GEOMATRIX

VOLUME II – APPENDIXES A – E

Fault Evaluation Study and Seismic Hazard Assessment

Private Fuel Storage Facility

Skull Valley, Utah

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Project No. 4790

Geomatrix Consultants

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SUPPLEMENTAL GEOPHYSICAL FEASIBILITY SURVEYS

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SUPPLEMENTAL GEOPHYSICAL FEASIBILITY SURVEYS

Two geophysical feasibility surveys were performed to evaluate the potential use of ground penetrating radar and magnetometer techniques to identify anomalies that may be related to capable faults at the proposed Private Fuel Storage Site (PFSF) in Skull Valley, Utah. The results of these feasibility surveys are presented below.

GROUND PENETRATING RADAR FEASIBILITY SURVEY

The purpose of this survey was to determine if ground-penetrating radar (GPR) is an appropriate tool to identify potential faults in the shallow subsurface at the PFSF site. If GPR reliably worked at the site then shallow faults might be identifiable with a superior resolution compared to S wave seismic reflection techniques. GPR surveys are commonly used to delineate subsurface targets such as shallow stratigraphy and faults.

GPR works on the principle of inducing high frequency radio waves into the earth and recording the energy that is reflected back from depth. Depth of penetration is dependent on the transmitting frequency, the dielectric constant of the subsurface material, the electrical conductivity of the subsurface material and its pore fluid. The presence of near-surface silts and clays may result in severe signal attenuation. Conversely, the presence of dry sands commonly results in excellent GPR signal propagation.

A successful GPR survey was previously performed approximately 5 miles east of the site to map the burial location of sheep. That GPR survey was performed on a gravel and sand alluvial fan on the west flank of the Stansbury Mountains.

A primary issue concerning the utility of GPR at the PFSF site is the depth of penetration of the radar energy that might be achieved. The shallow lithology of the site consists primarily of silt and clay material that attenuates the radar energy. It is possible to predict the attenuation properties of the soils if one has information concerning their electrical conductivity. An electrical conductivity greater than approximately 10 to 20 milliSeimens/meter (mS/m) would indicate that GPR energy would not propagate to the depths necessary to image potential shallow faults at the PFSF site. If the electrical conductivity is 5 mS/m or less, then the chances of a successful GPR survey is excellent.

To assess the likelihood of success of a GPR survey, a series of electrical conductivity measurements of the sediments were made at various locations around the site. A Geonics EM31 and solid state data logger were used for this purpose. The instrument simultaneously records the quadrature and in-phase components of the electromagnetic fields generated by the device's transmitter. The quadrature-component data are measurements of the electrical conductivity of the material within the instruments depth of investigation. All readings were taken with the instrument oriented parallel to the direction of travel, in the vertical dipole mode and with the instrument at waist height. The depth of penetration with the instrument in this configuration is approximately 12 to 15 feet. Readings were automatically stored in a solid state memory data logger during the survey. The data logger was interfaced to a portable computer and the data were transferred to a floppy disk for subsequent processing and interpretation. A base station was established and was revisited at the beginning and end of the investigation to check for instrument drift and malfunction. No instrument drift or malfunction was observed.

The electrical conductivities of the soils ranged from about 50 mS/m (Stansbury Sand Ridges) to over 400 mS/m (proposed storage site area). These conductivities are not favorable for obtaining high-resolution GPR data at depths where stratigraphy is old enough to be useful for evaluating fault capability. Therefore, additional GPR survey investigations were not pursued.

MAGNETOMETER FEASIBILITY SURVEY

A magnetometer feasibility survey was performed to investigate the possibility that magnetometer data may provide useful information concerning shallow capable faults. The magnetic signature of rocks and sediments is related to the relative content of magnetic minerals they contain. If a fault creates a significant offset in a unit exhibiting a high magnetic susceptibility than a series of magnetic measurements across the fault will show a change in the magnetic field. The anomaly magnitude will decrease and the wavelength increase with increasing distance from the source of the magnetic susceptibility contrast. The USGS aeromagnetic map of Utah was reviewed and there was no magnetic expression associated with the known range bounding faults in the area of the site. The PFSF Site occupies a broad subtle regional magnetic high of approximately 80 gammas with an anomaly wavelength on the order of 20 miles.

The stratigraphy in the vicinity of the proposed PFSF consists of an approximately 150- to 250-m (500- to 800-ft) thick section of Quaternary and Tertiary basin fill overlying Paleozoic bedrock. Magnetic measurements are commonly used to identify basement faulting owing to the relatively high magnetic susceptibility of basement rocks. By comparison, unconsolidated sediments and sedimentary rocks typically exhibit a much smaller magnetic susceptibility. A fault generally can not be identified with magnetic techniques unless it creates a lateral change in the magnetic susceptibility of subsurface units. An exception to this would be the case when secondary processes cause a mineral precipitate in the fault/fracture zone.

A ground based magnetometer survey was conducted to investigate the feasibility of the magnetic technique to assist in identifying capable faults at the site. A total of 9.6 km (6 mi) of magnetic profile data were measured along three parallel profile lines. These three lines, each 3.2 km (2 mi) in length were surveyed coincident with, and parallel to, seismic line PFSF 98-A. The three profiles were approximately 200 feet apart.

A Geometrics G858 cesium vapor magnetometer was used for the survey magnetometer and a Geometrics G856 magnetometer was used for the magnetic base station. Prior to the survey, the Space Environment Services office of the NOAA was contacted to obtain a magnetic forecast for the following 12 hours. This was done to minimize the chance of a solar storm causing large natural variations in the magnetic field that would render the field survey data, even with the corrections from the base magnetometer, largely useless. There were no solar storms forecast and an examination of the base station magnetometer revealed no evidence of significant magnetic variations during the survey. The base station magnetometer data was used to drift correct the survey magnetometer data by removing small scale natural, temporal, variations in the earth's magnetic field.

The three magnetic profiles are shown in Figure A-1, A-2, and A-3. Faults that were interpreted from the s-wave seismic survey of seismic line PFSF-98-A are plotted relative to the magnetometer data on Figure A-1. A common feature exhibited on all profiles is a change in magnetic character approximately ½ way through the lines. The eastern half of the profiles exhibit a relatively uniform magnetic response interrupted by very short wavelength anomalous spikes. The magnetic field increases approximately 40 gammas along the western half of the profiles. This change in magnetic response occurs at approximately line position 5000 feet. It is interesting to note that this change in magnetic response coincides with the point of the maximum gravity gradient. The increase in magnetic response from the center of the lines towards the west may be related to a decrease in the depth to magnetic basement rocks. Both P and S wave seismic data suggest a possible bedrock block dipping towards the east in this area. This tilted bedrock block may reflect a northwestern extension of Hickman Knolls.

In general, faults are recognized on both magnetic and gravity data by the identification of gradients. A gravity profile coincident with these magnetic profiles was extracted from the gridded Edcon gravity data set. This gravity profile and the calculated gradient is shown in Figure A-4. Due to the long wavelength of both the magnetic and gravity anomalies, the source of the anomalies is interpreted to be at significant depth, certainly much deeper than the upper 100 feet where work is focused to identify capable faults. Although the source of these anomalies may be related to a fault, the determination of the spatial positioning of that hypothesized fault is only approximate. The short wavelength magnetic anomalies are thought to be associated with lateral changes in the magnetic mineral content (i.e., near surface detrital magnetite) of the soils rather than evidence of shallow faulting. A comparison of the magnetic data and the faults interpreted from the S-wave seismic survey do not reveal a consistent magnetic response signature corresponding with the interpreted fault locations.

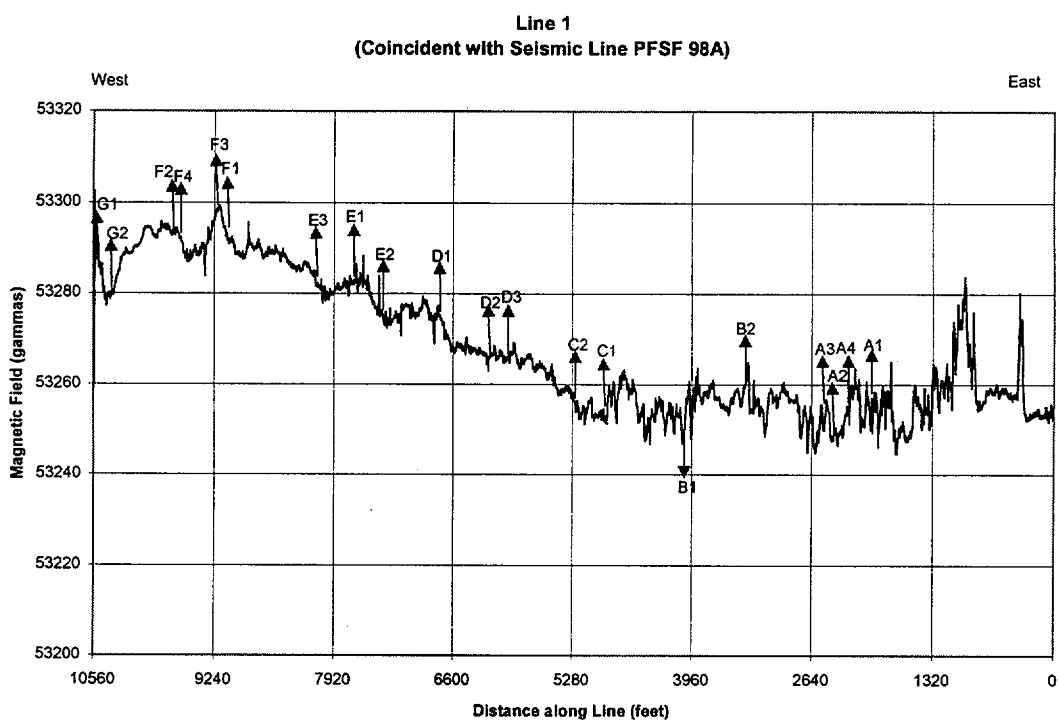

FIGURE A-1 Magnetic profile for line 1.

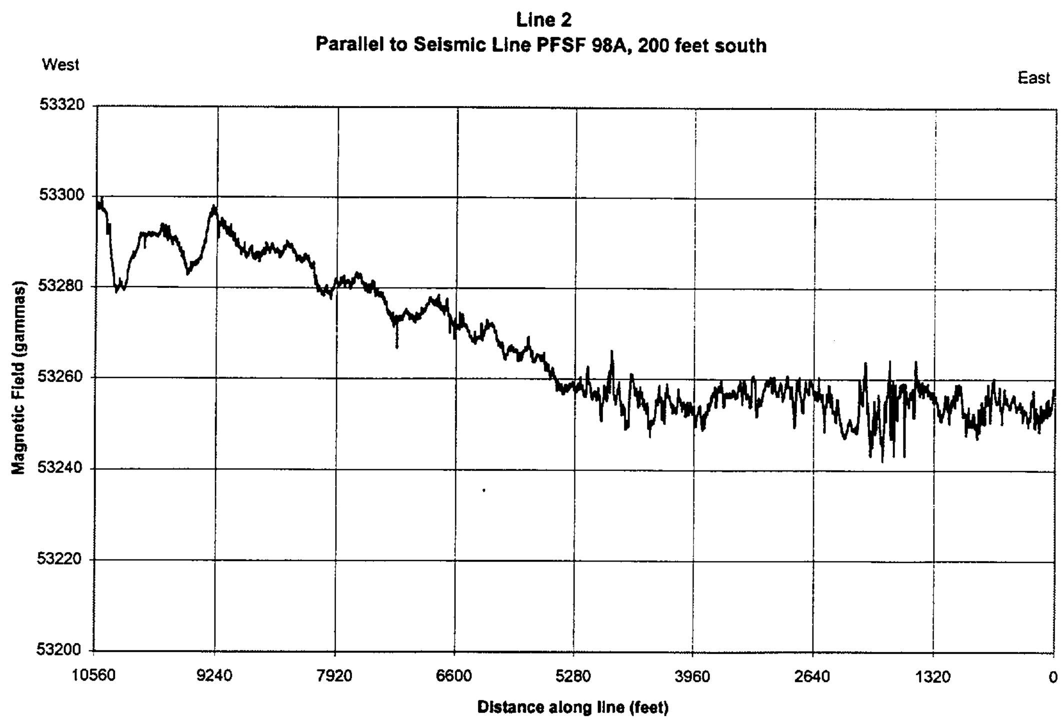

FIGURE A-2 Magnetic profile for line 2.

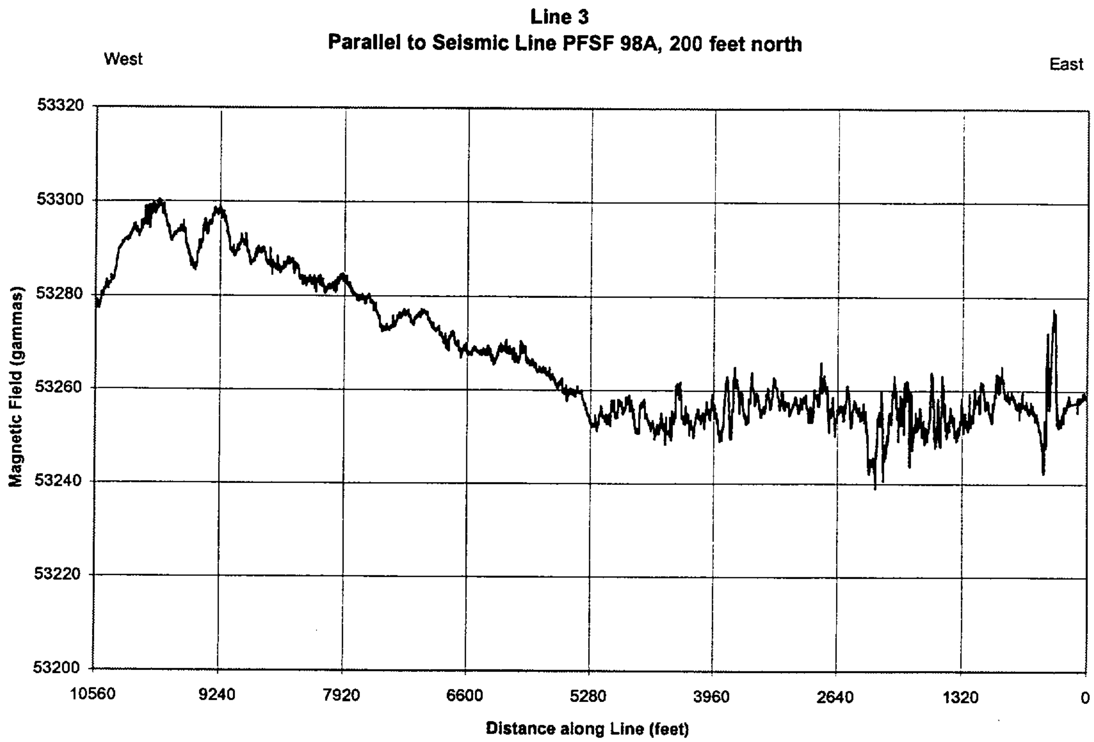

FIGURE A-3 Magnetic profile for line 3.

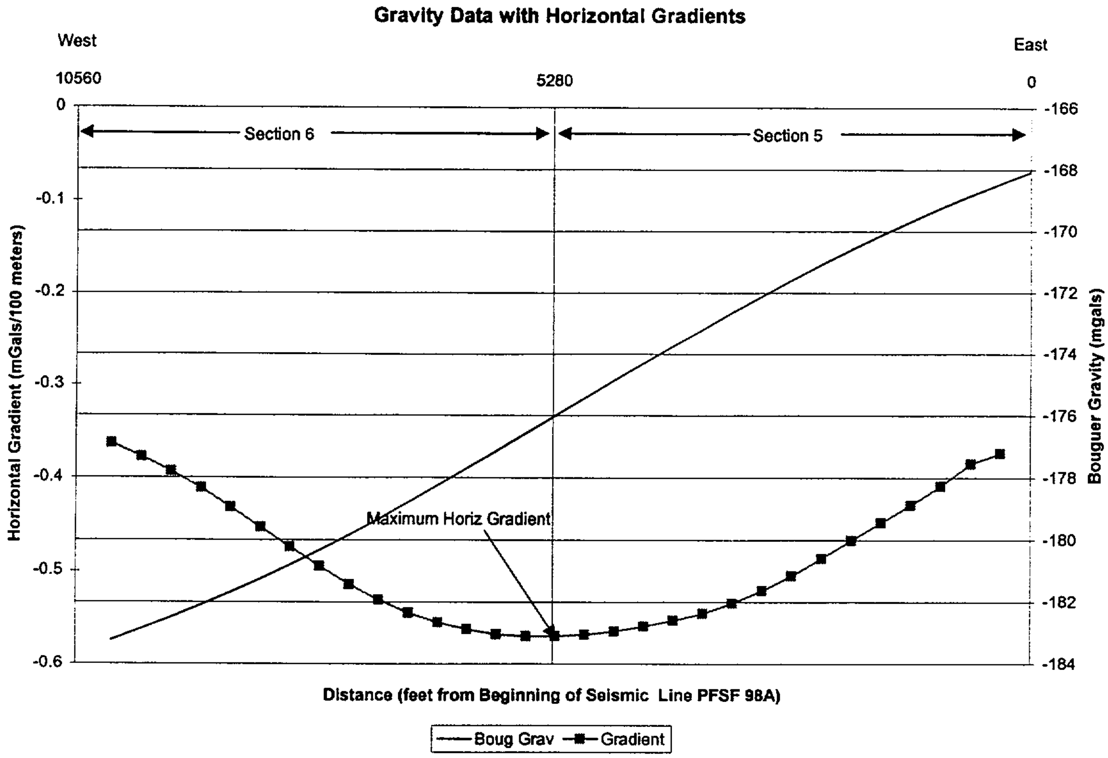

FIGURE A-4 Comparison of gravity and magnetic anomalies.

GEOMATRIX

APPENDIX B

BORING LOGS

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Boring Log Explanation

BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:	MEASURING POINT:
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST	COMPL.
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation	REMARKS

Notes

1. Soil descriptions for C-1 to C-28 are in accordance with the USCS as set forth by ASTM D2488-90 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)."
2. Soil color described according to Munsell Color Chart.
3. Carbonate soil classification described according to Birkeland (1984).
4. Dashed lines separating strata represent inferred boundaries between sampled intervals that may be abrupt or gradual transitions. Solid lines represent approximate boundaries observed within sample intervals.

Elevation (feet)

[STRATIGRAPHIC INTERPRETATIONS]

Interval of recovered soil core collected with split-spoon drive sampler

Interval of no recovery

B-1 (3/97)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-1**	
BORING LOCATION: E 1641361.537, N 755844.694	ELEVATION AND DATUM: 4491.65 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 6/15/98	DATE FINISHED: 6/15/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 32.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Richard Gillespie, Kathryn Hanson, and Don Currey	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4491.65 feet	REMARKS
0–0.5					SANDY SILT (ML) Brown, with roots	4491.15 feet
0.5–4					SILT (ML) Greenish gray with white calcite stringers, damp [BONNEVILLE DEEP-WATER FACIES]	4487.65 feet
4–5.8					SAND (SW) Light brown and yellowish brown, damp, fine sand, slight plasticity Very fine sand, trace silt, light brownish gray [POST-STANSBURY TRANSGRESSIVE FACIES]	4485.85 feet
5.8–6.1					(contact)	4485.55 feet
6.1–7					SILTY CLAY (CL) Gray with reddish brown mottling, moderate plasticity	
7–10					SAND (SW) Light brown, dry, fine sand, clean [STANSBURY TRANSGRESSIVE FACIES]	4481.65 feet
10–11.5					SAND (SW) Light brown, fine sand [STANSBURY REGRESSIVE FACIES?]	4480.15 feet
11.5–15					SILTY SAND (SM) Light gray and yellowish brown, fine sand Interbedded silt and fine sand, orange brown and gray [STANSBURY DEEP-WATER FACIES]	

B-1 (12/95)

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Log of Boring No. C-1 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–19					SILTY SAND (SM) Light yellowish gray, slightly damp, 10-20% nonplastic fines, uniform fine sand [STANSBURY DEEP-WATER FACIES]	4476.55 feet
19–20.2					SANDY SILT (ML) Yellowish gray and orange brown, damp, slightly plastic, fine sand, few thin clay interbeds [STANSBURY DEEP-WATER FACIES]	4472.85 feet
20.2–21					SILTY SAND (SM) Light brown, 10-12% nonplastic fines, uniform fine sand	4471.65 feet
21–23.5					SAND (SW) Light brown, dry, uniform fine sand [STANSBURY TRANSGRESSIVE FACIES]	4470.65 feet
23.5–25					SAND (SW) Light brown, dry, uniform fine sand, trace fine gravel [STANSBURY TRANSGRESSIVE FACIES]	4468.65 feet
25–25.4					SAND (SW) Similar to above, some gravel at bottom contact with silt [STANSBURY TRANSGRESSIVE FACIES]	4466.65 feet
25.4–29					SILT (ML) Light gray with orange streaks, dry, slightly plastic [WEAK SOIL DEVELOPED ON EOLIAN DEPOSITS]	4466.25 feet
29–32					SANDY SILT with GRAVEL (ML-GP) Slightly plastic, coarse to fine sand, mostly fine sand, 1 large cobble to 3-inch diameter maximum, medium to fine gravel, some caliche (?), attempt to auger ahead to 30 feet to clear hole, rough augering--gravelly caliche on bit, augered to approximately 32 feet in calichified gravel, very slow, sample from center of auger [PROMONTORY SOIL DEVELOPED ON PRE-BONNEVILLE ALLUVIUM-reworked eolian]	4462.65 feet; No penetration of augers, switch to drive samples
32					Bottom of boring at 32.0 feet.	4459.65 feet

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah		**Log of Boring No. C-2**	
BORING LOCATION: E 1641542.378, N 754439.646		ELEVATION AND DATUM: 4512.05 feet	
DRILLING CONTRACTOR: Layne Christensen		DATE STARTED: 6/15/98	DATE FINISHED: 6/15/98
DRILLING METHOD: Rotary auger with hollow stem		TOTAL DEPTH: 9.2 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61		DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)		LOGGED BY: Kathryn Hanson, Richard Gillespie, and Don Currey	
HAMMER WEIGHT: ---	DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4512.05 feet	REMARKS
0–2		X			CLAYEY SAND (SC)	4510.40 feet
2–5		X				4508.20 feet
					SAND (SW)	
5–6.4		X				4505.65 feet
					SILTY SAND (SM) with CALICHE (?)	4505.45 feet
6.4–9.2		X			SAND (SW) Sand with round pebbles	4503.05 feet
					GRAVEL (GP) Tufa or carbonate cemented gravel	4502.85 feet
					Bottom of boring at 9.2 feet.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 5

B-1 (12/95)

Project No. 4790	**Geomatrix Consultants**	

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-3**
BORING LOCATION: E 1639960.493, N 754583.010	ELEVATION AND DATUM: 4503.4 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 6/16/98 — DATE FINISHED: 6/17/98
.LLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 45.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Kathryn Hanson, Richard Gillespie, and Don Currey
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4503.4 feet	REMARKS
0–1.3					CLAYEY SILT (MH) Clayey silt with trace fine sand, scattered pebble in upper ??? 0.5 feet [BONNEVILLE or PROVO DEEP-WATER FACIES?]	4502.10 feet
1.8–3.0					SANDY GRAVEL (GP) Loose, subrounded gravel, 1.5-inch maximum diameter clast size [STANSBURY SHORELINE FACIES?]	4501.60 feet 4500.40 feet
3.0–4.5					SAND (SW) Fine sand, finely bedded, coarsens upward [STANSBURY SHORELINE FACIES?]	
4.5–5.0					No recovery	4498.40 feet
5.0–6.1					SAND (SW) Fine sand, trace fine gravel [STANSBURY REGRESSIVE FACIES?]	4497.30 feet
6.1–7.5					INTERBEDDED SANDY GRAVEL (GP) and SAND (SW) Fine to medium sandy gravel and interbedded sand [STANSBURY REGRESSIVE FACIES?]	4496.70 feet
7.5–8.8					SAND (SW) Fine sand, medium sand, and a few coarse sand beds, well stratified	4494.60 feet
8.8–10.0					No recovery	4502.40 feet
10.0–11.2					SAND (SW) Sand with minor pebbly sand [STANSBURY REGRESSIVE FACIES?]	
11.2–12.5					SANDY GRAVEL (GP) [STANSBURY REGRESSIVE FACIES?]	4490.90 feet
12.5–13.1					SAND (SW) Fine sand [STANSBURY TRANSGRESSIVE FACIES?]	4490.30 feet
13.1–15					SAND (SW) Light greenish gray, very fine sand, very soft [STANSBURY TRANSGRESSIVE FACIES?]	4488.75 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-3 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–17					SAND (SW) (continued)	
17–22.2					SAND (SW) Light reddish brown, thinly layered fine sand, trace gravel [STANSBURY TRANSGRESSIVE FACIES]	4486.50 feet
22.2–28.3					SILTY SAND (SM) Light yellowish gray to white (10YR 8/2), poorly sorted silty sand with caliche, gravelly, very dense, massive, Stage III carbonate, (all grains coated, voids filled), very slow augering [PROMONTORY SOIL DEVELOPED ON EOLIAN DEPOSIT]	4481.20 feet
28.3–29.9					SANDY SILT (ML) Light brown (10YR 7/2.5, m), poorly sorted [PRE-BONNEVILLE EOLIAN DEPOSIT-with B horizon soil]	4473.60 feet
29.9–31					SANDY SILT (ML) Light gray (10YR 8/1.5, m), poorly sorted, massive (Stage III) [PRE-BONNEVILLE EOLIAN DEPOSIT-with C_{ca} horizon soil]	4473.30 feet
31–33					GRAVELLY SILTY SAND (SP-SM) Poorly sorted, calcareous matrix, carbonate rinds (1-millimeter thick) on bottom of clasts [PRE-BONNEVILLE ALLUVIUM/COLLUVIUM DEPOSIT-with C_{ca} horizon soil]	4471.00 feet

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-3 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					GRAVELLY SILTY SAND (SP-SM) (continued)	
34					No recovery	4469.40 feet
35						
36						
37						
38						
39					SANDY SILT (ML) Upper portion of unit: Pale brown (10YR 6/3, d) and brown (10YR 5/3, m), poorly sorted	4464.40 feet
40					Bottom portion of unit: Light brownish gray to pale brown (10YR 6/2.5, m), poorly sorted, contains manganese-coated pellet clasts, effervesces strongly [SALT LAKE GROUP]	4463.40 feet 4462.90 feet
41						
42					CLAYEY SILT (MH) Brown (10YR 5.3/3, m), with trace fine sand; ash fragments? [SALT LAKE GROUP]	4461.30 feet 4461.00 feet
43					No recovery	
44					SANDY SILT (ML) Brown (7.5YR 5/3, m), fine sand, finely bedded with redder silt layers [SALT LAKE GROUP]	
45					SANDY SILT (ML) Brown to dark brown (7.5YR 4.5/4, m), poorly sorted, up to coarse sand size, subhorizontal platey structure (plates are 5-10 millimeters thick), manganese staining and gleying on pellet faces [SALT LAKE GROUP]	4458.40 feet
46						
47						
48					Bottom of boring at 45.0 feet.	
49						
50						
51						

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-4

BORING LOCATION: E 1638463.273, N 754847.030	ELEVATION AND DATUM: 4498.59 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/17/98 — DATE FINISHED: 10/17/98
ILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 45.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Kathryn Hanson, Richard Gillespie, and Don Currey
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. — Surface Elevation: 4498.59 feet	REMARKS
0–1.2					SOIL HORIZON 0.0-0.1 feet: AB-HORIZON SOIL, grayer, roots 0.1-0.7 feet: B-HORIZON SOIL 0.7-1.2 feet: C_{ca}-HORIZON SOIL [POST-PROVO EOLIAN]	4449.39 feet
1.2–4.3					SAND (SW) Yellowish brown (10YR 5.5/15, m) in upper 0.5 feet of unit, to light brownish gray (10YR 6/2.5, m) at base, fine sand, well sorted, fine bedding defined by heavy mineral layers, coarser (pebbles up to 1 centimeter) at base [REGRESSIVE BEACH SAND?]	
4.3–6					No recovery	4492.59 feet
6–8					SAND (SW) Fine to medium sand, well sorted, a few thin calcareous silt layers (approximately 2 millimeters thick) in section below 7.0 feet, fossil wing (?) found in sample from silt layer [POST-STANSBURY TRANSGRESSIVE FACIES]	
8–8.8					No recovery	
8.8–10					SAND (SW) Sand with pebbles [STANSBURY BEACH FACIES]	4489.39 feet 4488.59 feet
10–11.5					SAND (SW) Medium sand, pebbles at upper contact, more oxidation (red staining) associated with coarser beds [STANSBURY BEACH FACIES]	4487.84 feet 4487.44 feet
11.5–12.9					SAND (SW) Fine sand, very weakly bedded [STANSBURY BEACH FACIES]	4486.09 feet
12.9–14.5					SAND (SW) and SILT (ML) Finely bedded fine sand and calcareous silt layers, charophytes (?), abrupt upper contact [STANSBURY DEEP-WATER FACIES]	4484.99 feet
14.5–15					No recovery	

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-4 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16–17					SILTY SAND (SM) Light brownish gray to pale brown (10YR 6/2.5, m), silty fine sand, calcareous silt layers more abundant in lower 1.5 feet of section, redder colors due to oxidation associated with some beds [STANSBURY DEEP-WATER FACIES]	4483.59 feet
18					No recovery	
18–19					SAND (SW) Fine to very fine sand, well sorted [STANSBURY TRANGRESSIVE FACIES]	4479.29 feet
20–21					GRAVELLY SAND (SP-SW) Loose sand and gravel, gravel clasts are subrounded (clast size is 1-2 centimeters) [STANSBURY TRANGRESSIVE FACIES-Beach gravel and sand]	4478.59 feet; 4477.59 feet
22					Poorly sorted sand with pebbles (clast size up to 2.5 centimeters)	
23–24					SAND (SW) Light brownish gray (10YR 6/2, m), fine sand with some silt, more poorly sorted with more rock fragments relative to sand unit described at 20-21 feet [EOLIAN?]	4475.29 feet
25–26					GRAVELLY SAND (SP-SW) Poorly sorted fine sand with occasional pebbles, Stage II-III, (10YR 7/2, m) (?), in upper portion of section, incipient laminar or plate structure, massive with blotchy patches of greater carbonate accumulation in lower portion of section (Stage II) [PROMONTORY SOIL DEVELOPED ON PRE-BONNEVILLE EOLIAN DEPOSITS]	4473.59 feet; 4472.19 feet
27–28					SAND (SW) Very pale brown (10YR 7/3M), fine sand [PROMONTORY SOIL on EOLIAN?]	
28–29					SAND (SW) Fine sand with a few pebbles up to 2.5 centimeters clast size [PROMONTORY SOIL on EOLIAN?]	
30–31					SAND (SW) Pale brown (10YR 6/3M), cambric soil horizon [LITTLE VALLEY LAKE CYCLE-regressive beach facies with cambric B horizon soil]	4468.59 feet; 4467.79 feet
31–33					SAND (SW) Grayish brown to brown (10YR 5/2.5, m), fine sand, clean, well sorted, fine bedding (heavy mineral beds) [LITTLE VALLEY LAKE CYCLE-regressive beach facies]	4467.09 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-4 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
34					SAND (SW) (continued)	4464.39 feet
35					No recovery	4463.59 feet
36–37					SAND (SW) Fine sand, bedding weakly defined by thin faint heavy mineral layers, lower 3 inches of section is transitional to underlying unit [LITTLE VALLEY LAKE CYCLE-regressive beach facies]	4461.99 feet
37–38					SILTY CLAY (CL) Pale yellow (5YR 6.5/3, m) to pale olive, shell fragments and numerous ostracodes [LITTLE VALLEY LAKE CYCLE-deep water facies]	4460.59 feet 4460.19 feet 4459.79 feet
39					SILTY SAND (SM) [LITTLE VALLEY LAKE CYCLE-deep water facies]	
40					SILTY CLAY (CL) with SAND (SW) [LITTLE VALLEY LAKE CYCLE-deep water facies]	4458.59 feet
41					No recovery	4457.49 feet
42					SILTY CLAY (CL) with SAND (SW) [LITTLE VALLEY LAKE CYCLE-deep water facies]	4456.59 feet
43					SANDY GRAVEL (GP) Gravel clasts are rounded to subrounded, upper 6-7 inches of section is a fine sand [LITTLE VALLEY LAKE CYCLE-transgressive facies]	
44–47					SAND (SW) Light brownish gray (10YR 6/7M), poorly sorted sand (predominately fine to medium sand and gravel), gravel clasts up to 4 centimeters, continuous thin clay films; maganese staining and oxidation along bedding planes, continuous thin calcium carbonate coatings on all sides of one clast [LITTLE VALLEY LAKE CYCLE-transgressive facies]	4453.59 feet
47					Bottom of boring at 45.0 feet.	
48						
49						
50						
51						

B-2 (12/95)

Log of Boring No. C-5

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-5**
BORING LOCATION: 5650 feet on Seismic Line "A" E 1642780.417, N 759399.619	ELEVATION AND DATUM: 4469.78 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/5/98 — DATE FINISHED: 10/6/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 89.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock with K. Hanson and B. Swan
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4469.78 feet	REMARKS
0–3	0.5	SANDY SILT (ML) Very pale brown (10YR 7/4), dry, soft, platey soil structure [POST-PROVO REWORKED EOLIAN/SHEETWASH-with soil]	
3–5.5	1.5	CLAYEY SILT (MH) Upper 2 inches of unit is yellow (10YR 7/6) platey soil [POST-PROVO SOIL] grades into light gray (10YR 7/2), damp, soft to medium stiff, ostracode-rich, breaks into horizontal partings [PROVO DEEP-WATER FACIES]	4466.78 feet
5.5–8.5	0.5	CLAYEY SILT (MH) Light gray (10YR 7/1), damp, blocky [BONNEVILLE DEEP- WATER FACIES-blocky]	4464.28 feet
8.5–12.2	2.0	CLAYEY SILT (MH) Light gray (10YR 6/1) mottled with white (10YR), damp, soft, thin (1-4 millimeters) laminations, ostracode-rich; gradational lower contact [BONNEVILLE DEEP- WATER FACIES-laminated]	4461.28 feet
12.2–15	0.5	SILTY TO CLAYEY SAND (SM-SC) Yellow (10YR 7/6), damp, clayey interbeds to 1 inch, loose, well-bedded, minor carbonate reacts with acid [POST-STANSBURY TRANSGRESSIVE FACIES] clay-rich bed, 1 inch thick [DEEP WATER}	4457.58 feet
15			4454.78 feet

Samples taken at 0–1 ft, 5–6 ft, 10–10.5 ft.

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-5 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
				1.0	CLAY (CL) Pale olive (5Y 6/3), damp [CLAY INTERBED - DEEP WATER]	4454.08 feet
16					SILTY to CLAYEY SAND (SM-SC) Yellow (10YR 7/6), damp [POST STANSBURY TRANSGRESSIVE FACIES]	4452.68 feet
17					SILT (ML) Yellow (10YR 8/6), soft, fine sand to silt [STANSBURY REGRESSIVE FACIES]	4452.18 feet
18–21				1.5	CLAYEY SILT (MH) Yellowish to whitish (10YR 7/6-8/2), dry, medium dense, laminar with charaphytes Coarsens upward, top of whitish marl [STANSBURY DEEP-WATER FACIES SEQUENCE]	
22–25				1.0	CLAYEY SILT (MH) Similar, yellow (10Y 7/8), with less laminations, minor ostracodes, well-bedded [STANSBURY TRANSGRESSIVE FACIES]	4448.08 feet
26–29				<0.5	SAND (SW) Pale yellow (2.5Y 7/4), dry, loose, clean, well-sorted, massive, fine [STANSBURY TRANSGRESSIVE FACIES]	4443.78 feet
30–33				<0.5	SAND (SW) (same as above) Pale yellow (2.5Y 7/4), dry, loose, with interbedded medium grained layers, cross bedding [STANSBURY TRANSGRESSIVE FACIES]	4439.78 feet

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-5 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (same as above) (continued)	
34					Layers of oolitic, well sorted black mineral grains (<1 millimeter diameter), gastropod shells	Harder drilling
35						
36					Same, with scattered subrounded pebbles (to 1-inch) at base	
37					[POST-PROVO STANSBURY TRANSGRESSIVE FACIES-NEARSHORE]	
38						
39						
40				1.0	CLAYEY SAND to SILTY SAND (SW-SC) Brownish yellow (2.5Y 6/6), dry, laminated with sandy interbeds, medium stiff, varies to silty sand with increasing scattered subrounded pebbles, clay clasts or stringers to 1/2 inch [STANSBURY TRANSGRESSIVE FACIES]	4430.18 feet
41						
42				<0.5	SAND (SW) Pale yellow (2.5Y 7/4), dry, loose, with minor subrounded pebbles (<1%), fine to medium grained, well sorted, weakly bedded [STANSBURY TRANSGRESSIVE FACIES]	
43						
44				1.0	SANDY GRAVEL (GP) Pale yellow (2.5Y 7/4) to whitish, dry, loose, 70% poorly sorted subrounded to subangular gravel, 30% poorly sorted sand, clasts have <1 millimeter carbonate coatings on base, pebbles to 2 inches [PROMONTORY SOIL (?) developed on PRE-BONNEVILLE ALLUVIUM]	4425.88 feet
45						4424.78 feet
46						
47					Sand (SW) [REWORKED PRE-BONNEVILLE ALLUVIUM]	
48					Sandy gravel (CP), locally derived dolomite [REWORKED PRE-BONNEVILLE ALLUVIUM]	
49					GRAVELLY SAND (SP-SW) and CLAYEY SAND (SC) Very pale brown (10YR 7/4), dry with clayey sand, and fine sand containing black laminated mineral horizons, loose to medium dense, subrounded pebbles (average clast size ≤0.5 inch), interbedded [LITTLE VALLEY LACUSTRINE CYCLE-lagoon with reworked alluvium]	4420.58 feet
50						
51						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-5 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
52					GRAVELLY SAND (SP-SW) and CLAYEY SAND (SC) (continued)	
53				1.0		
54						
55						
56						
57				<0.5	Sand, silty, gravelly (same as above)	
58				1.0	SANDY SILT (MH) Very pale brown (10YR 8/4), medium dense, laminated	4412.58 feet
				<0.5	SILTY SAND (SW-SP)	4411.78 feet
59						
60					SANDY SILT (MH) Very pale brown (10YR 8/4), medium dense, laminated [LITTLE VALLEY LACUSTRINE (?)]	4410.78 feet; 4410.28 feet
61				<0.5	SANDY GRAVEL to GRAVELLY SAND (SP-SW) Poorly sorted, subrounded pebbles (<0.25 inch diameter) [ALLUVIUM WITH BEACH SAND REWORKED]	
62						
63						
64						
65						
66					Same with sand (SW), yellow (10YR 7/6), dry, well sorted, fine to medium clean [BEACH SAND REWORKED]	
67						
68				<0.5	[LITTLE VALLEY LACUSTRINE (?)- with reworked alluvium]	
69						

B-2 (12/95)

Project No. 4790

Geomatrix Consultants

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-5 (cont.)

