APPENDIX T



Miner Flat Dam Left Abutment Ridge Seepage Analysis, April 1997

GOLDER ASSOCIATES, VOLUMES 1 THRU II OF II

FEBRUARY 2007

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MINER FLAT DAM LEFT ABUTMENT RIDGE SEEPAGE ANALYSIS

VOLUME I OF II

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Distribution:

1 Copy - Morrison-Maierle/CSSA

1 Copy - Golder Associates Inc.

April 1997

943-2769

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ACRONYMS AND ABBREVIATIONS

ASTM American Society for Testing and Materials

cfs cubic feet per second Golder Golder Associates Inc.

gph gallons per hour gpm gallons per minute

ISRM International Society for Rock Mechanics

K Hydraulic conductivity
MM/CSSA Morrison-Maierle/CSSA
psi pounds per square inch
RQD rock quality designation

USCS Unified Soil Classification System

1.0 INTRODUCTION

This report presents the preliminary results of the Miner Flat dam - Phase I exploration program performed in 1995. This investigation was performed in accordance with the scope of work approved by Morrison-Maierle (MM/CSSA) in 1994 under an Agreement with Golder Associates Inc. dated April 28, 1994. The field investigation included core drilling, logging and testing of core, percussion hammer drilling and logging, packer testing, and installation of piezometers in order to estimate the seepage through the left abutment ridge of the proposed Miner Flat dam. Seepage through the left abutment was numerically modeled using data from this and previous geotechnical investigations. The estimated loss from seepage is approximately 0.13 cubic feet per second.

The proposed Miner Flat dam is located on the North Fork of the White River east of Arizona State Highway 73 at Mile Post 350, about 8 miles south of McNary and about 11 miles north of Whiteriver, on the Fort Apache Indian Reservation. The Fort Apache Indian Reservation comprises about 1,700,000 acres that are south of the Mogollon Rim and north of the Salt River in north-central Arizona (Figure 1). The Phase I exploration investigation was preceded by three geotechnical investigations performed by Mineral Systems, Inc. in 1981, 1982, and in late 1985 and early 1986. The purpose of the 1982 study was to determine the feasibility of constructing a dam near Miner Flat and to select an approximate alignment for the dam. The 1982 study (Robinson 1982) consisted of preparing a preliminary geologic map of the dam and reservoir area and drilling along the recommended axis of the dam. The 1985-1986 investigation (Mineral Systems, Inc. 1986) was directed towards further defining the geology of the dam axis and abutment areas. The earlier investigations defined the general suitability of the site for a gravity dam and appurtenant structures. The present investigation was performed in order to evaluate the potential for seepage through the left abutment ridge of the proposed dam and reservoir.

2.0 GEOLOGY

The Fort Apache Indian Reservation is south of the Mogollon Rim, that is considered the southern boundary of the Colorado Plateau physiographic province. The Fort Apache Indian Reservation is in the transition zone between the Colorado Plateau and the Basin and Range physiographic provinces. The North Fork of the White River originates in the White Mountains that comprise the northeast corner of the reservation. The White Mountains are composed of Tertiary and Quaternary volcanic rocks, that extend to and south of the proposed Miner Flat dam site. The volcanic rocks, predominantly basalts and andesites, were deposited on Paleozoic and Mesozoic sedimentary rocks. The sedimentary rocks in general, strike northwest and dip gently northeast, 2° to 8°. Locally the sedimentary rocks are cut by normal faults approximately parallel to the strike of the sedimentary formations. Small folds are locally superimposed on the regional dip.

The axis of the proposed Miner Flat dam crosses the North Fork of the White River where basalt exists in both the right and left abutments. The basalt is approximately 2 million years old (Condit 1983) and consists of a sequence of flows that came down an ancestral valley of the White River. The ancestral valley was then cut by the river into the Permian sandstones of the Coconino Sandstone and Supai Group and Tertiary gravel deposits, leaving a ridge of sandstone and basalt on the left abutment. Recent deposits include colluvium on the slopes and alluvium in the river valley.

The basalt is up to 260 feet thick in the right abutment and up to 211 feet thick on the left abutment. The basalt wraps around the left abutment ridge with Coconino Sandstone on the north side of the ridge and basalt on the south side of the ridge. East of the left abutment, the basalt thins out against the Coconino Sandstone.

The Coconino Sandstone, an aeolian deposit of Permian age, is a distinctive stratigraphic unit characterized by prominent cross-bedding, uniform grain size and general cliff-forming character (McKee 1933). The typical Coconino Sandstone extends over a vast area without any appreciable change in type of cross-bedding, purity of quartz sand, kind of cement, or general massive character (McKee 1933).

At the proposed Miner Flat dam site, the Coconino consists of friable, fine-grained, subrounded, equigranular, and well sorted quartz grains poorly cemented by siliceous cement. The Coconino Sandstone ranges in color from pale reddish brown, grayish orange pink, moderate reddish orange and moderate orange pink. Characteristic of the Coconino Sandstone are quartz overgrowths on some grains, which make the grains sparkle in sunlight. The beds of the Coconino Sandstone range from less than a foot to as much as 10 feet in thickness.

Underlying the Coconino Sandstone is the Supai Group. The Supai Group is separated into four formations that range in age from Early Pennsylvanian to Early Permian. From oldest to youngest, these formations are designated as the Watahomigi, Manakacha, and Wescogame Formations and the Esplanade Sandstone (McKee 1975). At the Miner Flat dam site, the Supai Group is represented by the Esplanade Sandstone. The Esplanade consists primarily of very fine-grained cross-stratified sandstone that forms massive cliffs. It includes small amounts of siltstone and mudstone that weather into slopes, benches, or recesses and, contains extensive beds of gypsum. The Supai Group observed at the site consist of moderate reddish orange to moderate reddish gray, calcareous siltstone, fine-grained sandstone, claystone, and light gray gypsum.

The Tertiary gravel deposits partially mantel the east end of the east abutment ridge, and slope wash from these deposits mask the bedrock. The deposits consist of bouldery gravel, coarse sand, sand and silt. The clasts are comprised of quartzite, sandstone, limestone, and chert derived from younger Precambrian and Paleozoic formations. Locally, cobbles of granite and diabase may be found.

Colluvial deposits that overlay bedrock on the left abutment is material derived from the inplace weathering of bedrock. The colluvium derived from the basalt consists of reddish brown to dark brown silt and clay, with subangular sand, gravel, cobbles and boulders composed of basalt. Colluvium derived from the Coconino Sandstone and Supai Group consist of light brown to pale reddish brown fine to medium sand, silt, and angular pieces of gravel and cobble size sandstone.

The alluvial deposits occurring in the river valley of the North Fork of the White River consist of boulders, gravel, sand, and silt. The coarser materials are derived from the local outcrops—such as basalt and sandstone—and from the Tertiary gravels. The materials are unconsolidated in the modern stream beds and poorly to moderately cemented in the older stream terraces.

3.0 FIELD INVESTIGATION

The 1995 field investigation included core and percussion hammer drilling, downhole surveying, packer testing, and installing piezometers for the purpose of obtaining hydrogeologic data for seepage analysis of the eastern abutment. The drillholes were spaced approximately 200 feet apart located along the ridge and about midway between the upstream and downstream cliffs (Figure 2) in accordance with the work plan provided by MM/CSSA on January 31, 1994.

3.1 Percussion Hammer Drilling

As a result of preliminary geologic mapping of the proposed dam site, and from earlier drilling, it was concluded that an abandoned stream channel may cross the left abutment. This channel would have developed after the deposition of the basalt and before the White River eroded its present channel. Previous drilling indicated that the bottom of the channel was below an elevation of 6,060 feet, that would be below the maximum elevation of the proposed reservoir. The material at the surface implied that the channel could be filled with highly permeable sand and gravel.

A total of 26 boreholes were drilled along the ridge between boreholes MF-102 and MF-218A (Figure 2).

Drilling was subcontracted to Layne Western Exploration (Layne) and North American Drilling (NAD), both from Phoenix, Arizona. An AP1000 percussion hammer drill rig with an open, 6 5/8-inch bit was used for the initial drilling program and an open, 9-inch bit was used for the later drilling program. The percussion hammer method uses dual wall drive pipe advanced by a single cylinder diesel pile drive hammer. Compressed air is forced down the annulus between the inner and outer drive pipe, and geologic samples are continuously returned up the center of the inner pipe. Percussion hammer drilling methods are best suited

and typically used in gravely or cobbly materials where standard penetration tests (SPT) are unable to collect representative material and blow counts.

The blow counts from the percussion hammer can be correlated to SPT equivalent blow counts (N60) and relative density by recording the blow counts and pressure within the drive cylinder for the same interval. Allowing for altitude and type of hammer on the AP1000, an SPT equivalent blow count (N60) was determined for each 1-foot interval. The equivalent blow counts are shown on the borehole logs in Appendix A. The SPT equivalent blow count number is used to correlate relative density or cohesion of the soils. Because an open bit was used in order to collect samples, the SPT equivalent blow counts will typically be lower than when a closed bit is used (Harder and Seed 1986). The SPT equivalent blow counts for the 9-inch bit were correlated from Sy and Campanella (1994).

Bulk samples were collected, labeled, and bagged at 5 foot intervals. Selected bulk samples were transported to Golder's Lakewood, Colorado soils laboratory for further classification and testing. Attempts were made to collect undisturbed samples in Shelby tubes below elevation 6,060. However, the soil below elevation 6,060 was typically too dense or hard to collect sufficient samples for testing. Only one sample had sufficient material for testing.

3.1.1 Material Classification

Materials encountered during percussion hammer drilling were visually classified and logged by a geological engineer in accordance with American Society for Testing and Materials (ASTM) D 2488-93. Material descriptions shown on the borehole logs (Appendix A) include: ASTM designations; density (for cohesionless soils) or consistency (for cohesive soils); color (based on the Munsell System using a Geological Society of America rock color chart); textural descriptions; percentage of minor components; and qualitative moisture content. Representative samples were tested with dilute hydrochloric acid to estimate relative calcium carbonate content.

3.1.2 <u>Laboratory Analysis</u>

Samples obtained from the field program were analyzed at the Golder Associates Inc. laboratory in Lakewood, Colorado in accordance with applicable ASTM standards. Laboratory testing was performed on 11 bulk samples and 1 undisturbed sample. The samples were selected from boreholes where the channel material was below elevation 6,060. The bulk samples were tested for Unified Soil Classification System (USCS) soil classification, Atterberg limits, specific gravity, and moisture density relationship (standard Proctor). The undisturbed sample consisted of clay that was tested for permeability.

The results of the laboratory testing programs are presented in Appendix B. The majority of the soil below elevation 6,060 is classified as clay (CL); one sample was classified as clayey sand (SC), although the clay content was at 49.6 percent (greater than 50 percent clay would be classified as CL). The Atterberg limits ranged from liquid limits of 27 to 40 and plastic index of 15 to 23, which indicate the clay is low to medium plasticity.

The clay sample collected in the Shelby Tube had a natural dry density of 108.2 pounds per cubic foot and natural moisture of 9.2 percent. The average permeability from laboratory testing was 2.7×10^{-7} cm/sec.

3.2 Core Drilling

Boreholes were drilled and cored along the axis of the ridge that forms the left abutment of the proposed Miner Flat dam to investigate the potential for seepage through the Supai Formation as required by the work plan provided by MM/CSSA dated January 31, 1994. The locations of the boreholes, shown on Figure 2, were in conformance with the work plan provided by MM/CSSA. Final location of the boreholes was determined in the field based on site logistics and access. All locations were approved by MM/CSSA prior to the commencement of drilling. Eight boreholes were drilled using HQ (2.375 inch diameter

core) wire-line equipment with dual-tube core barrels. The core drilling was performed by Golden Drilling Company of Canon City, Colorado. The program began on June 1, 1995 and was completed on August 30, 1995. A total of 2,263.8 feet of borehole was drilled. This included 153.2 feet of surficial materials (Tertiary gravel and colluvium) and 2,110.6 feet of rock. Surficial materials were drilled using air-rotary methods using a 6-inch diameter tricone bit. Once competent rock was encountered, 4-inch steel casing was installed and fully grouted with neat cement grout. The boreholes were then cored to their final elevation, in most cases an elevation of 5,740, as specified the work plan.

Each borehole was logged for lithology, RQD, number of natural fractures, and other engineering geologic parameters as specified in the work plan provided by MM/CSSA. In addition, all the core was photographed and stored for future reference.

Clear water was the intended drilling fluid during the planning and initial stages of drilling. The source of the water was the North Fork of the White River, supplied to the drill sites through 1-inch diameter plastic pipe from the supply pump at the river. The drilling fluid was changed to a polymer based drilling mud when core recovery and borehole stability became a problem. During the drilling of borehole MF-218 core recovery and borehole stability became a problem at a depth of approximately 160 feet. In consultation and with the agreement of MM/CSSA the drilling fluid was modified to a polymer-bentonite-additive fluid the reduced fluid loss, friction, and bedrock wetting. The benefits of the switch to the polymer-based fluid included better borehole stability, increased core recovery and faster penetration rates. The disadvantage was that packer testing could not be conducted during the drilling of the borehole as recommended by MM/CSSA but had to be delayed until the borehole was drilled to its final depth.

The work plan included six boreholes aligned with the ridge that formed the south or southeast abutment spaced 200 feet apart. Two additional boreholes were drilled due to fluid loss and borehole stability problems. MF-250 located at the north end of the series of

boreholes (Figure 2) was the first borehole to be drilled in this program. The borehole encountered basalt at a depth of 11.8 feet. Fluid loss and borehole stability became an immediate problem and the upper portion of the borehole required grouting in order to maintain the borehole. An additional borehole, MF-250A located approximately 50 feet south of MF-250, was drilled to perform packer tests in the grouted portion of the basalt. Borehole MF-218 was abandoned after fluid loss and borehole stability problems became overwhelming at a depth of 160 feet. Borehole MF-218A was drilled approximately 50 feet southeast of MF-218 as a replacement.

The overall average of core recovery was 86.3 percent. The core recovery was highest in the basalt with an average of 95.7 percent. Core recovery in the Coconino Sandstone was 82.7 percent. The core recovery was 90.0 percent in the sandstones and siltstones of the Supai Group and 100 percent in the gypsiferous sections of the Supai. Core recoveries increased by 9.6 percent in the Coconino and by 4.1 percent in the Supai as a result of changing from clear water to a polymer based drilling fluid.

3.2.1 Core Logging

Logs of lithologic and engineering properties of the rock drilled were compiled at the completion of each core run. Golder personnel were on site continuously during the drilling program to record drilling conditions and to log the core as it was extracted from the core barrels. A detailed engineering geologic log was prepared on site at the time of drilling, a portion of which is presented in Appendix A. The parameters that are presented in Appendix A include:

- ▶ Weathering or Alteration
- Rock Description
- Recovery

- Rock Quality Designation
- ► Fractures Per Foot Recovered
- ► Total Fractures
- General Comments

Detailed lithologic descriptions and drilling conditions were recorded at the time of drilling and kept separately. These detailed descriptions are available upon request.

3.2.1.1 Weathering or Alteration

Weathering or alteration describes the type and intensity of rockmass weathering or alteration classification using the International Society for Rock Mechanics (ISRM) classification system.

3.2.1.2 Rock Description

The rock description includes the rock type, the major minerals present, the grain size of the minerals or rock constituents, the texture of the rock fabric, and the color based on the Munsell System.

3.2.1.3 Recovery

The core recovery is recorded here as 100 times the length of core recovered in each core run. The percentage core recovery is calculated by dividing the recovered length by the run length. The mean core recovery for the basalt was 95.7 percent, 82.7 percent for the Coconino, and 93.1 percent for the Supai.

3.2.1.4 Rock Quality Designation

The rock quality designation (RQD) is a method for classifying recovered core to reflect the fracturing and alteration of rock masses (Deere 1963). RQD is the summation of the lengths of recovered, hard, sound core whose length are greater than two times the core diameter. For convenience RQD is recorded in the logs as 100 times the summed length. The RQD (%) is the RQD length divided by the run length and expressed as a percentage of the run length. The mean RQD for the basalt was 62.1 percent, for the Coconino was 18.8 percent, and for the Supai was 69.9 percent.

3.2.1.5 Fractures Per Foot Recovered

The fractures per foot recovered or fracture frequency is the total number of natural fractures observed in each core run divided by the total length of core recovered for that run. The mean fracture frequency for the basalt was 2.4 fractures per foot, for the Coconino was 5.9 fractures per foot, and for the Supai 2.8 fractures per foot.

3.2.1.6 General Comments

The general comments include summary notes of drilling and rockmass conditions. Contacts between formations are generally noted in the general comments.

3.2.2 <u>Downhole Surveys</u>

All the boreholes were surveyed to determine the accurate downhole location of the borehole. Seven of the boreholes were surveyed with an OWL TECHNICAL 780 series borehole deviation survey instrument to measure and record the path of the boreholes. Results of these surveys presented in Appendix C include the measured data of depth, inclination and bearing, and the calculated location of each survey measurement point.

3.3 Hydrological Testing Program

The objective of the hydrogeological testing was to obtain estimates of in situ hydraulic conductivity from the cored boreholes. Hydraulic conductivity was calculated from packer (injection) test data for specific intervals in the borehole.

3.3.1 Packer Testing Equipment

The test equipment included a packer assembly consisting of two inflatable packers in a straddle configuration connected by a perforated pipe providing a test interval of approximately 23 feet. Medium-duty, sliding-end, 2.7-inch uninflated outside diameter Baski Inflatable Packers were used for most of the testing. Packers were inflated from a nitrogen cylinder at the surface via an inflation line that was strapped to the drill pipe. Flow rates for this assembly ranged from approximately 1 gallon per hour (gph) to approximately 30 gallons per minute (gpm).

For the high-flow test intervals, an additional packer configuration was developed. The high-flow packer assembly consisted of 2-inch, inside diameter plumbing and a 10-foot test interval between packers. The high-flow assembly allowed testing of intervals with flow rates up to approximately 100 gpm.

During injection, the water supply was kept at a constant pressure in a baffle tank. From the baffle tank, flow was diverted to the drill pipe or bypassed through alternative valves and flow meters. The flow meters included three Omega Rotameters capable of measuring flows between 0.017 to 0.117 gpm (1 and 7 gallons gph), 0.1 to 1 gpm, and 1 to 5 gpm. Higher flow rates were measured with a turbine flow meter and totalizer, calibrated to 10 gpm for one complete revolution of the dial. Flowmeters were connected in parallel and each fitted with a valve to allow selection of a particular meter and to regulate the flow.

The pressure data acquisition equipment consisted of a number of alternative strain gauge transducers including two with a maximum pressure reading of 30 pounds per square inch (psi) and one with a maximum reading of 100 psi. Depending on the anticipated maximum pressure, the appropriate transducer was placed in the drill pipe, either below the static water level when testing below the water table or just above the top packer when testing in the unsaturated zone. The transducer cable was connected to a data logging system at the surface which processed the signal and provided the digital input to a laptop computer.

3.3.2 <u>Testing Procedures</u>

Testing all boreholes over their entire depths (except for unconsolidated Tertiary gravel) provided an unbiased sample of estimates for hydraulic conductivity. Complete coverage was achieved by sequentially testing adjacent intervals, starting from the bottom of each borehole. Some test interval locations varied slightly due to practical limitations of packer seating locations and borehole conditions.

Two rounds of packer testing were conducted; one in which all intervals in all boreholes were tested, and a second round which involved retesting high-flow intervals only. For the first round of packer testing, a 23-foot perforated test interval was used. This spacing was small enough to provide sufficient hydraulic conductivity estimates for adequate technical assessment of the site, yet large enough to achieve adequate coverage within the practical constraints imposed by time and budget. A second round of packer testing, using the high-flow packer assembly, was conducted to retest smaller (10-foot) intervals.

Two types of packer tests were possible: constant head (steady-state) tests, or constant rate (transient) test. In the saturated zone, either type of test could be conducted. In the unsaturated zone however, only constant head tests were conducted because results from constant rate tests reflect the saturation of the aquifer instead of providing accurate hydraulic properties.

The packer testing procedure can be summarized as follows:

- a) Take manual water level measurement
- b) Set and inflate packers
- c) Place transducer approximately 3 to 5 feet above top packer
- d) Begin logging pressure data
- e) Add slug of water for falling head test and calculate an injection rate
- f) Decide on test type and conduct test
- g) Deflate and raise packer assembly to next interval

3.3.2.1 Flow Rate Evaluation and Choice of Test Method

After placing the packer assembly, a water level measurement was taken (if the interval was below the water table) and the packers were inflated. Before starting data acquisition, the pre-test head was set to zero by adjusting an offset function in the data logging software. Acquisition of the pressure data began after packer inflation when in the unsaturated zone. When below the water table, it was preferable to begin acquisition before packer inflation. As a result of packer inflation, the test interval may be pressurized. Test initiation was delayed until the pressure pulse dissipated and the water level returned to the static condition.

A target flow rate for the test was estimated by conducting a short-term slug test. A volume of water sufficient to fill approximately 15 to 20 feet of drill pipe (2 to 3 gallons) was added 'instantaneously' and the rate at which the head decreased was recorded. In the unsaturated zone, prior to the slug test, it was necessary to fill the test interval and the saturate the rock in the immediate vicinity of the borehole. The volume of water draining into the formation was then calculated by multiplying the head drop by the cross-sectional area of the drill pipe, and the flow rate was calculated by dividing by the time over which the head drop occurred.

The interval location and the flow rate calculated from the falling head are the two criteria that determine which test method to use. If the interval was below the water table and the flow rate is greater than 0.1 gpm, then it was possible to attempt a constant rate test. If the interval was in the unsaturated zone and/or the flow rate during the falling head period was less than 0.1 gpm, then the 'constant head' test method was used since flow rates less than 0.1 gpm are too low to measure with confidence over the short time of the test. Under these conditions, pressure was held constant and head changes were measured.

3.3.2.2 Constant Rate (Transient) Test Procedure

After the water level returned to static from the falling head test, an appropriate flow rate was selected and the water delivery was set while the valves were in the bypass position (i.e., no down-hole flow). The valves were then switched to allow the constant flow to be directed down the drill pipe. Initially the pipe began to fill, as the head increased more flow entered the rock and pressure change decreased with time. The criterion for finishing the constant rate test was when the change of head with time was negligible or when the test duration reached three hours.

A practical difficulty with conducting constant rate tests was choosing an appropriate rate on the basis of a relatively small amount of information. The intent was to achieve a stable regime of radial flow in the adjacent formation (linear relationship on a semi-log plot) with the maximum possible head. It was difficult to maintain a truly constant rate over the duration of the test. If the injection of water flushed solid material from around the test interval, the shape of the pressure build-up curve could have been disturbed, and this may influence the quality of the data and analysis. Also, the injected water must travel approximately 150 feet down the drill pipe. This caused variations in the pressure data which makes analysis difficult. Although theoretically advantageous, the constant rate test method proved difficult to conduct. If the quality of the data after beginning a constant rate test was questionable, the decision was made to convert to the constant head method.

3.3.2.3 Constant Head (Steady State) Test Procedure

If a constant head is maintained, the change in rate will reduce logarithmically with time so that a steady-state analysis is acceptable with negligible error. Thiem (1906) and later Hvorslev (1951) developed equations and analysis procedures based on the assumption of steady-state radial flow. Their analyses require constant head values and corresponding pseudo-constant flow rates.

Three constant-head steps were generally achieved in three hours. Steps of equal head change, over the maximum range of available head, were attempted. The range of applicable heads were determined from the depth of the test interval or water table and the maximum practical flow rate. High permeability zones required high flow rates to achieve small increases in head thereby reducing the number of possible steps to one or two. The maximum flow rate was constrained by the available water supply and by the pressure losses in the packer assembly.

The procedure for obtaining a constant head step was to fill the drill pipe to the required head and then adjust the rate to maintain a constant head for the duration of the step. The rate was recorded at least every five minutes or when it was adjusted.

The ability to maintain a constant head varied according to the flow rate and the particular test conditions. When possible, a constant head was maintained with a variation of 0.5 feet or less. When the test interval was relatively deep, the flow rate was high and the applied head was low, the injected water had to travel over 100 feet to the water surface in the drill pipe causing short duration fluctuations in the head on the order of several feet.

If the test interval was close to the surface or the rock had low permeability, a head above the ground surface was imposed in order to obtain a high step or flow rate. This was achieved by attaching a sealed cap (stuffing box) on top of the drill pipe. This cap formed a secure seal around the transducer cable. The water supply system in this configuration is completely closed and an increase in flow rate will increase the pressure and the effective head imposed on the test interval.

Once the final constant head step was completed, the flow was diverted to the bypass and the falling head in the drill pipe was recorded electronically (removing the pressure cap if necessary). This falling-head data was used to confirm the flow rate. After collecting several minutes of falling head data, the data acquisition was halted and the packers deflated.

3.3.3 Packer Test Analyses and Results

The Theis curve-matching method (Theis 1935) was used to analyze the constant rate (transient) tests, and the straight line fitting method (Thiem 1906 and Hvorslev 1951) was used to analyze the constant head (steady-state) test. The transient test can provide an estimate of the hydraulic conductivity and storativity as well as other information about the presence or absence of no flow or constant pressure boundaries. The accuracy of the assumptions of the transient test, however, are questionable within an unsaturated zone and it is often difficult to maintain a constant flow with sufficient accuracy to gain many of the benefits of this method.

Several constant rate tests were attempted, however, data quality was poor due to the physical constraints of maintaining consistent flow in the deeper, saturated test intervals. Once ascertained that the data being collected was not suitable for a high-quality transient analysis, the test was converted to a constant head test.

For subsequent use in seepage modeling, hydraulic conductivity values were compiled based on the lithology in which tests were conducted. Two lithologies were tested: basalt and sandstone.

Figures 6 and 7 present histograms and cumulative distribution curves of the basalt and hydraulic conductivity values, respectively. Conductivity values for the basalt range from $21.6 \text{ to } 5.2 \text{ x } 10^{-2} \text{ cm/sec}$ with a geometric mean of $5.86 \text{ x } 10^{-5} \text{ cm/sec}$. The sandstone conductivity values range from $4.68 \text{ x } 10^{-3} \text{ to } 3.62 \text{ x } 10^{-8} \text{ cm/sec}$ with a geometric mean of $7.86 \text{ x } 10^{-5} \text{ cm/sec}$.

Figure 5 shows three cross sections with the packer test results posted along the borehole traces. In general the hydraulic conductivity decreases with depth.

3.4 Piezometers

After completion of the hydrological testing of the MF-218A, MF-250, MF-251, MF-252, MF-253, and MF-254 boreholes, piezometers were installed in these boreholes for long-term water-level monitoring. Piezometer construction summaries are provided in Appendix E.

Boreholes were backfilled with 3/4-inch rounded to sub-rounded gravel from the bottom of the borehole to the appropriate placement of the piezometer. Approximately 15 feet of bentonite "Holeplug" chips were placed on top of the gravel backfill. One foot of 10-12 grit silica sand was placed on top of the bentonite. The piezometer string consisted of 1.5-inch diameter, schedule-80, flush-threaded PVC with 20 feet of 0.020 inch slot for the screen. The filter pack consisted of 10-12 grit silica sand and was placed around the screen to 10 feet above the top of the screened section. Another 15 feet of bentonite "Holeplug" was placed on top of the filter pack and hydrated. The remainder of the borehole was backfilled with gravel to 10 feet below the surface except MF-218A, which was filled to 2 feet below ground surface. The installations were completed by grouting to the surface with Portland type I-II cement slurry with 5 percent Quickgel bentonite powder. Grout was allowed to settle overnight and then were topped off with additional grout the following day.

4.0 SEEPAGE MODEL

4.1 Objectives

The objective of the project as stated by the MM/CSSA work plan was to "Complete a sixhole transect on the left abutment for the purpose of investigating the potential for seepage through the Supai Formation. Specific objectives included using detailed site-specific geologic and hydrogeologic data to estimate aquifer water levels in the sandstone aquifer under boundary conditions defined by a full reservoir. Using this model, it is possible to estimate the seepage rate through the section of Coconino Sandstone, the formation that is most affected by the reservoir, that crops out along the sandstone ridge that forms the left abutment. The ridge consists of two distinct sections: 1) a "window" of Coconino Sandstone that outcrops across the ridge; and, 2) the tip of the ridge that is Coconino Sandstone overlain by Quaternary basalt. Both sections are considered to be potential preferred flow paths through the ridge. In addition, the potential for seepage through the "gravel channel" was evaluated.

4.2 "Gravel Channel" Seepage Potential

Previous core drilling and preliminary geologic mapping of the proposed dam site indicated that an abandoned river channel may cross the left abutment between boreholes MF-121 and MF-123 (Figure 2). From the previous drilling it was inferred that this channel, if it existed, would have been developed on top of the basalt surface prior to the erosion of the present channel of the North Fork of the White River. The bottom of the channel was interpreted to be at an elevation of approximately 6,055, below the maximum pool elevation of 6,060. The material at the surface implied that this channel could be filled with highly permeable sandy and cobbley gravel. If this channel exists then a potential for seepage from the reservoir exists. The "gravel channel" seepage potential was investigated by the use of the

percussion hammer drilling of 26 boreholes, logging of materials, laboratory analysis, and laboratory testing.

To evaluate the potential for seepage through the "gravel channel" a bedrock surface model was prepared from the following sources: previous drilling results, the results of the percussion hammer drilling, the bedrock contact from the 1995 core drilling program, and from selected surface outcrops. Figure 4 represents the results of the bedrock surface model. The surface model consisted of a 50 ft by 50 ft grid that covered the left abutment ridge. The bedrock elevation was estimated at each node using a Delaunay triangulation algorithm and then contoured with the 1 foot contour interval shown on Figure 4. The bedrock elevation data set contained 60 points. As with any surface modeling tool there are some inherent inaccuracies especially at the edges of the model and in areas of sparse data. Boreholes with the MF-B prefix have not been surveyed and are only approximately located. The bedrock contacts in these boreholes have been used as data for the surface modeling introducing another source of potential inaccuracy. The bedrock surface model therefore, should be used with discretion.

The surface model indicates that a true channel is not present on the left abutment. There is, however a relatively large westerly dipping bedrock surface bounded on the east by boreholes BA-1 and BA-7. The area between borehole MF-123 and BA-7 represents an area where water from the reservoir at elevation 6,060 could be lost through seepage above the bedrock surface.

Cross section A-A' (Figure 3) shows the surficial soil and top of bedrock along the existing access road between MF-218A and MF-102.

Soils encountered in the boreholes consisted of silty or clayey sands with gravels and cobbles near the northern and southern part of the section and silty clay with none to very little gravels or cobbles in the middle of the section

▶ Bedrock consists of sandstone in MFB-20, MFB-21, MFB-23, MFB-32, BA-8 and BA-1 and in all the other boreholes

Cross section B-B' (Figure 3) shows the surficial soil and top of bedrock encountered in the coreholes between MF-218A and MF-102 (Figure 4). The cross section suggests the following:

- Surficial soil encountered in the coreholes consists of clayey silt, silty sand and clay across this section
- ▶ Bedrock along this section is basalt
- ► The basalt bedrock surface dip to the west

Cross section C-C' shows the surficial soil and top of bedrock between MF-218A and MF-218 (Figure 3). The cross section suggests the following:

- Surficial soil encountered in the boreholes consists of silty sand and sand
- ▶ Depth to bedrock is shallow

The materials encountered in boreholes with bedrock elevations below 6,060 are sandy clay (CL) with a small percentage of gravel and cobbles. The materials are stiff to very stiff. Laboratory permeability testing of remolded samples of this material averaged 2.7×10^{-7} cm/sec.

It is not likely that this area of a low bedrock surface will represent much of a seepage loss. Uncertainties exist as to the eastern extent of the basalt bedrock in the area between borehole MF-123 and BA-7 and in the in situ permeability of the materials. A more detailed evaluation of the necessity of seepage mitigation in this area must be completed prior to final design of the dam and appurtenant structures.

4.3 Conceptual Bedrock Model

The sandstone ridge to the south and east of the proposed dam abutment will serve to contain the proposed reservoir. This narrow strip of land is considered a potential seepage pathway from the proposed reservoir.

Geologically, the ridge is divided approximately in half; the northern portion of the ridge consists of Permian sandstones overlain by Quaternary basalt and the southern part is composed of only Permian sandstone (Figure 8). This southern sandstone "window" is bounded by the occurrence of overlying basalt to the north and south. In the north, the sandstone/basalt contact dips gently westward across the ridge and then dips steeply underneath the North Fork of the White River.

The model of the ridge is divided into two segments based on the geology described above; the "basalt" model representing the northern section of the ridge, and the "sandstone window" model, representing the southern portion of the ridge. Figure 9 shows the outlines of the models. Each model is designed to run on its own and results from each model summed for a total seepage flow rate through the ridge. The northern tip of the ridge (the left abutment of the proposed dam) is not included in the model. The seepage modeling for the dam abutment and foundation is not included in the scope of this investigation.

The basalt model consists of two layers: an upper layer of basalt and a lower layer of sandstone. Seepage flow through the ridge is estimated by simulating a full reservoir (pool elevation of 6,060 feet) on the eastern edge of the ridge and a river elevation of 5900 feet on the western edge of the ridge. The reservoir acts as a source for recharge to the ridge and the river acts as the discharge sink.

The sandstone window model is designed similarly to the basalt model except that it consists only of one layer and the river discharge elevation is defined at 5,880 feet.

5.0 MODELING METHOD

Modeling was conducted using VISUAL MODFLOW (WHS 1996), a user interface for MODFLOW. MODFLOW is a three-dimensional, finite-difference groundwater flow model developed by the USGS. Groundwater flow within the aquifer is simulated using a block-centered, finite-difference approach. Layers can be simulated as confined, unconfined, or a combination of confined and unconfined. The finite-difference equations can be solved using a variety of iterative solution methods (McDonald and Harbaugh 1988).

5.1 Sandstone Window Model

The model of the sandstone window consists of one layer with a base elevation of 5,856 feet, approximately 800 feet square. The base elevation of 5,856 represents the approximate contact elevation between the Coconino Sandstone and Supai Group. The top surface of the model is defined by the topographic surface. The model is bounded on both the north and south by the surficial occurrence of the basalt/sandstone contact. The contacts are represented in the model as no-flow boundaries. The window is bounded on the east by the pool elevation of the reservoir (6,060 feet) and on the west by the North Fork of the White River (5,880 feet). These are represented as constant head boundaries (Figure 1). The grid consists of 100 by 100 divisions, or 10,000 variably-sized cells.

Hydraulic conductivity for the sandstone window model was based on results of constant-head injection packer testing conducted in borehole intervals open to the Coconino Sandstone. Hydraulic conductivity values from tested intervals in boreholes MF-218A and MF-253 were averaged (geometric mean) yielding a value of 1.94 x 10⁻⁴ cm/sec (Figure 10).

Recharge and evapotranspiration were assumed to be negligible given the arid climate and the depth to water in the area. Since the model was run under a steady-state condition, specific storage, yield and porosity parameters for the aquifer were not necessary. The sandstone

aquifer was defined as unconfined. Output from the flow model was used by the zone budget module of MODFLOW to calculate seepage.

The zone budget module of MODFLOW allows the calculation of flow rates from one section of the modeled area to an adjacent section. Sections are defined by the user and can consist of any combination of unique areas within the model area. For this modeling exercise, the flow of interest was that through the Coconino Sandstone window to the North Fork of the White River to the west. A zone was defined therefore, as encompassing the sandstone window in the east and another zone beginning at the east edge of the river. Flows were estimated based on the resultant steady-state water level contour map predicted by the flow model.

5.2 Basalt Model

The basalt model has a base elevation of 5,880 feet, is approximately 600 feet square, and consists of two layers. The upper layer consists of basalt and the lower layer of undifferentiated sandstone. As with the sandstone window model, the top surface of the model is defined by the topography. The location of the basalt/sandstone contact was based on control points and geologic mapping on the east side of the model area and extrapolated to the western portion of the model area. The north and south edges of the model are represented by no-flow boundaries. The model is defined on the east by the pool elevation of the reservoir (6,060 feet) and on the west by the North Fork of the White River (5,900 feet). These are represented as constant head boundaries (Figure 9). The grid consists of 100 columns by 92 rows and two layers, or 18,400 cells.

Hydraulic conductivity values used in the model were based on constant-head injection packer testing conducted in basalt and sandstone. Hydraulic conductivity values from basalt intervals from nine boreholes were averaged (geometric mean) yielding values ranging five orders of magnitude, from 10⁻⁴ to 10⁰ cm/sec. A value was assigned to the unfractured basalt

using the geometric mean of the results in the 10^{-3} to 10^{-4} cm/sec range. The high-flow zones in the basalt were represented as three pipes with hydraulic conductivities defined by the geometric mean of the hydraulic conductivity results in the 10^{-2} , 10^{-1} and 10^{0} cm/sec ranges, respectively (Figure 10). Geometries of the pipes were determined from the relative percentages of total packer test interval represented by each conductivity value used. For example, the 1.05×10^{-2} cm/sec conductivity value used in the model represents testing done over 2.1 percent of the total 1,065 feet of basalt that was packer tested. A three-dimensional "pipe" representing 2.1 percent of the total volume of basalt in the model was defined. The "pipe" extended the full width and thickness of the basalt in the model and was assigned the 1.05×10^{-2} cm/sec conductivity value.

Recharge and evapotranspiration were assumed to be negligible given the arid climate and the depth to water in the area. Since the model was run using a steady-state condition, specific storage, yield and porosity information for the aquifer were not necessary. The basalt layer was defined as unconfined and the sandstone aquifer was defined as confined with variable storage and transmissivity. Output from the flow model was used by the zone budget module of MODFLOW to calculate seepage.

The zones for the zone budget calculations were defined in a similar manner to those for the sandstone window model. For the basalt model, the flow of interest was that from both the sandstone and basalt to the North Fork of the White River. One zone was defined, therefore, as encompassing both layers of the basalt and the sandstone in the east and another zone beginning at the east edge of the river. Flow was calculated based on the resultant steady-state water level contour map predicted by the flow model.

5.3 Modeling Assumptions and Limitations

Groundwater numerical modeling is a process of simulating the natural flow system. Due to the natural complexity and variability of the hydrogeologic system, certain simplifying assumptions are necessary for defining the system for modeling purposes. These modeling assumptions include:

- Darcy flow conditions exist within the aquifer.
- No fracture flow occurs through the formation, that is, the ridge can be represented as a single-porosity flow system.

For the sandstone window model, the Darcy flow and no-fracture-flow assumptions are generally valid over the majority of the sandstone. Although some fracture flow may occur through some of the friable and weathered sandstone material, packer test and geologic logging results do not indicate that high-flow zones or fracture zones exist in the sandstone window. The assumption is uncertain in the basalt model since relatively discrete high-flow zones are known to exist. The "pipes" incorporated into the basalt model were designed to account for these discrete features in the basalt.

Each model layer is homogeneous and isotropic.

For the sandstone window, the assumption that each layer is homogeneous and isotropic is generally valid as, according to the geologic logs, major variation within the Coconino Sandstone at the site is uncommon both laterally and with depth. This assumption holds less for the basalt, which contains discontinuities and structural features such as fractures and interbasalt(lava)-flow-boundaries.

► Recharge and evaporation are negligible.

Net precipitation recharge is expected to be near zero for most of the year due to the arid climate in the region. Any recharge occurring in the model area is minor, and, compared to the groundwater flux driven by the reservoir head, can be considered negligible.

Saturated K values used in the model are similar to measured unsaturated K values.

Hydraulic conductivities were calculated from packer test data over the entire zone predicted to be part of the flow regime under reservoir conditions. This zone includes both currently saturated and unsaturated material. Unsaturated packer test intervals were saturated by adding water

prior to commencing a test since unsaturated hydraulic conductivity values are generally higher than saturated values. This allowed greater confidence in the conductivity values obtained from unsaturated packer testing.

- ▶ No flow occurs between the sandstone and basalt (sandstone window model only).
- No flow occurs between the Coconino and Supai Group below (sandstone window model only).

The assumption that there exists no hydrologic communication between adjacent formations is necessary for defining model boundaries, however this may not be a completely valid assumption. The competent basalt bounding the sandstone window is generally less hydraulically conductive than the sandstone but also contains high-flow zones. The particular high-flow features may have a much higher conductivity than the sandstone, therefore, flow may occur from the sandstone to a fractured basalt zone. At the lower boundary of the model, the Coconino Sandstone grades into the underlying, finer-grained Supai Group. The Supai Group has a slightly lower hydraulic conductivity. Also, it is unlikely that a significant downward hydraulic gradient exists in the Supai. This suggests that hydrologic communication would be minimal, however, effects of a no-flow boundary at the contact are uncertain.

Laterally continuous "pipes" of higher hydraulic conductivity are conservatively representative of discrete high-flow zones in the basalt (basalt model only).

The packer tests conducted by Golder in 1995 revealed zones of high hydraulic conductivity, presumably associated with flow through fractures or inter-(lava) flow boundaries. These discrete features, defined as "pipes" in the model, represent the most direct and continuous flow route through the ridge. The assumption that "pipes" through the basalt represent these discrete high-flow features, therefore, is a conservative assumption.

► The basalt/sandstone contact can be extrapolated from borehole logs and geologic mapping (basalt model only).

The basalt model was based on the assumption that the basalt/sandstone contact was laterally consistent and continuous and could be extrapolated

from the control points (boreholes). This assumption was necessary to extend the contact to the west of the known control points and agrees with the geologic model of the ridge. Additional information about the location of the contact is necessary to accurately define the geometry of the basalt and sandstone.

6.0 MODELING RESULTS AND DISCUSSION

6.1 Sandstone Window Model

6.1.1 Results

Modeling results are summarized in Table 1. The water level contour map predicted by VMODFLOW is shown in Figure 11 and in cross sections in Figure 12. Water levels vary between the two defined constant-head boundaries of 6,060 and 5,880 feet elevation across the modeled area. Flow occurs generally to the west from the proposed reservoir to the river. Seepage into the river is estimated at 0.09 cubic feet per second (cfs) (7551.3 ft³/day) across the entire interface between the sandstone window aquifer and the river. The base flow of the North Fork of the White River has been estimated by MM/CSSA as 120 cfs (Morrison Maierle, Inc. 1986). The potential loss from the reservoir is estimated to be less than 0.1 percent of the base flow, an insignificant loss.

