NR	NR	NR	NR
GW-17A	NR	NR	NR	NR	NR	NR

Sample	Th-230 Total pCi/l	Error 2σ	U Total mg/l	Rn-222 pCi/l	Error 2σ	Cs-137 Total pCi/l	Error 2σ
GW-19A	0.8	±0.9	0.0061	0	±750	1.0	±0.8
GW-19B	1.0	±0.3	0.0155	0	±870	0.0	±1.5
GW-21	1.2	±0.4	0.0260	0	±750	0.1	±1.7
GW-3	NR	NR	NR	NR	NR	NR	NR
GW-5	NR	NR	NR	NR	NR	NR	NR
GW-16	NR	NR	NR	NR	NR	NR	NR
GW-17A	NR	NR	NR	NR	NR	NR	NR

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300, GOLDEN, COLORADO 80401 PHONE (303) 277-1687

10-May-91

BINGHAM ENGINEERING COMPANY
5160 Wiley Post Way
Salt Lake City, UT 84116

Page: 2
Copy: 2 of 2
Set : 1

Attn:
Project: Envirocare of Utah PO #:

Received: 9-Apr-91 09:40

Job: 91675E Status: Final

Sample Type: Water

Sample	Gross Gamma Total pCi/l	Error 2σ	I-129 Total pCi/l	Sr Total pCi/l	Error 2σ	Tc-99 Total pCi/l	Error 2σ
GW-19A	100	±180	<2	0.0	±0.4	0	±42
GW-19B	160	±180	<4	0.0	±0.5	3	±44
GW-21	160	±180	<2	0.2	±0.4	21	±46
GW-3	180	±180	---	NR	NR	---	---
GW-5	280	±180	---	NR	NR	---	---
GW-16	180	±180	---	NR	NR	---	---
GW-17A	120	±180	---	NR	NR	---	---

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300, GOLDEN, COLORADO 80401 PHONE (303) 277-1687

7-May-91

BINGHAM ENGINEERING COMPANY
5160 Wiley Post Way
Salt Lake City, UT 84116

Page: 1
Copy: 1 of 2
Set : 1

Attn:
Project:

PO #:

Received: 10-Apr-91 09:20

Job: 91687E

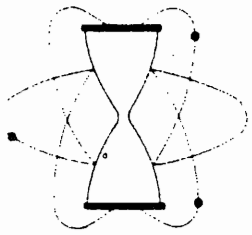
Status: Final

Sample Type: Water

Sample	Gross Alpha Total pCi/l	Error 2σ	Gross Beta Total pCi/l	Error 2σ	Gross Gamma Total pCi/l	Error 2σ
I-1-100	60	±120	210	±70	0	±180
GW-18	80	±210	480	±140	70	±180

LABORATORY RESULTS

ISOTOPIC DATA



KRUEGER ENTERPRISES, INC.

GEOCHRON LABORATORIES DIVISION

24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

STABLE ISOTOPE RATIO ANALYSES — REPORT OF ANALYTICAL WORK

Submitted by: Dr. Alan Mayo
P.O. Box 1960
Orem, Utah. 84059

Date Received: 04/23/91
Date Reported: 05/13/91
Your Reference: letter of 04/19/91

Our Lab. Number	Your Sample Number	Description	$\delta^{13}C$*
CR-67259	GW-3	Barium carbonate	- 2.7
CR-67260	GW-5	"	- 1.8
CR-67261	GW-16	"	- 6.9
CR-67262	GW-17A	"	- 1.9
CR-67263	GW-18A	"	- 2.7
CR-67264	I-1-100	"	- 5.2
CR-67265	GW-19A 30 feet	"	- 0.3
CR-67266	GW-19B 100 feet	"	- 1.3
CR-67267	GW-21	"	- 5.4

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

$$\delta^{13}C_{sample}‰ = \left| \frac{^{13}C/^{12}C_{sample}}{^{13}C/^{12}C_{standard}} - 1 \right| \times 1000$$

Where: $^{13}C/^{12}C$ standard is PDB

And: $^{13}C/^{12}C$ standard = 0.011237

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
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STABLE ISOTOPE RATIO ANALYSES

REPORT OF ANALYTICAL WORK

Submitted by: Alan Mayo
P.O. Box 1960
Orem, Utah 84059

Date Received: 04/23/91
Date Reported: 04/10/91
Your Reference: Mayo letter April 19

Our Lab. Number	Your Sample Number	Description	δD^*	$\delta^{18}O^*$
HOR-67268	GW-3	Water	-104	-10.5
HOR-67269	GW-5	Water	-115 -116**	-12.8
HOR-67270	GW-16	Water	-114	-13.5
HOR-67271	GW-17A	Water	-114	-13.1
HOR-67272	GW-18	Water	-112	-11.9
HOR-67273	I-1-100	Water	-121	-13.8
HOR-67274	GW-19A (30 feet)	Water	-103	-10.5
HOR-67275	GW-19B (100 feet)	Water	-107	-13.0
HOR-67276	GW-21	Water	-113	-13.4

** Duplicate preparations and analyses.

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

$$\delta R_{sample}‰ = \left[\frac{R_{sample}}{R_{standard}} - 1 \right] \times 1000$$

Where:

D/H standard is SMOW
$^{18}O/^{16}O$ standard is SMOW

And:

$D/H_{standard}$ = 0.000316**
$^{18}O/^{16}O_{standard}$ = 0.0039948**

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Alan Mayo
P.O. Box 1960
Orem, UT 84059

Date Received: 04/23/91
Date Reported: 05/10/91
Reference: Letter of April 19

REPORT OF TRITIUM ANALYSES

Our Lab No.	Your Sample No.	Tritium Units
T-4380	GW-19A (30 feet)	1.8 +/- 2.2
T-4381	GW-19B (100 feet)	2.8 +/- 2.2
T-4382	GW-21	4.9 +/- 2.2

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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-16760 — Date Received: 04/23/91

Your Reference: letter of 04/19/91 — Date Reported: 05/13/91

Submitted by: Alan L. Mayo
P.O. Box 1960
Orem, UT 84059

Sample Name: GW-19A, 30 feet.
Barium salt precipitate.

AGE = 18,500 +/- 1250 C-14 years BP (C-13 corrected).
(10.0 +/- 2.0) % of the modern (1950) C-14 activity.

Description: Barium salts precipitated from water sample.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 0.3 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-16761 — Date Received: 04/23/91

Your Reference: letter of 04/19/91 — Date Reported: 05/13/91

Submitted by: Alan L. Mayo
P.O. Box 1960
Orem, UT 84059

Sample Name: GW-19B, 100 feet.
Barium salt precipitate.

AGE = 23,750 +/- 1600 C-14 years BP (C-13 corrected).
(5.2 +/- 1.0) % of the modern (1950) C-14 activity.

Description: Barium salts precipitated from water sample.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 1.3 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-16762 — Date Received: 04/23/91

Your Reference: letter of 04/19/91 — Date Reported: 05/13/91

Submitted by: Alan L. Mayo
P.O. Box 1960
Orem, UT 84059

Sample Name: GW-21.
Barium salt precipitate.

AGE = 8125 +/- 310 C-14 years BP (C-13 corrected).
(36.4 +/- 1.4) % of the modern (1950) C-14 activity.

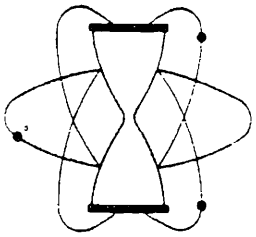
Description: Barium salts precipitated from water sample.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 5.4 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.
The age is referenced to the year A.D. 1950.



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STABLE ISOTOPE RATIO ANALYSES

REPORT OF ANALYTICAL WORK

Submitted by: Alan Mayo
P.O. Box 1960
Orem, Utah 84059

Date Received: 04/23/91
Date Reported: 04/15/91
Your Reference: Mayo letter April 19

Our Lab. Number	Your Sample Number	Description	$\delta^{34}S$*
SR-67264	I-1-100	Sulfate	+10.4
SR-67265	GW-19A (30 feet)	Sulfate	- 5.7
SR-67266	GW-19B (100 feet)	Sulfate	- 0.4
SR-67267	GW-21	Sulfate	- 2.9

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

$$\delta^{34}S_{sample}‰ = \left[\frac{^{34}S/^{32}S_{sample}}{^{34}S/^{32}S_{standard}} - 1 \right] \times 1000$$

Where:

$^{34}S/^{32}S$ standard is Cañon Diablo troilite

And:

$^{34}S/^{32}S = 0.0450045$

PREVIOUS

GROUNDWATER QUALITY DATA

GW - WELLS

ENVIROCARE OF UTAH
WATER QUALITY DATA

WELL IDENTIFICATION: GW-1

Parameters	Units	SAMPLING DATE												
Indicator Parameters		25-Mar-88	01-Jul-88	07-Oct-88	27-Feb-89	26-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	27-Mar-91	14-Jun-91
Chloride (Cl)	(mg/l)	22125	29700	21800	21500	32500	20760	23000	21900	3200	23918	NA	24600	23200
Sulfate (SO4)	(mg/l)	3100	3200	3100	3000	3000	3240	2100	1650	3680	3074	NA	3350	2970
TDS	(mg/l)	41080	41486	40736	NA	34600	39900	40184	41720	42500	42734	41900	66600	44600
Conductivity	(umhos/cm)	56749	56289	56097	NA	61400	69562.8	82303	49050	167400	43736	9826	87300	81600
Radiological		14-May-88	01-Jul-88	07-Oct-88	27-Feb-89	26-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	27-Mar-91	14-Jun-91
Radium (Ra-226)	(pCi/l)	9+/-1	9+/-?	18+/-1	5	3.6+/-1	3.1+/-1.1	<1.0+/-?	6.1 +/-2.0	3.2+/-1.0	3.3+/-1.0	26.7+/-13.	5.4+/-3.8	<1
Uranium (Total)	(pCi/l)	75+/-13	50+/-3	26+/-4	18	7+/-1	3.4+/-0.51	11+/-2	10+/-?	12	7.4	15.6	10.8	<0.7
Gross alpha	(pCi/l)	92+/-57	-8+/-?	180+/-64	144	11+/-9	49+/-30	19+/-18	16 +/-14	74+/-50	4+/-3	67+/-50	173+/-96	<3
Gross beta	(pCi/l)	< 12+/-50	-585+/-643	< 12	646	29+/-6	57+/-13	158+/-17	164 +/-18	275+/-59	35+/-4	107+/-101	435+/-74	291+/-63

WELL IDENTIFICATION: GW-2

Parameters	Units	SAMPLING DATE												
Indicator Parameters		14-May-88	01-Jul-88	07-Oct-88	27-Feb-89	26-Jun-89	28-Sep-89	12-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	28-Mar-91	24-May-91
Chloride (Cl)	(mg/l)	18625	28400	18000	18750	28500	18980	17880	18000	19400	20616	25489	33100	21600
Sulfate (SO4)	(mg/l)	1300	1300	1300	1300	1200	1840	1000	1203	1330	1294	1250	1610	1060
TDS	(mg/l)	33566	33996	33058	NA	29000	32900	31628	33920	34700	35020	34000	40900	36400
Conductivity	(umhos/cm)	48719	48590	48099	NA	52200	57969	70545	50140	91800	37488	7643	67200	120000
Radiological		15-Apr-88	01-Jul-88	07-Oct-88	27-Feb-89	26-Jun-89	28-Sep-89	12-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	28-Mar-91	24-May-91
Radium (Ra-226)	(pCi/l)	8+/-1	3+/-?	13+/-1	3	4.1+/-1	3.7+/-2	8.8+/-3	6.8+/-2.0	2.0+/-1.0	4.4+/-3.8	5.1+/-1.0	2.4+/-1.0	0.6+/-0.3
Uranium (Total)	(pCi/l)	43+/-5	<15.0+/-2	33+/-5	27	11+/-2	<0.7+/-?	7+/-1	12	8.8	6.8	8.1	6.1	<0.7
Gross alpha	(pCi/l)	20+/-36	-81+/-?	151+/-4	157	11+/-9	12+/-10	40+/-22	16+/-14	90+/-50	5+/-4	116+/-80	834+/-183	5+/-4
Gross beta	(pCi/l)	< 12+/-50	909+/-633	< 12z=/-z/	400	112+/-10	19+/-11	171+/-18	137+/-17	265+/-59	30+/-4	494+/-107	743+/-88	16+/-3

NO = None Detected NA = Not Analyzed

ENVIROCARE OF UTAH
WATER QUALITY DATA

WELL IDENTIFICATION: GW-3

Parameter	Units	SAMPLING DATE														
Indicator Parameters		14-May-88	05-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	12-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	28-Mar-91	29-Mar-91	24-May-91	25-May-91	05-Jun-91
Chloride (Cl)	(mg/l)	23375	31000	23050	24050	33800	24200	26200	23000	20600	25783	25900	37600	x24125	24300	x22875	26400
Sulfate (SO4)	(mg/l)	4000	4100	4300	4400	4000	4280	3650	1801	4570	3914	3400	4490	x2640	4030	x4100	4170
TDS	(mg/l)	44602	46224	46600	NA	41600	46200	46312	44820	45000	47496	48000	61900	x8980	47800	x44730	46100
Conductivity	(umhos/cm)	60176	60971	61643	NA	63500	69562	82303	52320	108000	43736	8734	81500	x57500	112000	x53200	113000
Radiological		15-Apr-88	05-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	12-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	28-Mar-91	29-Mar-91	24-May-91	25-May-91	05-Jun-91
Radium (Ra-226)	(pCi/l)	15+/-1	4+/-0	47+/-7	6	3.8+/-1.2	4,9+/-2.6	3.8+/-1	5.1+/-3.9	10+/-2.0	15.7+/-5.7	32.1+/-5.8	51.3+/-10.9	x2+/-216	<0.6	x5+/-0.5	30.3+/-7.2
Uranium (Total)	(pCi/l)	228+/-7	118+/-4	484+/-18	338	13+/-2	1.4+/-0.2	21+/-5	24+/-7	110	22	118	113	x10+/-3	<0.7	x12+/-3.0	89+/-4
Gross alpha	(pCi/l)	200+/-70	-50+/-3	559+/-?	370	11+/-8	59+/-31	30+/-20	20+/-18	110+/-99	27+/-24	284+/-178	316+/-120	x210+/-216	5+/-4	x116+/-150	91+/-80
Gross beta	(pCi/l)	< 12+/-40	-643+/-654	< 12+/-?	715	36+/-7	53+/-13	357+/-36	221+/-20	572+/-74	211+/-19	1175+/-142	467+/-76	x1098+/-277	65+/-13	x616+/-155	371+/-71

ND = None Detected NA = Not Analyzed
x Analyzed by State Health Lab

ENVIROCARE OF UTAH
WATER QUALITY DATA

WELL IDENTIFICATION: GW-4

Parameter	Units	SAMPLING DATE											
Indicator Parameters			01-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	12-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	18-Dec-90	29-Mar-91	14-Jun-91
Chloride (Cl)	(mg/l)	NA	37400	23350	24000	32700	24680	22400	22600	23200	25331	27700	24300	2500
Sulfate (SO4)	(mg/l)	NA	2600	2700	2900	2700	2680	1850	1604	4620	2757	2310	3050	2510
TDS	(mg/l)	NA	44866	44506	NA	42200	44000	44078	45040	44500	45804	45000	76600	47900
Conductivity	(umhos/cm)	NA	60347	60790	NA	61400	69563	82303	52320	108000	43736	9826	78900	88200
Radiological			01-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	12-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	18-Dec-90	29-Mar-91	14-Jun-91
Radium (Ra-226)	(pCi/l)	NA	1+/-0	7+/-?	14	5.3+/-1	3.6+/-1.5	<1.0+/-?	3.0+/-1.0	9.9+/-2.0	3.8+/-1.0	6.4+/-3.9	2.6+/-1.0	<1
Uranium (Total)	(pCi/l)	NA	38+/-3	22+/-4	84	13+/-2	<0.7+/-?	11+/-3	18+/-?	12	<0.7	14	<0.7	<0.7
Gross alpha	(pCi/l)	NA	64+/-61	219+/-?	97	14+/-10	32+/-27	17+/-15	19+/-17	79+/-50	5+/-4	134+/-104	316+/-120	<3
Gross beta	(pCi/l)	NA	<12+/-50	< 12+/-?	693	71+/-8	152+/-17	157+/-17	180+/-18	234+/-57	48+/-5	364+/-99	475+/-76	286+/-63

WELL IDENTIFICATION: GW-5

Parameter	Units	SAMPLING DATE											
Indicator Parameters		14-May-88	01-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	18-Dec-90	28-Mar-91	14-Jun-91
Chloride (Cl)	(mg/l)	18825	32400	24550	24750	35800	25100	20700	25000	31400	27466	28500	40200	25500
Sulfate (SO4)	(mg/l)	1200	2700	2500	2300	2600	2500	1760	1604	2600	2483	2400	2730	2270
TDS	(mg/l)	28788	46012	45878	NA	40200	43400	44692	44480	46100	47056	45800	74200	48000
Conductivity	(umhos/cm)	48076	62116	62390	NA	63500	69563	88182	52320	108000	43736	9830	70100	90400
Radiological		24-Mar-88	01-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	18-Dec-90	28-Mar-91	14-Jun-91
Radium (Ra-226)	(pCi/l)	10+/-1	2+/-0	6+/-1	9	4.2+/-1	7.5+/-4.6	17.6+/-5	5.8+/-3.9	7.0+/-5.2	2.9+/-1.0	8.9+/-4.7	2.9+/-1.0	<1
Uranium (Total)	(pCi/l)	223+/-15	10+/-1	24+/-2	16	8+/-1	2+/-0.3	12+/-3	18+/-?	20	10	8.1	<0.7	<0.7
Gross alpha	(pCi/l)	90+/-64	63+/-71	50+/-50	187	10+/-8	34+/-28	34+/-30	19+/-17	101+/-97	10+/-9	74+/-70	361+/-127	<3
Gross beta	(pCi/l)	< 12+/-50	< 12+/-50	< 12+/-?	745	51+/-7	90+/-15	210+/-30	220+/-20	327+/-62	64+/-8	494+/-107	556+/-80	270+/-62

ND = None Detected NA = Not Analyzed

ENVIROCARE OF UTAH
WATER QUALITY DATA

WELL IDENTIFICATION: GW-6

Parameter	Units	SAMPLING DATE											
Indicator Parameters		14-May-88	05-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	28-Mar-91	14-Jun-91
Chloride (Cl)	(mg/l)	25375	20400	16925	17400	18900	17700	11260	17000	26900	45001	19300	17700	21400
Sulfate (SO4)	(mg/l)	2500	1300	1300	1300	1300	1480	990	1087	1340	1276	1320	1520	1070
TDS	(mg/l)	46114	32032	31380	NA	28900	30900	29962	31580	32200	32060	31600	34500	34600
Conductivity	(umhos/cm)	62852	46197	45752	NA	47100	46375	58788	41420	75600	32802	6550	80300	88200
Radiological		15-Apr-88	05-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	28-Nov-90	28-Mar-91	14-Jun-91
Radium (Ra-226)	(pCi/l)	8+/-1	1+/-0	5+/-1	8	10.3+/-2	4.5+/-3.9	9.7+/-3	3.1+/-1.2	3.0+/-1.0	3.2+/-0.8	14.7+/-6.4	2.9+/-1.0	<1
Uranium (Total)	(pCi/l)	31+/-3	12+/-2	29+/-2	52	15+/-3	<0.7+/-?	8+/-3	14.0+/-?	13	<0.7	8.8	<0.7	<0.7
Gross alpha	(pCi/l)	59+/-32	14+/-29	245+/-71	117	11+/-9	23+/-20	15+/-6	18+/-18	NA	8+/-6	82+/-74	422+/-135	<3
Gross beta	(pCi/l)	< 12+/-25	< 12+/-50	< 12+/-?	394	71+/-8	45+/-13	145+/-17	53+/-13	NA	36+/-7	304+/-95	499+/-78	1111+/-97

WELL IDENTIFICATION: GW-8

Parameter	Units	SAMPLING DATE											
Indicator Parameters		14-May-88	05-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	13-Dec-90	28-Mar-91	24-May-91
Chloride (Cl)	(mg/l)	17850	19650	18050	19150	48800	18800	19640	18500	18800	20858	23000	19000	20200
Sulfate (SO4)	(mg/l)	1300	1200	1200	1300	1300	1800	960	1239	1380	627	1400	1160	1150
TDS	(mg/l)	31500	33438	33120	NA	32300	33100	33034	35400	35100	42734	34800	36300	37500
Conductivity	(umhos/cm)	46042	47966	48099	NA	51200	57969	70545	42510	86400	35145	6551	74600	119000
Radiological		21-Apr-88	05-Jul-88	07-Oct-88	27-Feb-89	30-Jun-89	28-Sep-89	11-Dec-89	21-Feb-90	19-Sep-90	28-Sep-90	13-Dec-90	28-Mar-91	24-May-91
Radium (Ra-226)	(pCi/l)	10+/-1	4+/-1	3+/-0	4	14.2+/-1.9	5.6+/-4	8.7+/-3	4.0+/-3.8	11.6+/-6	4.1+/-3.2	10.3+/-9.7	3.0+/-1.0	2.5+/-0.5
Uranium (Total)	(pCi/l)	85+/-8	5+/-5.0	10+/-1	37	6+/-1	4.1+/-0.61	5+/-2	9	13	6.8	6.8	<0.7	<0.7
Gross alpha	(pCi/l)	446+/-92	48+/-29	56+/-4	87	11+/-9	22+/-20	45+/-23	17+/-15	257+/-122	9+/-8	44+/-40	585+/-156	<3
Gross beta	(pCi/l)	< 12+/-50	227+/-630	< 12+/-?	621	37+/-7	139+/-17	162+/-17	186+/-19	589+/-74	72+/-8	327+/-96	610+/-83	30+/-12

ND = None Detected NA = Not Analyzed

SC - WELLS

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SC-1

Constituent	Units	30-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
CATIONS					
Aluminum (Al+3)	(mg/l)	<0.1b	<0.1	<0.1	<0.1
Barium (Ba+2)	(mg/l)	<0.1	0.4	<0.1	<0.1
Barium, total (bat2)	(mg/l)	0.24	0.4	0.2	0.2
Calcium (Ca+2)	(mg/l)	360	310	400	350
Cadmium (Cd+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Cadmium, total (Cd+2)	(mg/l)	0.11	<0.01	<0.01	<0.01
Cobalt (Co+2)	(mg/l)	NA	<0.1	<0.1	0.01
Copper (Cu+2)	(mg/l)	NA	<0.01	<0.01	0.01
Copper, total (Cu2)	(mg/l)	0.07	0.01	0.02	0.01
Potassium (K+)	(mg/l)	310	220	310	390
Magnesium (Mg+2)	(mg/l)	460	310	560	520
Manganese (Mn+2)	(mg/l)	NA	0.24	0.92	1.07
Manganese, total (Mn+2)	(mg/l)	NA	0.28	0.95	1.08
Sodium (Na+)	(mg/l)	11500	6200	12000	12600
Sodium, total (Na+)	(mg/l)	NA	6200	12000	12600
Ammonium (NH4+)	(mg/l)	NA	NA	NA	NA
Strontium (Sr+2)	(mg/l)	9.5	9.90	10.90	13.00
Zinc (Zn+2)	(mg/l)	0.07	0.04	<0.01	<0.01
Zinc, total (Zn)	(mg/l)	NA	0.05	0.3	0.04
ANIONS					
Chloride (Cl-)	(mg/l)	18417	10720	20725	20774
Cyanide (CN-)	(mg/l)	NA	<0.05	<0.005	<0.05
Carbonate (CO3-2)	(mg/l)	<1	<1	<1	<1
Fluoride (F-)	(mg/l)	0.49	0.88	0.53	0.62
Bicarbonate (HCO3-)	(mg/l)	271	168	268	249
Sulfide (HS-)	(mg/l)	NA	<0.05	<0.05	<0.1
Nitrate (NO3-)	(mg/l)	<0.1	<0.01	<0.05	0.2
Phosphate (PO4-3	(mg/l)	0.13	0.05	0.13	0.16
Sulfate (SO4-2)	(mg/l)	1761	545	13.6	1.773
OTHER CONSTITUENTS					
Silver (Ag)	(mg/l)	0.07	<0.01	<0.01	<0.01
Silver, total (Ag)	(mg/l)	NA	<0.01	<0.01	<0.01
Arsenic (Ar)	(mg/l)	0.01	0.02	0.01	<0.01
Arsenic, total (Ar)	(mg/l)	NA	0.02	0.01	<0.01
Boron (B)	(mg/l)	0.24	0.93	2.63	1.95
Chromium (Cr)	(mg/l)	0.03	<0.01	<0.01	<0.01
Chromium, total (Cr)	(mg/l)	0.03	0.01	<0..01	<0.01
Iron (Fe)	(mg/l)	0.14	0.07	0.2	<0.05
Iron, total (Fe)	(mg/l)	2.50	0.84	1.11	0.01
Mercury (Hg)	(mg/l)	2.7	<0.3	<0.3	<0.03
Molybdenum (Mo)	(mg/l)	<0.01	<0.01	<0.01	<0.01

ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-1 (cont.)

Constituent	Units	30-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
OTHER CONSTITUENTS (cont.)					
Ammonia (NH3)	(mg/l)	0.09	<0.02	<0.05	0.22
Nickel (Ni)	(mg/l)	NA	<0.05	<0.05	<0.05
Phosphorus (P)	(mg/l)	NA	NA	NA	NA
Lead (Pb)	(mg/l)	0.6	<0.05	<0.05	<0.01
Lead, total (Pb)	(mg/l)	0.6	<0.05	<0.05	1.39
Antimony (ugCl/L)	(mg/l)	NA	NA	NA	NA
Selenium (Se)	(mg/l)	<0.01	<0.01	<0.01	<0.01
Selenium, total (Se)	(mg/l)	NA	<0.01	<0.01	<0.01
Silicon	(mg/l)	NA	NA	NA	NA
Uranium (U)	(mg/l)	NA	NA	NA	NA
Vanadium (V)	(mg/l)	<0.5	<0.5	<0.5	<0.5
GENERAL CHARACTERISTICS					
Alkalinity	(mg/l)	NA	NA	NA	NA
Conductance	(UMHO/CM)	NA	NA	NA	NA
Conductance, In-situ	(UMHO/CM)	61500	45000	83000	57000
Redox Potential	(MVOLTS)	55	71	52	50
PH	(SU)	7.79	7.81	7.49	7.7
PH, In-situ	(SU)	7.9	8.3	7.7	7.4
Total Dissolved Solids (TDS)		33699	19717	37512	37238
Temperature	(C-DEGREE	NA	NA	NA	NA
Temperature, In-situ	(C-DEGREE	14.6	8.9	13.0	17.6
RADIONUCLIDES					
Gross alpha	(pCi/l)	0+/-110b	0.0+/-72.	0.0+/-235	0.0+/-132
Gross beta	(mg/l)	710+/-140	192+/-188	0.0+/-720	393+/-237
Pb-210	(pCi/l)	6.8+/-1.6	0.3+/-1.3	0.1+/-1.0	3.6+/-2.1
Po-210	(pCi/g)	0.0+/-0.3	0.2+/-0.4	0.3_+/-0.	0.5+/-0.4
Ra-226	(pCi/l)	0.8+/-0.2	0.7+/-0.2	1.2+/-0.2	1.2+/-0.3
Ra-228	(pCi/g)	NA	3.4+/-3.7	4.1+/-1.5	4.9+/-3.2
Th-230	(pCi/g)	3.4+/-0.8	0.0+/-2.1	2.5+/-1.2	0.6+/-2.4
Uranium (U308)	(mg/l)	8.1	2.7	7.4	5.4
Uranium, total (U308)	(mg/l)	8.1	2.7	8.8	5.4
ORGANIC COMPOUNDS					
Phenol	(mg/l)	NA	<0.005	<0.005	<0.005
Organic Carbon (TOC)	(mg/l)	NA	2	10	4

ND = None Detected NA = Not Analyzed

* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SC-2

Constituent	Units	22-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
CATION					
Aluminum (Al+3)	(mg/l)	<0.1	<0.1	<0.1	0.5
Barium (Ba+2)	(mg/l)	NA	<0.1	<0.1	<0.1
Barium, total (Ba+2)	(mg/l)	0.1	0.5	1.4	0.4
Calcium (Ca+2)	(mg/l)	600	560	610	570
Cadmium (Cd+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Cadmium, total (Cd)	(mg/l)	0.12	<0.01	<0.01	<0.01
Cobalt (Co+2)	(mg/l)	NA	0.1	<0.1	<0.01
Copper (Cu+2)	(mg/l)	NA	<0.01	<0.01	0.02
Copper, total (Cu)	(mg/l)	0.1	0.04	0.11	0.02
Potassium (K+)	(mg/l)	530	400	380	470
Magnesium (Mg+2)	(mg/l)	920	790	850	870
Manganese (Mn+2)	(mg/l)	0.11	0.09	0.06	0.09
Manganese, total (Mn+2)	(mg/l)	NA	0.83	0.06	0.6
Sodium (Na+)	(mg/l)	160000	17000	14000	15000
Sodium, total (Na+)	(mg/l)	NA	17000	14000	15000
Amonium (NH4+)	(mg/l)	NA	NA	NA	NA
Strontium (Sr+2)	(mg/l)	15.20	20.60	16.20	20.00
Zinc (Zn+2)	(mg/l)	0.05	0.05	<0.01	0.07
Zinc, total (Zn+2)	(mg/l)	NA	0.15	2.2	0.15
ANIONS					
Chloride (Cl-)	(mg/l)	25347	27169	24832	24585
Cyanide (CN-)	(mg/l)	NA	<0.05	<0.005	<0.05
Carbonate (CO3-2)	(mg/l)	<1	<1	<1	<1
Fluoride (F-)	(mg/l)	0.82	1.46	1	1.13
Bicarbonate (HCO3-)	(mg/l)	151	171	164	160
Sulfide (HS-)	(mg/l)	NA	<0.05	<0.05	<0.1
Nitrate (NO3-)	(mg/l)	0.9	<0.1	<0.05	2.1
Phosphate (PO4-3	(mg/l)	0.04	0.08	0.14	0.05
Sulfate (SO4-2)	(mg/l)	5144	4447	18.1	4152
OTHER CONSTITUENTS					
Silver (Ag)	(mg/l)	0.09	<0.01	<0.01	<0.01
Silver, total (Ag)	(mg/l)	NA	<0.01	<0.01	<0.01
Arsenic (Ar)	(mg/l)	NA	0.06	0.05	0.02
Arsenic, total (Ar)	(mg/l)	0.01	0.06	0.05	0.02
Boron (B)	(mg/l)	0.98	1.9	3.08	2.68
Chromium (Cr)	(mg/l)	NA	<0.01	<0.01	<0.01
Chromium, total (Cr)	(mg/l)	0.07	0.04	0.1	0.03
Iron (Fe)	(mg/l)	0.25	0.17	0.18	0.34
Iron, total (Fe)	(mg/l)	24.70	27.00	38.00	17.00
Mercury (Hg)	(mg/l)	1.0	0.3	<0.3	<0.3
Molybdenum (Mo)	(mg/l)	0.8	0.5	0.5	0.5

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-2 (Cont.)

