GEOTECHNICAL INVESTIGATION
NEW MEXICO FOREST HIGHWAY 12
NEW MEXICO STATE HIGHWAY 126
CUBA-LACUEVA, NEW MEXICO
PROJECT NO. 35321 REV. 3
VOL. 1 OF 3

KLEINFELDER
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GEOTECHNICAL INVESTIGATION
NEW MEXICO FOREST HIGHWAY 12
NEW MEXICO STATE HIGHWAY 126
CUBA-LACUEVA, NEW MEXICO
PROJECT NO. 35321 REV. 3
VOL. 1 OF 3

February 24, 2006

Prepared for:	Federal Highway Administration Central Federal Lands Highway Division
Submitted to:	Laren Livingston, Project Manager Parsons Brinckerhoff Quade and Douglas, Inc 1660 Lincoln Street, Suite 2100 Denver, Colorado 80264
Prepared By:	Kleinfelder, Inc. 8300 Jefferson NE, Suite B Albuquerque, New Mexico 87113
Reviewed By:	Dennis Hanneman, P.E. Senior Project Manager

REVISION HISTORY – VOLUME 1

Revision No.	Reason for Revision	Date of Issue
0	Initial issue	4/13/2004
1	Changes made to reflect changes in the alignment and the decision to go with a bridge over the Fenton Lake wetlands.	4/18/2005
2	Replaced cover page, signature letter, table of contents, Summary of Conclusions, and pages 1 through 42 of the text with revised cover page, signature letter, table of contents, Summary of Conclusions, and pages 1 through 44. Inserted Revision History page after cover page. Inserted the attached Figure C.1 as the leading page in Appendix C.	7/19/05
3	Rewriting of the main text of the report including the following: 1) reevaluation of Fenton Lake Bridge pile recommendations; 2) reevaluation of MSE wall recommendations; 3) presentation of rockery wall design parameters; 4) reevaluation of cut slope stability recommendations; 5) discussion of temporary work platform design for bridge construction.	2/24/06

REVISION HISTORY – VOLUME 2

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3	No changes to Vol. 2	Use Prior Version

REVISION HISTORY – VOLUME 3

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0	Initial issue	4/13/2004
1	Changes made to reflect changes in the alignment and the decision to go with a bridge over the Fenton Lake wetlands.	4/18/2005
2	Removed pages H-265 and H-267; added new GRLWEAP analysis (pages H-269-H316)	7/19/05
3	No Changes to Vol. 3	Use Prior Version

February 23, 2006
Project No. 35321

File No. ALB04RP001 Rev. 3

Mr. Laren Livingston, Project Manager
Parsons Brinckerhoff Quade and Douglas, Inc.
1660 Lincoln Street, Suite 2100
Denver, Colorado 80264

**SUBJECT: GEOTECHNICAL INVESTIGATION REPORT
NEW MEXICO FOREST HIGHWAY 12
NEW MEXICO STATE HIGHWAY 126
CUBA – LACUEVA, NEW MEXICO**

Dear Mr. Livingston:

Kleinfelder Inc. (Kleinfelder) is pleased to present the following geotechnical investigation report for the proposed New Mexico Forest Highway 12 / New Mexico State Highway 126 project. The purpose of our study was to evaluate the subsurface soil conditions at the subject site in order to develop geotechnical engineering recommendations to aid in project design and construction.

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned at (505) 344-7373.

Respectfully submitted,
KLEINFELDER, INC.

GLEN R. ANDERSEN NEW MEXICO 17303 LICENSED PROFESSIONAL ENGINEER 2/23/2006

Glen R. Andersen, P.E.
Geotechnical Department Manager

Reviewed by:

FOR:

Dennis Hanneman, P.E.
Senior Project Manager

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SUMMARY OF CONCLUSIONS

The project described in this report consists of the reconstruction and realignment of New Mexico Forest Highway 12 / New Mexico State Highway 126 from the vicinity of Fenton Lake to the Seven Springs Fish Hatchery.

The alignment follows along the existing NM SH 126 from Station 0+200 to about Station 2+000. Along this stretch, the alignment consists of a dirt-packed 2-lane roadway. Existing cut slopes are located along the northeast side of the roadway. These slopes are covered with sparse ground vegetation and trees. At about Station 2+000, the alignment turns towards the northeast and deviates from the present roadway to traverse along the toe of a mapped ancient landslide. This area is covered with native trees, shrubs and grasses and the ground is hummocky. From Station 2+240 to 2+400, the proposed alignment turns north and crosses over the wetlands on a bridge just upstream of Fenton Lake. At Station 2+400, the alignment crosses onto grassland and traverses up a slope, which continues to Station 2+500 were the alignment rejoins the existing roadway. The existing roadway along this section consists of a dirt-packed, narrow, 2-lane road. Several cuts are present on the upslope side of the roadway and multiple fills are present on the downslope side of the roadway. Sparse native grasses, shrubs, and trees cover the slopes. At Station 3+600, the proposed alignment deviates to the west from the existing roadway passing through a moderately wooded forest with generally sparse undergrowth. In a few areas, the undergrowth is relatively thick. Along this portion of the alignment, the roadway passes to the west of the community of Seven Springs. In this area, the proposed roadway grade results in relatively deep cuts on the upslope side of the proposed roadway with some shallow cuts on the downslope side of the roadway. The proposed alignment rejoins the existing roadway at Station 5+300. From Station 5+300 to the end of the project (Station 7+440), the proposed alignment follows the existing roadway. The existing roadway along this section consists of a dirt-packed, narrow, 2-lane road. Cut slopes are present on the upslope side of the roadway and fill slopes are present on the downslope side of the roadway. Sparse native grasses, shrubs, and trees cover the slopes.

The project alignment generally runs along the slopes of the valley that carries the Rio Cebolla. The lower portion of these slopes consists of colluvium and related hillslope deposits derived from Bandelier tuff. Further up the slope, deposits of the Otowi Member of the Banderlier tuff are encountered. Still further up the slope, deposits of the Tshiregе Member of the Bandelier tuff are encountered. As previously mentioned, a mapped ancient landslide is present on the southeast slope of the valley just before the proposed bridge crossing in the Fenton Lake Wetlands area. Alluvial deposits are present along the valley floor. These alluvial deposits consist mainly of sand, silt and gravel and are the products of the weathering of the Bandelier tuff deposits and of the underlying Permian aged Abo Formation. The Bandelier Tuff is a series of non-welded to densely welded ash flow and ash fall deposits interspersed with basal surge deposits, all resulting from eruptions of the volcanoes of the Jemez Mountains about 1.2 to 1.4 million years ago. Two major eruptions creating the Bandelier Tuff are represented by the lower Otowi Tuff member and the upper Tshirege Tuff member as previously mentioned. Subsequent rapid erosion and re-deposition of volcanic rock units have produced the mesa and canyon topography present today.

Both the alluvial deposits and the Bandelier Tuff overlie the Permian aged Abo formation consisting of stratified silty sandstone, sandy siltstone and mudstone with some minor layers of limestone.

A total of twenty nine (29) soil borings were advanced for this project. Thirteen (13) borings (B-01 through B-13) were drilled to depths ranging from 1.8 to 8.1 m (6 to 26.5 ft.) for pavement design and roadway cut and fill slope stability evaluations. Seven (7) borings (MSE-01 through MSE-07) were drilled to depths ranging from 4.7 to 11.1 m (15.5 to 36.5 ft.) to address design considerations for the proposed MSE retaining walls. Nine (9) borings were advanced in the area of Fenton Lake to provide design parameters for the roadway crossing over the wetlands area. Two (2) borings (BR-01 and BR-04) were drilled to depths of 14.8 and 18.6 m (48.7 to 61.0 ft.), respectively, along the proposed "old" bridge alignment. Two (2) borings (BR-02 and BR-03) were drilled to a depth of 18.4 m (60.3 ft) along the existing earthen embankment west of the proposed bridge alignment. Five (5) borings (BR-10, BR-11, BR-12, BR-14 and BR-16) were drilled to depths ranging from 11.9 m to 24.0 m (39.2 to 78.6 ft) along the proposed new alignment of the bridge.

In general, the borings encountered overburden materials that can be described in engineering terms as silty sands, sandy silts, silts, silty gravels, and gravels. Within the bridge borings (BR-10, BR-11, BR-12, BR-14 and BR-16), alluvial soils composed of silty sands, sandy silts and sands from the parent Bandelier tuff were encountered. In a couple of locations, these Bandelier tuff-derived alluvial deposits were underlain by high plasticity silts weathered from the Abo formation. Weathered and unweathered Otowi tuff deposits were found to underlay the alluvial soils in some of the locations and silty sandstones, sandy siltstones, or mudstones of the Abo formation were found to underlay the alluvial deposits in other areas. The density of the alluvial soils was loose to medium dense, with occasional zones of very loose soil. In these borings occasional cobble and boulder size particles were encountered. Several large boulders are present along the valleys slopes and valley floor at various positions along the alignment. These boulders have weathered and detached from the caprock on the mesas above the valleys and are considered to be present in the valley alluvial sediments. Along the remainder of the alignment, several of the borings (Borings B-08, B-09, MSE-02, MSE-03, MSE-04, MSE-05, MSE-06, and MSE-07) encountered materials appearing to be weathered Bandelier tuff underlying the previously described colluvium or fill materials.

This report includes geotechnical recommendations for the design and construction of a multi-span concrete bridge crossing the wetlands located along the new alignment of Highway 126, just to the northeast of Fenton Lake. According to the drawings provided, the bridge alignment extends 163.05 meters, with abutments at Station 2+240.955 and Station 2+404.005 and five interior bridge piers between the abutments. The bridge is being designed utilizing LRFD (load and resistance factor design) parameters for the driven piles. Prestressed concrete piles are the preferred foundation.

Mechanically stabilized earth walls (MSE walls) were originally proposed for 5 locations along the alignment. For this investigation, the bearing capacity and global stability were analyzed at each of these locations. In the final design, MSE walls are proposed at 4 locations with maximum height of 7.72 m (25.3 ft).

Cut and/or fill slopes are planned along the left and right sides of the alignment. Of the thirteen borings performed on the alignment in cut or fill areas, only three were drilled through material that would form a portion of a proposed cut slope. Accordingly, general recommendations are made for cut slopes in terms of expected behavior based upon the performance of other cut slopes in the vicinity. We are currently evaluating the proposed cut in the area of the ancient landslide near the south abutment of the new bridge location. Results will be provided under separate cover. Fill slopes were analyzed based upon the probable fill materials that will be used for construction. Estimates for the amount of settlement in the fill slopes is considered to be acceptable for the type of construction proposed and most likely will occur during the construction process.

Four rockery walls are proposed for the alignment. These walls are formed by stacking full width stones (running the full design width of the wall) in lifts to the full height of the wall. Design recommendations are given for a range of conditions representing the four rockery wall conditions. Rockery walls are not intended to be the sole means of stabilizing an unstable slope. If the backslope is inherently unstable, it should be stabilized first before placing the rockery wall. There will be a practical height for these rockery walls based upon the maximum size of stones available and the constructability of the wall with these maximum size stones. As a general rule of thumb, the base width of the wall will range from 1/3 to 1/2 of the wall height and this will impose a practical limit due to the size of the stones necessary to form the base lift.

A temporary work platform has been proposed for the construction of the Fenton Lake Bridge. This work platform can be constructed out of the colluvial soils derived from the volcanic tuff in the vicinity and multiple layers of geogrid. Corrugated metal pipes can be placed through the work platform to handle the flows in the Rio Cebolla that are expected during construction.

Pavement design recommendations are presented herein. The recommended pavement section consists of an asphaltic concrete (HMA) surface layer over an aggregate base course (ABC).

1 INTRODUCTION - GENERAL

This report presents the results of the geotechnical investigation for the proposed reconstruction and realignment of New Mexico State Highway (NM SH) 126. NM SH 126 is also known as New Mexico Forest Highway 12, Cuba - La Cueva. The current roadway consists of a dirt packed, two-lane roadway. Three single-span, single-lane bridges are located along the existing roadway.

The reconstruction and realignment will consist of the construction of a two-lane, asphalt-paved roadway along most of the present alignment from just east of Fenton Lake to the Seven Springs Fish Hatchery. The roadway will be realigned to cross the Fenton Lake Wetlands further to the northeast and the road will be realigned to bypass the small community of Seven Springs. The proposed construction is discussed in detail in Section 1.2.

The start of the project is located about 26 km (16 miles) southeast of Cuba, New Mexico at the approximate location where the existing paved roadway ends, about 2 km (1.24 miles) east of Fenton Lake. From the start of the alignment (Station 0+200), the roadway traverses to the west. At Fenton Lake (Station 2+000), the alignment turns to the north and traverses another 5.3 km (3.3 miles) to the project's end (Station 7+440) at the Seven Springs Fish Hatchery. The project has a total length of 7.24 km (4.5 miles). Elevations along the alignment range from approximately 2338 m (7671 ft.) to approximately 2420 m (7938 ft.). The project is located within Sandoval County in the Santa Fe National Forest.

The geotechnical investigation included a general site reconnaissance, a review of the geologic mapping literature, a phased subsurface exploration, cone penetrometer testing in the Fenton Lake wetlands area, seismic refraction testing, field soil classification and laboratory testing, engineering analyses, and preparation of this report. The general recommendations contained in this report are subject to the limitations presented herein.

The stationing of the project runs from south to north. As such, references to the left side and right side of the alignment are based on facing up-station, which generally refer to the west and east sides of the roadway, respectively. Reference to project stationing in this report should be considered approximate. Where discrepancies in stationing or project description arise between this report and the project plans and specifications, the project plans and specifications are the governing documents.

This investigation was based on the drawings supplied by Parsons Brinckerhoff Quade and Douglas, Inc in December 2003, September 2004 and November 2005. These drawing were used to create the plan of borings and the subsurface profiles presented in Appendix A and C of this report. On December 30, 2003, Parsons Brinckerhoff Quade and Douglas, Inc supplied Kleinfelder with post 30 percent drawings. These drawing brought revisions to the alignment from approximately Station 4+400 to the end of the project. This report also includes the LRFD (load and resistance factor design) for the proposed new bridge alignment dated March 22, 2004. Our analysis has been modified to include the post 30 percent drawings and the new bridge alignment for the revised scope of work in our proposal dated March 22, 2004 and the drawings dated November 16, 2005.

1.1 Proposed Construction

The proposed roadway will have a total width of 6.6 m (21.65 ft.) with 0.6 m (2-ft.) paved shoulders. The proposed alignment is a total of 7.24 km (4.5 miles) long. Additional improvements are discussed in the following subsections.

1.1.1 Proposed Bridge

The project is to include a multi-span concrete bridge from Sta 2+240.955 to Sta 2+404.005, which extends approximately 163.05 meters crossing the wetlands along the new alignment of Highway 126, just to the north of Fenton Lake. The bridge is being designed following LRFD (load and resistance factor design) parameters for the driven piles.

1.1.2 Mechanically Stabilized Earth Retaining Walls

Four mechanically stabilized earth retaining walls are planned to limit the encroachment of the highway right-of-way to forestlands and creeks. The proposed retaining wall locations are summarized in Table 1. The geotechnical design parameters for the proposed walls are provided in Section 5.5. Some wall heights are greater than those proposed in the drawings due to the soil types encountered.

Table 1 – Summary of MSE Walls

Station		Maximum Height m (ft)	Comments
From	To		
2+674R	2+780R	5.24 (17.2)	
4+190R	4+240R	7.34 (24.1)	
4+800R	4+945R	7.72 (25.3)	
7+070R	7+225R	6.12 (20.1)	

1.1.3 Rockery Walls

Four rockery walls are proposed along the alignment. Table 2 summarizes the location of these rockery walls. Recommended design parameters are presented in Section 5.5 of this report.

Table 2 – Summary of Rockery Walls

Station		Maximum Height m (ft)	Maximum Backslope Angle (°)	Comments
From	To			
6+150L	6+167L	5.3 (17.4)	30	Marginally Stable Slope
6+800L	6+880L	3.3 (10.8)	16	
6+940L	7+000L	2.3 (7.5)	17	
7+060L	7+090L	2.5 (8.2)	30	Marginally Stable Slope

1.1.4 Culverts

Several culverts are planned along the alignment. Table 3 summarizes the locations of the proposed culverts.

Table 3 – Stations for Proposed Culvert Locations

0+586.417	3+158.808	5+311.308
0+628.321	3+267.215	5+480.346
0+774.234	3+547.294	5+680.755
0+980.168	3+592.505	5+924.068
1+147.099	3+764.010	6+006.102
1+469.585	3+942.486	6+161.302
1+791.895	4+018.193	6+335.646
2+523.032	4+163.977	6+457.162
2+624.382	4+447.238	6+913.782
2+811.105	4+715.361	7+045.003
2+924.782	4+950.888	7+219.801
3+009.132	5+102.372	7+344.578

1.1.5 Proposed Permanent Cut and Fill Slopes

Cut and/or fill slopes are planned along the left and right sides of the alignment. Table 4 summarizes the proposed cut slopes that are 3 m or greater in height. Table 5 summarizes the proposed fill slopes that are 3 m or greater in height.

Table 4 – Proposed Cut Slopes 3 m or Greater in Height

Station		Cut Slope Inclination		Approximate Maximum Cut Height m (ft)		Comments (Backslope Angle)
From	To	Left (V:H)	Right (V:H)	Left	Right	
0+880	--		1:2.5		3.0	(10°)
1+469.6	--		1:1.75		3.0	(11°)
1+580	--		1:2		3.0	(12°)
1+788.5	--		1:1.25		4.0	(30°)
1+900	1+920		1:1.75 to 1:2		7.0	(11°)
1+950	--		1:2		3.5	(14°)
2+040	2+220		1:1.5 to 1:1.75		10.0*	Cuts through toe of mapped landslide (9°)
2+476.5	--	1:3		3.2		(8°)
2+500	--	1:1.5		4.3		(7°)
2+520	--	1:2		3.8		(12°)
2+600	2+720	1:1.5 to 1:2		14.8		(27°)
2+800	2+860	1:2 to 1:2.5		4.9		(9°)
3+020	3+100	1:1.75 to 1:2		4.7		(8°)
3+220	3+263	1:1.5 to 1:2		9.5		(8°)
3+420	3+460	1:2		4.5		(6°)
3+660	3+700	1:1.5 to 1:2		7.2		(9°)
3+780	3+900	1:1.5 to 1:2.5	1:4 to 1:2	7.4	3.5	(9°)
4+080	4+190	1:1.5 to 1:2		16.0		(18°)
4+220	4+400	1:1.5 to 1:2		15.6		(24°)
4+540	4+660	1:2		4.8		(0°)
4+760	4+780	1:2		4.0		(14°)
4+840	4+890	1:1.25 to 1:1.5		6.9		(30°)
4+950	4+962	1:2 to 1:2.5		3.0		(10°)
4+980	5+000	1:2		4.6		(11°)
5+040	5+080	1:1.5 to 1:2.1		6.9		(16°)
5+160	5+240	1:1.75 to 1:2		6.6		(11°)
5+360		1:2		3.3		(11°)
5+380	5+400	1:2		3.8		(13°)

Table 4 – Proposed Cut Slopes 3 m or Greater in Height

Station		Cut Slope Inclination		Approximate Maximum Cut Height m (ft)		Comments (Backslope Angle)
From	To	Left (V:H)	Right (V:H)	Left	Right	
6+645	6+740	1:1.25 to 1:1.5		8.3		(24°)
7+252	7+300	1:1.75 to 1:2		5.0		(16°)
7+420		1:2		3.4		(11°)

* Actual cut slope height cannot be determined from available topographic information.

Table 5 – Proposed Fill Embankments

Station		Proposed Fill Slope (fill slopes may not run the entire length of stationing)		Maximum Fill Height m (ft)	
From	To	Left (V:H)	Right (V:H)	Left	Right
0+280	1+860	1:2 to 1:20	1:1.75 to 1:20	3.8 (12.4)	1.5 (4.9)
1+960	2+020	1:1.5 to 1:4.8	1:6	3.7 (12.1)	0.6 (1.9)
2+409.3	2+460	1:1.5 to 1:6	1:3 to 1:4	4.0 (13.1)	3.6 (11.8)
2+520	2+580	1:10	1:3	1.1 (3.6)	2.0 (6.5)
2+660	--	none	1:8	none	0.9 (2.9)
2+720	2+820	1:1.75 to 1:10	1:3 to 1:13	4.4 (14.4)	1.8 (5.9)
2+860	3+000	1:2.5 to 1:6	1:1.75 to 1:13	1.0 (3.3)	2.8 (9.2)
3+120	3+320	1:4 to 1:20	1:3 to 1:4	1.2 (3.9)	4.2 (13.7)
3+480	3+640	1:3 to1:6	1:3	3.0 (9.8)	4.4 (14.4)
3+700	--	none	1:4	none	0.6 (1.9)
3+920	4+075	1:3 to 1.4	1:1.5 to 1:6	4.2 (13.7)	9.1 (29.8)
4+420	4+500	1:4 to 1:10	1:1 to 1:10	1.1 (3.6)	2.6 (8.5)
4+700	4+780	1:3	1:3	1.4 (4.6)	3.7 (12.1)
4+900	4+940	1:4 to 1:10	none	1.8 (5.9)	none
4+960	5+020	none	1:3 to 1:20	none	3.8 (12.4)
5+100	5+120	none	1:3	none	5.6 (18.3)
5+280	5+340	1:3 to 1:4	1:3	1 (3.3)	2.3 (7.5)
5+460	5+580	1:10	1:3 to 1:4	0.2 (0.6)	2.1 (6.9)
5+660	5+700	1:1 to 1:20	1:3	0.3 (1.0)	1.3 (4.2)

Table 5 – Proposed Fill Embankments

Station		Proposed Fill Slope (fill slopes may not run the entire length of stationing)		Maximum Fill Height m (ft)	
From	To	Left (V:H)	Right (V:H)	Left	Right
5+860	6+180	1:3 to 1:10	1:1.5 to 1:4	1.0 (3.3)	6.8 (22.3)
6+260	6+360	1:10	1:3	0.6 (1.9)	3.4 (11.1)
6+440	6+760	1:10	1:1.5 to 1:4	0.4 (1.3)	2.6 (8.5)
6+820	6+840	none	1:3	none	1.7 (5.5)
6+900	7+060	1:4 to 1:6	1:1.5 to 1:4	0.8 (2.6)	2.4 (7.8)
7+220	7+260	1:3	1:3	1.4 (4.6)	2.8 (9.2)
7+320	7+380	1:2 to 1:6.5	none	1.1 (3.6)	none
7+440	--	none	1:4	none	0.6 (1.9)

1.1.6 Specifications

Construction and design should be completed in accordance with the Standard Specifications for the Construction of Roads and Bridges on Federal Highway Projects, FP-03 by the United States Department of Transportation Federal Highway Administration Federal Lands Highway (USDOT FHWA FLH), Special Contract Requirements (SCR) prepared by the FHWA Central Federal Lands Highway Division (CFLHD), and the Standard Specifications for Highway Bridges, 17th Edition by American Association of State Highway and Transportation Officials (AASHTO). Hereafter, the specifications will be referred to as FP-03, then the pertaining section (i.e. FP-03, Section 255) or SCR, then the pertaining section (i.e. SCR-255). In addition, units will be presented in millimeters (mm), meters (m), kilometers (km), inches (in.), feet (ft.), and miles (mi).

2 FIELD EXPLORATION

Our field investigation consisted of a surface reconnaissance, geologic mapping, and subsurface exploration including drilling exploratory borings, cone penetrometer tests, and seismic refraction tests.

2.1 Subsurface Exploration

A total of twenty nine (29) soil borings were advanced for this project. Thirteen (13) borings (B-01 through B-13) were drilled to depths ranging from 1.8 to 8.1 m (6 to 26.5 ft.) for pavement design and roadway cut and fill slope stability evaluations. Seven (7) borings (MSE-01 through MSE-07) were drilled to depths ranging from 4.7 to 11.1 m (15.5 to 36.5 ft.) to address design considerations for the proposed MSE retaining walls. Nine (9) borings were advanced in the area of Fenton Lake to provide design parameters for the roadway crossing over the wetlands area. Two (2) borings (BR-01 and BR-04) were drilled to depths of 14.8 and 18.6 m (48.7 to 61.0 ft.), respectively, along the proposed "old" bridge alignment. Two (2) borings (BR-02 and BR-03) were drilled to a depth of 18.4 m (60.3 ft) along the existing earthen embankment west of the proposed bridge alignment. Five (5) borings (BR-10, BR-11, BR-12, BR-14 and BR-16) were drilled to depths ranging from 11.9 m to 24.0 m (39.2 to 78.6 ft) along the proposed new alignment of the bridge. Borings BR-13 and BR-15 were eliminated due to a limited exploration period into the wetlands. When it became evident that we would not finish the complete field exploration within the week, we evaluated the data we had already obtained and determined that we had sufficient information for design purposes. We opted to eliminate BR-13 and BR-15 instead of mobilizing a second time into the wetlands. A site plan showing the approximate boring locations is presented as Figure A.3 through A.14 in Appendix A. The logs of the borings are presented in Appendix B. Site photos with subsurface profiles at each boring location are presented in Appendix C. The information obtained from the seismic refraction tests is presented in Appendix F.

Exploratory drilling of borings B-01 through B-08, B-11 through B-13, BR-02, BR-03, MSE-01, and MSE-05 was accomplished using a truck-mounted CME-75 drill rig equipped with a 82.6 mm (3.25-inch) I.D. hollow-stem auger. Borings BR-10, BR-11, BR-12, BR-14, BR-16, BR-01, BR-04, MSE-02, B-09, MSE-03, MSE-04, B-10, MSE-06, and MSE-07 were drilled using a CME-55 drill rig mounted on a CME-300 tracked carrier equipped with a 82.6 mm (3.25-inch) I.D. hollow-stem auger. Selected soil and rock samples were obtained by a standard penetration test sampler, a 76.2 mm (3.0-inch) O.D., 61.5 mm (2.42)-inch I.D. ring lined sampler, and bulk samples from auger cuttings. The samplers were driven with a 620 N (140-pound) CME automatic hammer free-falling through a distance of 762.0 mm (30.0 inches). The sampler driving resistance was recorded as the number of blows per foot of penetration and is presented on the boring logs. Soil and rock samples from the borings were classified in the field by the field engineer/geologist and each sample was packaged and transported to our laboratory for further classification and testing.

2.2 Seismic Refraction Testing

On November 3 through 5, 2003, Kleinfelder performed seismic refraction surveys on eleven predetermined lines along the proposed Cuba-LaCueva road alignment. Seismic refraction is one of the most common surface-based geophysical site characterization techniques, due to its speedy form of application. The method was applied at the subject sites to predominantly determine depths to bedrock or high velocity layers, and the corresponding seismic velocities. Table 6 summarizes the stationing and offset for each of the seismic refraction sites.

Table 6 – Summary of Seismic Refraction Tests

Number	Beginning Station	Ending Station	Offset
S-1	1+865	1+895	6 m R to 2 m R (20 ft. R to 7 ft. R
S-2	2+050	2+120	12 m L (39 ft. L)

Table 6 – Summary of Seismic Refraction Tests

Number	Beginning Station	Ending Station	Offset
S-3	2+460	2+530	Centerline to 12 m R (Centerline to 39 ft. R)
S-4	2+660	2+730	5 m R to centerline (16 ft. R to centerline)
S-5	2+730	2+800	7 m R to 2 m R (23 ft. R to 7 ft. R)
S-6	3+005	3+075	2 m R to 5 m R (7 ft. R to 16 ft. R)
S-7	3+830	3+900	Approx. centerline
S-8	4+100	4+136	2 m R (7 ft. R)
S-9	4+210	4+248	Centerline to 2 m R (Centerline to 7 ft. R)
S-10	4+800	4+870	Approx. centerline
S-11	6+075	6+145	7 m R to 12 m R (23 ft. to 39 ft. R)

The surveys were carried out at each site using 12 geophones at 3 m or 6 m (10 ft or 20 ft) spacings. Seismic energy was imparted to the ground manually, using a sledgehammer to generate seismic waves. A DAQLink II seismograph, manufactured by Seismic Source Co., was used to record the compression energy signals. The refraction analyses were done using commercially available software. End results of the survey; that is, depth to higher velocity layers, compression wave velocities, and the velocity models for each site, are presented in Appendix F.

2.3 Cone Penetrometer Tests

Kleinfelder also performed Cone Penetrometer Tests (CPT) in accordance with the proposal dated March 22, 2004. They were performed at seven CPT locations along the bridge alignment, with termination depths that ranged from 3.8 to 13.7 m (12.6 to 44.8 ft) at tip refusal of the cone. CPTs were performed using a CME-55 drill rig mounted on a CME-300 tracked carrier equipped with the CPT setup. An electric cone penetrometer tip is attached to a string of steel rods and is pushed vertically into the ground at a constant rate of approximately 20 mm/sec (0.8 in/sec). The CPT data was continuously recorded by a computer connected to the cone penetrometer. The detailed CPT graphs and tabular information are presented in Appendix E. Boring and CPT locations are shown in the Site Map located on Figure A.14 of Appendix A.

3 LABORATORY TESTING

Moisture content, dry density tests, Atterberg limits tests, sieve analysis, R-value tests, and moisture density relationship tests were performed on representative samples. Field exploration and laboratory testing was performed in general accordance with AASHTO standards. Two different AASHTO Materials Reference Laboratories (AMRL) completed the laboratory testing. These laboratories were Kleinfelder in Albuquerque (AMRL #3575) and Kleinfelder in Colorado Springs (certified awaiting assignment of #). All of the tests performed except the R-value tests were run at the Albuquerque laboratory. Table 7 summarizes the laboratory test results. Table 8 summarizes the soil classifications that were developed based on the laboratory test results. Results of the laboratory tests completed are presented in Appendix D.

Table 7 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing									Unit Dry Weight kN/m³ (pcf)	Percent Moisture
		PI	LL	0.075 mm (#200)	0.150 mm (#100)	0.425 mm (#40)	2.000 mm (#10)	4.750 mm (#4)	9.525 mm (3/8")	12.7 mm (1/2")	19.05 mm (3/4")	25.4 mm (1")		
B-01	0.5 (1.5)	NP	NV	15	19	29	51	56	60	60	64	85	--	14.4%
B-02	0 (0)	--	--	38	47	62	87	93	99	100	100	100	--	13.9%
B-03	0 (0)	NP	NV	25	34	52	76	85	92	97	100	100	--	12.6%
B-04	0.5 (1.5)	--	--	19	24	35	60	72	84	86	89	100	--	21.4%
B-05	0.5 (1.5)	NP	NV	37	50	64	86	99	100	100	100	100	--	7.9%
B-06	0 (0)	NP	NV	27	37	52	79	87	96	96	100	100	--	7.0%
B-06	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	5.3%
B-06	3 (10)	NP	NV	15	22	35	62	73	81	84	100	100	--	4.1%
B-06	4.6 (15)	--	--	--	--	--	--	--	--	--	--	--	--	5.7%
B-06	6.1 (20)	--	--	--	--	--	--	--	--	--	--	--	--	12.4%
B-06	7.6 (25)	--	--	--	--	--	--	--	--	--	--	--	--	15.9%
B-07	0 (0)	NP	NV	26	39	55	76	84	91	93	94	100	--	11.3%
B-07	1.5 (5)	--	--	23	35	52	82	90	97	100	100	100	--	5.6%
B-08	0 (0)	NP	NV	40	48	59	83	92	99	100	100	100	--	6.2%
B-08	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	8.9%
B-08	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	20.2%
B-08	4.6 (15)	--	--	--	--	--	--	--	--	--	--	--	--	17.1%
B-08	5.5 (18)	--	--	--	--	--	--	--	--	--	--	--	--	19.9%
B-09	0 (0)	NP	NV	66	75	83	96	98	99	100	100	100	--	4.7%

Table 7 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing									Unit Dry Weight kN/m³ (pcf)	Percent Moisture
		PI	LL	0.075 mm (#200)	0.150 mm (#100)	0.425 mm (#40)	2.000 mm (#10)	4.750 mm (#4)	9.525 mm (3/8")	12.7 mm (1/2")	19.05 mm (3/4")	25.4 mm (1")		
B-09	2.7 (9)	--	--	--	--	--	--	--	--	--	--	--	--	8.6%
B-10	1.4 (4.5)	--	--	27	34	48	74	83	91	96	100	100	--	4.9%
B-11	0 (0)	NP	NV	29	36	49	75	83	91	94	96	100	--	10.6%
B-11	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	10.6%
B-11	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	13.9%
B-11	4 (13)	--	--	--	--	--	--	--	--	--	--	--	--	7.8%
B-12	0 (0)	NP	NV	38	45	54	72	83	98	98	100	100	--	9.3%
B-13	0.5 (1.5)	NP	NV	34	43	56	80	89	97	100	100	100	--	20.5%
BR-01	2.6 (8.5)	NP	NV	--	--	--	--	--	--	--	--	--	--	--
BR-01	4.1 (13.5)	--	--	31	40	47	63	69	80	82	91	95	--	30.5%
BR-01	7.2 (23.5)	--	--	30	38	50	72	79	84	88	92	97	--	32.6%
BR-01	10.2 (33.5)	--	--	11	16	27	57	70	85	92	100	100	--	15.7%
BR-01	11.7 (38.5)	--	--	26	--	--	--	--	--	--	--	--	--	10.5%
BR-01	14.8 (48.5)	--	--	--	--	--	--	--	--	--	--	--	--	12.7%
BR-02	1.5 (5)	NP	NV	21	29	44	74	84	99	100	100	100	--	26.8%
BR-02	6.1 (20)	--	--	41	50	66	94	98	100	100	100	100	--	34.9%
BR-02	12.2 (40)	--	--	11	16	30	59	73	87	91	94	100	--	23.4%
BR-03	4.6 (15)	--	--	54	64	74	91	95	98	99	100	100	--	43.8%
BR-04	2.7 (9)	--	--	20	32	50	80	90	96	98	100	100	--	41.2%
BR-04	5.8 (19)	--	--	16	23	37	68	81	92	96	98	100	--	29.9%
BR-04	14.9 (49)	--	--	31	39	54	67	74	82	88	97	100	--	20.6%
BR-04	16.5 (54)	--	--	73	--	--	--	--	--	--	--	--	--	13.9%
BR-10	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	72.9	41.9%
BR-10	3 (10)	NP	31	67	89	97	99	100	100	100	100	100	--	--
BR-10	7.6 (25)	--	--	39	44	52	69	78	87	90	94	94	--	--
BR-11	1.1 (3.5)	NP	33	--	--	--	--	--	--	--	--	--	--	--
BR-11	2.6 (8.5)	--	--	57	85	97	100	100	100	100	100	100	--	--

Table 7 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing									Unit Dry Weight kN/m³ (pcf)	Percent Moisture
		PI	LL	0.075 mm (#200)	0.150 mm (#100)	0.425 mm (#40)	2.000 mm (#10)	4.750 mm (#4)	9.525 mm (3/8")	12.7 mm (1/2")	19.05 mm (3/4")	25.4 mm (1")		
BR-11	4.1 (13.5)	--	--	--	--	--	--	--	--	--	--	--	84.0	19.2%
BR-11	5.6 (18.5)	--	--	63	85	97	100	100	100	100	100	100	--	--
BR-11	10.2 (33.5)	--	--	43	66	84	87	87	88	88	89	100	--	--
BR-12	1.1 (3.5)	--	--	70	81	92	98	100	100	100	100	100	76.3	39.4%
BR-12	4.1 (13.5)	--	--	18	25	39	69	78	91	95	98	98	--	--
BR-12	7.1 (23.5)	NP	43	69	78	87	98	100	100	100	100	100	--	--
BR-12	10.2 (33.5)	--	--	26	33	48	64	70	81	83	95	100	91.2	24.0%
BR-14	1.1 (3.5)	--	--	57	67	82	95	97	98	100	100	100	--	--
BR-14	2.6 (8.5)	--	--	60	71	81	94	97	99	100	100	100	--	--
BR-14	11.7 (38.5)	--	--	12	16	26	52	66	79	87	100	100	--	--
BR-14	16.3 (53.5)	26	60	99	99	100	100	100	100	100	100	100	--	--
BR-16	1.4 (4.5)	--	--	16	22	35	59	67	78	81	83	89	77.8	31.6%
BR-16	4.4 (14.5)	--	--	26	35	48	71	78	85	85	90	94	--	--
BR-16	5.9 (19.5)	--	--	18	26	44	76	85	93	95	99	100	--	--
BR-16	7.4 (24.5)	--	--	9	12	23	42	54	74	81	88	100	--	--
BR-16	10.5 (34.5)	--	--	21	31	51	65	72	80	83	95	100	80.8	35.4%
BR-16	12 (39.5)	--	--	6	9	20	54	63	72	77	92	93	--	--
MSE-01	0 (0)	NP	NV	16	23	33	48	57	73	82	92	100	--	4.4%
MSE-01	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	10.6%
MSE-01	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	8.4%
MSE-02	0 (0)	--	--	21	29	41	68	78	87	91	96	100	--	3.5%
MSE-03	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	14.4%
MSE-03	4.6 (15)	--	--	15	20	28	40	50	55	61	64	100	--	6.9%
MSE-04	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	4.9%
MSE-04	4.3 (14)	--	--	36	51	69	93	98	99	100	100	100	--	24.4%
MSE-05	0 (0)	--	--	18	22	31	50	67	90	95	100	100	--	4.4%
MSE-05	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	4.1%

Table 7 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing									Unit Dry Weight kN/m³ (pcf)	Percent Moisture
		PI	LL	0.075 mm (#200)	0.150 mm (#100)	0.425 mm (#40)	2.000 mm (#10)	4.750 mm (#4)	9.525 mm (3/8")	12.7 mm (1/2")	19.05 mm (3/4")	25.4 mm (1")		
MSE-05	3 (10)	--	--	15	18	26	44	59	75	82	97	100	--	4.1%
MSE-06	0 (0)	--	--	23	29	39	59	72	84	91	98	100	--	10.1%
MSE-06	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	23.4%
MSE-06	4.3 (14)	--	--	--	--	--	--	--	--	--	--	--	--	16.5%
MSE-07	0 (0)	--	--	--	--	--	--	--	--	--	--	--	--	9.1%
MSE-07	1.2 (4)	--	--	20	23	29	45	56	69	71	84	100	--	11.6%

Table 7 – Summary of Soil Classification (based on laboratory test results)

Boring Number	Depth of top of sample m (ft.)	Soil Classification	
		USCS	AASHTO
B-1	0.5 (1.5)	GM	A-1-b
B-02	0 (0)	SM	A-4(0)
B-03	0 (0)	SM	A-2-4(0)
B-04	0.5 (1.5)	SM	A-1-b
B-05	0.5 (1.5)	SM	A-4(0)
B-06	0 (0)	SM	A-2-4(0)
B-06	3 (10)	SM	A-1-b
B-07	0 (0)	SM	A-2-4(0)
B-07	1.5 (5)	SM	A-2-4(0)
B-08	0 (0)	SM	A-4(0)
B-09	0 (0)	ML	A-4(0)
B-10	1.4 (4.5)	SM	A-2-4(0)
B-11	0 (0)	SM	A-2-4(0)
B-12	0 (0)	SM	A-4(0)
B-13	0.5 (1.5)	SM	A-2-4(0)
BR-01	4.1 (13.5)	SM	A-2-4(0)
BR-01	7.2 (23.5)	SM	A-2-4(0)
BR-01	10.2 (33.5)	SP-SM	A-1-b
BR-02	1.5 (5)	SM	A-1-b
BR-02	6.1 (20)	SM	A-4(0)
BR-02	12.2 (40)	SP-SM	A-1-b

Table 7 – Summary of Soil Classification (based on laboratory test results)

Boring Number	Depth of top of sample m (ft.)	Soil Classification	
		USCS	AASHTO
BR-03	4.6 (15)	ML	A-4(0)
BR-04	2.7 (9)	SM	A-1-b
BR-04	5.8 (19)	SM	A-1-b
BR-04	14.9 (49)	SM	A-2-4(0)
BR-10	3 (10)	ML	A-4(0)
BR-10	7.6 (25)	SM	A-4(0)
BR-11	1.1 (3.5)	ML	A-4(0)
BR-11	2.6 (8.5)	ML	A-4(0)
BR-11	5.6 (18.5)	ML	A-4(0)
BR-11	10.2 (33.5)	SM	A-4(0)
BR-12	1.1 (3.5)	ML	A-4(0)
BR-12	4.1 (13.5)	SM	A-1-b
BR-12	7.1 (23.5)	ML	A-4(0)
BR-12	10.2 (33.5)	SM	A-2-4
BR-14	1.1 (3.5)	ML	A-4(0)
BR-14	2.6 (8.5)	ML	A-4(0)
BR-14	11.7 (38.5)	SM	A-1-b
BR-14	16.3 (53.5)	MH	A-7-5
BR-16	1.4 (4.5)	SM	A-1-b
BR-16	4.4 (14.5)	SM	A-2-4
BR-16	5.9 (19.5)	SM	A-1-b
BR-16	7.4 (24.5)	SP-SM	A-1-a
BR-16	10.5 (34.5)	SM	A-2-4
BR-16	12 (39.5)	SP-SM	A-1-a
MSE-01	0 (0)	GM	A-1-b
MSE-02	0 (0)	SM	A-1-b
MSE-03	4.6 (15)	GM	A-1-a
MSE-04	4.3 (14)	SM	A-4(0)
MSE-05	0 (0)	SM	A-1-b
MSE-05	3 (10)	GM	A-1-a
MSE-06	0 (0)	SM	A-1-b
MSE-07	1.2 (4)	SM	A-1-b

The summary of the laboratory test results for the borings of new bridge alignment is presented in Appendix D. A summary of the R-value test results has been included in Section 5.7.

Chemical analysis testing was performed on selected soil samples by Hall Environmental Analysis Laboratory to aid in predicting the corrosion potential of the cut fill materials. The testing included determining pH, resistivity, and chloride and sulfate contents. Additional discussions about the corrosion testing program, as well as a summary of laboratory test results are located in Section 5.8.4.

4 GENERAL SITE DESCRIPTIONS

4.1 Surface conditions

The alignment follows along the existing NM SH 126 from Station 0+200 to about Station 2+000. Along this stretch, the alignment consists of a dirt-packed 2-lane roadway. Existing cut slopes are located along the northeast side of the roadway. These slopes are covered with sparse ground vegetation and trees. At about Station 2+000, the alignment turns towards the northeast and deviates from the present roadway to traverse along the toe of a mapped ancient landslide. This area is covered with native trees, shrubs and grasses and the ground is hummocky. From Station 2+240 to 2+400, the proposed alignment turns north and crosses over the wetlands on a bridge just upstream of Fenton Lake. At Station 2+400, the alignment crosses onto grassland and traverses up a slope, which continues to Station 2+500 were the alignment rejoins the existing roadway. The existing roadway along this section consists of a dirt-packed, narrow, 2-lane road. Several cuts are present on the upslope side of the roadway and multiple fills are present on the downslope side of the roadway. Sparse native grasses, shrubs, and trees cover the slopes. At Station 3+600, the proposed alignment deviates to the west from the existing roadway passing through a moderately wooded forest with generally sparse undergrowth. In a few areas, the undergrowth is relatively thick. Along this portion of the alignment, the roadway passes to the west of the community of Seven Springs. In this area, the proposed roadway grade results in relatively deep cuts on the upslope side of the proposed roadway with some shallow cuts on the downslope side of the roadway. The proposed alignment rejoins the existing roadway at Station 5+300. From Station 5+300 to the end of the project (Station 7+440), the proposed alignment follows the existing roadway. The existing roadway along this section consists of a dirt-packed, narrow, 2-lane road. Cut slopes are present on the upslope side of the roadway and fill slopes are present on the downslope side of the roadway. Sparse native grasses, shrubs, and trees cover the slopes.

Utilities along the alignment primarily consist of overhead power and telephone lines.

4.2 Geologic and Subsurface Conditions

4.2.1 General Geology

The project alignment generally runs along the slopes of the valley that carries the Rio Cebolla. The lower portion of these slopes consists of colluvium and related hillslope deposits derived from Bandelier tuff. Further up the slope, deposits of the Otowi

Member of the Banderlier tuff are encountered. Still further up the slope, deposits of the Tshirege Member of the Bandelier tuff are encountered. As previously mentioned, a mapped ancient landslide is present on the southeast slope of the valley just before the proposed bridge crossing in the Fenton Lake Wetlands area. Alluvial deposits are present along the valley floor. These alluvial deposits consist mainly of sand, silt and gravel and are the products of the weathering of the Bandelier tuff deposits and of the underlying Permian-aged Abo Formation. The Bandelier Tuff is a series of non-welded to densely welded ash flow and ash fall deposits interspersed with basal surge deposits, all resulting from eruptions of the volcanoes of the Jemez Mountains about 1.2 to 1.4 million years ago. Two major eruptions creating the Bandelier Tuff are represented by the lower Otowi Tuff member and the upper Tshirege Tuff member as previously mentioned. Subsequent rapid erosion and re-deposition of volcanic rock units have produced the mesa and canyon topography present today.

Both the alluvial deposits and the Bandelier Tuff overlie the Permian-aged Abo formation consisting of stratified silty sandstone, sandy siltstone and mudstone with some minor layers of limestone.

4.2.2 Engineering Geology Assessment at Bridge Location

Proceeding from the lower units to the upper units, the geology at the proposed bridge location can be described as follows.

The **Abo Formation** underlies the entire area and is not presently exposed at the ground surface. This formation consists of beds of sandstone, mudstone, claystone and some thin limestones. The mudstones and claystones are expected to weather relatively rapidly to constituents (clay, silt, and sand) upon exposure to air or erosional forces. Very high Standard Penetration Test (SPT) results appear to correspond with the unweathered horizon of this unit. Some of the Abo Formation in the general vicinity of the proposed bridge has weathered and been transported and may be present in the valley floor alluvium as cobbles or boulders. An erosional surface (unconformity) was developed on the Abo Formation before deposition of the Bandelier Tuff. The Abo Formation is suitable for the end bearing of piles.

The **Otowi member of the Bandelier Tuff** is a white/pink/gray ash fall tuff that is poorly welded and soft, producing high SPT resistance due to the angularity of the ash particles. This tuff weathers into a loose to medium dense sand or silty sand (SW, SP, SP-SM, or SM). The Otowi member has been exposed on the river valley sides and has been redeposited as alluvial sediment. The Otowi member of the Bandelier Tuff is suitable for end bearing of piles.

The **Tshirege member of the Bandelier Tuff** is variably welded ash fall tuff that occurs on the uplands and caps the high ground on either side of the valley. More densely welded portions of this tuff weather to boulders and less densely welded portions weather to sandy soils that have been redeposited as alluvium on the valley floor. Some of the Tshirege tuff has moved downslope by mass wasting (landslides) onto the valley lower slopes and floor and may be present in the valley floor alluvium as cobble and boulder size particles.

The **Alluvium** in the valley floor consists of primarily sandy soils and is derived from the upstream erosion of the Bandelier Tuff and the Abo Formations. Alluvium derived from the Abo is red to brown and has higher plasticity. Alluvium from the Bandelier Tuff is gray and sandy with little or no plasticity. SPT blow counts in the alluvium are generally below 30 but there are occasional zones with higher blow counts that may be indicative of cobbles or boulders of the Bandelier Tuff or Abo Formation mudstones or sandstones. Very low SPT blow counts between 0 and 3 were often obtained in the silty sand and sandy silt indicating moderate to high compressibility.

4.2.3 Subsurface Conditions at Bridge Location

Based upon evaluation of the local geology, geologic unit classifications have been included on the boring logs for Borings BR-10, BR-11, BR-12, BR-14 and BR-16. These updated logs are included in Appendix A.

A subsurface profile based upon the geology and the boring logs is also presented as Figure 1 in Appendix A. Five strata have been identified in the profile. Two of these strata are alluvial deposits and the other three are bedrock formations consisting of either the Bandelier Tuff or the Abo Formation.

The following is an engineering description of each of the strata identified in the bridge borings.

STRATUM I - Very loose to medium dense alluvial sandy silts, sands and silty sands with occasional large volcanic tuff fragments (cobbles or boulders) derived from Bandelier Tuff.

STRATUM II - Stiff to hard high plasticity silt of alluvial origin derived from the Abo Formation with occasional large fragments of sandstone, mudstone or claystone (cobbles or boulders)

STRATUM III - Weathered volcanic tuff of the Otowi member of the Bandelier Formation.

STRATUM IV - Unweathered volcanic tuff of the Otowi member of the Bandelier Formation.

STRATUM V - Silty sandstone and mudstone of the Abo Formation

Stratum I (Alluvium) was encountered at the ground surface in all the borings and varied in thickness from 9.1 m to 14.5 m. At various depths and in some of the borings, slightly higher blow counts (above 30 blows per foot using the Modified California Sampler) were encountered during drilling and may be indicative of the possible presence of cobble or boulder size fragments of the Bandelier Tuff Formation (most likely the Tshirege member).

Stratum II (Alluvium) was encountered in two of the five borings (BR-14 and BR-16) underlying the previously described Stratum I alluvium and overlying the Abo Formation. The thickness of Stratum II ranged from approximately 4.9 m in BR-14 to about 3.9 m in BR-16. Relatively high blow counts (60 blows per foot) were encountered in the upper portion of this stratum in BR-14 indicative of the possible presence of cobble or boulder size fragments of the Abo Formation.

Stratum III (weathered tuff, Otowi member of the Bandelier Formation) was encountered in BR-10 and BR-12 underlying the previously described alluvial deposits in Stratum I. The thickness of this weathered tuff layer was approximately 1.3 m in each of these two borings. Relatively high SPT blow counts were recorded in this material, indicative of a moderately high strength.

Stratum IV (unweathered tuff, Otowi member of the Bandelier Formation) was found to underlie the weathered tuff in BR-10 and to extend to the termination depth of 12.3 m in this boring. Very high SPT blow counts measured in this tuff are indicative of a relatively high strength.

Stratum V (Abo Formation) was found to underlay the Stratum I alluvium in BR-11, the Stratum III weathered tuff in BR-12 and the Stratum II alluvium in BR-14 and BR-16. Blow counts measured in this formation are indicative of very high strength.

Groundwater was encountered at or near the ground surface in all of the borings performed for the bridge. Groundwater was encountered at depths of 0.9 m and 1.2 m in Borings BR-10 and BR-16, respectively. Groundwater was ponded at the surface in the location of BR-11, BR-12 and BR-14.

Fluctuations in the groundwater level may vary depending on seasonal rainfall, irrigation, water flow in the Rio Cebolla and/or runoff conditions that may not have been apparent at the time of our field investigation.

4.2.4 Subsurface Conditions Along Remaining Alignment

In general, the borings encountered soils that can be described in engineering terms as fill materials and natural soils composed of silty sands, sandy silts, silts, silty gravels, and gravels. As previously mentioned, the valley slopes are composed of colluvium and related hillslope deposits derived from Bandelier tuff. Geologic references indicate that these colluvial and hillslope deposits can vary in thickness from 5m to 50 m. Three of the borings (MSE-04, MSE-06, and MSE-07) encountered materials appearing to be Bandelier tuff or large boulders composed of Bandelier tuff at depths ranging from 4.3 m to 8.8 m below ground surface and underlying the previously described colluvium and related hill slope deposits.

4.3 Water

The following sections discuss the surface water observed, the groundwater encountered, erosion, and potential scour.

4.3.1 Surface Water

Surface water runoff from the surrounding slopes is collected by a series of small streams, and drainage pathways. These streams and drainage pathways carry the surface water to the Rio Cebolla or Fenton Lake. As discussed, several culverts are proposed to carry the surface water under the proposed roadway and into existing drainage paths.

4.3.2 Scour

Scour is estimated to be insignificant due to the observed flow of the Fenton Lake wetland areas. The stream that flows through the wetlands was observed to be relatively shallow with laminar flow. The upstream dam will help to control the quantity and velocity of the stream in this area.

With the removal of vegetation during construction, scour can increase during rainfall events and increased flow events. Care should be taken to reduce the removal of soils due to scour and the redeposition of these soils downstream.

4.3.3 Erosion

In our visual observations of the drainage crossings and the majority of the slopes along the roadway alignment, we did not observe indications of significant erosion. However, some erosional features were observed. The Bandelier Tuff and alluvial deposits can have rilling and gullying with a magnitude of as much as 0.6 m (2 ft.) to 0.9 m (3 ft.).

During construction and immediately after construction prior to vegetation taking root, the fresh cut and fill slopes have an increased erosion potential. Care should be taken to reduce the infiltration of the eroded material into drainage pathways and streams. This can be done by covering exposed slopes with erosion control materials such as straw, commercially available erosion control material, and/or mulching. In addition, significant erosion should be repaired prior to completing and vegetating the slope.

4.3.4 Groundwater

We encountered groundwater in 16 borings during our field investigation. Several of the borings were dry or not deep enough to penetrate the groundwater. At the bridge alignment, we encountered groundwater in all the boring locations during our field investigation. Table 8 shows groundwater data recorded during drilling operations.

Fluctuations of the ground water level may vary depending on seasonal rainfall, irrigation, water flow in Rio Cebolla, and/or runoff conditions that may not have been apparent at the time of our field investigation.

Table 8 – Groundwater Measurements

Boring Number	Stationing and Offset	Exploration Depth, m (ft)	Groundwater Depth, m (ft)	Date Measured
B-01	1+040, 6 m L	1.8 (6)	1.1 (3.5)	10/21/03
B-02	1+300, 4 m L	1.8 (6)	none	10/21/03
B-03	1+450, 8 m L	1.8 (6)	0.9 (3)	10/21/03
B-04	1+830, 4 m R	1.8 (6)	0.9 (3)	10/21/03
B-05	2+030, 5 m L	1.8 (6)	none	10/21/03
BR-01	2+240, 10 m L	14.8 (48.7)	1.2 (4)	11/13/03
BR-02	2+200, 100 m L	18.4 (60.3)	1.2 (4)	10/21/03
BR-03	2+350, 100 m L	18.4 (60.3)	1.5 (5)	10/22/03
BR-04	2+410, no offset	18 (59.2)	2.7 (9)	11/12/03
BR-10	2+249, 2.1 m L	12.1 (40)	0.9 (3)	9/17/04
BR-11	2+270, no offset	12.1 (40)	-0.3 (-1)	9/18/04
BR-12	2+297, 0.9 m L	24 (79)	-0.3 (-1)	9/18/04
BR-14	2+350, 1.5 m L	21 (69)	-0.3 (-1)	9/19/04
BR-16	2+405, 0.3 m R	22.8 (75)	1.2 (4)	9/17/04
B-06	2+500, 3.5 m R	8.1 (26.5)	none	10/22/03
MSE-01	2+740, 2 m R	11.1 (36.5)	10.8 (35.5)	10/22/03
B-07	3+440, 5 m R	5 (16.5)	none	10/23/03
B-08	3+900, 10 m L	5.9 (19.5)	none	10/23/03
MSE-02	4+220, 20 m R	4.7 (15.5)	none	11/11/03
B-09	4+560, no offset	4.7 (15.5)	none	11/11/03
MSE-03	4+860, 10 m R	4.7 (15.5)	none	11/11/03
MSE-04	4+900, 6 m R	7.8 (25.5)	none	11/11/03
B-10	5+240, no offset	1.8 (6)	none	11/12/03
B-11	5+840, 2 m L	4.4 (14.5)	none	10/23/03
MSE-05	6+130, no offset	11.1 (36.5)	7.3 (24)	10/23/03
B-12	6+720, 2 m R	1.8 (6)	none	10/23/03
MSE-06	7+100, 10 m R	9.3 (30.5)	0.9 (3)	11/12/03
MSE-07	7+180, 4 m R	7.4 (24.3)	1.5 (5)	11/12/03
B-13	7+400, 4 m R	1.8 (6)	none	10/23/03

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 General Discussion

Based upon the data collected during this investigation and engineering analysis, it is our opinion that the site may be developed as discussed in this report. These opinions conclusions, and recommendations are based on our field and office studies, the properties of the soils and rock encountered in our borings, cone penetrometer tests and seismic studies, the results of the laboratory testing program, and our understanding of the proposed development of the alignment.

5.2 Fenton Lake and Wetlands Bridge

The proposed bridge across the Fenton Lake Wetlands is to be a multispan concrete structure approximately 163.5m in length and extending between stations 2 + 240.955 and 2 + 404.005. The bridge will have five interior piers. The proposed pile type for the bridge abutments and piers is a 14-inch square prestressed concrete pile. It is our understanding that concrete piles were selected for durability in the harsh weather conditions of the Fenton Lake area.

5.2.1 Load and Resistance Factor Design (LRFD)

The bridge is being designed using LRFD. Table 9 presents the service loads and factored loads for each of the abutment and pier locations provided by Mr. Takahiko Kimura of Parsons Brinckerhoff. Based on the LRFD approach, these factored loads are compared to factored resistances and the former must be less than or equal to the latter. Factored resistances are determined from estimated ultimate pile capacities and resistance factors (reduction factors) that are based upon the method of analysis, type of pile design (e.g., friction, end-bearing), soil type, method of determining the soil properties, and type of monitoring/testing to be performed during pile installation.

Table 9 Service and Factored Loads for Fenton Lake Bridge

Location	Service Load per pile KN (kips)	Factored Load per Pile KN (kips)
Abutment 1 and Abutment 2	440 kN (98.9 kips)	590 kN (132.7 kips)
Piers 1 through 5	927 kN (208.4 kips)	1301 kN (292.4 kips)

The proposed piles are being designed as end-bearing piles on bedrock in either Strata III, IV, or V. It is our understanding that these piles will be installed using stress wave measurements with a Pile Driving Analyzer (PDA). Hence, in accordance with the AASHTO "LRFD Bridge Design Specifications 2nd Edition, with 2003 Interim Specifications (LRFD)", the resistance factor should be 0.45 for these piles.

Accordingly, based on the factored loads in Table 9, the minimum ultimate pile capacities (target resistances) for these piles to be used in static pile capacity analyses are summarized in Table 10.

Table 10 Minimum Ultimate Pile Capacity (Target Resistance) for Pile Design

Location	Minimum Ultimate Pile Capacity (Target Resistance) per Pile kN(kips)
Abutment 1 and 2	1311 kN (294 kips)
Piers 1 through 5	2891 kN (650 kips)

If the PDA is not used during installation, the resistance factor used to determine the minimum ultimate pile capacities will need to be modified.

5.2.2 Static Pile Capacity

The program DRIVEN 1.2 developed by the Federal Highway Administration was used to estimate the static pile capacities at each abutment and bridge location. Table 11 summarizes the geotechnical properties that were used in the DRIVEN analysis. Soil and rock properties were developed from the results of the field exploration and laboratory testing programs previously conducted. In particular, the friction angles used in the analysis for the Strata I and II alluvium were developed from the correlation to blow counts in DRIVEN 1.2 and from the results of four direct shear tests conducted on the materials. In the case of the bedrock (Bandelier Tuff and Abo Formation), no core samples were taken, so the unconfined compressive strengths of the rock used in the analysis were taken from experience with similar rock types in the general vicinity of the project and were selected as the lowest measured or estimated values. The depth and thickness of each strata were taken from the corresponding boring logs. In the case of Pier 3 and Pier 5, the depth and thickness of each strata were interpolated from the subsurface profile presented in Figure C.38.

Based on the DRIVEN analysis, the minimum ultimate pile capacities were achieved at the top of the identified end bearing stratum (Strata III, IV or V) for every location with the exception of Abutment 2. At this location, due to the lower minimum ultimate capacity require for an abutment in this design and the deeper Abo Formation, the minimum ultimate capacity is estimated to be achieved at a depth of approximately 16.8 m (or 4.5 m above the Abo Formation). However, piles at Abutment 2 should be driven to the top of the Abo Formation to reduce the potential for settlement.

Table 11 Summary of Geotechnical Properties Used for DRIVEN Analyses

Stratum	Total Unit Weight kN/m^3 (lbs/ft^3)	STRENGTH Unconfined Compressive Strength kPa (lbs/ft^2) or Friction Angle
I	18.8 kN/m^3 (119.6 lbs/ft^3)	$\Phi = 32°$
II	18.8 kN/m^3 (119.6 lbs/ft^3)	$\Phi = 32°$
III	18.8 kN/m^3 (119.6 lbs/ft^3)	UCS = 1,440 kPa (30,000 lbs/ft^2)
IV	18.8 kN/m^3 (119.6 lbs/ft^3)	UCS = 2,400 kPa (50,000 lbs/ft^2)
V	18.8 kN/m^3 (119.6 lbs/ft^3)	UCS = 4,800kPa (100,000 lbs/ft^2)

Based upon the DRIVEN analysis, the recommended pile design is to drive the 14-inch concrete piles to refusal on the top of either Stratum III, IV or V. Refusal is defined as greater than 10 blows per 25 mm (10 blows per inch). For end-bearing piles driven to refusal on bedrock, the pile capacity is generally limited by the structural capacity of the pile section. Table 12 presents the recommended minimum pile tip elevations corresponding to the top of the proposed rock end-bearing strata. Due to the highly irregular nature of the bedrock surface, the recommended minimum pile tip elevations presented in Table 4 should be verified by drilling and sounding at each pier location (especially in the locations of Pier 3 and Pier 5) prior to installation.

Table 12 Recommended Minimum Pile Tip Elevations to Exceed Target Resistances in Table 2

Location	Recommended Minimum Pile Tip Elevation meters (feet)	Notes
Abutment 1	2,327.9 m (7,637.3 ft)	
Pier 1	2,327.4 m (7,635.7 ft)	

Pier 2	2,322.0 m (7,618.2 ft)	
Pier 3	2,319.3 m (7,609.3 ft)	Interpolated between Pier 2 and Pier 4 borings. Must be verified by drilling prior to installation
Pier 4	2,318.6 m (7,607.0 ft)	
Pier 5	2,317.3 m (7,602.7ft)	Interpolated between Pier 4 and Abutment 2 borings. Must be verified by drilling prior to installation
Abutment 2	2,316.7 m (7600.6 ft)	Required capacity reached above rock stratum in alluvium, but minimum tip elevation corresponds to the top of rock in order to minimize the potential for differential movements.

As stated in Section 10.7.1.13 of the LRFD manual, we recommend that a test pile be driven at the location of each abutment/pier to: 1) determine pile installation characteristics; 2) evaluate the pile capacity with depth; and, 3) establish driving criteria for the remainder of the piles.

5.2.3 Evaluation Of Pile Driveability

A GRLWEAP analysis was performed to determine the driveability of the recommended pile tip elevations without damage. At each abutment and pier location, the static capacities from the DRIVEN analyses were used along with the following parameters:

1) A 355 mm (14 in.) square prestressed concrete pile driven just beyond the recommended minimum tip elevations presented in Table 4;
2) A minimum concrete compressive strength of 28 MPa (4,000 psi), a minimum prestress level of 5 MPa (725 psi), an allowable compressive driving stress of 18.8 MPa (2,727 psi), and an allowable tensile stress of 6.3 MPa (914 psi);
3) Blow counts ranging between 3 to 10 blows per 25 mm (3 to 10 blows per inch);
4) A Del-Mag 22-23 hammer with an ultimate hammer energy/power of 69.5 kJ/kW at 4.1 m stroke;
5) A stroke of 1.5 m;
6) A hammer efficiency of 72 percent;

7) A hammer cushion and pile cushion consisting of 25 mm (1 inch) of aluminum and 25 mm (1 inch) of Conbest, for a total thickness of 50 mm (2 inches) with an area of 1,829 cm^2 (xx in^2); and

8) A pile cap weight of 10.7 kN (2.4 kips).

Based on the above parameters, the piles can be driven to capacity without damage. Prior to driving the test piles, the contractor should perform a WEAP analysis for the proposed driving setup. The WEAP analysis and pile driving operations should be in accordance with Section 551 – Driven Piles of FP-03. We recommend that a pile driving analysis be conducted during installation of the piles to verify these preliminary analyses and protect the integrity of the piles. The contractor should not exceed the allowable driving stresses during installation. There can be variations in the subsurface conditions from those encountered during the field exploration (especially in the locations of Pier 3 and Pier 5 where the subsurface conditions have been estimated). Accordingly, it is recommended that a test pile be driven at each abutment and pier location.

Provided that the piles are driven to refusal on Strata III, IV or V, and the embankments for each abutment are constructed prior to pile installation, downdrag or group reduction factors are not required. Settlement of the piles bearing on bedrock should be negligible. We do recommend that the center-to-center spacing of the piles should be at least 2.5 pile diameters. Pile driving can cause the densification of loose sand around the pile being driven. Consideration should be given to the sequence of pile installation. We recommend that the piles in a given bent be installed starting at one end of the pile group and progressing to the other end.

Driving shoes should be placed on the pile tips to reduce the risk of installation damage while driving the pile into the bedrock and to assist in driving past any Bandelier Tuff or Abo Formation boulders that may be present in the overburden alluvial soils. Based on the conditions observed during our field exploration, we do not feel that pre-drilling or pre-blasting will be necessary.

5.2.4 Evaluation Of Lateral Load Behavior

The lateral deflection of individual piles at each abutment and pier location was estimated using LPILE plus 4.0 developed by Lyman Reese of the University of Texas at Austin. Table 5 summarizes the input parameters that were used in the LPILE analysis. Maximum lateral loads for abutment and pier locations along the longitudinal axis of the bridge were provided by Mr. Takahiko Kimura of Parsons Brinckerhoff, and are as follows: 40 kN (9 kips) per pile for Abutments 1 and 2; and, 62.3 kN (14 kips) per pile for Piers 1 through 5. No lateral loading was assumed to occur at the abutments from lateral spreading of the foundation soils under the approach embankments.

Based upon the soil properties summarized in Table 13 and the given lateral loads, the estimated lateral deflection at Abutments 1 and 2 is on the order of 0.5 inches. The estimated lateral deflection at Piers 1 through 5 is on the order of 1.25 inches.

Table 13 – Summary of Lateral Load (LPILE) Parameters for Driven Piles

Stratum	Soil Parameters			
	Model Type	K MN/m^3 (pci)	e_{50} mm/mm and in/in	γ kN/m^3 (pcf)
I, II Alluvium	Loose Sand below water table	6.8 (25)		9.0 (57.3)

Rock Parameters					
Stratum	Model Type	Unconfined Compressive Strength kPa (psi)	$E_{rock\ mass}$ MPa (ksi)	k_{rm} mm/mm and in/in	γ kN/m^3 (pcf)
III Weathered Tuff	Weak Rock	1,440 (208)	278 (40)	0.0005	19.6 (125)
IV Unweathered Tuff	Weak Rock	2,400 (347)	1,114 (162)	0.0005	19.6 (125)
V Abo Formation	Weak rock	4,800 (694)	2,287 (332)	0.0005	19.6 (125)

5.3 Temporary Work Platform

A temporary work platform is to be constructed in the Fenton Lake wetlands area to provide a surface for the installation of the driven piling. One possible design for this platform would involve the use of geogrids. The following presents a conceptual design for such a geogrid platform. Kleinfelder recommends that the contractor perform a value engineering study prior to selection of the working platform design.

The following assumptions have been made: 1) the maximum load on any outrigger is 231 kips; 2) the outriggers will be sitting on an outrigger mat that is 7 ft square (thus giving a bearing stress of 4,715 lbs/ft2); 3) the backfill for the crane pad will consist of the colluvial deposits of Bandelier tuff that will be excavated from the proposed cuts in the roadway; 4) the backfill will have an internal friction angle of 35o with no cohesion and a unit weight of 120 lbs/ft3; 5) the outside edge of the outrigger mats will be at least 5 ft from the edge of the platform slope; 6) the crane pad is 5 ft high with a width of 35 ft and 1V to 2H side slopes. In addition, the foundation soils (sandy silts in the wetland area) are assumed to have an internal friction angle of 35o with a reduced friction angle of 25o (to account for compressibility of the soils).

Based upon these assumptions, the platform will be able to support the crane loads using six layers of Tensar UX1800HS (uniaxial geogrid) or equivalent spaced a minimum of 4 inches apart and one layer of Tensar BX1100 installed on the subgrade to aid in construction and compaction. The uniaxial geogrid will need to be installed in an alternating fashion between layers so that equal strength is provided in both directions. The uniaxial grid would generally be installed near the bottom of the 5 ft section. Culverts can be installed in the platform by moving the geogrid section up or down in the general vicinity of the culvert as necessary.

5.4 Seismic Hazards Evaluation

Soil liquefaction is a condition where saturated, granular soils undergo a substantial loss of strength and deformation due to pore pressure increase resulting from cyclic stress application induced by earthquakes. In the process, the soil acquires mobility sufficient to permit both horizontal and vertical movements if the soil mass is not confined. Soils most susceptible to liquefaction are saturated, loose, clean, uniformly graded fine-grained sand deposits, although fine-grained silty sands, sandy silt, and gravel deposits can also experience liquefaction. If liquefaction occurs embankments and foundations on or within the liquefiable layer may undergo settlements.

Earthquake sources are identified primarily from published geologic records rather than recorded seismic data. Crustal earthquakes are the most common and are the source of the few moderate earthquakes that have originated in the Jemez Mountain area in recorded history. Although many faults have been mapped in the area, the potential activity of specific faults has generally not been well defined. As a result, there are significant uncertainties associated with evaluating many of the key parameters required to assess earthquake hazards.

The potential for seismically induced liquefaction to develop within a profile defined by the corrected blow counts (N') collected in exploratory boring locations was evaluated using the procedures outlined by the National Center for Earthquake Engineering Research 1997 (NCEER), which is based on the procedure originally proposed by Seed and Idriss in 1971. The procedure uses corrected blow counts (N') to estimate the cyclic resistance ratio (CRR) profile with depth (ratio of the cyclic shear stress required to cause liquefaction to the initial vertical stress). Correction for fine content and overburden pressures were applied to the blow counts. The cyclic stress ratio (CSR) with depth (ratio of cyclic shear stress to initial effective stress) resulting from the design level earthquake is estimated from the total and effective stresses, the peak ground surface acceleration value, the magnitude of the design level earthquake, and a depth dependent stress reduction factor. Liquefaction is likely at depths where the CSR exceeds the CRR (i.e., the cyclic shear stress induced by the earthquake exceeds the cyclic shear stress level required for liquefaction of the soil).

Based on AASHTO's Standard Specifications for Highway Bridges, 17th Edition, an acceleration coefficient of 0.07 was obtained from the Division 1A map for the project location. This coefficient was used in the analysis for liquefaction, the mechanically stabilized earth walls, the cut slopes, and the fill embankments. In addition, a Crustal earthquake magnitude of 6.0M was used in the liquefaction analysis. The liquefaction analysis assumed a minimum groundwater depth at or near the existing ground surface.

Based on the liquefaction analyses, the potential liquefiable zone (the loose soils from the ground surface to 12 to 17 m (39.4 to 55.8 ft.) below existing grade) are not expected to liquefy for the given parameters. We conclude that there are no significant earthquake induced landslides or lateral spreading hazards for the site.

5.5 Culverts

Several culverts are proposed to facilitate drainage across the roadway. The exact elevation of the base of the culverts was not known at the time this report was written.

We assume the base of the culvert will be situated within loose, silty sand or soft, sandy silt. The culverts may be designed based on an allowable bearing pressure of 90.9 kPa (1,900 psf) within the soft/loose layers.

The culvert areas should be stripped of vegetation, roots, old construction debris, and other organic material. It is estimated that the depth of stripping will be on the order of 150 to 200 mm (6 to 8 inches). The actual stripping depth should be based on field observations with particular attention given to old drainage areas, uneven topography, and excessively wet soils. The stripped areas should be observed to determine if additional excavation is required to remove weak or otherwise objectionable materials. The soils should be scarified and recompacted according to the recommendations presented in Section 5.9.

The culvert pads should be firm and able to support the construction equipment without displacement. Soft or yielding materials should be corrected and made stable before construction proceeds. The culvert pads should be proof rolled to detect soft spots, which if exist, should be reworked. Proof rolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or similar piece of equipment weighing approximately 25 tons. Proof rolling is intended to achieve additional compaction and to locate unstable areas. The proof rolling operations should be observed by a geotechnical engineer or his representative.

5.6 Mechanically Stabilized Earth Retaining Walls

Mechanically stabilized earth walls (MSE walls) consist of alternating layers of backfill soil and reinforcing material with facing elements. Commonly used reinforcing elements include welded wire mesh, metal straps, and geogrids. The maximum vertical spacing of the reinforcing elements is typically 600 mm (2 ft.). Reduced vertical spacing may be needed depending on the strength of the reinforcing material selected and other parameters. If geogrids are selected, long-term creep characteristics, durability characteristics, and installation damage should be taken into consideration in product selection and in determining long-term design strength characteristics. Pre-cast concrete members (panels or block) and welded wire mesh are widely used as facing elements.

NO APPEND. G
(CALCS)

Many MSE wall systems are available as proprietary wall systems. These systems are typically constructed on a "design-build" (DB) basis using the manufacture's design calculations. The DB contractor should determine the final design of the MSE walls based on the parameters given within this report. MSE walls should be designed and constructed in accordance with SCR – 255, as provided by CFLHD. This specification supercedes the FP-03, Section 255 specifications. The walls should be designed for an acceleration coefficient of 0.07.

5.6.1 Global Stability and Bearing Capacity

As previously summarized in Table 1, five MSE walls are currently proposed along the alignment. For this investigation, Kleinfelder was requested to perform external global stability and bearing capacity calculations for the proposed walls. The computerized program MSEW, developed specifically for the FHWA, was used for the analyses. Sufficiently high values were used for reinforcement strength so that the external stability of the wall could be analyzed. As such, modes of failure shown in the design calculations (Appendix G), including internal slope stability, pullout resistance, sliding stability, and wall connection resistance are not appropriate for this stage of design and should be analyzed once the reinforcement material and wall system is selected.

We based our global (deep-seated) slope stability model on results of subsurface explorations, geologic interpretations, assumed soil shear strengths and groundwater levels. A uniformly distributed dead load of 12 kPa (250 psf) was distributed at the crest of the roadway embankment to simulate construction or vehicular traffic. We generally assumed that the retained soils behind the reinforced zone have a friction angle of 30 degrees. In addition to the static analyses, a seismic force simulated by a horizontal force equivalent to an earthquake acceleration of 0.07 g times the mass of the potential sliding soils was used for our slope stability analysis.

Several of the planned MSE wall locations are situated at the mid-slope of existing marginally stable slopes. Our iterative bearing capacity and slope stability analyses indicated that the length of the reinforced soil zone often had to be lengthened beyond the standard minimums and/or the slope geometry and height of the wall had to change to maintain acceptable factors of safety. A summary of our results is presented in Table 14 and Table 15. Discussions for each MSE wall are presented in the following subsection.

Table 14 – Summary of MSE Global Slope Stability and Bearing Capacity Evaluation

MSE Wall Station		Critical Section Analyzed	Original Wall Height, m (ft)	Downslope Inclination Below Toe of MSE Wall V:H	Parameters Required to Maintain Bearing Capacity Factor of Safety ≥ 2.5 and Global Static Slope Factor of Safety ≥ 1.3			
To	From				Wall Height m (ft)	Horiz. Bench at Toe m (ft)	Length of Reinforced Zone m (ft)	Length of Reinforced Zone Height Ratio m or ft

Table 14 – Summary of MSE Global Slope Stability and Bearing Capacity Evaluation

MSE Wall Station		Critical Section Analyzed	Original Wall Height, m (ft)	Downslope Inclination Below Toe of MSE Wall V:H	Parameters Required to Maintain Bearing Capacity Factor of Safety ≥ 2.5 and Global Static Slope Factor of Safety ≥ 1.3			
To	From				Wall Height m (ft)	Horiz. Bench at Toe m (ft)	Length of Reinforced Zone m (ft)	Length of Reinforced Zone Height Ratio m or ft
2+674	2+780	2+720	4.0 (13.1)	1:2	4.9 (16.1)	3.1 (10)	4.9 (16.1)	1.0 * H
4+200	4+240 and 4+190	4+220	6.3 (20.7)	1:2	7.6 (25)	4.5 (15)	7.6 (25)	1.0 * H
4+800	4+945 and 4+190	4+900	8.0 (26.2)	1:3	8.6 (28.3)	2.0 (6.5)	5.7 (18.7)	0.7 * H
7+070	7+225	7+140	4.5 (14.8)	Flat	5.1 (16.8)	Already Flat	3.2 (10.4)	0.7 *H

Table 15 – Summary of MSE Factors of Safety

MSE Wall Station		Global Slope Factor of Safety		Bearing Capacity Factor of Safety	
To	From	Static	Seismic	Static	Seismic
2+674	2+780	1.6	1.4	2.5	2.1
4+200	4+240 and 4+190	1.5	1.3	2.5	2.1
4+800	4+945	1.3	1.1	2.8	2.0
7+070	7+225	1.9	1.7	3.7	2.4

<u>Sta. 2+674 to Sta. 2+780:</u> Based on the very loose to loose silty sand encountered near the base of the proposed wall in Boring MSE-01, as indicated by a SPT N' value of 3 blows per foot at a depth of 3.3 m (11 feet), the initial local shear bearing capacity analysis with a 1:2 (V:H) downslope below the base of the wall resulted in an inadequate FS. A reinforcement zone about 3 times the height of the wall would be required to achieve a FHWA recommended FS of at least 2.5. In lieu of significantly changing the roadway geometrics, we recommend that the height of the wall be increased from the original plans such that the toe of the wall is buried an extra 0.9 m (3 ft). This will facilitate a placement of a 3 m (10 ft.) wide horizontal bench between the

front of a 4.9 m (16.1 ft) wall and the 1:2 (V:H) downslope. Using this modified wall geometry, the subsequent analyses indicate that acceptable FS values can be achieve with a reinforced zone of at least 1.0 times the height of the wall.