DEPTH (feet): 52–69

Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
	GRAVELLY SAND (SP-SW) and CLAYEY SAND (SC) (continued)	
1.0		
<0.5	Sand, silty, gravelly (same as above)	
		4412.58 feet
1.0	SANDY SILT (MH) Very pale brown (10YR 8/4), medium dense, laminated	
		4411.78 feet
<0.5	SILTY SAND (SW-SP)	
		4410.78 feet
	SANDY SILT (MH) Very pale brown (10YR 8/4), medium dense, laminated [LITTLE VALLEY LACUSTRINE (?)]	4410.28 feet
<0.5	SANDY GRAVEL to GRAVELLY SAND (SP-SW) Poorly sorted, subrounded pebbles (<0.25 inch diameter) [ALLUVIUM WITH BEACH SAND REWORKED]	
	Same with sand (SW), yellow (10YR 7/6), dry, well sorted, fine to medium clean [BEACH SAND REWORKED]	
<0.5	[LITTLE VALLEY LACUSTRINE (?)- with reworked alluvium]	

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-5 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SANDY GRAVEL to GRAVELLY SAND (SP-SW) (continued)	
70–72					Same, pebble size up to 2 inches diameter, 1 inch average, increasing silt content with depth	
73					SILT (MH) Yellow (10YR 8/6), dry, interbed within unit, medium dense	
74					SANDY GRAVEL (SP) with SAND (SW) Medium dense, subrounded to subangular with sand, light gray (10YR 7/2)	
76.5					Top of soil at 76.5 feet, pebbles to 2 inches, calcium carbonate coatings 1-2 millimeters on pebbles	4393.28 feet
78.5				3.0		
79					No recovery - air rotary, hard, gravel fragments with carbonate coatings [PRE-LITTLE VALLEY ALLUVIUM]	Refusal; switched to air rotary
85					SANDY SILT (MH) Reddish brown (7.5YR 6/4), dry, scattered rounded pebbles to 3/4 inch (?-may be from upper units)	
86					Reddish clay	4383.78 feet
					White dust	
87					[SALT LAKE GROUP?]	4382.78 feet

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-5 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
88		X			SANDY SILT (MH) (continued) [SALT LAKE GROUP?]	
89					Bottom of boring at 89.0 feet.	4380.78 feet
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						
101						
102						
103						
104						
105						

B-2 (12/95)

Project No. 4790 | Geomatrix Consultants

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-6**

BORING LOCATION: 8150 feet on Seismic Line "A" E 1640287.621, N 759434.186		ELEVATION AND DATUM: 4465.24 feet	
DRILLING CONTRACTOR: Layne Christensen		DATE STARTED: 10/6/98	DATE FINISHED: 10/7/98
DRILLING METHOD: Rotary auger with hollow stem		TOTAL DEPTH: 48.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61		DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)		LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: ---	DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.24 feet	REMARKS
0–3.4					SANDY SILT (ML) Pale brown (10YR 6/3), dry, loose to medium dense, platey with dessimated carbonate [POST-PROVO REWORKED EOLIAN]	4461.84 feet
3.4–5					CLAYEY SILT (MH) Light yellowish brown (2.5Y 6/4) to olive gray (5Y 5/2), dry, carbonate stringers, blocky [BONNEVILLE DEEP-WATER FACIES-blocky]	4460.24 feet
5–9.2					CLAYEY SILT (MH) Yellow (2.5Y 7/6) to brownish yellow (10YR 6/8), damp, laminated, ostracode rich, gradational lower contact [BONNEVILLE DEEP-WATER FACIES-laminated]	4456.04 feet
9.2–13					SILTY to CLAYEY SAND (SM-SC) Brownish yellow (10YR 6/6), dry, fine, loose to medium stiff, well bedded, grades downward into very fine sand to silt [POST-STANSBURY TRANSGRESSIVE FACIES]	
13–14.5					SILT (ML) Very pale brown (10YR 8/3), dry, soft, charaphyte-rich layers [POST-STANSBURY REGRESSIVE FACIES grading down to STANSBURY DEEP-WATER FACIES]	4450.74 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-6 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16–17.5					SILT (ML) (continued) [POST-STANSBURY REGRESSIVE FACIES grading down to STANSBURY DEEP-WATER FACIES]	
17.5–20					INTERBEDDED SILT (ML) and CLAYEY SILT (MH) Silt (as above) and clayey silt beds (as below), clayey silt beds increase to 100% at 20 feet	4447.74 feet
20–24					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium stiff, laminated [STANSBURY DEEP-WATER FACIES]	4445.24 feet
24–27.5					SANDY SILT (ML) Pale yellow (2.5YR 7/4), dry, loose, clean, massive to weakly bedded, fine to very fine sand, minor clay component, otherwise clean [STANSBURY TRANSGRESSIVE FACIES]	4471.34 feet
27.5–30					SAND (SW) Pale yellow (2.5Y 7/4), dry, loose, fine [STANSBURY TRANSGRESSIVE FACIES]; Clay (at ~29.3 ft)	4437.64 feet
30–33					SAND (SW) (same as above) Very pale brown (10YR 7/4), dry, loose, massive, fine to medium grained , well sorted, well rounded grains, abundant quartz [STANSBURY TRANSGRESSIVE FACIES]	4435.24 feet

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-6 (cont.)**

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (same as above) (continued)	
34				<0.5		
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45					Scattered (<3%) rounded pebbles at base	4420.04 feet
					SANDY CLAY (CL) Yellowish brown (10YR 5/6), dry, low plasticity, laminar	
46				74.0		
47				<0.5 74.0	SAND (SW) and SANDY GRAVEL (GP) Sand as above, grades into sandy gravel, dry, hard, calcium carbonate cemented, rinds to 1 millimeter [PROMONTORY SOIL]	4418.54 feet
48					Bottom of boring at 48.0 feet.	4417.24 feet Refusal
49						
50						
51						

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	# Log of Boring No. C-7
BORING LOCATION: 9125 feet on Seismic Line "A" E 1639308.971, N 759450.749	ELEVATION AND DATUM: 4465.59 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/7/98 — DATE FINISHED: 10/7/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.59 feet	REMARKS
0–4.2				<0.5	SANDY GRAVELLY SILT (ML) Pink (7.5YR 7/4) to reddish yellow (7.5YR 6/6), dry, loose, platey minor (Stage I-II) [POST-PROVO REWORKED EOLIAN WITH SOIL]	
4.2–6.0				1.5	SILTY CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/3) with white (calcium carbonate) mottles, disordered structure, medium dense, blocky [BONNEVILLE DEEP-WATER FACIES-blocky]	4461.39 feet
6.0–9.0				1.0	CLAYEY SILT (MH) Yellow (2.5Y 7/6) , damp, medium stiff, laminar, ostracodes on layer partings, laminated, coarsens downwards into sandy silt; lower contact is gradational over 0.3 feet [BONNEVILLE DEEP-WATER FACIES-laminated]	4459.59 feet
9.0–12.0				0.5	SANDY SILT to SILTY SAND (ML-SM) Light yellow brown (2.5Y 6/4), dry, well bedded, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4456.59 feet
12.0–14.5				0.5	INTERBEDDED SANDY SILT and CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium stiff, laminated, interbeds of clayey silt increase to 100% of section at depth of 14.5 feet [POST-STANSBURY TRANSGRESSIVE FACIES?]	4453.59 feet
14.5–15					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry medium stiff, laminated [POST-STANSBURY TRANSGRESSIVE or STANSBURY REGRESSIVE FACIES?]	4451.09 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-7 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast.; consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAYEY SILT (MH) (continued)	
16						
17				1.0		
18						
19						
20					Fining downward [STANSBURY DEEP-WATER FACIES?]	
21						
22					Less laminations, coarser [STANSBURY TRANSGRESSIVE FACIES?]	
23					SANDY SILT (ML) Yellow (2.5Y 7/8), dry, laminar, medium stiff, similar to unit above except sandier	4442.79 feet
24						
25						
26						
27					Fines down to clayey silt (MH) laminations	
28						
					SILTY SAND (SW-SM) Very pale brown (10YR 7/4), dry, loose, well bedded in upper 1.5 feet, massive below	4437.09 feet
29						
30					INTERBEDDED CLAY (CL) and SAND (SW) [STANSBURY TRANSGRESSIVE FACIES-PLAYA DEPOSITS?]	
31						4433.39 feet
32					Clay, gray, plastic	4433.19 feet
					Clay, gray (5Y 6/1), clean, plastic, no laminations	4432.89 feet
33						

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-7 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					INTERBEDDED CLAY (CL) and SAND (SW) (continued) [STANSBURY TRANSGRESSIVE FACIES-PLAYA DEPOSITS?]	4432.49 feet
34					Clay (continued)	4431.79 feet
35					Clay, gray (5Y 6/1), clean, plastic, no laminations	
36					SAND (SW) Light gray (10YR 7/2), dry, loose, massive	
37						
38						
39						
40						
41						
42						
43						
44					Pea gravel Subrounded pebbles to 1 inch, up to 5% of sand [STANSBURY TRANSGRESSIVE FACIES-Beach]	
45					SANDY GRAVEL (GP) Dry, poorly sorted, subrounded to subangular pebbles to 1 inch, average 0.5 inch, well cemented with carbonate, top of soil [PROMONTARY SOIL developed on PRE-BONNEVILE ALLUVIUM]	4420.69 feet
46				>4		
47						
48						
49						
50					Bottom of boring at 50.0 feet.	4415.59 feet
51						

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-8**	
BORING LOCATION: 9100 feet on Seismic Line "A" E 1639337.563, N 759450.268	ELEVATION AND DATUM: 4465.37 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/7/98	DATE FINISHED: 10/7/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 4465.37 feet	REMARKS
0–2.5		X		<0.5	SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry, medium stiff, platey (Stage I-II carbonate) [POST-PROVO REWORKED EOLIAN]	
2.8–5		X		1.5	SILTY CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/3), damp, with white calcium carbonate mottles, chaotic structure, blocky, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4462.57 feet
5–8.5		X		1.0	CLAYEY SILT (MH) Yellow (2.5Y 7/6) , damp, medium dense, laminar, ostracodes on partings [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.37 feet
8.5–13		X			SANDY SILT (ML) Light yellow brown (2.5Y 6/4), dry, well bedded, soft Fines downward [POST-STANSBURY TRANSGRESSIVE FACIES]	4456.87 feet
13–14		X			INTERBEDDED SANDY SILT and CLAYEY SILT [POST-STANSBURY TRANSGRESSIVE FACIES]	
14–15		X			CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium dense, laminated/bedded	4450.57 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-8 (cont.)

Depth (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16					CLAYEY SILT (MH) (continued) [POST-STANSBURY TRANSGRESSIVE FACIES?]	
17				1.5	Fines downward	
18						
19						
20						
21					Grades to [STANSBURY REGRESSIVE FACIES	
22						
23					CLAYEY SILT (MH) and SILTY SAND (SM) Pale yellow (2.5Y 8/4), dry, medium dense, laminated/platey, whitish clayey silt layers with abundant ostracodes at 23.5-24 feet, ostracode fragments in silty fine sand (SM), coarsens downward [STANSBURY DEEP-WATER FACIES]	4442.37 feet
24				2.0		
25						
26						
27						
28						
29					SILTY SAND (SW-SM) Very pale brown (10YR 8/3), dry, loose, well bedded, well rounded, fine to very fine grained [STANSBURY TRANSGRESSIVE FACIES]	4436.67 feet
30						
31						
32					Sand (SW), massive (as above)	
33					CLAY (CL) Light olive gray (5Y 6/2), plastic, no laminations	4432.87 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-8 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAY (CL) (continued)	
34					SAND (as above)	4431.87 feet
					CLAY (CL)	4431.27 feet
35					SAND (SM) Massive (as above) [STANSBURY TRANSGRESSIVE FACIES]	4431.07 feet
36						
37						
38						
39						
40						
41						
42						
43						
44						
45					No recovery, gravel in cuttings, carbonate coatings on pebbles to 1 inch, 0.5 inch average clast size [PROMONTORY SOIL developed on PRE-BONNEVILLE ALLUVIUM]	4420.37 feet Hit hard material
46						
47						
48						
49						
50					Bottom of boring at 50.0 feet.	4415.37 feet
51						

B-2 (12/95)

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Log of Boring No. C-9

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-9**
BORING LOCATION: 9075 feet on Seismic Line "A" E 1639362.092, N 759449.977	ELEVATION AND DATUM: 4465.43 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/8/98 — DATE FINISHED: 10/8/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 55.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.43 feet	REMARKS
0–4				<0.5	SANDY SILT (ML) Reddish yellow (7.5YR 7/6), dry, loose to medium dense, platey [POST-PROVO REWORKED EOLIAN-minor Stage I carbonate]	
4				1.5	SILTY CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/4), dry, with white mottling, blocky, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4461.53 feet
5					CLAYEY SILT (MH) Yellow (10YR 8/6) , damp, medium dense, laminar, ostracods [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.43 feet
6.5				1.5		
8					SANDY SILT (ML) Pale yellow (2.5Y 7/4), dry, well bedded to laminar, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4457.43 feet
10				2.0		
12.5					Appearance of interbeds of clayey silt (MH), brownish yellow (10YR 6/6), dry, medium dense, laminar	4457.43 feet
14.2					CLAYEY SILT (MH) Brownish yellow (10YR 6/6), dry, medium dense, laminar [POST-STANSBURY TRANSGRESSIVE FACIES?]	4451.23 feet
15						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-9 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–18				1.5	CLAYEY SILT (MH) (continued) Fines downward	Problems with pitcher tube; depths of contacts between 15-20 feet are uncertain
18					Same (?), less laminations, minor ostracodes [POST-STANSBURY TRANSGRESSIVE FACIES and/or STANSBURY REGRESSIVE FACIES?]	4447.63 feet
24					CLAYEY SILT (MH) Pale yellow (2.5Y 8/2), dry, medium dense, laminar/platey, abundant ostracodes on partings, coarsens downward [STANSBURY DEEP-WATER FACIES]	4441.63 feet
29					SAND (SW) Light gray (2.5Y 7/2), dry, loose, fine to very fine [STANSBURY TRANSGRESSIVE FACIES]	4436.63 feet
30					SAND (SW) Very pale brown (10YR 8/4), dry, loose, massive, fine to medium grained [STANSBURY TRANSGRESSIVE FACIES]	4435.63 feet
32.4					CLAY (CL) Light olive brown (2.5Y 5/4), plastic [PLAYA DEPOSIT?]	4433.23 feet
32.6					SAND (SW) Very pale brown (10YR 8/4), dry, loose, massive, fine to medium grained [STANSBURY TRANSGRESSIVE FACIES]	4433.03 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-9 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (continued)	
34					CLAY (CL) Light olive brown (2.5Y 5/4), plastic [PLAYA DEPOSIT?]	4431.83 feet 4431.73 feet
35					SAND (SW) Very pale brown (10YR 8/4), dry, loose, massive, fine to medium grained [BEACH SAND] [STANSBURY TRANSGRESSIVE FACIES]	
36						
37						
38						
39						
40						
41						
42						
43						
44						
45					[PROMONTORY SOIL ON ALLUVIAL GRAVEL] No recovery, gravel cuttings with carbonate rinds to 1 millimeter	4420.43 feet Hard drilling
46						
47						
48						
49						
50						
51						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-9 (cont.)

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					[PROMONTORY SOIL ON ALLUVIAL GRAVEL] (continued)	
52						
53					No recovery, subangular to subrounded sandy gravel (SP)	
54						
55					Bottom of boring at 55.0 feet.	4410.43 feet
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						

Log of Boring No. C-10

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	Log of Boring No. C-10
BORING LOCATION: 9150 feet on Seismic Line "A" E 1639284.297, N 759450.206	ELEVATION AND DATUM: 4465.25 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/8/98 — DATE FINISHED: 10/8/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.25 feet	REMARKS
0–4	<0.5 (at ~2.5)	SANDY SILT (ML) Pink (7.5YR 7/4), dry, minor pebbles, loose, platey, weak Stage I carbonate [POST-PROVO REWORKED EOLIAN]	
4	1.5 (at ~4.5)	SILTY CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/3) with white mottles [BONNEVILLE DEEP-WATER FACIES-blocky]	4461.35 feet
5	1.0 (at 6)	CLAYEY SILT (MH) Yellow (2.5Y 7/6), medium dense, laminar, ostracodes on partings [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.45 feet
9		SANDY SILT to SILTY SAND (ML-SM) Very pale brown (10YR 8/4), dry, well bedded, fine sand, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4456.35 feet
12.3		INTERBEDDED CLAYEY SILT (MH) Yellow (2.5Y 7/5), dry, medium dense, laminated clayey silt beds increases from 20% to 100% at basal contact	4452.95 feet
14.3		CLAYEY SILT (MH) Yellow (2.5Y 7/5), dry, medium dense, laminated, fines downward [POST-STANSBURY TRANSGRESSIVE FACIES]	4450.95 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-10 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAYEY SILT (MH) (continued)	
16						
17						
18						
19					Finer than above, grades to SILT (ML)	
20						
21						
22						
23						
24						
25						No grinding, still sandy/silt
26						
27						
28						
29						
30						
31						
32						
33						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-10 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
34–44					SILTY SAND (SM) Olive yellow (2.5Y 6/6), damp, very fine, massive [STANSBURY TRANSGRESSIVE FACIES, BEACH SAND WITH EOLIAN?]	
44					? ——— ? ——— ? ——— ?	4421.25 feet
44–50					SANDY GRAVEL (GP) Minor carbonate coatings on subrounded to subangular clasts (from cuttings only), <1 inch average diameter pebbles [FROM CUTTINGS ONLY-PROMONTARY SOIL developed on PRE-BONNEVILLE ALLUVIUM]	Gravel drilling hard at 44-45 feet
50					Bottom of boring at 50.0 feet.	4415.25 feet
51						

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-11**
BORING LOCATION: 9175 feet on Seismic Line "A" E 1639259.919, N 759449.052	ELEVATION AND DATUM: 4465.40 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/8/98 — DATE FINISHED: 10/8/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.40 feet	REMARKS
0–3.3				<0.5	SANDY SILT (ML) Reddish yellow (7.5YR 5/6), dry, loose, disseminated carbonate [POST-PROVO REWORKED EOLIAN]	
3.3–4.5				1.5	CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/3) [BONNEVILLE DEEP-WATER FACIES-blocky]	4462.1 feet
4.5–15				1.0	CLAYEY SILT (MH) Olive yellow (2.5Y 6/6), damp to dry, medium dense, laminar [BONNEVILLE DEEP-WATER FACIES-laminated]	4463.3 feet
9					Same as above, laminations appear warped/folded (due to drilling?)	

B-1 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-11 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS

CLAYEY SILT (MH) (continued)

(17) Clayey based on cuttings, wet to damp

(18) ?

(20) Sandy silt (ML), yellow (10YR 8/6), damp, laminar, medium dense, almost a fine sand (may be slop from above)

(22) ?

(26) ?

(28) Clayey silt (MH), yellow (10YR 7/6), damp, medium dense, ostracodes on partings, laminar, coarsens down

(30) SAND (SW)
Light gray (10YR 7/2), dry, loose, well sorted, fine to medium grained, massive

(31) CLAY (CL) — 4434.4 feet
Light olive brown (2.5Y 5/4), damp, highly plastic, clean

(32) SAND (SW) — 4433.2 feet
Light gray (10YR 7/2), dry, loose, well sorted, fine to medium grained, massive — Wet interval — 4433.0 feet

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-11 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (continued)	
34					CLAY (CL) Light olive brown (2.5Y 5/4), damp, highly plastic, clean	4431.9 feet 4431.7 feet
35					SAND (SW) Light gray (10YR 7/2), dry, loose, well sorted, fine to medium grained, massive [STANSBURY TRANSGRESSIVE FACIES]	
37–38					Sand (SW), as above, massive with scattered subrounded to subangular pebbles to 0.5 inch	
44–45					Gravelly sand (SW), as above with increasing gravel to 50%, subrounded to subangular calcium carbonate coatings [LACUSTRINE with REWORKED ALLUVIAL GRAVEL]	Hard from 45-50 feet
48					SANDY GRAVEL (GP) Dry, rounded to subangular, poorly sorted, carbonate rinds to 1 millimeter, disseminated calcium carbonate to Stage I from 49-50 feet [PROMONTARY SOIL developed on REWORKED PRE-BONNEVILLE ALLUVIUM]	4417.3 feet "Really" hard
50						4415.4 feet
51					Bottom of boring at 50.0 feet.	

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-12**	
BORING LOCATION: 9162.5 feet on Seismic Line "A" E 1639272.478, N 759449.228	ELEVATION AND DATUM: 4465.32 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/9/98	DATE FINISHED: 10/10/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.32 feet	REMARKS
0–4	<0.5	SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry, loose, platey [POST-PROVO REWORKED EOLIAN-with soil]	
4–5	1.5	SILTY CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/4) with white mottles, blocky [BONNEVILLE DEEP-WATER FACIES-blocky]	4461.32 feet
5–9	1.0	CLAYEY SILT (MH) Yellow (2.5Y 7/8), dry, medium dense,, laminar, ostracodes abundant [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.32 feet
9–12.4	<0.5	SANDY SILT (ML) to SILTY SAND (SM) Light yellow brown (2.5Y 6/4) to light gray (10YR 7/2) (interbedded), dry, loose to medium dense, soft [POST-STANSBURY TRANSGRESSIVE FACIES] Appearance of interbeds of clayey silt (MH)	4456.32 feet
12.4–13.5	0.5	INTERBEDDED SANDY SILT (ML) and CLAYEY SILT (MH) Fines upward	4452.92 feet
13.5–15		CLAYEY SILT (MH) Yellow (2.5Y 7/8), damp, medium dense, laminated [POST-STANSBURY TRANSGRESSIVE FACIES] Two pervasive subplanar, irregular, fractures spaced 1 inch apart, 50° dip irregular, no offset of laminations (?)	4451.82 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-12 (cont.)**

Depth (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16				1.0	CLAYEY SILT (MH) (continued) [POST-STANSBURY TRANSGRESSIVE FACIES]	
17						
18				<0.5	SILTY SAND (SM) Very fine, interbedded with clayey silt [STANSBURY REGRESSIVE FACIES]	4447.32 feet
19					CLAYEY SILT (MH) As above except fines down [STANSBURY REGRESSIVE FACIES]	4446.32 feet
20						
21				1.5		
22						
23						
24					Sharp well defined contact at base	
					CLAYEY SILT (MH) Very pale brown (10YR 8/4), damp, medium dense, thin (<1 millimeter) laminations, ostracodes few on partings [STANSBURY DEEP-WATER FACIES]	4441.12 feet
25				2.0		
26					fracture (48° dip), planar, sharp	
27						
28					SILTY SAND (SW-SM) Very pale brown (10YR 7/4) to yellow (10YR 7/8) (stained?), well bedded to massive, loose [STANSBURY TRANSGRESSIVE FACIES]	4436.92 feet
29						
30						
31						
32						
33						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-12 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
34–38					SILTY SAND (SW-SM) (continued) [STANSBURY TRANSGRESSIVE FACIES]	
38–39					SANDY CLAY (CH) Olive (5Y 5/4), damp, medium plastic	4427.12 feet; 4427.02 feet
39–43					SAND (SW) Light gray (10YR 7/2), dry, loose, well sorted, clean, medium to fine sand [BEACH SAND], grades to gravelly sand (to 5% gravel), well rounded to 1/4 inch	
41					Thin (<0.5 inch) gravel stringer, well rounded pebbles to 0.5 inch [STANSBURY TRANSGRESSIVE FACIES]	
43.5					Sandy gravel layer, well rounded to 1 inch diameter	4421.82 feet
44–45					SANDY SILT (ML) Yellow (10YR 7/6), damp, medium dense	4421.62 feet
45–46					SAND (SW) Light gray (10YR 7/2), dry, loose, well sorted, increasing clay with depth	4420.32 feet; Hard drilling
46–50					Gravel cuttings [PROMONTARY SOIL developed on PRE-BONNEVILLE ALLUVIUM]	
50					Bottom of boring at 50.0 feet.	4415.32 feet

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-13**	
BORING LOCATION: 9200 feet on Seismic Line "A" E 1639233.421, N 759448.115	ELEVATION AND DATUM: 4464.85 feet	
RILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/10/98	DATE FINISHED: 10/10/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 55.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4464.85 feet	REMARKS
0–3.1		X		<0.5 (at 2)	SANDY SILT (ML) Reddish yellow (7.5 6/8), dry, loose, platey, weak Stage I carbonate [POST-PROVO REWORKED EOLIAN]	
3.1–4.1				1.0 (at 3.5)	SILTY CLAY to CLAYEY SILT (CL-MH) Olive yellow (2.5Y 6/6), dry, blocky [BONNEVILLE DEEP-WATER FACIES-blocky]	4461.75 feet
4.1–8.2		X		1.5 (at 5)	CLAYEY SILT (MH) Pale yellow (2.5Y 7/4) , dry, laminated, medium dense [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.75 feet
8.2–13.0		X			SANDY SILT to SILTY SAND (ML-SM) Light yellowish brown (2.5Y 6/4), dry, well bedded, soft to medium dense [POST-STANSBURY TRANSGRESSIVE FACIES] CLAYEY SILT (MH) Brownish yellow (10YR 6/6), dry, medium dense, laminar [UNIT7b, REGRESSIVE]	4456.65 feet
13.0–15					INTERBEDDED SANDY SILT (ML) and CLAYEY SILT (MH) Fractures dipping 45°-50°, sharp, planar CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium dense, well bedded to laminar	4451.85 feet 4450.05 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-13 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAYEY SILT (MH) (continued) [POST-STANSBURY TRANSGRESSIVE FACIES]	
16						
17						
18					SANDY SILT (ML) Yellow (10YR 8/6), dry, loose, well bedded, grades to interbeds of fine sand [STANSBURY REGRESSIVE FACIES]	4446.75 feet
19						
20					Fractures, 45° dip, sharp, planar	
21						
22					Fines downward	
23						
24					Increasing clay to clayey silt with abundant ostracodes, very pale brown (10YR 8/4), damp [STANSBURY DEEP-WATER FACIES]	
25						
26						
27						
28					SILTY SAND (SW-SM) Very pale brown (10YR 7/4) with staining (5Y 6/8), dry, loose, upper 1 foot bedded, else massive, fine to medium fine sand [STANSBURY TRANSGRESSIVE FACIES]	4437.15 feet
29						
30					SAND (SW) As above to medium grained, clean, well sorted, massive [STANSBURY TRANSGRESSIVE FACIES, BEACH SAND]	4434.85 feet
31						
32					CLAY (CL) Light olive brown (2.5Y 5/4), damp, highly plastic	
33						4432.15 feet

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAY (CL) (continued)	4431.75 feet
34					SAND (SW) As above to medium grained, clean, well sorted, massive	4431.05 feet; 4430.95 feet
35					CLAY (CL) Light olive brown (2.5Y 5/4), damp, highly plastic	
36					SAND (SW) Light gray (10YR 7/2), dry, loose, clean, well sorted, medium to fine grained, massive (as above)	
37						
38						
39						
40						
41						
42						
43						
44						
45					Sand (SW), as above [STANSBURY TRANSGRESSIVE FACIES]	Gravel cuttings at 45 feet
46						
47						
48					Clean sand, minor (<3%), well rounded to subrounded pebbles to 1 inch [BEACH GRAVEL]	
49					SANDY GRAVEL (GP) Very pale brown (10YR 8/3), poorly sorted, subangular to subrounded to 1.5 inches, average 0.7 inch, carbonate rinds to 1 millimeter, disseminated carbonate [PROMONTARY SOIL on PRE-BONNEVILLE ALLUVIUM]	4415.75 feet
50						
51						

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-13 (cont.)**

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SANDY GRAVEL (GP) (continued)	
52						
53						
54					Same	
55					Bottom of boring at 55.0 feet.	4409.85 feet
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	Log of Boring No. C-14	
BORING LOCATION: 9225 feet on Seismic Line "A" E 1639208.070, N 759450	ELEVATION AND DATUM: 4463.20 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/10/98	DATE FINISHED: 10/10/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4463.20 feet	REMARKS
0–1.5		X		0.5	SANDY SILT (ML) Reddish yellow (7.5YR 7/8), dry, medium dense, platey [POST-PROVO REWORKED EOLIAN-with weak soil]	
2.3				1.0	SILTY CLAY to CLAYEY SILT (CL-CH) Light yellowish brown (2.5Y 6/4), damp, blocky [UNIT4b, [BONNEVILLE DEEP-WATER FACIES-blocky]	4460.90 feet
3.6				1.5	CLAYEY SILT (CH) Pale yellow (2.5Y 7/3), dry, laminar, medium dense [BONNEVILLE DEEP-WATER FACIES-laminated]	4459.60 feet
5–6		X				
7.9				0.5	SANDY SILT to SILTY SAND (ML-SM) Light yellow brown (2.5Y 6/9), dry, well bedded to laminar, soft to medium dense] [POST-STANSBURY TRANSGRESSIVE FACIES]	4455.30 feet
9.0					INTERBEDDED SANDY SILT (ML) (as above) and CLAYEY SILT (MH) (as below) [POST-STANSBURY TRANSGRESSIVE FACIES]	4454.20 feet
10–11		X				
13.1				1.0	CLAYEY SILT (MH) Yellow (7.5Y 6/6), dry, medium dense, laminar, some sandy silt (ML)	4450.10 feet
15						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-14 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16–20					CLAYEY SILT (MH) (continued) Fining down	
21–27					SANDY SILT (ML) Yellow (2.5Y 7/8), dry, laminar, medium dense to loose, fines down to laminated [STANSBURY REGRESSIVE FACIES? grading down to STANSBURY DEEP-WATER FACIES?] Increasing clay content, laminations, sharp lower contact	4442.20 feet
28–32					SAND (SW) Very pale brown (10YR 7/4), dry, loose, upper 1 feet well bedded with 0.1-inch clay stringer, else massive [PRE-STANSBURY TRANSGRESSIVE FACIES] Clay (CL), light olive brown (2.5Y 5/4), highly plastic Clay (CL), light olive brown (2.5Y 5/4), highly plastic	4435.90 feet 4431.60 feet 4431.50 feet
33					SAND (SW) Light gray (10YR 7/2), dry, loose, fine to medium	4431.10 feet

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-14 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (continued) [STANSBURY TRANSGRESSIVE FACIES]	
34						
35						
36						
37						
38					Large round pebble (2 inches)	4425.20 feet
39						
40						
41						
42					Minor small (<0.2 inch) round pebbles <1%	
43					SANDY GRAVEL (GW) Subrounded pebbles to 1 inch, beach sand (well sorted) matrix [STANSBURY TRANSGRESSIVE FACIES]	4420.60 feet
44					SANDY GRAVEL (GP) Subrounded to subangular pebbles to 2-inch diameter, carbonate rinds on base of pebbles, medium dense, disseminated calcium carbonate [PROMONTORY SOIL? or LACUSTRINE with REWORKED GRAVEL]	4419.60 feet
45						
46						
47					GRAVELLY SAND Beach, subrounded [PROMONTORY SOIL?]	4416.60 feet
48					SANDY GRAVEL (GP) Subrounded, subangular, good 1-2 millimeter carbonate rinds, large (2-3 inches) clasts	4415.20 feet
49						
50					Bottom of boring at 50.0 feet.	4413.20 feet
51						

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah		# Log of Boring No. C-15	
BORING LOCATION: 9250 feet on Seismic Line "A" E 1639181.912, N 759451.971		ELEVATION AND DATUM: 4463.31 feet	
DRILLING CONTRACTOR: Layne Christensen		DATE STARTED: 10/10/98	DATE FINISHED: 10/10/98
DRILLING METHOD: Rotary auger with hollow stem		TOTAL DEPTH: 50.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61		DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)		LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: ---	DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4463.31 feet	REMARKS
					Auger to 30 feet; sample from 30 feet	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-15 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16–29					Auger to 30 feet; sample from 30 feet	
30–33		X			SAND (SW) Loose [STANSBURY TRANSGRESSIVE FACIES]	4433.31 feet Hole wet in upper 30 feet

B-2 (12/95)

Project No. 4790

Geomatrix Consultants

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-15 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					Auger to 30 feet; sample from 30 feet	
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30					SAND (SW) Loose [STANSBURY TRANSGRESSIVE FACIES]	— 4433.31 feet Hole wet in upper 30 feet
31						
32						
33						

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-15 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl, geo. inter.	REMARKS
					SAND (SW) (continued)	
34						
35						
36						
37						
38					? — ? — ? — ? SANDY CLAY (CL) Pale olive (5Y 6/4), damp, medium plastic	4425.31 feet Gravel (pebble?) at 38 feet
39					SAND (SW) Light gray (10YR 7/2), dry, loose, massive, well sorted, fine to medium [STANSBURY TRANSGRESSIVE FACIES]	4424.61 feet
40						
41						
42						
43						
44						
45						
46						
47					GRAVEL Cuttings are gravel with carbonate rinds to 1 millimeter [PROMONTORY SOIL developed on PRE-BONNEVILLE ALLUVUIM]	4416.31 feet Hard at 47 feet
48						
49						
50					Bottom of boring at 50.0 feet.	4413.31 feet
51						

B-2 (12/95)

Project No. 4790 | **Geomatrix Consultants**

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-16**	
BORING LOCATION: 9212.5 feet on Seismic Line "A" E 1639220.440, N 759448.870	ELEVATION AND DATUM: 4463.92 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/10/98	DATE FINISHED: 10/10/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 50.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock with K. Hanson and B. Swan	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4463.92 feet	REMARKS
					Auger to 25 feet; sample from 25-50 feet	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

B-1 (12/95)

Project No. 4790 | **Geomatrix Consultants**

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-16 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					Auger to 25 feet; sample from 25-50 feet	
16						
17						
18						
19						
20						
21						
22						
23						
24						
25					?	4438.92 feet Wet from 25-30 feet
26						
27						
28						
29						
30						
31						
32						
33						

B-2 (12/95)

Project No. 4790

Geomatrix Consultants

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-16 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
33–46.5					SAND (SW) (continued)	4425.92 feet Hard at 38 feet
46.5–50					SANDY GRAVEL (SP) Subrounded to subangular pebbles to 2 inches, in cuttings [PROMONTORY SOIL developed on PRE-BONNEVILLE ALLUVIUM]	4417.42 feet Hard at 46-47 feet
50					Bottom of boring at 50.0 feet.	4413.92 feet

Depth scale: 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	# Log of Boring No. C-17	
BORING LOCATION: 9187.5 feet on Seismic Line "A" E 1639246.253, N 759450.984	ELEVATION AND DATUM: 4464.39 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/10/98	DATE FINISHED: 10/11/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 55.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4464.39 feet	REMARKS
0–15					Auger to 25 feet; sample from 25-50 feet	Upper 10 feet is wet

B-1 (12/95)