Constituent	Units	22-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
OTHER CONSTITUENTS (cont.)					
Ammonia (NH3)	(mg/l)	0.19	<0.02	<0.05	0.14
Nickel (Ni)	(mg/l)	NA	<0.05	<0.05	<0.05
Phosphorus (P)	(mg/l)	NA	NA	NA	NA
Lead (P6)	(mg/l)	NA	<0.05	<0.05	<0.01
Lead, total (P6)	(mg/l)	<0..05	<0.05	<0.05	0.01
Antimony	(mg/l)	NA	NA	NA	NA
Selenium (Se)	(mg/l)	NA	<0.01	<0.01	<0.01
Selenium, total (Se)	(mg/l)	NA	0.02	<0.01	<0.01
Silicon	(mg/l)	NA	NA	NA	NA
Uranium (U)	(mg/l)	NA	NA	NA	NA
Vanadium (V)	(mg/l)	<0.05	0.5	<0.05	<0.5
GENERAL CHARACTERISTICS					
Alkalinity	(mg/l)	NA	NA	NA	NA
Conductance	(UMHO/CM)	NA	NA	NA	NA
Conductance, In-situ	(UMHO/CM)	66500	70000	96000	96000
Redox Potential	(MVOLTS)	91	50	48	45
PH	(SU)	7.8	7.58	7.77	7.59
PH, In-situ	(SU)	8.7	7.8	7.5	7.6
Total Dissolved Solids	(TDS)	50130	49935	44120	46842
Temperature	(C-DEGREE	NA	NA	NA	NA
Temperature, In-situ	(C-DEGREE	14.6	8.7	12	15.0
ORGANIC COMPOUNDS					
Phenol	(mg/l)	NA	<0.005	<0.005	<0.005
Organic Carbon (TOC)	(mg/l)	NA	4	17	12

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-2 (cont.)

Constituent	Units	22-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82	16-Apr-87	07-Apr-88	05-Oct-89	27-Jun-90
RADIONUCLIDES									
Gross alpha	(pCi/l)	155+/-188	76.3+/-183	345+/-435	0.0+/-252	80+/-51.0	71+/-47.0	45+/-211	NA
Gross beta	(pCi/l)	588+/-358	299+/-206	412+/-765	481+/-255	NA	NA	720+/-105	NA
Pb-210	(pCi/l)	0.6+/-0.6	0.4+/-1.3	0.8+/-1.2	5.4+/-2.4	NA	NA	NA	NA
Po-210	(pCi/l)	0.1+/-0.2	0.2+/-0.4	0.0+/-0.2	3.6+/-0.9	NA	NA	NA	NA
Ra-226	(pCi/l)	0.3+/-0.2	0.8+/-0.2	0.8+/-0.2	3.0+/-0.4	4.1+/-0.4	3+/-0.5	<0.5+/-0.5	1.5+/-0.6
Ra-228	(pCi/l)	NA	2.2+/-3.9	1.6+/-1.5	3.1+/-3.4	NA	NA	NA	<1+/-3.0
Th-230	(pCi/l)	2.2+/-1.1	2.6+/-1.4	2.7+/-1.1	3.7+/-2.1	NA	NA	NA	NA
U-238	(pCi/l)	27.1	35.2	35.9	22.1	NA	NA	NA	NA
U-238 (Total)	(pCi/l)	29.8	39.3	35.9	32.8	23.0+/-1.0	37.0+/-2.0	26.0+/-2.0	15.0+/-1.0

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SC-3

Constituent	Units	24-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
CATION					
Aluminum (Al+3)	(mg/l)	<0.1	<0.1	<0.1	<0.1
Barium (Ba+2)	(mg/l)	NA	<0.1	<0.1	<0.1
Barium, total (Ba+2)	(mg/l)	2.9	5.4	2.5	3.3
Calcium (Ca+2)	(mg/l)	280	300	310	300
Cadmium (Cd+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Cadmium, total (Cd+2)	(mg/l)	0.17	<0.01	<0.01	<0.01
Cobalt (Co+2)	(mg/l)	NA	<0.1	<0.1	<0.1
Copper (Cu+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Copper, total (Cu+2)	(mg/l)	0.26	0.27	0.14	0.22
Potassium (K+)	(mg/l)	430	360	350	430
Magnesium (Mg+2)	(mg/l)	400	400	470	430
Manganese (Mn+2)	(mg/l)	0.08	0.09	0.04	0.08
Manganese, total (Mn+2)	(mg/l)	NA	6.4	0.04	3.5
Sodium (Na+)	(mg/l)	11000	12000	11500	12000
Sodium, total (Na+)	(mg/l)	NA	12000	11500	12000
Amonium (NH4+)	(mg/l)	NA	NA	NA	NA
Strontium (Sr+2)	(mg/l)	10.70	14.60	12.00	15.00
Zinc (Zn+2)	(mg/l)	0.08	0.08	<0.01	0.03
Zinc, total (Zn+2)	(mg/l)	NA	3.1	1.5	0.72
ANIONS					
Chloride (Cl-)	(mg/l)	18309	19362	19149	19270
Cyanide (CN-)	(mg/l)	NA	<0.50	<0.005	<0.05
Carbonate (CO3-2)	(mg/l)	<1	NA	<1	<1
Fluoride (F-)	(mg/l)	1.35	1.4	0.94	1.03
Bicarbonate (HCO3-)	(mg/l)	329	342	338	338
Sulfide (HS-)	(mg/l)	NA	<0.05	<0.05	<0.1
Nitrate (NO3-)	(mg/l)	<0.1	<0.1	<0..5	<0.1
Phosphate (PO4-3	(mg/l)	0.02	0.14	0.18	0.08
Sulfate (SO4-2)	(mg/l)	1564	1524	14.4	1437
OTHER CONSTITUENTS					
Silver (Ag)	(mg/l)	0.05	<0.01	<0.01	<0.01
Silver, total (Ag)	(mg/l)	NA	<0.01	<0.01	<0.01
Arsenic (Ar)	(mg/l)	NA	0.01	0.01	<0.01
Arsenic, total (Ar)	(mg/l)	0.04	0.02	0.02	0.01
Boron (B)	(mg/l)	2.99	1.8	2.63	2.79
Chromium (Cr)	(mg/l)	NA	<0.01	<0.01	<0.01
Chromium, total (Cr)	(mg/l)	0.27	0.23	0.16	0.13
Iron (Fe)	(mg/l)	0.16	0.14	0.11	0.09
Iron, total (Fe)	(mg/l)	146	240	65.00	110
Mercury (Hg)	(mg/l)	0.8	<0.3	<0.3	<0.3
Molybenium (Mo)	(mg/l)	<0.1	<0.1	<0.1	<0.11

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* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-3 (cont.)

Constituent	Date	24-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
OTHER CONSTITUENTS (cont.)					
Ammonia (NH3)	(mg/l)	<0.05	<0.02	<0.05	<0.01
Nickel (Ni)	(mg/l)	NA	<0.05	<0.05	<0.055
Phosphorus (P)	(mg/l)	NA	NA	NA	NA
Lead (P6)	(mg/l)	NA	<0.05	<0.05	<0.01
Lead, total (P6)	(mg/l)	<0.1	0.14	<0.05	0.05
Antimony	(mg/l)	NA	NA	NA	NA
Selenium (Se)	(mg/l)	<0.01	<0.01	<0.01	<0.01
Selenium, total (Se)	(mg/l)	NA	0.01	<0.01	<0.01
Silicon	(mg/l)	NA	NA	NA	NA
Uranium (U)	(mg/l)	NA	NA	NA	NA
Vanadium (V)	(mg/l)	<0.5	<0.05	<0.5	<0.5
GENERAL CHARACTERISTICS					
Alkalinity	(mg/l)	NA	NA	NA	NA
Conductance	(UMHO/CM)	NA	NA	NA	NA
Conductance, In-situ	(UMHO/CM)	52500	64000	79000	70000
Redox Potential	(MVOLTS)	105	60	53	50
PH	(SU)	7.81	8	7.88	7.72
PH, In-situ	(SU)	7.8	7.7	7.5	7.5
Total Dissolved Solids	(TDS)	34830	34747	34418	34474
Temperature	(C-DEGREE	NA	NA	NA	NA
Temperature, In-situ	(C-DEGREE	14.9	8.9	12.0	14.0
ORGANIC COMPOUNDS					
Phenol	(mg/l)	NA	<0.005	<0.005	<0.005
Organic Carbon (TOC)	(mg/l)	NA	3	25	4

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WELL IDENTIFICATION: SC-3 (Cont.)

Constituent	Date	24-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82	16-Apr-87	07-Apr-88	05-Oct-89	27-Jun-90
RADIONUCLIDES									
Gross alpha	(pCi/l)	0+/-170	35.4+/-155	374+/-414	13.9+/-196	170+/-69.0	17+/-35.0	<2	NA
Gross beta	(pCi/l)	481+/-166	282+/-203	478+/-764	477+/-313	NA	NA	414+/-88.0	NA
Pb-210	(pCi/l)	0.5+/-0.7	0.0+/-1.3	0.5+/-1.1	7.4+/-2.2	NA	NA	NA	NA
Po-210	(pCi/l)	0.0+/-0.2	0.0+/-0.0	0.2+/-0.2	8.1+/-1.7	NA	NA	NA	NA
Ra-226	(pCi/l)	0.4+/-0.2	0.9+/-0.2	0.5+/-0.1	0.2+/-0.1	10.0+/-1.0	7+/-1.0	<0.5+/-0.5	<0.5+/-0.8
Ra-228	(pCi/l)	NA	2.9+/-3.4	0.8+/-1.2	0.0+/-2.8	NA	NA	NA	<1+/-3.0
Th-230	(pCi/l)	2.7+/-0.5	1.0+/-1.1	9.3+/-2.0	5.8+/-2.4	NA	NA	NA	NA
Uranium (U308)	(pCi/l)	6.8	11.5	11.5	6	NA	NA	NA	NA
Uranium, total (U308)	(pCi/l)	14.2	49.4	14.9	11.4	14.0+/-1.0	<1.0+/-1.0	51.0+/-3.0	8.0+/-1.0

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SC-4

Constituent	Units	29-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
CATION					
Aluminum (Al+3)	(mg/l)	<0.1	<0.1	<0.1	<0.1
Barium (Ba+2)	(mg/l)	NA	<0.1	<0.1	<0.1
Barium, total (Ba+2)	(mg/l)	4.2	1.2	1.2	0.2
Calcium (Ca+2)	(mg/l)	360	330	350	320
Cadmium (Cd+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Cadmium, total (Cd+2)	(mg/l)	0.15	<0.01	<0.01	
Cobalt (Co+2)	(mg/l)	NA	<0.1	<0.1	<0.1
Copper (Cu+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Copper, total (Cu+2)	(mg/l)	0.36	0.07	0.11	0.04
Potassium (K+)	(mg/l)	320	310	300	370
Magnesium (Mg+2)	(mg/l)	420	400	450	410
Manganese (Mn+2)	(mg/l)	0.22	0.13	0.11	0.08
Manganese, total (Mn+2)	(mg/l)	NA	1.21	0.13	0.31
Sodium (Na+)	(mg/l)	12000	12000	11500	11500
Sodium, total (Na+)	(mg/l)	NA	12000	12000	11500
Amonium (NH4+)	(mg/l)	NA	NA	NA	NA
Strontium (Sr+2)	(mg/l)	12.5	15.40	12.20	15.00
Zinc (Zn+2)	(mg/l)	0.05	0.16	<0.01	0.01
Zinc, total (Zn+2)	(mg/l)	NA	0.28	2.1	0.07
ANIONS					
Chloride (Cl-)	(mg/l)	19936	19228	19047	18863
Cyanide (CN-)	(mg/l)	NA	<0.05	<0.005	<0.05
Carbonate (CO3-2)	(mg/l)	<1	<1	<1	<1
Fluoride (F-)	(mg/l)	0.42	1.04	0.48	0.52
Bicarbonate (HCO3-)	(mg/l)	383	366	359	340
Sulfide (HS-)	(mg/l)	NA	0.05	<0.05	<0.01
Nitrate (NO3-)	(mg/l)	<0.1	<0.1	<0.05	<0.3
Phosphate (PO4-3	(mg/l)	0.13	0.27	0.13	0.07
Sulfate (SO4-2)	(mg/l)	2041	1534	15.2	1477
OTHER CONSTITUENTS					
Silver (Ag)	(mg/l)	1.07	<0.01	0.01	<0.01
Silver, total (SO4-2)	(mg/l)	NA	<0.01	<0.01	<0.01
Arsenic (Ar)	(mg/l)	NA	0.01	0.01	<0.01
Arsenic, total (Ar)	(mg/l)	0.07	0.01	0.01	<0.01
Boron (B)	(mg/l)	0.28	1.5	2.53	2.1
Chromium (Cr)	(mg/l)	NA	<0.01	<0.01	<0.01
Chromium, total (Cr)	(mg/l)	0.37	0.1	0.14	0.02
Iron (Fe)	(mg/l)	0.14	0.12	0.12	<0.05
Iron, total (Fe)	(mg/l)	229	59.00	47.00	12.00
Mercury (Hg)	(mg/l)	2.0	<0.3	<0.3	<0.3
Molybdenum (Mo)	(mg/l)	<0.1	<0.1	<0.1	<0.1

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-4 (cont.)

Constituent	Units	29-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
OTHER CONSTITUENTS (cont.)					
Ammonia (NH3)	(mg/l)	0.05	<0.02	<0.05	0.31
Nickel (Ni)	(mg/l)	NA	<0.05	0.05	<0.05
Phosphorus (P)	(mg/l)	NA	NA	NA	NA
Lead (P6)	(mg/l)	NA	<0.05	<0.05	<0.01
Lead, total (P6)	(mg/l)	0.8	0.05	<0.05	0.01
Antimony	(mg/l)	NA	NA	NA	NA
Selenium (Se)	(mg/l)	<0.01	<0.01	<0.01	<0.01
Selenium, total (Se)	(mg/l)	NA	0.01	<0.01	<0.01
Silicon	(mg/l)	NA	NA	NA	NA
Uranium (U)	(mg/l)	NA	NA	NA	NA
Vanadium (V)	(mg/l)	<0.5	<0.5	<0.5	<0.5
GENERAL CHARACTERISTICS					
Alkalinity	(mg/l)	NA	NA	NA	NA
Conductance	(UMHO/CM)	NA	NA	NA	NA
Conductance, In-situ	(UMHO/CM)	57000	60000	79000	79000
Redox Potential	(MVOLTS)	54	60	55	52
PH	(SU)	8.25	8.02	7.84	7.8
PH, In-situ	(SU)	7.8	7.8	7.5	7.5
Total Dissolved Solids	(TDS)	36150	34879	34520	33860
Temperature	(C-DEGREE	NA	NA	NA	NA
Temperature, In-situ	(C-DEGREE	13.4	9.7	13.00	13.00
ORGANIC COMPOUNDS					
Phenol	(mg/l)	NA	<0.005	<0.005	<0.005
Organic Carbon (TOC)	(mg/l)	NA	6	23	7

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-4 (cont.)

Constituent	Units	29-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82	16-Apr-87	07-Apr-88	05-Oct-89	27-Jun-90
RADIONUCLIDES									
Gross alpha	(pCi/l)	0+/-200	0.0+/-131	90.2+/-343	0.0+/-131	31+/-37.0	62+/-62.0	44+/-152	NA
Gross beta	(pCi/l)	41+/-188	346+/-205	198+/-748	323+/-232	NA	NA	652+/-101	NA
Pb-210	(pCi/l)	1.0+/-0.9	0.3+/-1.4	0.6+/-1.4	1.6+/-22.0	NA	NA	NA	NA
Po-210	(pCi/l)	0.0+/-0.4	0.1+/-0.2	0.2+/-0.2	0.8+/-0.5	NA	NA	NA	NA
Ra-226	(pCi/l)	0.5+/-0.2	1.5+/-0.3	2.0+/-0.2	1.1+/-0.2	2.0+/-0.2	<0.5+/-0.5	1+/-0.5	<0.5+/-0.8
Ra-228	(pCi/l)	NA	1.4+/-3.5	2.7+/-1.4	5.1+/-3.2	NA	NA	NA	9.4+/-3.5
Th-230	(pCi/l)	3.8+/-0.8	0.0+/-2.3	0.8+/-1.0	14.2+/-4.3	NA	NA	NA	NA
Uranium (U308)	(pCi/l)	8.8	11.5	13.5	10.1	NA	NA	NA	NA
Uranium, total (U308)	(pCi/l)	16.2	19.6	13.5	10.7	5.0+/-1.0	6.0+/-1.0	1.0+/-1.0	14.0+/-1.0

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SC-5

Constituent	Date	23-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
CATION					
Aluminum (Al+3)	(mg/l)	<0.1	<0.1	<0.1	<0.1
Barium (Ba+2)	(mg/l)	NA	<0.1	<0.1	<0.1
Barium, total (Ba+2)	(mg/l)	2.7	2.7	0.4	0.2
Calcium (Ca+2)	(mg/l)	240	240	260	230
Cadmium (Cd+2)	(mg/l)	NA	<0.01	<0.01	<0.01
Cadmium, total (Cd+2)	(mg/l)	0.18	<0.01	<0.01	<0.01
Cobalt (Co+2)	(mg/l)	NA	<0.1	<0.01	<0.01
Copper (Cu+2)	(mg/l)	NA	<0.01	<0.1	0.1
Copper, total (Cu+2)	(mg/l)	0.34	0.18	0.1	0.1
Potassium (K+)	(mg/l)	390	300	280	340
Magnesium (Mg+2)	(mg/l)	310	270	280	270
Manganese (Mn+2)	(mg/l)	0.11	0.11	0.09	0.07
Manganese, total (Mn+2)	(mg/l)	NA	3.84	0.1	0.37
Sodium (Na+)	(mg/l)	9140	8700	8150	8500
Sodium, total (Na+)	(mg/l)	NA	8700	8700	8500
Amonium (NH4+)	(mg/l)	NA	NA	NA	NA
Strontium (Sr+2)	(mg/l)	14.60	18.70	14.00	18.00
Zinc (Zn+2)	(mg/l)	0.06	0.09	<0.01	0.1
Zinc, total (Zn+2)	(mg/l)	NA	0.58	1.3	0.1
ANIONS					
Chloride (Cl-)	(mg/l)	14934	14690	13511	13502
Cyanide (CN-)	(mg/l)	NA	<0.05	<0.005	<0.05
Carbonate (CO3-2)	(mg/l)	<1	<1	<1	<1
Fluoride (F-)	(mg/l)	0.53	1.1	0.65	0.76
Bicarbonate (HCO3-)	(mg/l)	183	201	203	196
Sulfide (HS-)	(mg/l)	NA	0.05	<0.05	<0.1
Nitrate (NO3-)	(mg/l)	0.5	<0.1	<0.05	0.19
Phosphate (PO4-3	(mg/l)	0.06	0.09	0.14	0.14
Sulfate (SO4-2)	(mg/l)	1778	1036	10.3	951.00
OTHER CONSTITUENTS					
Silver (Ag)	(mg/l)	0.04	<0.01	<0.01	<0.01
Silver, total (Ag)	(mg/l)	NA	<0.01	<0.01	<0.01
Arsenic (Ar)	(mg/l)	NA	0.02	0.02	0.02
Arsenic, total (Ar)	(mg/l)	0.01	0.03	0.02	0.02
Boron (B)	(mg/l)	0.56	1.3	2.43	1.96
Chromium (Cr)	(mg/l)	NA	<0.01	<0.01	<0.01
Chromium, total (Cr)	(mg/l)	0.26	0.14	0.02	0.01
Iron (Fe)	(mg/l)	0.11	0.13	0.06	<0.05
Iron, total (Fe)	(mg/l)	167	150	6.00	9.00
Mercury (Hg)	(mg/l)	1.9	0.3	<0.3	<0.3
Molybdenum (Mo)	(mg/l)	<0.1	<0.1	<0.1	<0.1

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-5 (cont.)

Constituent	Units	23-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82
OTHER CONSTITUENTS (cont.)					
Ammonia (NH3)	(mg/l)	0.10	<0.02	0.05	<0.41
Nickel (Ni)	(mg/l)	NA	<0.05	<0.05	<0.0
Phosphorus (P)	(mg/l)	NA	NA	NA	NA
Lead (P6)	(mg/l)	NA	<0.05	<0.05	<0.01
Lead, total (P6)	(mg/l)	<0.01	0.12	<0.05	0.01
Antimony	(mg/l)	NA	NA	NA	NA
Selenium (Se)	(mg/l)	<0.01	<0.01	<0.01	<0.01
Selenium, total (Se)	(mg/l)	NA	<0.01	<0.01	<0.01
Silicon	(mg/l)	NA	NA	NA	NA
Uranium (U)	(mg/l)	NA	NA	NA	NA
Vanadium (V)	(mg/l)	<0.5	<0.5	<0.5	<0.5
GENERAL CHARACTERISTICS					
Alkalinity	(mg/l)	NA	NA	NA	NA
Conductance	(UMHO/CM)	NA	NA	NA	NA
Conductance, In-situ	(UMHO/CM)	51500	53000	60000	60000
Redox Potential	(MVOLTS)	104	67	62	57
PH	(SU)	7.50	8.10	7.83	8.00
PH, In-situ	(SU)	8.2	8.2	7.7	7.8
Total Dissolved Solids	(TDS)	27050	25277	24618	24270
Temperature	(C-DEGREE	NA	NA	NA	NA
Temperature, In-situ	(C-DEGREE	19.3	10.6	13.00	14
ORGANIC COMPOUNDS					
Phenol	(mg/l)	NA	<0.005	<0.005	<0.005
Organic Carbon (TOC)	(mg/l)	NA	4	12	0.14

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SC-5 (cont.)

Constituent	Units	23-Sep-81	08-Feb-82	02-Jun-82	25-Aug-82	16-Apr-87	07-Apr-88	05-Oct-89	27-Jun-90
Gross alpha	(pCi/l)	0+/-196	0.0+/-92.9	25.3+/-271	0.0+/-90.6	5+/-19.0	<2.0+/-2.0	<10	NA
Gross beta	(pCi/l)	564+/-193	320+/-198	309+/-405	231+/-218	NA	NA	326+/-81.0	NA
Pb-210	(pCi/l)	0.2+/-0.7	0.01.4	0.9+/-1.1	1.9+/-2.0	NA	NA	NA	NA
Po-210	(pCi/l)	0.0+/-0.2	0.2+/-0.2	0.0+/-0.1	1.7+/-0.6	NA	NA	NA	NA
Ra-226	(pCi/l)	0.6+/-0.2	0.8+/-0.2	1.0+/-0.2	2.0+/-0.3	1.7+/-0.3	2+/-0.5	6+/-0.5	<0.5+/-0.8
Ra-228	(pCi/l)	NA	0.3+/-3.7	1.2+/-1.3	2.8+/-3.2	NA	NA	NA	<1+/-3.0
Th-230	(pCi/l)	14.0+/-4.0	1.8+/-2.7	6.4+/-1.6	8.1+/-2.7	NA	NA	NA	NA
Uranium (U308)	(pCi/l)	3.4	2.7	6.1	2.7	NA	NA	NA	NA
Uranium, total (U308)	(pCi/l)	14.2	24.4	6.1	4.7	1.0+/-1.0	4.0+/-1.0	46+/-3.0	1.0+/-1.0

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

SLC - WELLS

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SLC201

Constituent	UNITS	01-Mar-84
CATION		
Aluminum (Al+3)	(mg/l)	< .003
Barium (Ba+2)	(mg/l)	< .100
Calcium (Ca+2)	(mg/l)	395.000
Cadmium (Cd+2)	(mg/l)	<.000
Cobalt (Co+2)	(mg/l)	NA
Copper (Cu+2)	(mg/l)	<.001
Potassium (K+)	(mg/l)	317.000
Magnesium (Mg+2)	(mg/l)	349.000
Manganese (Mn+2)	(mg/l)	0.080
Sodium (Na+)	(mg/l)	7310.000
Ammonium (NH4+)	(mg/l)	< .100
Strontium (Sr+2)	(mg/l)	NA
Zinc (Zn+2)	(mg/l)	0.051
ANIONS		
Chloride (Cl-)	(mg/l)	13000.000
Cyanide (CN-)	(mg/l)	<.001
Carbonate (CO3-2)	(mg/l)	NA
Fluoride (F-)	(mg/l)	<.100
Bicarbonate (HCO3-)	(mg/l)	NA
Sulfide (HS-)	(mg/l)	NA
Nitrate (NO3-)	(mg/l)	< 1.000
Phosphate (PO4-3	(mg/l)	NA
Sulfate (SO4-2)	(mg/l)	790.000
OTHER CONSTITUENTS		
Silver (Ag)	(mg/l)	<.000
Arsenic (Ar)	(mg/l)	<0.001
Boron (B)	(mg/l)	NA
Chromium (Cr)	(mg/l)	<0.001
Iron (Fe)	(mg/l)	0.160
Mercury (Hg)	(mg/l)	<.000
Molybdenum (Mo)	(mg/l)	<.001

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC201 (cont.)

Constituent	UNITS	01-Mar-84
OTHER CONSTITUENTS		
Ammonia (NH3)	(mg/l)	NA
Nickel (Ni)	(mg/l)	<.040
Phosphorus (P)	(mg/l)	<.010
Lead (P6)	(mg/l)	<.001
Antimony	(mg/l)	<.003
Selenium (Se)	(mg/l)	<.002
Silicon	(mg/l)	22.800
Uranium (U)	(mg/l)	0.003
Vanadium (V)	(mg/l)	<.004
GENERAL CHARACTERISTICS		
Alkalinity	(mg/l)	144.000
Conductance	(UMHO/CM)	25700.000
Conductance, In-situ	(UMHO/CM)	25400.000
Redox Potential	(MVOLTS)	390.000
PH	(SU)	7.100
PH, In-situ	(SU)	7.400
Total Dissolved Solids (TDS)		22600.000
Temperature	(C-DEGREE	12.600
Temperature, In-situ	(C-DEGREE	11.500
RADIONUCLIDES		
Gross alpha	(pCi/l)	NA
Gross beta	(mg/l)	NA
Pb-210	(pCi/l)	NA
Po-210	(pCi/g)	NA
Ra-226	(pCi/l)	NA
Ra-228	(pCi/l)	0.500
Th-230	(pCi/l)	0.000
Uranium (U308)	(mg/l)	0.003
Uranium, total (U308)	(mg/l)	NA
ORGANIC COMPOUNDS		
Phenol	(mg/l)	NA
Organic Carbon (TOC)	(mg/l)	NA

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC202

Constituent		Date	02-Mar-84
CATION			
Aluminum (Al+3)		(mg/l)	<.003
Barium (Ba+2)		(mg/l)	<.100
Calcium (Ca+2)		(mg/l)	479.000
Cadmium (Cd+2)		(mg/l)	<.000
Cobalt (Co+2)		(mg/l)	NA
Copper (Cu+2)		(mg/l)	<.001
Potassium (K+)		(mg/l)	356.000
Magnesium (Mg+2)		(mg/l)	465.000
Manganese (Mn+2)		(mg/l)	.060
Sodium (Na+)		(mg/l)	9240.000
Ammonium (NH4+)		(mg/l)	<.100
Strontium (Sr+2)		(mg/l)	NA
Zinc (Zn+2)		(mg/l)	.018
ANIONS			
Chloride (Cl-)		(mg/l)	16500.000
Cyanide (CN-)		(mg/l)	<.001
Carbonate (CO3-2)		(mg/l)	NA
Fluoride (F-)		(mg/l)	<.100
Bicarbonate (HCO3-)		(mg/l)	NA
Sulfide (HS-)		(mg/l)	NA
Nitrate (NO3-)		(mg/l)	<1.000
Phosphate (PO4-3		(mg/l)	NA
Sulfate (SO4-2)		(mg/l)	936.000
OTHER CONSTITUENTS			
Silver (Ag)		(mg/l)	<.000
Arsenic (Ar)		(mg/l)	<.001
Boron (B)		(mg/l)	NA
Chromium (Cr)		(mg/l)	<.001
Iron (Fe)		(mg/l)	0.110
Mercury (Hg)		(mg/l)	<.000
Molybdenum (Mo)		(mg/l)	<.001

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC202 (cont.)

Constituent	UNITS	02-Mar-84
OTHER CONSTITUENTS		
Ammonia (NH3)	(mg/l)	NA
Nickel (Ni)	(mg/l)	<.040
Phosphorus (P)	(mg/l)	<.010
Lead (P6)	(mg/l)	<.001
Antimony	(mg/l)	<.003
Selenium (Se)	(mg/l)	<.002
Silicon	(mg/l)	22.000
Uranium (U)	(mg/l)	0.002
Vanadium (V)	(mg/l)	<.004
GENERAL CHARACTERISTICS		
Alkalinity	(mg/l)	130.000
Conductance	(UMHO/CM)	27200.000
Conductance, In-situ	(UMHO/CM)	25600.000
Redox Potential	(MVOLTS)	NA
PH	(SU)	7.300
PH, In-situ	(SU)	7.500
Total Dissolved Solids (TDS)		24400.000
Temperature	(C-DEGREE	12.600
Temperature, In-situ	(C-DEGREE	9.100
RADIONUCLIDES		
Gross alpha	(pCi/l)	NA
Gross beta	(mg/l)	NA
Pb-210	(pCi/l)	NA
Po-210	(pCi/g)	NA
Ra-226	(pCi/l)	NA
Ra-228	(pCi/l)	.000
Th-230	(pCi/l)	NA
Uranium (U308)	(mg/l)	0.002
Uranium, total (U308)	(mg/l)	NA
ORGANIC COMPOUNDS		
Phenol	(mg/l)	NA
Organic Carbon (TOC)	(mg/l)	NA

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SLC203

Constituent	Date	01-Mar-84	21-Jun-84
CATION			
Aluminum (Al+3)	(mg/l)	<.003	<.400
Barium (Ba+2)	(mg/l)	<.100	<.100
Calcium (Ca+2)	(mg/l)	570.000	465.000
Cadmium (Cd+2)	(mg/l)	<.000	<.005
Cobalt (Co+2)	(mg/l)	NA	NA
Copper (Cu+2)	(mg/l)	<.001	<.060
Potassium (K+)	(mg/l)	551.000	535.000
Magnesium (Mg+2)	(mg/l)	710.000	620.000
Manganese (Mn+2)	(mg/l)	0.120	0.600
Sodium (Na+)	(mg/l)	13200.000	15500.000
Ammonium (NH4+)	(mg/l)	<.100	<.100
Strontium (Sr+2)	(mg/l)	NA	NA
Zinc (Zn+2)	(mg/l)	0.078	0.099
ANIONS			
Chloride (Cl-)	(mg/l)	23000.000	26000.000
Cyanide (CN-)	(mg/l)	<.001	<.010
Carbonate (CO3-2)	(mg/l)	NA	NA
Fluoride (F-)	(mg/l)	<.100	<.100
Bicarbonate (HCO3-)	(mg/l)	NA	NA
Sulfide (HS-)	(mg/l)	NA	NA
Nitrate (NO3-)	(mg/l)	<1.000	0.100
Phosphate (PO4-3	(mg/l)	NA	NA
Sulfate (SO4-2)	(mg/l)	3330.000	NA
OTHER CONSTITUENTS			
Silver (Ag)	(mg/l)	<.000	<.010
Arsenic (Ar)	(mg/l)	<.001	<.010
Boron (B)	(mg/l)	NA	NA
Chromium (Cr)	(mg/l)	<.001	<.010
Iron (Fe)	(mg/l)	0.220	0.030
Mercury (Hg)	(mg/l)	0.120	<.000
Molybdenum (Mo)	(mg/l)	<.001	<.010

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC203 (cont.)

