GEOTECHNICAL INVESTIGATION REPORT

Colter Channel Project

FCD 92-02

Maricopa County, Arizona

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Engineering & Environmental Services

AGRA
Earth & Environmental Group

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November 24, 1992

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Attention: George Cotton, P.E.

Re: **Colter Channel Project**
FCD 92-02
Maricopa County, Arizona

Gentlemen:

Our Geotechnical Investigation Report on the referenced project is herewith submitted. The report includes the results of exploratory drilling and test pit excavation and laboratory testing. Recommendations for excavation and channel slope stability and for design of bridge and box culvert foundations are presented.

Should any questions arise concerning our recommendations, please do not hesitate to call us.

Respectfully submitted,

SHB AGRA, Inc.

By Robert W. Crossley 11/24/92
Robert W. Crossley, P.E.

And
Norman H. Wetz, P.E.

Reviewed by
Lawrence A. Hansen, Ph.D., P.E.

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1. INTRODUCTION

This report is submitted pursuant to performance of a geotechnical investigation performed by SHB AGRA, Inc. (SHB) of the Colter Channel. The purpose of the investigation was to examine the subsurface profile along the 2.89 mile alignment of the proposed channel. This information has been used to provide recommendations concerning excavation, slope stability and erosion protection of the channel. A further objective of the investigation was to provide recommendations for bridge or box culvert foundations at El Mirage Road, Dysart Road and the Airline Canal crossings of the Colter Channel.

2. PROJECT DESCRIPTION

It is understood that a flood control channel will be built north of Camelback Road between Litchfield Road and the Agua Fria River north and east of the community of Litchfield Park.

The channel begins about 0.2 miles east of Litchfield Road in Section 15, T2N, R1W. The channel alignment is oriented approximately due east in a corridor which is located between 1/4 and 1/2 mile north of Camelback Road to a point 1/4 mile east of El Mirage Road. At that location, the alignment bends slightly to the south and terminates at the west bank of the Agua Fria River about 0.2 miles north of Camelback Road.

The channel invert will generally be about 4 to 5 feet below existing grade and may be as deep as 8 feet below surrounding grade in certain locations. The existing ground surface falls from elevation 1066 feet to about elevation 1020 feet, which is about 0.3 percent over the 2.89 miles.

Structures will be required to carry Dysart Road and El Mirage Road over the channel. Both bridges and box culverts will be considered for these two locations. A new box culvert will carry the Airline Canal under the Colter Channel.

3. INVESTIGATION

3.1 Subsurface Investigation

3.1.1 Backhoe Test Pits

Exploratory test pits were excavated with Case 580K backhoe at 26 locations along the 2.89 mile alignment. Most of the test pits were advanced to a depth of about 12 feet below existing grade in the area. At one location, the backhoe experienced refusal on a strongly cemented stratum. At a few other locations, particularly east of El Mirage Road near the Agua Fria River channel, the pits were terminated at shallower depths due to severe caving of the cohesionless "river-run" deposits.

Excavation of the test pits was directed and continuously observed by our field engineer, Roman Y. Jauregui, P.E. Mr. Jauregui prepared geotechnical logs of the pits which are presented in Appendix A of this report. Bulk samples of soils were retrieved from the sides of the various pits and were transported to our laboratory for testing.

3.1.2 Exploratory Borings

Borings were performed at 8 locations with our truck-mounted CME-55 drill rig advancing 6 5/8-inch diameter hollow stem auger. Borings were completed at three locations each near the Dysart Road and the

El Mirage Road crossings, and at two locations near the Airline Canal crossing.

Standard penetration testing and sampling in accordance with ASTM D1586 or open-end drive sampling using a 3-inch diameter split barrel drive sampler were performed at selected intervals in the borings.

Drilling of the borings also was directed by Mr. Jauregui. Geotechnical logs of the auger borings are also presented in Appendix A along with site plans showing the boring and test pit locations.

3.2 Laboratory Testing

Index tests (moisture content, dry density, Atterberg limits, grain-size distribution and hydrometer) were performed on selected drive samples and bulk samples recovered from the borings and test pits. Moisture content and dry density values are present on the boring logs. Grain-size distribution and Atterberg limit test results are presented in Appendix B.

Direct shear tests were performed on samples recovered from borings at the two possible bridge locations (Boring Nos. D-1, E-1, E-2 and E-3) for evaluation of the engineering behavior of the soils at those locations. Results of these tests are presented in Appendix B.

4. PROJECT SETTING & GEOTECHNICAL PROFILE

4.1 Project Setting

The proposed alignment of the Colter Channel traverses the floodplain and terraces of the Agua Fria River. In Section 15 where the channel

begins, the terrain is relatively undisturbed low desert with a relatively heavy growth of creosote and other desert brush and a few mesquite trees. Between Dysart Road and El Mirage Road, the channel will cross land which is currently in cultivation or which apparently was cultivated in the past. An irrigated field presently exists within the half mile east of Airline Canal. For about a half a mile west of El Mirage Road, the channel will traverse farm land. The final few hundred feet of the channel crosses the recent floodplain of the Agua Fria River. Some gravel mining within the river is occurring near the outfall.

4.2 Geotechnical Profile

Throughout the proposed alignment of the channel, fluvial and alluvial soils are present to depths of 10 feet and greater. The soils were deposited by running water either in the channel of the ancestral Agua Fria River or on alluvial fans reaching over the river's floodplain.

For purposes of discussion of subsurface conditions, the project site is divided into segments and structure locations as follows:

Channel Beginning to Dysart Road

Soils within this segment mainly consist of stratified fine grained alluvium. Silty clay and clayey silt predominant, with a lessor amount of clayey fine sand and silty sand also being present. The plasticity of the clay fraction is mostly in the low to medium range. Nearly all of the soils are cemented to some degree with calcium carbonate. In the upper 2 to 4 feet, the cementation is generally weak. Weak to moderately weak cementation is present at greater depths. Strong cementation of a mostly fine grained soil is attributed as the cause of refusal of the backhoe at location of TP-1 near the beginning of the channel.

Dysart Road Crossing

From the surface to depths of about 20 feet, clayey sand and silty sand with only a small percentage of gravel is present. The clays exhibit low to medium plasticity and are weakly to moderately cemented with calcium carbonate. From 20 to about 58 feet, clayey or silty sand and gravel mixtures are present. While the percentage of gravel and cobble sized fragments is large, the clay/silt and cement binder provides cohesion. At a depth of 58 feet in Boring No. D-2, a very highly plastic clay stratum was encountered.

Dysart Road to El Mirage Road

Soils to a depth of 12 feet are predominantly sandy, but possess sufficient clay and silt to behave as cohesive soils. A small amount of gravel is present. Generally the percentage of gravel increases toward the east. At most locations the soils encountered were cemented to some degree with carbonate, typically in the range of weak or weak to moderate.

Airline Canal Crossing

At the location where the Airline Canal will cross the Colter Channel, the subsoils consist of stratified silty sand, clayey sand and sandy clay in the upper 8 to 12 feet. At greater depths, silty sand, with some to considerable gravel, is present. The clayey soils exhibit highly variable plasticity, ranging from very low to high. Nearly all of the soils are weakly to moderately cemented with calcium carbonate.

El Mirage Road Crossing

From the surface to a depth of 8 to 12 feet, a silty sand and gravel mixture is present. This stratum possesses little if any plasticity, but is weakly cemented with calcium carbonate. Below the surficial stratum, a lens or pocket of silty clay, which is medium to highly plastic, was encountered. This stratum is about 10 to 15 feet thick. Below a depth of about 30 feet, a weakly cemented, well graded sand and gravel stratum is present to depths of 40 to 60 feet (Boring No. E-2).

El Mirage Road to Agua Fria River

Nearly all of the soils encountered to a depth of 12 feet are granular, being well graded clean sands, silty sands and sand/gravel mixtures. A few cobbles are also present in isolated

strata. These soils are geologically recent channel and flood-plain deposits of the Agua Fria River. Cementation for the most part is not present and locally severe caving of the sides of the backhoe test pits occurred.

4.3 Soil Moisture & Groundwater Conditions

No free groundwater was encountered in any of the borings. Moisture contents were found to be generally low throughout, which is typical in a desert setting.

5. DISCUSSION & RECOMMENDATIONS

5.1 Excavation & Conditions

Mass excavations for the channel can be made with conventional earth-moving equipment. In some locations, particularly west of Dysart Road, the cementation of the alluvial soils may result in difficult excavation. The use of heavy ripping teeth or of a hoe ram may be necessary in zones where strong cementation is encountered. The need for controlled blasting is not anticipated. For the segment east of El Mirage Road, excavation in the granular soils will be relatively easy, however caving and ravelling will occur if steep cuts are made.

5.2 Slope Stability & Erosion Protection

Permanent cut slopes in the sides of the channel should be no steeper than 1 1/2:1 (horizontal to vertical). In the relatively uncemented soils east of the El Mirage Road, permanent slopes should not exceed 2:1 without some type of erosion protection.

Throughout most reaches of the channel, the moderate to strong cementation of the predominantly fine grained soils will have the effect of greatly limiting the amount of erosion which will occur during the intermittent flows in the channel. In those reaches where cementation is very weak or absent, some erosion protection may be required.

The bottom of the channel could be lined with 8 inches to 1 foot of compacted silty clay obtained from excavation of the segment of the channel between Dysart Road and El Mirage Road. Placement of earth (clay) lining on slopes is very difficult and is generally not recommended.

Hand placement of well graded cobbles and boulders in the range of size from 3 to 18 inches is recommended. Additional protection would be afforded if a geomembrane lining were draped on the slopes prior to placement of rock. Coverage would need to be very complete to protect the geomembrane from deterioration resulting from exposure to the sun's ultra violet radiation. Another effective treatment would be the use of sprayed gunnite over wire mesh.

Local sandy soils from the Agua Fria River would be suitable for making soil-cement. However, the unit cost involved in mobilizing to mix and place what would be a relatively small volume of soil-cement on a project the size of Colter Channel would probably render the approach noncompetitive.

5.3 Foundation Design for Box Culverts

At the site of the Airline Canal, a box culvert will be used to carry

the Airline Canal under the Colter Channel. It is anticipated that the bottom of the box will be 5 to 8 feet below general surrounding grade.

Excavation should be made to the planned elevation of the base of the culvert floor. The exposed surface should be observed by a site representative of the geotechnical engineer. If locally soft or wet zones of soil are encountered, overexcavation and replacement with structural fill would be directed. If firm cemented soils, typical of these encountered in nearby borings (A-1 and A-2) are encountered, no overexcavation will be required.

If fill is needed beneath the floor of the box culvert, it should be placed in lifts no thicker than 8 inches and compacted to a density which is at least 95 percent of maximum dry density as determined by ASTM D698. The moisture content during compaction should be maintained within the limits of 1 percent below to 3 percent above optimum moisture content.