Sta. 4+200 to Sta. 4+240 and 4+190: Very loose to loose silty sand was encountered in the upper meter of boring MSE-02, as indicated by a SPT N' value of 4 blows per foot. A friction angle of 30 degrees and cohesion of 9.6 kPa (200 psf) was modeled for the foundation soil. The initial local shear bearing capacity analysis with a 1:2 (V:H) downslope below the base of the wall resulted in an inadequate FS, requiring a reinforcement zone about 3 times the height of the wall to achieve a FHWA recommended FS of at least 2.5. We recommend that the height of the wall be increased to 7.6 m (25.0 ft) such that the toe of the wall is buried an extra 1.3 m (4.3 ft) from the original plans. This will facilitate a placement of a 4.6 m (15 ft.) horizontal bench between the front of the wall and the 1:2 (V:H) downslope. Using this modified wall geometry, the subsequent analyses indicate that acceptable FS values can be achieve with a reinforced zone of at least 1.0 times the height of the wall.

Sta. 4+800 to Sta. 4+945: Based on the soft silt and medium dense silty sands encountered in borings MSE-03 and MSE-04, a friction angle of 30 degrees and a cohesion of 7.2 kPa (150 psf) was modeled for the foundation soil. Using the planned 8.0 m (26.2 ft) high wall geometry with a 2 m (6.5 ft.) bench below the base of the wall followed by a 1:3 (V:H) downslope, an acceptable bearing capacity and deep-seated slope stability FS values were achieved with a reinforced zone of at least 0.7 times the height of the wall. The wall height was increased to 8.6 m (28.3 ft.) to allow for a minimum embedment of 0.6 m at the toe of the wall.

Sta. 7+070 to Sta. 7+225: Borings MSE-06 and MSE-07 were drilled within Stations 7+070 and 7+225 for the MSE wall planned for the right side of the alignment. A rock buttress will be used along the cut slopes along the left side of the alignment. This rock buttress and cut slope are discussed in Section 5.6.1. Medium dense silty sands were encountered in borings MSE-06 and MSE-07, which were completed at the toe of the slope near Sta. 7+100 and Sta. 7+180, respectively. A friction angle of 34 degrees and cohesion of 2.4 kPa (50 psf) was modeled for the medium dense silty sand foundation soil. Groundwater was encountered at a depth of about 1 m (3.3 ft) below the proposed toe of the wall, but was modeled at the wall toe to account for seasonal fluctuations. Based on the boring profile, a friction angle of 34 degrees and cohesion of 2.4 kPa (50 psf) was modeled for the foundation soil. Based on the planned 4.5 m (14.8 ft) high wall geometry, an acceptable bearing capacity and deep-seated slope stability FS values were achieved with a reinforced zone of at least 0.7 times the height of the wall. The wall height was increased to 5.1 m (16.8 ft.) to allow for a minimum embedment of 0.6 m at the toe of the wall.

5.6.2 Site Preparation

Surface preparation and subgrade preparation should be conducted in accordance with sections 5.9.1 and 5.9.2 of this report. The MSE walls should be constructed in accordance with the SCR, Section 255.

5.7 Cut and Fill Slope Stability

5.7.1 Cut Slope Stability

As previously mentioned, of the thirteen (13) total borings performed for cut and fill engineering considerations, only six (6) of these borings were performed in cut sections and of these six, only three were actually drilled through soils that will be cut. Accordingly, cut slope stability recommendations presented herein are based upon assumed soil properties for these colluvial deposits and should be considered as approximate. Great care should be taken during construction to monitor the stability of these cut slopes given approximate nature of these stability evaluations. This monitoring should include an assessment of the nature of the materials being excavated and any cracking or other signs of impending slope instability.

Table 4 summarized the 31 proposed cuts that are greater than 3 m in height. Based upon the presence of colluvium and related hillslope deposits, general rules of thumb have been developed for the stability of these cut slopes. In these analyses, a friction angle of 40° with no cohesion has been used for the colluvial deposits and the critical condition for slope stability is considered to be during the spring melt or after a prolonged heavy rainfall event when these slopes may become saturated. Considering these slopes as "infinite" slopes for analysis, the maximum long-term stable slope angle is approximately 26°, corresponding to about 1V to 2H. Hence, it is anticipated that any cut slope through these colluvial deposits that is 1V to 2H or flatter will generally be stable.

Table 16 summarizes the expected performance for cut slopes based upon the "infinite slope" model just described.

Table 16 Expected Cut Slope Performance

Cut Slope	Expected Short-term Performance	Expected Long-Term Performance
1V to 2H	Stable	Limited surficial movement of material
1V to 1.75H	Stable	Some surficial downslope movement of material during spring melt or after heavy rains, some debris expected to accumulate at toe of slope
1V to 1.5H	Stable	Slumping and mass movement creating a hummocky surface during spring melt or after heavy rains, debris expected to accumulate at toe of slope
1V to 1.25H	Marginally Stable	Large deep-seated movements to be expected during spring melt or after heavy rainfall events, debris

		expected to accumulate at toe of slope and encroach on roadway
1V to 1H	Unstable, except for cut heights 5 ft or less where large boulders are present in the slope soils and serve to partially stabilize the slope	Large deep-seated movements continuing until entire slope assumes a stable slope angle, significant amounts of debris expected to accumulate at toe of slope and on roadway

Based upon the information presented in Table 16, Kleinfelder recommends that the cut slopes at 4+840 to 4+890 and the cut slopes at 6+645 to 6+740 that have design slopes of 1V:1.25H be reevaluated to either flatten the slope or to use a retaining wall system it at all possible.

Cut slopes in the ancient landslide area near the south abutment of the proposed bridge are currently being evaluated for the potential to reactivate the landslide. Results of our analyses will be provided under separate cover.

5.7.2 Fill Slope Stability

For the fill slopes, we assumed that the material obtained from the proposed cut sections will be used as fill material within the fill sections. In general, this material will consist of silty sand with gravel. Some layers of predominately silty material were encountered in the borings. This material should be blended with the more granular material prior to use as fill. Specifications for type of fill material and placement is discussed in Section 5.8. We modeled the general fill with strength parameters of friction (□) of 32 degrees and cohesion of 2.4 kPa (50 psf). Table 17 summarizes the results of our fill slope stability analyses.

Table 17 – Summary of Fill Slope Stability Analyses

Station Limits	Height m (ft)	Critical Station	Critical Height m (ft)	Slope Inclination (V:H)	Factor of Safety	
					Static	Seismic
2+409.33L/R to 2+440L/R	0.6 – 4 (1.9 – 13.1)	2+409.33R	4 (13.1)	1:1.5	1.5	1.3
3+940R/L to 4+075R/L	2.6 – 9.1 (8.5 – 29.8)	4+040R	9.1 (29.8)	1:1.5	1.3	1.1
5+900R to 6+166.81R	3.4 – 6.8 (11.1 – 22.3)	6+120R	6.8 (22.3)	1:1.5	1.3	1.1

We anticipate the majority of the soils encountered along the alignment will be reusable as engineered fill after clearing and grubbing is completed to clear and dispose of topsoil, grass, organic material and other unsuitable material. In general, mixtures of sand, gravel, cobbles, rock fragments, and low-plasticity silt or clay are anticipated along the alignment and may be used as engineered fill. We recommend placing and compacting engineered fill in accordance with Section 5.8. Conventional soil fill and rock fill slopes should be constructed according to FP-03, Section 204.

Existing embankment fill slopes or natural slopes steeper than 1:3 (V:H) should be keyed and benched in accordance with FP-03, Section 204.09(d) prior to placing new embankment fill. Keyways should extend into firm, undisturbed soil and/or rock. Soft, loose, or otherwise unsuitable subgrade soils should be over excavated and replaced with compacted engineered fill. Benches should be at least 0.9 m (3 ft.) high and of sufficient width to allow equipment to place engineered fill in near horizontal lifts. This is especially important for narrow "sliver" fills.

Prior to placing compacted fill within keyways, we recommend installing subdrains where significant subsurface seepage is encountered. The actual subdrain requirements (including location, lateral extent, and outlet conditions) will be evaluated by the project geotechnical and civil engineers based on the actual site conditions encountered after scalping and excavating the benches and keyways.

5.7.3 Fill Slope Settlement

We conducted settlement analyses where soft to medium stiff soils were identified in the boring logs and/or where large fills (approximately 3 m (10 ft.) or greater in thickness) were identified on the roadway design drawings. In areas where there were multiple cross sections with fill depths greater than about 3 m (10 ft.), we evaluated the section with the most fill. Settlement analyses were limited to the fill slopes identified as critical sections.

Table 18 presents estimated settlements of the subgrade soils due to the applied stress of the new embankment fill at selected locations. We expect settlement of granular and dry to slightly moist soils to be immediate and to occur during construction. Due to the partial widening of the existing embankment at several locations, the vertical fill thickness is often significantly less than the height of slope from the toe to crest. Three slope cross-sections were also identified as potentially "critical" with regards to consolidation settlement. (The critical sections assessed for potential settlement were not necessarily the same critical sections as previously evaluated for global stability).

Table 18 – Summary of Settlement Analysis

Station Limits	Slope Height m (ft)	Fill Thickness m (ft)	Critical Station	Critical Height m (ft)	Critical Fill Thickness m (ft)	Estimated Settlement mm (in)
2+409.33L/R to 2+440L/R	0.6 – 4 (1.9 – 13.1)	0.5 – 3.9 (1.6 – 12.8)	2+409.33R	4 (13.1)	3.9 (12.8)	73 (2.9)

Table 18 – Summary of Settlement Analysis

Station Limits	Slope Height m (ft)	Fill Thickness m (ft)	Critical Station	Critical Height m (ft)	Critical Fill Thickness m (ft)	Estimated Settlement mm (in)
3+940R/L to 4+075R/L	2.6 – 9.1 (8.5 – 29.8)	1.5 – 8.3 (4.9 – 27.2)	4+040R	9.1 (29.8)	8.3 (27.2)	124 (4.9)
5+900R to 6+166.81R	3.4 – 6.8 (11.1 – 22.3)	2.2 – 4.2 (7.2 – 13.8)	6+120R	6.8 (22.3)	4.2 (13.8)	69 (2.7)

Due to the granular nature of the soils, most of the settlement is expected to occur during construction. Where the settlement is greater than 77 mm (3 inches), the rate of consolidation can take longer than time needed for the construction of the slope. Where more than 77 mm (3 inches) of settlement is expected (Stations 3+940R/L to 4+075R/L), it is estimated that 90 percent settlement will occur in less than 1 month after the completion of the slope. We recommend that these fill sections be constructed early on in the construction sequencing to allow for settlement to take place prior to placing surfacing materials. After placement, of embankment fill to the finished elevation between stations 3+950 to 4+080, wait for a period of 1 month to allow the settlement to take place prior to final grading and placing of surfacing materials.

5.8 Rockery Walls

Table 2 summarized the proposed rockery wall locations. In locations where proposed rockery walls are retaining slopes that are inherently unstable, future movements of the slopes can have an adverse effect on the performance of the rockery walls. In such circumstances, stabilization measures on the slope prior to the use of a rockery wall can enhance the performance of the rockery walls. The colluvial and hillslope deposits previously described are considered to be unstable (under heavy rainfall conditions or during the Spring thaw) with poor vegetation and fewer buried boulders and with slope angles of 26° or greater. The presence of large boulders in the backslope and vegetation on the slope can have a semi-stabilizing effect. However, as previously mentioned, slope conditions were not investigated directly in the subsurface investigation so that at a particular location, the presence of larger boulders cannot be relied upon for a partial stabilizing effect for smaller rockery wall heights.

Accordingly, in situations where the backslope soils become fully saturated to a certain depth, downslope movements should be expected that would exert additional forces on the rockery walls that could compromise the upper portions of these walls. The magnitude of these additional forces will depend upon the depth of saturation and the presence of boulders or significant slope vegetation. Under these circumstances, the higher the rockery wall and the steeper the backslope angle, the greater the potential for a failure of the upper portion of the wall. Design parameters presented in this section are based upon unsaturated soil conditions. In order to provide some guidance with respect to the potential for increased forces due to saturated conditions, the recommendations for rockery wall dimensions are given below with a qualitative assessment of the potential stability of the wall.

Table 19 presents recommended rockery wall geometries that have a factor of safety against overturning of at least 1.5 or greater, against sliding of at least 1.5 or greater and against bearing capacity of at least 1.5 or greater based upon unsaturated conditions. Exceptions to this are noted on the table. The wall face batter for these walls is 1H:6V or approximately 10° from the vertical. A seismic coefficient of 0.07 has been used in this analysis. The backfill friction angle has been assumed to be 40° without cohesion and the backfill unit weight of 115 lbs/ft^3. The unit weight of the rockery walls with voids has been assumed to be 135 lbs/ft^3.

The Base Width (B) and the Top Width (b) presented in the table represent the width of the bottom lift of boulders and the top width of boulders, respectively.

Temporary cut slopes for installing the Rockery walls should follow the guidelines presented in the cut slope recommendation section. In general, the angle of repose for the colluvial soils and related hillslope deposits is assumed to be about 40° (without water and large boulders). The presence of very large boulders in the cut slope at specific locations can have a stabilizing effect that may permit local oversteepening. But, this localized stabilization should not be relied upon. Hence, temporary cut slopes should be designed to be less than 40° from the horizontal. During construction, if heavy rains occur, surficial movements can be expected for slopes 26° or greater. The depths of these surficial movements would depend upon the duration of the rainfall event, the amount of vegetation on the slope above the cut, and the depth to which the soils become saturated below the surface. Hence, care should be taken to plan these cuts during periods of time when no rain is expected.

Table 19 Recommended Rockery Wall Dimensions Based Upon Dry Backslope Conditions

Wall Height, m (ft)	Backslope Angle (degrees)					Comments
	5°	15°	25°	30°	35°	
(5)	B= (1.9 ft), b= (1.1 ft)		B = (1.9 ft) b = (1.4 ft)	B = (2.0 ft) b = (1.5 ft)	B = (2.5 ft) b = (1.7 ft)	
(7.5)	B= (2.9 ft), b= (1.6 ft)		B= (3.0 ft) b= (2.0 ft)	B = (3.3 ft) b = (2.0 ft)	B = (3.7 ft) b = (2.5 ft)	
(10)	B= (3.6 ft) b= (2.0 ft)	B= (3.6 ft) b= (2.4 ft)	B= (3.9 ft) b= (2.6 ft)	B = (4.5 ft) b = (2.7 ft)	B = (5.2 ft) b = (3.5 ft)	
(12.5)	B= (4.5 ft) b= (2.5 ft)	B= (4.6 ft) b= (2.8 ft)	B= (4.8 ft) b= (3.5 ft)	B = (6.2 ft) b = (4.8 ft)	B = (6.5 ft) b = (4.8 ft)	Backslope angle of 35° gives a Factor of Safety against sliding of 1.4
(15)	B= (5.5) b= (3.0)	B= (5.5) b= (3.5)	B= (5.7 ft) b= (4.0 ft)	B = (7.5 ft) b = (5.5 ft)	Not Reccommended	Backslope angle of 30° gives a Factor of Safety of 1.4 against sliding of 1.4. May exceed the practical limits for constructability in terms of placing the bottom lift
(17.5)	B= (6.4) b= (3.5)	B= (6.8) b= (3.7)	B= (7.9 ft) b= (4.8 ft)	Not Recommended	Not Recommended	May exceed the practical limits for constructability in terms of placing the bottom lift

For backslope angles greater than approximately 25°, the presence of large boulders in the soils and the presence of dense vegetation can have a stabilizing effect on the slope. For poorly vegetated slopes without large boulders in the soils, heavy rains or spring thaw conditions can cause surficial movements in the slope that could destabilize the upper portions of the rockery walls, depending upon the depth of saturation.

5.9 Pavement Design

The pavement design calculations were performed using the procedures outlined by the American Association of State Highway and Transportation Officials (AASHTO). The following parameters and the assumed values were used for the design:

- Reliability of 75%
- Overall deviation of 0.49
- Drainage coefficients of 1.0
- Structural coefficients of 0.44 for asphalt and 0.14 for aggregate base course
- Initial serviceability of 4.2
- Terminal serviceability of 2.5
- Design life of 20 years
- Average daily traffic of 389 in 2002 and 811 in 2026
- Traffic breakdown: 98% passenger cars
  1% 3-axle trucks
  0.5% 4-axle trucks
  0.5% 5-axle trucks
- Directional distribution of 60 percent

We calculated a growth rate of 2% based on the average daily traffic counts for 2002 and 2026. Based on the above values, total design Equivalent Single Axle Loads (ESAL's) were computed to be 108,595.

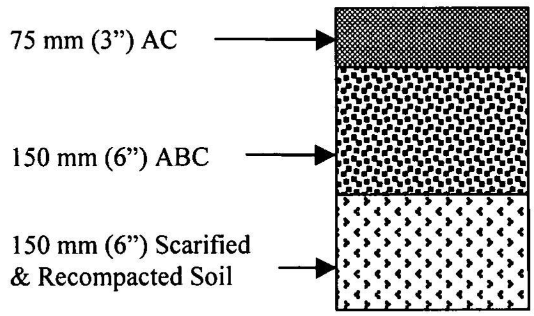
In terms of soil support parameters, eight R-value tests were conducted on bulk samples collected from the top 1.5 m (5 ft.) of borings B-01, B-03, B-05, B-10 through B-13, and MSE-01. These locations where selected to provide representative R-values along the alignment. The results of these laboratory tests are included in Appendix D and summarized in Table 20. Based on these results we selected an R-value of 44 (equivalent to a soil Resilient Modulus of 6.7 kPa (9,820 psi)) to be used in the pavement design. The R-value selected was based on an average R-value, minus ½ the standard deviation.

Table 20 – Summary of R-value Test Results

Boring	Depth	R-Value
B-01	0 to 1.5 m (5 ft.)	51
B-03	0 to 1.5 m (5 ft.)	51
B-05	0 to 1.5 m (5 ft.)	45
B-10	0 to 1.5 m (5 ft.)	67
B-11	0 to 1.5 m (5 ft.)	32

B-12	0 to 1.5 m (5 ft.)	39
B-13	0 to 1.5 m (5 ft.)	56
MSE-01	0 to 1.5 m (5 ft.)	57

On-site pavement can consist of a section consisting of an asphaltic concrete pavement (AC) surface layer over an aggregate base course (ABC). In the following figure, we have provided a suggested flexible pavement section for the given parameters. The following section has a structural number of 2.16.



The above section provides the minimum pavement section of AC over ABC as set forth by CFLHD. The minimum pavement section shown above provides a structural number of 2.16, which is greater than the structural number (1.97) determined based on the selected R-value. Therefore, an additional analysis was completed to determine the minimum R-value needed to support the given traffic using the minimum pavement section. The minimum R-value needed is 37 (equivalent to a resilient modulus of 5.38 kPa (7,740 psi). Therefore, the subgrade soils need to have an R-value of 37 or higher when compacted to at least 95 percent of the maximum dry density as determined by AASHTO T-99, method C. If the subgrade soils encountered during construction do not meet this requirement, at least 610 mm (24 in.) should be removed and replaced with general fill (refer to Section 5.8.3) that has minimum R-value of 37 when compacted to 95 percent of the dry density as determined by AASHTO T-99, method C. Compaction of the subgrade is discussed in more detail in Section 5.7.1.

The following sections provide recommendations for the subgrade, aggregate base course, and asphalt.

Since one pavement section is recommended, a life cycle cost analysis has not been completed. We understand Parsons Brinckerhoff Quade and Douglas, Inc will provide the initial quantities and cost estimate for the pavement section recommended.

5.9.1 Subgrade

The subgrade should be scarified to a minimum depth of 150 mm (6 in.) and recompacted to a density not less than 95 percent of the maximum dry density and within 2 percent of the optimum moisture content as determined by AASHTO T-99, method C. The subgrade should conform to FP_03, Section 204.

The subgrade materials consist of sand, gravel, and silt in varying proportions. Based on the Federal Aviation Administration (FAA) Airport Pavement Design and Evaluation manual, the subgrade soils classify as soil frost group FG-4, with approximately 610 mm (24 inches) of frost penetration. Though the frost group indicates a high potential for frost heave, due to the fines consisting of silt and the relatively dry weather conditions of the area, we do not expect a significant potential for frost heave. However, where groundwater is relatively shallow, there is a potential for significant frost heave. In addition, water infiltration into the subgrade will reduce the R-value. Therefore, where influxes of water, due to shallow groundwater or proposed drainage pathways, are possible the roadway subgrade, base material, and surface course should be graded to provide positive drainage away from the center of the roadway. (Refer to "Table 8 – Groundwater Measurements" for locations with shallow groundwater.)

The subgrade should be firm and able to support the construction equipment without displacement prior to constructing the pavement section. Soft or yielding subgrade should be corrected and made stable before construction proceeds. The subgrade should be proof rolled to detect soft spots, which if exist, should be reworked. Proof rolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or a similar piece of equipment weighing approximately 25 tons. Proof rolling is intended to achieve additional compaction and to locate unstable areas. The proof rolling operations should be observed by a geotechnical engineer or his representative.

There will be shrinkage losses when excavating and compacting the on-site soils and crushed tuff. For design estimates refer to Section 5.8.9.

5.9.2 Aggregate Base

The aggregate base course should consist of material meeting the FP-03, Section 703.05, Type D material specifications. The following gradation requirements should be met as determined by AASHTO T-27 and T-11.

Sieve Size (Square Openings)	Percent Passing by Weight
25 mm (1 in.)	100
19 mm (3/4 in.)	86 – 100 (±6)
9.5 mm (3/8 in.)	51 – 82 (±6)
4.75 mm (No. 4)	36 – 64 (±6)
0.425 mm (No. 40)	12 – 26 (±4)
0.075 mm (No. 200)	4 – 7 (±3)

The aggregate base should not have a liquid limit exceeding 25. The aggregate base course should be compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with AASHTO T-180, method D. Moisture content, at the time of compaction, should be within 2 percent of the optimum moisture content. The aggregate base course should be place and compacted in accordance with FP-03, Section 301.

The onsite soils will not meet the above requirements for aggregate base. The aggregate base will need to be imported from offsite.

5.9.3 Asphalt

We understand CFLHD prefers to use Superpave as the asphaltic concrete section. The Superpave should conform to FP-03, Section 401. Based on New Mexico Department of Transportation's (NMDOT) Pavement Type Selection and Design Policy, the asphalt binder should have a performance grade of 64-22. This value was selected based on the site's relative proximity to Jemez Springs, which has published performance grade values.

The mineral aggregate within the asphalt should conform to FP-03, Section 703.17. The bituminous material and aggregate proposed for use in construction by the contractor should be used in the mix design.

5.10 Earthwork

The following sections address the earthwork necessary for construction.

5.10.1 Surface Preparation

Vegetation, debris, existing structures, asphalt and any other deleterious materials should be removed from throughout the proposed alignment prior to placement of fill or roadway embankment in accordance with FP-03, Sections 201 and 203.

5.10.2 Subgrade Preparation

Subgrade preparation should be completed in accordance with FP-03, Section 204.09. After clearing and stripping operations are complete, exposed subgrade soils in areas to receive structural fill or pavement should be scarified to a minimum depth of 150 mm (6 inches), moisture conditioned to within 2 percent of optimum moisture content, and compacted in accordance with the recommendations presented below under Section 5.8.5, "Compaction Requirements". Moisture conditioning of the subgrade soils, as well as fill soils may consist of the addition of water and/or may include drying of the soils.

The subgrade should be firm and able to support the construction equipment without displacement prior to constructing the pavement section. Soft or yielding subgrade should be corrected and made stable before construction proceeds. The subgrade should be proof rolled to detect soft spots, which if exist, should be reworked. Proof rolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or a similar piece of equipment weighing approximately 25 tons. Proof rolling is intended to achieve additional compaction and to locate unstable areas. The proof rolling operations should be observed by a geotechnical engineer or their representative.

5.10.3 General Fill

The general fill may consist of unclassified borrow as defined by FP-03, Section 704.06. This material should have a soil classification of A-1, A-3, or A-2-4, as determined by AASHTO M-145. We recommend the maximum particle size deviate from the specification and be limited to 75 mm (3 inches). Most of the soils encountered during this investigation will meet the above requirements. However, some layers of A-4 material were encountered. This material can be blended with other onsite materials to produce a material suitable for use as fill. The general fill should be placed in accordance with the recommendations presented in Section 5.10.5, "Compaction Requirements".

5.10.4 Corrosivity of Fill Materials

Samples of the subsurface soils collected during our field investigation at the locations where the soils may be utilized for fill materials were randomly selected and submitted for testing. Hall Environmental Analysis Laboratory was selected to test the selected soil samples for pH, resistivity, chloride, and sulfate contents. The samples were selected from depths ranging from 0 to 5 m (0 to 16.5 ft) below the existing grade. These tests were performed to aid in establishing corrosive potential of the on-site soils for utilizing these soils as fill materials for MSE walls. The results of these tests are summarized in Table 21.

Table 21 – Summary of Geochemical Corrosion Testing

Boring	Depth m (ft)	Chloride (ppm)	Sulfate (ppm)	pH (dim)	Resistivity (Ohm-cm)
B-07	3 - 3.5 (10 – 11.5)	1.3	2.6	8.27	32500
	4.5 - 5 (15 - 16.5)	1.2	1.6	8.31	39100
B-09	1.2 -1.6 (4 – 5.5)	3.1	15	7.06	5840
	4.2 - 4.7 (14 - 15.5)	--	--	7.68	9490
B-10	0 - 0.4 (0 - 1.5)	3	9	5.85	5110
	0.9 - 1.3 (3 - 4.5)	4.7	--	8.16	91300
B-12	0.9 - 1.3 (3 - 4.5)	41	4.8	6.51	6210
B-13	0.9 - 1.3 (3 - 4.5)	9.4	--	6.28	5480

In accordance with section10.7.1.8 of the LRFD manual, the analytical laboratory results indicate that the samples tested are non-corrosive.

5.10.5 Compaction Requirements

We recommend that structural fill be spread in layers not exceeding 300 mm (12 inches) in thickness, moisture conditioned as necessary and compacted. The moisture content of the fill during compaction should be within 2 percent of optimum moisture content. A density of not less than 95 percent of maximum dry density should be obtained for the native soils and structural fill.

The optimum moisture content and maximum dry density for each soil type used should be determined in accordance with AASHTO T-99, method C (FP-03, Section 204.11).

5.10.6 Erosion Control

Native vegetation should be reestablished in all areas disturbed by construction activity. The primary objective of revegetation efforts is the mitigation of site erosion. Mulching and seeding should commence immediately following completion of construction operations.

Cut and fill slopes at 1:2 (V:H) and steeper (except undisturbed tuff) should be stabilized using rock rip-rap, concrete, anchored fabric seeded within native grasses, native shrubs, or other erosion control materials to prevent soil erosion. Slopes flatter than 1:2 (V:H) should be stabilized with native seed mixes that meet the requirements of the CFLHD.

5.10.7 Weather Limitations

Structural fill should not be placed when the atmospheric temperature is below 3 degrees Celsius (35 degrees Fahrenheit). When the temperature falls below 3 degrees Celsius (35 degrees Fahrenheit), all areas of completed work should be protected against detrimental effects of ground freezing and any areas damaged by freezing should be reconditioned and compacted in conformance with the above requirements.

5.10.8 Construction Observation & Testing

A representative of the geotechnical engineer should provide continuous on-site observation and testing during placement of bedding material, backfill, structural fill, asphalt pavement, and aggregate base course to document compliance with the recommendations contained herein. It is recommended that the tests of the material be made at the minimum rates as specified by FP-03.

5.10.9 Shrink/Swell Factors

The Shrink/Swell factors published in FHWA-DF-88-003, Table 6-12 were used to determine % Shrink/Swell. The Shrink/Swell factors were determined for each boring location depending upon the soil/rock conditions encountered at that particular boring. Table 22 summarizes the Shrink/Swell factors for all the boring locations in the project.

Table 22 – Summary of Shrink/Swell Factors

Boring	Station (m)	Soil Type Encountered	% Swell/ Shrink*
B-01	1+040	Silty gravel (v. loose)	-5
B-02	1+300	Silty sand (Med. dense)	-11
B-03	1+450	Sand & silt (loose – med. dense)	-14
B-04	1+830	Silty sand (v. loose – loose)	-11
B-05	2+030	Silty sand (loose – med. Dense)	-11
BR-01	2+240	Sand, silt & sandstone (loose – v. dense)	-8
BR-02	2+200	Sand, silt & siltstone (v. loose – v. dense)	-8
BR-03	2+350	Sand, silt & sandstone (v. loose – v. dense)	-8
BR-04	2+410	Sand, silt, siltstone & sandstone (v. loose – v. dense)	-8
BR-10	2+249	Sand, silt & sandstone (v. loose – v. dense)	-8
BR-11	2+270	Sand, silt, sandstone & mudstone (v. loose – v. dense)	-8
BR-12	2+297	Sand, silt, mudstone & sandstone (v. loose – v. dense)	-8
BR-14	2+350	Sand, silt, clay & mudstone (v. loose – v. dense)	-8
BR-16	2+405	Sand, silt, clay & mudstone (v. loose – v. dense)	-8
B-06	2+500	Silty sand (loose – med. dense)	-11
MSE-01	2+740	Sand, gravel & soil (v. loose – med. dense)	-9
B-07	3+440	Silty sand (loose)	-11
B-08	3+900	Sand & silt (med. dense – dense)	-14
MSE-02	4+220	Sand (v. loose – med. dense)	-11
B-09	4+560	Silty sand (loose – med. Dense)	-15
MSE-03	4+860	Silt & gravel (v. loose – med. dense)	-15
MSE-04	4+900	Silt & sand (v. loose – v. dense)	-10
B-10	5+240	Silty sand (loose – v. dense)	-11
B-11	5+840	Sand & silt (loose - med. dense)	-14
MSE-05	6+130	Sand & gravel (loose – med. dense)	-15
B-12	6+720	Sand & silt (loose - med. dense)	-14
MSE-06	7+100	Sand & silt (loose - dense)	-10
MSE-07	7+180	Sand (med. dense – v. dense)	-5
B-13	7+400	Sandy silt (v. loose – loose)	-11
* A negative number represents shrinkage.			

As shown in Table 22, the majority of the soils encountered on site will experience volume shrinkage when excavated and recompacted as fill. The soils presented above are expected to be encountered along much of the excavated areas along the site. Isolated zone of differing material may be encountered. Though not expected, the shrink/swell values for differing material should be evaluated on a case-by-case basis. For the purpose of estimating earthwork quantities, an average shrink of 10% may be used across the site.

5.11 Site Drainage & Moisture Protection

Post-construction moisture increases in the subsurface soils would create some decrease in the design life of the roadway. Thus, careful site drainage and moisture protection are considered important for the satisfactory performance of the roadway. All utility trenches should be backfilled with compacted, structural fill. Special care should be taken during installation of utility lines to reduce the possibility of leaks.

Care should also be taken to minimize the potential for surface water to collect upslope of MSE wall sections and percolate into the soils. Drainage should be provided to efficiently remove surface water from upslope areas under such circumstances.

5.12 Construction Considerations

Based upon the information collected from the twenty-nine exploratory boring drilled for the project, the soils to be encountered during earthwork operations are only slightly cemented and can be excavated with normal earthmoving equipment. The results of the seismic refraction lines are included in Appendix F. Most of the tuff is anticipated to be excavatable with conventional earthmoving equipment. However, the density, degree of welding, and the general hardness of the tuff may vary requiring heavy ripping and/or blasting in some areas. Refer to the seismic refraction survey (Section 2.2 and Appendix E) for compression wave velocities tested at several locations.

6 CLOSURE

6.1 Limitations

The recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the borings advanced during the field investigation phase. Additional soil borings will need to be performed if the layout of the subject site is substantially modified. It is anticipated that some variations in the soils will exist between the boring locations. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that differ significantly from those described in this report, Kleinfelder should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified. This report was prepared in accordance with generally accepted standards of practice at the time the report was written. No warranty, express or implied, is made. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

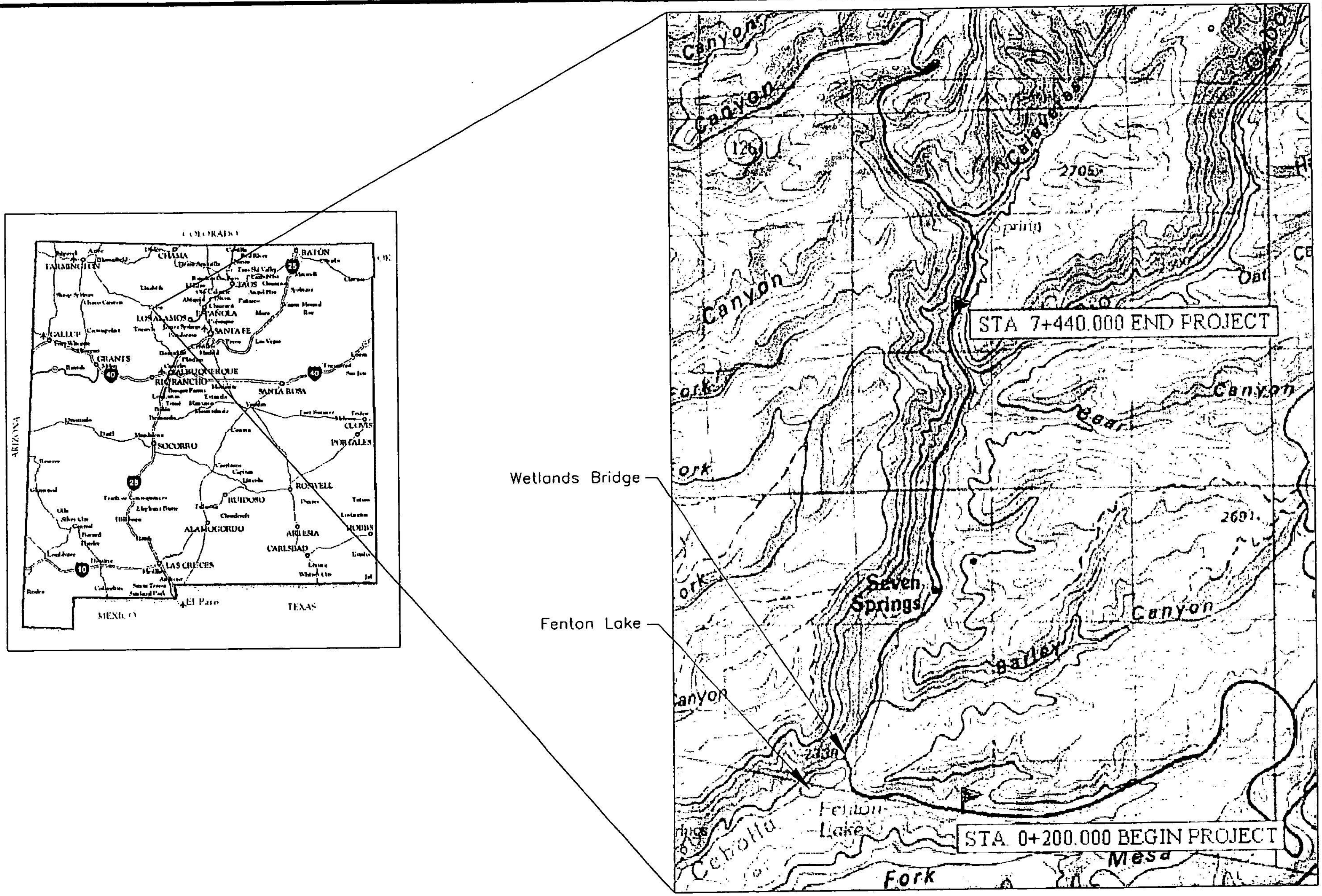
Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference" as that latter term is used relative to contracts or other matters of law.

This report may be used only by the Client and/or his representatives only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

Appendix A

APPENDIX A
Area of Investigation

We drilled 13 exploratory borings (B-01 through B-13) to depths ranging from 1.8 to 8.1 m (6 to 26.5 ft.) within the roadway and cut areas, 7 borings (MSE-01 through MSE-07) to depths ranging from 4.7 to 11.1 m (15.5 to 36.5 ft.) for the MSE retaining walls, 4 borings (BR-01 through BR-04) to depths ranging from 14.8 to 18.4 m (48.7 to 60.3 ft.), and 5 borings (BR-10, BR-11, BR-12, BR-14 and BR-16) to depths ranging from 12.1 to 22.8 m (40 to 75 ft). At the location of the proposed wetland crossing, borings BR-10, BR-11, BR-12, BR-14 and BR-16 were drilled along the proposed new bridge alignment. Borings BR-01 and BR-04 were drilled previously along the proposed old bridge alignment, and borings BR-02 and BR-03 were drilled along the existing earthen embankment west of the proposed alignment. The logs of the test borings and test pits are presented in Appendix B. A Site Vicinity Map showing the approximate project location is included as Figure A.1. A Site Plan showing the boring locations is presented as Figure A.3 through A.14.



KLEINFELDER

Drawn By: C. Landon	Date: November 2004
Project No.: 35321	Filename: Figure A.1.dwg
Scale: not-to-scale	Revision: 0

SITE LOCATION MAP
STA: 0+200.000 - 7+440.000
New Mexico State Highway 126
Cuba-La Cueva, New Mexico

FIGURE
A.1

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THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

KA LEGEND 3/24/05

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

PARTICLE SIZE LIMITS

CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		Fine	Medium	Coarse	Fine	Coarse		

0.002 mm   #200   #40   #10   #4   3/4"   3"   12"

Terminology Used to Describe Soils Relative to their Standard Penetration (N) in blows per foot (ASTM D1586)

Relative Firmness		Relative Consistency		Relative Density	
SILTS, CLAYS & COHESIVE GRANULAR SOILS (partially saturated)	N	SILTS & CLAYS (saturated or near saturated)	N	SANDS AND GRAVELS (uncemented/cohesionless)	N
Hard	50+	Hard	30+	Very Dense	50+
Very Stiff	31-50	Very Stiff	16-30	Dense	31-50
Stiff	16-30	Stiff	9-15	Medium Dense	11-30
Medium Stiff	9-15	Medium Stiff	5-8	Loose	5-10
Soft	5-8	Soft	3-4	Very Loose	0-4
Very Soft	0-4	Very Soft	0-2		

Initial Water Reading   Second Water Reading

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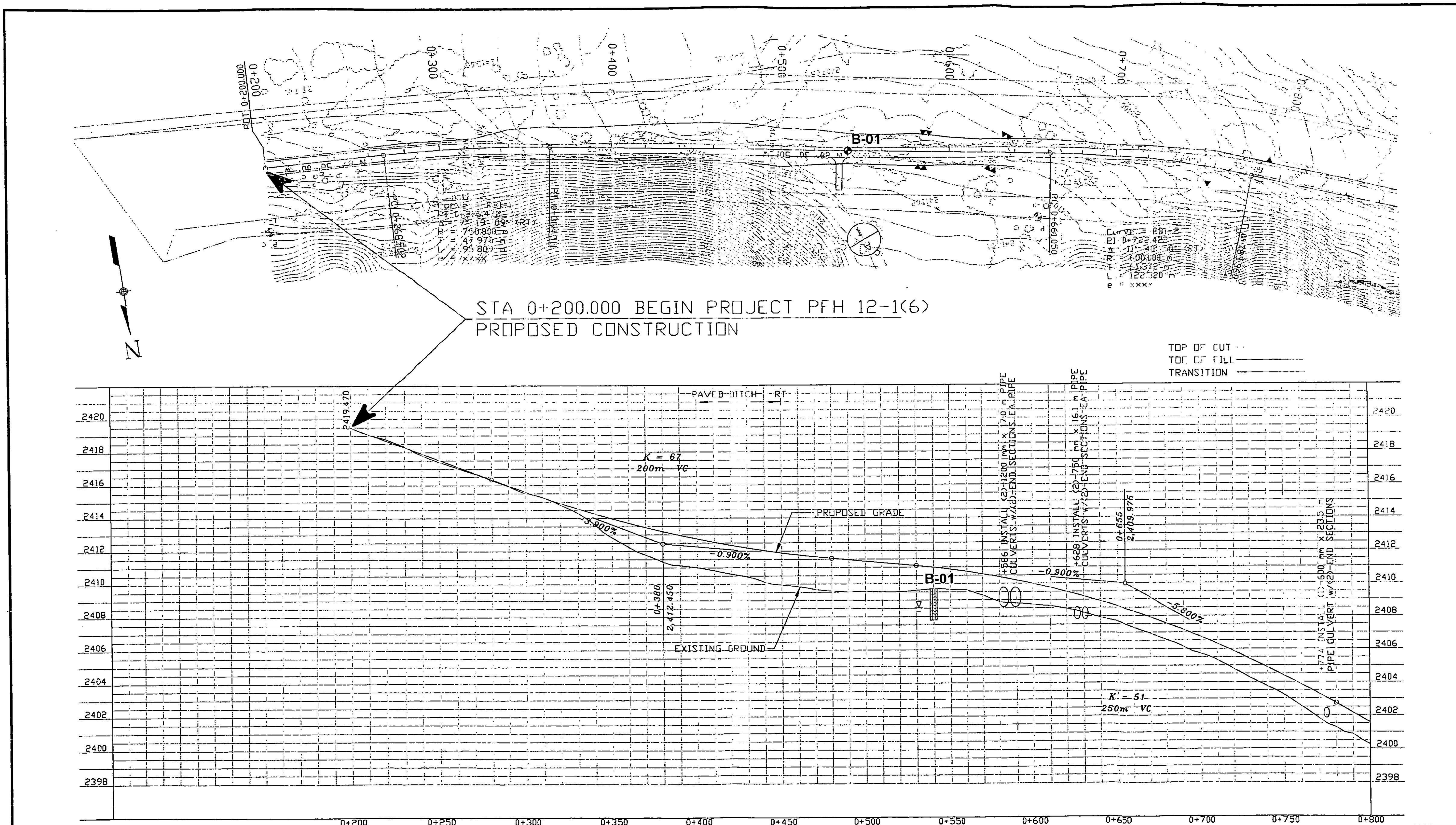
Project: 35321

New Mexico Forest Highway 12
New Mexico State Highway 126
Cuba-LaCueva, New Mexico

Soil Classification Partial Legend

FIGURE **A.2**



Note:
1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-01 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

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Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.3

SITE LOCATION MAP
Boring B-01
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.3

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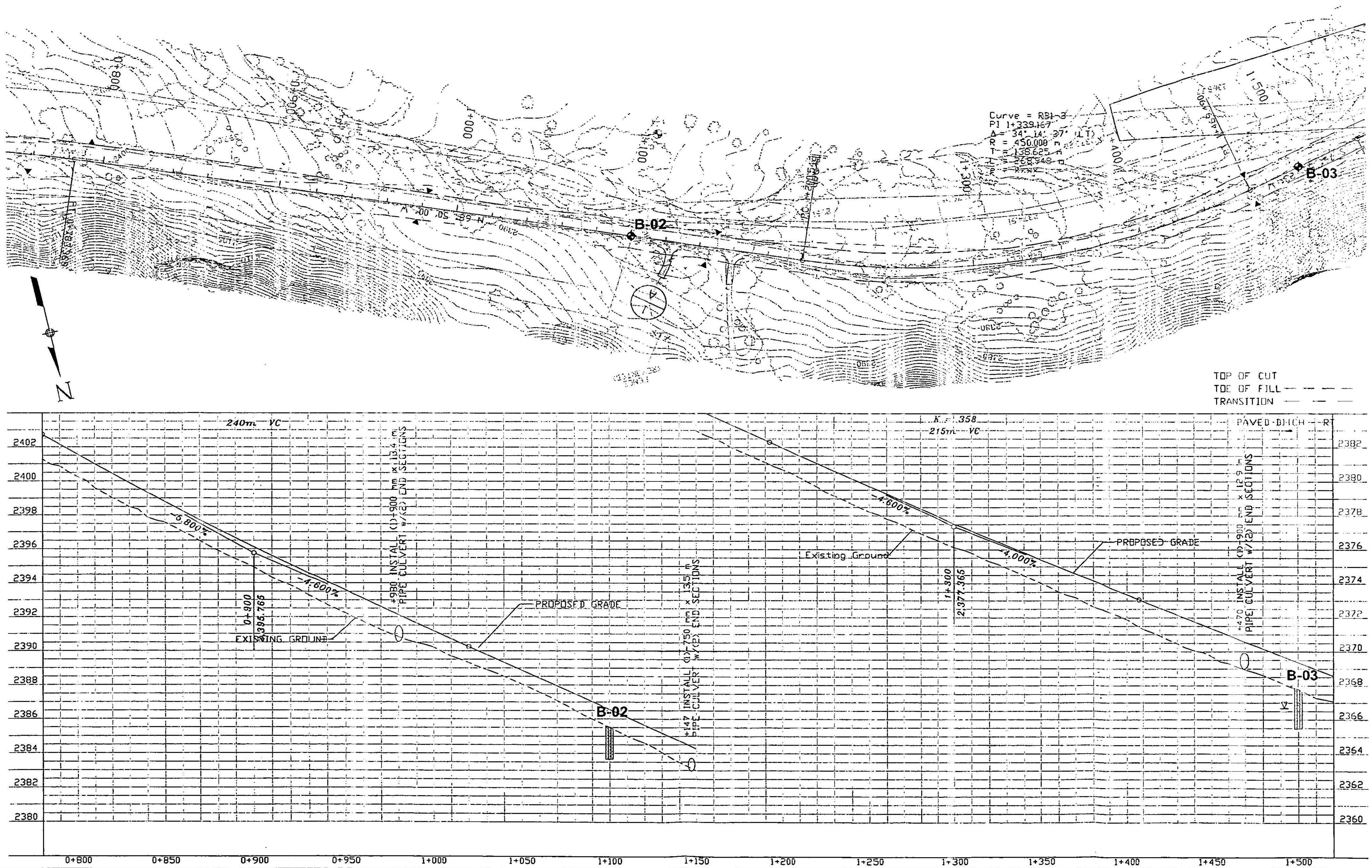

Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Borings B-02 and B-03 were drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure A.4

SITE LOCATION MAP
Borings B-02 & B-03
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.4

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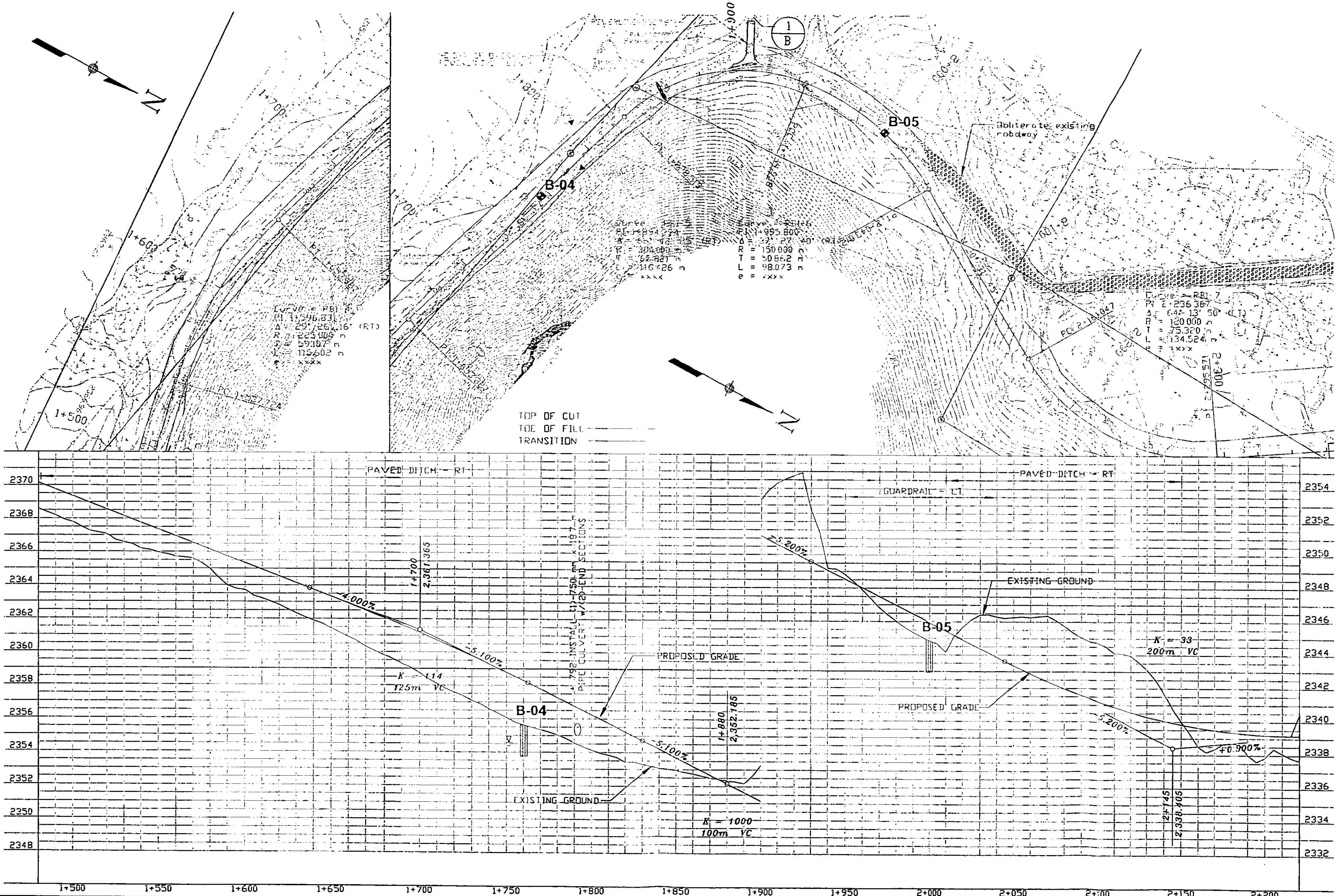

Note:
1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Borings B-04 and B-05 were drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.5

SITE LOCATION MAP
Borings B-04 & B-05
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.5

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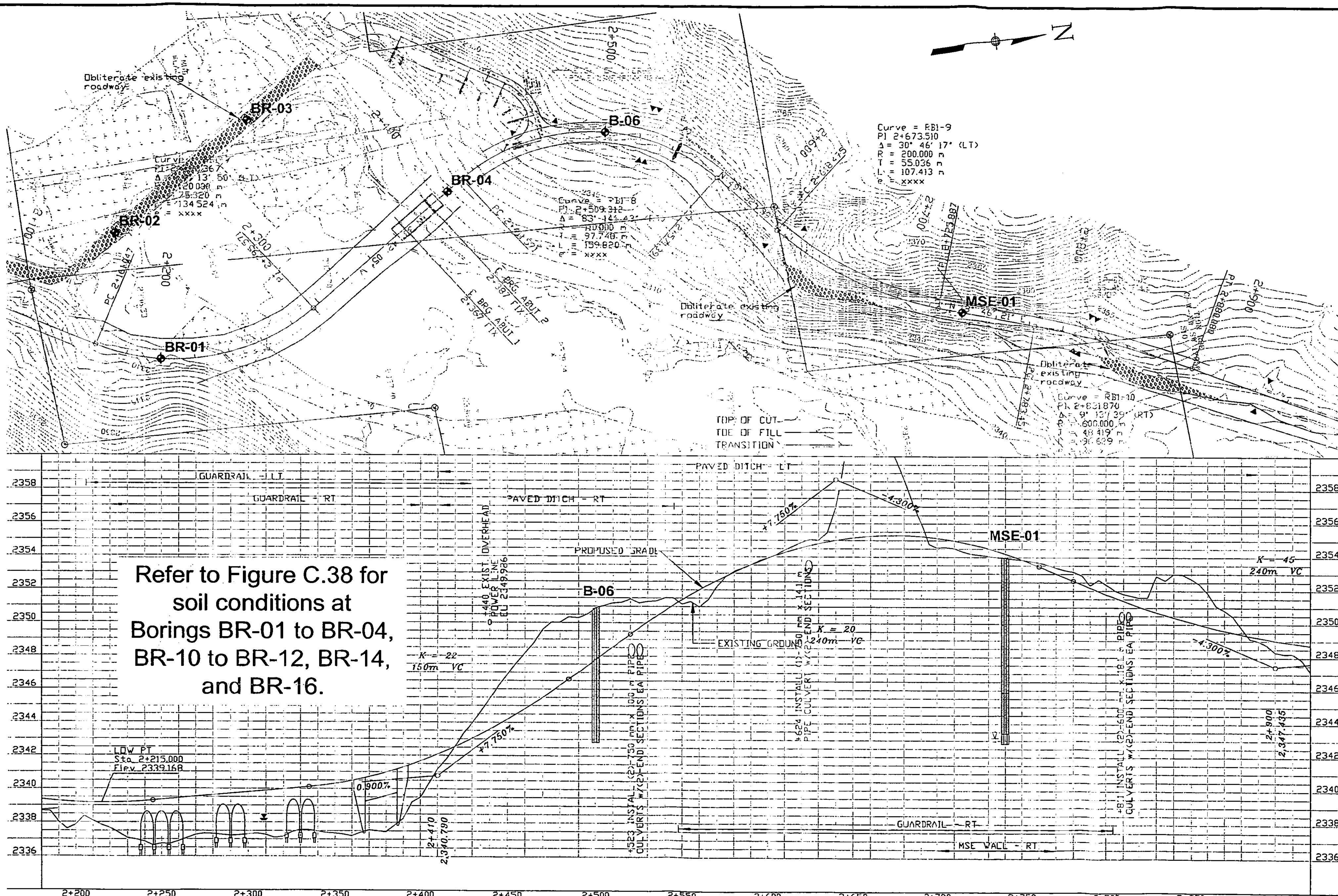

Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Refer to Figure A.14, for the locations of BR-01 through BR-04, BR-10 through BR-12, BR-14, and BR-16.
3. Borings B-06 and MSE-01 were drilled on 10/22/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: February 2004	SITE LOCATION MAP Borings B-06 & MSE-01 New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE A.6
Project No.: 35321	Filename: Figure A.6		

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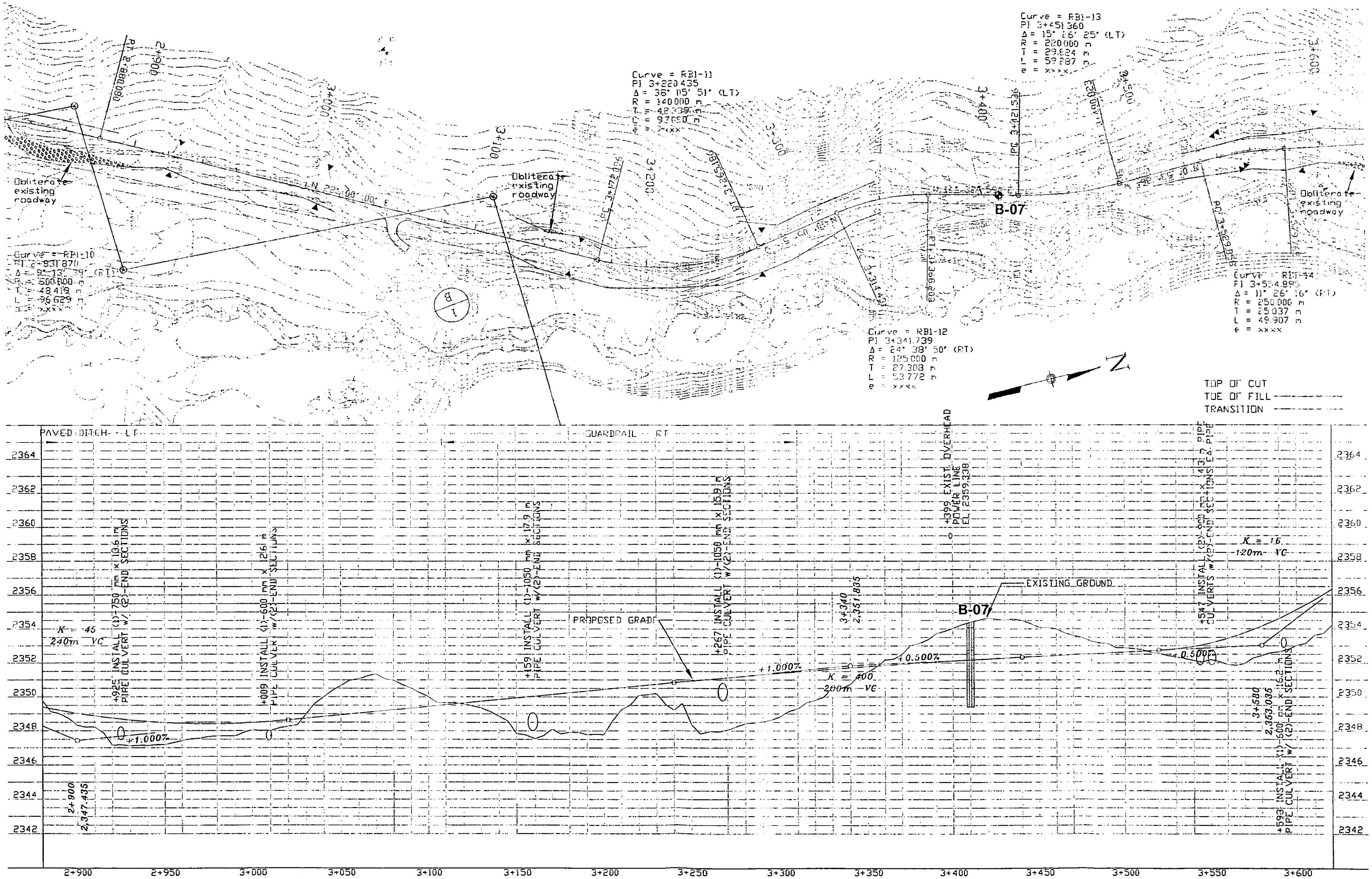

Note:
1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-07 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.7

SITE LOCATION MAP
Boring B-07
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.7

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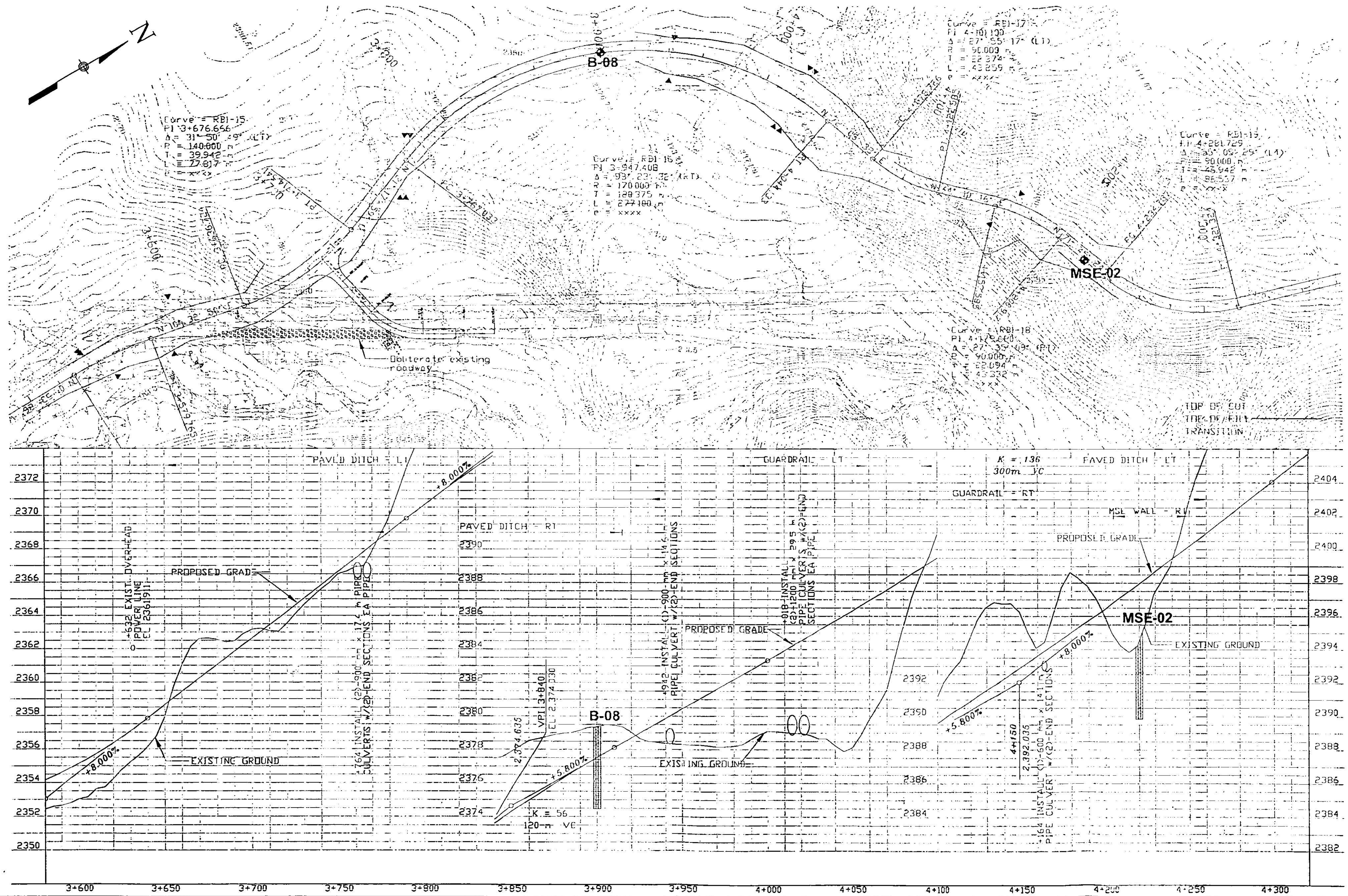

Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-08 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.
3. Boring MSE-02 was drilled on 11/11/2003 using a tracked mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.8

SITE LOCATION MAP
Borings B-08 & MSE-02
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.8

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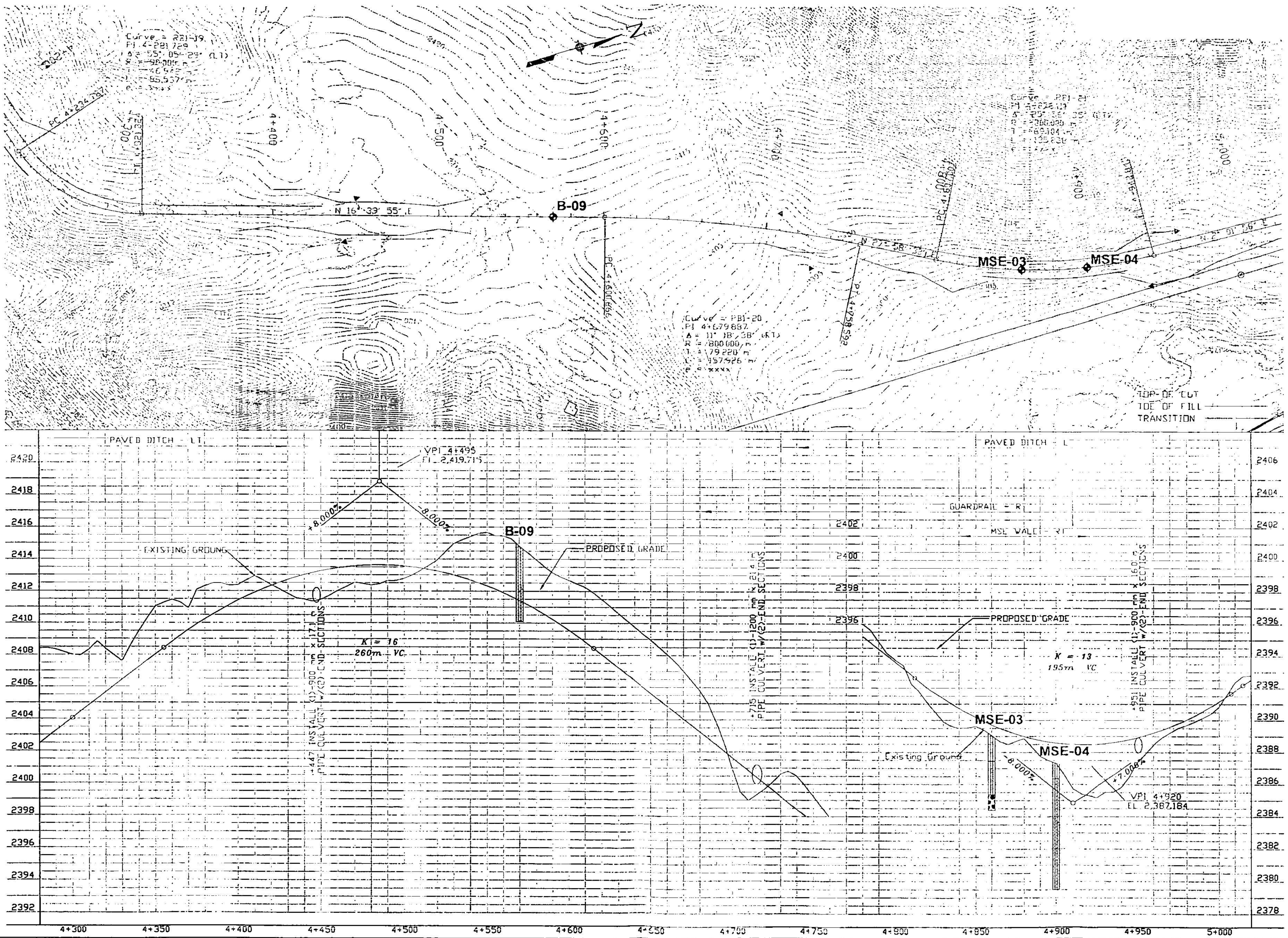

Note:
1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Borings B-09, MSE-03, and MSE-04 were drilled on 11/11/2003 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon | Date: February 2004
Project No.: 35321 | Filename: Figure A.9

SITE LOCATION MAP
Borings B-09, MSE-03, & MSE-04
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.9

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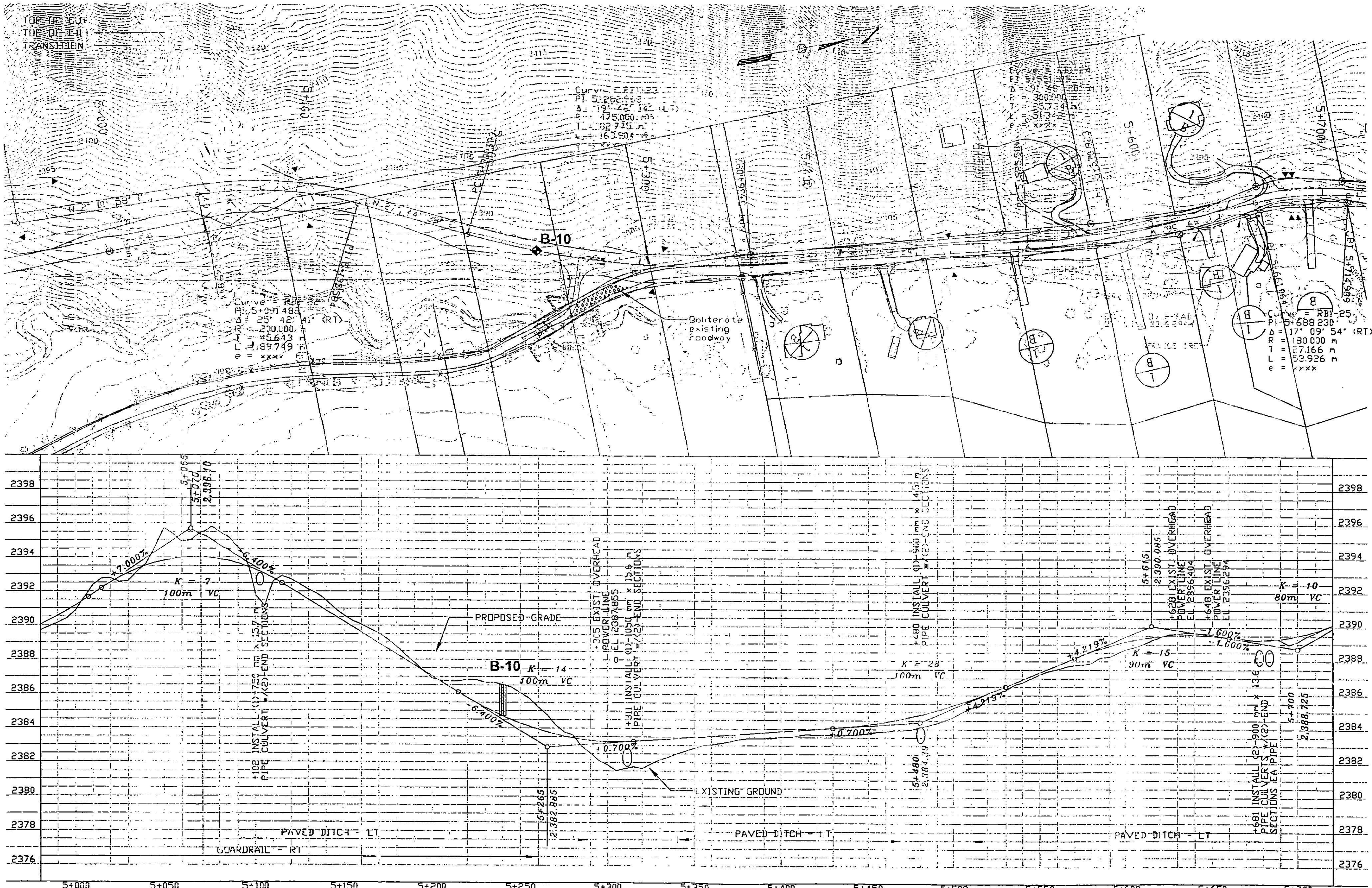

Note:
1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-10 was drilled on 11/12/2003 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon | Date: February 2004
Project No.: 35321 | Filename: Figure A.10

SITE LOCATION MAP
Boring B-10
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.10

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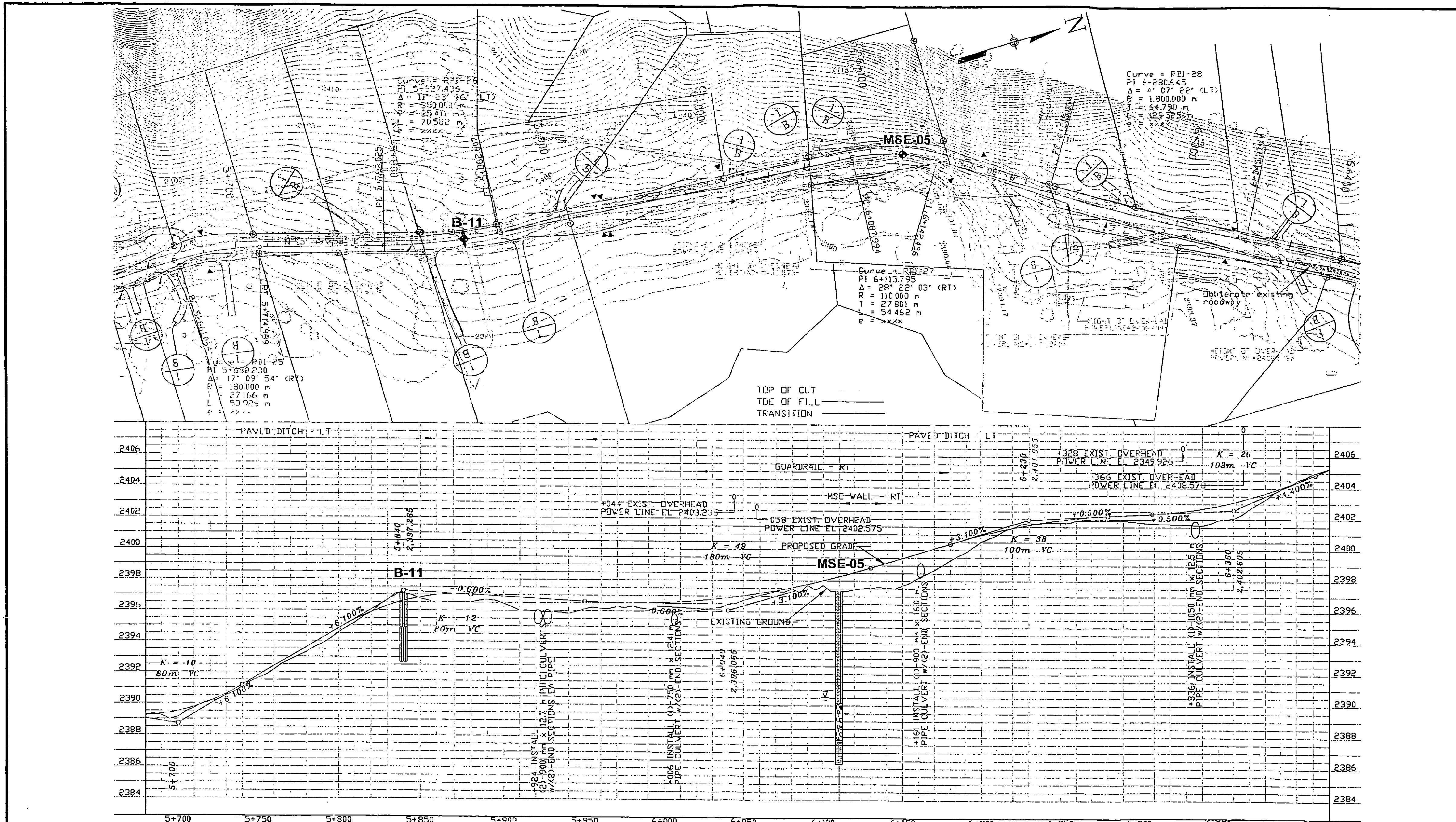

Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Borings B-11 and MSE-05 were drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER		SITE LOCATION MAP Borings B-11 & MSE-05 New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE A.11
Drawn By: C. Landon	Date: February 2004		
Project No.: 35321	Filename: Figure A.11		

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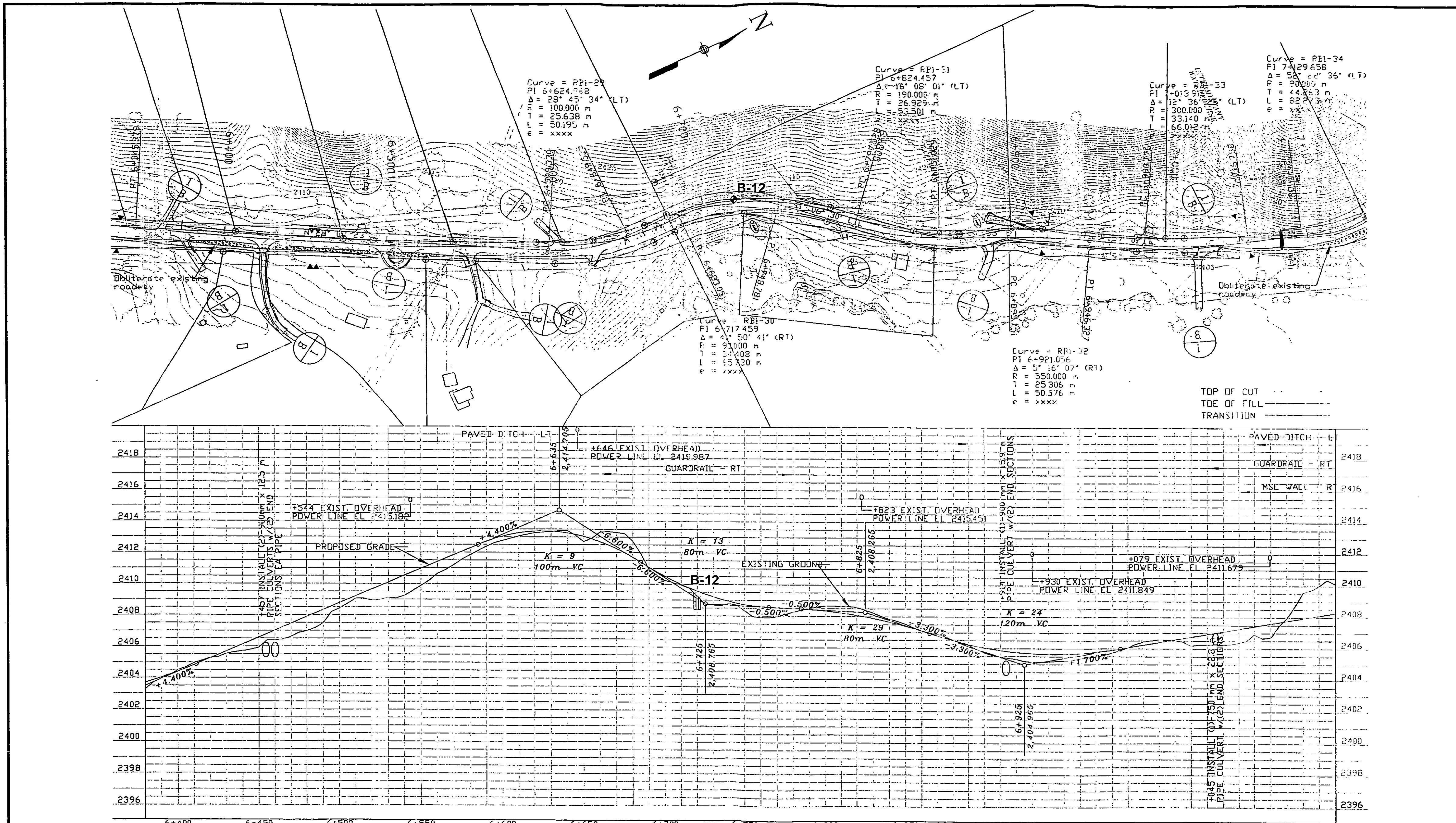

Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-12 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

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Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.12

SITE LOCATION MAP
Boring B-12
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.12

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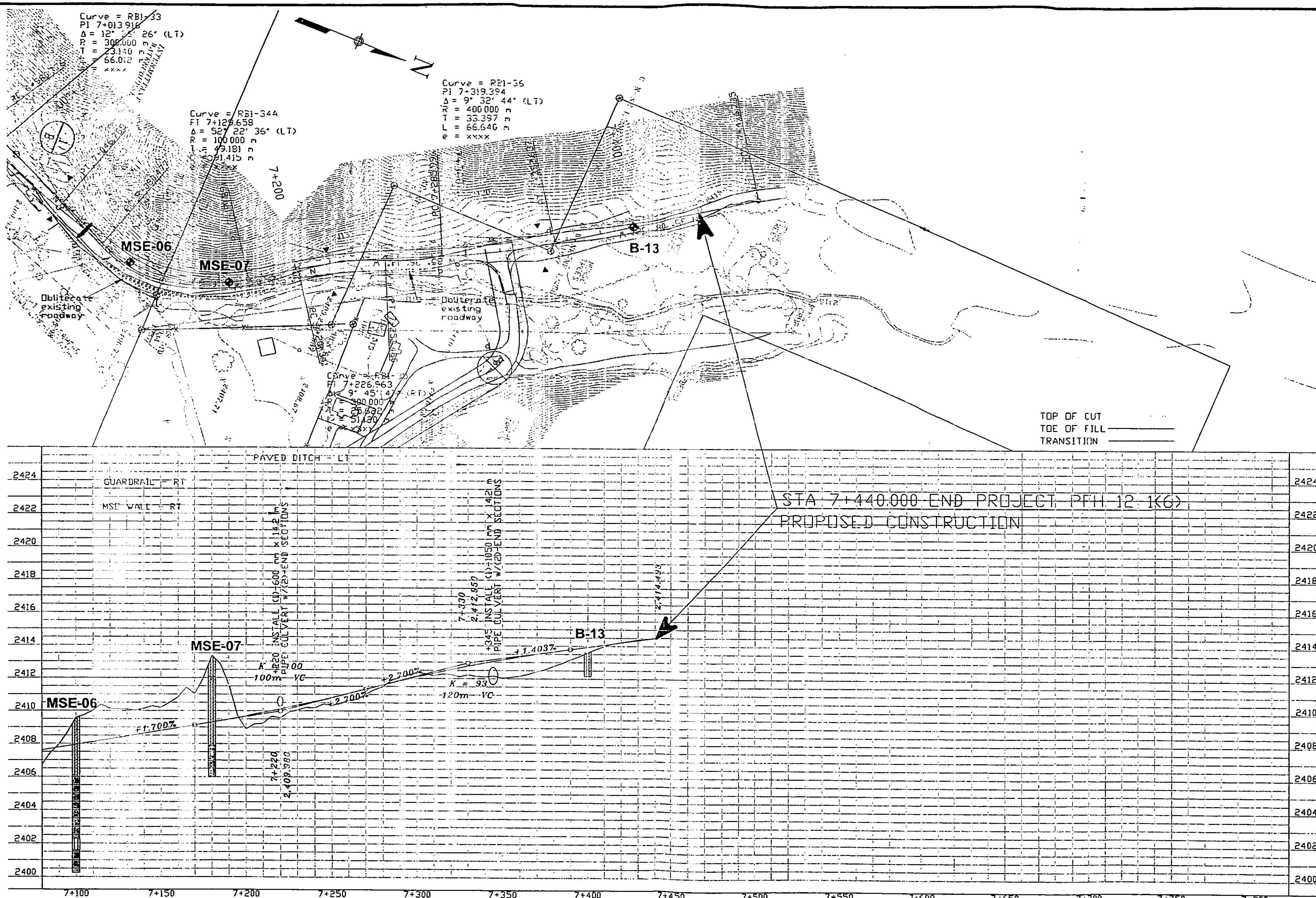

Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-13 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.
3. Borings MSE-06 and MSE-07 were drilled on 11/12/2003 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.13

SITE LOCATION MAP
Borings MSE-06, MSE-07, & B-13
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.13

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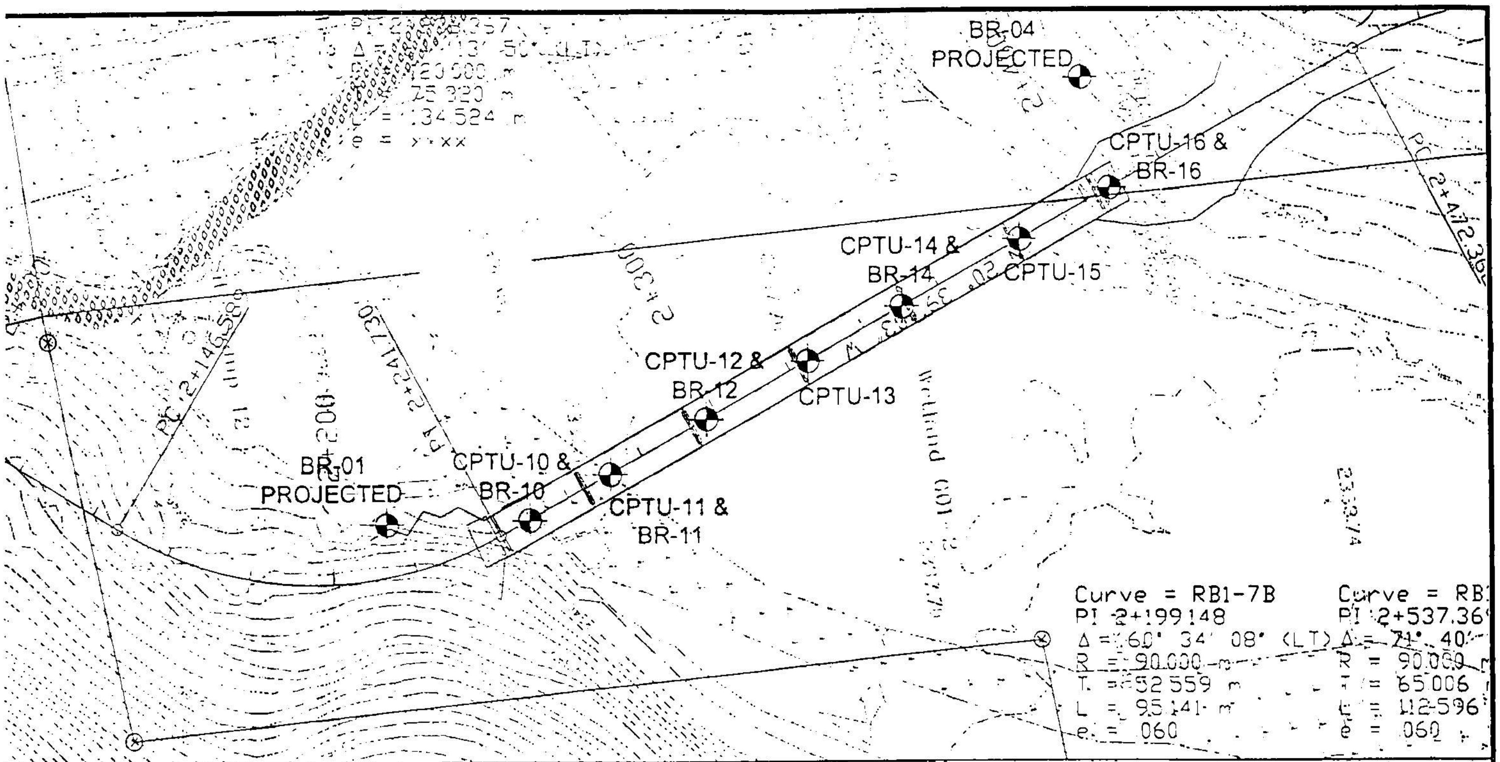
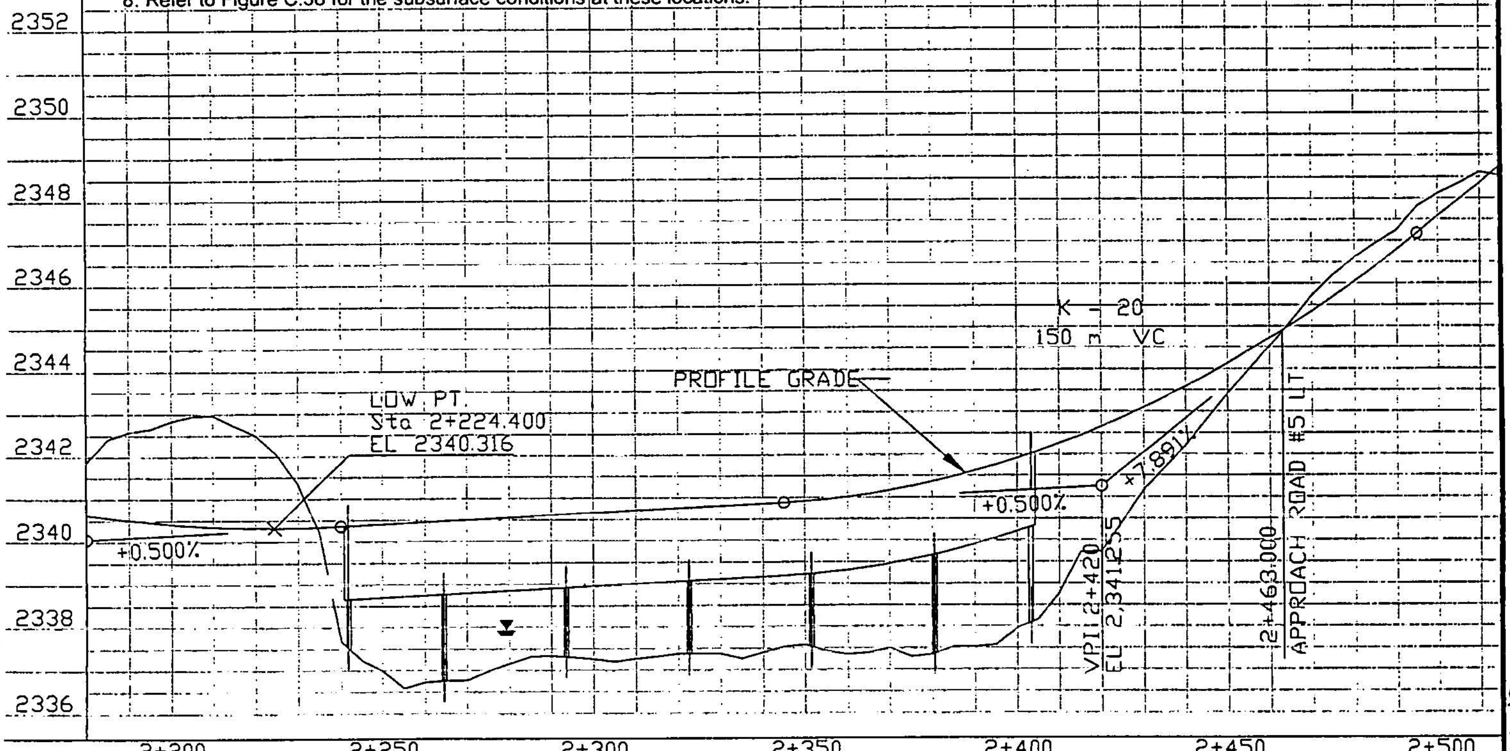


Note:

1. Refer to Partial Legend, Figure A.2 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring BR-01 was drilled on 11/13/2003 using a track mounted CME 300 equipped with a hollow stem auger.
3. Boring BR-02 was drilled on 10/21/2003 using a truck mounted CME 300 equipped with a hollow stem auger.
4. Boring BR-03 was drilled on 10/22/2003 using a truck mounted CME 300 equipped with a hollow stem auger.
5. Boring BR-04 was drilled on 11/12/2003 using a track mounted CME 300 equipped with a hollow stem auger.
6. Borings BR-10 through BR-12, BR-14, and BR-16 were drilled on 9/17/2004 through 9/19/2004 using a track mounted CME 300 equipped with a hollow stem auger.
7. Cone pentrometers CPT-10 through CPT-16 were advanced using equipment that was mounted on track mounted CME 300.
8. Refer to Figure C.38 for the subsurface conditions at these locations.



KLEINFELDER

Drawn By: C. Landon	Date: November 2004
Project No.: 35321	Filename: Figure A.14.dwg
Scale: reference above	Revision: 0

SITE MAP - BRIDGE LOCATION
STA: 2+200 - 2+400
New Mexico State Highway 126
Cuba-LaCueva , New Mexico

FIGURE
A.14

Appendix B

APPENDIX B
Boring Logs

Exploratory drilling of borings B-01 through B-08, B-11 through B-13, BR-02, BR-03, MSE-01, and MSE-05 was accomplished using a truck-mounted CME-75 drilling rig equipped with a 82.6 mm (3.25-inch) I.D. hollow-stem auger. Borings BR-10, BR-11, BR-12, BR-14, BR-16, BR-1, BR-04, MSE-02, B-09, MSE-03, MSE-04, B-10, MSE-06, and MSE-07 were drilled using a CME-55 mounted on a CME-300 tracked carrier equipped with a 82.6 mm (3.25-inch) I.D. hollow-stem auger. Selected soil and rock samples were obtained by a standard penetration test sampler, a 76.2 mm (3.0-inch) O.D., 61.5 mm (2.42)-inch I.D. ring lined sampler, and bulk samples from auger cuttings. The samplers were driven with a 620 N (140-pound) CME automatic hammer free-falling through a distance of 762.0 mm (30.0 inches). The sampler driving resistance was recorded as the number of blows per foot of penetration and is presented on the boring logs. Soil and rock samples from the borings were classified in the field by the field engineer/geologist and each sample was packaged and transported to our laboratory for further classification and testing.

KLEINFELDER

Boring Log

Date	Project Number	Project	Boring No.
Started: 10/21/2003 Completed: 10/21/2003	35321	NM State Highway 126	B-01
Backfilled: 10/21/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972147	Easting: 345317	Location: 1+040, 6 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.1 (3.5)	10:45:00 AM	10/21/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0			SPT	13						SILTY GRAVEL (GM) - gray-brown, moist, medium dense, fine to coarse grained gravel, with fine to coarse grained sand, uncemented.
				SPT	18	14.4		NV	NP	15	
∇	1			SPT	4						Very loose, wet.
				SPT	3						1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/21/2003	35321	NM State Highway 126	B-02
	Completed: 10/21/2003			
	Backfilled: 10/21/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972177		Easting: 345074	Location: 1+300, 4 m L	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3 " O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	11	13.9				38	SILTY SAND (SM) - gray-brown, dry to moist, medium dense, coarse grained sand, some gravel, uncemented.
			X	SPT	18						
	1		X	SPT	25						
			X	SPT	27						Red-brown.
											1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/24/2003	35321	NM State Highway 126	B-03
	Completed: 10/21/2003			
	Backfilled: 10/21/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972191		Easting: 344902	Location: 1+450, 8 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3 " O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
0.9 (3)	11:28:00 AM	10/21/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0			SPT	11	12.6		NV	NP	25	SILTY SAND (SM) - gray-brown, moist, medium dense, fine to coarse grained sand, with gravel, uncemented.
				SPT	12						
∇	1										1.1 m (3.5') Wet, very loose.
				SPT	7						SILT (ML) - gray, wet, very soft, low plasticity.
				SPT	2						
	2			SPT	0						
											2.3 m (7.5')

Total Depth 2.3 m (7.5')

KLEINFELDER Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/21/2003	35321	NM State Highway 126	B-04
	Completed: 10/21/2003			
	Backfilled: 10/21/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972210		Easting: 344586	Location: 1+830, 4 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
0.9 (3)	12:30:00 AM	10/21/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	10						SILTY SAND (SM) - gray-brown, moist to wet, medium dense, fine to coarse grained sand, with gravel, weakly cemented.
			X	SPT	5	21.4				19	
▽	1		X	SPT	6						Low plasticity, 0.5 ft. (0.15 m) gray, wet, very soft silt layer at 3 ft. (0.9 m). Wet, very loose.
			X	SPT	2						1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/21/2003	35321	NM State Highway 126	B-05
	Completed: 10/21/2003			
	Backfilled: 10/21/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972369		Easting: 344453	Location: 2+030, 5 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0										SILTY SAND (SM) - gray-brown, dry, medium dense, fine to coarse grained sand, with gravel, [Fill].
				SPT	10						
				SPT	8	7.9		NV	NP	37	Dark brown, stiff to very stiff, fine to medium grained.
	1			SPT	6						
				SPT	17						Some organics.
											1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/22/2003	35321	NM State Highway 126	B-06
	Completed: 10/22/2003			
	Backfilled: 10/22/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972770		Easting: 344474	Location: 2+500, 3.5 m R	

Sample Type
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0	SPT	7	7.0		NV	NP	27	SILTY SAND (SM) - brown, dry, loose, fine to medium grained sand, poorly graded, with gravel.
1.5	SPT	5	5.3					Light brown, fine to coarse grained.
3	SPT	8	4.1		NV	NP	15	
4.5	SPT	5	5.7					Trace cobbles.
6	SPT	17	12.4					Dry to moist, medium dense.
7.6	SPT	25	15.9					With increased fine sand content, with increased fine gravel content.
8.1								8.1 m (26.5')

Total Depth 8.1 m (26.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/23/2003	Completed: 10/23/2003	35321	NM State Highway 126	B-07
Backfilled: 10/23/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3973645		Easting: 344828	Location: 3+440, 5 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O D 2 42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	11	11.3		NV	NP	26	SILTY SAND (SM) - dark brown, dry, medium dense, with gravel, slight organic odor.
	0.6										0.6 m (2.0') SILTY SAND (SM) - brown, dry, loose, fine to medium grained sand, some gravel, with some coarse sand.
	1.7		X	SPT	6	5.6				23	
	3.2		X	SPT	6						
	4.7		X	SPT	6						
	5										5.0 m (16.5')

Total Depth 5.0 m (16.5')

KLEINFELDER | **Boring Log** | Sheet 1 of 1

Date		Project Number	Project	Boring No.
	Started: 10/23/2003	35321	NM State Highway 126	B-08
	Completed: 10/23/2003			
	Backfilled: 10/23/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3974066		Easting: 344798	Location: 3+900, 10 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3 " O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	10	6.2		NV	NP	40	SILTY SAND (SM) - brown, dry, stiff, with fine sand, some gravel, weakly cemented, low plasticity, with trace cobbles.
			X	SPT	30	8.9					
	2.4										2.4 m (8.0') SILT (ML) - brown, dry to moist, very stiff, moderately cemented, low plasticity, with gypsum nodules, (possible Bandelier tuff). Gray, ash-like.
			X	SPT	24	20.2					
											Light brown, hard, with quartz crystals, with fine pumice.
			X	SPT	19	17.1					
			X	SPT	47	19.9					5.9 m (19.5')

Total Depth 5.9 m (19.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/11/2003	35321	NM State Highway 126	B-09
	Completed: 11/11/2003			
	Backfilled: 11/11/2003	Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3974570		Easting: 345190	Location: 4+560, CL	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3" O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0				5	4.7		NV	NP	66	SANDY SILT (ML) - brown, dry, medium stiff, some organics, trace gravel, low plasticity, top 0.5 ft. (0.15 m) with high organic content..
				G SPT							
	1										1.4 m (4.5')
				SPT	22						SILTY SAND (SM) - red-brown, dry, medium dense, fine to medium grained sand, with pumice, strongly cemented, low plasticity, (possible Bandelier tuff).
	2										2.4 m (8.0')
											SANDY SILT (ML) - red-gray, dry, stiff, trace pumice, trace crystals, strongly cemented, laminated, (possible Bandelier tuff).
	3			SPT	15	8.6					
											Cemented layers below 11 ft. (3.4 m).
	4										
				SPT	16						Fine, ash-like layer from 14.5 to 15 ft. (4.4 to 4.6 m).
											4.7 m (15.5')

Total Depth 4.7 m (15.5')

KLEINFELDER — Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/12/2003	Project Number 35321	NM State Highway 126	B-10
	Completed: 11/12/2003			
	Backfilled: 11/12/2003	Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer

Northing: 3975177 | Easting: 345428 | Location: 5+240, CL

Sample Type
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3 " O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m) / Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0		X	SPT	2						SILTY SAND (SM) - brown, dry, very loose, fine to medium grained sand, poorly graded, some gravel, some roots.
		X	SPT	50/1.00"						Gray-brown, very dense, weakly cemented, with moderately to highly cemented seams.
1		X	SPT	39						Light brown, loose, fine to coarse grained sand.
		X	SPT	5	4.9				27	1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER Boring Log

Date — Started: 10/23/2003; Completed: 10/23/2003	Project Number 35321	Project NM State Highway 126	Boring No. B-11
Backfilled: 10/23/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3975792	Easting: 345522	Location: 5+840, 2 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m) / Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0		X	SPT	20	10.6		NV	NP	29	SILTY SAND (SM) - dark brown, dry, medium dense, fine to medium grained sand, poorly graded, with gravel.
1										Brown, loose.
		X	SPT	8	10.6					
2										2.1 m (7.0')
										SANDY SILT (ML) - light brown, dry, stiff to very stiff, trace gravel, weakly cemented, low plasticity.
3		X	SPT	5	13.9					
4		X	SPT	20	7.8					With increased sand and gravel content, with trace cobbles.
										4.4 m (14.5')

Total Depth 4.4 m (14.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/23/2003	Completed: 10/23/2003	35321	NM State Highway 126	B-12
Backfilled: 10/23/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3976582		Easting: 345797	Location: 6+720, 2 m R	

Sample Type: G - Grab Sample; CS - 3.5" I.D. Continuous Sampler; SPT - 2" O.D. 1.38" I.D. Tube Sample; U - 3" O.D. 2.42" I.D. Ring Sample; ST - 3" O.D. Thin-Walled Shelby Tube; NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m) / Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0		X	SPT	14	9.3		NV	NP	38	SILTY SAND (SM) - dark brown, dry, medium dense, fine to medium grained sand, with gravel.
		X	SPT	16						0.8 m (2.5')
1		X	SPT	6						SILT (ML) - light brown, dry, stiff, with fine sand, some gravel, low plasticity. Brown.
		X	SPT	5						1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/23/2003	35321	NM State Highway 126	B-13
	Completed: 10/23/2003			
	Backfilled: 10/23/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3977298		Easting: 345899	Location: 7+400, 4 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m) / Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0		X	SPT	4						SILTY SAND (SM) - dark brown, dry, loose, fine to medium grained, trace gravel.
		X	SPT	4	20.5		NV	NP	34	Moist, with increased fine gravel content.
1		X	SPT	9						With decreased fine gravel content.
		X	SPT	10						Wet.
										1.8 m (6.0')

Total Depth 1.8 m (6.0')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/13/2003	35321	NM State Highway 126	BR-01
	Completed: 11/13/2003			
	Backfilled: 11/13/2003	Rig Type: Track CME 300	Surface Elevation: 2338.0 m (7670.6')	Logged By: T Retterer
	Northing: 3972576	Easting: 344548	Location: 2+240, 10 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	8:50:00 AM	11/13/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve
▽ (1.2)	1.2		X	SPT	22					
	2.7		X	SPT	5			NV	NP	
	4.3		X	SPT	15	30.5				31
	5.8		X	SPT	12					
	7.3		X	SPT	9	32.6				30
	8.9		X	SPT	12					

Visual Classification

0.0 m – SILTY SAND (SM) - dark brown, moist, loose, fine to medium grained sand, with roots, trace gravel.

0.6 m (2.0') — El. 2337.4 m (7668.6')

SILTY SAND (SM) - brown, wet, medium dense, fine to medium grained sand, weakly cemented.

2.1 m (7.0') — El. 2335.9 m (7663.6')

SANDY SILT (ML) - gray, wet, medium stiff, with iron oxide stains, weakly cemented, low plasticity.

3.5 m (11.5') — El. 2334.5 m (7659.1')

SILTY SAND (SM) - red-brown, wet, medium dense, fine to coarse grained, with silt, with gravel, weakly cemented, with gray silt seams, with iron oxide staining.

4.6 m (15.0') — El. 2333.4 m (7655.6')

SAND (SP-SM) - gray, wet, medium dense, fine to medium grained sand, with silt, weakly cemented.

7.0 m (23.0') — El. 2331.0 m (7647.6')

SILTY SAND (SM) - red-brown, wet, stiff, fine grained, with gravel, weakly cemented.

7.9 m (26.0') — El. 2330.1 m (7644.6')

SAND (SP) - gray, wet, medium dense, fine to medium grained sand, trace silt, with gravel, weakly cemented, with some iron oxide staining.

KLEINFELDER Boring Log

Date		Project Number	Project	Boring No.
Started: 11/13/2003	Completed: 11/13/2003	35321	NM State Highway 126	BR-01
Backfilled: 11/13/2003		Rig Type: Track CME 300	Surface Elevation: 2338.0 m (7670.6')	Logged By: T Retterer
Northing: 3972576		Easting: 344548	Location: 2+240, 10 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	8:50:00 AM	11/13/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
9	SPT	12						SAND (SP) - gray, wet, medium dense, fine to medium grained sand, trace silt, with gravel, weakly cemented, with some iron oxide staining.
10.4 m (34.0')								El. 2327.6 m (7636.6')
	SPT	63	15.7				11	SAND (SP-SM) - gray, wet, very dense, fine to coarse grained, with silt, with gravel, weakly cemented.
11.1 m (36.5')								El. 2326.9 m (7634.1')
								SILTY SANDSTONE - red brown, fine grained, moderately to slightly weathered, soft.
	SPT	50/3.75"	10.5				26	
	SPT	50/5.75"						
14.8 m (48.7')	SPT	50/2"	12.7					Red-brown and green-gray, with clay seams from 48.5 to 48.7 ft. (14.7 to 14.8 m). El. 2323.2 m (7621.9')

Total Depth 14.8 m (48.7')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/21/2003		35321	NM State Highway 126	BR-02
Completed: 10/21/2003				
Backfilled: 10/21/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972542		Easting: 344485	Location: 2+200, 100 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	1:30:00 PM	10/21/2003

Groundwater Depth (m)	Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0	SPT	20						SILTY SAND (SM) - gray-brown, moist, medium dense, fine to coarse grained sand, poorly graded, with silt, with gravel, [Fill].
∇ (1.2)	1								Wet.
	1.5 m (5.0')	SPT	5	26.8		NV	NP	21	SILTY SAND (SM) - gray, wet, medium stiff, fine to medium grained sand, weakly cemented.
	3	U	10						
	4	SPT	5						Very loose.
	5	U	2						
	6	SPT	1	34.9				41	Fine grained sand, with increased silt content.
	7.8 m (25.5')	SPT	3						SILT (ML) - gray, wet, soft, weakly cemented, low plasticity.
	9								

Date		Project Number	Project	Boring No.
Started: 10/21/2003		35321	NM State Highway 126	BR-02
Completed: 10/21/2003				
Backfilled: 10/21/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972542		Easting: 344485	Location: 2+200, 100 m L	

Sample Type: G - Grab Sample; CS - 3.5" I.D. Continuous Sampler; SPT - 2" O.D. 1.38" I.D. Tube Sample; U - 3" O.D. 2.42" I.D. Ring Sample; ST - 3" O.D. Thin-Walled Shelby Tube; NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	1:30:00 PM	10/21/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
9								SILT (ML) - gray, wet, soft, weakly cemented, low plasticity.
	SPT	15						9.4 m (31.0')
10								SAND (SP-SM) - gray, wet, medium dense, medium to coarse grained sand, with silt, with gravel, weakly cemented, (possible completely weathered igneous rock).
11	SPT	19						
12	SPT	14	23.4				11	
13								
14	SPT	21						With gravel, some cobbles.
15	SPT	44						Dense, with highly cemented layers and seams, without gravel, without cobbles.
16								16.8 m (55.0')
17	SPT	50/4.00"						SANDY SILTSTONE - red brown, fine grained, moderately weathered, moderately hard.
18								

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Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/21/2003	35321	NM State Highway 126	BR-02
	Completed: 10/21/2003			
	Backfilled: 10/21/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972542		Easting: 344485	Location: 2+200, 100 m L	

Sample Type: G - Grab Sample; CS - 3.5" I.D. Continuous Sampler; SPT - 2" O.D. 1.38" I.D. Tube Sample; U - 3" O.D. 2.42" I.D. Ring Sample; ST - 3" O.D. Thin-Walled Shelby Tube; NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	1:30:00 PM	10/21/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	18	× × ×	☒	SPT	50/3"						SANDY SILTSTONE - red brown, fine grained, moderately weathered, moderately hard. 18.4 m (60.3')

Total Depth 18.4 m (60.3')

Date		Project Number	Project	Boring No.
	Started: 10/22/2003	35321	NM State Highway 126	BR-03
	Completed: 10/22/2003			
	Backfilled: 10/22/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972601		Easting: 344440	Location: 2+350, 100 m L	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3" O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.5 (5)	8:44:00 AM	10/22/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	13						SILTY SAND (SM) - red-brown, dry to moist, medium dense, fine to coarse grained, with gravel, [Fill].
	1										
▽	1.5		X	SPT	10						1.5 m (5.0') SILTY SAND (SM) - gray-brown, moist to wet, loose to medium dense, fine to medium grained sand, some gravel.
	2										
	2.4										2.4 m (8.0') SANDY SILT (ML) - gray, wet, soft to medium stiff, fine grained sand, some organics, weakly cemented, low plasticity.
	3		■	U	8						
	4										
	5		X	SPT	6	43.8				54	
	6		X	SPT	3						
	7										
	7.9		X	SPT	5						7.9 m (26.0') SILTY SAND (SM) - gray, wet, loose, fine to coarse grained sand, some gravel, with trace green gravel.
	8										
	9										

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Boring Log

Date		Project Number	Project	Boring No.
Started: 10/22/2003		35321	NM State Highway 126	BR-03
Completed: 10/22/2003				
Backfilled: 10/22/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3972601		Easting: 344440	Location: 2+350, 100 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.5 (5)	8:44:00 AM	10/22/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
9.3	SPT	3						9.3 m (30.5') SANDY SILT (ML) - gray, wet, soft, fine grained sand, low plasticity.
10.8	SPT	6						
11.0								11.0 m (36.0') SILTY SAND (SM) - gray, wet, very loose to loose, fine to medium grained sand, weakly cemented.
12.0								Some gravel.
12.3	SPT	3						
13.0								13.0 m (42.5') SAND (SP) - gray, wet, dense, medium to coarse grained sand, some gravel, weakly cemented, with clear grains (quartzitic, possible completely weathered igneous rock).
13.8	SPT	37						
15.3	SPT	50						Gray.
15.8								15.8 m (52.0') SILTY SANDSTONE - red brown, medium grained, moderately weathered, moderately hard, with gray silt nodules.
16.8	SPT	50/3"						

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Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/22/2003	35321	NM State Highway 126	BR-03
	Completed: 10/22/2003			
	Backfilled: 10/22/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
	Northing: 3972601	Easting: 344440	Location: 2+350, 100 m L	

Sample Type: G - Grab Sample; CS - 3.5" I.D. Continuous Sampler; SPT - 2" O.D. 1.38" I.D. Tube Sample; U - 3" O.D. 2.42" I.D. Ring Sample; ST - 3" O.D. Thin-Walled Shelby Tube; NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.5 (5)	8:44:00 AM	10/22/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	18										
			X	SPT	50/3.5"						18.4 m (60.3')

Total Depth 18.4 m (60.3')

Date		Project Number	Project	Boring No.
	Started: 11/12/2003	35321	NM State Highway 126	BR-04
	Completed: 11/12/2003			
	Backfilled: 11/12/2003	Rig Type: Track CME 300	Surface Elevation: 2340.0 m (7677.2')	Logged By: T Retterer
Northing: 3972722		Easting: 344484	Location: 2+410, CL	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3 " O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
2.7 (9)	12:23:00 PM	11/12/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0	SPT	5						SILTY SAND (SM) - brown, dry, loose, fine to medium grained sand, with gravel, with roots.
1.1 m (3.5')								El. 2338.9 m (7673.7')
	SPT	0						SILTY SAND (SM) - red-brown, wet, very loose to loose, fine to coarse grained sand, some gravel, weakly cemented. No recovery.
2.7 (groundwater ▽)								
3	SPT	4	41.2				20	
	SPT	11						
6	SPT	6	29.9				16	Brown-gray, with gravel.
	SPT	8						
9	SPT	7						

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 11/12/2003	Completed: 11/12/2003	35321	NM State Highway 126	BR-04
Backfilled: 11/12/2003		Rig Type: Track CME 300	Surface Elevation: 2340.0 m (7677.2')	Logged By: T Retterer
Northing: 3972722		Easting: 344484	Location: 2+410, CL	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3 " O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
2.7 (9)	12:23:00 PM	11/12/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
9	SPT	7						SILTY SAND (SM) - red-brown, wet, very loose to loose, fine to coarse grained sand, some gravel, weakly cemented.
10.5	SPT	15						
11.3 m (37.0')								El. 2328.7 m (7640.2')
								SILTY SAND (SM) - gray, wet, very loose, fine grained sand, with silt, with organics, moderately cemented, combination of organic and hydrocarbon odor, appears to be historic organics.
12	SPT	2						
12.5 m (41.0')								El. 2327.5 m (7636.2')
								SILTY SAND (SM) - brown, wet, medium dense, fine to coarse grained sand, moderately cemented.
13.5	SPT	18						
14.3 m (47.0')								El. 2325.7 m (7630.2')
								SILTY SAND (SM) - gray, wet, medium dense, fine grained sand, with gravel, with highly cemented seams and layers, with clay and silt seams and partings, possible decomposed sandstone.
15	SPT	27	20.6				31	
16.5 m (54.0')								El. 2323.5 m (7623.2')
16.5	SPT	50/4.5"	13.9				73	SANDY SILTSTONE - red brown, fine grained, moderately weathered, soft.
17.7 m (58.0')								El. 2322.3 m (7619.2')
18								

Date		Project Number	Project	Boring No.
	Started: 11/12/2003	35321	NM State Highway 126	BR-04
	Completed: 11/12/2003			
	Backfilled: 11/12/2003	Rig Type: Track CME 300	Surface Elevation: 2340.0 m (7677.2')	Logged By: T Retterer
Northing: 3972722		Easting: 344484	Location: 2+410, CL	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
2.7 (9)	12:23:00 PM	11/12/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	18			SPT	50/1.75"						SILTY SANDSTONE - brown, fine grained, moderately weathered, soft.
											18.6 m (61.0') Refusal with HSA at 61 ft. (18.6 m). El. 2321.4 m (7616.2')

Total Depth 18.6 m (61.0')

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Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/17/2004	35321	NM State Highway 126	BR-10
	Completed: 9/17/2004			
	Backfilled: 9/17/2004	Rig Type: Track CME 300	Surface Elevation: 2337.0 m (7667.3')	Logged By: C. Bhongir
Northing: 3972582		Easting: 344567	Location: 2+249, 2.1 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
0.9 (3)	3:25:00 PM	9/17/2004

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve
0–0.45	SPT	0					
1.5–1.95	U	19	41.9	11.0			
3.05–3.5	SPT	16			31	NP	67
4.6–5.05	SPT	12					
6.1–6.55	U	40					
7.6–8.05	SPT	15					39

Groundwater depth symbol (∇) at approx. 0.9 m.

Visual Classification

0 m: SANDY SILT (ML) - brown, moist, very loose to loose, with roots, weakly cemented, [STRATUM I].

1.5 m (5.0') — El. 2335.5 m (7662.3')

SAND (SP) - gray, wet, medium dense, fine to medium grained sand, poorly graded, some gravel, weakly cemented, [STRATUM I].

2.4 m (8.0') — El. 2334.6 m (7659.3')

SANDY SILT (ML) - brown, wet, medium dense, weakly cemented, low plasticity, [STRATUM I].

4.0 m (13.0') — El. 2333.0 m (7654.3')

SAND (SP) - gray, wet, medium dense, fine to medium grained sand, poorly graded, some gravel, weakly cemented, [STRATUM I].

5.5 m (18.0') — El. 2331.5 m (7649.3')

SILTY SAND (SM) - gray, wet, medium dense, fine to medium grained sand, poorly graded, with gravel, weakly cemented, [STRATUM I].

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Date		Project Number	Project	Boring No.
	Started: 9/17/2004	35321	NM State Highway 126	BR-10
	Completed: 9/17/2004			
	Backfilled: 9/17/2004	Rig Type: Track CME 300	Surface Elevation: 2337.0 m (7667.3')	Logged By: C. Bhongir
Northing: 3972582		Easting: 344567	Location: 2+249, 2.1 m L	

Sample Type: G - Grab Sample; CS - 3.5" I.D. Continuous Sampler; SPT - 2" O.D. 1.38" I.D. Tube Sample; U - 3" O.D. 2.42" I.D. Ring Sample; ST - 3" O.D. Thin-Walled Shelby Tube; NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
0.9 (3)	3:25:00 PM	9/17/2004

Groundwater Depth (m) / Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
9										9.1 m (30.0') El. 2327.9 m (7637.3')
		X	SPT	53						WEATHERED BANDELIER TUFF gray, fine grained, very soft, [STRATUM III].
10										10.4 m (34.0') El. 2326.6 m (7633.3')
		X	SPT	50/4"						SILTY SANDSTONE - gray, fine grained, highly to moderately weathered, very soft to soft, [STRATUM IV].
11										
12		X	SPT	50/4"						12.3 m (40.3') El. 2324.7 m (7627.0')

Total Depth 12.3 m (40.3')

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Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/18/2004	35321	NM State Highway 126	BR-11
	Completed: 9/18/2004			
	Backfilled: 9/18/2004	Rig Type: Track CME 300	Surface Elevation: 2336.5 m (7665.7')	Logged By: C. Bhongir
Northing: 3972603		Easting: 344563	Location: 2+270, CL	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	8:43:00 AM	9/18/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0			SPT	2						SANDY SILT (ML) - dark gray, wet, very loose to loose, some roots, weakly cemented, [STRATUM I].
	1			U	11			33	NP		3.5 to 5 ft.
	2–3			SPT	0					57	
	4			U	10	19.2	12.7				4.0 m (13.0') El. 2332.5 m (7652.7') SILTY SAND (SM) - gray, wet, very loose to loose, fine to medium grained sand, poorly graded, some gravel, weakly cemented, [STRATUM I].
	5–6			SPT	1					63	5.5 m (18.0') El. 2331.0 m (7647.7') SANDY SILT (ML) - gray, wet, very loose, some gravel, weakly cemented, [STRATUM I].
	7			SPT	16						6.7 m (22.0') El. 2329.8 m (7643.7') SILTY SAND (SM) - light gray, wet, medium dense, fine to medium grained sand, poorly graded, some gravel, weakly cemented, [STRATUM I].
	8–9			SPT	13						8.2 m (27.0') El. 2328.3 m (7638.7') SAND (SP) - gray, wet, medium dense, fine to medium grained, poorly graded, with gravel, weakly cemented, [STRATUM I].

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/18/2004	35321	NM State Highway 126	BR-11
	Completed: 9/18/2004			
	Backfilled: 9/18/2004	Rig Type: Track CME 300	Surface Elevation: 2336.5 m (7665.7')	Logged By: C. Bhongir
Northing: 3972603		Easting: 344563	Location: 2+270, CL	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D 1 38" I D Tube Sample
- U - 3" O D 2 42" I D Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	8:43:00 AM	9/18/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	9		X	SPT	13						9.1 m (30.0') El. 2327.4 m (7635.7') SILTY SANDSTONE - red, highly weathered, very soft to soft, ABO FORMATION [STRATUM V].
	10										
			X	SPT	50/5.5"					43	
											10.7 m (35.0') El. 2325.8 m (7630.7') MUDSTONE - dark gray, highly weathered, very soft to soft, ABO FORMATION [STRATUM V].
	11										
			X	SPT	50/3"						11.9 m (39.2') El. 2324.6 m (7626.5')

Total Depth 11.9 m (39.2')

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Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/18/2004	35321	NM State Highway 126	BR-12
	Completed: 9/18/2004			
	Backfilled: 9/18/2004	Rig Type: Track CME 300	Surface Elevation: 2336.5 m (7665.7')	Logged By: C. Bhongir
	Northing: 3972631	Easting: 344551	Location: 2+297, 0.9 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	12:52:00 PM	9/18/2004

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve
~0.2	SPT	1					
~1.3	U	8	39.4	8.7			70
~2.8	SPT	1					
~4.3	U	6					18
~5.8	SPT	2					
~7.3	U	8			43	NP	69
~8.8	SPT	15					

Visual Classification

0 – 3.0 m: SANDY SILT (ML) - dark brown, wet, very loose to loose, with roots, weakly cemented, [STRATUM I].

3.0 m (10.0') — El. 2333.5 m (7655.7')

SILTY SAND (SM) - gray, wet, very loose to loose, fine to medium grained sand, poorly graded, trace gravel, weakly cemented, [STRATUM I].

6.1 m (20.0') — El. 2330.4 m (7645.7')

SANDY SILT (ML) - gray, wet, loose, fine grained sand, poorly graded, trace gravel, weakly cemented, [STRATUM I].

8.5 m (28.0') — El. 2328.0 m (7637.7')

SILTY SAND (SM) - gray, wet, medium dense, fine to medium grained sand, poorly graded, weakly cemented, [STRATUM I].

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/18/2004	35321	NM State Highway 126	BR-12
	Completed: 9/18/2004			
	Backfilled: 9/18/2004	Rig Type: Track CME 300	Surface Elevation: 2336.5 m (7665.7')	Logged By: C. Bhongir
Northing: 3972631		Easting: 344551	Location: 2+297, 0.9 m L	

Sample Type: G - Grab Sample; CS - 3.5" I.D. Continuous Sampler; SPT - 2" O.D. 1.38" I.D. Tube Sample; U - 3" O.D. 2.42" I.D. Ring Sample; ST - 3" O.D. Thin-Walled Shelby Tube; NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	12:52:00 PM	9/18/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	9			SPT	15						SILTY SAND (SM) - gray, wet, medium dense, fine to medium grained sand, poorly graded, weakly cemented, [STRATUM I].
	10			U	27	24.0	10.4			26	
	11										11.0 m (36.0') El. 2325.5 m (7629.7') SAND (SP) - gray, wet, loose to medium dense, with gravel, with silt, [STRATUM I].
	12			SPT	7						Loose 39 - 40 feet.
	13			SPT	23						
	14										14.5 m (47.5') El. 2322.0 m (7618.2') WEATHERED BANDELIER TUFF gray, fine grained, very soft, [STRATUM III].
	15			SPT	53						15.8 m (52.0') El. 2320.6 m (7613.7') MUDSTONE - brown, highly weathered, soft, ABO FORMATION [STRATUM V].
	16			SPT	69						
	17			U	50/4"						
	18										

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/18/2004	35321	NM State Highway 126	BR-12
	Completed: 9/18/2004			
	Backfilled: 9/18/2004	Rig Type: Track CME 300	Surface Elevation: 2336.5 m (7665.7')	Logged By: C. Bhongir
Northing: 3972631		Easting: 344551	Location: 2+297, 0.9 m L	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	12:52:00 PM	9/18/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	18										MUDSTONE - brown, highly weathered, soft, ABO FORMATION [STRATUM V].
	19										
			X	SPT	50/3.5"						
	20										
	21		X	SPT	50/5"						
	22										
			X	SPT	50/3"						
	23										23.5 m (77.0') El. 2313.0 m (7588.7')
											SILTY SANDSTONE - gray, highly weathered, soft, ABO FORMATION [STRATUM V].
			X	SPT	50/1.5"						24.0 m (78.6') El. 2312.5 m (7587.1')

Total Depth 24.0 m (78.6')

KLEINFELDER

Boring Log

Date	Project Number	Project	Boring No.
Started: 9/19/2004	35321	NM State Highway 126	BR-14
Completed: 9/19/2004			
Backfilled: 9/19/2004	Rig Type: Track CME 300	Surface Elevation: 2337.5 m (7669.0')	Logged By: C. Bhongir
Northing: 3972685	Easting: 344533	Location: 2+350, 1.5 m L	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3" O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	9:31:00 AM	9/19/2004

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0								
	SPT	0						SANDY SILT (ML) - gray, wet, very loose to loose, fine grained, weakly cemented, [STRATUM I].
1								
	U	13					57	Medium stiff.
2								
	SPT	3					60	
3								
								3.7 m (12.0') El. 2333.9 m (7657.0')
								SAND (SP) - gray, wet, loose, fine to coarse grained, trace gravel, [STRATUM I].
4								
	U	11						
5								
								5.2 m (17.0') El. 2332.3 m (7652.0')
								SILTY SAND (SM) - gray, wet, very loose, fine to medium grained, trace gravel, [STRATUM I].
	SPT	3						
6								
								6.7 m (22.0') El. 2330.8 m (7647.0')
								SAND (SP) - gray, wet, very loose to medium dense, fine to coarse grained, trace silt, [STRATUM I].
7								
	U	23						
8								
	SPT	3						
9								

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/19/2004	35321	NM State Highway 126	BR-14
	Completed: 9/19/2004			
	Backfilled: 9/19/2004	Rig Type: Track CME 300	Surface Elevation: 2337.5 m (7669.0')	Logged By: C. Bhongir
Northing: 3972685		Easting: 344533	Location: 2+350, 1.5 m L	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O D 1 38" I D. Tube Sample
U - 3" O D 2 42" I D Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	9:31:00 AM	9/19/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	9			SPT	3						SAND (SP) - gray, wet, very loose to medium dense, fine to coarse grained, trace silt, [STRATUM I].
											9.8 m (32.0') El. 2327.8 m (7637.0')
	10										SAND (SP-SM) - gray, wet, medium dense, fine to coarse grained, with silt, some trace gravel, [STRATUM I].
				U	24						
	11										
	12			SPT	24					12	
											12.8 m (42.0') El. 2324.7 m (7627.0')
	13										SILT (MH) - red-brown, moist, stiff to hard, [STRATUM II].
				SPT	60						
	14										
	15			SPT	25						
	16										
				SPT	11			60	26	99	
	17										
											17.7 m (58.0') El. 2319.8 m (7611.0')
	18			SPT	30						SANDY CLAY (CL) - gray-brown, moist, hard, high plasticity [STRATUM II].

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/19/2004	35321	NM State Highway 126	BR-14
	Completed: 9/19/2004			
	Backfilled: 9/19/2004	Rig Type: Track CME 300	Surface Elevation: 2337.5 m (7669.0')	Logged By: C. Bhongir
Northing: 3972685		Easting: 344533	Location: 2+350, 1.5 m L	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D 1 38" I D. Tube Sample
U - 3" O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
-0.3 (-1)	9:31:00 AM	9/19/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	18		X	SPT	30						SANDY CLAY (CL) - gray-brown, moist, hard, high plasticity, [STRATUM II].
											18.9 m (62.0') El. 2318.6 m (7607.0')
	19										MUDSTONE - reddish brown and gray, highly weathered, soft, ABO FORMATION [STRATUM V].
			X	SPT	50/5.5"						
	20										
	21		X	SPT	50/5"						21.0 m (68.9') El. 2316.5 m (7600.1')

Total Depth 21.0 m (68.9')

KLEINFELDER — Boring Log

Date		Project Number	Project	Boring No.
Started: 9/16/2004	Completed: 9/17/2004	35321	NM State Highway 126	BR-16
Backfilled: 9/17/2004		Rig Type: Track CME 300	Surface Elevation: 2338.0 m (7670.6')	Logged By: C. Bhongir
Northing: 3972731		Easting: 344516	Location: 2+405, 0.3 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O D 1 38" I D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	4:48:00 PM	9/16/2004

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0–1.2	SPT	1						SANDY SILT (ML) - brown, moist, very loose, trace gravel, weakly cemented, with iron oxide, [STRATUM I].
1.2 m (4.0') El. 2336.8 m (7666.6')								Groundwater at 1.2 m
1.2–6.7	U	13	31.6	8.8			16	SILTY SAND (SM) - red-brown, wet, loose to medium dense, fine to coarse grained, trace gravel, [STRATUM I].
	SPT	7						
	U	31					26	
	SPT	4					18	
6.7 m (22.0') El. 2331.3 m (7648.6')								
6.7–9	U	19					9	SAND (SP-SM) - gray-brown, wet, loose to medium dense, fine to coarse grained, with silt, with gravel, [STRATUM I].

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/16/2004	35321	NM State Highway 126	BR-16
	Completed: 9/17/2004			
	Backfilled: 9/17/2004	Rig Type: Track CME 300	Surface Elevation: 2338.0 m (7670.6')	Logged By: C. Bhongir
Northing: 3972731		Easting: 344516	Location: 2+405, 0.3 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	4:48:00 PM	9/16/2004

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
9	SPT	6						SAND (SP-SM) - gray-brown, wet, loose to medium dense, fine to coarse grained, with silt, with gravel, [STRATUM I].
9.8 m (32.0')								El. 2328.2 m (7638.6') — SILTY SAND (SM) - gray, wet, medium dense, some gravel, weakly cemented, [STRATUM I].
10.8	U	18	35.4	9.2			21	
11.3 m (37.0')								El. 2326.7 m (7633.6') — SAND (SP-SM) - gray, wet, medium dense, fine to coarse grained, with silt, with gravel, [STRATUM I].
12.3	SPT	22					6	
13.8	U	28						
14.3 m (47.0')								El. 2323.7 m (7623.6') — SILTY SAND (SM) - gray-brown, wet, medium dense, fine to medium grained, trace gravel, [STRATUM I].
15.3	SPT	19						
16.8	U	20						
17.4 m (57.0')								El. 2320.6 m (7613.6') — SILT (MH) - red-gray, moist, stiff, [STRATUM II].
18								

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 9/16/2004	35321	NM State Highway 126	BR-16
	Completed: 9/17/2004			
	Backfilled: 9/17/2004	Rig Type: Track CME 300	Surface Elevation: 2338.0 m (7670.6')	Logged By: C. Bhongir
Northing: 3972731		Easting: 344516	Location: 2+405, 0.3 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.2 (4)	4:48:00 PM	9/16/2004

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	18										SILT (MH) - red-gray, moist, stiff, [STRATUM II].
				SPT	9						
	19										
	20			U	18						
	21										21.3 m (70.0') El. 2316.7 m (7600.6')
				U	58						MUDSTONE - red-brown, highly weathered to decomposed, soft, ABO FORMATION [STRATUM V].
	22										
				SPT	50/3"						22.8 m (74.8') El. 2315.2 m (7595.9')

Total Depth 22.8 m (74.8')

KLEINFELDER — Boring Log

Date		Project Number	Project	Boring No.
Started: 10/22/2003		35321	NM State Highway 126	MSE-01
Completed: 10/22/2003				
Backfilled: 10/22/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3973032		Easting: 344609	Location: 2+740, 2 m R	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3 " O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
10.8 (35.5)	5:00:00 PM	10/22/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0–0.5	SPT	22	4.4		NV	NP	16	SILTY SAND (SM) - light brown, dry, loose to medium dense, fine to medium grained sand, with gravel, some cobbles, weakly cemented.
1.5–2.0	SPT	8	10.6					
3.0–3.5	SPT	3	8.4					Very loose.
4.5–5.0	SPT	12						
5.2–5.8								Possible boulder from 17 to 19 ft. (5.2 to 5.8 m).
6.0–6.5	SPT	11						
7.6–8.1	SPT	10						7.9 m (26.0')
7.9–9								SILTY GRAVEL (GM) - dark brown, dry, loose, fine to coarse grained gravel, with fine to coarse grained sand. possibly Abo

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/22/2003		35321	NM State Highway 126	MSE-01
Completed: 10/22/2003				
Backfilled: 10/22/2003		Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3973032		Easting: 344609	Location: 2+740, 2 m R	

Sample Type
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
10.8 (35.5)	5:00:00 PM	10/22/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	9										SILTY GRAVEL (GM) - dark brown, dry, loose, fine to coarse grained gravel, with fine to coarse grained sand.
			X	SPT	50/5.50"						With increased gravel content.
	10										
∇											10.8 m (35.5')
			X	SPT	9						SANDY SILT (ML) - brown, wet, medium stiff, some gravel, weakly cemented, low plasticity.
	11										11.1 m (36.5')

Total Depth 11.1 m (36.5')

KLEINFELDER — Boring Log

Date — Started: 11/11/2003	Project Number 35321	Project NM State Highway 126	Boring No. MSE-02
Completed: 11/11/2003			
Backfilled: 11/11/2003	Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3974247	Easting: 345096	Location: 4+220, 20 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0										
			X	SPT	4	3.5				21	SILTY SAND (SM) - gray-brown, dry, loose, fine to coarse grained, with gravel, trace crystals, low plasticity, some moderately cemented seams, (possible Bandelier tuff).
	1										
			X	SPT	9						Weakly cemented, with moderately cemented seams.
	2										
	3		X	SPT	14						Gray, ash-like, fine grained, without sand. Medium dense, trace to no cemented seams and layers.
	4										
			X	SPT	15						4.7 m (15.5')

Total Depth 4.7 m (15.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/11/2003	35321	NM State Highway 126	MSE-03
	Completed: 11/11/2003			
	Backfilled: 11/11/2003	Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3974847		Easting: 13345333	Location: 4+860, 10 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	3						SILT (ML) - dark brown, dry, soft, trace coarse sand, some roots, low plasticity.
	1		X	SPT	4	14.4					Brown, with gravel, with cobbles, some boulders.
	1.8 m (6.0')										SILT (ML) - red-brown, dry, stiff, with strongly cemented zones, with pumice nodules, low plasticity, (possible Bandelier tuff).
	3		X	SPT	11						
	4.0 m (13.0')										SILTY GRAVEL (GM) - red-brown, dry, medium dense, fine to coarse grained, with pumice, with fine to coarse sand.
	4.5		X	SPT	15	6.9				15	
	4.7 m (15.5')										

Total Depth 4.7 m (15.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 11/11/2003		35321	NM State Highway 126	MSE-04
Completed: 11/11/2003				
Backfilled: 11/11/2003		Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3974882		Easting: 345309	Location: 4+900, 6 m R	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3 " O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
(none)		

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0–0.6	SPT	4						SANDY SILT (ML) - brown, soft, some organics, low plasticity.
0.6 m (2.0')								SILTY SAND (SM) - brown, dry, medium dense, fine to medium grained sand, with cobbles, with boulders.
~1.5	SPT	18	4.9					
~2.5								Red-brown, with abundant dark gray pumice fragments, weakly cemented, (possible Bandelier tuff).
~3	SPT	13						
~4.2								Gray, very dense, with white nodules, trace crystals, moderately cemented, with highly cemented seams, with pumice.
~4.5	SPT	50/5.00"	24.4				36	
~6	SPT	50/5.50"						
~7.6	SPT	69						
7.8 m (25.5')								

Total Depth 7.8 m (25.5')

KLEINFELDER

Boring Log

Date	Started: 10/23/2003	Project Number 35321	Project NM State Highway 126	Boring No. MSE-05
	Completed: 10/23/2003			
	Backfilled: 10/23/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3976070		Easting: 345558	Location: 6+130, CL	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
7.3 (24)	9:55:00 AM	10/23/2003

Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0								SILTY SAND (SM) - dark brown, dry, loose, fine to medium grained, some gravel.
	SPT	9	4.4				18	
1								
	SPT	8	4.1					Brown, with gravel, some cobbles.
2								
								Medium dense, weakly cemented.
3								
	SPT	19	4.1				15	
4								
	SPT	20						
5								
6								Red-brown.
	SPT	11						
7								
7.3 m (24.0') ∇								SILTY GRAVEL (GM) - gray, wet, loose, fine to coarse grained gravel, with medium to coarse sand, (possible Bandelier tuff).
	SPT	8						
8								
9								

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/23/2003	35321	NM State Highway 126	MSE-05
	Completed: 10/23/2003			
	Backfilled: 10/23/2003	Rig Type: CME 75	Surface Elevation:	Logged By: T Retterer
Northing: 3976070		Easting: 345558	Location: 6+130, CL	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
7.3 (24)	9:55:00 AM	10/23/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	9										SILTY GRAVEL (GM) - gray, wet, loose, fine to coarse grained gravel, with medium to coarse sand, (possible Bandelier tuff).
			X	SPT	9						
											9.8 m (32.0')
	10										SAND (SP) - gray, wet, medium dense, medium to coarse grained sand, with gravel, (possible Bandelier tuff).
	11		X	SPT	12						11.1 m (36.5')

Total Depth 11.1 m (36.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 11/12/2003	Completed: 11/12/2003	35321	NM State Highway 126	MSE-06
Backfilled: 11/12/2003		Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3976930		Easting: 346000	Location: 7+100, 10 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
0.9 (3)	8:27:00 AM	11/12/2003

Groundwater Depth (m)	Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0	SPT	13	10.1				23	SILTY SAND (SM) - brown, moist, medium dense, fine to coarse grained sand, with gravel.
▽	1								Dark brown, wet, loose.
		SPT	6	23.4					
	2								
	2.9 m (9.5')								
	3	SPT	11						SAND (SP) - gray, wet, medium dense, medium to coarse grained sand, with gravel, trace silt, weakly cemented, (possible Bandelier tuff).
	4								
		SPT	22	16.5					
	5								
	6	SPT	20						
									Without gravel from 21 to 24 ft..
	7								
	7.3 m (24.0')	SPT	13						SANDY SILT (ML) - gray, wet, stiff, with gravel, abundant iron oxide staining, weakly cemented, low plasticity, (possible Bandelier tuff).
	7.9 m (26.0')								
	8								SAND (SP) - red-gray, wet, very dense, medium to coarse grained sand, with Pumice, moderately cemented, (possible Bandelier tuff).
	9	SPT	57						

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/12/2003	Project Number 35321	NM State Highway 126	MSE-06
	Completed: 11/12/2003			
	Backfilled: 11/12/2003	Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3976930		Easting: 346000	Location: 7+100, 10 m R	

Sample Type:
G - Grab Sample
CS - 3.5" I.D. Continuous Sampler
SPT - 2" O.D. 1.38" I.D. Tube Sample
U - 3" O.D. 2.42" I.D. Ring Sample
ST - 3" O.D. Thin-Walled Shelby Tube
NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
0.9 (3)	8:27:00 AM	11/12/2003

Groundwater Depth (m)	Depth (m)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	9										
			X	SPT	57						9.3 m (30.5')

Total Depth 9.3 m (30.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/12/2003	35321	NM State Highway 126	MSE-07
	Completed: 11/12/2003			
	Backfilled: 11/12/2003	Rig Type: Track CME 300	Surface Elevation:	Logged By: T Retterer
Northing: 3977013		Easting: 345989	Location: 7+180, 4 m R	

Sample Type:
- G - Grab Sample
- CS - 3.5" I.D. Continuous Sampler
- SPT - 2" O.D. 1.38" I.D. Tube Sample
- U - 3" O.D. 2.42" I.D. Ring Sample
- ST - 3" O.D. Thin-Walled Shelby Tube
- NR - No Recovery

Groundwater

Depth, m (ft.)	Hour	Date
1.5 (5)	10:22:00 AM	11/12/2003

Groundwater Depth (m)	Depth (m)	Sample Type	Penetration Resistance (Blows / 0.3 m)	Moisture Content (%)	Dry Density (kN/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0	SPT	17	9.1					SILTY SAND (SM) - dark brown, dry, medium dense, fine to medium grained sand, with gravel, with cobbles, with possible boulders.
	1.4 m (4.5')								
▽ (1.5)		SPT	23	11.6				20	SILTY SAND (SM) - gray, moist, medium dense, medium to coarse grained sand, with gravel, some silt, weakly cemented, with pumice, (possible Bandelier tuff).
	3	SPT	13						
	4.5	SPT	14						Olive-gray, with increased silt content.
	5.2 m (17.0')								SAND (SP) - red-gray, wet, very dense, medium to coarse grained sand, with pumice, moderately cemented, (possible Bandelier tuff).
	6	SPT	50/3"						
	7.4 m (24.3')	SPT	50/3"						

Total Depth 7.4 m (24.3')

Appendix C

APPENDIX C
Site Photographs and Generalized Subsurface Profiles

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

KA LEGEND 4/27/03

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

PARTICLE SIZE LIMITS

CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		Fine	Medium	Coarse	Fine	Coarse		

0.002 mm — #200 — #40 — #10 — #4 — 3/4" — 3" — 12"

Terminology Used to Describe Soils Relative to their Standard Penetration (N) in blows per foot (ASTM D1586)

Relative Firmness		Relative Consistency		Relative Density	
SILTS, CLAYS & COHESIVE GRANULAR SOILS (partially saturated)	N	SILTS & CLAYS (saturated or near saturated)	N	SANDS AND GRAVELS (uncemented/cohesionless)	N
Hard	50+	Hard	30+	Very Dense	50+
Very Stiff	31-50	Very Stiff	16-30	Dense	31-50
Stiff	16-30	Stiff	9-15	Medium Dense	11-30
Medium Stiff	9-15	Medium Stiff	5-8	Loose	5-10
Soft	5-8	Soft	3-4	Very Loose	0-4
Very Soft	0-4	Very Soft	0-2		

▽ Initial Water Reading ▼ Second Water Reading

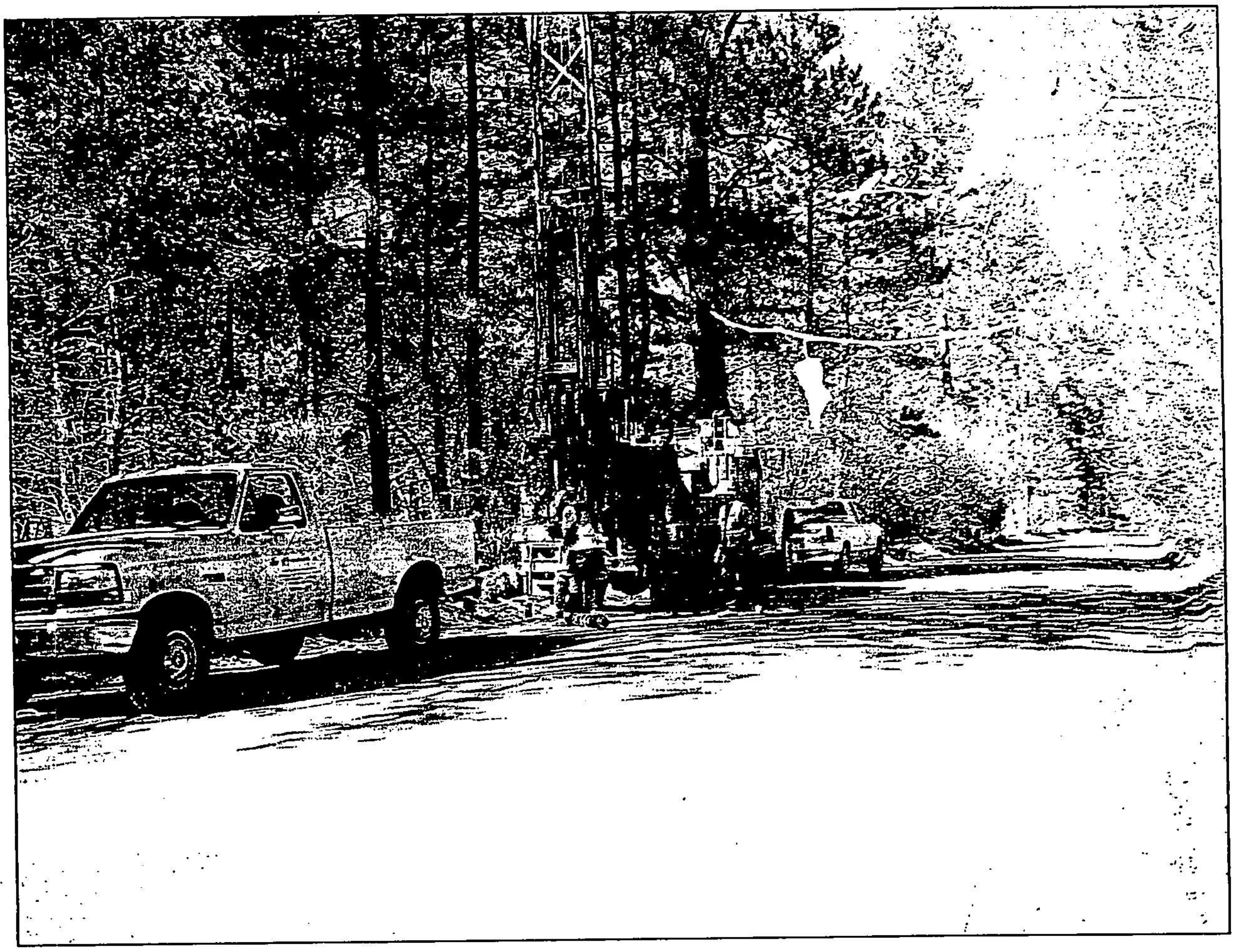
KLEINFELDER

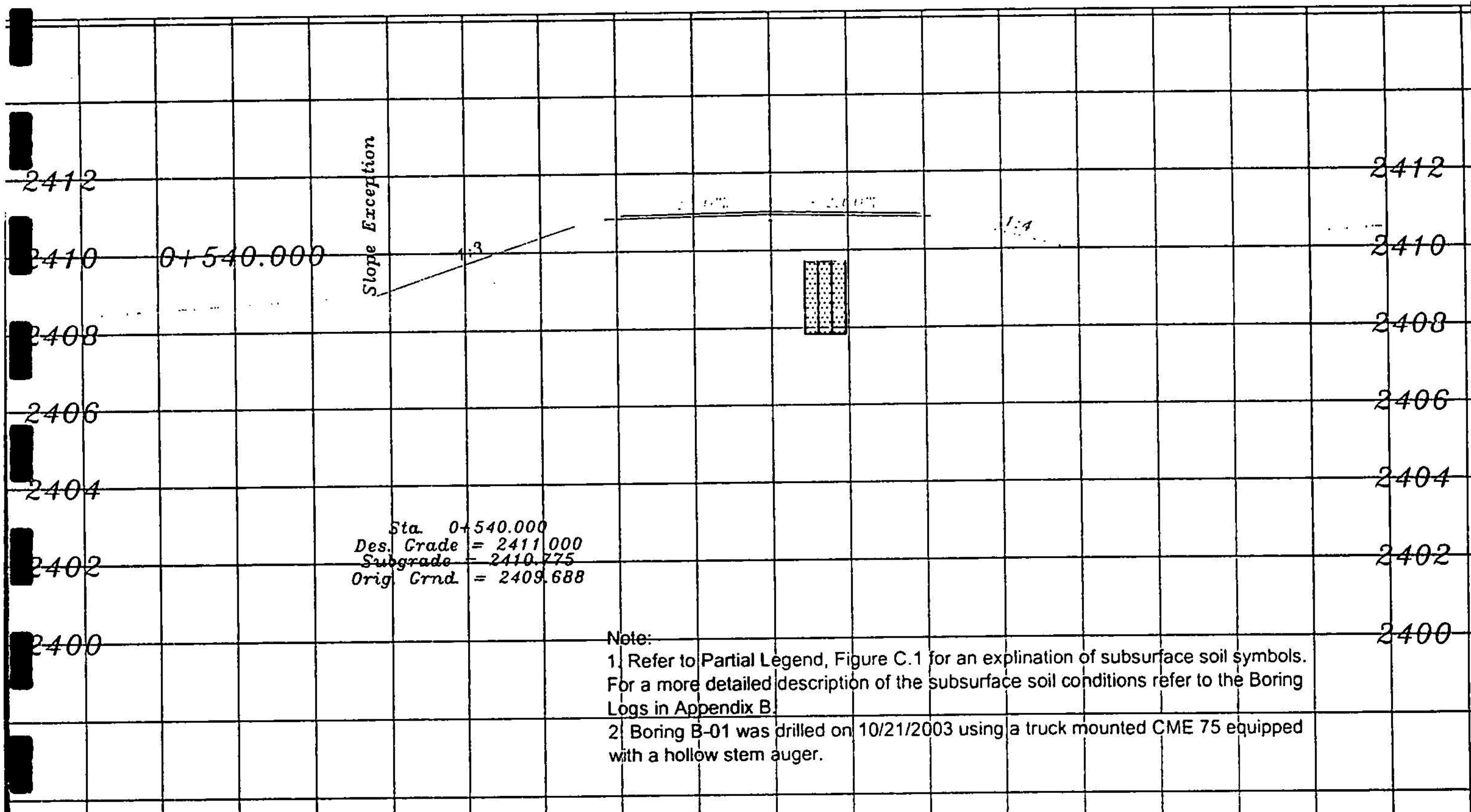
Project 35321

New Mexico Forest Highway 12
New Mexico State Highway 126
Cuba-LaCueva, New Mexico

Soil Classification Partial Legend

FIGURE **C.1**





Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-01 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER		BORING PROFILE Boring B-01 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE C.2
Drawn By: C. Landon	Date: January 2004		
Project No.: 35321	Filename: Figure C.2		

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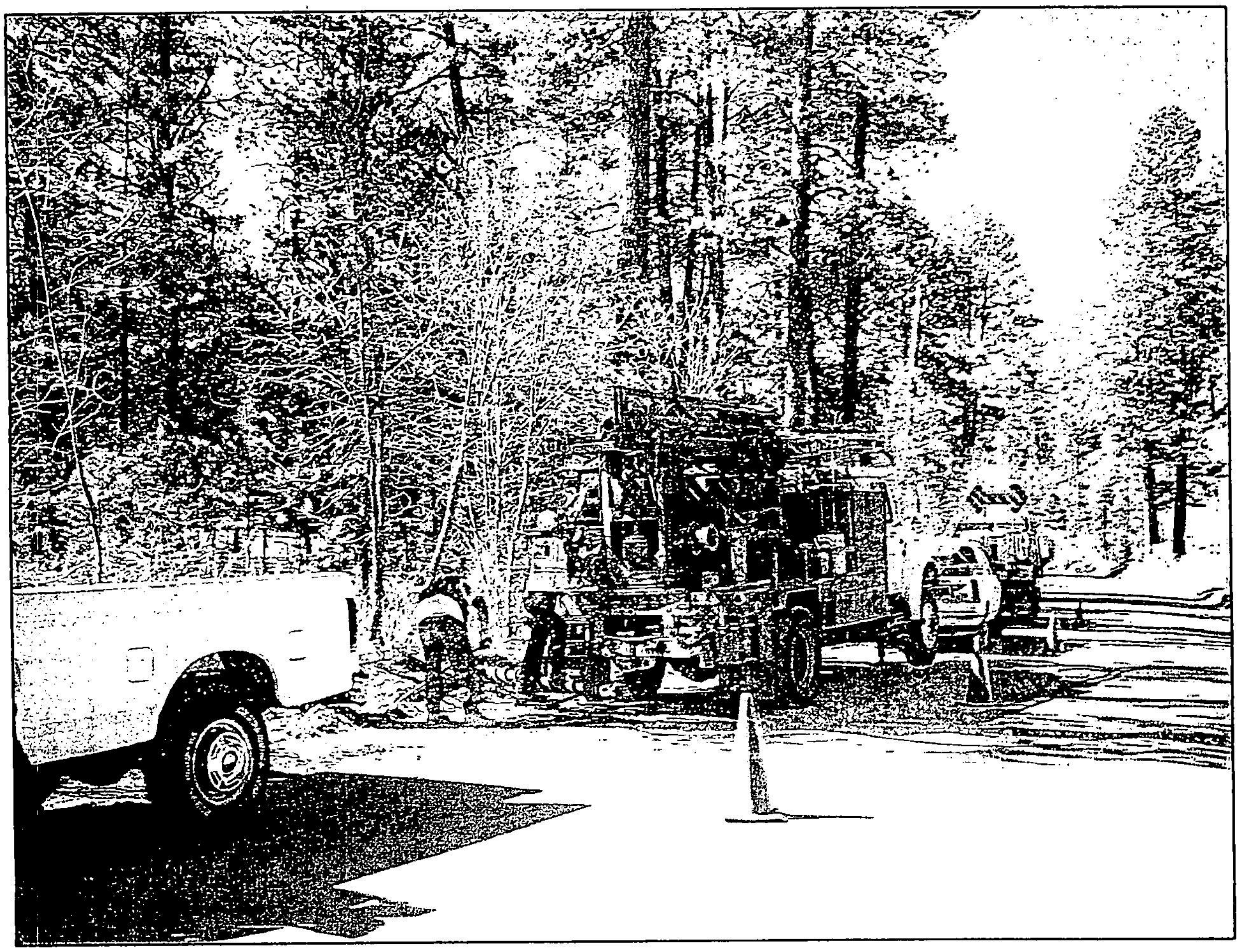
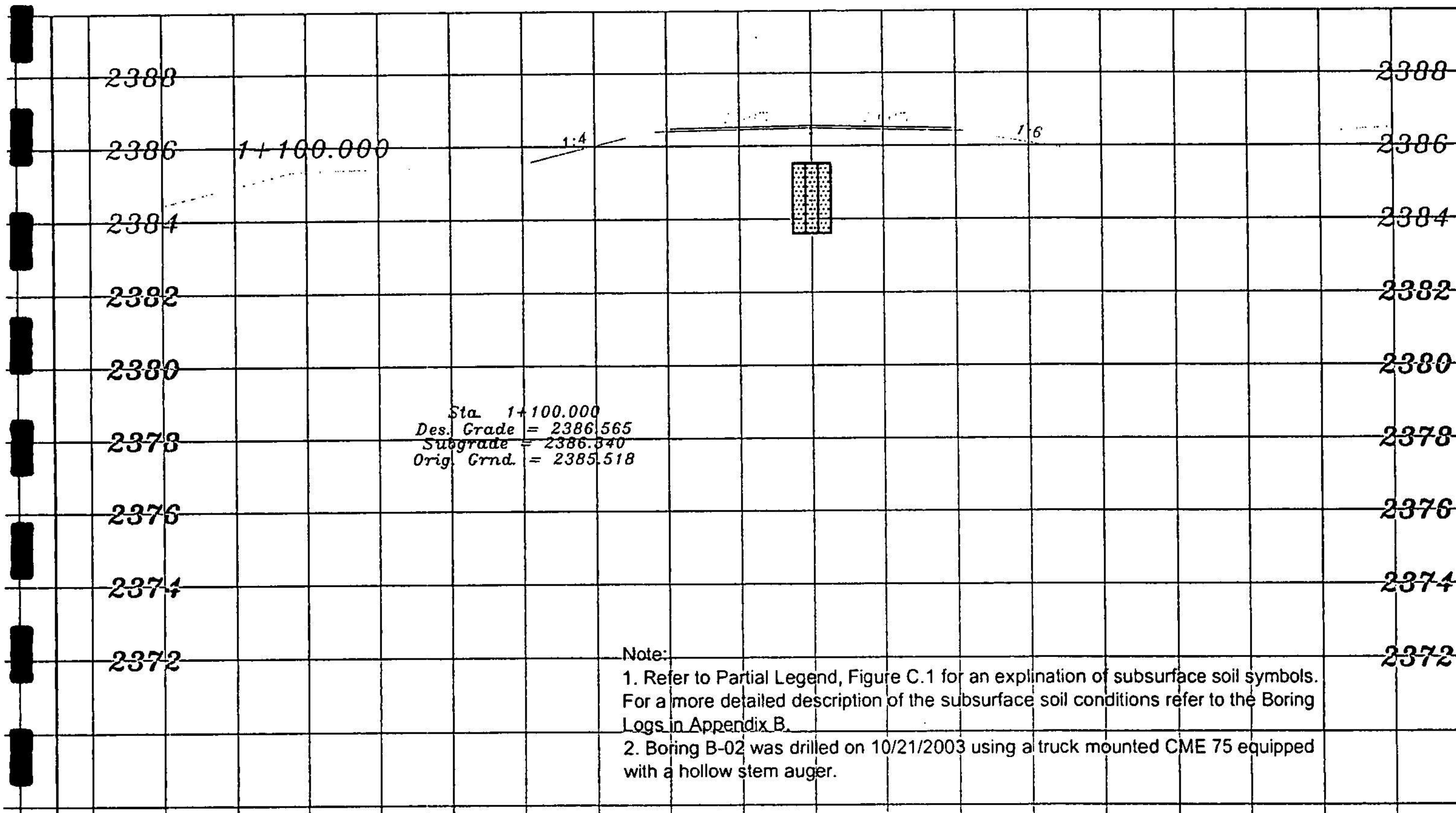