6.1.2 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate the effects on flow by changes in the hydraulic conductivity. The results of the analysis are presented in Table 2. The expected hydraulic conductivity represents the geometric mean of packer test results for the sandstone window. The model was re-run using the expected value plus one standard deviation and using the expected value minus one standard deviation. For the sandstone window model, these values are 1.94 x 10⁻⁴ cm/sec, 6.86 x 10⁻⁴ cm/sec and 5.5 x 10⁻⁵ cm/sec for the expected value, plus standard deviation and minus standard deviation, respectively. The sensitivity of the seepage rate to the hydraulic conductivity is linear (in agreement with Darcy's Law). Therefore, an order of magnitude increase in the hydraulic conductivity results in an order of magnitude increase in the seepage flow to the river.

6.1.3 Model Verification

The results of the sandstone model were verified by applying Darcy's Law:

$$Q = KiA$$

where:

 $Q = Flow Rate (ft^3/day)$

K = Hydraulic Conductivity = 0.000194 cm/sec = 0.55 ft/day

i = Hydraulic Gradient = 180 ft per 800 ft = 0.225 ft/ft

A = Cross-sectional Area = $1000 \text{ ft length x } 35 \text{ feet depth} = 35,000 \text{ ft}^2$

resulting in a total flow of 4331 ft³/day (0.05 cfs). The calculation and the result is included in Table 2 for comparison with the modeling and sensitivity analysis results.

6.1.4 Discussion

The relatively well-understood geometry of the sandstone window allowed construction of a straight-forward model, however, some of the simplifications required for simulating the boundary conditions are uncertain. Consideration of flow from the sandstone to the basalt would refine the model as would the consideration of flow paths through the underlying Supai Group.

6.2 Basalt Model

6.2.1 Results

The water level contour map of layer two predicted by the model is shown in Figure 11 and in cross sections in Figure 13. Water levels vary between the two defined constant-head boundaries of 6,060 and 5,900 feet elevation across the modeled area. Flow is generally to the west from the proposed reservoir to the river. Seepage into the river is estimated at 0.04

cfs (3,451 ft³/day) across the entire interface between the basalt/sandstone aquifer and the saturated interval below the river. This represents a loss of approximately 0.03 percent of the base flow of the North Fork of the White River.

6.2.2 Sensitivity Analysis

As with the sandstone window model, a sensitivity analysis was conducted on the basalt model. Results are presented in Table 2. Hydraulic conductivity values were varied by one standard deviation from the mean for both the basalt and the sandstone layers. Simulations were run using the plus-one-standard-deviation values for both layers and the minus-one-standard-deviation values for both layers to estimate maximum and minimum flow rates. For the basalt, the expected conductivity value is 2.88×10^{-5} cm/sec and the plus- and minus-one-standard-deviation values are 2.28×10^{-4} cm/sec and 3.63×10^{-6} cm/sec, respectively. Sandstone values were 1.13×10^{-4} cm/sec, 9.2×10^{-4} cm/sec and 1.4×10^{-5} cm/sec for the expected, plus-one-standard-deviation and minus-one-standard-deviation, respectively.

6.2.3 Model Verification

A Darcy's Law calculation was conducted to verify the modeling and results included in Table 2. The following inputs were used:

K = Hydraulic Conductivity (sandstone value) = 0.000113 cm/sec = 0.32 ft/day

i = Hydraulic Gradient = 160 ft per 600 ft = 0.27 ft/ft

A = Cross-sectional Area = $600 \text{ ft length x } 35 \text{ feet depth} = 21,000 \text{ ft}^2$

resulting in a total flow of 1,814 ft3/day (0.021 cfs).

6.2.4 Discussion

The basalt model consisted of two layers, four different hydraulic conductivity values, two imported surfaces with high relief, cell rewetting and two constant head boundaries. When running the model with the cell-rewetting package included, appropriate convergence was not achieved. To achieve convergence, the cell-rewetting package was excluded and the model was run with an original water level of 6,060 feet elevation. Residual heads were damped (*i.e.*, convergence acceleration less than 1) such that cells were not dewatered prematurely.

A substantial amount of the basalt (upper layer) was dry since much of the elevation of the base of the basalt is above the pool elevation of 6,060. The high-conductivity "pipes" showed little effect on the overall resultant water table. The steady-state water table intersects the basalt — and therefore the "pipes" — just to the east of the river, thereby minimizing the potential high-flow effects of the "pipes" and defining the sandstone as the controlling aquifer in the system.

7.0 CONCLUSIONS

The ridge that forms the left or southeastern abutment of the proposed Miner Flat dam is composed of Coconino Sandstone that is overlain by Quaternary-Tertiary basalt and up to 50 feet of Quaternary-Tertiary gravel. Eight boreholes have been cored along the axis of the ridge and packer tests have been performed in the holes to investigate the potential for seepage through the ridge. These core holes show that the thickness of the basalt overlying the Coconino Sandstone is variable and that the eastern and western extent of the basalt is unknown as well as the extent of the basalt to the south. Rock quality indicators such as RQD and fracture frequency show that the basalt is of fair quality and not intensely fractured. Packer tests performed in the holes indicated that the sandstones of the Coconino and Supai formations have a permeability of approximately 10^{-4} cm/sec. The permeability of the basalt is dependent on the number of hydraulically connected fractures intersected by the test interval. The majority of the packer tests performed in the basalt indicated a discrete feature hydraulic conductivity of 10^{-5} cm/sec.

Twenty six additional boreholes have been drilled through the Quaternary-Tertiary gravel to determine the elevation of the bedrock and the bedrock type. The purpose of these additional holes was to investigate the potential of seepage through the surficial material overlying the bedrock. The drilling of the surficial materials has shown that the thickness of the Quaternary-Tertiary gravel deposits are variable and that a broad, flatly dipping bedrock surface exits about halfway along the axis of the ridge. The "gravel" deposits are primarily clay and the concentration of sands, gravels, and cobbles at the surface are lag deposits left by the removal of the finer silts and clays by erosion. The elevation of the flatly dipping bedrock surface is below the proposed pool elevation of 6,060 and could present a possible seepage pathway. Laboratory testing of the surficial materials collected from boreholes indicate that the permeability of these materials is approximately 10^{-7} cm/sec.

Two hydrogeologic models were prepared to estimate the seepage losses through the bedrock of the ridge. The sandstone model representing the portion of the ridge that does not have a basalt cover is the most straight forward with the fewest simplifying assumptions. The results of the seepage modeling through the sandstone portion of the ridge indicate that the 1,000 feet of discharge length may yield approximately 0.09 cfs (7800 ft³ per day) with a reservoir pool elevation of 6,060. The basalt model representing the portion of the ridge that is covered with the basalt over the sandstone is much more complicated with considerably more simplifying assumptions. The results of the seepage modeling through the sandstone/basalt portion of the ridge indicate that the 600 feet of discharge length may yield 0.04 cfs (3,450 ft³ per day). The total seepage through the ridge is estimated to be approximately 0.13 cfs (11,000 ft³ per day). Given that the base flow of the North Fork of the White River is estimated as 120 cfs the loss from the reservoir through the left abutment ridge is estimated at approximately 0.1 percent, an insignificant loss.

8.0 RECOMMENDATIONS

The purpose and scope of the left abutment seepage modeling were to investigate the potential for seepage through the Permian sandstones of the left abutment ridge. The scope was expanded from the original work plan to include the basalt section of the left abutment area and the seepage potential of the surficial material. The following recommendations are made in order to answer the unresolved potential seepage related to the operation of the proposed Miner Flat dam.

The investigation of the seepage potential through the surficial material covering the bedrock of the ridge requires only minor additional work at this time. Boreholes that have not been surveyed, those boreholes with the MF-B prefix, should be surveyed. Borehole location data would then be included in the bedrock surface model and a new bedrock surface would be estimated. The final bedrock surface map would bring to a close the present scope of work. It is recommended that prior to construction of the dam that the eastern extent of the basalt be determined and that in situ permeability testing of the surficial materials be performed. A design of seepage mitigation alternatives, if required, cannot be completed with the current information.

The investigation of the potential seepage through the Permian sandstone, in particular the Coconino Sandstone where it is not blanketed by basalt, is essentially complete at this time. The 'sandstone window' model should be integrated with the 'basalt' model to fully represent the hydrogeological interrelationship of the left abutment ridge.

The investigation of the seepage potential through the left abutment ridge where it is blanketed by basalt on the western or downstream side is incomplete and requires additional investigation. The seepage potential of the basalt model was not included as part of the original work plan. Additional data and flow modeling pertaining to the discrete feature component of this model is required to fully evaluate the seepage potential of this area. The

eastern and southern extent of the basalt must be determined to fully model the seepage potential. The western or downstream geometry of the basalt must be determined as this is the discharge area of the potential seepage through this section of the left abutment ridge. The material between the bottom of the basalt and the sandstone including Tertiary colluvium and Tertiary alluvium has not been investigated, tested, or included in the current model. This potential flow path must be included in a more inclusive model. The 'sandstone window' model must be included in a more comprehensive analysis of the seepage potential of the left abutment ridge.

The two discreet areas modeled for this investigation represent two of many possible seepage pathways that emanate from the proposed reservoir. They do not include: the specific area of the dam abutments or foundation; the north side of the reservoir through the basalt and Tertiary alluvium; or, seepage to the east of the sandstone window. Due to the complex nature of the regional and local geology, more detailed field and analytical investigations should be conducted, including:

- A seepage model of the dam abutments and foundation
- An investigation, including modeling, of the hydrogeologic properties and extent of Tertiary alluvium/colluvium deposits below the foundation and abutments and to the west
- A stream survey to define losing and gaining reaches of the North Fork of the White River and to define stream losses through the Tertiary alluvium
- Expanded data collection, in support of refining existing conceptual and numerical models of the basalt
- A large-scale seepage model incorporating existing model information and additional data on other potential flow pathways
- Exhaustive water-level data for all piezometers and wells in the area
- Hydrogeologic and geologic information on areas north of the proposed dam and east of the sandstone window including water levels, hydraulic and flow parameters, and structural, stratigraphic and lithological data.

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TABLES

Golder Associates

TABLE 1

SEEPAGE MODELING AND SENSITIVITY ANALYSIS MINER FLAT DAM SITE - ARIZONA

Model Output Summary

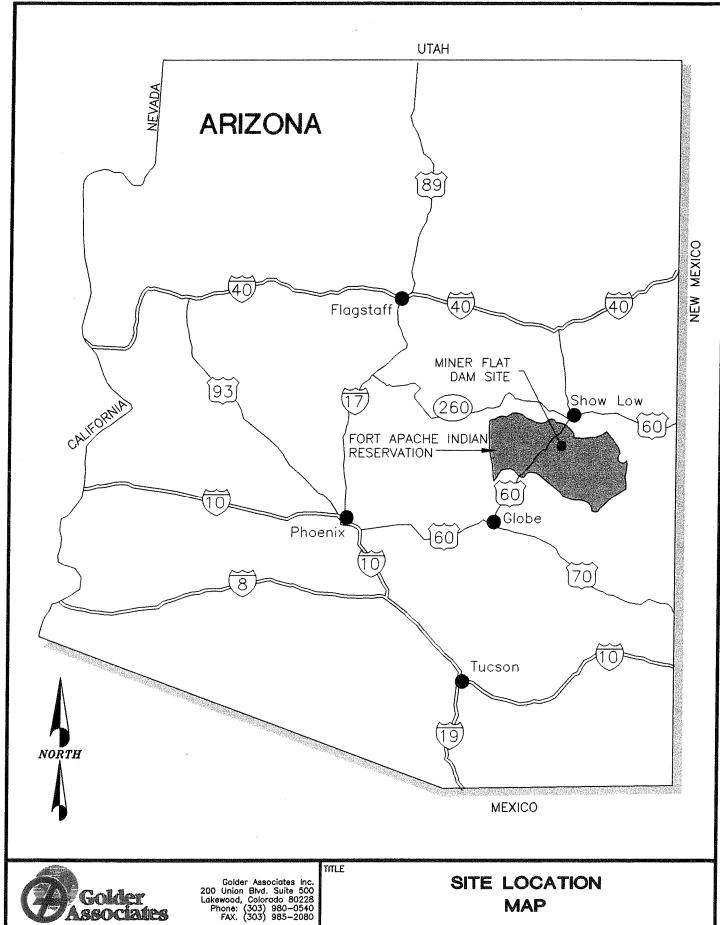
:	Seepage Rate	Dishcarge Width	Flow per foot
	(cfs)	(feet)	(cfs/foot)
Sandstone Window	0.087	1000	8.70E-05
Basalt	0.040	009	6.65E-05
Total	0.127	1600	7.94E-05

TABLE 2

SEEPAGE RATES AT VARYING HYDRAULIC CONDUCTIVITY VALUES MINER FLAT DAM SITE - ARIZONA

Model	Expe	Expected Value	+ 1 Stand	ard Deviation	- 1 Stano	+ 1 Standard Deviation - 1 Standard Deviation	Darcy	Darcy Calculation
	K Value	K Value Seepage Rate	K Value	K Value Seepage Rate K Value	K Value	Seepage Rate	K Value	Seepage Rate
	cm/sec	(cfs)	cm/sec	(cfs)	cm/sec	(cfs)	cm/sec	(cfs)
Sandstone Window	1.94E-04	0.087	6.86E-04	0.309	5.50E-05	0.025	1.94E-04	0.050
Basalt	2.88E-05	0.040	2.28E-04	0.334	1.13E-04	0.005	2.88E-05	0.021
Total	na	0.127	na	0.643	na	0.030	na	0.071

FIGURES



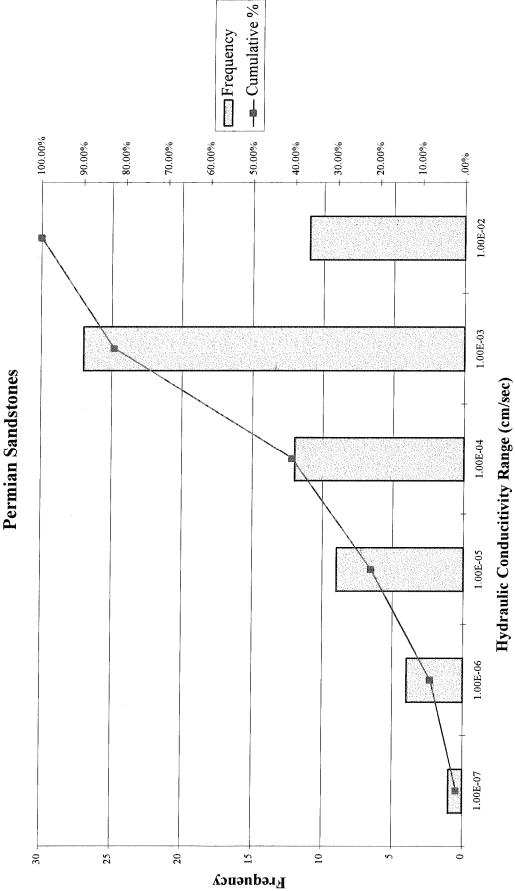


MORRISON-MAIERLE / CSSA MINER FLAT DAM

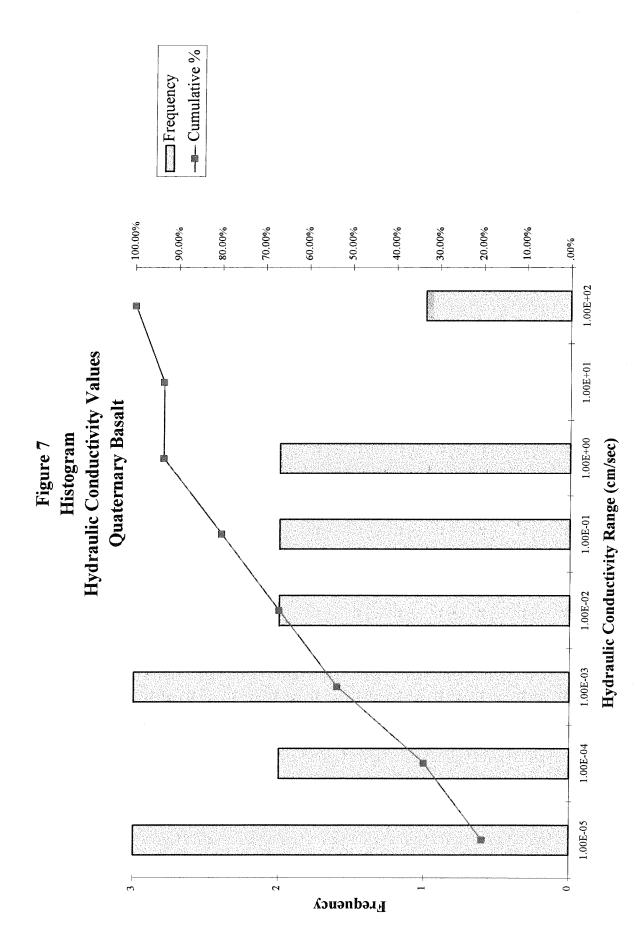
DRAWN	KAW	DATE	APRIL	1997	JOB NO.	943-2769
CHECK	D LB	SCALE		NTS	DWG NO./REV	. NO. A006
REVIEW	CHK	FILE NO	2769	A006	FIGURE NO.	1

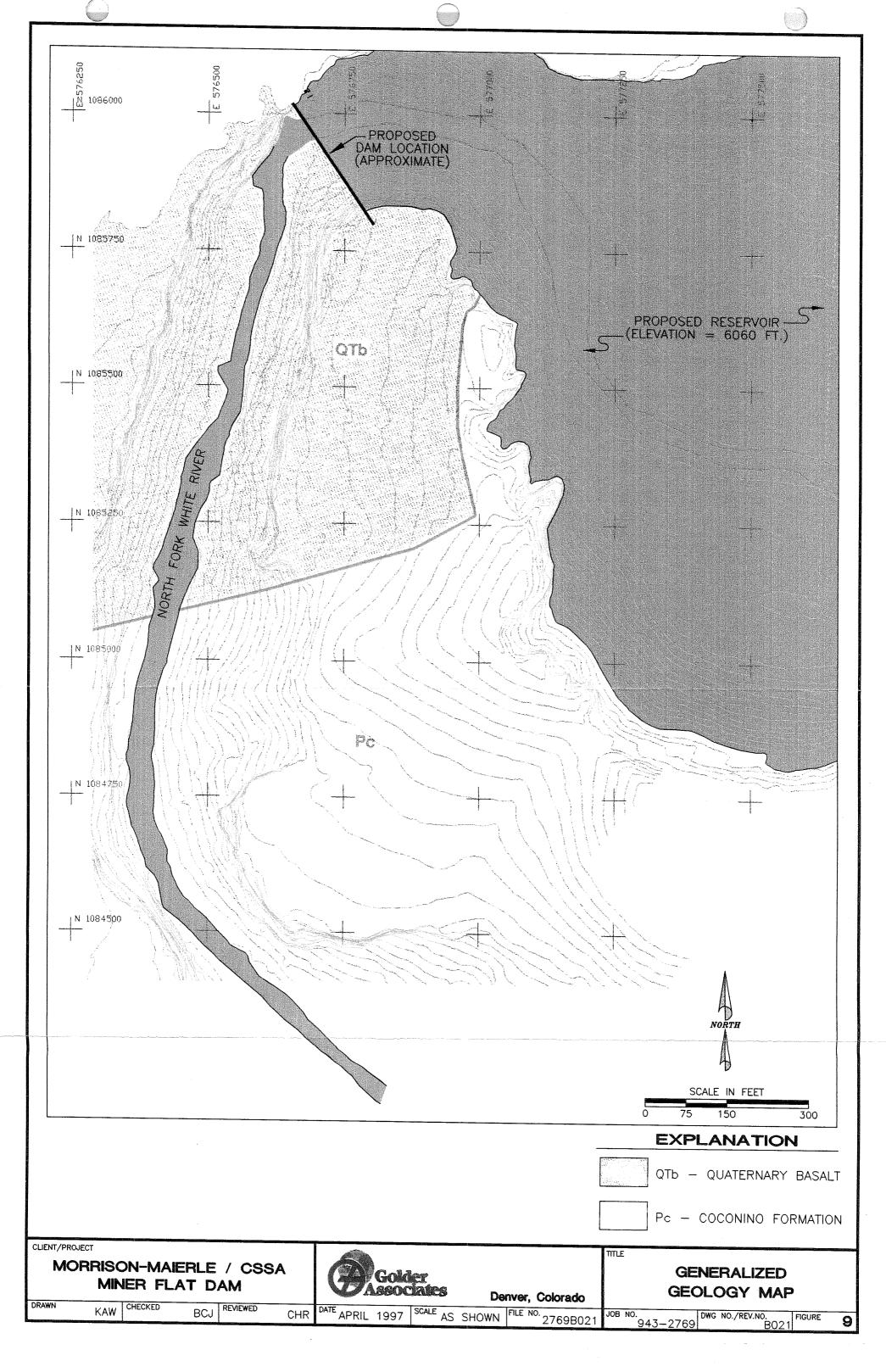


Figure 6
Histogram
Hydraulic Conductivity Values
Permian Sandstones



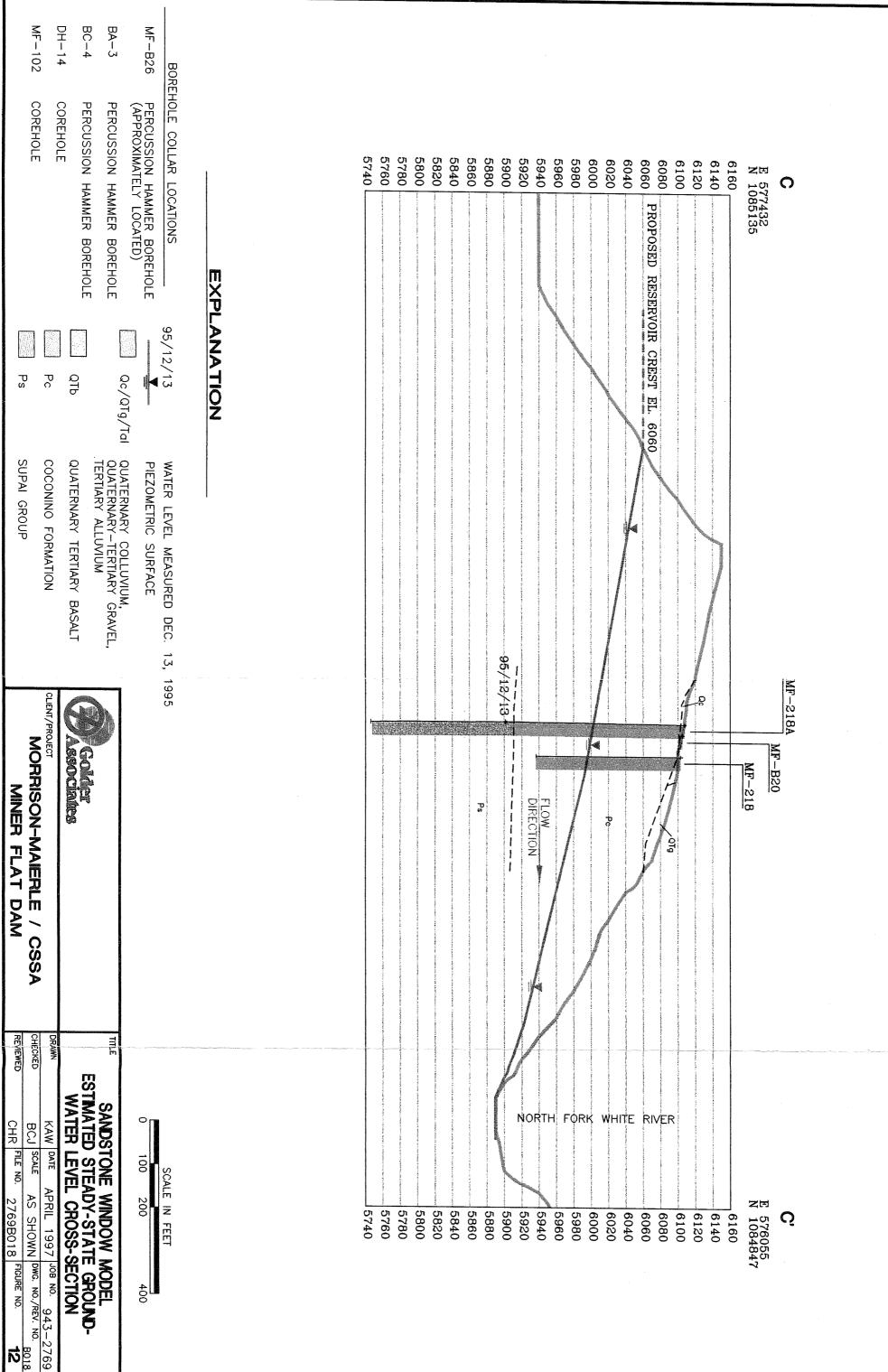
April 1997





KAW CHECKED BCJ REVIEWED CHR DATE APRIL 1997 SCALE AS SHOWN FILE NO. 2769B024 943-2769 DWG NO./REV.NO. B024 FIGURE

11



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APPENDIX A

BOREHOLE LOGS

EXPLANATION

TIT		~~~	רא
	4 90		н.

The depth of the borehole at the end of each core run.

WEATHERING/ ALTERATION:

A two letter code recording the type and intensity of the rock mass weathering or alteration.

The result of chemical weathering is decomposition of minerals.

Mechanical weathering results in the deterioration of the rock mass

-	

W	Weathering	The susceptibility of the rock or mineral to weathering
Α	Argillic	Pertaining to clay or clay minerals
Q	Silicification	The introduction of, or replacement by, silica
В	Calcareous	Contains calcium carbonate

Intensity

	AAASSAMAA J.	
F	Fresh	No visible sign of rock material weathering
S	Slightly	Discoloration indicates weathering of rock material and discontinuity surfaces.
M	Moderately	Less than half of the rock material is decomposed and/or disintegrated to a soil.
Н	Highly	More than half of the rock material is decomposed and/or disintegrated to a soil.

ROCK TYPE:

A six letter code recording; Rock type, Major minerals, Grain size, and Texture, bedding or sorting.

Type (Fi	rst 2 letters)	Mineral	ls (Second 2 letters)		Grain Size		Texture
SS	Sandstone	N	None	Α	Aphanitic	V	Vesicular
SI	Siltstone	v	Olivine	В	Boulder	M	Massive
SM	Silty Sandstone	Q	Quartz	С	Cobble	Α	Aphanitic
BA	Basalt	В	Biotite	G	Gravel	P	Porphyrtic
GY	Gypsum	K	Potassium Feldspar	v	Very Fine	В	Bedded
		Н	Hornblende	F	Fine	T	Thinly Bedded
		S	Sand	M	Medium	L	Laminated
		M	Silt	R	Coarse	R	Brecciated
		G	Gypsum	P	V.coarse	S	Scoracious
		С	Clay			X	Cross Bedded
		F	Iron				

RECOVERY:

The length of core recovered from each run. Expressed as length times 100.

Blank entries reflect no recovery for that interval.

RQD:

A quantitative index based on a core recovery procedure that is measured as the

combined length of core greater than 2 times the diameter; expressed as the length times 100

	Project	Miner Flat Sandstone		technical In	vestigation	- Phase I	Northing		Drilling Method		HQ Split		Project &	943-27691 Task 120 Page
	Location	Sandstone	в кюде	Ti dea	ann e need Sanaan e		Easting Elevation		Drilling Contraction	***	Golden D		Logged By Dete Started	L Bush/C Robinson Borshole MF-250
	F1	1 141			ig Wag		San High as	a tri		1.3			Date Completed	
	Depth	Weathering Alteration	Туре	Mineral	Rock D	escription Texture	Color	Recovery	RQD	Recovery %	RQD %	Frectures per foot rec.	Total Fractures	General Comments
ı	11.8	1450	OB BA	va	AF	V	N3	305	305	45.6	45.5	4.6	44	
- 1	18.5 22.6	ws ws	BA	l va	AV	ľ	N3	387	387	45.5 94.4	45.5 94.4	1.6 2.4	11 10	
-	27.6	ws	BA	P	AF	VM	N3	470	470	94.0	94.0	1.8	9	Vescular to massive
ĺ	32.6 33.6	ws	BA BA	P	AF AF	MV	N3 N3	260 100	260 100	52.0 100.0	52.0	0.8	4	massive to vescular
١	38.5	ws	BA	√p	AF	ľ	N3	435	435	88.8	100.0 88.8	5.0 1.8	5 9	
	41.2	ws	BA	P	AF	V	N3	250	250	92.6	92.6	4.1	11	
١	46.2	WS WF	BA BA	PQ VP	AF AF	MV	N3 N3	510 500	510 500	102.0	102.0	1.6	8	
1	51.2 56.2	WF	BA	Va	AF	M	N3	500	500	100.0 100.0	100.0	1.0 0.4	5 2	
١	61.2	ws	BA	V	AF	м	N3	485	485	97.0	97.0	1.8	9	some joints fresh
-	66.2 71.2	WF WF	BA BA	VQ VP	AF AF	M	N3 N3	492 500	492 500	98.4 100.0	98.4 100.0	0.8	4	
1	71.2 76.2	ws	BA	VP	AF	MV	N3	460	460	92.0	92.0	1.2	6 7	fresh to 73.2
1	81.2	ws	BA	VP	AF	M∨	5R6/2	494	494	98.8	98.8	2.2	11	
١	86.2 91.3	ws ws	BA BA	VP VP	AF AF	V	N3 N3	500 503	500 503	100.0 98.6	100.0 98.6	1.4	7	
-	96.3	WF	BA	VP	AF	M	N3	481	481	96.2	96.2	1.2 0.8	6 4	
-	101.3	WF	BA	VP	AF	М	N3	510	510	102.0	102.0	0.2	1	
	106.3 111.3	ws ws	BA BA	VP V	AF AF	S	N3 N3	500 310	500 310	100.0 62.0	100.0 62.0	1.6 1.2	8 6	highly fractured 108 7 109 6
١	116.3	WF	<u>م</u>	å	v	"	10R6/6	150	150	30.0	30.0	0.0	0	highly fractured 106.7-108.6 Basalt/sandstone contact at 109.3
	118.3	WF		Q	V		10R6/6	50	50	25.0	25.0	0.0	0	No Recovery
-[120.8 121.5				l	ŀ	<u> </u>	0	0	0.0 0.0	0.0 0.0	0.0 0.0	0	No Recovery No Recovery
1	124.6							15	"	0.0	0.0	0.0	0	No Recovery
1	127.7	WF	SS	Q	V	1	5YR7/2	180	180	58.1	58.1	0.0	0	
١	131.2 131.9	WF WF	SS SS	aa	V		5YR7/1 10R5/4	180 35	180 35	51,4 50.0	51.4 50.0	0.0 2.9	0 2	
İ	137.0	WF	SS	a	v	×	10R5/4	360	360	70.6	70.6	2.2	11	
1	140.0	WF	SS	Q	V		10R5/4	312	312	104.0	104.0	4.7	14	
1	147.1 152.1	WF WF	SS SS	a	V	X	10R5/4 10R5/4	190 470	190 470	26.8 94.0	26.8 94.0	0.6 3.8	4 19	-
١	157.2	WF	SS	a		B	10R6/6	436	436	85.5	85.5	2.4	12	
	162.1	WF	SS	Q	l v	В	10R6/6	110	110	22.4	22.4	0.8	4	
ļ	167.1 172.1	WF WF	SS SS	a	V	B XB	10R6/6 10R4/8	230 315	230 315	46.0 63.0	46.0 63.0	2.8 3.2	14 16	Į
1	177.1	WF	SS	a	v	ХB	10R4/6	260	260	52.u	52.0	3.0	15	Pc/Ps contact @177.1
١	182.1	WF WF	SS SS	QM	V	В	10R4/6 10R4/6	165	165	33.0	33.0	2.0	10	0.11
1	186.0 191.1	WF	SS	QM QM	v	8	10R4/6	320 420	320 420	82.1 82.4	82.1 82.4	3.1 2.5	12 13	Siltier @ 184 Sandy @ 187
1	196.1	WF	SS	Q	٧	В	10R4/6	450	450	90.0	90.0	1.6	8	
ľ	201.2 206.2	WF WF	SS SS	aa	V	BL B	10R4/8 10R4/8	376 350	376 350	73.7 70.0	73.7 70.0	2.4	12 9	Silty & laminated Highly fractured 203-205
ł	211.7	WF	SS	QM	v	В	10R4/6	270	270	49.1	49.1	1.8 0.0	0	Highly fractuled 205-205
1	216.2	WF	SI	QM	V	В	10R4/6	430	430	95.6	95.6	2.2	10	
	221.2 226.3	WF WF	SI SS	QM Q	V V	8 8	10R4/6 10R4/6	492 200	492 200	98.4 39.2	98.4 39.2	1.2 1.8	6 8	Highly fractured
	231.3	WF	SS	a	v		10R4/6	10	10	2.0	2.0	0.0	ō	No Recovery
	233.3	WF	SS	QM	V		10YR7/1	20	20	10.0	10.0	0.0	0	
	237.5 242.6	WF WF	SI SI	QM QM	. V	MB M	10R4/6 10R4/6	341 525	341 525	81.2 102.9	81.2 102.9	0.2 1.4	1 7	
	247.5	WF	SS	QM	VF	M	10YR8/6	410	410	83.7	83.7	0.8	4	Calcite filled fracture @15 degrees
	248.1	WF	CS	MC	MC	BX	10YR6/6	4	4	6.7	6.7	0.0	0	
	251.1 256.1	WF WF	SI SS	MC QM	MC VF	BX M	10R3/4 10R4/6	286 450	286 450	95.3 90.0	95.3 90.0	0.7 0.8	2 4	
	260.5	WF	SS	QM	VF	м	10R4/6	75	75	17.0	17,0	0.0	0	Mislatch
	262.5	WF	SS	QM	VF VF	BX	10R4/6 10R4/6	200 475	200	100.0	100.0	1.5	3	
	267.5 272.5	WF WF	SS SS	QM QM	VF VF	BX BX	10R4/6	4/5	475 497	95.0 99.4	95.0 99.4	1.4 2.6	7 13	
	277.5	WF	SM	QM	٧	вх	10R4/6	500	500	100.0	100.0	0.6	3	
	282.5	WF	SM	QM	٧	BX	10R4/6	500	500	100.0	100.0	1.0	5	
	287.5 291.5	WF WF	SM SI	QM MC	V VF	BX BX	10R4/6 N6	376 364	376 364	75.2 91.0	75.2 91.0	0. 6 0.5	3 2	
	296.5	WF	SM	MC	VF	BX	N6	420	420	84.0	84.0	2.2	11	
	301.5	WF	SM	cs	VF	BX	N6	515	515	103.0	103.0	1.4	7	
	305.1 310.0	WF	SM	cs	VF	BX	N6	360	360 0	100.0	100.0	1.1 0.0	4 0	Rods dropped 4.9'
	312.5	WF	SM	cs	VF	вх	N6	285	285	114.0	114.0	0.4	1	Toda dioppod 4.0
	317.5	wc	CL	GM	<u> </u>	İ	N6	490	490	98.0	98.0	0.0	0	Clay w/ 2.5' limestone boulder
1	322.3	WC WF	CL GY	SC GC	BV AV	м	N6 N7	345 490	345 490	71.9 98.0	71.9 98.0	0.0 1.0	0 5	Gypsum @ 322.6'
	331.3	WF	GY	GC	ÂV	M	N7	405	405	101.3	101.3	0.0	0	
L	eoh													End of Hole



Project	Miner Flat	Dam Geot	echnical In	vestigation	- Phase I	Northing	1085586.0	Drilling Met	od .	HQ Split	Tube Core	Project #	943-27691 Task 120 Page	. 46
Location	Sandstone	Ridge				Easting	576823.1	Drilling Cont	tractor	Golden D	rilling	Logged By	D.Alloway Borehole	MF-250/
						Elevation	6079.2	Inclination		90		Date Started Date Completed	8/29/95 8/30/95	11
	Weathering			Rock De	scription			,			Fractures	Total		
Depth	Alteration	Type	Mineral	Gr.Size	Texture	Color	Recovery	RQD	Recovery %	RQD%	per foot rec.	Fractures	General Comments	
8.7											Ť T			
12.3	WF	BA	QV	AV	V	N3	340	269	94.4	74.7	0.8	3		
17.3	ws	BA	QV	AV	V	N3	463	283	92.6	56.6	2.4	12	1	
22.3	ws	BA	QV	VF	V	N3	452	345	90.4	69.0	1.6	8		
27.3	ws	BA	QV	VF	V	N3	429	208	85.8	41.6	0.8	4	Ì	
31.3	ws	BA	QV	AV	V	N3	291	100	72.8	25.0	2.3	9		
36.3	ws	BA	QV	AF	V	N3	508	311	101.6	62.2	1.6	8	1	
41.3	ws	BA	QV	AF	l v	N3	500	349	100.0	69.8	1.8	9		
46.3	WF	BA	QV	AF	V	N3	500	422	100.0	84.4	1.6	8		
51.3	WF	BA	QV	AF	V	N3	500	420	100.0	84.0	1.2	6	1	
56.4	WF	BA	QV	AF	М	N4	515	444	101.0	87.1	0.8	4		
61.5	V/F	BA	QV	AF	М	N4	500	335	98.0	65.7	2.0	10		
66.5	WF	BA	QV	AF	М	N4	484	330	96.8	66.0	0.4	2		
71.5	WF	BA	QV	AF	M	N4	508	318	101.6	63.6	0.4	2		
76.5	ws	BA	QV	AF	٧	N4	500	126	100.0	25.2	2.4	12		
81.5	ws	ВА	QV	AF	V	N4	491	114	98.2	22.8	2.2	11		
86.5	WM	BA	QV	AF	V	N4	507	300	101.4	60.0	2.0	10		



Project Location	Miner Flat		achnical Inv	estigation -	Phase I	Northing Easting		O Drilling Met 9 Drilling Con		HQ Split 1 Golden Di	ube Core	Project # Logged By	943-27691 Task 120 Page LBush/C.Robinson Borehole MF-25
				LayKup		Elevation		Inclination		90		Deta Started	LBush/C.Robinson Borehole MF-25 6/30/95
	4 5/14/98			Davis D		* 2 %			t gett	,		Date Complete	d 7/23/95
Depth	Weathering Alteration	Туре	Mineral	Gr.Size	escription Texture	Color	Recovery	RQD	Recovery %	RQD %	Fractures per foot rec.	Total Fractures	General Comments
30.0													
31.5 36.5	WF	BA BA	VQ VQ	FA FA	AV	N6 N6	150	100	100.0	66.7	2.0	3.0	
41.6	WF	BA	VQ	FA	AM AM	N5	500 510	450 390	100.0	90.0	0.4	2.0	
45.9	WM	BA	va	AF	AV	5Y4/4	429	227	100.0 99.8	76.5 52.8	1.0 1.6	5.0	Claus Black Control
50.9	ws	BA	va	AF	ÂV	N4	498	255	99.6	51.0	1.6	7.0	Clay filled fractures Clay filled fractures
55.9	ws	BA	VQ	AF	AV	N4	506	255	101.2	51.0	1.0	5.0	5-20 degree day filled fracture
60.9	ws	BA	VQ	AF	AV	N4	459	362	91.8	72.4	0,8	4.0	Clay zone at 58 ft
65.9	WF	BA	VQ	AF	AV	N4	500	500	100.0	100.0	0.8	4.0	90 deg clay filled fracture
70.9	WF	BA	VQ	AF	AV	N4	480	420	96.0	84.0	0.6	3.0	
75.9	ws	BA	VQ	AF	AV	5YR4/1	500	220	100.0	44.0	3.2	16.0	
80.9	WS	SS	Q	V	В	10R7/4	250	65	50.0	13.0	2.0	10.0	CONTACT basalt/sandstone
84.4 89.4	ws ws	SS	a a	V	M	10R6/6 10R4/6	120 420	50	34.3	14.3	2.3	8.0	
92.3	WH	SS	a	F	M	5YR5/6	274	50 83	84.0 94.5	10.0 28.6	3.8	19.0	1/4:
97.3	WH	SS	ď	F	M	10R4/6	500	234	100.0	46.8	0.7 1.4	2.0 7.0	Very friable Very friable
102.3	WH	SS	q	VF	M	10R3/4	498	290	99.6	58.0	1.0	5.0	Very friable
107.4	WM.	SS	a	FM	В	10YR6/6	465	218	91.2	42.7	1.8	9.0	, madie
112.4	WM	SS	a	FV	В	10R3/4	490	217	98.0	43.4	1.6	8.0	1
117.4	WH	SS	Q	F	В	5YR3/4	486	0	97.2	0.0	1.2	6.0	Very friable
122.4	WH	SS	a	F	В	5YR3/4	479	0	95.8	0.0	1.4	7.0	Very friable
127.4	WH	SS	Q	FV	В	5YR3/4	500	0	100.0	0.0	0.4	2.0	Very friable
132.4	WH	SS	Q	F۷	В	5YR4/4	498	212	99.6	42.4	0.6	3.0	Very friable
137.4	ws	SS	Q	F	В	10R4/6	509	333	101.8	66.6	1.0	5.0	Very friable
142.4 147.4	WM WS	SS SS	a	F	B 8	10R4/6	490	198	98.0	39.6	0.8	4.0	
152.4	WH	SS	a	F	В	10R5/4 10R5/4	510 494	194 94	102.0 98.8	38.8 18.8	1.6	8.0	Van triable
157.4	WM	SS	a	F	В	10R5/4	500	348	100.0	69.6	0.2 1.8	1.0 9.0	Very friable
162.4	WM	SS	al	F	В	10R5/4	495	175	99.0	35.0	1.4	7.0	
167.4	WM	SS	a	F	В	5YR5/6	500	159	100.0	31.8	2.4	12.0	Clay filled fracture @ 167
172.4	WM	SS	Q	F	х	10YR6/6	474	306	94.8	61.2	1.6	8.0	Pc/Ps contact
177.4	WM	SS	Q	F	X	10R4/6	505	140	101.0	28.0	1.4	7.0	ļ
182.4	WM	SS	a	F	8	10R4/6	491	451	98.2	90.2	0.8	4.0	
187.4	WM	SS	Q	F	В	10R4/6	504	294	100.8	58.8	1.4	7.0	
192.4	WM	SS	a	F	8	10R4/6	498	430	99.6	86.0	0.6	3.0	
197.4 202.4	WH WH	SS SS	a	-	8	10R4/6 10R4/6	478 500	161	95.8	32.2	0.4	2.0	Very friable zones
207.4	WH	SS	a	F	8	10R4/6	500 500	0 100	100.0 100.0	0.0 20.0	0.2 0.4	1.0 2.0	Very little cement
211.2	WF	SM	MQ	VF	M	10R4/8	442	442	116.3	116.3	0.0	0.0	
215.8	WF	SM	MQ	VF	M	10R4/8	482	482	104.8	104.8	0.0	0.0	No nat, fractures
220.7	WF	SS	MQ	VF	M	10R4/6	487	487	99.4	99.4	0.0	0.0	No nat. fractures
225.0	WF	SS	MQ	VF	MB	10R4/8	491	346	114.2	80.5	1.4	6.0	SM to 223 R1 to 223
229.8	WF	SS	a	VF	В	10R5/4	475	175	99.0	36.5	1.3	6.0	no fract, in SM then R2
234.0	WF WF	SM	a s	VF	M	10R5/4	320	42	76.2	10.0	1.7	7.0	
238.8 243.6	WF	SM	MQ MQ	VF VF	M BM	10R5/4 10R5/4	407 475	65	84.8	13.5	1.3	6.0	
248.3	WF	SS	Q	VF	BM	10R5/4	450	260 210	99.0 95.7	54.2 44.7	1.5	7.0 8.0	
253.0	WF	SS	ā	VF	M	10R5/4	444	312	94.5	66.4	0.4	2.0	
257.9		_		ı			0	- /-	0.0	0.0	0.0	0.0	No recovery
259.1			1				0		0.0	0.0	0.0	0.0	No recovery
263.7	WF	cs	CM	v	м	10R5/4	453	310	98.5	67.4	0.7	3.0	,
268.2	WF	SI	QM	V	BX	10R4/6	451	451	100.2	100.2	0.0	0.0	
273.0	WF	SI	QM	V	BX	10R4/6	480	395	100.0	82.3	0.8	4.0	
278.0	WF	SI	QM	V.	BX	10R4/6	500	315	100.0	63.0	1.0		Silt like @ 276-277
283.1	WF	SI	QM OM	V	BX	10R4/6	455	455	89.2	89.2	0.4	2.0	
287.9 292.8	WF WF	SI	QM QM	V	BX BX	10R4/6 10R4/6	455 260	430 205	94.8	89.6	0.2	1.0	
295.7	WF	Si	QM	v	BX	10R4/6	480	480	53.1 165.5	41.8 165.5	0.4	2.0 0.0	Pick up lost core
300.7	WF	Si	MQ	VF	BX	10R4/8	510	510	102.0	102.0	0.0		No nat, fractures
305.6	WF	Si	MQ	Ÿ	BX	10R4/6	490	490	100.0	100.0	0.0	0.0	No nat. fractures
310.6	WF	Si	MQ	v	BX	5Y6/4	475	475	95.0	95.0	0.2	1.0	,
315.3	WF	CS	MC	A	BX	N5	485	485	103.2	103.2	0.0	0.0	
320.8	WF	cs	MC	A	BX	N5	258	232	48.7	43.8	0.4	2.0	
325.7	WF	SS	CQ	V	BX	N6	210	160	41.2	31.4	0.0		3/4" gravel 320-323
326.9	WF	SS	MQ	V	BX	5Y7/6	150	150	125.0	125.0	0.8		Black soot-like dust on barrel
332.0	WF	SS	ca	V	BX	N6	400	400	78.4	78.4	0.2	1.0	
336.8	WF	MI	MQ	V	BX	10R4/6	405	330	84.4	68.7	0.8	4.0	
340.7	WF	MI	MQ	v	BX	10R4/6	445	445	114.1	114.1	0.5	2.0	End of hole



