GEOTECHNICAL INVESTIGATION
NEW MEXICO FOREST HIGHWAY 12
NEW MEXICO STATE HIGHWAY 126
CUBA-LACUEVA, NEW MEXICO

KLEINFELDER

An employee owned company

April 13, 2004

GEOTECHNICAL INVESTIGATION
NEW MEXICO FOREST HIGHWAY 12
NEW MEXICO STATE HIGHWAY 126
CUBA-LACUEVA, NEW MEXICO
PROJECT NO. 35321

Prepared for:
Federal Highway Administration
Central Federal Lands Highway Division

Submitted to:
Mel Dahlberg, Project Manager
Parsons, Brinkerhoff, 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

Prepared By:
Taya Retterer, E.I.T.
Staff Professional

Reviewed By:
Roland D. Maynard, P.E.
Geotechnical Department Manager

KLEINFELDER
An employee owned company

April 13, 2004
Project No. 35321 File No. ALB04RP001

Mr. Mel Dahlberg, Project Manager
Parsons, Brinkerhoff, Quade, and Douglas, Inc.
1660 Lincoln Street, Suite 2100
Denver, Colorado 80264

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

Dear Mr. Dahlberg:

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.

Taya Retterer, EIT
Staff Professional

Joseph P. Laird, P.E.
Staff Engineer

Reviewed by:

ROLAND D. MAYNARD NEW MEXICO 15750 LICENSED PROFESSIONAL ENGINEER

4/13/04

Roland D. Maynard, P.E.
Geotechnical Department Manager

TAR:RDM:kja

KLEINFELDER 8300 Jefferson NE, Suite B, Albuquerque, NM 87113 (505) 344-7373 (505) 344-1711 fax

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SUMMARY OF CONCLUSIONS

We understand that the project will consist of the reconstruction and realignment of New Mexico (NM) State Highway (SH) 126.

Our field investigation consisted of a surface reconnaissance, geologic mapping, and subsurface exploration including drilling exploratory borings and seismic refraction tests. We drilled 13 exploratory borings (B-1 through B-13) to depths ranging from 1.8 to 8.1 m (6 to 26.5 ft.) within the roadway and cut areas, and 7 borings (MSE-1 through MSE-7) to depths ranging from 4.7 to 11.1 m (15.5 to 36.5 ft.) For the MSE retaining walls, and 4 borings (BR-1 through BR-4) to depths ranging from 14.8 to 18.4 m (48.7 to 60.3 ft.). At the location of the proposed wetland crossing, borings BR-1 and BR-4 were drilled along the proposed alignment. Borings BR-2 and BR-3 were drilled along the existing earthen embankment west of the proposed alignment.

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 north side of the existing roadway. These slopes are covered with sparse ground vegetation and trees. At Station 2+000, the alignment turns northeast and deviates from the present roadway to traverse between the wetlands and the toe of the slope. This area is covered with native trees, shrubs and grasses. From Station 2+240 to 2+400, the proposed alignment turns north and crosses over the wetlands associated with 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. Cut and fill slopes are evident on both sides 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. The roadway then passes through a moderately wooded forest with sparse undergrowth. In some areas, the undergrowth is relatively thick. Along this portion of the alignment, the roadway passes to the west of the community of Seven Springs. 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, fill slopes and small valleys are evident on both sides of the roadway. Sparse native grasses, shrubs, and trees cover the slopes.

The project site lies along side the Rio Cebolla, within the alluvial deposits of this river. The alluvial deposits consist mainly of sand, silt and gravel. Where the alignment deviates from the existing NM SH 126 to bypass Seven Springs, the Quaternary Bandelier Tuff Formation is encountered. 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. These ash flow members are separated by the Cerro Toledo Interval of volcanoclastic sediments and pumice. Subsequent rapid erosion and re-deposition of volcanic rock units have produced the mesa and canyon topography and the alluvial soils on mesa tops and in canyons.

Both the alluvial deposits and the Bandelier Tuff overly a formation of Glorieta sandstone, Yeso, Abo and Culter formations, undivided. The Glorieta sandstone, Yeso, Abo and Culter formations are merged within this area and the resultant bedrock consists of stratified silty sandstone and sandy siltstone.

In general, the borings encountered silty sand with layers of sandy silt, silt, silty gravel, and gravel. Within the bridge borings (BR-1 through BR-4), the silty sand and silt was underlain by silty sandstone or sandy siltstone. The density of the coarse-grained soils was loose to medium dense, with occasional zones of very loose soil. The consistency of the fine-grained soils varied considerably from very soft to stiff. Several of the borings (borings B-8, B-9, MSE-2, MSE-3, MSE-4, MSE-5, MSE-6, and MSE-7) noted soils as possible weathered Bandelier tuff. These soils appeared more soil-like than rock-like so were classified as such.

Based on the drawing provided to us by Parsons, Brinkerhoff, Quade, and Douglas, Inc. (received December 12, 2003), three options are being considered for the wetlands crossing northeast of Fenton Lake. Drainage option 1 consists of a multi-span bridge crossing from Station 2+236 to 2+386, the full width of the wetlands. Drainage option 2a consists of a single span bridge from Station 2+367 to 2+387, with an embankment crossing the remainder of the wetlands. The third option, drainage option 2b, consists of a two span bridge from Station 2+236 to 2+274, with an embankment crossing the remainder of the wetlands. Where the embankment crossed the wetlands, several aluminum arch culverts are planned. This report discusses the pile design for the bridge, stability for the embankment, and settlement for the embankment.

Mechanically stabilized earth walls (MSE walls) are proposed for 4 locations along the alignment. For this initial investigation, the bearing capacity and global stability were analyzed.

Cut and/or fill slopes are planned along the left and right sides of the alignment. Of these slopes, 20 critical cut slope sections and 7 critical fill slope sections were selected for analysis. In general, critical slopes selected for analysis were greater than 4.5 m (15 feet) in height or steeper than 1:2 (vertical to horizontal, V:H). Factors of safety for cut slopes ranged from 0.8 to 2.7 for static conditions and 0.7 to 2.3 for seismic conditions. For fill slopes, the factors of safety ranges from 1.6 to 1.7 for static conditions and 1.3 to 1.5 for seismic conditions. This report discussed the slope stability of the critical slopes and provides alternatives for those slopes that do not have acceptable factors of safety. Settlement for the fill slopes ranged from 2.3 to 13.5 cm (0.9 to 5.3 inches).

On-site pavement can consist of a section consisting of an asphaltic concrete (HMA) surface layer over an aggregate base course (ABC).

1 INTRODUCTION

1.1 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-LaCueva. The current roadway consists of a dirt packed, 2-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 2-lane, asphalt-paved roadway along most of the present alignment. Just south of Fenton Lake, the road will be realigned to cross the wetlands further to the east 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 and 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). The project is a total length of 7.24 km (4.5 miles). Elevations along the alignment range from 2338 m (7671 ft.) to 2420 m (7938 ft.). The project is located within Sandoval County in the Santa Fe National Forest.

The investigation included a general site reconnaissance, including geologic mapping, initial subsurface exploration, seismic refraction tests, limited sampling of selected underlying soil and rock, initial field and laboratory testing, initial engineering analyses, and preparation of this initial report. The general recommendations contained in this report are subject to the limitations presented herein.

It is anticipated that some changes will be made to the final project. It will be the responsibility of Parsons, Brinkerhoff, Quade, and Douglas and the Federal Highway Administration to evaluate the final project to determine if additional geotechnical investigation is required. Kleinfelder can complete additional geotechnical investigations at your request.

The Stationing of the project increases 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, respectively. Reference to project stationing in this report should be considered approximate. Where discrepancies in stationing or project description arise between this report and project plans and specifications, the project plans and specifications are the governing documents.

This investigation was based on the 30 percent drawings dated October 7, 2003 supplied by Parsons, Brinkerhoff, Quade, and Douglas. 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, Brinkerhoff, Quade, and Douglas supplied us with post 30 percent drawings.

These drawing brought revisions to the alignment from approximately Station 4+400 to the end of the project. Our analysis has been modified to include the post 30 percent drawings.

1.2 PROPOSED CONSTRUCTION

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

1.2.1 Proposed Bridge

The project is to include a crossing of the Fenton Lake wetlands east of the existing earthen embankment and bridge that serve the existing roadway. Several options are being considered for the wetland crossing. The options being considered are:

1. A multi-span structure with fill embankments;
2. A combination of bridge and culverts with fill embankments;
3. And a earthen embankment with culverts.

1.2.2 Mechanically Stabilized Earth Retaining Walls

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		Height m (ft)
To	From	
2+700R	2+760R	4.9 (16.1)
4+220R	4+240R	7.6 (25)
4+840R	4+920R	8.0 (26.2)
6+120R	6+140R	5.1 (16.7)
7+060R	7+220R	4.5 (14.8)

1.2.3 Culverts

Several culverts are planned along the alignment. Table 2 summarizes the locations of the proposed culverts.

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Table 2 – Summary of 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

1.2.4 Proposed Permanent Cut and Fill Slopes

Cut and/or fill slopes are planned along the left and right sides of the alignment. Table 3 summarizes the proposed cut slopes, while Table 4 summarizes the proposed fill slopes. Of these slopes, 20 critical cut slope sections and 7 critical fill slope sections were selected for analysis. These sections are discussed in detail in Section 5. In general, critical slopes selected for analysis were greater than 4.5 m (15 ft.) in height or steeper than 1:2 (vertical to horizontal, V:H).

Table 3 – Proposed Cut Slopes

Station		Proposed Cut Slope Inclination (cut slopes may not run the entire length of stationing)		Maximum Cut Height m (ft)	
From	To	Left (V:H)	Right (V:H)	Left	Right
0+200	0+320	1:20	1:4 to 1:20	0.3 (1)	0.6 (2)
0+780	1+060	none	1:3 to 1:10	--	2.4 (7.9)
1+380	1+600	none	1:2 to 1:4	--	3 (9.9)
1+880	2+220	1:2.5 to 1:20	1:2 to 1:4	2.4 (7.9)	9.6 (31.5)
2+420	3+120	1:2.5 to 1:10	1:3 to 1:20	13 (42.7)	2.7 (8.9)
3+200	3+260	1:2 to 1:3	none	6 (19.7)	--
3+340	3+520	1:2 to 1:4	1:3 to 1:20	5 (16.4)	1.4 (4.6)

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Table 3 – Proposed Cut Slopes

Station		Proposed Cut Slope Inclination (cut slopes may not run the entire length of stationing)		Maximum Cut Height m (ft)	
From	To	Left (V:H)	Right (V:H)	Left	Right
3+660	3+920	1:2 to 1:10	1:3 to 1:20	6.9 (22.6)	2.9 (9.5)
4+100	4+420	1:1.5 to 1:2.5	1:3 to 1:20	16.3 (53.5)	1.8 (5.9)
4+520	4+900	1:1 to 1:4	1:2 to 1:20	7.5 (24.6)	4.9 (16.1)
4+960	5+280	1:2 to 1:6	1:2 to 1:20	7 (23)	0.2 (0.7)
5+340	5+440	1:2	1:2	4 (13.1)	0.6 (2)
5+540	5+880	1:2	1:20	2.6 (8.5)	0.7 (2.3)
5+980	--	1:2	none	0.8 (2.6)	--
6+060	6+100	1:2	none	1 (3.3)	--
6+180	7+300	1:1 to 1:3	1:2 to 1:20	21.8 (71.5)	0.6 (2)

Table 4 – 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+200	0+320	1:6	none	0.4 (1.3)	--
0+340	1+860	1:3 to 1:20	1:2 to 1:10	3.7 (12.2)	2.1 (6.9)
1+960	2+020	1:2 to 1:4	1:4	3 (9.9)	0.5 (1.6)
2+160	2+400	1:4	1:4	2.8 (9.2)	2.6 (8.5)
2+540	2+620	none	1:2 to 1:4	--	4.9 (16.1)
2+680	2+800	1:10	1:2 to 1:4 / MSE	0.2 (0.7)	4.7 (15.4)
2+880	3+000	none	1:4	--	3 (9.9)
3+140	3+340	1:4 to 1:10	1:2 to 1:4	1.7 (5.6)	5 (16.4)
3+520	3+760	1:2 to 1:10	1:2 to 1:4	2.2 (7.2)	2.8 (9.2)
3+940	4+080	1:3 to 1:6	1:2 to 1:4	4.3 (14.1)	10 (32.8)
4+160	4+240	1:2	1:2 / MSE	0.4 (1.3)	12.4 (40.7)
4+420	4+500	1:4 to 1:6	1:3 to 1:4	0.8 (2.6)	1.8 (5.9)
4+700	7+440	1:3 to 1:10	1:2 to 1:20 / MSE	1.4 (4.6)	6.8 (22.3)

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1.2.5 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) and any 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.

2 FIELD EXPLORATION

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

2.1 SUBSURFACE EXPLORATION

We drilled 13 exploratory borings (B-1 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-1 through MSE-7) to depths ranging from 4.7 to 11.1 m (15.5 to 36.5 ft.) for the MSE retaining walls, and 4 borings (BR-1 through BR-4) to depths ranging from 14.8 to 18.4 m (48.7 to 60.3 ft.). At the location of the proposed wetland crossing, borings BR-1 and BR-4 were drilled along the proposed alignment. Borings BR-2 and BR-3 were drilled along the existing earthen embankment west of the proposed alignment. The logs of the borings are presented in Appendix B. A site plan showing the approximate boring locations is presented as Figure A.3 through A.13 in Appendix A. 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 E.

Exploratory drilling of borings B-1 through B-8, B-11 through B-13, BR-2, BR-3, MSE-1, and MSE-5 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-1, BR-4, MSE-2, B-9, MSE-3, MSE-4, B-10, MSE-6, and MSE-7 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.

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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 5 summarizes the stationing and offset for each of the seismic refraction sites.

Table 5 – Summary of Seismic Refraction Tests

Number	Beginning Station	Ending Station	Offset
S-1	1+865	1+895	6 m R to 2 m L (20 ft. R to 7 ft. L
S-2	2+050	2+120	12 m L (39 ft. L)
S-3	2+460	2+530	Centerline to 12 m R (Centerline to 39 ft. R)
S-4	2+670	2+740	5 m R to centerline (16 ft. R to centerline)
S-5	2+730	2+810	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+130	7 m R (23 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 E.

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 expect the R-value tests were run at the Albuquerque laboratory. Table 6 summarizes the laboratory test results. Table 7 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 6 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing										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")	38.1 mm (1 1/2")	
B-1	0.5 (1.5)	NP	NV	15	19	29	51	56	60	60	64	85	100	14.4%
B-2	0 (0)	--	--	38	47	62	87	93	99	100	100	100	100	13.9%
B-3	0 (0)	NP	NV	25	34	52	76	85	92	97	100	100	100	12.6%
B-4	0.5 (1.5)	--	--	19	24	35	60	72	84	86	89	100	100	21.4%
B-5	0.5 (1.5)	NP	NV	37	50	64	86	99	100	100	100	100	100	7.9%
B-6	0 (0)	NP	NV	27	37	52	79	87	96	96	100	100	100	7.0%
B-6	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	5.3%
B-6	3 (10)	NP	NV	15	22	35	62	73	81	84	100	100	100	4.1%
B-6	4.6 (15)	--	--	--	--	--	--	--	--	--	--	--	--	5.7%
B-6	6.1 (20)	--	--	--	--	--	--	--	--	--	--	--	--	12.4%
B-6	7.6 (25)	--	--	--	--	--	--	--	--	--	--	--	--	15.9%
B-7	0 (0)	NP	NV	26	39	55	76	84	91	93	94	100	100	11.3%
B-7	1.5 (5)	--	--	23	35	52	82	90	97	100	100	100	100	5.6%
B-8	0 (0)	NP	NV	40	48	59	83	92	99	100	100	100	100	6.2%
B-8	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	8.9%
B-8	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	20.2%
B-8	4.6 (15)	--	--	--	--	--	--	--	--	--	--	--	--	17.1%
B-8	5.5 (18)	--	--	--	--	--	--	--	--	--	--	--	--	19.9%

Table 6 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing										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")	38.1 mm (1 1/2")	
B-9	0 (0)	NP	NV	66	75	83	96	98	99	100	100	100	100	4.7%
B-9	2.7 (9)	--	--	--	--	--	--	--	--	--	--	--	--	8.6%
B-10	1.4 (4.5)	--	--	27	34	48	74	83	91	96	100	100	100	4.9%
B-11	0 (0)	NP	NV	29	36	49	75	83	91	94	96	100	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	100	9.3%
B-13	0.5 (1.5)	NP	NV	34	43	56	80	89	97	100	100	100	100	20.5%
BR-1	2.6 (8.5)	NP	NV	--	--	--	--	--	--	--	--	--	--	--
BR-1	4.1 (13.5)	--	--	31	40	47	63	69	80	82	91	95	100	30.5%
BR-1	7.2 (23.5)	--	--	30	38	50	72	79	84	88	92	97	100	32.6%
BR-1	10.2 (33.5)	--	--	11	16	27	57	70	85	92	100	100	100	15.7%
BR-1	11.7 (38.5)	--	--	26	--	--	--	--	--	--	--	--	--	10.5%
BR-1	14.8 (48.5)	--	--	--	--	--	--	--	--	--	--	--	--	12.7%
BR-2	1.5 (5)	NP	NV	21	29	44	74	84	99	100	100	100	100	26.8%
BR-2	6.1 (20)	--	--	41	50	66	94	98	100	100	100	100	100	34.9%
BR-2	12.2 (40)	--	--	11	16	30	59	73	87	91	94	100	100	23.4%
BR-3	4.6 (15)	--	--	54	64	74	91	95	98	99	100	100	100	43.8%
BR-4	2.7 (9)	--	--	20	32	50	80	90	96	98	100	100	100	41.2%
BR-4	5.8 (19)	--	--	16	23	37	68	81	92	96	98	100	100	29.9%
BR-4	14.9 (49)	--	--	31	39	54	67	74	82	88	97	100	100	20.6%
BR-4	16.5 (54)	--	--	73	--	--	--	--	--	--	--	--	--	13.9%
MSE-1	0 (0)	NP	NV	16	23	33	48	57	73	82	92	100	100	4.4%
MSE-1	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	10.6%

Table 6 – Summary of Laboratory Test Results

Boring Number	Depth of top of sample m (ft.)	Atterberg Limits		Sieve Analysis - Cumulative Percent Passing										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")	38.1 mm (1 1/2")	
MSE-1	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	8.4%
MSE-2	0 (0)	--	--	21	29	41	68	78	87	91	96	100	100	3.5%
MSE-3	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	14.4%
MSE-3	4.6 (15)	--	--	15	20	28	40	50	55	61	64	100	100	6.9%
MSE-4	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	4.9%
MSE-4	4.3 (14)	--	--	36	51	69	93	98	99	100	100	100	100	24.4%
MSE-5	0 (0)	--	--	18	22	31	50	67	90	95	100	100	100	4.4%
MSE-5	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	4.1%
MSE-5	3 (10)	--	--	15	18	26	44	59	75	82	97	100	100	4.1%
MSE-6	0 (0)	--	--	23	29	39	59	72	84	91	98	100	100	10.1%
MSE-6	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	23.4%
MSE-6	4.3 (14)	--	--	--	--	--	--	--	--	--	--	--	--	16.5%
MSE-7	0 (0)	--	--	--	--	--	--	--	--	--	--	--	--	9.1%
MSE-7	1.2 (4)	--	--	20	23	29	45	56	69	71	84	100	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-2	0 (0)	SM	A-4(0)
B-3	0 (0)	SM	A-2-4(0)
B-4	0.5 (1.5)	SM	A-1-b
B-5	0.5 (1.5)	SM	A-4(0)
B-6	0 (0)	SM	A-2-4(0)
B-6	3 (10)	SM	A-1-b
B-7	0 (0)	SM	A-2-4(0)
B-7	1.5 (5)	SM	A-2-4(0)

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-8	0 (0)	SM	A-4(0)
B-9	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-1	4.1 (13.5)	SM	A-2-4(0)
BR-1	7.2 (23.5)	SM	A-2-4(0)
BR-1	10.2 (33.5)	SP-SM	A-1-b
BR-2	1.5 (5)	SM	A-1-b
BR-2	6.1 (20)	SM	A-4(0)
BR-2	12.2 (40)	SP-SM	A-1-b
BR-3	4.6 (15)	ML	A-4(0)
BR-4	2.7 (9)	SM	A-1-b
BR-4	5.8 (19)	SM	A-1-b
BR-4	14.9 (49)	SM	A-2-4(0)
MSE-1	0 (0)	GM	A-1-b
MSE-2	0 (0)	SM	A-1-b
MSE-3	4.6 (15)	GM	A-1-a
MSE-4	4.3 (14)	SM	A-4(0)
MSE-5	0 (0)	SM	A-1-b
MSE-5	3 (10)	GM	A-1-a
MSE-6	0 (0)	SM	A-1-b
MSE-7	1.2 (4)	SM	A-1-b

A summary of the R-value test results has been included in Section 5.7.