It is recommended that a minimum of 4 inches of aggregate base course be placed beneath the floor of any box culvert to provide a smooth working surface and to aid in the curing of concrete.

With the treatment described in this section, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) should be assigned to the foundation soils for dead plus live loads.

At the Dysart Road and El Mirage Road crossings, it is anticipated that if box culverts are used to carry the Colter Channel beneath the roadways, the floor of the box will be about 4 to 6 feet below roadway grade. At these depths, the box floor should be designed on the basis

of an allowable soil bearing pressure of 2,000 psf for dead plus live loads at both locations.

5.4 Design Criteria for Box Culvert Walls

In designing for earth pressure against box culvert walls, it is assumed the structure will be rigid and absolutely restrained from lateral movement. Accordingly, the walls will be subject to a hydrostatic load diagram equal to that of a fluid imposing 50 pounds per square foot per foot of depth.

Relatively free draining granular backfill should be utilized behind the north and south sides of the culvert(s) above the channel elevation. This material should consist of relatively clean sand and gravel having no more than 12 percent passing the no. 200 sieve. The materials should be nonplastic when tested in accordance with ASTM D4318. Compaction of the fill should be to at least 95 percent of maximum dry density as determined by ASTM D698.

5.5 Drilled Pier Foundations for Bridges

5.5.1 Downward Capacities

Straight drilled, cast-in-place concrete piers may be used for support of bridge foundations at both the Dysart Road and El Mirage Road crossings. Piers should extend at least 10 feet below the elevation of the bottom of the channel and 10 feet below the pier cap or grade beam, whichever results in the greater depth. Safe downward capacities for 18-, 24- and 30-inch diameter piers are presented below:

Dysart Road Crossing

Diameter (feet)	Depth (feet)	Safe Downward Capacity (kips)
1.5	10.0	57
	15.0	80
2.0	10.0	81
	15.0	112
2.5	10.0	108

El Mirage Road Crossing

Diameter (feet)	Depth (feet)	Safe Downward Capacity (kips)
1.5	10.0	65
	15.0	100
2.0	10.0	94
	15.0	141
2.5	10.0	120

The capacities apply to full dead plus live loads. A one-third increase is recommended when considering wind or seismic forces. A minimum shaft diameter of 18 inches is recommended for drilled pier foundations.

5.5.2 Estimated Settlements

It is estimated that the settlement of cast-in-place concrete pier foundations designed and constructed in accordance with criteria presented herein will not exceed 1/2 inch. In most instances, settlements will be less than 1/4 inch. Settlements will occur immediately after construction and the first few applications of live loads.

5.5.3 Resistance to Lateral Loads

For the design of isolated drilled pier foundations against lateral

forces, the passive resistance should be considered as being equal to the forces exerted by an equivalent fluid having a unit weight of 900 pounds per cubic foot. A factor of safety of 2.5 is recommended in applying the ultimate bearing pressure to design.

Piers may be considered isolated when they are placed at least 3 diameters center to center perpendicular to the line of thrust, and 6 diameters center to center parallel to the line of thrust. Group reduction factors for more closely spaced pile groups can be provided upon request.

5.5.4 Geotechnical Conditions for Construction

It appears that drilled pier excavations can be advanced to the depths recommended with very little, if any, caving. A small amount of concrete overrun may occur where clean sands or silty sands are encountered. In our judgment, the pier excavations can be advanced with conventional auger drill rigs.

5.5.5 Cleaning of Pier Excavations

After each shaft has been advanced to the planned depth, the bottom of the excavation should be cleaned of slough and loose material in a manner acceptable to the geotechnical engineer. The cleaning should ultimately result in the bottom of the excavation having an average of no more than 4 inches of disturbed material prior to placement of concrete.

Various techniques may be used at the contractor's option to accomplish the cleaning. Manual cleaning with hand labor or by vacuum cleaning are acceptable. Careful machine cleaning with rig-mounted

tools also is acceptable but the equipment should be approved by the geotechnical engineer.

5.5.6 Placement of Concrete

Concrete should be placed through a hopper or other device approved by the geotechnical engineer so that it is channeled in such a manner to free fall and clear the walls of the excavation and reinforcing steel until it strikes the bottom.

Adequate compaction will be achieved by free fall of the concrete up to the top 5 feet. The top 5 feet of concrete should be vibrated in order to achieve proper compaction. The concrete should be designed, from a strength standpoint, so that the slump during placement is in the range of 5 to 7 inches.

5.5.7 Construction Quality Assurance

Continuous observation of the construction of drilled pier foundations should be carried out by a representative of the geotechnical engineer. The representative should verify proper diameter of the shaft, depth and cleaning, and should also verify the nature of materials encountered in the pier excavations. Concrete placement should be continuously observed to ensure that it meets requirements. A quality assurance report should be submitted on each pier stating all details have been observed and confirming that the pier meets construction requirements.

5.6 Spread-Type Footings for Bridges

Spread-type footings are feasible for the support of the bridges. However, spread-type footings are more susceptible to settlements should the supporting soils experience substantial moisture increases. This is particularly the case at the location at the El Mirage Bridge. Concrete lining in the bottom of the channel would assist in mitigating moisture infiltration and preventing scour. It is recommended that a preliminary safe soil bearing pressure of 4,000 psf be used to design spread-type footings. The footings should extend to at least elevation 1040 feet at Dysart Road and 1017 feet at El Mirage Road. A review of the above bearing pressures are recommended when the exact loads and type of bridge have been determined in order to estimate potential settlements.

5.7 Earth Fissure Inspection

A reconnaissance of the project area was made by David E. Peterson, P.G. and Keith H. Dahlen, P.E., both of this firm, on October 8, 1992. Recent aerial photography (Landiscor, Inc., negatives L-12 and M-12, dated October 3, 1990) was utilized to guide the field reconnaissance. The photos were examined for the presence of linear features which could indicate the existence of fissures. A known earth fissure located 2 miles north of the site (Shumann, 1974; SHB, 1982)* was examined. This fissure was clearly active, displaying lineal collapse features, surface erosion and zones of piping.

Several features not previously identified as fissures were identified from the air photos and examined in the field. The investigation

*References are listed at the end of this report.

encompassed a 5-square mile area located mostly along and to the north of the proposed channel alignment. No features were identified during the site reconnaissance that would indicate the presence of fissuring near the proposed alignment of the Colter Channel.

Historical fissuring has occurred in several areas along the west flank of a large underground salt dome, known as the Luke Salt Body, which underlies the project site (Eaton, 1972). Both ground subsidence and fissuring in the area are the result of groundwater level declines to the west of the salt dome and east of the White Tank Mountains. Several maps depicting the location of earth fissures have been developed for the project area (Emcon, 1989; SHB, 1990, 1988, 1982; Laney and others, 1978; U.S. Army Corp of Engineers, 1973).

Depths to groundwater in the site vicinity were estimated to be on the order of 10 to 20 feet before extensive irrigation-based agriculture was established in the western Salt River Valley in the early 20th century (Smith and others, 1982). The groundwater decline between 1928 and 1968 was about 130 feet near the project site, however, the groundwater decline over much of the area between the salt body and the White Tank Mountains exceeded 300 feet. The groundwater level near the project site has risen about 20 feet since 1968 (Reeter and Remick, 1986).

Based on our site reconnaissance and given the apparent geologic and hydrogeologic conditions in the site area, there appears to be little chance of earth fissuring occurring along or near the proposed channel alignment. The potential for fissures to occur within the project site appears to be limited to the area between Litchfield Road and Dysart Road, based on the existence of known fissures located north of Glendale Avenue which, if extended, would trend through this area.

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SHB AGRA, INC.
Engineering & Environmental Services

TEST DRILLING EQUIPMENT & PROCEDURES

Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 6 5/8" O.D., 3 1/4" I.D. hollow stem auger or 4 1/2" solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-55 or CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Ford industrial engines capable of delivering about 7,000 to 8,400 foot-pounds torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 16,000 to 20,000 pounds downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or river-run material, which normally requires other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42" diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Hammer Drill Drilling with the Hammer drill is accomplished with a Drill Systems AP1000 drill rig advancing a double-walled drive casing with a link-belt 180 diesel pile driving hammer, having a rated energy of 8,100 foot-pounds per blow. Where noted on the boring log, the hammer is equipped with a supercharger which can boost the energy to approximately 12,000 foot-pounds per blow. The supercharger is used only in portions of the boring where blow counts are relatively high. Cuttings are removed with compressed air by a reverse circulation process, and are collected in a cyclone from which grab samples are obtained. The drive casing is either 9" O.D. by 6" I.D. or 6 5/8" O.D. by 4" I.D. and employs an expendable bit of slightly larger diameter than the O.D. of the casing. Hammer blows required to advance the drive casing are recorded in 1' increments, as noted on the boring logs. Standard penetration tests or 2.42" diameter ring samples taken are noted on the boring logs.

Odex System The Odex (overburden drilling with the eccentric method) system, also referred to as the DTH (down-the-hole hammer) system, consists of a pneumatic-rotary percussion down-the-hole hammer operating at the bottom being drilled through a 5" diameter steel casing. The eccentric button percussion bit overreams the boreholes and allows advancement of the casing. The same compressed air or air-detergent (foam) mixture that operates the hammer also serves to expel the cuttings from the borehole, where they can be collected as grab samples. Retraction of the eccentric drill bit allows removal of the hammer from the center of the casing to facilitate standard penetration testing (ASTM D1586) where noted on the boring logs.

Schramm Rotadrill The Schramm T64H truck-mounted drill rig is a top drive rotary rig capable of up to 85,500 inches/pounds of torque with a pulldown capacity of 35,000 lbs. Drilling is performed with either 4", or larger, diameter Tricone roller bits or 4" to 6" diameter down-the-hole hammer. Cutting removal is facilitated by compressed air or air/water mixtures and collected in a cyclone. Where noted on the boring logs, grab samples of the cuttings were collected. When casing is required to stabilize the borehole, an Aardvark drill through casing hammer is utilized, permitting simultaneous drilling and driving of the casing. Casing penetration is recorded on the boring logs in feet per minute. Standard penetration, 2.42" diameter ring samples, Shelby tubes, pitcher tube or Denison samples taken are noted on the boring logs.

Description of Subsurface Exploration Methods (Cont.)