Constituent	UNITS	01-Mar-84	21-Jun-84
OTHER CONSTITUENTS			
Ammonia (NH3)	(mg/l)	NA	NA
Nickel (Ni)	(mg/l)	<.040	0.600
Phosphorus (P)	(mg/l)	<.010	0.200
Lead (P6)	(mg/l)	<.001	<.010
Antimony	(mg/l)	<.003	<.003
Selenium (Se)	(mg/l)	<.002	<.005
Silicon	(mg/l)	19.100	19.500
Uranium (U)	(mg/l)	0.007	0.009
Vanadium (V)	(mg/l)	<.004	<.010
GENERAL CHARACTERISTICS			
Alkalinity	(mg/l)	180.000	NA
Conductance	(UMHO/CM)	NA	NA
Conductance, In-situ	(UMHO/CM)	NA	NA
Redox Potential	(MVOLTS)	430.000	NA
PH	(SU)	6.300	NA
PH, In-situ	(SU)	6.700	7.570
Total Dissolved Solids (TDS)		44300.000	45800.000
Temperature	(C-DEGREE	12.500	12.900
Temperature, In-situ	(C-DEGREE	10.700	16.600
RADIONUCLIDES			
Gross alpha	(pCi/l)	NA	NA
Gross beta	(mg/l)	NA	NA
Pb-210	(pCi/l)	NA	NA
Po-210	(pCi/g)	NA	NA
Ra-226	(pCi/l)	NA	NA
Ra-228	(pCi/l)	.000	1.500
Th-230	(pCi/l)	NA	NA
Uranium (U308)	(mg/l)	.007	.009
Uranium, total (U308)	(mg/l)	NA	NA
ORGANIC COMPOUNDS			
Phenol	(mg/l)	NA	NA
Organic Carbon (TOC)	(mg/l)	NA	NA

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SLC204

Constituent	Date	01-Mar-84	22-Jun-84
CATION			
Aluminum (Al+3)	(mg/l)	<.003	.500
Barium (Ba+2)	(mg/l)	<.100	0.100
Calcium (Ca+2)	(mg/l)	334.000	216.000
Cadmium (Cd+2)	(mg/l)	<.000	<.005
Cobalt (Co+2)	(mg/l)	NA	NA
Copper (Cu+2)	(mg/l)	<.001	<.040
Potassium (K+)	(mg/l)	319.000	330.000
Magnesium (Mg+2)	(mg/l)	293.000	230.000
Manganese (Mn+2)	(mg/l)	0.130	0.270
Sodium (Na+)	(mg/l)	7270.000	7500.000
Ammonium (NH4+)	(mg/l)	<.100	<.100
Strontium (Sr+2)	(mg/l)	NA	NA
Zinc (Zn+2)	(mg/l)	0.029	0.071
ANIONS			
Chloride (Cl-)	(mg/l)	12500.000	12000.000
Cyanide (CN-)	(mg/l)	<.001	<.010
Carbonate (CO3-2)	(mg/l)	NA	NA
Fluoride (F-)	(mg/l)	<.100	<.100
Bicarbonate (HCO3-)	(mg/l)	NA	NA
Sulfide (HS-)	(mg/l)	NA	NA
Nitrate (NO3-)	(mg/l)	<1.000	0.100
Phosphate (PO4-3	(mg/l)	NA	NA
Sulfate (SO4-2)	(mg/l)	952.000	1170.000
OTHER CONSTITUENTS			
Silver (Ag)	(mg/l)	<.000	<.010
Arsenic (Ar)	(mg/l)	<.001	<.010
Boron (B)	(mg/l)	NA	NA
Chromium (Cr)	(mg/l)	<.001	<.010
Iron (Fe)	(mg/l)	0.150	0.430
Mercury (Hg)	(mg/l)	<.000	<.000
Molybdenum (Mo)	(mg/l)	<.001	<.010

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC204 (cont.)

Constituent	Units	01-Mar-84	22-Jun-84
OTHER CONSTITUENTS			
Ammonia (NH3)	(mg/l)	NA	NA
Nickel (Ni)	(mg/l)	<.040	0.270
Phosphorus (P)	(mg/l)	<.010	0.100
Lead (P6)	(mg/l)	<.001	<.010
Antimony	(mg/l)	<.003	<.003
Selenium (Se)	(mg/l)	<.002	<.005
Silicon	(mg/l)	21.400	25.800
Uranium (U)	(mg/l)	0.003	0.009
Vanadium (V)	(mg/l)	<.004	0.010
GENERAL CHARACTERISTICS			
Alkalinity	(mg/l)	184.000	NA
Conductance	(UMHO/CM)	24400.000	NA
Conductance, In-situ	(UMHO/CM)	24000.000	NA
Redox Potential	(MVOLTS)	410.000	NA
PH	(SU)	7.100	NA
PH, In-situ	(SU)	7.200	7.700
Total Dissolved Solids (TDS)		21200.210	21000.000
Temperature	(C-DEGREE	12.600	12.800
Temperature, In-situ	(C-DEGREE	10.900	14.500
RADIONUCLIDES			
Gross alpha	(pCi/l)	NA	NA
Gross beta	(mg/l)	NA	NA
Pb-210	(pCi/l)	NA	NA
Po-210	(pCi/g)	NA	NA
Ra-226	(pCi/l)	NA	NA
Ra-228	(pCi/l)	0.300	0.600
Th-230	(pCi/l)	NA	NA
Uranium (U308)	(mg/l)	NA	NA
Uranium, total (U308)	(mg/l)	NA	NA
ORGANIC COMPOUNDS			
Phenol	(mg/l)	NA	NA
Organic Carbon (TOC)	(mg/l)	NA	NA

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SLC205

Constituent		Date	01-Mar-84
CATION			
Aluminum (Al+3)		(mg/l)	<.003
Barium (Ba+2)		(mg/l)	(.100
Calcium (Ca+2)		(mg/l)	296.000
Cadmium (Cd+2)		(mg/l)	<.000
Cobalt (Co+2)		(mg/l)	NA
Copper (Cu+2)		(mg/l)	<.001
Potassium (K+)		(mg/l)	328.000
Magnesium (Mg+2)		(mg/l)	294.000
Manganese (Mn+2)		(mg/l)	0.090
Sodium (Na+)		(mg/l)	7650.000
Ammonium (NH4+)		(mg/l)	<.100
Strontium (Sr+2)		(mg/l)	NA
Zinc (Zn+2)		(mg/l)	0.043
ANIONS			
Chloride (Cl-)		(mg/l)	13000.000
Cyanide (CN-)		(mg/l)	<.001
Carbonate (CO3-2)		(mg/l)	NA
Fluoride (F-)		(mg/l)	<.100
Bicarbonate (HCO3-)		(mg/l)	NA
Sulfide (HS-)		(mg/l)	NA
Nitrate (NO3-)		(mg/l)	<1.000
Phosphate (PO4-3		(mg/l)	NA
Sulfate (SO4-2)		(mg/l)	1080.000
OTHER CONSTITUENTS			
Silver (Ag)		(mg/l)	<.000
Arsenic (Ar)		(mg/l)	<.001
Boron (B)		(mg/l)	NA
Chromium (Cr)		(mg/l)	<.001
Iron (Fe)		(mg/l)	0.210
Mercury (Hg)		(mg/l)	<.000
Molybdenum (Mo)		(mg/l)	<.001

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC205 (cont.)

Constituent	Units	01-Mar-84
OTHER CONSTITUENTS		
Ammonia (NH3)	(mg/l)	NA
Nickel (Ni)	(mg/l)	<.040
Phosphorus (P)	(mg/l)	<.010
Lead (P6)	(mg/l)	<.001
Antimony	(mg/l)	<.003
Selenium (Se)	(mg/l)	<.002
Silicon	(mg/l)	21.400
Uranium (U)	(mg/l)	0.003
Vanadium (V)	(mg/l)	<.004
GENERAL CHARACTERISTICS		
Alkalinity	(mg/l)	190.000
Conductance	(UMHO/CM)	25700.000
Conductance, In-situ	(UMHO/CM)	23500.000
Redox Potential	(MVOLTS)	340.000
PH	(SU)	8.500
PH, In-situ	(SU)	7.800
Total Dissolved Solids (TDS)		22300.000
Temperature	(C-DEGREE	12.100
Temperature, In-situ	(C-DEGREE	7.900
RADIONUCLIDES		
Gross alpha	(pCi/l)	NA
Gross beta	(mg/l)	NA
Pb-210	(pCi/l)	NA
Po-210	(pCi/g)	NA
Ra-226	(pCi/l)	NA
Ra-228	(pCi/l)	.000
Th-230	(pCi/l)	NA
Uranium (U308)	(mg/l)	NA
Uranium, total (U308)	(mg/l)	NA
ORGANIC COMPOUNDS		
Phenol	(mg/l)	NA
Organic Carbon (TOC)	(mg/l)	NA

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY
AT SOUTH CLIVE, UTAH

WELL IDENTIFICATION: SLC206

Constituent	Date	02-Mar-84	20-Jun-84
CATION			
Aluminum (Al+3)	(mg/l)	<.003	.300
Barium (Ba+2)	(mg/l)	<.100	0.100
Calcium (Ca+2)	(mg/l)	409.000	315.000
Cadmium (Cd+2)	(mg/l)	<.000	<.005
Cobalt (Co+2)	(mg/l)	NA	NA
Copper (Cu+2)	(mg/l)	<.001	<.050
Potassium (K+)	(mg/l)	360.000	470.000
Magnesium (Mg+2)	(mg/l)	387.000	260.000
Manganese (Mn+2)	(mg/l)	0.280	0.190
Sodium (Na+)	(mg/l)	8720.000	9020.000
Ammonium (NH4+)	(mg/l)	<.100	<.100
Strontium (Sr+2)	(mg/l)	NA	NA
Zinc (Zn+2)	(mg/l)	0.017	0.035
ANIONS			
Chloride (Cl-)	(mg/l)	15000.000	15000.000
Cyanide (CN-)	(mg/l)	<.001	<.010
Carbonate (CO3-2)	(mg/l)	NA	NA
Fluoride (F-)	(mg/l)	<.100	<.100
Bicarbonate (HCO3-)	(mg/l)	NA	NA
Sulfide (HS-)	(mg/l)	NA	NA
Nitrate (NO3-)	(mg/l)	<1.000	0.200
Phosphate (PO4-3	(mg/l)	NA	NA
Sulfate (SO4-2)	(mg/l)	1200.000	1140.000
OTHER CONSTITUENTS			
Silver (Ag)	(mg/l)	<.000	<.010
Arsenic (Ar)	(mg/l)	<.001	<.010
Boron (B)	(mg/l)	NA	NA
Chromium (Cr)	(mg/l)	<.001	<.010
Iron (Fe)	(mg/l)	0.180	0.030
Mercury (Hg)	(mg/l)	<.000	<.000
Molybdenum (Mo)	(mg/l)	<.001	<.010

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

WELL IDENTIFICATION: SLC206 (cont.)

Constituent	Units	02-Mar-84	20-Jun-84
OTHER CONSTITUENTS			
Ammonia (NH3)	(mg/l)	NA	NA
Nickel (Ni)	(mg/l)	<.040	0.260
Phosphorus (P)	(mg/l)	<.010	0.200
Lead (P6)	(mg/l)	<.001	<.010
Antimony	(mg/l)	<.003	<.003
Selenium (Se)	(mg/l)	<.002	<.005
Silicon	(mg/l)	22.300	21.600
Uranium (U)	(mg/l)	0.004	0.008
Vanadium (V)	(mg/l)	<.004	<.010
GENERAL CHARACTERISTICS			
Alkalinity	(mg/l)	160.000	NA
Conductance	(UMHO/CM)	29000.000	NA
Conductance, In-situ	(UMHO/CM)	25900.000	NA
Redox Potential	(MVOLTS)	NA	NA
pH	(SU)	7.100	NA
PH, In-situ	(SU)	7.300	7.570
Total Dissolved Solids (TDS)		26000.000	26000.000
Temperature	(C-DEGREE	12.700	12.800
Temperature, In-situ	(C-DEGREE	7.500	19.500
RADIONUCLIDES			
Gross alpha	(pCi/l)	NA	NA
Gross beta	(mg/l)	NA	NA
Pb-210	(pCi/l)	NA	NA
Po-210	(pCi/g)	NA	NA
Ra-226	(pCi/l)	NA	NA
Ra-228	(pCi/l)	.000	.900
Th-230	(pCi/l)	NA	NA
Uranium (U308)	(mg/l)	.004	.008
Uranium, total (U308)	(mg/l)	NA	NA
ORGANIC COMPOUNDS			
Phenol	(mg/l)	NA	NA
Organic Carbon (TOC)	(mg/l)	NA	NA

* ND = None Detected NA = Not Analyzed
* All values on a dissolved basis, unless otherwise noted

GROUNDWATER QUALITY

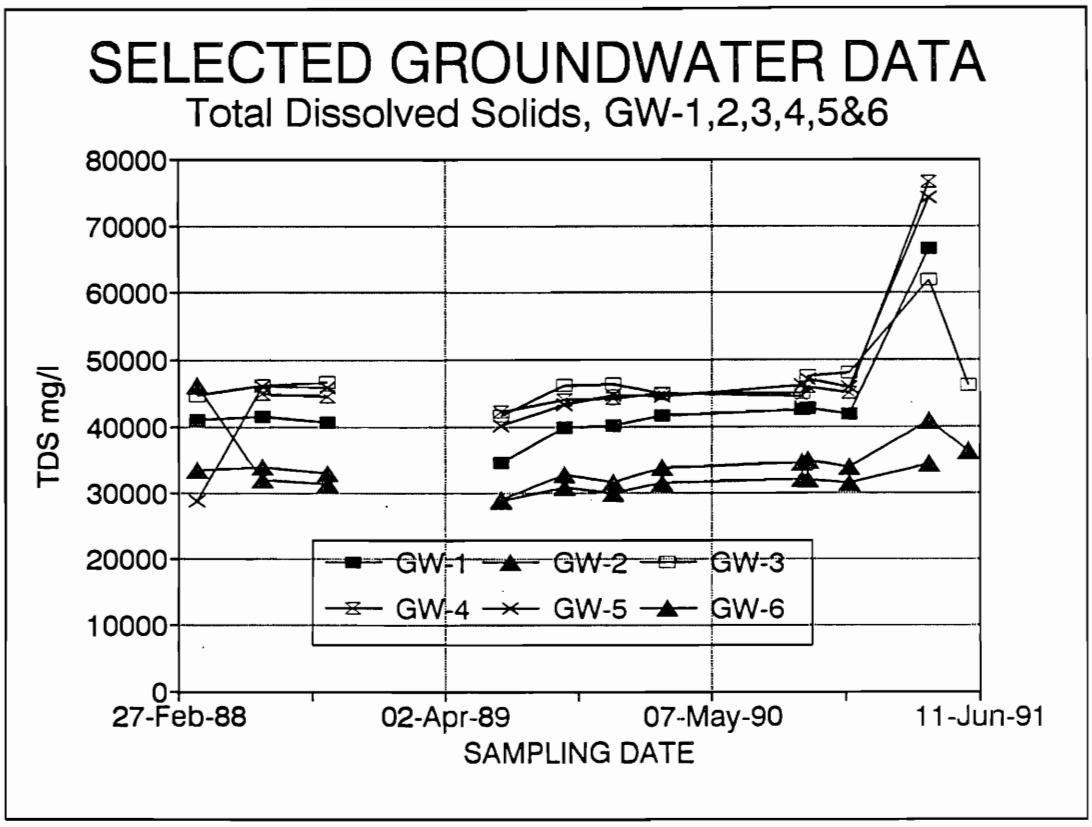
GRAPHS

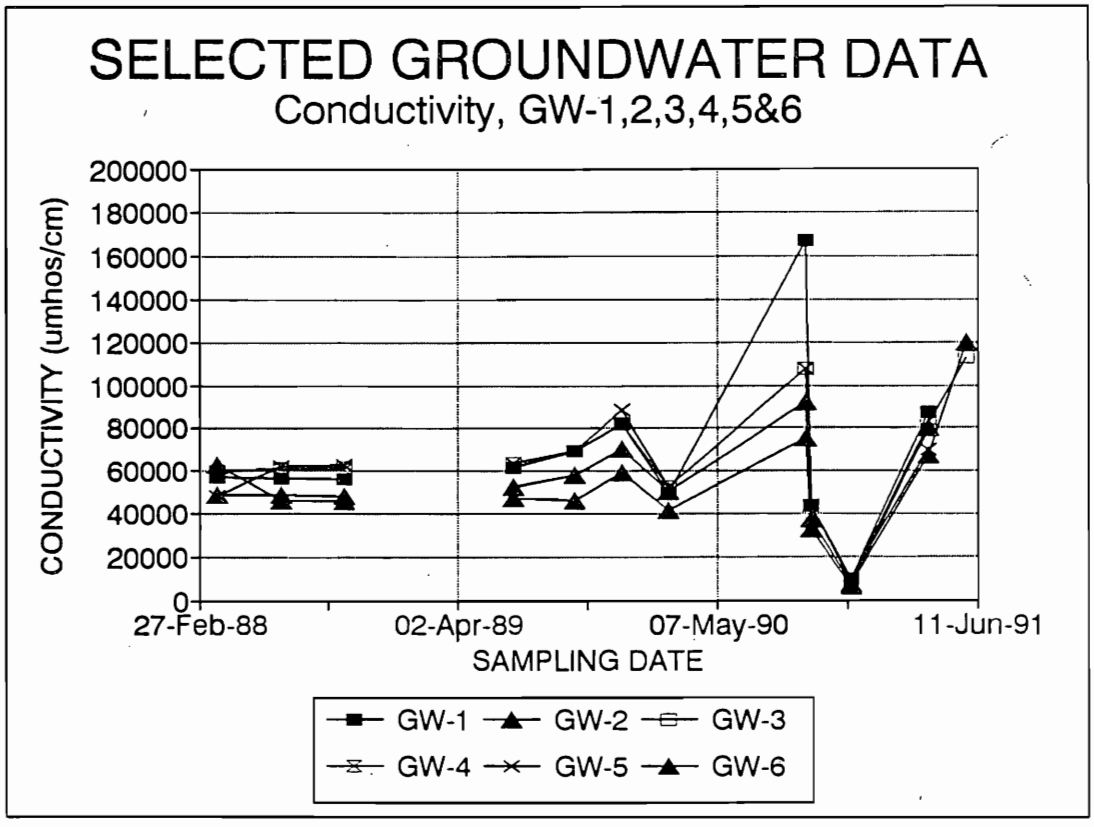
SELECTED INDICATOR PARAMETERS

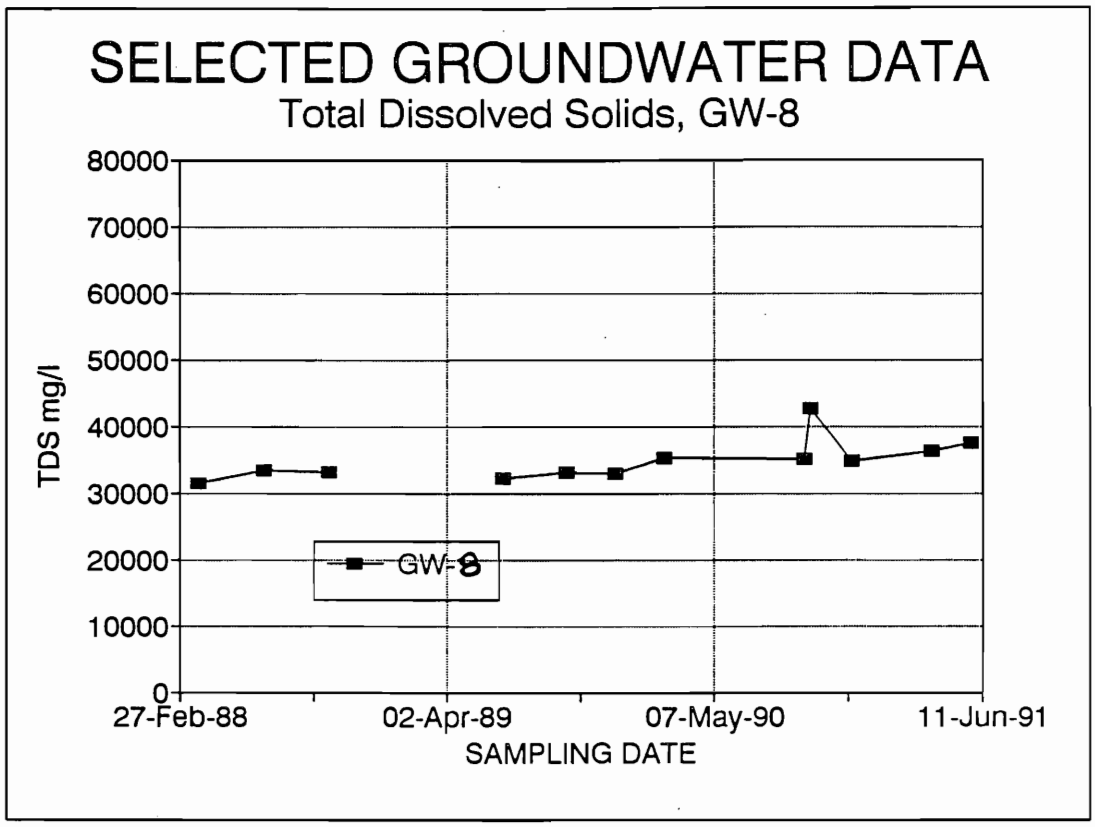
TDS

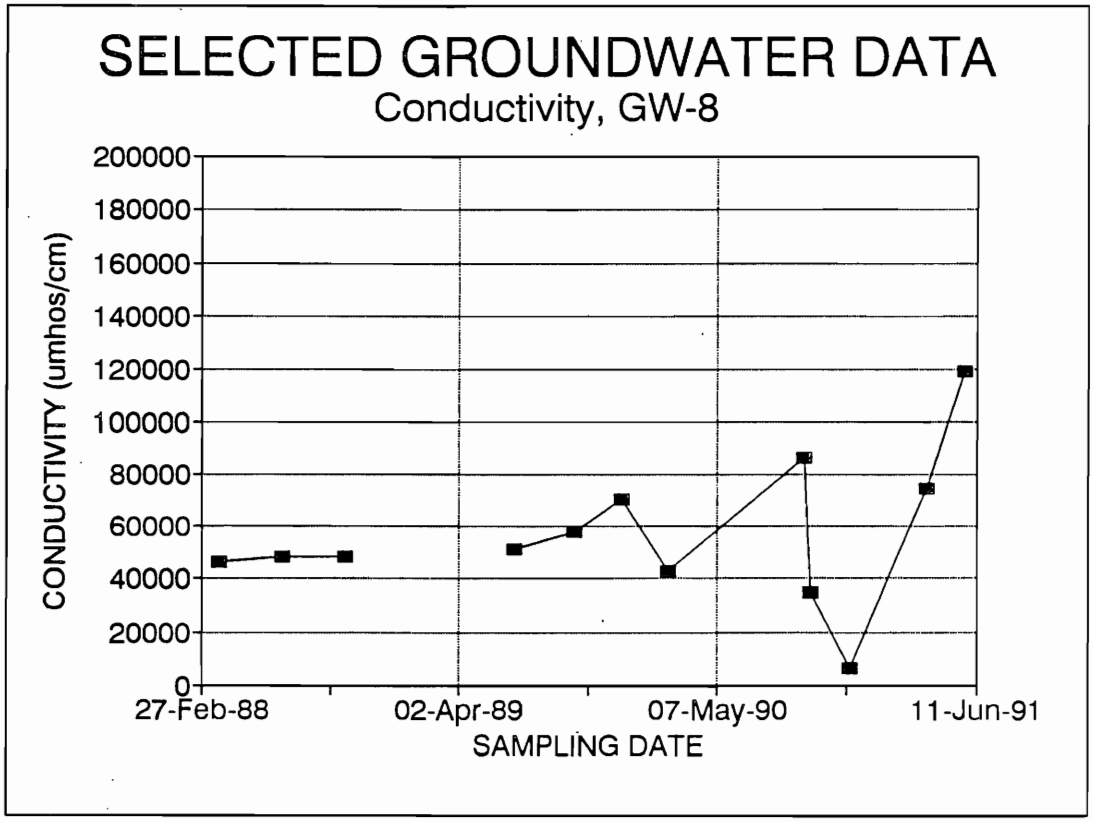
AND

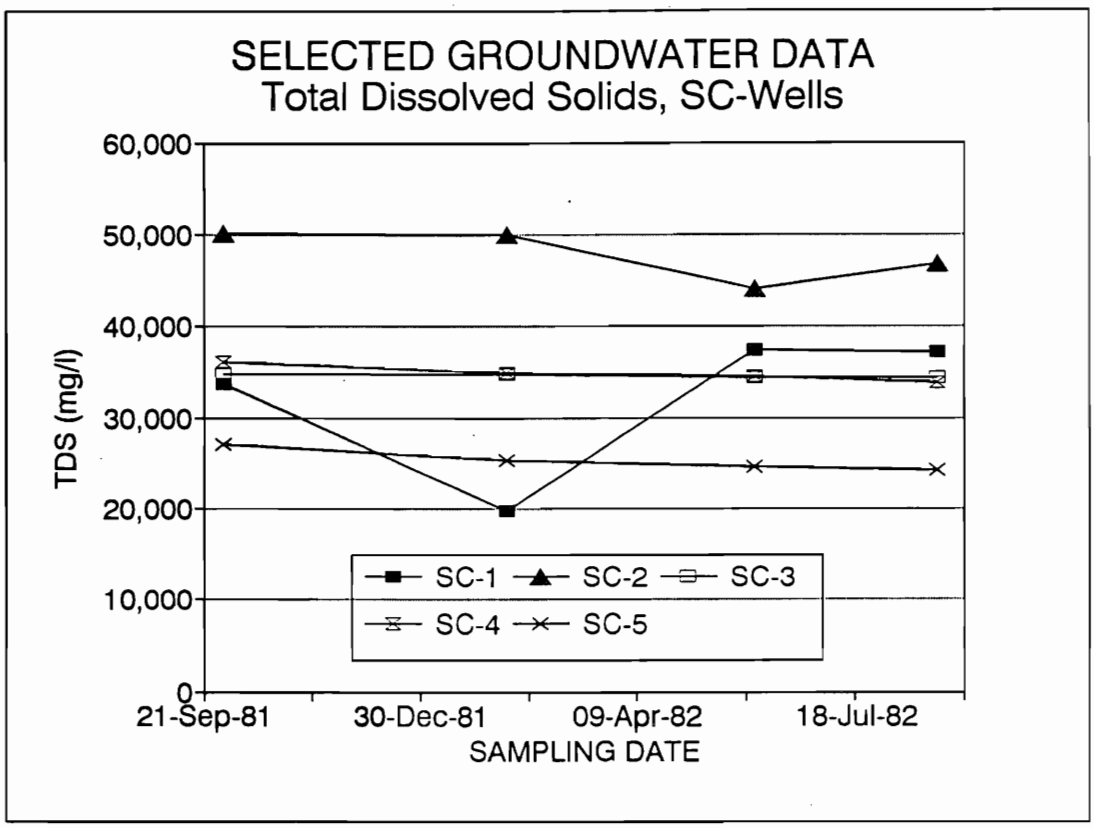
CONDUCTIVITY

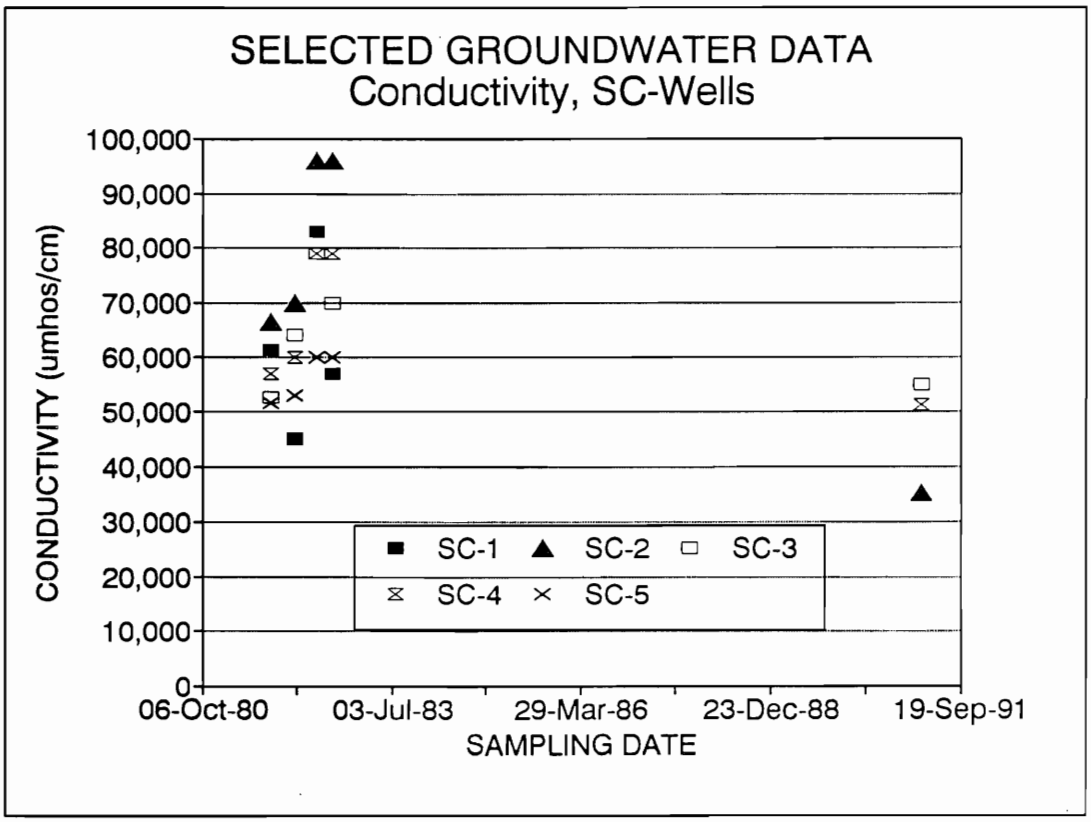

SELECTED GROUNDWATER DATA
Total Dissolved Solids, GW-1,2,3,4,5&6
TDS mg/l
80000
70000
60000
50000
40000
30000
20000
10000
0
27-Feb-88
02-Apr-89
07-May-90
11-Jun-91
SAMPLING DATE
GW-1
GW-2
GW-3
GW-4
GW-5
GW-6