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 north side of the existing roadway. These slopes are covered with sparse ground vegetation and trees. At Station 2+000, the alignment turns northeast and deviates from the present roadway to traverse between the wetlands and the toe of the slope. This area is covered with native trees, shrubs and grasses. From Station 2+240 to 2+400, the proposed alignment turns north and crosses over the wetlands associated with 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. Cut and fill slopes are evident on both sides 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. The roadway then passes through a moderately wooded forest with sparse undergrowth. In some areas, the undergrowth is relatively thick. Along this portion of the alignment, the roadway passes to the west of the community of Seven Springs. 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, fill slopes and small valleys are evident on both sides 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 site lays along side the Rio Cebolla, within the alluvial deposits of this river. The alluvial deposits consist mainly of sand, silt and gravel. Where the alignment deviates from the existing NM SH 126 to bypass Seven Springs, the Quaternary Bandelier Tuff Formation is encountered. 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. These ash flow members are separated by the Cerro Toledo Interval of volcanoclastic sediments and pumice. Subsequent rapid erosion and re-deposition of volcanic rock units have produced the mesa and canyon topography and the alluvial soils on mesa tops and in canyons. Both the alluvial deposits and the Bandelier Tuff overly a formation of Glorieta sandstone, Yeso, Abo and Culter formations, undivided. The Glorieta sandstone, Yeso, Abo and Culter formations are merged within this area and the resultant bedrock consists of stratified silty sandstone and sandy siltstone.

4.2.2 Subsurface Conditions

The following presents the soil and rock conditions encountered within the twenty-four exploratory borings drilled for this geotechnical investigation. In general, the borings encountered silty sand with layers of sandy silt, silt, silty gravel, and gravel. Within the bridge borings (BR-1 through BR-4), the silty sand and silt was underlain by silty sandstone or sandy siltstone. The density of the coarse-grained soils was loose to medium dense, with occasional zones of very loose soil. The consistency of the fine-grained soils varied considerably from very soft to stiff. Several of the borings (borings B-8, B-9, MSE-2, MSE-3, MSE-4, MSE-5, MSE-6, and MSE-7) noted soils as possible weathered Bandelier Tuff. These soils appeared more soil-like than rock-like so were classified as such. For a more detailed description of the subsurface conditions encountered, refer to the logs of the exploratory borings presented in Appendix B.

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, erosion was 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 with a tackified. In addition, significant erosion should be repaired prior to completing and vegetating the slope.

4.3.4 Groundwater

We encountered groundwater in 11 borings during our field investigation. Several of the borings were dry or not deep enough to penetrate the groundwater. 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-1	1+040, 6 m L	1.8 (6)	1.1 (3.5)	10/21/03
B-2	1+300, 4 m L	1.8 (6)	none	10/21/03
B-3	1+450, 8 m L	1.8 (6)	0.9 (3)	10/21/03
B-4	1+830, 4 m R	1.8 (6)	0.9 (3)	10/21/03
B-5	2+030, 5 m L	1.8 (6)	none	10/21/03
BR-1	2+240, 10 m L	14.8 (48.7)	1.2 (4)	11/13/03
BR-2	2+200, 100 m L	18.4 (60.3)	1.2 (4)	10/21/03
BR-3	2+350, 100 m L	18.4 (60.3)	1.5 (5)	10/22/03
BR-4	2+410, no offset	18 (59.2)	2.7 (9)	11/12/03
B-6	2+500, 3.5 m R	8.1 (26.5)	none	10/22/03
MSE-1	2+740, 2 m R	11.1 (36.5)	10.8 (35.5)	10/22/03
B-7	3+440, 5 m R	5 (16.5)	none	10/23/03
B-8	3+900, 10 m L	5.9 (19.5)	none	10/23/03
MSE-2	4+220, 20 m R	4.7 (15.5)	none	11/11/03
B-9	4+560, no offset	4.7 (15.5)	none	11/11/03
MSE-3	4+860, 10 m R	4.7 (15.5)	none	11/11/03
MSE-4	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-5	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-6	7+100, 10 m R	9.3 (30.5)	0.9 (3)	11/12/03
MSE-7	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

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5 CONCLUSIONS AND RECOMMENDATIONS

5.1 General Discussion

Based upon the data collected during this initial investigation and engineering analysis, it is our opinion that the site may be developed as discussed in this report. These opinions and, conclusions and recommendations, are based on our initial field and office studies, the properties of the soils and rock encountered in our borings and seismic studies, the results of the laboratory testing program, and our understanding of the proposed development of the alignment. Additional geotechnical investigations generating site and project design specific detailed recommendations may be warranted depending on the final construction configuration chosen. It is anticipated that some changes may be made to the final project. Kleinfelder should be notified if any such changes are made.

5.2 Summary of Soil Parameters

Based on the subsurface information obtained from the borings drilled for this project, the subsurface soils were divided into general material types as summarized below.

- Stratum A – Very loose to Loose Granular Soil – Silty sand, sand, gravel, and highly weathered to decomposed tuff with PI < 15 and N' of 10 or less.
- Stratum B - Medium Dense to Dense Granular Soil – Silty sand, sand, gravel, and moderately to slightly weathered tuff with PI < 15 and N' between 10 and 50
- Stratum C – Very Soft to Medium Stiff fine-grained cohesive soils - Silt to lean clay with a PI ≤ 15 and N' of 8 or less
- Stratum D - Stiff to Hard fine-grained cohesive soils – Silt to Lean clay with a PI ≤ 15 and N' between 8 and 30.
- Stratum E - Rock: Highly to completely weathered rock (Sandstone, Siltstone, Unweathered Tuff)
- Stratum F – Existing Granular Fill – Silty sand to sand
- Stratum G – Proposed Fill Material
  A - Granular Fill – Silty sand, clayey sand, silty gravel, or clayey gravel with PI < 15.
  B - Cohesive Fill – Lean to fat clay, mudstone or claystone with a PI ≥ 15.
  C - Rock Fill –Weathered to unweathered sandstone, siltstone or other material of similar composition

Using the laboratory test data, corrected blow counts (N'), and published correlations, we determined the geotechnical properties for each material type. Table 9 summarizes the geotechnical properties determined for each material type. These geotechnical properties were used for the design of the bridge, culverts, mechanically stabilized earth walls, embankments, and cut slopes.

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Table 9 – Summary of Geotechnical Properties

Stratum		Moist Unit Weight kN/m³ (pcf)	Shear Strength Parameters			
			Total Stress		Effective Stress	
			c_u kPa (psf)	ϕ deg	c' kPa (psf)	ϕ' deg
A	Very Loose to Loose Granular Soil	15.8 – 17.3 (100 – 110)	--	--	0 – 2 (0 – 50)	30 – 32
B	Medium Dense to Dense Granular Soil	17.3 – 18.9 (110 – 120)	--	--	0 – 2 (0 – 50)	34 – 36
C	Very Soft to Medium Stiff Fine-Grained Cohesive Soil	14.2 – 15.8 (90 – 100)	25 – 70 (500 –1,500)	0	5 – 14 (100 – 300)	22 – 28
D	Stiff to Hard Fine-Grained Cohesive Soil	15.8 – 17.3 (100 – 110)	50 – 120 (1,000 –2,500)	0	10 – 25 (200 – 500)	26 – 32
E	Rock	19.7 – 22.1 (125 – 140)	--	--	--	36 – 40
F	Existing Fill	18.9 – 20.5 (120 – 130)	--	--	0 – 5 (0 – 100)	32 – 34
Material Type G						
A	Granular Fill	18.9 – 20.5 (120 – 130)	--	--	0 – 5 (0 – 100)	32 – 34
B	Cohesive Fill	17.3 – 18.9 (110 – 120)	--	--	10 – 25 (200 – 500)	22 – 26
C	Rock Fill	19.7 – 21.3 (125 – 135)	--	--	0 – 2 (0 – 50)	40 – 44

Notes:
c_u: undrained shear strength
ϕ: friction angle
c': effective cohesion
ϕ': effective friction angle

5.3 Fenton Lake and Wetlands Bridge and Embankment

Based on the drawings provided to us by Parsons, Brinkerhoff, Quade, and Douglas, Inc. (received December 12, 2003), three options are being considered for the wetlands crossing northeast of Fenton Lake. Drainage option 1 consists of a multi-span bridge crossing from Station 2+236 to 2+386, the full width of the wetlands. Drainage option 2a consists of a single span bridge from Station 2+367 to 2+387, with an embankment crossing the remainder of the wetlands. The third option, drainage option 2b, consists of a two span bridge from Station 2+236 to 2+274, with an embankment crossing the remainder of the wetlands. Where the embankment crossed the wetlands, several aluminum arch culverts are planned. The following sections discuss the pile design for the bridge, stability for the embankment, and settlement for the embankment.

5.3.1 Driven Pile Recommendations

As shown in Subsurface Profile, Bridge Area, Figure 4 in Appendix C, saturated, silty sand and silt soils were encountered in the upper 12 to 17 m (39.4 to 55.8 ft.) below the ground surface. The recommended bearing stratum for the bridge abutment and bent loadings is the siltstone and fine-grained sandstone (rock), which underlies the wet alluvial soils.

The FHWA program DRIVEN was used to estimate ultimate pile tip capacities for typical HP and closed end pipe piles. The geologic conditions encountered at BR-2 were conservatively used for analyses. A summary of ultimate bearing values for 1.5 m (4.9 ft.) pile tip embedment into rock is presented in Table 10. A 1.5m (4.9 ft.) pile tip embedment would place the tip depth at approximately 16.8 m (55.1 ft.), elevation 2319.7 m (7610.6 ft.) Based on past experiences in these types of soils and rocks, we felt that 1.5 m (4.9 ft.) into the siltstone or sandstone layer would be the limiting depth of penetration without causing damage to the piles during the driving process. The estimated tip depth and elevation is based on top of pile at Elev. 2336.5 m (7665.7 ft.) and siltstone or sandstone being encountered at a depth of 15.3 m, Elev. 2321.2 m (50.2 ft, Elev. 7615.5 ft.) below the existing surface elevation.

Table 10 – Estimated Ultimate Axial Pile Capacities

Pile Type	Estimated Ultimate Total Axial Capacity
HP310x79 (HP12"x53)	1,095 kN (246 kips)
HP360x108 (HP14"x73)	1,493 kN (336 kips)
HP360x174 (HP14"x117)	1,914 kN (430 kips)
457 mm Pipe Closed (18 inch Pipe Closed)	3,266 kN (734 kips)
610 mm Pipe Closed (24 inch Pipe Closed)	5,412 kN (1,217 kips)

Figures 1 through 3 presented a graphical representation of the skin friction, end bearing, and total axial capacities versus depth. These values are ultimate capacities and are presented in kilo-Newtons (kN).

Figure 1 - Depth vs. Skin Friction

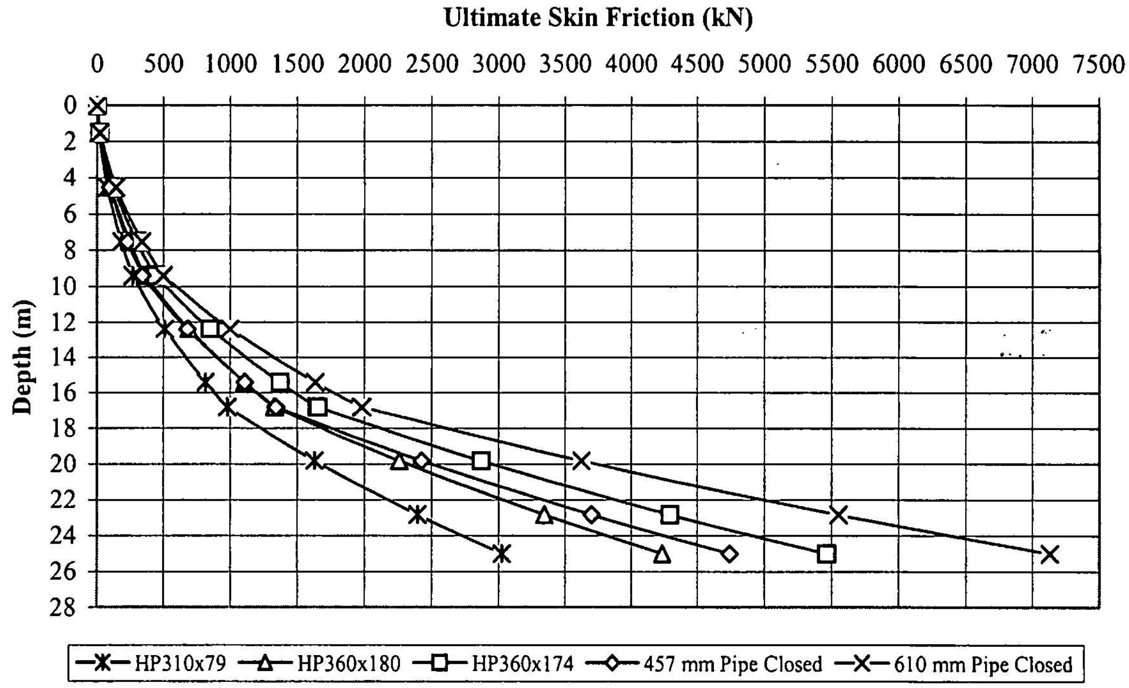


Figure 2 - Depth vs. End Bearing

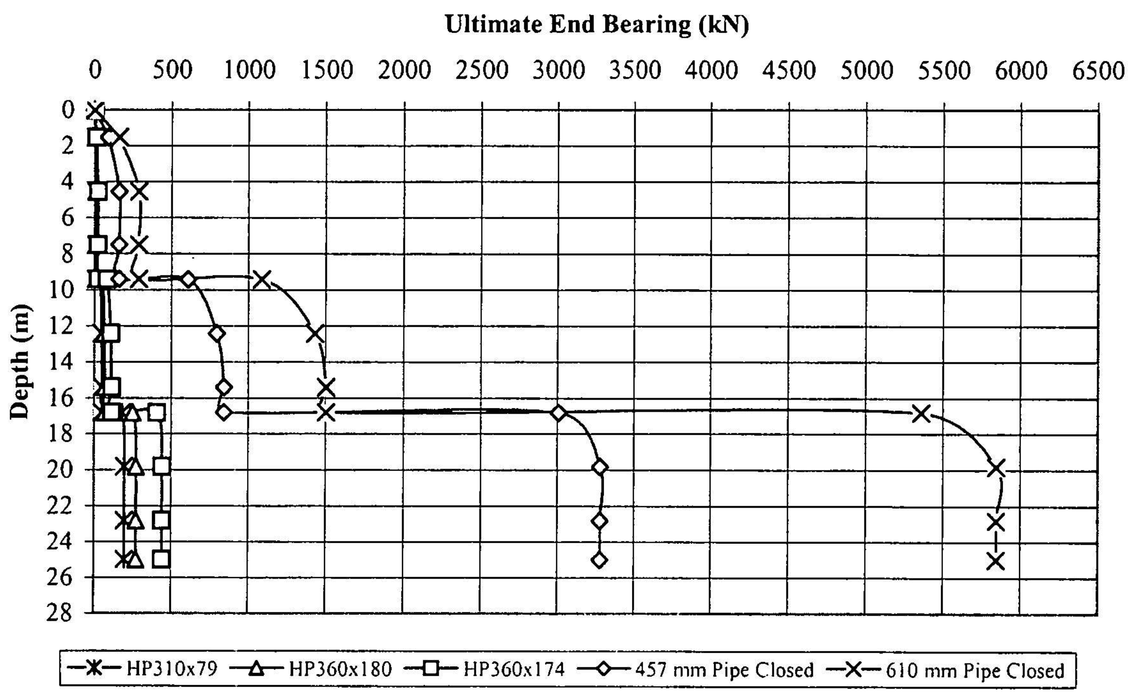
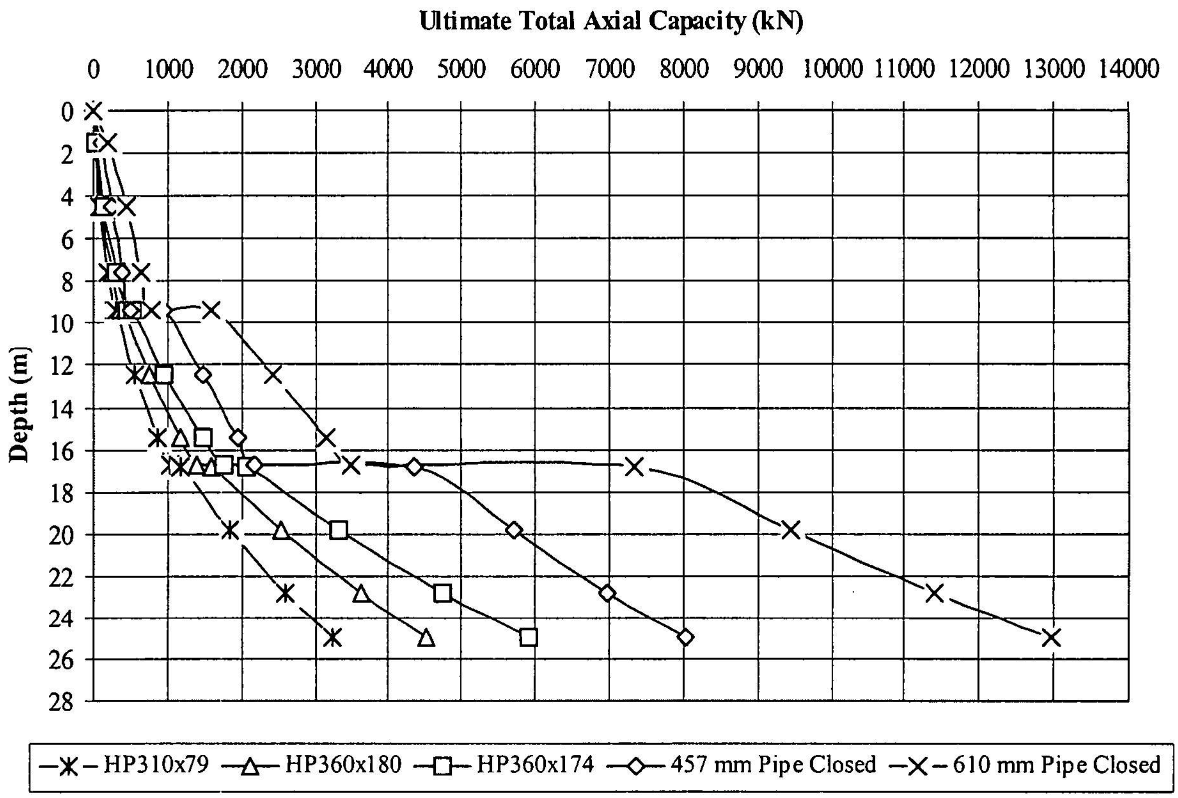


Figure 3 - Depth vs. Total Axial Capacity



Factor of Safeties applied to the ultimate values given above should be in accordance with Table 4.5.6.2A, Section 4.5.6.2 of the 17th Edition of the Standard Specification of Highway Bridges. Provided that the piles are founded in the siltstone/sandstone stratum, downdrag or group reduction factors are not required. Settlement of the pile embedded into the sandstone should be negligible. The structural engineer should verify the structural capacity of the piles for the design loads. Driving shoes should be placed on the pile tips to reduce the risk of installation damage while driving the pile into rock. An H-pile stinger or conical point may be placed on the end of the closed end of the pipe pile to help in installation of the piles. Pile construction and static load testing should be in accordance with FP-03, Section 551and SCR – 551.C. We recommend that one test pile should be installed at the location of each substructure unit to determine pile installation characteristics, evaluate pile capacity with depth, and to establish contractor pile order lengths. With the presence of the siltstone or sandstone layer, we would not anticipate that site lengths would differ significantly from what is recommended. We recommend that Wave equation analysis be utilized to determine drivability of the selected piles and also to monitor pile installation.

Lateral load parameters were developed for subsequent LPILE analyses. LPILE is a computer program that was developed by Dr. Lymon Reese, P.E. of the University of Texas at Austin, which utilizes a p-y curve finite difference technique of predicting the soil-structure interaction and response. Based on our interpretation of the subsurface strata and the results of the field and laboratory tests, the values shown in Table 11 may be used in the analysis for lateral loads. We note that the modulus values calculated from intact rock core samples were reduced to reflect the lowered stiffness of the rock mass, which includes discontinuities and weathered zones.

Table 11 – Summary of Lateral Load (LPILE) Parameters for Driven Piles

Depth m (ft.)	Soil Parameters				
	Model Type	**c / ϕ kPa (psi) / deg**	**K MN/m^3 (pci)**	**e_{50} mm/mm and in/in**	**γ kN/m^3 (pcf)**
0 – 1.52 (0 – 5)	Sand	0 (0) / 31	6.8 (25)	0.01	17.3 (110)
1.52 – 9.4 (5 – 30.8)	Sand, below water	0 (0) / 31	5.4 (20)	0.01	7.4 (47.6)
9.4 – 16.8 (30.8 – 55.1)	Sand, below water	0 (0) / 35	34 (125)	0.01	9.0 (57.6)
Rock Parameters					
Depth m (ft.)	**Model Type**	**UCS MPa (ksi)**	**$E_{rock\ mass}$ MPa (ksi)**	**e_{50} mm/mm and in/in**	**γ kN/m^3 (pcf)**
Below 16.8 (Below 55.1)	Weak rock	10 (1.45)	150 (21.8)	0.0005	19.6 (125)

If Wave-Equation Analysis is utilized for construction, Kleinfelder can provide the parameters necessary for input. However, this is beyond our scope of work for this project.

5.3.2 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 liquefactions 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 outlines 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) is 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. Down drag forces caused by liquefaction are expected to be negligible.