Project			echnical Inve	estigation -	Phase I	Northing		Drilling Me			Tube Core	of the control of	943-27691 Task 120 Page
Location	Sandstone	Ridge	1 1 1	of duby's		Essting		Drilling Co	ninector	Golden E		Logged By	LBush/D Alloway Borehole MF-25
18 JL -						Elevation	6089.0	Inclination		90		Date Completed	Gridad
	Weathering			Rock De	scription		1	T			Fractures	Total	
Depth	Alteration	Туре	Mineral	Gr.Size	Texture	Color	Recovery	RQD	Recovery %	RQD %	per foot rec.	Fractures	General Comments
19.5													
21.0	ws	BA	PV	A	V	N4	149	50	99.3	33.3	4	18	
26.0	WF	BA	PV	A	M	N3	500	480	100.0	96.0	4	8	
31.0	WF	BA	PV	A	M	N3	500	452	100.0	90.4	4	6	
36.0	ws	BA	PV	A	V	N3	475	183	95.0	36.6	11	26	
41.0	ws	BA	PV PV	A	V	N3	455	110	91.0	22.0	12	30	
46.0	WF	BA BA	PV	A	MV	N3 N3	500 500	355 440	100.0	71.0	5	30	
51.0 56.0	WF WF	BA BA	PV	A	M	N3	470	215	100.0 94.0	88.0 43.0	2 7	16	İ
61.0	WF	BA BA	PV	Â	M	N3	498	498	99.6	99.6	1 1	26 8	V. Little clay in fractures
66.0	WF	BA	PV	Â	М	N3	500	333	100.0	66.6	7	14	V. Lime day in nactures
71.0	WF	BA	PV	Â	М	N3	495	385	99.0	77.0	2	14	
76.0	WF	BA	PV	Â	M	N3	500	390	100.0	78.0	5	8	@55, v. little day
81.0	WF	BA	PV	Â	М	N3	500	185	100.0	37.0	11	28	agoo, v. mae day
86.0	WF	BA	PV	Ä	M	N3	494	400	98.8	80.0	3	14	CONTACT basait/sandstone
91.0	WF	SS	Q	VF	В	10R6/6	210	0	42.0	0.0	ŏ	0	OSTATION DECEMBER 1
96.0	WF	SS	co	VF	В	10R6/6	320	42	64.0	8.4	4	8	Graveily
101.0	WF	SS	ca	VF	В	10R6/6	320	ō	64.0	0.0	8	12	Highly fractured w/ day
106.0	WF	SS	a	VF	В	10R8/2	480	175	96.0	35.0	15	22	
111.0	WF	SS	a l	VF	В	10YR8/2	496	180	99.2	36.0	3	4	Highly fractured
116.0	ws	SS	a	VF	В	10YR7/4	500	0	100.0	0,0	15	12	Highly fractured
121.0	l ws l	SS	a	VF	В	10YR7/4	390	0	78.0	0.0	29	28	Highly fractured
122.6	ws	SS	a	VF	В	10YR7/4	140	0	87.5	0.0	4	16	Highly fractured
127.6	WF	SS	Q	VF	8	10YR7/4	480	50	96.0	10.0	8	14	1 * '
132.6	WF	SS	Q	VF	В	10YR8/2	480	90	96.0	18.0	11	20	
137.6	ws	SS	a	VF	so	10R5/4	325	0	65.0	0.0	3	6	Uncemented, soil like
142.6	ws	SS	QC	VF	so	10R5/4	355	0	71.0	0.0	2	8	
146.1	ws	SS	a	VF	so	10R5/4	275	0	78.6	0.0	0	0	Mostly soil like
151.2	WF	SS	a	VF	so	10R5/4	360	0	70.6	0.0	4	6	
156.3	WF	SS	a	F	BD	10R6/6	436	58	85.5	11.4	10	20	
161.5	ws	SS	Q	F۷	BO	10R6/6	370	0	71.2	0.0	10	20	Pc/Ps contact
166.6	WF	SS	Q	FV	М	10R6/6	321	59	62.9	11.6	6	9	Very fractured
171.7	ws	SS	Q	F۷	M	10R6/6	285	0	55.9	0.0	0	0	Very fractured many orientations
176.8	ws	SM	QM	FV	BD	10R4/6	200	50	39.2	9.8	0	0	Very fractured many orientations
181.0	ws	SM	QM	F	BD	10R4/6	162	0	38.6	0.0	0	0	Very fractured many orientations
187.0	WF	SS	Q	F	BD	10R6/6	231	0	38.5	0.0	4	9	Very fractured many orientations
192.0	ws	SS	Q	F	М	10YR10/7	294	0	58.8	0.0	2	5	Very fractured clay @ 192
197.0	WF	SS	Q	F	BD	10R4/6	504	163	100.8	32.6	6	11	
202.0	ws	SS	a	F	BD	10R4/6	509	345	101.8	69.0	3	4	
206.4	WF	SC	QC	FV	BD	10R4/6	344	189	78.2	43.0	2	10	Slipped 1' of core
211.5	WF	SC	QC	FV	BD	10R4/6	402	302	78.8	59.2	5	10	Picked up core from prev.
215.6	WF	SC	QC	F۷	BD	10R4/6	500	444	122.0	108.3	5	15	
220.8	WF	SC	QC	FV F	BD	10R4/6	518	457	99.6	87.9	2	8	
225.9	WF	SC SC	QC QC	F	BD BD	10R4/6 10R4/6	494 512	63 512	96.9 100.4	12.4	5	3 0	No natural fractures
231.0 236.1	WF WF	SC	QC QC	F	BD BD	10R4/6	460	154	90.2	100.4 30.2	5	9	
239.1	WF	SS	QC	F	BD	10R4/6	277	277	92.3	92.3	o l	0	Slipped core Picked up core from prev.,slipped core
242.6	WF	SC	QC	۴۷	80	10R4/6	358	320	102.3	91.4	2	4	Gained 0.7' from prev., slipped 0.6'
242.0	WF	SC SC	QC	F	BD	10R4/6	490	294	102.3	61.2	2	7	Curred 0.7 It of it prev., supped 0.0
252.5	WF	SS	Q	έν	BD	10YR7/4	502	461	98.4	90.4	1	2	
252.5	WF	SS	ď	F	BD	10R4/6	128	61	98.5	46.9	3	. 9	
257.5	WF	CS	ca	F	80	10R4/6	420	400	113.5	108.1	1	4	
262.6	WF	SC	ca	F	BD	10R4/6	442	442	86.7	86.7	25	ō	No natural fractures, slough in hole
267.8	WF	sc	QC	F	BD	10R5/6	520	520	104.0	104.0	1	3	
272.6	WF	cs	cq	F	BD	10R4/6	495	368	99.0	73.6	8	12	·
277.7	WF	cs	ca	F	BD	10R4/6	510	510	100.0	100.0	0 1	0	No natural fractures
282.6	WF	cs	ca	VF.	BD	10R4/8	495	373	101.0	76.1	6	12	
287.7	WF	cs	ca	FV	В	10R4/6	490	440	96.1	86.3	2	6	1
292.6	WF	cs	ca	VF	В	10YR4/2	500	301	102.0	61.4	6	20	
297.7	WF	cs	ca	F	В	10YR4/2	502	502	98.4	98.4	1	5	
302.6	WF	CM	CM	v	В	10YR4/2	505	460	103.1	93.9	4	7	1
307.7	WF	CM	CM	v	В	N5	505	375	99.0	73.5	0	ó	No natural fractures, day @ 304.7-306.2
312.6	WF	MC	MC	v	В	. N6	490	490	100.0	100.0	ŏ	Ö	No natural fractures
317.7	WF	MC	MC	νĺ	В	N4	504	504	98.8	98.8	ŏ	ŏ	No natural fractures
322.6	WF	MC	MC	ν̈́Ι	В	N5	498	408	101.6	83.3	1	5	The second of the second of
327.7	WF	CM	CM	v l	В	5Y4/4	500	500	98.0	98.0	o l	0	No natural fractures
332.7	WF	MC	MC	v l	В	5Y6/4	496	496	99.2	99.2	0	0	No natural fractures
EOH	'''			• 1	٠ ١						٠	•	End of Borehole



Project			echnical im	estigation	- Phase I	Northing	1085032.0	Dritting Me	thod	HQ Split	Tube Core	Project #	943-27691 Task 120 Page			
Location	Sandstone	Ridge	eselin rank	leganga sa		Easting	576791.7	Drilling Contractor		Golden D	rilling	Logged By	L Sust/C. Allowey Borehole MF			
					. Selfelia i i i i	Elevation	6103.1	Inclination		90.0		Date Started	6/3/95			
	127 THE									1,000		Data Completed	6/29/95			
	Weathering			~~~~	escription		1		1	1	Fractures	Total				
Depth	Alteration	Туре	Mineral	Gr.Size	Texture	Cotor	Recovery	ROD	Recovery %	RQD %	per foot	Frectures	General Comments			
8.7 12.5	WF	ss	ا م	F		10R4/6	130		1		1 .					
17.5	""	33	"	-		10140	1 0	0	34.2 0.0	0.0	0	0				
21.2	WF .	SS	ا	F	В	10R4/6	300	0	81.1	0.0	0	0	I Nahah a Karana a sa			
26.2	WF	SS	l a	F	B	10R4/8	460	0	92.0	0.0	5	4 25	Highly fractured			
26.7	WF	SS	a	F	"	10R4/8	50	0	100.0	0.0	0		Highly fractured			
31.7	WF	SS	a	-	İ	10R4/6	340	0	68.0	0.0	2	0	Highly fractured			
33.7	WF	SS	ā	VF	В	10R4/6	168	0	84.0	0.0	ó	0	Highly fractured			
34.1	ws	SS	QC	VF	В	10R4/6	45	Ö	112.5	0.0	0	ő	İ			
37.5	ws	SS	QC	VF	В	10R5/4	200	0	58.8	0.0	0	0	Highly fractured			
42.5	ws	SS	QC	VF	В	10R5/4	475	42	95.0	8.4	1 1	7	Highly fractured			
47.0	WF	SS	a	F	В	10R5/4	420	115	93.3	25.8	3	14	Highly fractured			
52.0	ws	SS	ا م	F	В	10R5/4	505	62	101.0	12.4	4	22	I lightly fractioned			
57.0	WF	SS	QC	F	В	10R5/4	510	118	102.0	23.6	4	21				
62.0	WF	SS	Q	F	В	10R5/4	490	60	98.0	12.0	3	16				
67.0	WF	SS	Q	F	В	10R6/6	475	328	95.0	65.6	2		Mod. fractured @ 66ft			
72.0	ws	SS	Q	F	х	10YR7/4	446	229	89.2	45.8	2	12	Very fractured @71 ft			
77.0	ws	SS	QC	F	X	10R5/4	493	250	98.6	50.0	2	10	Voly Hackarda (g) / //			
82.0	ws	SS	QC :	F	В	10R5/4	352	223	70.4	44.6	1 1	4	i			
87.0	ws	SS	Q	F	M	10YR7/4	300	110	60.0	22.0	2	10				
91.6	ws	SS	Q	F	В	10YR6/6	400	91	87.0	19.8	3	15				
96.7	ws	SS	Q	F	M	10YR6/6	401	114	78.6	22.4	3	15				
101.8	ws	SS	Q	F	M	10YR5/6	451	87	88.4	17.1	3	14				
106.5	ws	SS	QC	F	В	10YR4/6	443	135	94.3	28.7	3	12				
111.6	ws	SS	Q	F	8	10YR7/4	431	133	84.5	26.1	2	11	Highly fractured			
116.7	ws	SS	QC	F	В	10YR4/6	285	60	55.9	11.8	2	8	Highly fractured			
121.7	ws	SS	Q	F	М	10YR4/6	55	0	11.0	0.0	0	0	Highly fractured			
126.8	VVM	SS	QC	F	В	10YR4/6	110	0	21.8	0.0	0	1	Highly fractured			
131.8	ws	SS	a	F	В	5YR5/6	112	0	22.4	0.0	1		Highly fractured			
136.8	WS	SS	Q	F	8	5YR5/6	220	0	44.0	0.0	1		Highly fractured			
141,9	ws	SS	Q	F	M	10R5/4	212	0	41.6	0.0	2	12	Highly fractured			
144.9	WF	SS	Q	F		10R5/4	40	0	13.3	0.0	0		Poor Recovery			
149.0	WF	SI	MQ	VF .	ВМ	10R4/6	160	0	39.0	0.0	0	1	Poor Recovery			
154.0	ws	SS	MQ	F	M	10R5/4	210	86	42.0	17.2	0	2				
159.0	WF	ss	a	VF	В	10R5/4	278	42	55.6	8.4	1		Highly fractured			
160.0 163.0	WF	ss	_	_		400614	0	40	0.0	0.0	0		Rods dropped 159-160			
163.0	WF	SS	a	F	В	10R5/4 10R5/4	246 45	49 0	82.0 12.9	16.3 0.0	2 0	5	End of Hole			



Project Miner Flat Dam Geotechnic Location Sandstone Ridge			echnical Inv	estigation -	Phase I	Northing Easting							943-27891 Task 120 Page D.Allowey: Borehole MF-218			
				Elevation			- 1				Date Started	D.Allowey Borehole MF-2*				
										di var		Date Completed	8/28/95			
epth .	Weathering Alteration	Туре	Mineral	Rock D Gr.Size	escription Texture	Color	Recovery	RQD	Recovery %	RQD %	Fractures per foot rec.	Total Fractures	General Comments			
6.0	714414	1,172	1		102-00	-	1 110001017	1,7,40	Industry A	INGE A	pa location.	Fractures	General Continents			
11.0	WF	SS	Q	VF	В	10R6/6	482	125	96.4	25.0	2.8	14				
16.0	ws	SS	q	VF	В	10R6/6	512	0	102.4	0.0	4.6	23	Highly fractured, non cemented			
21.0	WS	SS	Q	VF VF	В	10R6/8	448	0	89.6	0.0	2.8	14	Highly fractured, non cemented			
22.0 27.0	ws ws	SS	a	VF	ВВ	10R6/6 5YR5/8	80 458	0	80.0 91.6	0.0	2.0	2	Highly fractured, non cemented			
32.0	ws	SS	a	VF	В	5YR5/8	492	0	98.4	0.0	4.8	12 24	Highly fractured, poorly camented Highly fractured, poorly camented			
37.0	ws	SS	ā	VF	В	5YR5/6	500	0	100.0	0.0	4.2	21	Highly fractured, poorly cemented			
42.0	ws	SS	Q	VF	В	5YR5/6	500	0	100.0	0.0	3.2	16	Highly fractured, poorly cemented			
47.0	ws	SS	Q	VF	В	5YR5/6	491	0	98.2	0.0	2.4	12	Clayey silt @ 45.7-47.3			
52.0 57.0	ws ws	SS SS	MQ	VF VF	B	10R6/6 10R6/6	451	0	90.2	0.0	2.4	12	Highly fractured poorly cemented			
62.0	ws	SS	ا	FV	8	10YR8/6	461 512	49 246	92.2	9.8 49.2	5.0 2.8	25 14	Highly fractured, poorly cemented			
67.0	WF	SS	a	FV	В	5YR5/6	486	0	97.2	0.0	11.0	55	V. Fractured, poorty cemented			
72.0	ws	SS	Q	FV	В	5YR5/6	486	74	97.2	14.8	2.8	14	poorly cemented			
77.0	WF	SS	Q	FV	В	5YR5/6	513	510	102.6	102.0	0.4	2	ľ			
82.0	WF	SS	Q	FV	В	5YR5/6	498	498	99.6	99.6	0.0	0	No natural fractures			
87.0	WF	SS	QC	FV	В	10R4/6	513	338	102.6	67.6	2.0	10				
92.0 97.0	ws ws	SS SS	Q	FV FV	B	5YR6/4 10YR7/4	478 484	0 57	95.6 96.8	0.0	3.2	16	Highly fractured, poorly cemented			
102.0	WF	SS	a	FV	В	10R6/6	500	240	100.0	11.4 48.0	2.8 1.6	14				
107.0	WF	SS	à	VF	В	10R6/6	508	0	101.6	0.0	2.8	14	Highly fractured, poorty cemented			
112.0	WF	SS	a	VF	В	10R6/8	500	143	100.0	28.6	2.8	14				
117.0	WF	SS	ca	VF	В	10R4/6	512	400	102.4	80.0	0.8	4				
122.0	ws	SS	Q	VF	В	10R7/4	500	248	100.0	49.6	1.2	6	1			
127.0	WS	SS	cq	VF VF	B B	10R4/8	482	0	96.4	0.0	1.8	9	.			
132.0	ws ws	SS SS	a	VF	В	10R6/6	464 450	0	92.8 90.0	0.0 0.0	0.4 1.6	2 8	V. poorly camented Soil-like, non camented			
142.0	ws	SS	q	VF	В	10R6/6	489	146	97.8	29.2	1.8	8	Soil-like, non cemented			
147.0	ws	SS	a	VF	В	10R6/6	475	0	95.0	0.0	1.8	9	V. poorly cemented			
152.0	WF	SS	a	VF	В	10R6/6	500	203	100.0	40.6	2.0	10	· ·			
157.0	ws	SS	Q	VF	В	10R6/6	480	0	96.0	0.0	2.6	13	Soil like, non cemented			
162.0	ws	SS	Q	VF	8 B	10YR7/4	486	65	97.2	17.0	1.4	7	Soil like to poorly cemented			
167.0 172.0	ws ws	SS SS	q	VF VF	В	10R6/6 10R6/6	477 480	0 50	95.4 96.0	0.0 10.0	1.2 3.0	6 15	soil like			
177.0	WF	SS	Ja	VF	XB	10R6/6	490	75	98.0	15.0	1.4	7	v. poorly cemented			
182.0	WF	SS	a l	VF	В	5YR5/6	484	54	96.8	10.8	1.8	9				
187.0	w l	SS	a	VF	В	5YR5/6	497	0	99.4	0.0	1.6	8				
192.0	WF	SS	Q	VF	В	5YR5/6	475	78	95.0	15.6	2.6	13				
197.0	WF	SS	Q	VF √F	В	5YR5/6	500	218	100.0	43.6	2.2	11	Pc/Ps contact			
202.0	WF WF	SS SS	a	VF VF	B	10R6/6	505 500	227 448	101.0 100.0	45.4 89.6	1.4 0.4	7 2	Weakly reactive to HCl to 232			
212.0	WF	SS	a	VF	8	10R6/6	500	350	100.0	70.0	1.4	7				
217.0	WF	SS	امًا	VF	В	10R4/6	501	415	100.2	83.0	0.2	1				
222.0	WF	SS	Q	VF	В	10R6/6	500	490	100.0	98.0	0.2	1				
227.0	WF	SS	Q	VF	XB	10R6/6	495	400	99.0	80.0	0.2	1				
232.0	ws	SS	Q	VF	В	10R4/6	500	50	100.0	10.0	2.0	10	Mod HCI, No nat'l fract.			
237.0	WF	SS	a	VF VF	В	10R4/6	511	506	102.2	101.2	0.2	1				
242.0 247.0	WF WF	SS SS	aa	VF VF	8 B	10R4/6 10R6/6	490 511	490 474	98.0 102.2	98.0 94.8	0.0	0	Weakly reactive, no natural fractures			
252.0	WF	SS	امّا	VF	В	10R6/6	508	402	101.8	80.4	0.2	3				
257.0	ws	SS	ā	VF	В	10R6/6	388	0	77.6	0.0	1.8	9				
262.0	WF	SS	Q	VF	В	10R6/6	490	314	98.0	62.8	5.0	25				
267.0	WF	SC	QC	VF	В	10R4/6	511	511	102.2	102.2	0.0	0	No natural fractures			
272.0	WF	sc	QC	VF	В	10R4/6	514	514	102.8	102.8	0.0		No natural fractures, HCI reactive			
277.0	WF	CM	CM	V V	B B	10R4/6	444	444	88.8	88.8	0.0		No natural fractures, lost core			
281.7 286.8	WF WF	CM CM	CM	v	8	10R4/6 10R4/6	533 471	533 471	113.4 92.4	113.4 92.4	0.0		Picked up core No natural fractures			
91.9	WF	SI	MC	v	В	10R4/6	330	206	64.7	40.4	0.6		Slipped core			
93.9	WF	SI	MC	v	В	10R4/8	390	314	195.0	157.0	0.5		Broken zone, picked up core			
98.5	WF	SI	МС	v	В	5YR3/4	506	451	110.0	98.0	1.3	6	and a control of the			
302.0	WF	SI	MC	v	В	5YR3/4	335	335	95.7	95.7	0.0		no natural fractures			
307.0	WF	SI	MC	٧	В	N7	522	430	104.4	86.0	1.2	6				
12.0	WF	Si	MC	V	В	N7 .	437	437	87.4	87.4	0.0		No natural fractures			
16.6	WF	Si	MC	V	В	N7	510	420	110.9	91.3	1.1	5				
21.7	WF WF	SI SI	MC	v	B B	N7 N7	508	466 506	99.6	91.4	0.8	4				
326.8	ws	Si	MC MC	v l	В	10YR6/2	513 490	130	100.6 96.1	99.2 25.5	0.4	2 2				
37.0	WF	Si	MC	v	8	N5	486	361	95.3	70.8	0.4	4				
142.0	WF	CM	MC	v	8	5YR4/4	510	469	102.0	93.8	0.6	3	Gypsum @ 345.9			
47.0	WF	CM	MC	v	В	5YR4/4	483	406	96.6	81.2	0.4	2				
52.0	WF	СМ	мс	V	В	5YR4/4	518	451	103.6	90.2	0.6	3				
57.0	WF	G	G	٧	В	N6	496	465	99.2	93.0	0.2	1				
62.0	WF	G	G	٧	В	N6	512	495	102.4	99	8.0	4	End of Hole			



roject ocation	Miner Flat Sandstone		technical Investigation - Phase I			Northing	1084797.0 Driffing Method			HQ Split 7 Golden Di	Tube Core	Project #	943-27691 Task 120 Page		
T. 148.	Odl RUSEDI R					Easting Bevation	576874.7 Drilling Contractor 6071.4 Inclination			90		Logged By Data Started	D.Allowey Borehole MF 6/3/95 8/21/95		
												Date Completed			
pth .	Weathering Alteration	Туре	Minerai	Rock De	Texture	Color	Recovery	RQD	Recovery %	RQD %	Fractures per foot rec.	Total Fractures			
34.8	7,000,000,000	1,,,,,		G.524	10,000		Recovery	RQD	Recovery A	RQD 78	per root rec.	rractures	General Comments		
37.2	WF	sc	QC	VF	В	10R6/6	239	70	99.6	29.2	2.1	5			
42.2	WF	sc	l oc	VF	В	10R6/6	500	63	100.0	12.6	2.0	10			
47.2	WF	SS	Q	VF	В	10YR6/6	510	200	102.0	40.0	1.8	9			
52.2	WF	SS	Q	VF	В	10YR6/6	494	149	98.8	29.8	2.0	10			
57.2	WF	SS	Q	VF	В	10YR8/2	505	324	101.0	64.8	1.2	6			
62.2	WF	sc	QC	VF	В	10R4/6	520	296	104.0	59.2	1.6	8			
67.2	WF	SS	Q	VF	BX	10R6/6	504	325	100.8	65.0	1.0	5			
72.2	WF	SS	Q	VF	BX	10R6/6	490	400	98.0	80.0	0.4	2	Top 1' very friable		
77.2	ws	SS	Q	VF	8	10R6/6	493	154	98.6	30.8	1.0	5	1		
82.2	ws	SS	Q	VF	BX	10R6/6	485	182	97.0	36.4	1.4	7	ì		
87.2	ws	SS	Q	VF	В	10R4/6	461	0	92.2	0.0	1.4	7			
92.0	WF	SS	Q	VF	ј в	10R4/6	498	288	103.8	60.0	1.0	5	1		
97.1	WF	SS	Q	VF	В	10YR8/2	510	203	100.0	39.8	2.2	11	Ì		
02.2	WF	SS	Q	VF	8	10R6/6	508	141	99.6	27.6	1.8	9			
07.2	ws	SS	Q	VF	В	10YR8/2	290	0	58.0	0.0	1.2	6	V.poorty cemented		
12.2	ws	SS	a	VF	В	10R6/6	475	50	95.0	10.0	0.8	4	V. poorly cemented, v. fractured		
17.2	WF	SS	a	∨F	8	10R7/4	483	0	96.6	0.0	2.8	14	V. poorly cemented, v. fractured		
22.2	ws	SS	Q :	VF	В	10YR8/2	460	0	92.0	0.0	1.4	7	V. poorly cemented		
27.2	ws	SS	Q	VF	В	10YR8/2	500	0	100.0	0.0	1.6	8	V. poorty cernented		
32.2	ws	SS	Q	VF	В	10YR8/2	458	0	91.6	0.0	1.8	9			
37.2	WF	SS	Q	VF	В	10R4/6	490	352	98.0	70.4	0.6	3			
42.2	WF	SS	Q	VF	В	10R6/6	497	368	99.4	73.2	0.4	2			
47.2	WF	SS	a	VF	В	10R6/6	505	307	101.0	61,4	0.8	4			
52.2	WF	SS	Q	VF	В	10R6/6	500	89	100.0	17.8	1.0	5			
57.2	WF	SS	Q	VF	В	10R6/6	500	359	100.0	71.8	1.4	7			
62.2	WF	SS	Q	VF	В	10R6/6	505	262	101.0	52.4	1.0	5			
67.2	WF	SS	a	VF	В	10R6/6	512	230	102.4	46.0	1.2	6	Pc/Ps contact		
72.2	WF	SS	a	VF	В	10R6/6	480	224	96.0	44.8	1.6	8			
77.2	WF	SS	Q	VF	В	10R6/6	508	380	101.6	76.0	1.2	6			
82.2	WF	SS	Q	VF	В	10R6/6	492	449	98.4	89.8	0.6	3	İ		
87.2	WF	SS	Q	VF	8	10R6/8	504	325	100.8	65.0	1.6	8	*		
92.2	WF	SS	Q	VF	В	5YR5/6	492	450	98.4	90.0	0.6	3			
97.2	WF	SS	Q	VF	8	5YR5/6	500	463	100.0	92.6	0.6	3			
02.2	WF	SS	Q	VF	8	5YR5/6	520	490	104.0	98.0	0.2	. 1			
07.2	WF	SS	a l	VF	В	5YR4/4	473	410	94.6	82.0	0.2	1			
12.2	WF	SS	Q	VF	В	5YR4/4	459	459	91.8	91.8	0.0	0	No natural fractures		
17.0	WF	SS	Q	VF	В	5YR4/4	515	515	107.3	107.3	0.0	0	No natural fractures		
22.1	WF	SS	Q	VF	В	5YR4/4	520	469	102.0	92.0	0.4	2			
27.2	WF	SS	Q	VF	В	5YR4/4	483	211	94.7	41.4	1.0	5			
31.7	WF	SS	Q	VF	В	5YR4/4	480	356	106.7	79.1	0.4	2			
36.8	WF	SS	a	VF	В	5YR4/4	504	418	98.8	82.0	0.0	0			
41.9	WF	SS	Q	VF	В	10R7/4	497	497	97.5	97.5	0.0	0	No natural fractures		
47.0	WF	SS	a	VF	В	5YR4/4	520	520	102.0	102.0	0.0	0	No natural fractures		
52.0	WF	SS	Q	VF	RB	10R7/4	500	115	100.0	23.0	1.0	5			
57.1	WF	SI	MQ	VF	RB	10R6/6	494	481	96.9	94.3	0.2	1			
32,1	WF	SI	MQ	VF	8	10R4/6	496	406	99.2	81.2	0.0	0	No natural fractures		
37.1	WF	SI	MQ	VF	В	10R4/6	523	512	104.6	102.4	0.2	1			
2.1	WF	SI	MQ	VF	В	10R4/6	510	510	102.0	102.0	0.0	0	No natural fractures		
7.1	WF	SC	MC	V	В	10R4/6	508	488	101.6	97.6	0.2	1			
32.1	WF	sc	MC	V	В	10R4/6	507	507	101.4	101.4	0.0	0	!		
7.1	WF	SC	MC	V	В	5YR4/4	445	412	89.0	82.4	0.6	3			
2.0	WF	cs	CM	V	RB	5YR4/4	515	165	105.1	33.7	5.1		V. fractured		
5.2	WF	sc	MC	V	RB	5YR5/2	300	94	93.8	29.4	0,6		Contact w/ Gypsum		
9.2	WF	sc	MC	V	В	5YR4/4	447	447	111.8	111.8	0.0		No natural fractures		
2.2	WF	sc	MC	V	В	5YR4/4	280	280	93.3	93.3	0.0		No natural fractures		
7.2	WF	GY	G	Α	M	N3	504	504	100.8	100.8	0.0	0	No natural fractures		
2.2	WF	GY	G	A	M	N3	500	495	100.0	99.0	0.2	1			
17.2	WF	GY	G	A	В	N5	510	510	102.0	102.0	0.0	0	No natural fractures		
22.2	WF	GY	G	Α	8	N5	500	500	100.0	100.0	0.0	0	No natural fractures		
27.2	WF	GY	G	A	В	N5	500	500	100.0	100.0	0.0		No natural fractures		



Project Location	Sandston		otechnical ir	rvestigation	- Phase I	Northing Easting		O Dritting Mes			Tube Core	······································	943-27691 Task 120 Page
	<u>Seruson</u>	a locka				Easting Elevation		7 Drilling Con 3 Inclination	rector :	Golden D		Logged By Date Started	0.Alloway Borehole MF-2:
					offer his							Date Completed	* ************************************
	Weethering				scription		1	T			Fractures	Total	
29.3	Alteration	Type	Mineral	Gr.Size	Texture	Color	Recovery	RQD	Recovery %	RQD %	per foot rec.	Frectures	General Comments
32.2	WF	BA	av	F	V	N4	289	289	99.7	99.7	0.0	0	No natural fractures
37.2	WF	BA	QV	F	V	N4	488	272	97.6	54.4	1.0	5	The traction is active to
42.2	WF	BA	QV) F	V	N4	500	500	100.0	100.0	0.2	1	
47.2	WF	BA	QV	F	V	N4	504	410	100.8	82.0	0.4	2	1/2" clay filled fracture @15 deg 43.3-44.3, wate
52.2	WF	BA	QV	F	<u>v</u>	N4	478	400	95.6	80.0	0.6	3	Slipped core
56.1	WF	BA	QV QV	F FM	M	N4	424	350	108.7	89.7	0.5	2	Begin mud use, picked core from previous
61.1 66.1	WF	BA BA	QV	FM	M	N4 N4	500 501	455 221	100.0	91.0	1.0	5	
71.1	WF	BA	QV	FM	M	N4	470	278	100.2 94.0	44.2 55.8	1.8	8 5	Basait/Sandstone contact @ 69.9
75.9	ws	SS	a	VF	М	10R7/4	450	0	93.7	0.0	0.0	0	Clay filled fractures, SS at 69.9, 100% water los. Non-cemented sand
81.0	ws	SS	a	VF	М	10R7/4	430	58	84.3	11.4	0.4	2	Non-cemented sand
86.0	ws	SS	Q	VF	М	10R4/8	362	52	72.4	10.4	0.6	3	Train solling busing
90.1	ws	SS	Q	VF	M	10R6/6	350	51	85.4	12.4	1.7	7	Slipped core
91.1	ws	SS	Q	VF	М	10R6/6	120	0	120.0	0.0	1.0	1	Picked up core from previous
96.1	ws	SS	a	VF	М	10R6/6	510	212	102.0	42.4	1.0	5	
101.1 104.7	ws ws	SS	Q Q	VF VF	B B	10R6/6	485	0	97.0	0.0	0.2	1	
109.7	ws	SS	ď	VF	8	10R6/6 10R6/6	306 445	138	85.0	0.0	0.8	3	
112.2	ws	SS	l a	VF	В	10R6/6	247	49	89.0 98.8	27.8 19.6	1.0	5	
117.2	ws	SS	Ìā	VF	В	10R6/6	510	128	102.0	25.6	1.8	9	
122.2	ws	SS	a	VF	8	10R6/6	500	110	100.0	22.0	1.4	7	Slipped core
127.2	ws	SS	Q	VF	В	10R6/6	512	144	102.4	28.8	0.8	4	Picked up core from previous
132.2	ws	SS	Q	VF	В	10R6/6	459	0	91.8	0.0	1.6	8	
137.2	ws	SS	Q	VF	В	5YR6/4	505	118	101.0	23.6	1.0	5	
142.2	ws	SS	Q	VF	В	5YR6/4	462	0	92.4	0.0	1.8	9	
147.1	ws ws	SS SS	a	VF VF	8	5YR6/4	492	0	100.4	0.0	2.2	11	Very fractured
152.1 157.1	ws	SS	da	VF	8 B	5YR5/6 5YR5/6	475 512	132 372	95.0 102.4	26.4 74.4	1.2 0.8	8	
162.1	WF	SS	امّا	VF	8	10R6/6	492	492	98.4	7 4.4 98.4	0.0	3 0	No natural fractures
167.1	WF	SS	a	VF	B	10R6/6	508	418	101.6	83.6	0.2	1	Soil like 184.8-185.7
172.1	ws	SS	a	VF	В	10R6/6	475	255	95.0	51.0	0.8	3	Very poorly camented
177.1	ws	SS	Q .	VF	В	10R6/6	500	130	100.0	26.0	0.4	2	Very poorly cemented
182.1	WF	SS	Q	VF	В	10YR7/4	503	356	100.6	71.2	0.8	3	Very poorly cemented
187.1	WF	SS	Q	VF	В	10YR7/4	500	448	100.0	89.6	0.6	3	
192.1 197,1	WF WF	SS SS	Q	VF VF	8	10YR7/4	496	450	99.2	90.0	1.2	6	
202.1	WF	SS	aa	VF	8 8	10R4/6 10R4/6	502 500	378 300	100.4 100.0	75.6	0.6	3	
207.1	WF	SS	QC	VF	8	10R6/6	504	455	100.8	60.0 91.0	0.6 0.2	3 1	Clause same there are a
212.1	WF	SS	QC	VF	В	10R4/8	491	377	98.2	75.4	0.4	2	Clayey zones throughout Lower part appears brecciated
217.1	WF	cs	cq	VF	8	10R4/6	510	510	102.0	102.0	0.0	ō	No natural fractures
22.1	WF	sc	QC	VF	8	10R4/8	500	393	100.0	78.6	0.4	2	
27.1	WF	sc	QC	VF	В	10R4/6	510	460	102.0	92.0	0.4	2	
232.1	WF	SC	CQ	VF	В	10R4/8	507	365	101.4	73.0	0.6	3	
237.1 242.1	WF	cs cs	cq	VF VF	B B	10R4/6 10R4/6	498 448	498 422	99.6	99.6	0.0	0	No natural fractures
46.7	WF	SC	QC	VF	8	10R4/6	486	448	89.6 105.7	84.4 97.4	0.6	3	Slipped core
51.5	WF	SC	QC	VF	В	5YR4/4	508	497	105.7	103.5	0.9	1	Gained core from previous
54.3	WF	CG	CG	VA	8	N5	291	144	103.9	51.4	0.4		Gypsum at 254.8
58.3	WF	G	G	Α	В	N5	398	398	99.5	99.5	0.0		No natural fractures
62.2	WF	G	G	A	В	N5	389	375	99.7	96.2	0.3	1	
87.2	ws	GC	GC	AF	В	5YR4/4	505	0	101.0	0.0	5.0		Many horiz, fractures
72.2	ws	C	C	V	В	N5	490	0	98.0	0.0	5.0	. 1	Soil like
77.2	WS WF	SI SC	MS MC	VA	В	N3	504	212	100.8	42.4	5.0		As above, layered clay and gypsum
82.2 87.2	WF	GC	GC	VA VA	B B	N5 5YR4/4	496 512	416 418	99.2	83.2	1.0	5	
92.2	ws	G	G	Ä	В	N3	508	418 508	102.4 101.6	83.6 101.6	1.2 0.6	6 3	
97.2	ws	GC	GC	ÂV	8	N5	495	472	99.0	94.4	0.6	3	
02.2	ws	GC	GC	ÂV	В	N5	499	499	99.8	99.8	0.8	3	
07.2	ws	GC	GC	AV	В	N5	513	513	102.8	102.6	0.4	2	
12.2	ws	G	G	A	В	N5	500	500	100.0	100.0	0.0		No natural fractures
17.2	ws	G	G	A	В	N5	502	502	100.4	100.4	0.0		No natural fractures
22.2	ws	CG	CG	VA	В	10R4/6	386	386	77.2	77.2	0.0		No natural fractures, slipped 1.2 ft of core
25.2	ws	CG	CG	VA	В	10R4/6	459	459	153.0	153.0	0.0	0	No natural fractures, picked up 1.1 ft of core
ОН			i									İ	End of Borehole



SITE NAME	E AND LOCATION			···	HOLE LOG DRILLING METHOD: BECKER HAMMER								
		LAT DAM NE RIDGE		SAMPLING METH	SAMPLING METHOD: BULK								
	36112372	NE NIBGE							START TIME 11:00	FIN 13:			
NORTHING EASTING: DRILL RIG	w		ELEVATION						DATE 25/95		TE 5/95		
ANGLE V	ERTICAL BEA	RING NA		SURFACE CONDITION	S ROAD								
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVAL BLOWCOUNT FRO BECKER HAMMEI BLOW COUNTS 10 20 30 40	SWBOL.		DESCRIPTION O	f material				K E	MDEX # STANK NO. 200	OTHER		
1 2 3			loose to GRAVEL, sand, 20 cobbles gravel, 4	ft.) Light brown (5 o compact, CLAYEY 35% fine to medium 1% silty clay, 20% si and 25% fine to ci (5% coarse subangune, dry, (SC)	ular d								
- 5 - 6 - 7			loose to to mediu clay, 10%	ft.) Light brown (5 c compact, CLAYEY um subrounded sand (fine to coarse si (5% cobbles, dry, (\$	SAND, 70% fine , 20% silty ubangular		mhimhimhim						
- 9 - 10 - 11 - 12 - 13			compact CLAY and subround sized sai	ft.) Light brown (to dense, well gra d GRAVEL, 75% fine ded sand, 15% subar indstone, 10% silty o ar cobbles, dry, (S	ded SAND with to coarse ngular gravel clay, (5%	<u>(-10.0)</u>	10.0						