Project No. 4790	**Geomatrix Consultants**

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-17 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					Auger to 25 feet; sample from 25-50 feet	
16						
17						
18						
19						
20						
21						
22						
23						
24						
25					CLAYEY SILT (MH) Very pale brown (10YR 8/3), damp, medium dense, laminated, scattered ostracodes, fines downward [STANSBURY DEEP-WATER FACIES]	4439.39 feet
26						
27						
28					SILTY SAND TO SAND (SW) Light gray, loose, fine to medium grained, well sorted, well rounded grains, massive [STANSBURY TRANSGRESSIVE FACIES]] Bedded	4436.59 feet
29						
30						
31						
32						
33						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-17 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
34–41					SAND (SW) Light gray in cuttings	
42					Thin gravel layer (<0.5 feet thck)	4393.28 feet
46–47					Sand (SW), light gray, medium dense, gravel with 1-2 millimeters-thick carbonate rinds in cuttings (reworked?)	Grinding on gravel
48					CLAY (CL)	4415.99 feet
49					SAND (SW) As above	4415.79 feet
					CLAYEY SILT (MH)	4415.19 feet
50					SAND (SW) As above	4414.79 feet
51						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-17 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (continued)	
52					GRAVEL (GP) Poorly sorted, subangular to subrounded, clasts to 1 inch, dolomite/limestone, carbonate rinds to 2 millimeter [PROMONTORY SOIL developed on PRE-BONNEVILLE ALLUVIUM]	4412.59 feet
53						
54						
55					Bottom of boring at 55.0 feet.	4409.39 feet
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah		# Log of Boring No. C-18	
BORING LOCATION: 6700 feet on Seismic Line "A" E 1641726.610, N 759403.004		ELEVATION AND DATUM: 4468.20 feet	
DRILLING CONTRACTOR: Layne Christensen		DATE STARTED: 10/11/98	DATE FINISHED: 10/11/98
DRILLING METHOD: Rotary auger with hollow stem		TOTAL DEPTH: 45.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61		DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)		LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: ---	DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4468.20 feet	REMARKS
0–4					SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry, loose, platey [POST-PROVO REWORKED EOLIAN-with weak soil]	
4–9.5					SILTY CLAY (CL) Pale olive (5Y 6/4), damp, with white mottles, disordered, blocky, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4464.30 feet
9.5–14.3					CLAYEY SILT (CH) Yellow (10YR 7/6), damp, medium dense, laminar, ostracodes [[BONNEVILLE DEEP-WATER FACIES-laminated]	4458.70 feet
14.3–15					SANDY SILT to SILTY SAND (ML-SM) Light yellow brown (2.5Y 5/4), dry, well bedded [POST-STANSBURY TRANSGRESSIVE FACIES]	4453.90 feet

B-1 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-18 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16					SANDY SILT to SILTY SAND (ML-SM) (continued)	
17					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium dense, laminated, fines up [POST-STANSBURY TRANSGRESSIVE FACIES]	4451.30 feet
18					CLAYEY SILT (MH) Yellow (2.5Y 7/6), as above but siltier, less laminated, fines down [POST-STANSBURY REGRESSIVE FACIES]	4450.30 feet
19						
20						
21						
22						
23						
24					More laminar, ostracodes [STANSBURY DEEP-WATER FACIES]	
25						
26						
27						
28					SILTY SAND (SW-SM) Very pale brown (10YR 7/4), with staining, medium dense, fine to very fine sand, massive except in upper foot [STANSBURY TRANSGRESSIVE FACIES]	4440.70 feet 4439.70 feet
29					Bedded	
30					SAND (SW) Light gray (10YR 7/1), dry, loose, well sorted, well rounded grains, fine to medium grained [STANSBURY TRANSGRESSIVE FACIES]	4438.20 feet
31						
32						
33						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-18 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
34–39					SAND (SW) (continued)	
39.5					Hard (cemented)	
42.8					SAND (SW) Light gray (10YR 7/1), dry, well sorted, well rounded grains, fine to medium grained, cemented, very hard [PROMONTORY SOIL]	4425.40 feet
44				5.0		
45					Bottom of boring at 45.0 feet.	4423.20 feet
46–51						

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-19**	
BORING LOCATION: 6600 feet on Seismic Line "A" E 1641828.768, N 759401.686	ELEVATION AND DATUM: 4467.37 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/12/98	DATE FINISHED: 10/12/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 37.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.37 feet	REMARKS
0–3					SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry, loose to medium dense, platey soil [POST-PROVO REWORKED EOLIAN-with soil]	
3–6					CLAYEY SILT (MH) Light olive gray (5Y 6/2), dry, blocky with disordered laminations [BONNEVILLE DEEP-WATER FACIES-blocky] 5: Vertical, planar fracture from 5.1 to 6.0+ feet	4464.27 feet
6–14					CLAYEY SILT (CH) Yellow (10YR 7/6), damp, medium dense, thin (1-3 millimeter) laminations, ostracodes on partings, fractured [BONNEVILLE DEEP-WATER FACIES-laminated] 13–14: Fractured, with deformed laminations [SOFT SEDIMENT DEFORMATION?]	4461.27 feet Wet from 10-12 feet
14–15					SANDY SILT to SILTY SAND (ML-SM) Light olive brown (2.5Y 5/4), damp, well bedded, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4453.37 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-19 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SANDY SILT to SILTY SAND (ML-SM) (continued)	
16					Contact not seen	4451.47 feet
					CLAYEY SILT (MH) Yellow (2.5Y 7/6), damp, medium dense, laminated, fines up [POST-STANSBURY TRANSGRESSIVE FACIES]	
19					Laminations are wavy, deformed, unlike any other core seen elsewhere [POST-STANSBURY REGRESSIVE FACIES?]	
21					?	
22					[STANSBURY DEEP-WATER FACIES?]	
24					SILTY SAND (SM) Yellow (2.5Y 7/6), as above but coarser, less laminated, fines down, medium dense [STANSBURY TRANSGRESSIVE FACIES?]	4443.97 feet
27					SILTY SAND (SM) to SAND (SW) Pale yellow to light gray (2.5Y 7/4 to 10YR 7/2), damp, upper 1 foot is well bedded, below is massive, fine to medium, loose [STANSBURY TRANSGRESSIVE FACIES]	4440.27 feet
30					SAND (SW) Light gray (10YR 7/2), dry, loose, massive, well sorted, subrounded grains, fine to medium grained [STANSBURY TRANSGRESSIVE FACIES	4437.37 feet
33						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-19 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
34–36					SAND (SW) (continued)	
36–37					SAND (SW) Light gray (10YR 7/2), dry, loose, massive, well sorted, subrounded grains, fine to medium grained, carbonate, few round pebbles to 1 inch [STANSBURY TRANSGRESSIVE FACIES/TOP OF PROMONTORY SOIL?]	4431.07 feet; 4430.37 feet Refusal
					Bottom of boring at 37.0 feet.	

Depth scale: 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	# Log of Boring No. C-20	
BORING LOCATION: 6550 feet on Seismic Line "A" E 1641879.326, N 759401.754	ELEVATION AND DATUM: 4467.60 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/12/98	DATE FINISHED: 10/12/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 27.7 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.60 feet	REMARKS
0–3.4					SANDY SILT (ML) Reddish yellow (7.5YR 6/8), dry, loose, platey [POST-PROVO REWORKED EOLIAN-with soil]	
3.4–8.4					SILTY CLAY to CLAYEY SILT (CL-MH) Pale olive (5Y 6/4), damp to wet, disordered, blocky, sheared (50°-dipping fracture from 3.4 to 5.0 feet), medium dense [BONNEVILLE DEEP-WATER FACIES-blocky] White (7.5YR 8/1)	4464.20 feet Wet from 5-10 feet
8.4–13.3					CLAYEY SILT (MH) Yellow (10YR 7/6), damp, medium dense, laminated, sheared (subvertical fracture from above unit), ostracodes on partings [BONNEVILLE DEEP-WATER FACIES-laminated]	4459.20 feet Saturated from 1 to 15 feet
13.3–15					SANDY SILT (ML) Brownish yellow (10YR 6/6), wet (saturated), well bedded, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4454.40 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-20 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–18					SANDY SILT (ML) (continued)	
18					SAND (SW) Very fine, pale yellow (2.5Y 8/4), dry very fine [STANSBURY TRANSGRESSIVE FACIES]	4449.70 feet
19					CLAYEY SILT (MH) Yellow (2.5Y 7/6), damp, medium dense to loose, laminated [STANSBURY DEEP-WATER FACIES?]	4448.60 feet
24					SANDY to CLAYEY SILT (ML-MH) Yellow (2.5Y 6/6), damp, loose to medium dense, poorly laminated/bedded [STANSBURY TRANSGRESSIVE FACIES]	4443.60 feet
27					SILTY SAND to SAND (ML-MH) Bedded [STANSBURY TRANSGRESSIVE FACIES]	4440.60 feet
27.7					Bottom of boring at 27.7 feet.	4439.90 feet Refusal

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah		# Log of Boring No. C-21	
BORING LOCATION: 6500 feet on Seismic Line "A" E 1641930.947, N 759399.081		ELEVATION AND DATUM: 4467.64 feet	
DRILLING CONTRACTOR: Layne Christensen		DATE STARTED: 10/12/98	DATE FINISHED: 10/12/98
DRILLING METHOD: Rotary auger with hollow stem		TOTAL DEPTH: 27.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61		DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)		LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: ---	DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.64 feet	REMARKS
0–3					SANDY SILT (ML) Reddish yellow (7.5YR 6/8), dry, loose [EOLIAN WITH SOIL]	
3–9					CLAYEY SILT (MH) Pale olive (5Y 6/4), whitish mottles, damp, medium dense, blocky, highy fractured, vertical fractures [BONNEVILLE DEEP-WATER FACIES-blocky]	4465.24 feet
9–12.4					CLAYEY SILT (MH) Yellow (10YR 7/6), damp, medium dense, laminated (1-3 millimeters), sheared, ostracodes [BONNEVILLE DEEP-WATER FACIES-laminated]]	4458.04 feet
12.4–15					SANDY SILT (ML) Brownish yellow (10YR 6/6), wet, weakly bedded, laminated, medium dense [POST-STANSBURY TRANSGRESSIVE FACIES]	4455.24 feet

B-1 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-21 (cont.)

Depth (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAYEY SILT (MH) (continued)	
16					1 inch clay seam	4451.04 feet
					CLAYEY SILT (MH) Pale yellow (2.5Y 8/4), well bedded, laminar, fines down	
19					SAND (SW) Very fine to fine [STANSBURY REGRESSIVE FACIES?]	4448.64 feet 4448.24 feet
20					CLAYEY SILT (MH) Yellow (2.5Y 7/6), damp, medium dense, laminated, ostracodes [STANSBURY DEEP-WATER FACIES]	
24					Fractured, 50°-dipping planar fractures	
25					Large round pebble (3 inch diameter)	4441.84 feet
26					SAND to SILTY SAND (SW-MH) Olive yellow (2.5Y 6/6), bedded [STANSBURY TRANSGRESSIVE FACIES]	
27					SAND (SW) White (10YR 8/1), massive [STANSBURY TRANSGRESSIVE FACIES]	4440.64 feet Refusal
					Bottom of boring at 27.0 feet.	

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-22**	
BORING LOCATION: 6650 feet on Seismic Line "A" E 1641778.451, N 759400.239	ELEVATION AND DATUM: 4467.43 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/12/98	DATE FINISHED: 10/12/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 27.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.43 feet	REMARKS
0–3.4					SANDY SILT (ML) Reddish yellow (7.5YR 6/8), dry, loose to medium dense [POST-PROVO EOLIAN-with soil]	
3.4–9.0					CLAYEY SILT (ML) Pale olive (5Y 6/4), dry, whitish mottling, blocky, fractured, medium dense to loose [BONNEVILLE DEEP-WATER FACIES-blocky] Wet	4464.03 feet
9.0–12.5					CLAYEY SILT (MH) Yellow (10YR 7/6), damp, medium dense, laminated, ostracodes [BONNEVILLE DEEP-WATER FACIES-laminated]	4458.43 feet
12.5–15					SANDY SILT (ML) Brownish yellow (10YR 6/6), damp, weakly bedded/laminated [POST-STANSBURY TRANSGRESSIVE FACIES]	4454.93 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-22 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16					CLAYEY SILT (MH) (continued) 1 inch clay seam at contact	
17–18					CLAYEY SILT (MH) Brownish yellow (2.5Y 8/4), damp, well bedded, laminations [STANSBURY TRANSGRESSIVE FACIES]	4451.13 feet
19					SAND (SW) Gray (10YR 7/2), dry, very fine, soft [STANSBURY REGRESSIVE FACIES]	4448.43 feet 4448.23 feet
20–23					CLAYEY SILT (MH) Yellow (2.5Y 7/6), damp, medium dense, charaphytes in upper foot [STANSBURY DEEP-WATER FACIES]	
24–25					SANDY SILT (ML) Olive yellow (2.5Y 6/6), damp, bedded coarsely [STANSBURY TRANSGRESSIVE FACIES]	4443.63 feet
26–27					SAND (SW) Light gray (10YR 7/2), dry, well sorted, fine grained, massive [STANSBURY TRANSGRESSIVE FACIES]	4441.43 feet
27					Bottom of boring at 27.0 feet.	4440.43 feet Refusal
28–33						

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah		Log of Boring No. C-23	
BORING LOCATION: 7200 feet on Seismic Line "A" E 1641232.004, N 759400.676		ELEVATION AND DATUM: 4467.63 feet	
DRILLING CONTRACTOR: Layne Christensen		DATE STARTED: 10/12/98	DATE FINISHED: 10/12/98
DRILLING METHOD: Rotary auger with hollow stem		TOTAL DEPTH: 45.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61		DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)		LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: ---	DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.63 feet	REMARKS
0					SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry, loose to medium dense, platey [POST-PROVO EOLIAN-with soil]	
3.0					SILTY CLAY (CL) Pale olive (5Y 6/4), wet, with white mottling, disordered, blocky, medium dense, abundant vertical fractures [BONNEVILLE DEEP-WATER FACIES-blocky]	4464.63 feet
8.5					CLAYEY SILT (MH) Yellow (10YR 7/6), damp, medium dense, laminar, ostracodes, vertical fractures [BONNEVILLE DEEP-WATER FACIES-laminated]	4459.13 feet
12.3					SANDY SILT to SILTY SAND (ML-SM) Light olive brown (2.5Y 5/4), wet, laminated to weakly bedded, soft, vertical fractures [POST-STANSBURY TRANSGRESSIVE FACIES]	4455.33 feet
15						

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-23 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl, geo. inter.	REMARKS
					SANDY SILT to SILTY SAND (ML-SM) (continued)	
16						
					CLAYEY SILT (MH) Yellow (2.5Y 7/6), damp, medium dense, finely laminated (<1-2 millimeters), laminations in lower portion dip 5°-10° from horizontal (tilted or drilling induced?) [STANSBURY DEEP-WATER FACIES]	4451.43 feet
17						
18						
19						
					CLAYEY SILT (MH) Yellow (2.5Y 7/6), damp, medium dense, as above but less clayey, less laminated, fines down [STANSBURY TRANSGRESSIVE FACIES]	4448.03 feet
20						
21						
22						
23						
24						
25					SILTY SAND to SAND (SW-SM) Pale gray (10YR 7/2), dry, massive, well sorted [STANSBURY TRANSGRESSIVE FACIES]	4442.63 feet
26					Very pale brown (10YR 7/4), bedded	
					Refusal, switch to air rotary	4441.13 feet Refusal; switched to air rotary
27						
28						
29						
30					SAND (SW) Light gray (10YR 7/2), cuttings only [STANSBURY TRANSGRESSIVE FACIES]	4437.63 feet
31						
32						
33						

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-23 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					SAND (SW) (continued)	
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45					Bottom of boring at 45.0 feet.	4422.63 feet Refusal
46						
47						
48						
49						
50						
51						

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-24**	
BORING LOCATION: 8000 feet on Seismic Line "A" E 1640433.189, N 759415.964	ELEVATION AND DATUM: 4465.57 feet	
RILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/13/98	DATE FINISHED: 10/13/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 27.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.57 feet	REMARKS
0–4					SANDY SILT (ML) Brownish yellow (10YR 6/8), dry, loose, platey [POST-PROVO EOLIAN-with weak soil]	
4						4461.67 feet
4–5.5					SILTY CLAY (CL) Light olive gray (5Y 6/1), wet, medium dense, blocky [BONNEVILLE DEEP-WATER FACIES-blocky]	
5.5						4460.17 feet
5.5–10					CLAYEY SILT (MH) Yellow (10YR 7/5), damp, medium dense, laminations to 2 millimeters, ostracodes [BONNEVILLE DEEP-WATER FACIES-laminated]	
10						4455.57 feet
10–14					SANDY SILT to SILTY SAND (ML-SM) Light yellow brown (2.5Y 5/4), moist, loose [POST-STANSBURY TRANSGRESSIVE FACIES]	
14						4451.47 feet
14–15					SANDY SILT to SILTY SAND (ML-SM) Light olive brown (2.5Y 5/5), moist, loose [STANSBURY REGRESSIVE FACIES? or POST-STANSBURY TRANSGRESSIVE FACIES?]	

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-24 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–19.7					SANDY SILT to SILTY SAND (ML-SM) (continued)	
19.7–24.5					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium dense, laminated (weakly), fines up [STANSBURY DEEP-WATER or STANSBURY TRANSGRESSIVE FACIES?]	4445.97 feet
24.5–26.5					CLAYEY SILT (MH) Olive yellow (2.5Y 6/6), dry, medium dense, moderately bedded, ostracodes [STANSBURY DEEP-WATER FACIES?]	4441.17 feet
26.5–27.0					SAND (SW) Pale gray (10YR 7/1), dry, loose, very fine, well sorted [STANSBURY TRANSGRESSIVE FACIES?]	4439.17 feet 4438.57 feet Refusal
					Bottom of boring at 27.0 feet.	

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-24 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16–19					SANDY SILT to SILTY SAND (ML-SM) (continued)	
20–24					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium dense, laminated (weakly), fines up [STANSBURY DEEP-WATER or STANSBURY TRANSGRESSIVE FACIES?]	4445.97 feet
25–26					CLAYEY SILT (MH) Olive yellow (2.5Y 6/6), dry, medium dense, moderately bedded, ostracodes [STANSBURY DEEP-WATER FACIES?]	4441.17 feet
27					SAND (SW) Pale gray (10YR 7/1), dry, loose, very fine, well sorted [STANSBURY TRANSGRESSIVE FACIES?]	4439.17 feet
					Bottom of boring at 27.0 feet.	4438.57 feet Refusal
28–33						

B-2 (12/95)

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-25**
BORING LOCATION: 7500 feet on Seismic Line "A" E 1640917.067, N 759410.004	ELEVATION AND DATUM: 4467.29 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/14/98 — DATE FINISHED: 10/14/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 28.0 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.29 feet	REMARKS
0–5					SANDY SILT (ML) Reddish yellow (7.5YR 7/6), dry, loose to medium dense, platey in lower 2 feet [POST-PROVO EOLIAN-with weak soil]	
5–9					SILTY CLAY (CL) Pale olive (5Y 6/4), damp to dry with white mottling, blocky, fractured, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4462.59 feet
9–12.5					CLAYEY SILT (MH) Brownish yellow (10YR 6/6), damp, medium dense, laminated (1-2 millimeters), ostracodes on partings [BONNEVILLE DEEP-WATER FACIES-laminated]	4458.59 feet
12.5–15					SANDY SILT to SILTY SAND (ML-SM) Light yellowish brown (2.5Y 6/4), damp, well bedded, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4455.09 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-25 (cont.)

Depth (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–17.5					SANDY SILT to SILTY SAND (ML-SM) (continued)	
17.5–20.8					CLAYEY SILT (MH) Yellow (10YR 7/8), dry, medium dense, laminated, fines up, abundant ostracodes on partings, lower contact not obvious [STANSBURY DEEP-WATER FACIES]	4450.09 feet
20.8–26.7					CLAYEY SILT (MH) Brownish yellow (10YR 6/8), dry, medium dense, ostracodes [STANSBURY DEEP-WATER FACIES]	4446.79 feet
26.7–28					SAND (SW) Light gray (10YR 7/2), dry, loose, well sorted [STANSBURY TRANSGRESSIVE FACIES]	4440.89 feet
28					Bottom of boring at 28.0 feet.	4439.29 feet Refusal

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	# Log of Boring No. C-26	
BORING LOCATION: 7800 feet on Seismic Line "A" E 1640627.805, N 759399.410	ELEVATION AND DATUM: 4467.00 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/14/98	DATE FINISHED: 10/14/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 27.4 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4467.00 feet	REMARKS
0–5					SANDY SILT (ML) Brownish yellow (10YR 6/8), dry, loose, soft, platey soil structure [POST-PROVO REWORKED EOLIAN-with weak soil]	
5–6.2					SILTY CLAY (CL) Light olive gray (5Y 6/2), wet, medium dense, blocky, disordered [BONNEVILLE DEEP-WATER FACIES-blocky]	4462.00 feet
6.2–10.5					CLAYEY SILT (MH) Yellow (10YR 7/6), damp, medium dense, laminated (1-2 millimeters), ostracodes abundant [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.80 feet
10.5–15					SANDY SILT to SILTY SAND (ML-SM) Light olive brown (2.5Y 5/4), dry, loose to medium dense [POST-STANSBURY TRANSGRESSIVE FACIES]	4456.50 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-26 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–19					SANDY SILT to SILTY SAND (ML-SM) (continued)	
					Sand (SW), light gray (10YR 7/2), loose [STANSBURY REGRESSIVE FACIES]	4448.50 feet
19–21					CLAYEY SILT (MH) Brownish yellow (10YR 6/8), dry, medium dense, poorly laminated to weakly bedded [STANSBURY DEEP-WATER FACIES]	4448.00 feet
21–26					CLAYEY SILT (MH) Yellow (10YR 7/6), dry to damp, laminar, ostracodes [STANSBURY DEEP-WATER FACIES]	4445.80 feet
26–27.4					SAND (SW) Light gray (10YR 7/1), dry, loose, very fine, clean, well sorted [STANSBURY TRANSGRESSIVE FACIES]	4440.80 feet
27.4					Bottom of boring at 27.4 feet.	4439.60 feet Refusal

B-2 (12/95)

Log of Boring No. C-27

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	Log of Boring No. C-27
BORING LOCATION: 7900 feet on Seismic Line "A" E 1640526.746, N 759419.631	ELEVATION AND DATUM: 4465.74 feet
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/14/98 — DATE FINISHED: 10/14/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 27.6 feet — MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST --- COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson — REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.74 feet	REMARKS
0–4					SANDY SILT (ML) Reddish yellow (7.5YR 6/8), dry loose, platey [POST-PROVO EOLIAN-with soil]	
4–5.5					SILTY CLAY (CL) Pale olive (5Y 6/4), damp with white mottling, blocky, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4462.04 feet
5.5–9.2					CLAYEY SILT (MH) Pale yellow (2.5Y 7/4), damp, medium dense, fractured, laminated, ostracodes on partings [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.24 feet
9.2–11.5					SILTY SAND to SANDY SILT (ML-SM) Yellow (2.5Y 7/6), dry, loose, soft, moderately well bedded [POST-STANSBURY TRANSGRESSIVE FACIES]	4456.54 feet
11.5–15					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, loose to medium dense, laminations 1-4 millimeters, fines up [POST-STANSBURY TRANSGRESSIVE FACIES]	4454.24 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-27 (cont.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
					CLAYEY SILT (MH) (continued)	
16					CLAYEY SILT to SANDY SILT (MH-ML) Yellow (2.5Y 7/6), damp, medium dense, weakly bedded, fines down to laminated [POST-STANSBURY TRANSGRESSIVE FACIES? STANSBURY DEEP-WATER FACIES]	4449.94 feet
23					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, laminar (less than above), ostracodes [STANSBURY DEEP-WATER FACIES]	4442.54 feet
26					SAND (SW) Light gray (10YR 7/2), dry, loose, very fine, well sorted [STANSBURY TRANSGRESSIVE FACIES]	4439.74 feet
27.6					Bottom of boring at 27.6 feet.	4438.14 feet Refusal

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-28**	
BORING LOCATION: 8400 feet on Seismic Line "A" E 1640030.760, N 759429.377	ELEVATION AND DATUM: 4465.95 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/14/98	DATE FINISHED: 10/14/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 30.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.95 feet	REMARKS
0–4.4					SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry loose, platey [POST-PROVO REWORKED EOLIAN-with weak soil]	
4.4–6.6					SILTY CLAY (CL) Pale olive (5Y 6/4), damp, with white mottling, blocky, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4461.55 feet
6.6–9.8					CLAYEY SILT (MH) Brownish yellow (10YR 6/6), damp, medium dense, laminations (1-2 millimeters), ostracodes [BONNEVILLE DEEP-WATER FACIES-laminated]	4459.35 feet
9.8–11.8					SANDY SILT to SILTY SAND (ML-SM) Light olive brown (2.5Y 5/4), damp, unbedded, soft [POST-STANSBURY TRANSGRESSIVE FACIES]	4456.15 feet
11.8–15					SANDY SILT (ML) Light olive brown (2.5Y 5/4), loose to medium dense, weakly bedded	4454.15 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-28 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
16–22					SANDY SILT (ML) (continued) [POST-STANSBURY TRANSGRESSIVE FACIES/] STANSBURY REGRESSIVE FACIES?]	
22–28					CLAYEY SILT (MH) Yellow (2.5Y 7/6) to white, wet, laminated, ostracodes on partings, medium dense [STANSBURY DEEP-WATER FACIES]	4443.75 feet
29–30					SAND (SW) Light gray (10YR 7/1), loose, very fine grained, well sorted [STANSBURY TRANSGRESSIVE FACIES]	4437.45 feet
30–33					Bottom of boring at 30.0 feet.	4435.95 feet Hard, refusal 170 blows / 5 inches

PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-29**	
BORING LOCATION: 8600 feet on Seismic Line "A" E 1639831.026, N 759429.123	ELEVATION AND DATUM: 4465.41 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/14/98	DATE FINISHED: 10/14/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 27.7 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Chris Hitchcock	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4465.41 feet	REMARKS
0–3					SANDY SILT (ML) Reddish yellow (7.5YR 7/8), dry loose, platey [POST-PROVO EOLIAN-with soil]	
3–5.3					SILTY CLAY (CL) Pale olive (5Y 6/4), dry, blocky, medium dense, white mottles [BONNEVILLE DEEP-WATER FACIES-blocky]	4462.41 feet
5.3–9.8					CLAYEY SILT (MH) Yellow (10YR 7/8), medium dense, laminated (1-2 millimeters), ostracodes on partings [BONNEVILLE DEEP-WATER FACIES-laminated]	4460.11 feet
9.8–15					SANDY SILT (ML) Yellow (10YR 7/6), dry, medium dense to loose, minor bedding [POST-STANSBURY TRANSGRESSIVE FACIES]	4455.61 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-29 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–17.5					SANDY SILT (ML) (continued)	
17.5–21.8					SANDY SILT to CLAYEY SILT (ML-MH) Yellow (10YR 7/8), dry, medium dense, laminated, fines down [POST-STANSBURY TRANSGRESSIVE FACIES/STANSBURY REGRESSIVE FACIES?]	4448.01 feet
21.8–26.2					CLAYEY SILT (MH) Very pale brown (10YR 8/3), dry, medium dense, ostracodes [STANSBURY DEEP-WATER FACIES]	4443.71 feet
26.2–27.7					SAND (SW) Light gray (10YR 7/1), dry, loose, very fine, with interbeds of clayey silt (MH) [STANSBURY TRANSGRESSIVE FACIES]	4439.31 feet
27.7					Bottom of boring at 27.7 feet.	4437.71 feet

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

B-2 (12/95)

Project No. 4790 | **Geomatrix Consultants** | Figure ---

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PROJECT: PRIVATE FUEL STORAGE FACILITY Skull Valley Goshute Reservation, Utah	**Log of Boring No. C-30**	
BORING LOCATION: 6900 feet on Seismic Line "A" E 1641522.947, N 759406.837	ELEVATION AND DATUM: 4468.10 feet	
DRILLING CONTRACTOR: Layne Christensen	DATE STARTED: 10/19/98	DATE FINISHED: 10/19/98
DRILLING METHOD: Rotary auger with hollow stem	TOTAL DEPTH: 51.0 feet	MEASURING POINT: Ground stake
DRILLING EQUIPMENT: Mobile B-61	DEPTH TO WATER: FIRST ---	COMPL. ---
SAMPLING METHOD: Hollow stem with 5-foot pitcher (I.D.=3.5 in., O.D.=4.0 in.)	LOGGED BY: Fred Chandler	
HAMMER WEIGHT: --- DROP: ---	REVIEWED BY: Kathryn Hanson	REG. NO. ---

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft²)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter. Surface Elevation: 4468.10 feet	REMARKS
0–3					SANDY SILT (ML) Reddish yellow (7.5YR 6/6), dry, loose, medium dense	
3–8.5					SILTY CLAY (CL) Pale olive (5Y 6/4), moist, with white mottling, blocky, medium dense [BONNEVILLE DEEP-WATER FACIES-blocky]	4465.10 feet
8.5–12					CLAYEY SILT (MH) Yellow (10YR 7/6), moist, medium dense, laminar, ostracodes [BONNEVILLE DEEP-WATER FACIES-laminated]	4459.50 feet
12–15					SILTY SAND to SANDY SILT (ML-SM) Light olive brown (2.5Y 5/4), moist, laminated, soft very fine sand interbeds	4456.10 feet

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-30 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
15–17					SILTY SAND to SANDY SILT (ML-SM) (continued)	
17–25					CLAYEY SILT (MH) Yellow (2.5Y 7/6), dry, medium dense, finely laminated [STANSBURY DEEP-WATER FACIES]	4451.10 feet
25–28					SILTY SAND (SW) Very pale brown (10YR 7/4), dry, bedded [STANSBURY TRANSGRESSIVE FACIES]	4443.10 feet
28–33					SAND (SW) Light gray (10YR 7/2), dry [STANSBURY TRANSGRESSIVE FACIES]	4440.10 feet

B-2 (12/95)

PROJECT: PRIVATE FUEL STORAGE FACILITY
Skull Valley Goshute Reservation, Utah

Log of Boring No. C-30 (cont.)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	Pocket Penetrometer (tons/ft2)	DESCRIPTION NAME (USCS Symbol): color, moist, % by weight., plast., consistency, structure, cementation, react. w/HCl. geo. inter.	REMARKS
33–45					SAND (SW) (continued)	4423.10 feet (at 43)
45–51					WELL-GRADED GRAVEL with SAND (GW) Light gray (10YR 7/2), subangular to subrounded [PRE-BONNEVILLE ALLUVIUM]	
51					Bottom of boring at 51.0 feet.	4417.10 feet

B-2 (12/95)

Project No. 4790

Geomatrix Consultants

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GEOMATRIX

APPENDIX C

TEST PIT AND HAND-EXCAVATED AUGER HOLE LOGS

LOG OF TEST PIT TP-1

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: adjacent to SWEC Borehole A2
(1927 Utah State Plane Coordinates)

Northing:
Easting:
Elevation: 4464.0 ft
Total Depth: 3.63 m (11.90 ft)

Logged By: K.L. Hanson, F.H. Swan, and D. Currey **Date:** 5/31/98

Checked By: K.L. Hanson **Date:** 10/2/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Unit descriptions from 2.63 m deep hand auger hole 1 located at same site; photos Roll KLH-2 (frames 9-15)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4464.0	0	0	Ground Surface: Flat	
			Same as unit below; more numerous roots.	A soil horizon/ developed on Post-Provo eolian deposit.
4463.97	0.03	0.1		
			Light gray to very pale brown (10YR 7/2.5, d), pale brown (10YR 6/3, m); slightly plastic, nonsticky, SILT; massive, single grain, loose; violent effervescence.	A3/B1 soil/horizon developed on Post-Provo eolian deposit.
4463.21	0.79	0.24		
			Very pale brown (10 YR 7/3, d), brown (10YR 5/3, m); slightly plastic, slightly sticky; slightly hard to hard; sandy SILT; weak subangular blocky structure; few thin clay films; soil structure most apparent in upper 20 cm, coarsens with depth to silty SAND with massive to fine subangular blocky structure to fine to medium SAND; transitional lower contact.	Eolian and reworked Post-Provo recessional deposits.
4461.87	2.13	0.65		
			Light gray (10YR 7/2, m), grades to (2.5 Y 7/2, m) near base, mixed with pale brown in upper part; slightly plastic, slightly sticky; very friable; sandy SILT; a few ostracode fragments.	Post-Provo recessional deposits?

4460.92	3.08	0.94		
			Light brownish gray to light olive gray (3Y 6/2, m) mottled mixed light reddish brown to reddish brown (5YR 6/4 and 5/4, m) to yellowish red (5YR 5/6, m) most prominent on ped faces (up to 30 to 70%), ~5% white mottles (salt precipitates) throughout unit but more prominent in upper part; slightly plastic, sticky; very friable; SILT, calcareous micrite matrix; massive breaking into weak medium blocky structure; numerous ostracodes (whole) noted at depth of 1.18 to 1.51 m.	Cambic B soil horizon (upper part) developed on Provo deep-water facies
4458.62	5.37	1.64		
				Transition zone (Bonneville flood?)
4458.03	5.97	1.82		
			Light gray to light brownish gray (2.5Y 6.5/2, m) <5% white mottles (salt precipitates); slightly plastic, sticky; very friable: very fine to fine sandy SILT; massive breaking into weak fine subangular blocky structure; ice-rafted pebble 1 cm long at depth of ~2 m; at 2.14 m light yellowish brown (2.5 Y 6/4, m) SILT mottled gray and light yellowish brown (10 YR 6/4, m) to yellowish brown (10YR 5/6 m), more apparent bedding; ostracodes.	Bonneville deep-water facies (blocky)
4454.75	9.24	2.82		
			Similar to unit above, but weakly laminated; drop stone at depth of 3.18 m.	Bonneville deep-water facies (laminated)
4453.57	10.43	3.18		
			Fine SAND.	Post-Stansbury transgressive facies.
4452.1	11.90	3.63 TD		
				Base of test pit

Note: north-trending fractures and infilled fractures present, some extend to lower sand; east-trending fractures subparallel to test pit also observed.

LOG OF TEST PIT TP-2

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: SW 1/4, NE 1/4, Sec. 7, T5S, R8W
(1927 Utah State Plane Coordinates)

Northing: N 755832.076
Easting: E 1641331.491
Elevation: 4492.402 ft
Total Depth: 3.4 m (11.15 ft)

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 6/1/98

Checked By: K.L. Hanson **Date:** 10/4/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Unshored trench, not logged in detail Borehole C-1 was drilled adjacent to TP-2 to a depth of 8.93 m (29.3 ft); see boring log (Geomatrix C-1) for more complete description of units.

Elevation (Feet)	**Depth**		**Description**	**Geologic Units / Comments**
	(Feet)	**(Meters)**		
4492.4	0	0		
			Ground Surface: Relatively flat; sage-covered	
			Marl.	Bonneville and Provo deep-water or reworked deep-water facies
4486.8	5.58	1.7		
			Fine to medium SAND; well sorted.	Post-Stansbury transgressive facies
4481.2	11.15	3.4 TD		
				Base of test pit.

LOG OF TEST PIT TP-6

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: NW 1/4 corner of Sec. 6, T5S, R8W
60 ft E, 20 ft S of Section corner

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 6/1/98

(1927 Utah State Plane Coordinates)

Northing:
Easting:

Checked By: K.L. Hanson **Date:** 10/4/98

Elevation: ~4446 ft (at section corner, from 1:24,000 Hickman Knolls 7 1/2' quad.)

Notes: Photos: KLH 3, frames 5 and 6 (fracture/burrow); frames 7 and 8 (view W and view E, respectively).

Total Depth: 4.0 m (13.12 ft)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
~4446	0	0	Ground Surface: flat, sage-covered	Eolian
~4443.05	2.95	0.9	White MARL at base, grades upward to pale brown with more silt.	Provo deep-water facies
~4436.82	9.18	2.8	MARL; grayer than above with ~5% iron-stained tubules that tend to follow bedding; abundant ostracodes, some along bedding; gradational lower contact.	Bonneville deep-water (blocky) facies
~4434.85	11.15	3.4	MARL; finely bedded, abundant ostracodes.	Bonneville deep-water (laminated) facies
~4432.88	13.12	4.0 TD		Base of test pit.

Note: Fissures present, infilled and modified by burrowing animals; no vertical displacement of beds across fissures.

Samples taken from all units.

LOG OF TEST PIT TP-3 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX **Project 4790**

Location: SW 1/4, NE 1/4, Sec. 7, T5S, R8W

(1927 Utah State Plane Coordinates)

Northing: N 755366.116
Easting: E 1641317.741
Elevation: 4495.891
Total Depth: 4.1 m (13.45 ft)

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 6/1/98

Checked By: K.L. Hanson **Date:** 10/4/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Unshored test pit, not logged in detail. Photos: KLH 3, frames 3 to 6

Elevation (Feet)	**Depth (Feet)**	**Depth (Meters)**	**Description**	**Geologic Units / Comments**
4495.9	0	0		
			Ground Surface: Relatively flat, sage-covered	
			SAND and interbedded SILT layers; silt beds range in thickness from ~0.5 to 1.0 cm; sand beds exhibit prominent cross bedding.	Stansbury shoreline (nearshore) and Post-Stansbury transgressive facies).
4485.4	10.5	3.2		
			Alternating clean SAND and 0.5 to 3-cm-thick CLAY beds.	Stansbury regressive facies
4484.6	11.32	3.45		
			Silty SAND; well bedded, kerophytes.	Stansbury deep-water facies
4482.4	13.45	4.1 TD		
				Base of test pit
			Sample ~3.65 m	

LOG OF TEST PIT TP-4

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: SW 1/4, NE 1/4, Sec. 7, T5S, R8W

(1927 Utah State Plane Coordinates)

Northing: N 755201.865
Easting: E 1640165.980
Elevation: 4496.261 ft
Total Depth: 4.3 m (14.10 ft)

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 6/1/98

Checked By: K.L. Hanson **Date:** 10/4/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Unshored test pit, not logged in detail.