5.3.3 Stability of the Embankment

Drainage options 2a and 2b involve the construction of an earthen embankment across some or all of the wetlands. This embankment will range in height from 2.5 m (8.2 ft.) to 4 m (13.1 ft.) with a side slope inclination of 1:2 (V:H). To minimize cross contamination of wet, loose native soils with the fill materials and layer of geotextile may be placed in-between the native soils and the fill in accordance with FP-03, Section 207.04. The embankment was analyzed for failure within the bearing soils during and immediately following construction and for failure of the embankment during operation. Both analyses where completed using soil properties based on the consistency/density of the subsurface soils encountered during our field investigation. Once settlement has occurred the factors of safety during operation will increase, due to the increase in soil strength caused by consolidation. Table 12 summarizes the results of our analysis. As shown in Table 12, the wetlands embankment should be stable both during construction operations of the roadway and on a long-term basis.

Table 12 – Embankment Slope Stability

Embankment Height m (ft.)	Factor of Safety during Operation	Factor of Safety during Construction
2.5 m (8.2 ft.)	1.9	1.7
4 m (13.1 ft.)	1.6	1.5

5.3.4 Settlement of the Embankment

As stated previously, saturated, silty sand and silt soils were encountered in the upper 12 to 17 m (39.4 to 55.8 ft.) below the ground surface. These soils are very loose to loose in density and very soft to soft in consistency. A settlement analyses was completed for a 2.5 m (8.2 ft.) high and a 4 m (13.1 ft.) high embankment. Soil properties were calculated based on an average corrected blow count of 5 for the full depth of silty sand and silt soils (approximately 15.2 m (50 ft.)). Table 13 summarizes the results of our analysis. Additional settlement due to liquefaction is not expected.

Table 13 – Embankment Settlement

Embankment Height m (ft.)	Settlement mm (in.)
2.5 m (8.2 ft.)	168 (6.6)
4 m (13.1 ft.)	239 (9.4)

Due to the granular nature of the soils, we anticipate that the majority of the settlement will occur during construction. We did calculate the time it would take to consolidate the soils if the soils were primarily fine-grained. Based on these calculations, approximately 42.5 days (1.4 months) are required to reach 90 percent consolidation. Settlement should be monitored with settlement plates placed at 60 m (200-foot) spacings along the wetlands embankment. The placement of the arch culverts and pavement should not occur prior to reaching 90 percent of the settlement.

5.3.5 Embankment Construction

During the construction of the embankment, we recommend that temporary culverts consisting of corrugated metal pipe or the equivalent be placed in lieu of the permanent arch culverts. This will allow for the settlement to occur prior to the placement of the permanent arch culverts.

The embankment can be constructed to full height in one construction period. Construction of the embankment can take place in stages as the wetland area is crossed (i.e. construct from bank to 15 m (50 ft.) into wetland area, then construct from 15 m (50 ft.) in to 30 m (100 ft.) into the wetland area). As shown previously, the subgrade soils can support the full weight of the embankment prior to settling. The embankment should be allowed to settle to at least 90 percent prior to placing the permanent arch culverts or the roadway. Once 90 percent settlement has been reached, the temporary culverts should be removed and replaced with the permanent arch culverts. Bearing capacity and construction of the culverts is discussed in Section 5.3.

Prior to fill placement, vegetation, debris, and other organic materials should be removed throughout the proposed embankment. Organic material should be removed to within 610 mm (24 inches) of the surface of the area to receive fill to reduce the potential settlement due to decomposition of the organic material. Clearing and grubbing should be done in general accordance with FP-03, Sections 201 and 202, with the above recommendations taken into consideration.

After clearing and stripping operations are complete, exposed subgrade soils should be scarified to a minimum depth of 610 mm (24 in.) and compacted to at least 95 percent of the maximum dry density as determined by AASHTO T-99, method C. Groundwater may be encountered at or above the ground surface. Prior to placement of the geogrid, the subgrade should be uniform and free of mounds or depressions.

The wetlands embankment fill should consist of select borrow meeting the requirements of FP-03, Section 704.07. The liquid limit of the select borrow should not exceed 30. The material should meet the following gradation requirements.

Sieve Size (Square Openings)	Percent Passing by Weight
76 mm (3 in.)	100
25 mm (1 in.)	70 – 100
4.75 mm (No. 4)	30 – 70
0.075 mm (No. 200)	0 – 5

Fill material should be placed and compacted in general accordance with Section 5.8.4, which references the appropriate FP-03 section.

5.4 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.

5.4.1 Wetlands Embankment Culverts

We understand arch culverts supported on strip footings will be used to provide flow pathways for the wetlands through the embankment. As discussed previously, prior to the placement of the arch culverts the embankment should be constructed using temporary corrugated metal pipe culverts or the equivalent. The temporary culverts should be placed at the same locations as the arch culverts. The embankment should be allowed to settle at least 90 percent before the temporary culverts are removed and replaced with the permanent arch culverts.

When the temporary culverts are removed, the area should be scarified and recompacted to a depth of 0.6 m (2 ft.) below the toe of the embankment. This will provide a uniform building

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pad on which to support the arch culverts. The strip footings used for the arch culverts may be designed based on an allowable bearing capacity of 71.8 kilo-Pascals (kPa, 1,500 pounds per square foot, psf). The strip footings should have a minimum width of 0.3 m (1 ft.). The temporary culverts can be designed based on a bearing capacity of 47.9 kPa (1,000 psf). Foundations should be placed a minimum of 1 meter (3.28 feet) below adjacent ground to protect against frost. Scour depth should be determined in accordance with the anticipated flows and gradations performed on the near surface soils at the locations of the proposed culverts.

5.4.2 Roadway Culverts

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 5.7.

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.

5.5 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 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.

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 –

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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.

As previously summarized in Table 1, six 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 F), 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
2+700	2+760	2+720	4.0 (13.1)	1:2	4.9 (16.1)	3.1 (10)	4.9 (16.1)	1.0 * H
4+220	4+240	4+220	6.3 (20.7)	1:2	7.6 (25)	4.5 (15)	7.6 (25)	1.0 * H
4+840	4+920	4+900	8.0 (26.2)	1:3	8.0 (26.2)	2.0 (6.5)	5.7 (18.7)	0.7 * H

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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
6+120	6+140	6+140	5.1 (16.7)	1:4	5.1 (16.7)	1.5 (5)	3.6 (11.7)	0.7 * H
7+060	7+220	7+140	4.5 (14.8)	Flat	4.5 (14.8)	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+700	2+760	1.6	1.4	2.5	2.1
4+220	4+240	1.5	1.3	2.5	2.1
4+840	4+920	1.3	1.1	2.8	2.0
6+120	6+140	1.6	1.4	3.6	2.3
7+060	7+220	1.9	1.7	3.7	2.4

<u>Sta. 2+700 to Sta. 2+760:</u> Based on the very loose to loose silty sand encountered near the base of the proposed wall in Boring MSE-1, 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.

<u>Sta. 4+220 to Sta. 4+240:</u> Very loose to loose silty sand was encountered in the upper meter of boring MSE-2, 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+840 to Sta. 4+920: Based on the soft silt and medium dense silty sands encountered in borings MSE-3 and MSE-4, 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.

Sta. 6+120 to Sta. 6+140: Medium dense silty sands were encountered in boring MSE-5, which was completed at the crest of the planned 5.1 m (16.7 ft) MSE wall. Groundwater was encountered at a depth of about 3.1 m (10 ft) below the proposed toe of the wall. 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 wall geometry with a 1.5 m (5 ft.) bench below the base of the wall followed by a 1:4 (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.

Sta. 7+060 to Sta. 7+140: Based on the post 30 percent drawing, this wall has been removed. However, the design for the MSE wall in this section has been included as an alternative to the cut slope, which is unstable as discussed in Section 5.5. Medium dense silty sands were encountered in borings MSE-6 and MSE-7, which was 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.

5.5.1 Site Preparation

Surface preparation and subgrade preparation should be conducted in accordance with sections 5.8.1 and 5.8.2 of this report. The MSE walls should be constructed in accordance with the SCR, Section 255. Select granular fill should be used as the reinforced backfill material. Onsite soils may be used if they classify as an A-2-4 material or better. Meaning the percent passing the #200 sieve should not exceed 35, the liquid limit should not exceed 40, and the plasticity index should not exceed 10. In addition, the material should have a minimum friction angle of 34 degrees, when compacted in accordance with Section 5.8.4. The wall designer should take this material type into consideration for drainage and durability when designing the MSE walls. As an alternative, the contractor may import select backfill meeting the FP-03, Section 704.10 specifications for the MSE walls.

5.5.2 Constructability of the MSE Walls

The MSE wall sections were analyzed for the short-term stability of the cut slopes required for the construction of the MSE walls. A friction angle of 30 degrees and cohesion of 2.4 kPa (50 psf) was modeled for the exposed soil. A factor of safety of slightly more than 1 was used. Based on these parameters, the following general recommendations apply for temporary cuts used during construction only.

1. For H = 0 to 4.6 m (0 to 15 ft.), Max. cut inclination = 1:1 (V:H)
2. For H = 4.6 to 9.1 m (15 to 30 ft.), Max. cut inclination = 1:1.25 (V:H)
3. For H = 9.1 to 12.2 m (30 to 40 ft.), Max. cut inclination = 1:1.5 (V:H)

5.6 CUT AND FILL SLOPE STABILITY

Prior to selecting "critical" sections for slope stability and settlement analyses, we reviewed roadway design drawings, boring logs, and laboratory tests results. We selected critical sections after considering the over-all height of the each embankment or cut, the amount and thickness of new fill where applicable, and the relative density or relative stiffness of the underlying soils. A total of 20 cut slope sections and 7 fill slope sections were selected for analysis. Critical slopes were identified as having a minimum inclination of 1:2 (V:H), a minimum slope height of about 4.6 m (15 ft.), and a new fill thickness of 1.5 m (5 ft.) or greater. In areas where there were multiple cross sections with slope heights greater than about 4.6 m (15 ft.) and/or fills greater than 1.5 m (5 ft.) in depth, the section with the highest slope was selected for analysis. No slope stability analyses were performed for slopes constructed at a height of less than 4.6 m (15 ft.) within reasonably good soils. Based on the relative uniformity of the soils encountered across the alignment these slopes are considered stable. The exception is slopes having an inclination steeper than 1:2 (V:H). These slopes were analyzed on a case-by-case basis.

5.6.1 Cut Slope Stability

We evaluated each of the critical sections independently using available site-specific data. Table 16 summarizes the results of our cut slope stability analyses.

Table 16 – Summary of Cut Slope Stability Analyses

Station Limits	Height m (ft)	Critical Station	Critical Height m (ft)	Proposed Slope Inclination (V:H)	Factor of Safety	
					Static	Seismic
1+880R to 1+960R	4 – 9.6 (13.1 – 31.5)	1+920R	9.6 (31.5)	1:2	1.7	1.4

Table 16 – Summary of Cut Slope Stability Analyses

Station Limits	Height m (ft)	Critical Station	Critical Height m (ft)	Proposed Slope Inclination (V:H)	Factor of Safety	
					Static	Seismic
2+020R to 2+220R	1.4 – 8.8 (4.6 – 28.9)	2+120R	8.8 (28.9)	1:2	1.8	1.5
2+440L to 2+540L	1.8 – 8.1 (5.9 – 26.6)	2+500L	8.1 (26.6)	1:2	1.6	1.4
2+600L to 2+720L	3.1 – 13 (10.2 – 42.7)	2+660L	13 (42.7)	1:2	1.6	1.4
2+960L to 3+120L	1.9 – 5.4 (6.2 – 17.7)	3+060L	5.4 (17.7)	1:2	1.8	1.5
3+200L to 3+260L	2 – 6.4 (6.6 – 21)	3+260L	6.4 (21)	1:2	1.8	1.5
3+360L to 3+500L	3 – 5 (9.9 – 16.4)	3+420L	5 (16.4)	1:2	1.9	1.7
3+660L to 3+700L	4.4 – 6.9 (14.4 – 22.7)	3+660L	6.9 (22.7)	1:2	1.7	1.5
3+780L to 3+920L	0.5 – 6.4 (1.6 – 21)	3+820L	6.4 (21)	1:2	2.7	2.3
4+100L to 4+200L	3.4 – 16.3 (11.2 – 53.5)	4+140L	16.3 (53.5)	1:1.5	1.4	1.2
4+240L to 4+420L	2.8 – 15.4 (9.2 – 50.6)	4+280L	15.4 (50.6)	1:2	1.9	1.6
4+540L/R to 4+680L/R	1.7 – 6.4 (5.6 – 21)	4+640L	6.4 (21)	1:2	2.4	2.1
4+740L to 4+900L	1.4 – 7.5 (4.6 – 24.6)	4+860L	7.5 (24.6)	1:1	1.1	1.0
5+020L to 5+080L	2 – 7 (6.6 – 30)	5+060L	7 (30)	1:2	2.2	1.9
5+120L to 5+280L	1.5 – 5.6 (4.9 – 18.4)	5+240L	5.6 (18.4)	1:2	2.4	2.1
6+640L to 6+740L	3 – 10.8 (9.8 – 35.4)	6+700L	10.8 (35.4)	1:1.5	1.3	1.2
6+800L to 6+900L	3 – 5.8 (9.8 – 19)	6+840L	5.8 (19)	1:2	2.0	1.7
6+940L to 6+960L	2 – 4.2 (6.6 – 13.8)	6+940L	4.2 (13.8)	1:2	2.2	1.9

Table 16 – Summary of Cut Slope Stability Analyses

Station Limits	Height m (ft)	Critical Station	Critical Height m (ft)	Proposed Slope Inclination (V:H)	Factor of Safety	
					Static	Seismic
7+060L to 7+200L	2.8 – 21.8 (9.2 – 71.5)	7+140L	21.8 (71.5)	1:1	0.8	0.7
7+260L to 7+300L	2.8 – 6.3 (9.2 – 20.7)	7+260L	6.3 (20.7)	1:2	1.8	1.5

As shown in Table 16, the cut slopes analyzed between 4+740L to 4+900L and 7+060L to 7+200L do not have acceptable factors of safety (at least 1.3 for static and 1.1 for seismic). We recommend these slopes be reevaluated. Possible alternatives include

1. Using a MSE walls in conjunction with a 1:1 (V:H) slope, or
2. Flattening the slopes to 1:1.5 (V:H); or
3. Placing a retaining wall or soil nail wall along the base of the cut slope side.

If a MSE wall on the right side of the roadway is used in conjunction with a cut slope on the left side of the roadway, a slope inclination of 1:1 (V:H) should be limited to a slope height of 4.6 m (15 ft.) or less. Additionally, the MSE wall may be coupled with a 1:1.5 (V:H) cut slope, which would allow for greater slope height.

We understand that flattening the slopes to 1:1.5 (V:H) would cause the slopes to extend the height of the existing slopes. However, the use of a 1:1.5 (V:H) cut slope in conjunction with a MSE wall along the right side of the road or a retaining wall placed at the toe of the cut slope would reduce the height of the cut.

Alternatively, a retaining wall or soil nail wall may be used instead of a significant cut slope. As stated previously, a retaining wall or soil nail along the left side can be used in conjunction with a MSE wall on the right side or a 1:1 or 1:1.5 (V:H) cut slope extending from the top of the wall.

Kleinfelder should review whichever alternative is selected prior to the alternative being approved for construction.

5.6.2 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 (ϕ) of 32 degrees and cohesion of 2.4 kPa (50 psf). Table 17 summarizes the results of our fill slope stability analyses.

Table 14 – 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+560R to 2+620R	1.8 – 4.9 (5.9 – 16.1)	2+620R	4.9 (16.1)	1:2	1.7	1.4
2+780R to 2+800R	2.5 – 4.6 (8.2 – 15.1)	2+780R	4.7 (15.1)	1:2	1.7	1.5
3+140R to 3+340R	0.6 – 6.4 (2 – 21)	3+240R	5 (21)	1:2	1.6	1.4
3+940R/L to 4+080R/L	2.8 – 10 (9.2 – 32.8)	4+060R	10 (32.8)	1:2	1.7	1.4
4+160R to 4+200R	0 – 12.4 (0 – 40.7)	4+160R	12.4 (40.7)	1:2	1.6	1.3
4+700R to 5+060R[1]	0 – 6 (0 – 19.7)	4+820R	6 (19.7)	1:2	1.7	1.5
6+000R to 6+160R[2]	0.8 – 7.5 (2.6 – 24.6)	6+160R	7.5 (24.6)	1:2	1.7	1.4

Notes:

1. Excluding station 4+840 to 4+920, where an MSE wall is proposed. MSE walls are discussed in Section 5.4.

2. Excluding station 6+120 to 6+140, where an MSE wall is proposed. MSE walls are discussed in Section 5.4.

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.

5.6.3 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. Fifteen 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+560R to 2+620R	1.8 – 4.9 (5.9 – 16.1)	0.6 – 1.1 (2 – 3.6)	2+620R	4.9 (16.1)	1.1 (3.6)	23 (0.9)
2+780R to 2+800R	2.5 – 4.6 (8.2 – 15.1)	0.3 – 2.1 (1 – 7)	2+780R	4.7 (15.1)	2.1 (6.9)	48 (1.9)
3+140R to 3+340R	0.6 – 6.4 (2 – 21)	1 – 3.1 (3.3 – 10.2)	3+240R	5 (21)	3.1 (10.2)	66 (2.6)
3+940R/L to 4+080R/L	2.8 – 10 (9.2 – 32.8)	1.7 – 8.4 (5.6 – 27.6)	4+060R	10 (32.8)	8.4 (27.6)	135 (5.3)
4+160R to 4+200R	0 – 12.4 (0 – 40.7)	0 – 1.2 (0 – 3.9)	4+160R	12.4 (40.7)	1.2 (3.9)	30 (1.2)
4+700R to 5+060R	0 – 6 (0 – 19.7)	0 – 2.9 (0 – 9.5)	4+820R	6 (19.7)	2.9 (9.5)	89 (3.5)
6+000R to 6+160R	0.8 – 7.5 (2.6 – 24.6)	0.4 – 3.4 (1.3 – 11.2)	6+160R	7.5 (24.6)	3.4 (11.2)	66 (2.6)

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+080R/L and 4+700R to 5+060R), it is estimated that 90 percent settlement will occur in less than 1 month after the completion of the slope.

5.7 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

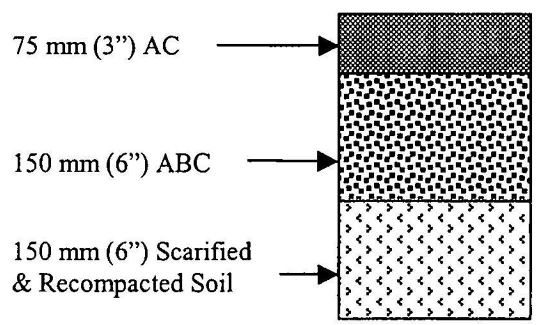
We calculated a growth rate of 2% based on the average daily traffic counts for 2002 and 2026. Based on the above values, total design Equivalent Single Axle Loads (ESAL's) were computed to be 108,595.

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-1, B-3, B-5, B-10 through B-13, and MSE-1. 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 19. 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 19 – Summary of R-value Test Results

Boring	Depth	R-Value
B-1	0 to 1.5 m (5 ft.)	51
B-3	0 to 1.5 m (5 ft.)	51
B-5	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-1	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.

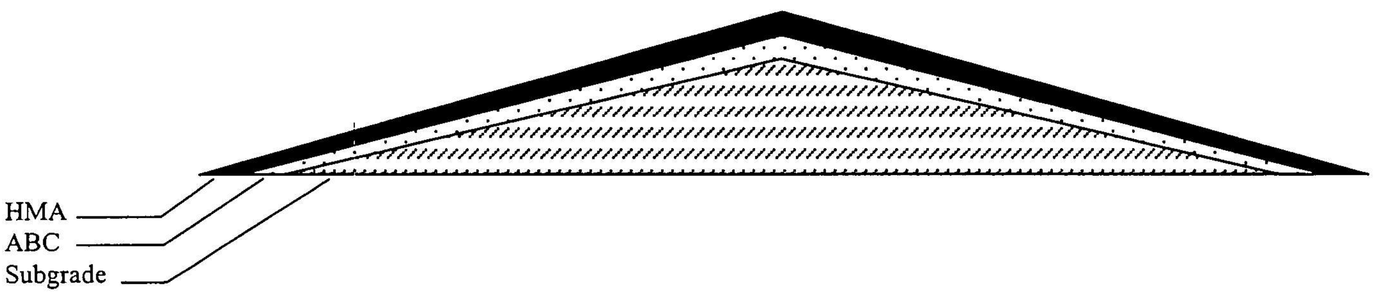
The following sections provide recommendations for the subgrade, aggregate base course, and asphalt.

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

5.7.1 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 indications a high potential for frost heave, due to the fines consisting of silt and the relatively dry weather conditions of the area, we do 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 as shown in the following figure.



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 located unstable areas. The proof rolling operations should be observed by a geotechnical engineer or his representative.

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There will be shrinkage losses when excavating and compacting the on-site soils and crushed tuff. For design estimates, we anticipate that shrink/swell from bank yards to compacted yards for soil and weathered tuff materials will be less than 5% shrink/swell.

5.7.2 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. We understand Parsons, Brinkerhoff, Quade, and Douglas will identify possible aggregate suppliers.

5.7.3 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.

5.8 EARTHWORK

The following sections address the earthwork necessary for construction. However, the construction of the fill embankments within the wetlands will require different specifications, due to shallow groundwater. Refer to section 5.3.5 for specifications relating to the construction of embankments within the wetlands.

5.8.1 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.