SELECTED GROUNDWATER DATA
Conductivity, GW-1,2,3,4,5&6
CONDUCTIVITY (umhos/cm)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
27-Feb-88
02-Apr-89
07-May-90
11-Jun-91
SAMPLING DATE
GW-1
GW-2
GW-3
GW-4
GW-5
GW-6


SELECTED GROUNDWATER DATA
Total Dissolved Solids, GW-8
TDS mg/l
80000
70000
60000
50000
40000
30000
20000
10000
0
GW-8
27-Feb-88
02-Apr-89
07-May-90
11-Jun-91
SAMPLING DATE

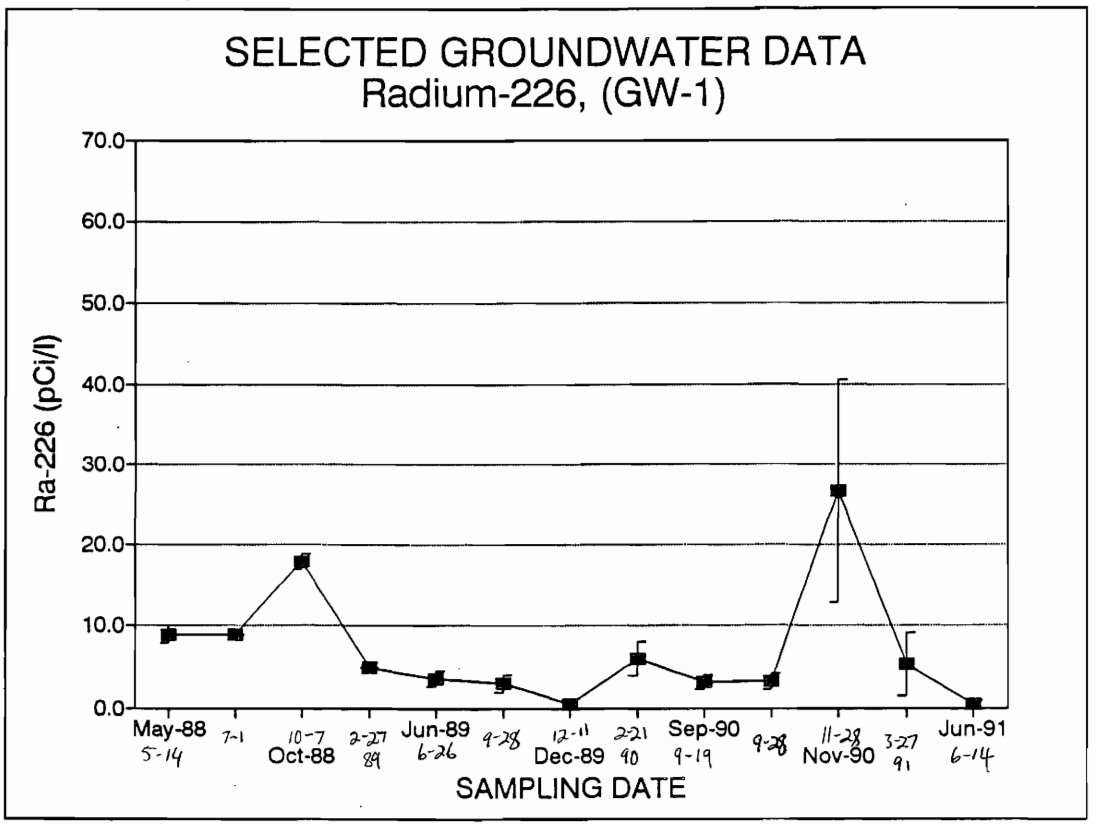

SELECTED GROUNDWATER DATA
Conductivity, GW-8
CONDUCTIVITY (umhos/cm)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
27-Feb-88
02-Apr-89
07-May-90
11-Jun-91
SAMPLING DATE

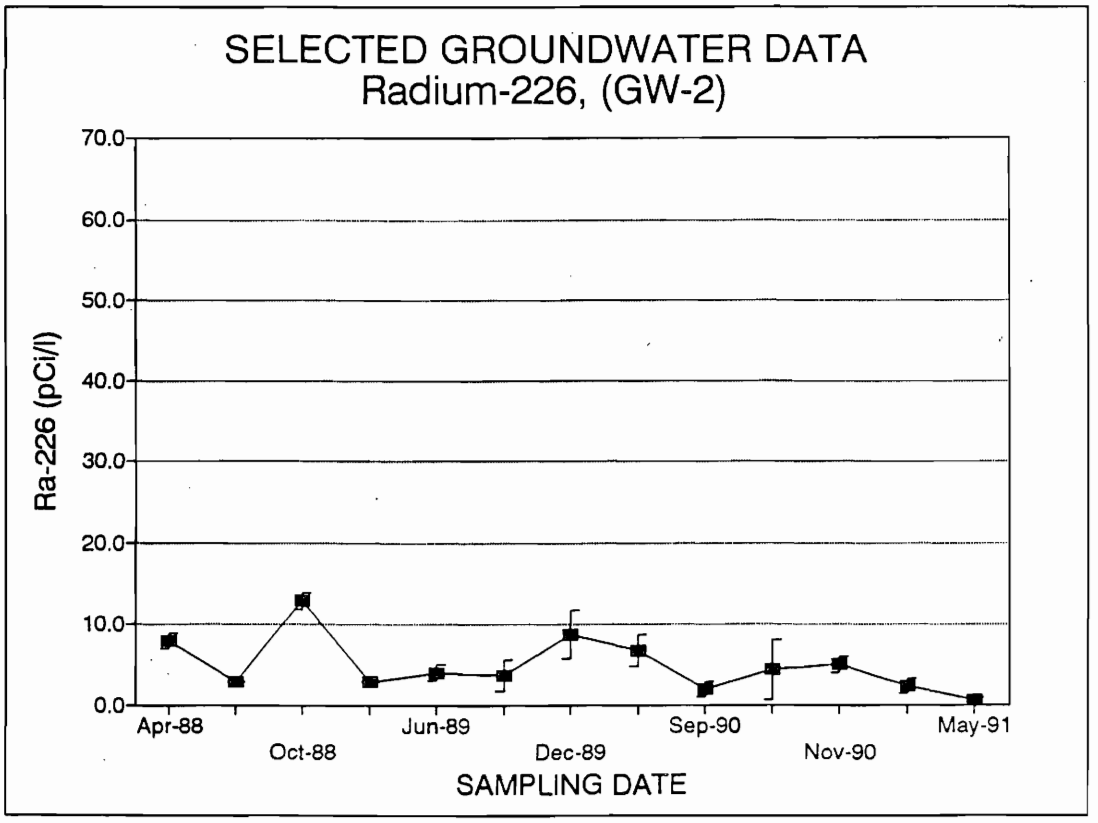

SELECTED GROUNDWATER DATA
Total Dissolved Solids, SC-Wells
TDS (mg/l)
60,000
50,000
40,000
30,000
20,000
10,000
0
21-Sep-81
30-Dec-81
09-Apr-82
18-Jul-82
SAMPLING DATE
SC-1
SC-2
SC-3
SC-4
SC-5

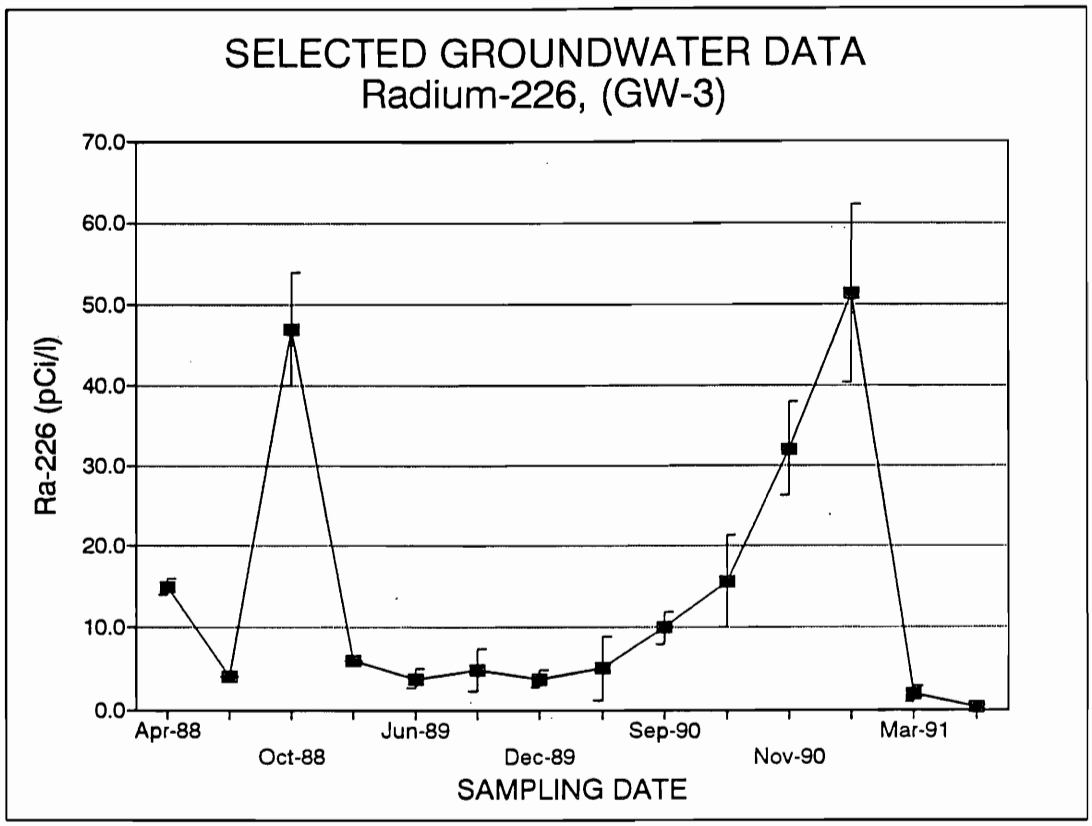

SELECTED GROUNDWATER DATA
Conductivity, SC-Wells
CONDUCTIVITY (umhos/cm)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
06-Oct-80
03-Jul-83
29-Mar-86
23-Dec-88
19-Sep-91
SAMPLING DATE
SC-1
SC-2
SC-3
SC-4
SC-5

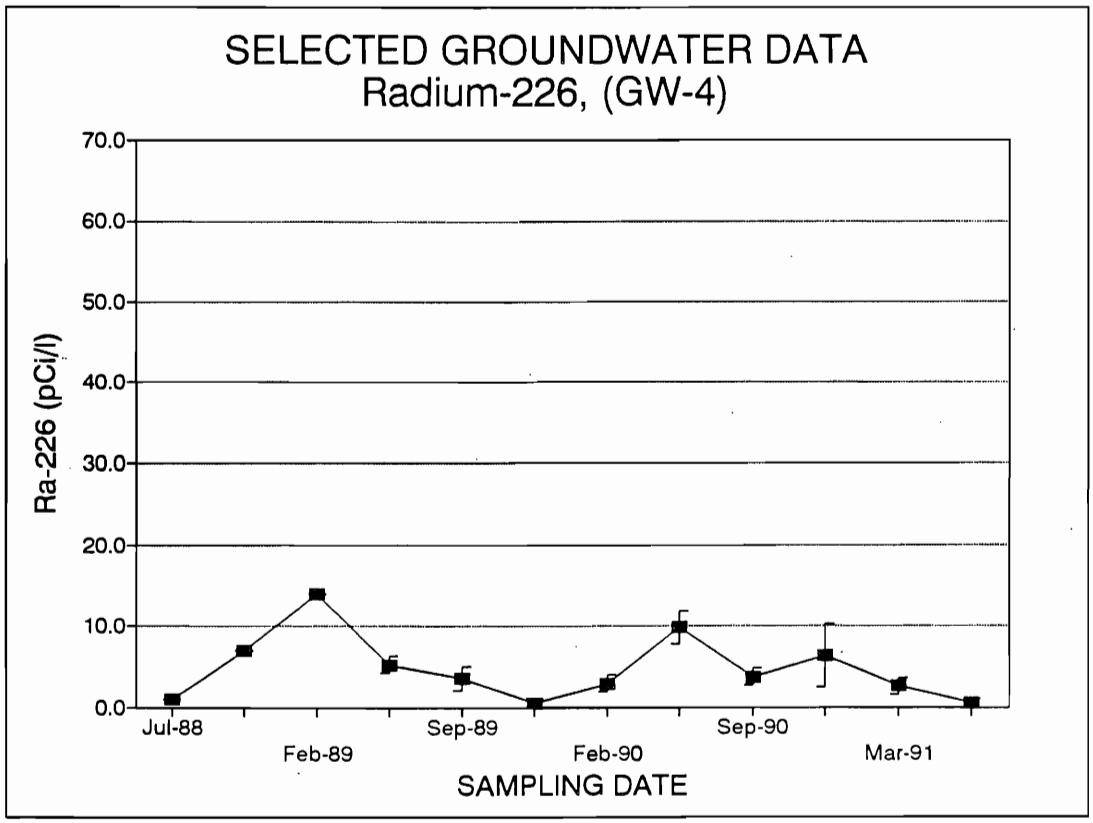
SELECTED RADIONUCLIDES

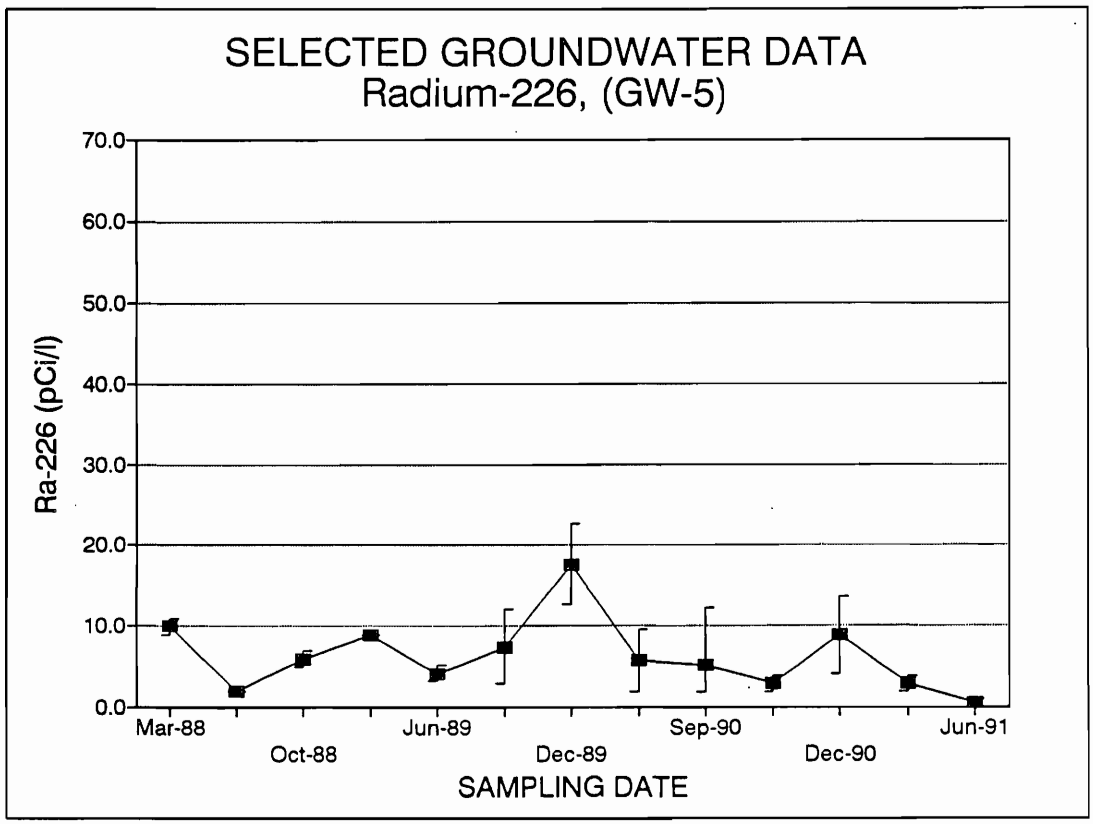
RADIUM - 226

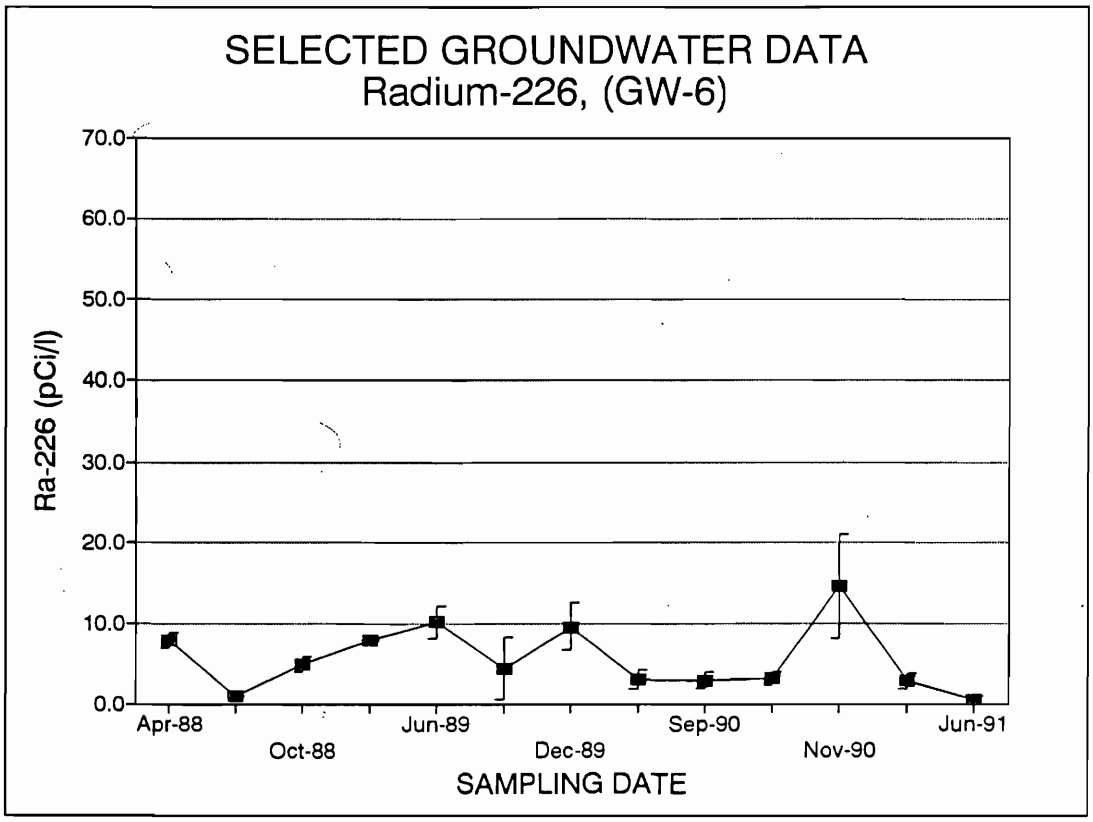

SELECTED GROUNDWATER DATA
Radium-226, (GW-1)
Ra-226 (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
May-88
5-14
7-1
10-7
Oct-88
2-27
89
Jun-89
6-26
9-28
12-11
Dec-89
2-21
90
Sep-90
9-19
9-28
11-28
Nov-90
3-27
91
Jun-91
6-14
SAMPLING DATE

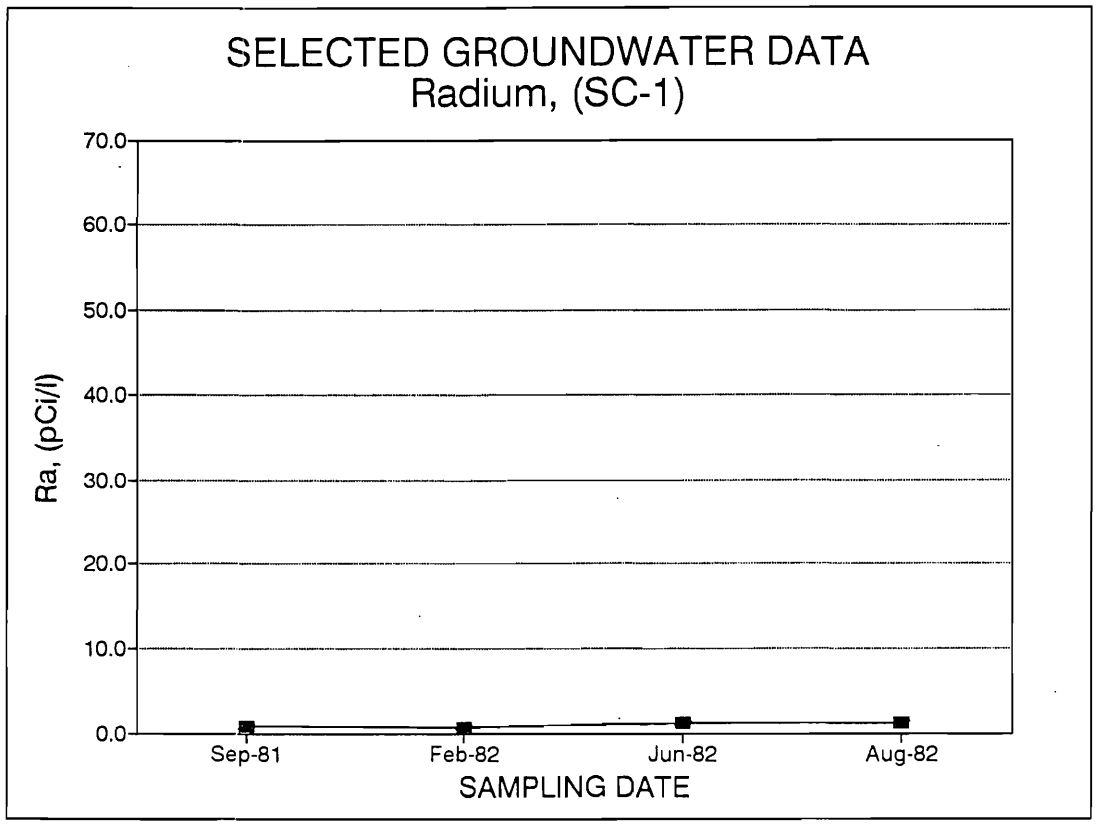

SELECTED GROUNDWATER DATA
Radium-226, (GW-2)
Ra-226 (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Apr-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
May-91
SAMPLING DATE

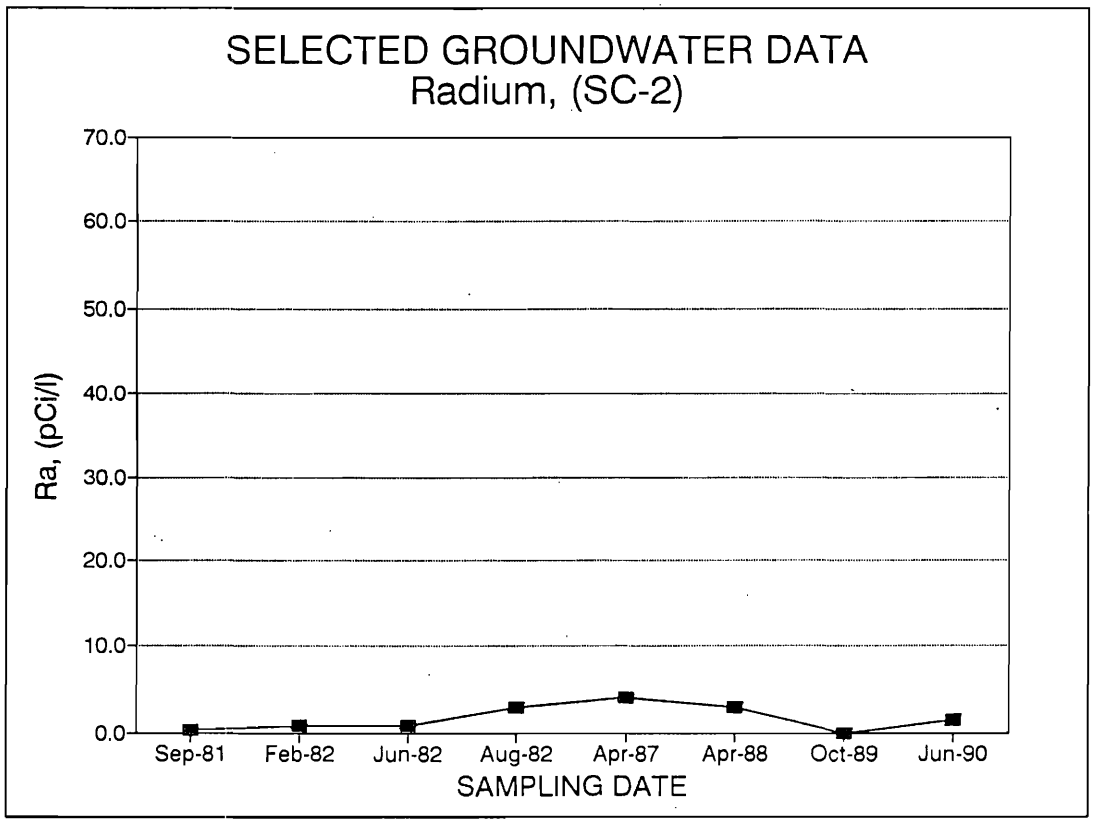

SELECTED GROUNDWATER DATA
Radium-226, (GW-3)
Ra-226 (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Apr-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
Mar-91
SAMPLING DATE

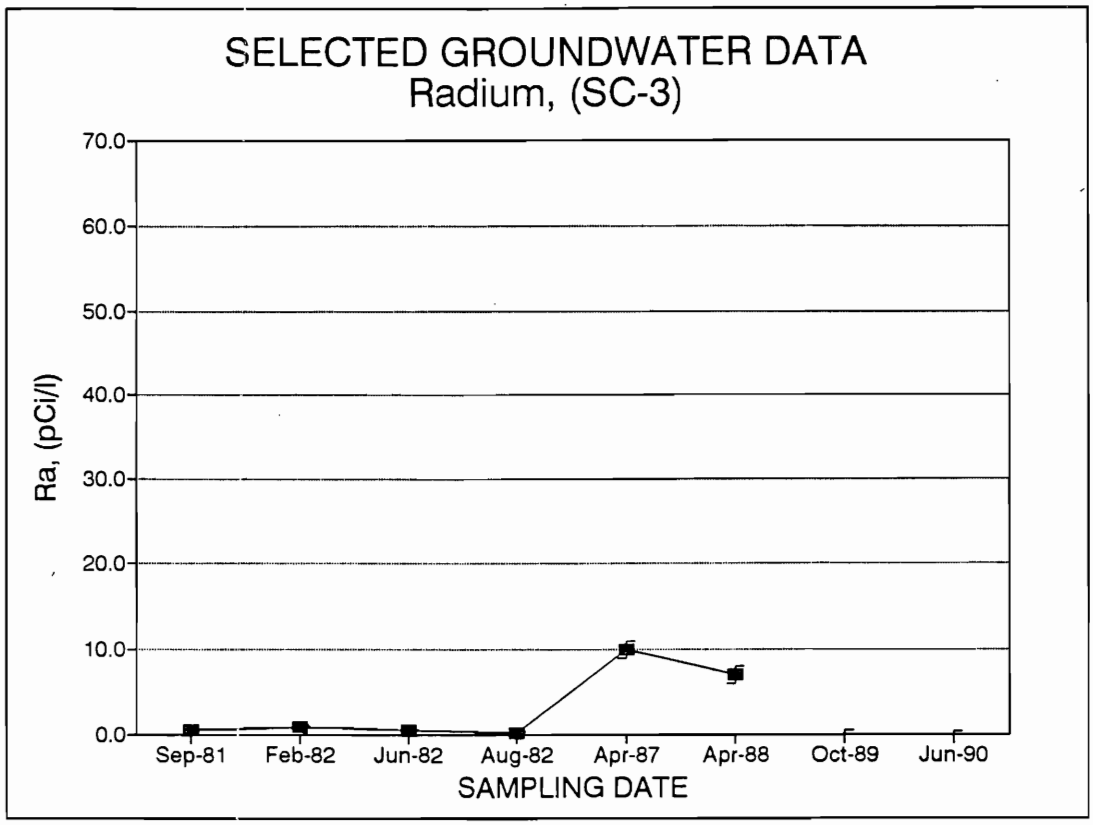

SELECTED GROUNDWATER DATA
Radium-226, (GW-4)
Ra-226 (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Jul-88
Feb-89
Sep-89
Feb-90
Sep-90
Mar-91
SAMPLING DATE