	S	OIL BOR	REHOLE LOG		(F)	older sociates
SITE NAM	E AND LOCATION		DRILLING METHOD: BECKER	HAMMER	BORING N	√0.
					ВА	-1
· · · ·					SHEET	
	MINER FLAT		SAMPLING METHOD: BULK			VF 4
	SANDSTONE RI	IDGE			DRM	LING
					START	FINISH
					TME	TIME
					11:00	13:30
NORTHING	:				DATE	DATE
NORTHING EASTING:		ELEVATION			7/25/95	7/25/95
DRILL RIG			SURFACE CONDITIONS ROAD		***************************************	
ANGLE V		A				
SAMPLE I	44MMER				·	
H _C	SPT (N ₆₀) EQUIVALENT				TEST RES	SULTS
F OF	SPT (N ₅₀) EQUIVALENT BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS	정			1 1 1	SULTS
EV#		SYMBOL	DESCRIPTION OF MATERIAL		E E	₹8
DEPTH IN FEET (ELEVATION)	10 20 30 40 80	~			WATER CONTENT & CONTENT & LIQUID LIMIT PLASTICITY WINEY & CONTENT OF THE PLASTICITY	LESS THAN NO. 200 OTHER TESTS
					30 7 €3	13¥ 2H
		(40.0-47.0	ft.) BEDROCK, sandstone			
=				=		
46				=		
				3		
L 47		Fred of B	4.70	(-47.0) 47.0 -		
E		End of a	orehole at 47.0 ft.	= =		
E 48				Ξ		
= "						
F 40				=		
E 49				3		
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<u></u> 50				目		
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58				크		
= 1				# 1		
59				4		
				\exists		;

		SOIL	BOR	EHOLE LOG		Golder 880 clates	
SITE NAME	AND LOCATION			DRILLING METHOD: BECKER HAMMER	BORING B		LAYNE VESTERN EXPLORATION
		-		SAMPLING METHOD: BULK	SHEET	or 3	LX CX
	MINER FLA SANDSTONE					MLLING	TER
					 START	FINISH	Ĭ,
					13:30	15:20	AYNE
			*		DATE	DATE]
NORTHING: EASTING:		ETE/	/ATION		7/25/95	7/25/95	2
DRILL RIG	AP1000 BECKER HAMM			SURFACE CONDITIONS RUAD			CONTR
SAMPLE H		, NA			 		1
		Т			TEST R	ESULTS	2
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVALENT BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 10 20 30 40 80	SWABOL		DESCRIPTION OF MATERIAL	K	INDEX % LESS THAN NO. 200 OTHER TESTS	DRILLING
1			(10.0-15.0 ft (10.0-15.0 ft (10.7 6/2), LEAN CLAY, COARSE SUM	.) Pale yellowish brown stiff to very stiff, SANDY 60% silty clay, 40% fine to brounded sand, dry, (CL) c.) Pale yellowish brown stiff to hard, SANDY LEAN silty clay, 40% fine to medium sand, 10% fine to cocise gravel, (5% subangular			JOB NO.:943-22691,170

	SOI	L BOF	REHOLE	LOG	4	(older sociate	3
SITE NAME AND	LOCATION		DRILLING METH	DO: BECKER HAMME	R	8	ORING BA	NO.	4
-1						s	HEET		_
	MINER FLAT DAM		SAMPLING METH	OO: BULK		\dashv	2 () F 3	
	SANDSTONE RIDGE						DRN	LUNG	
						S	TART	FINISH	1
							TIME	TIME	
							3:30	15:20	
NORTHING:				 			DATE	DATE	I
EASTING: DRILL RIG AP	1000 BECKER HAMMER	LEVATION		<u> </u>		///	25/95	7/25/9	95
ANGLE VERTI			SURFACE CONDITIONS	RUAD					_
SAMPLE HAMME									- 1
	T					7	EST RE	ST II IS	
DEPTH IN FEET (ELEVATION)	T (N ₅₀) EQUIVALENT BLOWCOUNT FROM						K	T	
æĘ	BECKER HAMMER BLOW COUNTS 30 30 40 80 6		000000000000000000000000000000000000000			36	ቜ ዾ.	3	
	20 30 40 80 K		DESCRIPTION OF	MAIERGAL		WATER	LIQUID LIMIT	LESS THAN NO. 200	1
8						\$8	물 [돌	1 3 5 1	TESTS
									\exists
=		(10YR 6/2	ft.) Pale yellowish 13, very stiff to h	ard, SANDY	3		ļ		
16		LEAN CLA	Y, 60% silty clay, : ubrounded sand,	35% fine to 5% fine to	mhinhinhin				
		coarse s dry, (CL)	ubangular gravel :	sized sandstone,	#		İ		
		u. y, 1027			3				
= ''									
18					=				
: '					=				
					#		İ		
- '3									1
- 00	1				-20.03 c0.05-3				
— 20		(20.0-25.0	ft.) Pale yellowish), compact to dens	brown			Ī		
: .	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	SAND, 60%	fine to medium su	brounded sand,	3				
— 21		subangula	clay, 10% fine to a r gravel size sand	ioarse Istone, damp,	=				
		(SC)			\exists				
_ 22					=				
					ヸ				
- 23					=				-
					4				
- 24					= = = = = = = = = = = = = = = = = = = =				İ
					3				
- 25		(25.0-30.0	ft.) Pale yellowish	hnowe	4			.	.
		(10YR 6/2)	, compact to very	dense, CLAYEY	= = = = = = = = = = = = = = = = = = = =				
- 26		20% silty	fine to medium sui clay, <5% coarse s	orounded sand, Subangular	3				ł
	50	sand, damp), (SC)	J	= 1				
27		€ 26.0-29.0	0 ft., boulders		# 1				
- 26 - 27									
:	>50] [
– 28					=				
	•				#				1 ;
- 29									9
] [8
<u> </u>									

			SO	L BO	REI	HOLE	LOG				Œ		older		
SITE NAME	E AND LOC	ATION				DRILLING METHO	D: BECKER	HAMMER			BOR	NG N			
)]							BA-	-2		
1											SHEE	.T			
	١	MINER FLA	T DAM		L	SAMPLING METH	DO: BULK				3	OF	- 3		
		SANDSTONE										DRILL	JNG		
					Ĺ						STAR	rr	FINI	SH	
											TIME		ПМ	Æ	
											13:3	0	15:8	20	
NORTHING:											DATE	Ε	DAT	ĪΕ	١.
EASTING:				ELEVATION		·				7	/25/	95	7/25	/95	
DRILL RIG	AP1000	BECKER HAM	MER		SUR	FACE CONDITIONS	ROAD								İ
ANGLE V	ERTICAL	BEARING	NA NA												
SAMPLE H	IAMMER														
-	SPT /N	.) FOUNDAMENT									TEST	RES	ULTS		
DEPTH IN FEET (ELEVATION)	BLOWC	o) Equivalent Count From Er Hammer	ا با								K				
≇ §	BLOV	W COUNTS	SYMBOL			DESCRIPTION OF	MATERIAL			K	LICAUID LINAIT	≥	₹.		
E3 (10 20	30 40 50	&			DESCRIPTION OF	MAZI CT/RAF			se	9	E X	S THAN 200	50	
8										WATER	ਤੁ	PLASTICITY INDEX %	LESS NO. 2	OTHER	
	7									·		· · · · ·			
_				(30.0-35 (10YR 6)	.0 ft.) /2), cor	Pale yellowish mpact to dens	brown se. CLAYFY								
_ ,				SAND, 60	0% fine	to medium su	brounded s	and,							
31				30% silt sand, do	y clay, imp, (Si	. 10% subanguli C)	ar coarse								
	•			-											
— 32									=						
F	•														
33			1111						111111111111111111111111111111111111111						
- 1	•		1333						=						
_ 34									_=						
- '									=			l			
- ,,									=					- 1	
- 35				(35.0-40.	0 ft.>	Pale yellowish	brown						. 1		
=	•			fine to	medium	npact, CLAYEY subrounded s	and, 50% si	ity	3						
36				clay, (5) (SC)	. subai	ngular coarse	sand, damp),	=						
=	•								╡						ì
37			1777						크						
-	a		199						=						
- 38			1111						\exists		·				
:			1111						\exists						
: ,									コ						
- 39															
	•														
- 40						Pale yellowish			ヨ						
:				(10YR 6/	com	pact to dens and 10% coar:	e, CLAYEY S	SAND, 60%	\exists						
- 41				to suba	ngulor	sand sized bo	salt and	we u							
				quartz,	30% sil	ty clay, damp,	(20)		⇉		l				
_ , ,									コ		I				
- 42									=						
	•								\exists						
<u>-</u> 43	.								3		ı				,
:									3						
- 44			777		+ P+C	ALT DEPOS		(-44.0)	44.0						2
: '				·		ALT BEDRUCK		(-44.2)	44.2						014
-	1 1	1 1 1	1 1	Fua of F	orenol	e at 44.2 ft.				1 1	1	1	- 1		ζ

	SOIL B	ORI	EHOLE LOG		Ó	AG AL	older locial	es	
SITE NAME AND LOCATION			DRILLING METHOD: BECKER HAMME	R		DRING N BA	Ю.		LAYNE WESTERN EXPLORATION
			CALCUMA ACTION - PILLY			HEET	•		EXPL
MINER FL SANDSTON			SAMPLING METHOD: BULK			1 O	F 3		ERN
3514231614	C NIDGE				s	TART	FINE	SH	WEST
						TME	TIM	Ε	Ä
						5:20	8:4 DAT		LA
NORTHING: EASTING:	ELEVATION					25/95	7/26/	_	٨
DRILL RIG AP1000 BECKER HAI			SURFACE CONDITIONS ROAD	<u> </u>					Ë
	₩G NA								္ပ
SAMPLE HAMMER					T				ပ္
SPT (N ₅₀) EQUIVALET BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 10 20 30 40 8	NABO!		DESCRIPTION OF MATERIAL			PLASTICITY NOEX &		OTHER TESTS	DRILLING CONTR
1 2 3 4 4 5 5 6 7 7 8 8 9 9 10 10 11 11 12 12 13 14 14 16 14	(10) sitt mea to qua (5.0 (10) fine ctay gra san (10.0 (10) LEAI coa coa coa	(R 6/2), , 40% fir itium to occurrence coarse crtzite, -10.0 ft. (R 6/2), y, 20% fir vel and dstone, -15.0 ft R 5/2), N CLAY, N SE subirese grav	Pale yellowish brown compact, CLAYEY SAND, 50% where subrounded sand, 30% silty ine to coarse subrounded cobble size quartzite and damp, (SC)	-10.0> 10.0				AT ALLOWOLD STREET, ST	JOB NO.: 943-22691170 LOGGED BY M.D. ALLOWAY FILENAME: BA-3 DATE SPETEMBER 1995 CHK'D RY I RITSH

		SOIL	BOR	EHOLE LOG	E	Golde	r Mes
SITE NAME A	AND LOCATION			DRILLING METHOD: BECKER HAMMER	BOR	NG NO. BA-3	
* New York					SHEE		
	MINER FLAT			SAMPLING METHOD: BULK	 5	OF 3	
	SANDSTONE	KIDGE			 STAF	DRILLING	HSH
					TIM		ME
					15:2		40
NORTHING:					 7/25/		ATE 6/95
EASTING: DRILL RIG	AP1000 BECKER HAMME	ELEVATK R		SURFACE CONDITIONS RELAD	1/23/	93 //26	5/93
ANGLE VER		,,	,	SOUTHER CONTINUES	 		
SAMPLE HAM	IMER						
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVALENT BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 10 20 30 40 80	SWBOL		DESCRIPTION OF MATERIAL	MATER CONTENT & LIQUID LIMIT & F	PLASTICITY MDEX # LESS THAN NO. 200	
16 17 18 19 20 21 22 23 24 25 26 27 28			(20.0-25.0 f stiff to ve 80% silty cl subrounded subangular	t.) Moderate yellowish brown stiff to very stiff, SANDY 70% silty clay, 20% fine to rounded to subangular sand, 10% fine to coarse, subangular d sandstone, (CL) t.) Light brown (SYR 5/6), rry stiff, LEAN CLAY with SAND, ay, 10% fine to medium sand, 10% coarse sand sized sandstone and basalt, (CL) t.) Light brown (SYR 6/2), stiff to SANDY LEAN CLAY with GRAVEL, ay, 20% fine to coarse subrounded not to coarse gravel sized sandstone and angular quartzite,			

SITE NAME	E AND LOCAT		5011	L BOR	DRM	LLING METHO	D: BECKER	HAMMER			SHEE	NG NA BA-	-3	28
		INER FLAT			SAM	PLING METH	DO: BULK				3	OF		
	SA	ANDSTONE	RIDGE									DRILL		
							T				STAR		FINE	
						···					15:2	a	8:41	,
NORTHING:											DATI	Ε	DAT	E
EASTING:				EVATION						7	/25/	95	7/26/	95
DRILL RIG		ECKER HAMME			SURFACE	CONDITIONS	ROAD			· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	
SAMPLE H		BEARING	INM										·····	
									*****	П	TEST	RES	ULTS	-
DEPTH IN FEET (ELEVATION)	BLOWCO	EQUIVALENT UNT FROM									34			
X X	BLOW	R HAMMER COUNTS	SYMBOL		DES	CRIPTION OF	MATERIAL			% H	3	≧ ⊾	₹ 。	
	10 30	30 40 50] @		-					WATER	LIQUID LIMIT	S C	LESS THAN NO. 200	TESTS T
٥	*****									≸ 8	3	5₹	ਜ਼ੋ8	Ē₽
_			M	(30.0-35.0	ft.) Ligh	nt brown (5YR 6/2),		_			T		\dashv
_	•			clay, 50%	fine to	with SAND, medium sub	prounded so	ınd.	\equiv					ļ
31				<5% fine	o coars	e gravel	and cobble damp, (CL)		\exists					İ
-	•			31264 346	ungutur	sanas tone,	damp, (CL)		=					
32														
=	•													
33														
=									=					
34									=					
= '									=					
35									=					
= 33				(35.0-40.0	ft.) Ligh	nt brown (CLAY with	5YR 6/2),		\equiv			İ	- 1	
= _	•			silty clay	35% fin-	e to mediu	m subround	led	=					
36				sand, (5% subangula	fine to r sandst	coarse gr :ane, <5% c	avel sized oarse sand		=				į	
=	•			damp, (CL)					E				- 1	
_ 37									=					
=														
- 38									=					
=									3					
_ 39														
=									=					
40				(400 410	C+> 11				E					
0						t brown (5 CLAY with			\exists				- 1	
=						fine to m	edium subangular		Ⅎ					
41				sand, damp			300angatar	(-41.3)	41.3			İ		
=		+ >50		€ 41.3 ft.,				(-41.7)	41.7					
42				End of Bo	rehole a	t 41.7 ft.			3					
=									3					
43									unlundu			ŀ		
=									=					
									3					
: ''									크		İ			

SITE NAM	E AND LOCATION	<u> </u>	L BOR	DRILLING METH		AMMER			BORSA	BA-	ciates	
		LAT DAM		SAMPLING METH	HOO: BULK				SHEET	0F	***************************************	
j	SANDSTO	NE RIDGE								DROLLLI	NG.	_
									TIME		FINISH	
					 				9:00	İ	TIME 10:05	
					 				DATE		DATE	-
NORTHING EASTING:	:	-	LEVATION					— 7.	/26/9		7/26/95	
DRILL RIG	AP1000 BECKER H		LEVATION	SURFACE CONDITIONS	e RUAD						, 20, ,,	- }
ANGLE V		ING NA		SURFACE CONDITION	3 (0/1)	· · · · · · · · · · · · · · · · · · ·		·				
SAMPLE H						······································						
								7	TEST	RESU	LTS	┦ }
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVAL BLOWCOUNT FROI BECKER HAMMER BLOW COUNTS 10 20 30 40	SWBOL SWBOL		DESCRIPTION O	F MATERIAL	4		WATER CONTENT %	LIQUID LIMIT X	PLASTICITY NIDEX &	NO. 200	I TESTS
31 - 32 - 33 - 33 - 34 - 35 - 36 - 37 - 38 - 39 - 40			stiff to v 65% silty of subrounder subangular (35.0-40.4 i yellowish b very stiff GRAVEL, 70 medium sub gravel size	ft.) Moderate briery stiff, LEAN clay, 30% fine to disand, (5% fine to fine gravel, (CL) ft.) Moderate briem (5% fine fine gravel, (CL) ft.) Moderate briem (5% fine fine gravel, (CL) ft.) Moderate briem (5% fine fine fine gravel, (CL) ft.) Moderate briem (5% fine fine fine gravel, (CL) ft.) Moderate briem (CL) ft.) Moderat	CLAY with SAN medium to coarse own to pale o 10YR 6/2), LEAN CLAY wifine to X fine to coaindstone, <5%	th						LOGGED RY
41 42 43 44				BEDROCK, basalt		(-41.4)	41.4 =					OR NO . 943-97691170

SITE NAME AND LOCATION	SOIL BO	REHOLE LOG DRILLING METHOD: BECKER HAMMER			Golden Associa NG NO.	ites
MINED C	LAT DAM	SAMPLING METHOD: BULK		SHEE 1	BA-5 T of 3	
MINER FI SANDSTOI	NE RIDGE				DRILLING	
				STAR	T FIN	ISH
				TIME	. ITI	Æ
				10:05	140	20
NORTHING:				DATE	DA DA	TE
EASTING:	ELEVATION			7/26/	95 7/26	/95
DRILL RIG AP1000 BECKER H	······································	SURFACE CONDITIONS RUAD				
	tING NA					
SAMPLE HAMMER						
SPT (N) EQUIVAL BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS	3.4800 - 1.000	DESCRIPTION OF MATERIAL	WATER	₩ ₩	PLASTICITY WIDEX & LESS THAN NO. 200	OTHER TESTS
	firm to salty c sands t subang sands t (5.0-10.0 firm to 10% fine coarse basalt, stiff to clay, 10	oft.) Moderate brown (5YR 4/4), overy stiff, LEAN CLAY, 85% silty of fine to coarse subrounded sand, see sand sized subangular sand and c(CL)				

FILENAME:

S	OIL BOR	EHOLE LOG	Gol	der clases
SITE NAME AND LOCATION		DRILLING METHOD: BECKER HAMMER	BORING NO.	i
MINER FLAT D SANDSTONE RIJ	JAM DGE	SAMPLING METHOD: BULK	SHEET 3 OF DRILLIN	3 • G
SANDS LINE KIT	Dac			FINISH
				14:20 DATE
NORTHING: EASTING:	ELEVATION			1
DRILL RIG AP1000 BECKER HAMMER ANGLE VERTICAL BEARING NA	1	SURFACE CONDITIONS ROAD		7/26/95
SAMPLE HAMMER			TEST RESUL	LTS
SPT (N ₅₀) EQUIVALENT BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS HELD 10 20 30 40 50	SWBOL	DESCRIPTION OF MATERIAL	WATER CONTENT & LIQUID LIMIT & PLASTICITY INDEX X	NO. 200 STAN STAN STAN STAN STAN STAN STAN STAN
31	(35.0-39.0 (10YR 5/2 LEAN CLAY medium su subangula	ft.) Moderate yellowish brown), stiff to hard, SANDY LEAN silty clay, 35% fine to medium ed sand, coarse sand size asalt, (CL) ft.) Moderate yellowish brown), very stiff to hard, SANDY Y, 70% silty clay, 30% fine to brounded sand, coarse sand size r basalt, (CL) (-39.0) 39.0 , BEDROCK, basalt (-39.3) 39.3 prehole at 39.3 ft.		
- 40 - 41 - 42 - 43 - 44				

		SOII	L BOR	EHOLE	LOG		(Golder	in a
SITE NA	ME AND LOCATI	ON		DRILLING METHOD	BECKER HAMME	ER		BORING	NO. BA-6	
					**************************************			SHEET	JA-6	
				SAMPLING METHO	D: BULK			1	or 3	i
		NER FLAT DAM NDSTONE RIDGE						D	RILLING	
	_	· · - · · · · · · · · · · ·						START	FIN	ISH
								TIME	TIA	Æ
								14:20	17:0	30
NORTHIN	G:							DATE	DA.	
EASTING:			EVATION				7,	/26/95	5 7/26	/95
DRILL RI	G AP1000 BE VERTICAL	CKER HAMMER BEARING NA		SURFACE CONDITIONS	ROAD					
SAMPLE		BEARANG TIC						··· · · · · · · · · · · · · · · · · ·		
	1		<u>_</u>				T	TEST I	RESULTS	
DEPTH IN FEET (ELEVATION)	BLOWCOU	EQUIVALENT INT FROM HAMMER &						×		
Z K	SLOW (HAMMER SCOUNTS 99		DESCRIPTION OF	MATERIAL.		× =	LIQUID LIMIT	× 100 × 100	
<u>\$</u>	10 20 30	0 40 80 K					WATER	9	MOEX X LESS THA NO. 200	OTHER
0]						≸ 8	3 5	S S S	5₽
_			(0.0-5.0 ft	.) Moderate brown	(5YR 4/4),	-	ГТ		<u> </u>	\mathbf{H}
E	•		silty clay,	tiff, LEAN CLAY wit 15% fine to mediur	subrounded	目				
1			sand and	subangular basalt, avel sized subrour	5% fine to	=				
	•		dry, (CL)	3,200 300 00.	dea sands cone,	=				
2										
Ξ	•					3				
3						=				
						3				
_ 4						=				
	•					3				
<u> </u>				t.) Moderate brown `to hard, LEAN CL						
_	*		80% silty o	clay, 15% fine to me	edium	3				
6			coarse su	d sand and subang brounded sand and	subangular	=		1		
			to angular	fine gravel sized sandstone, dry, ()	subrounded CL)	3				
 7										
= ′		1 603				1111111				
8 _						目				
		.				3				
9 										
		*>50				-10.0> 10.0				
<u> </u>		1 1	(10.0-15.0 f	t.) Maderate brown	to	10.07				j
		>50	10YR 5/2),	yellowish brown (5Y very dense, CLAYE	Y SAND, 80%	3				
11			(SC)	d sand, 20% silty c	.ay, dry,	=	1			
_		* >50	€ 10.0-11.2	ft., sandstone boul	der	3				
12			-			=				
=		>50								
<u> </u>						=				
=		>50				\exists				
14						当				
=		>50				=				
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			SOIL	BOF	REF	HOLE	LO	3			(Go Ass	ider octai	ies
SITE NAME	AND LOCA	ATION				DRILLING METH	XO: BECK	ER HAMMER				BORN	NG NC		******
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					F	***				·	_	SHEE		_	
		MINER FLA			-	SAMPLING METH	IOO: BUL	<u> </u>			-	2		. 3	
	2	ANDSTONE	. RIDGE		-								DRILL		
					<u> </u>							STAR		FINE	
											_	14:20	,	17:3	30
											十	DATE	:	DAT	E
ORTHING: ASTING:			ELI	EVATION							7	/26/	95	7/26/	/95
RILL RIG		BECKER HAM			SURF	ACE CONDITIONS	ROAD								
NGLE VI		BEARING	3 NA		 										
AMPLE H	AMMER				<u></u>				·		т-	-	-	14 550	
	SPT (N 50) EQUIVALENT OUNT FROM	r	,							-	IESI K	RESI	JLIS	
DEPTH IN FEET (ELEVATION)	BECKE	R HAMMER	SYMBOL								×	E E	∠	3	
		30 40 80	8		1	DESCRIPTION OF	MATERIAL				WATER	LIQUID LIMIT	EX EX	3 TH 200	80
80										- 1	₹8		PLASTICITY NDEX %	LESS THAN NO. 200	OTHER
				450.000			45115								
- 1		•>	50	hard, SA	NDY LE	Moderate bro EAN CLAY, 70;	silty clo	ıy,		\exists					
- 16				damp, (Cl		dium subroun	ded sand,			4					
		•>	50	€ 16.0-16	.8 ft.,	sandstone b	oulder			Ξ					
- 17										4					
		e								\exists					
- 18										4					
l		•								\exists	1 1				
19		1.11								\exists					
		•								\exists				ĺ	
20				(20.0-25.0	Ft.) F	Pale yellowish	brown		20.0>20.	<u>-</u>			ı		
	•			(10YR 6/2	2), comi	pact to den ine to mediur	se, POORL'	Y ded		=		l			
- 21				sand, dry	(SP)					\exists					
	•		! ::::1							#				1	
22			 							日					
		•													
23										\exists					
				€ 23.5-25	5.0 ft.,	fine grained	sandstor	ne boulder	•	#					
24						-				日			İ		
	•						-	. =		, =					
25			<i> </i>	(25.0-30.0	f t.) M	Moderate bro	wn (SYR 4		5.0225.	긤					
	•			stiff to	very :	stiff, LEAN (45% fine to	CLAY with	SAND,		=					
26				subround	ed san	nd, $<5\%$ fine t	a coarse	sand		크					
	•			size ungu	nur Da	isalt, damp, (UL)			\exists					
27										크					
	•									\exists]			
28										_					
25 26 27 28	•									∄					
29										4					l
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			SOI	L BOI	REHO	LE LC)G			(Go	kler ociate	-s
E NAME	AND LOCATION	ON			DRILLIN	G METHOD: BE	CKER HAMM	ER				NG NO).	
												BA-	.6	
											SHEE		_	
			AT DAM		SAMPU	NG METHOD: BU	JLK			-	3	OF		
	SAr	אח2 ו העוז	E RIDGE									DRILL		
										_	STAR		FINIS	
									· · · · · · · · · · · · · · · · · · ·	_	14:20		17:30	
										$\neg \vdash$	DATE		DATE	
THING: TNG:	· · · · · · · · · · · · · · · · · · ·		ε	ELEVATION					***************************************	7	/26/	95	7/26/	95
L RIG	AP1000 BE	CKER HAM	1MER		SURFACE CO	NOTIONS ROAD								
	RTICAL	BEARIN	G NA						****					
PLE HA	MMER				<u> </u>			3-4						
اعا	SPT (N 50) BLOWCOU	EQUIVALEN	п							-	TEST BR	RESI	JLTS	
(ELEVATION)	BECKER BLOW (HAMMER	SYMBOL							96		_	2	
	10 20 30		8		DESCRIP	TION OF MATERY	AL.		-	WATER	LIQUID LAMIT	PLASTICITY NDEX #	₹ 8	- 1
									1	₩	ᅙ	ŽŠ	S	TESTS
										لت		-		
) ft.) Modero ff, SANDY LE	ate brown (5Y	R 4/4),							
31				55% silty	/ clay, 45% f	ine to medium			=					l
"丨						l fine to coar ze sandstone,			\exists					
		11							=		Ì			
2										l l	į		İ	İ
_	•								Ħ					
3									\exists					
.	1								3					
4									ᆿ					-
_	•			(25.0.24)									1	
5				hard, SAI	NDY LEAN CLA	ite brown (5Y) AY with GRAVE	R 4/4), 'L,		\exists					į
l		•		subround	led sand, 15%	ine to medium fine to coar	se		\exists					
6			777		nd cobble siz t., BEDROCK, k	re sandstone,	(CL) (-	36.2) 36.2 36.4) 36.4				1		
-					orehole at 3		(30,47 30,4	-3					
7									\exists					
									7					
8									\exists					-
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NAME	AND LOCATION	N			DRILLING M	ETHOO: BECK	ER HAMME	R			BORIN				LAYNE WESTERN EXPLORATION
										-		BA-	- /		LOR
					SAMPLING	METHOD: BUL	K				SHEET		. 3		Š
		ER FLAT DI DSTONE RII								<u> </u>		DRILL			ERN
											START		FINI	SH	VES
											TIME		TIM	E	N Lu
										_	8:00		8:3		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
ING:				******			-		_	Щ,	DATE /27/9		DA1 7/27.		_
G: RIG	AP1000 BECH	KER HAMMER	ELEV	MON	SURFACE CONDIT	NONS ROAD	1				, ,, , , ,	<u> </u>	1727.	/ 93	Ë
VE	ERTICAL	BEARING NA													CONTR
E HA	WIMER														ර
$\backslash \parallel$	SPT (N 50) EX BLOWCOUN	OUWALENT									TEST	RESL	JLTS		DRILLING
	BECKER H BLOW CO	AMMER	ᇶᆝ							₩.	× 1		22		₹
	10 20 30	40 50	STREED.		DESCRIPTION	N OF MATERIAL			1	~5	5	Ē×	207¥	æ (0	
										WATER	Onon	PLASTICITY NDEX &	LESS THAN NO. 200	EST	
				(3.0. (3.0. (4.1.))											
	4			firm to ho	.) Moderate b ird, SANDY LE	AN CLAY with	Ο,		\exists	1 1					
				coarse su	5% silty clay, brounded sand	1, 15% fine to			_						
				coarse gr sandstone	avel and cobb and quartzit	ile sized sub e, damp, (CL)	rounded		\exists						
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1							•		\exists	1 1					Σ.
	"	'	7					(-5.0)	5.0						-
			<u> </u>	(5.0-10.0 ft) Light brown	(5YR 6/4),		<u> </u>	3.0			- 1			
		1.		GRAVEL, 50	very dense, Cl)% fine to med	lium subround	ied		3						
İ				cabble size	fine to coars ed subrounded	l to subangu	lar		=			-		İ	_
				20% silty o	and subangulo lay, damp, (SC	ir quartzite,)			∃						₹
			\aleph						\exists						GFI
) 50 <u>()</u>	\mathcal{Z}								Ī				OGGED
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Ì			<u> </u>				(-10.0)	10.0						
				(10.0-15.0 f ⁻ dense to v	t.) Light brow very dense, PC	n (5YR 6/4), IORLY GRADED	SAND		3		ı				
				with GRAVE	L, 70% fine to I sand, 30% gr	medium			=						1
		•>50			l and subangul		e, <5%		\exists						120
		7.30		Jany Clay,	ر ادا رجاند				_=						69
															943-27691.170
									=						943
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		SOIL	. во	REHOLE	LOG			Á	Gold	ler lates
SITE NAME	E AND LOCATION			DRILLING METI-	ЮО: ВЕСКЕК НАМ	MER		BOR	NG NO.	
Sake.									BA-7	
(SHEE	:ī	
	MINER F	LAT DAM		SAMPLING MET	HOD: BULK			3	OF	3
	SANDSTO	NE RIDGE							DRILLIN	3
								STAR	रा	FINISH
								TIME	1	ЭМП
								8:00		8:30
NORTHING	\$							DATI		DATE
EASTING: DRILL RIG	AP1000 BECKER H		VATION					7/27/	95 77	27/95
ANGLE V		RING NA		SURFACE CONDITION	S RUAD		**************************************			
SAMPLE H										
				1			11	TECT	RESUL	re
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVAL BLOWCOUNT FROM BECKER HAMMER	ENT						₩.	NESOL	3
ZĘ.	BECKER HAMMER BLOW COUNTS	SW/BOL					l k	7	J_ 3	:
E9	10 20 30 40	so E		DESCRIPTION O	F MATERIAL		WATER	LIQUID LIMIT	PLASTICITY INDEX #	8 20
80							N S S	夏	308	NO. 20 OTHER TESTS
							تا ل			2 0 -
:		1 800	(28.0-30	.5 ft.) Light brown tiff to hard, LEAN	(5YR 6/4),		3 _			
- ,		*,**	180% silt	v clav. 20% fine to	medium		目			
- 31			\ <u>subroun</u> @ 30.5 f	nded sand, damp, (CL ft., BEDROCK, basalt	.)	(-30.5) 30.5 (-31.0) 31.0 1	4			
			End of	Soil Borehole at 31	.0 ft.	31.0]			
- 32							3			
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MINER FLAT DAM SANDSTONE RIDGE START PINCH TIME 1 TIME 1 800 900 NORTHWIS: ELEVATION DELEVATION SURFACE CONSTITIONS RUAD SAMPLE HAMMER SURFACE CONSTITIONS RUAD TEST RESULTS TEST RESULTS TEST RESULTS TEST RESULTS TEST RESULTS TO 30 30 40 10 DESCRIPTION OF MATERIAL (0.07-5.0 Ft.) Moderate yellowish brown (10YR 5/2), loses to compact, SILTY SAND with GRAVEL (0.07 Fine to coarse subangular to subrounded gravel SIZEd sandstone, damp, (SM)	SITE NAME AND LOCATION	201F RO	REHOLE LOG ORBLING METHOD: BECKER HAMME	ER	BORING	Golder 860 Clates No. 4-8
START FINISH TIME TIME BROD 9-00 BROD 9-00 BRIL RIG AP1000 BECKER HAMMER SURFACE CONDITIONS RDAD SAMPLE HAMMER SPT (N) EDUNMENT BLOW COUNTS 19 39 39 49 80 6 DESCRIPTION OF MATERIAL (0.0-5.0 ft.) Moderate yellowish brown (10YR 5/2), loose to compact, SILTY SAND with GRAVEL, 60% fine to medium subrounded sand, 20% sit, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM)			SAMPLING METHOD: BULK		 i .	of 1
MORTHWIG: EASTING: DATE BATTO DATE BATT/95 BATL RIC AP1000 SECKER HAMMER SURFACE CONDITIONS RDAD SMAPLE HAMMER SURFACE CONDITIONS RDAD SAMPLE HAMMER SPECKER HAMMER SURFACE CONDITIONS RDAD TEST RESULTS BLOWCOUNT FROM BECKER HAMMER BLOWCOUNT FROM BLOWCOUNTS RDAD OUTPE 5/2), Loose to compact, SILTY SAND with GRAVEL, 60% Fine to medium submounded sand, 20% sit, 20% Fine to coarse subangular to submounded gravel sized sandstone, damp, (SM) (5.0-10.0 ft.) Moderate yellowish brown (10YR 5/2), compact to dense, SILTY SAND with GRAVEL, 60% Fine to medium submounded sand, 20% sit, 20% Fine to coarse subangular to submounded gravel sized sandstone, damp, (SM)	SANDSTON	NE RIDGE				T
NORTHING: EASTING: BALLOS BECKER HAMMER SURFACE CONDITIONS BALLOS BECKER HAMMER SAMPLE HAMMER SPT (N) EDUNALENT BLOWOUNTS RD. SPT (N						
NORTHING: ELEVATION BRILL RIG AP1000 BECKER HAMMER SURFACE CONDITIONS READ ANGLE VERTICAL BEARING NA SUMPLE HAMMER SURFACE CONDITIONS READ TEST RESULTS BELOWCOUNT FROM BECKER HAMMER BLOWCOUNTS 10 20 30 40 80 CO.0-5.0 ft.) Moderate yellowish brown CIOYR 5/2), loose to compact, SILTY SAND With GRAVEL, 60% fine to nedium subcounded sand, 20% sit, 20% fine to compace sized sandstone, damp, (SM) CS.0-10.0 ft.) Moderate yellowish brown CIOYR 5/2), compact to dense, SILTY SAND With GRAVEL, 60% fine to nedium sized sandstone, damp, (SM) (S.0-10.0 ft.) Moderate yellowish brown CIOYR 5/2), compact to dense, SILTY SAND With GRAVEL, 60% fine to nedium sized sandstone, damp, (SM)					8:00	9:00
DRILL RIG AP1000 BECKER HAMMER ANGLE VERTICAL BEARING NA SAMPLE HAMMER BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 19 20 30 49 89 DESCRIPTION OF MATERIAL 1	NORTHING:					1 1
ANGLE VERTICAL BEARING NA SAMPLE HANNER SPT (No.) EQUIVALENT BLOWGOUNT FROM BECKER HANNER BLOW COUNTS 19 30 30 40 80 10 30 30 40 80 CO.0-5.0 ft.) Moderate yellowish brown (IOYR 5/2), loose to compact, SILTY SAND with GRAVEL, 60% fine to nedium subrounded gravel sized sandstone, damp, (SM) (S0-10.0 ft.) Moderate yellowish brown (IOYR 5/2), compact to dense, SILTY SAND with GRAVEL, 60% fine to medium subrounded gravel sized sandstone, damp, (SM)			Current State		8/1/95	8/1/95
SPT (N.c.) ECUNALENT BLOW COUNTS BLOW COUNTS 10 20 30 40 80 CO.0-5.0 ft.) Moderate yellowish brown (10YR 5/2), loose to compact, SILTY SAND with GRAVEL, 60% fine to nedium subrounded sand, 20% sitt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM) (5.0-10.0 ft.) Moderate yellowish brown (10YR 5/2), compact to dense, SILTY SAND with GRAVEL, 50% fine to nedium subrounded sand, 20% sitt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM)			SURFACE CONDITIONS RUAD			
(0.0-5.0 ft.) Moderate yellowish brown (10YR 5/2), loose to conpact, SILTY SAND with GRAVEL, 60% fine to medium subrounded sand, 20% silt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM) (5.0-10.0 ft.) Moderate yellowish brown (10YR 5/2), compact to dense, SILTY SAND with GRAVEL, 60% fine to medium subrounded sand, 20% silt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM)	SAMPLE HAMMER					
(0.0-5.0 ft.) Moderate yellowish brown (10YR 5/2), loose to conpact, SILTY SAND with GRAVEL, 60% fine to medium subrounded sand, 20% silt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM) (5.0-10.0 ft.) Moderate yellowish brown (10YR 5/2), compact to dense, SILTY SAND with GRAVEL, 60% fine to medium subrounded sand, 20% silt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM)	SPT (N 50) EQUIVALE	МТ				SULTS
(0.0-5.0 ft.) Moderate yellowish brown (10YR 5/2), loose to compact, SILTY SANII with GRAVEL, 60% fine to nedium subrounded sand, 20% silt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM) (5.0-10.0 ft.) Moderate yellowish brown (10YR 5/2), compact to dense, SILTY SANID with GRAVEL, 60% fine to medium subrounded sand, 20% silt, 20% fine to coarse subangular to subrounded gravel sized sandstone, damp, (SM)	BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 10 20 30 40 8	. 151	DESCRIPTION OF MATERIAL			ESS THAN O. 200 THER ESTS
	- 4 - 5 - 6 - 7	(10YR 5. with GR. subrour coarse sized si	/2), loose to compact, SILTY SAND AVEL, 60% fine to medium maded sand, 20% silt, 20% fine to subangular to subrounded gravel andstone, damp, (SM) ft.) Moderate yellowish brown (2), compact to dense, SILTY SAND AVEL, 60% fine to medium ded sand, 20% silt, 20% fine to subrounded gravel			

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SEPTEMBER

SITE NAME AND LO		IL BOF	REHOLE LOG		1	Œ	Go Assa	lder odates	8
SIE NAME AND LO	MINER FLAT DAM		SAMPLING METHOD: BECKER HA	MMER		SHEE	BC-	-	
	SANDSTONE RIDGE						DRSLLI	NG	
						STAF		FINISH	\dashv
						10:41 DATI		10:45	_
NORTHING: EASTING:		ELEVATION				8/1/9	- 1	DATE 8/1/95	
	BECKER HAMMER		SURFACE CONDITIONS RUAD			***************************************			
SAMPLE HAMMER	BEARING NA								_
) FOURALENT				П	TEST	RESU	ILTS	\dashv
<u> 2</u> BECI	50) EQUIVALENT COUNT FROM GER HAMMER W COUNTS 30 40 80		DESCRIPTION OF MATERIAL		WATER CONTENT %	LIQUID LIMIT X	PLASTICITY NDEX #	NO. 200 OTHER	TESTS
- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		to medium sand, 20%	t.) Moderate yellowish brown (2), loose, SILTY SAND, 80% fine in sand, (5% coarse subrounded silt, dry, (SM) BEDROCK, basalt orehole at 2.5 ft.	(-2.0) 2.0 (-2.5) 2.5					

SITE NAME AND LO		L BOF	PRILLING METHOD: BECKER HA	AMMER	BORIN	Golder Associates G NO. BC-5
	MINER FLAT DAM SANDSTONE RIDGE		SAMPLING METHOD: BULK		SHEET 1	OF 1
					START TIME 11:00 DATE	FINISH TIME 11:40 DATE
ANGLE VERTICAL	BECKER HAMMER BEARING NA	LEVATION	SURFACE CONDITIONS RUAD		8/1/95	
Fig. Brow	SO) EQUIVALENT COUNT FROM ER HAMMER W COUNTS SO 40 80		DESCRIPTION OF MATERIAL		K F	NOEX X NOEX X NO. 200 OTHER TESTS
1		(10YR 6/2 to medium fine to c sandstone subrounde (2.0-5.0 fine fine fine fine fine fine fine fine	t.) Pale yellowish brown), loose, SILTY SAND, 65% fine subrounded sand, 20% silt, 15% carse gravel sized subrounded end quartzite, (5% coarse ed sand, dry, (SM) t.) Moderate yellowish brown), firm to very stiff, LEAN CLAY, 80% silty clay, 20% fine to 4 coarse subrounded sand, damp t.) Moderate yellowish brown , very stiff to hard, SILTY CLA 80% silty clay, 20% fine to d (5% coarse subrounded sand, t.) Moderate yellowish brown , very stiff to hard, SANDY , 70% silty clay, 30% fine subrounded, sand, damp, (CL) BEDROCK, basalt renole at 11.9 ft.	, <u></u>		

		S	SOIL	BOF	REHO	DLE	LOC	}		É	Gold Associ	ler Intes	
SITE NA	ME AND LOCAT	TION			DRILL	ling method	D: BECKE	R HAMMER			NG NO. MF-B2		DRILLING
		INER FLAT ANDSTONE 1			SAM	PLING METHO	DO: BULK			SHEE	OF DRILLING		NORTH AMERICAN DRILLING
	35	HADSTEINE T	KIDGE							STAR	rr i	FINISH TIME	NORTH A
NORTHIN EASTING:	G :		ELE	EVATION					1	9:50 DATI 2/9/	=	10:30 DATE /9/95	<u>بم</u>
DRILL RIV	VERTICAL	ECKER HAMME! BEARING !			SURFACE	CONDITIONS							CONTR
DEPTH IN FEET (ELEVATION)	BECKER	EQUIVALENT UNT FROM HAMMER COUNTS 30 40 50	SWBOL		DESC	CRIPTION OF	MATERIAL		WATER CONTENT %	×	PLASTICITY WIDEX & LINGS HAN	MO. 200 W	DRILLING
- 4 5 6 7 8 9 10 11		•>50 •>50		(10YR 6/6 fine to r gravel, c	ft.) Dark y 6), very lo medium gra dry (SP) ft.) BEDROG	ose to la in, <5% fin CK, Sandst	ose, SANI e subangu	(-2.5) (-4.1)					JOB NO.: 943-27691170 LOGGED BY L. BUSH/C. ROBINSON FILENAME: MFB20