5.8.2 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 5.8.4, "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 located unstable areas. The proof rolling operations should be observed by a geotechnical engineer or his representative.

5.8.3 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 was 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 5.8.4, "Compaction Requirements".

5.8.4 Compaction Requirements

We recommend that structural fill be spread in layers not exceeding 200 mm (8 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).

5.8.5 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.

5.8.6 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.

5.8.7 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.

5.9 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 water and sewer lines to reduce the possibility of leaks.

5.10 Construction Considerations

Based upon the information collected from the twenty-four exploratory boring drilled for the project, the soils to be encountered during earthwork operations are only slightly cemented and the tuff bedrock is considered to be soft and can be excavated with normal earthmoving equipment. The results of the seismic refraction lines are included in Appendix E. 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. There will be shrinkage losses when excavating and compacting the on-site soils and crushed tuff. For design estimates, we anticipate that shrink/swell from bank yards to compacted yards for soil and weathered tuff materials will be less than 5% shrink/swell.

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.

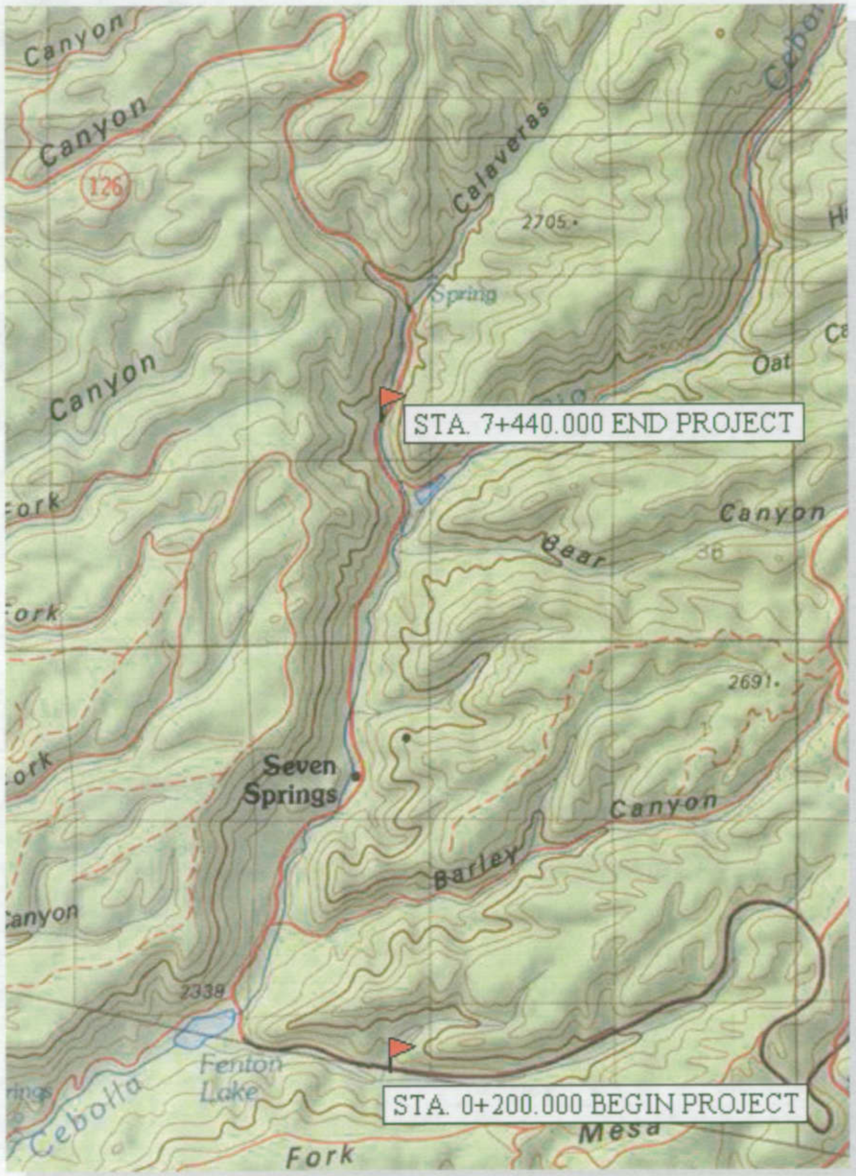
Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference" as that latter term is used relative to contracts or other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

The field investigation consisted of a surface reconnaissance and subsurface exploration including drilling exploratory borings and excavation test pits. We drilled 24 exploratory borings and logged them to depths ranging from about 1.8 to 18.4 m (6 to 60.3 ft.) below existing grade. 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.13.



Notes:
1. All boundaries and locations are approximate
2. Drawing Not to Scale

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Drawn By: C. Landon
Project No: 35321

Date: January 2004
Filename: Figure 1

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

FIGURE
A.1

G:\Geotech\Projects\35321 Cuba-LaCueva\Figures

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 4/12/04

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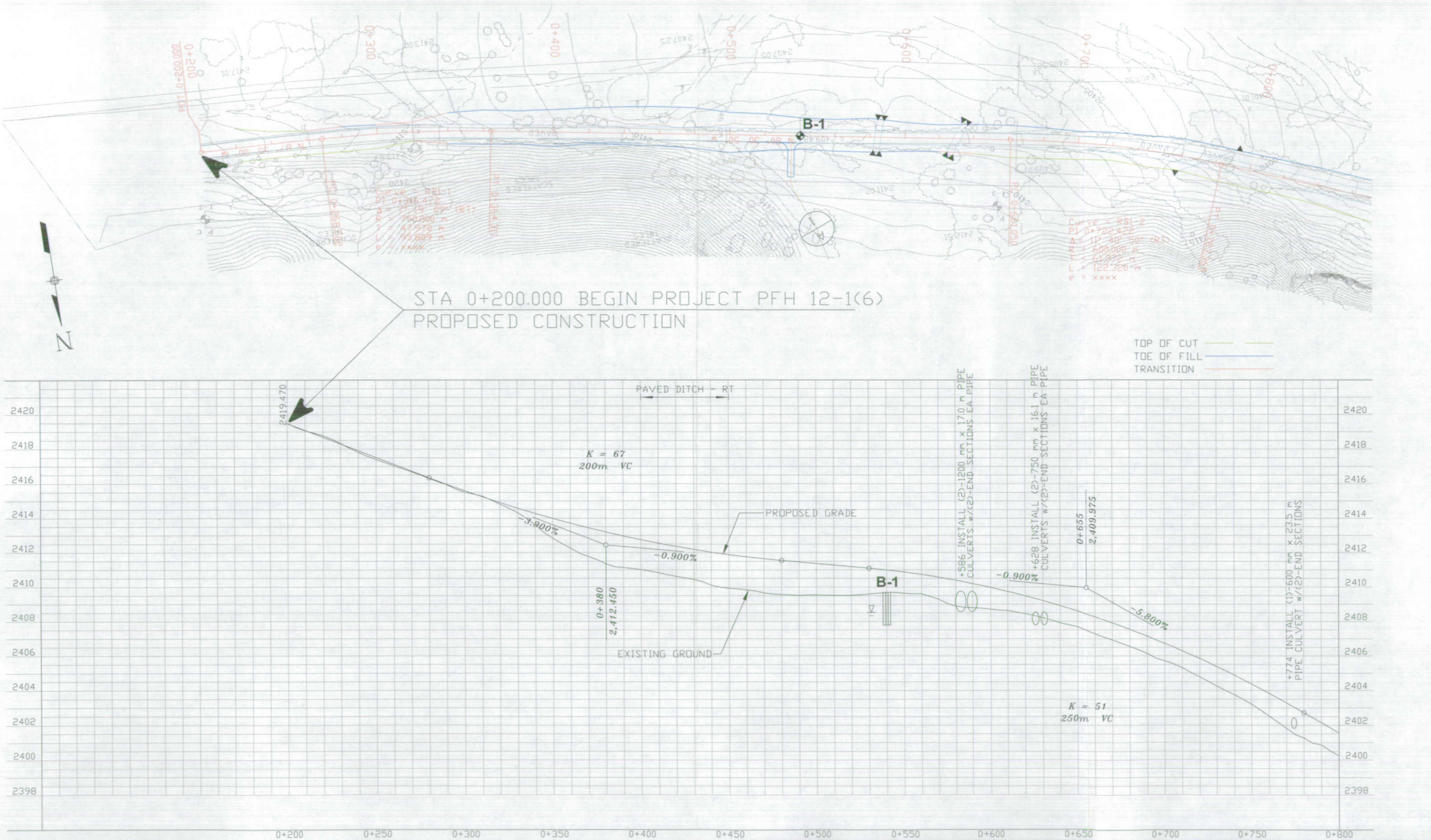
New Mexico Forest Highway 12
New Mexico State Highway 126
Cuba-LaCueva, New Mexico

Soil Classification Legend

FIGURE **A.2**



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Drawn By: C. Landon

Project No.: 35321

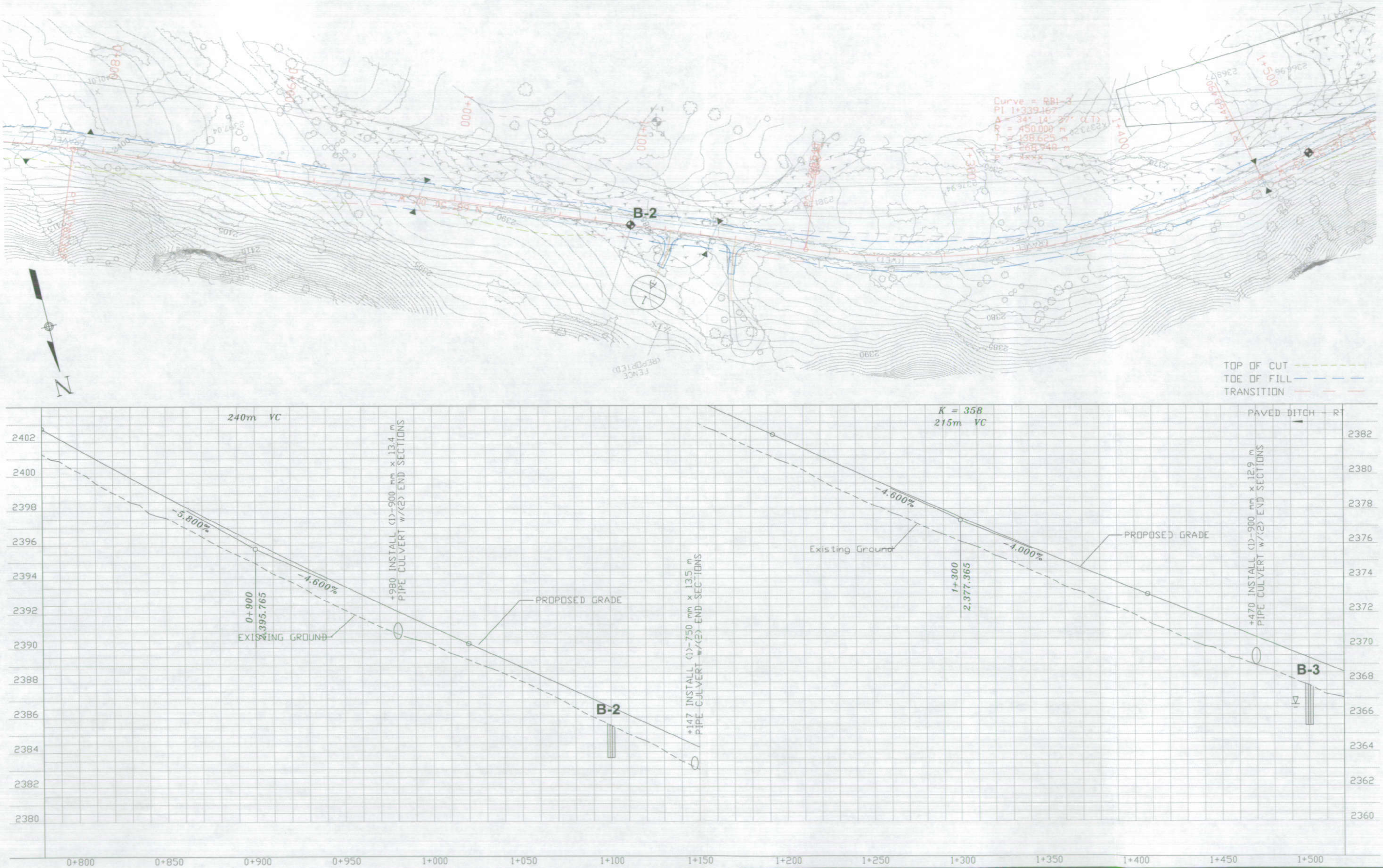
Date: February 2004

Filename: Figure A.3

SITE LOCATION MAP
Boring B-1
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE

A.3



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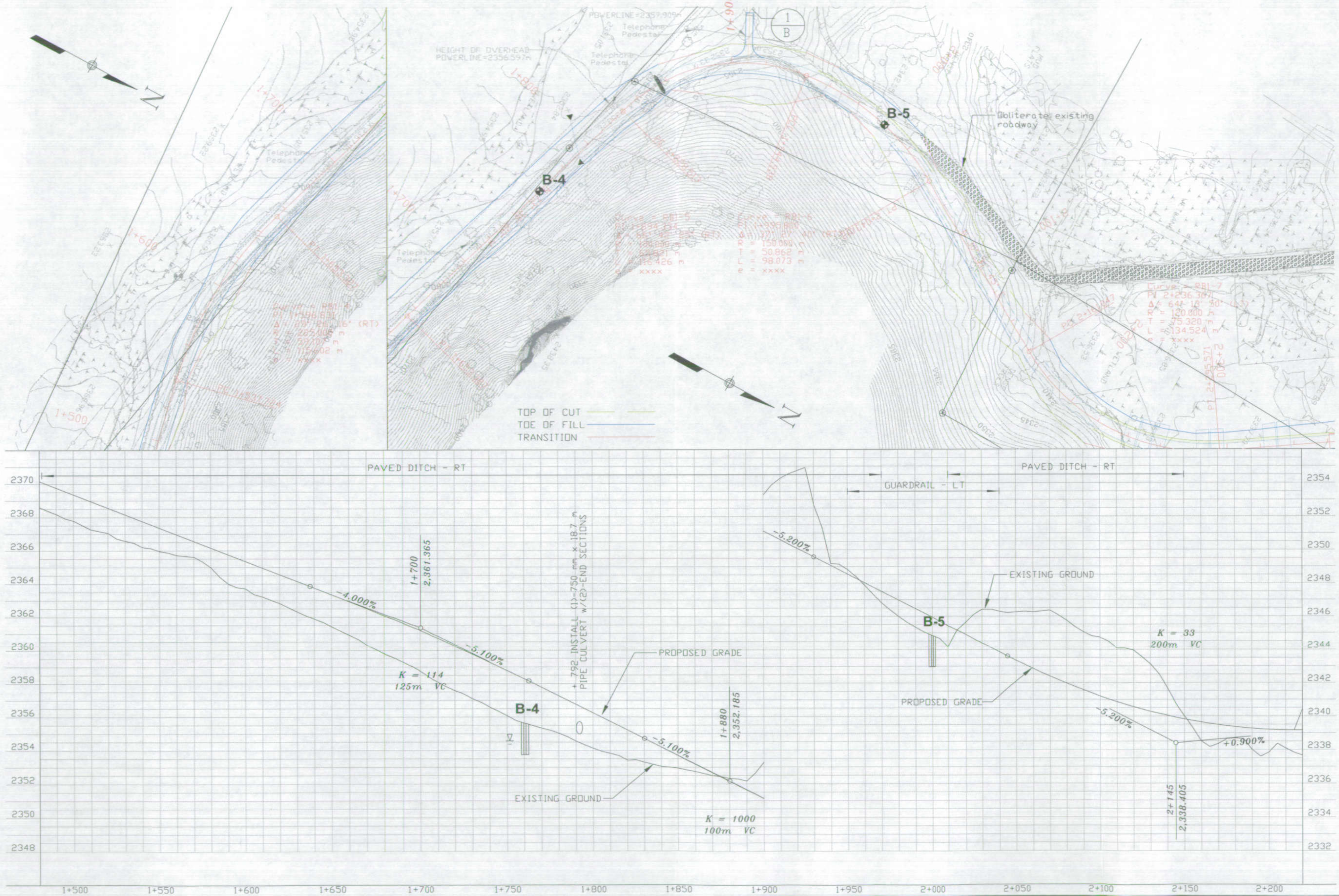
Drawn By: C. Landon
Project No.: 35321
Date: January 2004
Filename: Figure A.4

SITE LOCATION MAP
Borings B-2 & B-3
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.4



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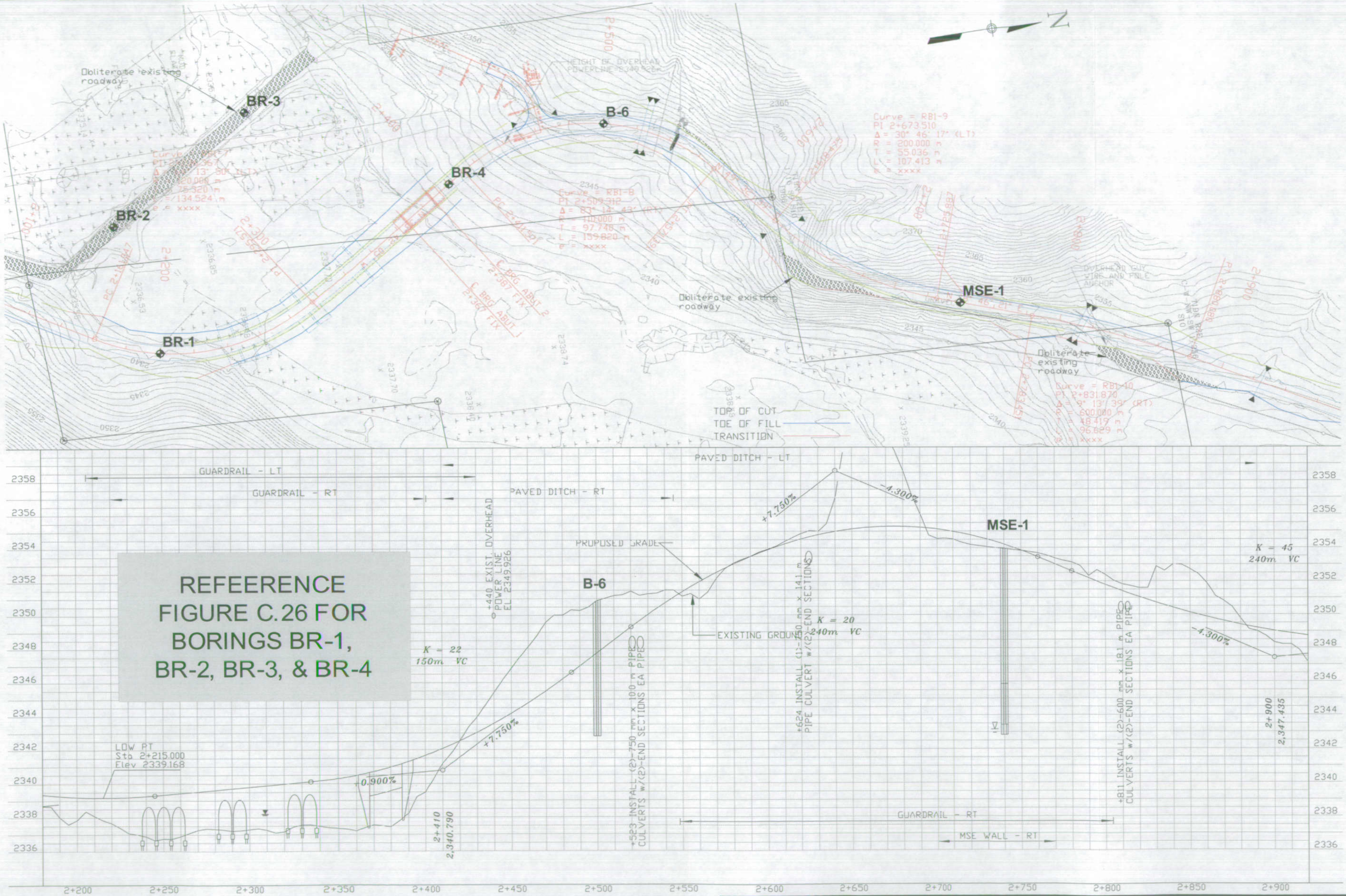
Drawn By: C. Landon	Date: February 2004
Project No.: 35321	Filename: Figure A.5

SITE LOCATION MAP
Borings B-4 & B-5
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.5