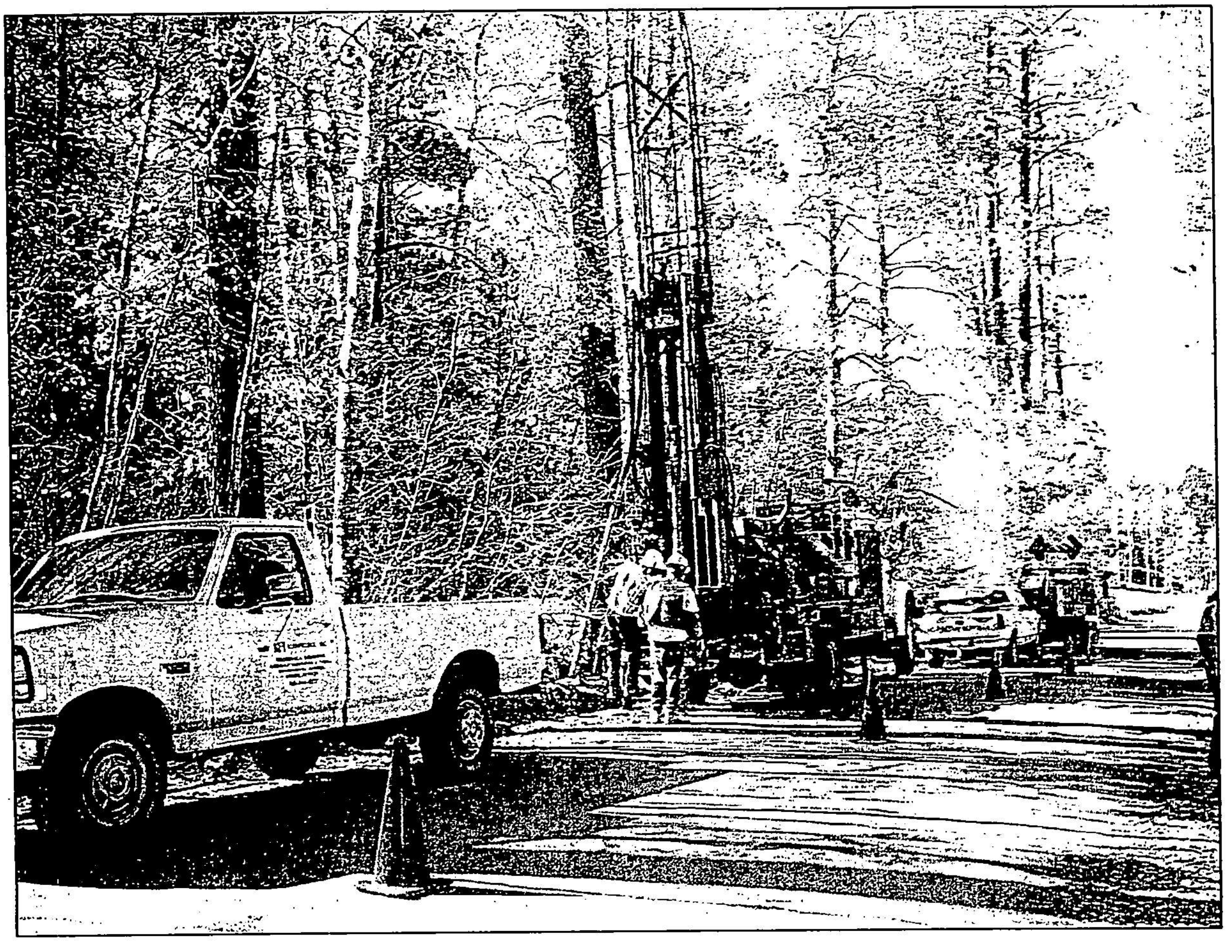
Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-02 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

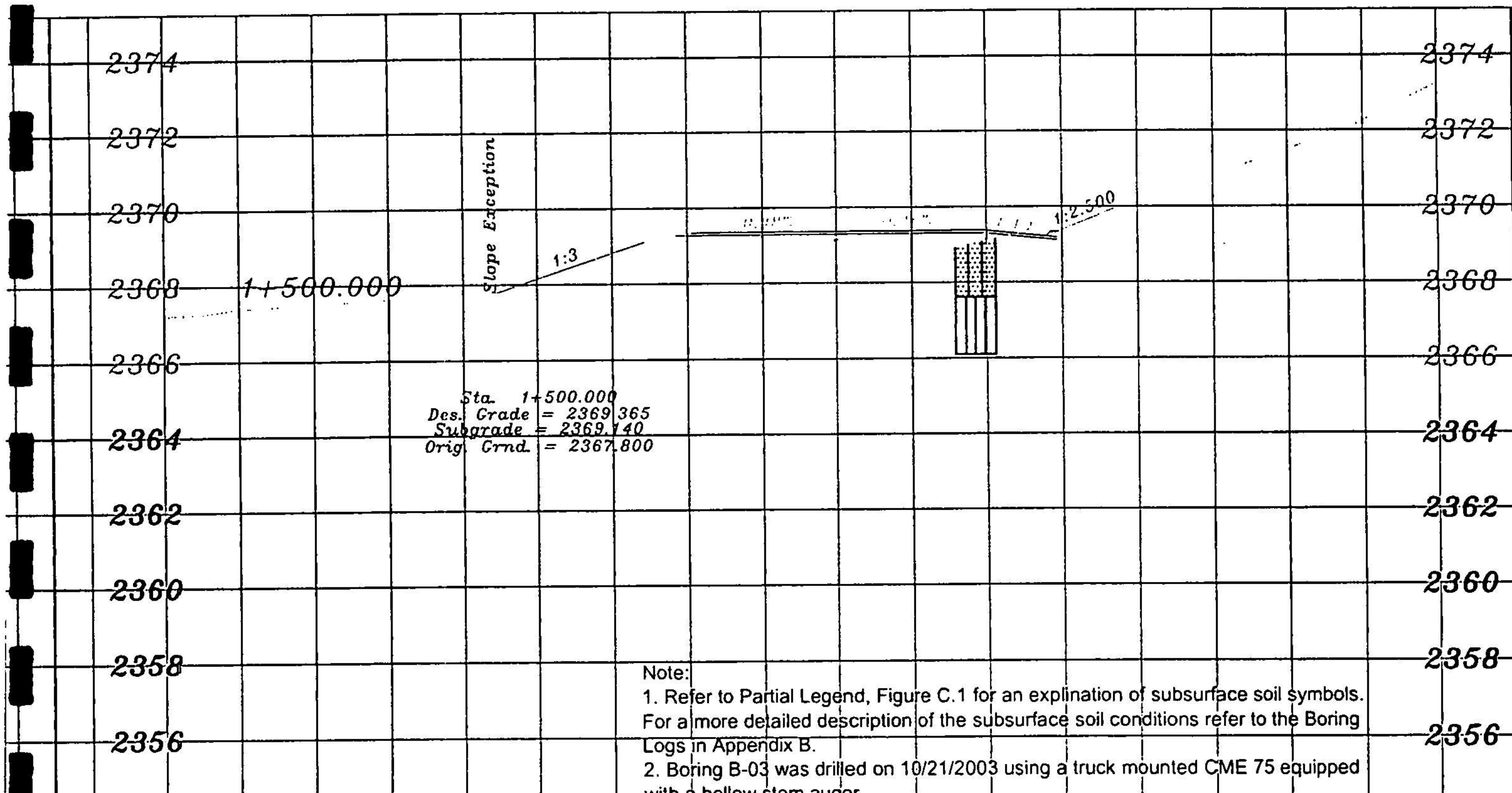
KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.3

BORING PROFILE
Boring B-02 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.3





Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-03 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER		BORING PROFILE Boring B-03 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE C.4
Drawn By: C. Landon	Date: January 2004		
Project No.: 35321	Filename: Figure C.4		

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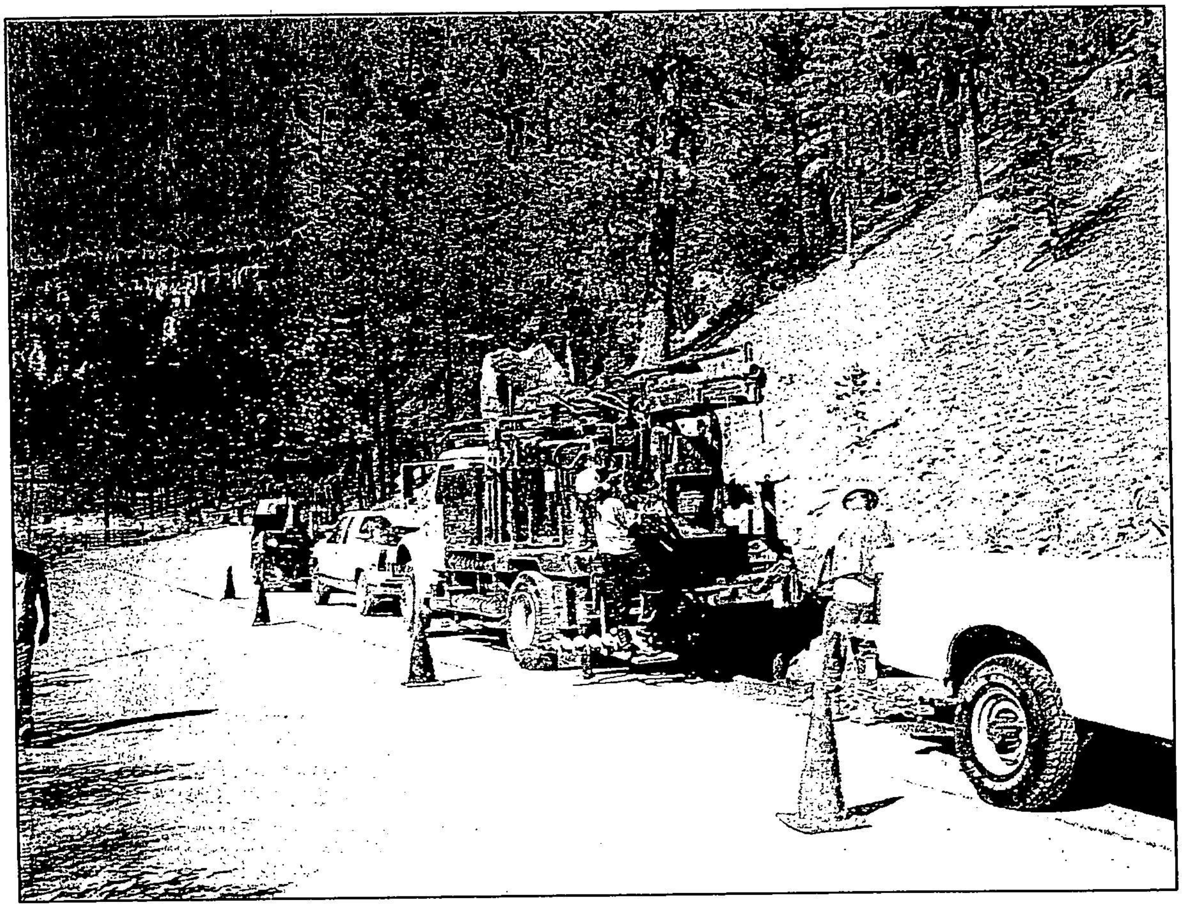
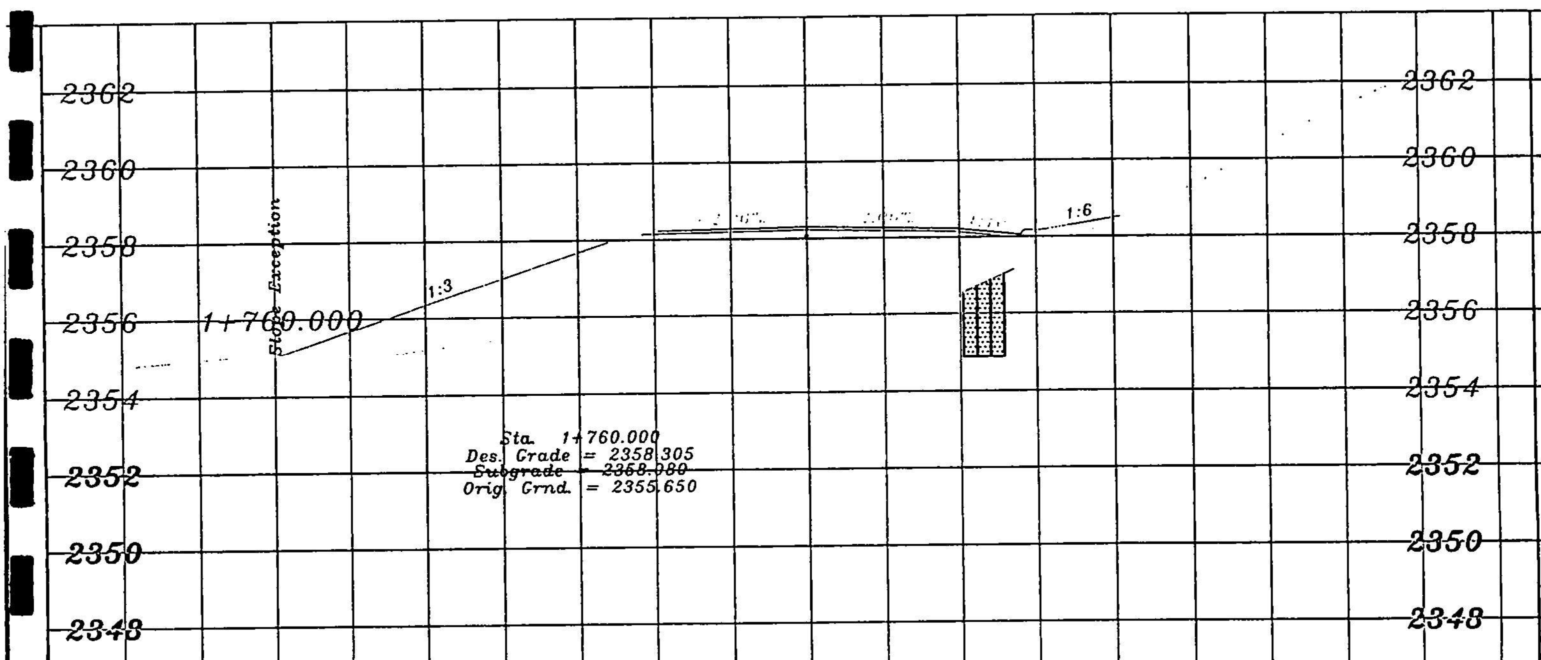
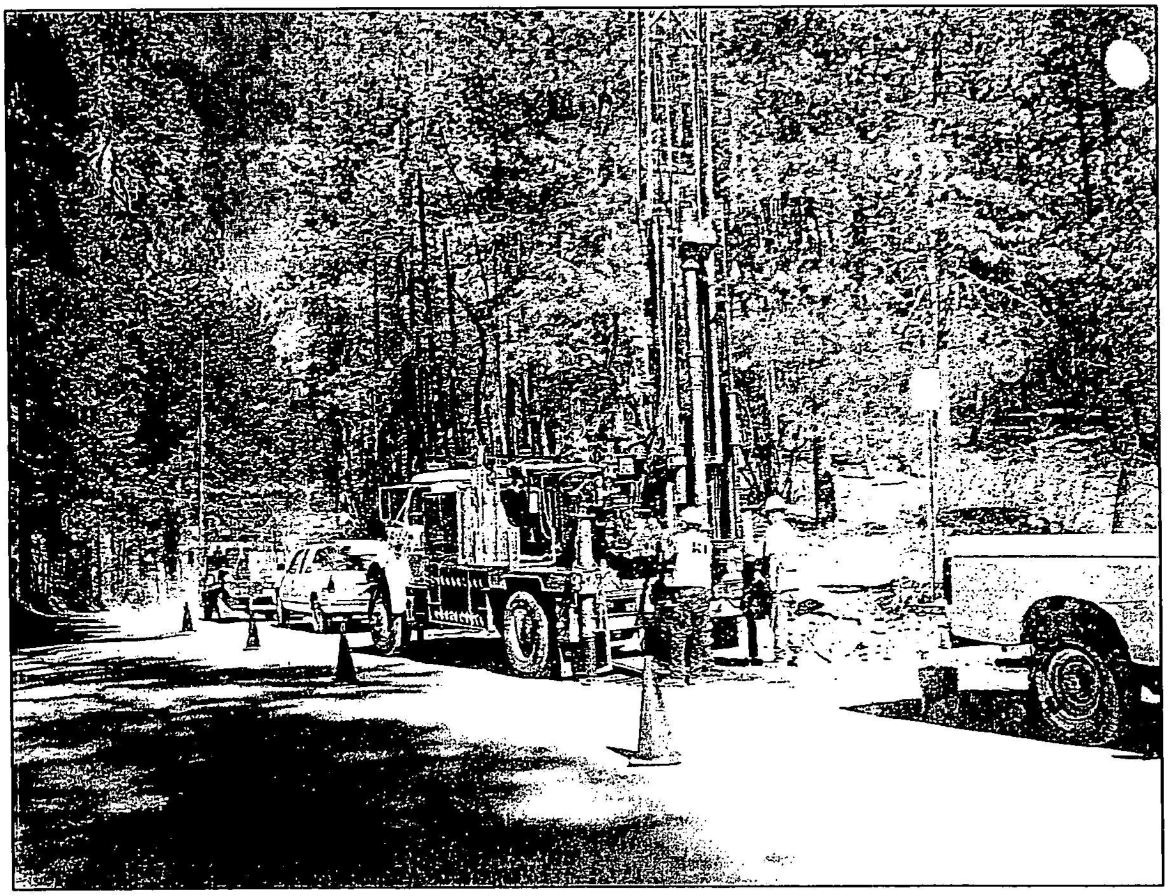
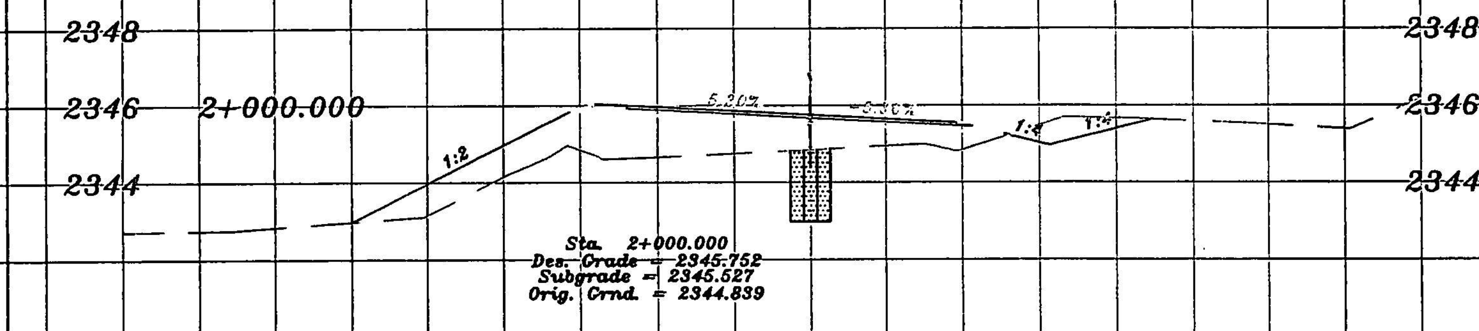




Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-04 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER		BORING PROFILE Boring B-04 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE C.5
Drawn By: C. Landon	Date: January 2004		
Project No.: 35321	Filename: Figure C.5		





Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-05 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: C.6

BORING PROFILE
Boring B-05 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.6

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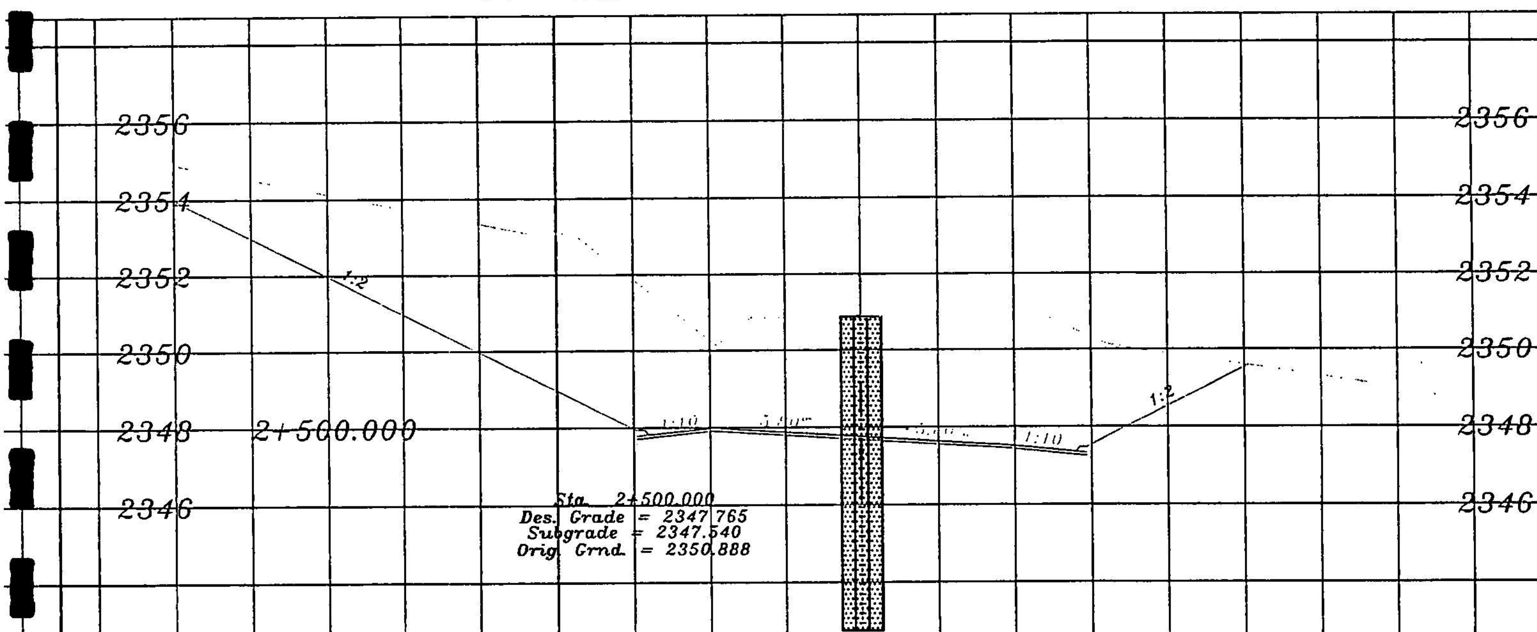

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-06 was drilled on 10/22/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

rawn By: C. Landon	Date: January 2004	**BORING PROFILE** **Boring B-06 Profile** **New Mexico Hwy. 126** **Cuba - La Cueva, New Mexico**	FIGURE **C.7**
roject No.: 35321	Filename: Figure C.7		

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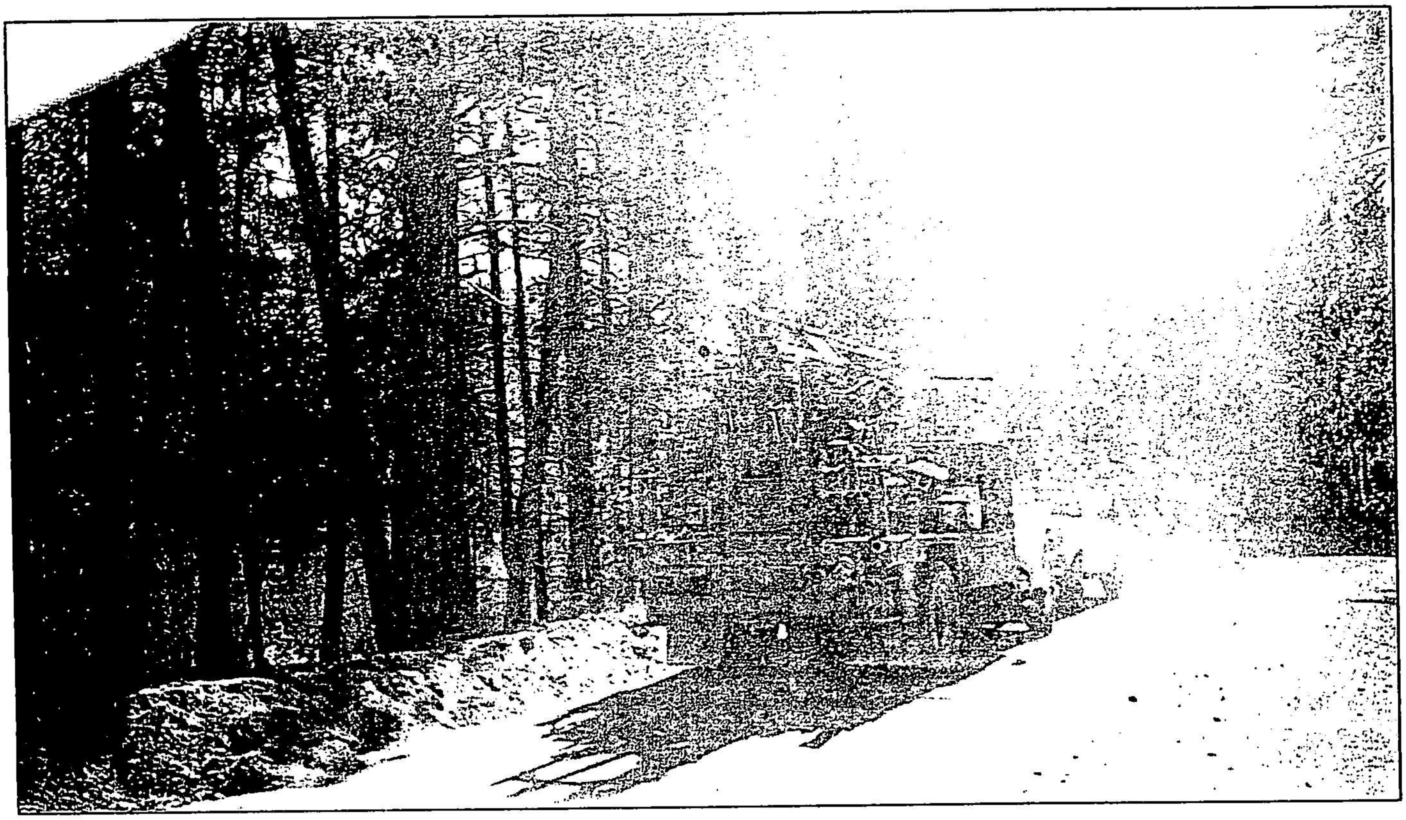

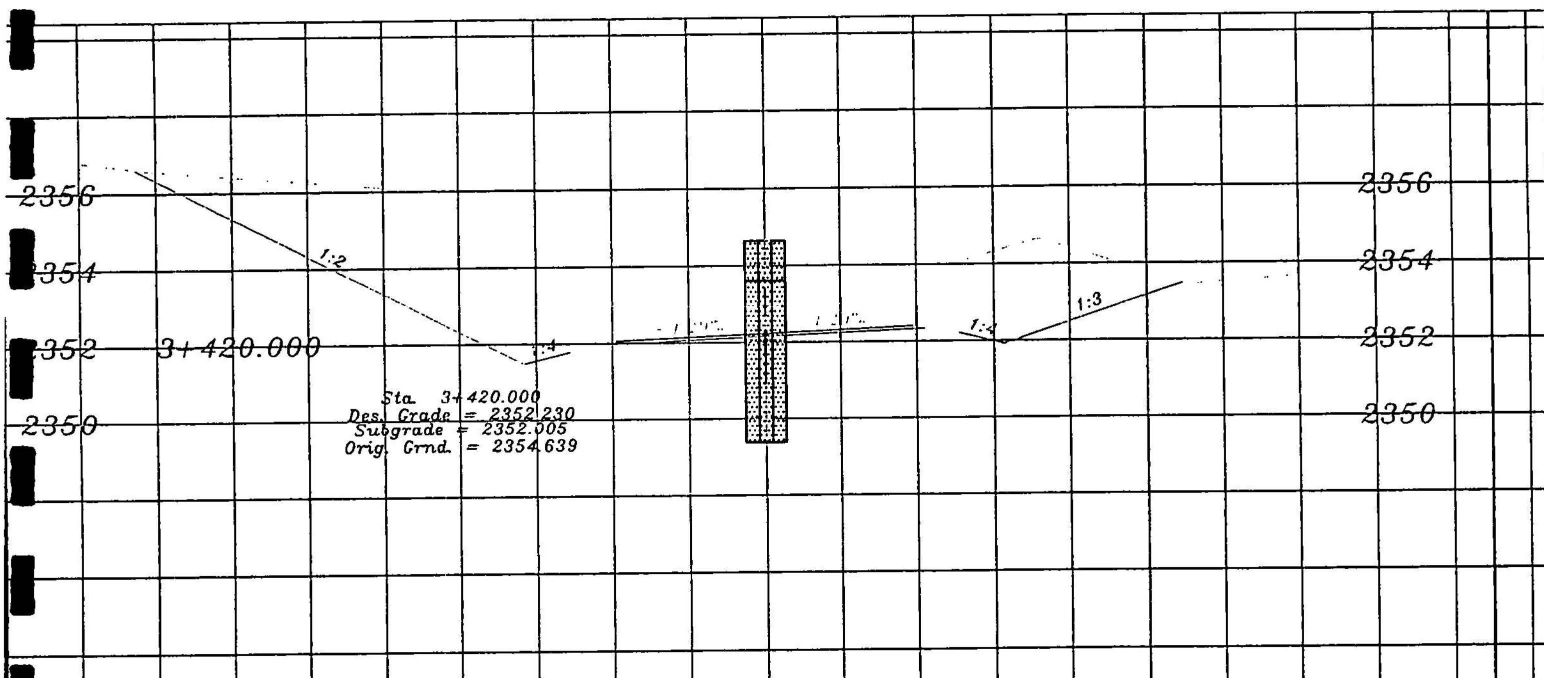

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-07 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: January 2004	**BORING PROFILE** **Boring B-07 Profile** **New Mexico Hwy. 126** **Cuba - La Cueva, New Mexico**	FIGURE **C.8**
Project No.: 35321	Filename: Figure C.8		

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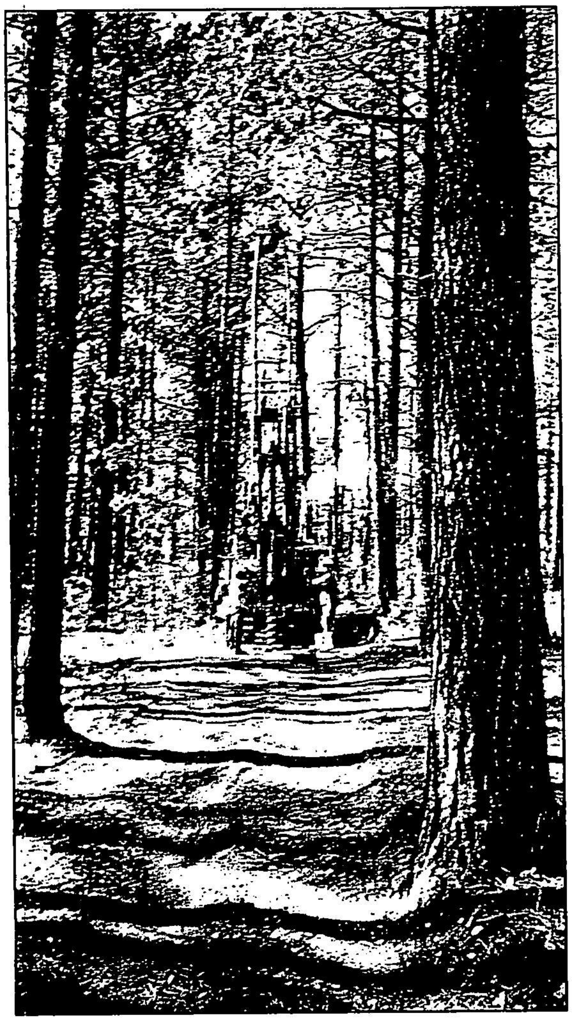

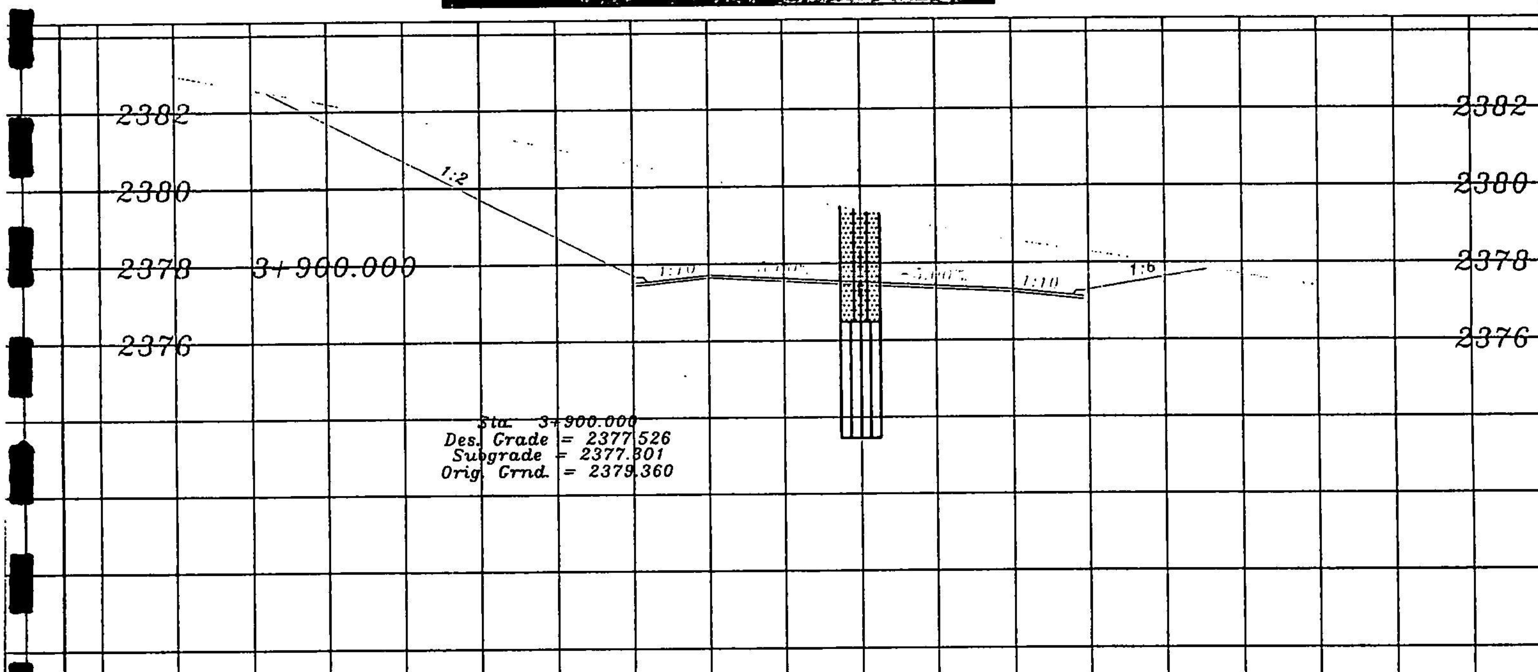

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-08 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.9

BORING PROFILE
Boring B-08 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.9

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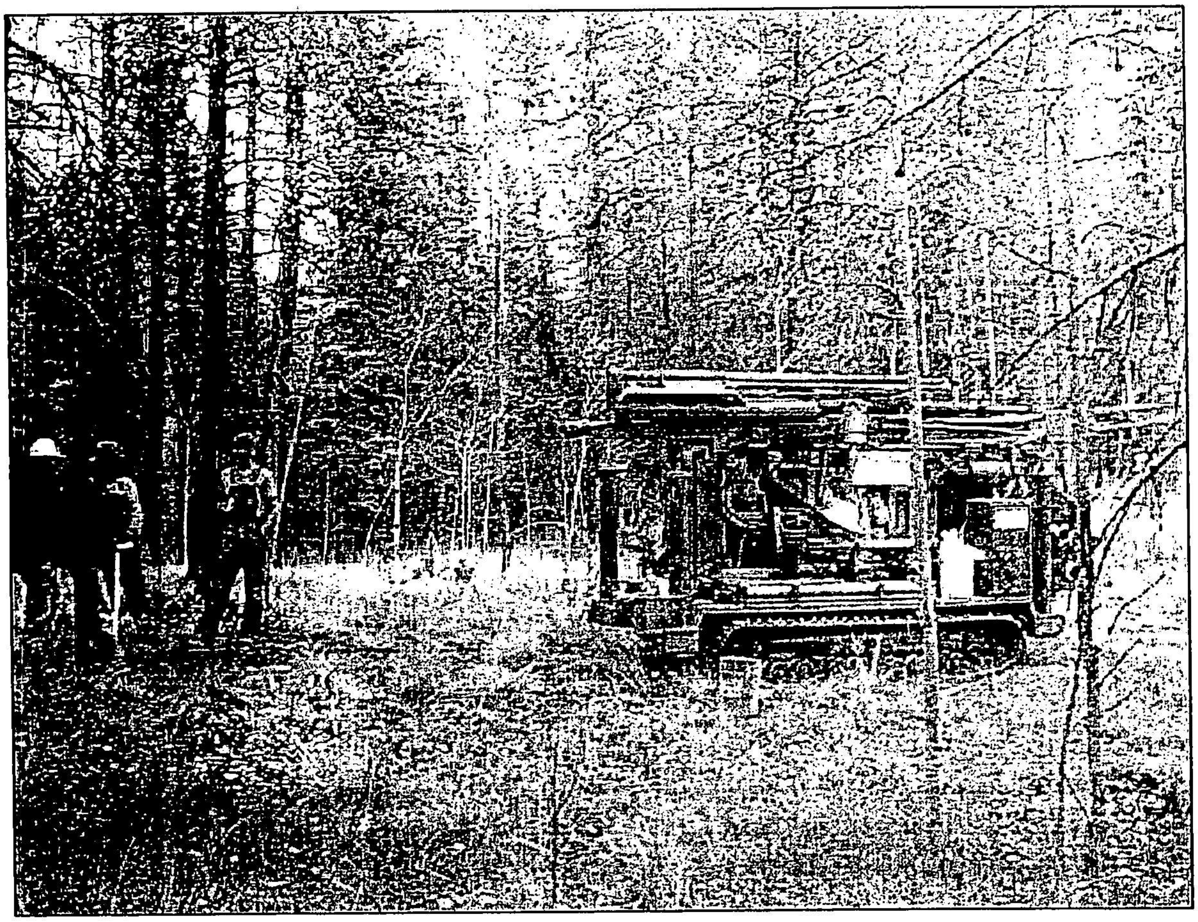

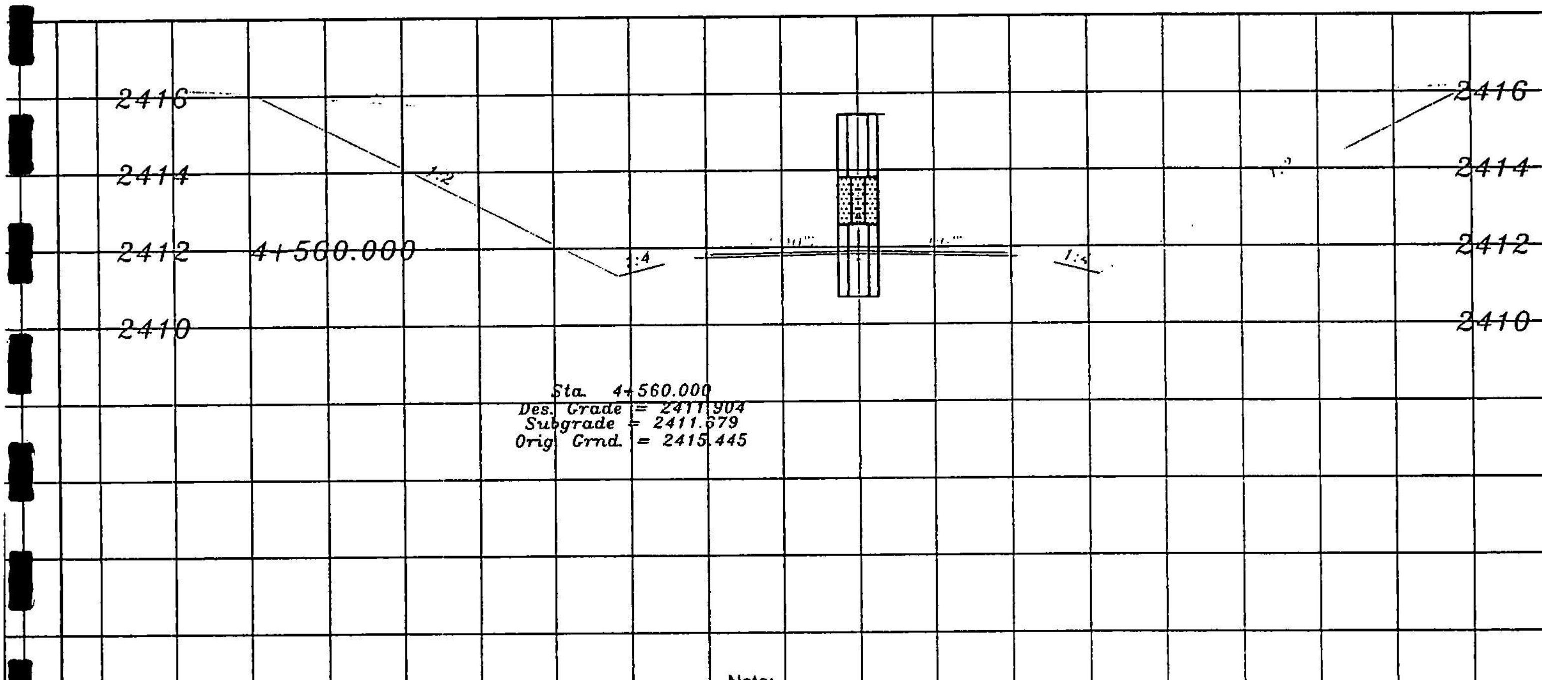

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-09 was drilled on 11/11/2003 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: January 2004	**BORING PROFILE** **Boring B-09 Profile** **New Mexico Hwy. 126** **Cuba - La Cueva, New Mexico**	FIGURE **C.10**
Project No.: 35321	Filename: Figure C.10		

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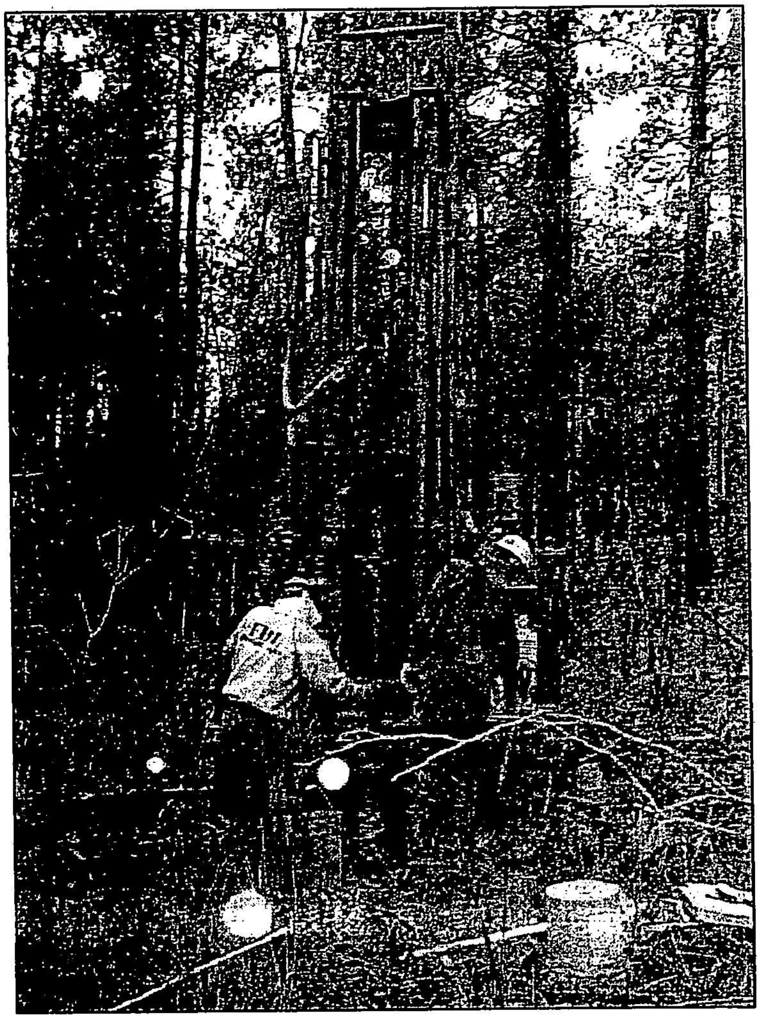

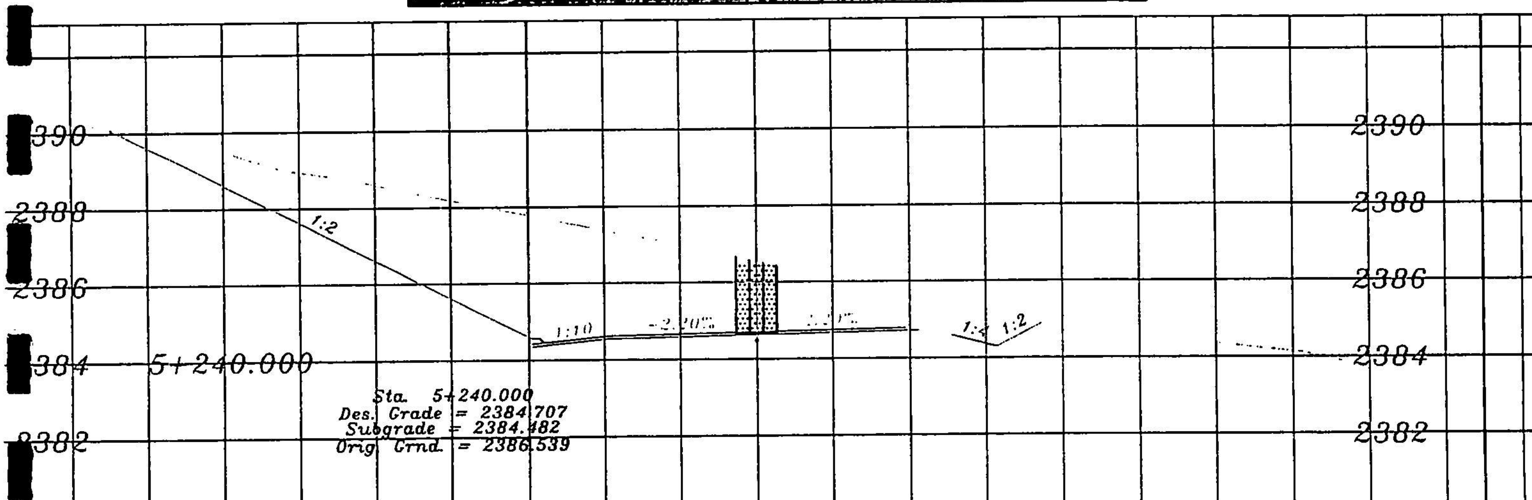

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-10 was drilled on 11/12/2003 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: January 2004	**BORING PROFILE** Boring B-10 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE **C.11**
Project No.: 35321	Filename: Figure C.11		

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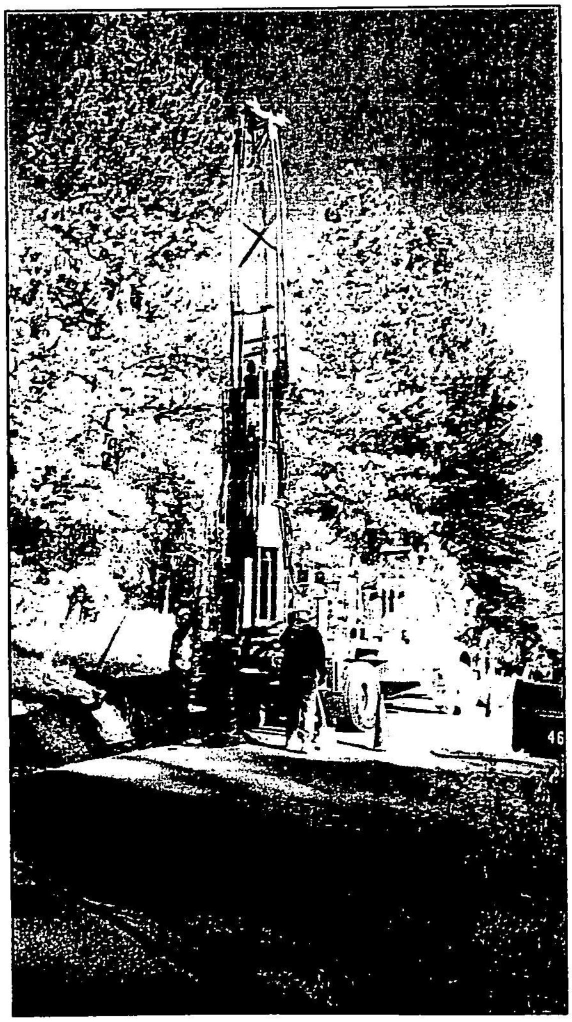

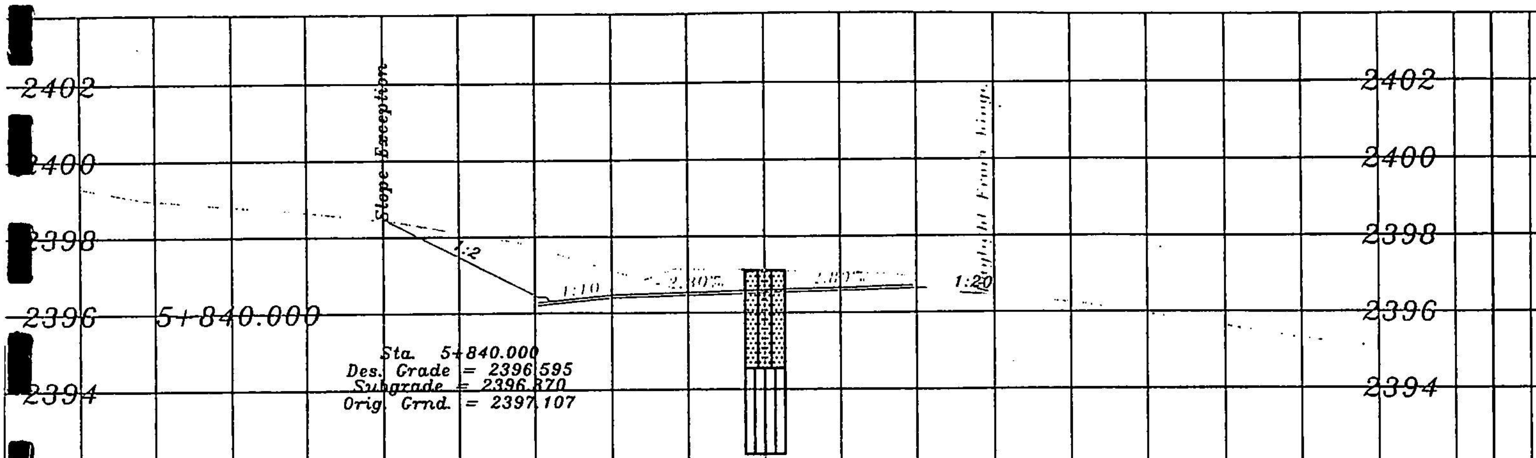

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-11 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.12

BORING PROFILE
Boring B-11 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE **C.12**

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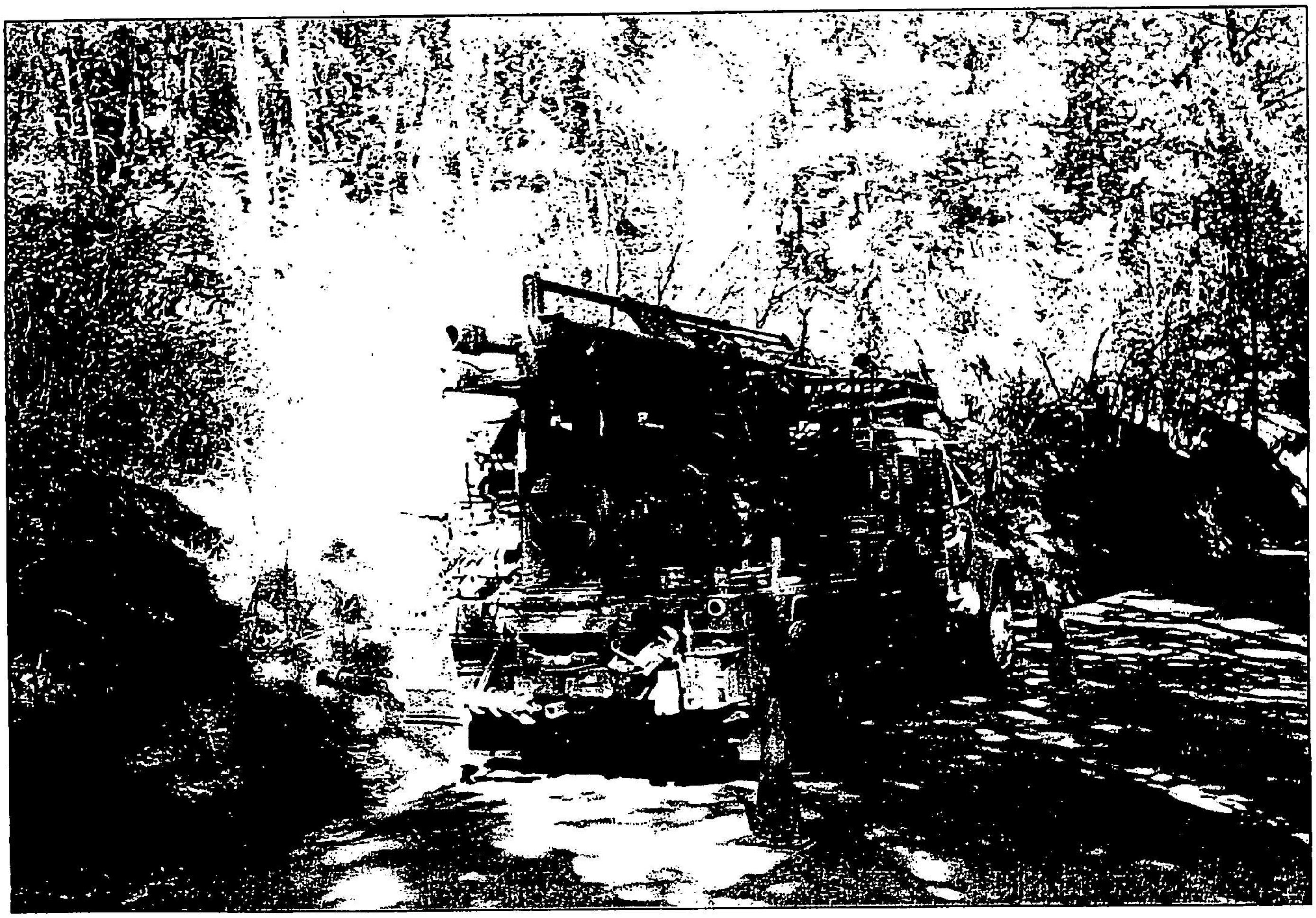
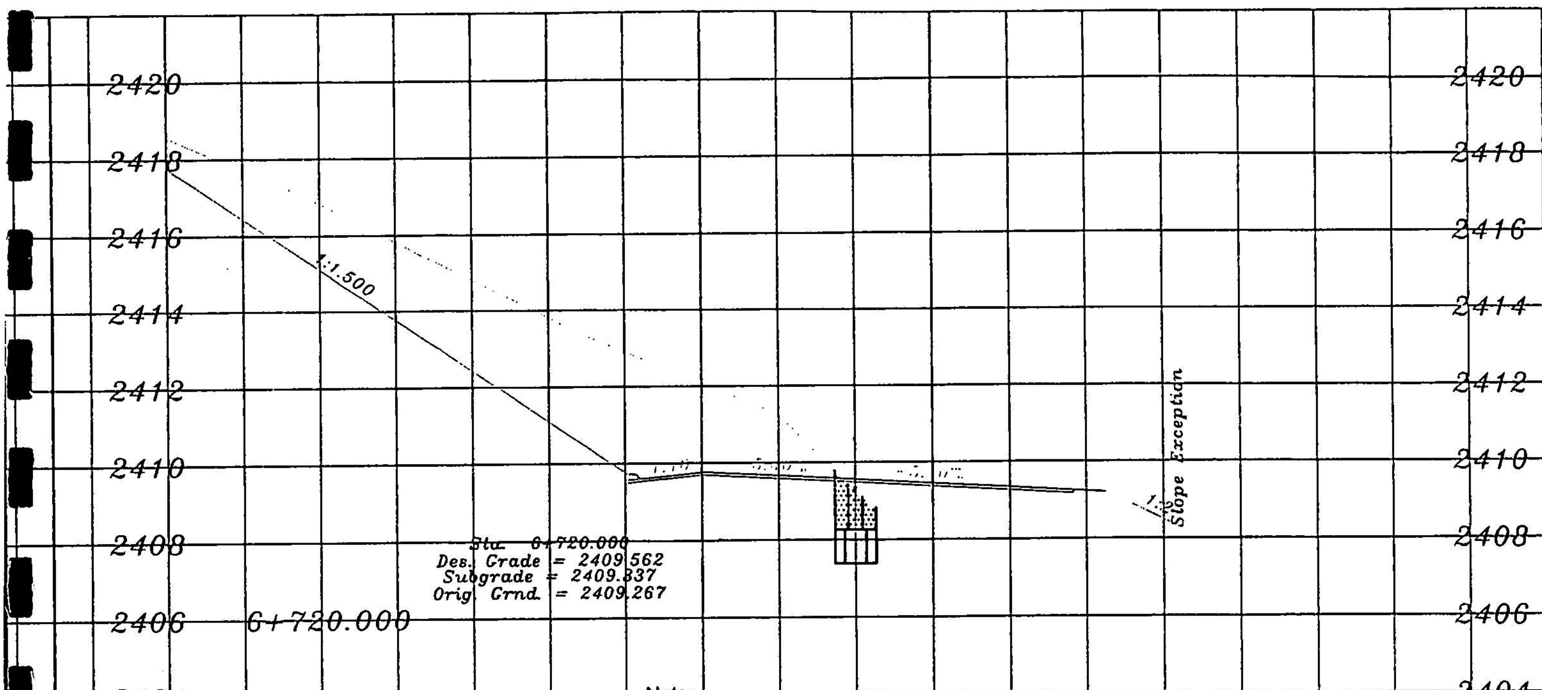
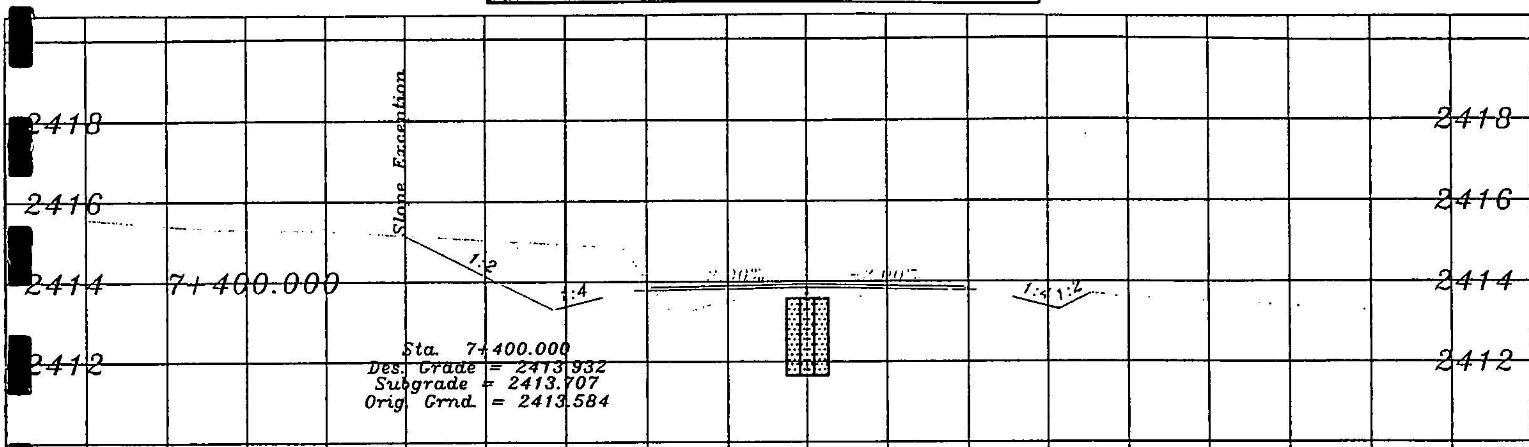




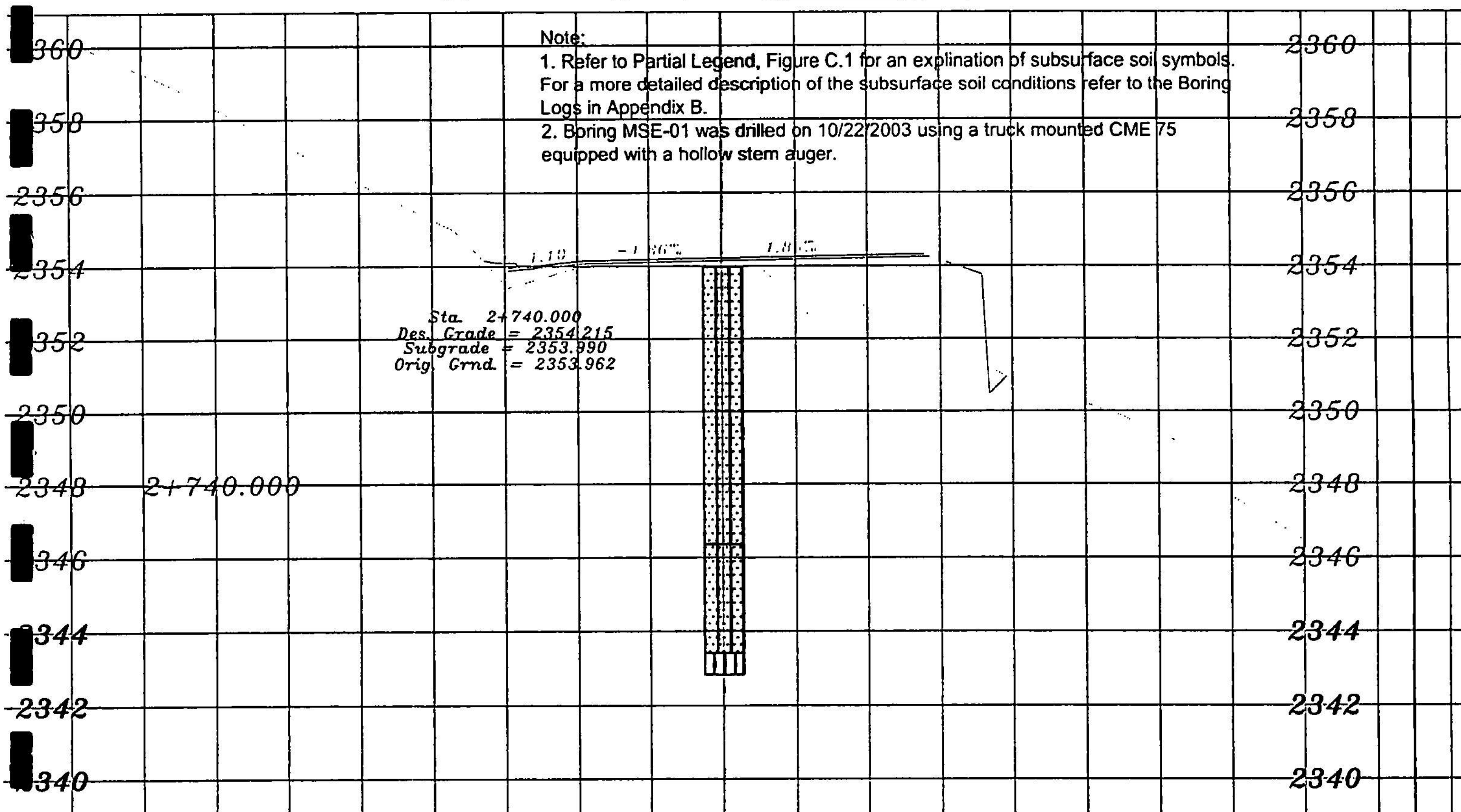
Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-12 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER		BORING PROFILE Boring B-12 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE C.13
Drawn By: C. Landon	Date: January 2004		
Project No.: 35321	Filename: Figure C.13		



Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring B-13 was drilled on 10/23/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

KLEINFELDER		BORING PROFILE Boring B-13 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico	FIGURE C.14
Drawn By: C. Landon	Date: January 2004		
Project No.: 35321	Filename: Figure C.14		



KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.19

BORING PROFILE
Boring MSE-01 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.15

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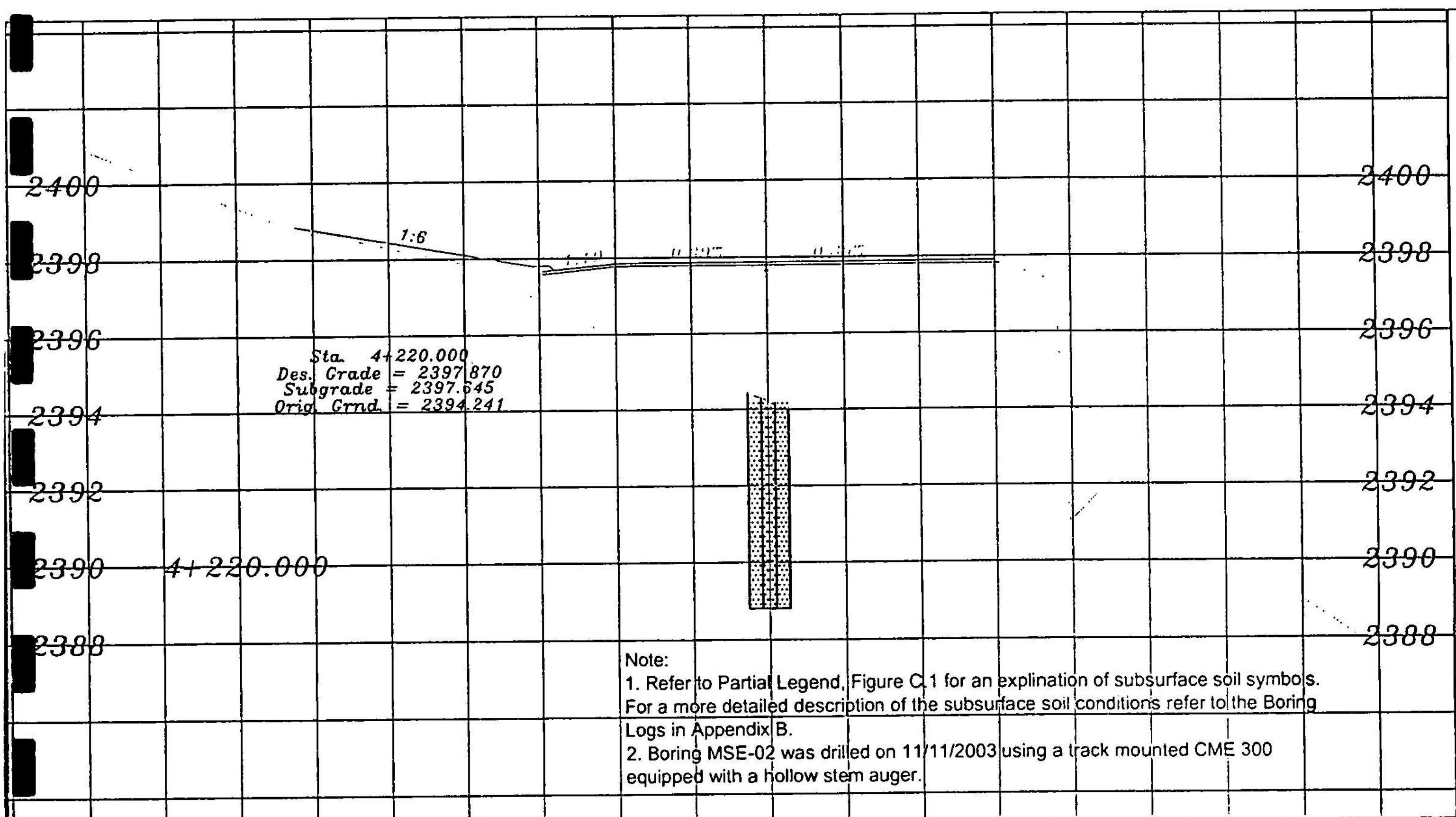
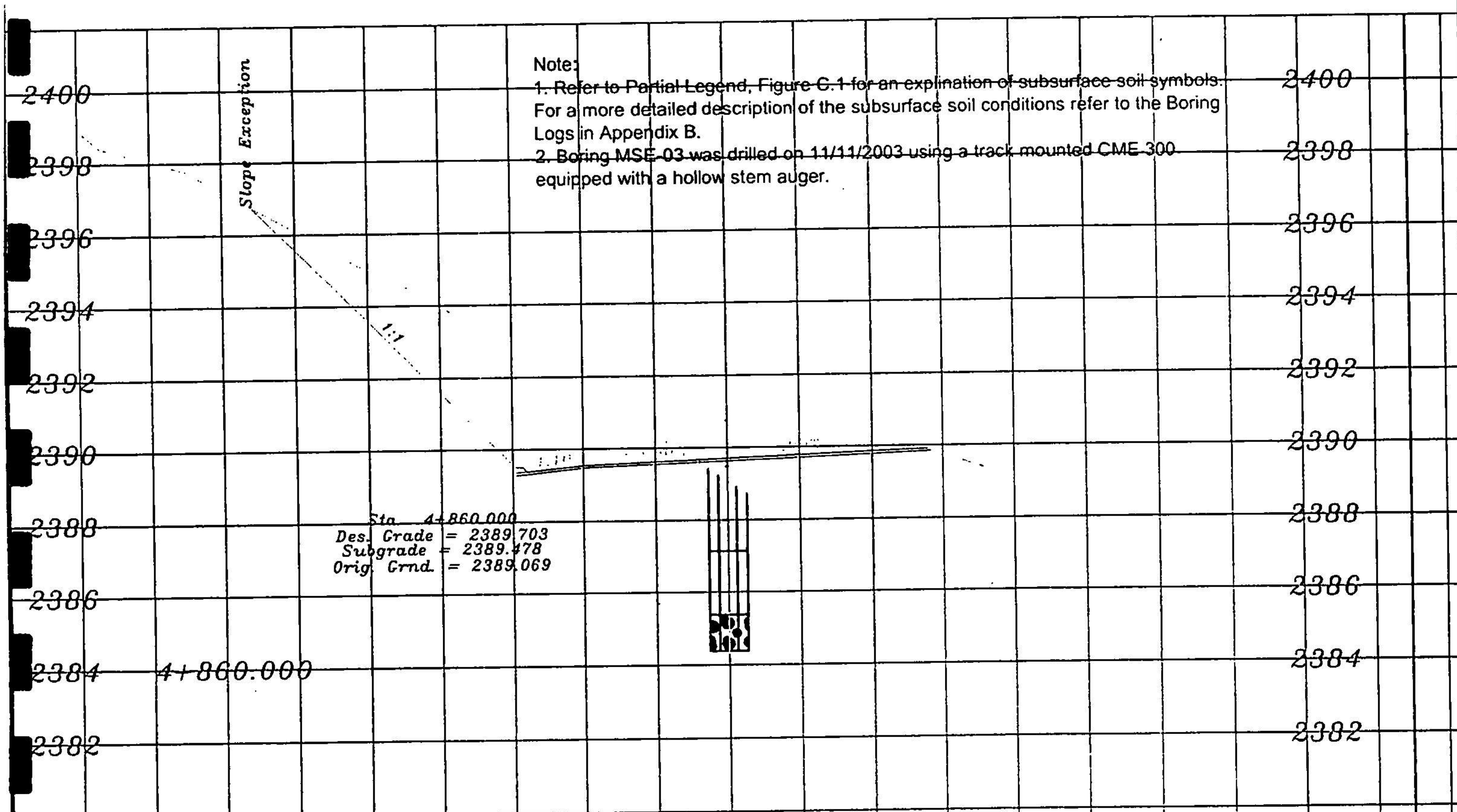


KLEINFELDER

BORING PROFILE
Boring MSE-02 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE **C.16**

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.20

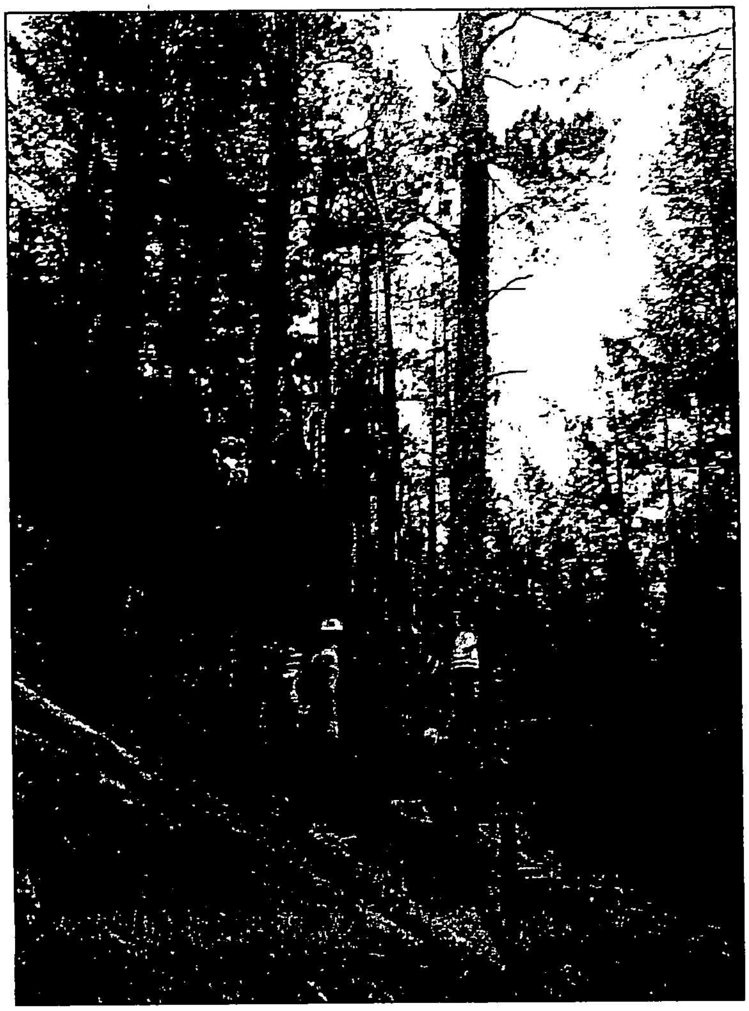


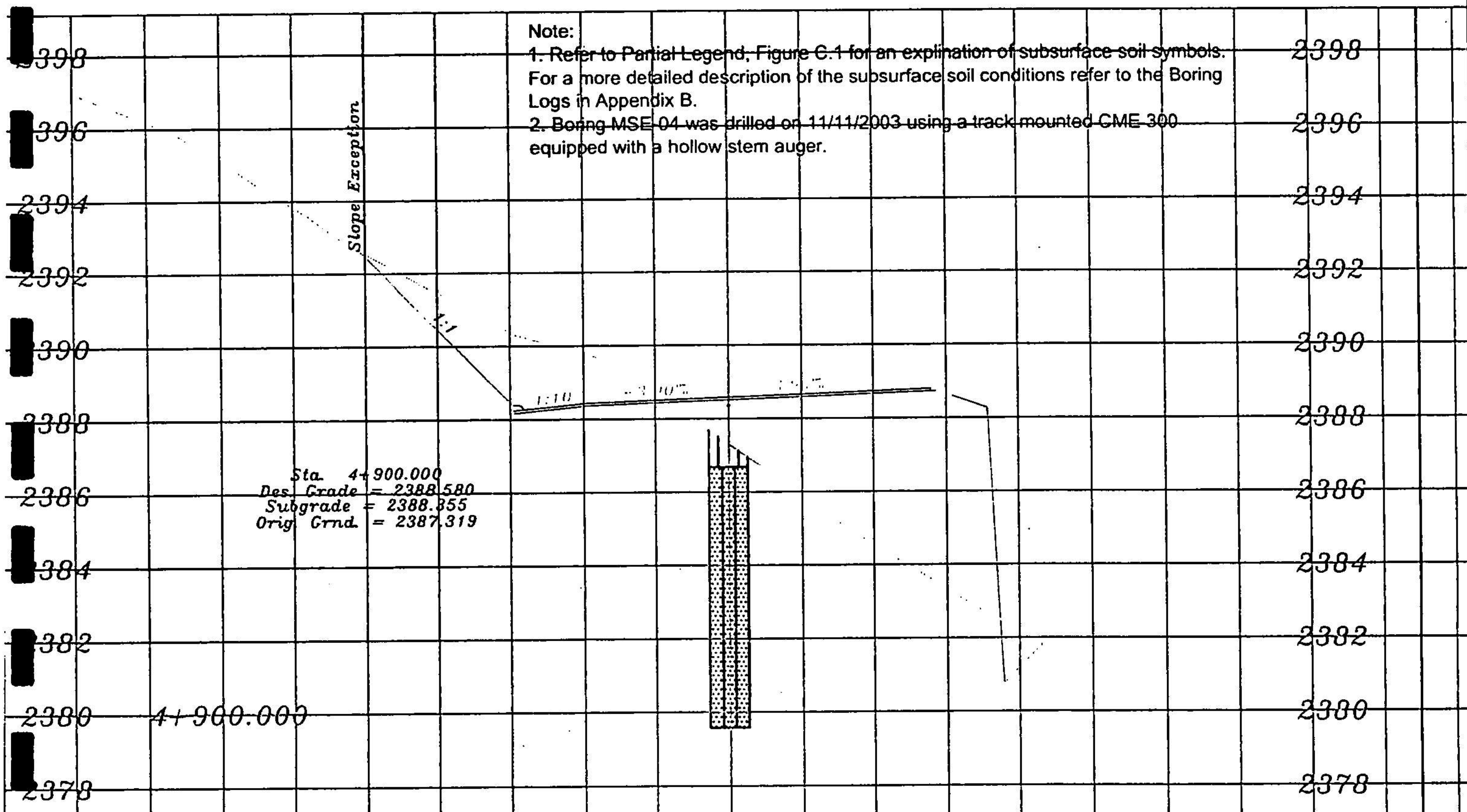
KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.21