	, S		T DAM	L BOF	PRILLING METHO	O: BECKER	HAMMER			BORING I	Older 80 Class NO. -B21 DF 1 LUNG FINIS 1140	3H E
NORTHI EASTING DRILL F	3: R ig ap1000	BECKER HAMM	IER	ELEVATION	SURFACE CONDITIONS				12	2/9/95	12/9/	95
	VERTICAL.	BEARING	T I						7	TEST RE	~ 11 TA	
DEPTH IN FEET (ELEVATION)	SPT (No. BLOWC BECKE BLOW	D) EQUIVALENT COUNT FROM ER HAMMER IN COUNTS 30 40 80	STABOL		DESCRIPTION OF	MATERIAL			WATER CONTENT &	34	X X Q	STEAT STATE OF LAND OF
1 2 3 4 4 5 6 7 8 9 10 11 12 13 14 11 14 11 14			50	dark yel to compo <5% fine <2.5-5.0 f	ft.) Light brown (5) flowish orange (10YR act, SAND, fine to r subangular gravel, ft.) BEDROCK, Sands Borehole at 5.0 ft.	6/6), very nedium grain dry (SP)	(-2.5)	2.5				JOB NO: 943-2769170 I OGGED BY I RICHAC DIBINGON

		Part Control of the C		SC	IL	ВО	RE	HOLE	LO	G			(Go Ass	lder	les	ט
SITE NAME	E AND LOCA	ATION						DRILLING METI-	OD: BECK	ER HAMMI	ER				G NO			NORTH AMERICAN DRILLING
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			FLA				-	SAMPLING MET	1400: BULK			*	_	1	OF			a L
	S	ANDS.	TONE	RIDO	ΞE		-			2454 11111 - Holding Green					DRILL			1
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NORTHING: EASTING:	:				5 60	/ATION	}				_		1:	2/9/9	95	12/9/	/95	۵
DRILL RIG	AP1000 I	BECKER	HAMM	ER	CLEV	AIN	SUR	FACE CONDITION	vs				1					
ANGLE V			EARING			F 1 771 3 - 3 - 4	-											5
SAMPLE H	MMER		.,					Y 		****								ALION SINE
)	SPT (N.) FOLE	WAI FNT	T		***************************************								TEST	RES	JLTS		Z
DEPTH IN FEET (ELEVATION)	SPT (N 50 BLOWCK BECKE	OUNT F	TROM MER	ا ا	.								×	K				=
.¥ XATI	BLOW	COUN	กร	SAMBOL				DESCRIPTION	OF MATERIAL					LIQUID LIMIT	PLASTICITY INDEX %	H S		-
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_		111		T:::	::	(0.0-5.0	ft.) L	ight brown (5YR 5/6) t	to		_						
	 •					dark ye	ellowish	n orange (10) medium grain	'R 6/6), co	ompact,		=						i
<u>-</u> 1						coarse dry (SP	subro	ounded grave	l, <5% clay,	,								1
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					\aleph	(10YR 5/	/4), ve	ry stiff to	hard, LEAN	N		=						
_ 6					\mathbb{N}	<5% to	10% f.	0% fine to m gravel, dry,	(CL)	•								
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a				12	\mathcal{I}						(-8.0)	8.0	1 1					9
=			>5	iO		(10YR 5/	/4), hai	Moderate yel .rd, CLAYEY S	ILT, 20% f	wn 'ine		_						
_ 9						to mediu subroun	um sani ided or	id, <5% fine t ravel, dry, (N	o coarse (L)									
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12					.	(12.0-16.1	0 ft.)	Grayish oran	106	ζ-	-12.0)	12.0						2760
- i			,		<u>: </u>	(10YR 7/	/4), loc	ose to dense	SILTY			3						07116926-676
		1 1		: :	:	SANU, fir	ne gra	in, 40% claye e subrounde	y silt, 10% d aravel, c	dry		크		l	1			σ
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s	ITE NAM	E AND LOC	ATION	· · · · · · · · · · · · · · · · · · ·				DRILLING	METHOD:	BECKE	ER HAMME	IR .		\dashv	BORIN M	G NO	-		NORTH AMERICAN DRILLING
															SHEET				AN D
		ľ	MINER	FLAT	T DAM			SAMPLING	METHO): BULK					2	OF	4		AERIC
		S	ZUNA	TONE	RIDGE			 						-	START	ORBILLIA -	NG FINIS		FH A
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N	ORTHING	:			_									—] ,	DATE 2/9/9	- 1	DATI /9/1	_	~
-	asting: Rill Rig	AP1000	BECKER	R HAMM		LEVATION	Ts	URFACE CON	OTTIONS			<u> </u>				٠ ١.			E N
		∨ERTICAL		EARING															S
s	AMPLE H	WHER																_	Ç
	DEPTH IN FEET (ELEVATION)	BECK	O) EQUI COUNT I ER HAM W COUN 30 4	FROM IMER ITS	SWBOL			DESCRIPTI	ION OF (MATERIAL				WATER CONTENT %	×	PLASTICITY NODEX #	₹ _Q	OTHER	DRILLING CONTR
	- 16 - 17 - 18 - 19 - 20			•		(10 SA fin (25) (16 (10 SII gr (10 SII sil'	JYR 7/4), IND, fine gone to coal Mine to coal Mine gone Mine gone Mine gone Mine gone Mine gone Mine gone Mine gone Mine gone gone Mine gone Mine gone Mine gone Mine gone Mine gone Mine gone gone Mine gone Mine gone gone gone gone gone gone gone go	:.) Grayish dense to v fine grain e to coars	dense, Stayey unded grange to ha ix fine orange very deed, 30%	SILTY sit, (5%, gravel, o rd, CLAY subrour	dry (EY nded	-16.0) -19.0)	19.0						L. BUSH/C. ROBINSON
	- 21 - 22 - 23 - 24 - 25 - 26		•			(26	5.0-47.0 f1	t.) Light br	rown (S	YR 6/4)		26.0)	26.0						I OGGED BY
	- 27 - 28 - 29		•			co: gr:	mpact to ain, <5% to	dense, SAN o 10% fine gravel, dry	ND, fine to coa	to med	ium		unhunhun						JOB NO.: 243-27691170

		SOIL	BOR	EHOLE	LOC	3				Gol Asso	der clates	
SITE NAM	Æ AND LOCATION			DRILLING METHO	O: BECKE	ER HAMMER				IG NO.		NORTH AMERICAN DRILLING
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1						······································			SHEE			CAN
	MINER FL			SAMPLING METH	OO: BULK			$ \downarrow$	3	OF	4	ME.R.
	SANDSTON	NE RIDGE								DRILLIN	······································	Ŧ
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NORTHING:	G:	ETE/	/ATION					1	12/9/9	95 1	2/9/95	22
DRILL RK	G AP1000 BECKER HA			SURFACE CONDITIONS	······································	 						DRILLING CONTR
ANGLE	VERTICAL BEAR	ING NA] 8
SAMPLE	HAMMER											ပ္
ta_	SPT (N so) EQUIVALE	ENT THE							7	RESU	LTS	=
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVALE BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS	4 8					:) be	×		,	
₩ ₩	ł	. 5		DESCRIPTION OF	MATERIAL			~ 5	UQUID LIMIT	PLASTICITY INDEX #	NO. 200 OTHER	1 —
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								20	<u>'</u>		JZ OF	1
			(26.0-47.0	ft.) Light brown to dense, SAND, fir	(5YR 6/4)							1
31	¶		grain, <5%	to 10% fine to co	oarse	ium	_					
= 31			subangula	ir gravel, dry (SP))							HVI
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44												JOB NO.: FII FNAMF:
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		SOIL	BORE	HOLE	LOG			(Gold Assoc	er Aire]
SITE NAME	AND LOCATION			DRILLING METHOD	BECKER	HAMMER			BORIN			AMERICAN BRILLING
þ										F-B2:	3	DRII
							,	_	SHEET			CAN
	MINER FL			SAMPLING METHO	O: BULK			+	4	OF	4	MERI
	SANDSTON	E RIDGE								DALLING.		Ŧ
						7		_	START		INISH TIME	NORTH
								_	13:10	,	7:00	
								$\neg \vdash$	DATE		DATE	1
NORTHING: EASTING:		ELEV	ATION					11	2/9/9	5 12.	/9/95	2
DRILL RIG	AP1000 BECKER HAI	MMER	SU	RFACE CONDITIONS		· · · · · · · · · · · · · · · · · · ·				····		DRILLING CONTR
angle v	ERTICAL BEARIN	VG NA] 8
SAMPLE H	WANTER											၂ ပ
5	SPT (N ₅₀) EQUIVALED BLOWCOUNT FROM	NT								RESULT	<u>s</u>	3
E.S.	BECKER HAMMER	ਰ						be	×	.		₹
DEPTH IN FEET (ELEVATION)	BLOW COUNTS	SYMBOL		DESCRIPTION OF	MATERIAL			- 5	UMAN OIMON	PLASTICITY WINDEX & LESS THAN	8	
[편	19 20 30 40 89	<u>" " </u>			į			WATER	暴	ହୁଷ୍ଟ	NO. 20	×
					·····			≱ 0	2	<u> </u>	2 6	1
. 1			(26.0-47.0 ft.	.) Light brown (5YR 6/4),						T	1
: 1	•	! :::: !	grain, <5% to	dense, SAND, find 10% fine to co	e to medium arse	1	\exists					
- 46			subangular g	ravel, dry (SP)			\exists					
	•						=					
- 47			(47.0-49.0 ft.	.) Moderate yell	awish brown	(-47.0)	47.0		I	l		
	•		(10YR 5/4), c	ompact to dens im grain, <5% to	e, SAND,		=			ľ		BUSH/C. ROBINSON
- 48			10% fine grav	vel, (SP-SC)	,		=				ŀ	Jag
		>50					=					ن
- 49			(49.0-51.0 ft.)	BEDROCK, Sand	stone	(-49.0)	49.0					SH
- 1	•						=					Ħ
- 50							\exists					
1							∃					
- 51		2000	End of Borek	nole at 51.0 ft.	-	(-51.0)	51.0					
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- 52												
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_							∃					JOB NO.:
- 59							目					JOB NO.:
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SOIL SITE NAME AND LOCATION							B	OR	EF	HOL	E.	LO	G				(Go	ider ociai	hes	
										DRILLING	METHO	BECK	ER HAM	IMER					IG NO	0.		DOTH AMCOSCAM BOTH
									-								_	SHEE	IF-E	24		2
					SAMPLING METHOD: BULK								\dashv	1 OF 4				40,0				
MINER FLAT DAM SANDSTONE RIDGE							as on better the freeze BOCK							DRILLING								
																		STAR	T	FINE	SH	1
																		TIME		TIM	1	2
									F							·		14:15 DATE		17:4 DA1		ŀ
THING:	:						2 014		-				-				— ₁₂	2/11/	- 1	12/11.	i	
TMG: L RIG	AP1000 1	BECKE	R H	AMME	R	ELEVAT	IION	Т	SURF	ACE CON	OMONS		<u>.l</u>		L							GTIACO
LE V	/ERTICAL		BEAR	NG	NA																	Ç
PLE H	AMMER																					٢
	SPT (N ₅₀) EQL	JIVALI	ENT													-	TEST	RES	ULTS	-	
Š	BECKE		MMER		둹	•										İ	×	=	~	3		Ē
(ELEVATION)			40	80	SYMBOL				1	DESCRIPT	10N OF	MATERIAL					WATER	LIQUID LIMA	PLASTICITY WIDEX %	20± 200±	850	-
					1											ı	\$8		PLA	LESS THAN NO. 200	OTHER TESTS	
		T	T	T	777	J	(0.0-	100 64	+ > Ma							_						
	4					3	(10YF	7 5/4)	to	modera:	te bro	vish brav wn (5YR .AY, 10%	4/4),			∃						
1						1	to r	redium	sand		ine sub	rounded				\exists					87	
	•					}	grav	, er, (2)	% P00	ats, ary	y, (CL)					=						
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			İ				(10YR	5/4),	hard	d, sandy	y LEAN	wish bro SILTY (\exists			l			
,							subr	ounded	d to	dium sa: subang	ular g	ravel, (5	5%									
		.					carb (CL)	on, 🕂	sand	stone	cobble	at 10',	damp,			\exists						Ç
2																\exists		- 1	-			,
-			1													\exists						941 10 756 610
3										······································				(-14.0)	14.0							ò
_					m		(14.0- (10YR	57.7 f 5/4),	ft.) M	Moderat pact to	e yello	wish bro dense,	own			日				İ		•
4							inter	bedded	d SIL	.TY SAN	D and	SAND, (5 Ingular (i% to oravel			丑					ł	ON BOI
			,	>50			<5% s	subrou	unded	to sui	bangulo	ir sands ly seams	tone			\exists			- 1			g
					: : ::		34' 0	ind 55	, t.J.	y, (SM o	ind SP	y seams	, u, i			Ŧ		į	ı	- 1	-	=

		SOIL	BORE	EHOLE	LOC)		Ć) Ga	ociata	-8
SITE HAM	E AND LOCATION			DRILLING METHO	DO: BECKE	R HAMMER			MF-E	0.	MORTH AMERICAN DRILLING
1								SHE			☐ Z
	MINER FL	AT DAM		SAMPLING METH	100: BULK			5	OF	- 4	RIC
	SANDSTON								DRILL	JNG	AM
					T			STA TIM		FINIS	H H
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								DA [*]	re	DATE	-
NORTHING EASTING:		ELEV	ATION					12/11	/95	12/11/	95 2
DRILL RIG			s	JURIFACE CONDITIONS	3						DRILLING CONTR
SAMPLE H	VERTICAL BEARIN	KG NA									\dashv \circ
		1 1			· · · · · · · · · · · · · · · · · · ·	······································	T	TEX	T RESI	H TS	니 일
	SPT (N 50) EQUIVALEN BLOWCOUNT FROM	" _						N			\exists
DEPTH IN FEET (ELEVATION)	BECKER HAMMER BLOW COUNTS	SYMBOL		DESCRIPTION OF MATERIAL							OR I
€ ∃	10 20 30 40 50	&		manufactur (1911 9)				WATER CONTENT % LIQUID LIMIT	PLASTICITY NDEX &	LESS THAN NO. 200	IESTS TESTS
								≸8 3	5 ₹	교용	Б ₽
- 1			(14.0-57.7 ft	t.) Moderate yel	lawish bro	awn .		Г	T	ПТ	_
=			interbedded	compact to ver SILTY SAND and	SAND. (5)	% to	\exists				
16			20% fine sub	brounded to sul ided to subangu	oanoular c	ravel.	=				
=			cobbles to	4.5%, 6° silty o	lav seams	at					
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= 40	•						=				NSC
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_ 27											943-27691170
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- 25 - 26 - 27 - 28 - 29							=				JOB NO.:
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		SOIL	BOR	REHOLE	LO	G	A SALES SECTION OF THE SALES S		É	Go	ociai	les	
SITE NAM	ME AND LOCATION	· · · · · · · · · · · · · · · · · · ·		DRULLING MET	HOO: BECK	ER HAMMER				NG N			NORTH AMERICAN DRILLING
)										MF - I	324		DRI
1				CALCOLDIO ACC	7100				SHEE 3		_ 1		ICAN
	MINER FL SANDSTON			SAMPLING ME	INOUE BULK					OF DRILL			AME.R
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									TIMI	Ε	TIM	ε	NDR
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NORTHINK	G:								DAT	_	DAT	_	
EASTING:	**************************************	ELEV/	ATION			1			12/11/	95	12/11.	/95	F
		NG NA		SURFACE CONDITIO	MS .								Ó
SAMPLE		NO INA											DRILLING CONTR
	T	AT I				//	×	ΤL	TES	RES	ULTS		×
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVALE BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS	" _d						ΙΙ,	×				Ħ
EX-		151		DESCRIPTION	OF MATERIAL				LIQUID LIMIT	PLASTICITY INDEX X	LESS THAN NO. 200		9
E	10 20 30 40 5	10 %						WATER		S S	SS .	OTHER TESTS	
							,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	35	3 3	₹ ₹	3₹	52	
			(14.0-57.7	ft.) Moderate	rellowish br	.owu	-	3 [T	T			
Ε			interbedd), compact to vied SILTY SAND (ind SAND, K	5% to	-]					
 31			<5% subro	subrounded to s ounded to suban	gular sands	stone		11					
Ε	•		cobbles t	to 4.5", 6" silty 55", dry, (SM and	clav seam	s at	=]					
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Ε]					SH/C. RC
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36 													JOB NO.:
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NAM	E AND L	OCATK	NC								L	DROLLIN	g meth	00:	BECKER	R HAN	4MER				\int		46 N			NORTH AMERICAN DRILLING
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		MIN	NER	Fì	ΑT	D.A	AM.					SAMPLI	NG METI	100:	BULK			· · · · · · · · · · · · · · · · · · ·			1	4	OF	. 4		RICA
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THING ING:			·				ELE	EVATIO	M												12	2/11/	95	12/11.	/95	표.
L RIG		O BE	-							_	SURF	ACE CO	MOITION	S												DRILLING CONTR
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						T							1				*************			П		TEST	RESI	JLTS		NG NG
UEPIH WN FEET (ELEVATION)	SPT (BLO BE	WCOU CYED	NT FI	ROM	NI I	١,																×				긜
EVATI	5	LOW C	JUNI	15		3						DESCRI	PTION O	F MATE	RIAL						× ×	3	Σ×.	¥Q.		OR
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			\Box					((14.0-5 (10YR	57.7 f 5/4).	ft.)	Moder	ate ye to ver	llowis	h bro	wn		····		3 [
16								i	nterb	edde	a SI	LTY S	AND an	d SAN	ID, <5%	ta	I.		_	11						
								· ·	(5% su cobble	ubrou s to	unded 4.5	d to s	ubangu siltv d	lar s	sandst	one	·			#						BUSH
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		•	SOII	L BOI	RE	HOLE	LO	G			(Golde Associa] .,
SITE NAM	E AND LOCATIO	N				DRILLING METH	00: BECK	ER HAM	MER			BORSIN	G NO.		AMERICAN DRILLING
					}				*****				F-B25	 	DRI
					-							SHEET			CAN
		ER FLAT			}	SAMPLING MET	HOO: BULK		·			1	OF 4	·	YERI
	SAN	DSTONE	KIDGE		-								ORBILLING		Ī
					ŀ		1	T	~	ì	_	START		ME	NORTH
					ŀ	****			_		_	9:15	- 1	:30	
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NORTHING EASTING:			Ð.	EVATION	ľ						12	2/12/9	95 12/1	2/95	2
DRILL RIC	AP1000 BEC	KER HAMME	ER		SUR	RFACE CONDITION	\$								CONTR
ANGLE	VERTICAL	BEARING	NA												පි
SAMPLE I	HAMMER	,			<u> </u>										ပ
Ħ	SPT (N ₅₀) E BLOWCOUN	QUIVALENT										_	RESULTS		DRILLING
DEPTH IN FEET (ELEVATION)	i becker i	-KAMIMER	뒿								×	×	.		묽
₽¥ K	BLOW C		SWIBOL			DESCRIPTION O	F MATERIAL					UNION DIRNU	PLASTICITY WOEX & LESS THAN		
9 9 9	10 20 30	70 20	- "								WATER	훓		OTHER	
											≇ 0	3	E E 32	PE	
			1111	(0.0-7.0	ft.) Mo	oderate brow	in (5YR 4/	'4),		_		П		T	
- 1 - 2 - 3 - 4	•			20% to 3	30% fii	stiff, LEAN ne to medium	sand, 10%	fine		=					
- 1				subangul dry, (CL:		avel, <5% roc	its, damp	to							
_	•														
- 2															_
	•													1 1	SON
- 3										᠆					BUSH/C. ROBINSON
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1	•									=					B
- 5										=					
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ļ	•									ᆿ					₩
- 7				(7.0-9.0 f	rt.) Do	ark yellowish	brown	-	(-7.0)	7.0		ļ			
				(10YR 6/6	6), car	mpact, SAND, unded gravel	10% fine t	o Clay				Ī			COCCED
- 8				dry (SP-	SC	maca gravey	10% Skey	ciay,		=					\subseteq
	•									=					
- 9				(9.0–13.0	6+) M	loderate brow	un (SVR 4	/A)	(-9.0)	9.0					
	•			very stil	ff ta	hard, LEAN :	SILTY CLAY	Υ,		\exists					
- 10				subround	led to	arse sand, (S rounded gro	ox fine to avel, quar	coars tzite	ie.	=					
				copple a	t 11',	damp (CL)				=					
. 11										ヨ					1
										\exists					170
ا و ١٠										_=					169
14										日					943-27691170
,		•						((-13.0)	13.0					943
15				(13.0-21.0	ft.) N	Moderate bro	wn (5YR 4	/4),							1
- 7 - 8 - 9 - 10 - 11 - 12 - 13		•		to coars	e sub	ense, SILTY SA prounded to a	מאו, זט% fi aunded gi	ne ravel,		\exists					0:
14				10% silty	clay,	ary (SM)				크					JOB NO.:
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	SOIL	BORE	HOLE	LOC	}	All the state of t	(Gol	der Cates]
SITE NAME AND LOCATION			DRILLING METHO	D: BECKE	R HAMMER				NG NO	•	Jan 1 Hod
								SHEE	T		
MINER FL			SAMPLING METH	XO: BULK			_	5	OF	4	NODIH AMEDICAN
SANDSTON	F KIDGF		-			······································		CT10	DRBLLI	****	- 3
								STAR		FINISH	1 5
							_	9:15		13:30	
NORTHING:								DATE		DATE	
EASTING:	ELEVA						16	2/12/	95 1	2/12/95	1 6
DRILL RIG AP1000 BECKER HA ANGLE VERTICAL BEARN	MMER IG NA	SU	JRFACE CONDITIONS								CONITB
SAMPLE HAMMER	10 Ma							·		····	1
F. SPT (No.) FOLINALE	vr							TEST	RESU	LTS	d ₹
SPT (N ₅₀) EQUIVALED BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 10 20 30 40 8	🗸		DESCRIPTION OF	MATERIAL.			WATER CONTENT %	LIQUID LIMIT X	PLASTICITY INDEX %	NO. 200 OTHER	DRII INC
		(21.0-59.0 ft) dense and ha SAND and LEA grain sand, (5 quartzite and calcareous s	Moderate brown dense, SILTY SA subbrounded to replace t	n (5YR 4/ SILTY Fine to me se gravel obles, to 38.5'	(-21.0) (4), edium 1, 1%	21.0					JOB NO.:943_27691,170

		SOIL	. BOF	REHOLE	LO	3	144		(Gol	lder clates	7
SITE NAME	E AND LOCATION			DRILLING ME	THOO: BECK	ER HAMMER	}			BORK	NG NO.	•	1
1											MF-Ba	25	┨
7							·····			SHEE			
Ì	MINER FLAT SANDSTONE			SAMPLING M	ETHOO: BULK				-	3	OF	4	4
	24M72 LOVE	KIDGE				- Marilland					DROLLIA		4
						T	T T	-11		STAR		FINISH	\dashv
						 			-	9:15		13:30	
				MM-113-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1					_	DATE	-	DATE	1
NORTHING: EASTING:	:	5.5	VATION						12	/12/	'95 17	2/12/95	
DRILL RIG	AP1000 BECKER HAMME			SURFACE CONDITI	ONS		<u> </u>		1			***************************************	1
ANGLE \	VERTICAL BEARING	NA											
SAMPLE H	MAMMER												1
5 -	SPT (N 50) EQUIVALENT								ļ,	TEST	RESU	LTS	
DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVALENT BLOWCOUNT FROM BECKER HAMMER	ਰ							K	K		_ 1	Ì
# N	BLOW COUNTS	SWBOL		DESCRIPTION	OF MATERIAL					LIQUID LIMAT	E×C	MO. 200 OTHER TESTS	1
[5년]	10 20 30 40 80	┦ " ┃			į.			ı	WATER		PLASTICITY NOEX &	MO. 20 OTHER	
		<u> </u>		-					38	ž	₹ ₹	교통 일반	1
_			(21.0-59.0	ft) Moderate k	rown (5YR	1/4),		\exists	П		П		
_	•		dense and	d hard, interbed LEAN SILTY CLA	lded SILTY AY, fine to 1	nedium		\exists			1 1		
31			grain san	d, <5% fine to c and sandstone	oarse orav	el, 1%	•	\exists		İ		1 1	
	•		calcareou	us stringers at amp to dry, (SM	38' to 38.5	'and		#					
32			at JJ, di	amp to ary, (sm	and LL)			3					
-													
<u> </u>							•	_					
- 1	•							\exists					
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edward S	SITE NAM	E AND LOCATIO	XN					DRILLING METH	00: BECKE	ER HAMMER					NG N			Control of the contro
-1														SHEE	T			
			IER FL					SAMPLING METI	100: BULK					4	0/			į
		ZAN	1DT2CI	NE. RI.	DGE		ŀ								DRILL			
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Ε	ORTHING: ASTING:				EU.	EVATION							12	/12/	95	12/12	/95	ç
_	IRILL RIG		KER HA	MMER			SUR	FACE CONDITIONS	S									
$\overline{}$		/ERTICAL	BEAR	NG NA			-						·					EIACC
S	AMPLE H	AMMER		·····	·····							-						
	H_	SPT (N ₅₀) E	QUIVALE	NT										*****	RES	ULTS		4
	DEPTH IN FEET (FLEVATION)	SPT (N ₅₀) E BLOWCOUN BECKER H	HAMMER		<u>ಜ</u>								34	K				
	FA	BLOW C		.	SWIBOL			DESCRIPTION OF	F MATERIAL					LIQUID LIMIT	ξ×	LESS THAN NO. 200		Z
		10 20 30	40 5		"								WATER	景	E X	200	OTHER TESTS	
										Water State of the			₹0	ž	Z Z	₽¥	5 2	
				:	N	(21.0-59.0	0 ft)	Moderate bro	own (SYR 4	/4),			П			T		
_			٩		\mathbb{N}	dense ar	nd har	rd, interbedde N SILTY CLAY,	d SILTY			\exists						
	- 46				N	grain sai	.nd, <5%	% fine to coa sandstone c	rse orave	l, 1%	-	\exists						
_			•			calcareo	us st	ringers at 38	8' to 38.5'	and		\exists		İ		ı	ľ	
_	- 47				\mathcal{U}	at 35', d	damp t	to dry, (SM a	nd CL)		-	4						
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_	59		1		7					(-59.0)	59.0	╡						9
	33			>50				BEDROCK, Base		(-59.5)		∃						JOB NO.:
	- 1					End of Bo	orehol	e at 59.5 ft.				=						9

AND LOCATION		OIL	. BOF		LE L	OG BECKER H	AMMER		<u> </u>	BORN	GO ASSO IG NO		NORTH AMERICAN DRILLING
				CALIFO	D40 4477400	21414				SHEET	7		CAN
		FLAT DAM DNE RIDGE		SAMPL	ING METHOD:	BULK				1	OF DRILLI	2 2	MER.
	34117316	INC KIDUL						···	_	STAR		FINISH	- ₹
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<u>:</u>			VATION						12	2/12/	95 1	2/12/95	<u> </u>
	AP1000 BECKER H			SURFACE C	ONDITIONS	· · · · · · · · · · · · · · · · · · ·		***************************************					CONTR
	RTICAL BEA	RING NA							**********			************	1
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	SPT (N 50) EQUIVAL BLOWCOUNT FRO	LENT .								IESI IESI	RESU	<u> </u>	4 =
	BECKER HAMME BLOW COUNTS	R 151		A.S.	1070Ai	***			×	F	اح	₹.	DRILLING
	10 20 30 40	<u>so</u> &		DESCR	IPTION OF MATE	KIAL			WATER	MIT GINOT	PLASTICITY NDEX X	200 EE	_
									\$8	3		MO 20	2
			(00-30-6	+ \ Coover	arange (10Y)	7 / / >							7
•			soft to	firm, SILT,	<5% fine san	d, dry		3				ı	
			(ML)								ı		
•								\exists					
									1 1				
•								E					N.
			(3.0-5.0 f	t.) Pole vei	llowish brown		(-3.0)	3.0					N B
ŧ	4		(10YR 6/2	2) to light	brown (5YR 6 medium grain	/4).		Ξ					H
			<5% coar	se sand, 20	% fine to co	arse							BUSHZC, ROBINSON
4	,		Subanguit	ir gravel t	o 3°, dry (Si			Ξ					
		1 1	(5.0-15.0	6+) Link+ b	rown, (5YR 6	/45	(-5.0)	5.0					-
	•		firm to h	iard, LEAN :	SILTY CLAY.	and SILTY	,	3					
			(CL)	e grainea, t.	5% fine grav	ei, ary		=					}
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SITE NAM	C AA40 1	00470	NA	_		IL DO	<u> </u>	DRILLING METHO					r		ASS NG N	oda oda	tes	,
SHE NAM	E ANOUL	UCATIO	re					DROLLING METHO	O: BECK	ER HAMMER	***************************************				mg n MF-I	-		Contract of the contract of th
														SHEE		1844		
		MIN	ER F	LAT	DAM	İ		SAMPLING METH	00: BULK					2	0	, 2		2
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VORTHING EASTING:	t					ELEVATION							12	2/12/	/95	12/12	/95	ç
XRILL RIG		0 BEC					SU	RFACE CONDITIONS										OTI400
	√ERTICAI	<u> </u>	BEA	RING	NA		╀—									 ,		
SAMPLE I					T								T	75.0		11170		<u> </u>
E &	SPT (I	N ₅₀) E WCOUN XER H	QUIVAL T FRO	ENT M										IK I	RES	OLI3	一	CINIT
DEPTH IN FEET (ELEVATION)	BEC BL	CKER H	ETNUX	R	SMBOL			DESCRIPTION OF	MATERIAL				×		≥	₹_		ō
	10 2	9 30	40	80	3			SECOND HOST OF	- APPENDING				WATER	LIQUID LIMIT	PLASTICITY NDEX &	LESS THAN NO. 200	DESTS TESTS	_
۵			-	·	<u></u>								≨ 8	3	5₹	교용	₽₽	
				T	::::	(15.0-17.0	ft.)	Pale yellowish	brown						Ī		\Box	
ا ۔ ا			1		::::	CIOYR 6/	2), de 1e gr	ense to very (ained, 10% silty	dense.			∃						
-16						dry, (SP)					\exists						
- 17				•>50						⟨−1 7	.0) 1	7.0						
ĺ			l	>50		(17.0-18.0	ft)	BEDROCK, Sands	stone	*	· · · · · · · · · · · · · · · · · · ·							2
- 18										<-18	.0> 1	8.0						BUSHZC, RUBINSON
, ,						End of	soren	nole at 18.0 ft.				=						R
-19												\exists						3/H2
18 19 20												∃						H.
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	SO	IL BOF	REHOLE LOG		D AS	older lociales
SITE NAME AND	LOCATION		DRILLING METHOD: BECKER	HAMMER	BORING N	Ю.
A Committee of the Comm	MINER FLAT DAM		SAMPLING METHOD: BULK		SHEET 1 0	F 1
	SANDSTONE RIDGE				DRILL START	
					TIME	TIME
					16:35 DATE	17:16 DATE
NORTHING: EASTING:		ELEVATION			12/12/95	
ANGLE VERTIC	000 BECKER HAMMER Cal Bearing Na		SURFACE CONDITIONS			
SAMPLE HAMMET					·	
E SPT	(N 50) EQUIVALENT				TEST RES	ULTS
CELEVATION)	LÓWCÓUNT FROM ECKER HAMMER BLOW COUNTS 20 30 40 80 6		DESCRIPTION OF MATERIAL		1 1. 1	₹.
	30 30 40 SO 6		Description of Registration		WATER CONTENT LIQUID LIA PLASTICIT NDEX %	LESS THAN NO. 200 OTHER TESTS
					38 7 43	교종 [2년
-		very loos	t.) Grayish orange (10YR 7/4), se to loose, SAND and LEAN AY, fine grain, <5% fine gravel,	=		
= 1		dry (SP	and CL)	=		
_ 2 °				=		
2 - 3 - -				=		
<u>}</u> 3		(3.0-5.0 f	t.) Pale yellowish brown	(-3.0) 3.0		
= •		(10YR 6/2 grain, (5%), compact, SAND, fine to medium fine subangular gravel, dry	¬ ∃		
<u> </u>		(SP)				
_ 5				(-5.0) 5.0 —		
-		compact i	t.) Pale brown (5YR 5/6), to dense, SAND and LEAN SILTY fine to coarse gravel,	3		
6		dry (SP a	nd CL)			
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8				耳		
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8 9				=		
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- 11		(11.0-14.0 f	t.) Light brown (5YR 5/6),	(-11.0) 11.0		
	•	dense, SAN clay, dry,	D, fine grain, <5% silty			
-12				=		
13				<u>E_</u>		
		(14.0-14.3 F	t.) Light brown (5YR 5/6),	(-14.0) 14.0		
14		hard, LEAN dry, (CL)	SILTY CLAY, 10% fine sand,	(-14.3) 14.3		
	•>50	(14.3-15.0 F	t.) BEDROCK, Basalt rehole at 15.0 ft.			

				SOI	L BOI	REI	HOLE	LOG				É	Ass	okke ocia	ies
	SITE NAME	E AND LOCATION	N				DRILLING METHOD	BECKER H	HAMMER				MF-I		
200		MINE	ER FLAT	DAM			SAMPLING METHO	O: BULK				1	Of	- 1	
			DSTONE I			-							DRILL	JNG	
						-			·			STAF		FIN	-
						-						7:55		10:1	
	NORTHING:											DAT	Ε	OA.	
L	EASTING:				LEVATION	[18	2/13/	/95	12/13	/95
<u>_</u>	DRILL RIG		BEARING I		· · · · · · · · · · · · · · · · · · ·	SUR	FACE CONDITIONS					***********			
г	SAMPLE H		CENTRA	NA .											
r	+ :	SPT (N.s.) FO	N INVALENT		***************************************						T-	TEST	RES	ULTS	
	DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EC BLOWCOUNT BECKER H BLOW CO	ammer	SW480L			DESCRIPTION OF I	MATERIAL			WATER CONTENT %	×			OTHER TESTS
					(10YR 6/	6) to	rk yellowish or pale yellowish	brown							
_	- 1				(10YR 6/2	2). laa	se to compact angular grave	SANTL fine		三					
		•			-		0 0	, , ,		目					Ì
_	- 2				•					=					
\										3				l	l
<u></u>	- 3			111	(3.0-4.5	ft.) Mo	derate brown	(5YR 4/4),	(-3.0)	3.0					
<u> </u>	_ 4	•			to mediur	m sand	AN SILTY CLAY, 1, <5% fine grav	vel, dry, (CL	.>	=					Ì
_	7		.		-				(-4.5)	4.5					
_	- 5				dense, SA	AND, fir	jht brown (5YR ne to medium g	rain, 10% to						ı	
_			>50		Subround	ta coi led gro	arse subangula avel, (5% silty	ir to clay, dry							
_	- 6				(SP) (5.0-10.2	ft.) BE	DROCK, Sandsta	one	(-5.0)	5.0			İ		
_			>50							∃					
_	- 7									目			l		
=	- 8		>50							=					
_	8		•>50							目					
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-			*> 50							目					
_	- 10								(-10.2)	10.2					
-					End of Bo	orehole	e at 10.2 ft.			=					
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SITE NA	ME AND	LOCATIO	N	SC	DIL	. ВО	RE	HOLE		R HAMMER				ASS NG N		P.
				.AT DA IE RIDI				SAMPLING ME	NHOO: BULK				SHEE		r 1	
NOTE: MA	Α.												TIME 10:25 DATE	E 5	TIA 10:4 DA	45
NORTHIN EASTING: DRILL RI ANGLE SAMPLE	G AP1 VERTIC			MMER NG NA	ELEN	/ATION	SUR	RFACE CONDITIO	vs.			12	2/13/	^{'95}	12/13	1/95
DEPTH IN FEET (ELEVATION)	SPT Bit B	(N ₅₀) E LOWCOUN ECKER H BLOW CO	CUIVALENT FROM IAMMER CUNTS	3				DESCRIPTION (OF MATERIAL			WATER CONTENT %	×	PLASTICITY RA	¥.	OTHER
1 2 2 3 4 5 5 6 7 7 8 8 9 10 11 1 1 2 1 3 1 1 1 1 2 1 3 1 1 1 1 2 1 3 1 1 1 1						(1048 5.) loose t grain, 10 gravel,	ft.) BE	DRUCK, Sands	(5YR 5/6), to medium subangular	(-6.0) 6.0					

			SOIL	ВС	RE	HOLE L	.OG				Á	G	alder Octates	
SITE N	AME AND LOCATE	ON				DRILLING METHOD:	BECKER HA	AMMER				NG N	0.	-
- 4		NER_FLAT				SAMPLING METHOD:	BULK				SHEE 1		. 1	
	1A2	NDSTONE	RIDGE								STAR	DROLL	JING FINISH	_
											TIME		TIME	\dashv
											11:00		11:30	
NORTHIN EASTING	/G: :		ല	EVATION							DATE /13/2	1	DATE 12/13/95	
DRILL R		CKER HAMME	R		SUF	REACE CONDITIONS								\exists
***************************************	VERTICAL HAMMER	BEARING	NA											
	1		T								****	-	14 200	4
馬多	SPT (N _{so}) I	EQUIVALENT NT FROM									1621	RESI	LIS	7
DEPTH IN FEET (ELEVATION)	BECKER BLOW C	COUNTS	SMBOL			DESCRIPTION OF MAT	ERIAL			×	LEAST.	چظ	₹	
	10 20 30	40 50	8				,			WATER	TIMU CINOU	PLASTICITY INDEX &	LESS THAN NO. 200 OTHER	213
										≩ 8	ž	도울	98 5	3
				(0.0-3.5	ft.) M	oderate yellowish ose to compact, S	brown	A _	\equiv					1
= 1			::::	medium dry (Si	grain,	15% fine angular g	ravel,	to	∃					
			::::	ury (Si	r,				\equiv					
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E 3			::::						三					
= 2 = 3 = 1				10= 05				(-3.5)	3.5					
4				(3.5-9.0	ואַ ג.ד+ ו	EDROCK, Sandstone								
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<u> </u>				End of	Boreho	le at 9.0 ft.		(-9.0)	9.0					
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money.	SIE NA	Æ ANO LO	CAIRON					DRILLING METI	NOO: BECKE	R HAMMER				MF- ET		····
A 1			MINER					SAMPLING ME	1400: BULK				1	0	2	
			SANDS	TUNE	RIDGE					74.			STA	DRBL	LING	KSU
													TIM		TIA	
													12:3		13:5	
	NORTHING	G:			Ε	LEVATION							DAT 2/13,	· •	DA 12/13	- 1
	DRILL RK		BECKER	R HAMME			SU	REACE CONDITION	ts							
-		VERTICAL	8	EARING	NA		ļ									
ŀ	SAMPLE	Ţ			T	·	<u></u>					11	77***	2 000	4 11 70	
	DEPTH IN FEET (FLEVATION)	SPT (N	50) EQUIP ICOUNT F CER HAM	VALENT TROM									K	RES	ULIS	\sqcap
	X¥	BLC	W COUN	ITS	SWEGE			DESCRIPTION (OF MATERIAL			k	3	≥	₹	
l	₹₫	10 20	30 4	9 80	- 6							WATER	LIQUID LIMIT	PLASTICITY NOEX X	LESS THAN NO. 200	OFFER TESTS
L] ≸8	3	독물	ਜ਼ੋ8	퉏
F						(0.0-3.0 H	ft.) P	ale yellowish ery loose to	brown		***	3 [<u> </u>			\Box
E	1 2 3					SILTY SA	AND. F	ine to medium coarse subro	ornin.	1	-]				
H		.				dry (SM)	, , ,	.ourse samoi	unded grave	ι,	-]				
_	_ 2										=					
LL											_	3				
No.	_ 3									(-3.	0.8 <0	<u> </u>				
_	_					(10YR 6/2	2) to	Moderate yell moderate br	own (5YR 4)	/43.	_					
_	- 4					fine sand	hard, d, 10%	LEAN SILTY fine subrour	CLAY, 5% to ided gravel,	40% dry] [
_	-					(CL)					-] [
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_						(10YR 6/2) to	Moderate yell moderate bro	own (5YR 4/	4),	=					
3.	-13					dense, CL	AYEY	SAND, fine gravel, dry (ain, 40% silt	У						
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			SOIL	BOR	REHOLE LO	G		Ó		older sociales	
	SITE HAM	E AND LOCATION	A Company of the Comp		ORILLING METHOD: BEC	KER HAMMER			MF-	ю.	NORTH AMERICAN DRILLING
line.		MINER FL SANDSTON			SAMPLING METHOD: BUL!	К			-	F S	MERICAN
		301473 1 014	C NIDGE				I		PART ME	LING FINISH TIME	NORTH A
	NORTHING:								930 ATE	13:55 DATE	-
	EASTING: DRILL RIG	AP1000 BECKER HAM	MMER	/ATION	SURFACE CONDITIONS			12/1	3/95	12/13/95	CONTR
	ANGLE V		4G NA								7
	DEPTH IN FEET (ELEVATION)	SPT (N ₅₀) EQUIVALEN BLOWCOUNT FROM BECKER HAMMER BLOW COUNTS 10 20 30 40 80	. 5		DESCRIPTION OF MATERIAL				PLASTICITY & SERVICE WITH A SERVICE WAS THE SERVICE WITH A SERVICE WAS THE SERVICE WITH A SERVICE WAS THE SERV		DRILLING
	16 		>50	(10YR 6/2) dense, CL/ c(ay, <5%	ft.) Moderate yellowish br) to moderate brown (5YR AYEY SAND, fine grain, 40% fine gravel, dry (SC) ft.) BEDRUCK, Basalt rehole at 18.5 ft.	4/4), silty (-18.0) 1	8.0				. BUSH/C. ROBINSON
	20 21 22 23										LOGGED BY
	- 24 25 26										
	- 27 - 28 - 29						mlunlunlun				JOB NO.:943_27691170