KLEINFELDER

Drawn By: C. Landon

Project No.: 35321

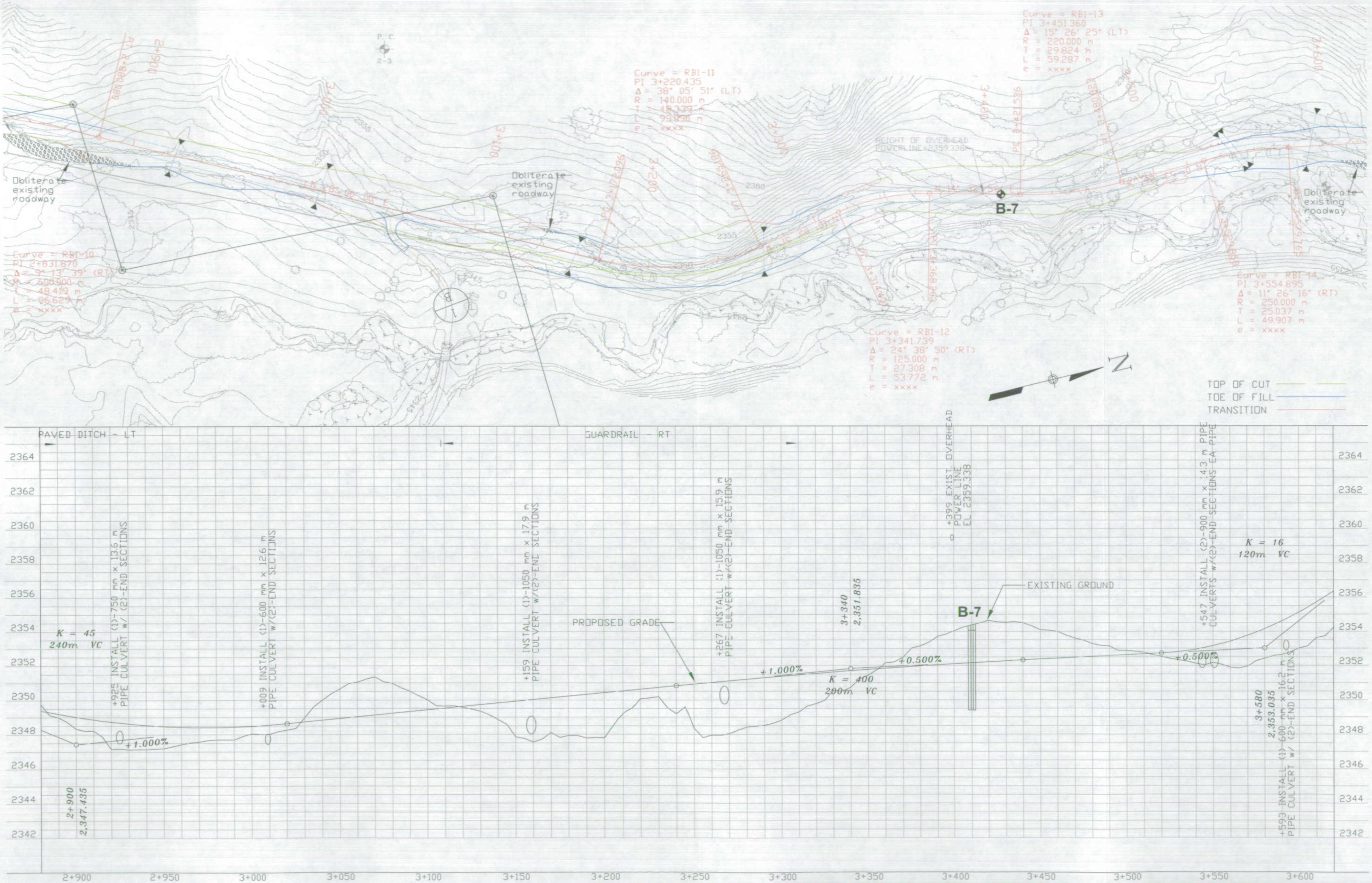
Date: February 2004

Filename: Figure A.6

SITE LOCATION MAP
Borings BR-1, BR-2, BR-3, BR-4, B-6, & MSE-1
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE

A.6



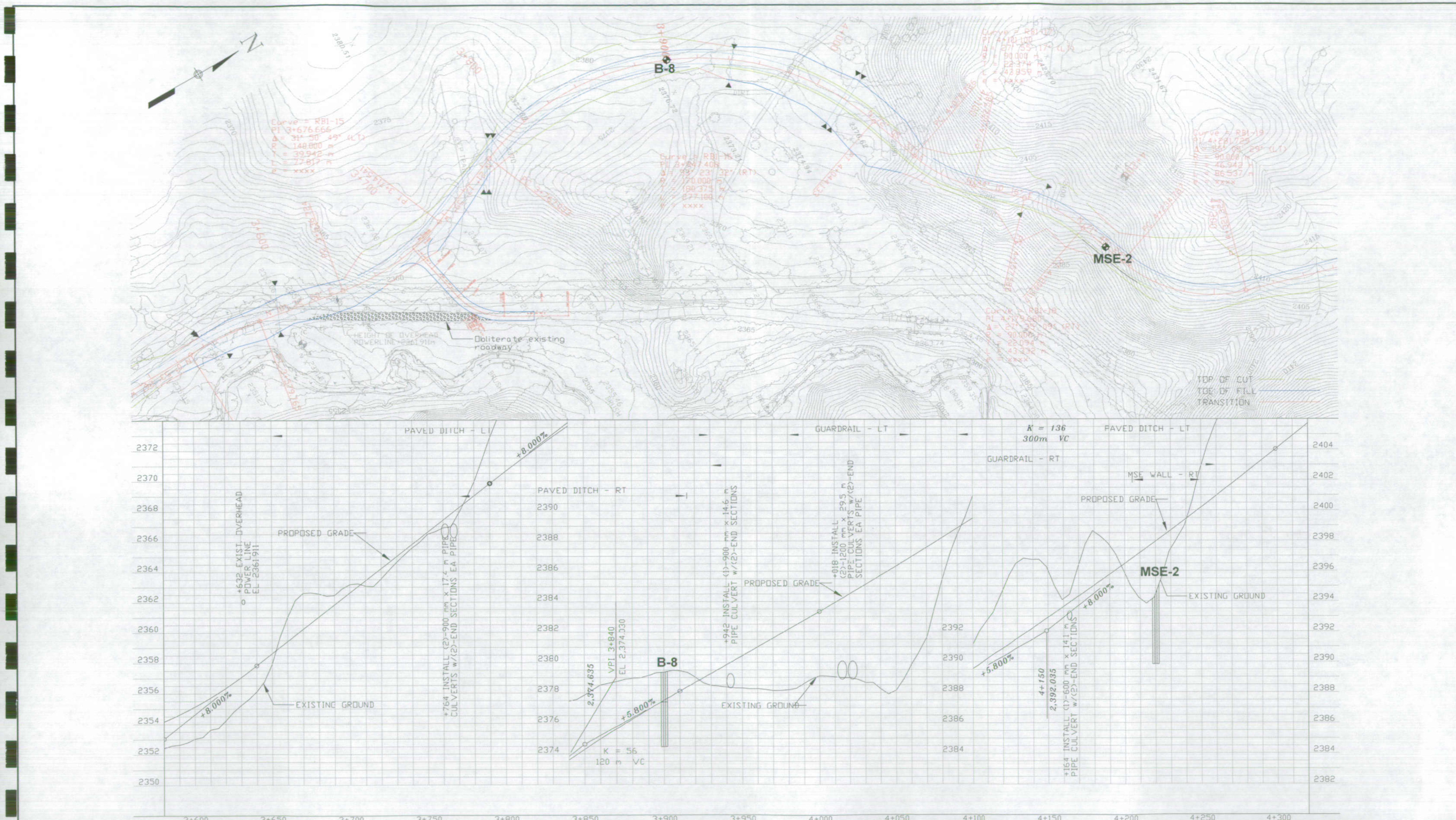
KLEINFELDER

Drawn By: C. Landon | Date: February 2004

Project No.: 35321 | Filename: Figure A.7

SITE LOCATION MAP
Boring B-7
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.7



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Drawn By: C. Landon

Project No.: 35321

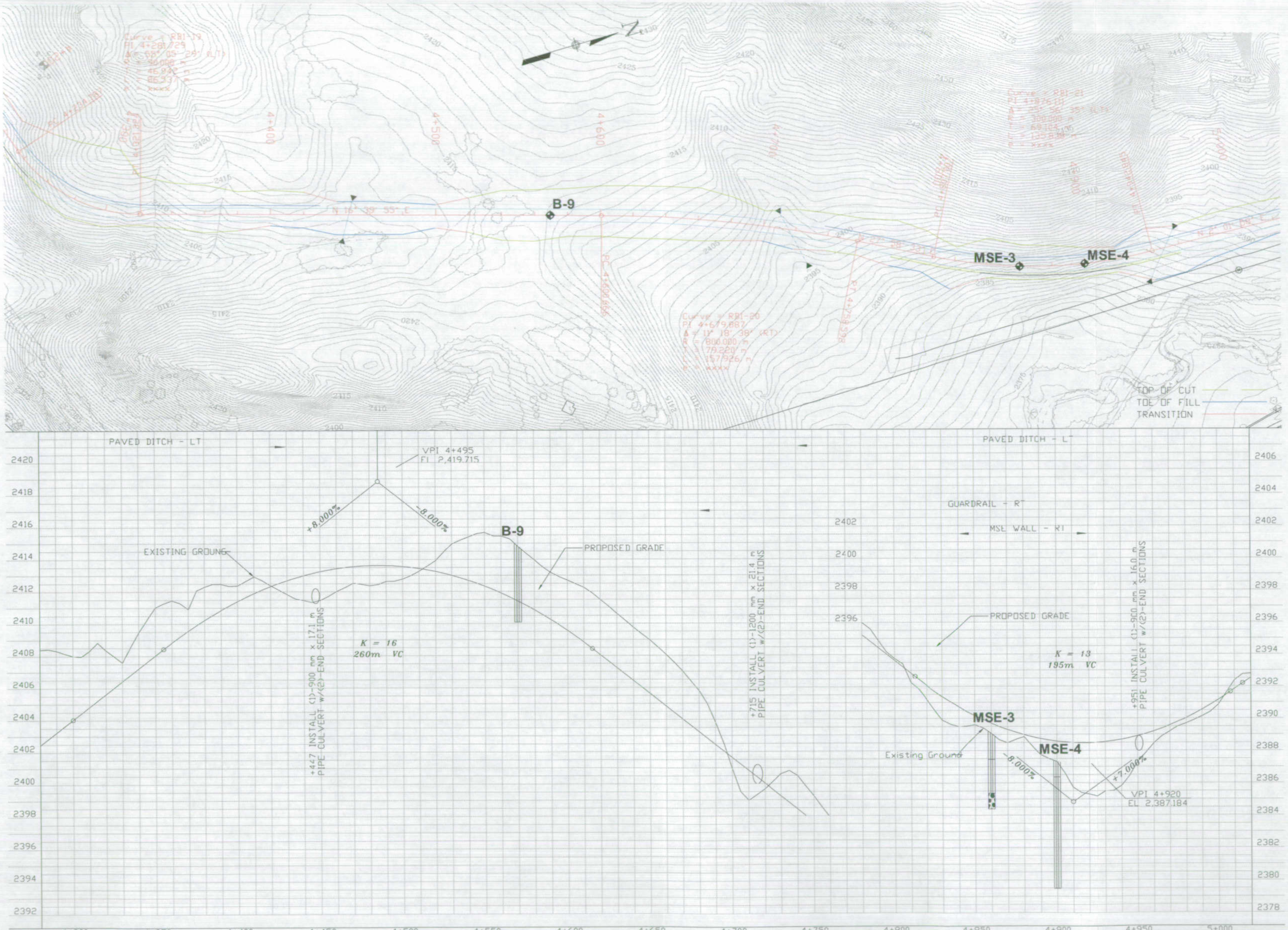
Date: February 2004

Filename: Figure A.8

SITE LOCATION MAP
Borings B-8 & MSE-2
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE

A.8



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Drawn By: C. Landon

Project No.: 35321

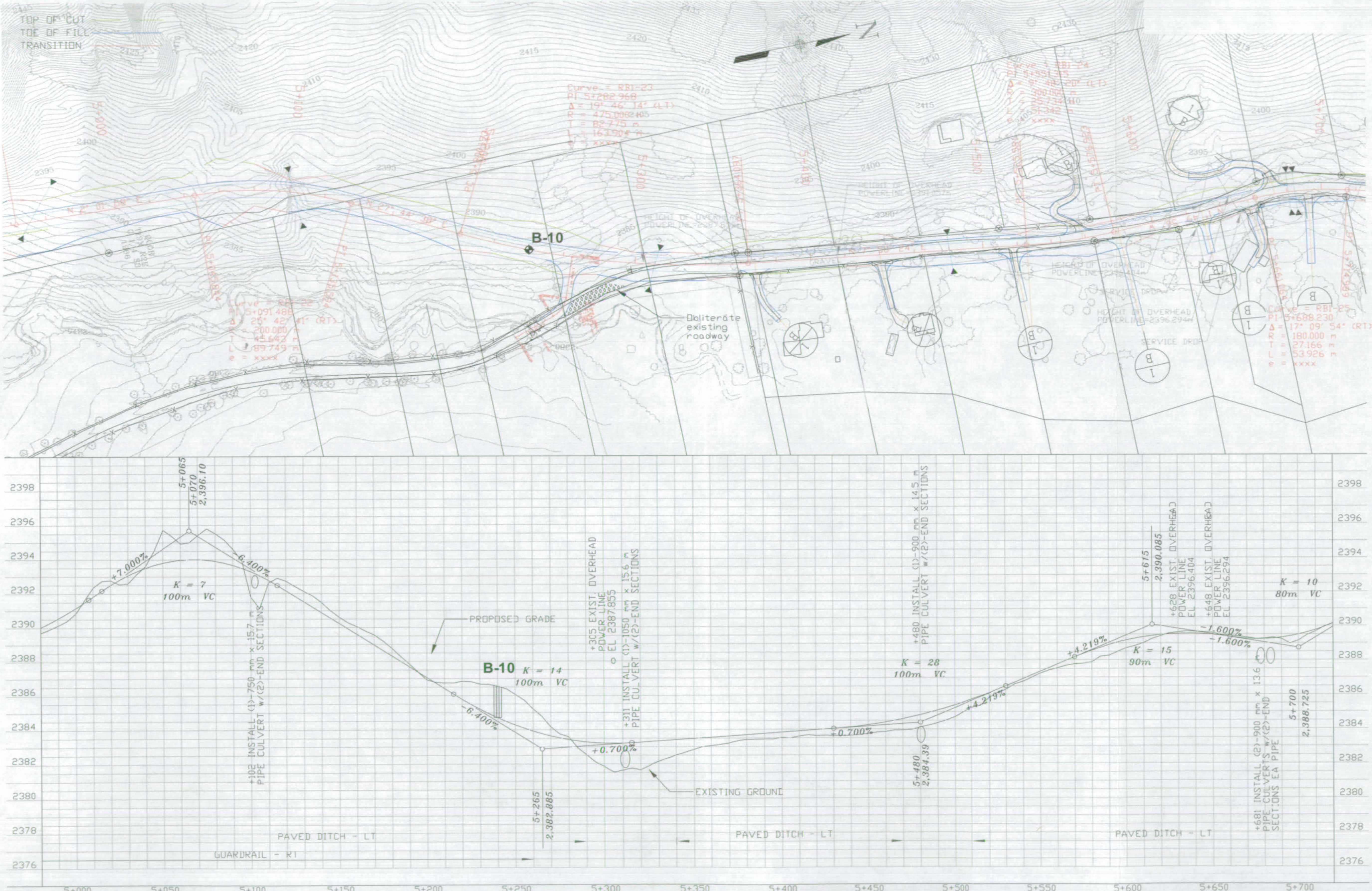
Date: February 2004

Filename: Figure A.9

SITE LOCATION MAP
Borings B-9, MSE-3, & MSE-4
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE

A.9



KLEINFELDER

Drawn By: C. Landon

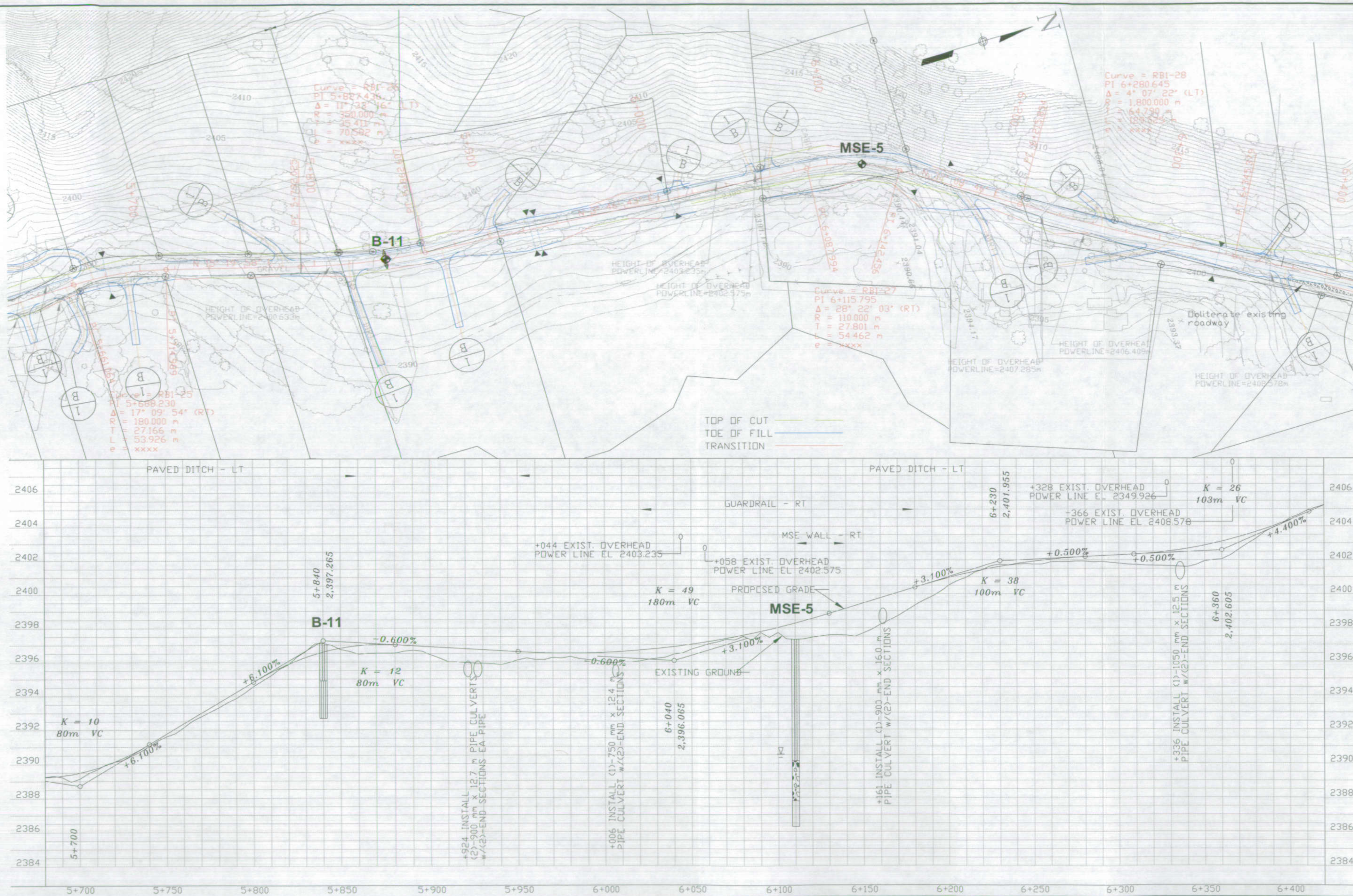
Project No.: 35321

Date: February 2004

Filename: Figure A.10

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

FIGURE
A.10

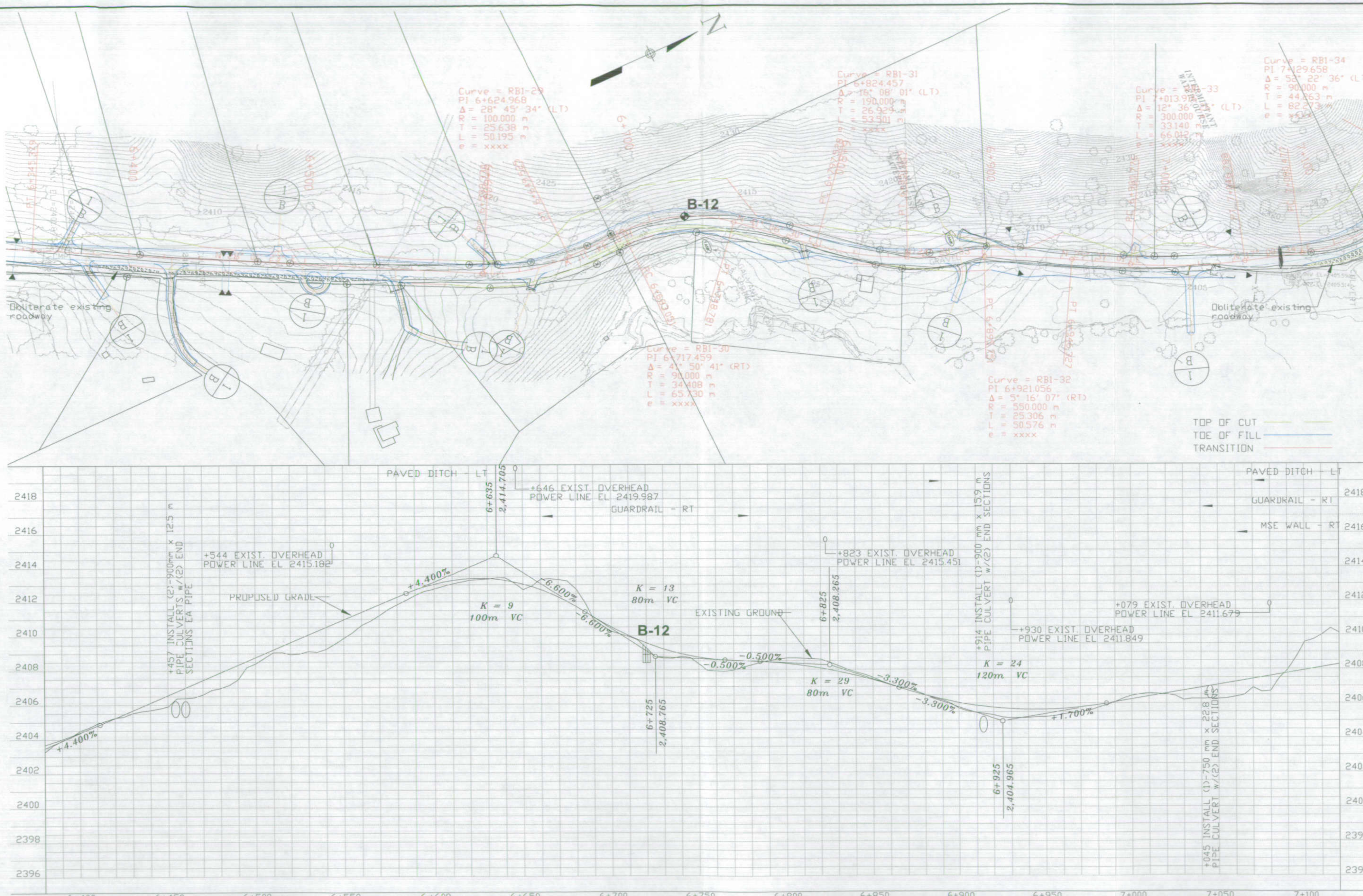


KLEINFELDER

Drawn By: C. Landon | Date: February 2004
Project No.: 35321 | Filename: Figure A.11