BORING PROFILE
Boring MSE-03 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.17





KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.22

BORING PROFILE
Boring MSE-04 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.18

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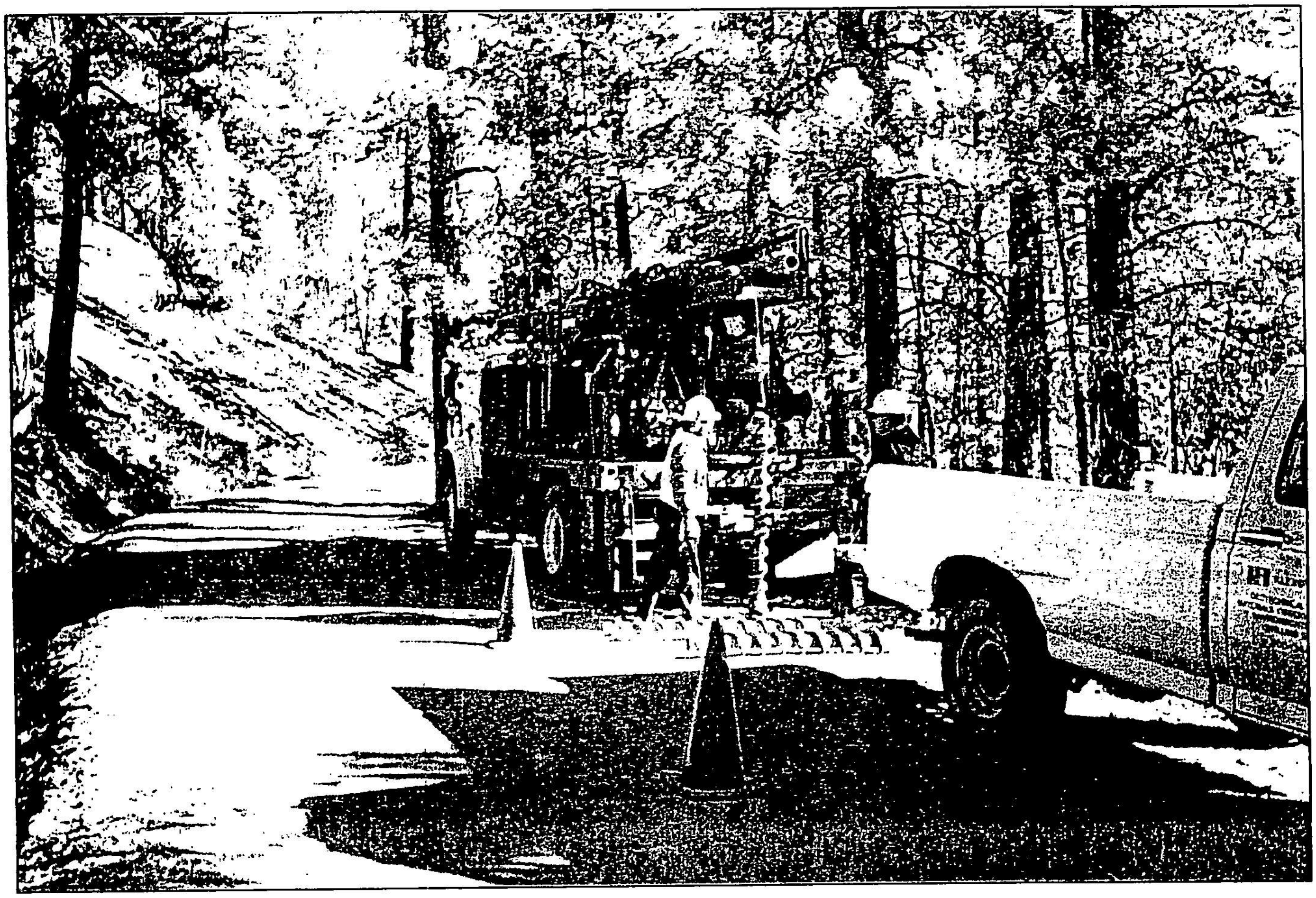
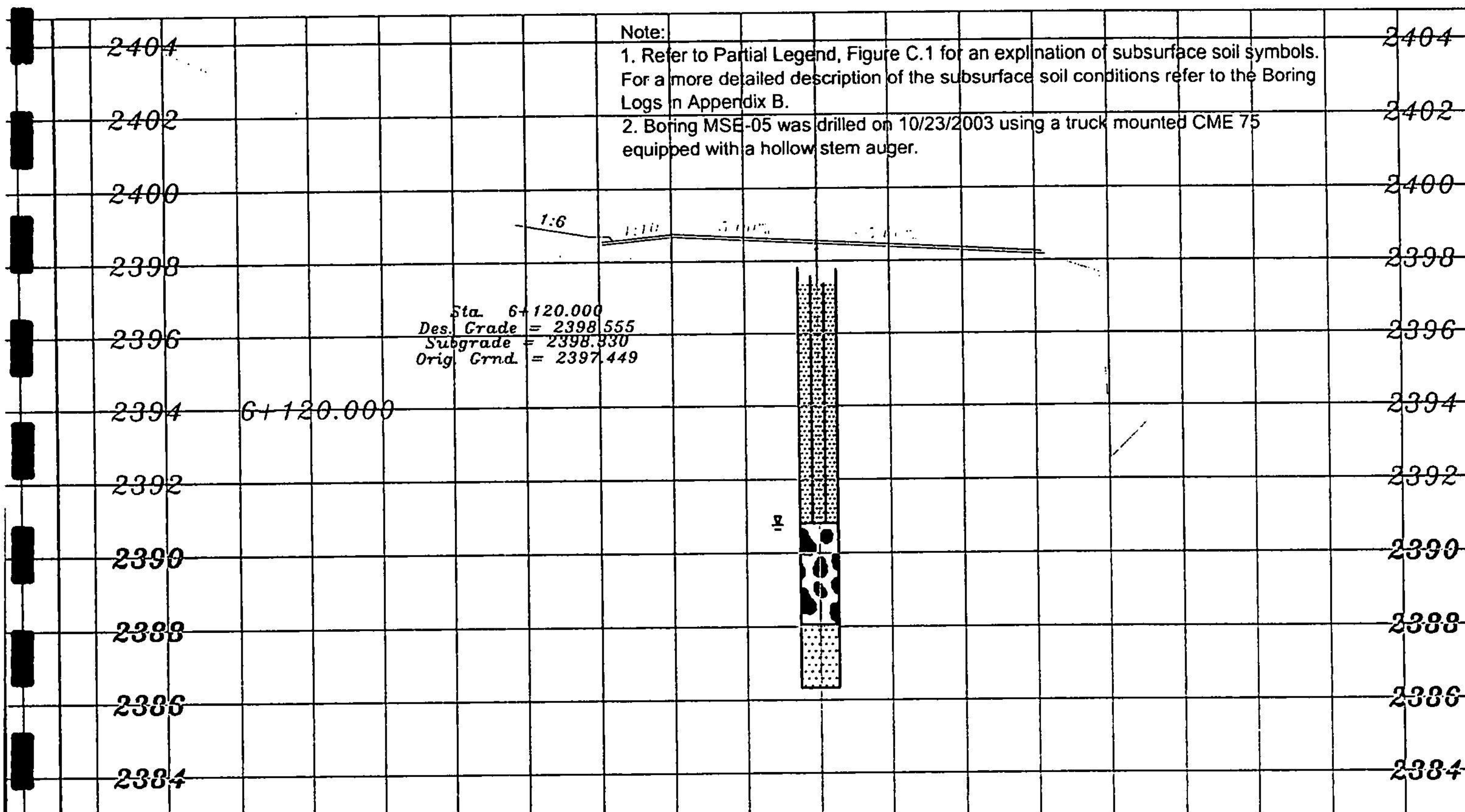


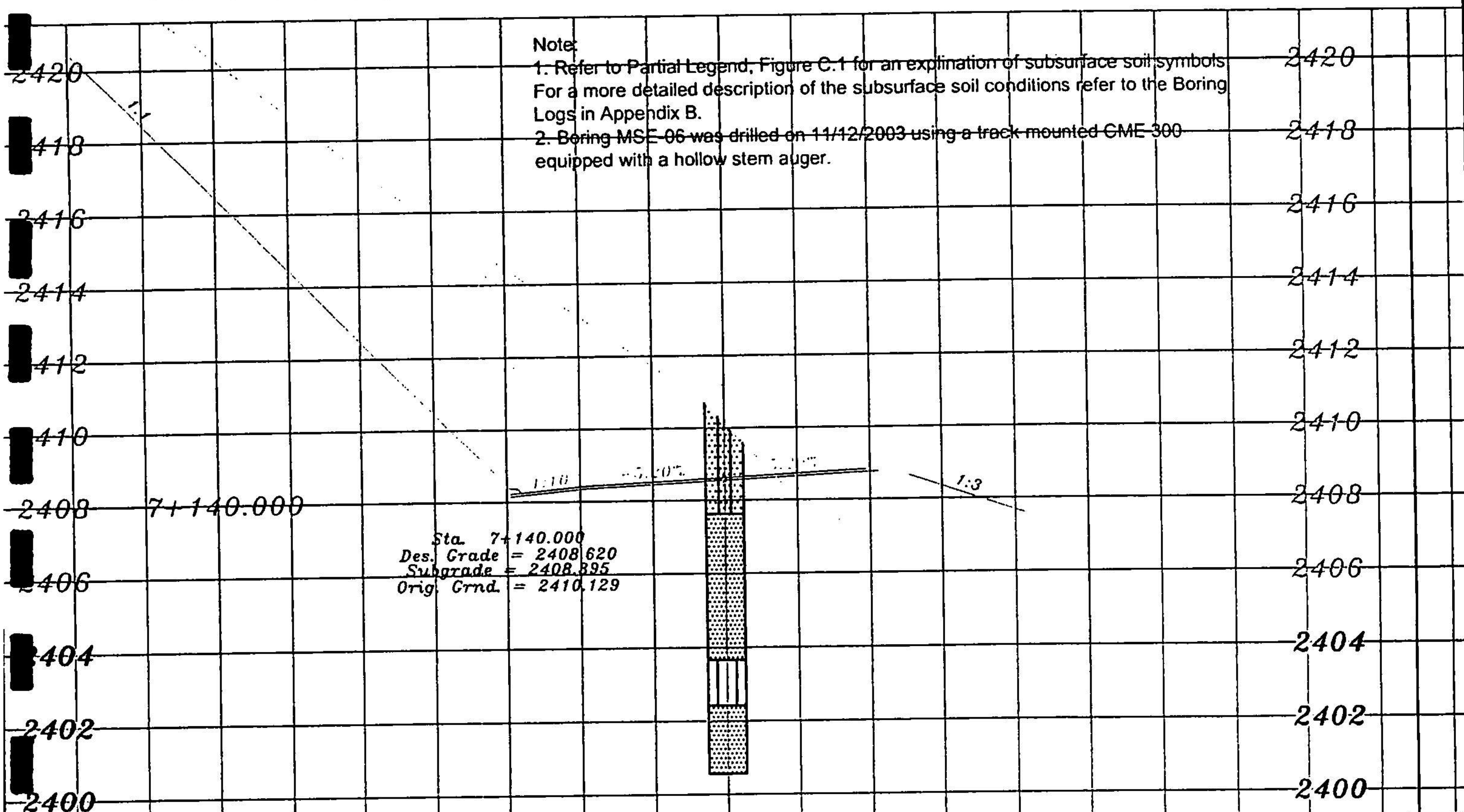


KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.23

BORING PROFILE
Boring MSE-05 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.19

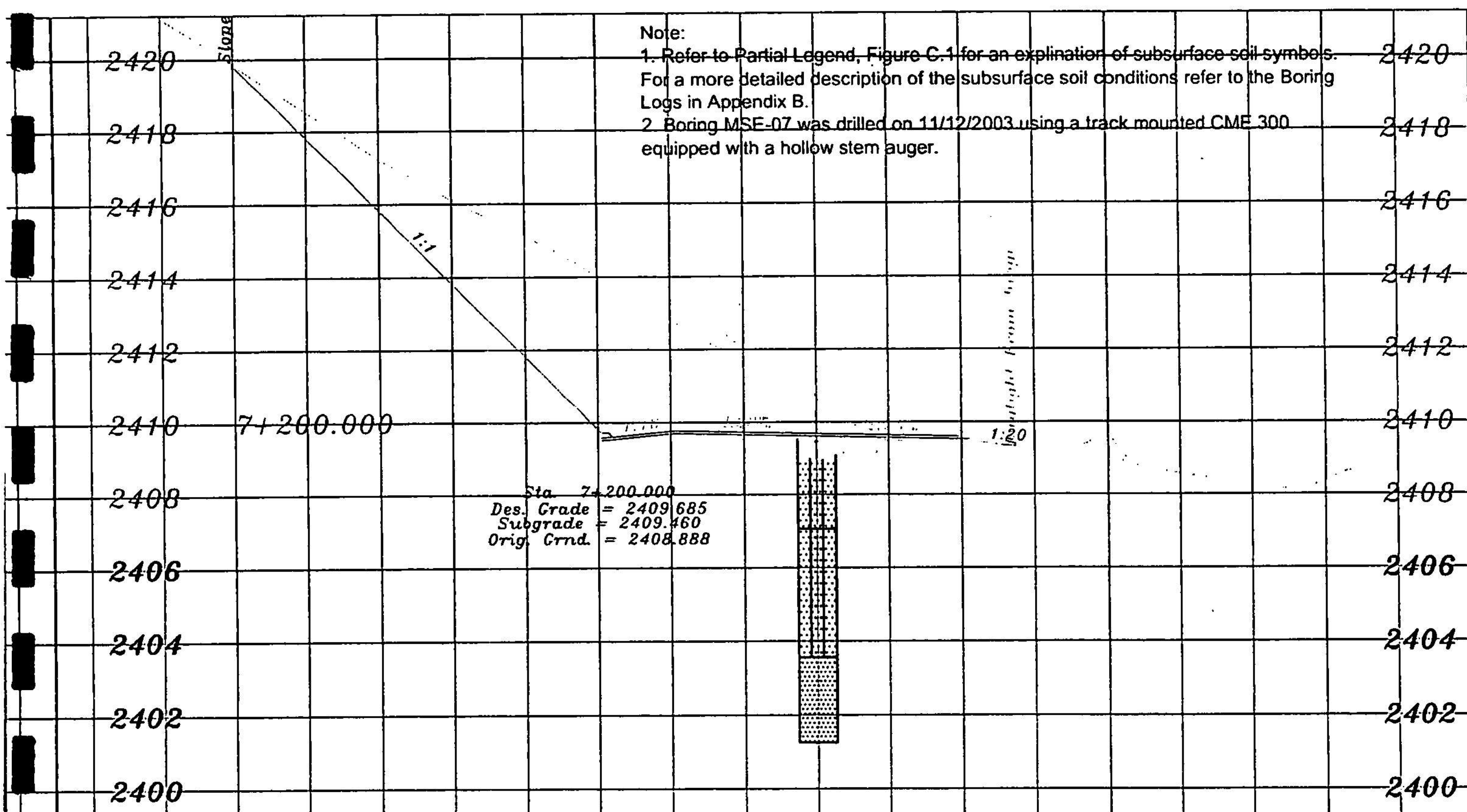


KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.24

BORING PROFILE
Boring MSE-06 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.20



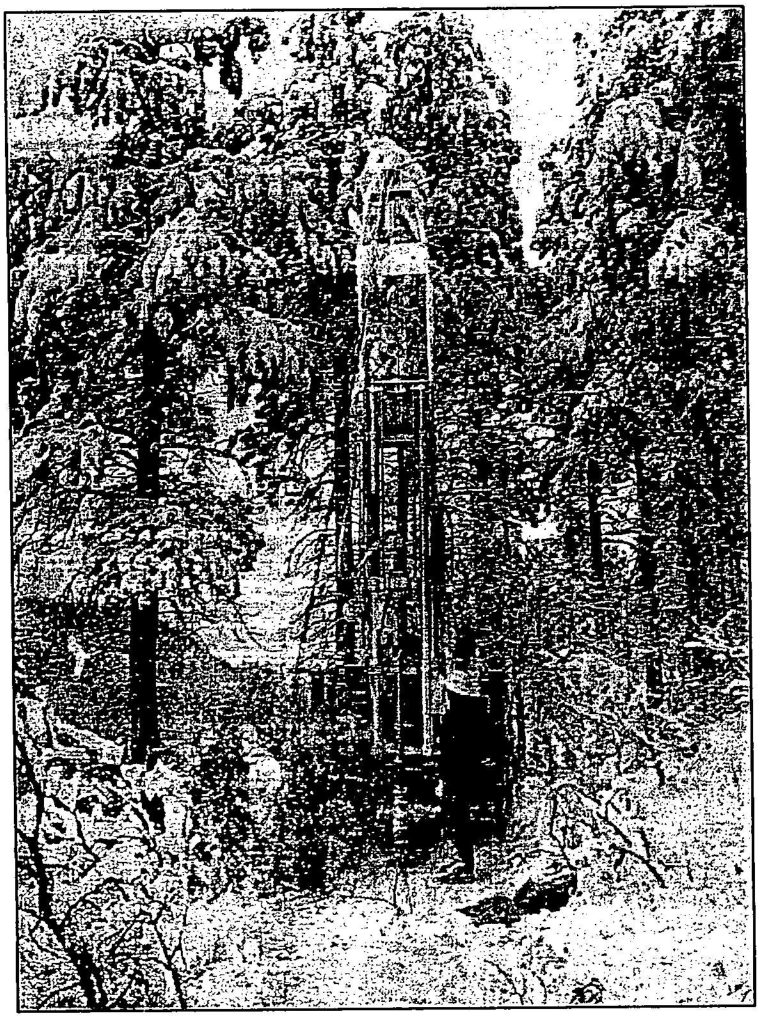
Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring MSE-07 was drilled on 11/12/2003 using a track mounted CME 300 equipped with a hollow stem auger.

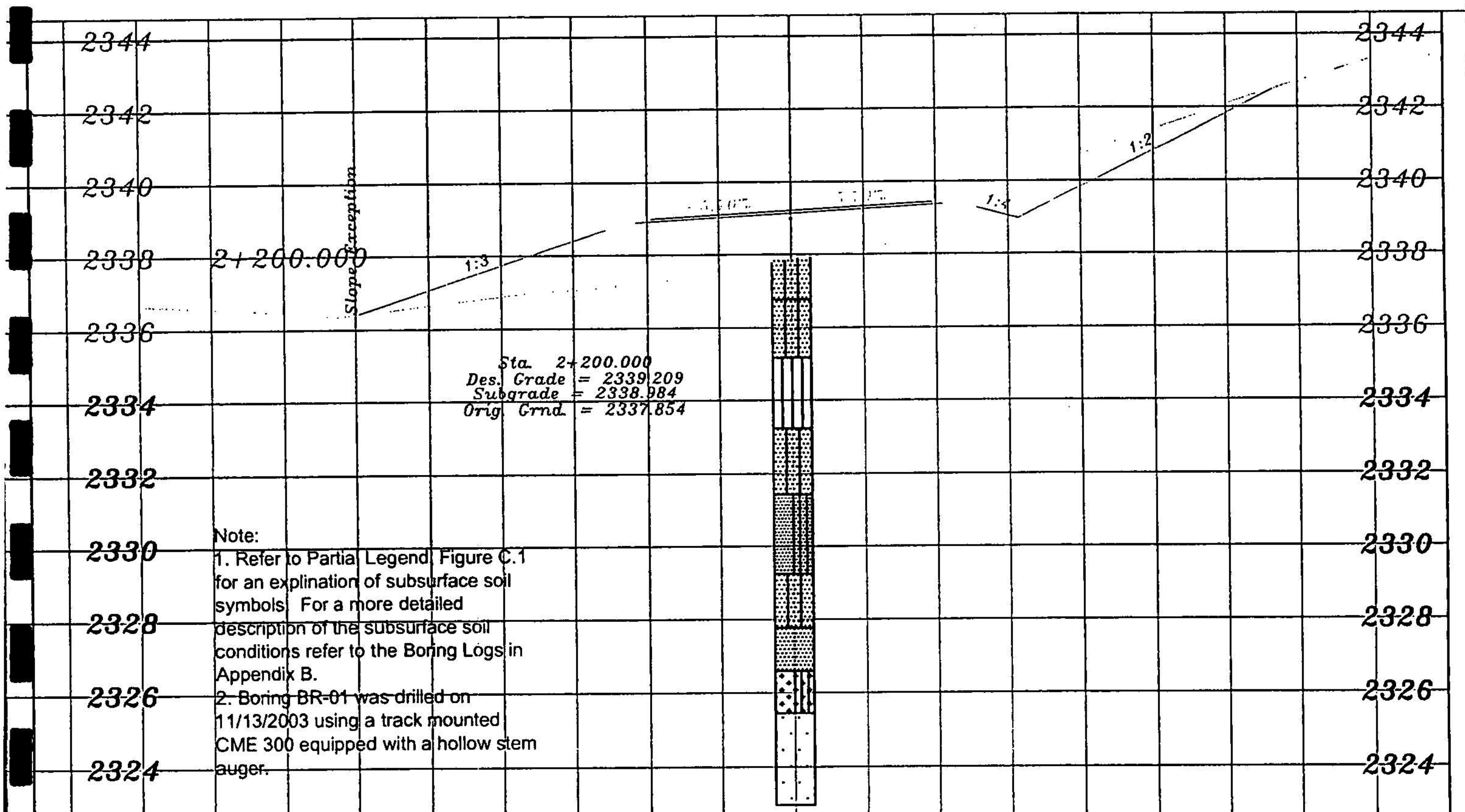
KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.25

BORING PROFILE
Boring MSE-07 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.21



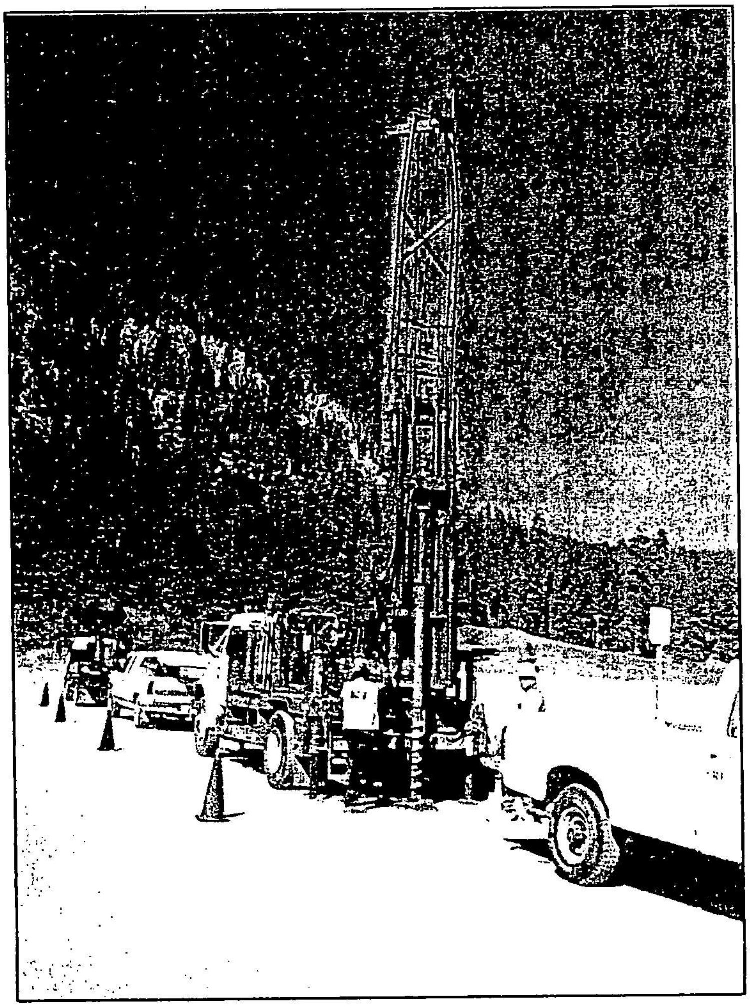


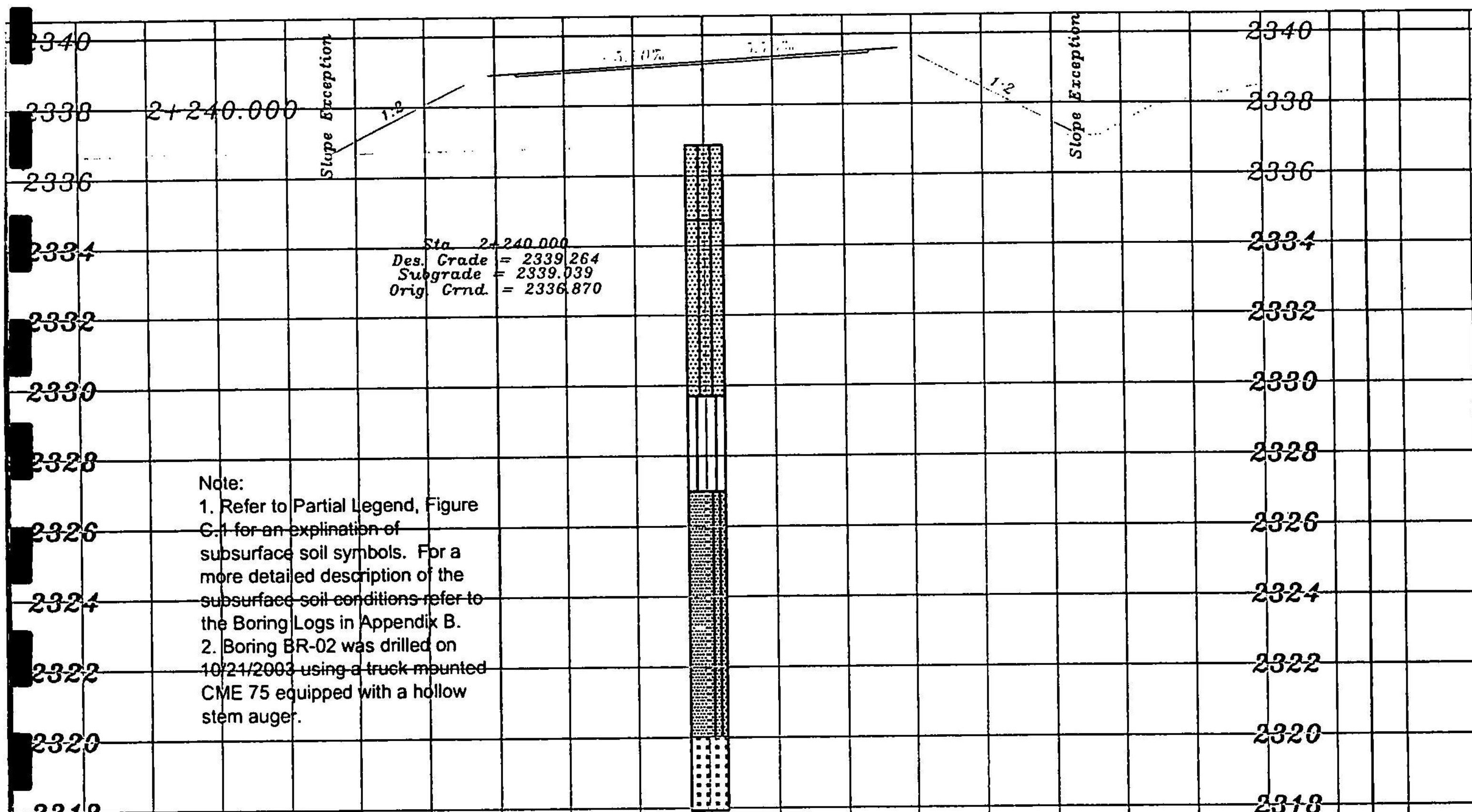
KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.15

BORING PROFILE
Boring BR-01 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.22





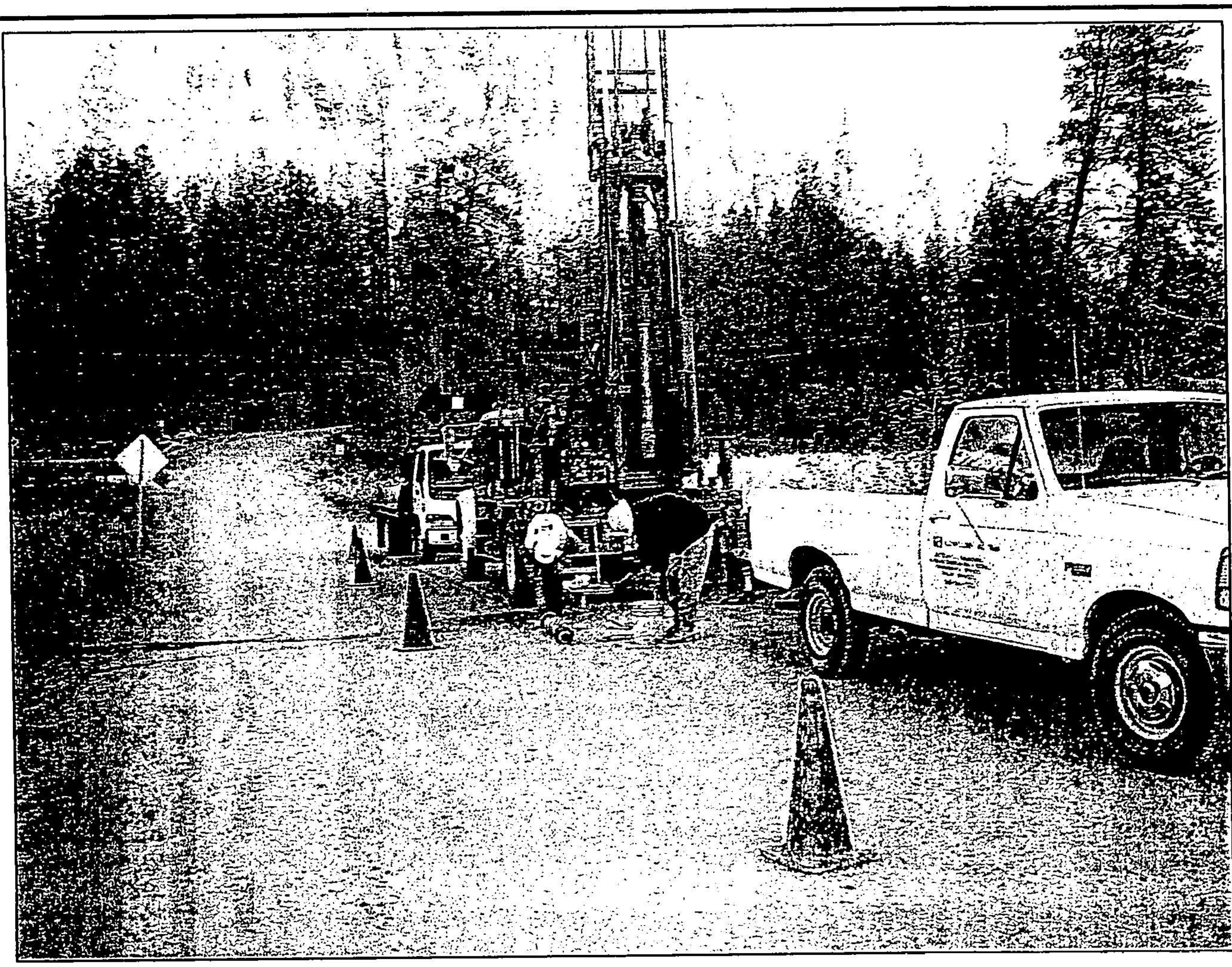
Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring BR-02 was drilled on 10/21/2003 using a truck mounted CME 75 equipped with a hollow stem auger.

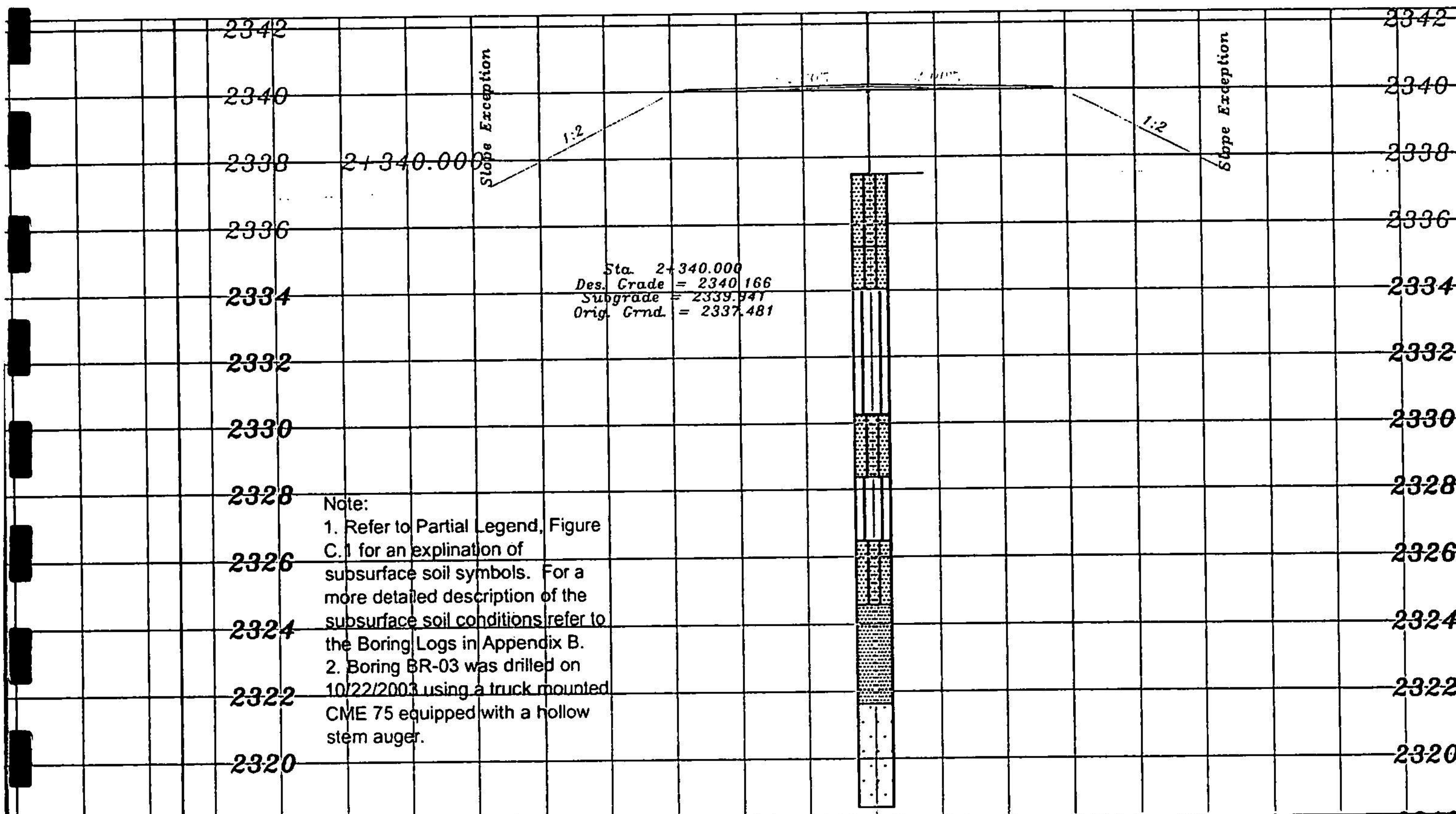
KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.16

BORING PROFILE
Boring BR-02 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.23



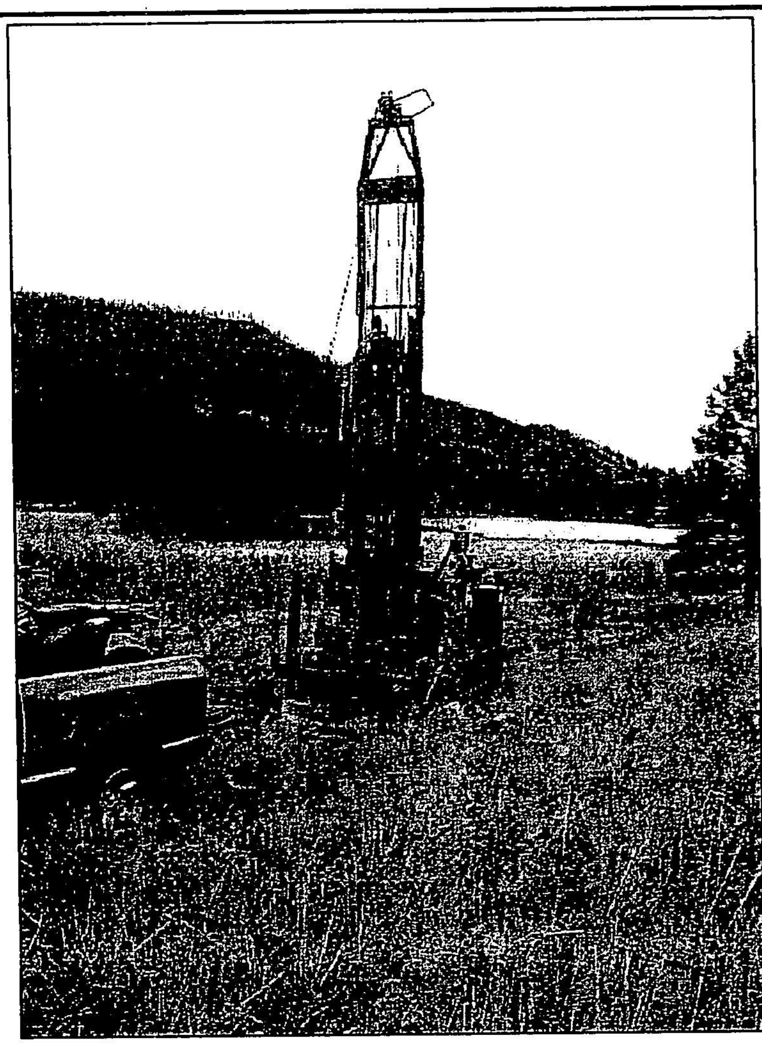


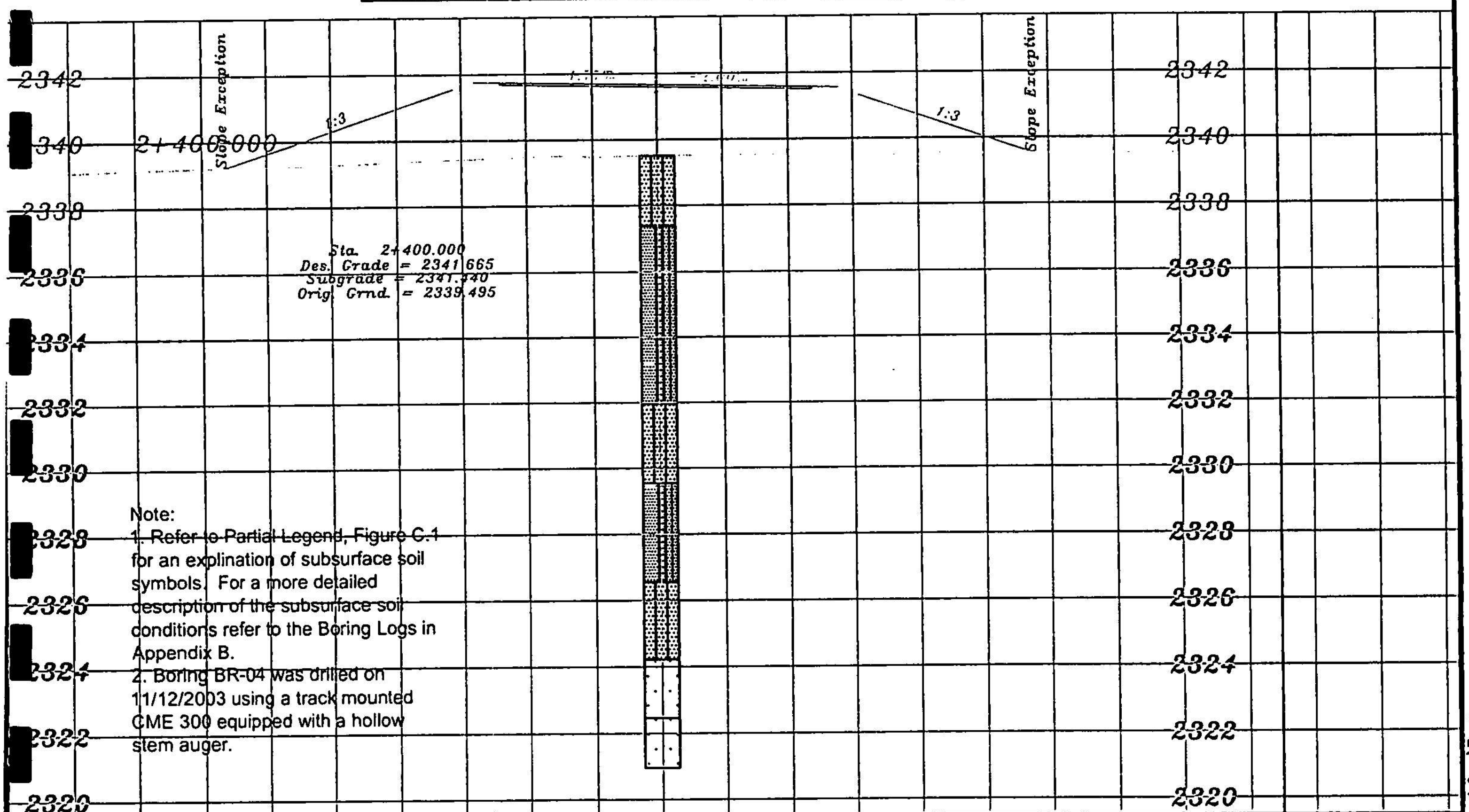
KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.17

BORING PROFILE
Boring BR-03 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.24





Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring BR-04 was drilled on 11/12/2003 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.18

BORING PROFILE
Boring BR-04 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.25

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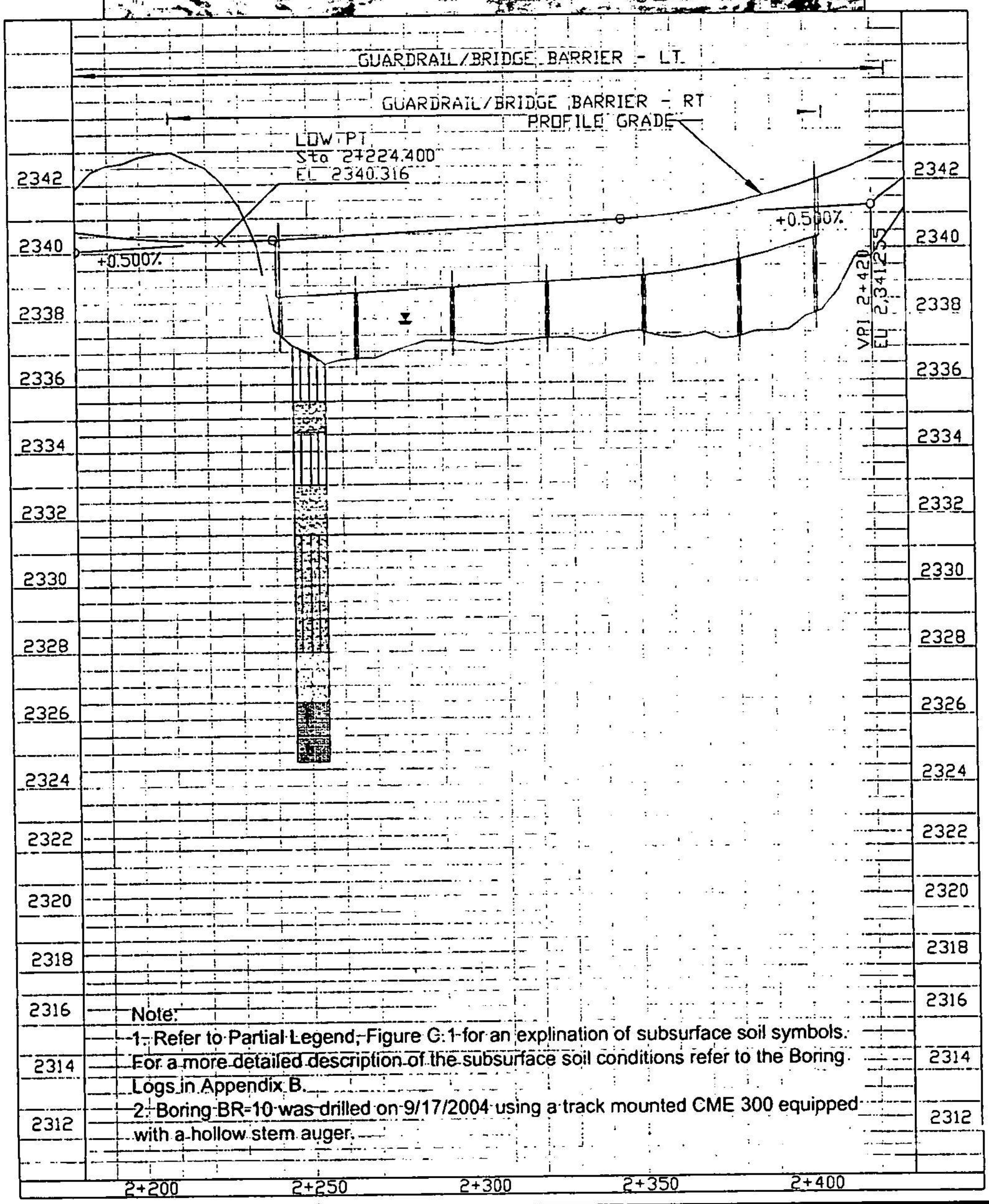

Note:
1. Refer to Partial Legend, Figure G.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring BR-10 was drilled on 9/17/2004 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER		BORING PROFILE BORING BR-10 New Mexico Highway 126 Cuba-LaCueva , New Mexico	FIGURE **C.26**
Drawn By: C. Bhongir	Date: November 2004		
Project No.: 35321	Filename: Figure C.26.dwg		
Scale: reference above	Revision: 0		

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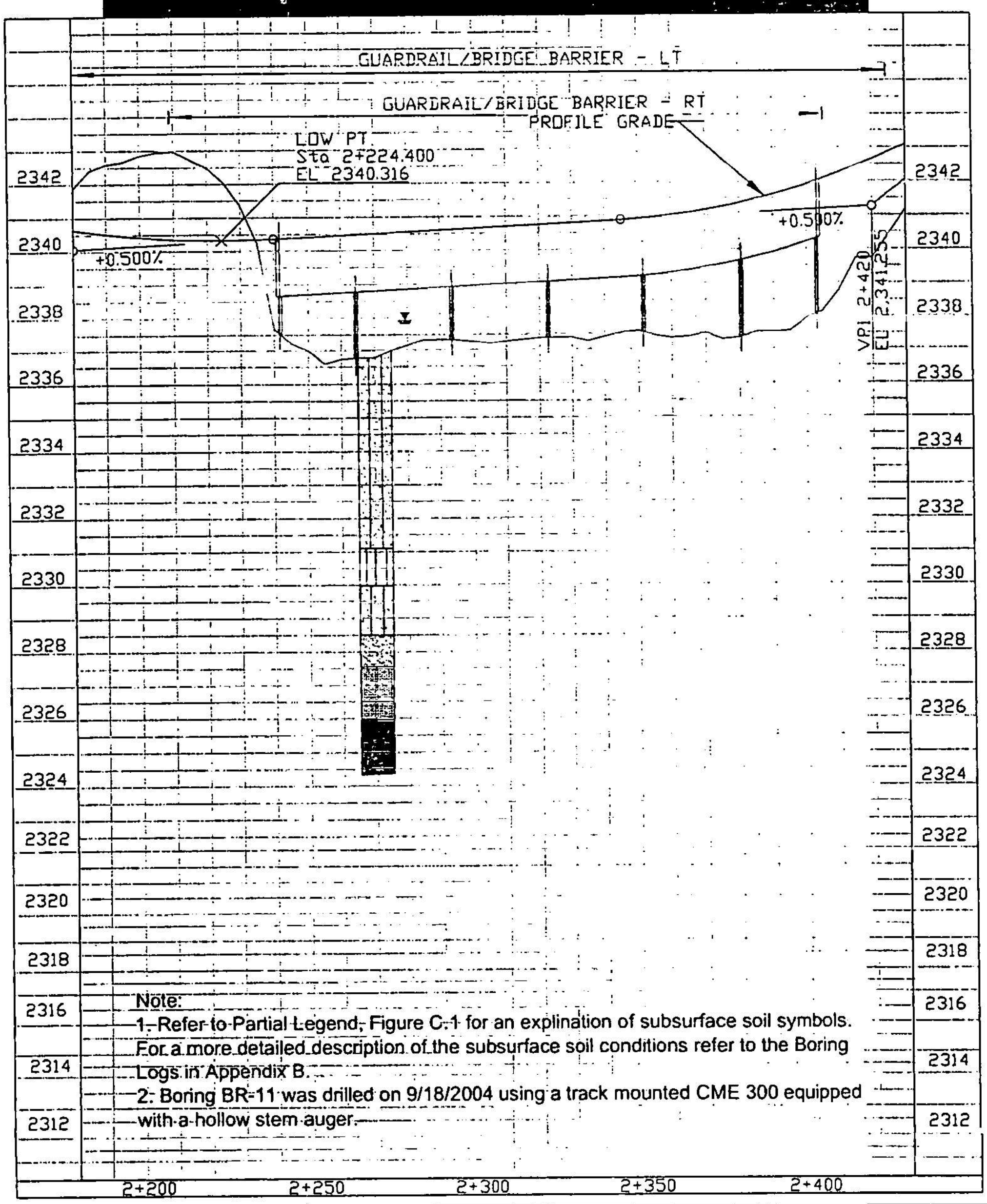

Note:
1. Refer to Partial Legend, Figure C-1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring BR-11 was drilled on 9/18/2004 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004
Project No.: 35321	Filename: Figure C.27.dwg
Scale: reference above	Revision: 0

BORING PROFILE
BORING BR-11
New Mexico Highway 126
Cuba-LaCueva , New Mexico

FIGURE
C.27

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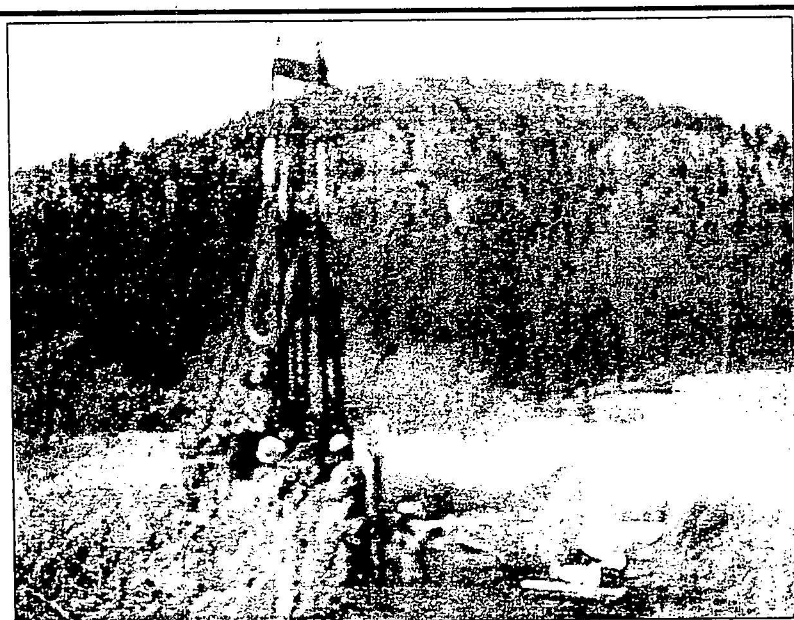

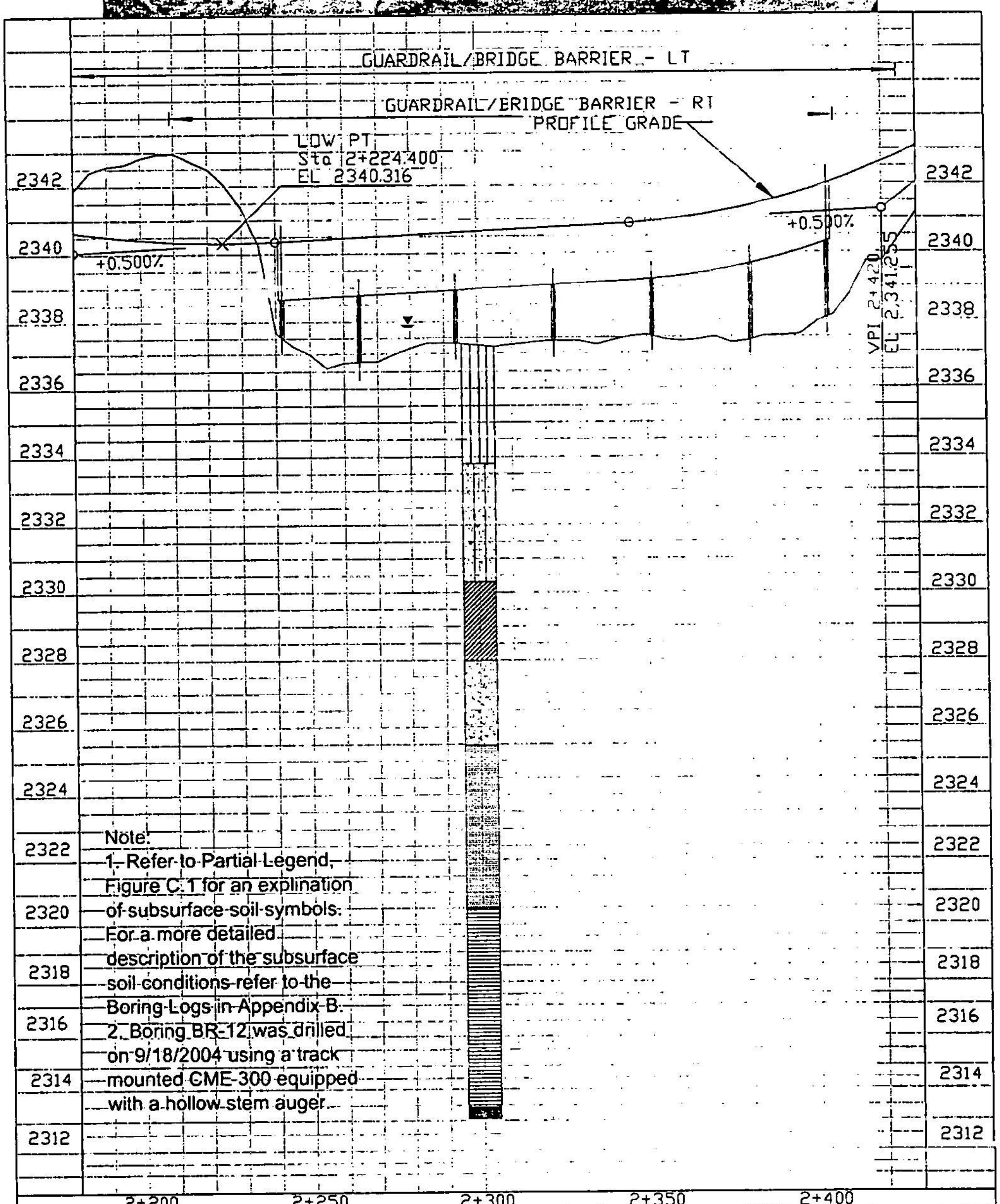

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004	BORING PROFILE BORING BR-12 New Mexico Highway 126 Cuba-LaCueva , New Mexico	FIGURE C.28
Project No.: 35321	Filename: Figure C.28.dwg		
Scale: reference above	Revision: 0		

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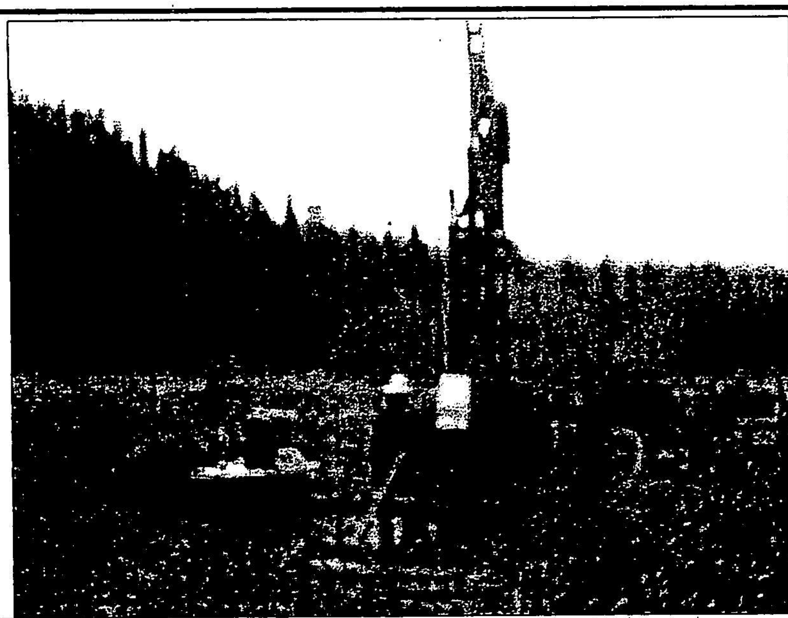

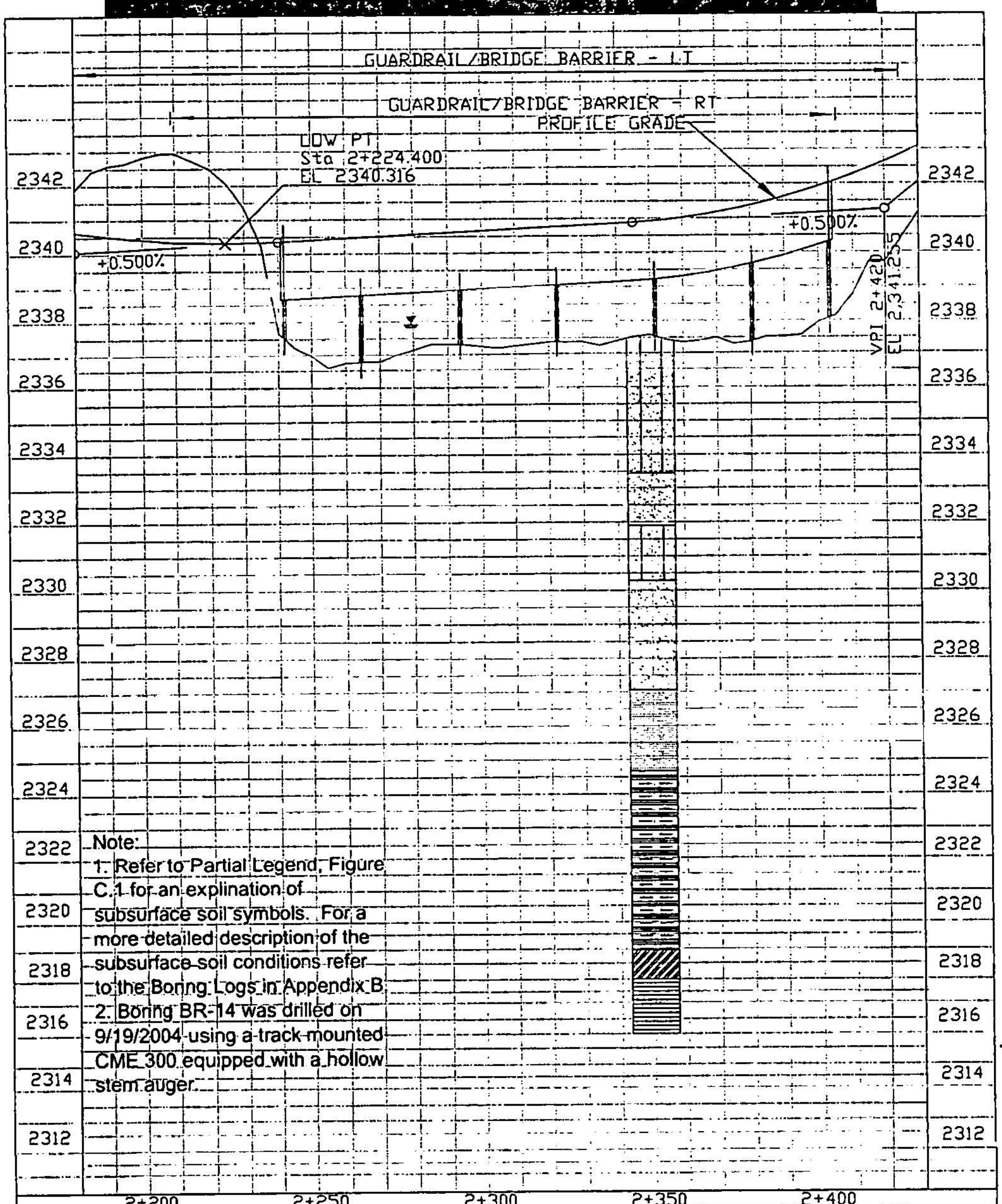

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004
Project No.: 35321	Filename: Figure C.29.dwg
Scale: reference above	Revision: 0

BORING PROFILE
BORING BR-14
New Mexico Highway 126
Cuba-LaCueva , New Mexico

FIGURE

C.29

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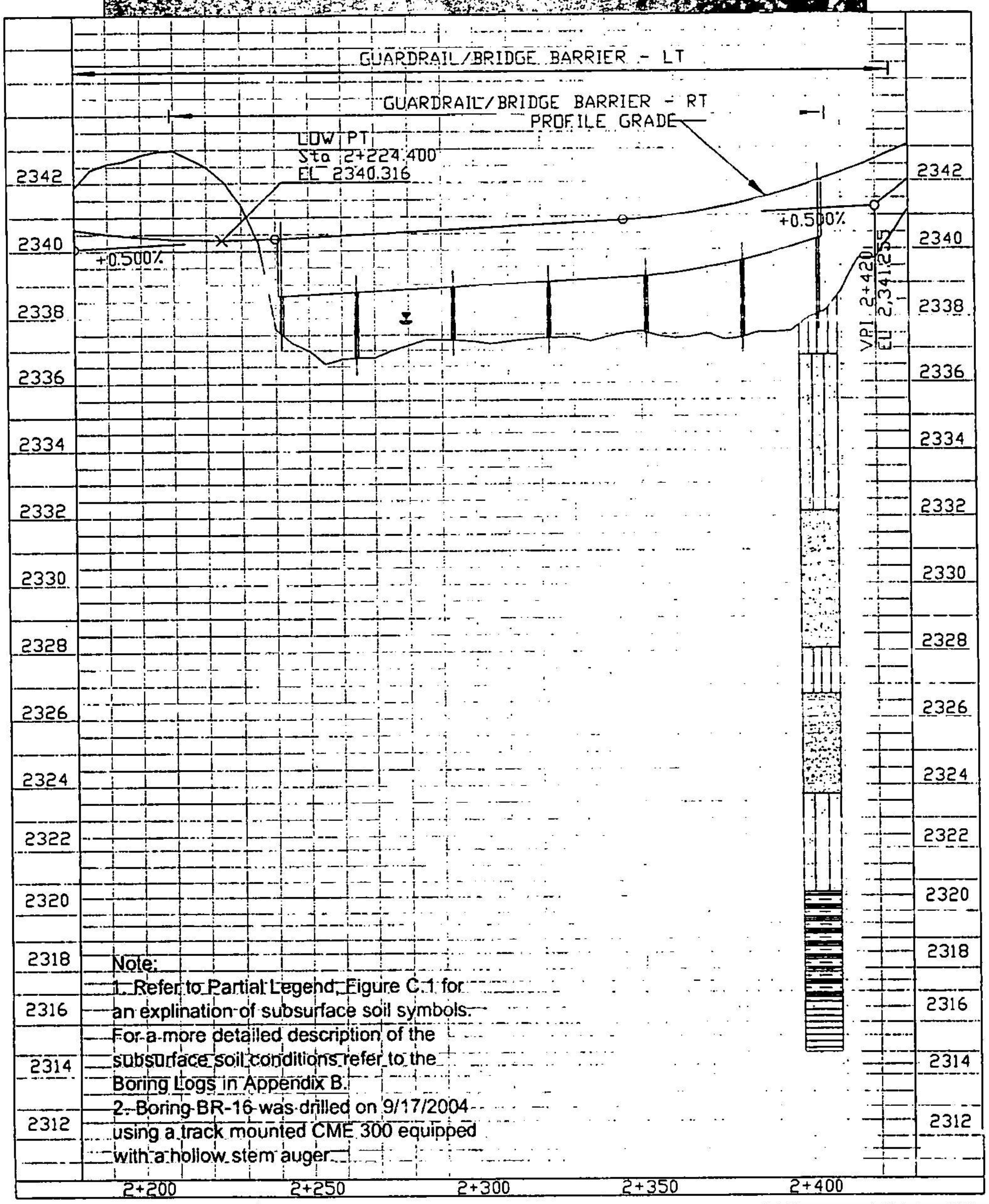

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Boring BR-16 was drilled on 9/17/2004 using a track mounted CME 300 equipped with a hollow stem auger.