		SOIL	BOF	REHOLE	LOG	W. 47 - 10 - 10 - 10 - 10 - 10 - 10 - 10 - 1		Ć	Go	lder ociates	
SITE	NAME AND LOCATION			DRILLING METI-	IOO: BECKER HA	MMER			NG N	Э.	\exists
_									MF-E	32	
1								SHEE	ा		
	MINER F			SAMPLING MET	HOO: BULK			1	OF	-	_
	ZANDZTU	NE RIDGE							DRILL		_
								STAF		FINISH	4
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								DAT		DATE	-
NORTH EASTIN	W VG: vG:	ELE	EVATION		1				_	12/13/95	5
DRILL	RIG AP1000 BECKER H			SURFACE CONDITION	s					-	
ANGLE	VERTICAL BEAR	NG NA									-
SAMPL	e hammer						<u> </u>		***************************************	-	i
.	SPT (N 50) EQUIVALE	ENT TWO						TEST	RESL	JLTS	
DEPTH IN FEET	BLOWCOUNT FROM BECKER HAMMER	4 1 1						M.			7
₹ 2	BLOW COUNTS	SWBOL		DESCRIPTION O	F MATERIAL			UQUID LAMIT	PLASTICITY NDEX %	₹ 。	
5	10 20 30 40	80 N					WATER	9	S S	NO. 20	2
<u>۵</u>							≨ 8	3	53	98 E	
_		T [::::	(0.0-3.0 f	t.) Moderate yello	wich hoown			T	T		7
	•		(10YR 5/4	b), very loose to ledium grain, dry,	loose, SAND,		31				
_ 1			rine to m	ledium grain, ary,	(25)	-	 				
_	1 6 1 1 1						3				
_ 2						-	31				
=							‡	l			
<u> </u>			/02.05 =			(-3.0) 3.0	∄				
-		777	very stif	t.) Moderate brow f, LEAN SANDY SIL	n (5YR 4/4), .TY CLAY, fine		크				
_ 4			to medium	grain, dry (CL) t.) Light brown (5	VD E (C) 1	(-3.5) 3.5	#				
			to compac	ct, CLAYEY SAND.	fine to medium	_	 				
5			grain, (3% gravel to	fine to coarse s 4%, damp (SC)	supangular		∃				
						_	∃				
_ 6						(-6.0) 6.0	 				
= ~			(6.0-29.0 f	ft.) Moderate bro to dense, SAND, fi	wn (5YR 4/4),		31				١,
<u> </u>			grain, <5%	clay, <5% to 20%	fine subangular	•	=				}
- /			dry (SP)	% såndstone cobb	les to 4°,		= 		1		5
							3		l		01000
- 8							#		-		-
-	•					:					
- 9		::::					3 I I				
	•					:	= 				
- 10							 		ı		
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		::::				-	 				≝

			SOII	L BOF	REH	OLE	LOC)		((older]
(~	SITE NAME	E AND LOCATION			DR	lling method	BECKE	R HAMMER				NG N	0.	44.9	NDT I INC
V.,	1	MINER FL SANDSTON			SAA	IPLING METHO	0: BULK				SHEE 2	T OF			NORTH AMERICAN DRILLING
											STAR	rr E	FIN	Æ	NURTH
	NORTHING: EASTING:		Đ.	EVATION						12	14:20 DATE 2/13/		16:0 DAT 12/13	TE	<u></u>
	DRILL RIG				SURFACE	CONDITIONS									CONTR
	SAMPLE H		re na			- Augusta				 					1
	N FEET TOOK)	SPT (N ₅₀) EQUIVALEN BLOWCOUNT FROM BECKER HAMMER	1 1								×	RES			DRILLING
	DEPTH IN FEET (ELEVATION)	BLOW COUNTS 10 20 30 40 80	SWBOL		DES	CRIPTION OF	MATERIAL.			WATER CONTENT	UNIO CINALI	PLASTICITY INDEX %	LESS THAN NO. 200	OTHER TESTS	
	16 17 18 19 19 10 10 10 10 10 10			compact grain, <5%	to dense : clav. <5	rate brown , SAND, fine % to 20% f tone cobble	to media	um.							i. Bush/c. Rabinson
	- 21 - 22 - 23 - 24 - 25														LOGGED BY
	- 26 - 27 - 28 - 29			(10R 7/4), interbedde fine ta me	to moder compact d CLAYEY dium grai	rate reddi ate orange to very de SAND and n, <5% to 2 vel, dry, (S	pink ense, SAND, 0%		29.0						JOB NO.: 243-27691179

			SOIL	BO	REHOLE	LOG		Ć) C	older ociales	
(····	SITE NAM	ME AND LOCATION			DRILLING METH	OO: BECKER HAMM	IER	8	XROWG N	Ю.	AMERICAN DRILLING
F. 10.20	ĺ	MINER FL			SAMPLING METI	HOO: BULK			IEET 3 of		IERICAN
		NDT 2 UNA 2	NE KINGE					s	DRILL	LING FINISH	NDRTH AM
									:20	16:00	Į ģ
	NORTHING EASTING:	ž:	ខារ	EVATION					ATE 3/95	DATE 12/13/95	
	DRILL RIG				SURFACE CONDITIONS	S			0,70	12/13/70	CONTR
	SAMPLE H		NG NA					·····			1
	# <u>\$</u>	SPT (N ₅₀) EQUIVALE BLOWCOUNT FROM BECKER HAMMER	NT T					-	ST RES	ULTS	DRILLING
	DEPTH IN FEET (ELEVATION)	BLOW COUNTS	SWBOL		DESCRIPTION OF	F MATERIAL		WATER CONTENT &	PLASTICITY NDEX %	LESS THAN NO. 200 OTHER	_
				(290-47)	5 C+ \ Madain 1			\$8 5	5.3	교용 일본	
ļ	_ 31	•		(10R 6/6) (10R 7/4)	5 ft.) Moderate re) to moderate ora), compact to very ded CLAYEY SAND a	nge pink	=				
	=	•		fine to r	medium grain, (5% to coarse gravel, dry,	20%	Ξ				
	32 	•					=				2
	- 33						=				RUBINSON
	34						三				BUSH/C. RD
Ē	35						աևակառևակա				r. Bus
	- 36						uluuluu				
E	- 37						=				LOGGED BY
E	- 38										19907
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E	- 39						, 				
E	- 40						· =				
	- 41										ı
E	- 42						=				021165
E							目				943-27691.120 MFB32
	- 43		50				릨				^
E	- 44						mhimhin				JOB NO.:
E][909

		SOI	L BO	RE	HOLE LO)G			(G.	older oca		
E NAME AN	IO LOCATION				DRILLING METHOD: BE	CKER HAMM	ER				NG N			THE STOCK OF THE S
				ŀ							1F - E	332		
				-	SAMPLING METHOD: BU	1.12				SHEE 4		_ 4		
	MINER FLA SANDSTONE				SPERFLING MEINOU: BU	LK			_		DRILL			9
	2HI1D2 BI4F	- KIDGE		ŀ						STAR		FINI	en.	
				ľ						TIME		TIM		
				ľ						14:20	,	16:0	00	
THING:								***************************************		DATE	:	DAT	ſΈ	
TING:		***************************************	LEVATION						12	2/13/	95	12/13	/95	(
	P1000 BECKER HAM			SUR	FACE CONDITIONS	White the second second second second second second second second second second second second second second se								1
LE VERT		G NA							· · · · · · · · · · · · · · · · · · ·					CELECO OIN LIED
		- 1 - 1						т	7			4 4 555		9
(ELEVATION)	PT (N 50) EQUIVALENT BLOWCOUNT FROM BECKER HAMMER	п								NG (ED)	RES	ULIS	П	-
ATIO M	BECKER HAMMER BLOW COUNTS	SAMBOL						l	146		_	3		Ş
	30 30 40 50	&			DESCRIPTION OF MATERIA	VL.		-	WATER	LIQUID LIMIT	PLASTICITY NDEX X	LESS THAN NO. 200	P5 92	
								- 1	₹8	3	Z S	35	ESE SE	
1 1		1567:1												
			(10R 6/	′6) to 1	Moderate reddish o moderate orange pink	(=						
6		\mathbb{N} :	SAND, f	fine to	rbedded CLAYEY SAN medium grain, <5% to	50%								
		\mathbb{N} :	fine to	coars	e gravel, dry, (SC an	nd SP)		=						
7								\exists						
		>50	(475-4	90 6+7	BEDROCK, Sandstone	(-	47.5) 47.5	=	1 1	ı				į
8			(47.5-4	2.0 F C.2	BEDRUCK, SandStone			目					ļ	
11		>50						3						0
9			Fod of	Ronaho	ole at 49.0 ft.	(-	49.0) 49.0					ı İ		J. Asild
			ina di	DOI EIL	Sie ut 47.0 1 6.			∃						ā
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APPENDIX B LABORATORY TESTS RESULTS

SUMMARY OF SOIL DATA TABLE 1

MMCSSA/MINER FLAT/AZ

Project Number 943-27691.170

ARIZONA Project Name Location

MOISTIDEN RELATIONSHIP ADDITIONAL TEST	COMMENTS	(SEE NOTES)	-	E		8	1	1	1			-	1	ļ	1		L	
TATIONSHIP	РВОСТОЯ	MOIST(%)	9.5	11.0	ļ		-	15.0	-	15.5	1	1	1	1	ı	1	-	1
MOIST/DEN RI	STANDARD PROCTOR	PCF(DRY)	127.0	124.5	-	1	1	115.0	-	113.0					Į.	-	-	1
	SPECIFIC	GRAVITY	2.57	2.57	-	2.60	2.64	2.58	2.65	2.63	2.63	2.66	2.64		l	1		l
STRIBUTION	% FINER NO.	200 SIEVE	36	50	1	51	62	67	71	65	70	57	54			100.00	1	ļ
GRAIN SIZE DISTRIBUTION	% FINER NO	4 SIEVE	100	100	-	100	100	100	100	100	100	100	100		-	-	-	1
		-78	1	!	ļ	!			!	!	!	-			1	-	l	
ATTERBERG	LIMITS	pl.	-	15	17	15	18	23	16	17	20	22	18		-		ļ	l
ATTE	#1	n'a	1	12	13	14	16	17	19	17	18	15	16	1			ŀ	ŀ
		77	!	27	30	29	34	40	35	34	38	37	34	1	1		ŀ	I
NATURAL	MOISTURE	9,6	1	1	1	!	1	1	1	***	1	1	1	-			1	ļ
1108 SORT	CLASSI-	FICATION		SC	1	CL	CL	CL	CL	CL	CL	CL	CL	1	-	1	1	ı
SAMPLE	DEPTH	(ii)	35-40'	35-40'	40-45'	30-35,	35-40'	30–35,	35-40'	30–35'	35-39	25–30'	30-35'	!	-		ł	I I
SAMPLE	ý		8	-	!	1	1	1	1	1	-	1	!	ļ			ļ	-
BORING	2		BA-1	BA-2	BA-2	BA-3	BA-3	BA-4	BA-4	BA-5	BA-5	BA-6	BA-6	1			1	1

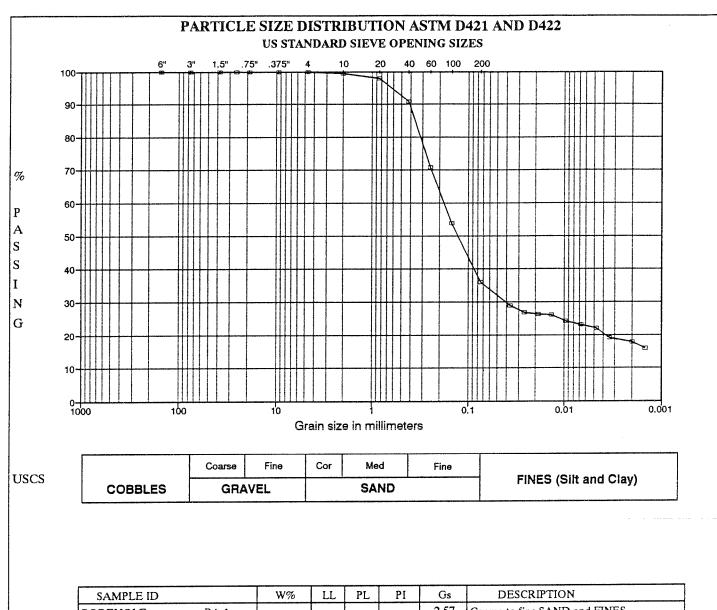
NOTES:

LL = LIQUID LIMIT

PL = PLASTIC LIMIT
PI = PLASTIC INDEX
SL = SHRINKAGE LIMIT

T = TRIAXIAL TEST

U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
P = PROCTOR TEST
DS = DIRECT SHEAR TEST
Porm = PERMEABILITY



SAMPLE ID		W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	BA-1					2.57	Coarse to fine SAND and FINES
SAMPLE NO.							
DEPTH	35-40'						
	Sample Type:		Date 7	ested:	10/19/95		USCS:

RCS

DATE:

10/23/95

CHECKED:

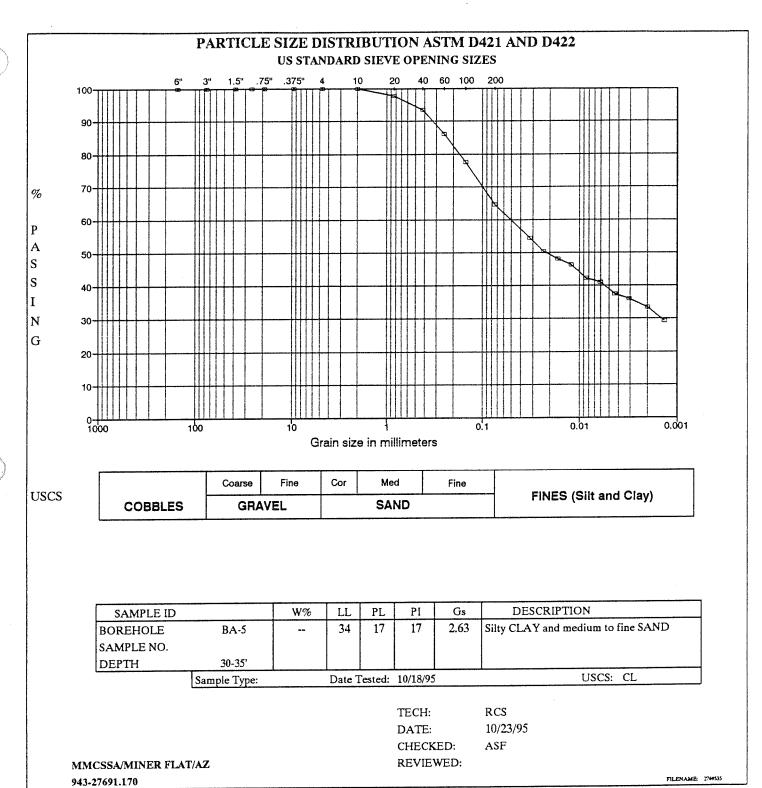
ASF

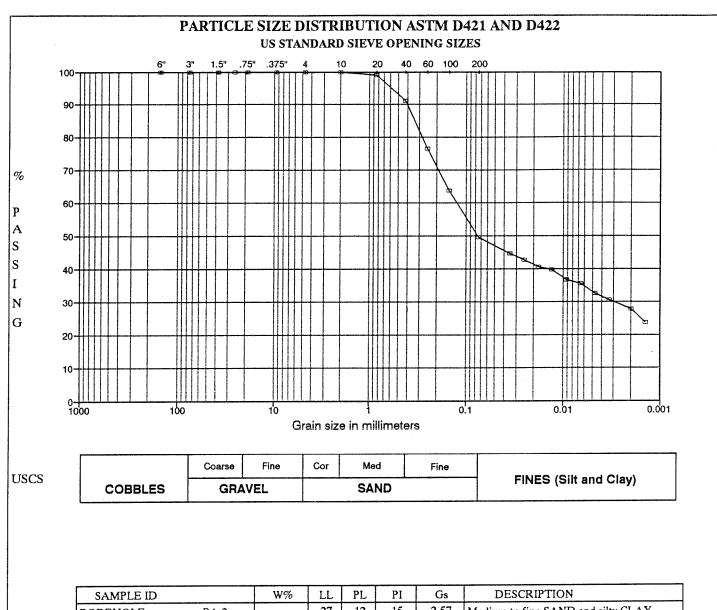
MMCSSA/MINER FLAT/AZ

943-27691.170

REVIEWED:

FILENAME: 2769140





SAMPLE ID		W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	BA-2		27	12	15	2.57	Medium to fine SAND and silty CLAY
SAMPLE NO.							
DEPTH	35-40'				:		
	Sample Type:		Date T	ested:	10/19/95		USCS: SC

BRB

DATE:

10/23/95

CHECKED:

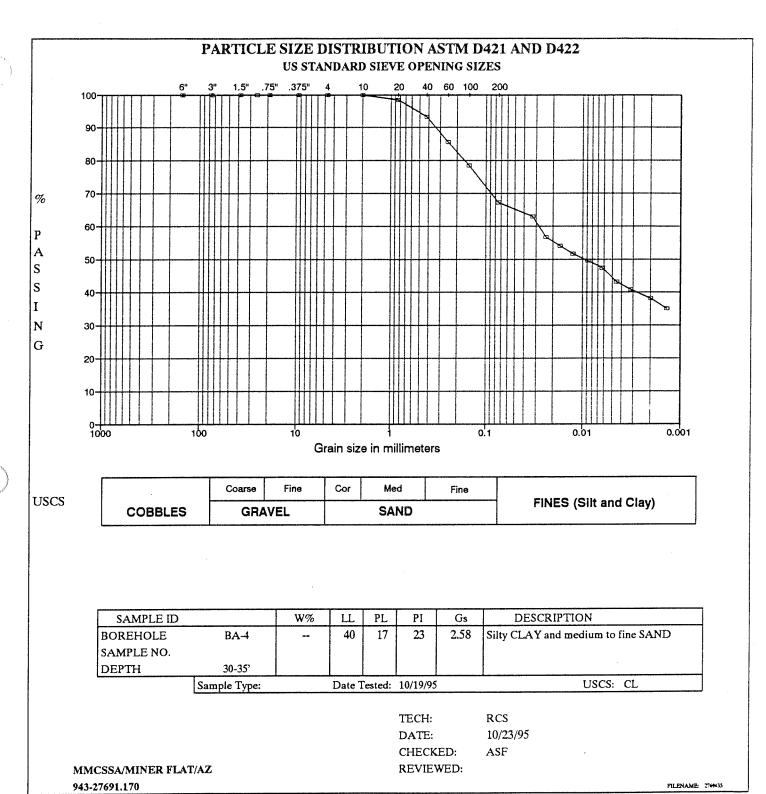
ASF

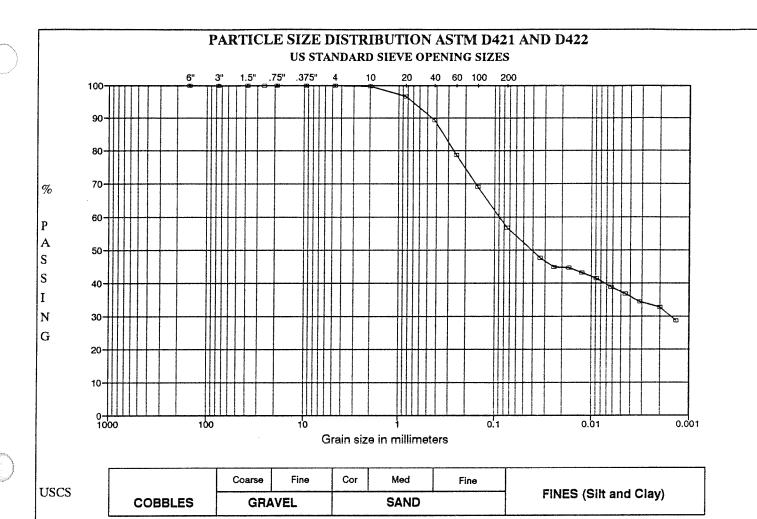
MMCSSA/MINER FLAT/AZ

943-27691.170

REVIEWED:

FILENAME: 2769240





SAMPLE ID		W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	BA-6		37	15	22	2.66	Silty CLAY and medium to fine SAND
SAMPLE NO.							
DEPTH	25-30'						
	Sample Type:		Date 7	ested:	10/18/95		USCS: CL

RCS

DATE:

10/23/95

CHECKED:

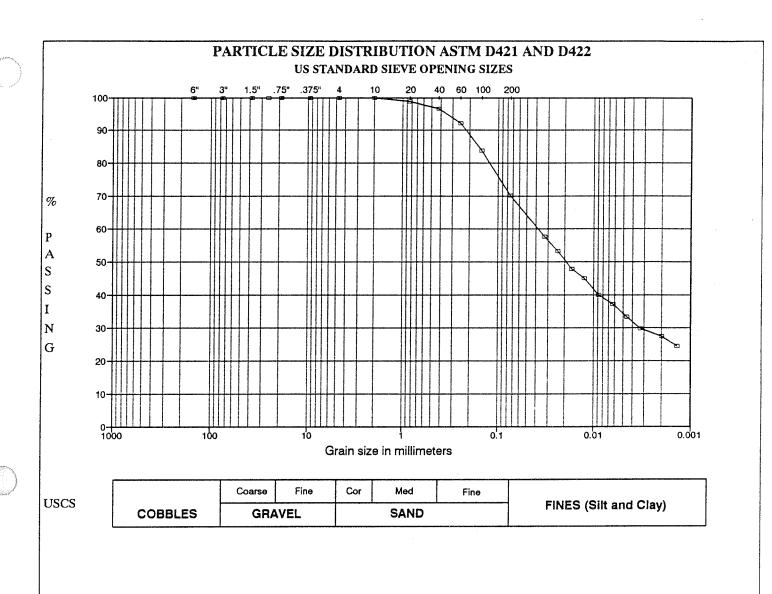
ASF

MMCSSA/MINER FLAT/AZ

943-27691.170

REVIEWED:

FILENAME: 2769630



SAMPLE ID		W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	BA-5		38	18	20	2.63	Silty CLAY with some medium to fine
SAMPLE NO.	4						sand
DEPTH	35-39'						
	Sample Type:		Date T	ested:	10/18/95	i	USCS: CL

RCS

DATE:

10/23/95

CHECKED:

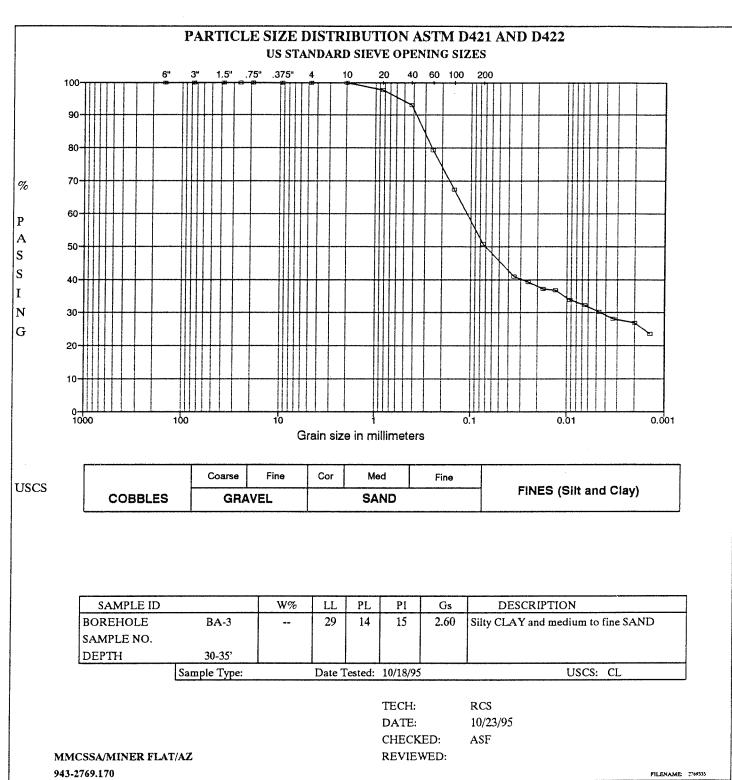
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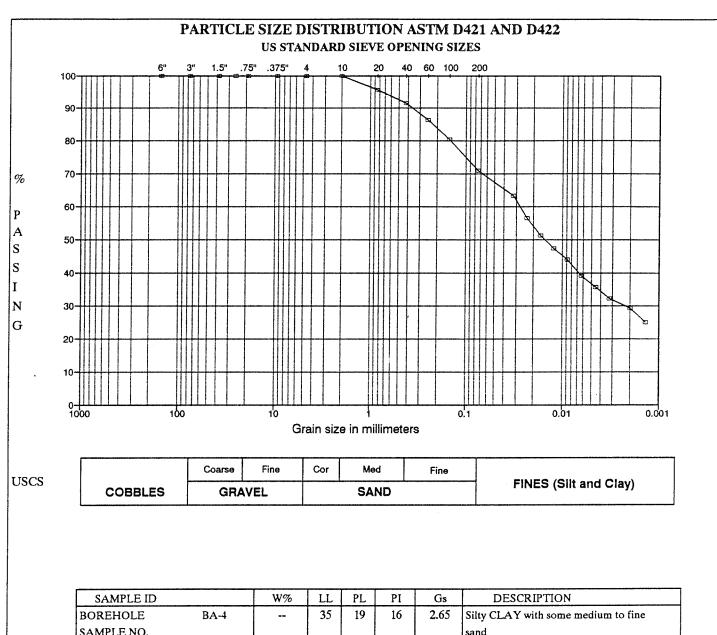
MMCSSA/MINER FLAT/AZ

943-27691,170

REVIEWED:

FILENAME: 2769539





SAMPLE ID		W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	BA-4		35	19	16	2.65	Silty CLAY with some medium to fine
SAMPLE NO.							sand
DEPTH	35-40'						
	Sample Type:		Date 7	ested:	10/19/95		USCS: CL

BRB

DATE:

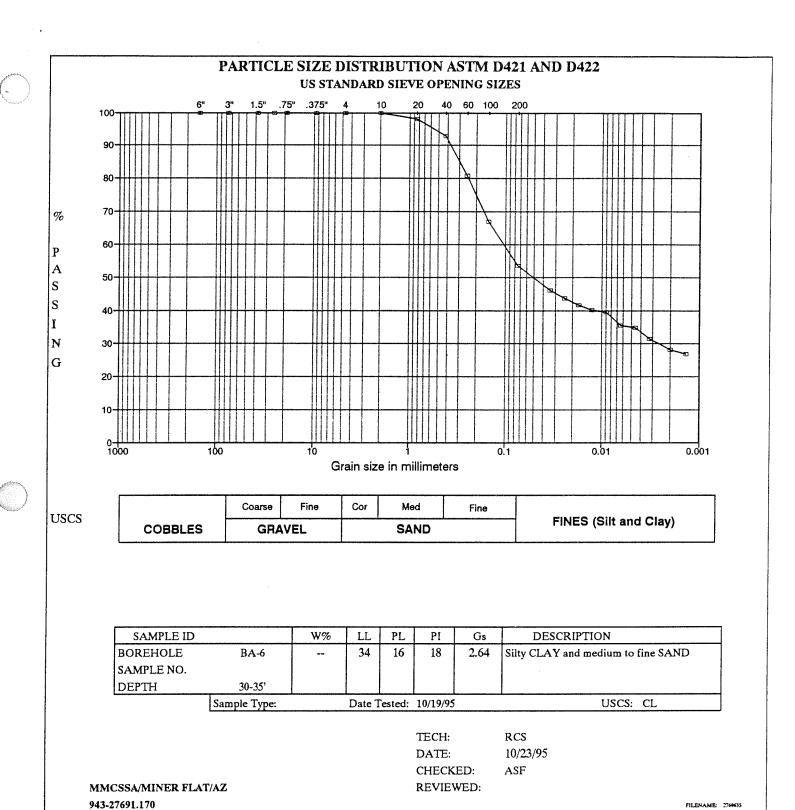
10/23/95

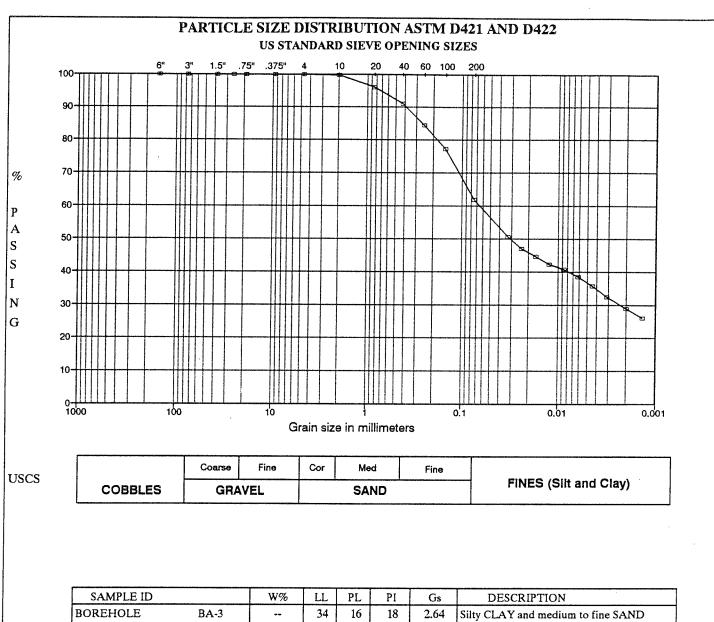
CHECKED:

ASF

MMCSSA/MINER FLAT/AZ 943-27691.170

REVIEWED:





SAMPLE ID		W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE	BA-3		34	16	18	2.64	Silty CLAY and medium to fine SAND
SAMPLE NO.							
DEPTH	35-40'						
	Sample Type:		Date T	ested:	10/18/95		USCS: CL

RCS

DATE:

10/23/95

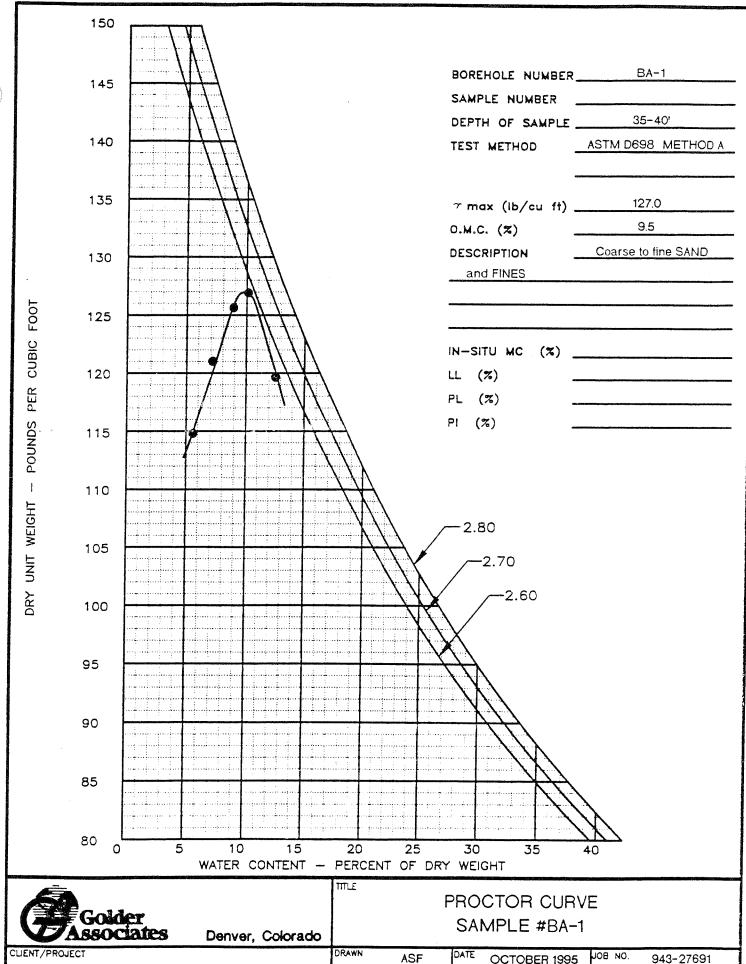
CHECKED:

ASF

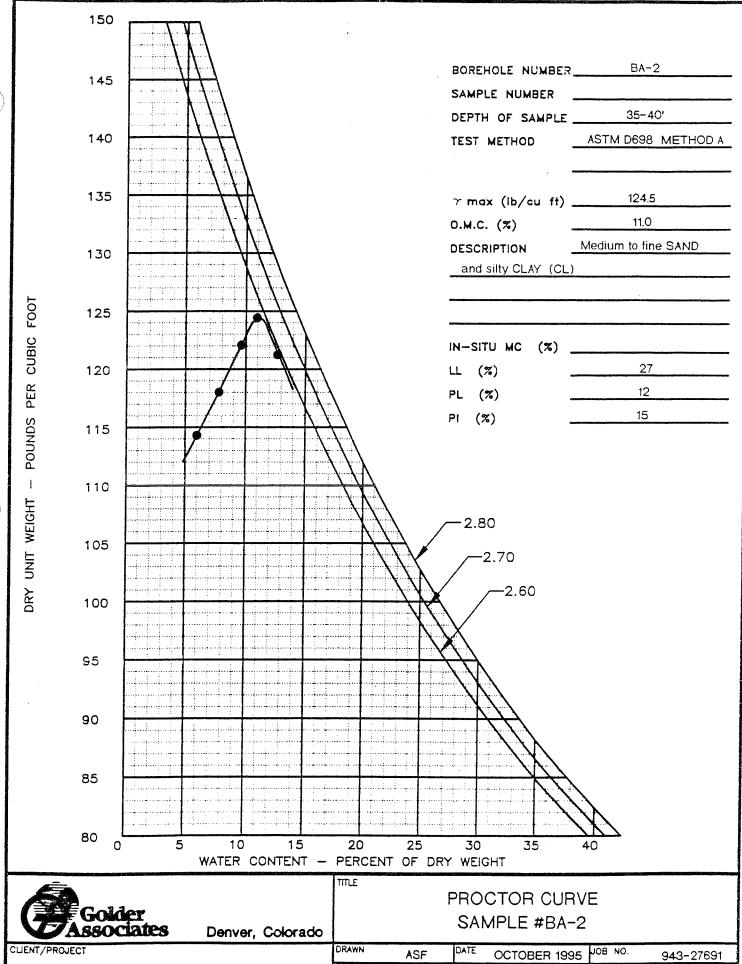
MMCSSA/MINER FLAT/AZ 943-27691.170

REVIEWED:

FILENAME: 1747340



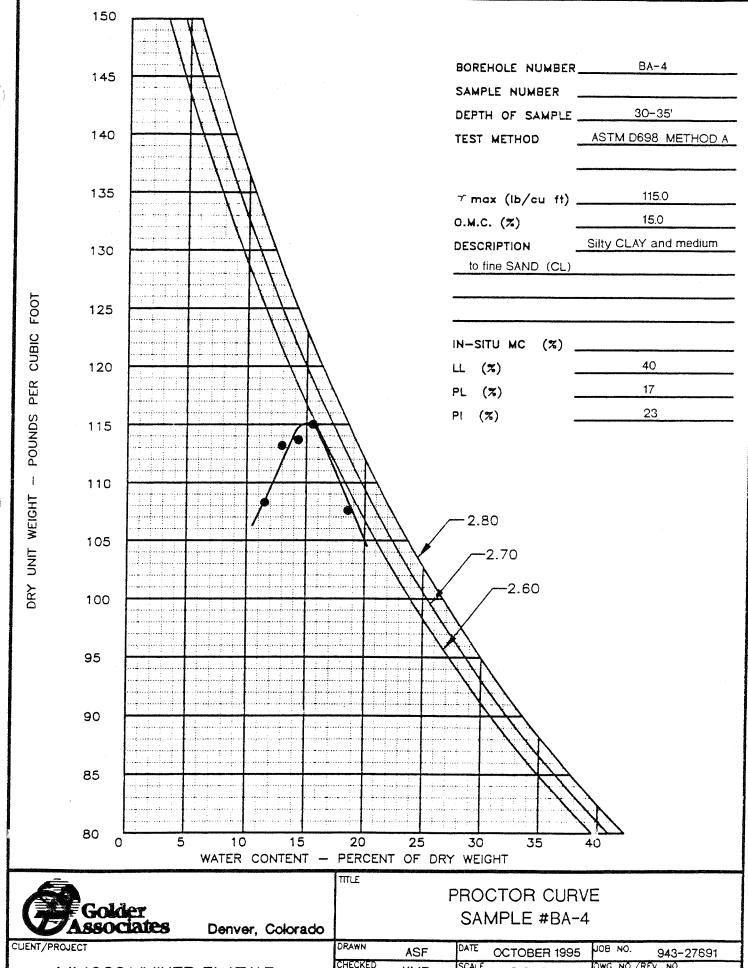
OCTOBER 1995 DWG NO./REV. NO. **KMR** AS SHOWN REVIEWED FIGURE NO. WATER.DWG



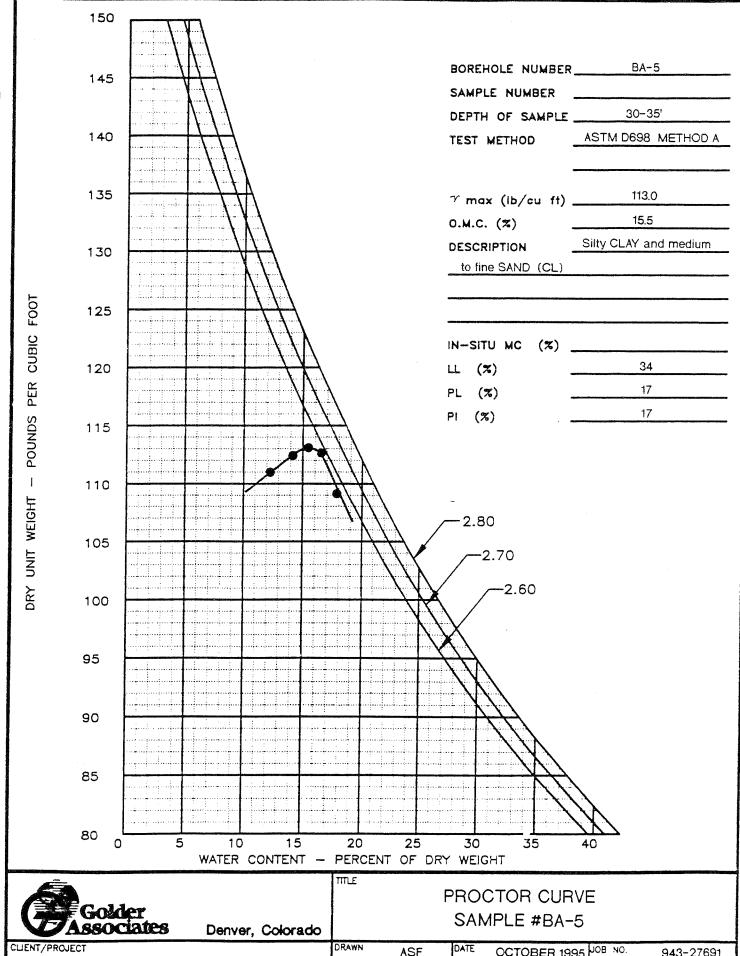
DRAWN ASF DATE OCTOBER 1995 NO. 943-27691

CHECKED KMR SCALE AS SHOWN DWG NO./REV. NO.

REVIEWED FILE NO. WATER.DWG FIGURE NO.



CHECKED DWG NO./REV. NO. KMR AS SHOWN FIGURE NO. FILE NO. WATER.DWG



ASF OCTOBER 1995 HOB NO. 943-27691 CHECKED OWG NO./REV. NO. **KMR** AS SHOWN REVIEWED FILE NO. WATER.DWG IGURE NO.

943-27691.170 MMCSSA/MINER FLAT/AZ

TABLE 2
SUMMARY OF FLEXIBLE WALL PERMEABILITY TEST RESULTS

SAMPLE NUMBER	BA-5					
Sample Length (cm)	9.60		· · · · · · · · · · · · · · · · · · ·	-		
Sample Diameter (cm)	7.26					
Sample Dry Density (pcf)	108.2					
Maximum Dry Density (pcf)	1					
Compaction (%)	-					
Initial Moisture Content (%)	9.2					
Optimum Moisture Content (%)	1					
Effective Stress (psi)	5	White with the rest				
Back Pressure (psi)	95					
Gradient	13					
Average Permeability (cm/sec)	2.7X10 ⁻⁷					

APPENDIX C DOWNHOLE SURVEYS

BOREHOLE: MF-218A COLLAR COORDINATES

NORTH 1,085,010.0 * EAST 576,800.0 * Miner Flat Dam

Surveyed By: DA

Main Access Road

Date Surveyed: August 29, 1995

ELEVATION 6,007.0 * (Estimated)

BOREHOLE - AS DRILLED

Time Surveyed: 10:03 am

Raw Data From	Owl Technical Assoc.