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4496.3	0	0	Ground Surface: flat, sage-covered	
			Silty SAND; well bedded, ostracodes.	Bonneville deep-water facies
4492.43	3.87	1.18		
			Fine to medium SAND with SILT lenses spaced approximately 10 to 20 cm apart; clean, well sorted.	Stansbury shoreline and Post-Stansbury transgressive facies
4486.46	9.84	3.0		
			Silty SAND; ostracodes.	Stansbury deep-water facies
4482.2	14.1	4.3 TD		
				Base of test pit

# LOG OF TEST PIT TP-5 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX **Project 4790**

Location: SW 1/4, NE 1/4, Sec. 7, T5S, R8W

(1927 Utah State Plane Coordinates)

Northing: N 755129.868
Easting: E 1640474.080
Elevation: 4497.927
Total Depth: ~4.0 m (13.12 ft)

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 6/1/98

Checked By: K.L. Hanson **Date:** 10/4/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Stratigraphy exposed in TP-5 appeared comparable to TP-4. TP-5 caved in to about half the original depth before it could be described.

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments

Not described in detail due to cave-in.

LOG OF TEST PIT TP-7

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: NE 1/4, SE 1/4 Section 6, T5S, R8W; 43 ft south of Seismic Profile A at 5700 ft from BOL
(1927 Utah State Plane Coordinates)

Logged By: K.L. Hanson and F.H. Swan

Date: 9/19/98; 10/5/98

Northing:
Easting:
Elevation: ~4469 ft
Total Depth: 6.45 m (21.16 ft)

Checked By: K.L. Hanson

Date: 10/5/98

Notes: Elevation based on inspection of detailed topographic map of site and surveyed elevation of Boring C-5 located approximately 50 ft to the east. Photographic Slides: Roll 98-9-1 (frames 1-4)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4469	0	0	Ground Surface: Flat; low sand ridge covered with Indian rice grass (eastern end); mixed shrubs and sage on reworked alluvial playa surface (western end). Test pit lies south (above) a prominent post-Provo recessional shoreline.	
			Grayish brown (10YR 5/2.5, d) silty fine SAND; plastic, nonsticky; massive; platey, planar, abrupt to sharp lower contact.	Reworked eolian, sheetwash
4467.1	1.90	0.58		
			Pale brown (10YR 6/3, d) silty fine sand; weak (< 5%) white filamentous carbonate; numerous krotovina; abrupt, planar lower contact except where disrupted by krotovina.	Reworked eolian, sheetwash
4466.6	2.43	0.74		
			Pale brown to brown, slightly redder on ped faces; sandy clayey SILT; fine angular blocky structure.	Post-Provo soil (Cambic B soil horizon) developed on underlying unit.
4466.0	2.98	0.91		
			Light gray (10YR 7/2, m); sandy clayey SILT; massive; abundant ostracodes; abrupt planar lower contact; fractures and infilled fissures present as described below.	Provo deep-water facies

4464.6	4.36	1.33	Light gray to gray (10YR 6/1, m) mottled with white; plastic, sticky; very fine sandy clayey SILT; irregular coarse angular blocky structure; ostracode-rich; manganese or iron-oxide staining along root tubules; fractures and infilled fissures present as described below; abrupt smooth lower contact.	Bonneville deep-water (blocky) facies
4461.59	7.41	2.26	Pale brown (10YR 6/3, m); fine sandy SILT (sandy marl); fines upwards; well bedded, thinly laminated, laminae commonly < 1mm; abundant ostracodes.	Bonneville deep-water (laminated) facies
4457.36	11.64	3.55	Alternating light yellowish brown and brownish gray silty to clayey SAND, well bedded. Beds are generally 2 to 5 cm thick; gradational lower contact.	Post-Stansbury transgressive facies
4454.96 – 4454.5	[14.04 - 14.50]	[4.28 - 4.42]	Thinly bedded (up to 1 mm thick) marly SAND; some ostracodes.	[Possible Interbed of deeper water sediment, secondary fluctuation]
4454.21 – 4453.32	[14.79 - 15.68]	[4.51 - 4.78]	[Bed of gray clay that contain lenses and discontinuous beds of sand; gypsum present; appears to be some slumping or disruption of the bed.]	Stansbury regression - intertidal mudflat environment?
4452.24	16.76	5.11	Coarsening upward from thinly bedded marly sand with thin (< 1mm) white layers that appear to have diatoms, aragonite, small ostracodes, and abundant kerophytes.	Stansbury deep-water and regressive facies
4447.84	21.16	6.45 TD		Base of test pit.

Note: Fractures and fissures observed in deep-water sediments cannot be traced downwards. The fractures may be the result of strong ground motion or dessication or freeze-thaw that occurred on the mud flats subsequent to the drop of the lake below this elevation and prior to deposition of overlying units.

Samples:
0.8 to 0.9 m
1.2 to 1.3 m
2.1 to 2.2 m
3.1 to 3.2 m
3.9 to 4.2 m
4.51 to 4.78 m
5.3 to 5.35 m
6.3 to 6.45 m (collected 5 gallon bucket sample from which samples 4790/FS-1a/TP-7 and 4790/FS-1b/TP-7 were derived.) These samples were dated at 24,600 ± 190 and 23,990 ± 380 RCYBP (radiocarbon years before present), respectively (see Appendix D).

LOG OF TEST PIT TP-8

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: C. Section 6, T5S, R8W; 39.5 ft south of Seismic Profile A at 7680 ft from BOL
(1927 Utah State Plane Coordinates)
Northing:
Easting:
Elevation: ~4466 ft.
Total Depth: 6.1 m (20 ft)

Logged By: K.L. Hanson, and F.H. Swan **Date:** 9/17/98

Checked By: K.L. Hanson **Date:** 10/1/98

Notes: Elevation based on inspection of detailed topographic map of site and surveyed elevation of Trench T-2 located approximately 50 ft to the north. Field review by Dr. D. Currey on 9/20/98; Photographic Slides: Roll KLH-98-9-1, frames 5-8

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
~4466	0	0	Ground Surface: Gentle north slope (middle of post-Provo recessional shoreline erosional scarp).	
			Similar to unit below, except mottled with slightly more organic material.	A/E soil horizon developed on eolian deposits.
~4465.34	0.66	0.20	Brown (10YR 5/3, m); plastic, nonsticky; fine sandy SILT; massive; many pores and root tubules.	Eolian deposit.
~4463.64	2.36	0.72	Pale brown to brown (10YR 5.5/3, m), slightly redder on ped faces; sandy clayey SILT; fine blocky structure; clear irregular lower soil boundary.	Cambic B soil horizon developed on underlying unit.
~4463.24	2.76	0.84	Light gray (10YR 7/2, m); sandy clayey SILT; massive; abundant ostracodes; clear smooth to wavy lower contact; fractures and infilled fissures present as described below.	Provo deep-water facies
~4462.42	3.58	1.09	Similar to underlying unit, except finer blocky structure, more strongly mottled white and reddish brown; fractures and infilled fissures present as described below; clear irregular lower contact.	Bonneville flood and post-flood Provo deep-water facies

~4461.74	4.26	1.3	Light gray to gray (10YR 6/1, m) mottled with white; plastic, sticky; very fine sandy clayey SILT; irregular coarse angular blocky structure; ostracode-rich; manganese or iron-oxide staining along root tubules; fractures and infilled fissures present as described below; clear lower contact.	Bonneville deep-water facies (blocky)
~4459.77	6.23	1.9	Pale brown (10YR 6/3, m); fine sandy SILT (sandy marl); fines upwards; well bedded, thinly laminated, laminae commonly < 1mm; abundant ostracodes.	Bonneville deep-water (laminated) facies
~4455.08	10.92	3.33	Alternating light yellowish brown and light brownish gray silty to clayey SAND, well bedded. Beds are generally 2 to 5 cm thick; gradational lower contact at depth of 16.40 ft (5.0 m).	Post-Stansbury transgressive facies
	[15.12-15.48]	[4.61-4.72]	[Thinly bedded (up to 1mm thick) marly SAND, some ostracodes.]	[Interbed of deeper-water sediment (possible secondary fluctuation).]
~4449.60	16.40	5.0	Interbedded very fine and fine SAND; lower contact is sharp, irregular unconformity that suggests subaerial or more likely sublacustrine erosion.	Stansbury regressive (near-shore) facies
~4447.63	18.37	5.6	White (10YR 8/1, m), light gray (10YR 7/2, m), grayish brown (10YR 5/2, m), and yellowish brown (10 YR 5/8, m); very fine SAND and calcareous SILT beds with ostracodes; finely bedded.	Stansbury deep-water facies
~4445.99	20.01	6.1 TD		Base of test pit

Note: Fractures observed in deep-water sediments cannot be traced downward; prominent infilled fissure in deep-water sediments widens upward to a few centimenters and can be traced to base of soil formed on Provo deep-water sediments. The fissure appears to have formed prior to significant soil formation as the redder color does not extend into the fissure infill. The fissure may be the result of strong ground motion or dessication or freeze-thaw that occurred on the mud flats subsequent to the drop of the lake below this elevation and prior to deposition of overlying deposits. A thin, dark, silty laminae at a depth of 3.8 m can be traced unbroken across the entire length of test pit.

LOG OF TEST PIT TP-9

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: NW 1/4, SW 1/4, Sec. 6, T5S, R8W 31 ft south of seismic Profile A at 10140 ft

(1927 Utah State Plane Coordinates)

Northing:

Easting:

Elevation: ~4461 ft

Total Depth: 6.2 m (20.34 ft)

Logged By: K.L. Hanson and F.H. Swan

Date: 9/19/98

Checked By: K.L. Hanson

Date: 10/4/98

Notes: Elevation based on inspection of Hickman Knolls 7.5-minute quadrangle (scale 1:24,000). Photographic Slides: KLH-98-9-1 (frames 23-24)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4461	0	0	Ground Surface: flat	
			Reworked marl; abrupt, wavy bottom of top soil.	Eolian and reworked marl.
4460.28	0.72	0.22		
			Disseminated carbonate; clear wavy to irregular soil boundary.	Cca soil horizon developed on underlying unit.
4459.59	1.41	0.43		
			Similar to Unit 4a as described in TP-8	Bonneville deep-water (laminated) facies
4457.72	3.28	1.00		
			Fining upward sequence; beds at base (bottom 20 cm) range from < 1 cm to 3 cm; sharp, smooth contacts at individual beds within unit; smooth, gradational lower contact.	Bonneville deep-water laminated facies?
4455.75	5.25	1.60		
			Thick sequence of well bedded fine to very fine SAND; well sorted.	Post-Stansbury transgressive facies
4446.6	14.43	4.40		
			Cross bedded fine SAND with partings of reddish brown fine sandy SILT; lower contact slopes to the west; sharp, smooth lower contact to this subunit.	Stansbury regressive (near-shore) facies
4443.75	17.25	5.26		
			Marly SAND, finely laminated with thin marl layers at base; coarsening upward sequence; marl laminae are fewer and beds thicken upwards.	Stansbury deep-water facies
4440.66	20.34	6.20 TD		Base of test pit

LOG OF TEST PIT TP-10

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: SW 1/4, NW 1/4, Sec. 5, T5S, R8W ~30 ft south of seismic Profile B at 1500 ft W of BOL

Logged By: K.L. Hanson and F.H. Swan **Date:** 9/19/98

(1927 Utah State Plane Coordinates)

Northing: N757637.298 (east end)
N757624.115 (west end)

Easting: E 1643120.091 (east end)
E 1643105.557 (west end)

Elevation: 4481.455 (east end)
4481.544 (west end)

Total Depth: 1.5 m (4.92 ft)

Checked By: K.L. Hanson **Date:** 10/4/98

Notes: Test pit unstable, caved during excavation

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4481.5 (avg.)	0	0	Ground Surface: Flat, playa	
			Platey structure; vesicular; abrupt wavy lower contact	Playa and eolian deposits
4481.07	0.43	0.13		
			Sandy clayey SILT.	Reworked marl
4479.86	1.64	0.5		
			Silty SAND; dry, very loose, fine to very fine; well sorted.	Stansbury shoreline or post-Stansbury transgressive facies.
4476.58	4.92	1.5 TD		Base of test pit.

LOG OF TEST PIT TP-11 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX **Project 4790**

See Figure C-1

LOG OF TEST PIT TP-12 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX
	Project 4790

See Figure C-2

LOG OF TEST PIT TP-13

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: North flank of Hickman Knolls
SW 1/4 of Section T5S, R8W

Logged By: K.L. Hanson and C. Hitchcock **Date:** 9/23/98

(1927 Utah State Plane Coordinates)

Northing: N 75393.237 (east end)
N 753980.148 (west end)

Easting: E 1643157.746 (east end)
E 1643132.498 (west end)

Elevation: 4516.259 (east end)
4516.364 (west end)

Total Depth: 3.0 m (measured ~2 m from west end of test pit)

Checked By: K.L. Hanson **Date:** 10/1/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98; Photographic slides: Roll KLH-98-9-1 (frames 9-11); KLH-98-9-2 (frames 19-20).

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4516.3 (average)	0	0	Ground Surface: Grass covered gently north-sloping surface.	
			Very pale brown (10YR 8/3, d); sandy SILT; stage I+ carbonate in upper 30 cm, carbonate decreases with depth, carbonate (Cca soil horizon) extends to depth of 65 cm; sharp lower contact with underlying unit.	Post-Provo Eolian (minor alluvium)
4513.3	2.98	0.91		
			Very fine to fine SAND; well sorted, moderately bedded; contains scattered reworked gravel from underlying unit; sharp lower contact.	Stansbury (?) shoreline (shallow water), transgressive facies
4512.36	3.94	1.2		
			Sandy GRAVEL; clast supported; loose; well sorted medium sand matrix; subrounded to rounded gravel clasts; mode 5 cm; flattened discoidal) gravel clasts; thin continuous carbonate coating on bottoms of clasts in upper 30 cm; incipient tufa in gravel and overlying sand near upper contact.	Stansbury (?) shoreline facies (gravel bar) (upper)
4509.5	6.89	2.1		
			SAND; well bedded; appears to contain thin beds of finer silt/clay (unshored test pit, too deep to observe directly)	Stansbury regressive facies
4506.44	9.864	3.0 TD		
			Total depth to deepest part of test pit.	

LOG OF TEST PIT TP-14

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: NW 1/4, SW 1/4, Sec. 7, T5S, R8W
Hickman Knolls 7 1/2 ' Quad.

Logged By: K. L. Hanson and C. Hitchcock **Date:** 9/23/98

(1927 Utah State Plane Coordinates)
Northing: N753469.355 (north)
Easting: E1637770.441 (north)
Elevation: 4518.524 (north)
Total Depth: 3.2 m (10.5 ft)

Checked By: K. L. Hanson **Date:** 10/4/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98; Photographic Slides: KLH-98-9-1 (frames 12-13)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4518.52	0	0	Ground Surface: Crest of gravel bar	
			(10YR 7/6,d) (10YR 6/4, m) sandy SILT; sand is predominantly fine to medium, some coarse; scattered rounded pebbles; massive; stage I carbonate in upper 25 cm.	Post-Provo eolian with minor reworked gravel
4515.24	3.28	1.0		
			Sandy GRAVEL; 80 % gravel; 20% sand; clast-supported; well bedded, prominent foreset beds dip approximately 30 degrees south; gravel clasts are subrounded to rounded; mode 2 to 3 cm; range <1 to 10 cm; pebble clasts are discoidal; moderately to well sorted; stage I+ carbonate in upper 15 cm, carbonate on clast bottoms down to 40 cm in upper part of gravel.	Stansbury shoreline facies (cross-valley barrier beach bar (upper))
4509.34	9.18	2.8		
			Fine SAND; massive	Stansbury (regressive facies)
4508.02	10.5	3.2 TD		
				Base of test pit

LOG OF TEST PIT TP-15

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: North flank of Hickman Knolls
SE 1/4 Section 7, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 753813.175 (east end)
N 753808.319 (west end)
Easting: E 1641934.788 (east end)
E 1641910.535 (east end)
Elevation: 4537.258 ft (east end)
4536.939 ft (west end)
Total Depth: 4.5 m (14.76 ft)

Logged By: K. L. Hanson and C. Hitchcock **Date:** 9/23/98

Checked By: K. L. Hanson **Date:** 10/1/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98

Elevation (Feet)	**Depth (Feet)**	**Depth (Meters)**	**Description**	**Geologic Units / Comments**
4536.94 (west end)	0	0	Ground Surface: Gently north sloping, grass covered	
			Sandy GRAVEL with interbeds of fine SAND up to 30 cm thick; poorly sorted; subangular to rounded clasts; weak stratification dipping basinward; gravel clasts mode 3 to 5 cm in coarser beds, occasional cobbles.	Post-Provo Sand Ramp. (Alluvium with interbedded eolian deposits)
4527.76	9.184	2.8		
			Boulder GRAVEL; boulders up to 40 cm in the long dimension, rounded; carbonate rinds (~ 1mm thick) on clast bottoms.	Post-Provo Sand ramp (basal lag)
4526.44	10.5	3.2		
			Note: Due to instability of unshored trench, it was not possible to directly observe deposits below 3.2 m depth.	
4522.18	14.76	4.5 TD		
				Base of test pit

LOG OF TEST PIT TP-16 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX **Project 4790**

Location: North flank of Hickman Knolls
SE 1/4 Section 7, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 754018.665 (west end)
N 754015.400 (east end)
Easting: E 1641907.036 (west end)
E 1641928.598 (east end)
Elevation: 4528.645 ft (west end)
4529.009 ft (east end)
Total Depth: 3.5 m (11.48 ft); 2.3 m (7.54 ft) after backfilling

Logged By: K. L. Hanson and C. Hitchcock — **Date:** 9/23/98

Checked By: K. L. Hanson — **Date:** 10/1/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Photographic Slides: KLH-98-9-2 (frame 8)

Elevation (Feet)	**Depth**		**Description**	**Geologic Units / Comments**
	(Feet)	**(Meters)**		
4528.82 (avg.)	0	0	Ground Surface: Gently north dipping, grass covered.	
4521.28	7.54	2.3		
			Similar to upper 2.8 m in TP-15: Sandy GRAVEL with interbeds of fine SAND; poorly sorted; subangular to rounded clasts.	Post-Provo sand ramp (Alluvium interbedded with eolian deposits)
4517.34	11.48	3.5 TD		
			Rock too hard to penetrate with backhoe; Fragments of hard, dark gray dolomite breccia in spoil from bottom of test pit.	Bedrock contact? Base of test pit.

LOG OF TEST PIT TP-17

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: North flank of Hickman Knolls (SE 1/4 of Section 7, T5S, R8W)

(1927 Utah State Plane Coordinates)

Northing: N 754021.628 (east end)
N 754023.322 (west end)

Easting: E 1641888.514 (east end)
E 1641869.277 (west end)

Elevation: 4528.331 (east end)
4528.633 (west end)

Total Depth: 5.0 m (16.4 ft)

Logged By: K.L. Hanson and C. Hitchcock **Date:** 9/23/98

Checked By: K. L. Hanson **Date:** 10/1/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98. Photographic Slides: KLH-98-9-2 (frame 10)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4528.48 (avg.)	0	0	Ground Surface: Gently north dipping, grass covered	
			Silty fine SAND with scattered pebbles.	Post-Provo sand ramp
4525.5	2.98	0.91		
			Sandy GRAVEL	Post-Provo sand ramp
4522.84	5.64	1.72		
			Predominantly SAND with scattered gravel clasts	Post-Provo sand ramp
4518.97	9.51	2.9		
			Boulder gravel	Post-Provo sand ramp (basal log)
			Note: Deposits too deep to observe directly in unshored test pit. Based on samples collected from the backhoe bucket spoil the lower deposits include the following:	

4517.98	10.5	3.2		
			White (10 YR 8/1, d) gravelly SAND; poorly sorted; subangular to subrounded clasts; stage III carbonate; pebble clasts generally better rounded than sample described below; massive.	Promontory Soil (K horizon?) developed on pre-Bonneville alluvium
			Very pale brown (10 YR 8/2, d) sandy GRAVEL; poorly sorted; subrounded to subangular pea-size gravel; stage II carbonate; massive; hard.	Promontory soil (CCa horizon?) developed on pre-Bonneville Alluvium
4512.08	16.4	5.0 TD		
				Base of test pit

LOG OF TEST PIT TP-18 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX **Project 4790**

Location: North flank of Hickman Knolls
SE 1/4 of Section 7, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 754369.229 (east end)
N 754372.516 (west end)
Easting: E 1641569.168 (east end)
E 1641548.165 (west end)
Elevation: 4515.595 (west end)
4515.060 (east end)
Total Depth: 4.1 m (13.45 ft)

Logged By: K. L. Hanson, F. H. Swan, and C. Hitchcock **Date:** 9/23/98

Checked By: K. L. Hanson **Date:** 10/1/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4515.3 (avg.)	0	0	Ground Surface: Relatively flat; grass covered	
			Predominantly SAND	Post-Provo sand ramp
4508.08	7.21	2.2		
			Gravelly SAND; well rounded gravel (probably reworked from underlying unit)	Basal Post-Provo sand ramp
4507.76	7.54	2.3		
			Fining upward sequence of gray (10 YR 6.4, m), very friable, crudely stratified SAND and gravelly SAND	Stansbury shoreline facies (gravel bar (lower ?))
4505.13	10.17	3.1		
			Very pale brown (10 YR 8/3, d) sandy GRAVEL and gravelly SAND; pebbles are well rounded and subangular, some small boulders and lag cobbles up to 20 cm; stage II carbonate (plugged, no laminar cap).	Promontory Soil ? developed on pre-Bonneville sand ramp.
4504.3	10.99	3.35		
			(5Y 7/4, d) pea GRAVEL; < 1mm to 3 mm (mode) with common small pebbles (typically < 5cm).	Pre-Bonneville sand ramp
4503.16	12.14	3.7		
			Bouldery GRAVEL; well cemented; boulders with thick (up to 7 mm, avg. 4mm) carbonate rinds on bottoms of clasts; white (2.5 YR 8/1, d) basal tufa?.	Paleosol (pre-Promontory soil) developed on pre-Little Valley alluvium
4501.85	13.45	4.1 TD		
				Base of test pit

LOG OF TEST PIT TP-19

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: North flank of Hickman Knolls
SW 1/4 of Section 8, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 753836.176
Easting: E 1643967.632
Elevation: 4514.762 ft
Total Depth: 4.3 to 4.5 m (14.10 to 14.76 ft) prior to cave-in; 3.71 m (12.17 ft) post cave-in

Logged By: K.L. Hanson, and F.H. Swan — **Date:** 9/24/98

Checked By: K.L. Hanson — **Date:** 10/1/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT, 9/22/98; Photographic slides: Roll KLH 98-9-2 (frames 16 to 18)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4514.76	0	0	Ground Surface-Playa at margin of eolian sand ramp	
			Light brownish gray (10YR 6/2, d) to grayish brown (10 YR 5/2, d) very fine SANDY LOAM; vesicular structure in upper 5 cm; fine to medium platey structure in lower part; clear wavy lower boundary.	A soil horizon developed on Post-Provo eolian/playa deposit
4514.53	0.23	0.07		
			Very pale brown (10 YR 7/3.5, d) silty very fine SAND; well sorted; stage I carbonate; clear wavy lower contact.	Cca soil horizon developed on Post-Provo eolian/playa deposit
4513.81	0.95	0.29		
			Light gray to very pale brown (10 YR 7/2.5, d) very fine SAND interbedded with silty fine SAND; beds are < 1 cm to 3 to 5 cm; well sorted; sharp lower contact.	Bonneville transgressive facies (shallow water)
4512.76	2.00	0.61		
			Fine to medium SAND; well sorted; discontinuous incipient tufa; abundant filamentous white salts; iron-oxide staining locally; abrupt smooth lower contact.	Stansbury (?) shoreline facies
4512.46	2.30	0.70		
			Sandy GRAVEL; clast supported; well rounded; mode of gravel clasts is 2 to 3 cm, 10 cm (max.); flattened (discoidal) clasts; iron-oxide staining and mottles <5%; abrupt smooth lower contact.	Stansbury (?) shoreline facies (gravel bar)

4511.74	3.02	0.92		
			Interbedded fine sand, very fine sand, and silty fine SAND; alternating layers <1 cm to 5 cm thick; sharp lower contact.	Stansbury regressive facies
4510.69	4.07	1.24		
			Very pale brown (10 YR 7/3, d) in upper 1.5 m; light gray to light grayish brown (10YR 6.5/2, d) in lower part; medium SAND; very well sorted; subrounded grains; iron-oxide staining along distinct beds and roots in upper 1.5 m; cross bedding; occasional pebble (< 1 cm) and stringers of pebbles.	Stansbury regressive facies
4502.59	12.17	3.71		
				Post cave-in base of test pit
			Note: From material coming out of backhoe bucket from deeper parts of the test pit prior to the cave, we infer that the test pit originally exposed two lower units as described below.	
			Light olive gray (5Y 6/2, d) and white; interbedded marly SAND and sandy MARL; ostracodes; massive breaking into irregular coarse angular blocky structure; some laminar bedding observed.	Stansbury deep-water facies
			Subangular carbonate-coated locally derived gravel clasts; mode 2 to 3 cm; poorly sorted sand matrix	Promontory soil developed on Pre-Bonneville subaerial alluvium or colluvium
4500.66 to 4500	14.10 to 14.76 ft.	4.3 to 4.5 m TD		
				Pre-cave-in base of test pit

LOG OF TEST PIT TP-20

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: North margin of Hickman Knolls
SE 1/4 of Section 7, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing:
Easting:
Elevation: ~4515.5 (interpolated from TP 12 and TP-18 elevations)
Total Depth: 5.15 m (16.89 ft)

Logged By: F.H. Swan, K.L.Hanson, C. Hitchcock, and R.P. Gillespie **Date:** 9/24/98 9/25/98

Checked By: K.L. Hanson **Date:** 10/2/98

Notes: Location of west end of TP-20 is 46.25 m east of east end of TP-18; 16.5 m south of center line of dirt road.

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4515.5	0	0	Ground Surface: Grass covered, distal margin of sand ramp.	
			Very fine SAND with occasional pebbles and alignments of pebbles (generally < 1cm); bottom 10 to 15 cm is a basal pebbly unit that includes ~30% reworked Stansbury bar gravel; minor thin beta horizon at contact, < 5 % white filaments in beta horizon.	Post-Provo sand ramp
4507.3	8.2	2.5		
			Sandy GRAVEL; matrix is well sorted, medium sand; mode of gravel clasts is 2 to 3 cm, max. 10 to 15 cm; clasts are well rounded to subrounded; thin almost continuous to continuous carbonate coatings on bottoms of clasts, matrix has slightly more filamentous carbonate (~ 5 %) compared to overlying unit; loose; clear smooth lower contact.	Stansbury shoreline facies (gravel bar (lower ?))
4506.64	8.86	2.7		
			Yellowish brown (10 YR 5/0, d) gravelly SAND; contains 10 to 20% cobbles and small boulders; cobbles up to 30 cm;matrix-supported; clasts are predominantly rounded but some are subrounded to subangular; poorly sorted; moderate iron-oxide; good weathering rinds up to 1mm with calcium carbonate coatings on cobbles; well rounded to angular (locally derived) cobbles of black dolomite.	same as above (with reworked ? calcium carbonate coated clasts from underlying unit)
4505.33	10.17	3.1		
			Light gray (10YR 7/2, d) silty SAND; predominantly fine sand with stringers of coarse sand; carbonate-rich stringers (<5% of total); generally massive; gradational boundary with lower unit.	Promontory soil developed on pre-Bonneville sand ramp (alluvium)

LOG OF TEST PIT TP-20

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

4504.68	10.82	3.3		
			Sandy GRAVEL; 40 to 50 % cobbles and boulders; clasts are subrounded to rounded; calcium-carbonate coated, 1 mm-thick rinds; matrix similar to unit above.	Pre-Bonneville sand ramp (locally-derived lag gravel)
4504.02	11.48	3.5		
			Yellow (2.5 YR 6/2, d) silty SAND with cobbles; matrix is better sorted than above; boulder lag near base; fining-upward sequence; stage III carbonate (1 to 2 mm-thick continuous carbonate rinds, matrix plugged with carbonate); clear and irregular lower soil boundary.	K soil horizon developed on pre-Little Valley lacustrine cycle alluvium
4501.23	14.27	4.35		
			Olive yellow (2.5 YR 5/4, d) silty SAND that grades downward into coarse SAND and fine GRAVEL;angular gravel clasts; stage II carbonate (diffuse carbonate, some pebbles with carbonate rinds).	Cca soil horizon developed on pre-Little Valley lacustrine cycle alluvium
4498.61	16.89	5.15 TD		
			Note: Base of Cca horizon not exposed in test pit.	Base of test pit.

LOG OF TEST PIT TP-21

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: NE 1/4 Section 5, T4S, R8W
(1927 Utah State Plane Coordinates)
Northing: N761316.19
Easting: E1647390.112
Elevation: 4514.482
Total Depth: 1.4 m (4.59 ft)

Logged By: C. Hitchcock and R.P. Gillespie — **Date:** 9/24/98

Checked By: K.L. Hanson — **Date:** 10/2/98

Notes: Location and elevation of test pit surveyed by Hill and Jameson, Farmington, UT, 10/19/98. Photographic Slide: Roll KLH-98-9-2 (frame 12).

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
	0	0	Ground Surface	
			Brownish yellow (10 YR 6/4, d), silty, sandy GRAVEL: 40% gravel, 50% silt, and 10% sand; loose to very loose; subrounded to subangular clasts; mode 5 to 10 cm; poorly sorted; fine-grained (silt) eolian matrix; disseminated stage I carbonate in upper 30 cm.	Post-Provo alluvium with reworked eolian.
4512.05	2.43	0.74		
			Brownish yellow (10 YR 6/6,d) silty (mixed with marl) GRAVEL; rounded clasts; mode 10 to 15 cm.	Post-Provo alluvium (lag gravel)
4511.86	2.62	0.80		
			Very pale brown (10YR 8/2, d) SILT; silt (90 to 100 %); loose to medium dense; fine laminations, ostracodes on whitish partings (marl).	Bonneville or Provo deep-water facies
4510.87	3.61	1.10		
			Yellowish brown (10YR 5/6,d); sandy GRAVEL; gravel (60 to 70%), sand (30 to 40 %); damp, loose; sand is clean; subangular to subrounded clasts; mode 10 cm; no bedding; iron-oxide stains/coatings on pebbles.	Stansbury shoreline facies (gravel bar)
4509.89	4.59	1.40 TD		
				Base of test pit

LOG OF TEST PIT TP-22

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: NE 1/4 Section 5, T4S, R8W
(1927 Utah State Plane Coordinates)
Northing: N761469.809
Easting: E1647300.711
Elevation: 4512.137
Total Depth: 3.1 m (10.17 ft)

Logged By: C. Hitchcock and R.P. Gillespie **Date:** 9/24/98

Checked By: K.L. Hanson **Date:** 10/2/98

Notes: Location and elevation of test pit surveyed by Hill and Jameson, Farmington, UT, 10/19/98. Photographic Slide: Roll KLH-98-9-2 (frame 12).

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
	0	0	Ground Surface:	
			Brownish yellow (10 YR 6/4,d) silty sandy GRAVEL; gravel (35%), silt (60 %), sand (5 %); subangular to subrounded clasts up to 10 cm; mode 7 cm; poorly sorted; irregular development of stage I carbonate in upper 30 cm.	Alluvium and Post-Provo eolian deposits
4510.107	2.03	0.62		
			Very pale brown (10YR 7/3, d) SILT; loose to medium dense; fine laminations; ostracodes on partings (marl).	Bonneville or Provo deep-water facies
4509.187	2.95	0.90		
			Yellowish brown (10 YR 5/6, d) sandy GRAVEL; gravel (60 %), sand (40 %); poorly sorted with subrounded clasts to 20 cm, mode 10 %; sand is very clean with subrounded grains (beach sand); no bedding except hint of coarser layers.	Stansbury shoreline facies (gravel bar)
4507.377	4.76	1.45		
			Grayish brown (multi-colored) gravelly SAND; sand (80%), gravel (10 to 5 %), fines <3%,; subrounded clasts to 5 cm (pea-gravel); loose to very loose.	Stansbury shoreline facies (Beach sand)
4506.757	5.38	1.64 TD		
				Base of test pit

LOG OF TEST PIT TP-23

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: Hickman Knolls 7.5-minute quadrangle;
NE 1/4, SW 1/4, Section 7, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 753848.340
Easting: E 1639488.617
Elevation: 4517.475 ft
Total Depth: 2.79+m

Logged By: R.P. Gillespie **Date:** 10/19/98

Checked By: K. L. Hanson **Date:** 11/27/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT 10/19/98

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4517.47	0	0	Ground surface	
4514.31	3.16	0.96		
			Gravel; clean; bed appears to slope south	Stansbury shoreline facies (cross valley gravel bar, upper)
4508.31	9.16+	2.79+ TD	Walls caved, exact depth not measured prior to caving	Base of test pit

LOG OF TEST PIT TP-24 *Private Fuel Storage Facility* *Skull Valley, Utah*	GEOMATRIX **Project 4790**

Location: Hickman Knolls 7.5-minute quadrangle
NW 1/4, SE 1/4, Section 7, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 754012.158
Easting: E 1640594.605
Elevation: 4518.184 ft
Total Depth: >2.16 m (not measured)

Logged By: R. P. Gillespie **Date:** 10/19/98

Checked By: K. L. Hanson **Date:** 11/27/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT 10/19/98

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4518.184	0	0	Ground surface	
4516.024	2.16	0.66	Top of gravel	Stansbury shoreline facies (cross valley gravel bar, upper)
	2.16+	0.66+ TD	Test pit was not deepened to determine the bottom of the gravel.	Base of test pit

LOG OF TEST PIT TP-25

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: Hickman Knolls 7.5-minute quadrangle
NW 1/4, SE 1/4, Section 8, T5S, R8W
(1927 Utah State Plane Coordinates)
Northing: N 753984.847
Easting: E 1646104.028
Elevation: 4516.085 ft
Total Depth: 0.96 m

Logged By: R.P. Gillespie **Date:** 10/19/98

Checked By: K. L. Hanson **Date:** 11/27/98

Notes: Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT 10/19/98

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4516.085	0	0	Ground surface	
			Eolian deposit	Post-Provo eolian deposit
4516.024	3.16	0.96		
			Green clay	Bonneville or Provo deep-water facies
4516.024	3.16	0.96 TD		

LOG OF HAND EXCAVATED AUGER HOLE AH-2

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: SE 1/4, SE 1/4, SE 1/4, Section 5, T5S, R8W; 250 ft east of Section Corner; Station 1380 (Geosphere Seismic Line 3)

(1927 Utah State Plane Coordinates)

Northing:

Easting:

Elevation: 4486 ft (from detailed topographic map of site (Scale 1in = 500 ft)

Total Depth: 10.82 ft (3.3 m)

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 5/31/98

Checked By: K. L. Hanson **Date:** 11/28/98

Notes: Hand drilled auger hole; Photograph KLH-2 (frame 22)

Elevation (Feet)	Depth (Feet)	Depth (Meters)	Description	Geologic Units / Comments
4486	0	0	Ground surface: crest of grass covered sand ridge	
			Silty SAND	Post-Provo Eolian Deposit
4483.38	2.62	0.8		
			Marl or reworked marl	Bonneville or Provo deep-water facies
4482.72	3.28	1.00		
			SAND; well sorted medium to fine sand; upper 50 to 100 cm contains more silt and clay; sand grains coated (cambic soil?); clean sand at depth of 1.98 m	Post-Stansbury transgressive facies (sand ridge)
4476.98	9.02	2.75		
			SAND; similar to above except more oxidized (browner)	same as above
4476.49	9.51	2.9	SILT lenses or "blebs"	
			SAND; similar to above	same as above
4475.18	10.82	3.3 TD		Total Depth

LOG OF HAND EXCAVATED AUGER HOLE AH-3

Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX

Project 4790

Location: SE 1/4, SE 1/4, SE 1/4, Section 5, T5S, R8W; 200 ft east of Section Corner; Station 1380 (Geosphere Seismic Line 3)

(1927 Utah State Plane Coordinates)
Northing:
Easting:

Elevation: 4485 ft
(from detailed topographic map of site
(Scale 1in = 500 ft)

Total Depth: 4.66 ft (1.42 m)

Logged By: K.L. Hanson, F.H. Swan, R.P. Gillespie, and D. Currey **Date:** 5/31/98

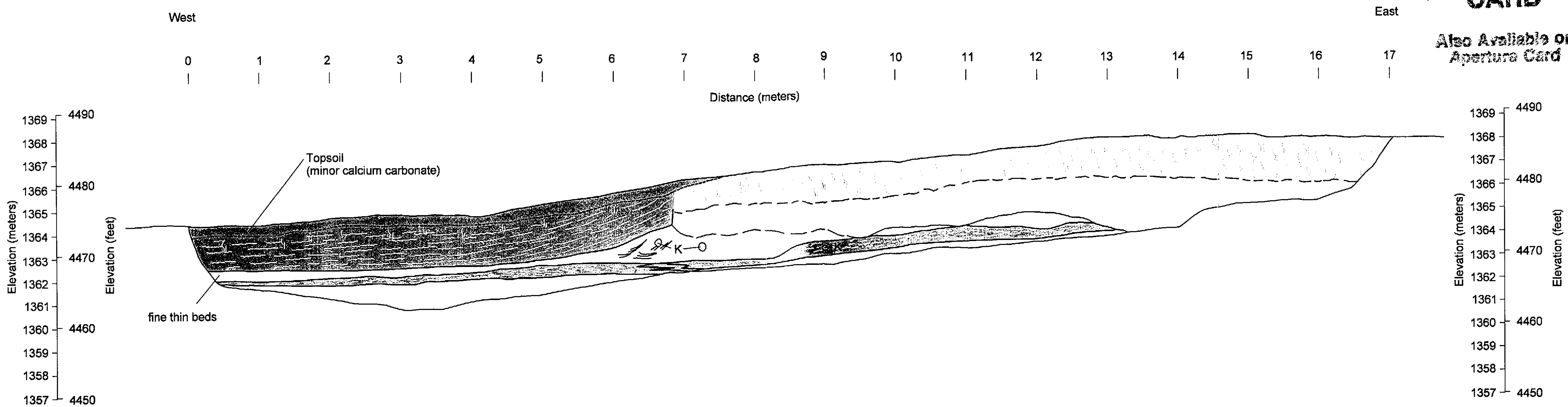
Checked By: K.L. Hanson **Date:** 11/28/98

Notes: Hand drilled auger hole
Photographs KLH 2 (frames 17 to 21)

Elevation (Feet)	**Depth (Feet)**	**Depth (Meters)**	**Description**	**Geologic Units / Comments**
4485 ft	0	0	Ground Surface: flat, playa	
			Marl; ostracodes	Bonneville or Provo deep-water facies
4481.75	3.25	0.99		
			SAND; fine to medium sand, some coarse sand	Post-Stansbury transgressive facies (sand ridge)
4480.34	4.66	1.42 TD		Total Depth

APERTURE CARD

Also Available on Aperture Card



EXPLANATION

UNIT DESCRIPTIONS

POST-PROVO PLAYA DEPOSIT
Brownish yellow (10yr 6/6) with (gley 5g 8/1) mottles; clayey silt(ml); damp; carbonate; soft; silt (90 %), clay (10 %); fine laminations (1 to 4 mm thick)

SOIL FORMED ON POST-PROVO EOLIAN DEPOSIT
Pale yellow (2.5y 8/4) silty sand similar to underlying unit; stage I to II? carbonate; blocky structure, platey

POST-PROVO EOLIAN DEPOSIT
Brownish yellow (10yr 6/6) silty sand (ml); dry; loose; sand (85%), silt (15 %); fine to very fine, minor mafics, quartz; well-sorted?