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004
Project No.: 35321	Filename: Figure C.30.dwg
Scale: reference above	Revision: 0

BORING PROFILE
BORING BR-16
New Mexico Highway 126
Cuba-LaCueva , New Mexico

FIGURE
C.30

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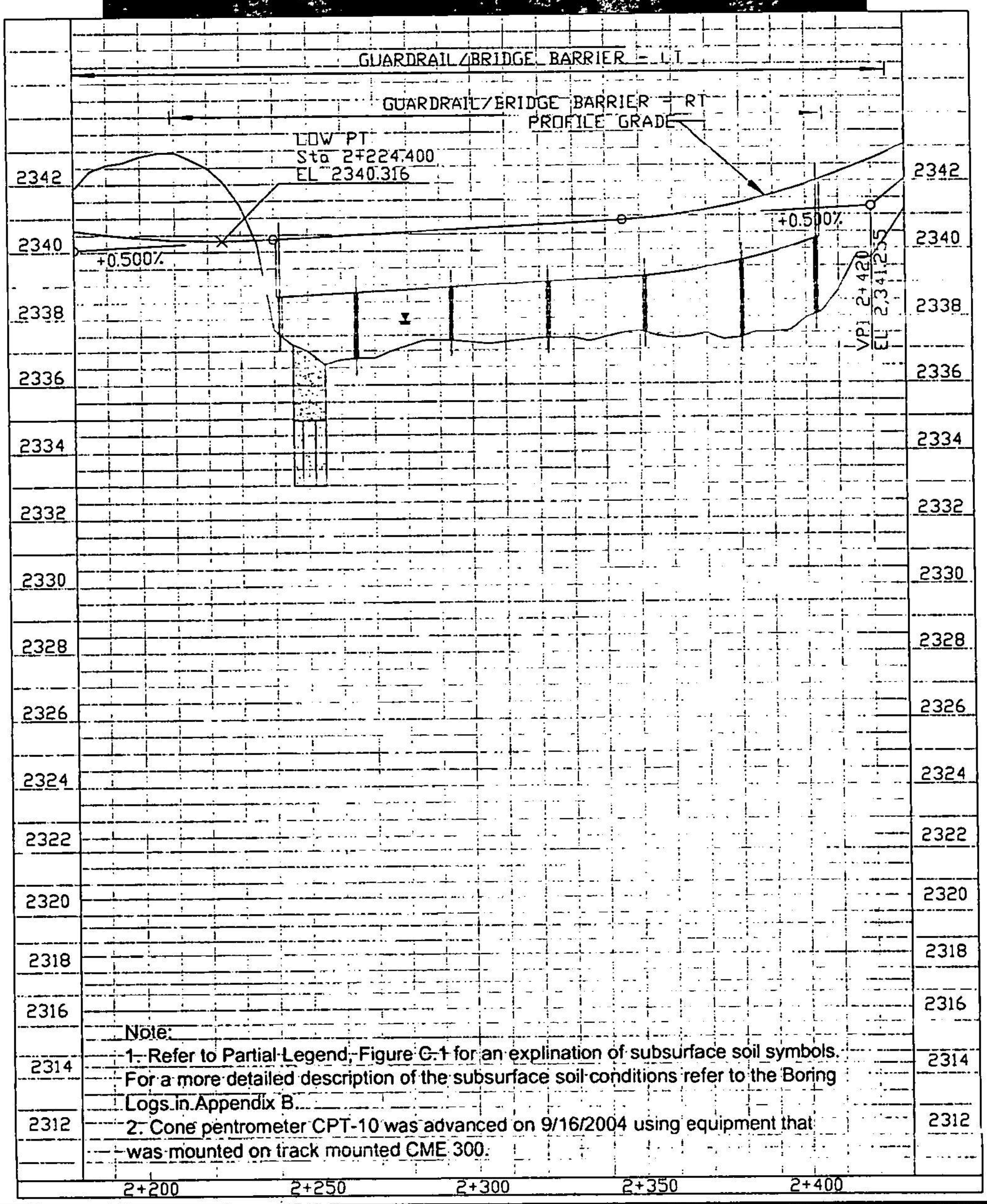

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004
Project No.: 35321	Filename: Figure C.31.dwg
Scale: reference above	Revision: 0

CPT PROFILE
CPTU-10
New Mexico Highway 126
Cuba-LaCueva , New Mexico

FIGURE

C.31

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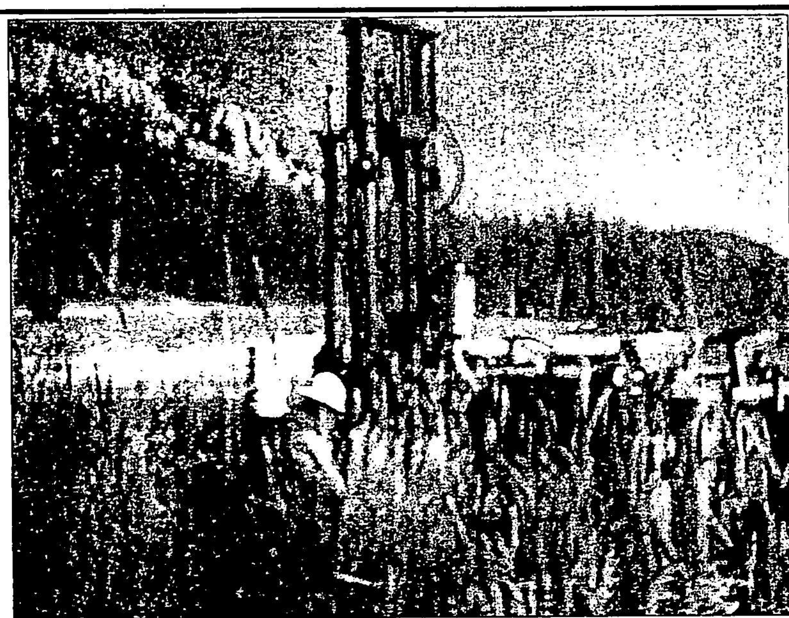

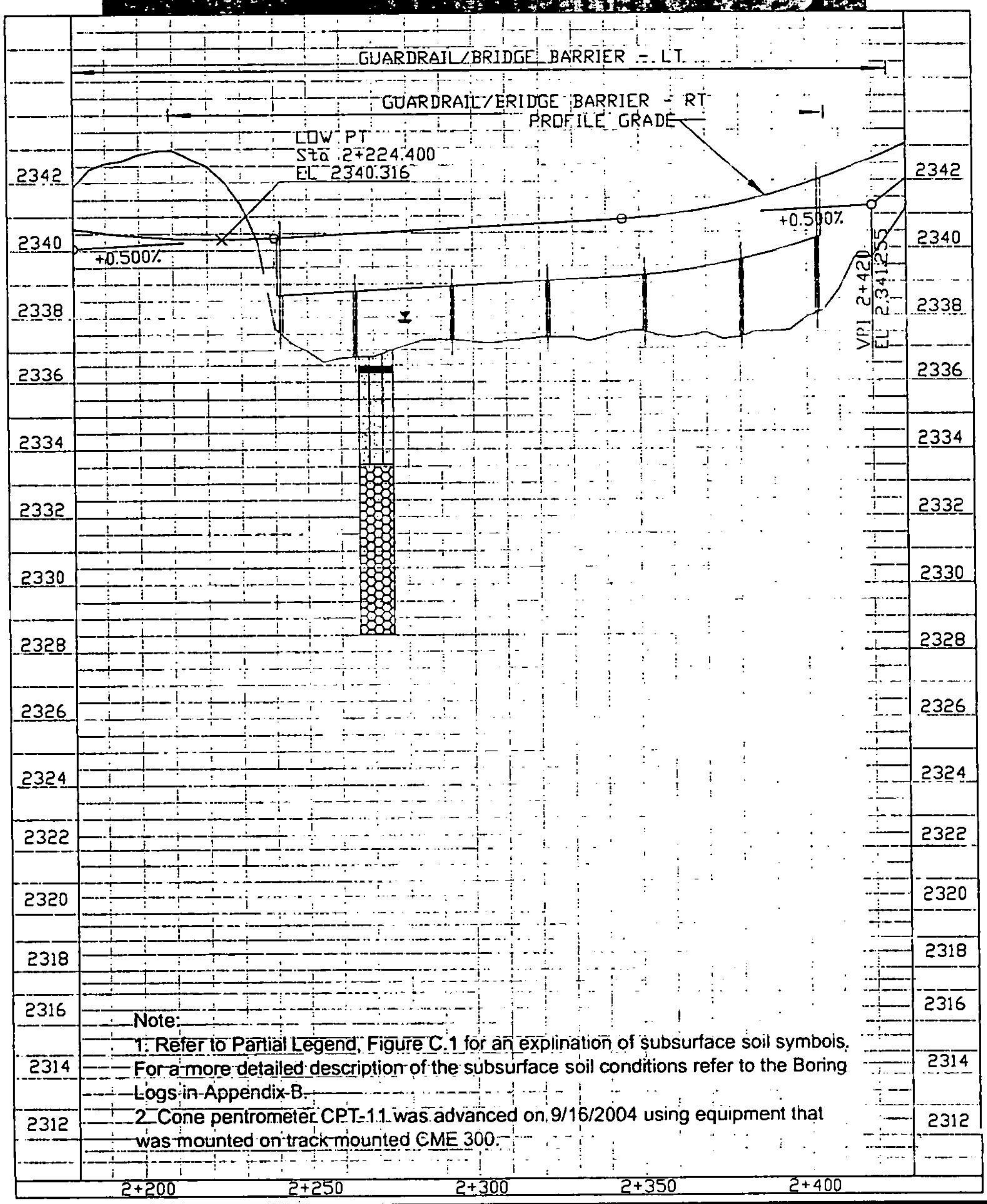

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004
Project No.: 35321	Filename: Figure C.32.dwg
Scale: reference above	Revision: 0

CPT PROFILE
CPTU-11
New Mexico Highway 126
Cuba-LaCueva , New Mexico

FIGURE
C.32

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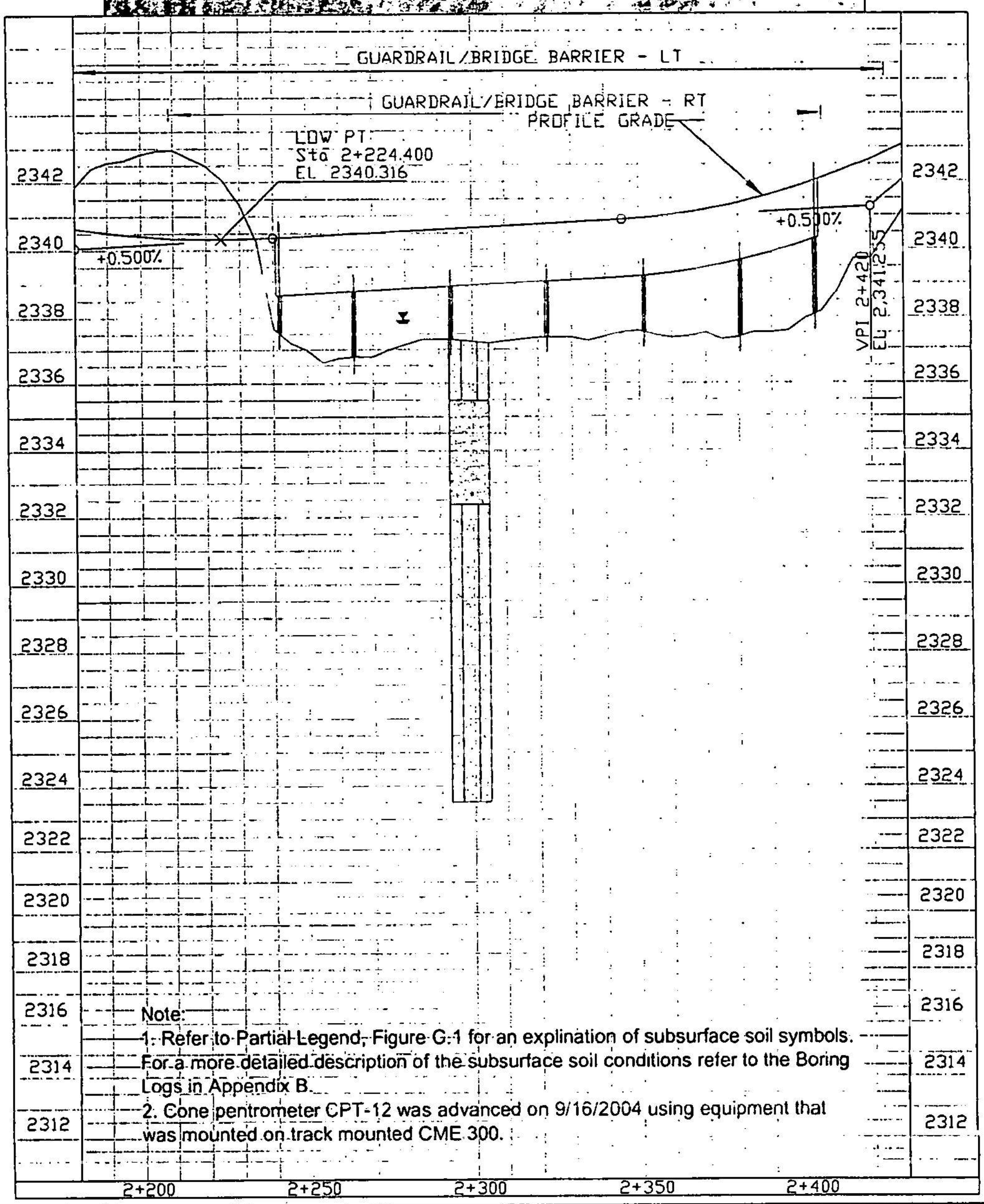

KLEINFELDER		CPT PROFILE CPTU-12 New Mexico Highway 126 Cuba-LaCueva , New Mexico	FIGURE C.33
Drawn By: C. Bhongir	Date: November 2004		
Project No.: 35321	Filename: Figure C.33.dwg		
Scale: reference above	Revision: 0		

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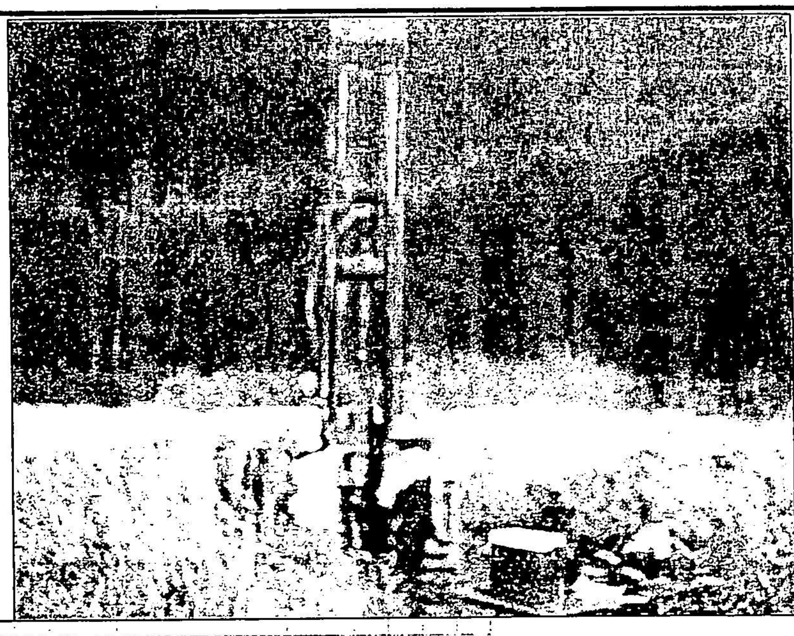

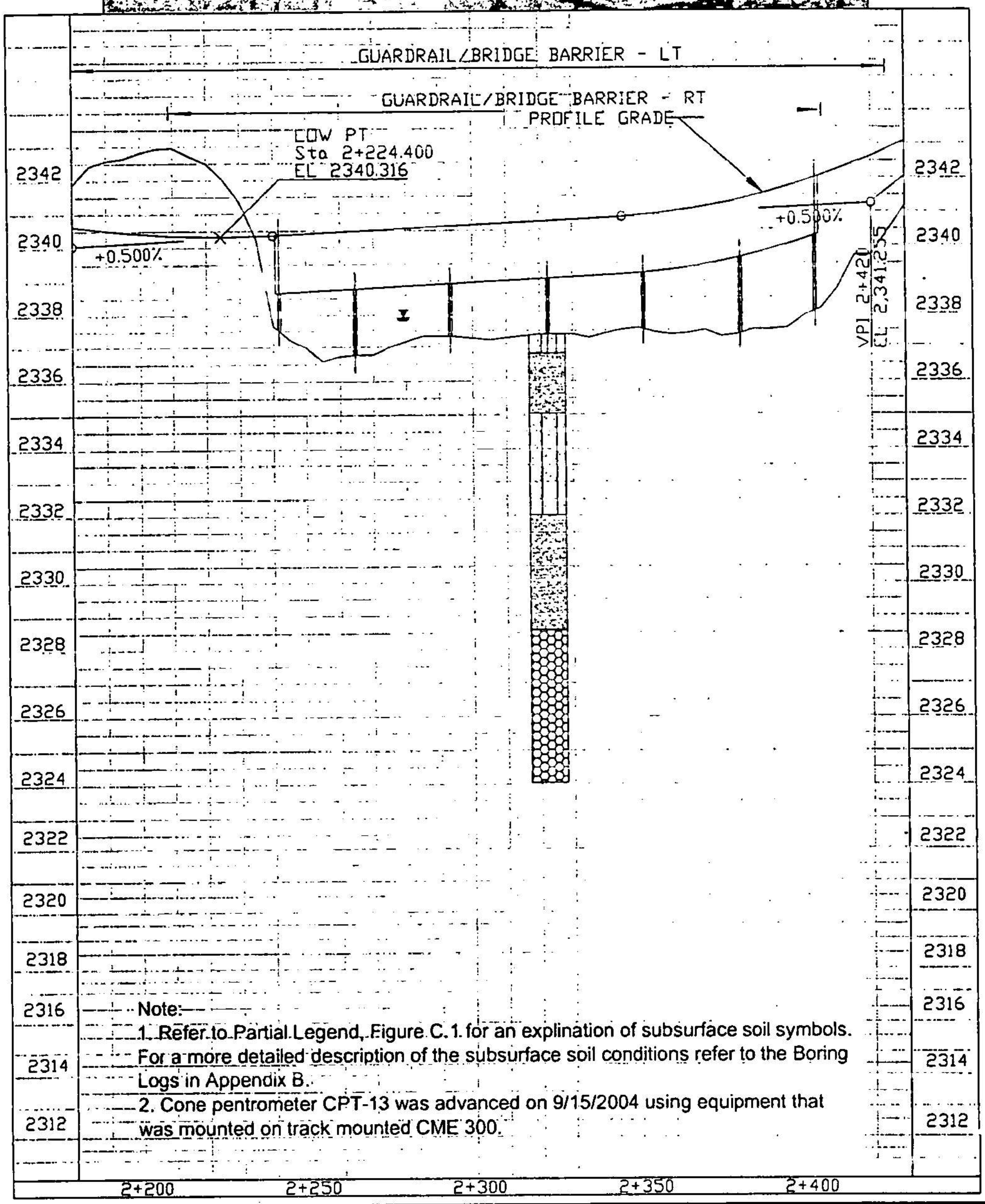

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004	**CPT PROFILE** CPTU-13 New Mexico Highway 126 Cuba-LaCueva , New Mexico
Project No.: 35321	Filename: Figure C.34.dwg	
Scale: reference above	Revision: 0	

FIGURE

C.34

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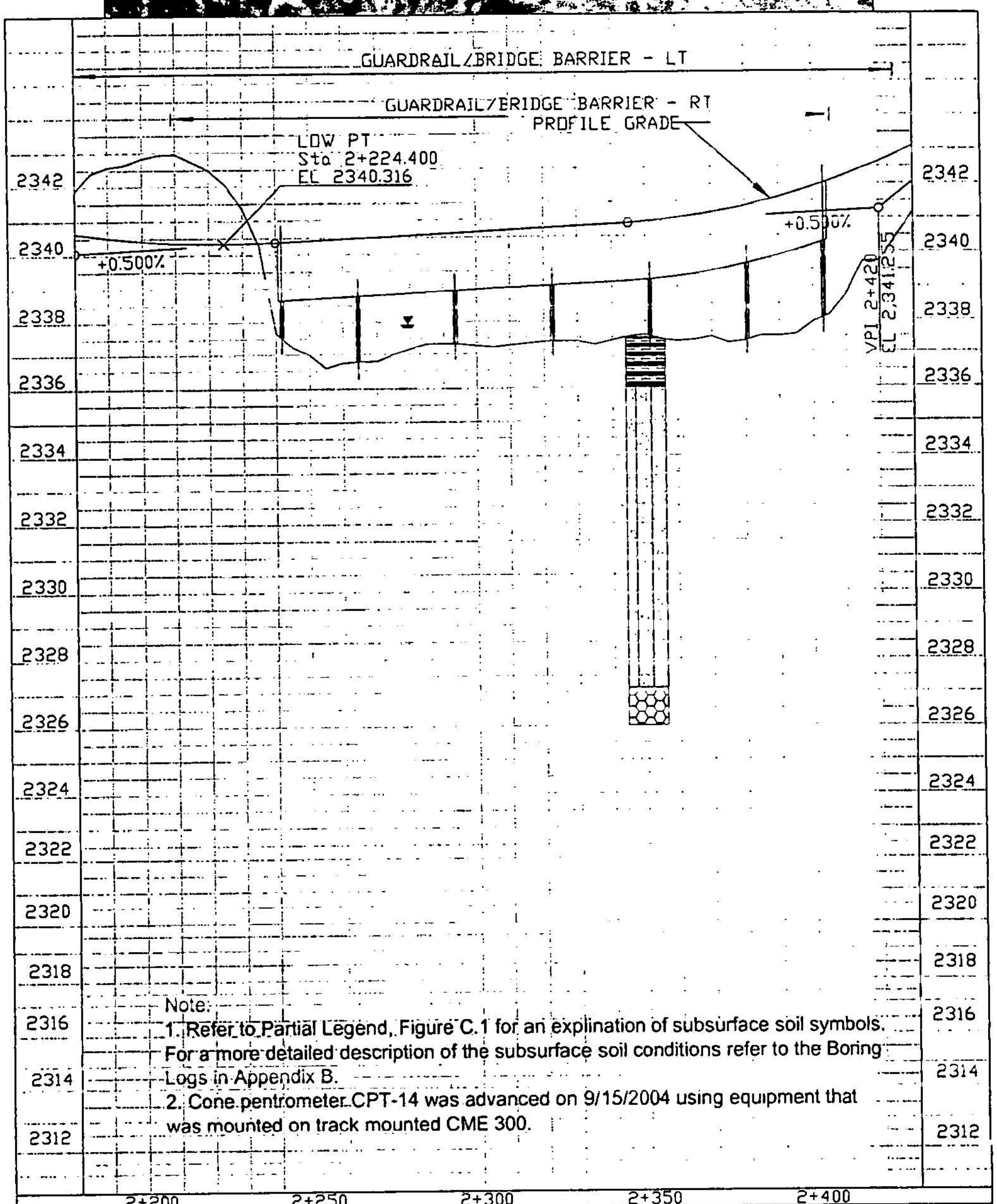

KLEINFELDER

Drawn By: C. Bhongir	Date: November 2004	CPT PROFILE CPTU-14 New Mexico Highway 126 Cuba-LaCueva , New Mexico	FIGURE C.35
Project No.: 35321	Filename: Figure C.35.dwg		
Scale: reference above	Revision: 0		

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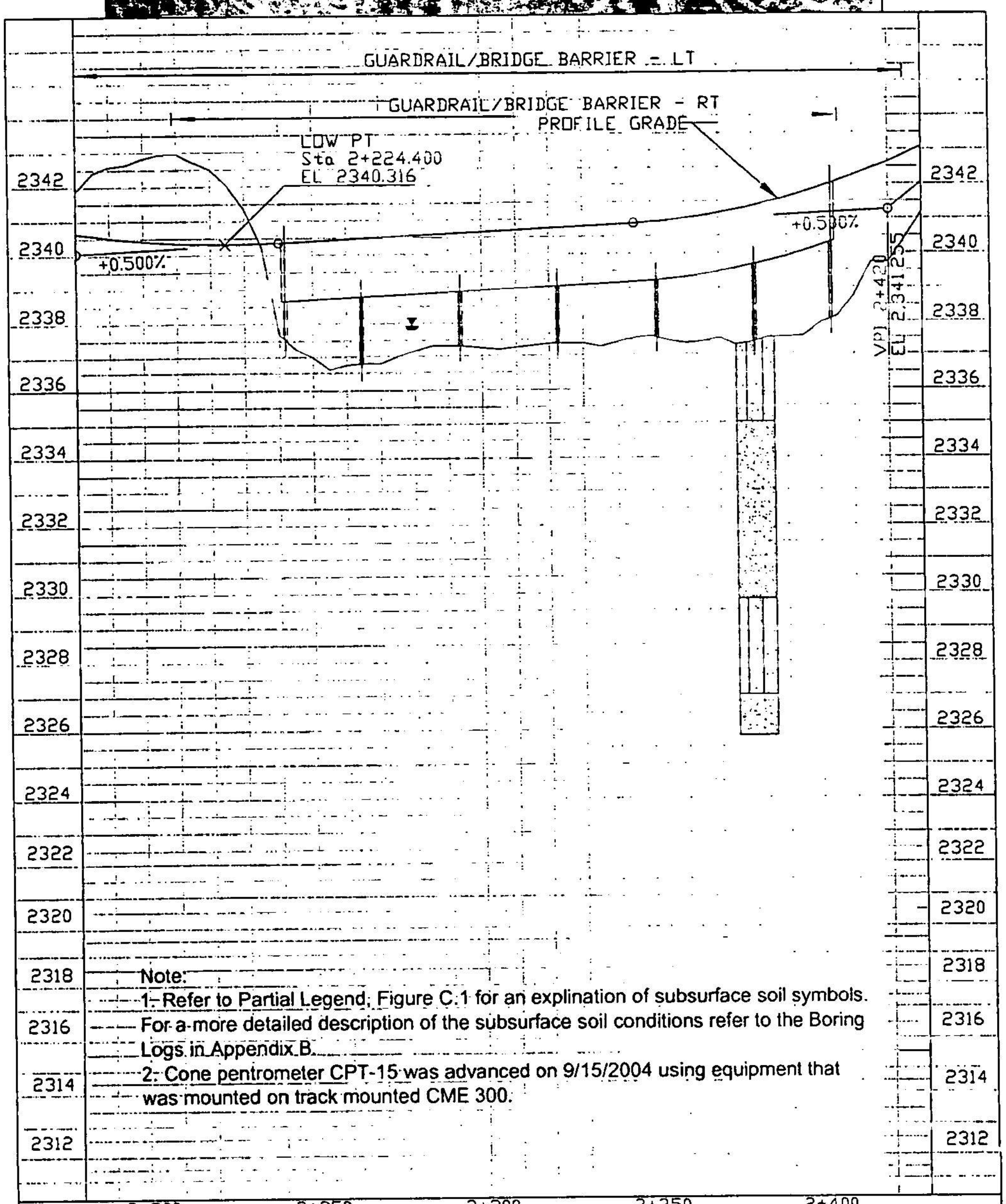

KLEINFELDER		CPT PROFILE CPTU-15 New Mexico Highway 126 Cuba-LaCueva , New Mexico	FIGURE C.36
Drawn By: C. Bhongir	Date: November 2004		
Project No.: 35321	Filename: Figure C.36.dwg		
Scale: reference above	Revision: 0		

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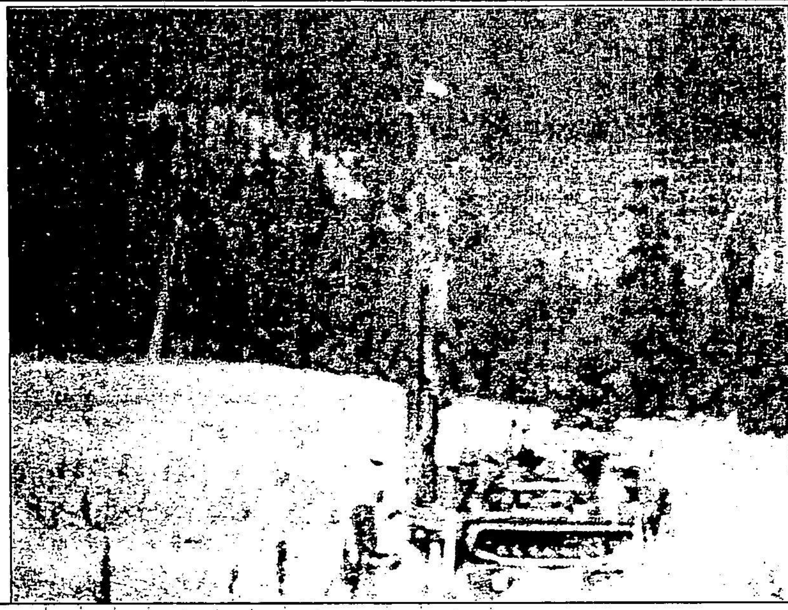

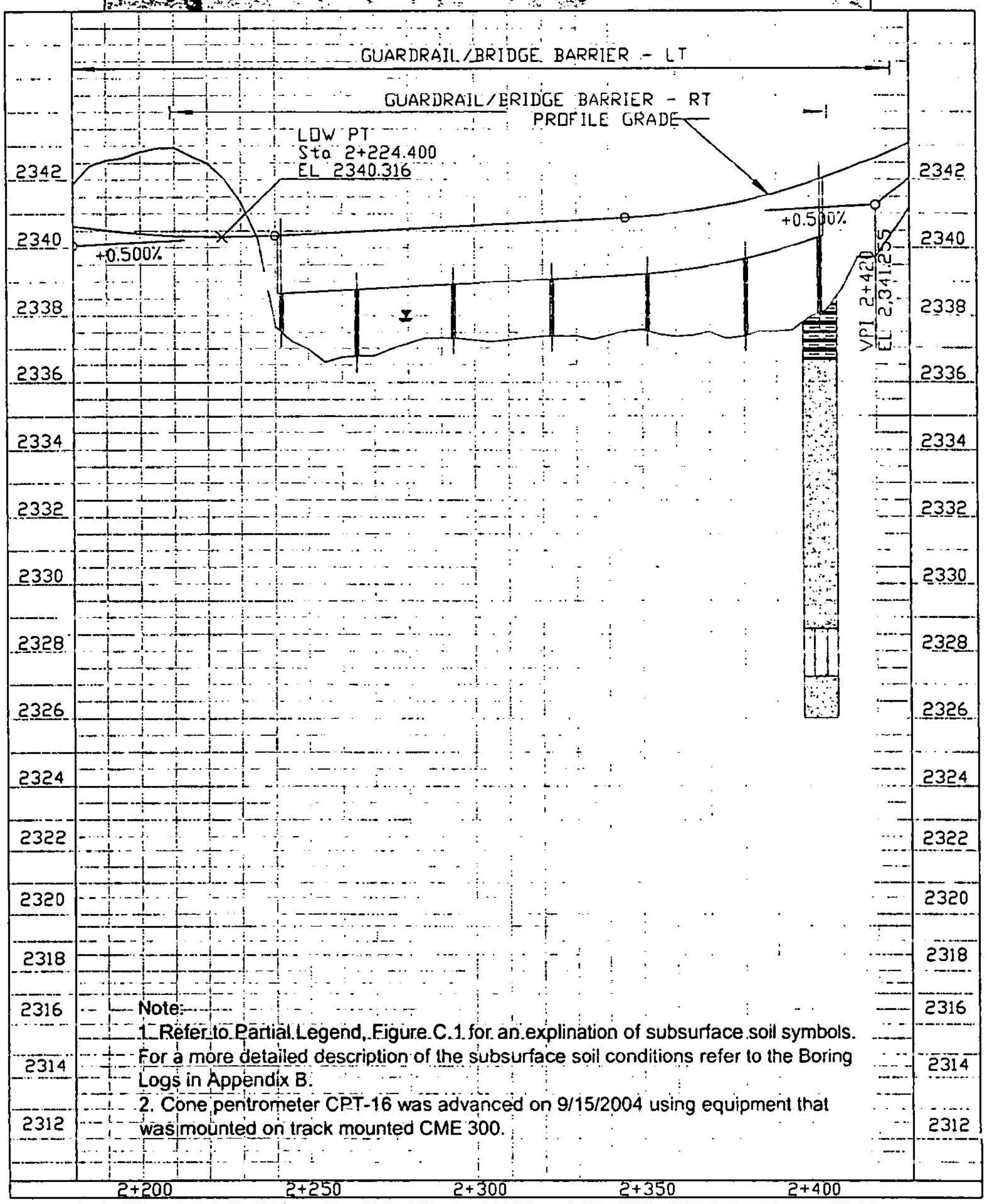

Note:
1. Refer to Partial Legend, Figure C.1 for an explination of subsurface soil symbols. For a more detailed description of the subsurface soil conditions refer to the Boring Logs in Appendix B.
2. Cone pentrometer CPT-16 was advanced on 9/15/2004 using equipment that was mounted on track mounted CME 300.

KLEINFELDER		CPT PROFILE CPTU-16 New Mexico Highway 126 Cuba-LaCueva , New Mexico	FIGURE C.37
awn By: C. Bhongir	Date: November 2004		
Project No.: 35321	Filename: Figure C.37.dwg		
ale: reference above	Revision: 0		

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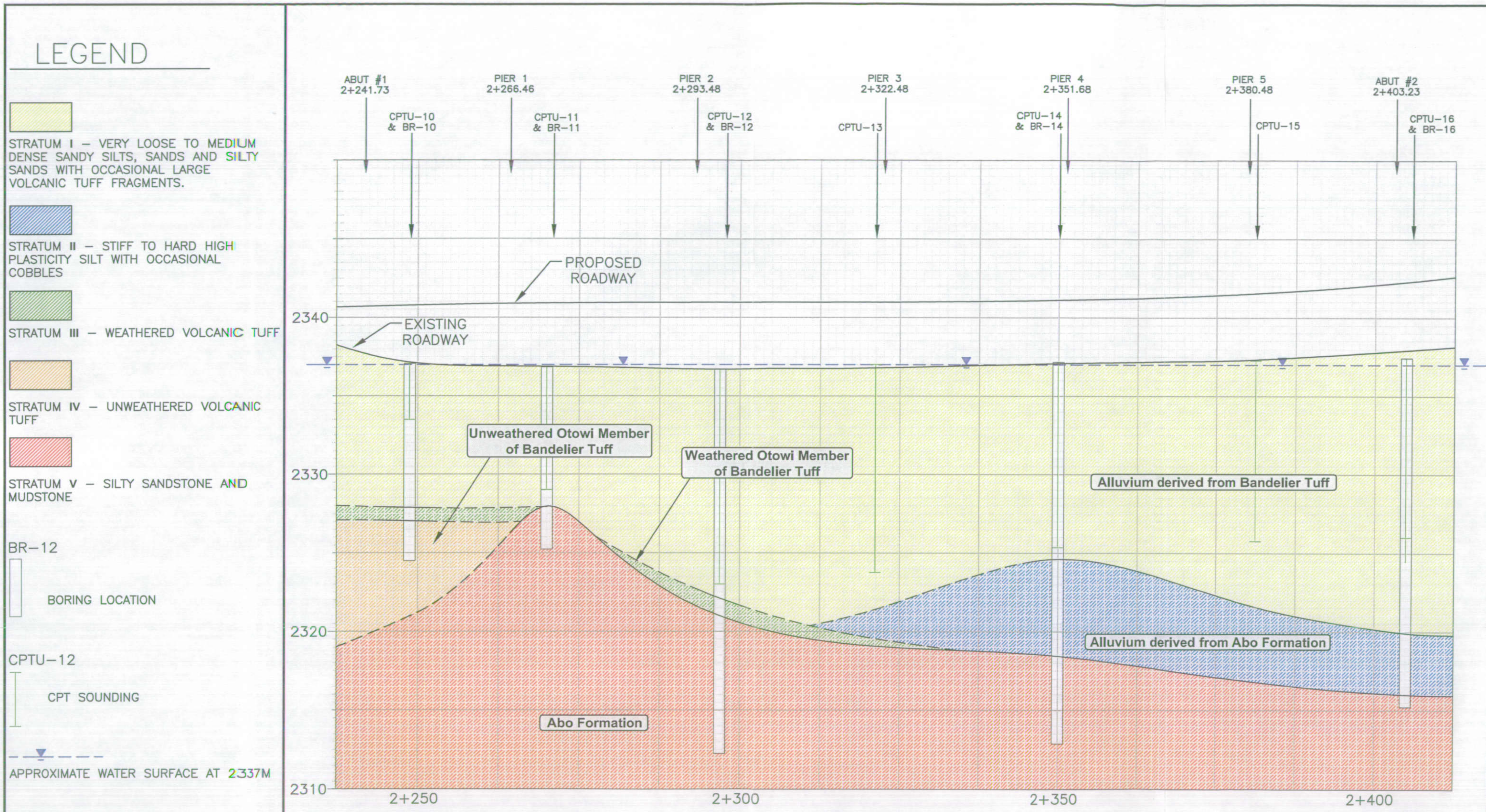

Notes:
1. For a more detailed description of the subsurface soil conditions refer to the Boring Logs.
2. Borings BR-10 through BR-12, BR-14, and BR-16 were drilled on 9/17/2004 through 9/19/2004 using a track mounted CME 300 equipped with a hollow stem auger.
3. The strata contacts are based upon interpolation between borings and CPTs and may not represent actual subsurface conditions.

KLEINFELDER

Drawn By: C.Landon	Date: December 2005
Project No.: 35321	Filename: 35321_1_0.dwg
Scale: –	Revision: –

SOIL PROFILE ALONG ALIGNMENT
Sta: 2+200 - 2+400
New Mexico State Highway 126
Cuba-LaCueva, New Mexico

FIGURE
C.38

Appendix D

APPENDIX D
Laboratory Test Results

SUMMARY OF LABORATORY ANALYSIS

Figure D.1

Project: **NM State Highway 126**
Project Number: **35321**

Location: **Cuba - LaCueva, NM**

Boring Number	Depth m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Accumulative % Passing										Moisture Content	Dry Density	Unconfined Comp. Strength
		USCS	AASHTO	PI	LL	0.075 mm (No. 200)	0.150 mm (No. 100)	0.425 mm (No. 40)	2.000 mm (No. 10)	4.750 mm (No. 4)	9.525 mm (3/8 in)	12.7 mm (1/2 in)	19.05 mm (3/4 in)	25.4 mm (1 in)	38.1 mm (1 1/2 in)	(%)	(pcf)	(tsf)
B-01	0.5 - 0.9 (1.5 - 3.0)	GM	A-1-b	NP	NV	15	19	29	51	56	60	60	64	85	100	14.4	--	--
B-02	0.0 - 0.5 (0.0 - 1.5)	SM	A-4	--	--	38	47	62	87	93	99	100	100	100	100	13.9	--	--
B-03	0.0 - 0.5 (0.0 - 1.5)	SM	A-2-4	NP	NV	25	34	52	76	85	92	97	100	100	100	12.6	--	--
B-04	0.5 - 0.9 (1.5 - 3.0)	SM	A-1-b	--	--	19	24	35	60	72	84	89	100	100	100	21.4	--	--
B-05	0.5 - 0.9 (1.5 - 3.0)	SM	A-4	NP	NV	37	50	64	86	99	100	100	100	100	100	7.9	--	--
B-06	0.0 - 0.5 (0.0 - 1.5)	SM	A-2-4	NP	NV	27	37	52	79	87	96	96	100	100	100	7.0	--	--
B-06	1.5 - 2.0 (5.0 - 6.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.3	--	--
B-06	3.0 - 3.5 (10.0 - 11.5)	SM	A-1-b	NP	NV	15	22	35	62	73	81	84	100	100	100	4.1	--	--
B-06	4.5 - 5.0 (15.0 - 16.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.7	--	--
B-06	6.1 - 6.5 (20.0 - 21.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.4	--	--
B-06	7.6 - 8.0 (25.0 - 26.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.9	--	--
B-07	0.0 - 0.5 (0.0 - 1.5)	SM	A-2-4	NP	NV	26	39	55	76	84	91	93	94	100	100	11.3	--	--
B-07	1.5 - 2.0 (5.0 - 6.5)	SM	A-2-4	--	--	23	35	52	82	90	97	100	100	100	100	5.6	--	--
B-08	0.0 - 0.5 (0.0 - 1.5)	SM	A-4	NP	NV	40	48	59	83	92	99	100	100	100	100	6.2	--	--
B-08	1.5 - 2.0 (5.0 - 6.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.9	--	--
B-08	3.0 - 3.5 (10.0 - 11.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.2	--	--
B-08	4.5 - 5.0 (15.0 - 16.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.1	--	--
B-08	5.5 - 5.9 (18.0 - 19.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.9	--	--
B-09	0.0 - 0.5 (0.0 - 1.5)	ML	A-4	NP	NV	66	75	83	96	98	99	100	100	100	100	4.7	--	--
B-09	2.7 - 3.2 (9.0 - 10.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.6	--	--
B-10	1.4 - 1.8 (4.5 - 6.0)	SM	A-2-4	--	--	27	34	48	74	83	91	96	100	100	100	4.9	--	--

Kleinfelder

SUMMARY OF LABORATORY ANALYSIS

Figure D.2

Project: **NM State Highway 126**
Project Number: **35321**

Location: **Cuba - LaCueva, NM**

Boring Number	Depth m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Accumulative % Passing										Moisture Content	Dry Density	Unconfined Comp. Strength
		USCS	AASHTO	PI	LL	0.075 mm (No. 200)	0.150 mm (No. 100)	0.425 mm (No. 40)	2.000 mm (No. 10)	4.750 mm (No. 4)	9.525 mm (3/8 in)	12.7 mm (1/2 in)	19.05 mm (3/4 in)	25.4 mm (1 in)	38.1 mm (1 1/2 in)	(%)	(pcf)	(tsf)
B-11	0.0 - 0.5 (0.0 - 1.5)	SM	A-2-4	NP	NV	29	36	49	75	83	91	94	96	100	100	10.6	--	--
B-11	1.5 - 2.0 (5.0 - 6.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.6	--	--
B-11	3.0 - 3.5 (10.0 - 11.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.9	--	--
B-11	3.9 - 4.4 (13.0 - 14.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.8	--	--
B-12	0.0 - 0.5 (0.0 - 1.5)	SM	A-4	NP	NV	38	45	54	72	83	98	98	100	100	100	9.3	--	--
B-13	0.5 - 0.9 (1.5 - 3.0)	SM	A-2-4	NP	NV	34	43	56	80	89	97	100	100	100	100	20.5	--	--
BR-01	2.6 - 3.0 (8.5 - 10.0)	--	--	NP	NV	--	--	--	--	--	--	--	--	--	--	--	--	--
BR-01	4.1 - 4.5 (13.5 - 15.0)	SM	A-2-4	--	--	31	40	47	63	69	80	82	91	95	100	30.5	--	--
BR-01	7.1 - 7.6 (23.5 - 25.0)	SM	A-2-4	--	--	30	38	50	72	79	84	88	92	97	100	32.6	--	--
BR-01	10.1 - 10.6 (33.5 - 35.0)	SP-SM	A-1-b	--	--	11	16	27	57	70	85	92	100	100	100	15.7	--	--
BR-01	11.7 - 11.8 (38.5 - 38.8)	--	--	--	--	26	--	--	--	--	--	--	--	--	--	10.5	--	--
BR-01	14.7 - 14.7 (48.5 - 48.7)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.7	--	--
BR-02	1.5 - 2.0 (5.0 - 6.5)	SM	A-1-b	NP	NV	21	29	44	74	84	99	100	100	100	100	26.8	--	--
BR-02	6.1 - 6.5 (20.0 - 21.5)	SM	A-4	--	--	41	50	66	94	98	100	100	100	100	100	34.9	--	--
BR-02	12.1 - 12.6 (40.0 - 41.5)	SP-SM	A-1-b	--	--	11	16	30	59	73	87	91	94	100	100	23.4	--	--
BR-03	4.5 - 5.0 (15.0 - 16.5)	ML	A-4	--	--	54	64	74	91	95	98	99	100	100	100	43.8	--	--
BR-04	2.7 - 3.2 (9.0 - 10.5)	SM	A-1-b	--	--	20	32	50	80	90	96	98	100	100	100	41.2	--	--
BR-04	5.8 - 6.2 (19.0 - 20.5)	SM	A-1-b	--	--	16	23	37	68	81	92	96	98	100	100	29.9	--	--
BR-04	14.8 - 15.3 (49.0 - 50.5)	SM	A-2-4	--	--	31	39	54	67	74	82	88	97	100	100	20.6	--	--
BR-04	16.4 - 16.5 (54.0 - 54.4)	--	--	--	--	73	--	--	--	--	--	--	--	--	--	13.9	--	--
BR-10	1.5 - 2.0 (5.0 - 6.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	41.9	67.0	--

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SUMMARY OF LABORATORY ANALYSIS

Figure D.3

Project: **NM State Highway 126**
Project Number: **35321**

Location: **Cuba - LaCueva, NM**

Boring Number	Depth m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Accumulative % Passing										Moisture Content	Dry Density	Unconfined Comp. Strength
		USCS	AASHTO	PI	LL	0.075 mm (No. 200)	0.150 mm (No. 100)	0.425 mm (No. 40)	2.000 mm (No. 10)	4.750 mm (No. 4)	9.525 mm (3/8 in)	12.7 mm (1/2 in)	19.05 mm (3/4 in)	25.4 mm (1 in)	38.1 mm (1 1/2 in)	(%)	(pcf)	(tsf)
BR-10	3.0 - 3.5 (10.0 - 11.5)	ML	A-4	NP	31	67	89	97	99	100	100	100	100	100	100	--	--	--
BR-10	7.6 - 8.0 (25.0 - 26.5)	SM	A-4	--	--	39	44	52	69	78	87	90	94	94	100	--	--	--
BR-11	1.1 - 1.5 (3.5 - 5.0)	ML	A-4	NP	33	--	--	--	--	--	--	--	--	--	--	--	--	--
BR-11	2.6 - 3.0 (8.5 - 10.0)	ML	A-4	--	--	57	85	97	99	100	100	100	100	100	100	--	--	--
BR-11	4.1 - 4.5 (13.5 - 15.0)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.2	77.3	--
BR-11	5.6 - 6.1 (18.5 - 20.0)	ML	A-4	--	--	63	85	97	100	100	100	100	100	100	100	--	--	--
BR-11	10.1 - 10.4 (33.5 - 34.5)	SM	A-4	--	--	43	66	84	87	87	88	88	89	100	100	--	--	--
BR-12	1.1 - 1.5 (3.5 - 5.0)	ML	A-4	--	--	70	81	92	98	100	100	100	100	100	100	39.4	52.6	--
BR-12	4.1 - 4.5 (13.5 - 15.0)	SM	A-1-b	--	--	18	25	39	69	78	91	95	98	98	100	--	--	--
BR-12	7.1 - 7.6 (23.5 - 25.0)	ML	A-4	NP	43	69	78	87	98	100	100	100	100	100	100	--	--	--
BR-12	10.1 - 10.6 (33.5 - 35.0)	SM	A-2-4	--	--	26	33	48	64	70	81	83	95	100	100	24.0	62.9	--
BR-14	1.1 - 1.5 (3.5 - 5.0)	ML	A-4	--	--	57	67	82	95	97	98	100	100	100	100	--	--	--
BR-14	2.6 - 3.0 (8.5 - 10.0)	ML	A-4	--	--	60	71	81	94	97	99	100	100	100	100	--	--	--
BR-14	11.7 - 12.1 (38.5 - 40.0)	SM	A-1-b	--	--	12	16	26	52	66	79	87	100	100	100	--	--	--
BR-14	16.2 - 16.7 (53.5 - 55.0)	MH	A-7-5	26	60	99	99	100	100	100	100	100	100	100	100	--	--	--
BR-16	1.4 - 1.8 (4.5 - 6.0)	SM	A-1-b	--	--	16	22	35	59	67	78	81	83	89	100	31.6	53.7	--
BR-16	4.4 - 4.8 (14.5 - 16.0)	SM	A-2-4	--	--	26	35	48	71	78	85	85	90	94	100	--	--	--
BR-16	5.9 - 6.4 (19.5 - 21.0)	SM	A-1-b	--	--	18	26	44	76	85	93	95	99	100	100	--	--	--
BR-16	7.4 - 7.9 (24.5 - 26.0)	SP-SM	A-1-a	--	--	9	12	23	42	54	74	81	88	100	100	--	--	--
BR-16	10.4 - 10.9 (34.5 - 36.0)	SM	A-2-4	--	--	21	31	51	65	72	80	83	95	100	100	35.4	55.7	--
BR-16	12.0 - 12.4 (39.5 - 41.0)	SP-SM	A-1-a	--	--	6	9	20	54	63	72	77	92	93	100	--	--	--

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SUMMARY OF LABORATORY ANALYSIS

Figure D.4

Project: **NM State Highway 126**
Project Number: **35321**

Location: **Cuba - LaCueva, NM**

Boring Number	Depth m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Accumulative % Passing										Moisture Content (%)	Dry Density (pcf)	Unconfined Comp. Strength (tsf)
		USCS	AASHTO	PI	LL	0.075 mm (No. 200)	0.150 mm (No. 100)	0.425 mm (No. 40)	2.000 mm (No. 10)	4.750 mm (No. 4)	9.525 mm (3/8 in)	12.7 mm (1/2 in)	19.05 mm (3/4 in)	25.4 mm (1 in)	38.1 mm (1 1/2 in)			
MSE-01	0.0 - 0.5 (0.0 - 1.5)	GM	A-1-b	NP	NV	16	23	33	48	57	73	82	92	100	100	4.4	--	--
MSE-01	1.5 - 2.0 (5.0 - 6.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.6	--	--
MSE-01	3.0 - 3.5 (10.0 - 11.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.4	--	--
MSE-02	0.0 - 0.5 (0.0 - 1.5)	SM	A-1-b	--	--	21	29	41	68	78	87	91	96	100	100	3.5	--	--
MSE-03	1.2 - 1.7 (4.0 - 5.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.4	--	--
MSE-03	4.2 - 4.7 (14.0 - 15.5)	GM	A-1-a	--	--	15	20	28	40	50	55	61	64	100	100	6.9	--	--
MSE-04	1.2 - 1.7 (4.0 - 5.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.9	--	--
MSE-04	4.2 - 4.7 (14.0 - 15.4)	SM	A-4	--	--	36	51	69	93	98	99	100	100	100	100	24.4	--	--
MSE-05	0.0 - 0.5 (0.0 - 1.5)	SM	A-1-b	--	--	18	22	31	50	67	90	95	100	100	100	4.4	--	--
MSE-05	1.5 - 2.0 (5.0 - 6.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.1	--	--
MSE-05	3.0 - 3.5 (10.0 - 11.5)	GM	A-1-a	--	--	15	18	26	44	59	75	82	97	100	100	4.1	--	--
MSE-06	0.0 - 0.5 (0.0 - 1.5)	SM	A-1-b	--	--	23	29	39	59	72	84	91	98	100	100	10.1	--	--
MSE-06	1.2 - 1.7 (4.0 - 5.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.4	--	--
MSE-06	4.2 - 4.7 (14.0 - 15.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.5	--	--
MSE-07	0.0 - 0.5 (0.0 - 1.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.1	--	--
MSE-07	1.2 - 1.7 (4.0 - 5.5)	SM	A-1-b	--	--	20	23	29	45	56	69	71	84	100	100	11.6	--	--

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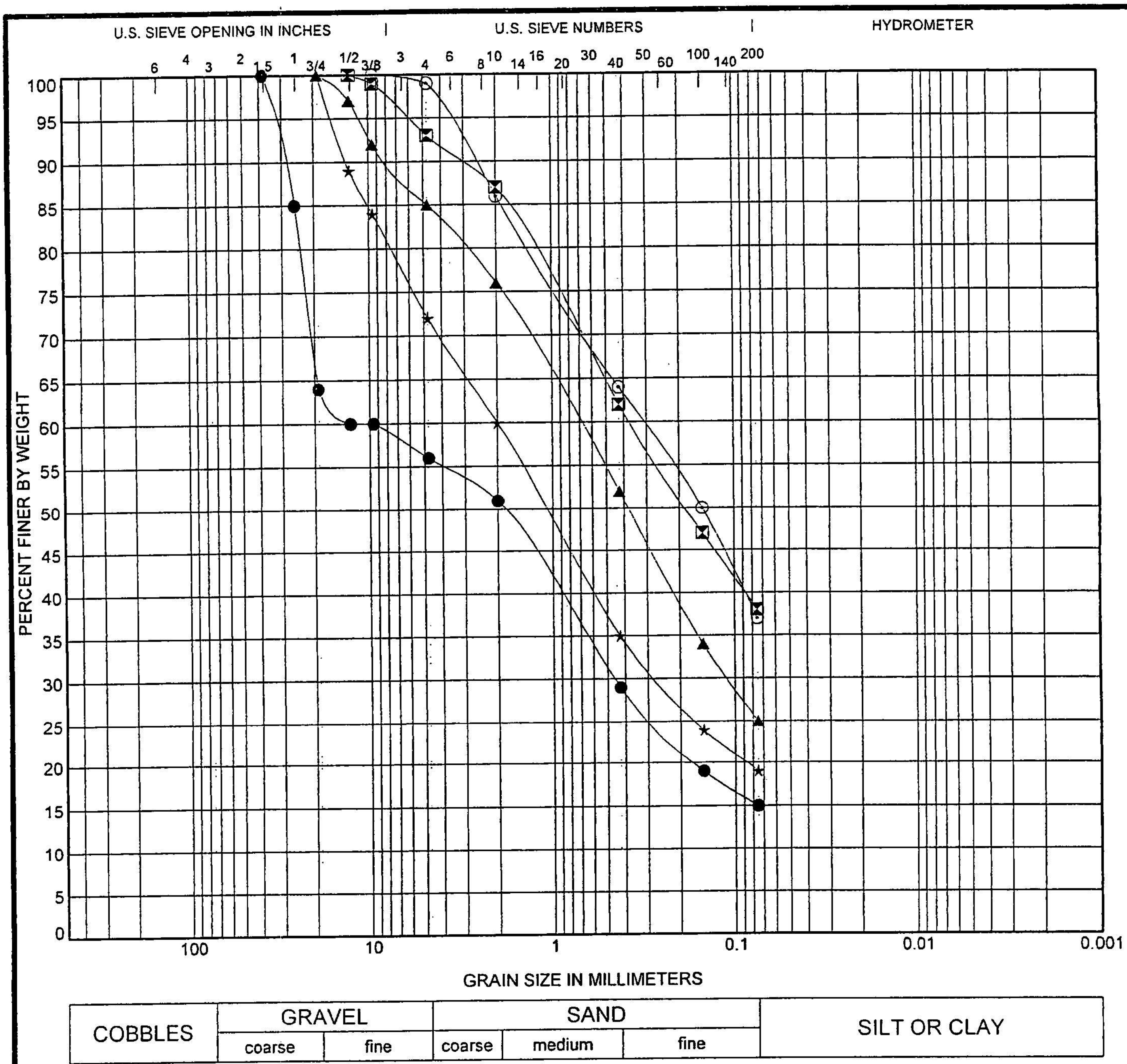

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01	0.5 m (1.5')	38.1	9.525	0.456		44.0	41.0	15.0	
⊠	B-02	0.0 m (0.0')	12.7	0.37			7.0	55.0	38.0	
▲	B-03	0.0 m (0.0')	19.05	0.712	0.11		15.0	60.0	25.0	
★	B-04	0.5 m (1.5')	19.05	2	0.265		28.0	53.0	19.0	
⊙	B-05	0.5 m (1.5')	9.525	0.316			1.0	62.0	37.0	

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05

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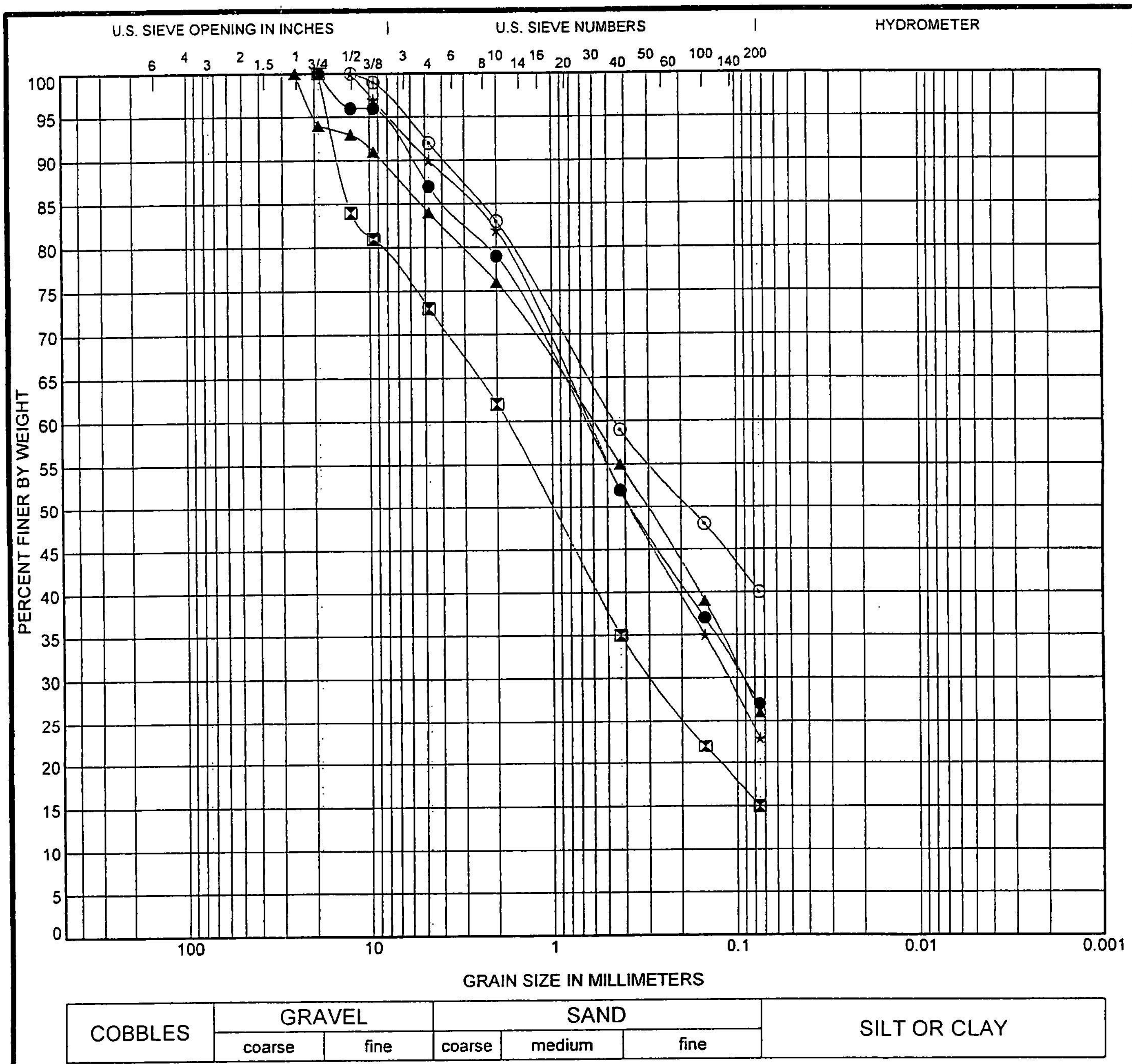
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321



Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-06	0.0 m (0.0')	19.05	0.672	0.092		13.0	60.0	27.0	
⊠	B-06	3.0 m (10.0')	19.05	1.783	0.285		27.0	58.0	15.0	
▲	B-07	0.0 m (0.0')	25.4	0.615	0.093		16.0	58.0	26.0	
★	B-07	1.5 m (5.0')	12.7	0.642	0.112		10.0	67.0	23.0	
⊙	B-08	0.0 m (0.0')	12.7	0.453			8.0	52.0	40.0	

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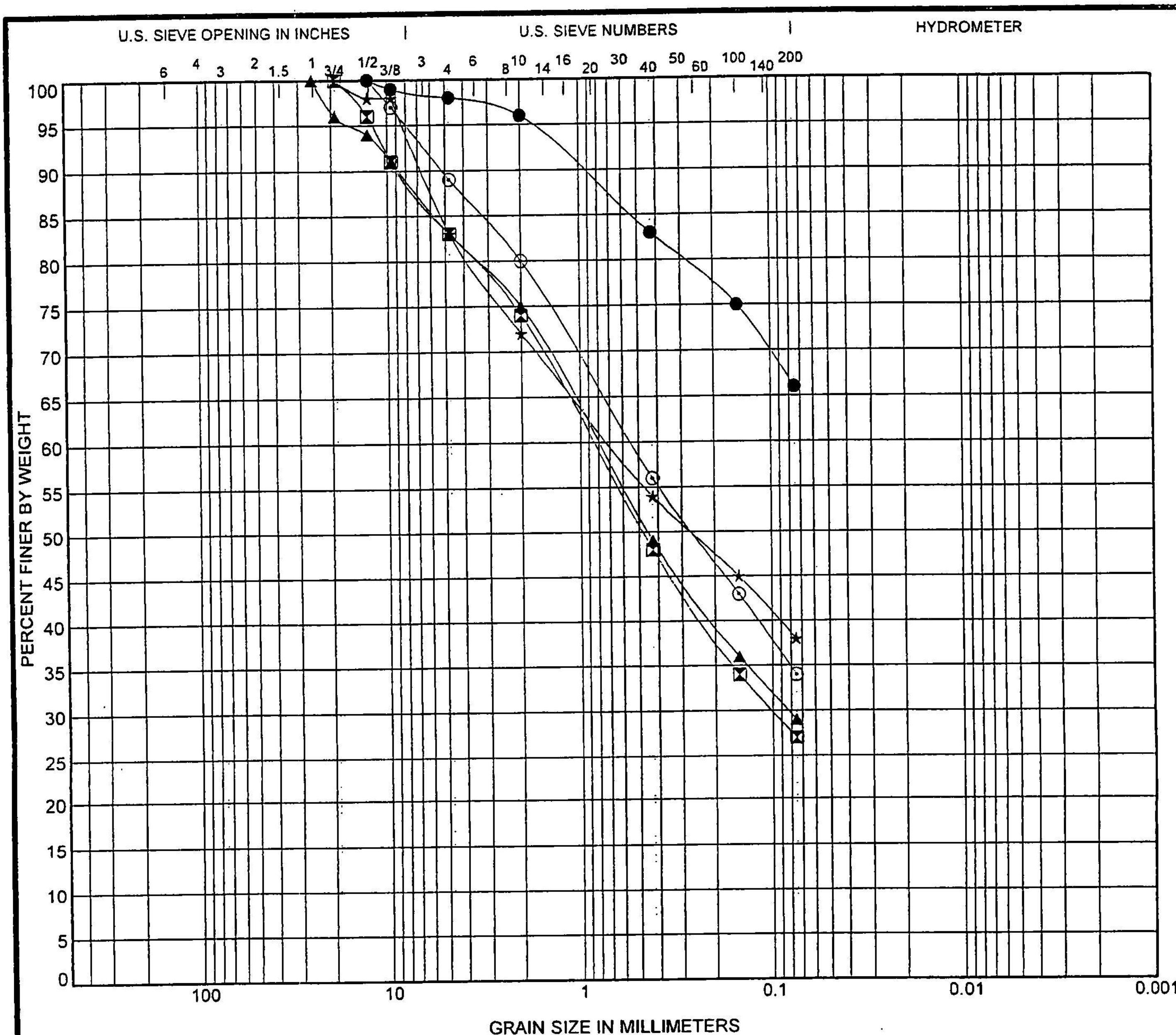
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-09	0.0 m (0.0')	12.7				2.0	32.0	66.0	
⊠	B-10	1.4 m (4.5')	19.05	0.869	0.101		17.0	56.0	27.0	
▲	B-11	0.0 m (0.0')	25.4	0.818	0.083		17.0	54.0	29.0	
★	B-12	0.0 m (0.0')	19.05	0.712			17.0	45.0	38.0	
⊙	B-13	0.5 m (1.5')	12.7	0.55			11.0	55.0	34.0	

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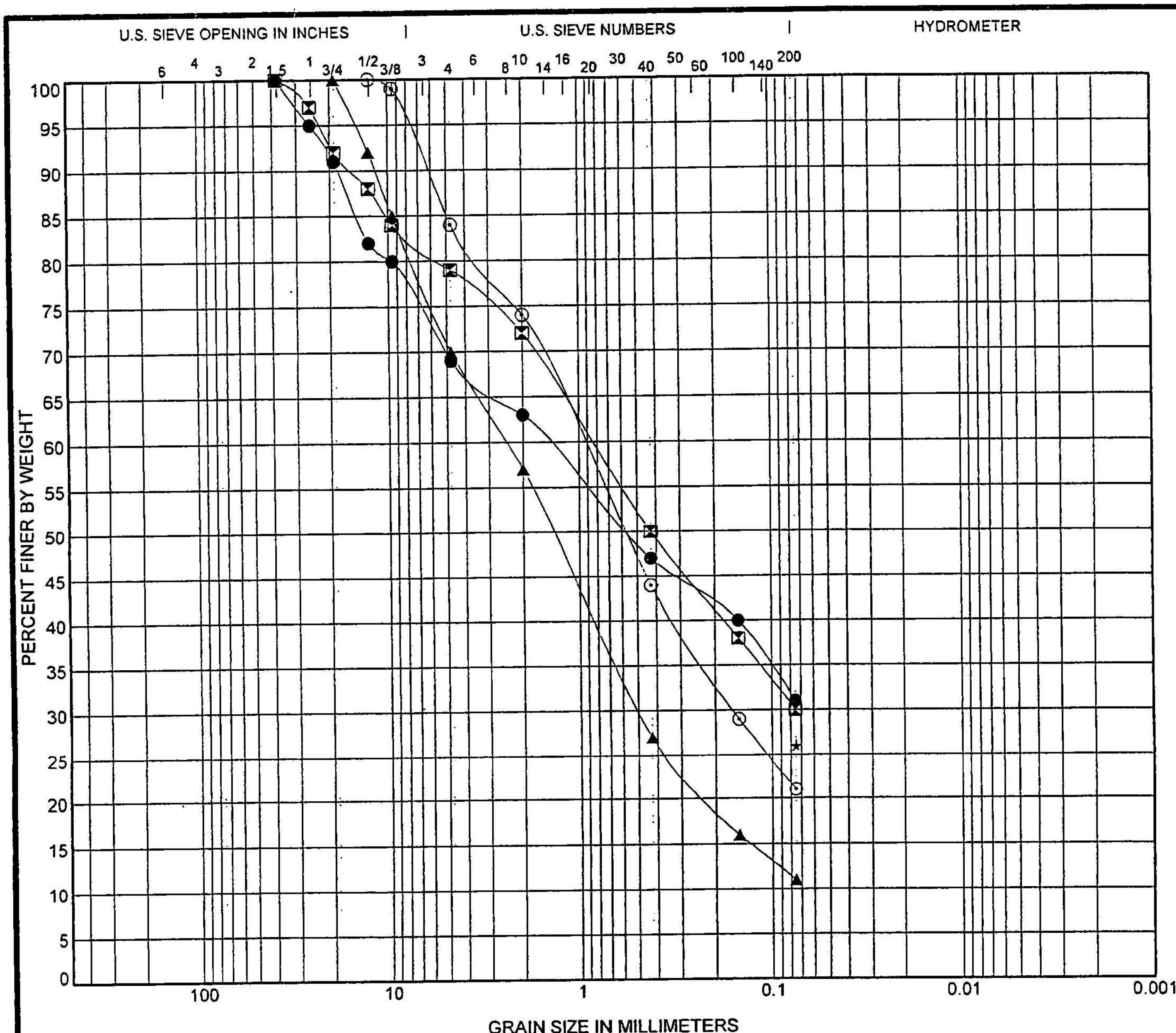
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-01	4.1 m (13.5')	38.1	1.496			31.0	38.0	31.0	
⊠	BR-01	7.1 m (23.5')	38.1	0.859	0.075		21.0	49.0	30.0	
▲	BR-01	10.1 m (33.5')	19.05	2.442	0.496		30.0	59.0	11.0	
★	BR-01	11.7 m (38.5')	0.075				0.0	0.0	26.0	
⊙	BR-02	1.5 m (5.0')	12.7	0.971	0.161		16.0	63.0	21.0	

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05

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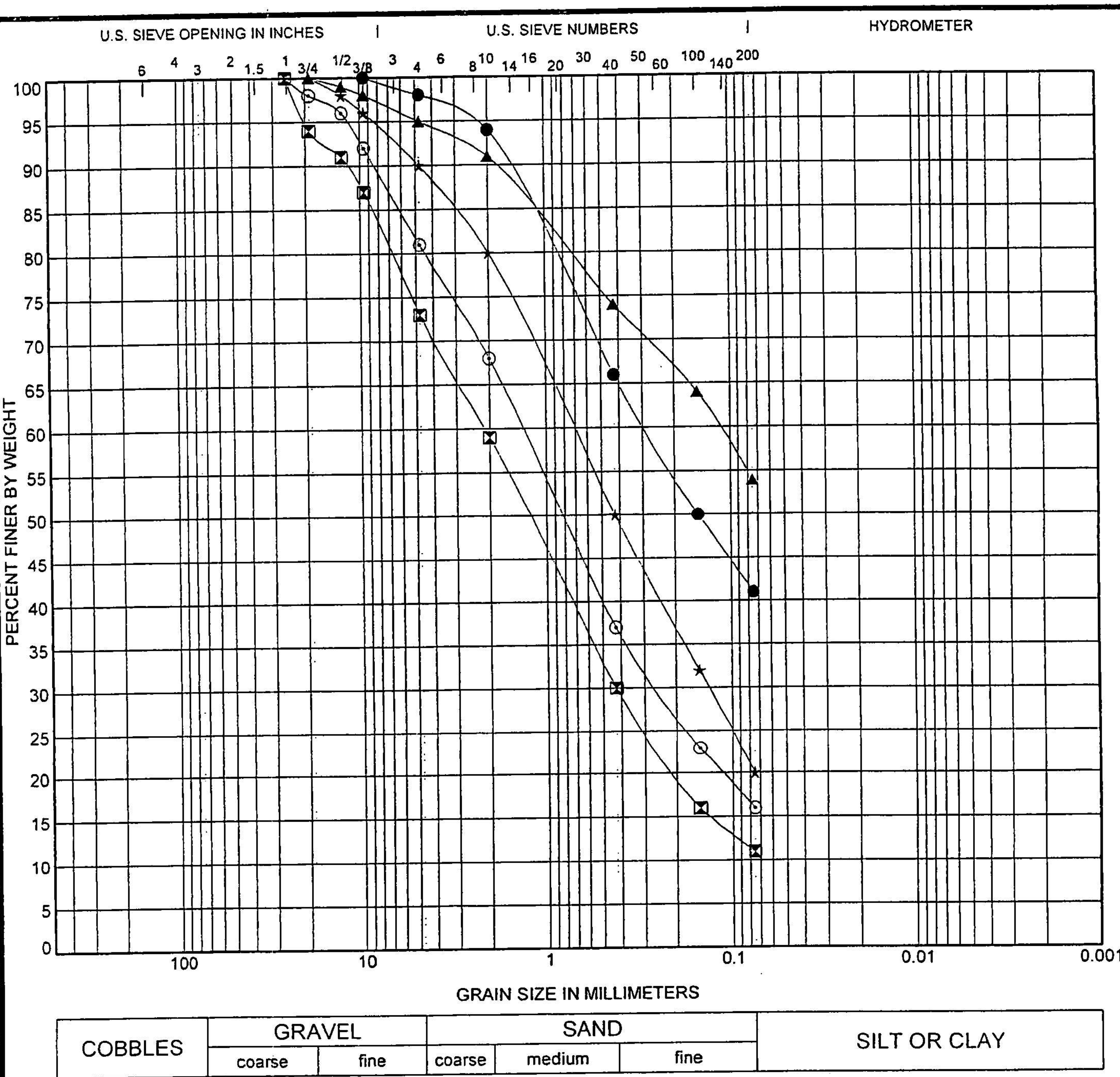
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321



	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-02	6.1 m (20.0')	9.525	0.288			2.0	57.0	41.0	
⊠	BR-02	12.1 m (40.0')	25.4	2.127	0.425		27.0	62.0	11.0	
▲	BR-03	4.5 m (15.0')	19.05	0.114			5.0	41.0	54.0	
★	BR-04	2.7 m (9.0')	19.05	0.712	0.134		10.0	70.0	20.0	
⊙	BR-04	5.8 m (19.0')	25.4	1.341	0.252		19.0	65.0	16.0	

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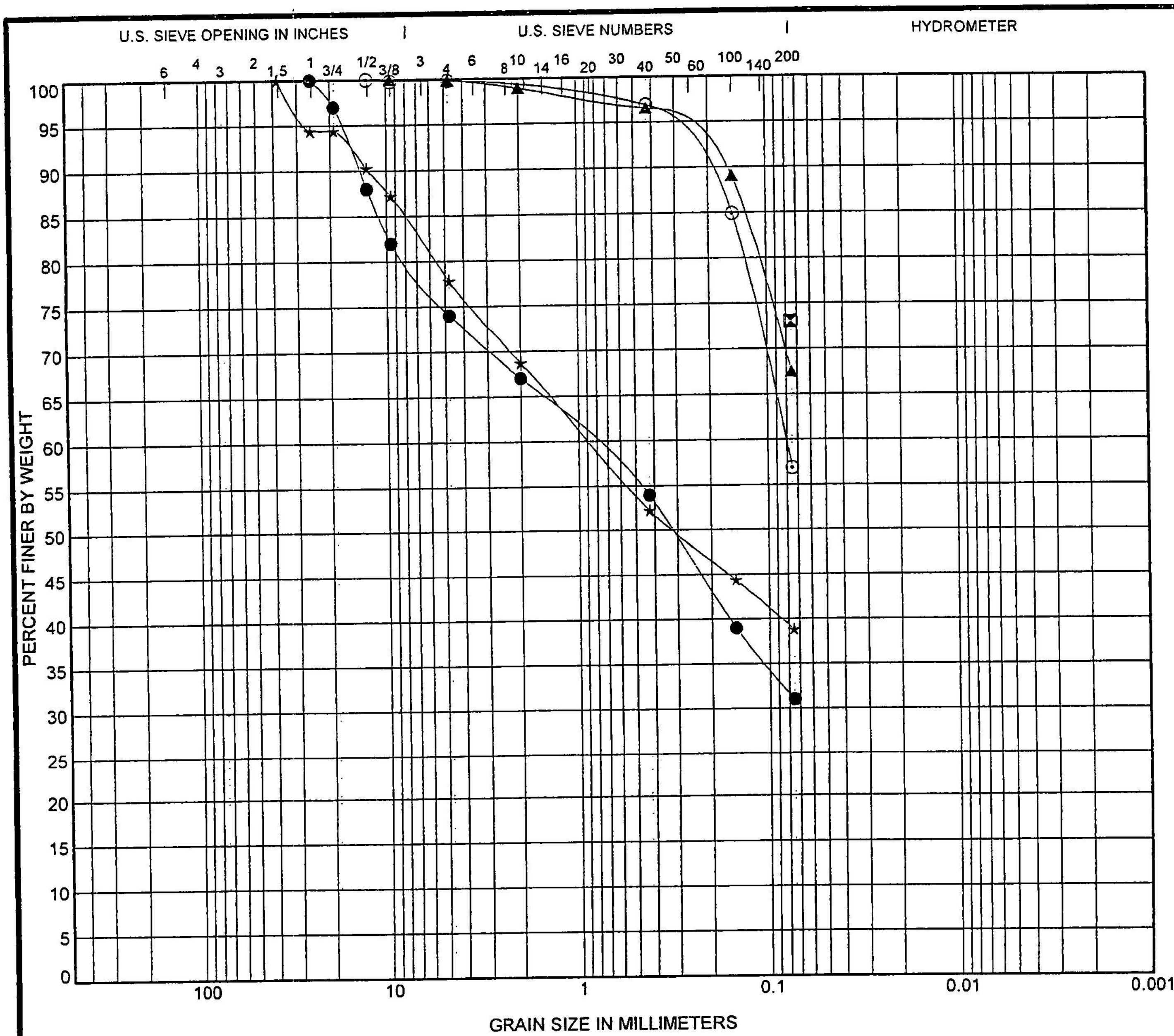
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-04 14.8 m (49.0')	25.4	0.869			26.0	43.0	31.0	
⊠	BR-04 16.4 m (54.0')	0.075				0.0	0.0	73.0	
▲	BR-10 3.0 m (10.0')	9.525				0.2	32.4	67.5	
★	BR-10 7.6 m (25.0')	38.1	0.878			22.2	39.0	38.8	
⊙	BR-11 2.6 m (8.5')	12.7	0.081			0.2	42.9	56.9	

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GRAIN SIZE DISTRIBUTION

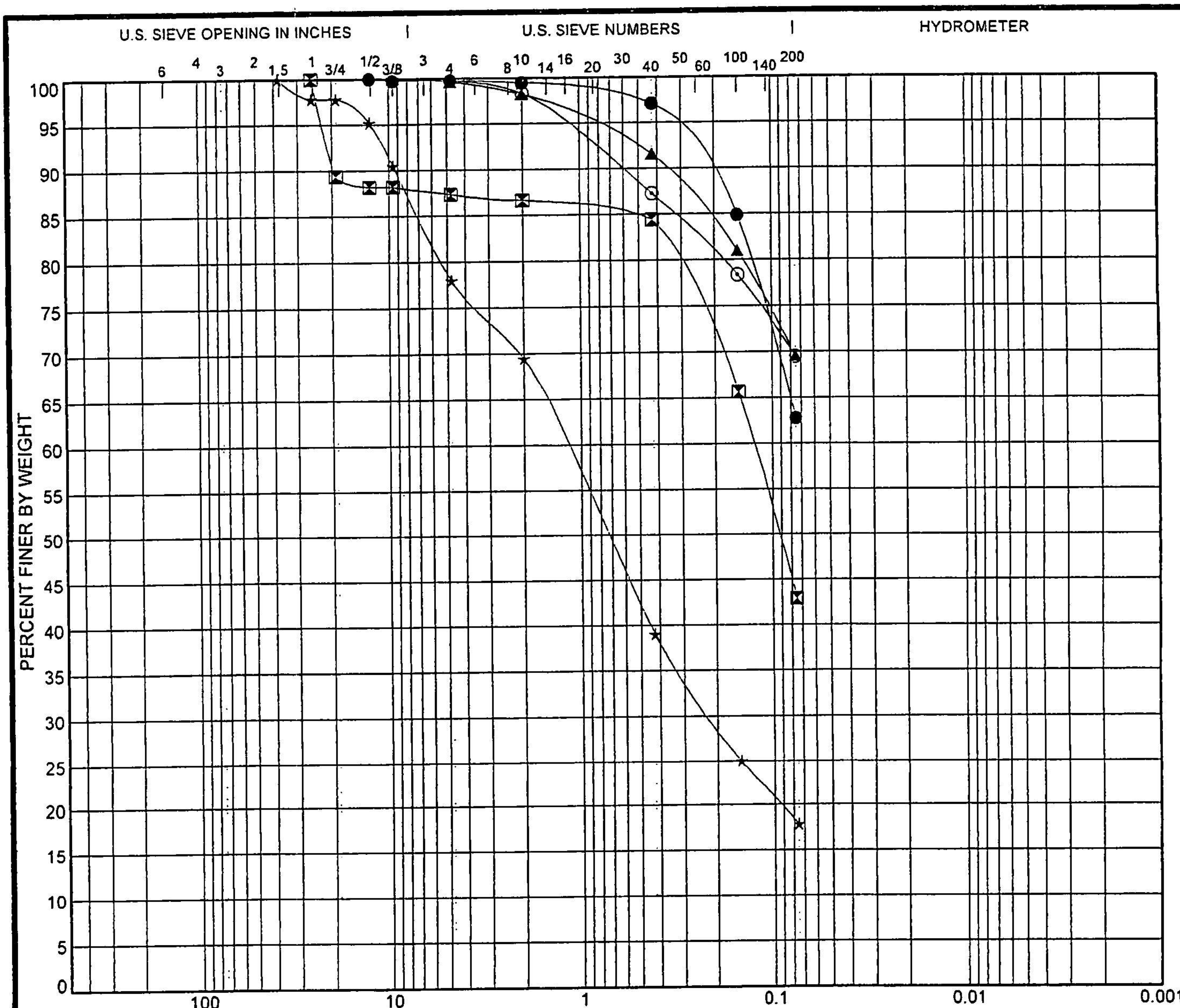
Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05

Figure D.10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-11	5.6 m (18.5')	12.7				0.2	37.0	62.8	
⊠	BR-11	10.1 m (33.5')	25.4	0.126			12.7	44.5	42.9	
▲	BR-12	1.1 m (3.5')	9.525				0.4	30.1	69.6	
★	BR-12	4.1 m (13.5')	38.1	1.235	0.217		22.0	60.1	17.9	
⊙	BR-12	7.1 m (23.5')	9.525				0.3	30.3	69.5	

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05

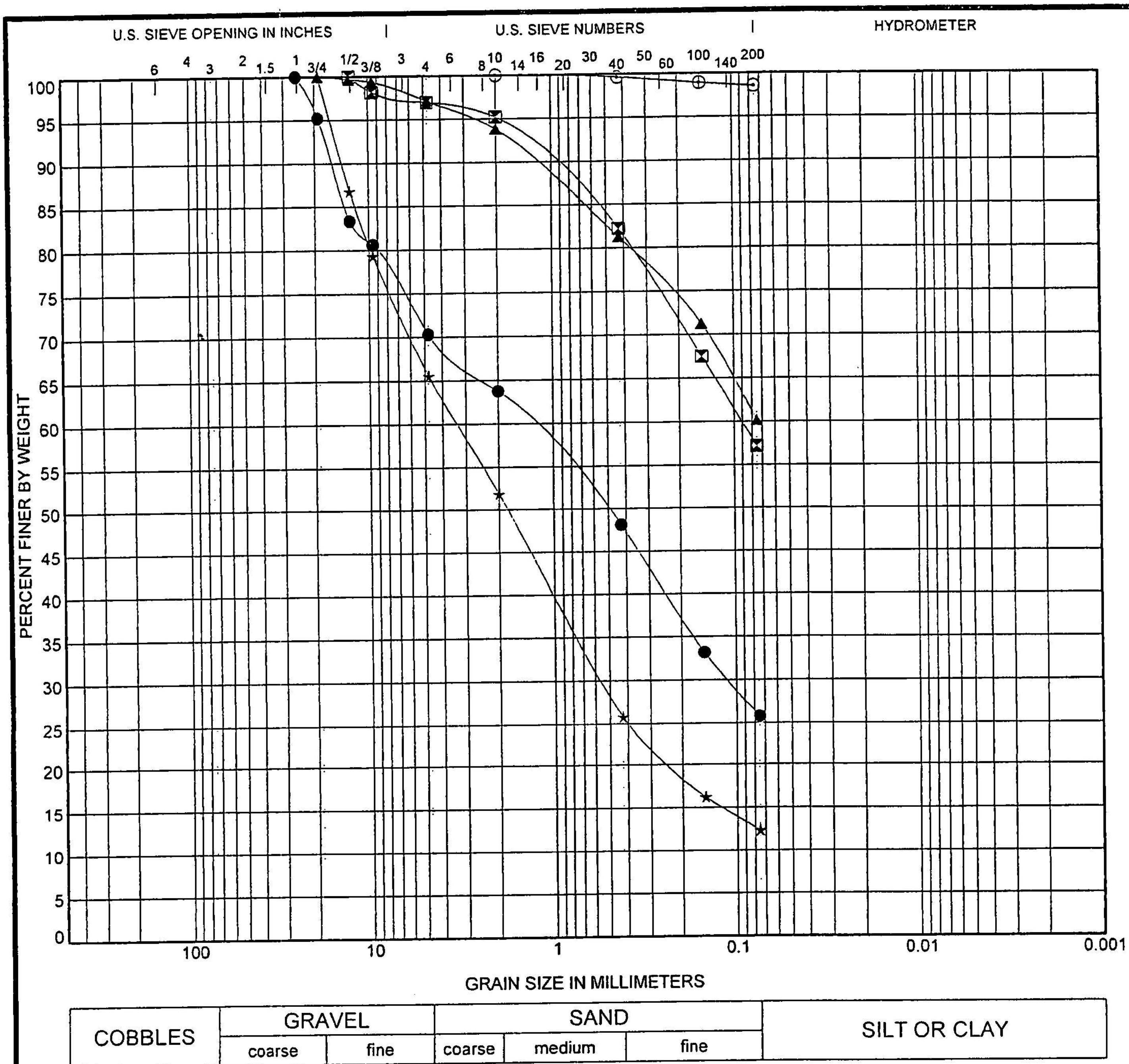
KLEINFELDER

GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321



Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● BR-12	10.1 m (33.5')	25.4	1.376	0.111		29.7	44.5	25.8	
⊠ BR-14	1.1 m (3.5')	12.7	0.091			3.0	39.8	57.2	
▲ BR-14	2.6 m (8.5')	19.05				2.9	37.0	60.2	
★ BR-14	11.7 m (38.5')	19.05	3.34	0.544		34.4	53.2	12.3	
⊙ BR-14	16.2 m (53.5')	2				0.0	1.5	98.5	