SITE LOCATION MAP
Borings B-11 & MSE-5
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
A.11

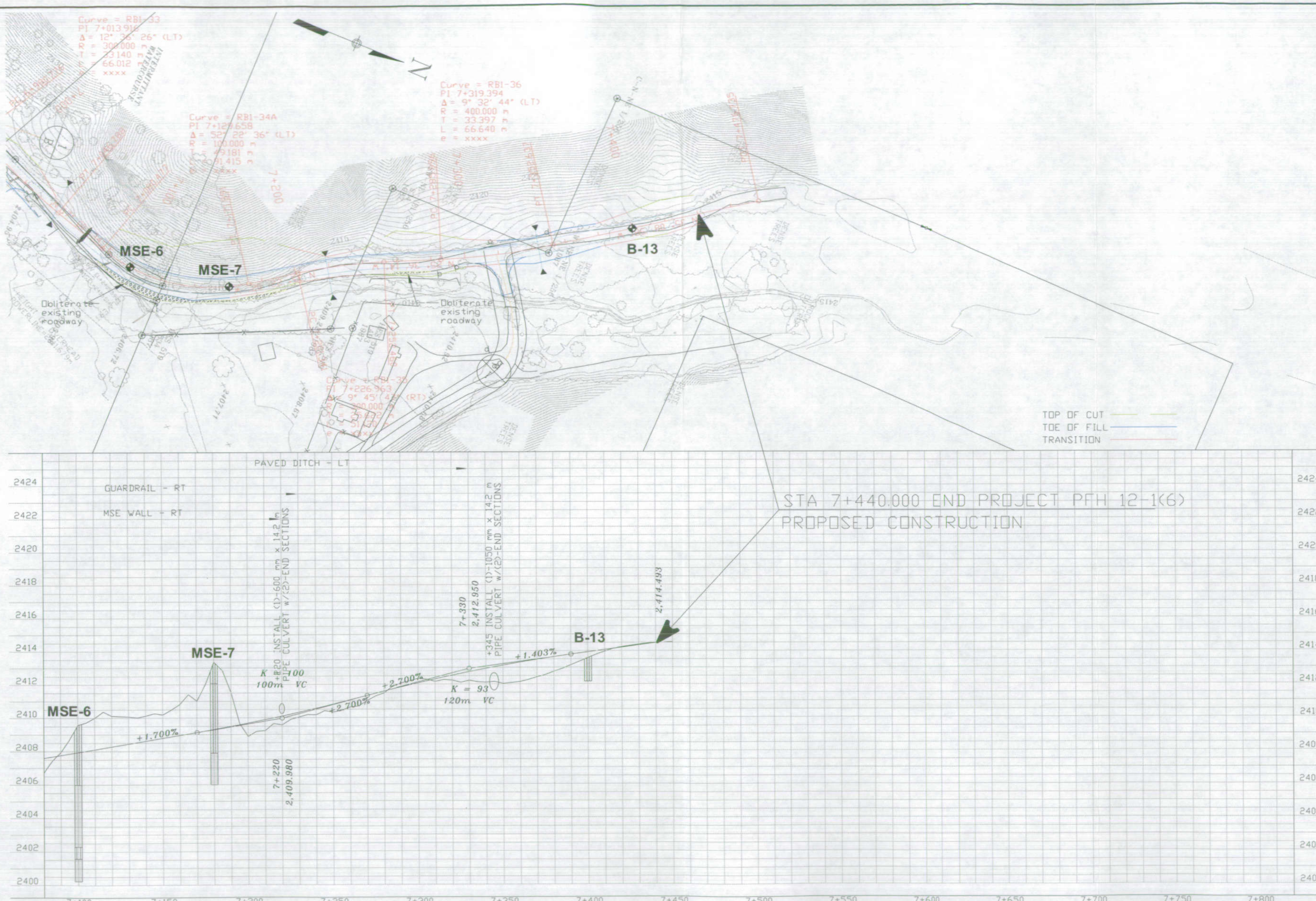


KLEINFELDER

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

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

FIGURE
A.12



KLEINFELDER

Drawn By: C. Landon

Date: February 2004

Project No.: 35321

Filename: Figure A.13

SITE LOCATION MAP
Borings MSE-6, MSE-7, & B-13
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE

A.13

Appendix B

APPENDIX B
Boring Logs

Exploratory drilling of borings B-1 through B-8, B-11 through B-13, BR-2, BR-3, MSE-1, and MSE-5 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-1, BR-4, MSE-2, B-9, MSE-3, MSE-4, B-10, MSE-6, and MSE-7 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	35321	NM State Highway 126	B-1
	Completed: 10/21/2003			
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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		NP	NV	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-2
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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 Started: 10/24/2003	**Project Number**	**Project**	**Boring No.**
Completed: 10/21/2003	35321	NM State Highway 126	B-3
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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	11	12.6		NP	NV	25	SILTY SAND (SM) - gray-brown, moist, medium dense, fine to coarse grained sand, with gravel, uncemented.
▽ (0.9)			X	SPT	12						
	1		X	SPT	7						1.1 m (3.5') Wet, very loose. SILT (ML) - gray, wet, very soft, low plasticity.
			X	SPT	2						
	2		X	SPT	0						2.3 m (7.5')

Total Depth 2.3 m (7.5')

KLEINFELDER

Boring Log

Date Started: 10/21/2003; Completed: 10/21/2003	**Project Number** 35321	**Project** NM State Highway 126	**Boring No.** B-4
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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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-5
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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		NP	NV	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-6
	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	

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

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	35321	NM State Highway 126	B-7
	Completed: 10/23/2003			
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0			SPT	11	11.3		NP	NV	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										
				SPT	6	5.6				23	
	2										
	3			SPT	6						
	4										
				SPT	6						
	5										5.0 m (16.5')

Total Depth 5.0 m (16.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/23/2003	35321	NM State Highway 126	B-8
	Completed: 10/23/2003			
	Backfilled: 10/23/2003	Rig Type: Track Rig	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	

Depth (m)	Sample Type	Penetration Resistance (Blows per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0–2.4	SPT	10	6.2		NP	NV	39	SILTY SAND (SM) - brown, dry, stiff, with fine sand, some gravel, weakly cemented, low plasticity, with trace cobbles.
	SPT	30	8.9					2.4 m (8.0')
2.4–5.9								SILT (ML) - brown, dry to moist, very stiff, moderately cemented, low plasticity, with gypsum nodules, (possible Bandelier tuff).
	SPT	24	20.2					Gray, ash-like.
								Light brown, hard, with quartz crystals, with fine pumice.
	SPT	19	17.1					
	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-9
	Completed: 11/11/2003			
	Backfilled: 11/11/2003	Rig Type: Track Rig	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0				5						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		8.5		NP	NV	66	
	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	35321	NM State Highway 126	B-10
	Completed: 11/12/2003			
	Backfilled: 11/12/2003	Rig Type: Track Rig	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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		Project Number	Project	Boring No.
	Started: 10/23/2003	35321	NM State Highway 126	B-11
	Completed: 10/23/2003			
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	20	10.6		NP	NV	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	35321	NM State Highway 126	B-12
	Completed: 10/23/2003			
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	14	9.3		NP	NV	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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		NP	NV	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	Completed: 11/13/2003	35321	NM State Highway 126	BR-1
Backfilled: 11/13/2003		Rig Type: Track Rig	Surface Elevation:	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0 – 0.6 m (2.0')								SILTY SAND (SM) - dark brown, moist, loose, fine to medium grained sand, with roots, trace gravel.
0.6 m (2.0') – 2.1 m (7.0')								SILTY SAND (SM) - brown, wet, medium dense, fine to medium grained sand, weakly cemented.
~1.2 (groundwater ∇)	SPT	22						
2.1 m (7.0') – 3.5 m (11.5')								SANDY SILT (ML) - gray, wet, medium stiff, with iron oxide stains, weakly cemented, low plasticity.
~2.7	SPT	5			NP	NV		
3.5 m (11.5') – 4.6 m (15.0')								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.
~4.3	SPT	15	30.5				31	
4.6 m (15.0') – 7.0 m (23.0')								SAND (SP-SM) - gray, wet, medium dense, fine to medium grained sand, with silt, weakly cemented.
~5.8	SPT	12						
7.0 m (23.0') – 7.9 m (26.0')								SILTY SAND (SM) - red-brown, wet, stiff, fine grained, with gravel, weakly cemented.
~7.4	SPT	9	32.6				30	
7.9 m (26.0') – 10								SAND (SP) - gray, wet, medium dense, fine to medium grained sand, trace silt, with gravel, weakly cemented, with some iron oxide staining.
~8.9	SPT	12						

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/13/2003	35321	NM State Highway 126	BR-1
	Completed: 11/13/2003			
	Backfilled: 11/13/2003	Rig Type: Track Rig	Surface Elevation:	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
10.4	SPT	63	15.7				11	10.4 m (34.0') SAND (SP-SM) - gray, wet, very dense, fine to coarse grained, with silt, with gravel, weakly cemented.
11.1								11.1 m (36.5') SILTY SANDSTONE - red brown, fine grained, moderately to slightly weathered, soft.
11.8	SPT	50/3.75"	10.5				26	
13.3	SPT	50/5.75"						
14.8	SPT	50/2"	12.7					14.8 m (48.7') Red-brown and green-gray, with clay seams from 48.5 to 48.7 ft. (14.7 to 14.8 m).

Total Depth 14.8 m (48.7')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/21/2003	Completed: 10/21/2003	35321	NM State Highway 126	BR-2
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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0–1.5	SPT	20						SILTY SAND (SM) - gray-brown, moist, medium dense, fine to coarse grained sand, poorly graded, with silt, with gravel, [Fill].
∇ (1.2)									Wet.
	1.5 m (5.0')	SPT	5	26.8		NP	NV	21	SILTY SAND (SM) - gray, wet, medium stiff, fine to medium grained sand, weakly cemented.
		U	10						
		SPT	5						
									Very loose.
		U	2						
		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.
	9.4 m (31.0')	SPT	15						
	10								

KLEINFELDER

Boring Log

Date: Started: 10/21/2003; Completed: 10/21/2003; Backfilled: 10/21/2003	Project Number 35321	Project NM State Highway 126	Boring No. BR-2
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
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	
14	SPT	21						With gravel, some cobbles.
15	SPT	44						Dense, with highly cemented layers and seams, without gravel, without cobbles.
16.8 m (55.0')								
17	SPT	50/4.00"						SANDY SILTSTONE - red brown, fine grained, moderately weathered, moderately hard.
18.4 m (60.3')	SPT	50/3"						

Total Depth 18.4 m (60.3')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/22/2003	Completed: 10/22/2003	35321	NM State Highway 126	BR-3
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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
0	SPT	13						SILTY SAND (SM) - red-brown, dry to moist, medium dense, fine to coarse grained, with gravel, [Fill].
1.5 m (5.0')	SPT	10						SILTY SAND (SM) - gray-brown, moist to wet, loose to medium dense, fine to medium grained sand, some gravel.
2.4 m (8.0')								SANDY SILT (ML) - gray, wet, soft to medium stiff, fine grained sand, some organics, weakly cemented, low plasticity.
	U	8						
	SPT	6	43.8				54	
	SPT	3						
	SPT	5						
7.9 m (26.0')								SILTY SAND (SM) - gray, wet, loose, fine to coarse grained sand, some gravel, with trace green gravel.
9.3 m (30.5')	SPT	3						SANDY SILT (ML) - gray, wet, soft, fine grained sand, low plasticity.
10								

Date		Project Number	Project	Boring No.
	Started: 10/22/2003	35321	NM State Highway 126	BR-3
	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 per 0.3 m)	Visual Classification
10–11.0	SPT (≈10.7)	6	SANDY SILT (ML) - gray, wet, soft, fine grained sand, low plasticity.
11.0 m (36.0')			
11.0–13.0	SPT (≈12.3)	3	SILTY SAND (SM) - gray, wet, very loose to loose, fine to medium grained sand, weakly cemented. Some gravel.
13.0 m (42.5')			
13.0–15.8	SPT (≈13.8)	37	SAND (SP) - gray, wet, dense, medium to coarse grained sand, some gravel, weakly cemented, with clear grains (quartzitic, possible completely weathered igneous rock).
	SPT (≈15.3)	50	Gray.
15.8 m (52.0')			
15.8–18.4	SPT (≈16.8)	50/3"	SILTY SANDSTONE - red brown, medium grained, moderately weathered, moderately hard, with gray silt nodules.
	SPT (≈18.4)	50/3.5"	
18.4 m (60.3')			

Columns also printed (no data): Groundwater Depth (m), Graphical Log, Sample Taken, Moisture Content (%), Dry Density (kg/cu. m), Liquid Limit, Plasticity Index, Percent Passing No. 200 Sieve.

Total Depth 18.4 m (60.3')

Boring Log

Date		Project Number	Project		Boring No.
	Started: 11/12/2003	35321	NM State Highway 126		BR-4
	Completed: 11/12/2003				
	Backfilled: 11/12/2003	Rig Type: Track Rig	Surface Elevation:	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)	Graphical Log	Sample Taken	Sample Type	Penetration Resistance (Blows per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	5						SILTY SAND (SM) - brown, dry, loose, fine to medium grained sand, with gravel, with roots.
	1.1										1.1 m (3.5')
			X	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										
	3		X	SPT	4	41.2				20	
			X	SPT	11						
	6		X	SPT	6	29.9				16	Brown-gray, with gravel.
			X	SPT	8						
	9		X	SPT	7						
	10										

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 11/12/2003		35321	NM State Highway 126	BR-4
Completed: 11/12/2003				
Backfilled: 11/12/2003		Rig Type: Track Rig	Surface Elevation:	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)	Sample Type	Penetration Resistance (Blows per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
10								SILTY SAND (SM) - red-brown, wet, very loose to loose, fine to coarse grained sand, some gravel, weakly cemented.
	SPT	15						
11.3 m (37.0')								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')								SILTY SAND (SM) - brown, wet, medium dense, fine to coarse grained sand, moderately cemented.
	SPT	18						
14.3 m (47.0')								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')	SPT	50/4.5"	13.9				73	SANDY SILTSTONE - red brown, fine grained, moderately weathered, soft.
17.7 m (58.0')								SILTY SANDSTONE - brown, fine grained, moderately weathered, soft.
18	SPT	50/1.75"						
18.6 m (61.0')								Refusal with HSA at 61 ft. (18.6 m).

Total Depth 18.6 m (61.0')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/22/2003	35321	NM State Highway 126	MSE-1
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0		X	SPT	22	4.4		NP	NV	16	SILTY SAND (SM) - light brown, dry, loose to medium dense, fine to medium grained sand, with gravel, some cobbles, weakly cemented.
	1										
			X	SPT	8	10.6					
	2										
	3		X	SPT	3	8.4					Very loose.
	4										
			X	SPT	12						
	5										Possible boulder from 17 to 19 ft. (5.2 to 5.8 m).
	6		X	SPT	11						
	7										
			X	SPT	10						7.9 m (26.0')
	8										SILTY GRAVEL (GM) - dark brown, dry, loose, fine to coarse grained gravel, with fine to coarse grained sand.
	9		X	SPT	50/5.50"						With increased gravel content.
	10										

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/22/2003	35321	NM State Highway 126	MSE-1
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	10										SILTY GRAVEL (GM) - dark brown, dry, loose, fine to coarse grained gravel, with fine to coarse grained sand.
∇											10.8 m (35.5')
	11		X	SPT	9						SANDY SILT (ML) - brown, wet, medium stiff, some gravel, weakly cemented, low plasticity.
											11.1 m (36.5')

Total Depth 11.1 m (36.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 11/11/2003	35321	NM State Highway 126	MSE-2
	Completed: 11/11/2003			
	Backfilled: 11/11/2003	Rig Type: Track Rig	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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-3
	Completed: 11/11/2003			
	Backfilled: 11/11/2003	Rig Type: Track Rig	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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.
	2										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		X	SPT	15	6.9				15	4.0 m (13.0') SILTY GRAVEL (GM) - red-brown, dry, medium dense, fine to coarse grained, with pumice, with fine to coarse sand.
											4.7 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-4
	Completed: 11/11/2003			
	Backfilled: 11/11/2003	Rig Type: Track Rig	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	

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

Total Depth 7.8 m (25.5')

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
Started: 10/23/2003		35321	NM State Highway 126	MSE-5
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

Sample Type	Penetration Resistance (Blows per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve
SPT	9	4.4				18
SPT	8	4.1				
SPT	19	4.1				15
SPT	20					
SPT	11					
SPT	8					
SPT	9					

Visual Classification

Depth (m) 0: SILTY SAND (SM) - dark brown, dry, loose, fine to medium grained, some gravel.

Brown, with gravel, some cobbles.

Medium dense, weakly cemented.

Red-brown.

7.3 m (24.0') (groundwater ▽)

SILTY GRAVEL (GM) - gray, wet, loose, fine to coarse grained gravel, with medium to coarse sand, (possible Bandelier tuff).