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

cli/M1-92/02-14-92

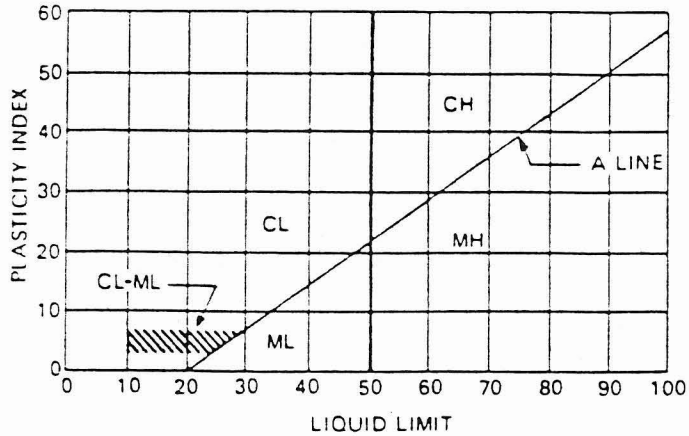
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (LIMITS PLOT BELOW "A" LINE & HATCHED ZONE ON PLASTICITY CHART)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (LIMITS PLOT ABOVE "A" LINE & HATCHED ZONE ON PLASTICITY CHART)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

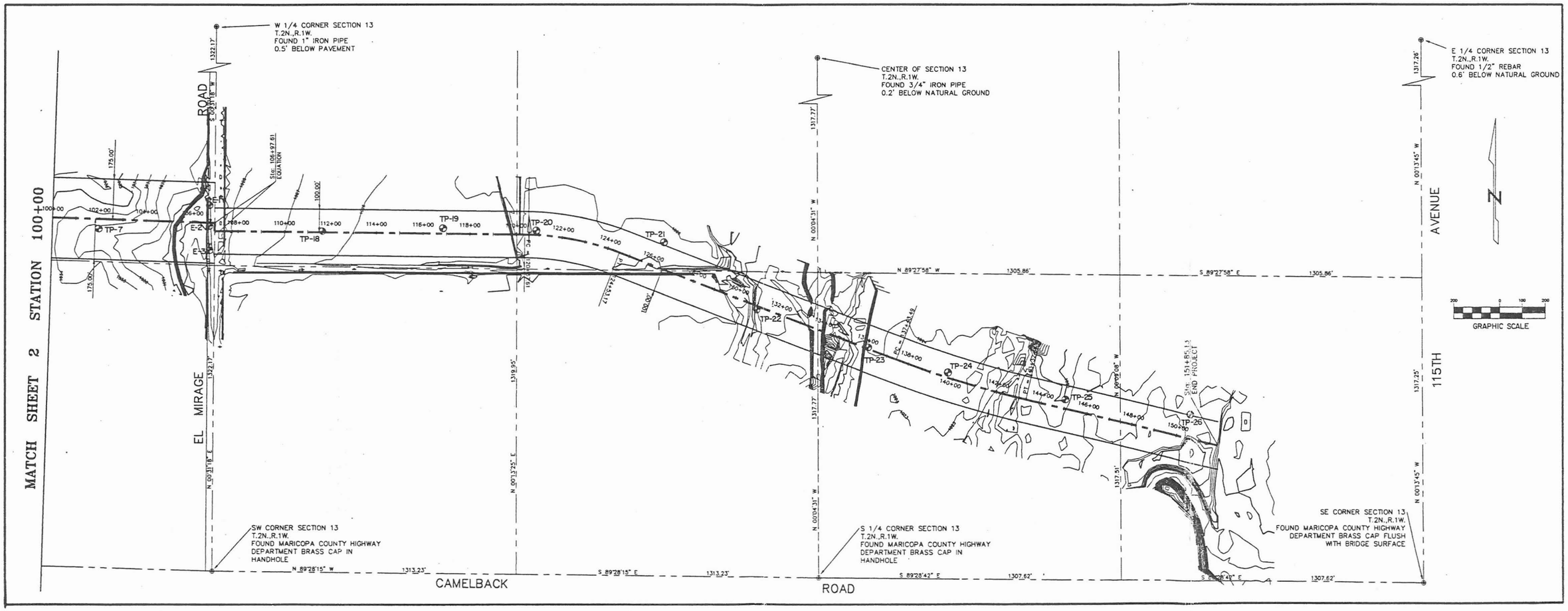
2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

clj/M1-92/02-14-92



REFERENCE DRAWING : PLAN AND PROFILE SHEETS PROVIDED
BY WOOD/PATEL ASSOC. DATED : 10/92 SHEET 3/3

SITE PLAN - SHOWING BORING AND TEST PIT LOCATIONS

Colter Channel Project
FCD 92-02
Maricopa County, Arizona
SHB Job No. E92-186

A-5

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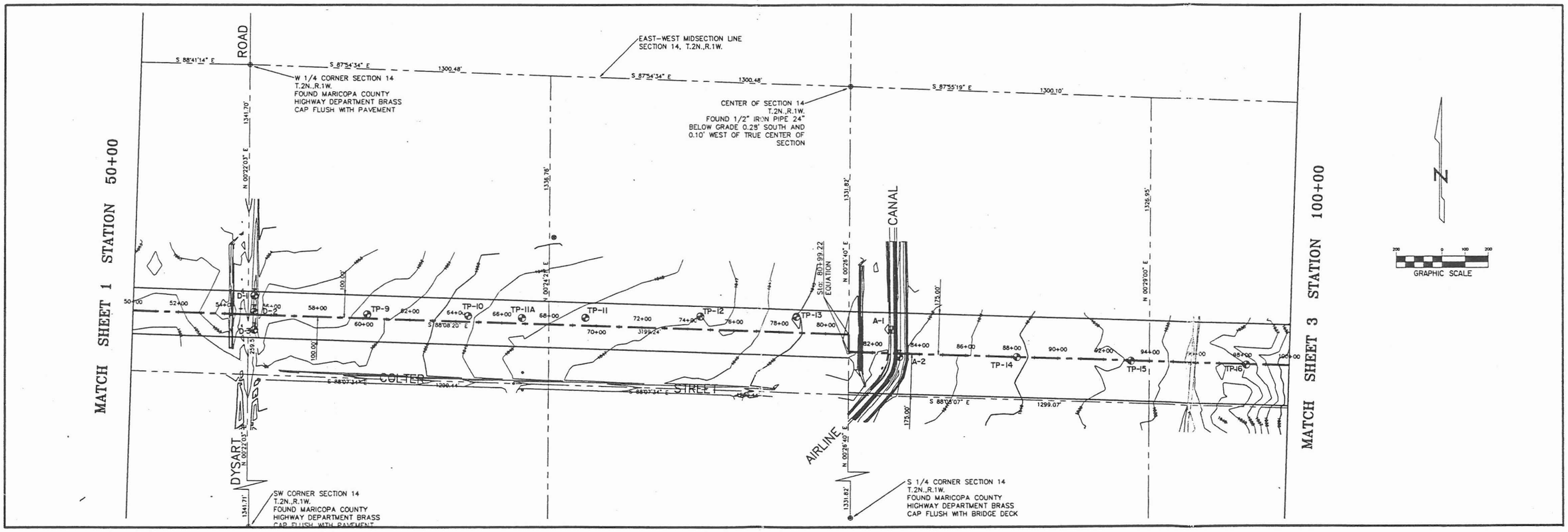

REFERENCE DRAWING : PLAN AND PROFILE SHEETS PROVIDED
BY WOOD/PATEL ASSOC. DATED : 10/92 SHEET 2/3

SITE PLAN - SHOWING BORING AND TEST PIT LOCATIONS

Colter Channel Project
FCD 92-02
Maricopa County, Arizona
SHB Job No. E92-186

A-6

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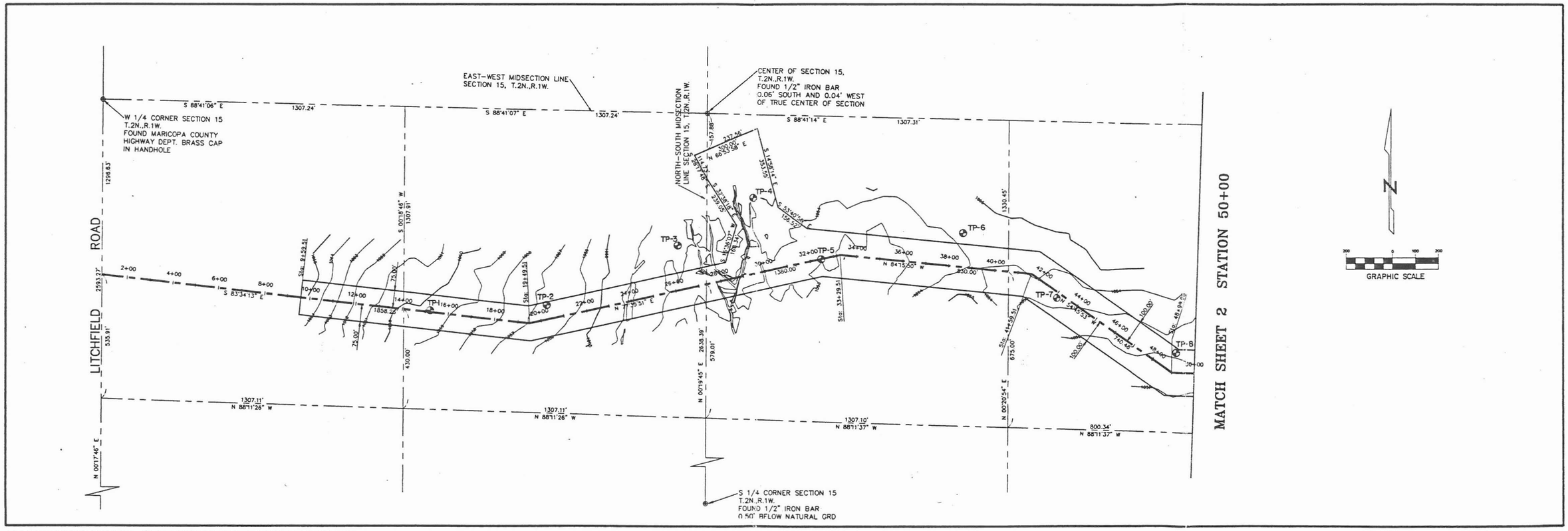

REFERENCE DRAWING : PLAN AND PROFILE SHEETS PROVIDED BY WOOD/PATEL ASSOC. DATED : 10/92 SHEET 1/3

SITE PLAN - SHOWING BORING AND TEST PIT LOCATIONS

Colter Channel Project
FCD 92-02
Maricopa County, Arizona
SHB Job No. E92-186

A-7

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PROJECT Colter Channel

LOG OF TEST BORING NO. A-1

JOB NO. E92-186 DATE 10-13-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1043.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	10-6-8			SM	moist, moderately firm	**SILTY SAND**, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, brown
				U	27	99	11			
5								SC	moist, firm	**CLAYEY SAND**, considerable silt, trace of gravel, predominantly fine grained, subangular, moderately lime cemented, medium plasticity, light brown note: zones of strongly lime cementation
				S	13-15-16					
10										
15				U	50	113	11			
								SC	moist, hard	**CLAYEY SAND**, some to considerable gravel, predominantly medium to fine grained, subangular, moderately to strongly lime cemented, low plasticity, light brown note: thin lenses of gravel
20				S	50/3"					
25				S	48-50/6"			SM	moist, hard	**SILTY SAND**, trace of gravel, poorly graded, subangular, weakly lime cemented, low plasticity to nonplastic, brown
30				S	41-50/3"					
35										Stopped Auger at 29'6" Sampler refused at 30'3"
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