SHORELINE PROVO RECESSIONAL (?) DEPOSIT
Very pale brown (10yr 8/2) silty sand (sm); dry; very loose; sand (80%), silt (20%); subrounded; fine to very fine; well sorted

BONNEVILLE OR PROVO DEEP-WATER FACIES
Yellow (10yr 7/8) sandy, clayey silt (ml); dry; loose to medium dense; varying sand and clay content; laminations; small gastropod shells

STANSBURY SHORELINE OR POST-STANSBURY TRANSGRESSIVE FACIES (SAND RIDGE)
Very pale brown (10yr 8/2) silty sand (ml); dry; very loose; sand (95%), <5% clastics and clay; fine to very fine; well sorted; >75% shell fragments

Cross bedding

K — Krotovina (filled animal burrows)

9902220046-09

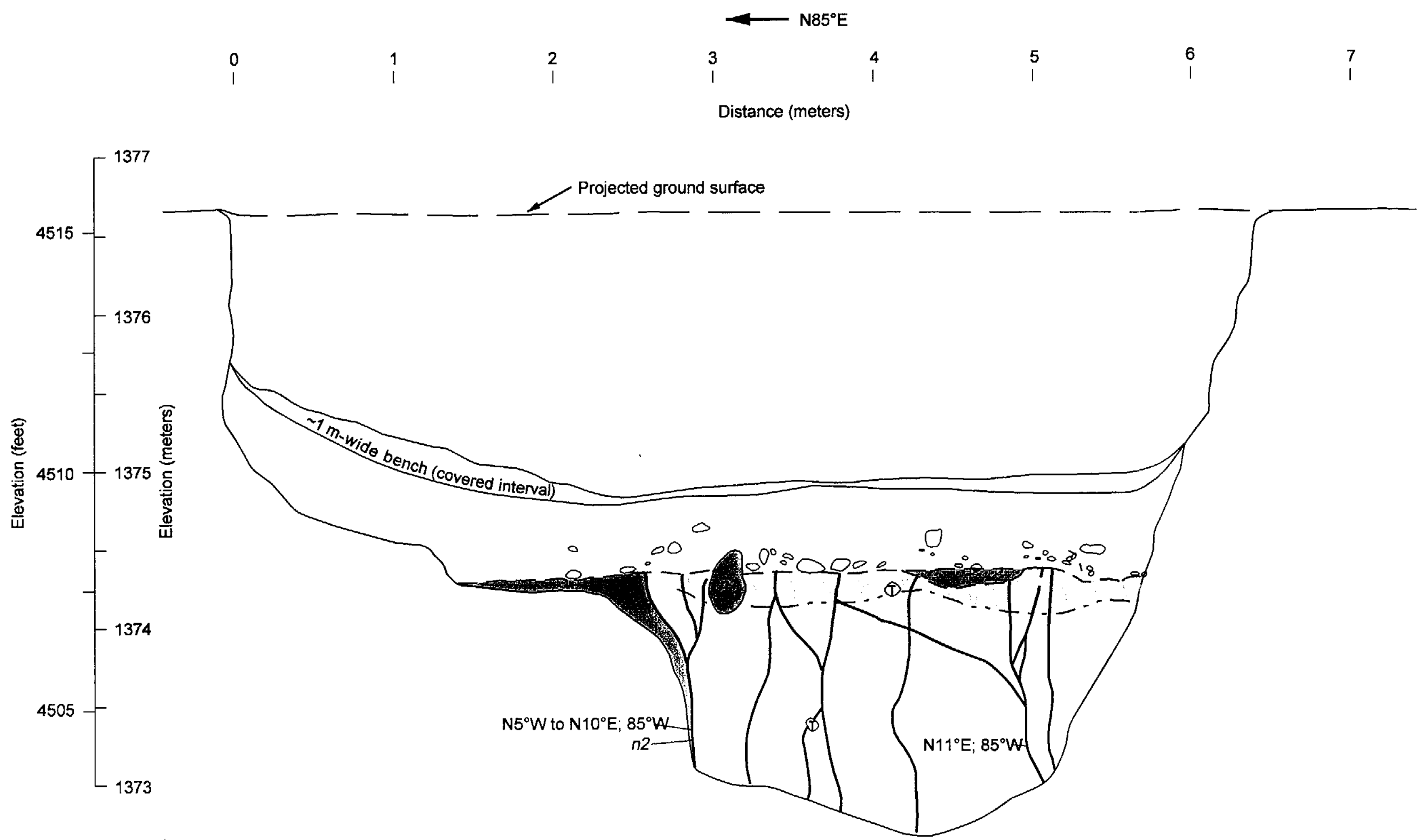
Location:	Hickman Knolls 7.5-minute quadrangle SE 1/4, SE 1/4, SE 1/4, T5S, R8W	Logged By:	C. Hitchcock and R. P. Gillespie	Date:	9/21/98
(1927 Utah State Plane Coordinates) Lat:	N 757280 (east end)	Checked By:	K. L. Hanson	Date:	9/23/98
Long:	E 1642708 (east end)	Notes:	Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT 9/22/98		
Elevation:	4486 ft (east end)				
Total Depth:	see log				

Note:

Location of test pit shown on Plate 1.

MAP OF NORTH WALL
TEST PIT TP-11
Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX | Project No. 4790 | Figure C-1



APERTURE CARD

Also Available on Aperture Card

EXPLANATION

UNIT DESCRIPTIONS

POST-PROVE SAND RAMP DEPOSITS
Brownish yellow (10yr 6/6 dry) silty fine sand; occasional subrounded to rounded pebbles up to 2 to 3 cm; a few discontinuous pebbly sand lenses; gravelly near base with cobbles and boulders up to 10 to 20 cm common

STANSBURY NEAR-SHORE BAR/BEACH DEPOSIT
Sandy gravel; poorly sorted; subangular to well-rounded pebbles in a sandy matrix; carbonate rinds up to 1 mm on the bottoms of clasts; elevation 4508 ft. (1374.4 m)

PRE-STANSBURY BURIED PALEOSOL (PROMONTORY SOIL?) DEVELOPED ON SHEAR ZONE
Very pale brown (10yr 8/3 dry) stage II to III carbonate; weak platey structure locally; nearly continuous rinds on clasts and matrix plugged with carbonate

SHEAR ZONE
Sheared and brecciated dolomite (paleozoic) includes blocks of tuffaceous siltstone (indicated by T); derived from Tertiary Salt Lake Formation; more numerous and larger blocks (up to 0.5m in width) observed in north wall of test pit. Numerous silica-carbonate filled fractures

BEDROCK (PALEOZOIC)
Very dark gray to black brecciated dolomite; similar to rocks that crop out in Hickman Knolls to the east of TP-12

— — — Sharp lithologic contact

- - — - - — Clear soil boundary (gradational over a 2.5- to 6-cm-wide interval)

——— Prominent silica-carbonate filled fracture

Notes:

n1 Detached dolomite boulder.

n2 Mullion structure and groove lineations plunging steeply south.

Location of test pit shown on Plate 1.

9902220046-10

Location:	Hickman Knolls 7.5-minute quadrangle NW 1/4, NE 1/4, SW 1/4 Section 7, T5S, R8W	Logged By:	K. L. Hanson and F. H. Swan	Date:	9/21/98
(1927 Utah State Plane Coordinates)		Checked By:	M. Angell	Date:	9/25/98
Lat:	N 754383	Notes:	Location and elevation of test pit surveyed by Hill & Jameson, Farmington, UT 9/22/98		
Long:	E 1641960				
Elevation:	4516.2 ft (east end)				
Total Depth:	7 m (23 ft)				

MAP OF SOUTH WALL
TEST PIT 12
Private Fuel Storage Facility
Skull Valley, Utah

GEOMATRIX	Project No. 4790	Figure C-2

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SFPRNT2\Splash 5750 v5.0 geomtrx.ctb
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GEOMATRIX

APPENDIX D

GEOCHRONOLOGY REPORTS (TEPHRACHRONOLOGY AND RADIOCARBON ANALYSIS)

Michael E. Perkins
Dept. of Geology and Geophysics
135 S. 1460 E. Room 719
University of Utah
Salt Lake City, UT 84112-0111

7 December 1998

Katheryn Hanson
Principal Geologist
Geomatrix Consultants
100 Pine Street, 10th Floor
San Francisco, CA 94111

Dear Katheryn:

As requested, I analyzed glass shards from four samples of vitric tuffs collected from Skull Valley, UT. Sample ID's are tr1-1, 2, 3 and 4. The samples were analyzed on the Cameca SX-50 microprobe at the Dept. of Geology and Geophysics, University of Utah. General procedures for sample preparation and analyses are described in Perkins et al. (1995). The analyses for these samples were compared with those in an extensive database of analyses/stratigraphic data/age dates for late Cenozoic vitric tephra layers (≤16 Ma) in the Western U. S. This database has been assembled by myself and several colleagues at the Department of Geology and Geophysics. Some of the key tephra layers in this database are described in published papers (Perkins et al., 1995 and 1998; Williams, 1994). The analyses of your samples and those of the most similar samples in the Univ. of Utah tephra database are given in enclosed tables. The correlations of the four samples are discussed below.

Samples tr1-1, 2, and 3 gray vitric tuffs. These three samples are compositionally identical (within measurement error) as is clear from both the analyses of individual shards (Table 1) and the mean composition of the shards from each sample (Table 2). The tr1-1/2/3 ash bed, here termed the Skull Valley ash bed, does not match to any sample in our database. It most closely resembles a tuff in the Salt Lake Fm in the Cache Valley, UT area (Table 3a). An analysis of this ash bed (cv12-20-6pg) is included in Table 2 for reference. The Salt Lake Fm. in the Cache Valley area was deposited in the interval 11–5 Ma (Perkins, unpublished data). The Skull Valley ash does not closely resemble any Quaternary ash bed in our database (Table 3a) so, I conclude that the Skull Valley ash bed is most likely an ash bed in the Salt Lake Fm. Regionally the Salt Lake Formation ranges in age from ~16 to 4 Ma.

Sample tr1-4 is white biotite bearing ash bed. It is a good compositional match to two ~15.4 Ma ash beds in the Rio Grande Rift north of Santa Fe, New Mexico (samples rg-18 and rg-143), as well as several other similar, middle Miocene ash beds in the Rio Grande Rift. The match between tr1-4 and both rg-18 and rg-143 is clear by the visual comparison of the analyses (Table 2), the plot of Fe vs. Ca (Fig. 1), and the value of the distance function, **D**, between these two samples (Tables 3b). As discussed in Perkins et al. (1995; 1998) we expect **D**≤3.8 (for a seven element comparison) between two compositionally identical samples.

The possible match of a sample with two or more different ash beds is not uncommon when using probe analyses for correlations. As noted by Perkins et al. (1998) such correlations are not definitive. However, the results discussed above are consistent with the conclusion that samples tr-1, 2, 3, and 4 are middle to late Miocene in age and are part of the Salt Lake Fm. Furthermore, there is no reason to believe that they are Quaternary tuffs.

If it is important to more precisely delimit the age of these tuffs, I can analyze tr1-4 together with its likely correlatives by the XRF method. This would provide a more definitive test the possible correlation between these two samples (Perkins et al., 1998). Note however, that three or more samples need to be analyzed (at least tr1-4, rg-18, and rg-143). Since sample preparation for XRF analyses are laborious, and my time for such work is limited, I will be unable to do them until after the first of next year.

If you have questions concerning any of the above or the enclosed invoice for the electron probe analyses, please contact me at your convenience.

Regards,

Michael E. Perkins
801-581-6552 (office)
mperk@mines.utah.ed

Table 1. Electron probe microanalyses of individual glass shards from Skull Valley ash bed samples[1].

Samples	SiO_2	TiO_2	Al_2O_3	Fe_2O_3[2]	MnO	MgO	CaO	BaO	Na_2O	K_2O	Cl	F	–O	H_2O	Sum
tr1-1	71.3	0.17	12.5	1.73	.103	0.04	0.47	0.00	3.4	5.3	0.20	0.23	0.14	5.0	100.3
tr1-1	70.6	0.12	12.4	1.67	.110	0.03	0.47	0.00	3.4	5.1	0.18	0.26	0.15	5.8	100.0
tr1-1	70.4	0.10	12.3	1.70	.071	0.04	0.45	0.01	3.4	5.1	0.16	0.27	0.15	6.1	99.9
tr1-1	70.9	0.10	12.4	1.73	.081	0.05	0.47	0.00	3.2	5.3	0.17	0.26	0.15	5.4	99.9
tr1-1	71.1	0.09	12.4	1.70	.071	0.05	0.47	0.00	3.3	5.2	0.15	0.29	0.16	5.2	99.9
tr1-1	70.9	0.17	12.3	1.67	.072	0.04	0.44	0.00	3.5	5.2	0.14	0.28	0.15	5.6	100.2
tr1-1	70.7	0.08	12.5	1.66	.069	0.04	0.46	0.00	3.4	4.9	0.14	0.31	0.16	7.2	101.3
tr1-1	70.9	0.05	12.2	1.59	.092	0.04	0.47	0.04	3.4	4.8	0.17	0.24	0.14	6.0	99.9
tr1-1	70.8	0.09	12.3	1.60	.077	0.05	0.49	0.00	3.5	4.9	0.18	0.33	0.18	6.3	100.4
tr1-1	71.3	0.08	12.3	1.69	.074	0.05	0.47	0.03	3.1	5.4	0.16	0.23	0.13	5.7	100.5
tr1-1	70.9	0.11	12.6	1.69	.081	0.03	0.44	0.02	3.4	5.7	0.19	0.32	0.18	5.0	100.3
tr1-1	70.6	0.06	12.5	1.64	.099	0.05	0.47	0.00	3.3	4.9	0.18	0.33	0.18	6.8	100.7
tr1-1	70.6	0.06	12.3	1.74	.111	0.05	0.46	0.00	3.3	5.0	0.16	0.25	0.14	7.1	101.0
tr1-1	70.7	0.14	12.3	1.70	.096	0.04	0.45	0.00	3.8	5.2	0.19	0.29	0.17	5.5	100.2
tr1-1	71.1	0.11	12.3	1.82	.089	0.03	0.44	0.00	3.2	5.4	0.17	0.30	0.16	5.1	99.9
tr1-1	70.8	0.10	12.3	1.68	.062	0.04	0.47	0.04	3.0	5.5	0.18	0.24	0.14	5.3	99.6
tr1-1	70.7	0.09	12.4	1.63	.076	0.04	0.46	0.00	3.1	5.4	0.18	0.22	0.13	6.1	100.3
tr1-1	70.9	0.11	12.4	1.72	.053	0.03	0.45	0.00	3.5	4.6	0.18	0.20	0.12	6.9	100.9
tr1-1	71.1	0.14	12.4	1.66	.086	0.03	0.46	0.00	3.7	4.9	0.17	0.25	0.14	5.3	100.1
tr1-1	70.9	0.12	12.3	1.67	.082	0.05	0.49	0.00	3.5	5.2	0.18	0.35	0.19	5.0	99.6
tr1-1	70.5	0.12	12.4	1.73	.077	0.03	0.47	0.00	3.2	5.0	0.18	0.24	0.14	5.9	99.7
tr1-1	70.7	0.07	12.2	1.58	.107	0.05	0.47	0.02	3.6	5.1	0.17	0.33	0.18	5.8	100.0
tr1-2	71.1	0.07	12.4	1.68	.047	0.05	0.45	0.00	3.4	5.1	0.16	0.33	0.18	5.2	99.8
tr1-2	70.9	0.12	12.3	1.65	.076	0.05	0.45	0.04	3.4	5.2	0.16	0.31	0.17	5.4	99.9
tr1-2	71.1	0.07	12.3	1.70	.066	0.04	0.50	0.00	3.4	5.1	0.18	0.29	0.16	4.0	98.6
tr1-2	70.8	0.09	12.2	1.71	.085	0.04	0.46	0.00	3.4	5.0	0.18	0.32	0.18	6.3	100.4
tr1-2	70.6	0.13	12.3	1.51	.101	0.03	0.46	0.00	3.3	4.9	0.18	0.28	0.16	7.1	100.7
tr1-2	70.8	0.09	12.3	1.73	.086	0.04	0.45	0.00	3.4	5.0	0.17	0.35	0.19	7.0	101.2
tr1-2	70.5	0.12	12.4	1.65	.067	0.04	0.46	0.00	3.4	5.1	0.18	0.31	0.17	6.9	101.0
tr1-2	70.8	0.12	12.4	1.64	.085	0.04	0.52	0.00	3.4	5.2	0.18	0.34	0.18	5.9	100.4
tr1-2	70.9	0.12	12.4	1.71	.054	0.04	0.49	0.00	3.8	4.9	0.14	0.34	0.18	5.5	100.2
tr1-2	70.4	0.08	12.3	1.73	.074	0.05	0.46	0.00	3.5	5.0	0.18	0.32	0.17	6.8	100.7
tr1-2	71.1	0.11	12.3	1.60	.074	0.05	0.48	0.00	3.3	5.0	0.17	0.26	0.15	6.7	101.0
tr1-2	71.1	0.08	12.3	1.70	.053	0.04	0.49	0.00	3.4	5.2	0.17	0.25	0.14	5.6	100.2
tr1-2	71.1	0.09	12.5	1.73	.090	0.04	0.47	0.00	3.3	5.1	0.19	0.31	0.17	5.3	100.0
tr1-2	70.7	0.10	12.3	1.65	.048	0.05	0.46	0.00	3.3	4.9	0.18	0.28	0.16	6.6	100.4
tr1-2	70.9	0.12	12.4	1.61	.069	0.01	0.46	0.00	3.7	4.9	0.16	0.26	0.15	5.1	99.5
tr1-2	70.8	0.07	12.4	1.61	.098	0.04	0.48	0.00	3.5	5.1	0.17	0.31	0.17	6.3	100.7
tr1-2	71.1	0.08	12.5	1.72	.083	0.05	0.47	0.00	3.3	5.5	0.19	0.30	0.17	4.4	99.5
tr1-2	70.7	0.13	12.3	1.64	.098	0.04	0.48	0.00	3.2	4.7	0.19	0.32	0.18	7.1	100.7
tr1-2	71.0	0.05	12.3	1.63	.085	0.05	0.47	0.00	3.4	5.2	0.17	0.30	0.16	5.7	100.2
tr1-2	71.4	0.08	12.3	1.58	.149	0.04	0.49	0.02	3.4	5.2	0.19	0.29	0.16	4.7	99.7
tr1-2	70.8	0.12	12.3	1.67	.063	0.04	0.49	0.00	3.4	4.9	0.16	0.28	0.15	7.0	101.1
tr1-2	70.4	0.07	12.3	1.62	.088	0.05	0.46	0.07	3.5	5.0	0.18	0.26	0.15	6.3	100.2
tr1-3	70.6	0.15	12.2	1.63	.066	0.05	0.46	0.00	3.4	4.9	0.18	0.19	0.12	5.1	98.8
tr1-3	70.4	0.13	12.2	1.61	.086	0.03	0.47	0.00	3.4	5.6	0.16	0.17	0.11	5.5	99.6
tr1-3	70.7	0.12	12.3	1.67	.075	0.03	0.46	0.00	3.3	5.1	0.17	0.23	0.14	5.4	99.4
tr1-3	70.6	0.08	12.3	1.65	.105	0.05	0.48	0.00	3.3	5.4	0.14	0.30	0.16	6.2	100.4
tr1-3	70.3	0.06	12.2	1.71	.073	0.05	0.46	0.00	3.3	5.3	0.18	0.24	0.14	6.3	100.0
tr1-3	71.4	0.10	12.3	1.74	.076	0.06	0.49	0.00	3.5	4.7	0.19	0.26	0.15	5.5	100.2
tr1-3	71.2	0.06	12.3	1.65	.096	0.07	0.46	0.00	3.3	5.1	0.18	0.33	0.18	5.5	100.1
tr1-3	71.5	0.06	12.4	1.61	.080	0.05	0.45	0.00	3.6	5.0	0.19	0.31	0.17	4.9	100.0
tr1-3	70.8	0.05	12.4	1.74	.081	0.05	0.47	0.02	3.4	5.2	0.15	0.29	0.16	5.7	100.2
tr1-3	71.3	0.09	12.5	1.69	.044	0.03	0.45	0.00	3.6	5.1	0.18	0.30	0.17	5.3	100.4
tr1-3	71.0	0.11	12.2	1.66	.066	0.03	0.45	0.00	3.0	5.3	0.17	0.28	0.16	5.7	99.8
tr1-3	71.6	0.15	12.4	1.55	.061	0.04	0.46	0.00	3.2	5.3	0.18	0.25	0.15	4.6	99.6
tr1-3	70.9	0.11	12.3	1.74	.066	0.05	0.49	0.00	3.5	5.1	0.19	0.25	0.15	5.0	99.5
tr1-3	71.2	0.08	12.4	1.74	.063	0.05	0.46	0.00	3.5	5.2	0.16	0.34	0.18	5.7	100.7
tr1-3	71.3	0.10	12.3	1.60	.048	0.04	0.48	0.02	3.6	5.3	0.20	0.26	0.15	5.0	100.1
tr1-3	71.3	0.11	12.3	1.67	.053	0.07	0.46	0.00	3.3	5.2	0.18	0.19	0.12	4.8	99.5
tr1-3	70.9	0.13	12.4	1.65	.087	0.05	0.46	0.00	3.4	5.2	0.18	0.31	0.17	5.3	99.9
tr1-3	71.0	0.10	12.3	1.74	.076	0.04	0.47	0.00	3.6	4.6	0.15	0.31	0.16	6.4	100.6
tr1-3	70.7	0.12	12.4	1.68	.091	0.04	0.47	0.00	3.5	5.0	0.20	0.27	0.16	5.1	99.4
tr1-3	71.0	0.10	12.3	1.63	.097	0.05	0.48	0.01	3.5	4.8	0.19	0.28	0.16	6.5	100.8
tr1-3	71.0	0.06	12.3	1.71	.051	0.07	0.46	0.03	3.4	5.0	0.16	0.35	0.18	4.6	99.0
tr1-3	70.9	0.10	12.3	1.72	.119	0.05	0.48	0.00	3.5	4.9	0.17	0.37	0.19	5.8	100.2
tr1-4	72.3	0.19	11.6	0.79	.019	0.06	0.50	0.00	3.0	5.4	0.16	0.33	0.18	5.2	99.4
tr1-4	72.6	0.15	11.8	0.76	.061	0.05	0.52	0.00	2.8	5.2	0.12	0.38	0.19	5.7	100.0
tr1-4	72.7	0.15	11.6	0.78	.084	0.06	0.48	0.01	2.9	5.2	0.13	0.36	0.18	4.8	99.1
tr1-4	72.7	0.07	11.8	0.82	.042	0.07	0.49	0.00	2.8	5.5	0.14	0.34	0.17	4.9	99.5
tr1-4	73.4	0.14	11.8	0.71	.058	0.05	0.50	0.00	2.8	5.3	0.13	0.39	0.19	5.0	100.1
tr1-4	72.9	0.17	11.7	0.74	.019	0.06	0.49	0.00	2.9	5.4	0.13	0.44	0.21	4.9	99.6
tr1-4	72.9	0.10	11.7	0.76	.043	0.06	0.49	0.00	2.8	5.3	0.13	0.36	0.18	5.6	100.1
tr1-4	72.8	0.11	11.7	0.77	.108	0.04	0.52	0.00	2.8	5.5	0.16	0.31	0.17	4.6	99.3
tr1-4	73.3	0.09	11.8	0.75	.058	0.04	0.51	0.00	2.9	5.0	0.14	0.36	0.18	5.7	100.5
tr1-4	73.4	0.12	11.9	0.83	.051	0.04	0.49	0.00	3.0	5.1	0.13	0.35	0.18	4.7	99.9
tr1-4	72.9	0.07	11.6	0.81	.075	0.06	0.51	0.00	2.7	5.1	0.15	0.40	0.20	5.7	99.9
tr1-4	73.5	0.11	11.7	0.75	.056	0.03	0.47	0.00	3.1	5.1	0.14	0.44	0.22	5.0	100.2
tr1-4	73.2	0.12	11.9	0.75	.025	0.05	0.51	0.00	3.1	5.4	0.15	0.32	0.17	3.7	99.1
tr1-4	72.8	0.16	11.8	0.75	.042	0.06	0.50	0.00	3.0	5.3	0.13	0.37	0.19	5.4	100.1
tr1-4	72.7	0.13	11.9	0.74	.090	0.04	0.49	0.03	2.8	5.1	0.13	0.40	0.20	5.5	99.8
tr1-4	73.1	0.14	11.9	0.78	.079	0.05	0.49	0.01	2.8	5.3	0.16	0.42	0.21	5.7	100.7
tr1-4	73.0	0.09	11.7	0.77	.081	0.04	0.49	0.00	2.8	5.3	0.13	0.41	0.20	5.9	100.5
tr1-4	72.6	0.09	11.7	0.82	.016	0.08	0.49	0.00	2.8	5.4	0.13	0.30	0.16	5.5	99.8
tr1-4	73.0	0.14	11.8	0.82	.033	0.04	0.51	0.00	2.8	5.0	0.15	0.40	0.20	5.1	99.6
tr1-4	72.9	0.14	11.7	0.84	.099	0.06	0.51	0.01	2.8	5.0	0.15	0.41	0.21	4.9	99.3
tr1-4	72.9	0.13	11.8	0.74	.084	0.05	0.51	0.00	3.0	5.2	0.14	0.30	0.16	4.8	99.5
tr1-4	73.1	0.11	11.7	0.81	.053	0.04	0.48	0.00	2.8	5.3	0.14	0.35	0.18	5.4	100.1

1. All analytical concentrations in wt%.
2. Total Fe as Fe_2O_3.

Table 2. Averages of electron probe microanalyses of glass shards from Skull Valley, UT ash bed samples and some similar ash bed samples from other areas

Samples[1]	n[2]	SiO_2 [.5][6]	**TiO_2**[3] [.01]	**Al_2O_3** [.2]	**Fe2O_3**[4] [.03]	**MnO** [.005]	**MgO** [.01]	**CaO** [.02]	BaO [.02]	Na_2O[5] [.2]	K_2O [.3]	**Cl** [.004]	F [.03]	H2O [1.0]	–O [.03]	Sum [1.0]
tr1-1	22	70.8	0.10	12.4	1.68	0.083	0.04	0.46	0.01	3.4	5.1	0.17	0.27	5.8	0.15	100.2
tr1-2	22	70.9	0.10	12.3	1.66	0.079	0.04	0.47	0.01	3.4	5.0	0.17	0.30	6.0	0.17	100.3
tr1-3	22	71.0	0.10	12.3	1.67	0.075	0.05	0.47	0.00	3.4	5.1	0.17	0.28	5.5	0.16	100.0
cv 12-20-6pg	20	70.9	0.11	12.5	1.56	0.076	0.05	0.53	0.00	2.9	5.7	0.18	0.31	5.0	0.18	99.64
tr1-4	22	72.9	0.12	11.8	0.78	0.058	0.05	0.50	0.00	2.9	5.2	0.14	0.37	5.2	0.19	99.8
rg- 18	20	72.5	0.12	11.7	0.77	0.054	0.06	0.48	0.04	2.4	6.3	0.14	0.11	5.4	0.08	100.0
rg-143	20	73.3	0.12	11.8	0.83	0.050	0.06	0.51	0.03	2.3	6.0	0.14	0.13	4.6	0.09	99.8
Walcott ash bed	20	74.1	0.18	11.5	1.21	0.040	0.08	0.48	0.10	3.3	5.1	0.10	0.09	3.3	0.06	99.3

1. The "tr1" samples are from Skull Valley, UT. The "cv" sample is from the Cache Valley, UT area. The "rg" samples are from the Rio Grande Rift, New Mexico. The Walcott ash bed sample is from the type section near American Falls, ID.
2. Number of analyzed glass shards. Analyses are average concentrations.
3. Oxides/elements highlighted with bold font are used in comparison of samples and calculation of **D** values.
4. Total Fe as Fe_2O3.
5. Alkalies are subject to cation exchange with groundwater so measured concentrations do not reflect original concentrations.
6. Estimated precision of average concentrations.

Table 3a. Comparison of sample tr1-1 with other database samples

Sample[1]	D[2]	Age
tr1-1[3]	**0.0**	
tr1-2	**1.3**	
tr1-3	**1.5**	
cv12-20-6pg	6.0	l.-Miocene

1. All database samples with D≤6.0 are listed in table.
2. D is a measure of the compositional distance between comparison sample (tr1-1) and listed samples (Perkins et al., 1995). TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, and Cl used for comparisons. D = 0 indicates exactly identical composition. Samples with D ≤ 3.8 are statistically identical.
3. Samples with D ≤ 3.8 are highlighted with boldface font.

Table 3b. Comparison of Sample tr1-4 with other database samples

Sample	D	Age
tr1-4	**0.0**	
rg-18	**1.5**	**m. Miocene**
rg-143	**2.2**	**m. Miocene**
rg-139	**2.5**	**m. Miocene**
don95-769	**3.5**	**Oligocene**
cov95-852	**3.5**	**m. Miocene**
cmt-4	4.1	m. Miocene
cmt-64	4.1	m. Miocene
rg-135	4.2	m. Miocene
rg-164	4.3	m. Miocene
rg-151	4.6	m. Miocene
rg- 42	4.7	m. Miocene
rg- 20	4.7	m. Miocene
sor2850-II	4.8	Pliocene
buf94-622	4.9	m. Miocene
rg- 62white	5.0	m. Miocene
rg- 40white	5.1	m. Miocene
rg- 15	5.4	m. Miocene
971005A	5.5	m. Miocene
as89-40	5.6	m. Miocene
cov95-842	5.7	l. Miocene
sv93-290	5.9	m. Miocene
i90- 7	5.9	m. Miocene
JPUNM-10-dac	6.0	Pliocene

Note: Explanation as in footnotes of Table 3a.

Figure 1a. Fe vs. Ca for Skull Valley ash bed and similar ash bed in Cache Valley, UT

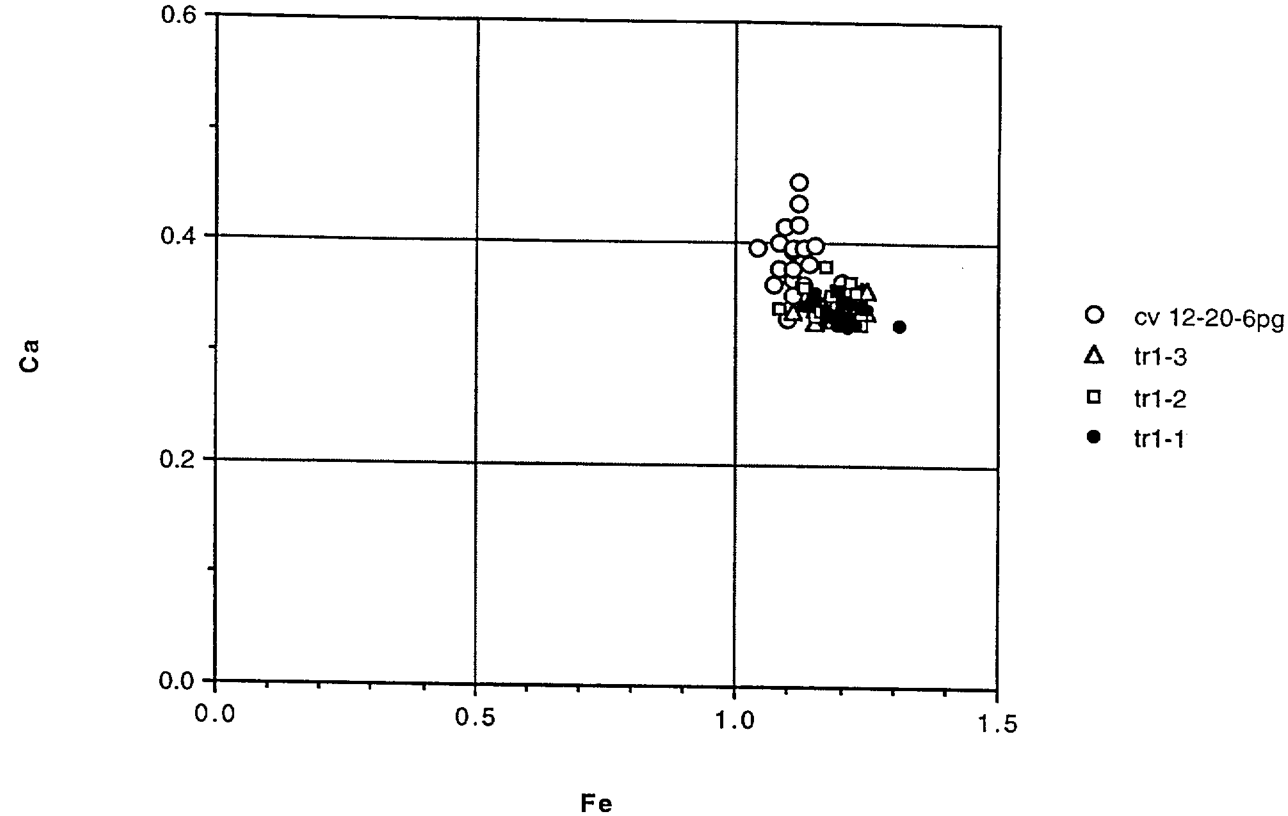
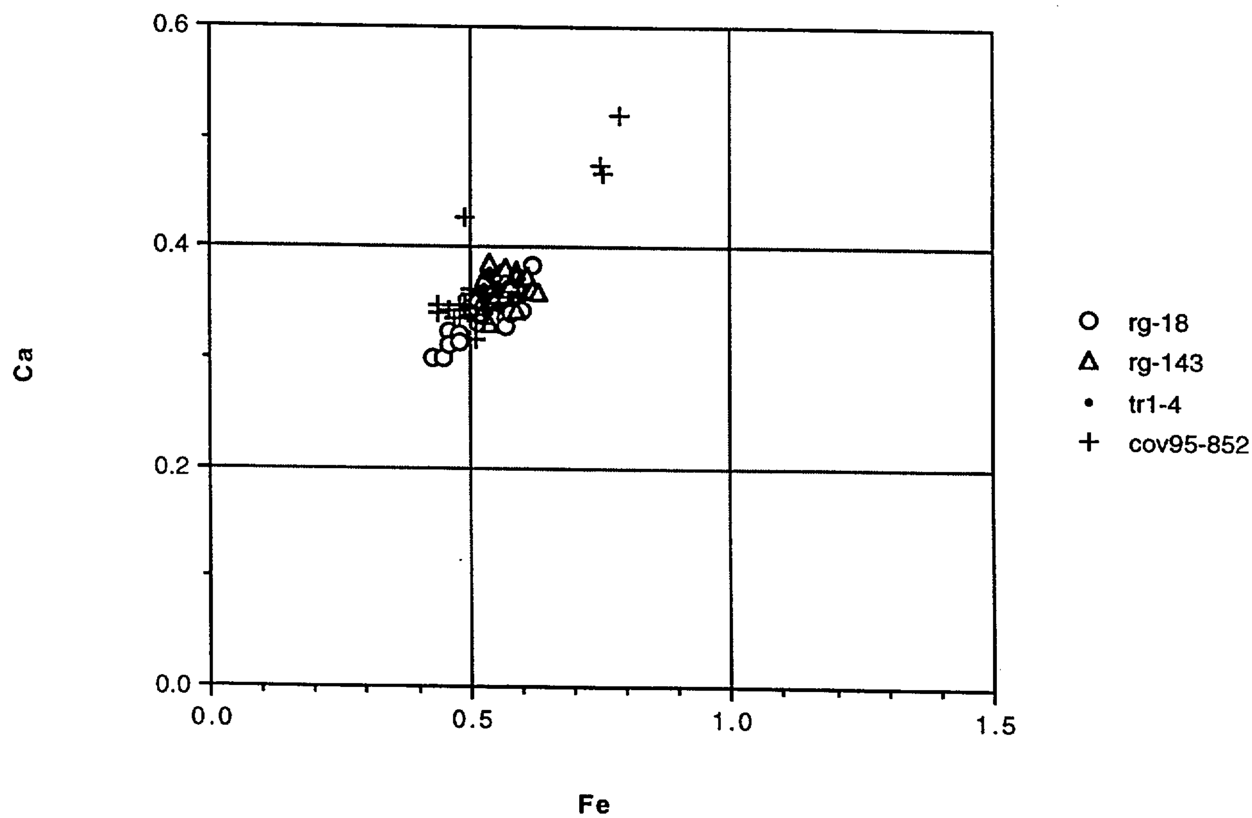


Figure 1b. Fe vs. Ca for ash bed tr1-4 and compositionally similar ash beds.