9.8 m (32.0')

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

KLEINFELDER

Boring Log

Date		Project Number	Project	Boring No.
	Started: 10/23/2003	35321	NM State Highway 126	MSE-5
	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	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	35321	NM State Highway 126	MSE-6
Completed: 11/12/2003			
Backfilled: 11/12/2003	Rig Type: Track Rig	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/cu. m)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve	Visual Classification
	0–0.45	SPT	13	10.1				23	SILTY SAND (SM) - brown, moist, medium dense, fine to coarse grained sand, with gravel.
∇ 0.9	1								Dark brown, wet, loose.
	1.2–1.65	SPT	6	23.4					
	2.9								2.9 m (9.5')
	2.9–3.35	SPT	11						SAND (SP) - gray, wet, medium dense, medium to coarse grained sand, with gravel, trace silt, weakly cemented, (possible Bandelier tuff).
	4.4–4.85	SPT	22	16.5					
	5.9–6.35	SPT	20						
	6.5								Without gravel from 21 to 24 ft..
	7.3								7.3 m (24.0')
	7.3–7.75	SPT	13						SANDY SILT (ML) - gray, wet, stiff, with gravel, abundant iron oxide staining, weakly cemented, low plasticity, (possible Bandelier tuff).
	7.9								7.9 m (26.0')
	7.9								SAND (SP) - red-gray, wet, very dense, medium to coarse grained sand, with Pumice, moderately cemented, (possible Bandelier tuff).
	8.85–9.3	SPT	57						
	9.3								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	Completed: 11/12/2003	35321	NM State Highway 126	MSE-7
Backfilled: 11/12/2003		Rig Type: Track Rig	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 per 0.3 m)	Moisture Content (%)	Dry Density (kg/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')								
∇		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						
		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 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 4/12/04

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

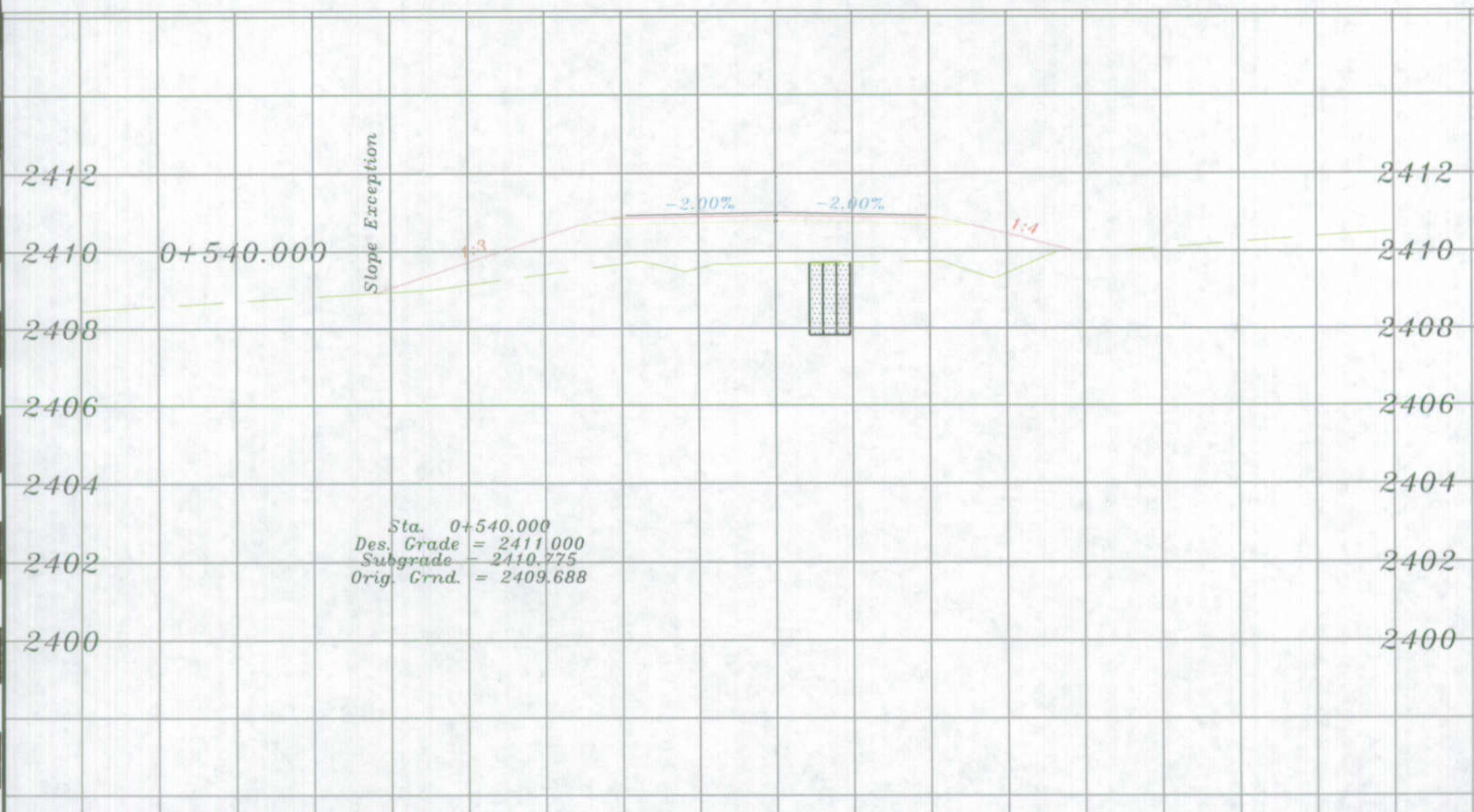
KLEINFELDER

Project: 35321

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

Soil Classification Legend

FIGURE **C.1**

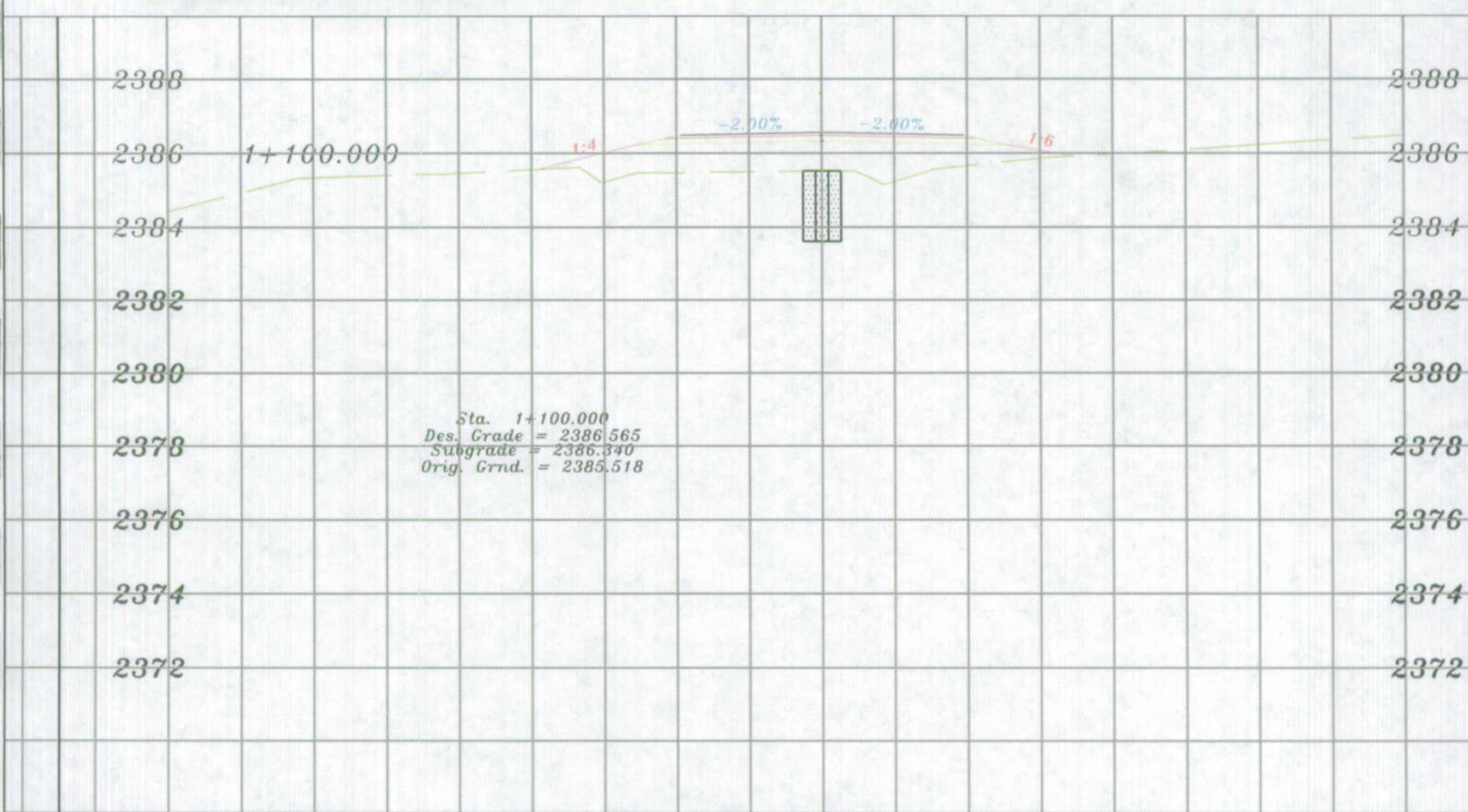


KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.2

BORING PROFILE
Boring B-1 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.2

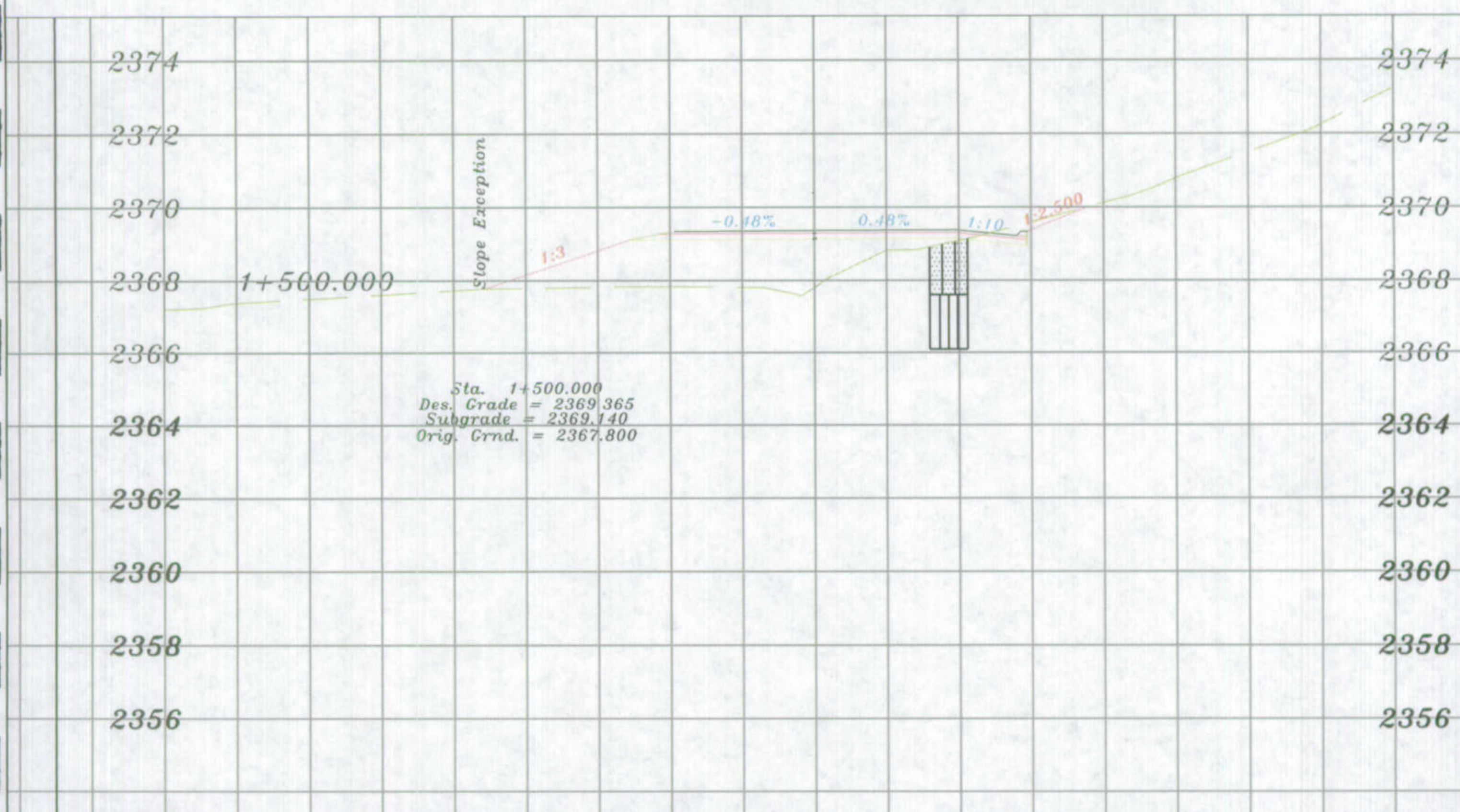


KLEINFELDER

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

BORING PROFILE
Boring B-2 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.3

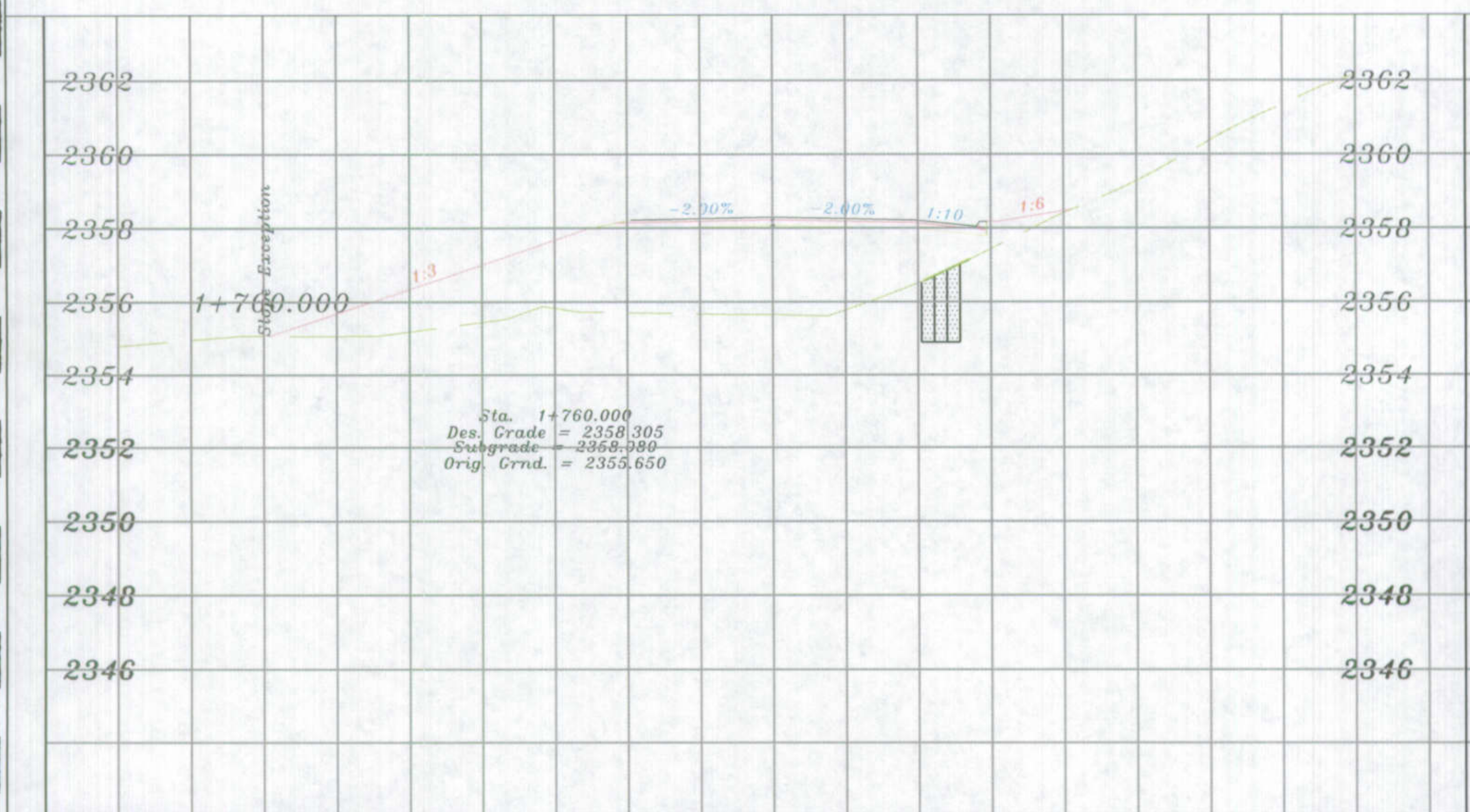


KLEINFELDER

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

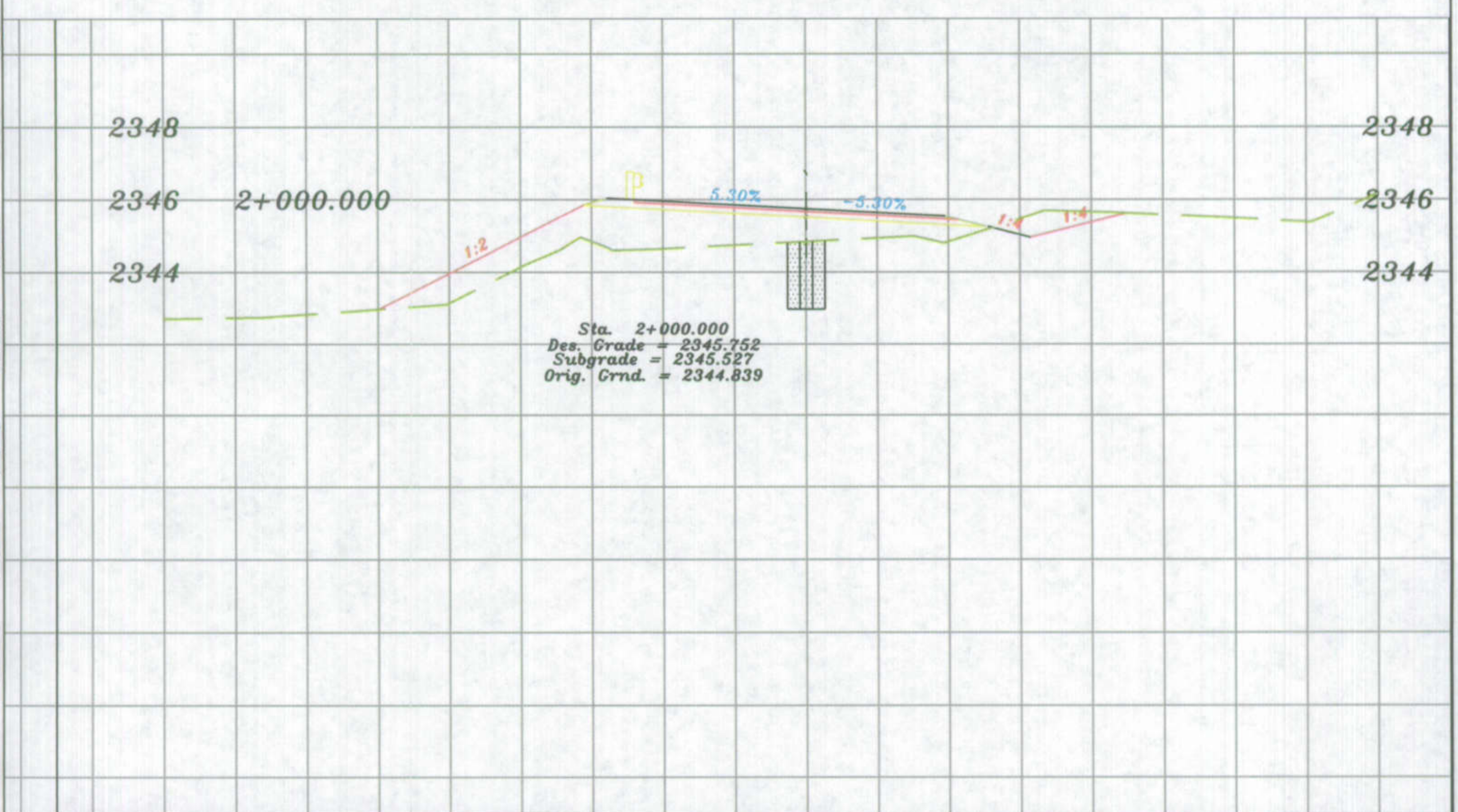
BORING PROFILE
Boring B-3 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.4



KLEINFELDER

Drawn By: C. Landon	Date: January 2004	**BORING PROFILE** Boring B-4 Profile New Mexico Hwy. 126 Cuba - La Cueva, New Mexico
Project No.: 35321	Filename: Figure C.5	FIGURE C.5

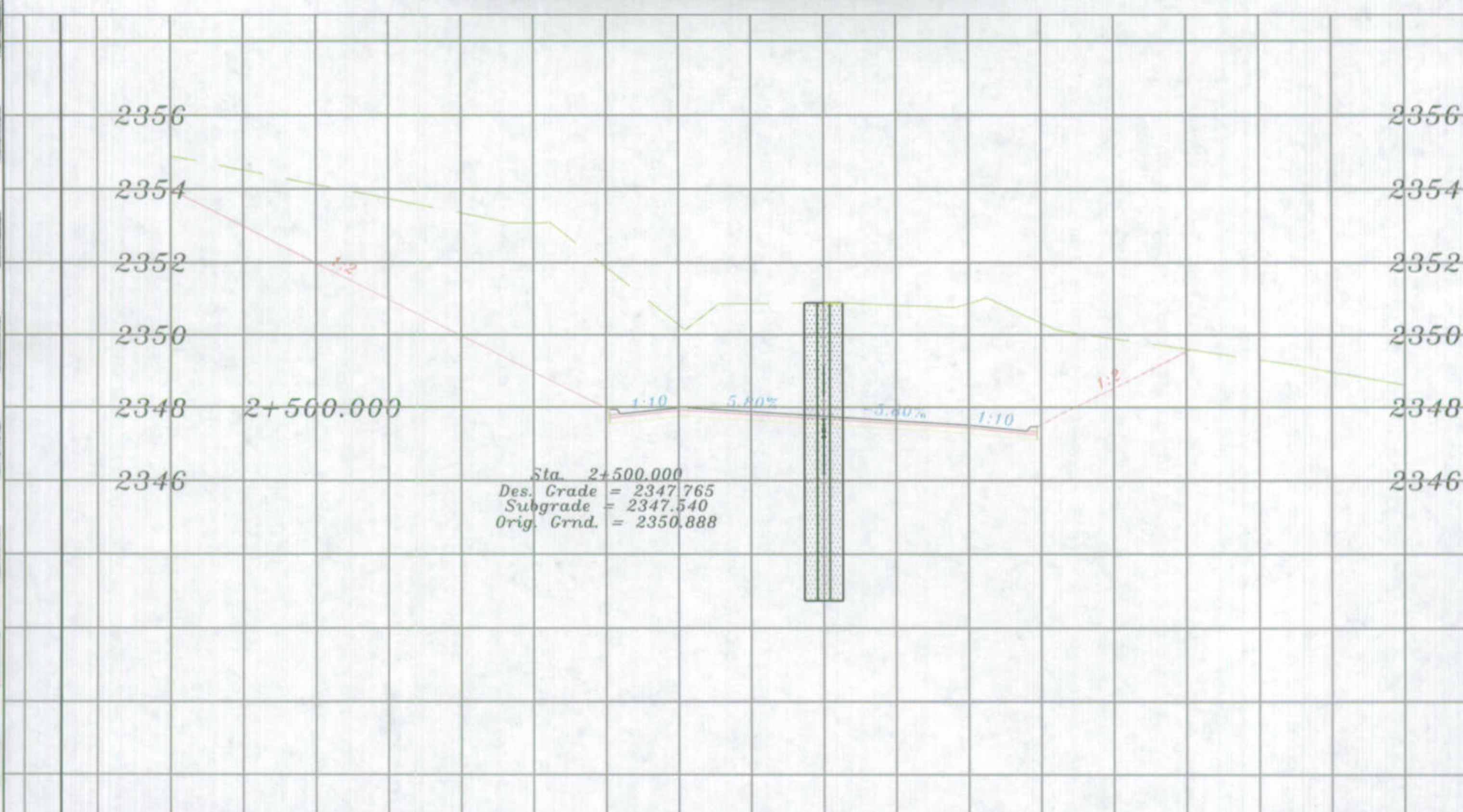


KLEINFELDER

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

BORING PROFILE
Boring B-5 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.6