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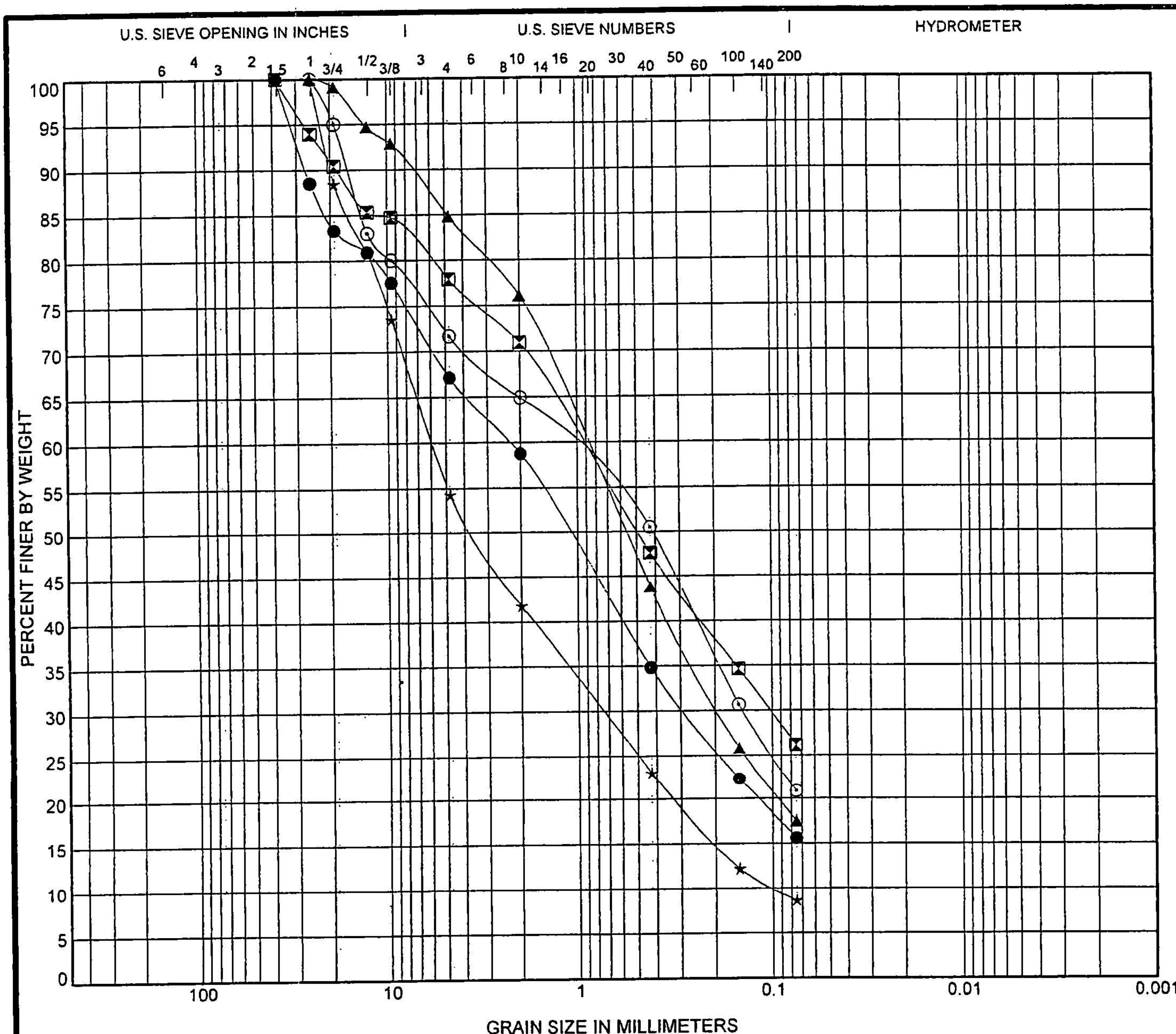
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-16	1.4 m (4.5')	38.1	2.271	0.284		32.9	51.5	15.6	
⊠	BR-16	4.4 m (14.5')	38.1	0.968	0.103		22.1	51.7	26.2	
▲	BR-16	5.9 m (19.5')	25.4	0.924	0.191		15.2	67.3	17.5	
★	BR-16	7.4 m (24.5')	25.4	5.832	0.752	0.098	45.7	45.7	8.6	
⊙	BR-16	10.4 m (34.5')	25.4	1.178	0.143		28.3	50.8	20.9	

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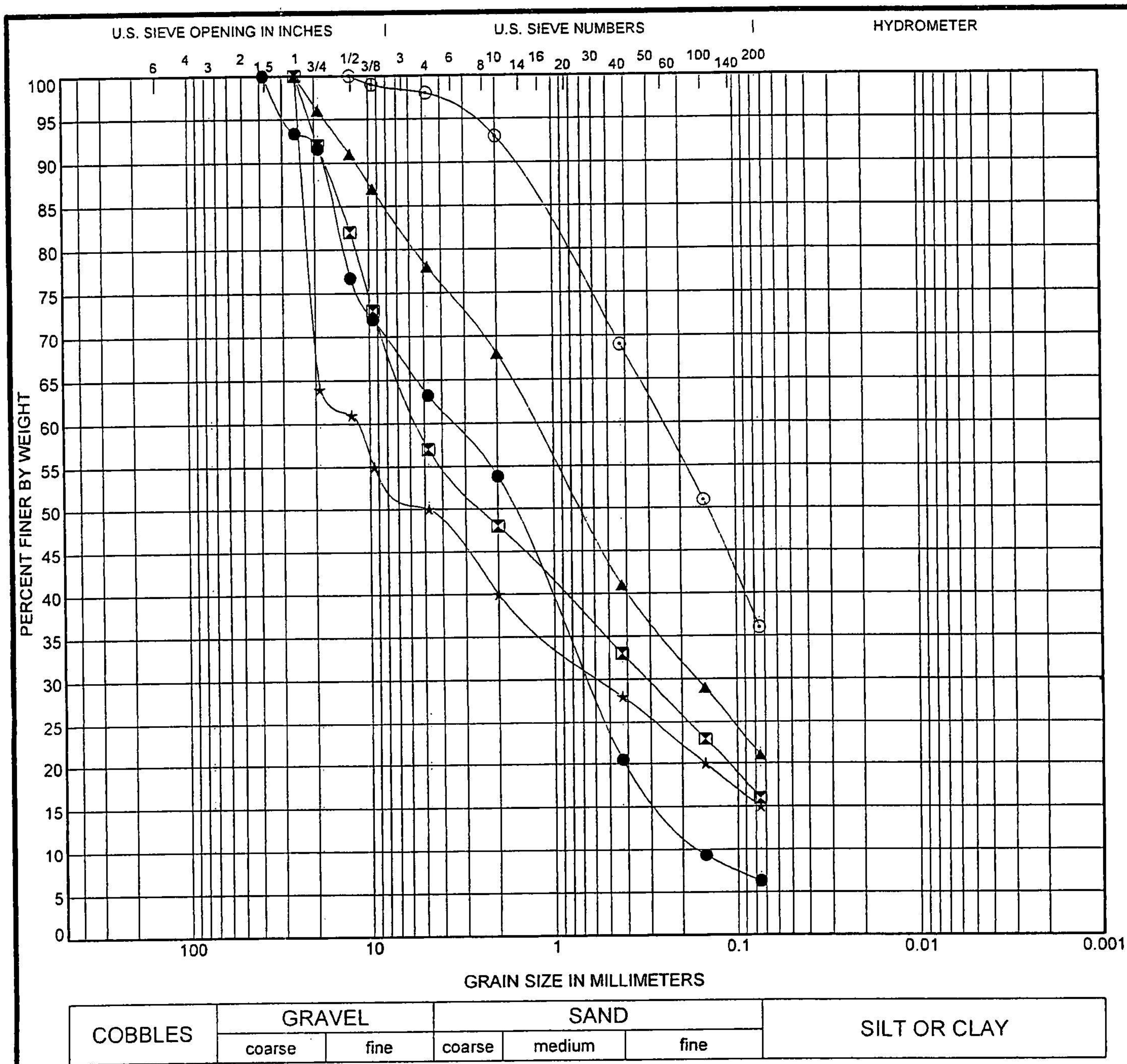
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-16 12.0 m (39.5')	38.1	3.521	0.661	0.16	36.8	56.9	6.3	
⊠	MSE-01 0.0 m (0.0')	25.4	5.412	0.311		43.0	41.0	16.0	
▲	MSE-02 0.0 m (0.0')	25.4	1.264	0.164		22.0	57.0	21.0	
★	MSE-03 4.2 m (14.0')	25.4	12.105	0.55		50.0	35.0	15.0	
⊙	MSE-04 4.2 m (14.0')	12.7	0.252			2.0	62.0	36.0	

KLEINFELDER

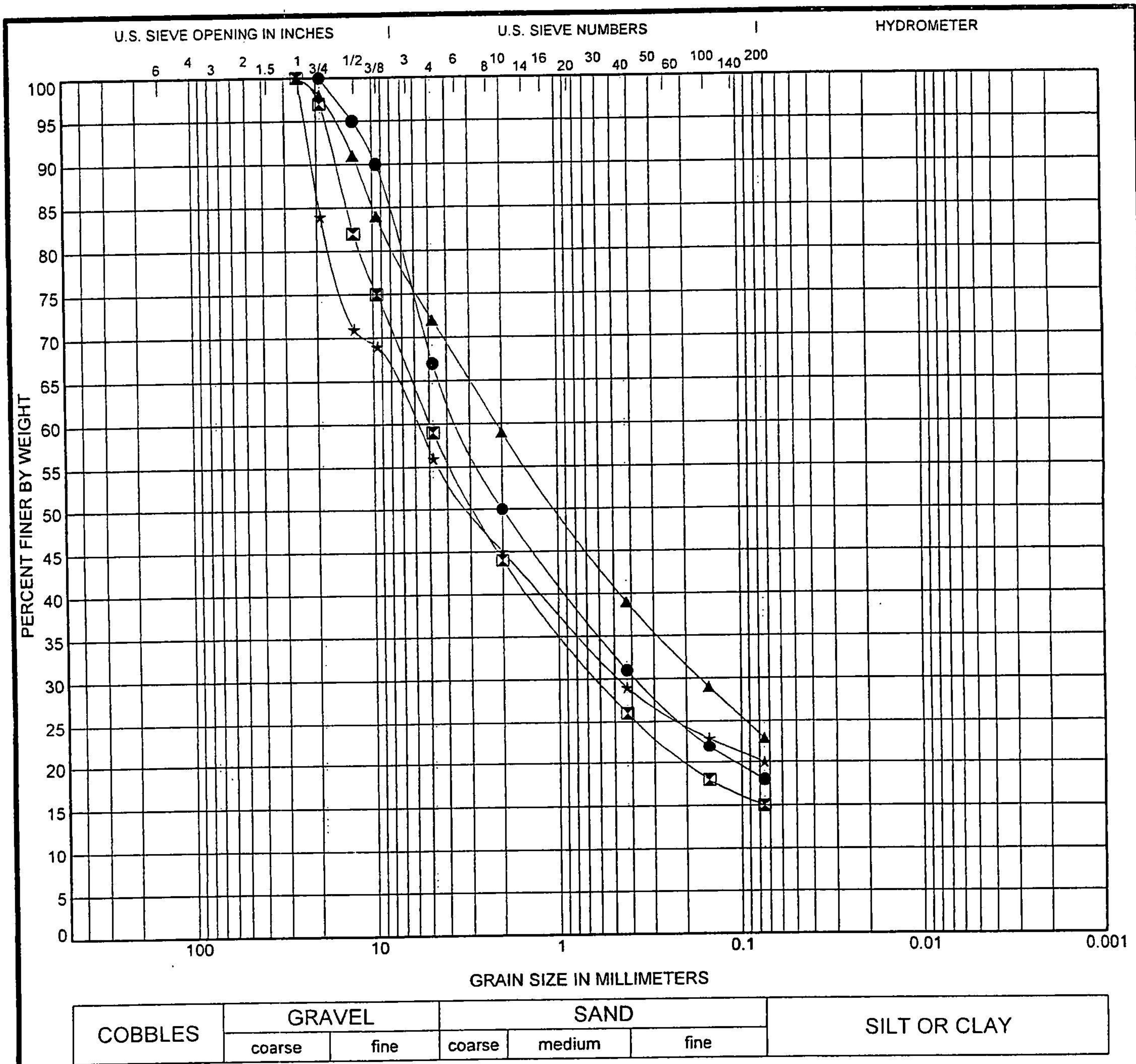
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	MSE-05 0.0 m (0.0')	19.05	3.327	0.379		33.0	49.0	18.0	
⊠	MSE-05 3.0 m (10.0')	25.4	4.961	0.6		41.0	44.0	15.0	
▲	MSE-06 0.0 m (0.0')	25.4	2.138	0.166		28.0	49.0	23.0	
★	MSE-07 1.2 m (4.0')	25.4	5.884	0.468		44.0	36.0	20.0	

KLEINFELDER

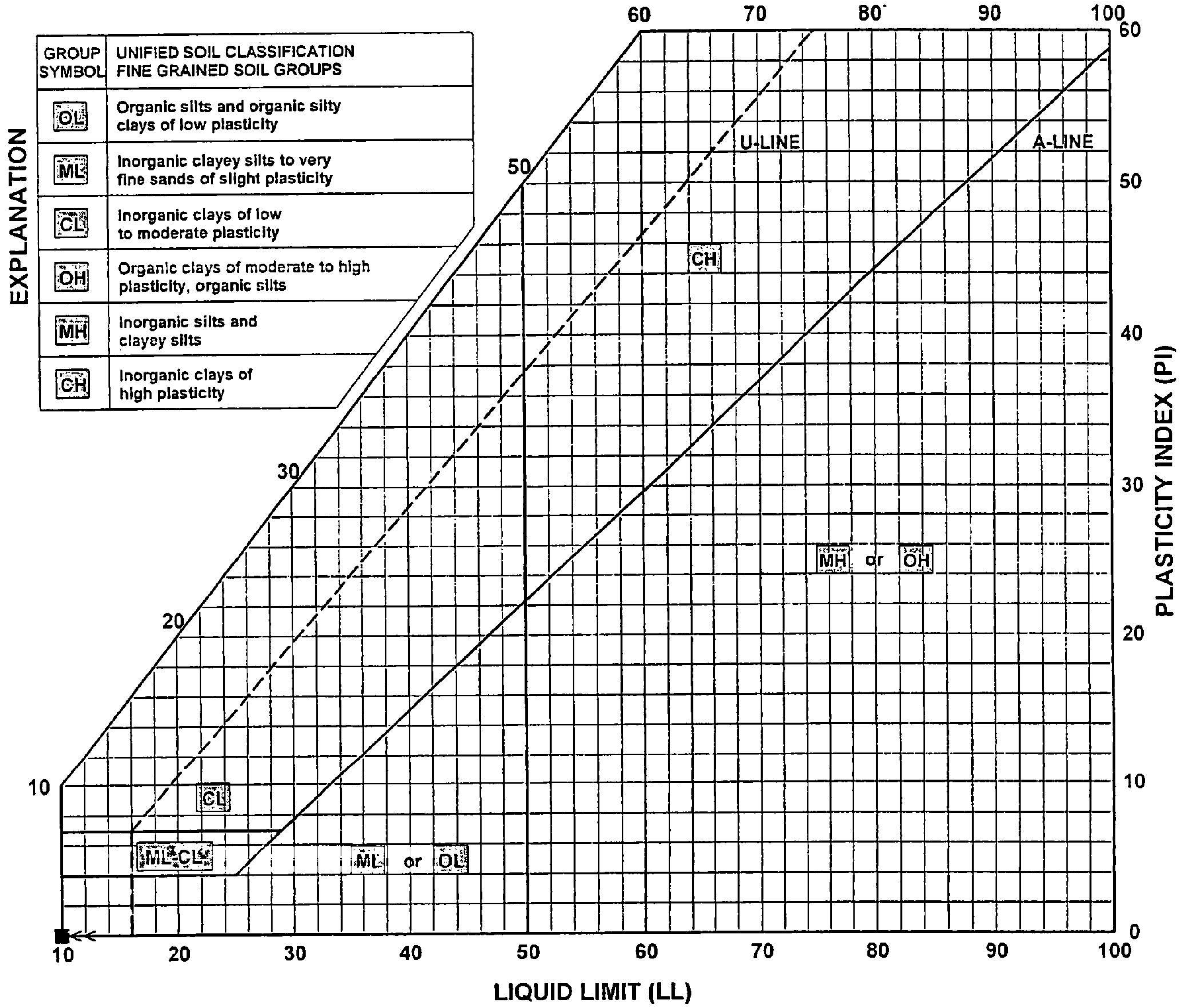
GRAIN SIZE DISTRIBUTION

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI GRAIN SIZE METRIC 35321 FINAL.GPJ TRINITY.GDT 3/22/05



	Specimen Identification		Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
●	B-01	0.5 m (1.5')	NV	NV	NP
⧗	B-03	0.0 m (0.0')	NV	NV	NP
▲	B-05	0.5 m (1.5')	NV	NV	NP
★	B-06	0.0 m (0.0')	NV	NV	NP
⊙	B-06	3.0 m (10.0')	NV	NV	NP

KLEINFELDER

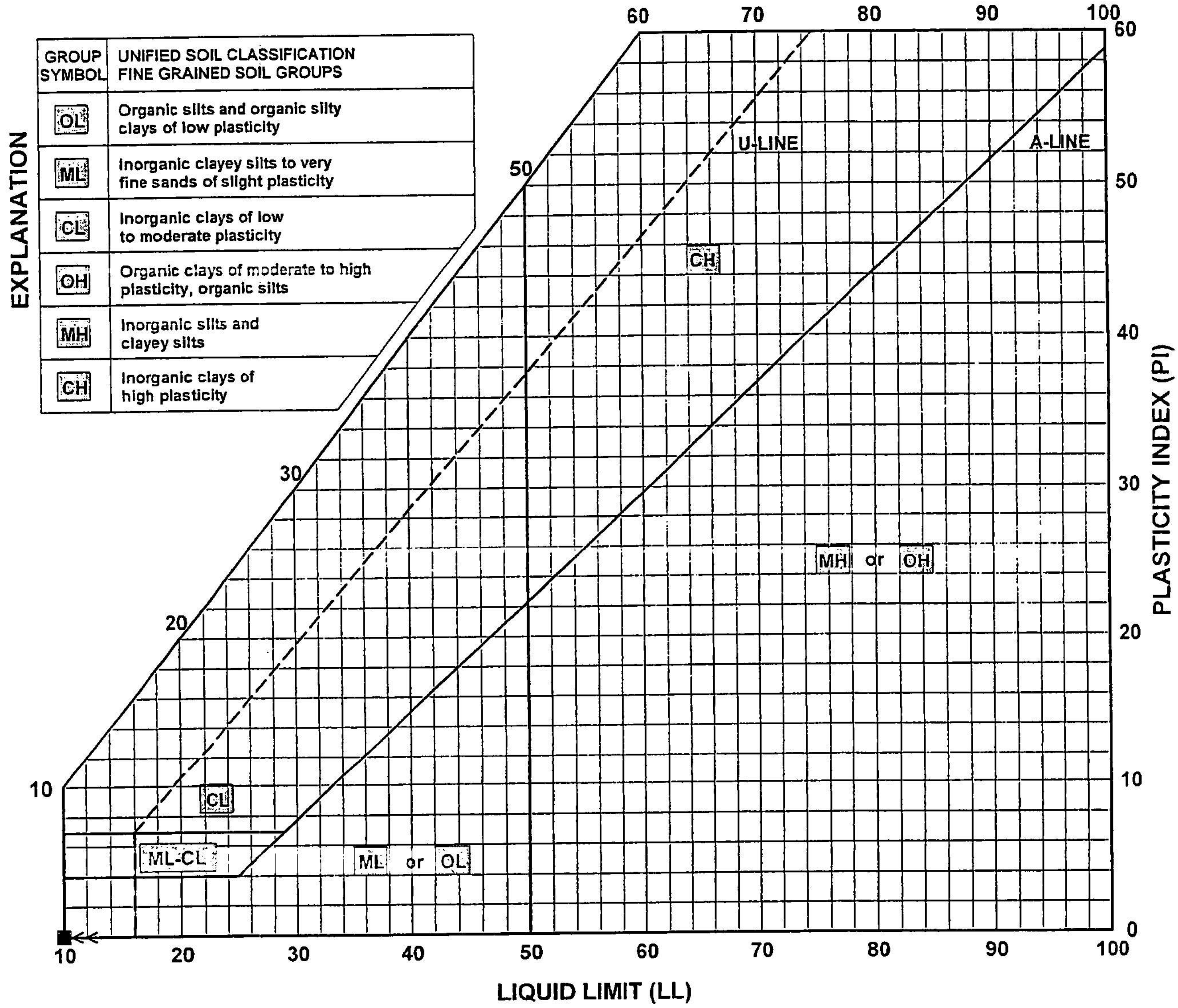
ATTERBERG LIMITS

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI ATTER METRIC 35321 FINAL.GPJ NEWKALOG02.GDT 3/22/05



Specimen Identification			Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
●	B-07	0.0 m (0.0')	NV	NV	NP
⊠	B-08	0.0 m (0.0')	NV	NV	NP
▲	B-09	0.0 m (0.0')	NV	NV	NP
★	B-11	0.0 m (0.0')	NV	NV	NP
⊙	B-12	0.0 m (0.0')	NV	NV	NP

KLEINFELDER

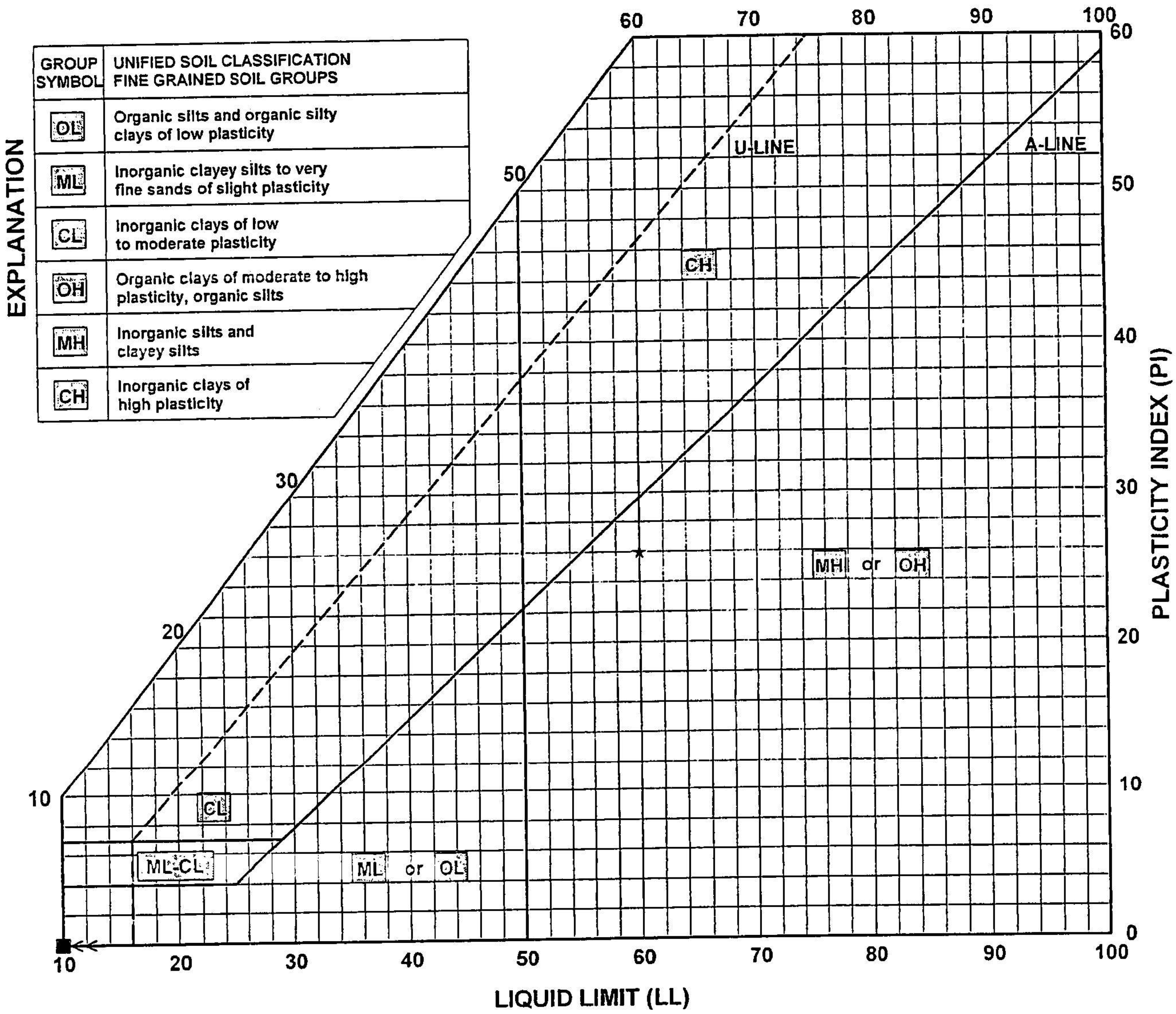
ATTERBERG LIMITS

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI ATTER METRIC 35321 FINAL.GPJ NEWKALOG02.GDT 3/22/05



Specimen Identification			Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
●	B-13	0.5 m (1.5')	NV	NV	NP
⊠	BR-01	2.6 m (8.5')	NV	NV	NP
▲	BR-02	1.5 m (5.0')	NV	NV	NP
★	BR-14	16.2 m (53.5')	60	34	26
⊙	MSE-01	0.0 m (0.0')	NV	NV	NP

KLEINFELDER

ATTERBERG LIMITS

Project: NM State Highway 126

Location: Cuba - LaCueva, NM

Project Number: 35321

KLI ATTER METRIC 35321 FINAL.GPJ NEWKALOG02.GDT 3/22/05

SAMPLE A-0 TEST BY R. JONES TEST DATE 11/17/03

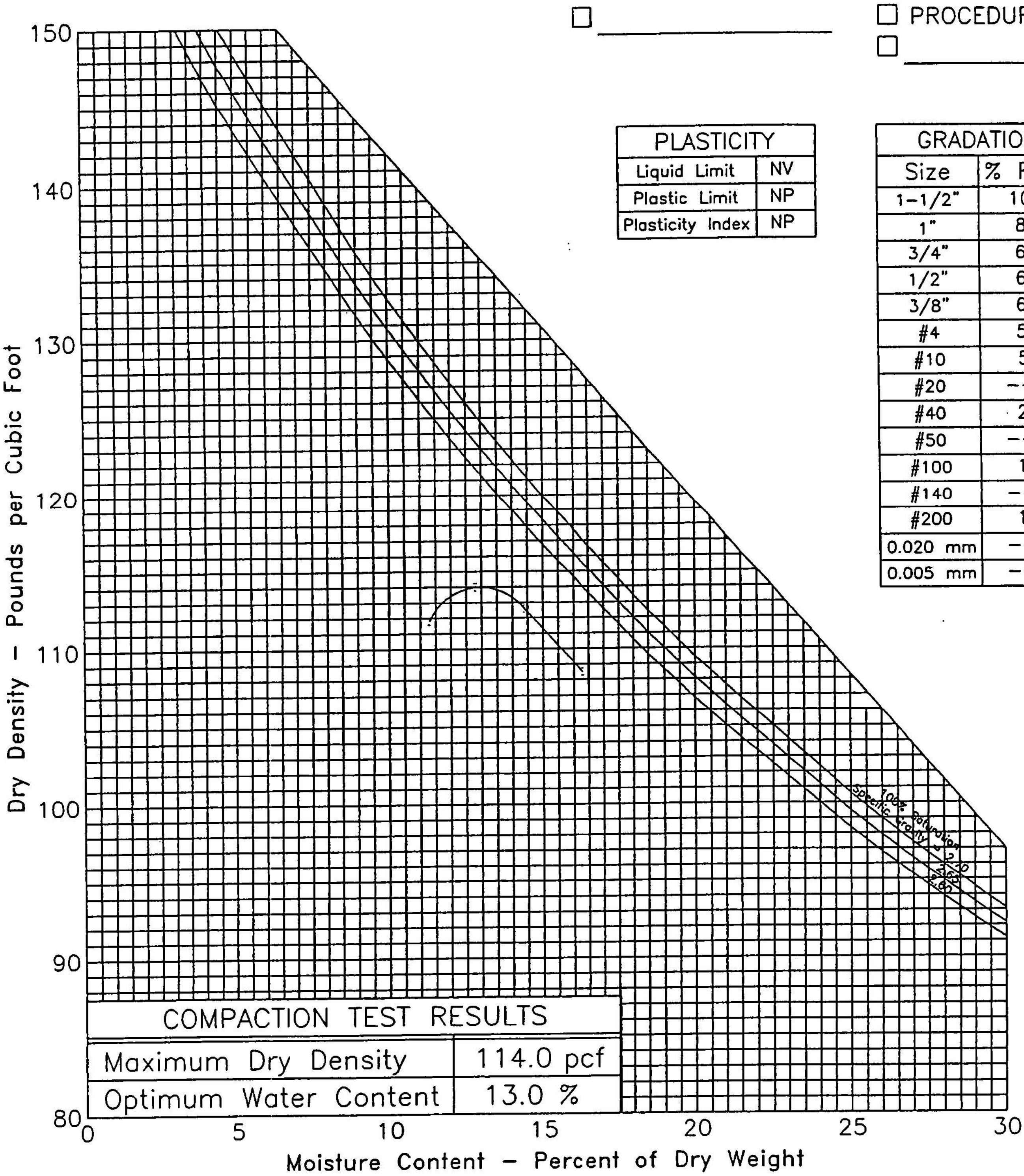
LOCATION B-1 (0'-3')

SOIL TYPE GM (A-1-b)

TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______



PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	85
3/4"	64
1/2"	60
3/8"	60
#4	56
#10	51
#20	---
#40	29
#50	---
#100	19
#140	---
#200	15
0.020 mm	---
0.005 mm	---

COMPACTION TEST RESULTS	
Maximum Dry Density	114.0 pcf
Optimum Water Content	13.0 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.19

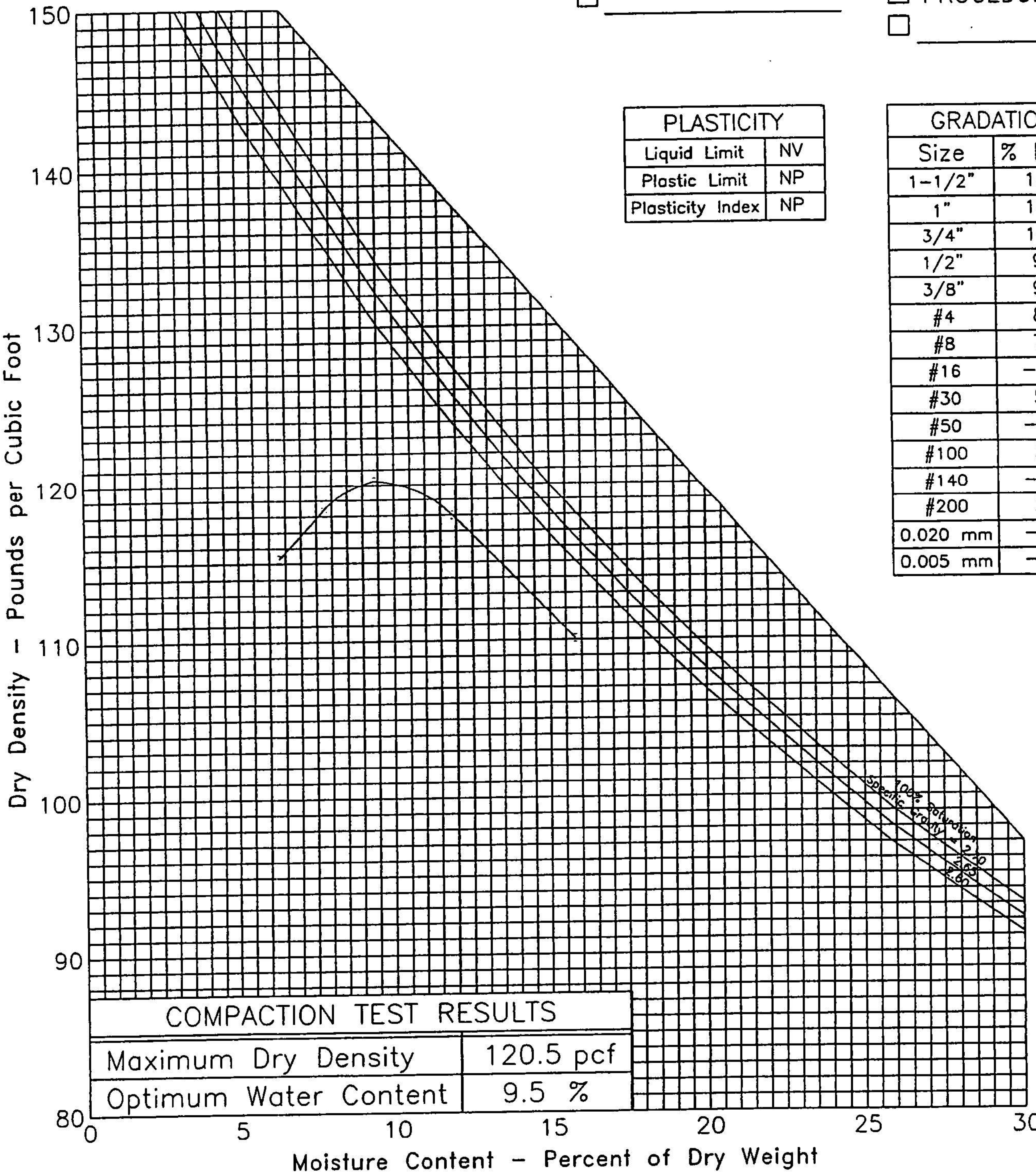
SAMPLE A-0 TEST BY R. JONES TEST DATE 11/17/03

LOCATION B-3 (0-3')

SOIL TYPE SM (A-2-4(0))

TEST METHOD:
- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ____

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ____



PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	97
3/8"	92
#4	85
#8	76
#16	---
#30	52
#50	---
#100	34
#140	---
#200	25
0.020 mm	---
0.005 mm	---

COMPACTION TEST RESULTS	
Maximum Dry Density	120.5 pcf
Optimum Water Content	9.5 %

KLEINFELDER

CHECKED BY:
PROJECT NO. 35321

FN: PROCTOR
DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.20

SAMPLE A-0 TEST BY R. STUMP TEST DATE 11/12/03

LOCATION B-5 (0-5')

SOIL TYPE SM (A-4(0))

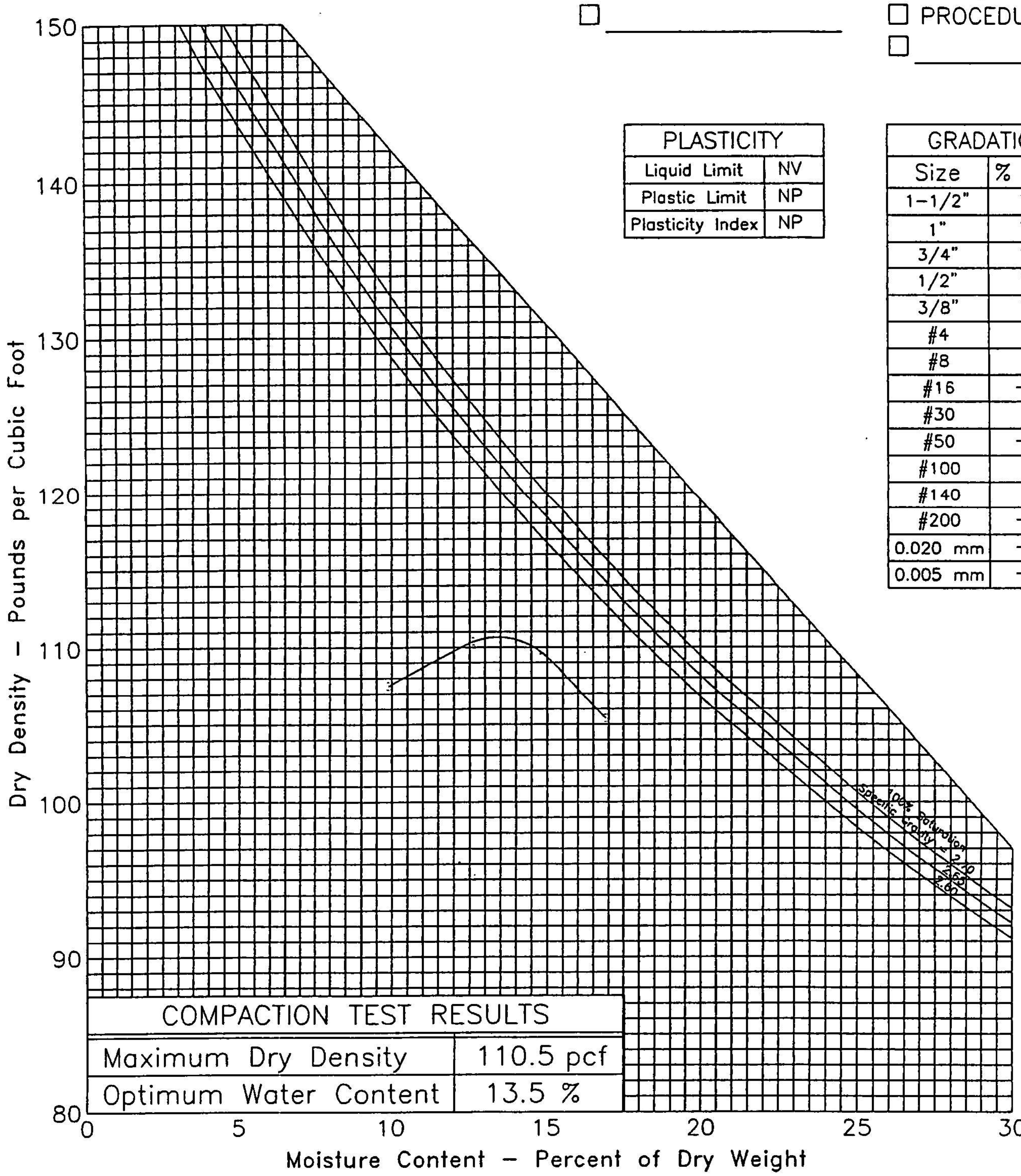
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	99
#8	86
#16	---
#30	64
#50	---
#100	50
#140	37
#200	---
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	110.5 pcf
Optimum Water Content	13.5 %

KLEINFELDER

CHECKED BY: | FN: PROCTOR

PROJECT NO. 35321 | DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.21

SAMPLE A-0 TEST BY R. STUMP TEST DATE 11/11/03

LOCATION B-6, 0 m (0 ft.)

SOIL TYPE SM (A-2-4(0))

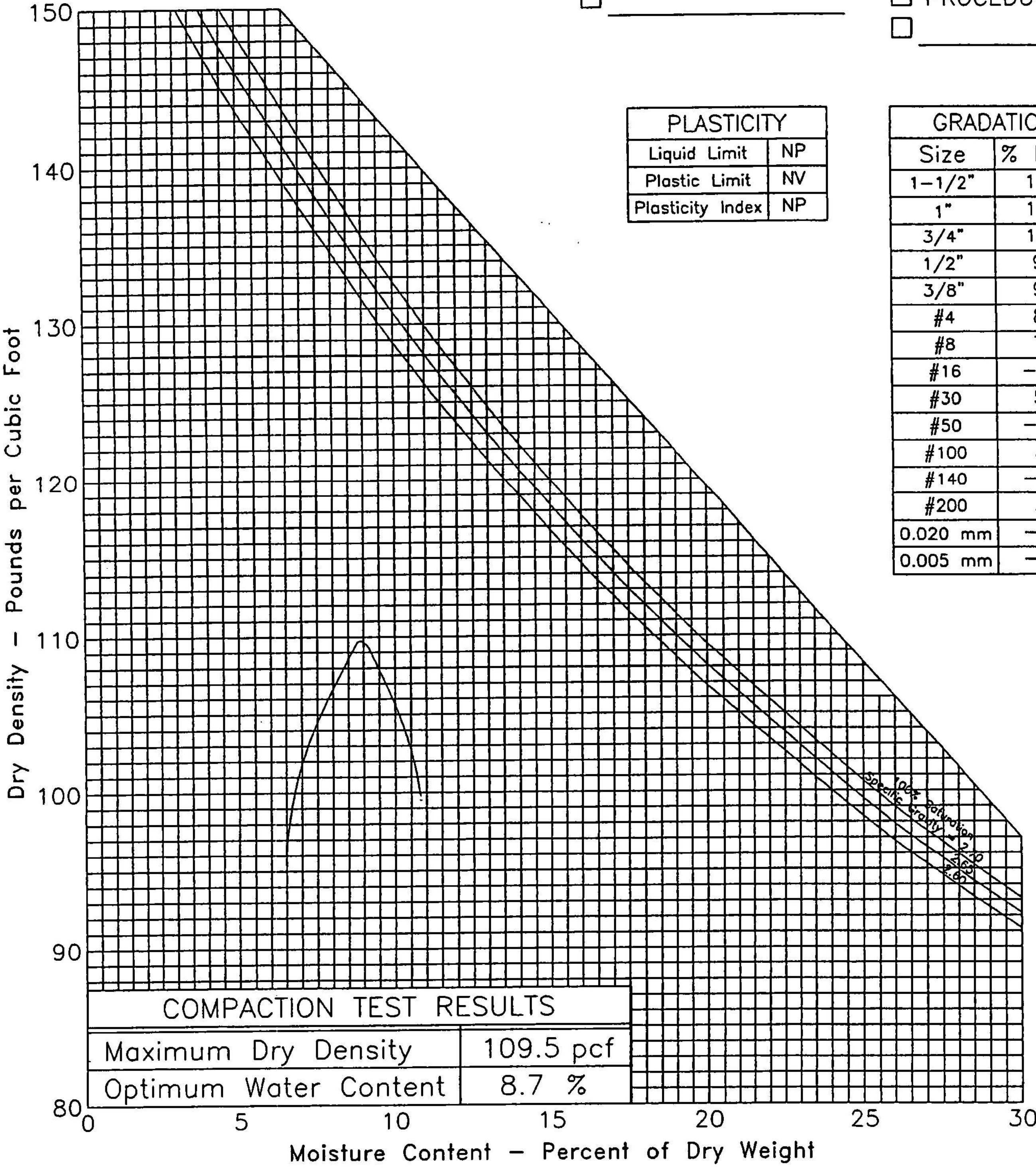
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NP
Plastic Limit	NV
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	96
3/8"	96
#4	87
#8	79
#16	---
#30	52
#50	---
#100	37
#140	---
#200	27
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	109.5 pcf
Optimum Water Content	8.7 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.22

SAMPLE A–0 TEST BY R. STUMP TEST DATE 11/12/03

LOCATION B–7, 0 m (0 ft.)

SOIL TYPE SM (A–2–4(0))

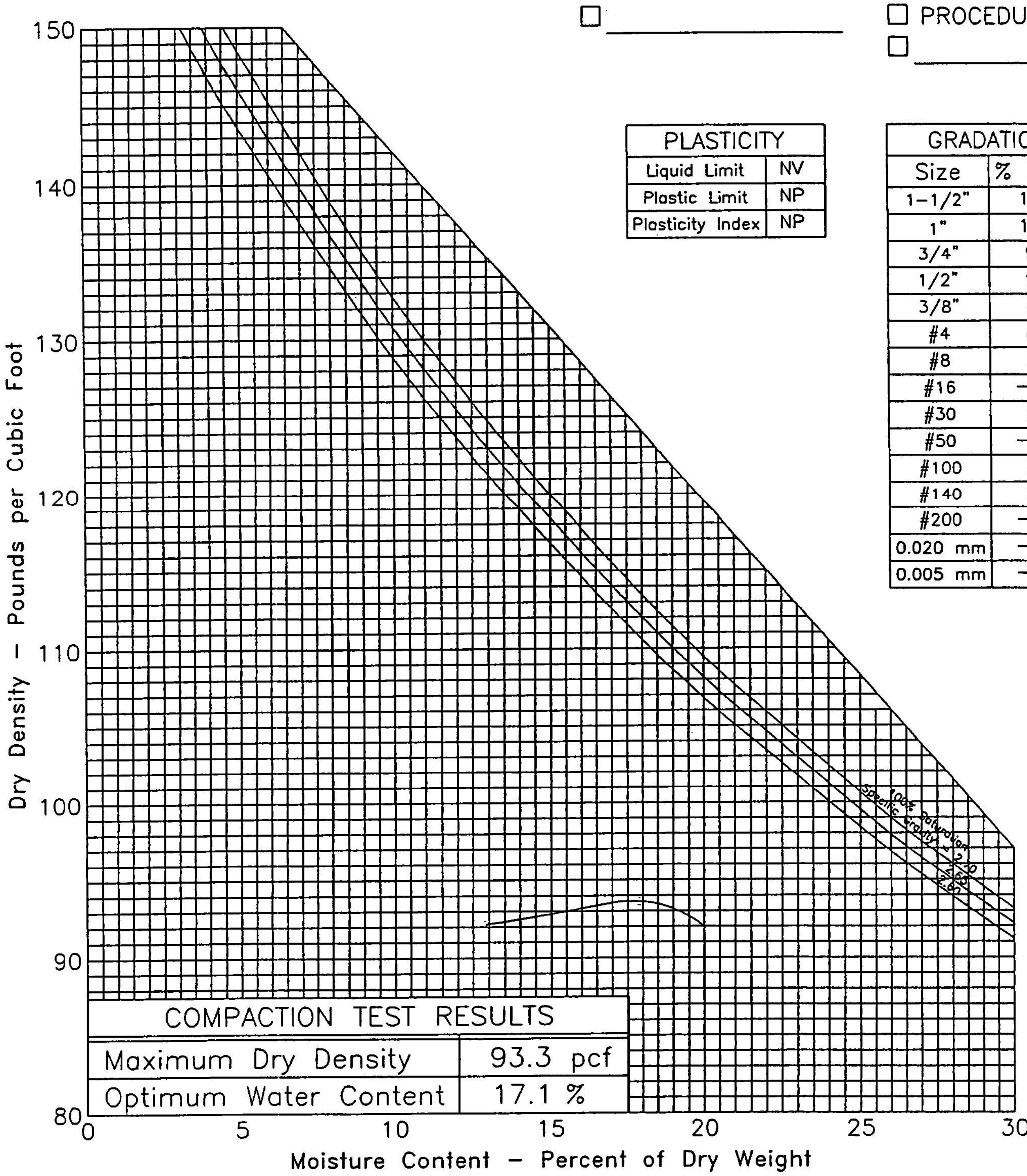
TEST METHOD:

☐ ASTM D 698–00
☒ ASTM D 1557–00
☐ ______

☒ PROCEDURE A
☐ PROCEDURE B
☐ PROCEDURE C
☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1–1/2"	100
1"	100
3/4"	94
1/2"	93
3/8"	91
#4	84
#8	76
#16	---
#30	55
#50	---
#100	39
#140	26
#200	---
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	93.3 pcf
Optimum Water Content	17.1 %

KLEINFELDER

CHECKED BY:
PROJECT NO. 35321

FN: PROCTOR
DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.23

SAMPLE A-0 TEST BY R. JONES TEST DATE 11/17/03

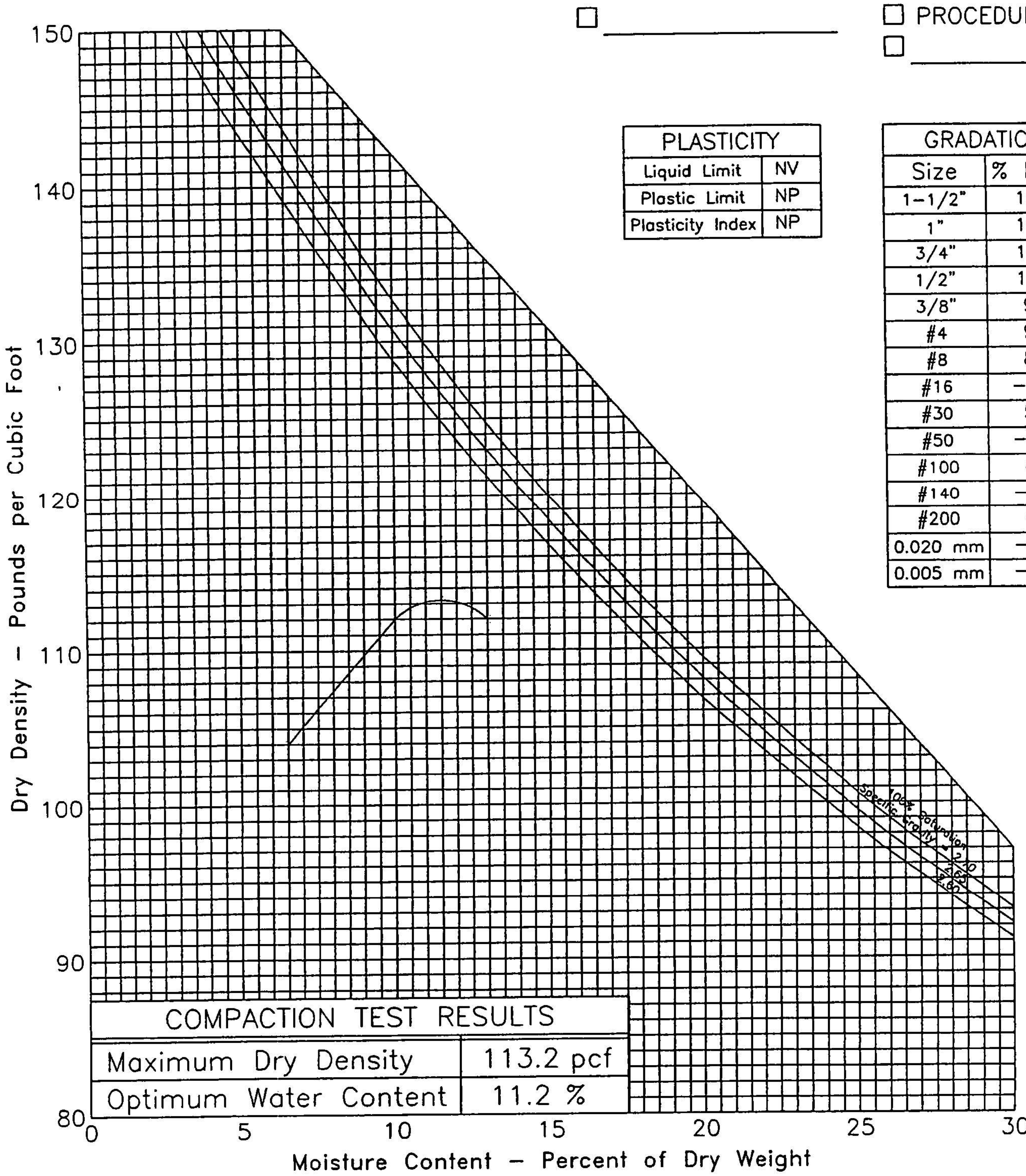
LOCATION B-8, 0 m (0 ft.)

SOIL TYPE SM (A-4(0))

TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐



PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	99
#4	92
#8	83
#16	---
#30	59
#50	---
#100	48
#140	---
#200	40
0.020 mm	---
0.005 mm	---

COMPACTION TEST RESULTS	
Maximum Dry Density	113.2 pcf
Optimum Water Content	11.2 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.24

SAMPLE A-0 TEST BY R. JONES TEST DATE 11/17/03

LOCATION B-9, 0 m (0 ft.)

SOIL TYPE ML (A-4(0))

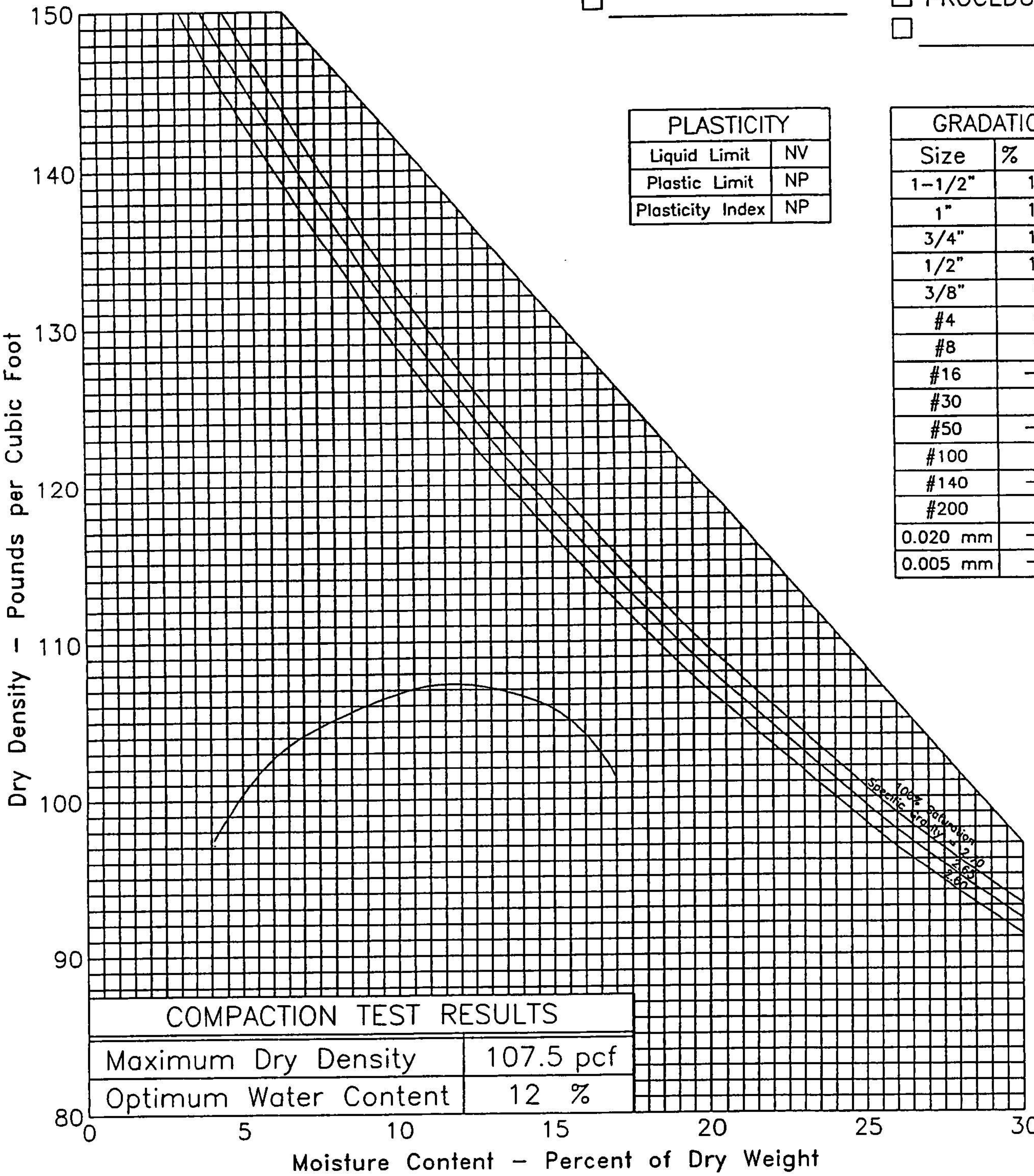
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	99
#4	98
#8	96
#16	---
#30	83
#50	---
#100	75
#140	---
#200	66
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	107.5 pcf
Optimum Water Content	12 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE
D.25

SAMPLE A-0 TEST BY R. JONES TEST DATE 11/17/03

LOCATION B-10, 0 m (0 ft.)

SOIL TYPE SM

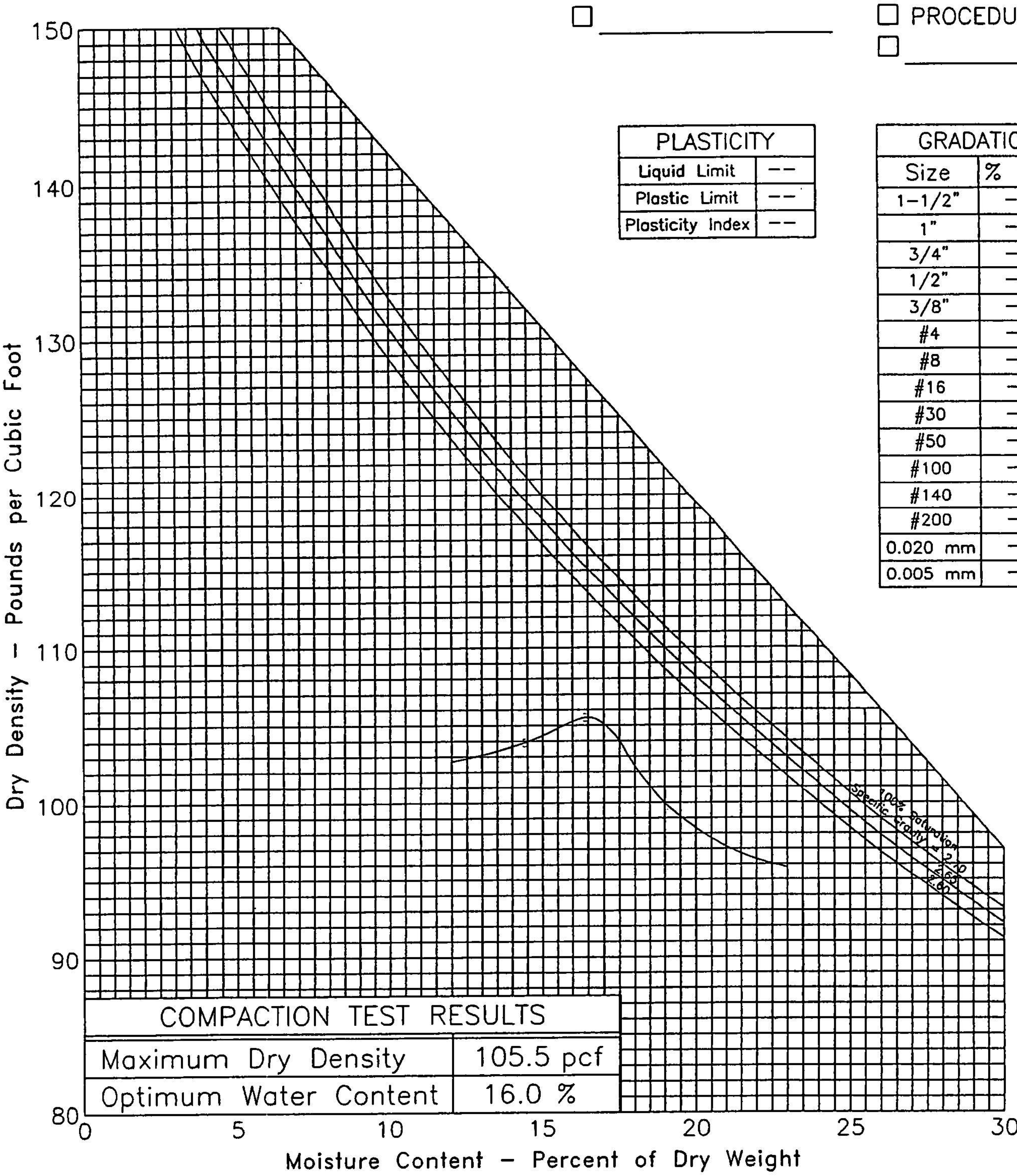
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	--
Plastic Limit	--
Plasticity Index	--

GRADATION	
Size	% Finer
1-1/2"	---
1"	---
3/4"	---
1/2"	---
3/8"	---
#4	---
#8	---
#16	---
#30	---
#50	---
#100	---
#140	---
#200	---
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	105.5 pcf
Optimum Water Content	16.0 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.26

SAMPLE A-0 TEST BY G. ESPINOSA TEST DATE 11/11/03

LOCATION B-11, 0 m (0 ft.)

SOIL TYPE SM (A-2-4(0))

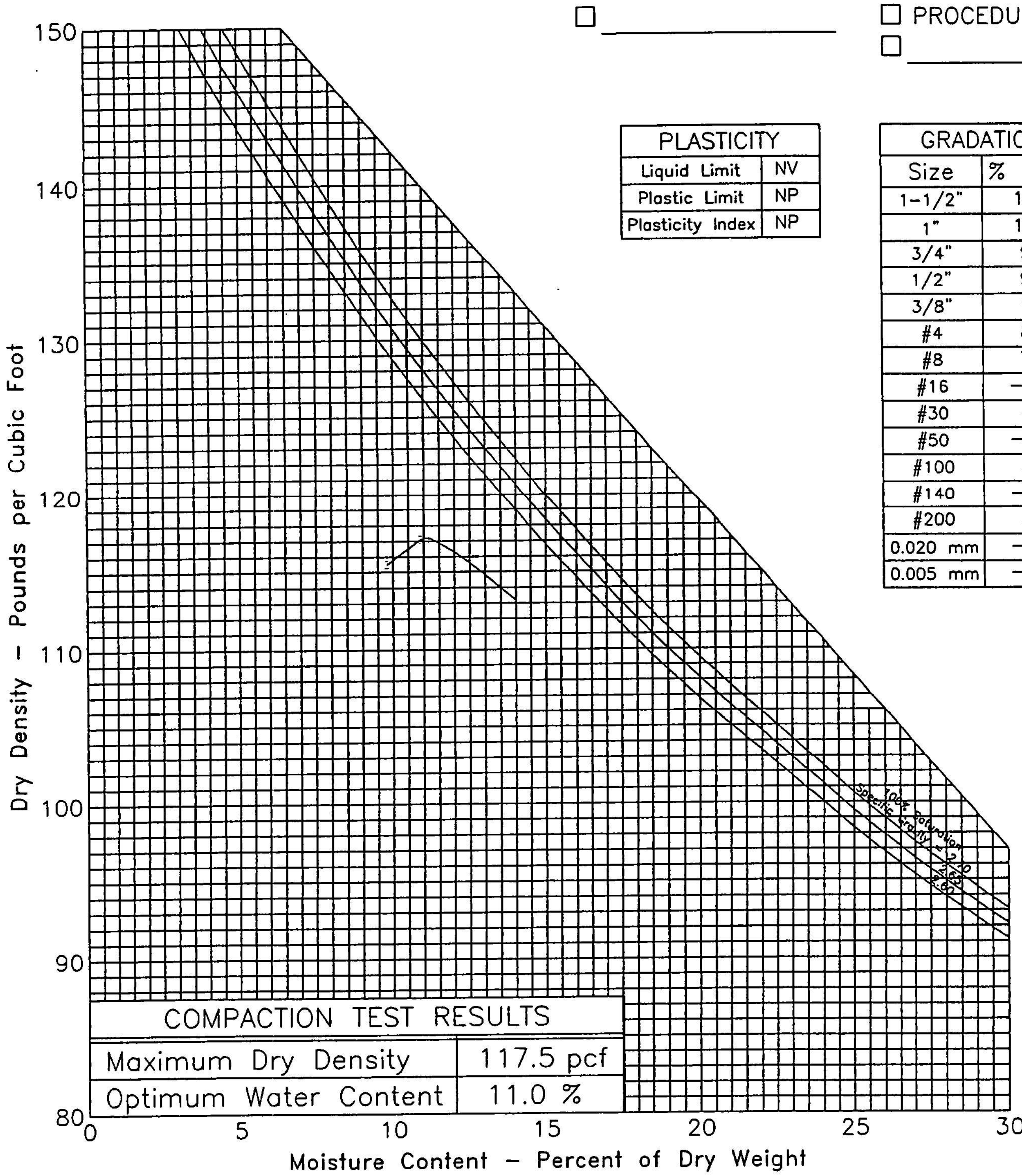
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	96
1/2"	94
3/8"	91
#4	83
#8	75
#16	---
#30	49
#50	---
#100	36
#140	---
#200	29
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	117.5 pcf
Optimum Water Content	11.0 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.27

SAMPLE A-0 TEST BY S. STAFFORD TEST DATE 11/11/03

LOCATION B-12, 0 m (0 ft.)

SOIL TYPE SM (A-4(0))

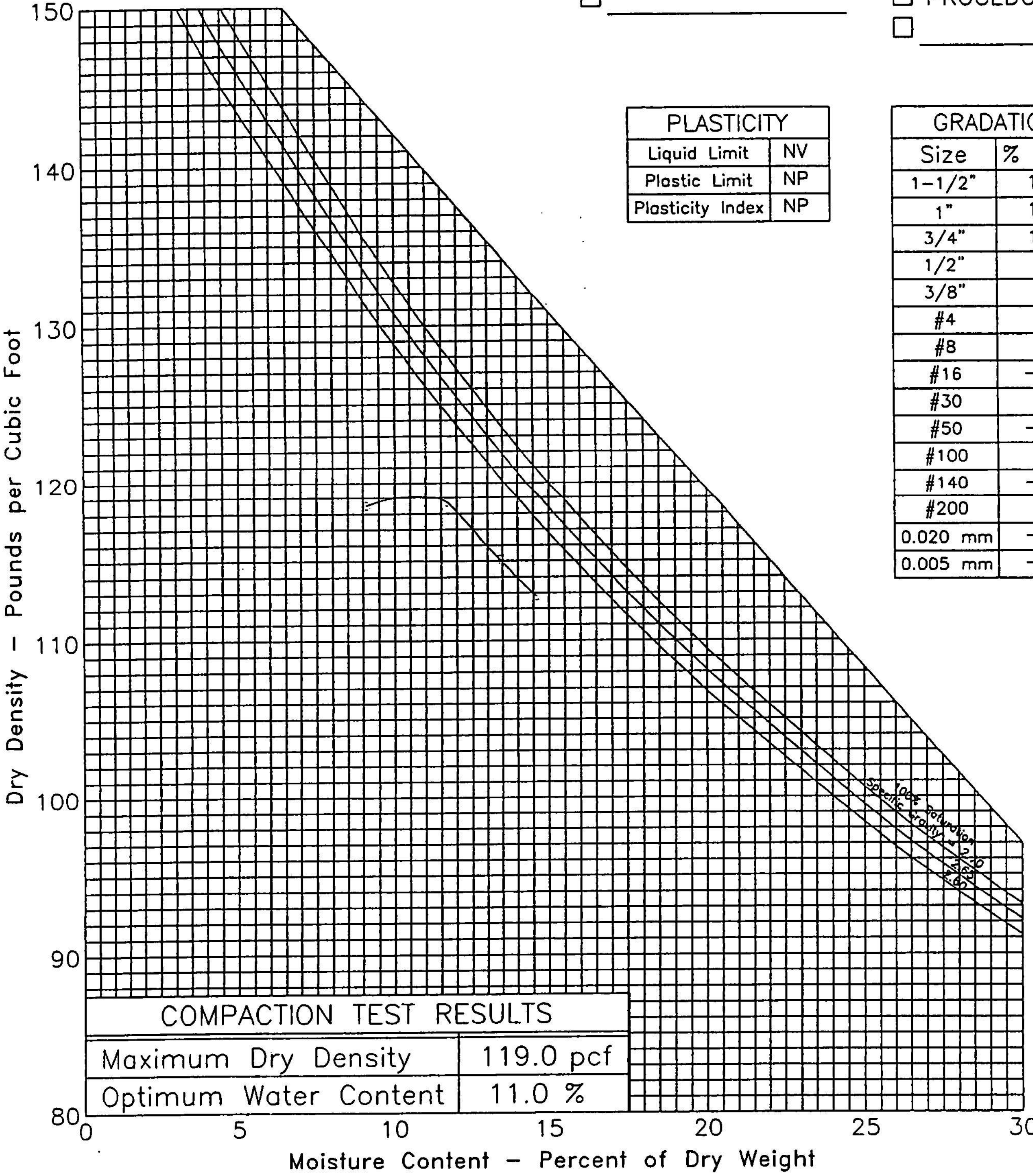
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	98
3/8"	98
#4	83
#8	72
#16	---
#30	54
#50	---
#100	45
#140	---
#200	38
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	119.0 pcf
Optimum Water Content	11.0 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.28

SAMPLE A-0 TEST BY R. STUMP TEST DATE 11/11/03

LOCATION B-13, 0 m (0 ft.)

SOIL TYPE SM (A-2-4(0)

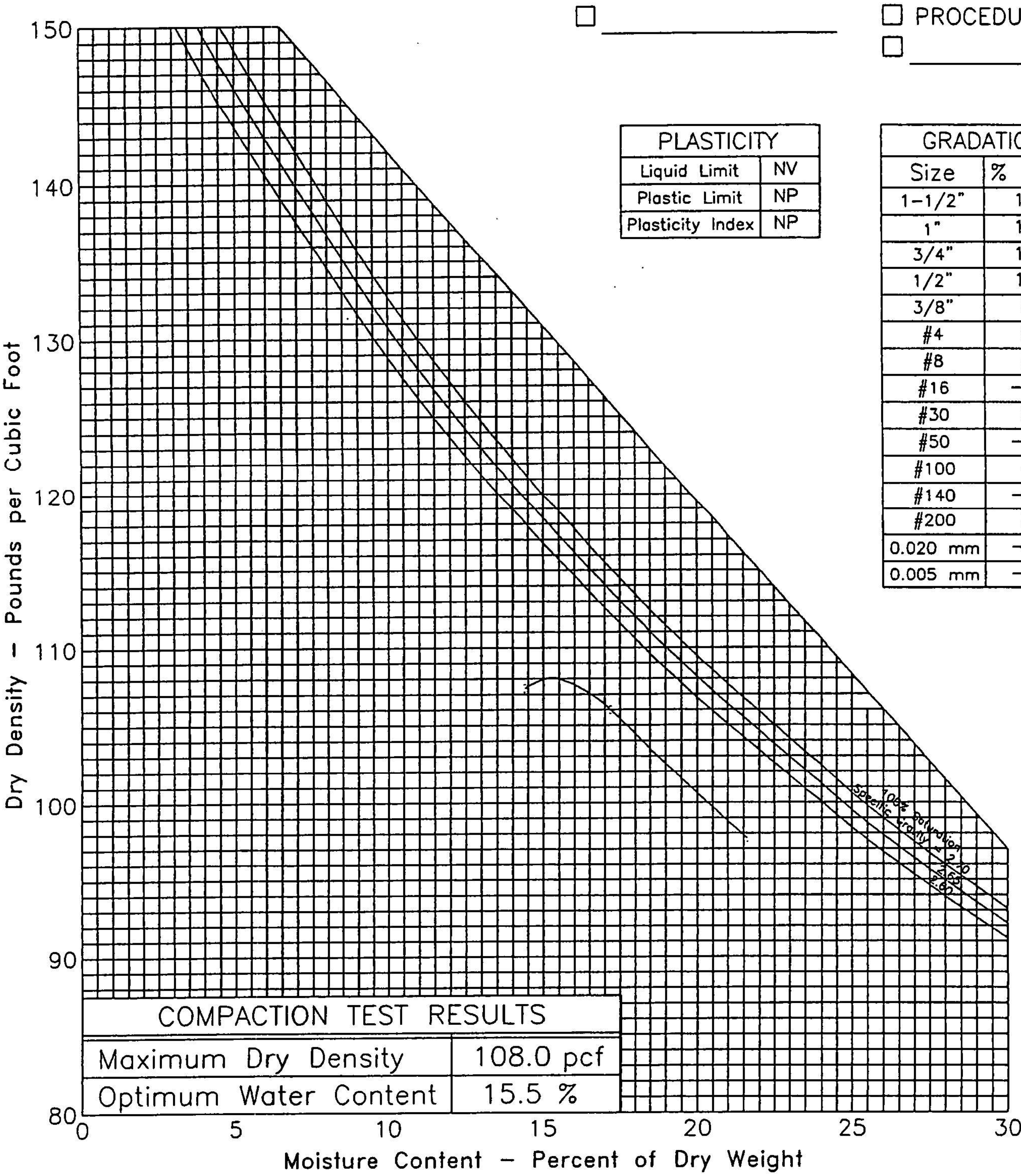
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	97
#4	89
#8	80
#16	---
#30	56
#50	---
#100	43
#140	---
#200	34
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	108.0 pcf
Optimum Water Content	15.5 %

KLEINFELDER

CHECKED BY:	FN: PROCTOR
PROJECT NO. 35321	DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.29

SAMPLE A-0 TEST BY R. JONES TEST DATE 11/17/03

LOCATION MSE-1, 0 m (0 ft.)

SOIL TYPE GM (A-1-b)

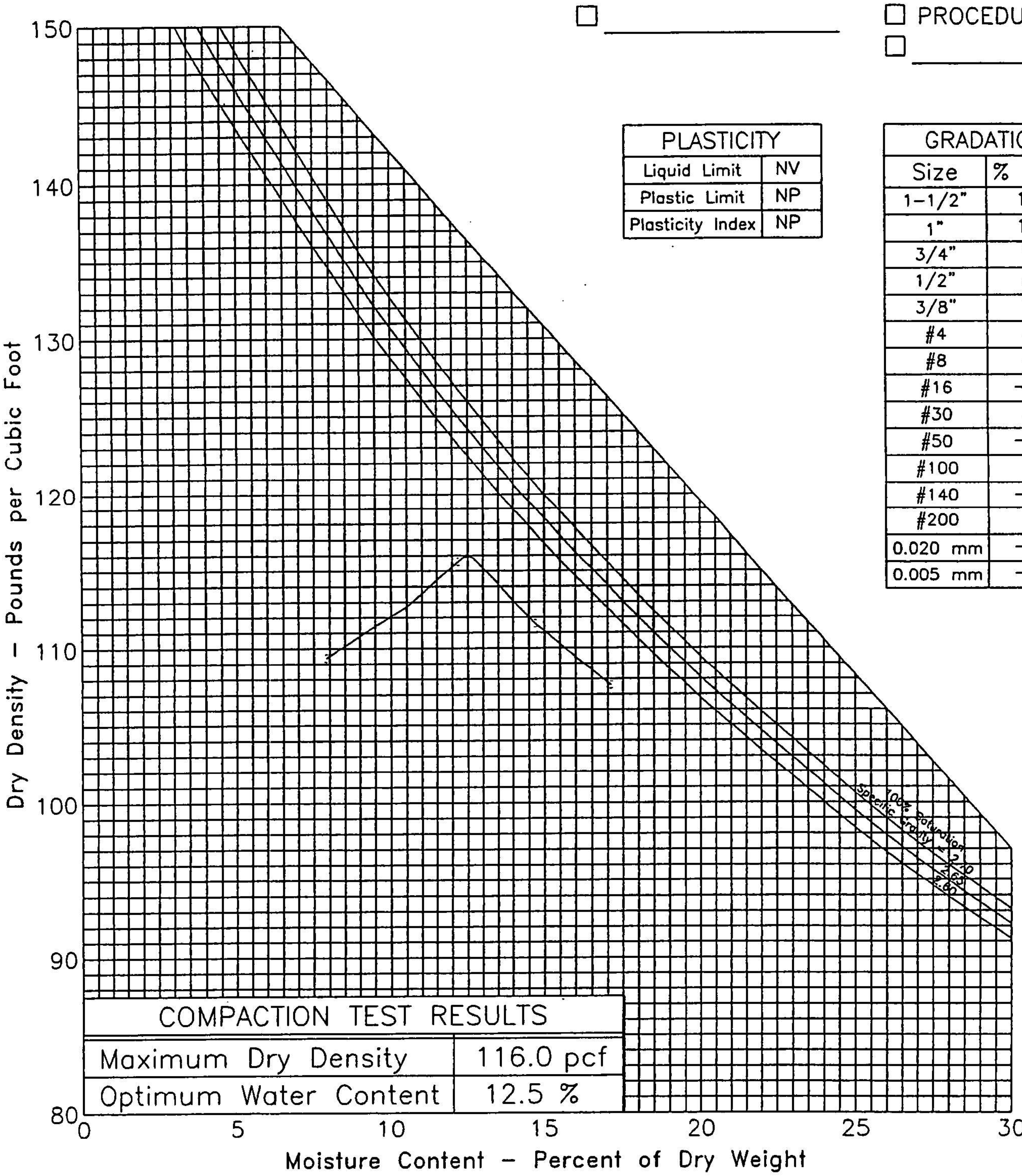
TEST METHOD:

- ☐ ASTM D 698-00
- ☒ ASTM D 1557-00
- ☐ ______

- ☒ PROCEDURE A
- ☐ PROCEDURE B
- ☐ PROCEDURE C
- ☐ ______

PLASTICITY	
Liquid Limit	NV
Plastic Limit	NP
Plasticity Index	NP

GRADATION	
Size	% Finer
1-1/2"	100
1"	100
3/4"	92
1/2"	82
3/8"	73
#4	57
#8	48
#16	---
#30	33
#50	---
#100	23
#140	---
#200	16
0.020 mm	---
0.005 mm	---



COMPACTION TEST RESULTS	
Maximum Dry Density	116.0 pcf
Optimum Water Content	12.5 %

KLEINFELDER

CHECKED BY:

PROJECT NO. 35391

FN: PROCTOR

DATE __/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.30

Sample: B-1, 0 m (0 ft.)