PROJECT Colter Channel

LOG OF TEST BORING NO. A-2

JOB NO. E92-186 DATE 10-13-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1044.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	14-11-11			CL	moist firm to very firm	**SANDY CLAY**, weakly lime cemented, medium to low plasticity, brown note: weakly to moderately lime cemented at 5'
5				S	11-20-30		10			
10				U	16	105	4	SP-SM	moist medium dense	**SAND**, trace of silt, predominantly medium to fine grained, subangular, nonplastic, light brown
15				S	19-12-13			SP	moist medium dense	**SAND & GRAVEL**, trace of silt, poorly graded, subangular, nonplastic, light note: zones of strongly lime cemented materials
20				U	39					
25				S	25-50/5"			SM	moist hard	**SILTY SAND**, some fine gravel, poorly graded, subangular, moderately lime cemented, nonplastic, brown note: strongly lime cemented below 27'
				S	47-50/2"					
30										Auger refused at 28' Sampler refused at 28'8"
35										
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

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

PROJECT Colter Channel

LOG OF TEST BORING NO. D-1

JOB NO. E92-186 DATE 10-15-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1052.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	7-7-7			SM	moist moderately firm	**SILTY SAND**, predominantly medium to fine grained, subangular, weakly lime cemented, nonplastic, brown
5				S	6-11-13			SC	moist firm	**CLAYEY SAND**, considerable silt & trace of fine grained gravel, poorly graded, subangular, weakly lime cemented, medium plasticity, brown note: moderately lime cemented below 6'6"
10				S	16-22-32					
15				S	15-22-35			SC	moist hard to very dense	**CLAYEY SAND**, some to considerable gravel, poorly graded, subangular, weakly lime cemented, medium plasticity, brown note: some stratification due to gravel lenses (GM) & sand, lenses (SP-SM) note: occasional zones of uncemented soils
20				U	70	110	17			
25				S	29-45-50/3"					
				S	50/1"			GC	slightly moist hard	**CLAYEY SAND & GRAVEL**, trace of small cobbles, poorly graded, subrounded, moderately lime cemented, low plasticity, brown
30										
35										Auger refused at 29' Sampler refused at 29'1"
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

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LOG OF TEST BORING NO. D-2

JOB NO. E92-186 DATE 10-15-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1051.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	11-9-11			SM	slightly moist firm	**SILTY SAND**, trace of fine grained gravel, predominantly medium to fine grained, subangular, weakly lime cemented, nonplastic, brown
5				S	15-16-18			SM-SC	slightly moist	**SILTY SAND**, considerable to some fine grained gravel, some clay, poorly graded, subangular, weakly lime cemented, low plasticity, light brown
10				S	8-27-50				dense to very dense	
15				U	45	113	4	SM	moist dense	**SILTY SAND & GRAVEL**, predominantly fine grained, subrounded, weakly lime cemented, low plasticity, brown
20				S	35-50/3"			SC	moist hard	**CLAYEY SAND**, considerable silt, some fine grained gravel, poorly graded subangular, weakly to moderately lime cemented, low to medium plasticity, brown
25				S	46-35-38			SM	moist very dense	**SILTY SAND**, some gravel, poorly graded, subangular, weakly lime cemented, nonplastic, brown note: trace of coarse grained gravel & small cobbles from 26' to 28'
30				S	50/3"				moist hard	**CLAYEY SAND**, considerable gravel, poorly graded, subangular, weakly lime cemented, low to medium plasticity, brown note: some moderately to strongly lime cemented zones
35				S	50/4"		5	SC		
40				S	17-29-38					
45				S	100/9"	114	6	GP-GC	moist hard	**SAND & GRAVEL**, some silt & clay, poorly graded, subrounded, medium plasticity, light brown
50				S	27-50/3"					

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

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LOG OF TEST BORING NO. D-2

JOB NO. E92-186 DATE 10-15-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1051.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50								GP-GC		
55				S	50/2"			GC	moist, hard	CLAYEY SAND & GRAVEL, predominantly fine grained, subrounded, low plasticity, brown
60				S	10-10-14		39	CH	moist, firm	SILTY CLAY, some sand, high plasticity, light green
65										Stopped Auger at 59'6" Stopped Sampler at 61'
70										
75										
80										
85										
90										
95										
100										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

PROJECT Colter Channel

LOG OF TEST BORING NO. D-3

JOB NO. E92-186 DATE 10-14-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1051.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	20-18-15			SM-SC	slightly moist, firm	**SILTY SAND**, some clay, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, light brown
5				S	7-11-15					
10				S	15-15-12			GP-GC	moist, medium dense	**SANDY GRAVEL**, some silt, trace of clay, poorly graded, subangular, weakly lime cemented, low plasticity, light brown
15				S	36-33-19					
20				S	27-50/4"			SM-SC	moist, very dense to hard	**SILTY SAND**, some gravel & clay, predominantly fine to medium grained, subrounded, weakly lime cemented, medium plasticity, light brown
25				S	30-50/3"					
30				S	28-50/2"			GC-GM	moist, hard	**CLAYEY SAND & GRAVEL**, considerable silt, poorly graded, subrounded, moderately lime cemented, low plasticity, brown
				S	50/3"					
35										Auger refused at 34' Sampler refused at 34'3"
40										
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

PROJECT Colter Channel

LOG OF TEST BORING NO. E-1

JOB NO. E92-186 DATE 10-14-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1027.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	10-16-18			SP-SM	moist	**SAND & GRAVEL**, some silt, trace of small cobbles, poorly graded, subrounded, weakly lime cemented, nonplastic, brown
5				S	9-13-11					
10				S	9-17-20			SC	moist very firm	**CLAYEY SAND**, considerable silt & trace of fine grained gravel, predominantly medium to fine, subangular, weakly lime cemented, low plasticity, brown
15				U	100/5"			CH	slightly moist hard	**SILTY CLAY**, some sand, moderately lime cemented, high plasticity, brown
20				S	50/2"			GC	moist hard	**CLAYEY GRAVEL**, considerable silt & sand, trace of small cobbles, poorly graded, subrounded, weakly to moderately lime cemented, low to medium plasticity, brown
25				S	43-50/6"			GM	slightly moist hard to very dense	**SILTY SAND & GRAVEL**, some small cobbles, poorly graded, subrounded, weakly lime cemented, nonplastic, light brown
30				S	35-46-50/3"					
35				S	19-38-50/5"			SP	slightly moist very dense	**SAND**, trace of silt & fine grained gravel, poorly graded, subangular, nonplastic, light brown
40				S	41-50/6"			SM	slightly moist hard	**SILTY SAND**, considerable gravel, poorly graded, subangular, weakly lime cemented, nonplastic, brown
45										Stopped Auger at 39'6" Sampler refused at 40'6"
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

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LOG OF TEST BORING NO. E-2

JOB NO. E92-186 DATE 10-13-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1027.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	14-21-23			GM	moist, very firm	**SAND & GRAVEL**, considerable fine grained sand & some small cobbles, poorly graded, subrounded, weakly lime cemented, nonplastic, brown
5				S	12-14-18					
10				S	15-50/5"			CL	moist, hard	**SANDY CLAY**, moderately lime cemented, low to medium plasticity, light brown
15				S	26-50/6"					
20				U	51	90	13	ML	moist, very firm	**SANDY SILT**, weakly lime cemented, low plasticity, brown
25				S	18-20-25					
30				S	16-36-50/5"			SP-SM	moist, very dense	**SAND**, some gravel & trace of silt, poorly graded, subangular, nonplastic, light brown
35				S	24-50/4"					
40				S	29-50/4"			GP-GM	moist, very dense	**SAND & GRAVEL**, trace of silt, poorly graded, subrounded, nonplastic, light brown
45								SC-SM	moist, hard	**SAND**, some clay & considerable silt, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, brown note: trace of gravel from 48' to 52'
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

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LOG OF TEST BORING NO. E-2

JOB NO. E92-186 DATE 10-13-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1027.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50				S	25-50/6"					SAND, continued
								SC-SM		
55				S	10-15-22					
60				S	10-9-7					
										Stopped Auger at 59'6" Stopped Sampler at 61'
65										
70										
75										
80										
85										
90										
95										
100										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

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

PROJECT Colter Channel

LOG OF TEST BORING NO. E-3

JOB NO. E92-186 DATE 10-14-92

RIG TYPE CME-55
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1027.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								SM	moist	**SILTY SAND**, trace of gravel, predominantly medium to fine grained, subangular, weakly lime cemented, nonplastic, brown
				S	9-8-12				firm	
5				S	8-12-14			GM	moist	**SILTY SAND & GRAVEL**, trace of small cobbles, poorly graded, subrounded, weakly lime cemented, nonplastic, brown
									firm to hard	
10				S	28-32-50/4"					
15				S	28-33-35				moist hard	**SILTY CLAY**, considerable sand, weakly lime cemented, medium plasticity, brown
								CL		
20				U	56					
25				S	14-25-35					
30				S	23-44-50				slightly moist very dense	**SILTY SAND**, considerable gravel, predominantly fine to medium grained, subangular, low plasticity, light brown
								SM		
35				U	38					
40				S	12-35-50/5"					
45										Stopped Auger at 39'6" Sampler refused at 40'11"
50										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

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

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LOG OF TEST PIT NO. TP-1

JOB NO. E92-186 DATE 10-1-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1059.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	SANDY SILT, weakly lime cemented, low plasticity, brown
					ML		
			D	6.0			
						moderately firm	
						slightly moist	SANDY CLAY, considerable silt, weakly to moderately lime cemented, medium plasticity, brown
			D	6.0			
5					CL	very firm	
10						slightly moist	SANDY SILT, strongly lime cemented, low plasticity, light brown
					ML		
			D				
						hard	
							Backhoe refused at 11'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-2

JOB NO. E92-186 DATE 10-1-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1056.7'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	**SANDY SILT**, weakly lime cemented, low plasticity, brown
						moderately firm to hard	note: moderately lime cemented below 7' & strongly lime cemented below 10'6"
					ML		
5			D	8.0			
10							
							Backhoe refused at 11'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-3

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1053.2'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	**CLAYEY SILT**, considerable fine grained sand, weakly lime cemented, low plasticity, brown
					ML-CL		
			D			firm	
						slightly moist	**SILTY CLAY**, some fine grained sand, weakly to moderately lime cemented, low plasticity, brown
			D	6.0			
5						very firm	
					CL		
10						slightly moist	**SILTY SAND**, trace of gravel, poorly graded, subangular, weakly to moderately lime cemented, low plasticity, brown
					SM		
			D			hard	
							Backhoe refused at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-4