	HOLE	Model 780	.	TRUE	DISTANCE	DICTANCE				
	DEPTH		ECTION	DEPTH	DISTANCE NORTH	EAST	CLOSURE	NODTUNO	EACTING	F1 F3 /4 75 0
	(ft.)	(from Vert.) No		(ft.)	(ft.)	(ft.)	(ft.)	NORTHING (ft.)	EASTING (ft.)	ELEVATION
ĺ	(4.17)	1		1,,,,	1,/	(14./	(16.7	(11.)	(11.)	(ft.)
	0.0	0.0 •	0 •	0.00	0.00	0.00	0.00	1,085,010.0	576,800.0	6,007.0
ı	10.0	2.4 *	11 °	10.00	0.21	0.04	0.21	1,085,010.2	576,800.0	
-	20.0	1.6 *	0 •	19.99	0.55	0.08	0.56	1,085,010.6	576,800.1	5,987.0
- 1	30.0	3.0 °	18 °	29.98	0.94	0.16		1,085,010.9	576,800.2	
-	40.0	2.8 °	2 °	39.97	1.43	0.25	1.45	1,085,011,4	576,800.3	5,967.0
	50.0	2.8 °	0 •	49.96	1.92	0.26	1.94	1,085,011.9	576,800.3	5,957.0
1	60.0	2.7 °	356 °	59.94	2.40	0.24	2.41	1,085,012.4	576,800.2	5,947.1
1	70.0	2.4 °	351 •	69.93	2.84	0.19	2.85	1,085,012.8	576,800.2	5,937.1
1	80.0	2.0 °	358 °	79.93	3.22	0.15	3.23	1,085,013.2	576,800.2	5,927.1
	90.0	2.7 °	10 °	89.92	3.63	0.19	3.63	1,085,013.6	576,800.2	5,917.1
	100.0	2.5 *	351 °	99.91	4.08	0.20	4.08	1,085,014.1	576,800.2	5,907.1
-	110.0	2.7 °	15 °	109.90	4.52	0.22	4.52	1,085,014.5	576,800.2	5,897.1
۱	120.0	2.8 °	354 *	119.89	4.99	0.26	5.00	1,085,015.0	576,800.3	5,887.1
Į	130.0	2.4 °	343 °	129.88	5.43	0.17	5.44	1,085,015.4	576,800.2	5,877.1
1	140.0	1.8 *	347 *	139.87	5.79	0.07	5.79	1,085,015.8	576,800.1	5,867.1
-	150.0	2.6 *	355 *	149.86	6.17	0.02	6.17	1,085,016.2	576,800.0	5,857.1
ı	160.0	1.8 *	11 *	159.85	6.55	0.03	6.55	1,085,016.5	576,800.0	5,847.1
	170.0	1.8 *	351 ⁴	169.85	6.85	0.04	6.85	1,085,016.9	576,800.0	5,837.2
١	180.0	2.0 *	10 1	179.84	7.18	0.04	7.18	1,085,017.2	576,800.0	5,827.2
ı	190.0	1.7 *	349 °	189.84	7.50	0.04	7.50	1,085,017.5	576,800.0	5,817.2
ı	200.0	2.0 °	2 °	199.83	7.82	0.02	7.82	1,085,017.8	576,800.0	5,807.2
١	210.0	1.6 *	343 *	209.83	8.13	-0.01	8.13	1,085,018.1	576,800.0	5,797.2
ı	220.0	1.5 °	347 °	219.82	8.39	-0.08	8.39	1,085,018.4	576,799.9	5,787.2
Į	230.0	1.8 °	323 °	229.82	8.64	-0.21	8.64	1,085,018.6	576,799.8	5,777.2
ĺ	240.0	2.0 °	322 •	239.81	8.90	-0.41	8.91	1,085,018.9	576,799.6	5,767.2
ı	250.0	2.0 °	317 °	249.81	9.17	-0.64	9.19	1,085,019.2	576,799.4	5,757.2
ł	260.0	2.7 °	346 °	259.80	9.52	-0.81	9.56	1,085,019.5	576,799.2	5,747.2
1	270.0	2.7 °	353 °	269.79	9.99	-0.90	10.03	1,085,020.0	576,799.1	5,737.2
	280.0	2.5 *	353 *	279.78	10.44	-0.95	10.48	1,085,020.4	576,799.0	5,727.2
-	290.0	2.5 •	350 °	289.77	10.87	-1.02	10.92	1,085,020.9	576,799.0	5,717.2
l	300.0	2.7 °	345 °	299.76	11.31	-1.12	11.37	1,085,021.3	576,798.9	5,707.2
-	310.0 320.0	2.7 ° 1.6 °	350 °	309.75	11.77	-1.22	11.83	1,085,021.8	576,798.8	5,697.3
l	320.0	1.6 ° 1.7 °	329 °	319.74 329.74	12.12 12.37	-1.33	12.20	1,085,022.1	576,798.7	5,687.3
	340.0	1.7	320 •	329.74	12.57	-1.48 -1.66	12.45 12.71	1,085,022.4 1,085,022.6	576,798.5	5,677.3
1	350.0	2.2 •	334 °	349.73	12.89	-1.84	13.02	1,085,022.8	576,798.3 576,798.2	5,667.3 5,657.3
	359.9	2.6 *	336 *	359.62	13.27	-2.01	13.42	1,085,023.3	576,798.0	5,647.4
L								,,-	J. 5,. 55.6	-,
-				The second secon	The second liverage of the second liverage of					

Error Analysis Bottom Coordinates

Missed the target of the designed hole (0.0°,0.0°) by:

13.3 ft. North
2.0 ft. East
0.3 ft. Higher
13.42 feet Total
3.73% Tolerance

Northing Easting Elevation

1,085,023.3 +/- 0.1 576,798.0 +/- 0.3 5,647.4 +/- 0.0

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0°-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

NORTHING, EASTING, ELEV.: Coordinates calculated from the collar coordinates. Collar coordinates furnished by Geodetic Surveys, Inc..
(* Estimated coordinates have not been surveyed.)

BOREHOLE: MF250 COLLAR COORDINATES Miner Flat Dam

Sandstone Ridge

Surveyed By: !b/cr

NORTH EAST ELEVATION

TH 1,085,615.0 * ST 576,875.0 *

76,875.0 * 6,081.0 * (Estimated)

BOREHOLE - AS DRILLED

Time Surveyed: 12:45 pm

Date Surveyed: June 19, 1995

Raw Data From Owl Technical Assoc.

HOLE	Model 780	TRUE	DISTANCE	DICTANCE				
DEPTH	INCLINATION DIRECTION	DEPTH	NORTH	EAST	CLOSURE	NORTHING	FACTINO	FI = 4 = 6.1
(ft.)	(from Vert.) North=360		(ft.)	(ft.)	(ft.)	(ft.)	EASTING (ft.)	ELEVATION
		1.57		14.7	(11.7	171.7	(71.)	(ft.)
0.0	0.0 • 0 •	0.00	0.00	0.00	0.00	1,085,615.0	576,875.0	6,081.0
5.0	0.5 ° 108 °	5.00		0.02	0.02	1,085,615.0	576,875.0	-,
10.0	1.3 ° 316 °	10.00		0.00	0.03	1,085,615.0	576,875.0	
20.0	0.5 ° 106 °	20.00		-0.03	0.10	1,085,615,1	576,875.0 576,875.0	6,061.0
30.0	1.7 ° 83 °	30.00		0.15	0.19	1,085,615.1	576,875.0 576,875.2	6,051.0
40.0	1.2 ° 40 °	39.99	0.20	0.37	0.42	1,085,615.2	576,875.4	6,041.0
50.0	1.0 ° 45 °	49.99	0.34	0.50	0.60	1,085,615.3	576,875.5	6,031.0
60.0	1.1 ° 35 °	59.99	0.48	0.61	0.78	1,085,615.5	576,875.6	6,031.0
70.0	1.0 ° 37 °	69.99	0.63	0.72	0.96	1,085,615.6	576,875.7	6,011.0
80.0	0.9 ° 29 °	79.99	0.77	0.81	1.12	1,085,615.8	576,875.7 576.875.8	6,001.0
90.0	0.4 ° 85 °	89.98	0.84	0.89	1.22	1,085,615.8	576,875.9	
100.0	1.7 ° 99 °	99.98	0.82	1.07	1.35	1,085,615.8	576,876.1	5,991.0 5,981.0
110.0	1.2 ° 47 °	109.98	0.87	1.29	1.56	1,085,615.9	576,876.3	5,971.0
120.0	1.8 * 79 *	119.98	0.97	1.52	1.80	1,085,616.0	576,876.5	
130.0	0.9 * 35 *	129.97	1.07	1.72	2.02	1,085,616.1	576,876.7	5,961.0 5,951.0
140.0	1.0 • 41 •	139.97	1.20	1.82	2.18	1,085,616.2	576,876.8	5,951.0 5,941.0
150.0	1.9 ° 101 °	149.97	1.23	2.04	2.38	1,085,616.2	576,877.0	5,931.0
160.0	0.5 * 37 *	159.96	1.23	2.23	2.55	1,085,616.2	576,877.2	
170.0	0.9 * 129 *	169.96	1.22	2.32	2.62	1,085,616.2	576,877.2	5,921.0
180.0	1.7 * 109 *	179.96	1.12	2.52	2.76	1,085,616.1	576,877.5 576,877.5	5,911.0
190.0	1.8 ° 72 °	189.96	1.12	2.81	3.02	1,085,616.1	576,877.8	5,901.0 5,891.0
200.0	1.8 * 90 *	199.95	1.17	3.12	3.33	1,085,616.2	576,877.8	
210.0	1.5 * 45 *	209.95	1.26	3.37	3.59	1,085,616.3	576,878.4	5,881.0 5,871.1
220.0	1.7 ° 49 °	219.94	1.45	3.57	3.85	1,085,616.5	576,878.6	5,861.1
230.0	2.4 • 61 •	229.94	1.65	3.87	4.20	1,085,616.7	576,878.9	5,851.1
240.0	1.4 * 44 *	239.93	1.84	4.13	4.52	1,085,616.8	576,879.1	5,841.1
250.0	1.1 • 43 •	249.93	2.00	4.28	4.73	1,085,617.0	576,879.1 576,879.3	5,831.1
260.0	1.3 • 44 •	259.93	2.15	4.43	4.92	1,085,617.2	576,879.4	5,821.1
270.0	1.6 ° 47 °	269.92	2.33	4.61	5.16	1,085,817.3	576,879.6	5,811.1
280.0	1.1 40 °	279.92	2.50	4.77	5.39	1,085,617.5	576,879.8	5,801.1
290.0	1.1 ° 44 °	289.92	2.64	4.90	5.57	1,085,617.6	576,879.9	5,791.1
300.0	1.2 ° 43 °	299.92	2.78	5.04	5.76	1,085,617.8	576,880.0	5,781.1
310.0	1.7 ° 54 °	309.91	2.95	5.23	6.00	1,085,617.9	576,880.2	5,771.1
316.8	2.7 • 65 •	316.51	3.07	5.45	6.26	1,085,618.1	576,880.5	5,764.5
320.0	1.9 ° 100 °	319.90	3.10	5.58	6.38	1,085,618.1	576,880.6	5,761.1
330.0 331.3	2.1 ° 58 °	329.90	3.16	5.90	6.69	1,085,618.2	576,880.9	5,751.1
331.3	2.3 ° 61 °	331.20	3.19	5.94	6.74	1,085,618.2	576,880.9	5,749.8
<u> </u>	<u> </u>							

Error Analysis Bottom Coordinates

Missed the target of the designed hole (0.0°,0.0°) by:

3.2 ft. North 5.9 ft. East 0.1 ft. Higher 6.74 feet Total 2.04% Tolerance Northing 1,08 Easting 57 Elevation

1,085,618.2 +/- 0.3 576,880.9 +/- 0.1 5,749.8 +/- 0.0

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0'-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

BOREHOLE: MF-250A COLLAR COORDINATES

NORTH 1,085,615.0 * 576,840.0 *

ELEVATION 6,081.0 * (Estimated)

Miner Flat Dam

Surveyed By: CHR

DAM END OF SANDSTONE RIDGE

Date Surveyed: September 1, 1995

BOREHOLE - AS DRILLED

Time Surveyed: 2:23 pm

Raw Data From	Owl Technical Assoc.
HOLE	Madal 790

	HOLE	Model 780		TRUE	DISTANCE	DISTANCE				
4	DEPTH	INCLINATION		DEPTH	NORTH	EAST	CLOSURE	NORTHING	EASTING	ELEVATION
	(ft.)	(from Vert.)	* North=360 *	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
1	0.0	0.0	. 0.	0.00	0.00	2.00				
1	5.0			0.00	0.00	0.00	0.00	1,085,615.0	576,840.0	
İ	6.0	0.9	ľ	5.00		0.03	0.04	1,085,615.0	576,840.0	
1		0.8		6.00	0.03	0.03		1,085,615.0	576,840.0	
	7.5	0.8 1	1	7.50	0.03	0.03	0.05	1,085,615.0	576,840.0	
1	10.0	1.0 °		10.00	0.03	0.07	0.08	1,085,615.0	576,840.1	6,071.0
1	15.0	1.0 °		15.00	0.07	0.11	0.13	1,085,615.1	576,840.1	6,066.0
ł	20.0	1.0 4		20.00	0.10	0.15	0.18	1,085,615.1	576,840.2	6,061.0
1	25.0	1.6 4	}	25.00	0.08	0.26	0.27	1,085,615.1	576,840.3	6,056.0
	30.0	1.6 °		29.99	0.10	0.40	0.41	1,085,615.1	576,840.4	6,051.0
Į.	35.0	1.4 °		34.99	0.15	0.52	0.54	1,085,615.2	576,840.5	6,046.0
1	40.0	1.4 °		39.99	0.21	0.62	0.66	1,085,615.2	576,840.6	6,041.0
1	45.0	1.3 °		44.99	0.27	0.73	0.78	1,085,615.3	578,840.7	6,036.0
1	50.0	1.3 °		49.99	0.34	0.82	0.88	1,085,615.3	576,840.8	6,031.0
Ì	55.0	1.5 °		54.99	0.41	0.92	1.00	1,085,615.4	576,840.9	6,026.0
1	60.0	1.5 °	ſ	59.99	0.44	1.04	1.13	1,085,615.4	576,841.0	6,021.0
i .	65.0	1.5 °		64.98	0.46	1.17	1.26	1,085,615.5	576,841.2	6,016.0
ļ	70.0	1.6 °	81 *	69.98	0.48	1.30	1.39	1,085,615.5	576,841.3	6,011.0
ŀ	75.0	1.6 *	96 *	74.98	0.49	1.44	1.52	1,085,615.5	576,841.4	6,006.0
	80.0	1.6 °	103 °	79.98	0.46	1.58	1.65	1,085,615.5	576,841.6	6,001.0
1	85.0	1.4 °	112 °	84.98	0.43	1.70	1.76	1,085,615.4	576,841.7	5,996.0
ļ	86.0	1.4 °	114 °	85.98	0.42	1.73	1.78	1,085,615.4	576,841.7	5,995.0
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	E	ror Analysis	
•	Bottom Coordinates		
Missed the target of the designed hole (0.0°,0.0°) by:			
0.4 ft. North	Northing	1,085,615.4 +/- 0.1	
1.7 ft. East	Easting	576,841,7 +/- 0,0	
0.0 ft. Higher	Elevation	5.995.0 +/- 0.0	
1.78 feet Total		.,	
2.07% Tolerance			

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0°-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

BOREHOLE: MF-251 COLLAR COORDINATES

NORTH 1,085,390.0 *

EAST 576,875.0 *

ELEVATION 6,089.0 * (Estimated)

Miner Flat Dam

Surveyed By: da

Secondary Access Road

BOREHOLE - AS DRILLED

Date Surveyed: August 21, 1995

Time Surveyed: 5:03 pm,

Raw Data From Owl Technical Assoc.

HOLE		TRUE	DISTANCE	DISTANCE				
DEPTH		DEPTH	NORTH	EAST	CLOSURE	NORTHING	EASTING	ELEVATION
(ft.)	(from Vert.) North=360	1 (ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
]						
0.0	0.0 • 0	1		0.00	0.00	1,085,390.0	576,875.0	6,089.0
10.0	1.8 ° 110			0.15		1,085,389.9	576,875.1	6,079.0
20.0	2.0 ° 189			0.27	0.39	1,085,389.7	576,875.3	6,069.0
30.0	2.0 ° 291	29.99		0.08	0.40	1,085,389.6	576,875.1	6,059.0
40.0	2.1 • 309	1		-0.23	0.31	1,085,389.8	576,874.8	6,049.0
50.0	0.9 ° 210			-0.41	0.44	1,085,389.8	576,874.6	6,039.0
60.0	1.6 ° 352	59.97		-0.47	0.48	1,085,389.9	576,874.5	6,029.0
70.0	2.1 ° 288 '	69.97	0.10	-0.66	0.67	1,085,390.1	576,874.3	6,019.0
80.0	2.0 • 113 '	į.	0.09	-0.68	0.68	1,085,390.1	576,874.3	6,009.0
90.0	2.1 ° 97 '		-0.00	-0.33	0.33	1,085,390.0	576,874.7	5,999.0
100.0	2.1 ° 14 '	99.95	0.15	-0.11	0.19	1,085,390.2	576,874.9	5,989.1
110.0	2.0 25 4	109.94	0.49	0.01	0.49	1,085,390.5	576,875.0	5,979.1
120.0	2.1 • 222 •	119.94	0.51	-0.04	0.51	1,085,390.5	576,875.0	5,969.1
130.0	2.2 ° 304 °	129.93	0.48	-0.32	0.58	1,085,390.5	576,874.7	5,959.1
140.0	2.2 * 342 *	139.92	0.77	-0.54	0.94	1,085,390.8	576,874.5	5,949.1
150.0	2.0 ° 67 °	149.91	1.02	-0.44	1.11	1,085,391.0	578,874.6	5,939.1
160.0	2.0 ° 33 °	159.91	1.24	-0.18	1.25	1,085,391.2	576,874.8	5,929.1
170.0	1.9 * 98 *	169.90	1.36	0.08	1.36	1,085,391.4	576,875.1	5,919.1
180.0	1.9 ° 6 °	179.90	1.50	0.26	1.53	1,085,391.5	576,875.3	5,909.1
190.0	1.4 ° 252 °	189.89	1.63	0.16	1.64	1,085,391.6	578,875.2	5,899.1
200.0	1.6 ° 176 °	199.89	1.45	0.05	1.45	1,085,391.5	576,875.1	5,889.1
210.0	1.1 ° 79 °	209.89	1.33	0.16	1.34	1,085,391.3	576,875.2	5,879.1
220.0	1.9 ° 87 °	219.88	1.36	0.42	1.42	1,085,391.4	576,875.4	5,869.1
230.0	1.4 ° 76 °	229.88	1.40	0.70	1.56	1,085,391.4	576,875.7	5,859.1
240.0	0.9 ° 74 °	239.88	1.45	0.90	1.70	1,085,391.4	576,875.9	5,849.1
250.0	0.9 ° 69 °	249.88	1.50	1.05	1.83	1,085,391.5	576,876.0	5,839.1
260.0	0.9 ° 68 °	259.87	1.56	1.19	1.96	1,085,391.6	576,876.2	5,829.1
270.0	1.4 ° 81 °	269.87	1.60	1.39	2.12	1,085,391.6	576,876.4	5,819.1
280.0	1.0 ° 71 °	279.87	1.65	1.59	2.29	1,085,391.7	576,876.6	5,809.1
290.0	1.0 ° 76 °	289.87	1.70	1.76	2.44	1,085,391.7	576,876.8	5,799.1
300.0	1.0 ° 166 °	299.87	1.64	1.86	2.48	1,085,391.6	576,876.9	5,789.1
310.0	0.9 ° 165 °	309.86	1.48	1.90	2.41	1,085,391.5	576,876.9	5,779.1
320.0	0.5 176 176 1	319.86	1.36	1.93	2.36	1,085,391.4	576,876.9	5,769.1
330.0	0.3 ° 124 °	329.86	1.30	1.95	2.34	1,085,391.3	576,877.0	5,759.1
331.8	0.4 ° 142 °	331.66	1.29	1.96	2.35	1,085,391.3	576,877.0	5,757.3
			A-11					

Error Analysis Bottom Coordinates

Missed the target of the designed hole (0.0°,0.0°) by:

1.3 ft. North
2.0 ft. East
0.1 ft. Higher
2.35 feet Total
0.71% Tolerance

Northing 1,085,391.3 +/- 0.3 Easting 576,877.0 +/- 0.1 Elevation 5,757.3 +/- 0.0

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0°-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

BOREHOLE: MF-252 COLLAR COORDINATES

Miner Flat Dam

Surveyed By: DA

NORTH EAST ELEVATION

97791780

1,085,205.0 * 576,845.0 *

6,082.0 * (Estimated)

BOREHOLE - AS DRILLED

Secondary Access Road

Time Surveyed: 09:29 am

Date Surveyed: August 22, 1995

Raw Data From Owl Technical Assoc.

HOLE	Model 780	TRUE	DISTANCE	DISTANCE				
DEPTH	INCLINATION DIRECTION	DEPTH	NORTH	EAST	CLOSURE	NORTHING	EASTING	ELEVATION
(ft.)	(from Vert.) ° North=360	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
0.0	0.0 ° 0 °	0.00		0.00	0.00	1,085,205.0	576,845.0	6,082.0
10.0	2.5 ° 8 °	10.00		0.03	0.22	1,085,205.2	576,845.0	6,072.0
20.0	2.4 ° 323 °	19.99		-0.07	0.60	1,085,205.6	576,844.9	6,062.0
30.0	1.8 ° 19 °	29.98		-0.14	0.93	1,085,205.9	576,844.9	6,052.0
40.0	1.6 ° 22 °	39.97		-0.04	1.19	1,085,206.2	576,845.0	6,042.0
50.0	1.6 ° 24 °	49.97		0.07	1.45	1,085,206.4	576,845.1	6,032.0
60.0	1.7 ° 21 °	59.97	—	0.18	1.73	1,085,206.7	576,845.2	6,022.0
70.0	1.5 ° 21 °	69.96	1.98	0.28	2.00	1,085,207.0	576,845.3	6,012.0
80.0	1.6 ° 23 °	79.96	2.23	0.38	2.26	1,085,207.2	576,845.4	6,002.0
90.0	2.2 ° 54 °	89.95	2.47	0.59	2.54	1,085,207.5	576,845.6	5,992.0
100.0	2.1 ° 57 °	99.95	2.68	0.90	2.83	1,085,207.7	576,845.9	5,982.1
110.0	1.8 ° 18 °	109.94	2.93	1.10	3.13	1,085,207.9	576,846.1	5,972.1
120.0	2.2 ° 51 °	119.93	3.20	1.30	3.46	1,085,208.2	576,846.3	5,962.1
130.0	2.5 ° 30 °	129.93	3.51	1.56	3.84	1,085,208.5	576,846.6	5,952.1
140.0	2.5 ° 24 °	139.92	3.90	1.76	4.28	1,085,208.9	576,846.8	5,942.1
150.0	1.5 ° 26 °	149.91	4.22	1.90	4.63	1,085,209.2	576,846.9	5,932.1
160.0	1.6 ° 20 °	159.91	4.46	2.01	4.90	1,085,209.5	576,847.0	5,922.1
170.0	1.3 ° 14 °	169.90	4.71	2.08	5,15	1,085,209.7	576,847.1	5,912.1
180.0	2.2 ° 55 °	179.90	4.93	2.27	5.42	1,085,209.9	576,847.3	5,902.1
190.0	2.4 ° 39 °	189.89	5.20	2.56	5.79	1,085,210.2	576,847.6	5,892.1
200.0	2.2 ° 48 °	199.88	5.49	2.83	6.18	1,085,210.5	576,847.8	5,882.1
210.0	2.4 ° 39 °	209.87	5.78	3.11	6.56	1,085,210.8	576,848,1	5,872.1
220.0	2.3 ° 49 °	219.87	6.07	3.39	6.96	1,085,211.1	576,848.4	5,862.1
230.0	1.3 ° 37 °	229.86	6.30	3.61	7.26	1,085,211.3	576,848.6	5,852.1
240.0	1.5 ° 18 °	239.86	6.51	3.72	7.50	1,085,211.5	576,848.7	5,842.1
250.0	1.4 ° 20 °	249.85	6.75	3.80	7.75	1,085,211.8	576,848.8	5,832.1
260.0	1.9 ° 10 °	259.85	7.03	3.87	8.03	1,085,212.0	576,848.9	5,822.2
270.0	1.7 ° 9 °	269.84	7.34	3.92	8.32	1,085,212.3	576,848,9	5,812.21
280.0	1.7 ° 11 °	279.84	7.63	3.98	8.60	1,085,212.6	576,849.0	5,802.2
290.0	1.3 ° 22 °	289.84	7.88	4.05	8.86	1,085,212.9	576,849.0	5,792.2
300.0	2.2 ° 29 °	299.83	8.16	4.18	9.16	1,085,213.2	576,849.2	5,782.2
310.0	1.1 ° 22 °	309.83	8.41	4.31	9.45	1,085,213.4	576,849.3	5,772.2
320.0	1.5 ° 12 °	319.82	8.63	4.37	9.67	1,085,213.6	576,849.4	5,762.2
330.0	2.5 ° 20 °	329.82	8.96	4.48	10.02	1,085,214.0	576,849.5	5,752.2
<u> </u>								

Епо	r Analysis
Bottom	Coordinates

Missed the target of the designed hole (0.0°,0.0°) by:

9.0 ft. North
4.5 ft. East
0.2 ft. Higher
10.02 feet Total
3.04% Tolerance

Northing 1,085,214.0 +/- 0.2 Easting 576,849.5 +/- 0.2 Elevation 5,752.2 +/- 0.0

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0°-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

BOREHOLE: MF-253 COLLAR COORDINATES MINER FLAT

Surveyed By: DA

ŅORTH EAST 1,084,815.0 * 578,940.0 * ROAD E

Date Surveyed: June 19, 1995

ELEVATION

76,940.0 * 6,079.0 * (Estimated)

BOREHOLE - AS DRILLED

Time Surveyed: 12:45 pm

Raw Data	From	Owl	Technical	Assoc.

	HOLE			TRUE	DISTANCE	DISTANCE				
	DEPTH			DEPTH	NORTH	EAST	CLOSURE	NORTHING	EASTING	ELEVATION
	(ft.)	(from Vert.)	* North=360 *	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
İ										
	0.0	0.0	-	0.00	0.00	0.00	0.00	1,084,815.0	576,940.0	6,079.0
	10.0	0.7		10.00	0.05	0.03	0.06	1,084,815.1	576,940.0	6,069.0
	20.0	0.3		20.00	0.10	0.09	0.13	1,084,815.1	576,940.1	6,059.0
	30.0	0.9		30.00	0.02	0.14	0.14	1,084,815.0	576,940.1	6,049.0
1	40.0	1.0 '		40.00	-0.13	0.12	0.17	1,084,814.9	576,940.1	6,039.0
	50.0	1.0 °		50.00	-0.25	-0.00	0.25	1,084,814.8	576,940.0	6,029.0
	60.0	1.0 °		59.99	-0.32	-0.16	0.36	1,084,814.7	576,939.8	6,019.0
	70.0	1.1 °		69.99	-0.41	-0.31	0.51	1,084,814.6	576,939.7	6,009.0
1	80.0	0.9 °		79.99	-0.56	-0.37	0.67	1,084,814.4	576,939,6	5,999.0
	90.0	0.9 °		89.99	-0.71	-0.34	0.79	1,084,814.3	576,939.7	5,989.0
	100.0	0.8 °		99.99	-0.78	-0.38	0.86	1,084,814.2	576,939.6	5,979.0
	110.0	1.1 °		109.99	-0.85	-0.50	0.98	1,084,814.2	576,939.5	5,969.0
ı	120.0	0.6 °		119.99	-0.92	-0.60	1.09	1,084,814.1	576,939.4	5,959.0
	130.0	1.3 °		129.98	-0.93	-0.76	1.20	1,084,814.1	576,939.2	5,949.0
	140.0	1.3 °		139.98	-1.04	-0.95	1.41	1,084,814.0	576,939.1	5,939.0
	150.0	1.3 °		149.98	-1.13	-1.15	1.61	1,084,813.9	576,938.9	5,929.0
1	160.0	0.5 °		159.98	-1.19	-1.23	1.71	1,084,813.8	576,938.8	5,919.0
1	170.0	0.7 •	161 °	169.98	-1.28	-1.19	1.74	1,084,813.7	576,938.8	5,909.0
	180.0	1.0 °	177 °	179.98	-1.42	-1.16	1.84	1,084,813.6	576,938.8	5,899.0
1	190.0	0.7 *	162 °	189.97	-1.57	-1.14	1.94	1,084,813.4	576,938.9	5,889.0
	200.0	1.0 °	174 °	199.97	-1.71	-1.11	2.04	1,084,813.3	576,938.9	5,879.0
1	210.0	0.9 °	171 °	209.97	-1.88	-1.09	2.17	1,084,813.1	576,938.9	5,869.0
	220.0	0.7 °	161 *	219.97	-2.01	-1.06	2.27	1,084,813.0	576,938.9	5,859.0
i i	230.0	1.1 °	170 °	229.97	-2.17	-1.02	2.39	1,084,812.8	576,939.0	5,849.0
1	240.0	1.0 *	189 °	239.97	- 2.35	-1.02	2.56	1,084,812.7	576,939.0	5,839.0
ı	250.0	0.9 °	176 °	249.97	-2.51	-1.03	2.71	1,084,812.5	576,939.0	5,829.0
	260.0	0.2 °	287 °	259.97	-2.58	-1.04	2.78	1,084,812.4	576,939.0	5,819.0
	270.0	1.4 °	295 *	269.96	-2.53	-1.16	2.78	1,084,812,5	576,938.8	5,809.0
Į .	280.0	1.2 °	287 °	279.96	-2.44	-1.38	2.81	1,084,812.6	576,938.6	5,799.0
	290.0	1.7 °	245 •	289.96	-2.48	-1.61	2.95	1,084,812.5	576,938.4	5,789.0
	300.0	1.4 *	268 °	299.96	-2.54	-1.87	3.16	1,084,812.5	576,938.1	5,779.0
1	310.0	1.5 °	272 °	309.95	-2.54	-2.12	3.31	1,084,812.5	576,937.9	5,769.0
	320.0	1.4 °	277 °	319.95	-2.52	-2.37	3.46	1,084,812.5	576,937.6	5,759.1
L										

Error Analysis Bottom Coordinates

Missed the target of the designed hole (0.0°,0.0°) by:

2.5 ft. North
1.9 ft. East
20.0 ft. Higher
20.29 feet Total
6.34% Tolerance

Northing 1,084,812.5 +/- 0.2 Easting 576,937.6 +/- 0.2 Elevation 5,759.1 +/- 0.0

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0°-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

BOREHOLE: MF-254 COLLAR COORDINATES

Miner Flat Dam

Surveyed By: DA

NORTH EAST

1,084,687.0 * 577,105.0 *

Secondary Access Road - South End

Date Surveyed: August 22, 1995

ELEVATION

6,082.0 * (Estimated)

BOREHOLE - AS DRILLED

Time Surveyed: 10:15 am

Raw	Data	From	Owl	Technical	Assoc.

	HOLE	Model 780	10000.	TRUE	DISTANCE	DISTANCE				
	DEPTH			DEPTH	NORTH	EAST	CLOSURE	NORTHING	EASTING	ELEVATION
_	(ft.)	(from Vert.)	 North=360 * 	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
	0.0	0.0		0.00	0.00	0.00	0.00	1,084,687.0	577,105.0	6,082.0
1	10.0	0.9		10.00	0.01	0.08	0.08	1,084,687.0	577,105.1	6,072.0
1	20.0	0.5		20.00	-0.03	0.14	0.14	1,084,687.0	577,105.1	6,062.0
1	30.0	0.8 °		30.00	-0.02	0.08	0.08	1,084,687.0	577,105.1	6,052.0
1	40.0	0.4 °		40.00	0.06	0.05	0.08	1,084,687.1	577,105.0	6,042.0
ļ	50.0	0.8 °		50.00	0.03	0.04	0.05	1,084,687.0	577,105.0	6,032.0
	60,0	1.1 °		60.00	-0.11	-0.04	0.11	1,084,686.9	577,105.0	6,022.0
	70.0	1.0 °		69.99	-0.12	-0.18	0.22	1,084,686.9	577,104.8	6,012.0
	80.0	0.9 *		79.99	-0.04	-0.33	0.33	1,084,687.0	577,104.7	6,002.0
1	90.0	0.7 °		89.99	0.04	-0.43	0.44	1,084,687.0	577,104.6	5,992.0
1	100.0	1.2 °		99.99	0.12	-0.57	0.58	1,084,687.1	577,104.4	5,982.0
1	110.0	1.2 °		109.99	0.15	-0.78	0.79	1,084,687.2	577,104.2	5,972.0
	120.0	1.3 *	237 •	119.99	0.10	-0.98	0.98	1,084,687.1	577,104.0	5,962.0
1	130.0	1.1 °		129.98	-0.05	-1.12	1.12	1,084,687.0	577,103.9	5,952.0
	140.0	1.1 *		139.98	-0.21	-1.22	1.24	1,084,686.8	577,103.8	5,942.0
	150.0	0.1 °		149.98	-0.29	-1.28	1.31	1,084,686.7	577,103.7	5,932.0
]	160.0	1.3 *	251 *	159.98	-0.33	-1.38	1.42	1,084,686.7	577,103.6	5,922.0
	170.0	0.9 °	291 *	169.98	-0.34	-1.56	1.59	1,084,686.7	577,103,4	5,912.0
1	180.0	1.1 °	276 *	179.98	-0.30	-1.73	1.75	1,084,686,7	577,103.3	5,902.0
1	190.0	1.1 *	277 °	189.97	-0.28	-1.92	1.94	1,084,686.7	577,103,1	5,892.0
	200.0	0.5 °	133 °	199.97	-0.30	-1.98	2.00	1,084,686.7	577,103.0	5,882.0
1	210.0	0.4 °	109 °	209.97	-0.34	-1.92	1.95	1,084,686,7	577,103.1	5,872.0
	220.0	1.0 °	291 °	219.97	-0.32	-1.96	1.99	1,084,686,7	577,103.0	5,862.0
1	230.0	1.1 °	268 °	229.97	-0.29	-2.14	2.16	1,084,686.7	577,102.9	5,852.0
1	240.0	1.1 *	290 °	239.97	-0.26	-2.33	2.34	1,084,686.7	577,102.7	5,842.0
	250.0	0.8 °	304 °	249.97	-0.19	-2.48	2.48	1,084,686,8	577,102.5	5,832.0
1	260.0	1.2 °	280 °	259.96	-0.13	-2.64	2.64	1,084,686.9	577,102.4	5,822.0
	270.0	1.1 °	292 *	269.96	-0.08	-2.83	2.83	1,084,686.9	577,102.2	5,812.0
1	280.0	1.0 °	298 °	279.96	-0.00	-3.00	3.00	1,084,687.0	577,102.0	5,802.0
1	290.0	1.1 *	281 °	289.96	0.06	-3.17	3.17	1,084,687.1	577,101.8	5,792.0
1	300.0	0.4 °	134 °	299.96	0.05	-3.24	3.24	1,084,687.1	577,101.8	5,782.0
	310.0	0.8 *	162 °	309.96	-0.04	-3.19	3.19	1,084,687.0	577,101.8	5,772.0
	320.0	1.2 °	261 °	319.96	-0.12	-3.27	3.27	1,084,686.9	577,101.7	5,762.0
	325.1	1.5 °	270 °	325.05	-0.13	-3.39	3.39	1,084,686.9	577,101.6	5,756.9
L										

Error Analysis Bottom Coordinates

Missed the target of the designed hole (0.0°,0.0°) by:

0.1 ft. North
3.4 ft. East
0.0 ft. Higher
3.39 feet Total
1.04% Tolerance

Northing Easting Elevation

1,084,686.9 +/- 0.3 577,101.6 +/- 0.0 5,756.9 +/- 0.0

EXPLANATION

HOLE DEPTH: Length along the borehole axis from the collar to the point of the survey, NOT vertical depth.

INCLINATION: Equivalent to "Dip" with the exception that 0° INCLINATION = VERTICAL and 90° INCLINATION = HORIZONTAL. INCLINATION greater than 90° implies UP.

DIRECTION: Equivalent to "Bearing" of the borehole at the point of survey. Measured on a magnetic azimuth (0°-360°) system.

DISTANCE NORTH, DISTANCE EAST - Distances from the collar calculated on a TRUE NORTH-SOUTH grid.

CLOSURE: The horizontal distance from the collar of the borehole to the survey point.

APPENDIX D

GEOPHYSICS

r	Miner Flat Bo		
Borehole Diameter (Inches) 2	Gamma (cps) 0 50 100 150 200	SP and Spt Resistance 0 100 200 300 400	Temperature (degrees C)
0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 50 100 150 200	0 100 200 300 400	0 10 20 30 40
		Accordingly	
10	10	10	10
	LALLA MARIE		"
144 Day 164 Da	20 To the state of		
20	20	20	20
M	No.		
30	30	30	30
	**		
40	40	40	40
	To a second		
50	50	50	50
	**		
60	60 3	60	60
70	70	70	70
(get) (get)	((con))	((pec)	((ees)
SDepth (feet)	Doepth (Geo.)	Pepil (fect)	SDepth (feet)
30	25	••	\$0
	way de service		
90	90 3-	90	90
	3		
100	100	100	100
	100 Angles		100
	-		
110	110	110	110
120	120	120	120
	-		
	多	land de la contra del la contra de la contra de la contra del la contra del la contra del la contra de la contra dela	
130	130	130	130
	14 Annual 1		
140	140	140	140
	A-A-4-0-E		

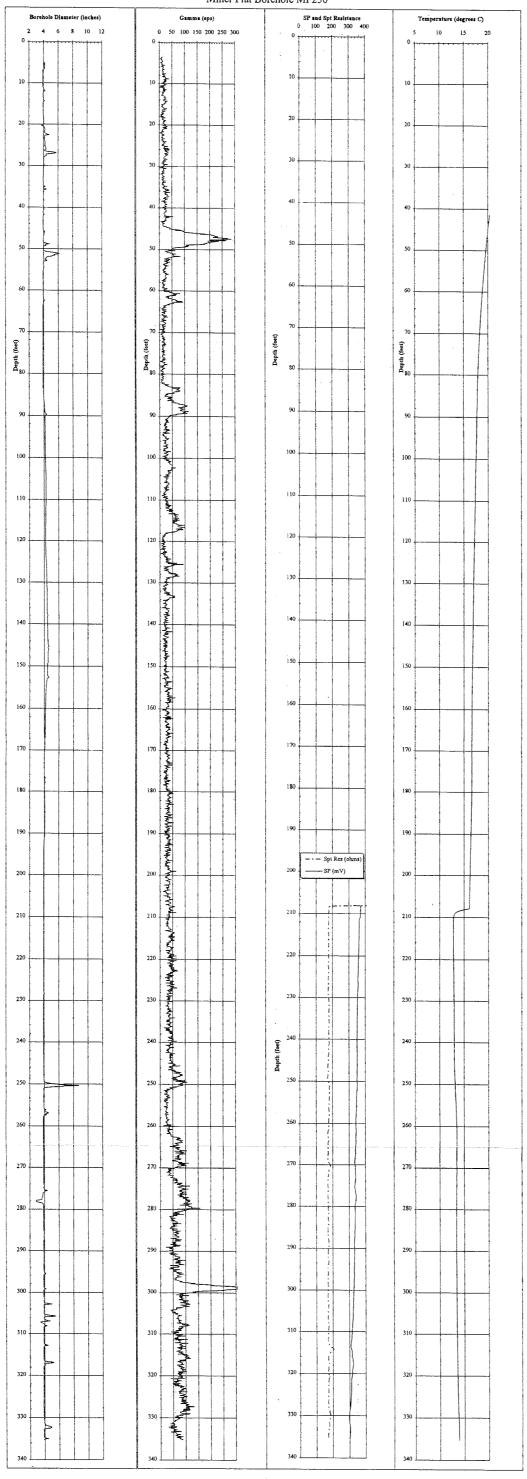
150	150	150	150
	35		
160	160	160	160
170	170	170	
370	170	170	170
180	180	180	180
190	190	190	190
	\$		
200	200	200	200
210	210	210	210
	# 1		
220	220	220	220
	A COMMON TO A COMM		
230	230	230	230
240	240	240	240
		240	240
250	250	250	250
260	260	260	260
270	270	270	270
280	280	280	280
	The state of the s		
290	290	290	290
300	300	300	300
310	310	310	
310	310	310	310
320	320	320	320
330	330	330	
		330	330
		Spi Res (ohms)	
340	340	340 SP (mV)	340
	:		

Books No.		Borenoie MF218A	
Borehole Diameter (Inches) 2 4 6 2 10 12	Gamma (cps) 0 50 100 150 200	SP and Spt Resistance 0 100 200 300 400 500	Temperature (degrees C) § 10 15 20
	0	0	0
10	10	10	10
			
20	20	20	20
30	30	30	30
	1		
40	40	40	40
	*		
50	50		
	* ************************************	50	50
60			
*	« *	60	60
	*		
70	70 T	70	70
Operation (See)	Depth (Geet)	Depth (feet)	Depth (feed)
Ato	a 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	\$0	40
	\$ P		
90	90	90	90
	A-Mary		
100	90 The rad way of the	100	100
	St. Andrews		
110	3	110	110
	The state of the s	110	
120			
	120	120	120
130	SAN A		
130	130	130	130
	3		
140	140 140 150 150 150 150 150 150 150 150 150 15	140	140
	\$5.00 m		
150	150	150	150
	* NO.		
160	160	160	160
M	Har William Lander Hard Bases	م الم	
170	170		170
	***	170	170
180	January 4		
	110	180	120
	 		
190	190	190	190
		No. of company of the contract	
200	200	200	200
	No.		
210	210	210	210
		 	
220	220	220	220
	\$		
230	230		270
	\$	230	230
340			
240	240	240	240
1			1
250	250	250	250
	\$		
260	260	260	260
270	270	270	270
280	280	210	280
290	290	1:2	200
	3	290	290
200	3		
300	300	1 300	300
310	310	310	310
320	320	320	320
330	330	330	330
340	340	340 Spt Res (ohms) 340 SP (mV)	340
		or (mV)	
	N ₁		