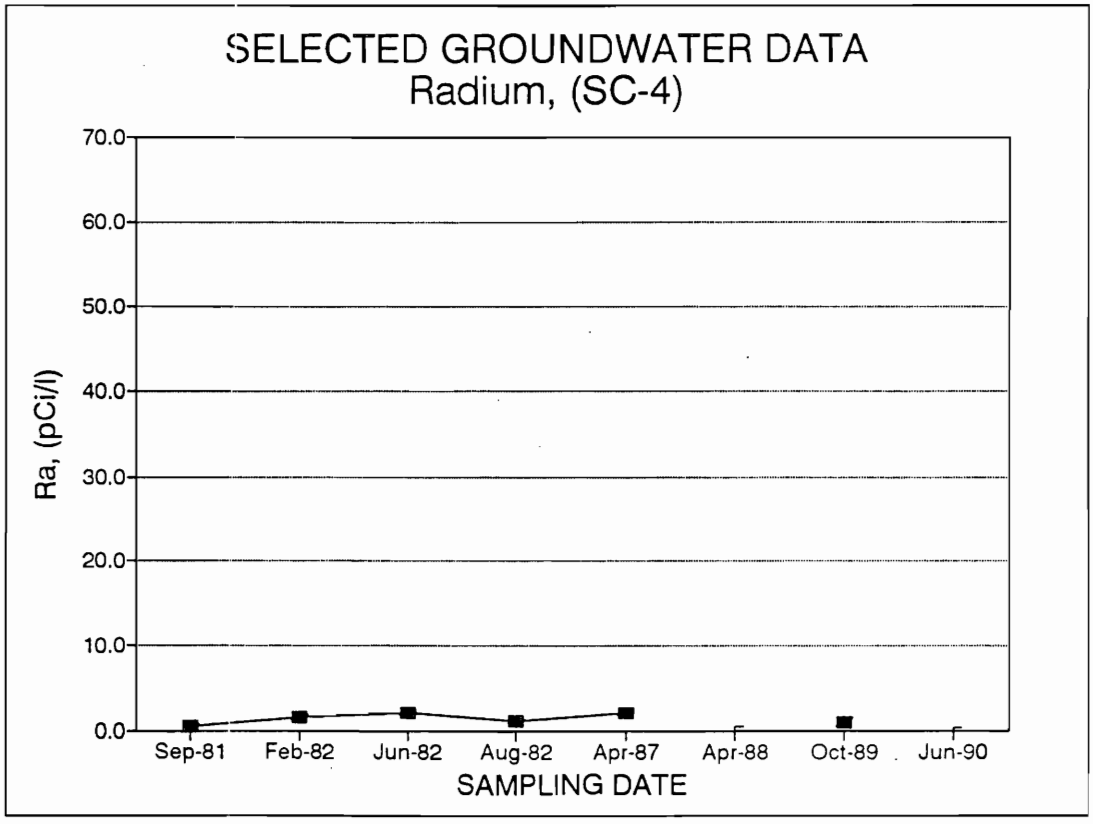

SELECTED GROUNDWATER DATA
Radium-226, (GW-5)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra-226 (pCi/l)
Mar-88
Oct-88
Jun-89
Dec-89
Sep-90
Dec-90
Jun-91
SAMPLING DATE

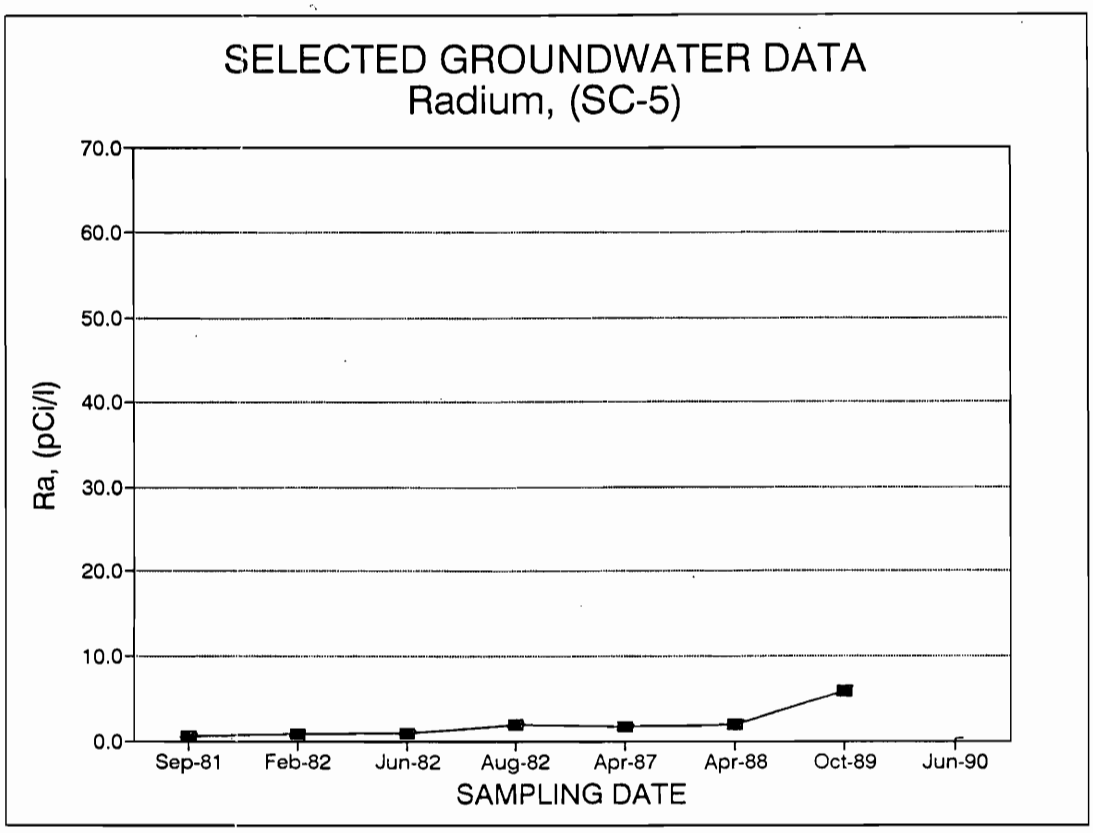

SELECTED GROUNDWATER DATA
Radium-226, (GW-6)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra-226 (pCi/l)
Apr-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
Jun-91
SAMPLING DATE


SELECTED GROUNDWATER DATA
Radium, (SC-1)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra, (pCi/l)
Sep-81
Feb-82
Jun-82
Aug-82
SAMPLING DATE

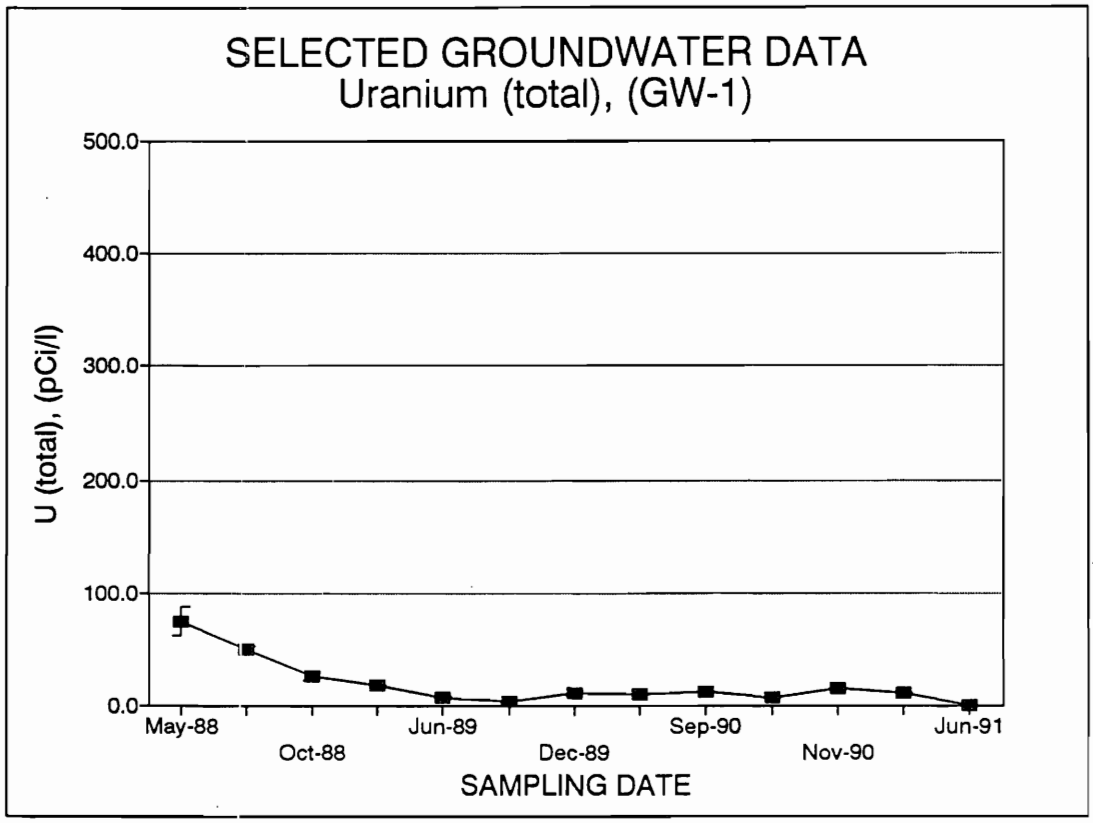

SELECTED GROUNDWATER DATA
Radium, (SC-2)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra, (pCi/l)
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE

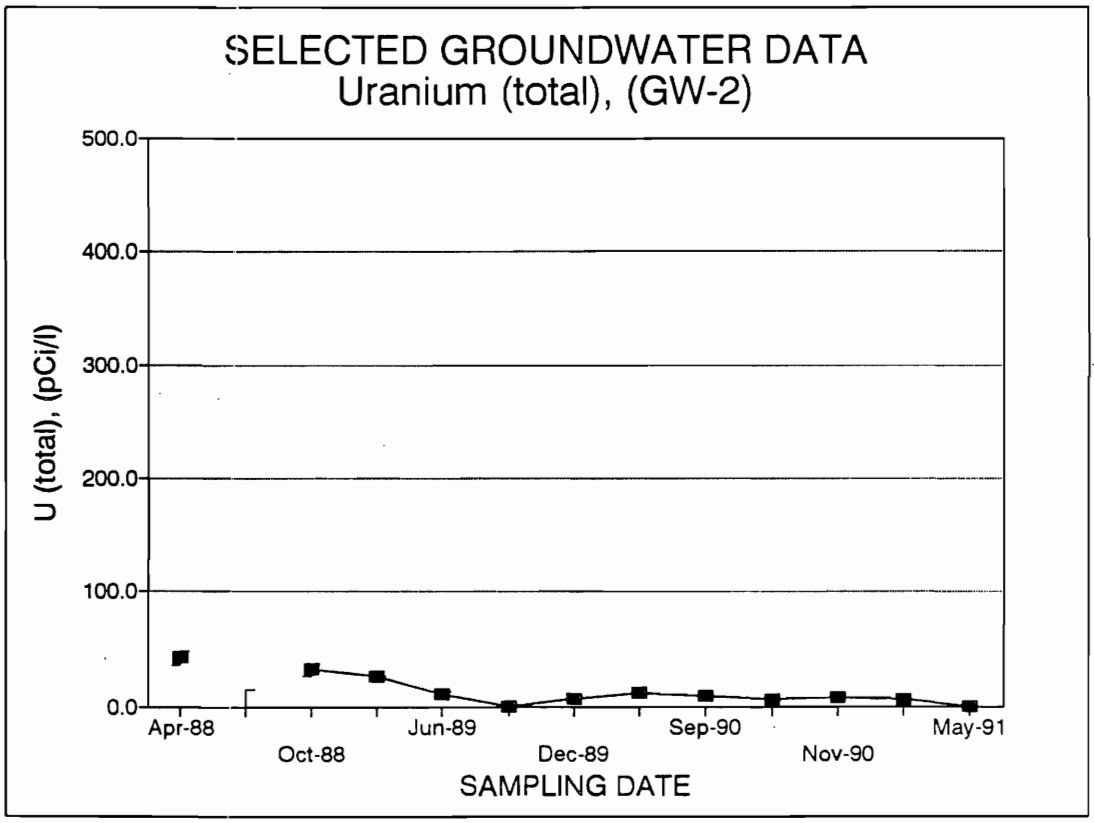

SELECTED GROUNDWATER DATA
Radium, (SC-3)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra, (pCi/l)
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE

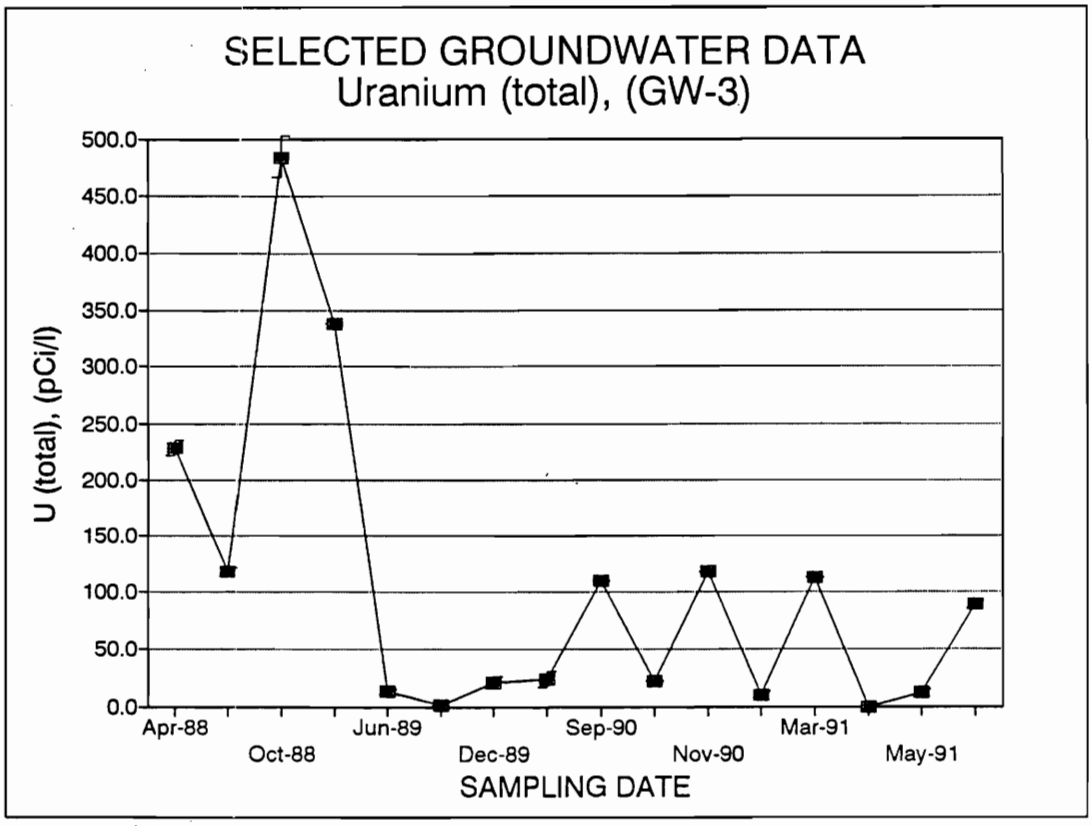

SELECTED GROUNDWATER DATA
Radium, (SC-4)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra, (pCi/l)
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE

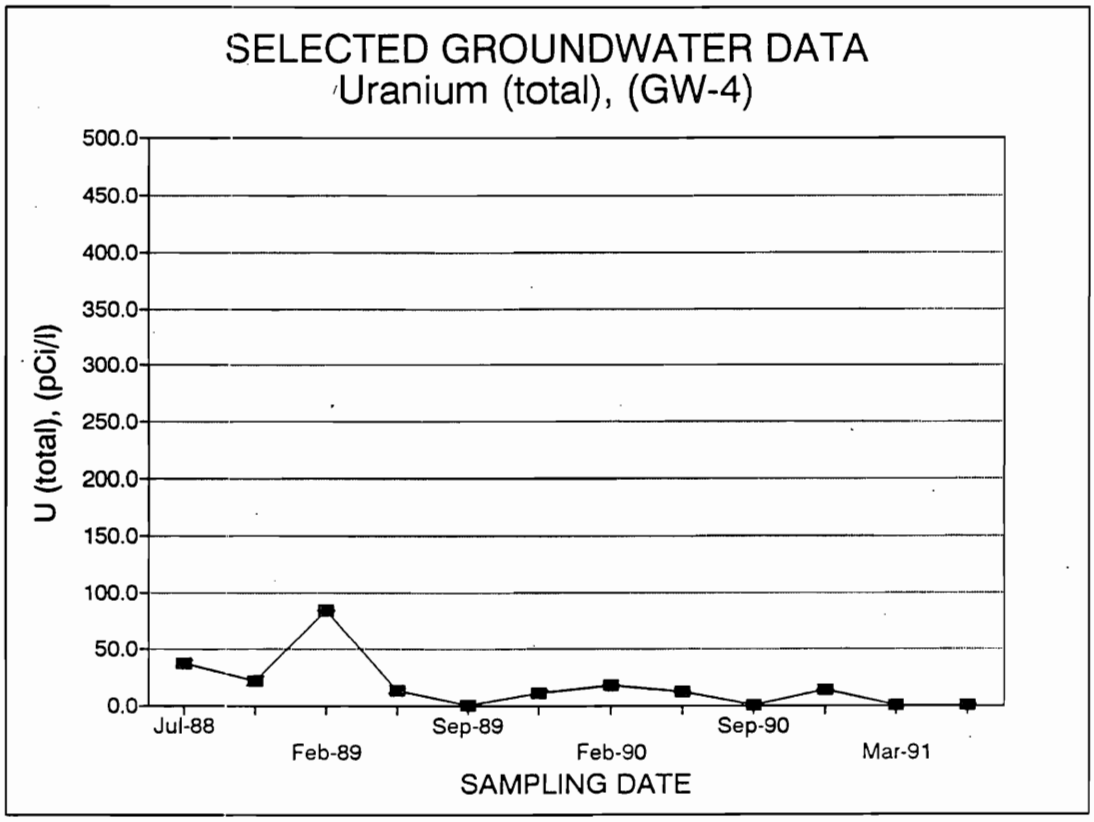

SELECTED GROUNDWATER DATA
Radium, (SC-5)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Ra, (pCi/l)
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE

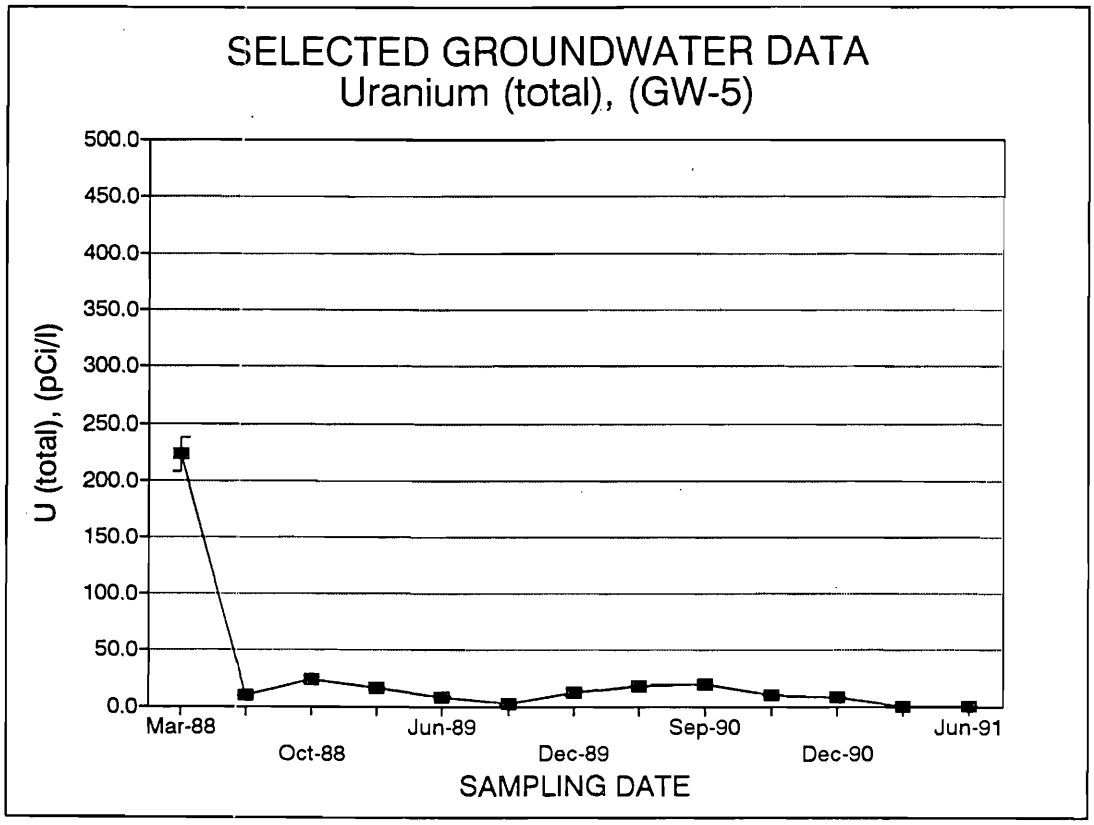
URANIUM (Total)

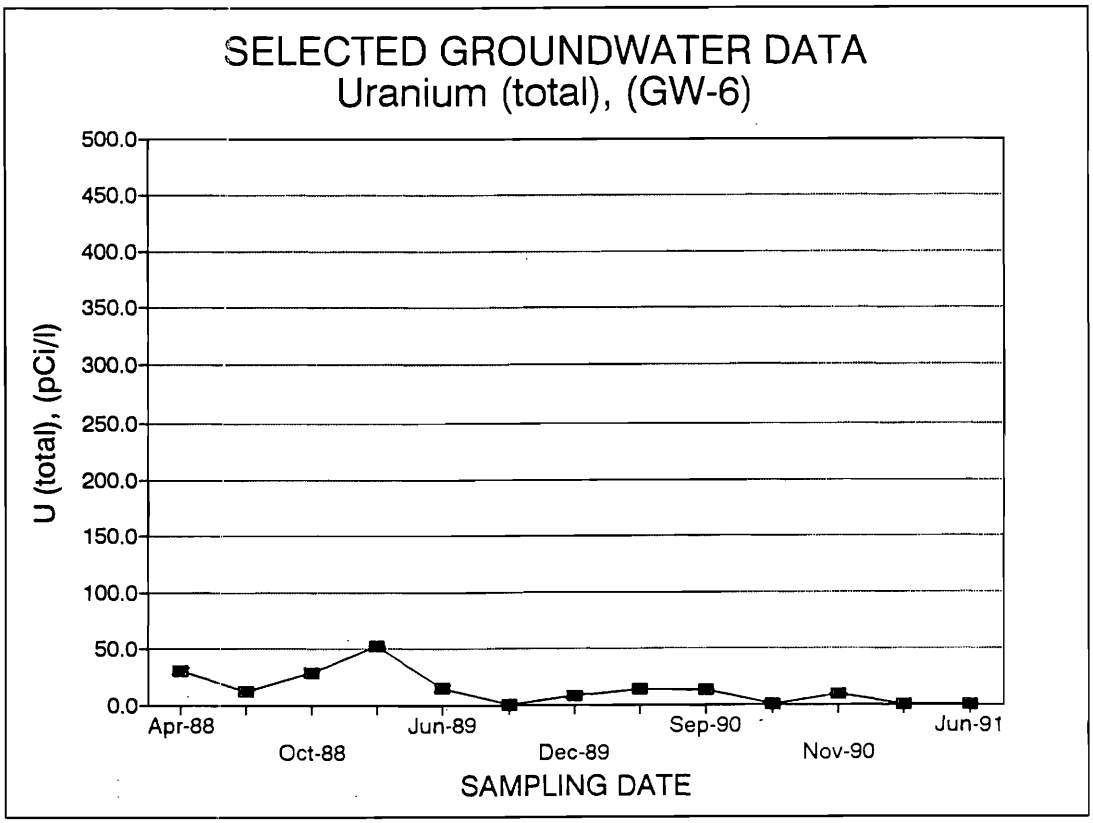

SELECTED GROUNDWATER DATA
Uranium (total), (GW-1)
U (total), (pCi/l)
500.0
400.0
300.0
200.0
100.0
0.0
May-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
Jun-91
SAMPLING DATE

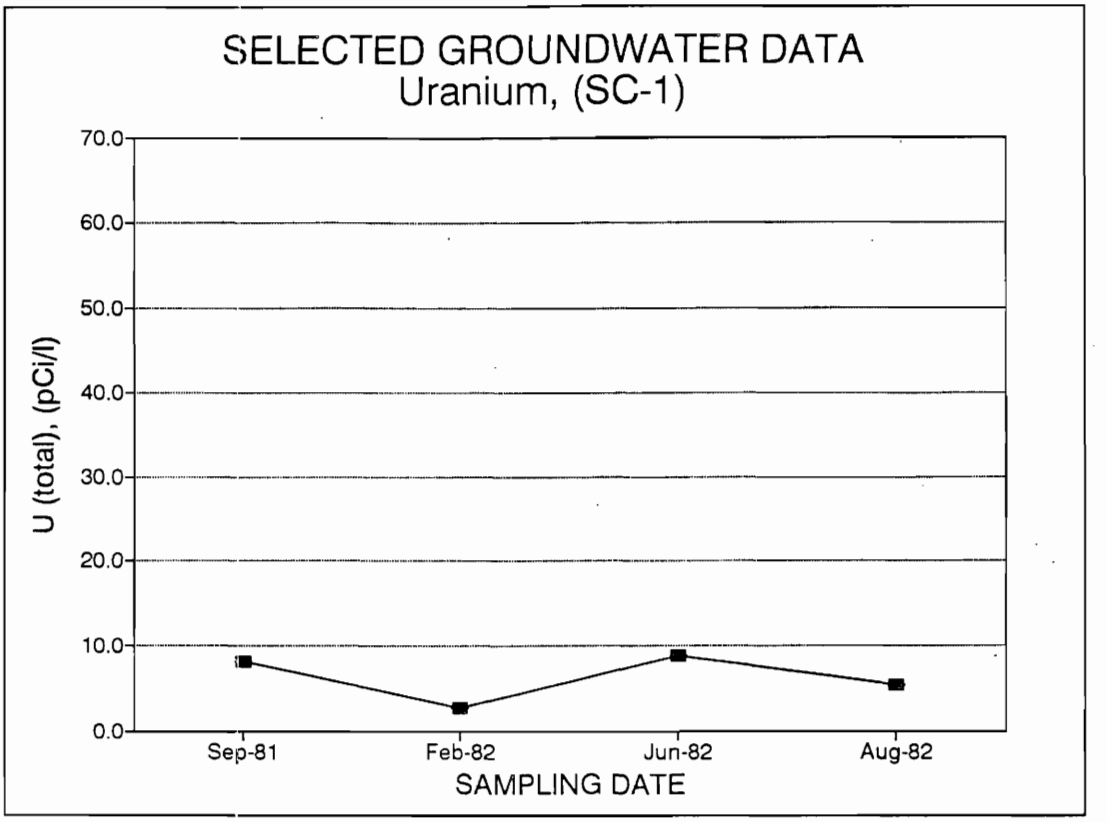

SELECTED GROUNDWATER DATA
Uranium (total), (GW-2)
U (total), (pCi/l)
500.0
400.0
300.0
200.0
100.0
0.0
Apr-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
May-91
SAMPLING DATE

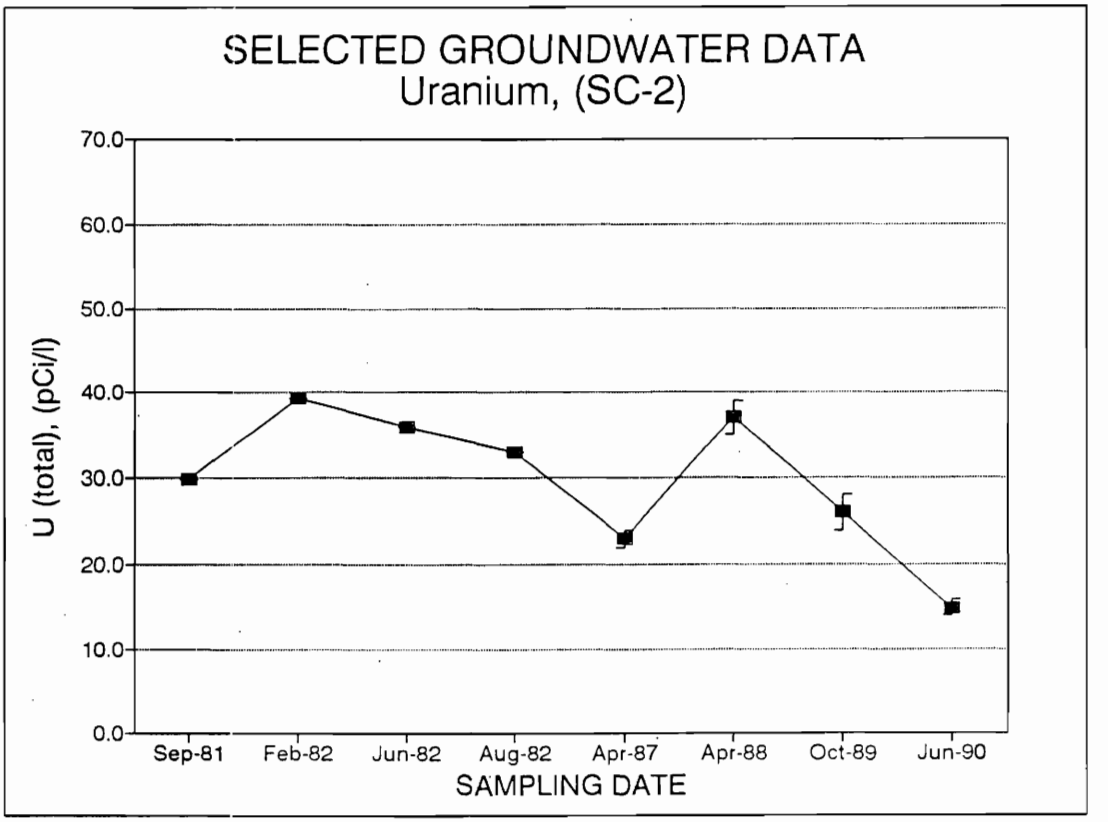

SELECTED GROUNDWATER DATA
Uranium (total), (GW-3)
U (total), (pCi/l)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Apr-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
Mar-91
May-91
SAMPLING DATE