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1055.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	**CLAYEY SILT**, some sand, weakly lime cemented, low plasticity, brown
					CL-ML	firm	
5			D	5.0			
						slightly moist	**SILTY CLAY**, some fine grained sand, weakly to moderately lime cemented, low plasticity, brown
					CL	hard	
10			D				
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-5

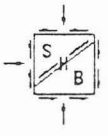
JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1053.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	SILTY CLAY, some fine grained sand, weakly to moderately lime cemented, low plasticity, brown
					CL-ML		
			D			moderately firm	
						slightly moist	SANDY SILT, trace of clay, weakly to moderately lime cemented, low plasticity, brown
5					ML	firm	
			D	6.0			
10							
							Stopped Backhoe at 11'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample



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LOG OF TEST PIT NO. TP-6

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1054.2'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	**SANDY CLAY**, some silt, weakly lime cemented, low to medium plasticity, brown
			D				
						moderately firm	
					CL		
5							
			D	7.0			
							SILTY CLAY, considerable fine grained sand, weakly lime cemented, low to medium plasticity, brown
						slightly moist	
					CL		
10			D			hard	
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-7

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1053.2'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist firm	**CLAYEY SAND**, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, brown note: weakly to moderately lime cemented below 4'
					SC		
			D				
5							
			D	7.0		slightly moist	**SANDY CLAY**, weakly to moderately lime cemented, medium plasticity, brown
					CL	hard	
10							
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-8

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1052.2'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	**CLAYEY SAND**, predominantly medium to fine grained, subangular, weakly lime cemented, medium plasticity, brown
			D			moderately firm	
							note: moderately lime cemented below 7' & some fine grained gravel
					SC		
5							
			D	8.0			
10							
					SP-SM	moist	**SILTY SAND**, trace of gravel, poorly graded, subangular, weakly lime cemented, nonplastic, light brown
			D			dense	
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-9

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1051.6'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	**SANDY SILT**, trace of fine grained gravel, weakly lime cemented, low plasticity, brown
					ML		
			D			moderately firm	
							SILTY SAND, some fine grained gravel, poorly graded, subangular, moderately lime cemented, nonplastic, light brown
			D			slightly moist	
					SM		
5						hard	
							SILTY SAND & GRAVEL, some small cobbles, poorly graded, subrounded, nonplastic, light brown
						slightly moist	note: strongly lime cemented below 9'
			D	2.0			
					SP-SM	dense	
10							
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-10

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1049.1'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	SANDY SILT, weakly lime cemented, low plasticity, brown
			D		ML	moderately firm	
			D			slightly moist	CLAYEY SAND, trace of gravel, poorly graded, subangular, moderately lime cemented, medium plasticity, light brown
5					SC	hard	
			D	5.0			
						moist	SILTY SAND & GRAVEL, trace of cobbles, poorly graded, subangular, nonplastic, light brown
10					SP-SM	dense	
			D				
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-11

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1047.8'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	CLAYEY SAND, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, brown
			D			moderately firm	
					SC		
5							SANDY CLAY, trace of fine grained gravel, weakly to moderately lime cemented, medium plasticity, brown
			D	6.0		moist	
						firm	note: thin lenses of clean, fine grained sand (SP) below 9'
					CL		
10							
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-11A

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1048.4'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	CLAYEY SAND, trace of fine grained gravel, predominantly medium to fine grained, subangular, weakly lime cemented, medium plasticity, brown
					SC	moderately firm	note: slight increase in lime cementation below 4'
5							
							Stopped Backhoe at 6'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-12

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1047.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	CLAYEY SAND, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, brown
					SC		
			D			moderately firm	
							CLAYEY SAND, considerable fine grained gravel, poorly graded, subangular, moderately to strongly lime cemented, low plasticity, light brown
					SC	moist	
			D			hard	
5							CLAYEY SAND & GRAVEL, trace of small cobbles, poorly graded, subangular, weakly to moderately lime cemented, medium plasticity, light brown
						moist	
			D	3.0		hard	
					SP-SC		
10			D				
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-13

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1045.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	moist firm	**SANDY SILT**, weakly lime cemented, low plasticity, brown
			D				
					SC	moist hard	**CLAYEY SAND**, some fine grained gravel, poorly graded, subangular, moderately to strongly lime cemented, low plasticity, light brown
			D				
5							
			D	4.0	SC	moist hard	**CLAYEY SAND**, some fine grained gravel, poorly graded, subangular, low plasticity, light brown note: occasional small cobbles
					GM	slightly moist hard	**SANDY GRAVEL**, some silt, poorly graded, subrounded, weakly lime cemented, nonplastic, light brown note: zones of strong lime cementation
10			D				
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-14

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1040.1'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	**SANDY CLAY**, trace of gravel, weakly lime cemented, low plasticity, brown
			D			moderately firm	
					CL		note: increase in lime cementation below 3' (to moderately lime cemented) some zones of strongly lime cementation
5			D	8.0			
			D			moist	**SILTY SAND**, predominantly medium to fine grained, subangular, nonplastic, light brown
10					SP-SM	dense	
15							Stopped Backhoe at 12'
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-15

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1038.9'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	CLAYEY SAND, trace of fine grained gravel, predominantly medium to fine grained, subangular, weakly lime cemented, low to medium plasticity, brown
			D			moderately firm	
					SC		
5			D	9.0			
						moist	CLAYEY SAND, trace of fine grained gravel, predominantly medium to fine grained, subangular, moderately to strongly lime cemented, low plasticity, brown
			D			hard	
10					SC		
							Stopped Backhoe at 11'6"
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-16

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1038.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		SC	slightly moist	CLAYEY SAND, trace of fine grained gravel, predominantly fine grained, subangular, weakly lime cemented, low plasticity, brown
						firm	
			D		SC		
						slightly moist	CLAYEY SAND & GRAVEL, poorly graded, subrounded, weakly lime cemented, low plasticity, light brown
			D	8.0		hard	note: trace of small cobbles
5							
					SC	slightly moist	CLAYEY SAND, some fine grained gravel, predominantly medium to fine grained, subangular, moderately lime cemented, medium plasticity, light brown
						hard	note: zones of moderately to strongly lime cementation
10							
							Stopped Backhoe at 12'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-17

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1032.9'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SM-SC	moist firm	**SILTY SAND**, trace of clay & gravel, poorly graded, subangular, weakly lime cemented, low plasticity, brown
			D				
					SC	moist very firm	**CLAYEY SAND**, considerable silt, predominantly medium to fine grained, subangular, weakly lime cemented, low plasticity, brown
5			D				
			D	4.0	SM	moist dense note: trace of small to medium cobbles below 10'	**SILTY SAND**, trace of fine grained gravel, poorly graded, subangular, weakly lime cemented, nonplastic, brown
10							
15							Stopped Backhoe at 12'6"
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-18

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1086.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content of Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very moist	SANDY SILT, trace of fine grained gravel, low plasticity, dark brown
					ML		
			D			moderately firm	
						very moist	SILTY SAND, trace of fine grained gravel, predominantly medium to fine grained, subangular, nonplastic, light brown
					SM	medium dense	
5			D	7.0			
			D				SAND & GRAVEL, trace of silt & small cobbles, well graded, subangular, nonplastic, brown
						moist	
					SW-		
10					SM	dense	
							Stopped Backhoe at 11'6"
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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LOG OF TEST PIT NO. TP-19

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1026.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		D			SM	very moist firm	**SILTY SAND**, predominantly medium to fine, subangular, nonplastic, dark brown
					SP	very moist	**SAND**, trace of silt, some fine grained gravel, poorly graded, subangular, nonplastic, light brown
		D		5.0		medium dense	
5							
					SW-SM	very moist medium dense	**SAND & GRAVEL**, trace of silt, well graded, subangular, nonplastic, nonplastic, brown
		D					
10							
							Stopped Backhoe at 11'6"
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-20

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1025.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	**SILTY SAND**, predominantly fine grained, subangular, nonplastic, brown
			D		SM	loose	
					SW-	moist	**SILTY SAND**, some fine grained gravel, well graded, subangular, nonplastic, brown
			D	1.0	SM	medium dense	
5							**SAND & GRAVEL**, trace of silt & small cobbles, poorly graded, subangular, nonplastic, brown
					SP-		
					SM	moist	
						medium dense	
			D				
10							Stopped Backhoe at 10'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-21

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1025.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D			moist	**SILTY SAND**, predominantly fine grained, subangular, nonplastic, brown
					SM	loose	
						moist	**SILTY SAND**, some gravel, poorly graded, subangular, nonplastic, light brown
							note: trace of medium cobbles from 3' to 4'
			D	1.0	SP-SM	loose	
5							
10							Stopped Backhoe at 9'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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JOB NO. E92-186 DATE 9-30-92

LOG OF TEST PIT NO. TP-22

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1024.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		D	3.0		SM	moist loose	**SILTY SAND**, predominantly medium to fine grained, subangular, nonplastic, brown
5		D			SP	moist loose	**SAND**, some gravel, poorly graded, subangular, nonplastic, brown note: increase coarse grained gravel below 5'
10							Stopped Backhoe at 8'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-23

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1023.5'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist	**SILTY SAND**, trace of fine grained gravel, predominantly medium to fine grained, subangular, nonplastic, brown
					SM		
			D	3.0		loose	
							SAND & GRAVEL, trace of silt & fine to medium cobbles, well graded, subangular, nonplastic, light brown
						moist	
5			D		SW-SM	medium dense	
10			D				
							Stopped Backhoe at 11'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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SALT LAKE CITY · LAKEWOOD/DENVER

PROJECT Colter Channel

LOG OF TEST PIT NO. TP-24

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1024.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D	2.0		moist	**SILTY SAND**, trace of fine grained gravel, predominantly medium to fine grained, subangular, nonplastic, brown
					SP-	loose	
					SM		
			D		GW	moist	**SAND & GRAVEL**, trace of small cobbles, well graded, subrounded, nonplastic, light brown
5						dense	
			D		SW-	moist	**SAND & GRAVEL**, trace of small cobbles & silt, well graded, subangular, weakly lime cemented, nonplastic, brown
					SM	dense to hard	
10							Stopped Backhoe at 10'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

SHB AGRA, INC.