BETA ANALYTIC INC.

RADIOCARBON DATING SERVICES

Mr. DARDEN G. HOOD
'rector

RONALD E. HATFIELD
Laboratory Manager

CHRISTOPHER PATRICK
TERESA A. ZILKO-MILLER
Associate Managers

January 4, 1999

Mr. Donald L. Wells/F. Swan
Geomatrix Consultants
100 Pine Street, 10th Floor
San Francisco, CA 94111

Dear Mr. Wells and Mr. Swan:

Please find enclosed the radiocarbon dating results for two samples of carbonate sediment (4790/FS-1a/TP-7 and 4790/FS-1b/TP-7) which were submitted on December 17 for analysis on the ADVANCE delivery basis. They were both very small, requiring us to convert the sample carbon to graphite and then to count the radiocarbon atomically using an accelerator mass spectrometer (AMS). They each provided plenty of carbon for reliable measurements and all analytical steps went normally. The quoted errors represent 1 sigma statistics. Since these errors cannot include uncertainties outside of those which can be quantified during measurement, it is best to consider them as minimum quotes.

Literature discussing the generalities of analysis and calendar calibration are enclosed. The "Analytical Procedures and Final Report" discussion should answer most questions about the report and results. If you have any specific questions, please do not hesitate to contact us.

When reporting the results, you should designate the radiocarbon "BP" ages as the "Conventional Radiocarbon Age", quote the measured C13/C12 ratios and note that the dates were done at Beta Analytic. Calendar calibrated results are not enclosed as the results were beyond the calendar calibration range.

Our invoice is enclosed. Please, immediately give it to the appropriate office for prompt payment or send VISA charge authorization. Thank you.

Sincerely,

Darden Hood

4985 S.W. 74 COURT, MIAMI, FL 33155 U.S.A.
TELEPHONE: 305-667-5167 / FAX: 305-663-0964 / INTERNET: beta@radiocarbon.com
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BETA

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REPORT OF RADIOCARBON DATING ANALYSES

Mr. Donald L. Wells/F. Swan — December 18, 1998

Geomatrix Consultants — January 4, 1999

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-125764	24140 +/- 190 BP	+ 2.7 o/oo	24600 +/- 190 BP

SAMPLE #: 4790/FS-1a/TP-7
ANALYSIS: ADVANCE-AMS
MATERIAL/PRETREATMENT:(carbonate sediment): none

Sample Data	Measured C14 Age	C13/C12 Ratio	Conventional C14 Age (*)
Beta-125765	23560 +/- 380 BP	+ 0.7 o/oo	23990 +/- 380 BP

SAMPLE #: 4790/FS-1b/TP-7
ANALYSIS: ADVANCE-AMS
MATERIAL/PRETREATMENT:(carbonate sediment): none

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

Mr. DARDEN G. HOOD
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ANALYTICAL PROCEDURES AND FINAL REPORT

FINAL REPORT

This package includes the final date report, this statement outlining our analytical procedures, a glossary of pretreatment terms, calendar calibration information, billing documents (containing balance/credit information and the number of samples submitted within the yearly discount period), and peripheral items to use with future submittals. The final report includes the individual analysis method, the delivery basis, the material type and the individual pretreatments applied. Please recall any correspondences or communications we may have had regarding sample integrity, size, special considerations or conversions from one analytical technique to another (e.g. radiometric to AMS). The final report has also been sent by fax or e-mail, where available.

PRETREATMENT

Results were obtained on the portion of suitable carbon remaining after any necessary chemical and mechanical pretreatments of the submitted material. Pretreatments were applied, where necessary, to isolate ^{14}C which may best represent the time event of interest. Individual pretreatments are listed on the report next to each result and are defined in the enclosed glossary. When interpreting the results, it is important to consider the pretreatments. Some samples cannot be fully pretreated making their ^{14}C ages more subjective than samples which can be fully pretreated. Some materials receive no pretreatments. Please read the pretreatment glossary.

ANALYSIS

Materials measured by the radiometric technique were analyzed by synthesizing sample carbon to benzene (92% C), measuring for ^{14}C content in a scintillation spectrometer, and then calculating for radiocarbon age. If the Extended Counting Service was used, the ^{14}C content was measured for a greatly extended period of time. AMS results were derived from reduction of sample carbon to graphite (100 %C), along with standards and backgrounds. The graphite was then sent for ^{14}C measurement in an accelerator-mass-spectrometer located at one of six collaborating research facilities, who return the results to us for verification, isotopic fractionation correction, calendar calibration, and reporting.

THE RADIOCARBON AGE AND CALENDAR CALIBRATION

The "Conventional C14 Age (*)" is the result after applying C13/C12 corrections to the measured age and is the most appropriate radiocarbon age (the "*" is discussed at the bottom of the final report). Applicable calendar calibrations are included for organic materials and fresh water carbonates between 0 and 10,000 BP and for marine carbonates between 0 and 8,300 BP. If certain calibrations are not included with this report, the results were either too young, too old, or inappropriate for calibration.

APPENDIX E

PROPRIETARY INDUSTRY GRAVITY DATA

APPENDIX E

PROPRIETARY INDUSTRY GRAVITY DATA

Approximately 1030 gravity measurements have been collected over a 400 square mile area in Skull Valley for the purpose of supporting oil exploration. These land based gravity data were acquired by Edcon, Inc. in 1978 along roads at a measurement spacing of approximately ¼ mile.

Gravity surveys measure the earth's acceleration of gravity, which is directly related to the subsurface density distribution. Geologic faults are sometimes expressed by an increased lateral change (horizontal gradient) of the gravity field.

During the initial phase of this investigation, Geomatrix licensed 80 gravity stations from Edcon, Inc. comprising two east-west profiles from this data set. These profiles are located immediately north and south of the PFSF site. After reviewing these data, Geomatrix licensed the remaining gravity measurements from Edcon, Inc. The color contoured Bouguer Gravity data are shown on Plate E-1. The terrain correction was computed to Hayford-Bowie Zone J using a density of 2.67 g/cm^3. The Bouguer gravity was computed using a density of 2.67 g/cm3. The 1930 International gravity formula was used to compute the latitude correction.

These gravity data are owned by Edcon, Inc. and may not be publicly distributed. Geomatrix received permission from Edcon, Inc. to publicly present contoured gravity data in the immediate vicinity of the site. As such, Plate 1 shows contoured gravity data within a radius of approximately 2.5 miles of the site.

The Skull Valley gravity data are used to assist with the regional fault interpretations and with the development of the regional structural cross-sections (Figures 2-1 and 2-3). The prominent gravity lows, gravity highs, and areas having steep gravity gradients are presented on Plate 6. In addition, the gravity data are used to assist in the placement of two of the shear wave seismic lines. Line PFSF-98A was extended eastward such that it crossed the maximum horizontal gravity gradient. The orientation of seismic line PFSF-98B was chosen so as to trend perpendicular to the local basin structure as inferred from the gravity data.

TERRAIN CORRECTED BOUGER GRAVITY MAP (Proprietary Data Licensed from EDCON, Inc.) Private Fuel Storage Facility Skull Valley, Utah		
GEOMATRIX	Project No. 4790	Plate E-1

NOTE: This 1:100,000-scale gravity map is based on proprietary data that are owned by Edcon, Inc. The license agreement prohibits general distribution of the regional gravity data. Plate E-1 may be made available to reviewers of this report who agree to abide by the terms of the license agreement.

GEOMATRIX

VOLUME III – APPENDIX F

Fault Evaluation Study and Seismic Hazard Assessment

Private Fuel Storage Facility

Skull Valley, Utah

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February 1999

Project No. 4790

Geomatrix Consultants

GEOMATRIX

APPENDIX F

ASSESSMENT OF APPROPRIATE GROUND MOTION ATTENUATION RELATIONSHIPS

APPENDIX F
ASSESSMENT OF APPROPRIATE GROUND MOTION ATTENUATION RELATIONSHIPS

INTRODUCTION

At present, strong motion data recorded in Utah are very limited. In the past, evaluations of seismic hazard, (e.g. Youngs and others, 1987) have typically concluded from examination of the limited strong and weak motion (i.e. seismographic network recordings) that strong ground motion attenuation relationships developed from analysis of California earthquake recordings can be used for Basin and Range sites. However, more recent studies have used examinations of world-wide normal faulting earthquake data together with a variety of modeling techniques to infer that there may be significant differences between strong ground motions in California and those from normal faulting earthquakes in extensional tectonic regimes, such as the Basin and Range region of north-central Utah. Much of this work was reviewed as part of the seismic hazard assessment for the proposed nuclear waste repository at Yucca Mountain, Nevada (CRWMS M&O, 1998). As part of that study, a panel of seven ground motion experts was assembled to provide assessments of the appropriate ground motion models for the Basin and Range region of southern Nevada. In that study, two basic approaches were used to develop ground motion attenuation relationships, one based on modifications to empirical California strong motion attenuation relationships and one based on numerical modeling. For this study, we utilize the results of the Yucca mountain study to modify California empirical ground motions to the conditions at Skull Valley, Utah. These modifications account for the effects of the characteristics of the earthquake source, the crustal wave propagation path, and the local site geology.

MODIFICATIONS FOR EARTHQUAKE SOURCE EFFECTS

The ground motion expert panel for the Yucca Mountain study selected seven alternative empirical attenuation relationships for use in estimating strong ground motions from normal faulting earthquakes. These relationships are listed in Table F-1. Five alternative scaling relationships were developed for the project to scale the relationships for the difference between the earthquake sources of California strike-slip earthquakes and normal faulting earthquakes (see column 2 of Table F-1). The first is the assumption that there is no significant difference (no scaling). The second scaling method is a set of empirical adjustment factors derived by Dr. N. Abrahamson to adjust the Abrahamson and Silva (1997) attenuation relationships from strike-slip to normal faulting (designated A-E in Table F-1). The third scaling method used by the expert panel is one-half of the empirical adjustment factors developed by Dr. N. Abrahamson (designated 1/2A-E in Table F-1). The fourth and fifth scaling factors were developed by Drs. K. Campbell and W. Silva using the point source stochastic ground motion model and the difference in stress drop between California strike-slip and extensional normal faulting earthquakes (designated KCSC and WSSC, respectively in Table F-1).

The amount of scaling as a function of earthquake magnitude and ground motion period is shown on Figure F-1. The empirical scaling relationship developed by Dr. Abrahamson was only defined for the period range of PGA to 2.0 seconds. For this study we assume that the scaling factor he obtained for 2.0 second spectral acceleration also applies to longer periods.

The third column of Table F-1 lists the relative weights applied to each of the scaled empirical attenuation relationships. These weights are an average of the weights assigned by the seven ground motion panel experts. We propose to use this assessment to select appropriate scaled empirical attenuation relationships to apply to normal faulting earthquakes in Utah. The assessments for the Yucca Mountain project were for rock site conditions, while the Skull Valley site is located on alluvial soils. Five of the rock site attenuation relationships listed in Table F-1 have companion alluvial soil site attenuation relationships. The fourth column of Table F-1 lists the re-normalized weights for these five relationships scaled with the indicated earthquake source scaling factors. The relationship developed by Sabetta and Pugliese (1996) was not included because it was given a low weight by only one expert, resulting in a combined average relative weight of less that one percent.

As indicated on Figure F-1, the scaling factors developed by Drs. Campbell (KCSC) and Silva (WSSC) are very similar. Therefore, for this study, we used Dr. Silva's scaling factors for both KCSC and WSSC scaling because they have a convenient numerical expression that can be used to adjust the coefficients of the selected empirical attenuation relationships. As a result, 17 alternative scaled empirical attenuation relationships were used to model horizontal ground motions at the site.

A similar process was used to specify empirical attenuation relationships for vertical motions. Table F-2 lists the empirical attenuation relationships for vertical motions considered by the Yucca Mountain Ground Motion Expert Panel. There are fewer relationships available for vertical motions. One panel member chose to apply a vertical/horizontal ground motion ratio for rock sites to the Boore and others (1997) attenuation relationship as one option for specifying vertical motions.

The second column of Table F-2 lists the scaling relationships to adjust the empirical models to normal faulting conditions. Dr. Abrahamson developed a separate set of empirical adjustment factors for vertical motions. The stress drop scaling factors for horizontal motions developed by Drs. Campbell and Silva were assumed by the panel members to also apply to vertical motions. Figure F-2 compares the resulting scaling relationships for vertical motions.

The third column of Table F-2 lists the relative weights applied to each of the scaled empirical attenuation relationships averaged over the seven ground motion panel experts. The fourth column of Table F-1 lists the re-normalized weights for those relationships that have companion soil site attenuation relationships. No vertical/horizontal ratio for soil sites was developed by the expert panel and the Sadigh and others (1997) relationships do not contain coefficients for vertical motions on soil sites. As a result, nine alternative attenuation relationships were used to evaluate ground motions for vertical sites.

MODIFICATIONS FOR CRUSTAL PATH EFFECTS

The rate of attenuation of ground motion level with distance from the source is controlled by geometric spreading of the wave front and anelastic energy absorption by the crustal rocks along the travel path. Given that the earthquakes of interest to the Skull Valley site are expected to occur in the upper portion of the earth's crust in similar geometries to California earthquakes, we assume that similar geometric spreading effects occur in both regions. The energy absorption along the travel path is usually represented by the quality factor, Q. Crustal rocks in California generally have a relatively low value of Q, that is often modeled by the relationship $Q = 150f^{0.6}$, where f is the frequency of the seismic wave. Singh and Herrmann (1983) assessed Q for the Utah region to be $Q = 500f^{0.2}$. This higher value of Q may result in less attenuation of seismic waves with distance compared to California. The difference in Q is expected to have no significant effect for nearby sources because the travel path is only a few kilometers. However, the most active source of large earthquakes in the region is the Wasatch fault, located approximately 80 km to the east of the site. For this source, the effects of differences in crustal attenuation may be important.

The effect of differences in Q between California and Utah was assessed using the technique applied for the Yucca Mountain study. The point source stochastic ground motion model (Hanks, 1979; Hanks and McGuire, 1981; Boore, 1983, 1986). was used to simulate spectral accelerations for a magnitude 7 earthquake at a range of distances using the Q expressions for California and Utah (a magnitude 7 earthquake was chosen as the likely size of earthquakes on the Wasatch fault that may have a significant contribution to hazard at the site. All other parameters were set at appropriate values for California earthquakes. Figure F-3 shows the results of these simulations.

The difference between the ground motion levels as a function of distance, r, can be modeled by the expression (Youngs and others, 1987):

$$SA(\text{Utah } Q) / SA(\text{California } Q) = 1.0 + \gamma r \qquad \textbf{(F-1)}$$

The values of parameter γ obtained from the simulations are:

Period (sec)	γ
PGA	0.0046
0.075	0.0036
0.1	0.0042
0.2	0.0052
0.3	0.0053
0.5	0.0050
1.0	0.0044
2.0	0.0036
4.0	0.0028

These values, together with Equation **(F-1)** were used to adjust the selected empirical attenuation relationships to account for the expected difference in crustal attenuation between California and north-central Utah.

MODIFICATIONS FOR LOCAL SITE CONDITIONS

Soil profile at the Skull Valley site consist of approximately 45 feet of latest Pleistocene alluvium (silts, clays and dense sands) underlain by Pleistocene silts and clays. These are, in turn, underlain by partially consolidated Tertiary sediments of the Salt Lake group to a depth of 400 to 800 ft. The shallow refraction surveys (Geosphere Midwest, 1997) indicate a shear wave velocity of approximately 750 ft/sec for the latest Pleistocene sediments and 2000 ft/sec for the Pleistocene sediments. These velocities are consistent with the average velocities estimated by Bay Geophysics (1999) of 800 ft/sec for the soil above the Pleistocene boundary and 1,100 ft/sec for soil above the Tertiary boundary. Shear wave velocity data from the Salt

Lake Valley suggests velocities in the range of 1,000 to 1,750 m/sec (3,280 to 5,741 ft/sec) for the Tertiary Salt Lake group (Tinsley and others, 1991; Williams and others, 1993; Wong and Silva, 1993).

On the basis of the depth to rock and the general soil conditions, one would classify the Skull Valley site as a deep alluvial soil site. However, the available shear wave velocity data suggests that the materials are somewhat stiffer than typically associated with alluvial soil sites representative of the empirical ground motion data base used to develop the California soil site attenuation relationships. Figure F-4 compares the estimated velocity profile for the Skull Valley site with the velocity profile developed by Silva and others (1998) to represent alluvial soils typical of California soil site strong motion recording stations. The velocities for the deeper sediments in Skull Valley are much higher that the corresponding velocities in typical California deep soil deposits.

In order to evaluate the effect of the different velocity profiles on ground motions, a analysis of the relative response of the Skull Valley soil profile compared to the generic California deep soil profile was performed. These analyses were performed using the following approach:

1. Select a set of rock site recordings from earthquakes within the appropriate magnitude range and scale the recordings to ground motion levels relevant to evaluating the site hazard.

2. Deconvolve the recordings to a depth where the crustal velocities in California and Utah are similar, removing the rock site amplification.

3. Compute the response of the California generic deep soil and Skull Valley profiles using the deconvolved rock motions from step 2.

4. Compute the ratio of the response spectra for the surface motions obtained from the site response analyses of step 3. Use the statistics of these response spectral ratios to assess the expected difference between the response of California deep soil sites and the Skull Valley site.

SELECTION OF ROCK SITE RECORDINGS

It is expected that the major contributions to the hazard will be from large magnitude earthquakes occurring on the nearby Skull Valley and Stansbury faults. Therefore, twelve rock recordings from magnitude ~6.5 to 7 earthquakes were selected for the site response analyses. Table F-3 lists the selected recordings. Six of the recordings are from California earthquakes and six are from large normal faulting earthquakes recorded in Italy.

The recordings were scaled to ground motion levels corresponding to maximum magnitude events on the two nearby faults. The mean maximum magnitude for the Stansbury fault is **M** 7. Using the rock-site attenuation relationship developed by Abrahamson and Silva (1997) scaled to normal faulting conditions, the resulting median peak ground acceleration is 0.32g. Figure F-5 shows the corresponding response spectrum. Each of the rock recordings were scaled so that their response spectrum matches the target spectrum on average by minimizing the area between the two spectrum. The mean maximum magnitude for the East fault is **M** 6.5. Using the rock-site attenuation relationship developed by Abrahamson and Silva (1997) scaled to normal faulting conditions, the resulting median peak ground acceleration is 0.57g. Figure F-6 shows the corresponding response spectrum and the rock recordings scaled to match.

Deconvolution of Rock Motions

The recorded rock surface motions were deconvolved to a depth where the crustal velocities are comparable in California and Utah. Figure F-7 shows crustal shear wave velocity profiles developed for northern and southern California by Wald and others (1991) and Magistrale and others (1992), respectively. Also shown on Figure F-7 are shear wave velocity profiles for the site region. The crustal velocity profile used for earthquake location in north-central Utah consists of the following (J. Pechmann, Univ. of Utah, pers. comm., 1999):

Utah Crustal Velocity Profile

Depth Range (km)	P-Velocity (km/sec)	S-Velocity (km/sec)
0 – 1.4	3.4	1.95
1.4 – 15.5	5.9	3.39

The three-layer Skull Valley model shown on Figure F-7 represents 500 ft of Tertiary basin fill with a velocity of 1.375 km/sec over the above crustal velocity profile. Also shown on Figure F-7 is a two-layer profile consisting of 500 ft of Tertiary basin fill with a velocity of 1.375 km/sec over a uniform crustal velocity of 3 km/sec. This velocity was used by Wong and Silva (1993) to represent the upper crustal velocity in north-central Utah and was used for sensitivity analyses in this study. It was judged that the three profiles reached sufficiently similar velocities at a depth of 3 km to use this depth as the appropriate base point for site response analyses.

The near-surface shear wave velocities at rock site recording stations typically exhibit a strong velocity gradient. Figure F-8 shows an average shear wave velocity profile developed by Silva and others (1998) to represent the near-surface velocities at California strong motion stations.

This 100-m profile was placed at the top of the two California crustal velocity profiles to represent near-surface conditions.

The deconvolution calculation were performed using the one-dimensional wave propagation computer program SHAKE (Schnable and others, 1972). Figure F-9 shows the normalized shear modulus and damping curves recommended by Silva and others (1998) for use at shallow depths in weathered and fractured rock typical of the velocity profile shown on Figure F-8. Once the rock velocity reaches 3,000 ft/sec (at a depth of about 50 ft), the rock is assumed to behave linearly (no modulus reduction).

The material damping in the rock below a depth of 50 ft was estimated using the observed high frequency attenuation at rock site recording stations. This is modeled by the attenuation parameter developed by Anderson and Hough (1984) have show that the high frequency attenuation of ground motions in the near surface can be modeled by the attenuation parameter . Silva and Darragh (1996) indicate that is related to the near surface shear wave quality factor, Q_s by the expression:

$$\kappa = \frac{H}{Q_s V_s} \tag{F-2}$$

where H is the portion of the crust over which the energy loss occurs and V_s is the average shear wave velocity over H. The appropriate value of H is 1 to 2 km (Silva and Darragh, 1992).

Q_s is, in turn, related to the material damping, λ, used in liner viscoelastic wave propagation modeling (such as the site response analyses performed for this study using the program SHAKE) by the expression:

$$\lambda = \frac{1}{2Q_s} \tag{F-3}$$

Silva and Darragh (1992) found that Q_s for WUS rocks is proportional to shear wave velocity and that a average value of $\kappa = 0.04$ sec is appropriate for California rock site strong motion recording stations. Using the assumption that $Q_s \propto V_S$, material damping values were computed for each of the layers in the upper 2 km of the California crustal models using Equations **(F-2)** and **(F-3)** to produce a composite κ of 0.04 sec. The resulting Q_s values and equivalent damping values for the upper 2 km of the northern and southern California velocity models are given in Table F-4. Damping in the rock below a depth of 2 km was set to zero.

The deconvolution analysis assumes that all of the surface rock motions are a result of vertically propagating shear waves. However, Silva (1986) found that some of the surface motions consist of higher mode surface waves. He recommended that motions for frequencies higher than about 15 Hz be filtered out of the surface motions before deconvolution to reduce the potential for overestimation of the motions at depth. He also indicated that the motions should be removed using an anti-aliasing filter rather than the abrupt frequency cut-off employed in program SHAKE. Accordingly, the rock recordings were low-pass filtered with a Butterworth filter prior to being input into the deconvolution analysis. The filtering was preformed prior to scaling the records to the target rock motion response spectra shown on Figures F-4 and F-5. The records were also high-pass filtered above a frequency of 0.14 Hz (a period of 7.0 sec.) and base-line corrected to remove spurious low frequency motions. Twenty-four base motions were then computed at a depth of 3 km, twelve for the northern California crust and 12 for the southern California crust.

Site Response Analyses

The twenty-four base motions were used to compute the response of the soil profiles shown on Figure F-4. Silva and others (1998) used two alternative sets of soil modulus and damping relationships for California alluvial soils. One set, designated herein as Set A, was developed by EPRI (1993) and is shown on Figure F-10a. A second, somewhat stiffer set was found to work well for some sites. These curves , designated herein as Set B, are shown on Figure F-10b. Both sets were used to compute the soil profile responses.

Because only limited shear wave velocity data are available for the Skull Valley sediments, sensitivity analyses were performed using a range of shear wave velocities.

As indicated above, the average velocity for the Holocene and Pleistocene sediments are estimated to be 750 and 2,000 ft/sec, respectively. The range in velocities reported by Geosphere Midwest (1997) was from about 700 to 790 ft/sec for the latest Pleistocene soils and 1,700 to 2,400 for the Pleistocene soils. Analyses were conducted using the upper and lower limits of these velocity ranges as well as the midpoint. Analyses were conducted using both Set A and Set B modulus and damping relationships (Figures F-10a and F-10b).

Analyses were also conducted using the lower limit, the midpoint and the upper limit of the shear wave velocity for the Tertiary sediments. An additional set of analyses was also conducted assuming that the velocity of the sediments varies linearly from the lower limit at the top of the Tertiary layer to the upper limit at the bottom. The Tertiary sediments and underlying rock were assumed to behave linearly. The damping in the Tertiary sediments and rock to a depth of 2 km was computed using the same technique outlined above for the California crustal models. Wong and Silva (1993) used a κ of 0.04 sec for Utah sites, similar to California rock sites. However, the higher near-surface rock velocities in Utah suggest that the κ values may be somewhat lower. Accordingly, κ values of 0.02, 0.03, and 0.04 sec were used in the analyses. Table F-5 lists the resulting Q_s values and equivalent damping values for the upper 2 km of the Utah crustal models. Damping in the rock below a depth of 2 km was set to zero.

Relative Site Response

The relative response of the Skull Valley sediments compared to typical California deep soil sites was evaluated by computing the ratio of the response spectra for the computed surface motions for each individual input base rock motion. Figure F-11 shows an example of one such set of spectral ratios. Each plot shows the ratio of surface response spectra computed using the rock motion indicated. The rock motions in this example were scaled to the **M** 6.5 rock spectra (0.57g PGA) and deconvolved through the southern California crustal model. The California soil motions were computed using the deep soil velocity profile shown on Figure F-4 placed on top of the southern California crust and using Set A soil modulus and damping relationships. The Skull Valley sediment motions were computed using the median sediment velocities on the three-layer crustal model with a κ of 0.03 sec and Set A soil modulus and damping relationships. The individual rock input motions produce variations in the relative response reflecting differences in the frequency content of the records. Because we are interested in the average differences in the relative response of the two profiles and because ground motions are typically assumed to be lognormally distributed, we use the geometric mean (average of the logs) of the spectral ratios to evaluate the relative response and assume that this represents the median relative response.

Figure F-12 shows examples of the statistics of the individual spectral ratios. Each curve on part (a) is the geometric mean of twelve spectral ratios. The curve labeled "So. CA crust, Set A is the geometric mean of the twelve spectral ratios shown on Figure F-11. The curves four curves shown on part (a) indicate the effect of the two California crustal models and the alternative soil modulus and damping relationships. As indicated, the two crustal models produce very similar spectral ratios. The alternative sets of soil properties produce a greater difference in the spectral ratios. Set B properties produce lower spectral ratios because the stiffer modulus reduction and lower damping values produce higher response for the California deep soil profiles. Because the empirical attenuation relationships use data from both northern and southern California and because Silva and others (1998) found both sets of soil properties to be appropriate for California sites, we compute the average relative response over all four California conditions (48 spectral ratios).

Part (b) of Figure F-12 shows the effect of the level of motion on the median spectral ratio. [The curve labeled 0.57g PGA rock motions is the geometric mean of the four curves shown on Part (a).] Slightly lower spectral ratios are computed using the higher level rock input motions, indicating that the shaking level has a somewhat greater effect on the Skull Valley sediment response than on the California deep soil response.

Figure F-13 shows the effect of variations in the properties of the Pleistocene soils on the median spectral ratios. Part (a) shows the effect of the alternative sets of shear modulus and damping relationships (Figures F-10a and F-10b) and part be shows the effect of varying the soil velocity over the range in reported velocities. The alternative sets of modulus and damping curves have a greater effect than the range of low-strain shear wave velocities on the relative response.

Figure F-14 shows addition effects of variations in the velocities of the Skull Valley sediments. Part (a) shows the effect of varying the Tertiary sediment velocity, including a gradational velocity model. The effect of the velocity variations is relatively small. Comparison of part (a) of Figure F-14 with part (b) of Figure F-13 indicates the frequency range controlled by the various sediments. The relative response for ground motion periods less than about 0.5 sec (frequencies greater than 2 Hz) are affected by the velocities assigned to the Holocene and Pleistocene soils while the relative response for periods greater than about 0.5 sec are affected by the velocities assigned to the Tertiary sediments. Part (b) of Figure F-14 combines the velocity variations of the previous two cases, shown the effect of varying the velocities of all of the sediments over the ranges indicated above.

Figure F-15 shows the effect of the alternative crustal properties on the median relative response. Part (a) shows the effect of varying κ from 0.02 to 0.04 sec and part (b) shows the effect of using the two-layer versus the three-layer velocity profiles shown on Figure F-7.

Varying κ has only a minor effect on the relative response at high frequencies and the alternative crustal velocity profile only has a significant effect at periods longer than 2 seconds.

The results of the relative response calculations are summarized on Figure F-16. Part (a) shows the median relative response curves for the cases discussed above using rock motions scaled to both **M** 7.0 and **M** 6.5 input levels. The variations in the relative response reflect uncertainties in the velocity of the sediments, the appropriate modulus and damping relationships, and the properties of the upper crust in Skull Valley. Part (b) shows the median relative response computed over the uncertainty in the site properties for the two input motion levels. These results indicate that the response of the Skull Valley site is slightly higher for high frequency motions and is lower for low frequency motions.

The exact peaks and valleys in the curves shown on part (b) arise in part because only a single average profile was used to represent the response of California deep soil sites. It is expected that if the variation in California soil profile velocities and depths was incorporated into the relative response analysis through the use of Monte Carlo simulation, then the relative spectral ratios will be smoothed out [see EPRI (1993) for an example of this approach]. Accordingly, a smooth relative response curve was constructed through the computed median spectral ratios as shown on part (b) of Figure F-16. Greater smoothing was applied to the long period spectral ratios because it is likely that considering a range of depths for the California profiles would tend to fill in the large "valley" in the median spectral ratios. The resulting site response adjustment factors are:

Period (sec)	Site Adjustment Factor
PGA	1.05
0.05	1.05
0.075	1.05
0.1	1.10
0.15	1.15
0.2	1.15
0.3	1.125
0.5	1.10
0.75	1.00
1.0	0.85
1.5	0.75
2.0	0.75
3.0	0.75
4.0	0.80

These factors were used to scale the empirical deep soil attenuation relationships to the Skull Valley site conditions.