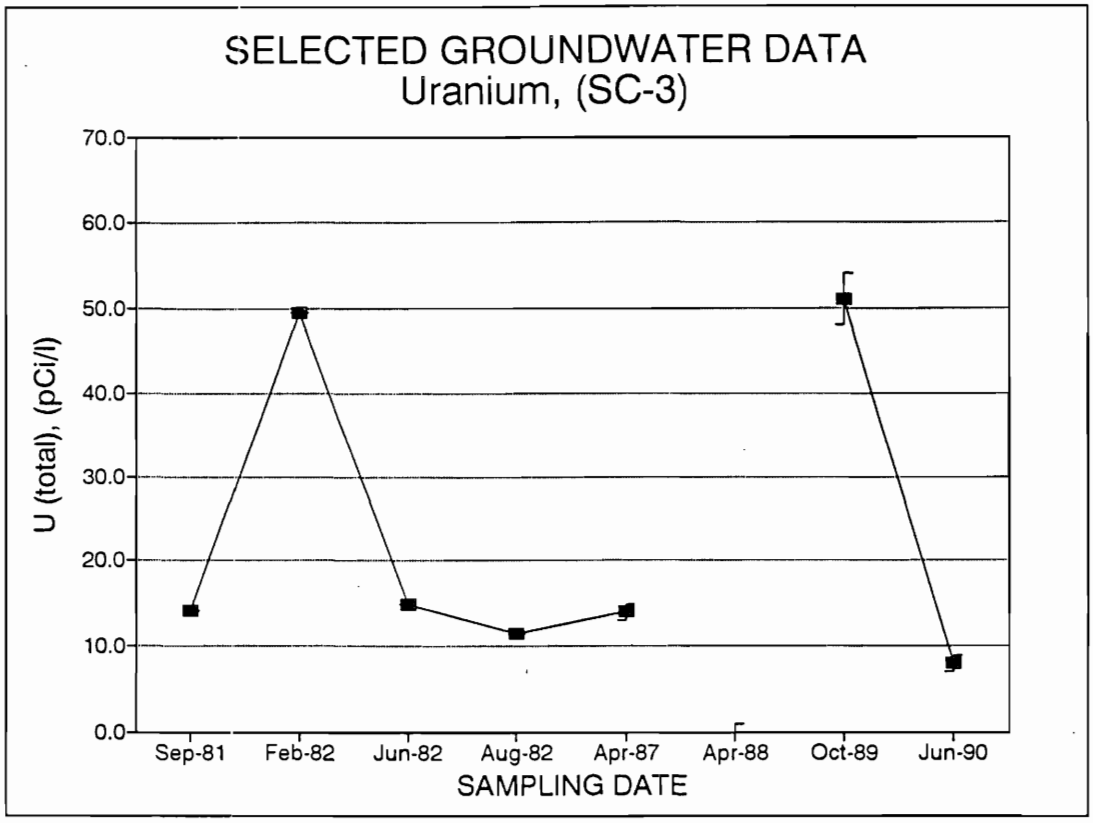

SELECTED GROUNDWATER DATA
Uranium (total), (GW-4)
U (total), (pCi/l)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Jul-88
Feb-89
Sep-89
Feb-90
Sep-90
Mar-91
SAMPLING DATE

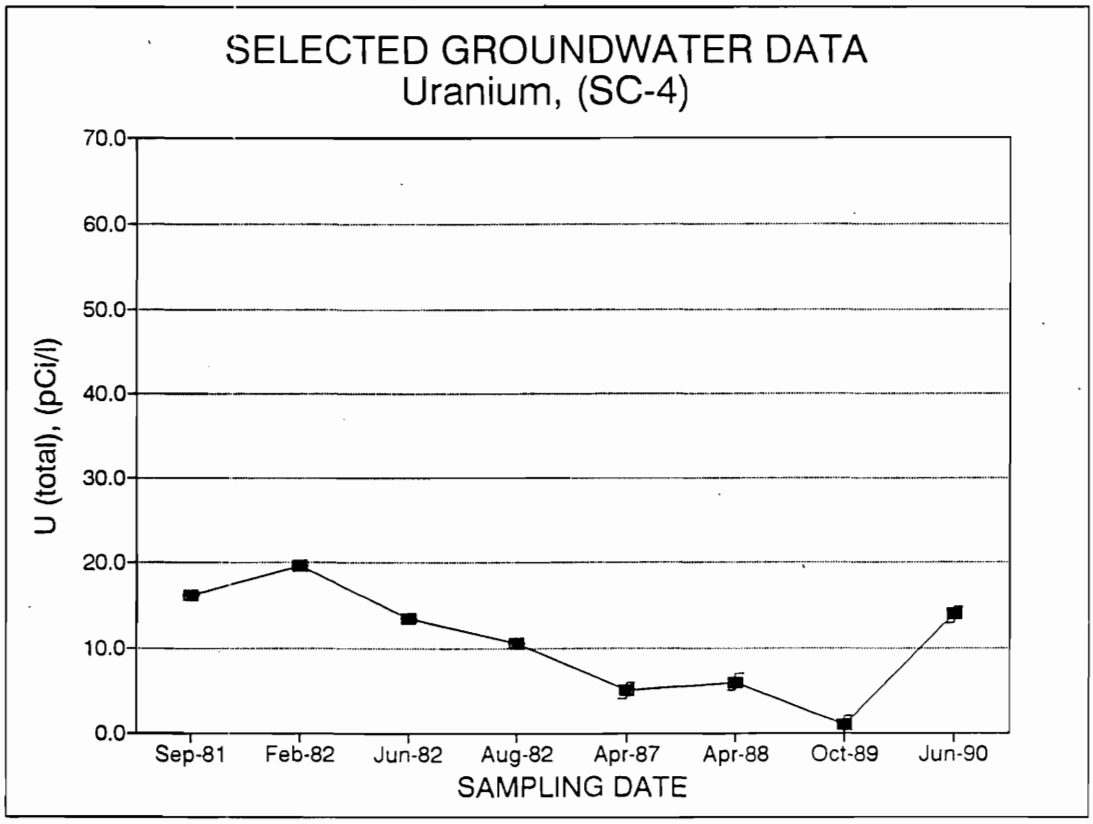

SELECTED GROUNDWATER DATA
Uranium (total), (GW-5)
U (total), (pCi/l)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Mar-88
Oct-88
Jun-89
Dec-89
Sep-90
Dec-90
Jun-91
SAMPLING DATE

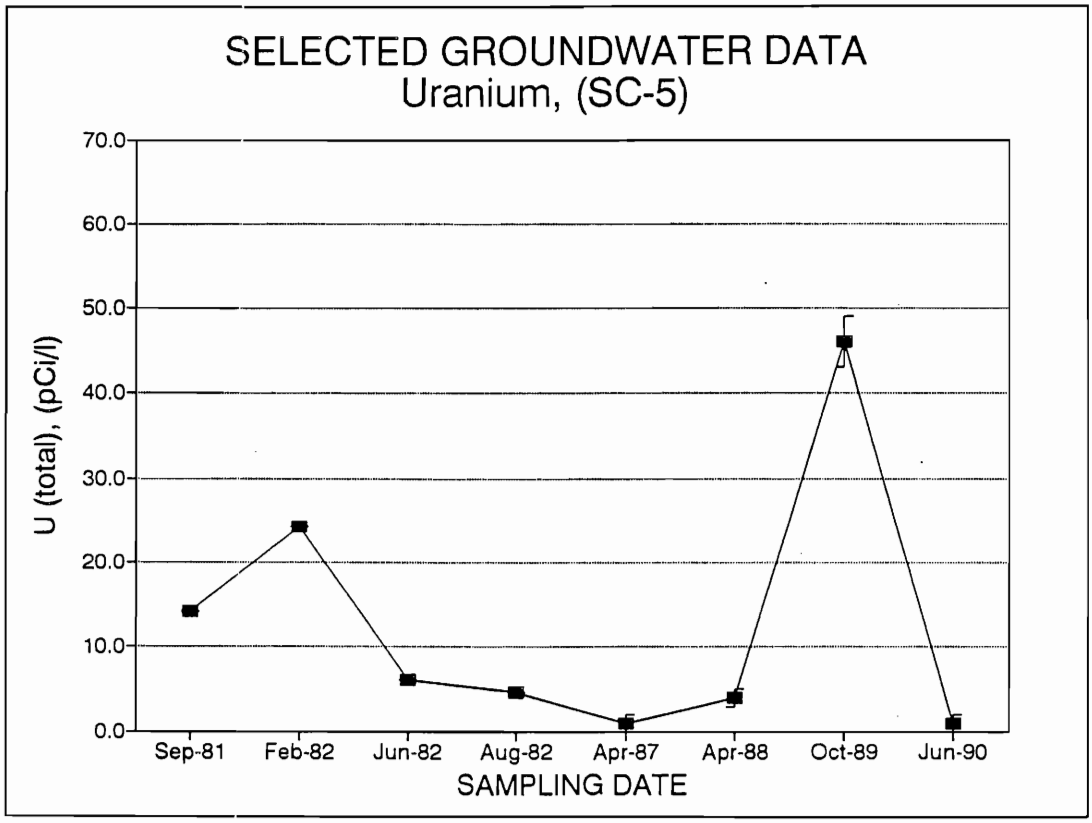

SELECTED GROUNDWATER DATA
Uranium (total), (GW-6)
U (total), (pCi/l)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Apr-88
Oct-88
Jun-89
Dec-89
Sep-90
Nov-90
Jun-91
SAMPLING DATE


SELECTED GROUNDWATER DATA
Uranium, (SC-1)
U (total), (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sep-81
Feb-82
Jun-82
Aug-82
SAMPLING DATE

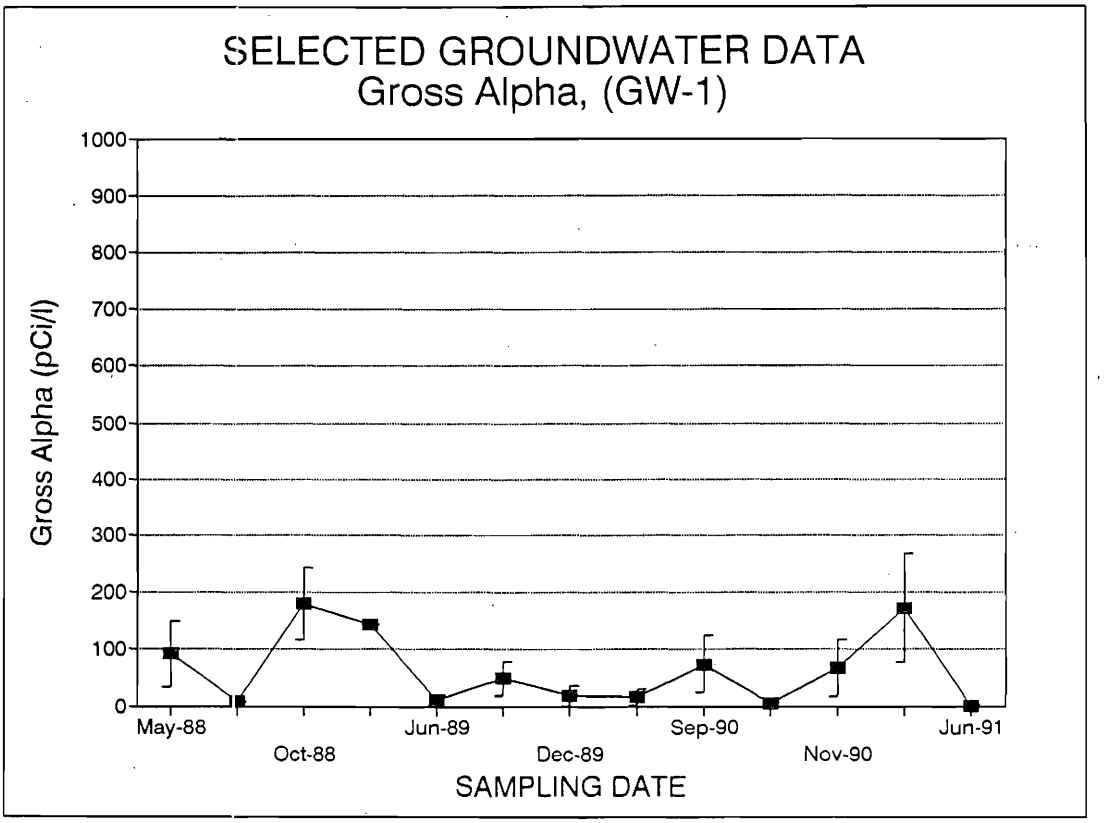

SELECTED GROUNDWATER DATA
Uranium, (SC-2)
U (total), (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE


SELECTED GROUNDWATER DATA
Uranium, (SC-3)
U (total), (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE


SELECTED GROUNDWATER DATA
Uranium, (SC-4)
U (total), (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE


SELECTED GROUNDWATER DATA
Uranium, (SC-5)
U (total), (pCi/l)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sep-81
Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE

GROSS ALPHA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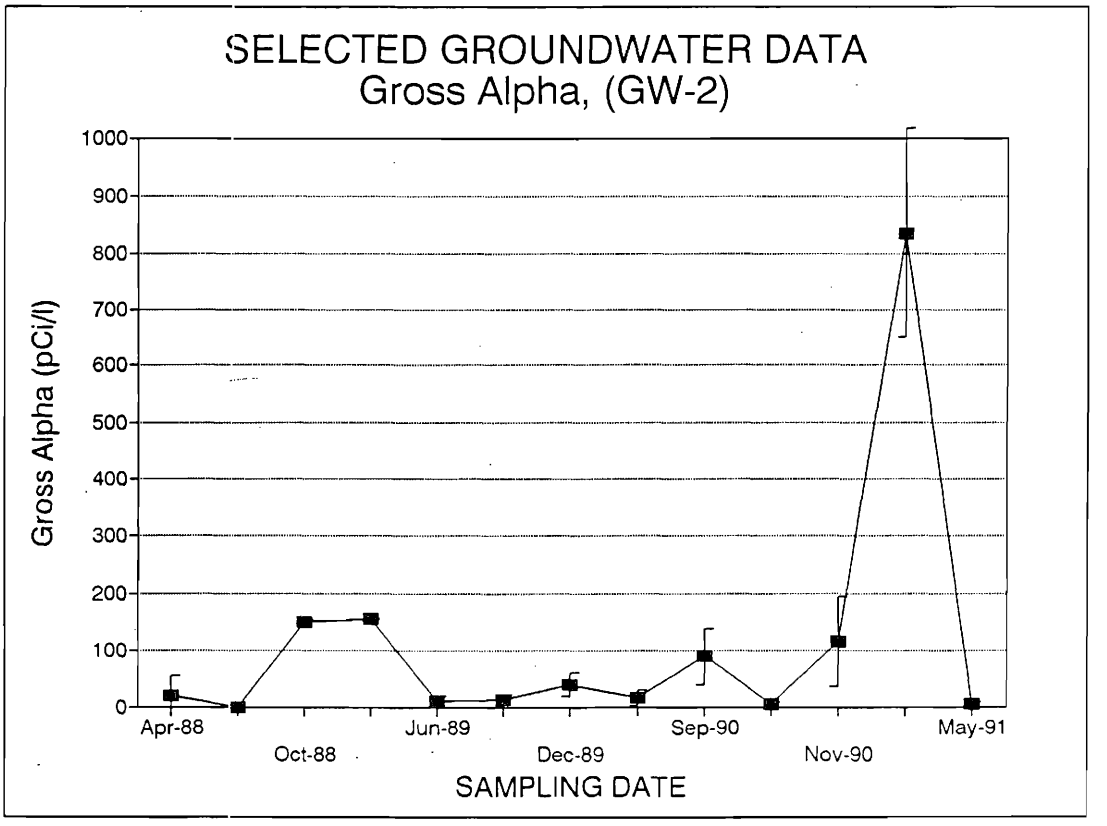
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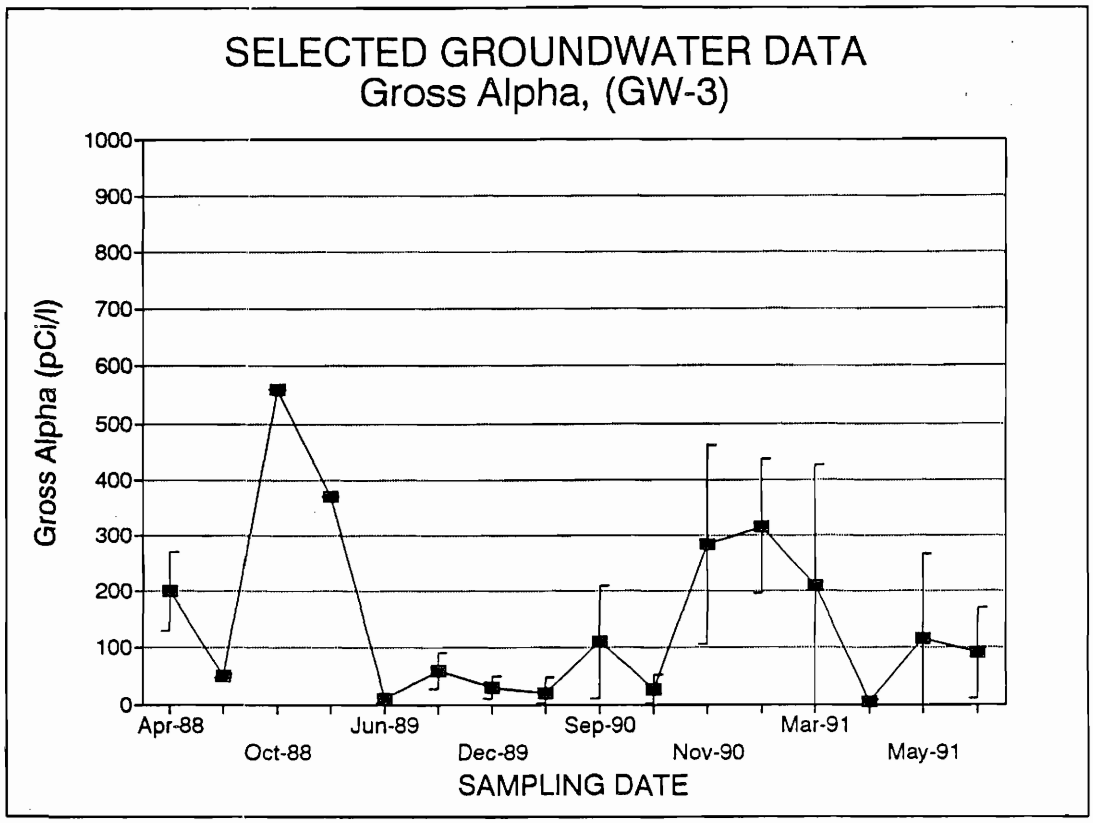
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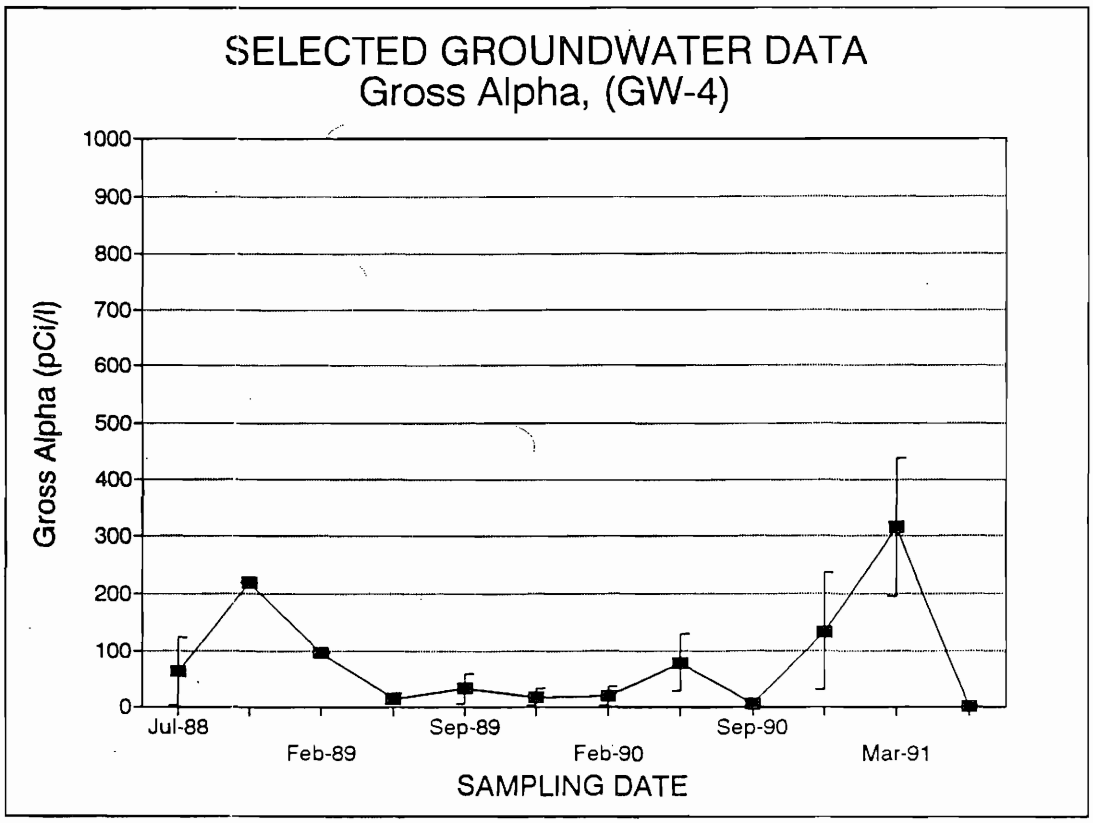
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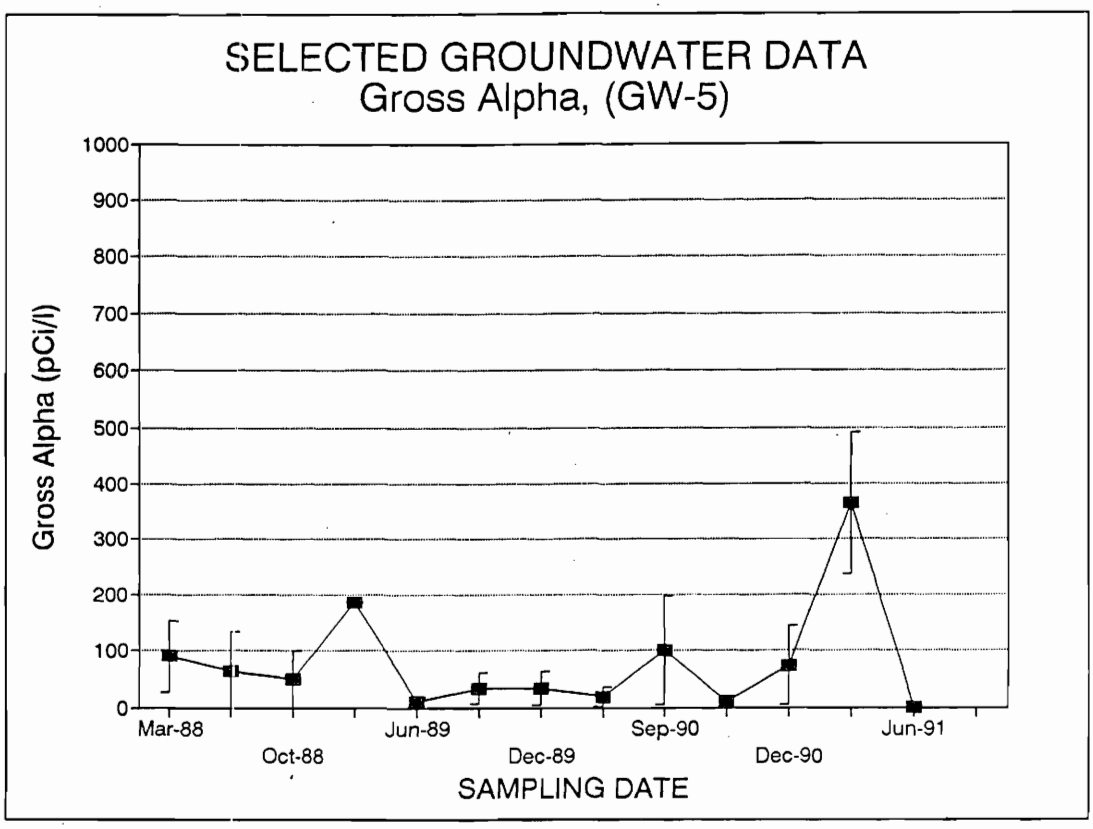
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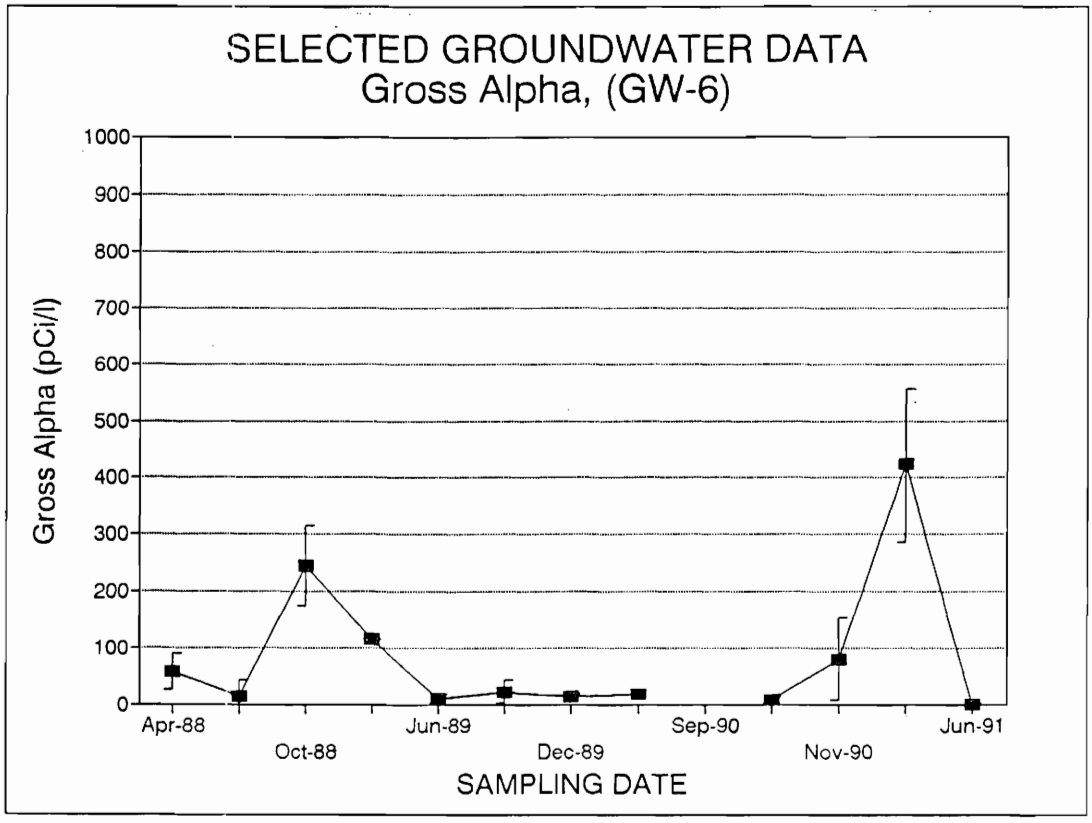
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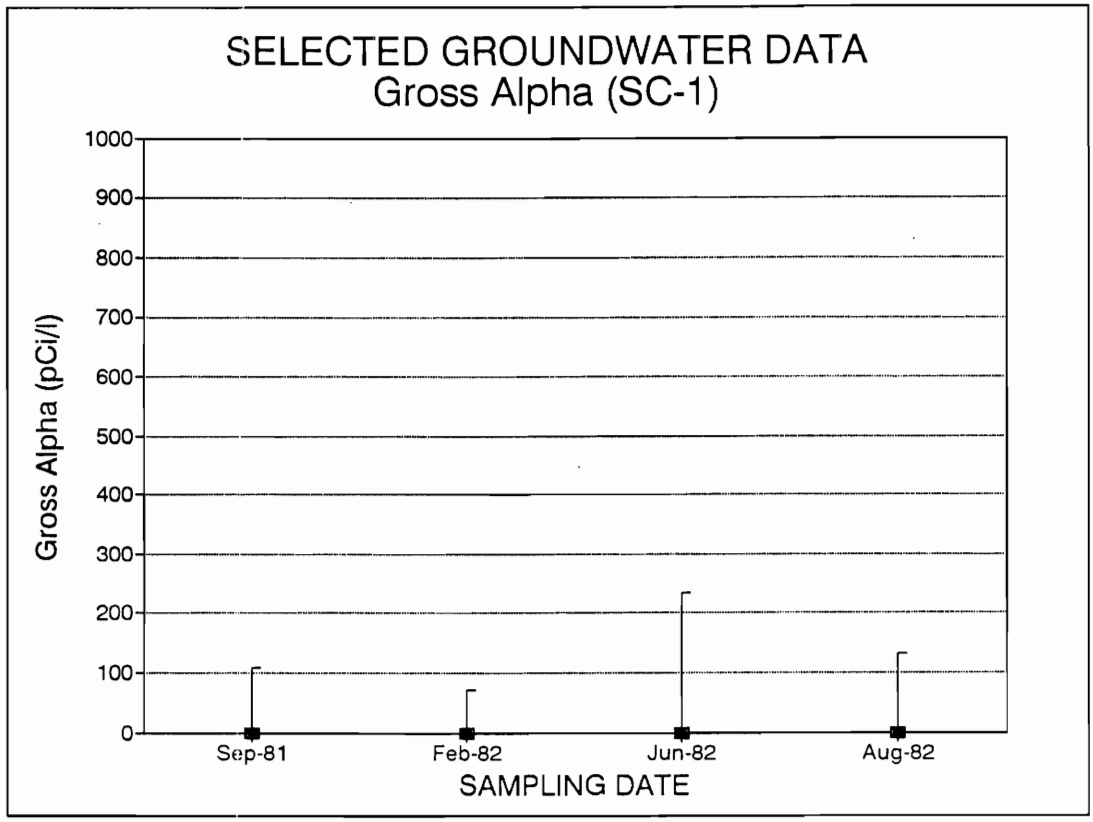
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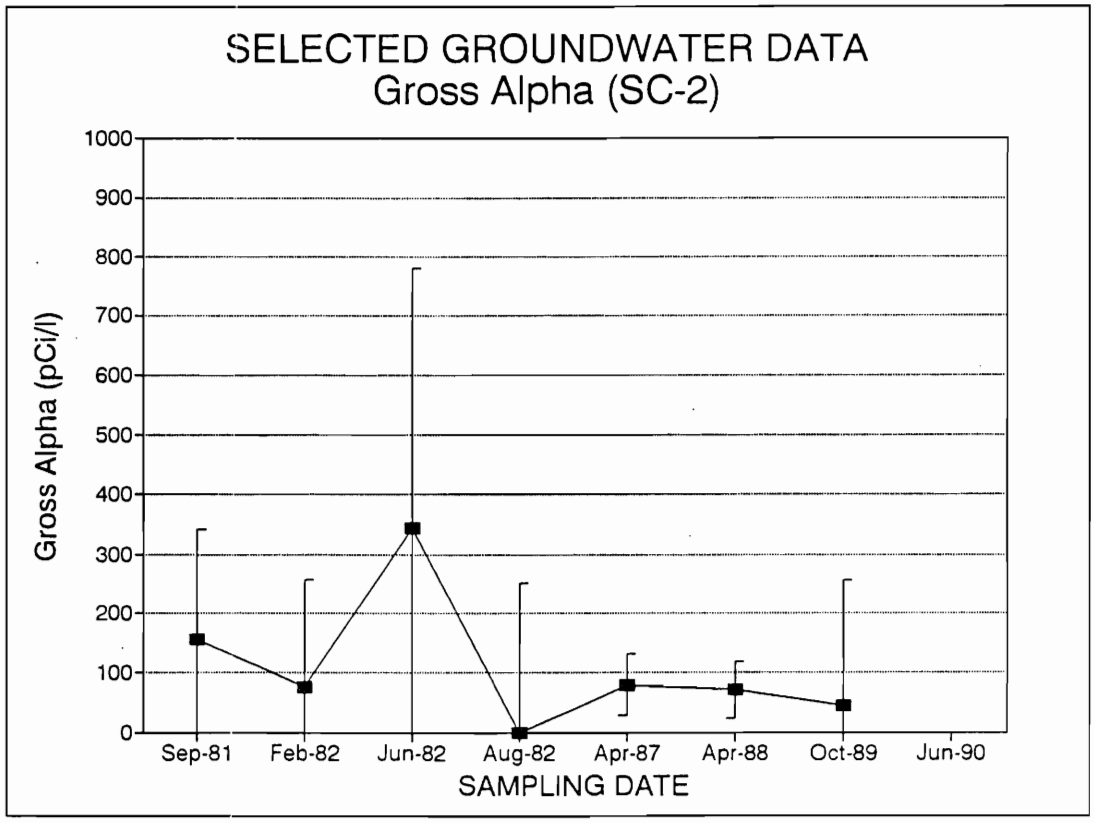
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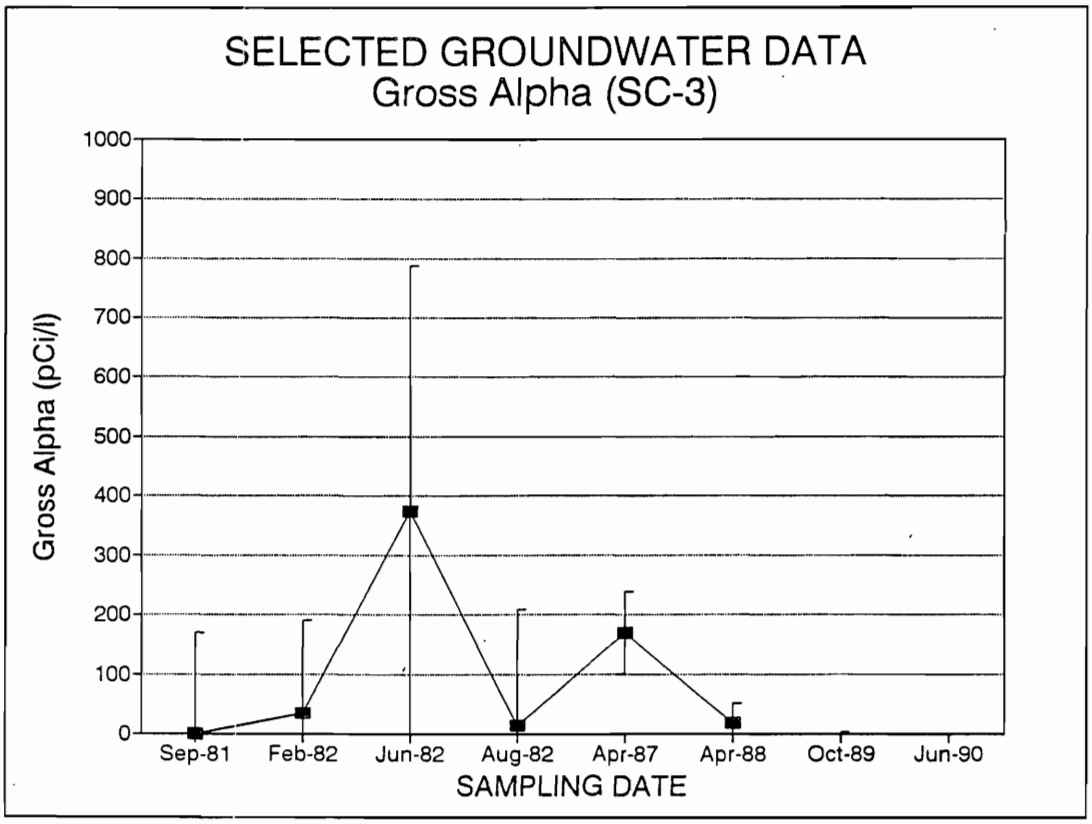
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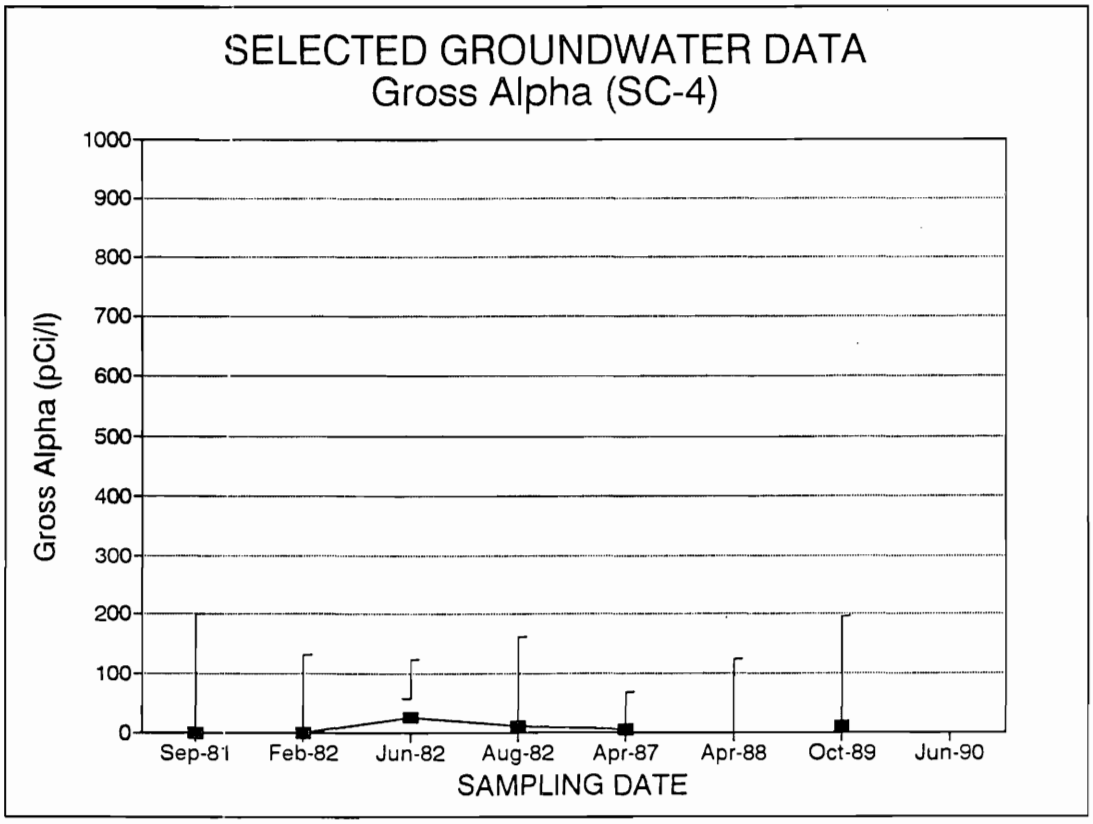
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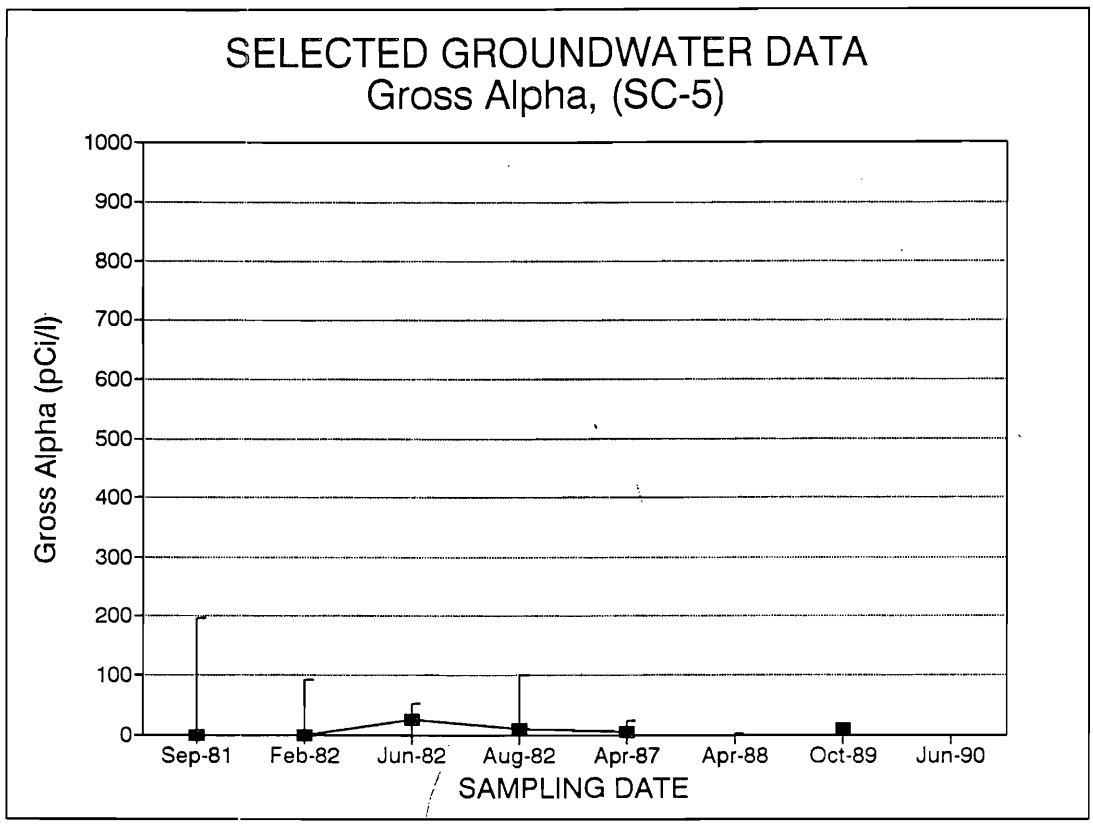
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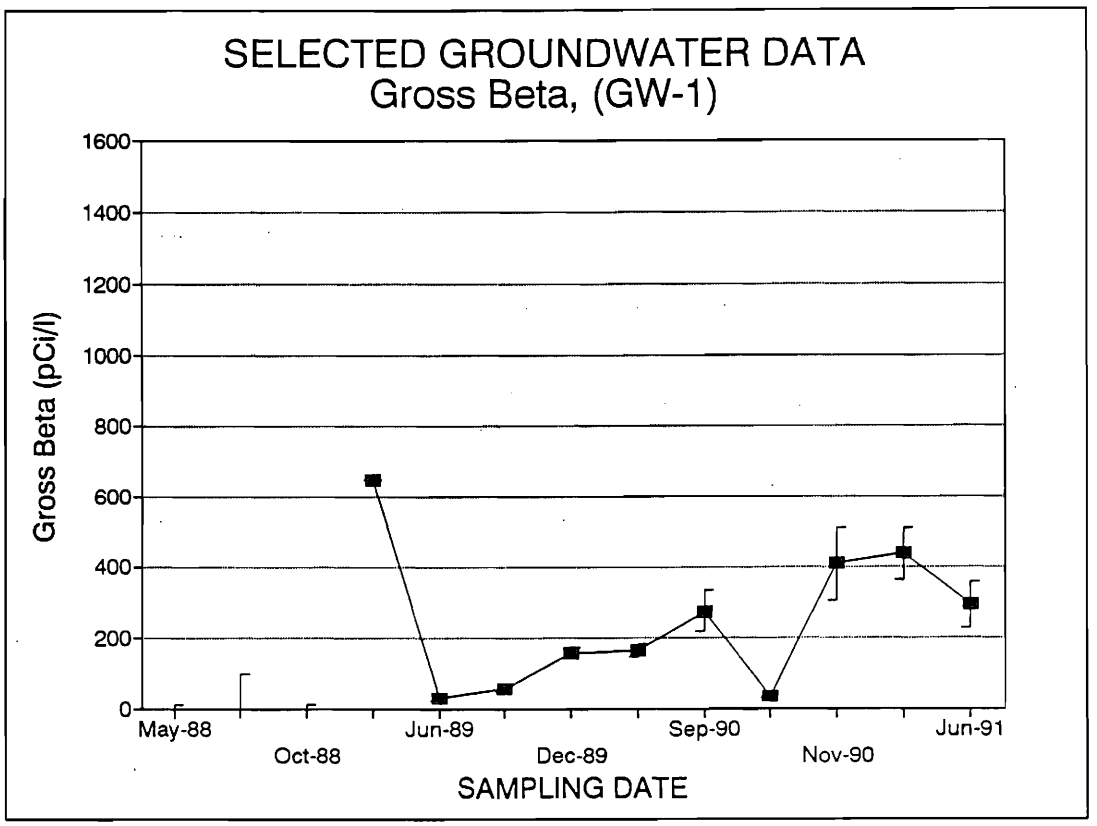
GROSS BETA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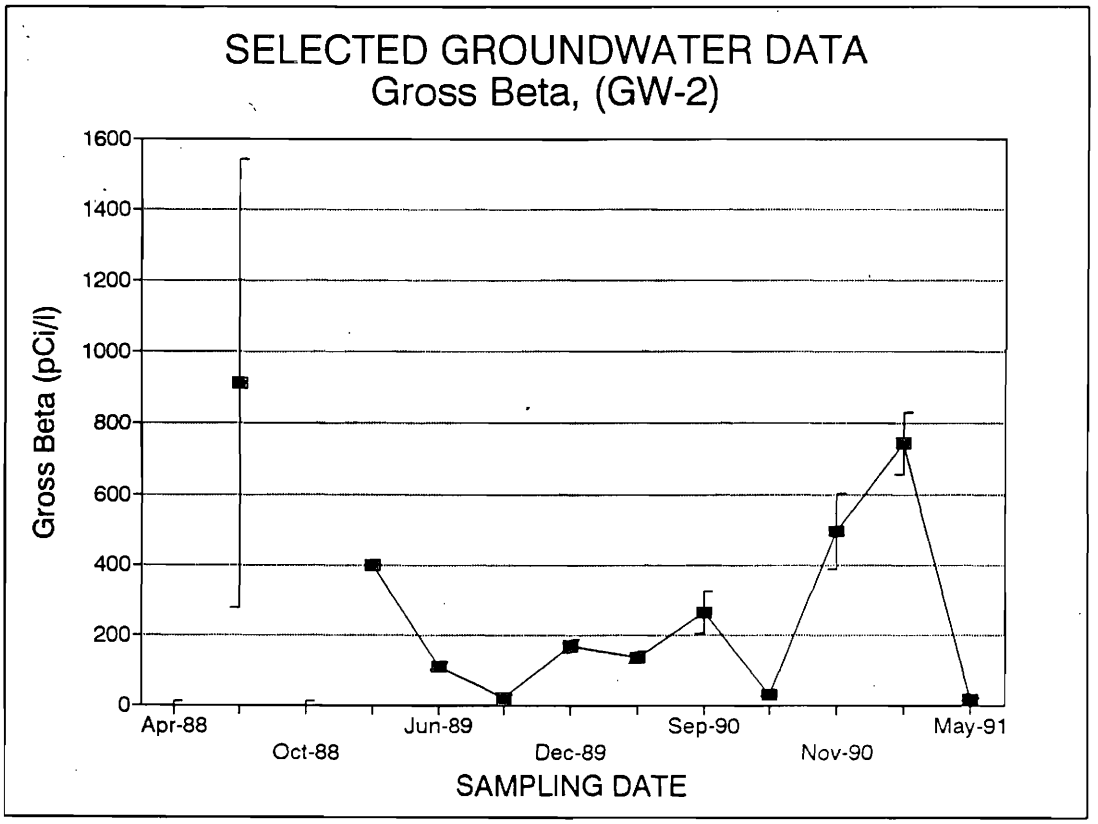
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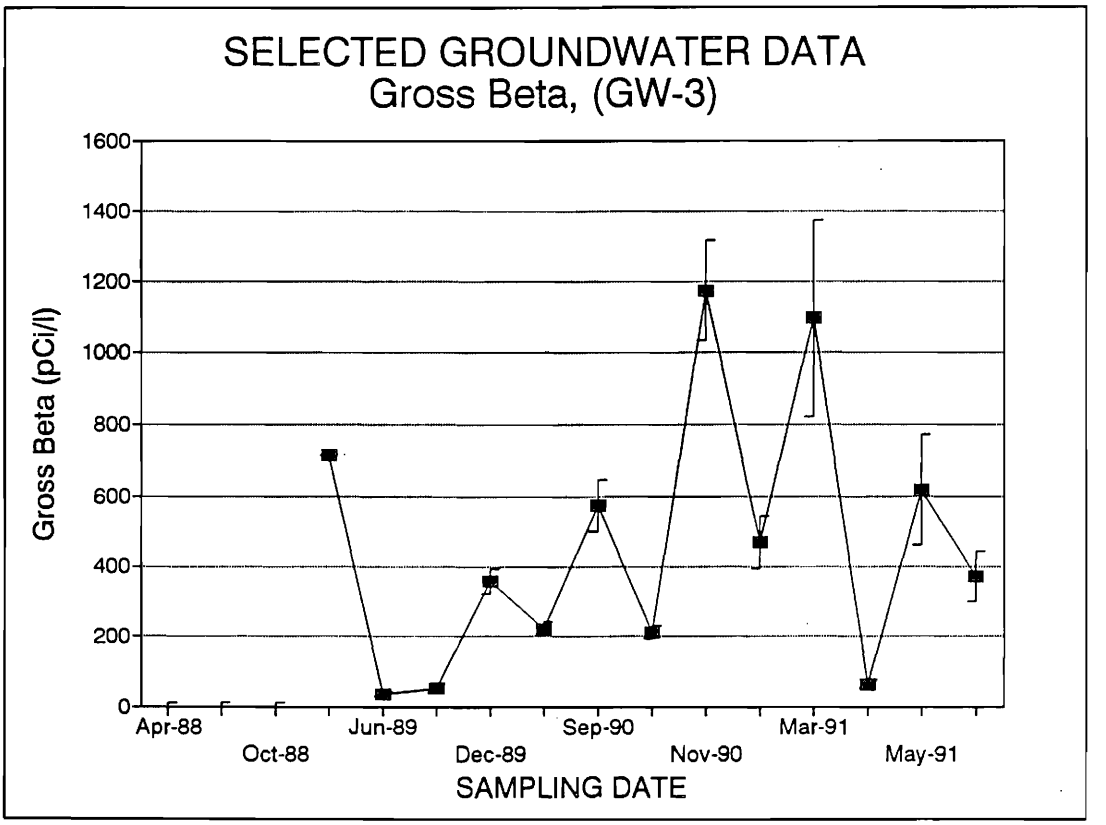
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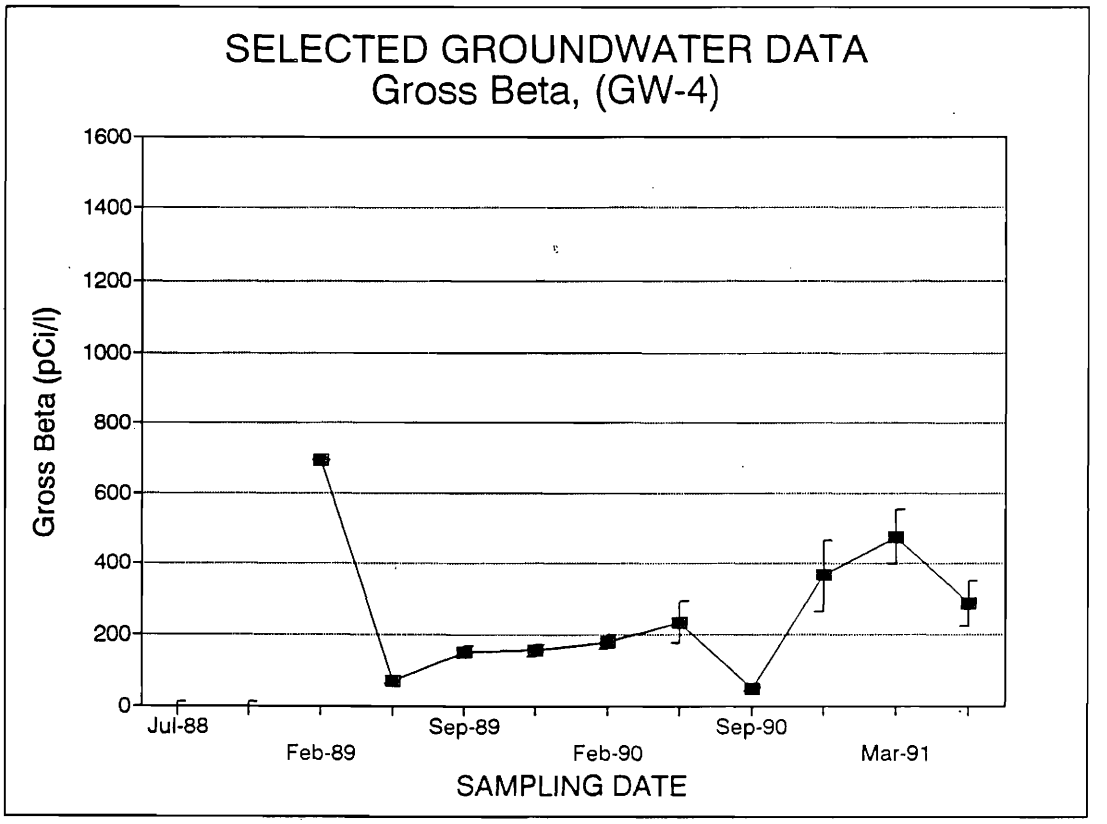
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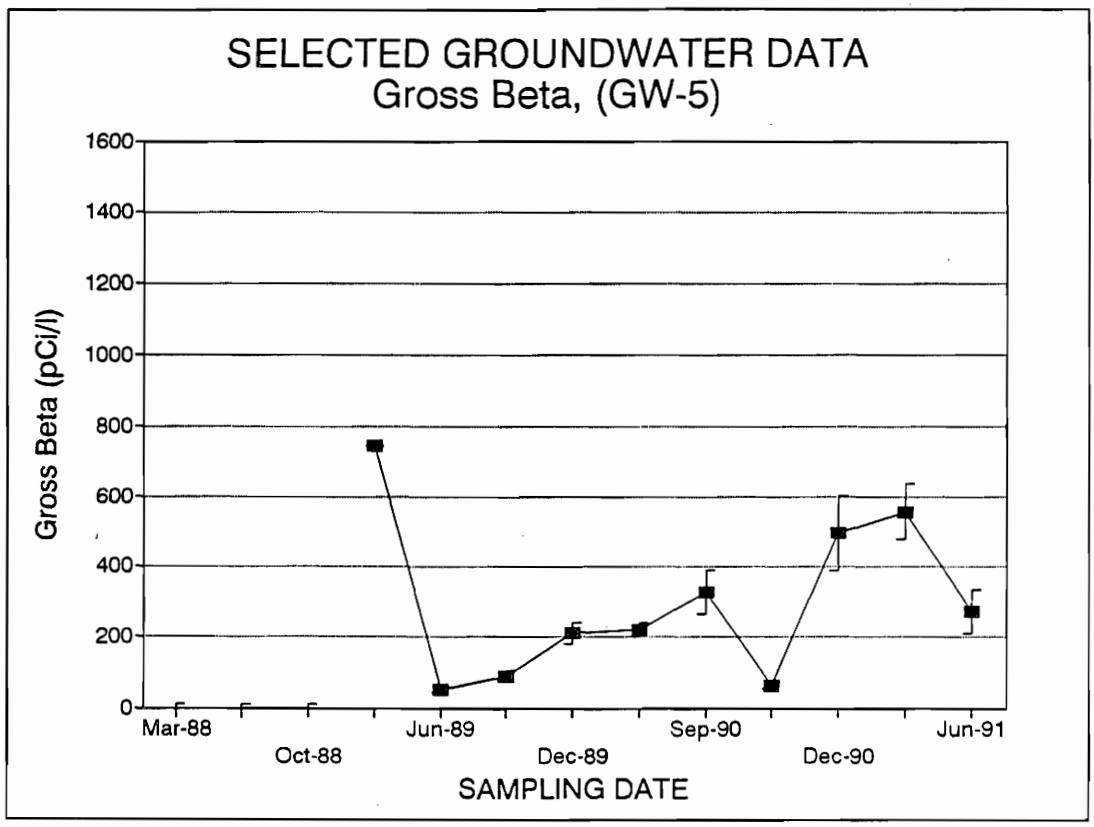
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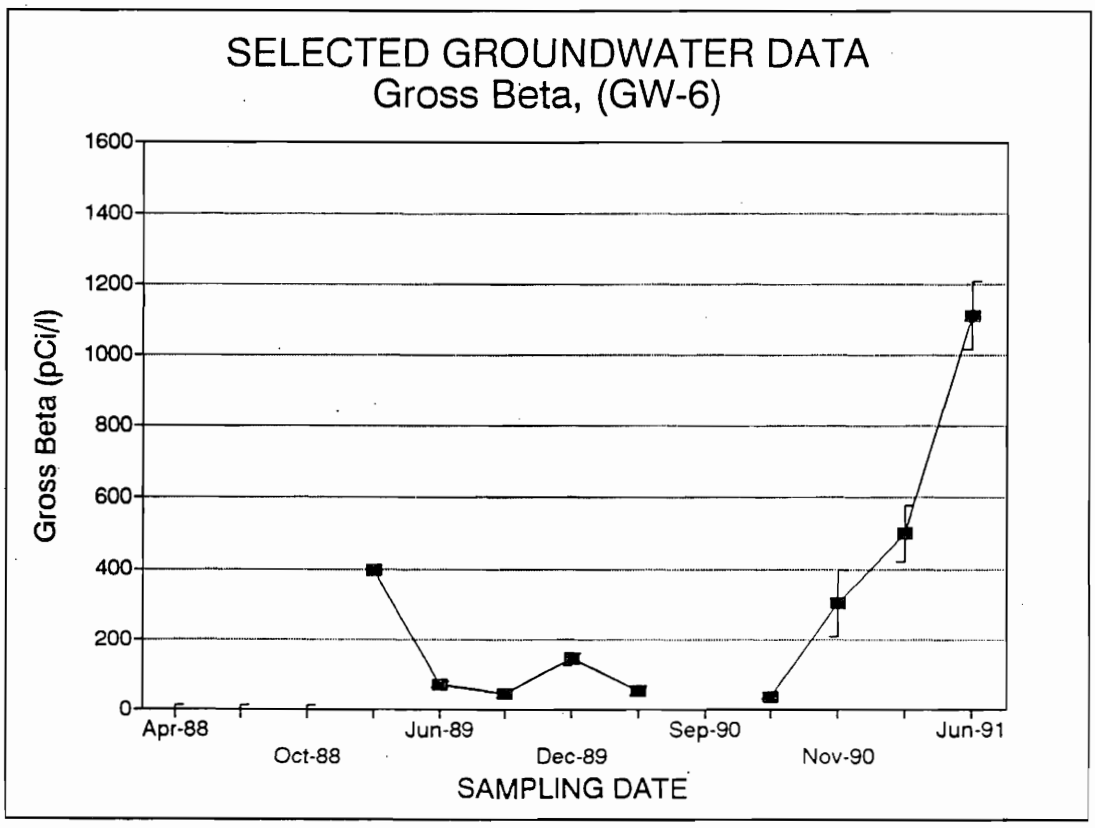
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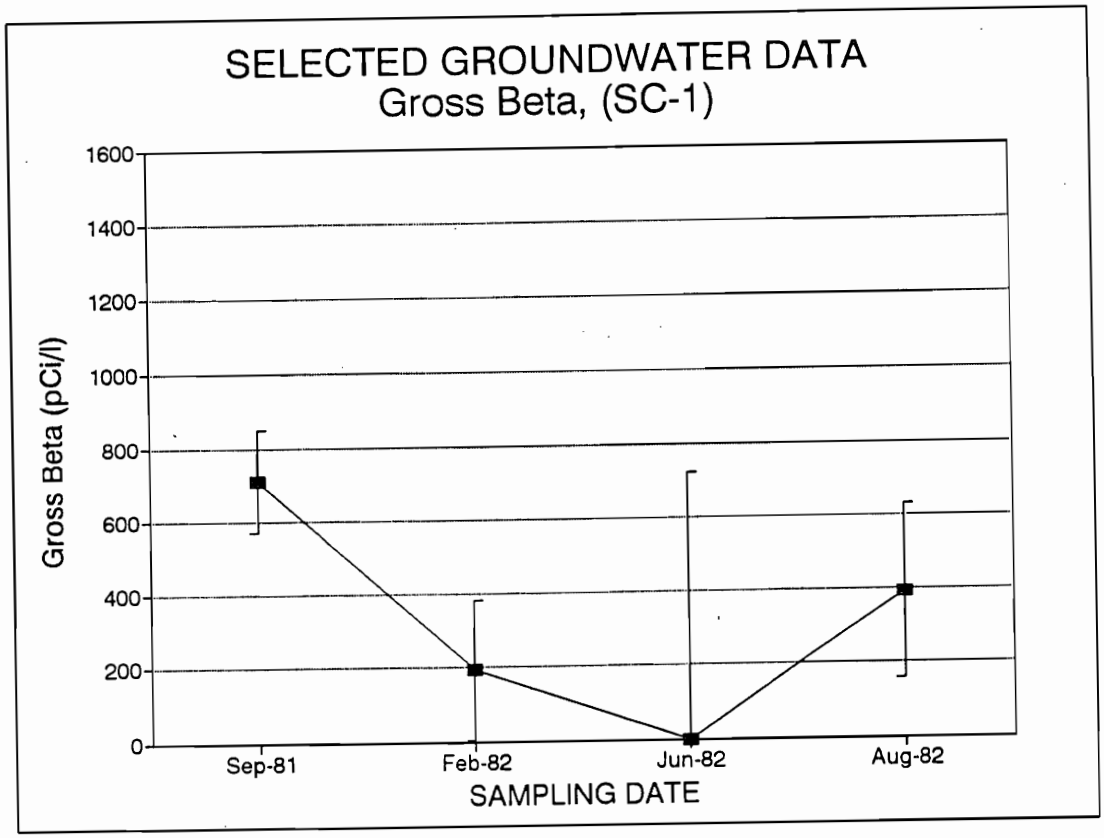
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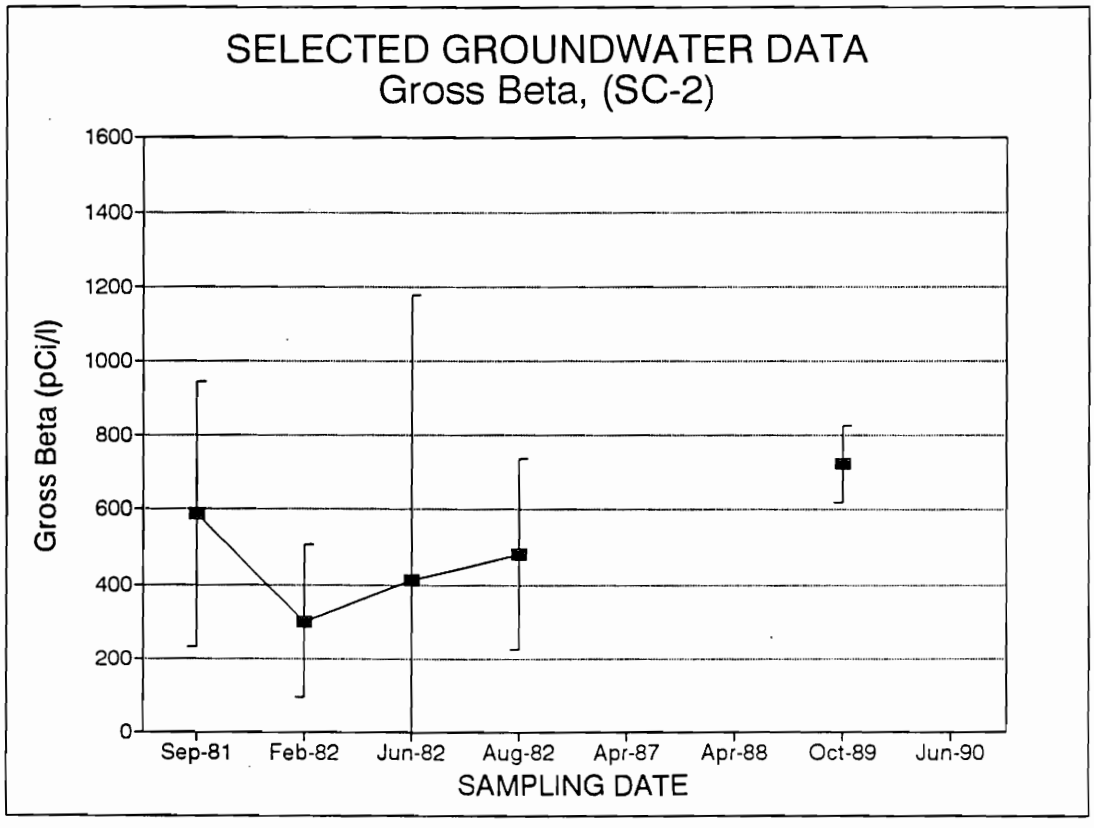
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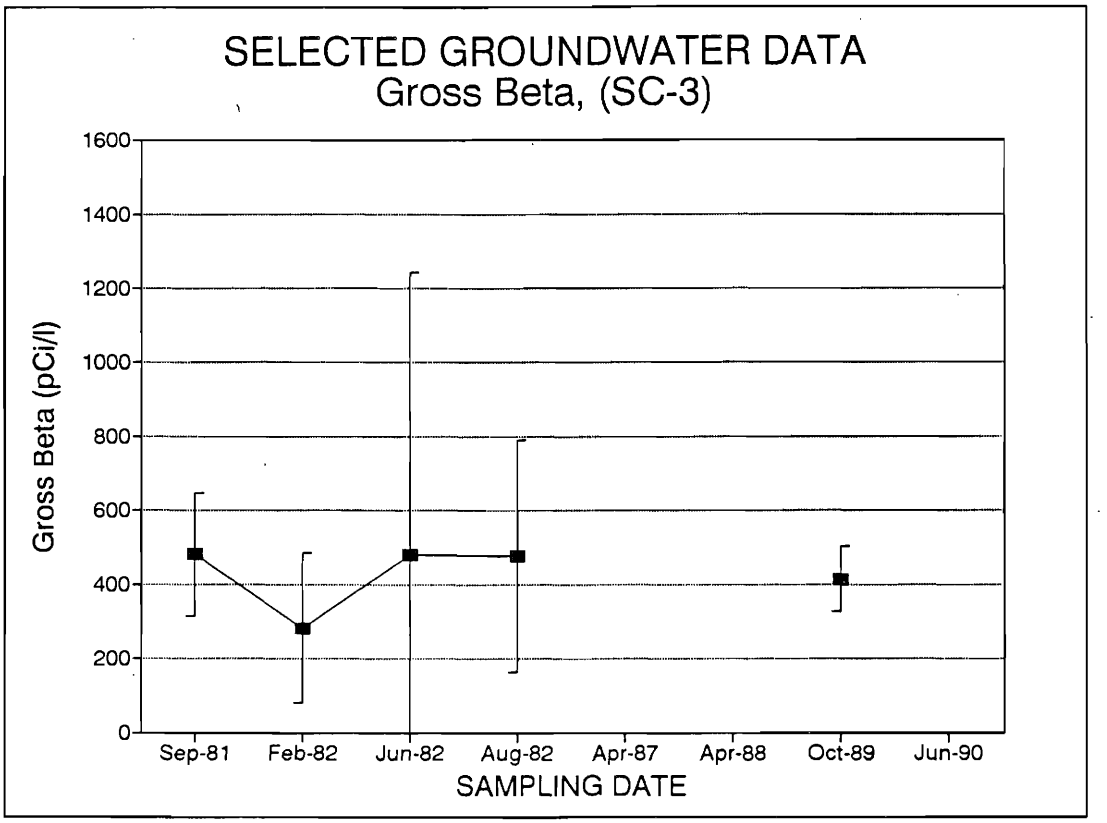
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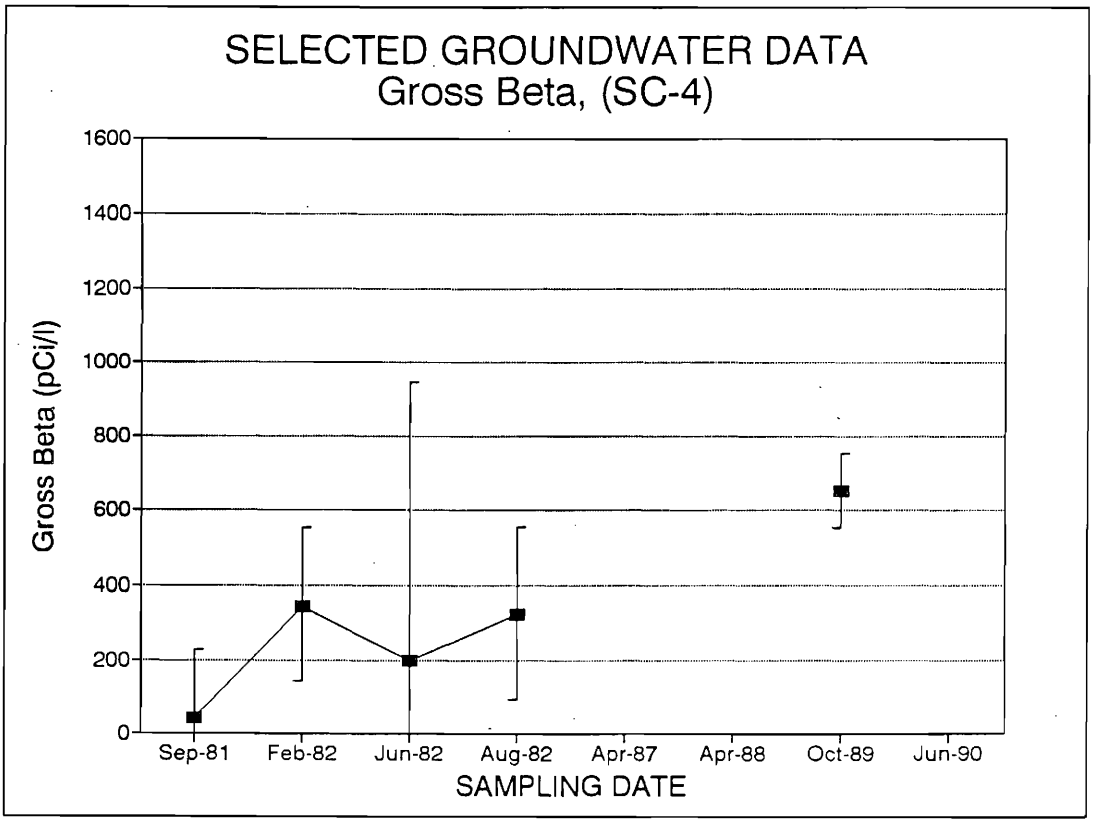
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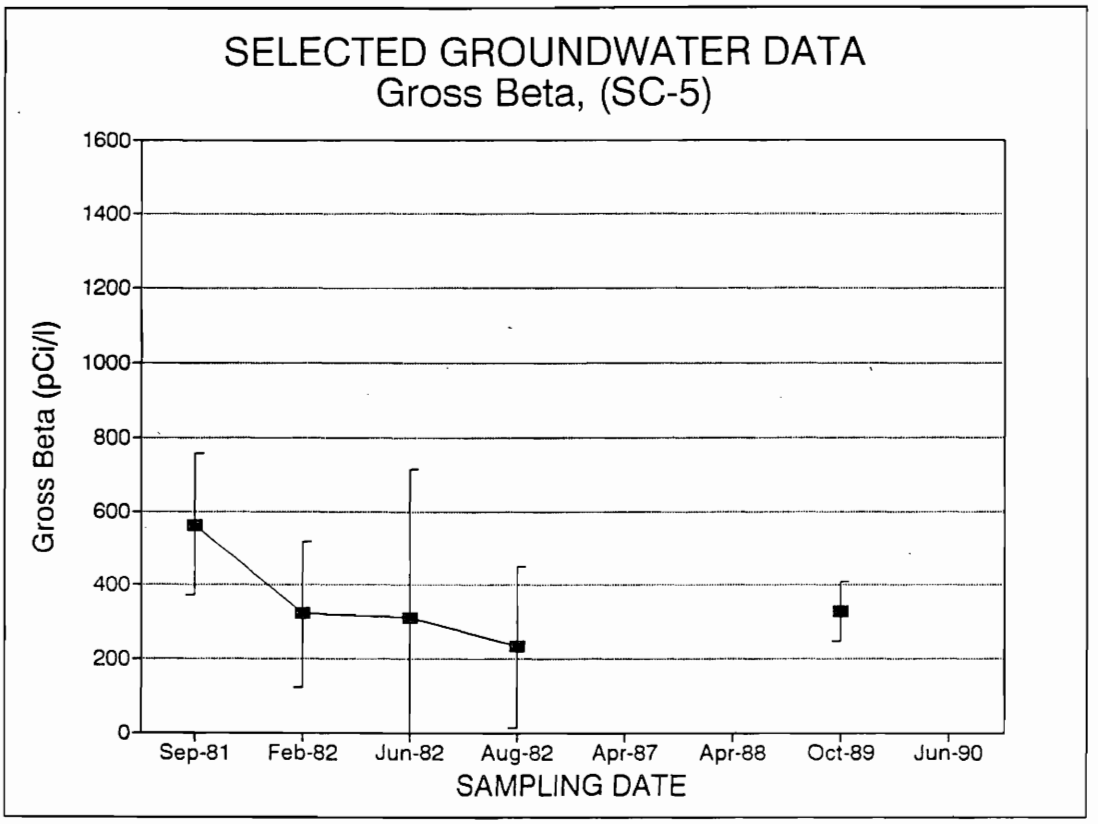
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Feb-82
Jun-82
Aug-82
Apr-87
Apr-88
Oct-89
Jun-90
SAMPLING DATE