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PROJECT Colter Channel

LOG OF TEST PIT NO. TP-25

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1025.0'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D	5.0		moist	**SILTY SAND**, predominantly medium to fine grained, subangular, nonplastic, brown
						loose	
					SM		
						moist	**SAND**, trace of gravel, poorly graded, subangular, nonplastic, light brown
5					SP	loose	note: lense of gravel (<6" thick) at 5' with trace of small cobbles
			D				
							Stopped Backhoe at 7'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

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PROJECT Colter Channel

LOG OF TEST PIT NO. TP-26

JOB NO. E92-186 DATE 9-30-92

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION Backhoe with 24" bucket
ELEVATION 1025.2'
DATUM Topo (Wood/Patel)

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	**SILTY SAND**, some gravel, well graded, subangular, nonplastic, brown
						loose	note: trace of small cobbles from 6' to 7'
					SW-SM		
			D	2.0			
5							
					SP	moist	**SAND**, some gravel, poorly graded, subangular, nonplastic, light brown
			D				
10						loose	
							Stopped Backhoe at 10'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
J - Jar Sample

SHB AGRA, INC.
Engineering & Environmental Services

LABORATORY TESTING PROCEDURES

Consolidation Tests Soiltest or Clockhouse apparatus of the "floating-ring" type are employed for the one-dimensional consolidation tests. They are designed to receive 1 inch high 2.5 inch O.D. brass liner rings with soil specimens as secured in the field. Procedures for the tests generally are those outlined in ASTM D2435. Loads are applied in several increments to the upper surface of the test specimen and the resulting deformations are recorded at selected time intervals for each increment. For soils which are essentially saturated, each increment of load is maintained until the deformation versus log of time curve indicates completion of primary consolidation. For partially saturated soils, each increment of load is maintained until the rate of deformation is equal or less than 1/10,000 inch per hour. Applied loads are such that each new increment is equal to the total previously applied loading. Porous stones are placed in contact with the top and bottom of the specimens to permit free addition or expulsion of water. For partially saturated soils, the tests are normally performed at in situ moisture conditions until consolidation is complete under stresses approximately equal to those which will be imposed by the combined overburden and foundation loads. The samples are then submerged to show the effect of moisture increase and the tests continued under higher loadings. Generally, the tests are continued to about twice the anticipated curve due to overburden and structural loads with a rebound curve then being established by releasing loads.

Expansion Tests The same type of consolidometer apparatus described above is used in expansion testing. Undisturbed samples contained in brass liner rings are placed in the consolidometers, subjected to appropriate surcharge loads and submerged. The loads are maintained until the expansion versus log of time curve indicates the completion of "primary swell".

Direct Shear Tests Direct shear tests are run using a Clockhouse or Soiltest apparatus of the strain-control of approximately 0.05 inch per minute. The machine is designed to receive one of the 1 inch high 2.42 inch diameter specimens obtained by tube sampling. Generally, each sample is sheared under a normal load equivalent to the effective overburden pressure at the point of sampling. In some instances, samples are sheared at several normal loads to obtain the cohesion and angle of internal friction. When necessary, samples are saturated and/or consolidated before shearing in order to approximate the anticipated controlling field loading conditions.

clj/M1-92/03-03-92

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E92-186
W/O 5

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
A-1	4.5'-5.5'	SC	38	22	48	64	83	87	90	93	94	94	95	96	98	98	
					100												2-186-98
A-1	14.5'-15.5'	SC	30	8	28	37	48	54	60	71	77	78	82	84	90	92	
					92	100											2-186-100
A-2	4.5'-6'	CL	47	28	52	63	74	80	86	92	96	96	99	100			2-186-105
A-2	9.5'-10.5'	SP-SM	NV	NP	6.1	11	34	58	80	95	98	98	100				2-186-106
E-2	19.5'-20.5'	ML	35	8	76	93	99	100									2-186-114

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E92-186
W/O 6

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
D-1	4.5'-6'	SC	40	17	46	55	66	73	80	88	94	95	98	99	100		2-186-124
D-1	19.5'-20.5'	SC	46	30	42	47	56	64	77	91	95	96	98	99	99	100	2-186-127
D-2	34.5'-34'10"		NA	NA	15	19	24	28	37	57	67	69	76	81	86	92	2-186-137
					100												
D-2	44.5'-45.25'	GP-GC	36	16	7.4	10	15	18	23	37	44	45	52	55	61	64	2-186-139
					73	84	100										
D-2	59.5'-61'	CH	%117	85	84	91	98	99	100								2-186-142

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E92-186
W/O 4

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
E-1	4.5'-6'	SP-SM	NV	NP	8.9	12	17	22	30	42	49	51	60	67	76	80	
					90	100											2-186-73
E-1	14.5'-14'11"	CH	77	55	85	93	96	97	98	99	99	99	100				2-186-74
E-3	34.5'-35.5'	SM	38	9	37	42	47	51	57	70	76	78	79	85	87	89	
					96	100											2-186-87
D-3	9.5'-11'		NA	NA	6.6	9	13	14	16	18	21	21	25	27	30	32	
					38	55	100										2-186-91
D-3	19.5'-20'4"	SM-SC	28	7	19	25	36	43	53	70	79	81	88	91	94	98	
					100												2-186-93

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E2-186
W/O 1

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
#TP-12 @ 7-8'	-	SP-SC	36	16	12	15	22	28	34	50	53	55	62	66	72	75	
					82	86	89	91	95		100						2-186-3
#TP-10 @ 7-8'	-	SC	38	18	43	52	64	72	80	93	94	95	97	98	99		2-186-9
#TP-11 @ 6-7'	-	CL	31	19	55	64	73	78	83	91	95	96	98	99	100		2-186-6
#TP-9 @ 8-9'	-	SP-SM	NV	NP	7.4	10	16	22	28	44	45	47	56	61	69	74	
					82	88	94	97	100								2-186-13
#TP-8 @ 8-9'	-	SC	36	14	28	35	46	53	60	73	75	76	81	83	86	88	
					91	93	93	93	100								2-186-15
#TP-7 @ 7-8'	-	CL	35	15	67	77	84	87	90	96	97	98					2-186-18
#TP-6 @ 6-7'	-	CL	31	14	71	82	89	92	95	98	99	99					2-186-20
#TP-5 @ 6-7'	-	ML	30	6	86	96	99	99	99								2-186-23
#TP-4 @ 5-6'	-	CL-ML	26	7	77	93	98	99	99								2-186-24
#TP-3 @ 4-5'	-	CL	31	13	81	92	96	97	98	100							2-186-27

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E2-186
W/O 2

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
#TP-25	0'-2'	SM	NV	NP	35	69	93	97	98	99							2-186-31
#TP-26	4'-5'	SW-SM	NV	NP	7.2	15	33	46	58	84	86	88	92	93	95	96	
					98	98											2-186-29
#TP-24	0'-2'	SP-SM	NV	NP	11	20	46	60	72	85	89	90	93	94	95	96	
					98												2-186-33
#TP-23	1'-2'	SM	NV	NP	13	28	54	65	76	86	90	91	93	94	94	95	
					97	98											2-186-36
#TP-22	1/2"-2'	SM	NV	NP	19	45	75	86	92	98	99	99					2-186-39
#TP-21	4'-5'	SP-SM	NV	NP	6.6	16	40	54	67	78	83	84	87	88	90	92	
					94	95	97	97	100								2-186-42
#TP-20	4'-5'	SW-SM	NV	NP	11	16	28	37	49	68	77	80	87	88	92	93	
					96	97	98										2-186-44
#TP-17	9'-10	SM	NV	NP	17	23	39	54	65	83	85	87	92	94	96	98	
					99												2-186-48
#TP-16	4'-5'	SC	50	23	24	29	34	37	41	50	61	65	86	90	94	96	
					98												2-186-51
#TP-13	6'-7'	SC	30	11	20	20	32	53	68	72	73	78	81	83	85	86	
					88	89	90	91	91		100						2-186-54

SERGENT, HAUSKINS & BECKWITH

TABULATION OF TEST RESULTS

Job No. E2-186
W/O 3

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200 .75"	#100 1"	#50 1.5"	#40 2"	#30 2.5"	#16 3"	#10 3.5"	#8 4"	#4 6"	.25" 8"	.375" 10"	.5" 12"	LAB NO
#TP-19	4'-5'	SP	NV	NP	3.1	5	15	27	40	71	75	78	84	87	91	93	
					96	98											2-186-57
#TP-18	5'-6'	SM	NV	NP	24	37	53	65	79	96	97	97	99	99	99	99	
					99	99											2-186-60
#TP-15	5'-6'	SC	33	12	34	41	51	58	65	81	84	86	91	93	97	98	
																	2-186-63
#TP-14	5'-6'	CL	27	8	55	67	79	85	90	98	99	99					2-186-66
#TP-2	5'-6'	ML	22	3	58	72	80	85	90	99	99	99					2-186-68
#TP-1	1'-2'	ML	25	3	72	87	93	95	97	99							2-186-69
#TP-1	4'-5'	CL	35	21	51	60	69	76	81	90	91	92	95	96	98	99	
					100												2-186-70

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CONSULTING GEOTECHNICAL ENGINEERS

PROJECT	COLTER CHANNEL	**JOB No**	E92-186
SAMPLE	TP-3 @ 4'-5'	**W. O. No**	7
		LAB NO.	27
		DATE	11/17/92

HYDROMETER TEST REPORT (ASTM D-422)

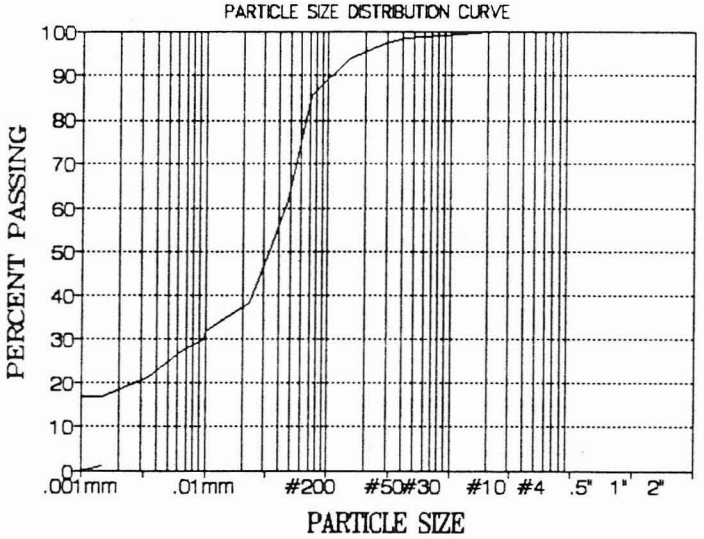
WEIGHT OF SAMPLE DISPERSED	48.80	**SPECIFIC GRAVITY OF SOLIDS**	2.470
PERCENT PASSING #10 SIEVE	100.00		

CALCULATED RESULTS

PARTICAL SIZE (DIA. mm)	0.0474	0.0347	0.0228	0.0133	0.0095	0.0068	0.0034	0.0014
PERCENT SAMPLE TESTED	61.6	50.9	38.2	34.0	29.7	27.6	21.1	16.7
PERCENT TOTAL SAMPLE	61.6	50.9	38.2	34.0	29.7	27.6	21.1	16.7

SIEVE ANALYSIS AFTER HYDROMETER ACCUMULATED % PASSING

#200	#100	#50	#40	#30	#16	#10
86	94	97	99	99	100	100



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PROJECT	COLTER CHANNEL	**JOB No**	E92-186
SAMPLE	TP-5 @ 6'-7'	**W. O. No**	7
		LAB NO.	23
		DATE	11/17/92