MF218GPH.XLS, Composite Plot

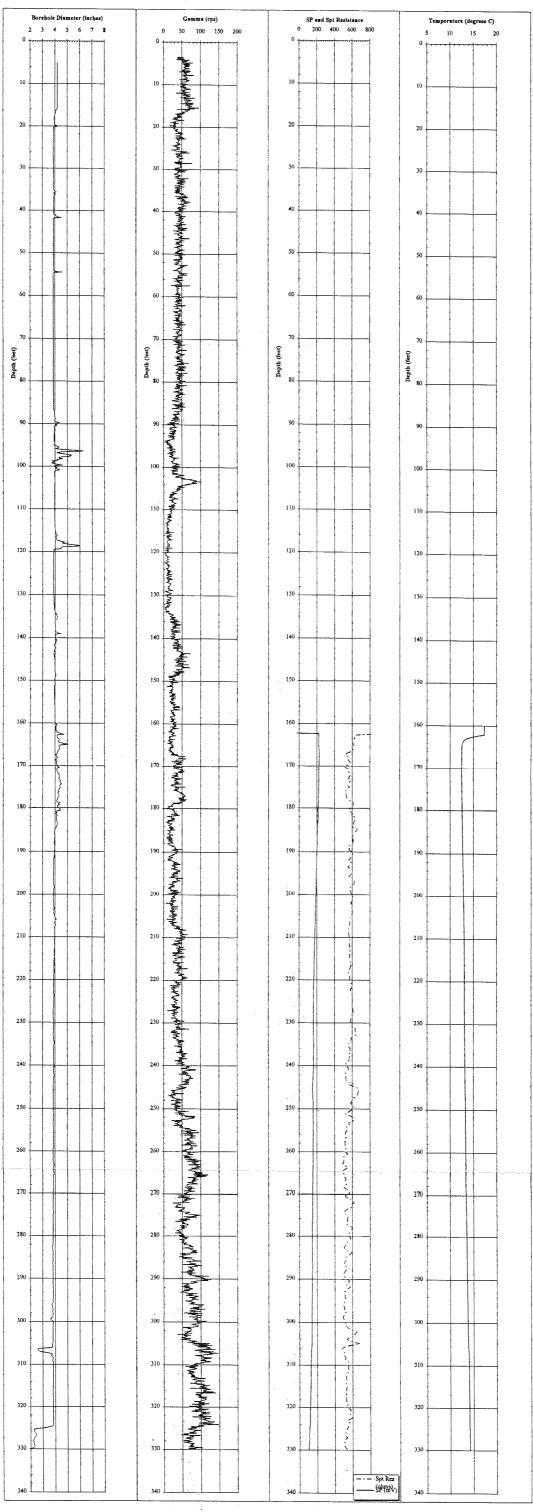
Page | of 1

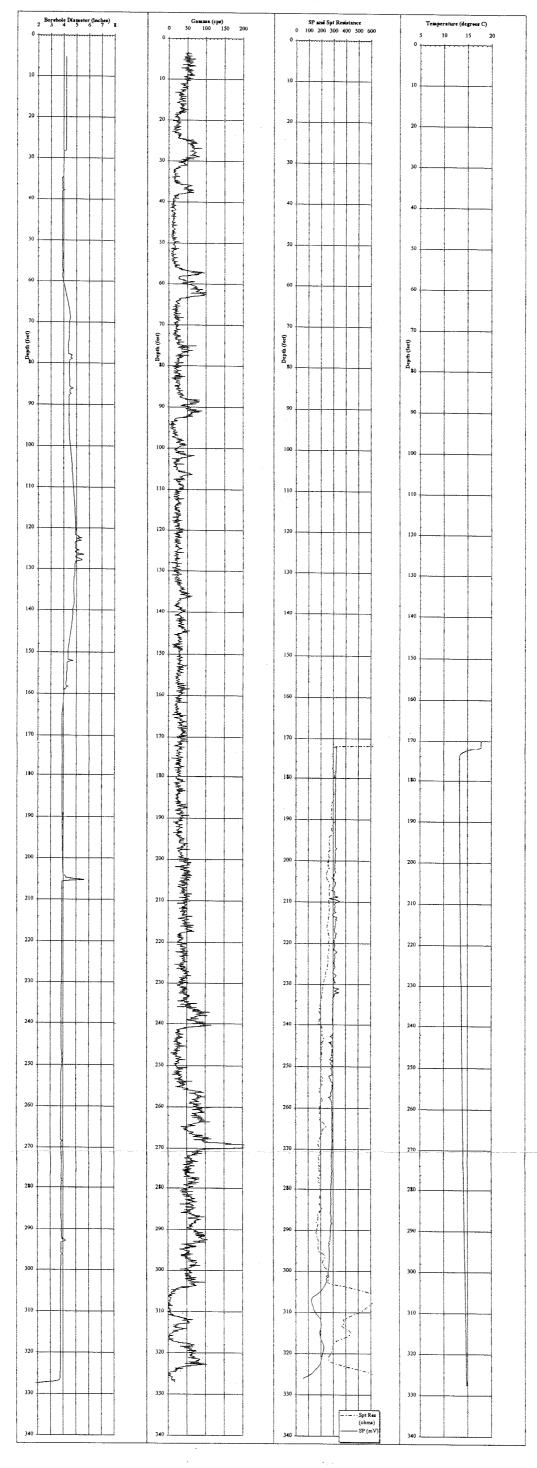
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943 2269

Borehole Diameter (inches)	Gamma (cps)	SP and Spt Resistance	Temperature (degrees C)
2 4 6 8 10 12	0 100 200	0 100 200 300 400 500 600	0 10 20 30 40
		0	
10	10		10
		10	
20	20		
20	-	20	20
30	30	30	30
40	40	40	40
	50 March March March		
50	50	50	50
	\$		
60	60 35	60	60
	1		
70			70
	Depth (feet)	70	1 1 1 1 1 1 1 1
Depth (feet)	Apples Apples	Os Depth (fee)	Os Depth (feet)
-80	80	A 80	20
	1 2 m	The second secon	
90	90	90	90
	the shape of the state of the s		
100	100	100	100
	3-3		
110	110	110	110
	\$		
120	120		120
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130	130		
	WACHEN !	130	130
	140 144 144 144 144 144 144 144 144 144		
140	140	140	140
	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		
150	150	150	150
	\$		
160	160	160	160
170	170	170	170
	1		
180	180		100
	***	180	180
	\$		
190	190	190	190
	*		
200	200	200	200
	1		
210	210	210	210
	[€		
220	220	220	220
	1		
230	230	230	230
	And Herbert		
240	100		
240	240	240	240
	3		
250	250	250	250
	1		
260	260	260	260
270	270	270	270
	5	\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\	
280	280	280	280
	 		
290	290	290	290
	3		
300			
300	300	300	300
310	310	310	310
	1		
320	320	320	320
	[1 14	
330	330	330	330
	*		
340	340	Spf Res (ohms) SP (mV)	340
			340
	•		





Second Process Seco		Miner Flat I		
		Gamma (cps) 0 50 100 150 200		Temperature (degrees C) 5 10 15 20
		<u> </u>		
	10	10	10	10
	20	20	20	20
		**		
		NA STATE OF THE ST		
	30	30	30	30
		\$		
	40	10	40	40
10				
10	50	50	50	50
10		W. Ar		
10	60	60	60	60
10				
10				
10		70		
10	(s) lipida	Sp. (%)	(to	oj) spete
10	\$10	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	20	80
100				
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100		32/4/20		
100	100	100	100	100
100		And Assault		
100		110		110
100	110	***	110	
100		A STAN		
100	120	120	120	120
100		\$		1.00
100	130	130	130	130
110 100 100 100 100 100 100 100 100 100				
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160 160 160 160 160 160 160 160 160 160		W W		
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APPENDIX E

PIEZOMETER INSTALLATIONS

VVGII NO. MF-218A Boring No. X-Ref: MF-218A PIEZOMETER CONSTRUCTION SUMMARY Survey Coords: Northing: Elevation Ground Level 1085006.50 6107.52 ft. Easting: 576834.81 Top of PVC Casing 6108.42 ft. **Drilling Summary:** Construction Time log: Start Finish Total Depth 362.0 ft. Task Date Time Date Time Borehole Diameter 3.65 in. Drilling 8/21/95 14:00 8/28/95 17:30 Casing Stickup Height 0.90 ft. B. Mathews Driller Dresser DBS-25 Ria Casing: RSG 3.65 in. Core Bit Bit(s) 12/18/95 9:52 12/18/95 9:55 C1 12/18/95 9:55 12/18/95 10:28 Drilling Fluid Polymer/Water 100 Filter Placement: 12/18/95 10:28 12/18/95 10:55 6 ft.-2 in., 4 in. dia. Steel **Protective Casing** Cementing: 12/18/95 16:04 12/18/95 16:08 Development: Well Design & Specifications Basis: Geologic Log X Geophysical Log 150 Casing string(s): C = Casing S = Screen Well Development Water Level on 12/18/95 = 149.95 FBTC String(s) Depth Elevation + 0.90 206.00 C1 6108.42 - 5901,52 206.00 S1 226.00 5901.52 - 5881.52 200 Stabilization Test Data: Time pН Spec. Cond. Temp (°C) Casing: C1 1.5 in. Schedule 80, Flush Threaded PVC Screen: S1 1.5 in. Schedule 80, Flush Threaded 0.020 Slot PVC 10-12 Silica Sand (196.0-228.0 ft.) Filter Pack: Recovery Data: Portland Type I-II Cement Slurry with 5% Grout Seal: Quickgel Bentonite Powder (0.0-2.0 ft.) 3/4 in. Gravel (2.0-178.0 and Backfill: 60 243.0-362.0 ft.) 50 Bentonite Seal: Wyoming Grade 3/8 in. Bentonite 30 20 Holeplug Bentonite Chips 10 (178.0-196.0 and 228.0-243.0 ft.)

-400 (____)

Not to Hariz. Scale Supervised Job Number

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nber	Ī

B. Johnson 943–27691.140 Site

Comments: Used coupling (PVC) at 130.0 ft.; glued with Uni-Weld 1200 PVC Cement/ACE 44393

PVC Pipe Cleaner. Upper backfilling took only ~18 gallons of gravel; may have bridged.

Miner Flat Dam

TIME (Minutes)

File Name MF-218A

VV011 NO. MF-250

			PIEZON	METER CONST	RUCTIO	ON SUN	MARY	,		
		Survey Coords	: Northing:	1085625.57	Elevati	ion Groun	d Level	6079.1	6#	
			Easting:	576826.36		p of PVC		6080.0		
	2 2 2	Drilling Sum	marv:		Constr	uction Ti	me log.			
TI TI		J9 00			0011341	dollon in		tart	Fi	nish
		Total Depth	331.3 ft.		Task		Date	Time	Date	Time
		Borehole Diam			Drilling		6/2/95	7:00	6/19/95	12:45
	┠╥┸┼┦	Casing Stickup	· · · · · · · · · · · · · · · · · · ·	.90 ft.						
50		Driller	B. Mathews							
					-					
		Rig Dress	er DBS-25		Casing:			***************************************	***************************************	
		Bit(s) RSG	3.65 in. Core Bit		S1		12/16/95	9:50	12/16/95	9:58
		Drilling Fluid	DolumorAMot		<u>C1</u>		12/16/95	9:58	12/16/95	10:09
100		Drilling Fluid	Polymer/Wat	er	Filter Pla	acement:	12/16/95	10:15	12/16/95	
		Protective Cas	ing 15 ft., 4 in. di	ia. Steel	Cementi		12/18/95	16:50	12/18/95	11:30 17:00
	\times				Develop					
	1::::	Mall Design	9. Specifications		}					
			& Specifications		-					
150	1::::	T .	ogic Log X Geoph	**************************************						
	158,62	Casing string(s	s): $C = Casing S = Screen$	een		evelopm		50 00 FF	· T O	
		Depti	String(s)	Elevation	water Le	evel on 12	/18/95 = 1	59.62 FE	310	
		+ 0.90 -	148.00 C1	6080.06 - 5931.16						***************************************
		148.00 -	168.00 S1	5931.16 - 5911.16						
200		_		-						***************************************
	1111				0. 1 "					
					Stabiliz	ation Te	st Data:			
					Time	рН	Spec	Cond.	Tem	p (°C)
		Casing: C1	1.5 in. Schedule 80, F	lush Threaded PVC		Pi.	- Opec	. 00114.	1611	p (0)
250										
		0	15:- 0-5-4-4-00 5	The state of the s						
		Screen: S1	1.5 in. Schedule 80, F 0.020 Slot PVC	iusn inreaded		L		·····		
	72		0.020 310(1 40	***************************************						
300		Filter Pack:	10-12 Silica Sand (14	8.0-180.0 ft.)	Recove	ery Data:				
	[
	1	Grout Seal:	Portland Type I-II Cen	ment Slurry with 5%	100					
. 1			Quickgel Bentonite Po	owder (0.0-10.0 ft.)	90					
T0=331.3°		Backfill:	3/4 in. Gravel (10.0-10	33.0 and	70 - E 60					#
350			190.0-331.3 ft.)		RECOVERY 0 0 0 0					
330		Bentonite Seal:	Wyoming Grade 3/8 in	n. Bentonite	× 30-					\blacksquare
			Holeplug Bentonite Cl	nips	10					
			(133.0-148.0 and 180.	.0-190.0 ft.)	0	0 20	- +0	60	80	100
						T	IME (Minu	tes)		
400		Comments:								
400										
)										
Not to Hariz.	Scale	Supervised by	B. Johnson	Site	Miner Flat	Dam				
		' Job Number	943-27691.140	File Name	MF-250					

VVGII INO. MF-251

Boring No. X-Ref: MF-251

			Survey Coords	s:	Northing: Easting:	1085422.42 576870.86	2	Elevati	on Groun	d Level	6088.9		The second secon
0/		9.8 1	Drilling Sum	man/:		37.0070.00			ction Ti		0003.3	70 1(.	
14		R 9 1		iinaiy.				Consut	iction ii	-	tart	Fi	inish
		9 9 9 9 9	Total Depth		340.7 ft.			Task		Date	Time	Date	Time
:			Borehole Dian		3.65 in.			Drilling		6/2/95	17:57	7/23/95	17:30
		┥┠┼┼┼	Casing Sticku Driller			.00 ft.			-		OLOGICA MONOTORINA		***************************************
50			Driller	B. Mathey	vs								-

•		╽┟╩╁		ser DBS-25				Casing:					
			Bit(s) RSG	3.65 in. Co	re Bit			<u>S1</u>		12/16/95	14:15	12/16/95	14:17
			Drilling Fluid		Polymer/Wa	tor		<u>C1</u>		12/16/95	14:17	12/16/95	14:37
100	.] [Drining Flaid		Olymei/vva	(8)		Filter Pla	cement:	12/16/95	14:37	12/16/95	14:50
		1	Protective Cas	sing 3	30 ft., 4 in. c	lia. Steel		Cementi		12/18/95	17:05	12/18/95	17:15
•								Develop	ment:				
			Well Design	& Specific	cations								
			•	•							l		l
-150			Casing string(logic Log >	********	hysical Log	OFFICE AND ADDRESS OF THE STREET	Wall De	· · · · · · · · · · · · · · · · · · ·				
- I]	Casing stringt	s). C = Casi	ing 5 = 50	6611			evelopme	en /18/95 = 1	70.84 FF	BTC	
			Dept	h	String(s)	Eleva	ation			710700 7	70.0712	<u> </u>	
	_	177		169.00	C1		5919.96	**************************************					***************************************
			169.00 -	189.00	<u>S1</u>	5919.96 -	5899.96						
-200							***************************************						
)	1			***************************************		·	Stabiliz	ation Te	st Data:			
-					***************************************				4	or Data.			
			1					Time	рН	Spec	. Cond.	Tem	p (°C)
			Casing: C1	1.5 in. Sci	nedule 80, f	Flush Thread	ded PVC						
-250			1										
'.			Screen: S1	1.5 in. Sc!	nedule 80, f	lush Thread	ded						
] - , , , , , , , , , , , , , , , , , ,	0.020 Slot	PVC								
			Filter Pack:	10-12 Sili	ca Sand (15	9 0_191 O f	+ \	Recove	ry Data:				
-300			inter rack.	10-12 000	ca band (10	75.0-151.01	,	1100000	iy Dala.				
0		===	Grout Seal:	Portland T	Type I-II Ce	ment Slurry	with 5%						
			3.00.00		Bentonite P			90					\blacksquare
- i			Backfill:		avel (10.0-1		10.0 10.)	≥ 70					
	D=340.7°	J Mara		205.0-340		··········		A RECOVERY					〓
-350			Bentonite Seal:		Grade 3/8 i	n. Bentonite		¥ 40					
			Domoinio Godin		Bentonite C	······································		20					
					9.0 and 191)	"	0 20) 40	60	80	100
				(111.0 10	0.0 4.14 101	.0 200.0	<u>/</u>			IME (Minu			
			Comments:					1			,		
-400				4						· · · · · · · · · · · · · · · · · · ·			
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	1				***************************************				****	***************************************			
													
Not t	o Horiz.	Scale	Supervised by		l. Johnson		Site	Miner Flat	Dam				
			Job Number	9	43-27691.140)	File Name	MF-251	- Million Contraction				

File Name MF-251

Job Number

VV911 NO. MF-252 Boring No. X-Ref: MF-252 PIEZOMETER CONSTRUCTION SUMMARY Survey Coords: Northing: 1085229.89 Elevation Ground Level 6074.16 ft. Easting: 576821.43 Top of PVC Casing 6074.91 ft. **Drilling Summary:** Construction Time log: Start Finish Total Depth 332.7 ft. Task Date Time Date Time Borehole Diameter 3.65 in. Drilling 6/15/95 7:30 8/2/95 11:30 Casing Stickup Height 0.75 ft. B. Mathews Dresser DBS-25 Ria Casing: RSG 3.65 in. Core Bit Bit(s) S1 12/17/95 14:42 12/17/95 14:45 12/17/95 14:45 12/17/95 15:30 **Drilling Fluid** Polymer/Water Filter Placement: 12/17/95 12/17/95 16:00 16:30 **Protective Casing** 20 ft., 4 in. dia. Steel Cementing: 12/18/95 12/18/95 16:32 16:40 Development: Well Design & Specifications Basis: Geologic Log X Geophysical Log 150 Casing string(s): C = Casing S = Screen Well Development Water Level on 12/18/95 = 161.11 FBTC Depth String(s) Elevation + 0.75 160.00 C1 6074.91 - 5914.16 160.00 S1 180.00 5914.18 - 5894.16 Stabilization Test Data: Time Spec. Cond. Temp (°C) Casing: C1 1.5 in. Schedule 80, Flush Threaded PVC Screen: S1 1.5 in. Schedule 80, Flush Threaded 0.020 Slot PVC Filter Pack: 10-12 Silica Sand (148.0-182.0 ft.) Recovery Data: 300 Grout Seal: Portland Type I-II Cement Slurry with 5% Quickgel Bentonite Powder (0.0-10.0 ft.) 80 Backfill: 3/4 in. Gravel (10.0-130.0 and 70 50 197.0-332.7 ft.) 50 350 40 Bentonite Seal: Wyoming Grade 3/8 in. Bentonite 30 20 Holeplug Bentonite Chips 10 (130.0-148.0 and 182.0-197.0 ft.) TIME (Minutes) Comments: Some caving/bridging near top of upper bentonite seal, added additional 1/2 bag to ensure at least 15 ft. of seal; used coupling (galvanized steel) at 150.0 ft.

Not to Horiz. Scale

Supervised by Job Number B. Johnson 943-27891.140 Site

Miner Flat Dam

File Name MF-252

4 4 011 14U. MIT-200

	ONSTRUCTION SUMMAR	CC	ER	1ET	ZO	21E	F
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" "		PIEZOMETER CONST	TRUCTION SUN	<i>I</i> MARY	•		
	Survey Coord	s: Northing: 1084797.33 Easting: 576874.74	Elevation Groun Top of PVC		6071.4 6072.6		
2/ 4 24	RAA Drilling Sum					110.	
	িন্ন Drilling Sum	imary:	Construction Ti	-			
	ৰিপ্ৰ মূৰ্বী Total Depth	327.2 ft.	Task	Date	art Time	Fi Date	nish Time
	विश्व Borehole Dian		Drilling	6/3/95	14:42	8/21/95	13:50
	Casing Sticku	-				0/21/83	13.30
so i	Driller	B. Mathews					
	Rig Dress	ser DBS-25	Casing:				
	· · ·	3.65 in. Core Bit	S1	12/15/95	8:56	12/15/95	9:00
			C1	12/15/95	9:00	12/15/95	9:08
00	Drilling Fluid	Polymer/Water					
	Protective Cas	sing 35 ft., 4 in. dia. Steel	Filter Placement: Cementing:	12/15/95	9:10	12/15/95	11:30
	Trottoctive Gat	00 ft., 4 ff. da. 3666	Development:	12/18/95	15:45	12/18/95	15:50
	Mall Davis	9 O					
	well Design	& Specifications				***************************************	
50	1.1.1.1	logic Log X Geophysical Log			T-178.000		
	Casing string(s): C = Casing S = Screen	Well Developme				
	▼ Dept	h String(s) Elevation	Water Level on 12	/18/95 = 1	/1.48 FB	TC	
	+ 1.20 -	177.00 C1 6072.61 - 5894.41				***************************************	
	177.00 -	197.00 S1 5894.41 - 5874.41					
200	-						
	<u> </u>		Stabilization To	at Data.			
			Stabilization Te	st Data:			
			Time pH	Spec.	Cond.	Tem	p (°C)
	Casing: C1	1.5 in. Schedule 80, Flush Threaded PVC					- (- /
50							
	Screen: S1	1.5 in. Schedule 80, Flush Threaded					
		0.020 Slot PVC			1		
	Filter Pack:	10 10 0ilion Cond (107.0 100.0 h.)	5				
00	Filter Pack:	10-12 Silica Sand (167.0-199.0 ft.)	Recovery Data:				
	Grout Seal:	Portland Type I-II Cement Slurry with 5%					
	Groot Seal.	Quickgel Bentonite Powder (0.0–10.0 ft.)	90				\Box
TD=327.2'	Backfill:	3/4 in. Gravel (10.0–152.0 and	80 70				
		215.0–327.2 ft.)	8ECOAERY 0 00 00				
50	Bentonite Seal:	Wyoming Grade 3/8 in. Bentonite	¥ 40 × 30				
		Holeplug Bentonite Chips	20				
		(152.0-167.0 and 199.0-215.0 ft.)	0 20	40	60	80	
			T	ME (Minut	es)		
	Comments:						
00							
(*)			W-100				
							,
Not to Horiz. S	Scale Supervised by	B. Johnson Site	Miner Flat Dam		····		

								٧	veli No.	MF-25	54	
							Boi	ring No.	X-Ref	MF-25	54	
	_]				PIEZO	METER CONST	FRUCTI	ON SUN	MARY	,		
			Survey Coord	s:	Northing:	1084655.39	Eleva	tion Groun	d I evei	6061.2)5 ft	
				-	Easting:	577063.74		op of PVC		6062.0		····
7 7	22	2 A A	Drilling Sum	marv.	HS		Const	······································				
` 1 1		1 A A 1 A A	Drining Juni	iiiiaiy.			Consti	ruction Ti	_	tart	.	-1-4
		8 9	Total Depth		325.2 ft.		Task		Date	Time	Date	nish Time
	i		Borehole Dian	_	3.65 in.		Drilling		8/13/95	12:45	8/8/95	11:30
•4		H	Casing Sticku			.80 ft.						
so 📑		Щ	Driller	B. Mathe	ws				******		-	
		╟┼╟┐										
		H	Rig Dress	ser DBS-2	5		Casing:	 .		-	***************************************	
			Bit(s) RSG	3.65 in. Co	re Bit		S1		12/15/95	14:33	12/15/95	14:35
							C1		12/15/95	14:35	12/15/95	14:50
00			Drilling Fluid		Polymer/Wa	ter						
			Protective Cas	Nino.	20.5 # 4:=	dia Ohnai	1	acement:	12/15/95	14:50	12/15/95	15:30
			Protective Cas	sing _	29.5 ft., 4 in.	dia. Steel	Cement	-	12/18/95	15:22	12/18/95	15:30
:							Develor	ment.	400 00000000000000000000000000000000000			
5		::::	Well Design	& Specifi	ications							***************************************
50			Basis: Geol	logic Log	X Geop	hysical Log						
	+	15501	Casing string(s): C = Cas			Well D	evelopme	ent			
								evel on 12		55.01 FB	TC	
	J: : :		Dept		String(s)							
	† 10 8. 1_		+ 0.80 -	155.00	C1	6062.05 - 5906.25						
20			155.00 -	175.00	<u>S1</u>	5906.25 - 5886.25						
200]						-	 					
	. 4		_	***************************************			Stabili	zation Te	st Data:			
	•.		-	***************************************		-						
		14					Time	рН	Spec.	Cond.	Tem	p (°C)
	•-		Casing: C1	1.5 in. Sc	hedule 80, F	lush Threaded PVC						
50		77										
			Screen: S1	1.5 in, Sc	hedule 80. F	lush Threaded						
				0.020 Slo								
		₹										
00			Filter Pack:	10-12 Sili	ica Sand (14	5.0-177.0 ft.)	Recov	ery Data:	4			
	••			-								
		\square	Grout Seal:			nent Slurry with 5%	100					T
TD=325	.2'					owder (0.0-10.0 ft.)	80					
			Backfill:		avel (10.0-1	30.0 and	¥ 50					\Box
50				192.0-325			RECOVERY 0 0 0 0					
			Bentonite Seal:		Grade 3/8 in		30					
					Bentonite Cl		10					\Box
				(130.0-14	5.0 and 177.	0-192.0 ft.)	٥٦	0 20	40	60	80 1	00
						****		TI	ME (Minu	tes)		
			Comments:									

Not to Hariz, Scale

Supervised by Job Number B. Johnson 943–27691.140 Site

Miner Flat Dam

File Name MF-254

VVEILINO. MF-218A Boring No. X-Ref: MF-218A PIEZOMETER CONSTRUCTION SUMMARY Survey Coords: Northing: Elevation Ground Level 1085006.50 6107.52 ft. 576834.81 Easting: Top of PVC Casing 6108.42 ft. **Drilling Summary:** Construction Time log: Start Finish Total Depth 362.0 ft. Task Date Time Date Time Borehole Diameter 3.65 in. Drilling 8/21/95 14:00 8/28/95 17:30 Casing Stickup Height 0.90 ft. Driller B. Mathews Rig Dresser DBS-25 Casing: RSG 3.65 in. Core Bit Bit(s) 12/18/95 9:52 12/18/95 9:55 12/18/95 9:55 12/18/95 10:28 Drilling Fluid Polymer/Water Filter Placement: 12/18/95 10:28 12/18/95 10:55 Protective Casing 6 ft.-2 in., 4 in. dia. Steel Cementing: 12/18/95 16:04 12/18/95 16:08 Development: Well Design & Specifications Basis: Geologic Log X Geophysical Log 49,9 Casing string(s): C = Casing S = Screen Well Development Water Level on 12/18/95 = 149.95 FBTC String(s) Depth Elevation + 0.90 206.00 C1 6108.42 - 5901.52 206.00 226.00 S1 5901.52 - 5881.52 Stabilization Test Data: Time Ηα Spec. Cond. Temp (°C) Casing: C1 1.5 in. Schedule 80, Flush Threaded PVC Screen: S1 1.5 in. Schedule 80, Flush Threaded 0.020 Slot PVC 10-12 Silica Sand (196.0-228.0 ft.) Filter Pack: Recovery Data: Portland Type I-II Cement Slurry with 5% Grout Seal: 100 90 Quickgel Bentonite Powder (0.0-2.0 ft.) ao 70 3/4 in. Gravel (2.0-178.0 and Backfill: 60 243.0-362.0 ft.) 50 40 Bentonite Seal: Wyoming Grade 3/8 in. Bentonite 30 TD=362.0° Holeplug Bentonite Chips (178.0-196.0 and 228.0-243.0 ft.) TIME (Minutes) Comments: Used coupling (PVC) at 130.0 ft.; glued with Uni-Weld 1200 PVC Cement/ACE 44393

Not to Hariz. Scale

50

100

150

200

250

300

350

400

Supervised by Job Number B. Johnson 943–27691.140 Site

PVC Pipe Cleaner. Upper backfilling took only ~18 gallons of gravel; may have bridged.

Miner Flat Dam

File Name MF-218A

Well No. MF-250

Boring No. X-Ref: MF-250

			PIEZOMETER CONS	TRUCTI	ON SUI	MMARY	1		
		Survey Coord			ition Groun		6079.		
			Easting: 576826.36	_ 7	op of PVC	Casing	6080.0	06 ft.	
	2.2	Drilling Sur	mmary:	Const	ruction T				***************************************
F		Total Depth	331.3 ft.	Task		Date	Start Time	1	inish
		Borehole Dia		Drilling		6/2/95	7:00	Date 8/19/95	Time
		Casing Stick	up Height 0.90 ft.	-			7.00	0/19/95	12:4
	╽┟╫╥	Driller	B. Mathews						
	ПП			_	**************************************				
		Rig Dres	sser DBS-25	Casing					
			3.65 in. Core Bit	- Si	•	12/16/95	9:50	12/16/95	9:58
				C1		12/16/95	9:58	12/16/95	10:0
		Drilling Fluid	Polymer/Water						
		Protective Ca	ising 15 ft., 4 in. dia. Steel	-	lacement:	12/16/95	10:15	12/16/95	11:30
		Trotective Ca	ising 15 it., 4 iii. dia. Steel	Cemen Develor	-	12/18/95	16:50	12/18/95	17:00
	1			- Bevelor	Jillelit.	***************************************			ļ
		: Well Design	n & Specifications						
		Basis: Geo	plogic Log X Geophysical Log						
	<u>*</u>	Casing string	(s): C = Casing S = Screen		evelopme				
	158.6	. i	the lower column to	Water L	evel on 12	/18/95 = 1	59.62 FB	TC	
		+ 0.90 -							+
		148.00 -	148.00 C1 6080.06 - 5931.16 168.00 S1 5931.16 - 5911.16	-					***************************************
		-	3331.70						
		-						**	
<u>[</u>]				Stabiliz	zation Te	st Data:			
					T				
		Casing: C1	1.5 in. Schedule 80, Flush Threaded PVC	Time	рН	Spec.	Cond.	1 emp	p (°C)
		4							
		Screen: S1	1.5 in. Schedule 80, Flush Threaded 0.020 Slot PVC						
	Z	4	0.020 Slot FVC						
		Filter Pack:	10-12 Silica Sand (148.0-180.0 ft.)	Recove	ery Data:				
	\overline{Z}	Grout Seal:	Portland Type I-II Cement Slurry with 5%	100	, , , , , , , , , , , , , , , , , , ,				,
1			Quickgel Bentonite Powder (0.0-10.0 ft.)	90					
TD=331.3'		Backfill:	3/4 in. Gravel (10.0-133.0 and	70					+
			190.0-331.3 ft.)	§ 50					\Box
		Bentonite Seal:	Wyoming Grade 3/8 in. Bentonite	30					\Box
			Holeplug Bentonite Chips	10					目
			(133.0-148.0 and 180.0-190.0 ft.)	0	0 20	+0	60	80 10	00
					TII	ME (Minut	es)		
		Comments:							
Dr.									
to Horiz. S	cale	Supervised by	B. Johnson Site	Miner Flat	Dam				
		Job Number	943-27691.140 File Name	MF-250					

File Name MF-250

VVEILINO. MF-251

			PII	EZO	METER	CONST		NUS NC				
		Survey Coord	Territoria de la constitución de	thing: ting:	1085422. 576870.8			tion Groun		6088.9		
	9.9	Prinning Sur	nmary:				Constr	uction Ti	me log:			
	2 0	a'∮	0.4						1	tart	1	nish
والم المال المال	2 3			0.7 ft. 35 in.			Task Drilling		Date	Time	Date	Time
		Casing Stick			1.00 ft.		Drining		6/2/95	17:57	7/23/95	17:30
-50	╽╫╫	Driller	B. Mathews			**************************************						
]				W-634			-			
		Rig Dres	sser DBS-25				Casing:					
			3.65 in. Core Bit				S1		12/16/95	14:15	12/16/95	14:17
							C1		12/16/95	14:17	12/16/95	14:37
-100		Drilling Fluid	Polym	er/Wa	iter	WILLS	Filter DI	acement:				
	1 :::	Protective Ca	sing 30 ft.,	4 in. d	tia. Steel		Cement		12/16/95	14:37	12/16/95	14:50
							Develop	-				
		Well Design	a & Specificatio	ns					-			
		:∤	logic Log X		businal Las	_						
-150		· 1	(s): $C = Casing S$		-		Well D	evelopme	ent			
							I .	evel on 12		70.84 FB	TC	
	▼	Dept		ng(s)		ation						
	170.8	+ 1.00 -	169.00 C1 189.00 S1		6089.96						· • • • • • • • • • • • • • • • • • • •	
-200		103.00	109.00		5919.96	- 5899.96					***************************************	***************************************
		-			-	-						
							Stabiliz	ation Te	st Data:			•
							Time	рН	Spec	Cond.	Tem	o (°C)
		Casing: C1	1.5 in. Schedule	80, F	lush Threa	ded PVC		F				(0)
-250												
	ZZ	*										
		Screen: S1	1.5 in. Schedule	80, F	lush Threa	ded						
] -	0.020 Slot PVC									
200		Filter Pack:	10-12 Silica Sar	nd (15)	9.0-191.0.6	+)	Recove	ry Data:				
-300			, , , , , , , , , , , , , , , , , , , ,		0.0 101.0 .	",	1100010	iy Data.				
		Grout Seal:	Portland Type I-	-II Cen	nent Slurry	with 5%	100 —			···		
			Quickgel Bentor				90					
è : .		Backfill:	3/4 in. Gravel (1	0.0-14	44.0 and		70					Н
TD=340.7'			205.0-340.7 ft.)				RECOVERY					
		Bentonite Seal:	Wyoming Grade	3/8 in	. Bentonite		30					
			Holeplug Bentor				10					
			(144.0-159.0 and	d 191.	0-205.0 ft.)	J	0 20	40	60	80 1	00
		C		· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	TII	ME (Minut	es)		
-400		Comments:					· · · · · · · · · · · · · · · · · · ·					
										·		
·											······································	
Not to Hariz.	Scale	Supervised by	B. Johns			Site	Miner Flat	Dam				
		Job Number	943-2769	91.140		File Name	MF-251					

Well No. MF-252

1	'				PIEZO	METER CON	ISTR	UCTI	ON SUI	MMARY	•		
			Survey Coor	ds:	Northing:	1085229.89		Eleva	tion Groun	d Level	6074.	16 ft.	
1000				***************************************	Easting:	576821.43			op of PVC		6074.9		
		222	Drilling Sur	mmary:				Consti	uction Ti	me log:			
[]		999						901.00	000001111	_	tart	F	inish
		╽┣╫┼┼	Total Depth		332.7 ft.			Task		Date	Time	Date	Time
			Borehole Dia	_	3.65 in.			Drilling		6/15/95	7:30	8/2/95	11:30
		┊ ┡╁╅╁╫	Casing Stick	up Height B. Mathe).75 ft.	-	· · · · · · · · · · · · · · · · · · ·					
50			Dilliei	D. Matrie	WS		-			***************************************			
							- -						
•	•			sser DBS-25				Casing:					
			Bit(s) RSC	3.65 in. Co	re Bit			S1		12/17/95	14:42	12/17/95	14:45
	1.0		Drilling Fluid		Polymer/Wa	tor	_ -	C1		12/17/95	14:45	12/17/95	15:30
100	1		Drining Fluid		Olymer/wa	(G)	- -	Filter PI	acement:	12/17/95	18:00	10/17/05	
			Protective Ca	ising 2	20 ft., 4 in. d	ia. Steel	-	Cement	1	12/18/95	16:00	12/17/95	16:40
								Develop	ment:				
			Well Design	a & Specifi	cations								
			_	•			-	······································		<u></u>]		!
150			Casing string	ologic Log >	· ·	hysical Log	_ _	M-II D					
	\equiv	161.11	Casing string	(s). C = Cas	ing 3 = Scr	een			evelopme evel on 12/		21 11 50	TC	
	=		Dept	th .	String(s)	Elevation	-			10/00 - 10	J1. [1 1 D	10	-
[<u>L</u>			+ 0.75 -	160.00	<u>C1</u>	6074.91 - 5914.16	6 -	·					
	#* (St		160.00 -	180.00	<u>S1</u>	5914.16 - 5894.16	в						
2001			-				_						
$\langle \langle \rangle \rangle$				***************************************			- s	Stahiliz	ation Tes	et Data:			
	• • •		***************************************			-	- `	/(dDIII2	ation 163	n Dala.			
	• •			-				Time	рН	Spec.	Cond.	Tem	p (°C)
•			Casing: C1	1.5 in. Sch	redule 80, F	lush Threaded PV	<u>c</u> _						
250	• • •			***************************************			_ _						(
• • •					****		_ _						
			Screen: S1	1.5 in. Sch	edule 80, Fi	ush Threaded	- -						
				0.020 Slot	PVC								
		ME	ilter Pack:	10 12 Silio	o Cond /146	3.0-182.0 ft.)			D-1				·······
00		\mathbb{Z}_{1}	iller Fack.	10-12 3110	a Sanu (146	5.U-182.U II.)	- ^m	ecove	ry Data:				
			rout Seal:	Portland To	vne I-II Com	nent Slurry with 5%	_						
	2	1	out ocai.			wder (0.0-10.0 ft.)		90					\Box
TD=	332.7		ackfill:		vel (10.0-13		-	80 70					Hi l
			dokiiii.	197.0-332.		U.U and	X RECOMERY	60 50					
50		R	entonite Seal:		Grade 3/8 in.	Rentonito	* RE	40					\Box
			ornormo ocar.		entonite Ch		-	30 <u> </u>					
					.0 and 182.0		-	10	20	+0	60		
				(100.0-140	.0 and 102.0	J- 197.0 IL.J	-	,				80 10	00
			Comments:	Some cavir	ng/bridaina i	near top of upper b	l Jentoni	te seal		ME (Minute		aneuro	
00						alvanized steel) at			auueu au	unional 1/2	Luay to 6	=115010	
		-			-Juping (ye	artaritzea steer) at	10.01						
4/		-									·····		
		-		**************************************									
at to H	doriz. Sc	cale S	Supervised by	8	Johnson	Site	Mir	ner Flat C	lam	· Marine and a second s	- November of State o		
		1	loh Number		2-27601 140	GILE	IVIII	iei i latti.	aiii				

Well No. MF-253 Boring No. X-Ref: MF-253 00 00 08 1:30 5:50

		1		PIEZOMETER CO	NSTR	IUCTI(ON SUI	MMAR'	7		
			Survey Coo	rds: Northing: 1084797.33 Easting: 576874.74			ion Groun		6071.4		***************************************
			Drilling Su	ımmary:		Constr	uction Ti	_			
-50		9 9 R	Total Depth	ameter 3.65 in.		Task Drilling		Date 8/3/95	Time 14:42	Date 8/21/95	Tir 13
-100				esser DBS-25 G 3.65 in. Core Bit Polymer/Water		Casing: S1 C1		12/15/95	8:56	12/15/95	9:0
			Protective Co	asing 35 ft., 4 in. dia. Steel n & Specifications		Filter Pla Cementii Developr	ng:	12/15/95	9:10	12/15/95	11:
-150		•	Basis: Ge	Basis: Geologic Log X Geophysical Log Casing string(s): C = Casing S = Screen				Well Development Water Level on 12/18/95 = 17			
-200		771.	Dep + 1.20 - 177.00 - - - -	oth String(s) Elevation 177.00 C1 6072.61 - 5894.41 197.00 S1 5894.41 - 5874.41 - - - - - - - -		Stabilization Test Data:					
-250			Casing: C1	1.5 in. Schedule 80, Flush Threaded P		Time	рН	Spec.	Cond.	Temp) (°C
			Screen: S1	1.5 in. Schedule 80, Flush Threaded 0.020 Slot PVC							
-300		•	Filter Pack:	10-12 Silica Sand (167.0-199.0 ft.)	_ A	Recover	y Data:				
TO=	327.2	Ē	Grout Seal:	Portland Type I-II Cement Slurry with 5 Quickgel Bentonite Powder (0.0-10.0 ft.		100 90 80		ļ			Н
· 350			Backfill:	3/4 in. Gravel (10.0-152.0 and 215.0-327.2 ft.)	* RECOMERY	70					
			Bentonite Seal:	Wyoming Grade 3/8 in. Bentonite Holeplug Bentonite Chips (152.0-167.0 and 199.0-215.0 ft.)	- st	40 30 20 10 0		+o	60	80 10	20
400			Comments:				1 ItA	ic (willute	:5)		Annanius Annanius
Not to H	toriz. S	cale	Supervised by	B. Johnson Site	Mir	ner Flat Da	ım				

943-27691.140

File Name MF-253

Job Number

Well No. MF-254

		PIEZOMETER CONS	TRUCTION SU	MMAR	1		***************************************
	Survey Coor	ds: Northing: 1084655.39	Elevation Grou	6061.25 ft.			
		Easting: 577063.74	Top of PV	6062.05 ft.			
	Drilling Su	mmary:	Construction 7	Time loa:			
1 11 P	역명 (영영				Start	Fi	inish
	Total Depth	325.2 ft.	Task	Date	Time	Date	Time
	Borehole Dia		Drilling	6/13/95	12:45	8/8/95	11:30
1 1 1	Casing Stick Driller	up Height 0.80 ft. B. Mathews	-				
	Щ —	O. Matriews	-				
	• • •	sser DBS-25	Casing:				
	Bit(s) RSC	3 3.65 in. Core Bit	S1	12/15/95	14:33	12/15/95	14:35
	Drilling Flyid		C1	12/15/95	14:35	12/15/95	14:50
	Drilling Fluid	Polymer/Water	Cite Discourse				
	Protective Ca	asing 29.5 ft., 4 in. dia. Steel	Filter Placement: Cementing:	12/15/95	14:50	12/15/95	15:30
		20.0 /11, / 111. 0.0.1. 0.1007	Development:	12/18/95	15:22	12/18/95	15:30
	347-11-5	0.0					
	well Design	n & Specifications	-				
	Basis: Geo	plogic Log X Geophysical Log					
	Casing string	(s): C = Casing S = Screen	Well Developm	ent			
		in the second	Water Level on 12	2/18/95 = 1	55.01 FB	TC	
	Dep						
	+ 0.80 -	155.00 C1 6062.05 - 5906.25 175.00 S1 5906.25 - 5888.25					
• • •	155.00	175.00 S1 5908.25 - 5886.25		· · · · · · · · · · · · · · · · · · ·	·	·	
	-					·	
		_	Stabilization Te	st Data:			
	-						
	Z casima: 61	15 12 02 5 1 1 5 1	Time pH	Spec.	Cond.	Temp	(°C)
	Casing: C1	1.5 in. Schedule 80, Flush Threaded PVC					
· · Z	<u> </u>					Mr	
	₹						····
	Screen: S1	1.5 in. Schedule 80, Flush Threaded					
		0.020 Slot PVC			L		
	Filter Pack:	10-12 Silica Sand (145.0-177.0 ft.)				***************************************	
	The rack.	10-12 Silica Salid (145.0-177.0 ft.)	Recovery Data:				
	Grout Seal:	Portland Type I. II Coment Characterists 504					
	Grout Seal.	Portland Type I-II Cement Slurry with 5%	100				
=325.2'	Doglatille	Quickgel Bentonite Powder (0.0-10.0 ft.)	80				
	Backfill:	3/4 in. Gravel (10.0-130.0 and	70 60				\Box
	Domanian Orași	192.0-325.2 ft.)	RECOMERY				
	Bentonite Seal:		30				
ŀ		Holeplug Bentonite Chips	10				
		(130.0-145.0 and 177.0-192.0 ft.)	0 20	40	60	80 10	00
			TI	ME (Minute	es)		
	Comments:		-1				
						,	
							 -
					35,500		
Horiz. Scale	1 '	B. Johnson Site	Miner Flat Dam		-,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2.11	,
	Job Number	943-27691 140 File Name	ME DEA		مختصفات		