APPENDIX D

CONTAMINANT TRANSPORT MODELING

BINGHAM ENVIRONMENTAL
5160 Wiley Post Way, Salt Lake City, Utah 84116, (801) 532-2230, FAX (801) 328-3381
A Bingham Engineering Company

March 7, 1991

Envirocare of Utah
215 South State Street, Suite 1160
Salt Lake City, Utah 84111

Attention: Mr. Charles Judd
Vice President of Operations

RE: Subsurface Contaminate Transport Based on PATHRAE Modeling
Low Level Radioactive Waste Landfill
Envirocare of Utah Facility
South Clive, Utah

Dear Mr. Judd:

This letter and the attached Rogers & Associates Engineering (Rogers) memorandum provide additional documentation for the PATHRAE model which was used in evaluating the potential for groundwater contamination due to the Envirocare Low Level Radioactive Waste (LLRW) Landfill Facility. Rogers, the firm which developed the PATHRAE model for the U.S. Environmental Protection Agency (EPA), utilized the PATHRAE model in 1990 as part of a risk assessment of the Envirocare Facility. One of the main advantages of using the PATHRAE model is its ease of operation while still considering a comprehensive set of contaminants and environmental pathways.

The PATHRAE model was developed for the EPA to assist in evaluating the risk of contaminated LLRW materials migrating from the disposal site. The model allows the user to evaluate ten different off-site and on-site pathways one of which is the groundwater transport to a well (groundwater contamination pathway). The PATHRAE model allows the user to simulate the movement of leachate from the bottom of the landfill cell through the unsaturated zone to the groundwater surface. PATHRAE then estimates the contaminant concentrations in the groundwater and simulates the contaminant transport in the direction of groundwater flow.

Rogers has provided additional documentation (see attached memorandum) on the 1990 PATHRAE computer runs for the Envirocare LLRW Site. This documentation includes the basis for selection of distribution coefficients, a discussion of contaminant retardation and rationale for selection of other key input parameters.

Model Verification

Groundwater concentrations of radionuclides predicted by PATHRAE have been compared to predictions utilizing alternative subsurface contaminant transport models and to groundwater quality data available for several waste sites. These comparisons have been performed by Rogers and other independent organizations. Results of these comparisons indicate that PATHRAE is a good model for predicting potential contamination pathways for a LLRW site. The model tends to predict higher groundwater contamination than a more detailed contaminant transport model would compute, however, for preliminary risk assessments this more conservative approach is preferable.

Rogers utilized PATHRAE to perform assessments of groundwater concentrations at the Savannah River Plant located in South Carolina. A copy of the report, dated September 1986, has been provided for your information. Measured groundwater concentration data was available for some of the waste sites at the Savannah River Plant. The measured concentrations are compared with the concentrations calculated by PATHRAE on Figure 4-1 and Table 4-2 of the report. The calculated values compare favorably with the observed groundwater concentrations, especially for the radionuclides.

Faculty members at Clemson University performed independent verification of the PATHRAE model by evaluating the computer code and comparing PATHRAE with alternative groundwater contaminant transport models. A copy of the Clemson University report is also provided for your information. The conclusions of the report are that the PATHRAE model tends to predict higher groundwater concentrations than other standard two and three dimensional contaminant models because it neglects vertical dispersion for movement in the unsaturated zone.. The conclusions of the Clemson University evaluations were that the PATHRAE subsurface contaminant transport code is a conservative model for predicting contamination of groundwater.

In summary, the PATHRAE model is a good tool for predicting potential contamination pathways for a LLRW site. The model tends to predict higher groundwater contamination than a more detailed contaminant transport model would predict, however, for risk assessments this more conservative approach is preferable.

References

Merrell, G.B. and V.C Rogers, "*Modeling of Waste Sites at the Savannah River Plant Using the PATHRAE Computer Code,*" Rogers and Associates Engineering Corporation, September 1986.

Field, R.A., A.W. Elzerman, T.J. Overcamp, N. Giannopoulos, S. Crider and B.L. Sill, "*Verification and Sensitivity of the Calculational Methodology Utilized in the PATHRAE Code to Predict Subsurface Contaminant Transport for Risk Assessments of SRP Waste Sites*", Clemson University, June 1986.

U.S. EPA, "*Low-Level and NARM Radioactive Wastes, Model Documentation, PATHRAE-EPA, Methodology and Users Manual*", December 1987.

Baird, R.D., M.K. Bollenbacher, E.S. Murphy, R. Shuman, and R.B. Klein, "*Evaluation of the Potential Public Health Impacts Associated with Radioactive Waste Disposal at a site near Clive, Utah*", Rogers and Associates Engineering Corporation, June 1990.

Merrell, G.B., V.C. Rogers, K.K. Nielson and M.W. Grant, "*The PATHRAE Performance Assessment Code for the Land Disposal of Radioactive Wastes*", Rogers and Associates Engineering Corporation, November 1985.

"*Hydrogeologic Study, Mixed Waste Landfill Cell, South Clive, Tooele County, Utah*", Delta Geotechnical Consultants, November 29, 1989.

This information is provided for your information and to forward to the UDH. Please feel free to call and discuss these items.

Sincerely,

BINGHAM ENVIRONMENTAL

Stanley L. Plaisier, P.E.
Project Manager

cc: Gary Merrell - Rogers and Associates Engineering Co.

TECHNICAL INFORMATION MEMORANDUM

SUBJECT: APPLICATION OF THE PATHRAE COMPUTER CODE TO THE CLIVE DISPOSAL SITE

BY: G.B. Merrell

FOR: Bingham Environmental

DATE: March 7, 1991

Rogers & Associates Engineering Corporation

R
A
E

INTRODUCTION

The PATHRAE computer code[1] has been developed for the U.S. Environmental Protection Agency by Rogers and Associates Engineering. The model is used to assess the release, environmental transport, and human uptake of radionuclides resulting from the land disposal of low-level radioactive waste (LLRW). The model considers environmental transport through groundwater, surface water, air, plants, animals, and external exposure.

The PATHRAE code has been used to perform radionuclide release and transport simulations for the Envirocare LLRW facility at Clive, Utah.[2] Two of the key parameters in this analysis were the water infiltration rate through the disposal cells and the distribution coefficients used in the release and transport calculations. Of particular interest at this time are the calculations of radionuclide release and transport through the unsaturated zone between the bottom of the disposal cells and the shallow unconfined aquifer. A water infiltration rate of 1.24 mm/yr was selected, based on estimates provided in the hydrogeologic study for the mixed waste landfill cell.[3] This technical information memorandum addresses specific items as requested by the Utah Department of Health.

Distribution Coefficients

The distribution coefficient, or Kd, is one of the key parameters in describing the release and environmental transport of radionuclides. The distribution coefficient is used to quantify the tendency of each radionuclide to be adsorbed by soil. This adsorption affects the release rates of radionuclides from waste and the rates at which the radionuclides can be transported through soils and other geologic media.

The distribution coefficient, hereafter referred to as Kd, is defined as the equilibrium ratio of the concentration of adsorbed radionuclide to the concentration of the radionuclide in water. Adsorbed radionuclide concentrations are typically expressed as picocuries per gram of soil (pCi/g). The liquid concentrations are expressed as picocuries per milliliter of

liquid water (pCi/ml). Thus, the ratio of these concentrations results in the Kd having units of milliliters per gram (ml/g).

The use of the Kd for estimating radionuclide release and transport differs from the approach of using the radionuclide solubility. Solubility is based on the gradual dissolution of radionuclides in water and their subsequent transport as solutes. Since the molar concentrations of radionuclides in radioactive wastes are generally very low, the solubility is not believed to be an important or limiting factor when modeling release and transport mechanisms. In contrast, the use of the Kd accounts for adsorption of radionuclides by the surrounding geologic medium. For the low radionuclide concentrations generally found in LLRW, adsorption is believed to be the dominant process in radionuclide release and transport.

In practice, the Kd can be determined from laboratory measurements of radionuclide equilibrium between soil and water. This is a direct method of determining the radionuclide partitioning between soil and water. An indirect method of determining the Kd is to measure the groundwater migration rates of radionuclides in the field. The ratio of the water flow velocity to the radionuclide velocity defines a retardation factor. The Kd can then be calculated from the retardation factor.

When used in contaminant release and transport assessments, the Kd is used to determine radionuclide leach rates and transport properties. The lower the Kd, the higher the release rates and transport velocities will be. This is because a low Kd minimizes the effect of adsorption and retardation be the soil. For the Clive assessment conservative Kd values were used so that the radiological impacts through the groundwater pathway would not be underestimated.

Contaminant Retardation Factors

Subsurface radionuclide migration relies on the presence of water to transport the radionuclides by advection. Due to adsorption of the radionuclides by soil particles, the speed of radionuclide migration can be less than the flow speed of the water. The flow speed of the

water divided by the speed of radionuclide migration is known as the retardation factor. The retardation factor is related to the Kd as follows:

$$R = 1 + d*Kd/(p*s)$$

where,

R	=	radionuclide retardation factor,
d	=	density of the soil (g/cc)
Kd	=	distribution coefficient (ml/g),
p	=	effective porosity of soil,
s	=	soil moisture content (fraction of saturation).

The performance assessment for the Clive site utilized physical characteristics obtained from the Hydrogeologic Study report.[3] The PATHRAE analysis used a soil density of 1.6 g/cm^3 and an effective porosity of 0.20 in the unsaturated zone. The moisture content was taken to be 23.9 percent of saturation, which corresponds to a volumetric water content of 0.048.

The value of the Kd may vary by several orders of magnitude, depending on the soil type and geochemistry. The Kd values used in the analysis of the Clive disposal site are listed in Table 1. The table also shows the range of Kd values found in Reference 5, which itself is a survey of several literature sources of Kd values. The values in the analysis of the Clive site are the values recommended in Reference 5. For comparison, the table shows the Kd values used by the EPA in their performance assessments of a generic radioactive waste disposal site in an arid climate. The EPA analyses are documented in Reference 4.

In general, the values used for the Clive analysis are near the conservative end of the range. The most conservative (lowest) values in the ranges were not considered realistic for the site. In many cases, the Kd values at the lower extreme of the ranges are based on unusual conditions such as very high or very low pH, the presence of chemical chelating agents, ligands, or organic solvents.

For some elements, Kd values were not available in the literature surveyed. For some of these cases the Kd was estimated based on chemical similarities with other elements. This was done for europium and iridium. The europium Kd was assumed to be the same as that

Table 1. Element Kd values used for Clive assessment.

Element	Kd (ml/g)	Kd Range	Reference for Kd and Range	EPA Arid Site Kd[4]
Americium	100.	1 - 100,000	5	200,000.
Antimony	4000.	100 - 10,000	5	45.
Beryllium	5.	(a)	Assumed	(b)
Cadmium	6.	1 - 100	5	(b)
Calcium	5.	(a)	Assumed	(b)
Carbon	0.01	(a)	5	0.01
Cesium	500.	10 - 100,000	5	10,000.
Chromium	40.	1 - 1000	5	(b)
Cobalt	10.	0.1 - 1000	5	5000.
Curium	3000.	100 - 100,000	5	3300.
Europium	1000.	10 - 10,000	5, (c)	4000.
Hydrogen	0.001	(a)	5	0.01
Iodine	0.20	0.001 - 1	5	0.10
Iridium	160.	100 - 1000	5, (d)	(b)
Iron	5.	(a)	Assumed	2000.
Lead	100.	1 - 10,000	5	220.
Manganese	5.	(a)	Assumed	150.
Mercury	10,000.	(a)	5	(b)
Neptunium	10.	0.1 - 1000	5	5.
Nickel	100.	10 - 1000	5	3000.
Niobium	300.	90 - 1980	6	350.
Plutonium	100.	10 - 100,000	5	2000.
Polonium	100.	10 - 10,000	5	220.
Potassium	5.	(a)	Assumed	(b)
Radium	100.	10 - 1,000,000	5	220.
Ruthenium	160.	100 - 1000	5	220.
Silver	100.	10 - 1000	5	(b)
Sodium	0.001	(a)	Assumed	(b)
Strontium	8.	1 - 1000	5	150.
Technetium	0.001	0.001 - 100	5	0.10
Thorium	100.	10 - 100,000	5	60,000.
Tin	100.	(a)	5	(b)
Uranium	40.	0.1 - 1,000,000	5	6.
Zinc	15.	0.1 - 10,000	5	(b)

(a) No range of values found in literature.
(b) Radionuclide not included in EPA assessments.
(c) Europium Kd is taken to be the same as that for Cerium.
(d) Iridium Kd is taken to be the same as that for Ruthenium.

for cerium. This is a reasonable choice because both europium and cerium are transition elements of the lanthanide series and have similar chemical valence states. Iridium was assigned the same Kd as ruthenium, since both are transition elements with similar valence states. Ruthenium is the element most chemically similar to iridium for which Kd information was available.

The Kd for sodium was assumed to be 0.001 ml/g. This means that the mobility of sodium is essentially the same as that of water. For all other elements which did not appear in the literature, a Kd of 5 ml/g was assumed. This value was applied to beryllium, calcium, iron, manganese, and potassium. By comparison with the other elements, a Kd of 5 ml/g appears conservatively low.

The Kd for polonium was assumed to be the same as that of lead, which is its parent radionuclide. Reference 5 recommends a Kd of 400 for polonium, but since polonium is a short-lived daughter product of lead, the lead Kd of 100 ml/g was applied to polonium as well. This is because the polonium is in secular equilibrium with the lead and will therefore mimic lead's environmental transport properties.

Sensitivity of Results to Kd and Dispersion

For all of the radionuclides included in the release and transport assessment, only two (C-14 and Tc-99) are calculated to reach the shallow water table within the first 1,000 years after closure of the disposal site. All of the other radionuclides are either short-lived or are highly immobile in the unsaturated zone. The Kd values, retardation factors, and predicted travel time times through the unsaturated zone are shown in Table 2. The travel time is based on a distance of 6.4 meters from the bottom of the waste (8 feet below natural grade) to the top of the unconfined aquifer. The vertical water velocity through the unsaturated zone was estimated to be 0.02 m/yr, based on information contained in the Hydrogeologic Study report.[3] The high retardation factors for most of the radionuclides provide a significant margin of safety for protection of the shallow unconfined aquifer.

Table 2. Radionuclide Kd values and unsaturated zone transit times.

Nuclide	Kd (ml/g)	Retardation Factor	Unsat. Zone Transit Time (yr)
Am-241	100	3.35E+03	1,020,000.
Am-243	100	3.35E+03	1,020,000.
C-14	.01	1.34E+00	407.
Cd-109	6	2.02E+02	61,600.
Cm-242	3000	1.01E+05	30,700,000.
Cm-243	3000	1.01E+05	30,700,000.
Cm-244	3000	1.01E+05	30,700,000.
Co-57	10	3.36E+02	102,000.
Co-60	10	3.36E+02	102,000.
Cs-134	500	1.68E+04	5,110,000.
Cs-137	500	1.68E+04	5,110,000.
Fe-55	5	1.69E+02	51,400.
H-3	.001	1.03E+00	315.
I-129	.20	7.70E+00	2,350.
Mn-54	5	1.69E+02	51,400.
Na-22	.001	1.03E+00	315.
Nb-94	300	1.01E+04	3,070,000.
Ni-59	100	3.35E+03	1,020,000.
Ni-63	100	3.35E+03	1,020,000.
Np-237	10	3.36E+02	102,000.
Pu-238	100	3.35E+03	1,020,000.
Pu-239	100	3.35E+03	1,020,000.
Pu-240	100	3.35E+03	1,020,000.
Pu-241	100	3.35E+03	1,020,000.
Pu-242	100	3.35E+03	1,020,000.
Ra-226	100	3.35E+03	1,020,000.
Ru-106	160	5.36E+03	1,630,000.
Sn-113	100	3.35E+03	1,020,000.
Sr-90	8	2.69E+02	82,000.
Tc-99	.001	1.03E+00	315.
Th-230	100	3.35E+03	1,020,000.
Th-232	100	3.35E+03	1,020,000.
U-234	40	1.34E+03	409,000.
U-235	40	1.34E+03	409,000.
U-236	40	1.34E+03	409,000.
U-238	40	1.34E+03	409,000.
Zn-65	15	5.04E+02	154,000.
Be-7	5	1.69E+02	51,400.
K-40	5	1.69E+02	51,400.
Ca-45	5	1.69E+02	51,400.
Cr-51	40	1.34E+03	409,000.
Co-56	10	3.36E+02	102,000.
Co-58	10	3.36E+02	102,000.

Table 2. Continued.

Nuclide	Kd (ml/g)	Retardation Factor	Unsat. Zone Transit Time (yr)
Ag-110m	100	3.35E+03	1,020,000.
Sb-124	4000	1.34E+05	40,900,000.
Sb-125	4000	1.34E+05	40,900,000.
Eu-152	1000	3.35E+04	10,200,000.
Eu-154	1000	3.35E+04	10,200,000.
Ir-192	160	5.36E+03	1,630,000.
Hg-203	10000	3.35E+05	102,000,000.
Pb-210	100	3.35E+03	1,020,000.
Po-210	100	3.35E+03	1,020,000.
Ra-228	100	3.35E+03	1,020,000.
U-depl.	40	1.34E+03	409,000.

The calculations of radionuclide transport through the unsaturated zone did not include the effects of dispersion or diffusion. The inclusion of these effects could result in a portion of the radionuclide inventory migrating slightly faster than predicted. For the long-lived radionuclides this could cause the radionuclides to arrive at the water table slightly earlier than predicted. However, the peak concentrations in groundwater would not differ from those calculated in the previous study. For short-lived radionuclides, dispersion may shorten the arrival time at the water table and therefore, reduce the time period for these short-lived radionuclides to decay in the unsaturated zone. The only short-lived radionuclides that could possibly be affected in this way are H-3 and Na-22. All of the others have very long travel times in the unsaturated zone. For H-3 and Na-22, their short halflives (12.3 and 2.6 years, respectively) will still provide a sufficient margin of safety so that neither will be expected to reach the water table.

Protection of the Unconfined Aquifer

The five most mobile radionuclides are H-3, C-14, Na-22, I-129, and Tc-99. Of these five, H-3 and Na-22 are short-lived and decay to innocuous levels before reaching the water table. Although I-129 is long-lived, its predicted travel time through the unsaturated zone is conservatively estimated at over 2300 years.

The only radionuclides predicted to reach the aquifer beneath the site during the first 1,000 years after disposal are C-14 and Tc-99. These are the only radionuclides which are both long-lived and highly mobile. The potential future concentrations of these radionuclides in the aquifer are dependent on the assumptions regarding the dilution of the contaminated leachate in the aquifer. These assumptions are documented in the previous site assessment[2] and in the PATHRAE methodology manual.[1]

It is anticipated that C-14 and Tc-99 will be excluded from the disposal facility permit request. This being the case, the modeling results indicate that no radionuclide contamination of the unconfined aquifer will occur for at least 1,000 years after closure of the disposal facility. For this reason, protection of the unconfined aquifer is ensured and further documentation of the groundwater calculations is irrelevant to the current licensing effort.

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