HYDROMETER TEST REPORT (ASTM D-422)

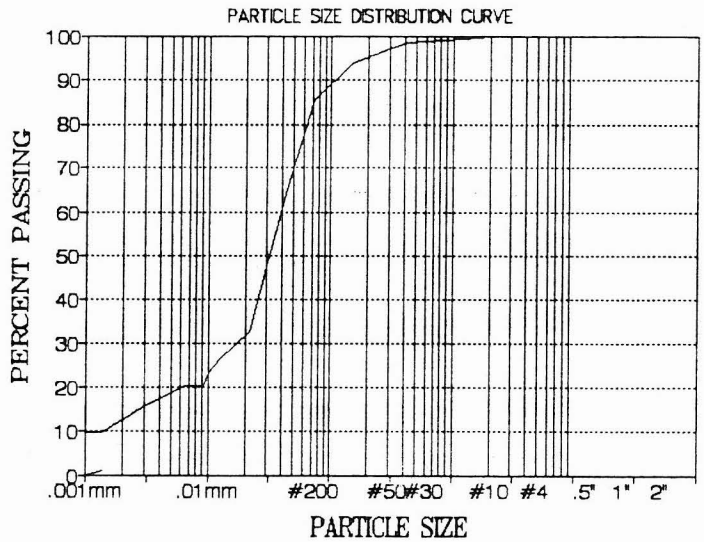
WEIGHT OF SAMPLE DISPERSED	48.75	**SPECIFIC GRAVITY OF SOLIDS**	2.694
PERCENT PASSING #10 SIEVE	100.00		

CALCULATED RESULTS

PARTICAL SIZE (DIA. mm)	0.0432	0.0321	0.0215	0.0126	0.0091	0.0064	0.0032	0.0014
PERCENT SAMPLE TESTED	65.1	50.8	32.5	26.4	20.3	20.3	16.1	9.9
PERCENT TOTAL SAMPLE	65.1	50.8	32.5	26.4	20.3	20.3	16.1	9.9

SIEVE ANALYSIS AFTER HYDROMETER ACCUMULATED % PASSING

#200	#100	#50	#40	#30	#16	#10
85	94	97	99	99	100	100



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PROJECT	COLTER CHANNEL	**JOB No**	E92-186
SAMPLE	TP-6 @ 6'-7'	**W. O. No**	7
		LAB NO.	20
		DATE	11/17/92

HYDROMETER TEST REPORT (ASTM D-422)

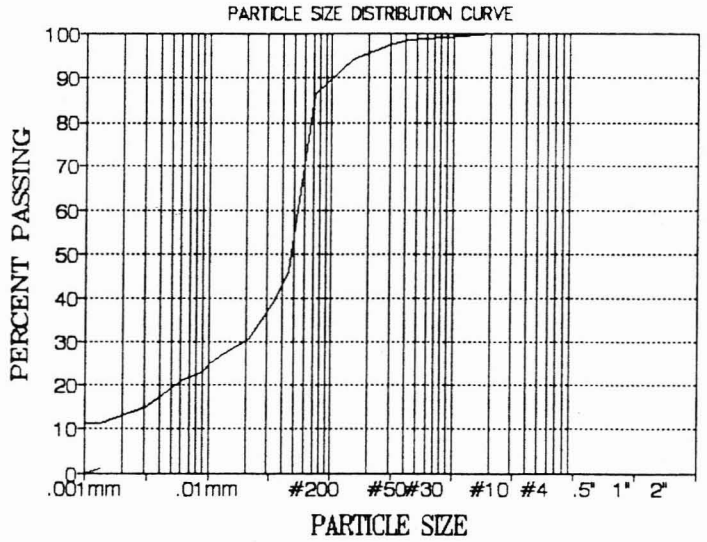
WEIGHT OF SAMPLE DISPERSED	51.19	**SPECIFIC GRAVITY OF SOLIDS**	2.747
PERCENT PASSING #10 SIEVE	100.00		

CALCULATED RESULTS

PARTICAL SIZE (DIA. mm)	0.0450	0.0326	0.0212	0.0124	0.0088	0.0063	0.0032	0.0013
PERCENT SAMPLE TESTED	46.0	38.3	30.7	26.8	23.0	21.1	15.2	11.2
PERCENT TOTAL SAMPLE	46.0	38.3	30.7	26.8	23.0	21.1	15.2	11.2

SIEVE ANALYSIS AFTER HYDROMETER ACCUMULATED % PASSING

#200	#100	#50	#40	#30	#16	#10
86	94	97	99	99	100	100



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PROJECT	COLTER CHANNEL	**JOB No**	E92-186
SAMPLE	TP-11 @ 6'-7'	**W. O. No**	7
		LAB NO.	6
		DATE	11/17/92

HYDROMETER TEST REPORT (ASTM D-422)

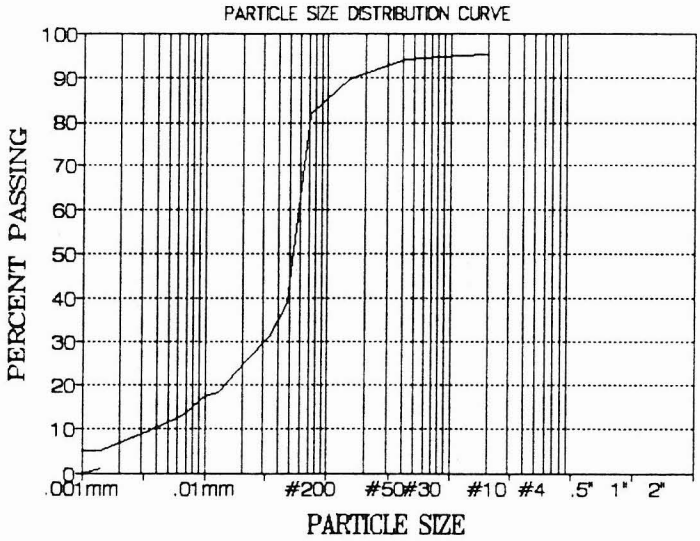
WEIGHT OF SAMPLE DISPERSED	51.24	**SPECIFIC GRAVITY OF SOLIDS**	2.703
PERCENT PASSING #10 SIEVE	95.30		

CALCULATED RESULTS

PARTICAL SIZE (DIA. mm)	0.0465	0.0337	0.0217	0.0128	0.0091	0.0065	0.0032	0.0014
PERCENT SAMPLE TESTED	40.6	32.8	27.0	19.3	17.4	13.5	9.5	5.5
PERCENT TOTAL SAMPLE	38.6	31.3	25.8	18.4	16.6	12.9	9.1	5.3

SIEVE ANALYSIS AFTER HYDROMETER ACCUMULATED % PASSING

#200	#100	#50	#40	#30	#16	#10
82	90	93	94	94	95	95



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PROJECT	COLTER CHANNEL	**JOB No**	E92-186
SAMPLE	TP-14 @ 5'-6'	**W. O. No**	7
		LAB NO.	66
		DATE	11/17/92

HYDROMETER TEST REPORT (ASTM D-422)

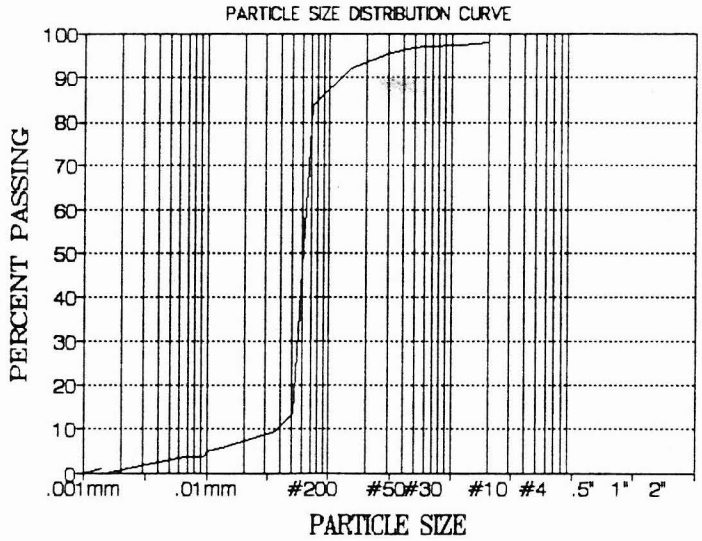
WEIGHT OF SAMPLE DISPERSED	49.06	**SPECIFIC GRAVITY OF SOLIDS**	2.730
PERCENT PASSING #10 SIEVE	98.00		

CALCULATED RESULTS

PARTICAL SIZE (DIA. mm)	0.0504	0.0360	0.0229	0.0133	0.0094	0.0067	0.0033	0.0014
PERCENT SAMPLE TESTED	13.9	9.9	7.9	5.9	3.9	3.9	1.9	-0.3
PERCENT TOTAL SAMPLE	13.6	9.7	7.7	5.8	3.8	3.8	1.8	-0.3

SIEVE ANALYSIS AFTER HYDROMETER ACCUMULATED % PASSING

#200	#100	#50	#40	#30	#16	#10
84	92	95	97	97	98	98



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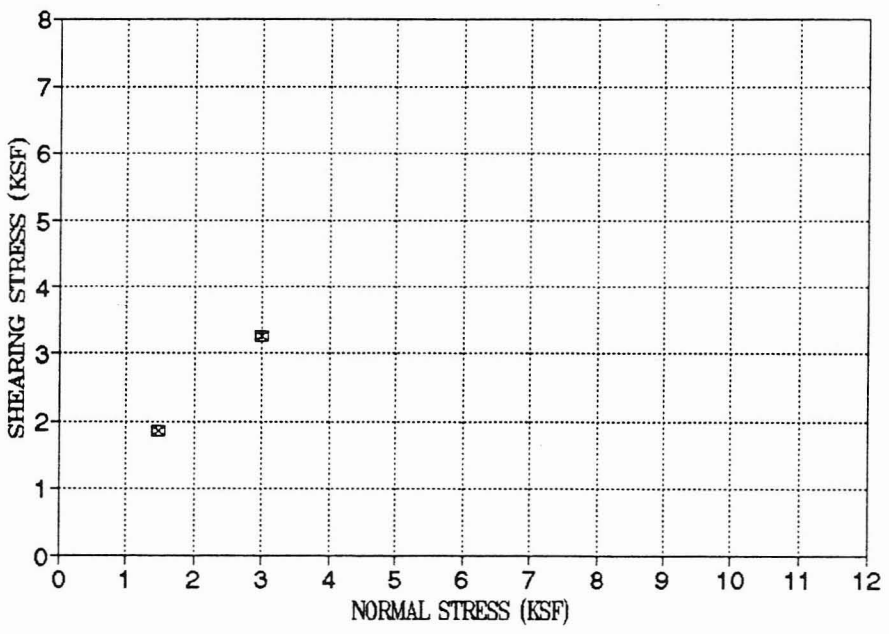
PROJECT: COLTER CHANNEL
LOCATION: D-1 @ 19.5' TO 20.5'