TEST SPECIMEN		A	B	C	D	E
DATE TESTED		11/19/03	11/19/03	11/19/03		
SPECIMEN FABRICATION	Compacted Air Pressure psi	--	--	--		
	Initial Moisture %	--	--	--		
	Moisture at Compaction %	16.0	14.1	14.6		
	Briquette Height in.	2.5	2.5	2.5		
	Density, dry pcf	104.5	108.7	105.2		
EXUDATION PRESSURE psi		58	580	255		
EXPANSION PRESSURE psf		0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds psi	--	--	--		
	P_h at 2000 pounds psi	136	29	68		
	Displacement turns	3.7	3.96	3.98		
	"R" Value	10.7	74.0	45.9		
Corrected "R" Value		--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE ---

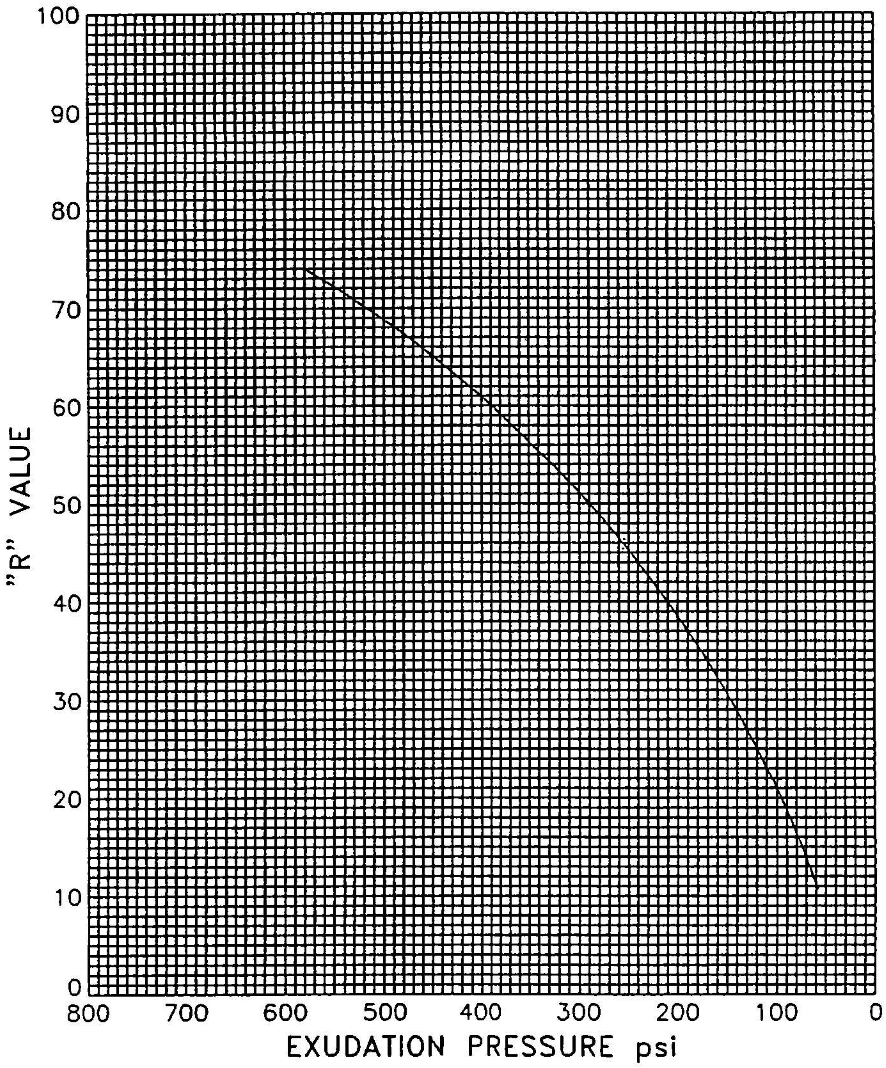
"R" VALUE @ 300 PSI EXUDATION PRESSURE 51

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	85
3/4"	64
1/2"	60
3/8"	60
#4	56
#8	51
#16	--
#30	29
#50	--
#100	19
#140	--
#200	15
0.001 mm	--

LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS GM

AASHTO A-1-b



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY:	FN: HVEEM
PROJECT NO. 35321	DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.31

Sample: B-3, 0 m (0 ft.)

TEST SPECIMEN			A	B	C	D	E
DATE TESTED			11/14/03	11/14/03	11/14/03		
SPECIMEN FABRICATION	Compacted Air Pressure	psi	--	--	--		
	Initial Moisture	%	--	--	--		
	Moisture at Compaction	%	13.1	13.6	11.4		
	Briquette Height	in.	2.5	2.5	2.5		
	Density, dry	pcf	110.0	108.7	111.9		
EXUDATION PRESSURE		psi	487	110	176		
EXPANSION PRESSURE		psf	0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds	psi	--	--	--		
	P_h at 2000 pounds	psi	64	118	91		
	Displacement	turns	2.73	3.04	3.09		
	"R" Value		57.9	22.6	38.0		
Corrected "R" Value			--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE --

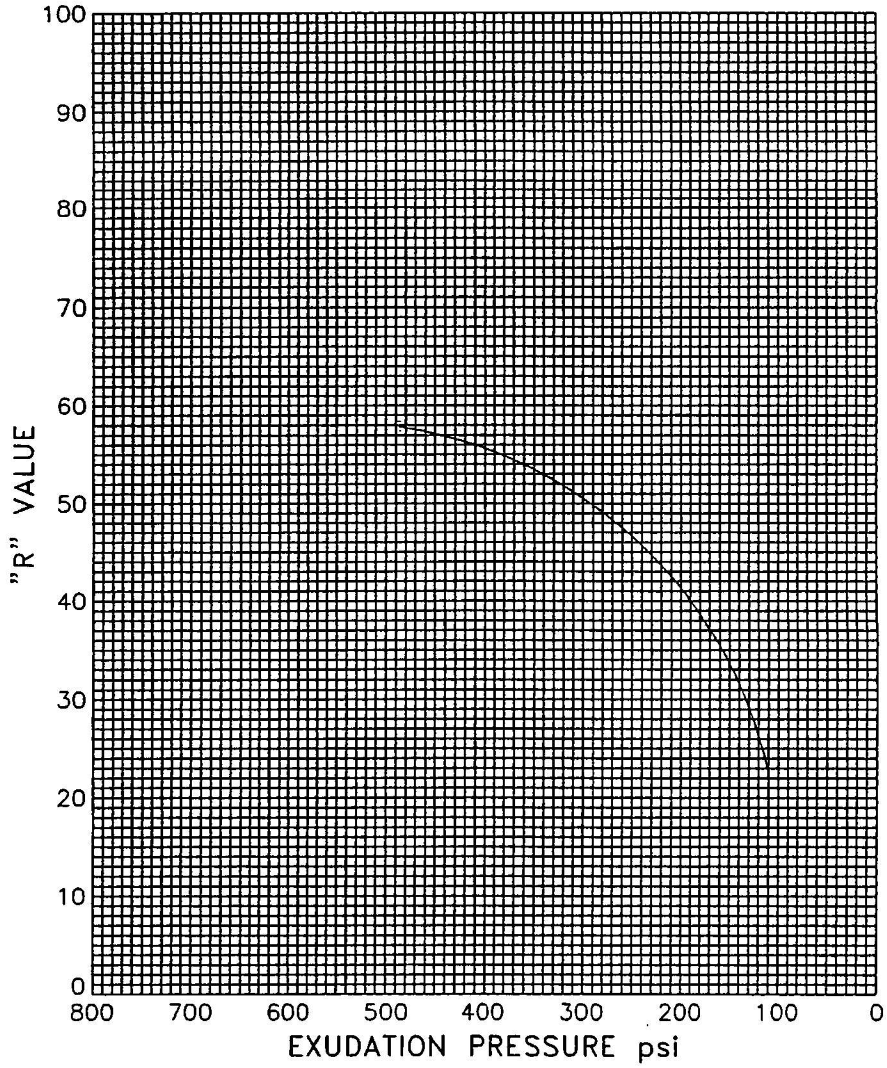
"R" VALUE @ 300 PSI EXUDATION PRESSURE 51

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	100
3/4"	97
1/2"	92
3/8"	85
#4	76
#8	52
#16	--
#30	52
#50	--
#100	34
#140	--
#200	25
0.001 mm	--

LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS SM

AASHTO A-2-4(0)



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY:	FN: HVEEM	HVEEM TEST CUBA LACUEVA NEW MEXICO PARSONS BRINKERHOFF	FIGURE D.32
PROJECT NO. 35321	DATE: 11/03		

Sample: B-5, 0 m (0 ft.)

TEST SPECIMEN			A	B	C	D	E
DATE TESTED			11/14/03	11/14/03	11/14/03		
SPECIMEN FABRICATION	Compacted Air Pressure	psi	--	--	--		
	Initial Moisture	%	--	--	--		
	Moisture at Compaction	%	14.1	16.1	18.1		
	Briquette Height	in.	2.5	2.5	2.5		
	Density, dry	pcf	104.0	102.7	100.9		
EXUDATION PRESSURE		psi	644	430	153		
EXPANSION PRESSURE		psf	0.00	0.00	0.00		
STABILOMETER	P_h at 1000 pounds	psi	--	--	--		
	P_h at 2000 pounds	psi	40	60	81		
	Displacement	turns	4.00	3.80	3.98		
	"R" Value		65.2	52.3	38.0		
Corrected "R" Value			--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE --

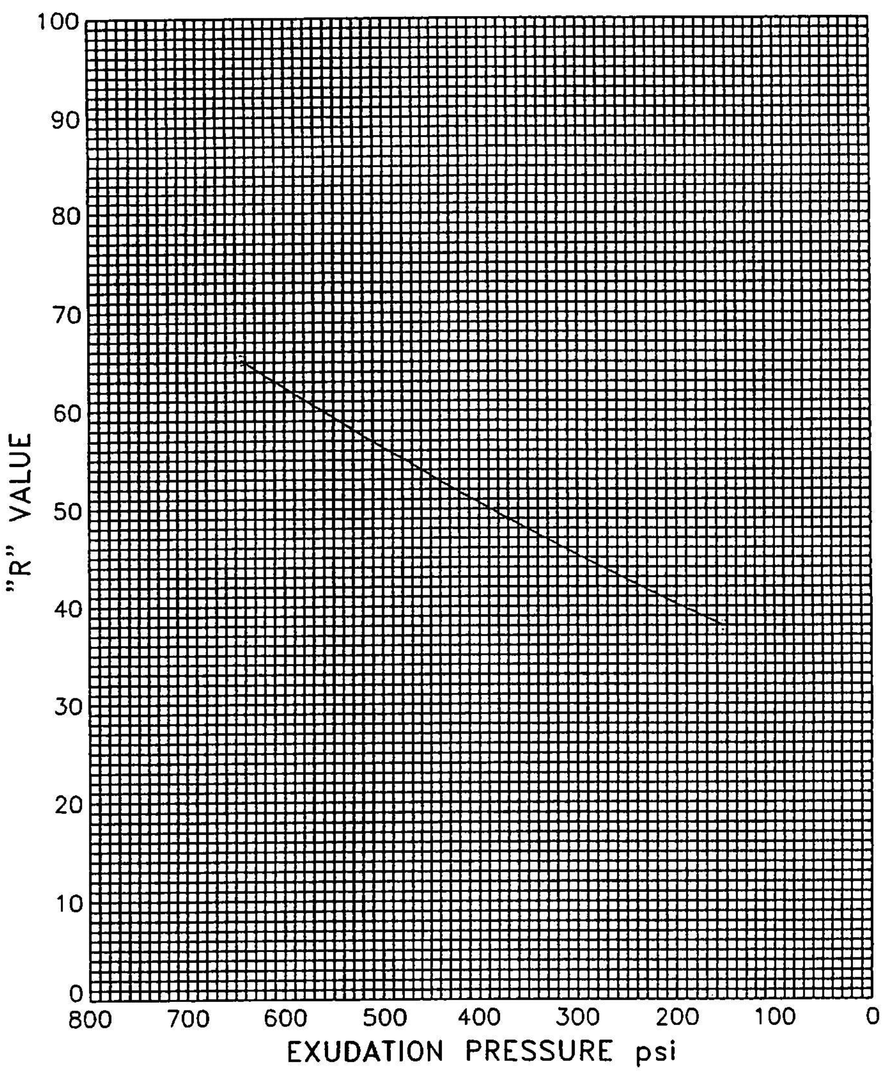
"R" VALUE @ 300 PSI EXUDATION PRESSURE 45

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	99
#8	86
#16	--
#30	64
#50	--
#100	50
#140	--
#200	37
0.001 mm	--

LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS SM

AASHTO A-4(0)



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY: | FN: HVEEM

PROJECT NO. 35321 | DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.33

Sample: B-10, 0 m (0 ft.)

		TEST SPECIMEN	A	B	C	D	E
		DATE TESTED	11/19/03	11/19/03	11/19/03		
SPECIMEN FABRICATION	Compacted Air Pressure	psi	--	--	--		
	Initial Moisture	%	--	--	--		
	Moisture at Compaction	%	20.0	19.6	20.7		
	Briquette Height	in.	2.5	2.5	2.5		
	Density, dry	pcf	93.8	94.9	109.8		
EXUDATION PRESSURE		psi	311	225	555		
EXPANSION PRESSURE		psf	0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds	psi	--	--	--		
	P_h at 2000 pounds	psi	42	59	27		
	Displacement	turns	3.21	3.78	3.01		
	"R" Value		68.6	53.1	80.4		
Corrected "R" Value			--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE --

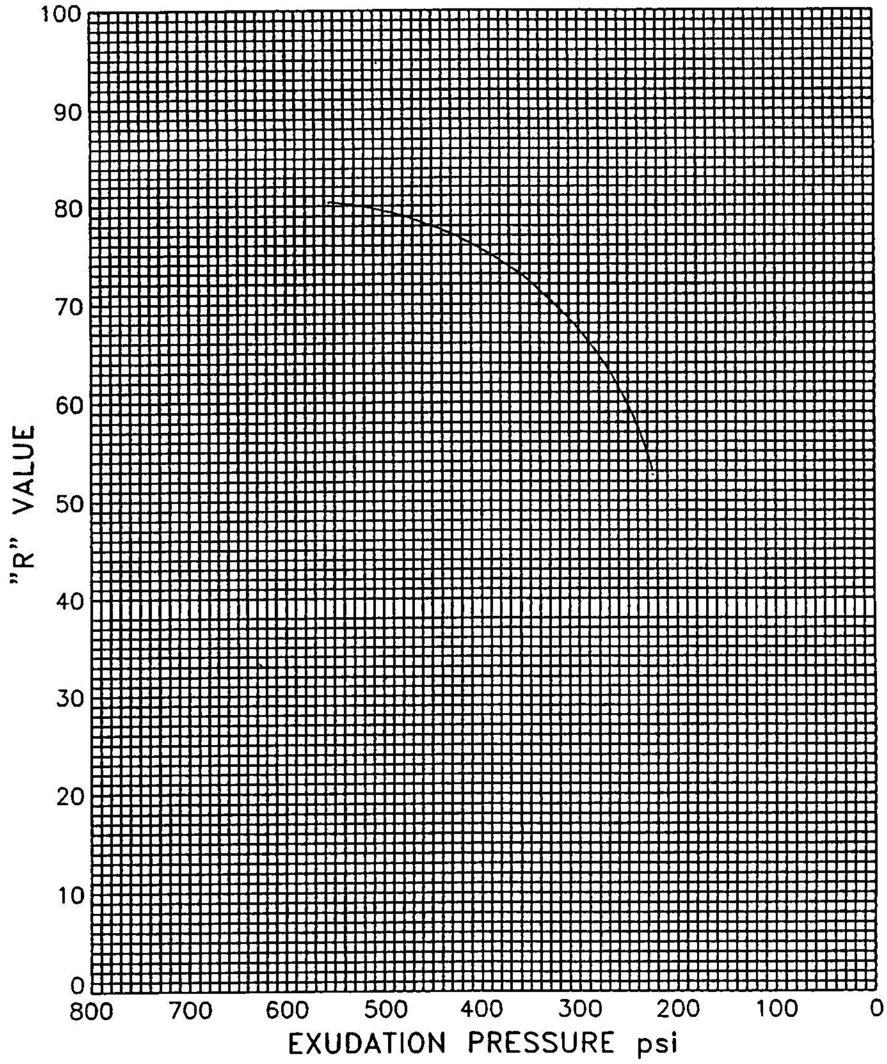
"R" VALUE @ 300 PSI EXUDATION PRESSURE 67

GRADATION	
Size	% Finer
2"	--
1-1/2"	--
1"	--
3/4"	--
1/2"	--
3/8"	--
#4	--
#8	--
#16	--
#30	--
#50	--
#100	--
#140	--
#200	--
0.001 mm	--

LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	
SAND EQUIVALENT	

USCS --

AASHTO --



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY:

FN: HVEEM

PROJECT NO. 35321

DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.34

Sample: B-11, 0 m (0 ft.)

TEST SPECIMEN			A	B	C	D	E
DATE TESTED			11/07/03	11/07/03	11/07/03		
SPECIMEN FABRICATION	Compacted Air Pressure	psi	--	--	--		
	Initial Moisture	%	--	--	--		
	Moisture at Compaction	%	14.3	13.4	11.6		
	Briquette Height	in.	2.5	2.5	2.5		
	Density, dry	pcf	108.3	109.4	110.5		
EXUDATION PRESSURE		psi	152	380	462		
EXPANSION PRESSURE		psf	0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds	psi	--	--	--		
	P_h at 2000 pounds	psi	134	78	54		
	Displacement	turns	3.00	3.20	3.18		
	"R" Value		13.9	45.1	60.7		
Corrected "R" Value			--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE --

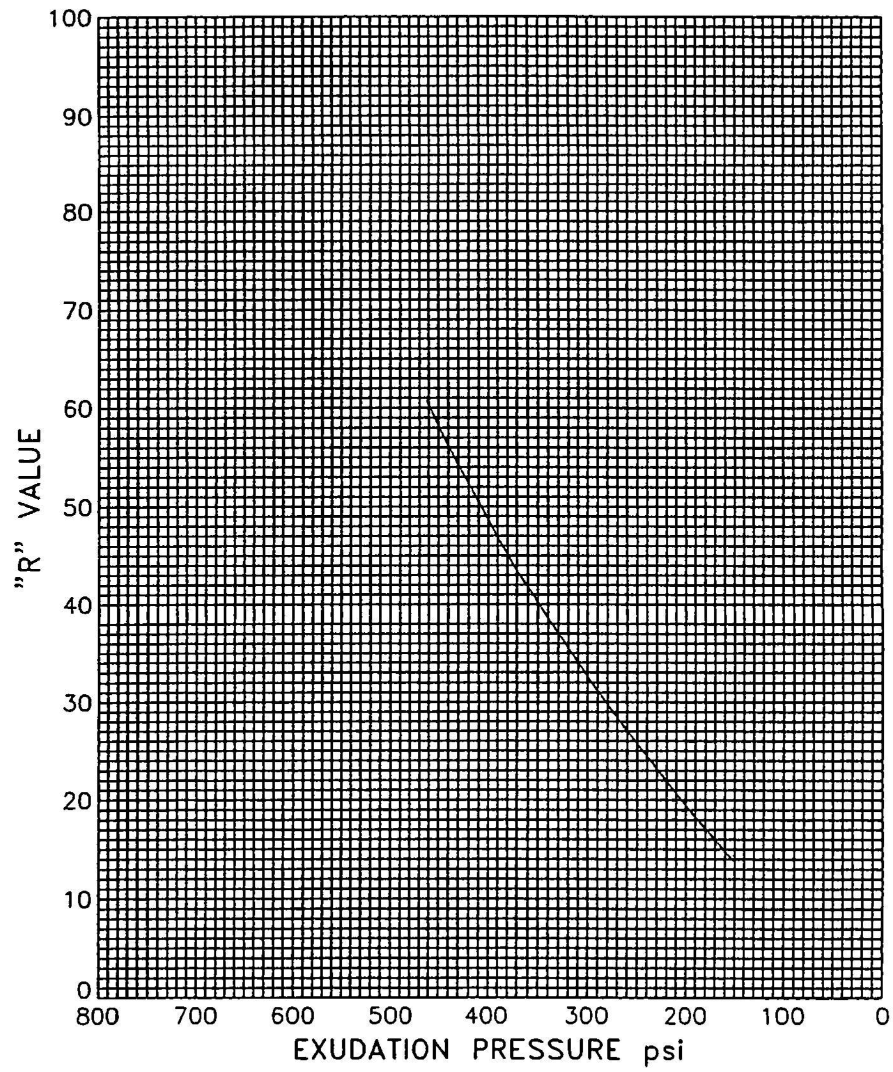
"R" VALUE @ 300 PSI EXUDATION PRESSURE 32

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	100
3/4"	96
1/2"	94
3/8"	91
#4	83
#8	75
#16	--
#30	49
#50	--
#100	36
#140	--
#200	29
0.001 mm	--

LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS SM

AASHTO A-2-4(0)



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY: | FN: HVEEM
PROJECT NO. 35321 | DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.35

Sample: B-12, 0 m (0 ft.)

TEST SPECIMEN			A	B	C	D	E
DATE TESTED			11/12/03	11/12/03	11/12/03		
SPECIMEN FABRICATION	Compacted Air Pressure	psi	--	--	--		
	Initial Moisture	%	--	--	--		
	Moisture at Compaction	%	11.1	13.0	13.7		
	Briquette Height	in.	2.5	2.5	2.5		
	Density, dry	pcf	116.0	112.2	109.5		
EXUDATION PRESSURE		psi	509	299	251		
EXPANSION PRESSURE		psf	0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds	psi	--	--	--		
	P_h at 2000 pounds	psi	70	95	114		
	Displacement	turns	2.68	2.72	2.97		
	"R" Value		54.5	38.6	25.4		
Corrected "R" Value			--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE ---

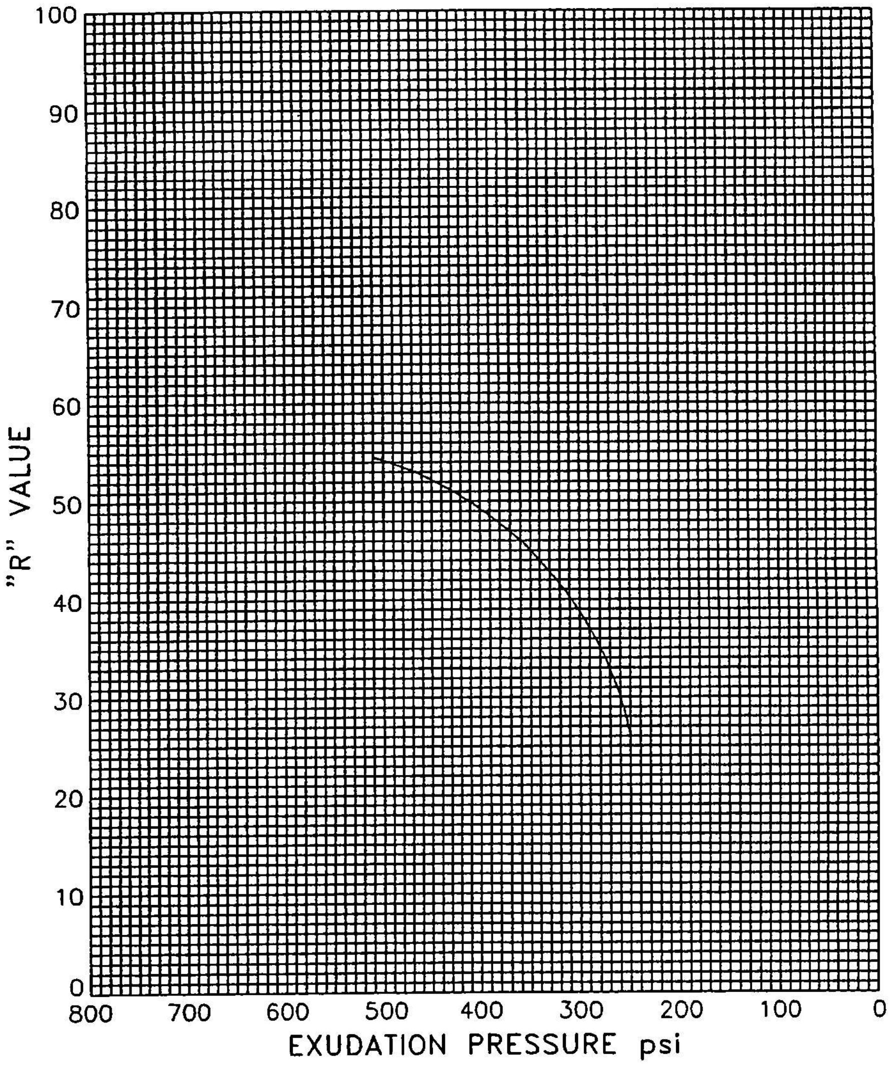
"R" VALUE @ 300 PSI EXUDATION PRESSURE 39

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	98
3/8"	98
#4	83
#8	72
#16	--
#30	54
#50	--
#100	45
#140	--
#200	38
0.001 mm	--

LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS SM

AASHTO A-4(0)



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY:	FN: HVEEM
PROJECT NO. 35321	DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.36

Sample: B-13, 0 m (0 ft.)

			A	B	C	D	E
TEST SPECIMEN			A	B	C	D	E
DATE TESTED			11/12/03	11/12/03	11/12/03		
SPECIMEN FABRICATION	Compacted Air Pressure	psi	--	--	--		
	Initial Moisture	%	--	--	--		
	Moisture at Compaction	%	21.3	20.5	17.9		
	Briquette Height	in.	2.5	2.5	2.5		
	Density, dry	pcf	96.2	96.6	101.6		
EXUDATION PRESSURE		psi	84	123	451		
EXPANSION PRESSURE		psf	0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds	psi	--	--	--		
	P_h at 2000 pounds	psi	143	119	37		
	Displacement	turns	3.12	3.11	3.03		
	"R" Value		8.7	21.7	73.3		
Corrected "R" Value			--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE --

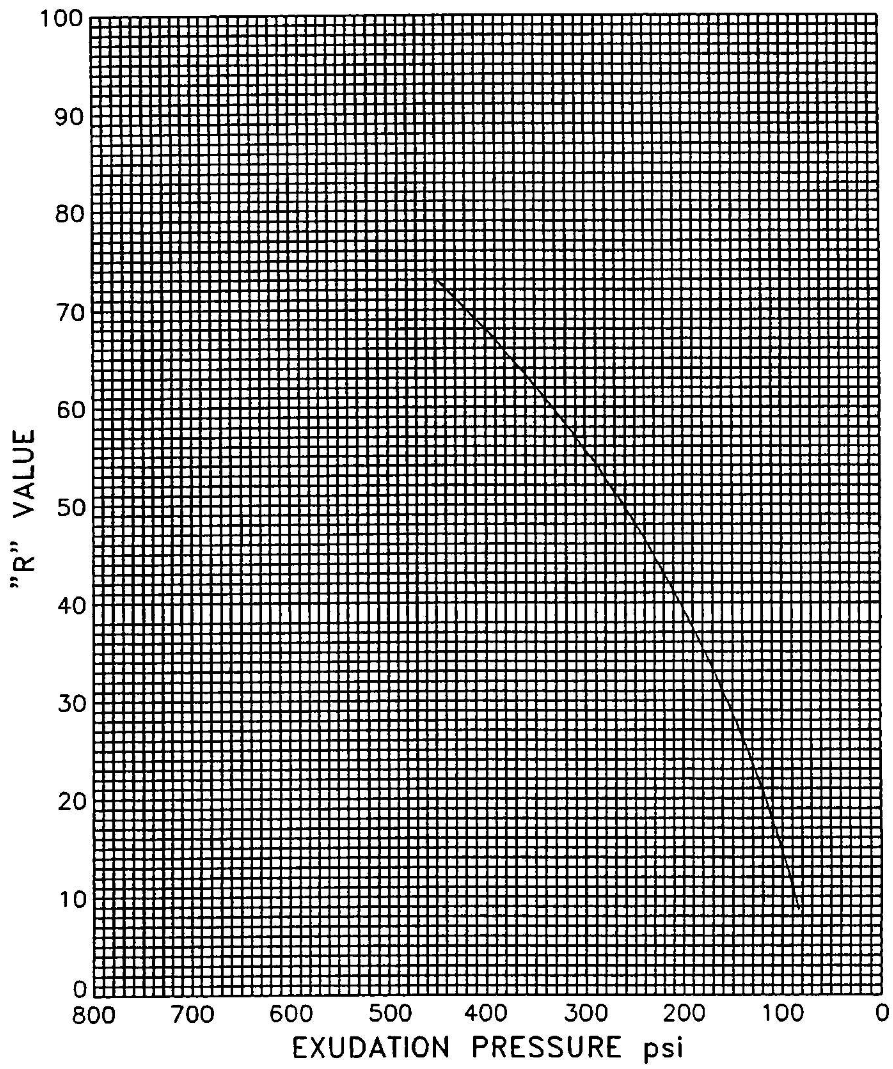
"R" VALUE @ 300 PSI EXUDATION PRESSURE 56

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	97
#4	89
#8	80
#16	--
#30	56
#50	--
#100	43
#140	--
#200	34
0.001 mm	--

LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS SM

AASHTO A-2-4(0)



KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY:

FN: HVEEM

PROJECT NO. 35321

DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.37

Sample: MSE-1, 0 m (0 ft.)

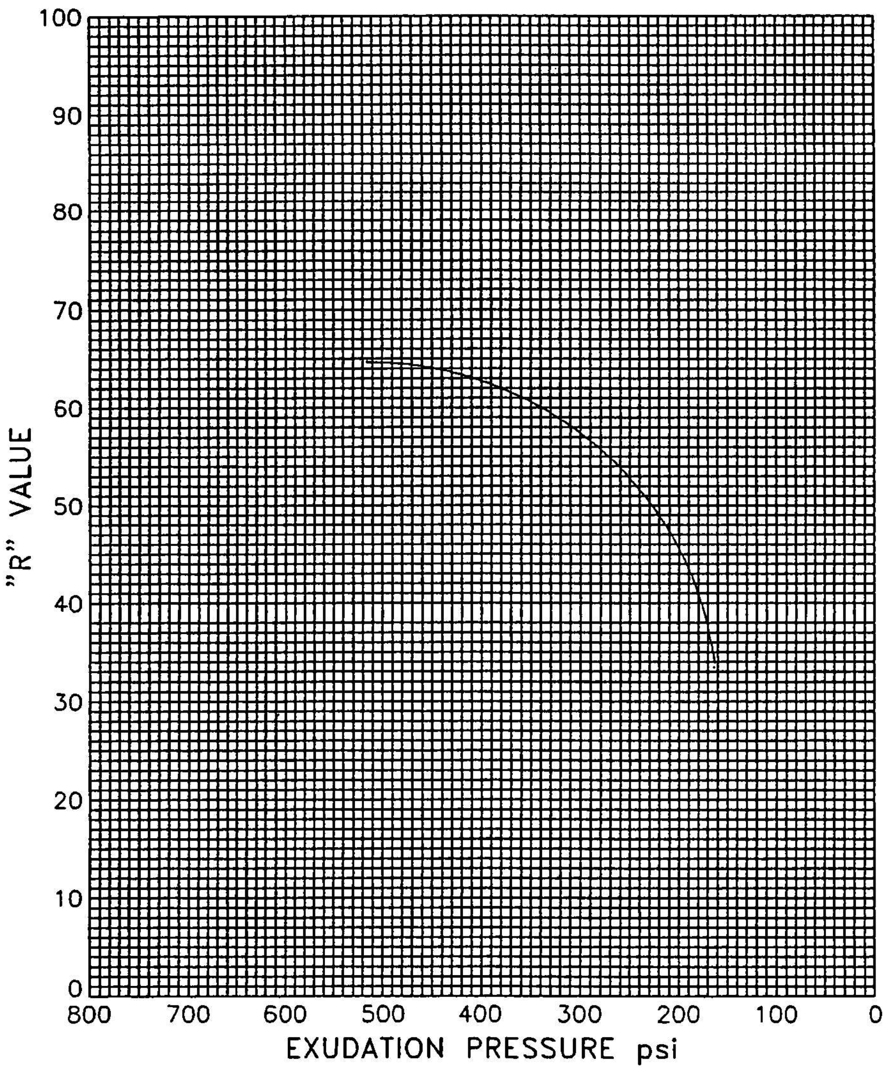
TEST SPECIMEN		A	B	C	D	E
DATE TESTED		11/17/03	11/17/03	11/17/03		
SPECIMEN FABRICATION	Compacted Air Pressure psi	--	--	--		
	Initial Moisture %	--	--	--		
	Moisture at Compaction %	13.3	16.0	14.7		
	Briquette Height in.	2.5	2.5	2.5		
	Density, dry pcf	108.3	103.7	103.4		
EXUDATION PRESSURE psi		516	163	395		
EXPANSION PRESSURE psf		0.00	0.00	0.00		
STABIL-OMETER	P_h at 1000 pounds psi	--	--	--		
	P_h at 2000 pounds psi	48	95	50		
	Displacement turns	3.18	3.33	3.28		
	"R" Value	64.7	33.9	62.6		
Corrected "R" Value		--	--	--		

EXPANSION @ 300 PSI EXUDATION PRESSURE 0 psf

DISPLACEMENT @ 300 PSI EXUDATION PRESSURE --

"R" VALUE @ 300 PSI EXUDATION PRESSURE 57.0

GRADATION	
Size	% Finer
2"	100
1-1/2"	100
1"	100
3/4"	92
1/2"	82
3/8"	73
#4	57
#8	48
#16	--
#30	33
#50	--
#100	23
#140	--
#200	16
0.001 mm	--



LIQUID LIMIT	NV
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP
SAND EQUIVALENT	

USCS GM

AASHTO A-1-b

KLEINFELDER

4815 LIST DRIVE, UNIT 115
COLORADO SPRINGS, CO 80919

CHECKED BY: | FN: HVEEM

PROJECT NO. 35321 | DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

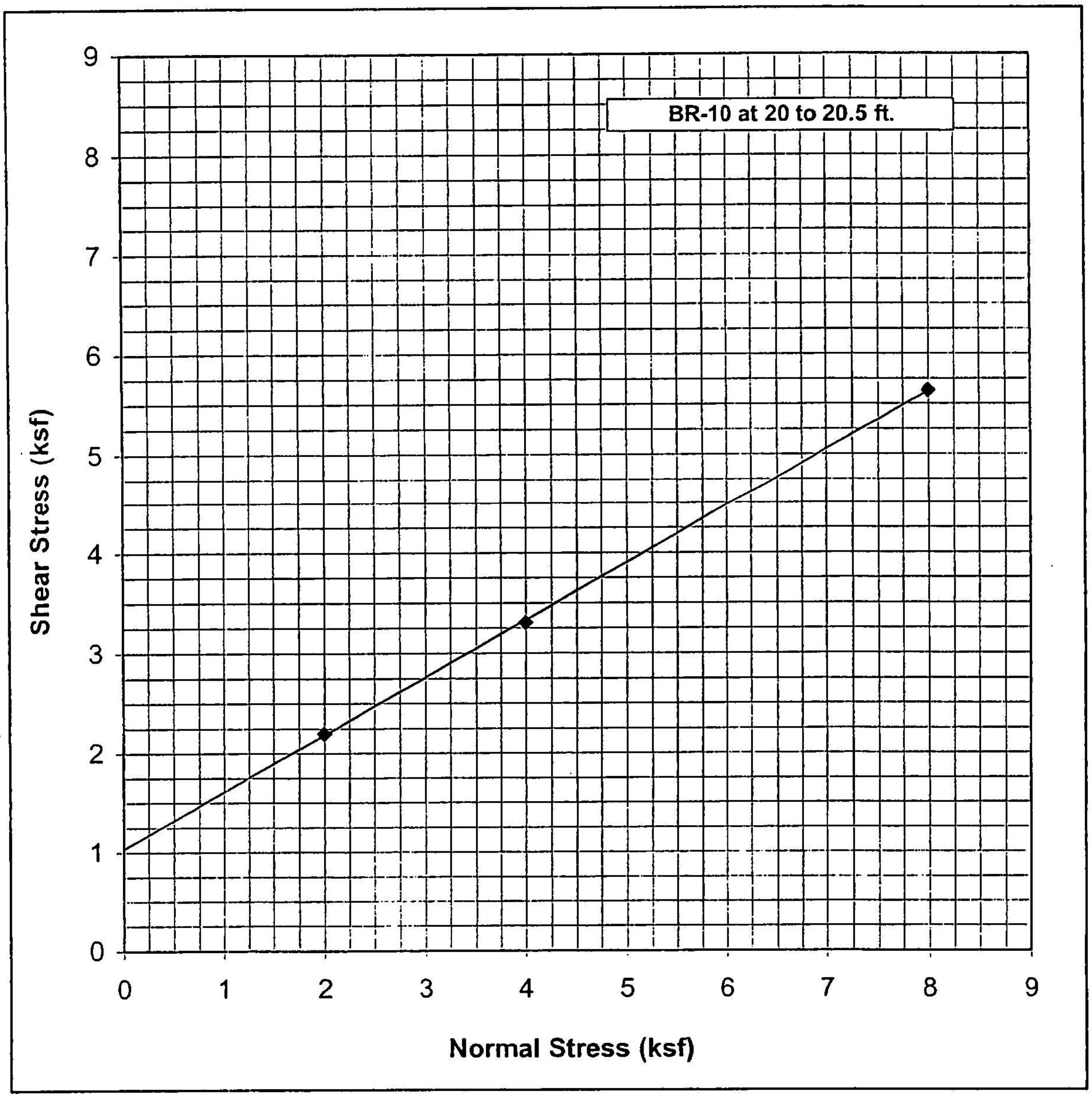
FIGURE

D.38

DIRECT SHEAR TEST RESULTS

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-10
DEPTH: 20 to 20.5 ft.
SAMPLE DESCRIPTION: Silty Sand
UNIFIED SOIL CLASSIFACTION: SM

Normal Stress (ksf)	Shear Stress (ksf)	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)
2.0	2.198	84.5	31.8
4.0	3.306	90.5	30.3
8.0	5.635	88.6	28.8



Mohr-Coulomb Failure Envelope

$\phi = 30°$

c = 1.0 ksf

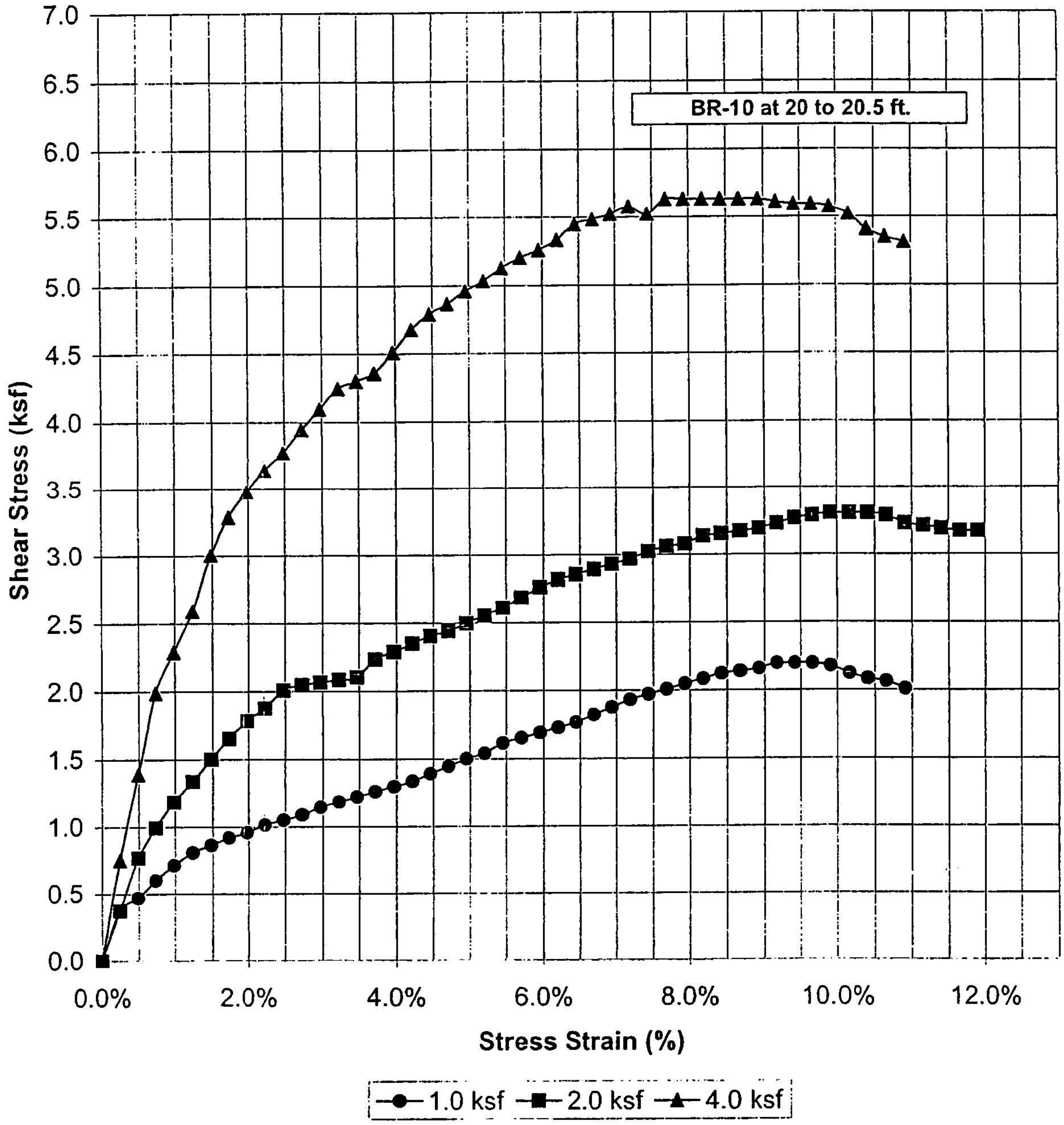
KLEINFELDER

PROJECT: NM 126
Cuba - LaCueva, New Mexico
PROJECT NO: 35321

DIRECT SHEAR TEST RESULTS (cont.)

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-10
DEPTH: 20 to 20.5 ft.
SAMPLE DESCRIPTION: Silty Sand
UNIFIED SOIL CLASSIFACTION: SM

		In-Situ	
Normal Stress (ksf)	Shear Stress (ksf)	Dry Density (pcf)	Moisture Content (%)
2.0	2.198	84.5	31.8
4.0	3.306	90.5	30.3
8.0	5.635	88.6	28.8



KLEINFELDER

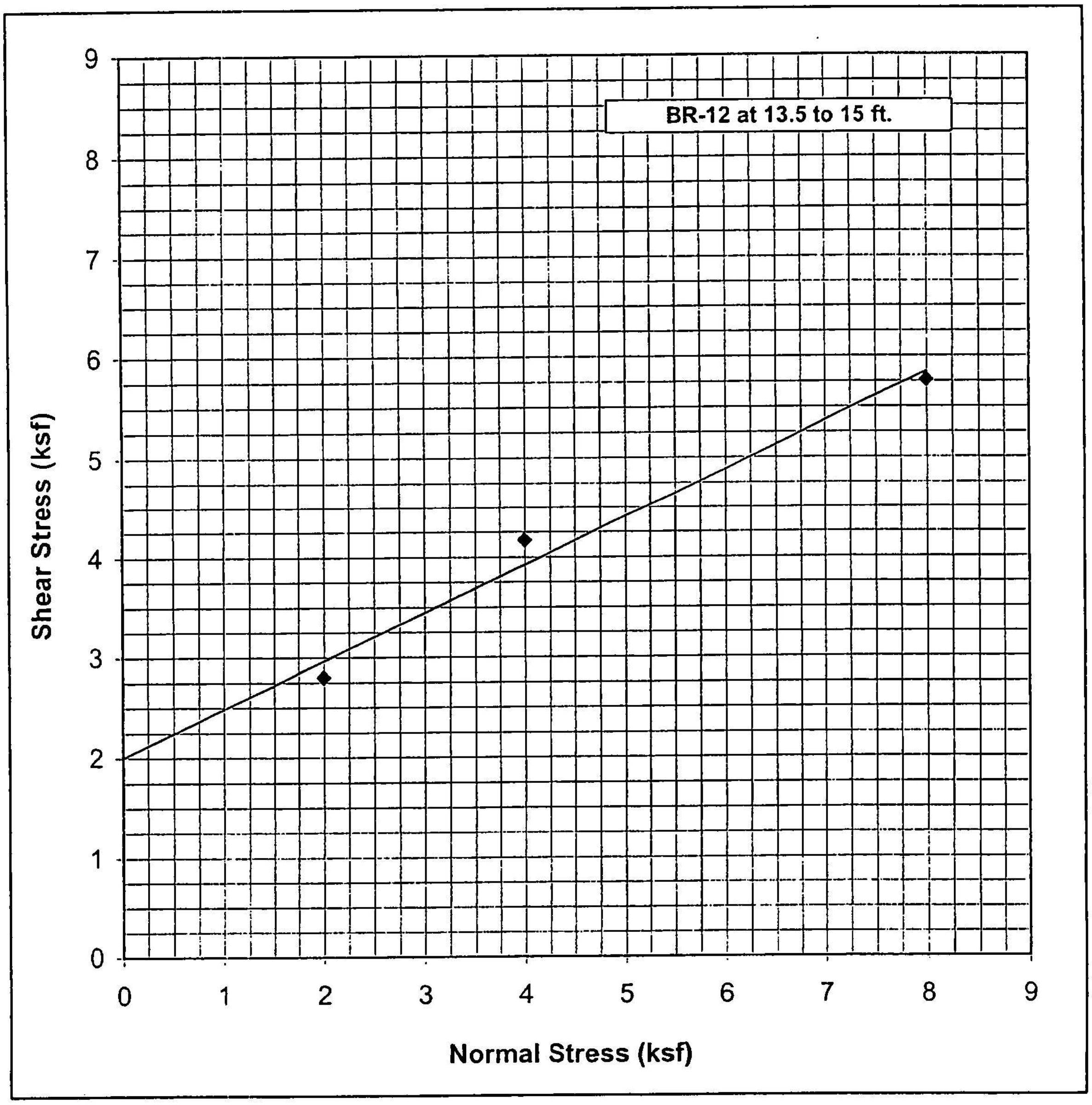
PROJECT: NM 126
Cuba - LaCueva, New Mexico
PROJECT NO: 35321

Figure D.40

DIRECT SHEAR TEST RESULTS

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-12
DEPTH: 13.5 to 15 ft.
SAMPLE DESCRIPTION: Silty Sand
UNIFIED SOIL CLASSIFACTION: SM

Normal Stress (ksf)	Shear Stress (ksf)	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)
2.0	2.799	85.7	26.0
4.0	4.170	94.1	24.2
8.0	5.767	81.3	26.0



Mohr-Coulomb Failure Envelope

$\phi = 26°$

c = 2.0 ksf

KLEINFELDER

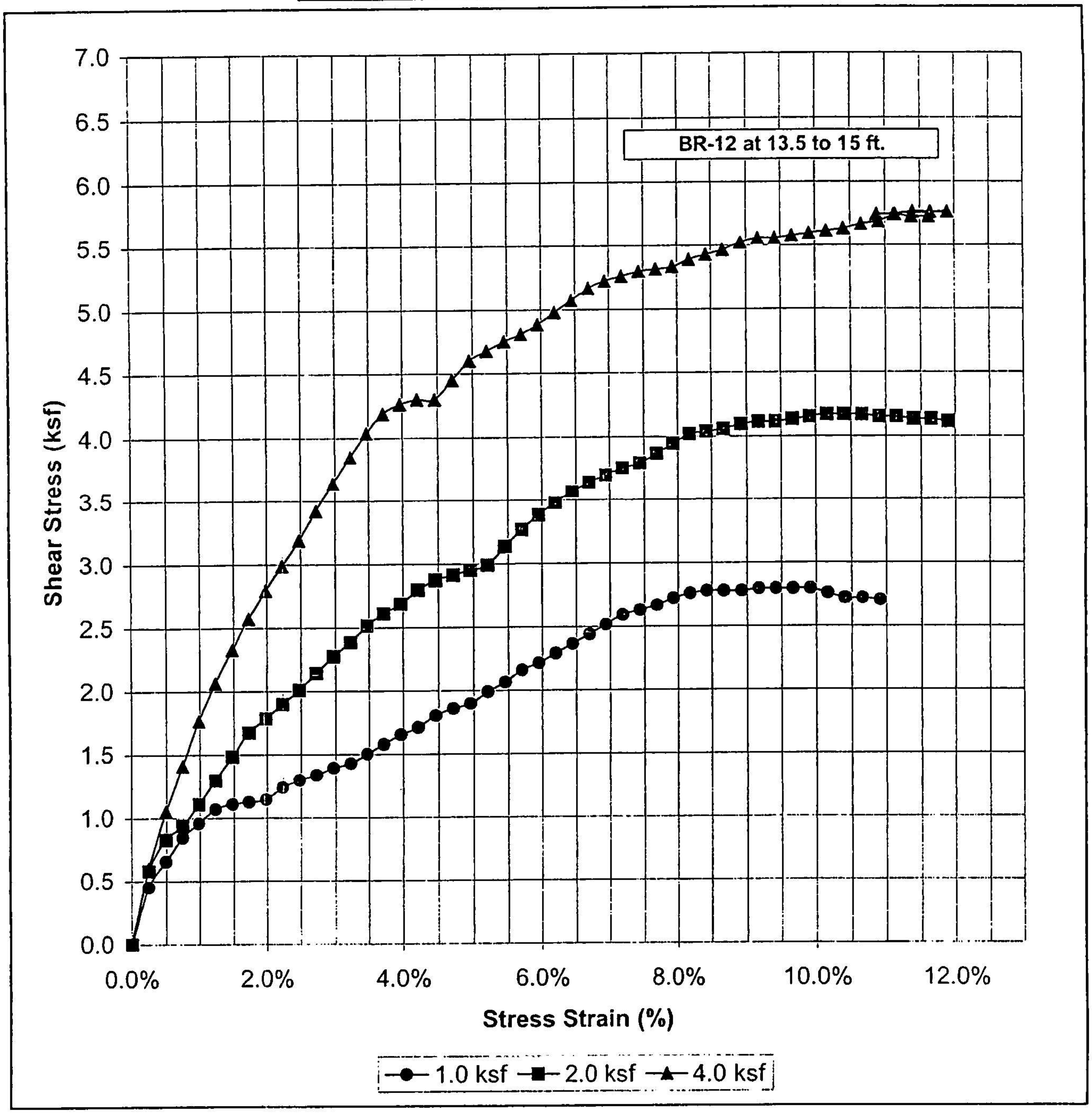
PROJECT: NM 126
Cuba - LaCueva , New Mexico
PROJECT NO: 35321

Figure D.41

DIRECT SHEAR TEST RESULTS (cont.)

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-12
DEPTH: 13.5 to 15 ft.
SAMPLE DESCRIPTION: Silty Sand
UNIFIED SOIL CLASSIFACTION: SM

Normal Stress (ksf)	Shear Stress (ksf)	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)
2.0	2.799	85.7	26.0
4.0	4.170	94.1	24.2
8.0	5.767	81.3	26.0



KLEINFELDER

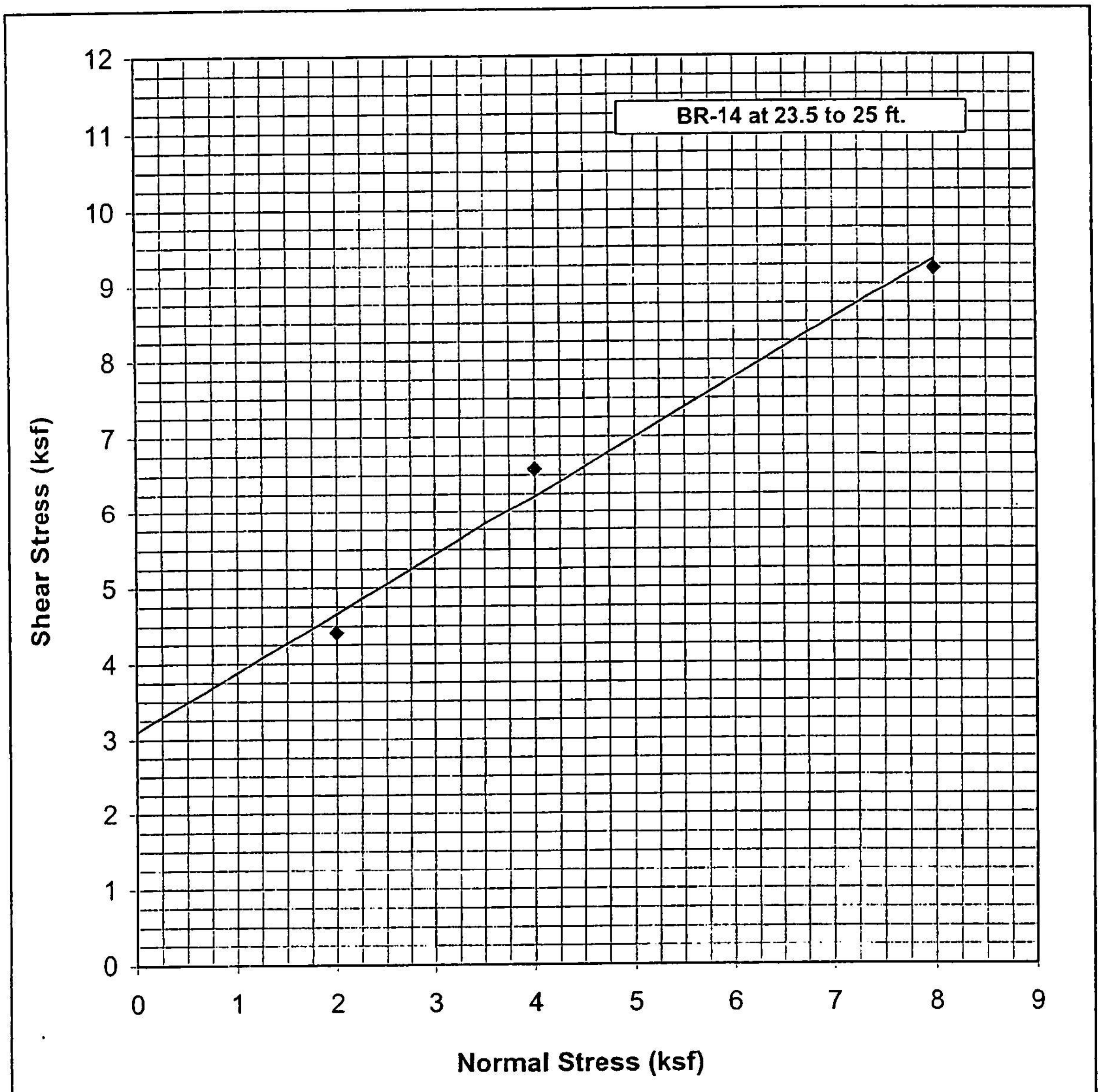
PROJECT: NM 126
Cuba - LaCueva, New Mexico
PROJECT NO: 35321

Figure D.42

DIRECT SHEAR TEST RESULTS

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-14
DEPTH: 23.5 to 25 ft.
SAMPLE DESCRIPTION: Sand
UNIFIED SOIL CLASSIFACTION: SP

		In-Situ	
Normal Stress (ksf)	Shear Stress (ksf)	Dry Density (pcf)	Moisture Content (%)
2.0	4.414	98.1	21.1
4.0	6.574	98.4	19.8
8.0	9.204	96.8	20.4



Mohr-Coulomb Failure Envelope

$\phi = 38°$

c = 3.1 ksf

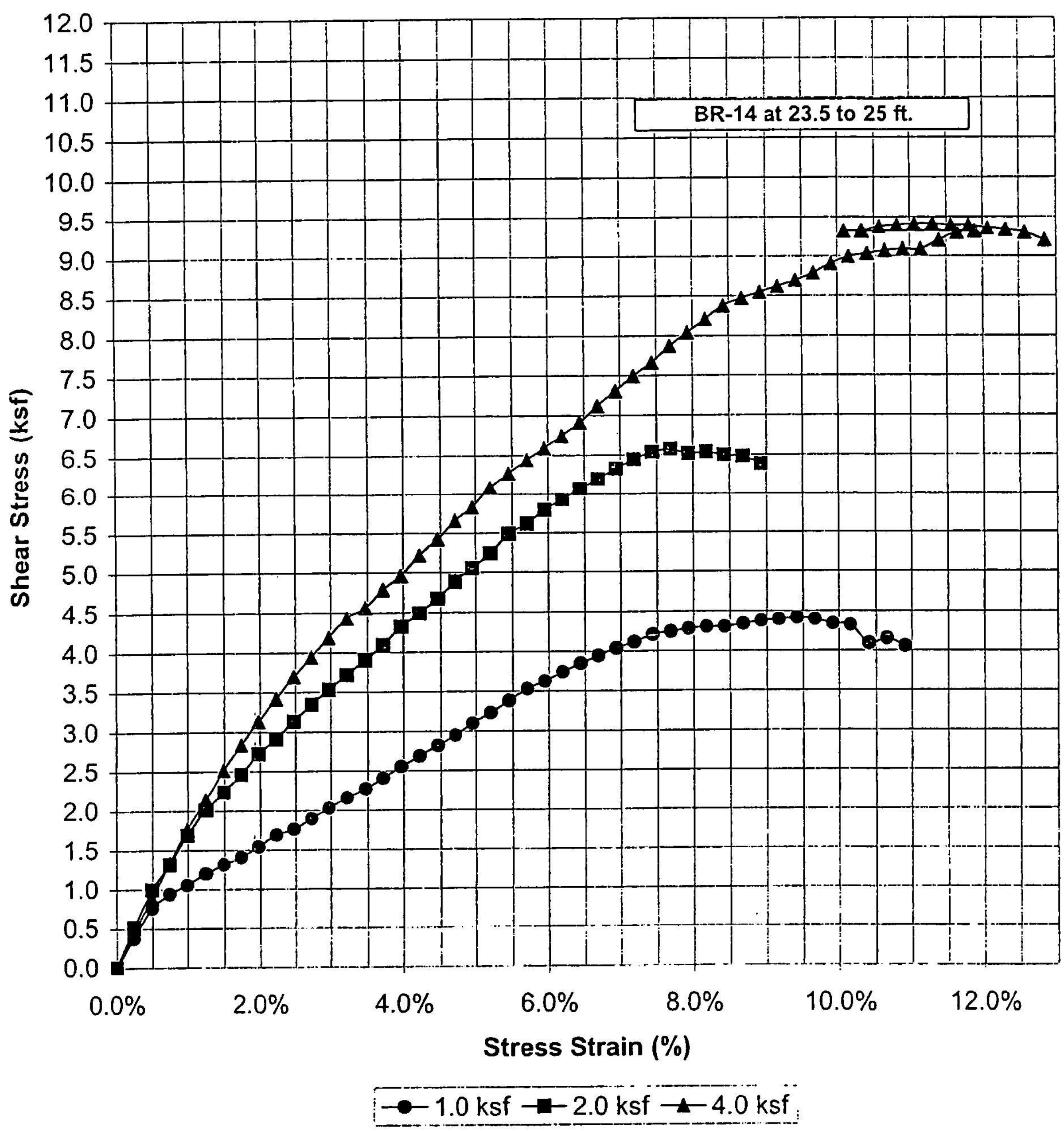
KLEINFELDER

PROJECT: NM 126
Cuba - LaCueva, New Mexico
PROJECT NO: 35321

DIRECT SHEAR TEST RESULTS (cont.)

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-14
DEPTH: 23.5 to 25 ft.
SAMPLE DESCRIPTION: Sand
UNIFIED SOIL CLASSIFACTION: SP

Normal Stress (ksf)	Shear Stress (ksf)	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)
2.0	4.414	98.1	21.1
4.0	6.574	98.4	19.8
8.0	9.204	96.8	20.4



PROJECT: NM 126
Cuba - LaCueva, New Mexico

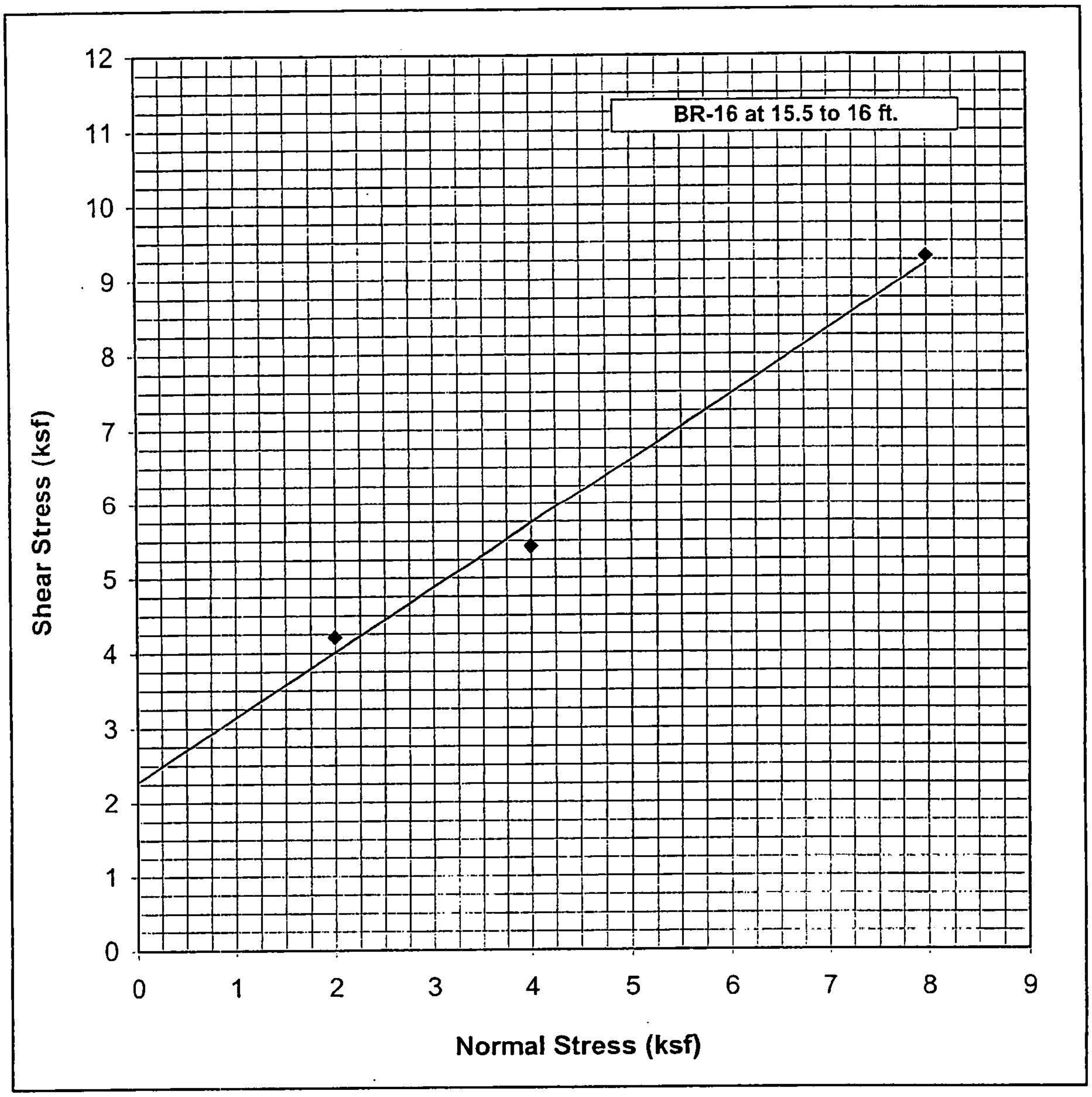
KLEINFELDER **PROJECT NO:** 35321

Figure D.44

DIRECT SHEAR TEST RESULTS

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-16
DEPTH: 15.5 to 16 ft.
SAMPLE DESCRIPTION: Sand
UNIFIED SOIL CLASSIFACTION: SP

Normal Stress (ksf)	Shear Stress (ksf)	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)
2.0	4.208	83.7	24.8
4.0	5.429	80.8	27.9
8.0	9.298	83.0	29.3



Mohr-Coulomb Failure Envelope

$\phi = 41°$

c = 2.3 ksf

PROJECT: NM 126
Cuba - LaCueva, New Mexico
PROJECT NO: 35321

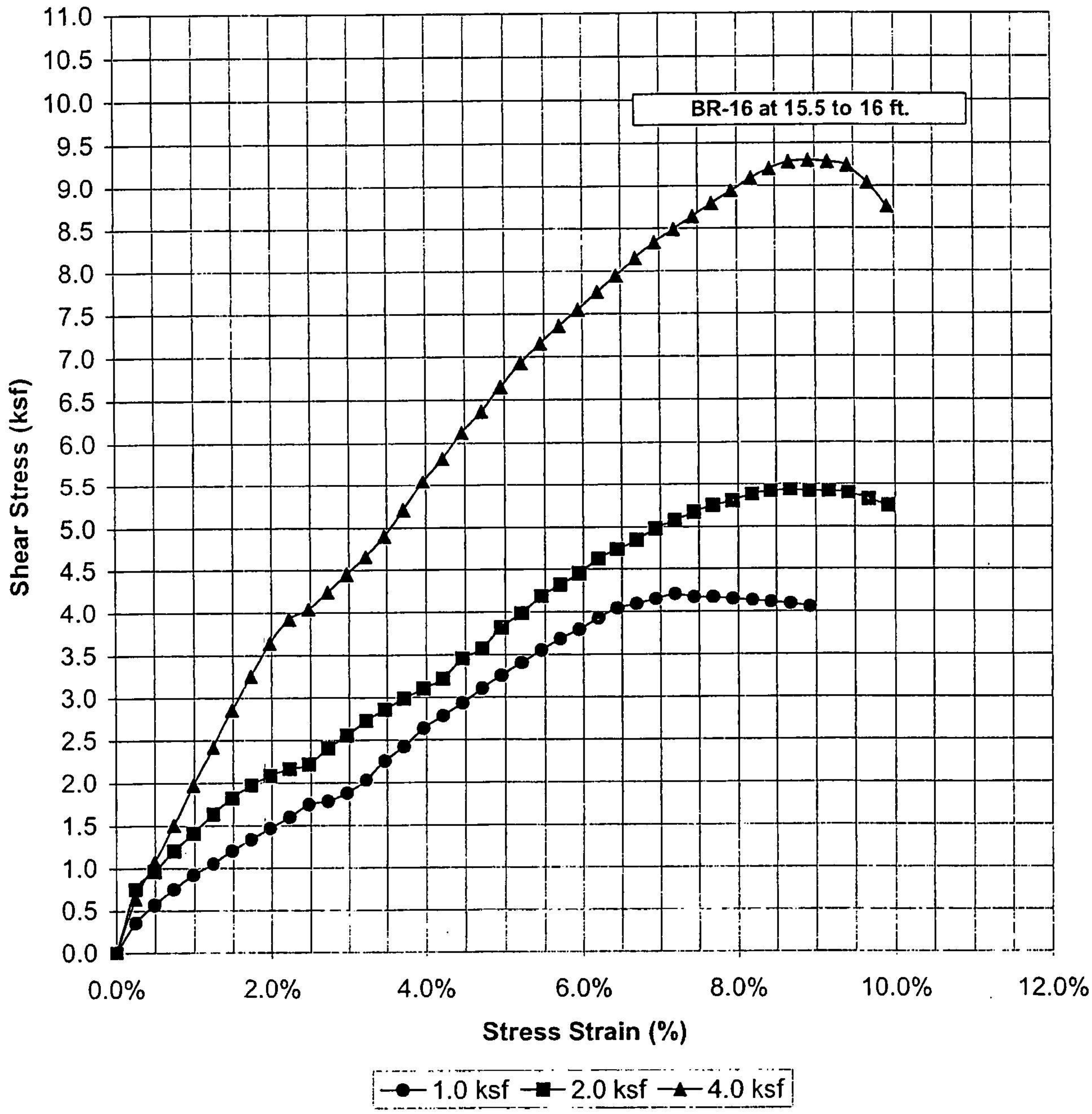
KLEINFELDER

Figure D.45

DIRECT SHEAR TEST RESULTS (cont.)

PROJECT NUMBER: 35321
DATE: 10/18/2004
BORING NO.: BR-16
DEPTH: 15.5 to 16 ft.
SAMPLE DESCRIPTION: Sand
UNIFIED SOIL CLASSIFACTION: SP

		In-Situ	
Normal Stress (ksf)	Shear Stress (ksf)	Dry Density (pcf)	Moisture Content (%)
2.0	4.208	83.7	24.8
4.0	5.429	80.8	27.9
8.0	9.298	83.0	29.3



KLEINFELDER

PROJECT: NM 126
Cuba - LaCueva, New Mexico
PROJECT NO: 35321

Figure D.46

COVER LETTER

November 18, 2004

Taya Retterer
Kleinfelder
8300 Jefferson, NE Suite B
Albuquerque, NM 87113
TEL: (505) 344-7373
FAX (505) 344-1711

RE: NM SH 126 Cuba-La Cueva, NM Order No.: 0411169

Dear Taya Retterer:

Hall Environmental Analysis Laboratory received 8 samples on 11/15/2004 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent.

Reporting limits are determined by EPA methodology. No determination of compounds below these (denoted by the ND or < sign) has been made.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman, Business Manager
Nancy McDuffie, Laboratory Manager

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-7, S-3
Lab Order:	0411169	**Collection Date:**	10/23/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-01	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	1.3	0.30		mg/Kg	1	11/17/2004 5:31:42 AM
Sulfate	2.6	1.5		mg/Kg	1	11/17/2004 5:31:42 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	8.27	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	32500	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

- ND - Not Detected at the Reporting Limit
- J - Analyte detected below quantitation limits
- B - Analyte detected in the associated Method Blank
- * - Value exceeds Maximum Contaminant Level
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-7, S-4
Lab Order:	0411169	**Collection Date:**	10/23/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-02	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	1.2	0.30		mg/Kg	1	11/17/2004 5:48:31 AM
Sulfate	1.6	1.5		mg/Kg	1	11/17/2004 5:48:31 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	8.31	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	39100	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

- ND - Not Detected at the Reporting Limit
- J - Analyte detected below quantitation limits
- B - Analyte detected in the associated Method Blank
- * - Value exceeds Maximum Contaminant Level
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-9, S-2
Lab Order:	0411169	**Collection Date:**	11/11/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-03	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	3.1	1.5		mg/Kg	5	11/17/2004 6:55:42 AM
Sulfate	15	7.5		mg/Kg	5	11/17/2004 6:55:42 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	7.06	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	5840	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	Client Sample ID:	B-9, S-4
Lab Order:	0411169	Collection Date:	11/11/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-04	Matrix:	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	ND	1.5		mg/Kg	5	11/17/2004 7:12:31 AM
Sulfate	ND	7.5		mg/Kg	5	11/17/2004 7:12:31 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	7.68	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	9490	1.00		Ohms * cm	1	11/18/2004

Qualifiers:
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- B - Analyte detected in the associated Method Blank
- * - Value exceeds Maximum Contaminant Level
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-10, S-1
Lab Order:	0411169	**Collection Date:**	11/12/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-05	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: MAP
Chloride	3.0	1.5		mg/Kg	5	11/17/2004 7:29:20 AM
Sulfate	9.0	7.5		mg/Kg	5	11/17/2004 7:29:20 AM
EPA METHOD 150.1: PH						Analyst: CMC
pH	5.85	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: MAP
Resistivity	5110	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

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J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-10, S-3
Lab Order:	0411169	**Collection Date:**	11/12/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-06	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	4.7	0.30		mg/Kg	1	11/17/2004 7:46:03 AM
Sulfate	ND	1.5		mg/Kg	1	11/17/2004 7:46:03 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	8.16	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	91300	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-12, S-3
Lab Order:	0411169	**Collection Date:**	10/23/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-07	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	41	0.30		mg/Kg	1	11/17/2004 8:02:46 AM
Sulfate	4.8	1.5		mg/Kg	1	11/17/2004 8:02:46 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	6.51	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	6210	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

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- J - Analyte detected below quantitation limits
- B - Analyte detected in the associated Method Blank
- * - Value exceeds Maximum Contaminant Level
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT:	Kleinfelder	**Client Sample ID:**	B-13, S-3
Lab Order:	0411169	**Collection Date:**	10/23/2004
Project:	NM SH 126 Cuba-La Cueva, NM		
Lab ID:	0411169-08	**Matrix:**	SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 9056A: ANIONS						Analyst: **MAP**
Chloride	9.4	3.0		mg/Kg	10	11/17/2004 8:19:35 AM
Sulfate	ND	15		mg/Kg	10	11/17/2004 8:19:35 AM
EPA METHOD 150.1: PH						Analyst: **CMC**
pH	6.28	0.010		pH Units	1	11/16/2004
RESISTIVITY						Analyst: **MAP**
Resistivity	5480	1.00		Ohms * cm	1	11/18/2004

Qualifiers:

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- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- E - Value above quantitation range

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT: Kleinfelder
Work Order: 0411169
Project: NM SH 126 Cuba-La Cueva, NM

QC SUMMARY REPORT

Method Blank

Sample ID **MB-6899** Batch ID: **6899** Test Code: **E300** Units: **mg/Kg** Analysis Date **11/17/2004 3:50:51 AM** Prep Date **11/16/2004**

Client ID: Run ID: **LC_041116A** SeqNo: **321252**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	ND	0.3									
Sulfate	ND	1.5									

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Qualifiers: ND - Not Detected at the Reporting Limit
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R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT: Kleinfelder
Work Order: 0411169
Project: NM SH 126 Cuba-La Cueva, NM

QC SUMMARY REPORT

Sample Duplicate

Sample ID **0411169-02A DUP** Batch ID: **6899** Test Code: **E300** Units: **mg/Kg** Analysis Date **11/17/2004 6:05:14 AM** Prep Date **11/16/2004**
Client ID: **B-7, S-4** Run ID: **LC_041116A** SeqNo: **321260**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	1.346	0.3	0	0	0	0	0	1.152	15.6	20	
Sulfate	1.681	1.5	0	0	0	0	0	1.645	2.16	20	

Sample ID **0411169-05A DUP** Batch ID: **R13825** Test Code: **bos** Units: **Ohms * cm** Analysis Date **11/18/2004** Prep Date
Client ID: **B-10, S-1** Run ID: **WC_041118A** SeqNo: **321453**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Resistivity	4380	1	0	0	0	85	115	5110	15.4	20	

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Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT: Kleinfelder
Work Order: 0411169
Project: NM SH 126 Cuba-La Cueva, NM

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0411169-02A MS** Batch ID: **6899** Test Code: **E300** Units: **mg/Kg** Analysis Date **11/17/2004 6:22:03 AM** Prep Date **11/16/2004**

Client ID: **B-7, S-4** Run ID: **LC_041116A** SeqNo: **321261**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	14.13	0.3	15	1.152	86.5	80	120	0			
Sulfate	28.5	1.5	30	1.645	89.5	80	120	0			

Sample ID **0411169-02A MSD** Batch ID: **6899** Test Code: **E300** Units: **mg/Kg** Analysis Date **11/17/2004 6:38:53 AM** Prep Date **11/16/2004**

Client ID: **B-7, S-4** Run ID: **LC_041116A** SeqNo: **321262**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	14.98	0.3	15	1.152	92.2	80	120	14.13	5.85	20	
Sulfate	28.85	1.5	30	1.645	90.7	80	120	28.5	1.25	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

Hall Environmental Analysis Laboratory

Date: *18-Nov-04*

CLIENT: Kleinfelder
Work Order: 0411169
Project: NM SH 126 Cuba-La Cueva, NM

QC SUMMARY REPORT

Laboratory Control Spike - generic

Sample ID **LCS-6899** Batch ID: **6899** Test Code: **E300** Units: **mg/Kg** Analysis Date **11/17/2004 4:07:36 AM** Prep Date **11/16/2004**

Client ID: Run ID: **LC_041116A** SeqNo: **321253**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	13.81	0.3	15	0	92.1	90	110	0			
Sulfate	28.16	1.5	30	0	93.9	90	110	0			

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Qualifiers: ND - Not Detected at the Reporting Limit; J - Analyte detected below quantitation limits; S - Spike Recovery outside accepted recovery limits; R - RPD outside accepted recovery limits; B - Analyte detected in the associated Method Blank

Hall Environmental Analysis Laboratory

Sample Receipt Checklist

Client Name KLEIN

Date and Time Received: 11/15/2004

Work Order Number 0411169

Received by AT

Checklist completed by [signature] Signature Date 11/15/04

Matrix

Carrier name Client drop-off

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☐	Not Shipped ☑
Custody seals intact on sample bottles?	Yes ☐	No ☑	N/A ☐	
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Water - VOA vials have zero headspace?	No VOA vials submitted ☑	Yes ☐	No ☐	
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑	

Container/Temp Blank temperature? **16°** *4° C ± 2 Acceptable*
If given sufficient time to cool.

COMMENTS:

Client contacted ______ Date contacted: ______ Person contacted ______

Contacted by: ______ Regarding ______

Comments: ______

Corrective Action ______