TABLE F-1

EMPIRICAL ATTENUATION RELATIONSHIPS FOR HORIZONTAL MOTIONS AND SEISMIC SOURCE SCALING FACTORS FROM THE YUCCA MOUNTAIN GROUND MOTION EXPERT PANEL

Private Fuel Storage Facility
Skull Valley, Utah

Rock Site Attenuation Relationship	Earthquake Source Scaling Method	Average Weight Across Expert Panel	Re-normalized Weights for Companion Soil Relationships
Abrahamson and Silva (1997)	None	0	0
	A-E	0.222	0.246
	½ A-E	0.036	0.040
	KCSC	0.051	0.056
	WSSC	0.014	0.016
Boore and others (1997)	None	0.006	0.006
	A-E	0.014	0.016
	½ A-E	0.036	0.040
	KCSC	0.042	0.046
	WSSC	0.050	0.055
Campbell (1997)	None	0.006	0.006
	A-E	0.029	0.032
	½ A-E	0.036	0.040
	KCSC	0.051	0.056
	WSSC	0.036	0.040
Idriss (1991, 1997)	None	0.006	
	A-E	0.014	
	½ A-E	0	
	KCSC	0.051	
	WSSC	0.021	
Sadigh and others (1997)	None	0.006	0.006
	A-E	0.029	0.032
	½ A-E	0.036	0.040
	KCSC	0.051	0.056
	WSSC	0.021	0.024
Spudich and others (1997)	None	0.115	0.128
	KCSC	0.018	0.020
Sabetta and Pugliese (1996)	None	0.006	

GEOMATRIX

TABLE F-2

EMPIRICAL ATTENUATION RELATIONSHIPS FOR VERTICAL MOTIONS AND SEISMIC SOURCE SCALING FACTORS FROM THE YUCCA MOUNTAIN GROUND MOTION EXPERT PANEL

Private Fuel Storage Facility
Skull Valley, Utah

Rock Site Attenuation Relationship	Earthquake Source Scaling Method	Average Weight Across Expert Panel	Re-normalized Weights for Companion Soil Relationships
Abrahamson and Silva (1997)	None	0	0
	A-E	0.321	0.436
	½ A-E	0.036	0.048
	KCSC	0.095	0.129
	WSSC	0.026	0.035
Boore and others (1997) × Vertical/Horizontal Ratio	None	0	
	A-E	0	
	½ A-E	0.036	
	KCSC	0	
	WSSC	0	
Campbell (1997)	None	0.014	0.018
	A-E	0.041	0.055
	½ A-E	0.036	0.048
	KCSC	0.095	0.129
	WSSC	0.074	0.100
Sadigh and others (1997)	None	0.014	
	A-E	0.041	
	½ A-E	0.036	
	KCSC	0.095	
	WSSC	0.042	

GEOMATRIX

TABLE F-3

ROCK RECORDINGS USED IN SITE RESPONSE ANALYSES

Private Fuel Storage Facility
Skull Valley, Utah

Record	Earthquake	M	Station	Comp (°)	Distance (km)	PGA (g)
1	San Fernando, CA	6.6	Pacoima Dam [279]	254	2.8	1.16
2	1971/02/09		Lake Hughs #12 [128]	021	20.3	0.37
3	Victoria, Mexico 1980/06/09	6.4	Cerro Prieto	045	34.8	0.62
4	Irpinia, Italy	6.9	Bagnoli Irpinio	000	10.9	0.14
5	1980/11/23		Bagnoli Irpinio	270		0.20
6			Sturno	000	16.2	0.25
7			Sturno	270		0.36
8	Irpinia, Italy aftershock	6.2	Calitri	000	8.4	0.18
9	1980/11/23		Calitri	270		0.17
10	Loma Prieta, CA	7.0	Gilroy #1	090	11.2	0.47
11	1989/10/17		Corratilos	000	5.1	0.64
12			Corratilos	090		0.48

TABLE F-4

MATERIAL DAMPING FOR CALIFORNIA CRUSTAL MODELS

Private Fuel Storage Facility
Skull Valley, Utah

Material Damping for California Crustal Models

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.1	1.14	11.2	4.5	0.008
0.1-0.5	1.95	19.2	2.6	0.011
0.5-1.0	2.48	24.4	2.1	0.008
1.0-2.0	2.77	27.3	1.8	0.013
				$\Sigma\kappa = 0.04$

Southern California Crust

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.1	1.14	18.3	2.7	0.005
0.1-0.4	1.53	24.6	2.0	0.008
0.4-1.0	1.67	26.9	1.9	0.013
1.0-1.5	1.96	31.5	1.6	0.008
1.5-2.0	2.31	37.1	1.3	0.006
				$\Sigma\kappa = 0.04$

GEOMATRIX

TABLE F-5

MATERIAL DAMPING FOR SKULL VALLEY CRUSTAL PROFILES

Private Fuel Storage Facility
Skull Valley, Utah

Three Crustal Layers, κ = 0.02 sec, Low Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.0	28.4	1.8	0.007
0.2-1.4	1.95	55.4	0.9	0.011
1.4-2.0	3.39	96.2	0.5	0.002
				$\Sigma\kappa$ = 0.02

Three Crustal Layers, κ = 0.03 sec, Low Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.0	18.9	2.6	0.011
0.2-1.4	1.95	36.9	1.4	0.016
1.4-2.0	3.39	64.2	0.8	0.003
				$\Sigma\kappa$ = 0.03

Three Crustal Layers, κ = 0.04 sec, Low Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.0	14.2	3.5	0.014
0.2-1.4	1.95	27.7	1.8	0.022
1.4-2.0	3.39	48.1	1.0	0.004
				$\Sigma\kappa$ = 0.04

Three Crustal Layers, κ = 0.02 sec, Midrange Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.375	32.6	1.5	0.004
0.2-1.4	1.95	46.2	1.1	0.014
1.4-2.0	3.39	80.3	0.6	0.002
				$\Sigma\kappa$ = 0.02

TABLE F-5

MATERIAL DAMPING FOR SKULL VALLEY CRUSTAL PROFILES

Private Fuel Storage Facility
Skull Valley, Utah

Three Crustal Layers, κ = 0.03 sec, Midrange Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.375	21.7	3.1	0.009
0.2-1.4	1.95	30.8	2.2	0.027
1.4-2.0	3.39	53.5	1.3	0.004
				$\Sigma\kappa$ = 0.03

Three Crustal Layers, κ = 0.04 sec, Midrange Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.375	16.3	3.1	0.009
0.2-1.4	1.95	23.1	2.2	0.027
1.4-2.0	3.39	40.1	1.3	0.004
				$\Sigma\kappa$ = 0.04

Three Crustal Layers, κ = 0.02 sec, High Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.75	37.9	1.3	0.003
0.2-1.4	1.95	42.2	1.2	0.015
1.4-2.0	3.39	73.4	0.7	0.002
				$\Sigma\kappa$ = 0.02

Three Crustal Layers, κ = 0.03 sec, High Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.75	25.3	2.0	0.005
0.2-1.4	1.95	28.2	1.8	0.021
1.4-2.0	3.39	48.9	1.0	0.004
				$\Sigma\kappa$ = 0.03

TABLE F-5

MATERIAL DAMPING FOR SKULL VALLEY CRUSTAL PROFILES

Private Fuel Storage Facility
Skull Valley, Utah

Three Crustal Layers, κ = 0.04 sec, High Tertiary V_s

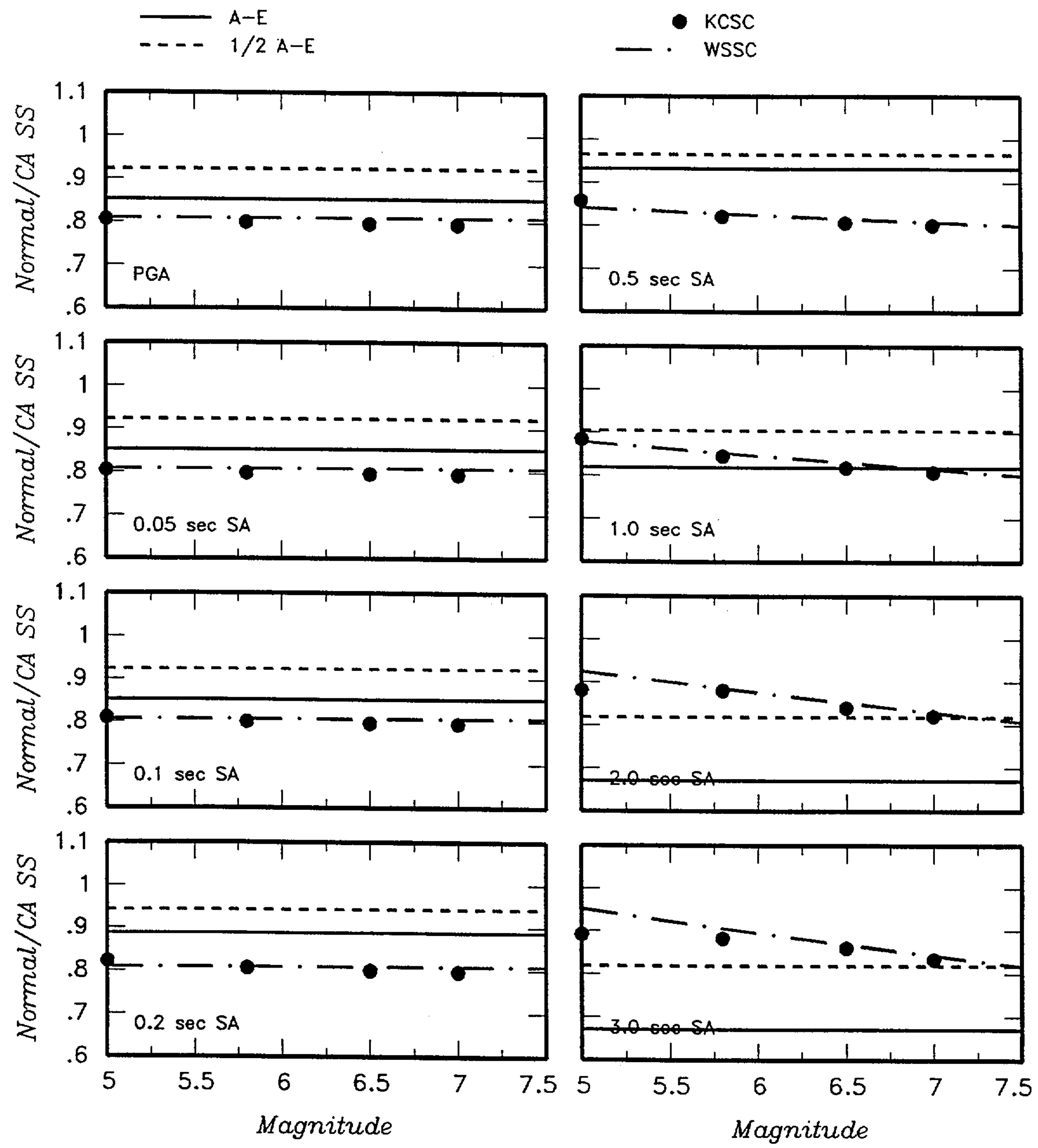
Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.75	18.9	2.6	0.006
0.2-1.4	1.95	21.1	2.4	0.029
1.4-2.0	3.39	36.7	1.4	0.005
				$\Sigma\kappa$ = 0.04

Three Crustal Layers, κ = 0.03 sec, Gradational Tertiary V_s

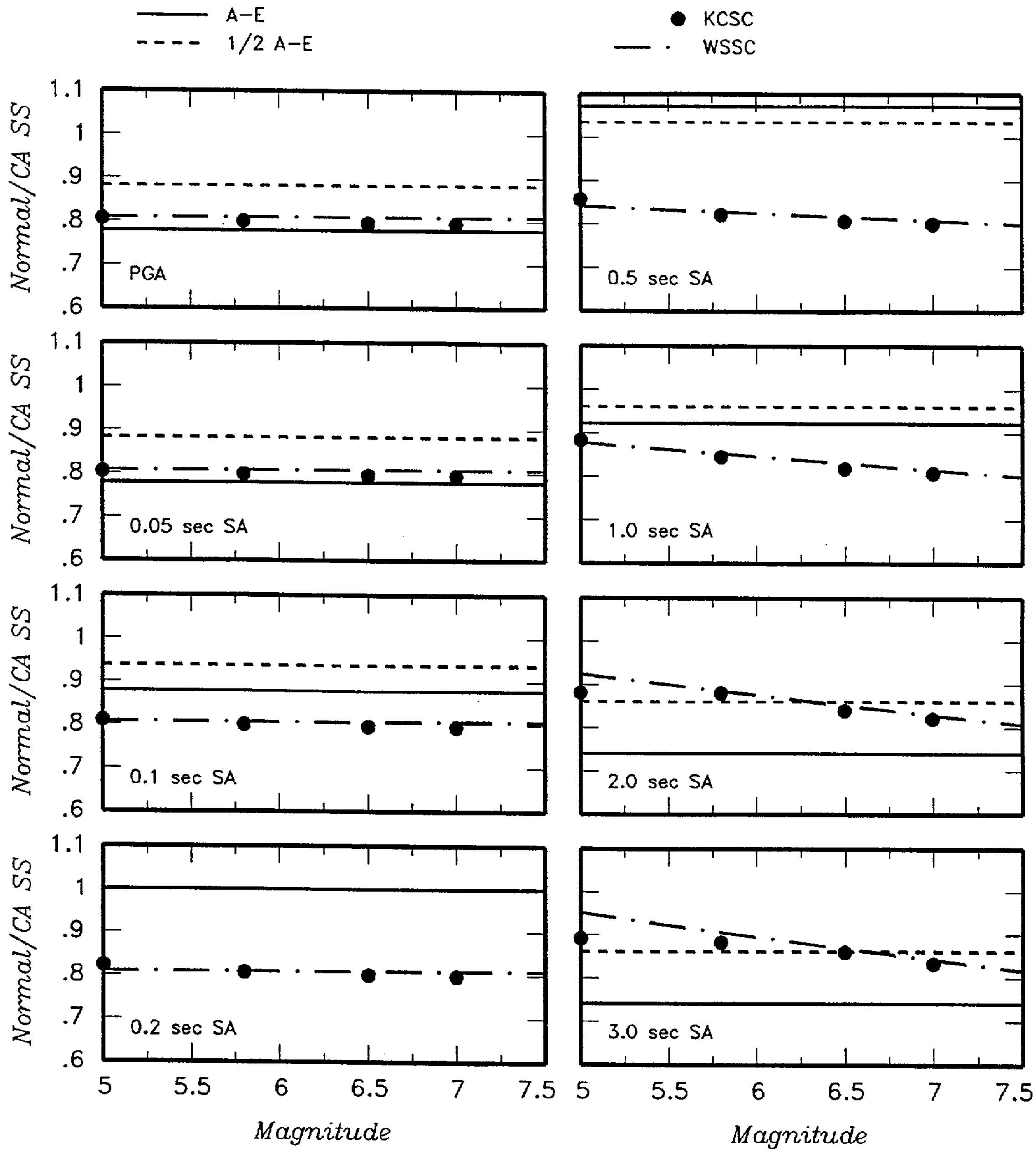
Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.05	1.0	16.3	3.1	0.003
0.05-0.1	1.25	20.3	2.5	0.002
0.1-0.15	1.5	24.4	2.1	0.001
0.15-02	1.75	28.5	1.8	0.001
0.2-1.4	1.95	31.7	1.6	0.020
1.4-2.0	3.39	55.2	0.9	0.003
				$\Sigma\kappa$ = 0.03

Two Crustal Layers, κ = 0.03 sec, Low Tertiary V_s

Depth Range (km)	V_s (km/sec)	Q_s	λ (%)	Layer κ (sec)
0-0.2	1.0	13.3	3.8	0.015
0.2-2.0	3.0	40.0	1.3	0.015
				$\Sigma\kappa$ = 0.03



GEOMATRIX	SCALING RELATIONSHIPS DEVELOPED FOR THE YUCCA MOUNTAIN PROJECT (CRWMS M&O, 1998) FOR TRANSLATING HORIZONTAL GROUND MOTIONS FROM CALIFORNIA STRIKE-SLIP EARTHQUAKES TO EXTENSIONAL TECTONICS NORMAL FAULTING EARTHQUAKE MOTIONS.	Project No. 4790 Figure **F-1**

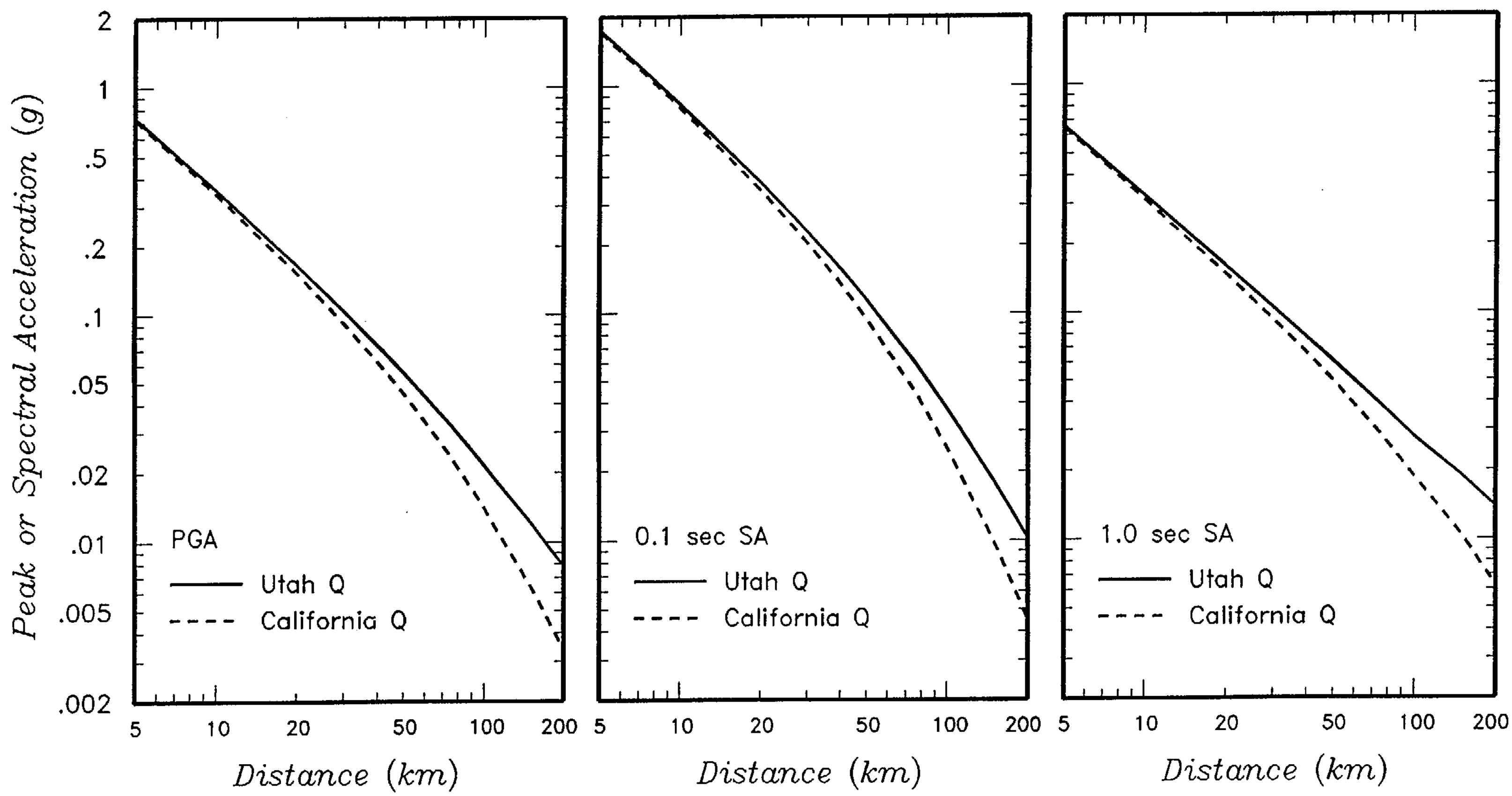


GEOMATRIX

SCALING RELATIONSHIPS DEVELOPED FOR THE YUCCA MOUNTAIN PROJECT (CRWMS M&O, 1998) FOR TRANSLATING VERTICAL GROUND MOTIONS FROM CALIFORNIA STRIKE-SLIP EARTHQUAKES TO EXTENSIONAL TECTONICS NORMAL FAULTING EARTHQUAKE MOTIONS.

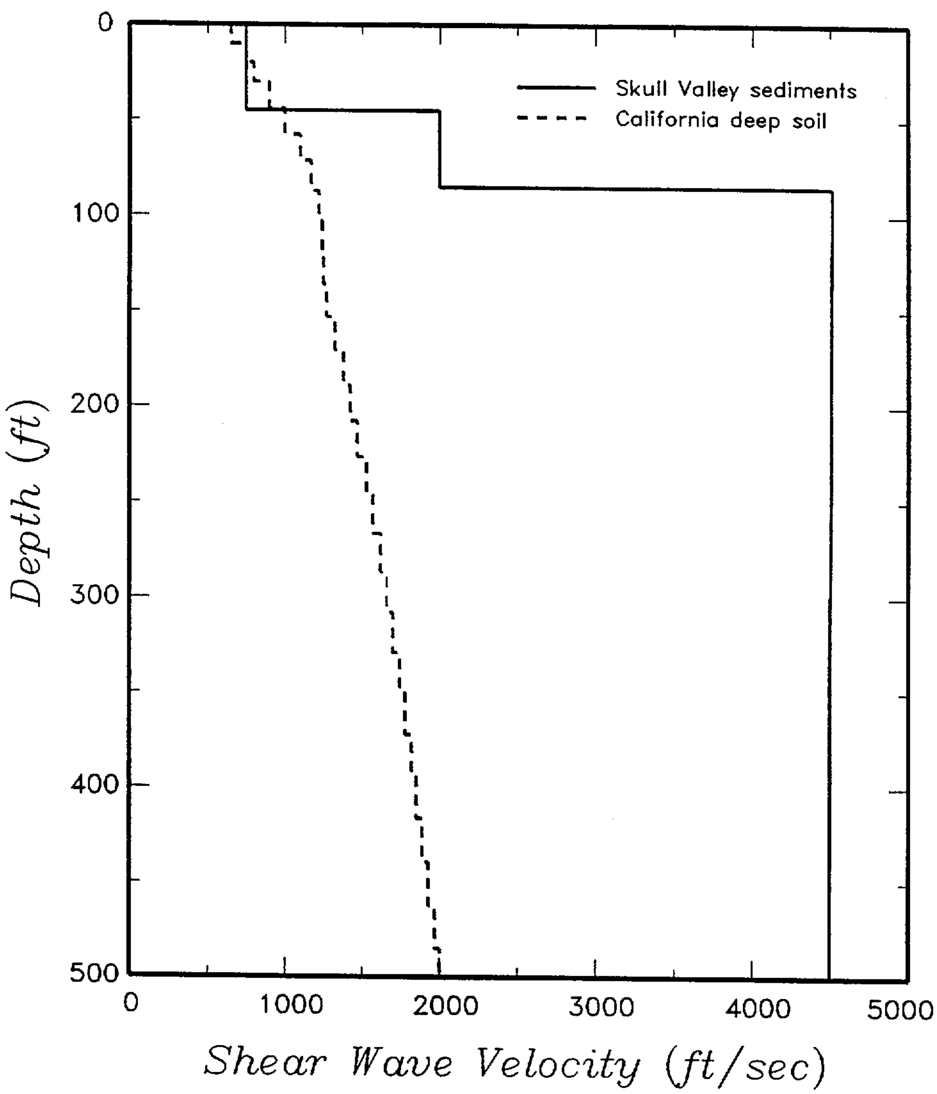
Project No. 4790

Figure F-2



GEOMATRIX	ATTENUATION OF GROUND MOTION COMPUTED USING THE STOCHASTIC GROUND MOTION MODEL WITH Q = $150f^{0.6}$ FOR CALIFORNIA AND Q = $500f^{0.2}$ FOR UTAH.	Project No. 4790 Figure F-3

Non-GDS



GEOMATRIX

COMPARISON OF THE SHEAR WAVE VELOCITY PROFILE FOR THE SKULL VALLEY SEDIMENTS USING THE MIDPOINT OF THE VELOCITY RANGE FOR THE SALT LAKE GROUP TO THE GENERIC CALIFORNIA DEEP SOIL PROFILE DEVELOPED BY SILVA AND OTHERS (1998).

Project No. 4790

Figure F-4

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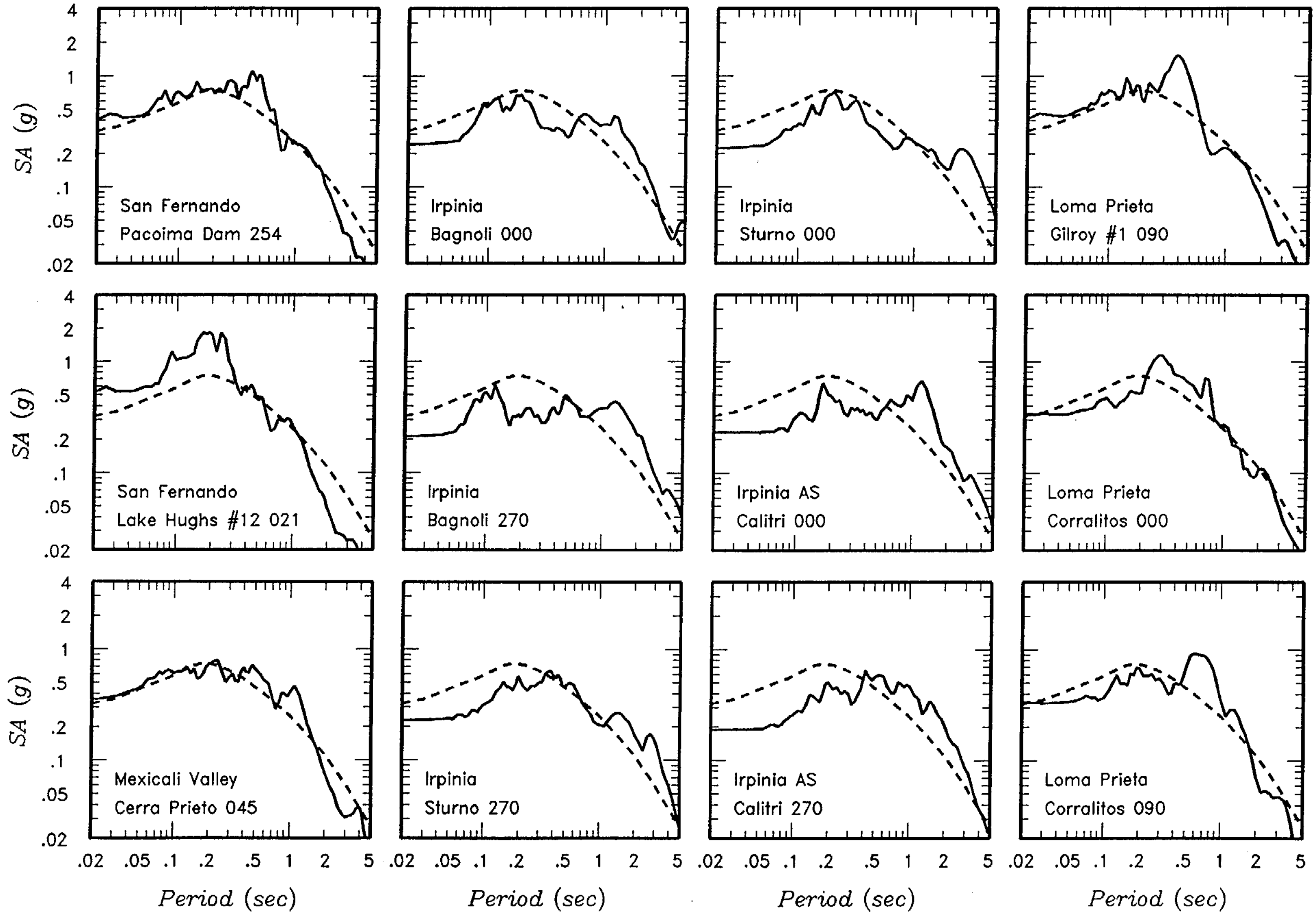
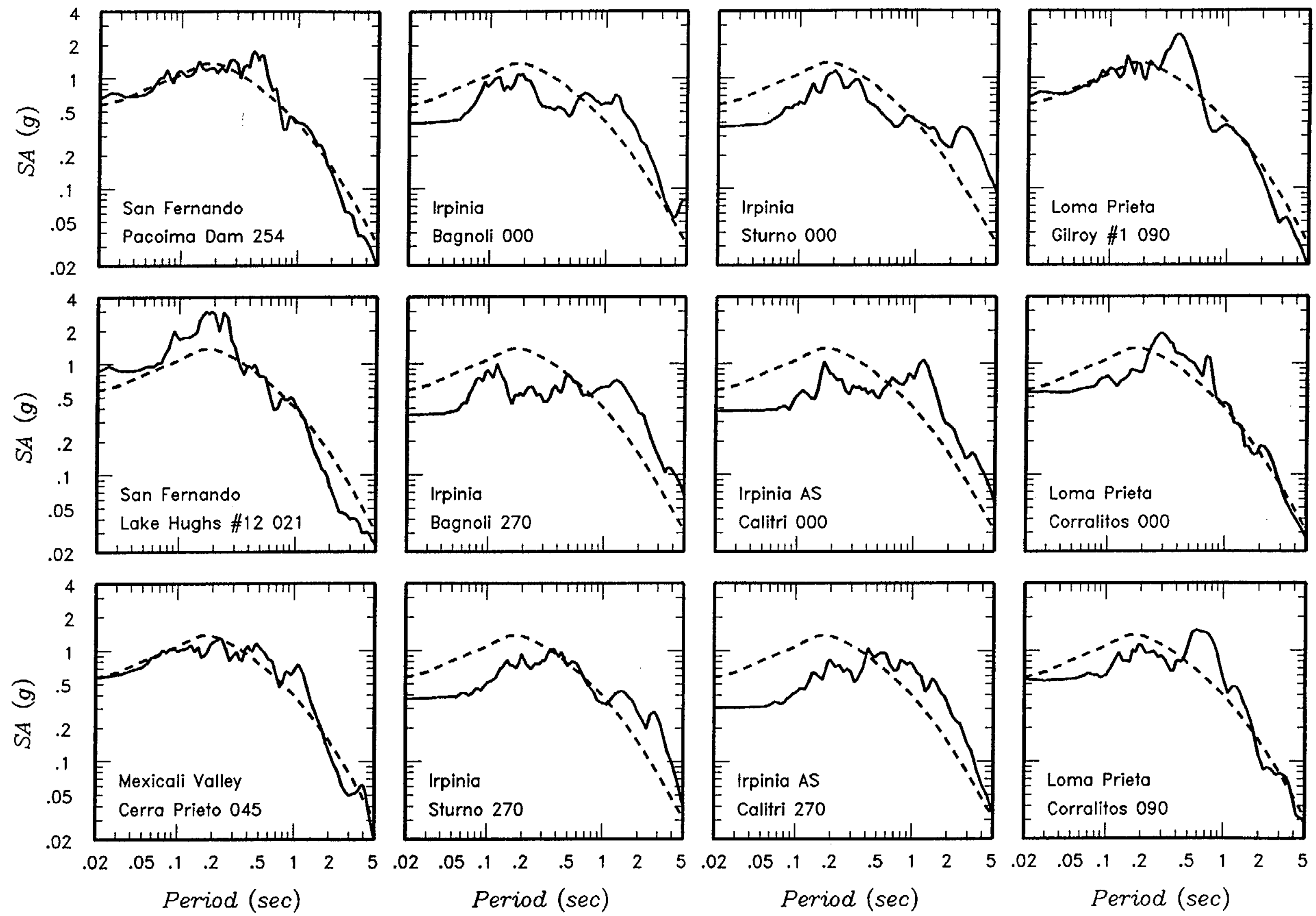


GEOMATRIX

ROCK SITE MOTIONS SCALED TO MEDIAN RESPONSE SPECTRUM FOR A M 7 EARTHQUAKE ON THE STANSBURY FAULT.

Project No. 4790

Figure F-5

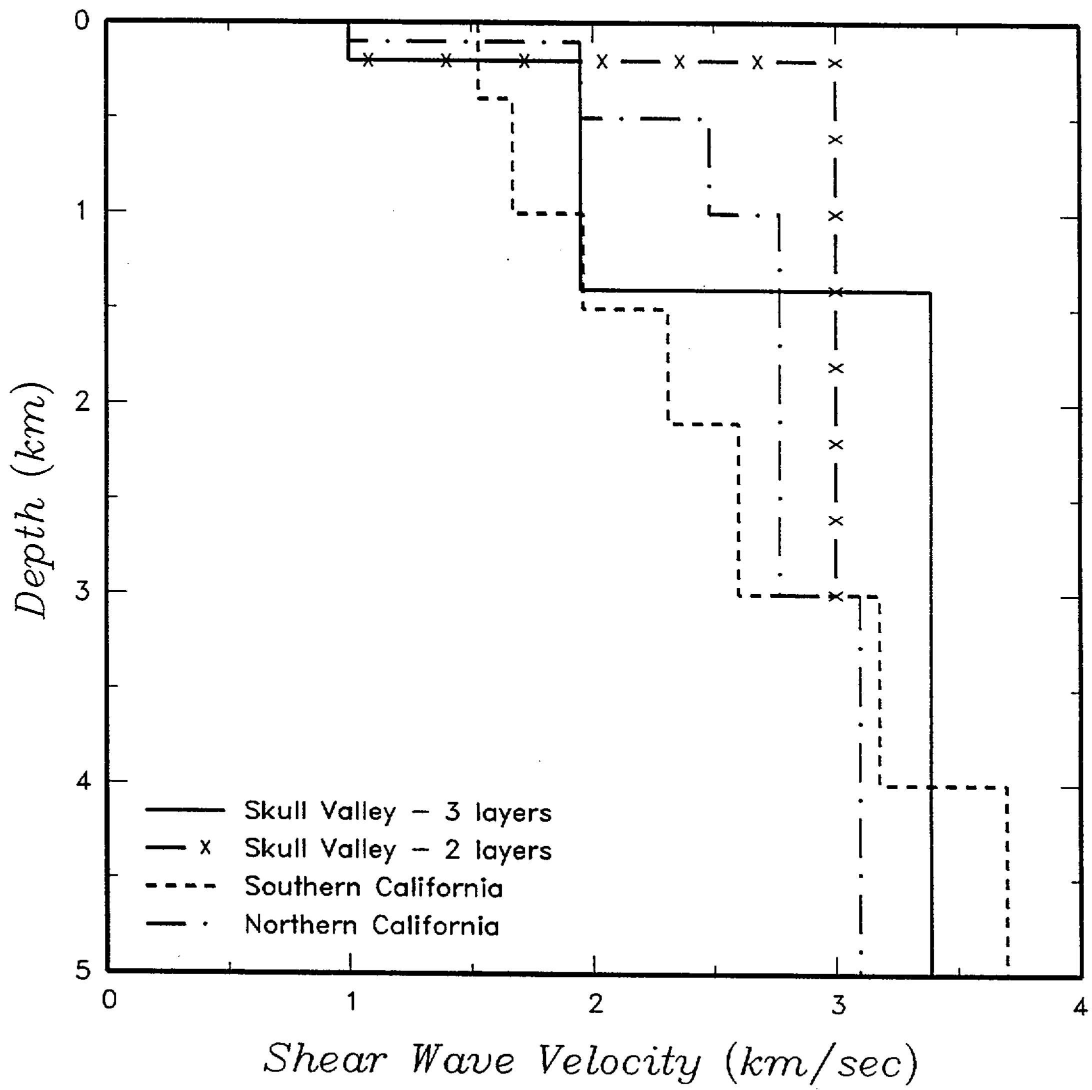


GEOMATRIX

ROCK SITE MOTIONS SCALED TO MEDIAN RESPONSE SPECTRUM FOR A **M** 6.5 EARTHQUAKE ON THE EAST FAULT.

Project No. 4790

Figure F-6

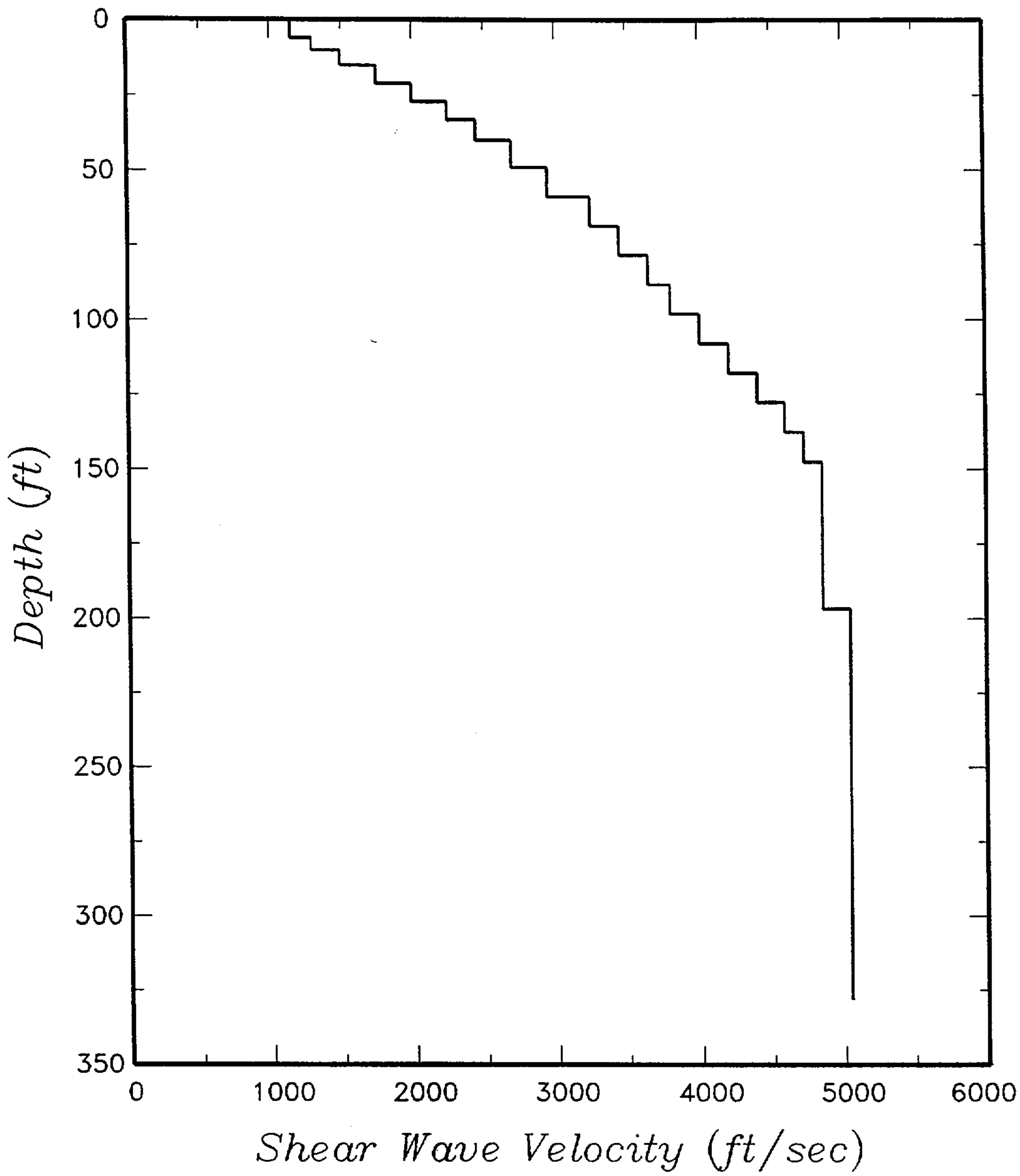


GEOMATRIX

COMPARISON OF CRUSTAL VELOCITY PROFILES FOR NORTH-CENTRAL UTAH TO THOSE FOR NORTHERN AND SOUTHERN CALIFORNIA.