DATE 10/23/92
JOB NO. E92-186
W.O.NO. 6
LAB NO. 127

DIRECT SHEAR TEST(SATURATED)ASTM D-3080

Normal Stress	1.465 KSF	2.998 KSF
Initial Moisture Content	17.3%	21.5%
Dry Density	110.5 LB/CU FT	100.0 LB/CU FT
Moisture at Saturation	21.4%	26.2%
Maximum Vertical Deformation @ T max.	0.022 IN	0.0428 IN
Shearing Stress, T max.	1.8 KSF	3.3 KSF



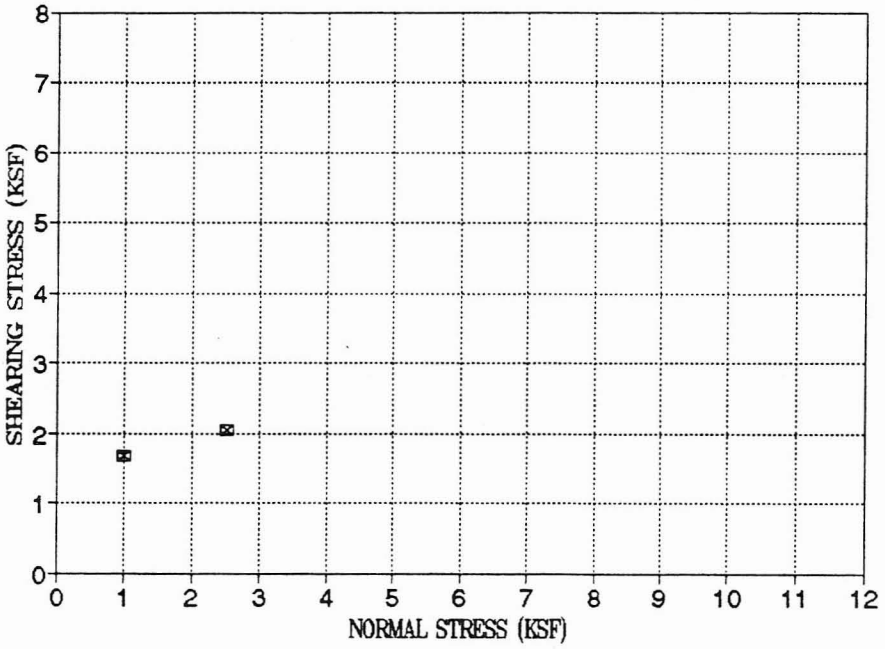
SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT: COLTER CHANNEL
LOCATION: E-1 @ 14.5' TO 14'11"

DATE 10/23/92
JOB NO. E92-186
W.O.NO. 4
LAB NO. 74

DIRECT SHEAR TEST(SATURATED)ASTM D-3080

Normal Stress	0.995 KSF	2.528 KSF
Initial Moisture Content	14.7%	12.3%
Dry Density	99.8 LB/CU FT	104.8 LB/CU FT
Moisture at Saturation	27.6%	24.4%
Maximum Vertical Deformation @ T max.	0.0088 IN	-0.003 IN
Shearing Stress, T max.	1.7 KSF	2.1 KSF



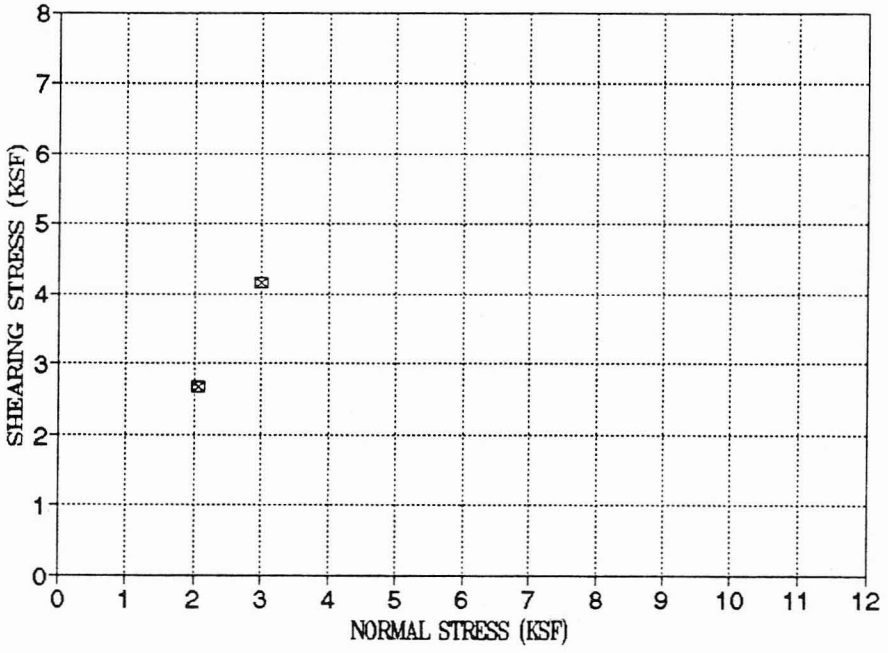
SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT: COLTER CHANNEL
LOCATION: E-3 @ 34.5' TO 35.5'

DATE 10/23/92
JOB NO. E92-186
W.O.NO. 4
LAB NO. 87

DIRECT SHEAR TEST(SATURATED)ASTM D-3080

Normal Stress	2.059 KSF	2.998 KSF
Initial Moisture Content	10.9%	8.6%
Dry Density	119.8 LB/CU FT	125.8 LB/CU FT
Moisture at Saturation	16.1%	13.2%
Maximum Vertical Deformation @ T max.	0.026 IN	0.0315 IN
Shearing Stress, T max.	2.7 KSF	4.2 KSF

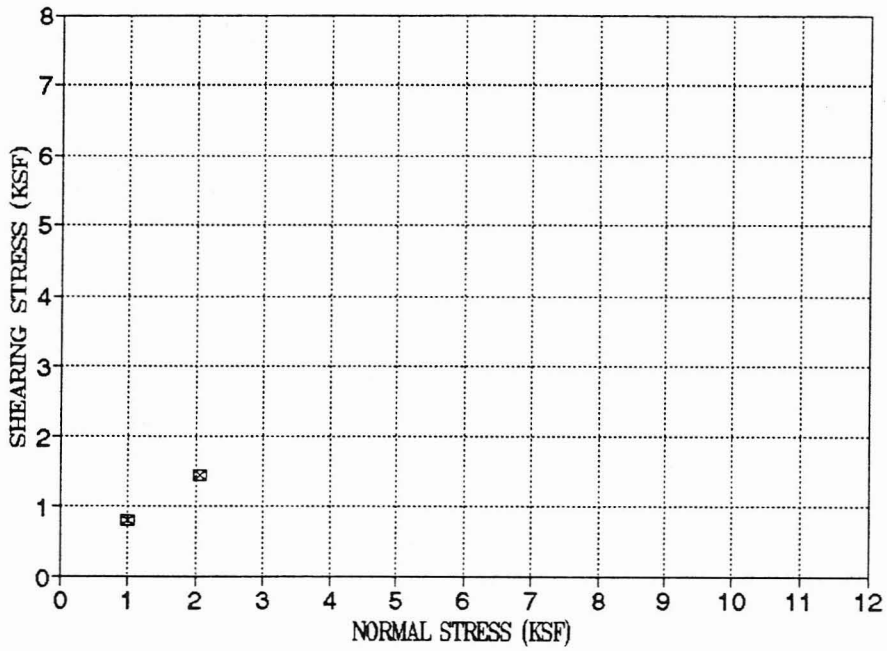


SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT:	COLTER CHANNEL	**DATE**	10/23/92
LOCATION:	E-2 @ 19.5' TO 20.5'	**JOB NO.**	E92-186
		W.O.NO.	5
		LAB NO.	114

DIRECT SHEAR TEST(SATURATED)ASTM D-3080

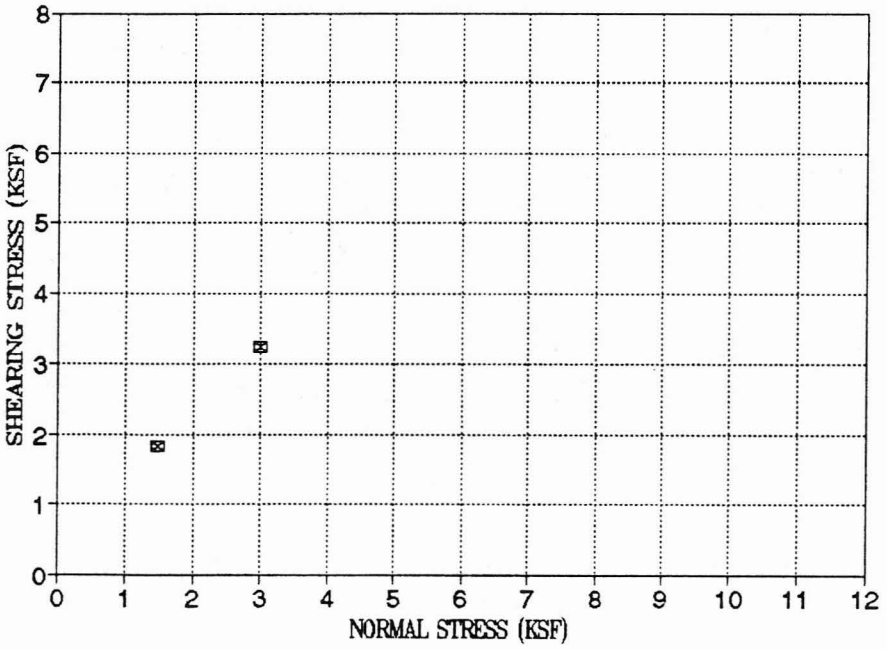
Normal Stress	0.995 KSF	2.059 KSF
Initial Moisture Content	12.8%	12.6%
Dry Density	89.6 LB/CU FT	89.5 LB/CU FT
Moisture at Saturation	32.4%	32.0%
Maximum Vertical Deformation @ T max.	0.006 IN	-0.001 IN
Shearing Stress, T max.	0.8 KSF	1.4 KSF



SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT: COLTER CHANNEL
LOCATION: D-1 @ 19.5' TO 20.5'

DATE 10/23/92
JOB NO. E92-186
W.O.NO. 6
LAB NO. 127

DIRECT SHEAR TEST(SATURATED)ASTM D-3080

Normal Stress	1.465 KSF	2.998 KSF
Initial Moisture Content	17.3%	21.5%
Dry Density	110.5 LB/CU FT	100.0 LB/CU FT
Moisture at Saturation	21.4%	26.2%
Maximum Vertical Deformation @ T max.	0.022 IN	0.0428 IN
Shearing Stress, T max.	1.8 KSF	3.3 KSF