Project No. 4790

Figure F-7

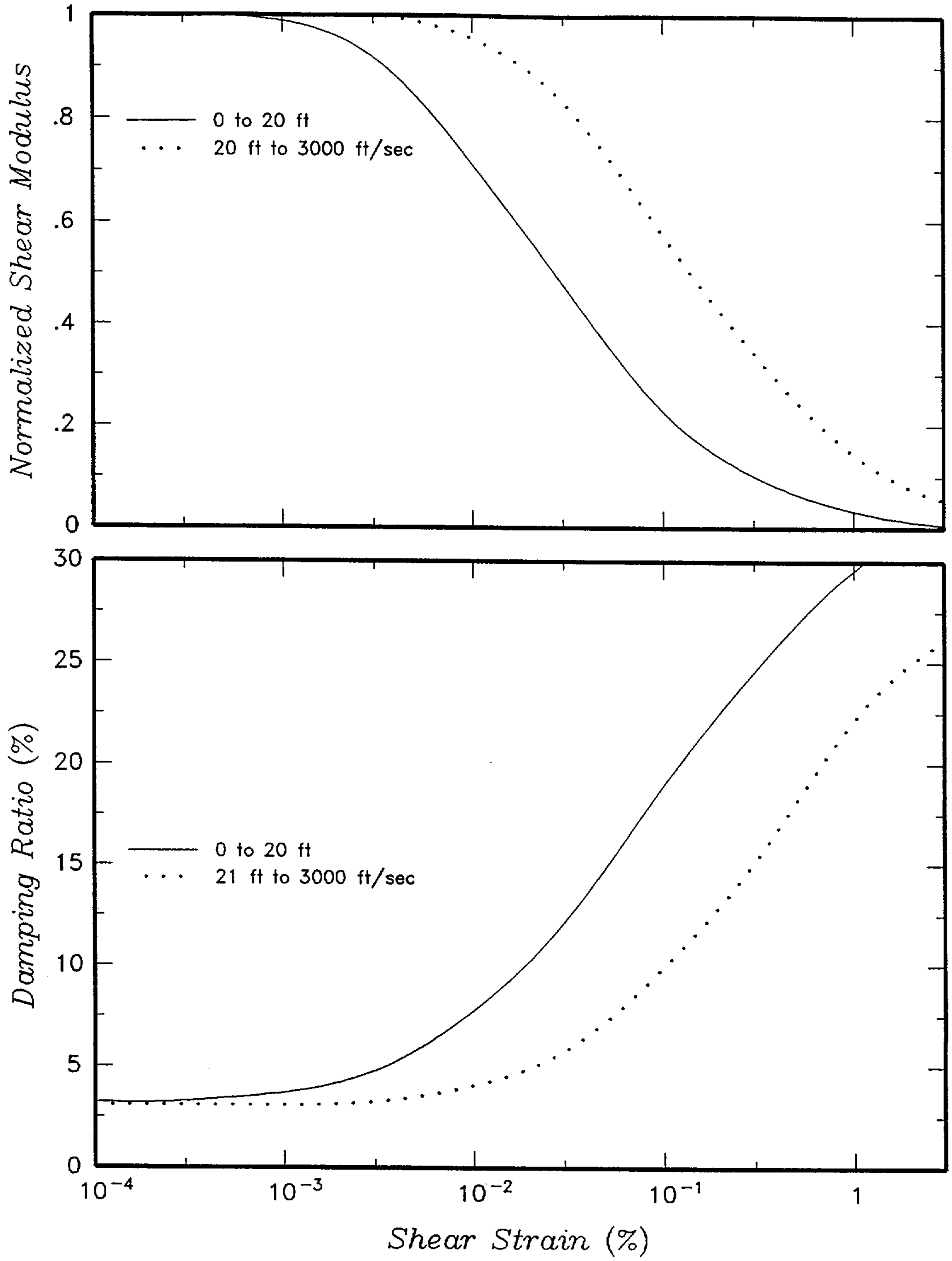


GEOMATRIX

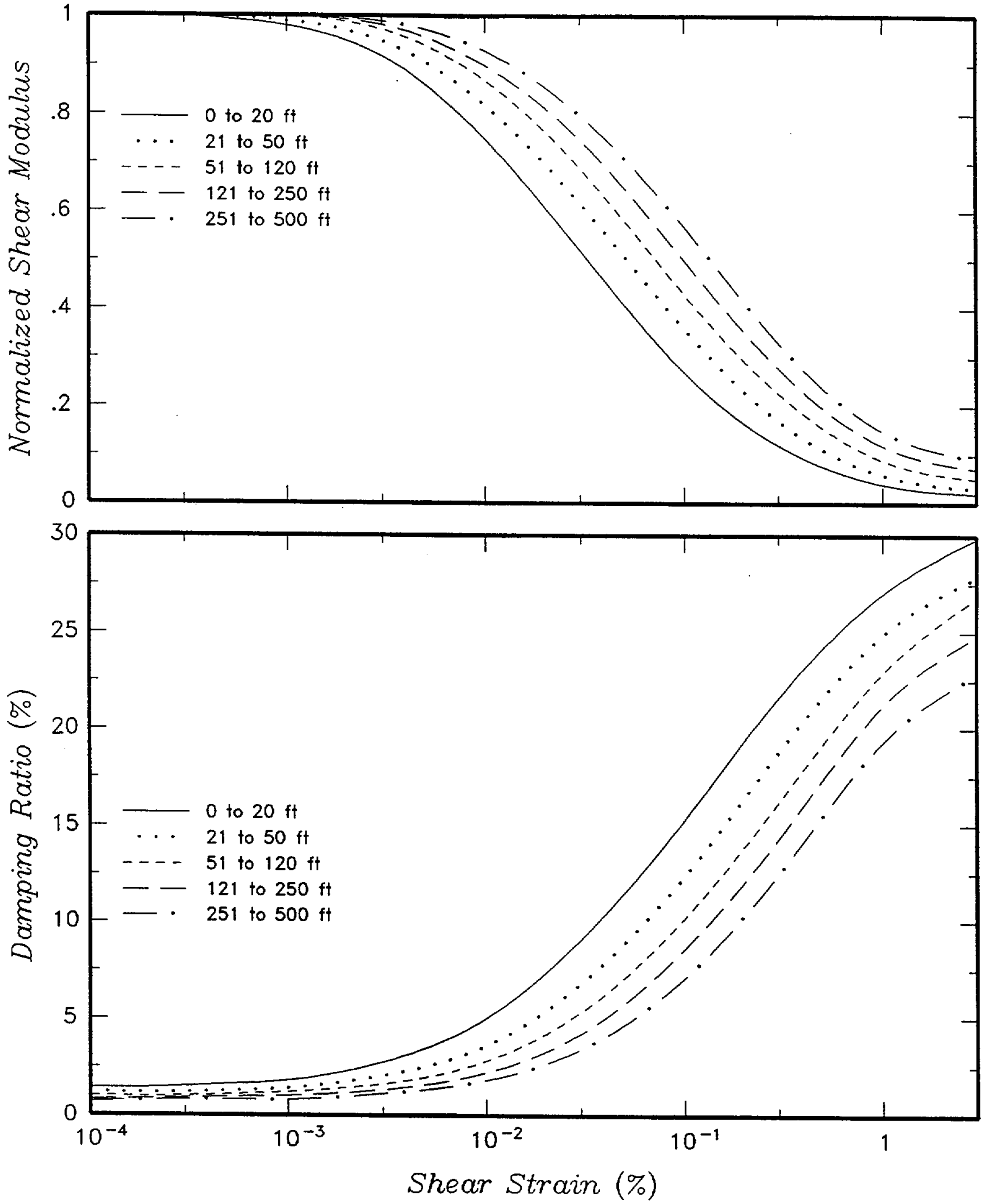
GENERIC SHALLOW ROCK VELOCITY PROFILE DEVELOPED BY SILVA AND OTHERS (1998) TO REPRESENT CALIFORNIA ROCK SITE STRONG MOTION STATIONS.

Project No. 4790

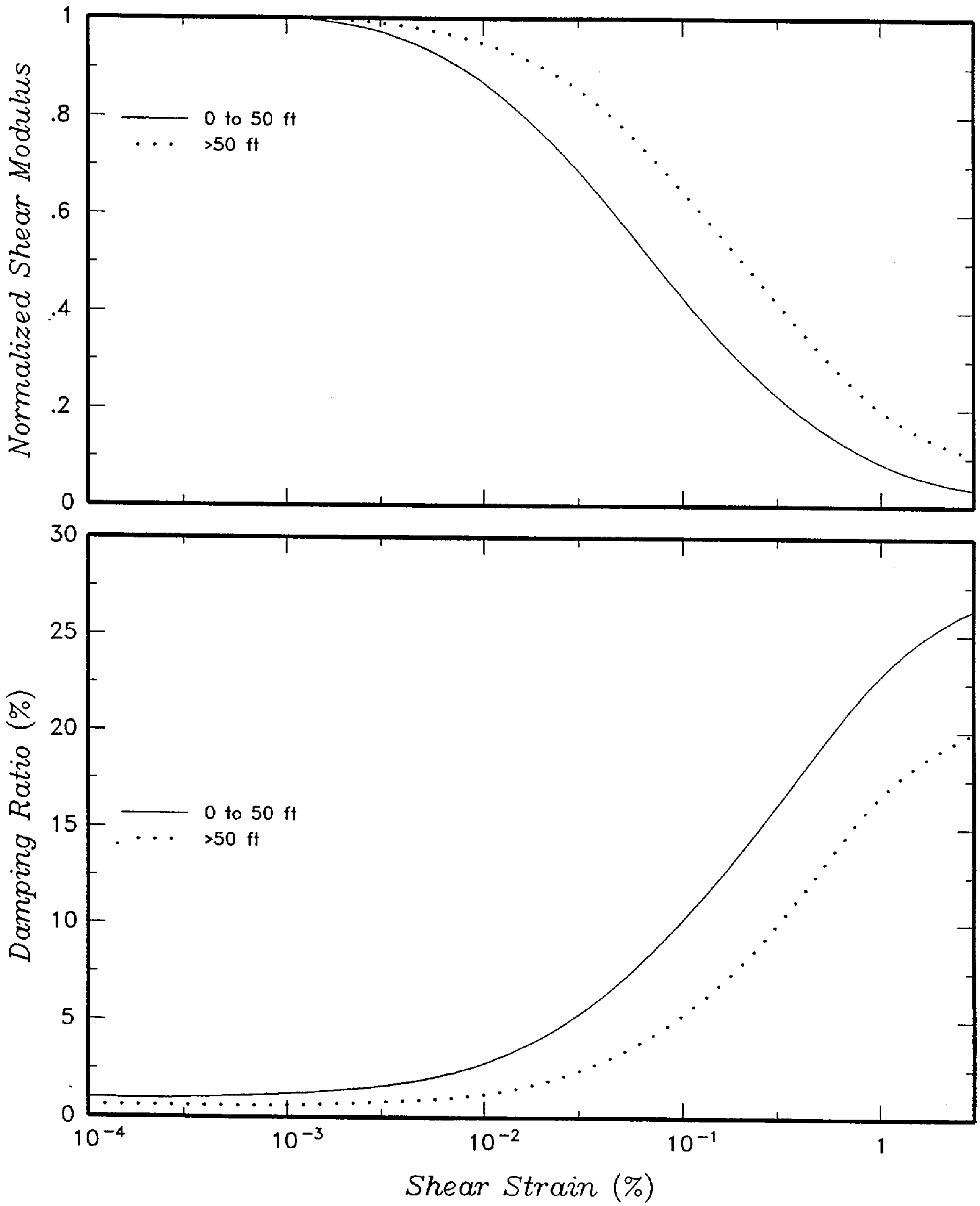
Figure F-8



GEOMATRIX	MODULUS REDUCTION AND DAMPING RELATIONSHIPS FOR WEATHERED ROCK (SILVA AND OTHERS, 1998).	Project No. 4790
		Figure **F-9**



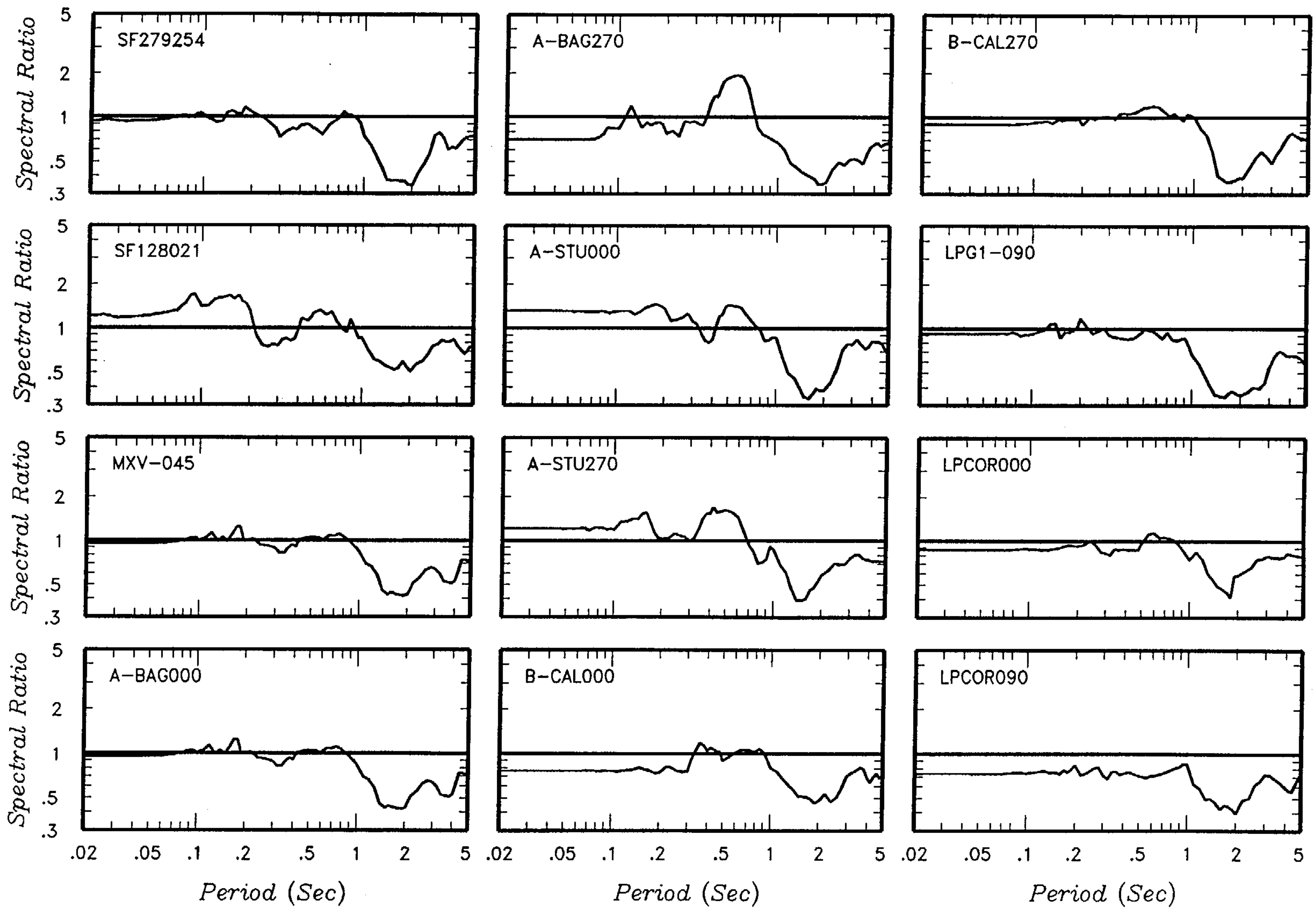
GEOMATRIX	SET A MODULUS REDUCTION AND DAMPING RELATIONSHIPS FOR DEEP ALLUVIAL SOIL DEVELOPED BY EPRI (1993).	Project No. 4790
		Figure **F-10a**



GEOMATRIX

SET B MODULUS REDUCTION AND DAMPING RELATIONSHIPS FOR DEEP ALLUVIAL SOIL DEVELOPED BY SILVA AND OTHERS (1998).

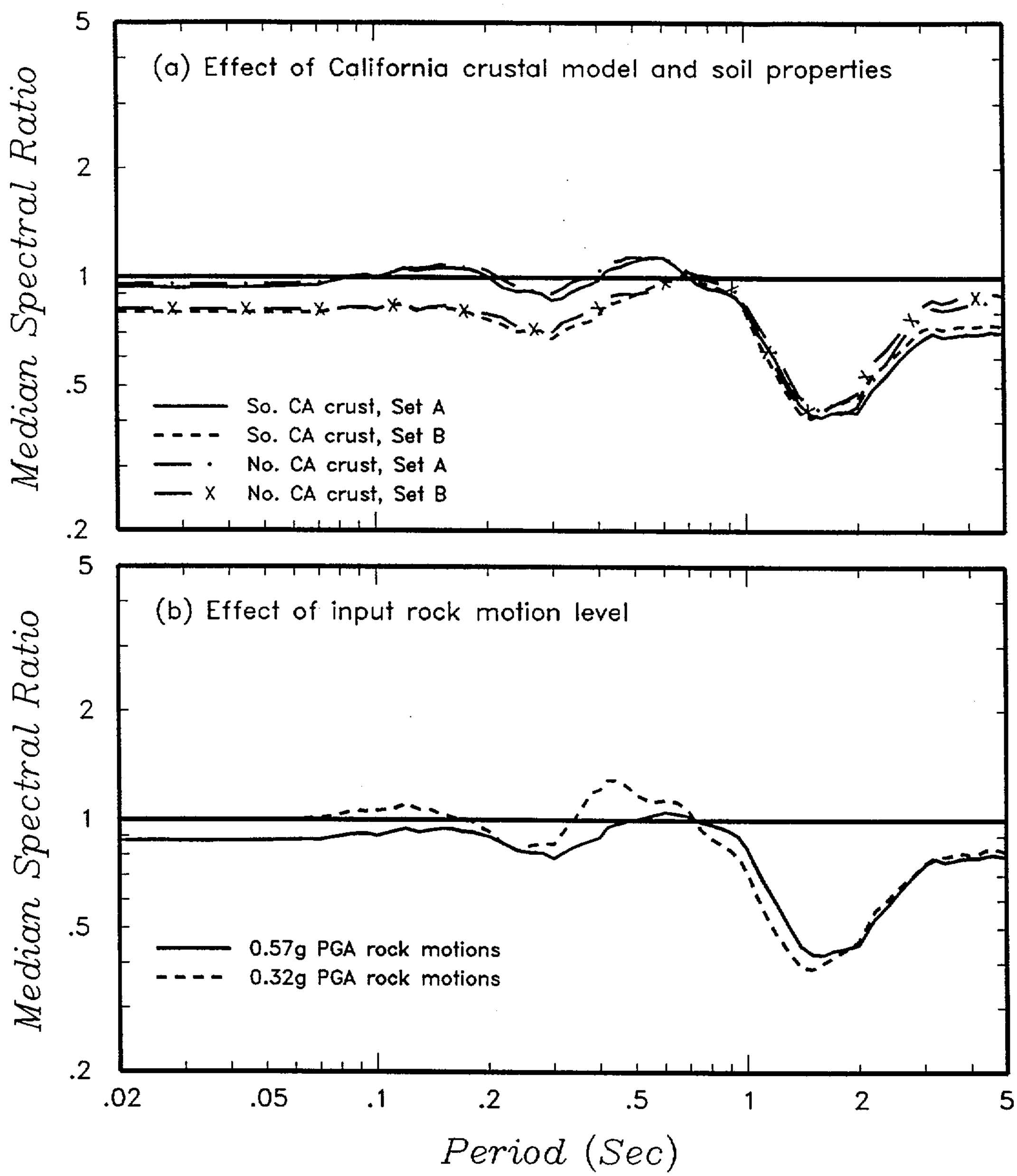
Project No.	4790
Figure	F-10b



GEOMATRIX

INDIVIDUAL RESPONSE SPECTRAL RATIOS COMPUTED USING ROCK MOTIONS FROM FIGURE F-6 DECONVOLVED THROUGH THE SOUTHERN CALIFORNIA CRUST. THE CURVES SHOW THE RATIO OF SKULL VALLEY SEDIMENT RESPONSE (THREE-LAYER CRUSTAL MODEL, MEDIAN SEDIMENT VELOCITY, κ = 0.03 SEC, SET A PROPERTIES) TO CALIFORNIA DEEP SOIL RESPONSE (SOUTHERN CALIFORNIA CRUSTAL MODEL, SET A PROPERTIES).

Project No.
4790
Figure
F-11



GEOMATRIX

(A) EFFECT OF CALIFORNIA CRUSTAL PROFILE AND SOIL PROPERTIES ON MEDIAN RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING THREE-LAYER CRUSTAL MODEL, MEDIAN SEDIMENT VELOCITY, κ = 0.03 SEC, AND SET A PROPERTIES. ROCK MOTIONS SCALED TO M 6.5 (FIGURE F-6). (B) EFFECT OF ROCK MOTION INPUT LEVEL ON RELATIVE RESPONSE. SKULL VALLEY RESPONSE SAME AS (A). CURVES ARE MEDIAN RESPONSE OVER ALL CALIFORNIA MODELS.

Project No. 4790

Figure F-12

Non-GDS

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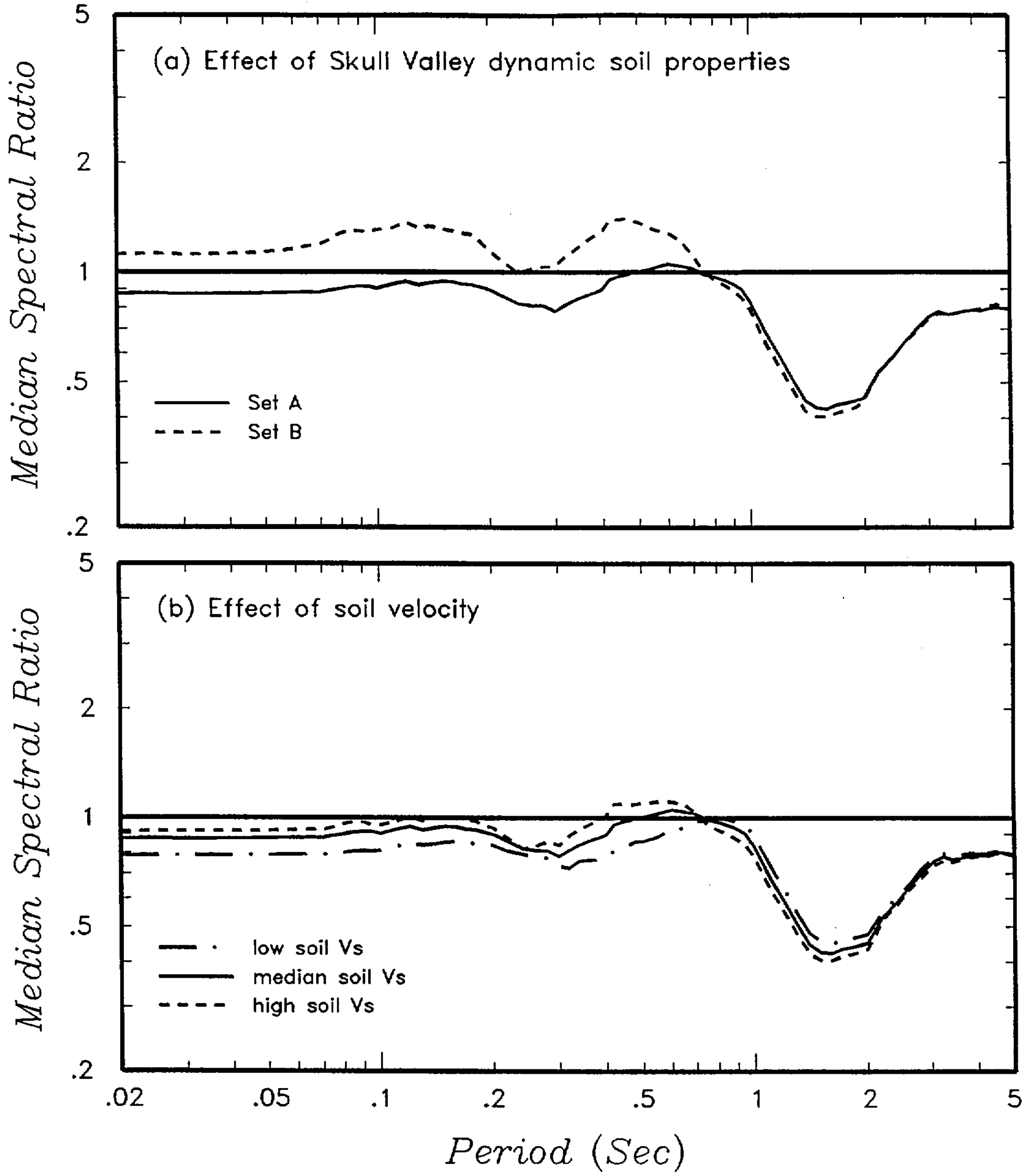
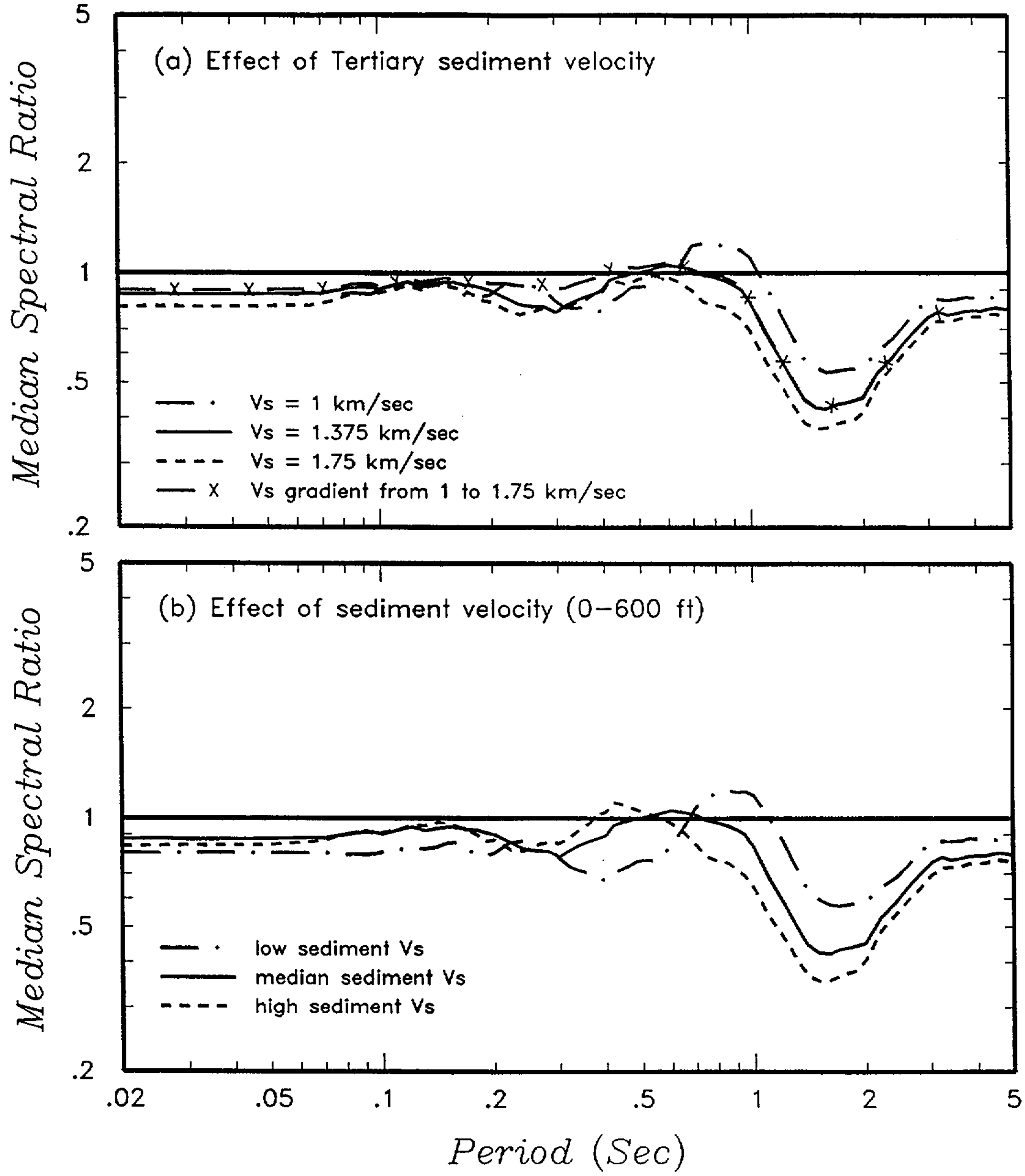
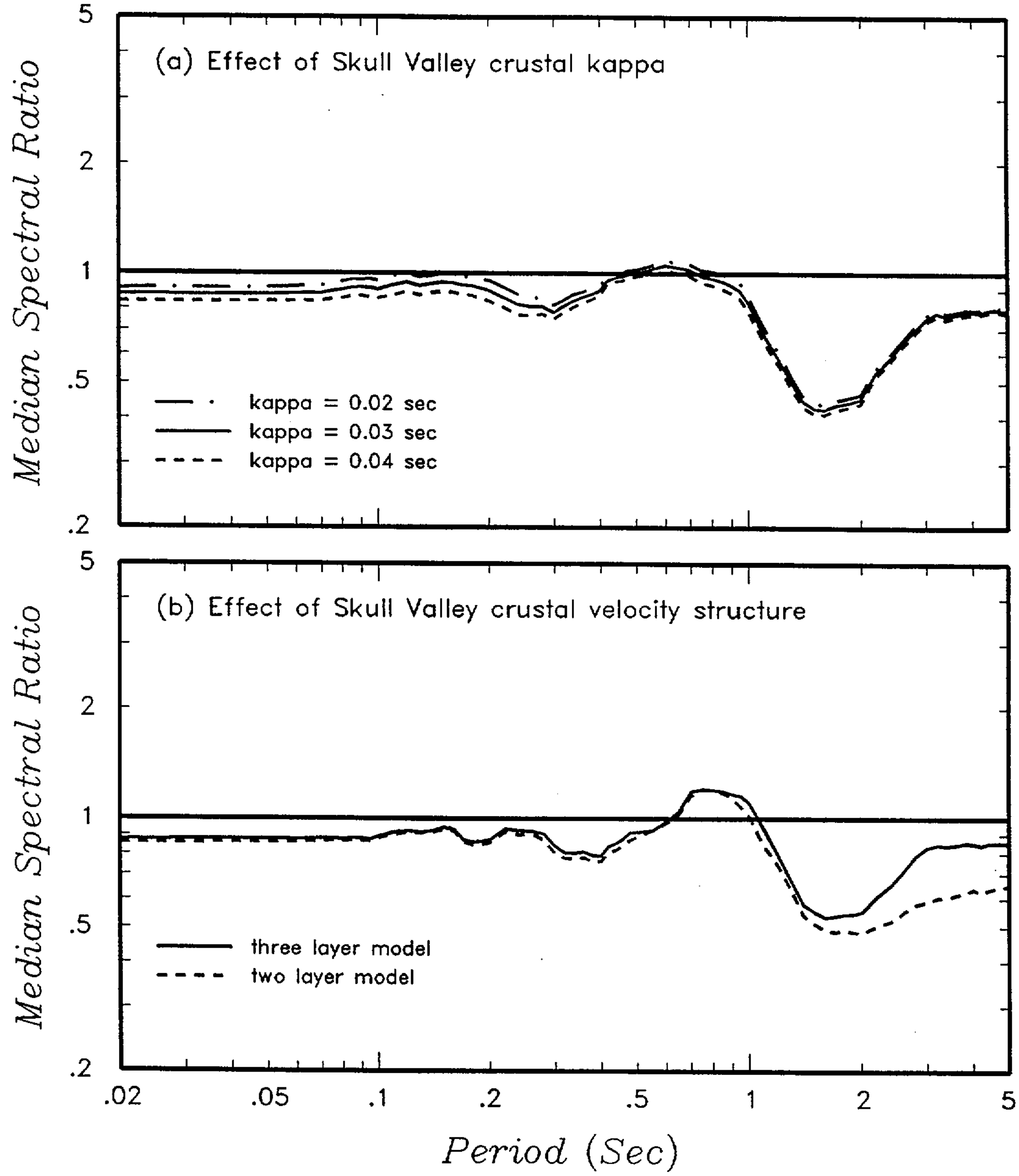


GEOMATRIX	(A) EFFECT OF CHOICE OF SOIL PROPERTIES FOR SKULL VALLEY SOILS ON MEDIAN RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING THREE-LAYER CRUSTAL MODEL, MEDIAN SEDIMENT VELOCITY, AND κ = 0.03 SEC. (B) EFFECT OF VELOCITY OF HOLOCENE AND PLEISTOCENE SOILS ON RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING THREE-LAYER CRUSTAL MODEL, MEDIAN TERTIARY VELOCITY, κ = 0.03 SEC, AND SET A PROPERTIES. ROCK MOTIONS SCALED TO M 6.5 FOR BOTH PLOTS.	Project No. 4790 Figure F-13



GEOMATRIX	(A) EFFECT OF VELOCITY OF TERTIARY SEDIMENTS ON RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING THREE-LAYER CRUSTAL MODEL, MEDIAN SOIL VELOCITIES, κ = 0.03 sec, AND SET A PROPERTIES. (B) EFFECT OF VARYING VELOCITY OF ALL OF THE SEDIMENTS ON RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING THREE-LAYER CRUSTAL MODEL, κ = 0.03 SEC, AND SET A PROPERTIES. ROCK MOTIONS SCALED TO M 6.5 FOR BOTH PLOTS.	Project No. 4790 Figure **F-14**

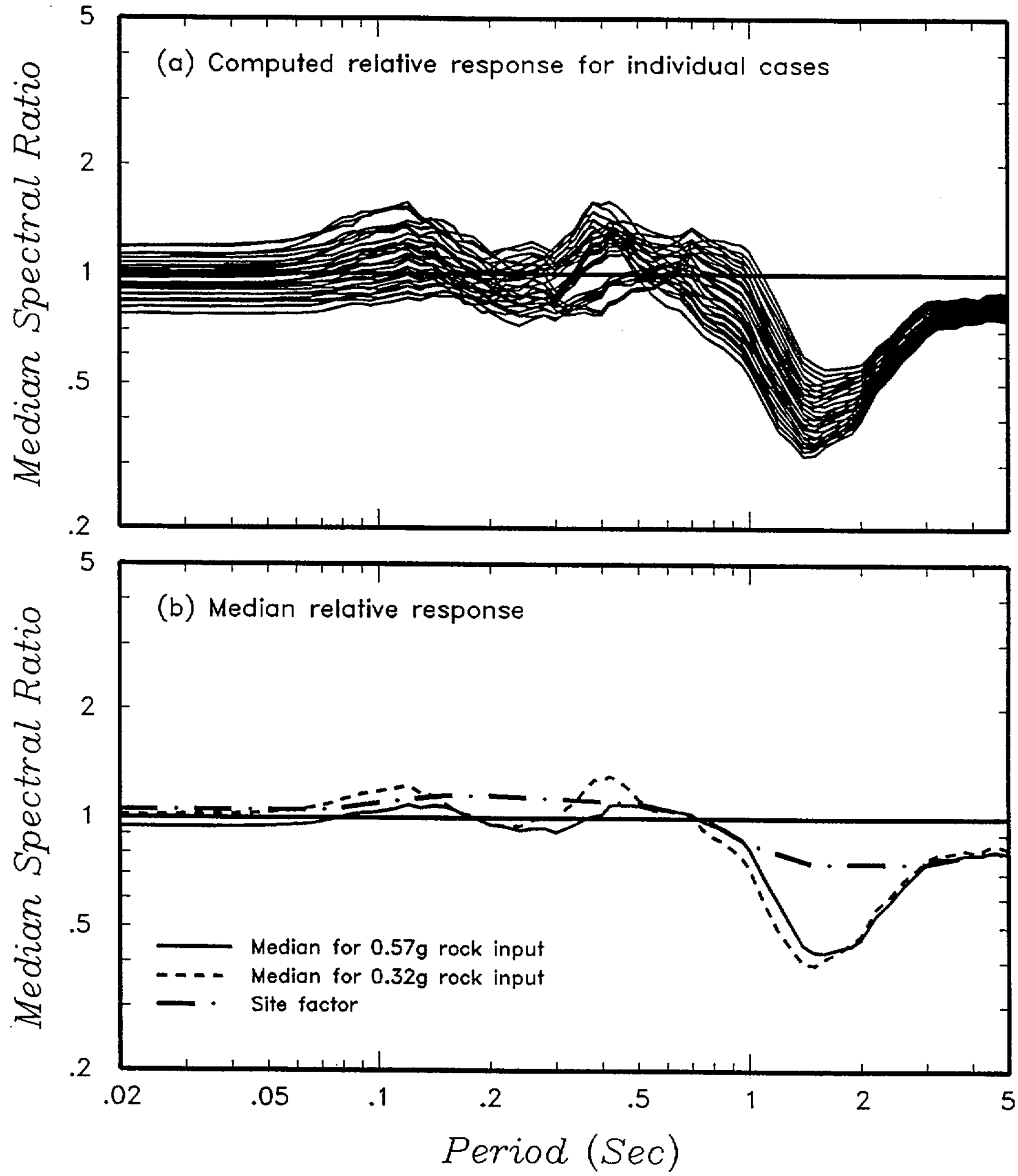


GEOMATRIX

(A) EFFECT OF CHOICE OF κ ON MEDIAN RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING THREE-LAYER CRUSTAL MODEL, MEDIAN SEDIMENT VELOCITY, AND SET A PROPERTIES. (B) EFFECT OF ALTERNATIVE UTAH CRUSTAL MODELS ON MEDIAN RELATIVE RESPONSE. SKULL VALLEY SEDIMENT RESPONSE COMPUTED USING MEDIAN SEDIMENT VELOCITY, κ = 0.03 SEC, AND SET A PROPERTIES. ROCK MOTIONS SCALED TO **M** 6.5 FOR BOTH PLOTS.

Project No. 4790

Figure F-15



GEOMATRIX

SUMMARY OF RELATIVE RESPONSE ANALYSES. (A) MEDIAN RELATIVE RESPONSE CURVES FROM PREVIOUS CASES (VARIATIONS IN SEDIMENT VELOCITY, SOIL MODULUS AND DAMPING CURVES, κ, AND INPUT ROCK MOTION LEVEL). (B) MEDIAN RELATIVE RESPONSE FOR ALL CASES FOR INPUT ROCK MOTIONS SCALED TO 0.32 G (M 7 EARTHQUAKE) AND 0.57G (M 6.5 EARTHQUAKE). ALSO SHOWN IS AVERAGE SITE CORRECTION FACTOR USED TO ADJUST CALIFORNIA DEEP SOIL EMPIRICAL ATTENUATION RELATIONSHIPS TO SOIL CONDITIONS AT THE SKULL VALLEY SITE.

Project No.	4790
Figure	F-16