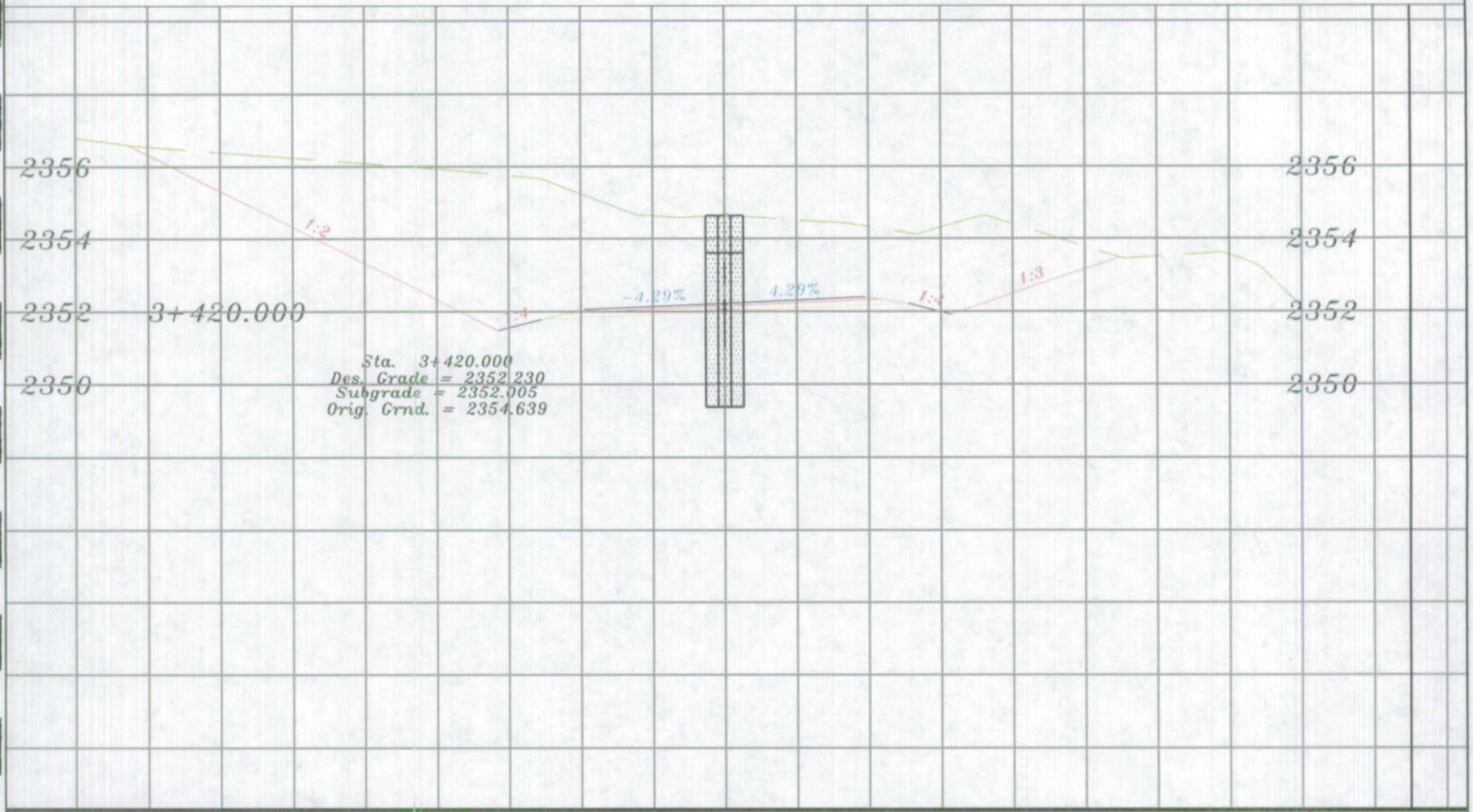


KLEINFELDER

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

BORING PROFILE
Boring B-6 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.7

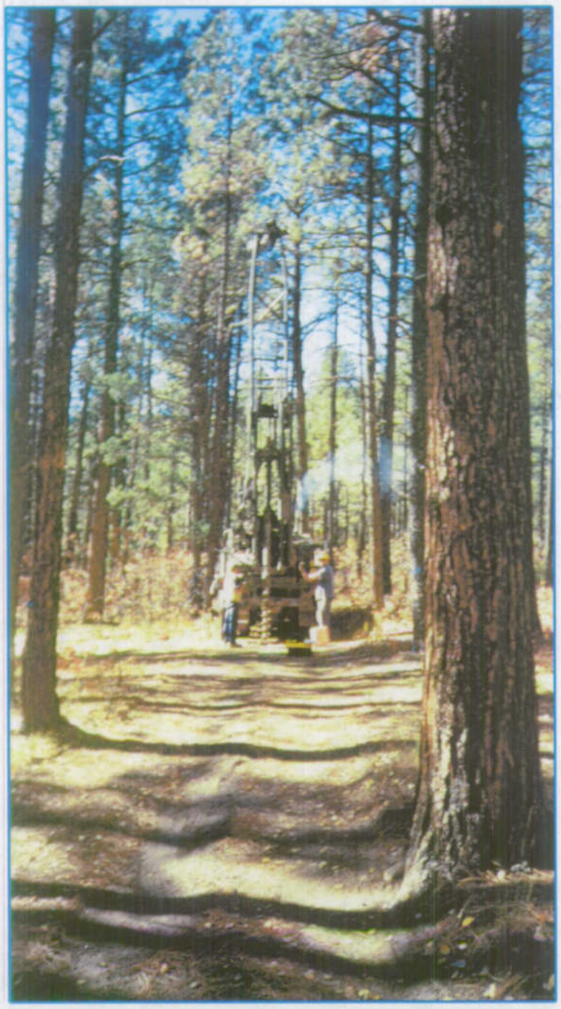


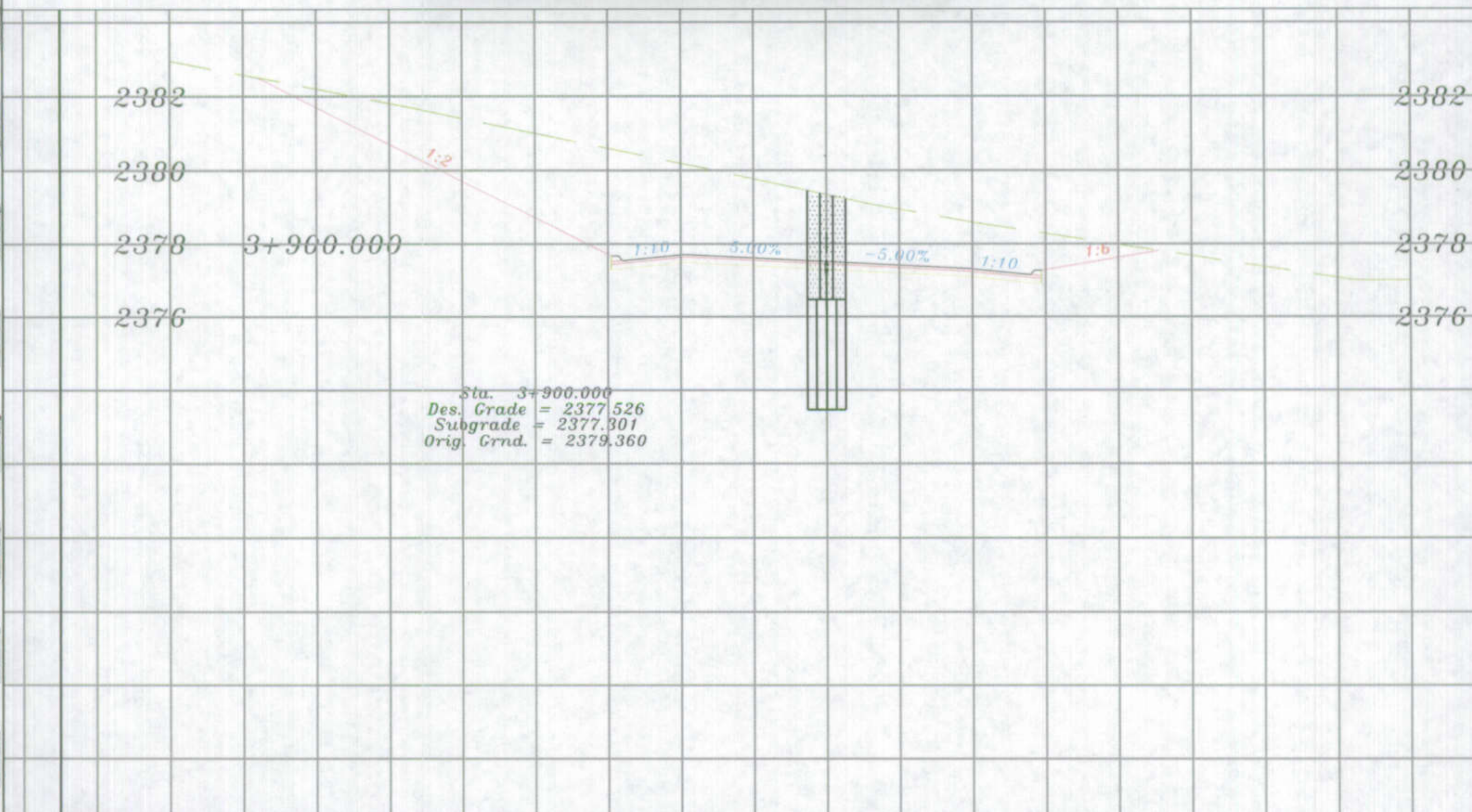
KLEINFELDER

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

BORING PROFILE
Boring B-7 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.8



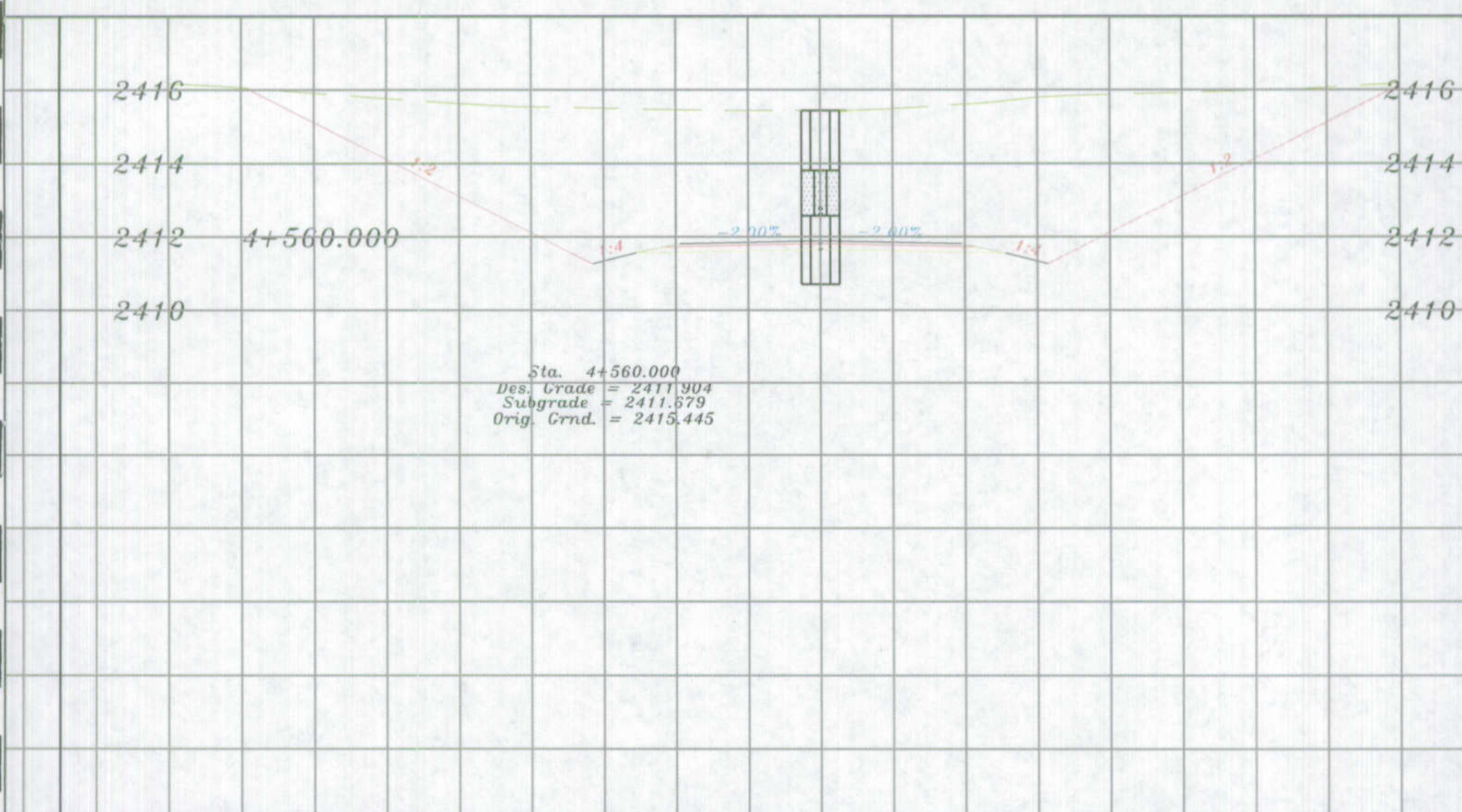


KLEINFELDER

BORING PROFILE
Boring B-8 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.9

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

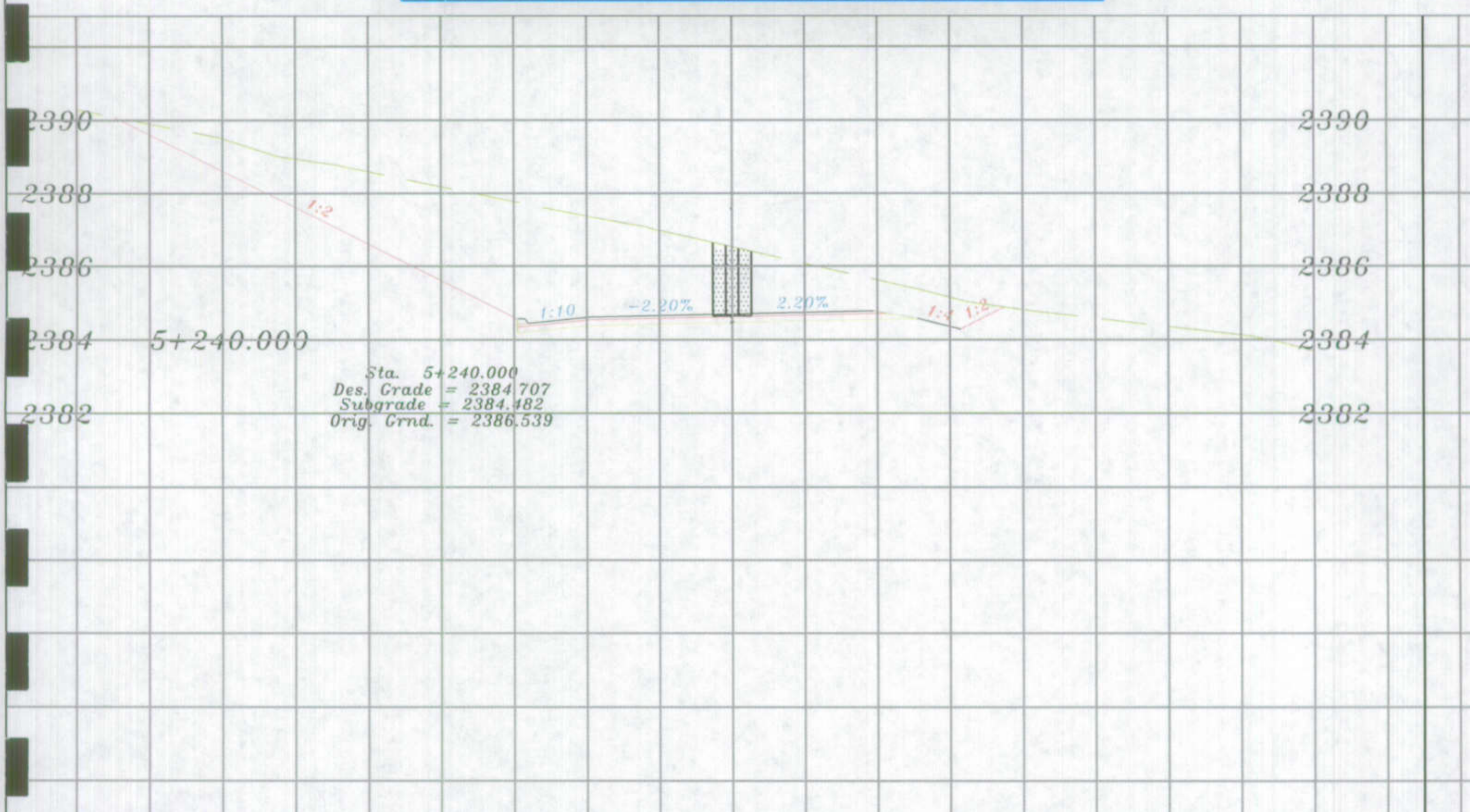


KLEINFELDER

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

BORING PROFILE
Boring B-9 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.10

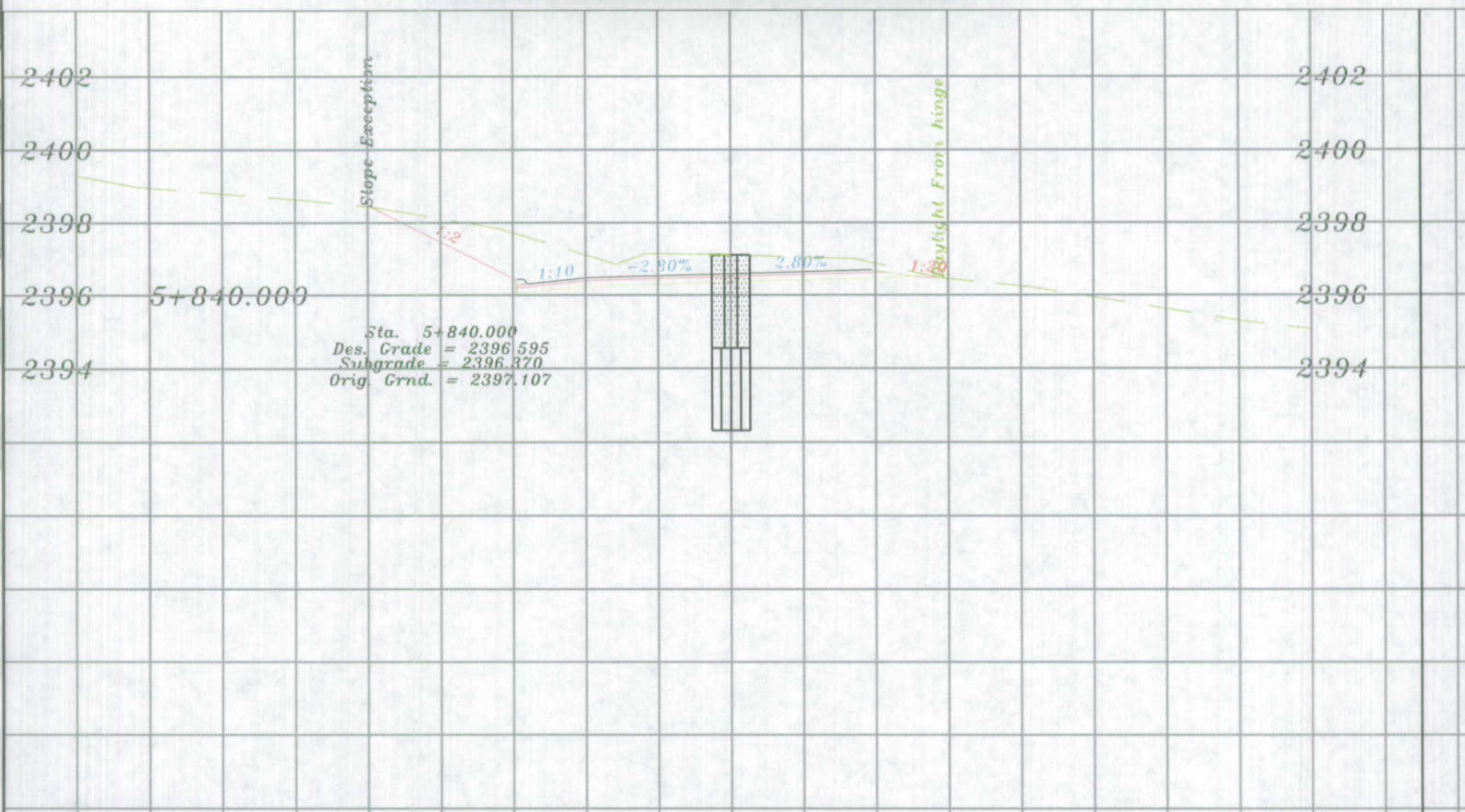


KLEINFELDER

BORING PROFILE
Boring B-10 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.11

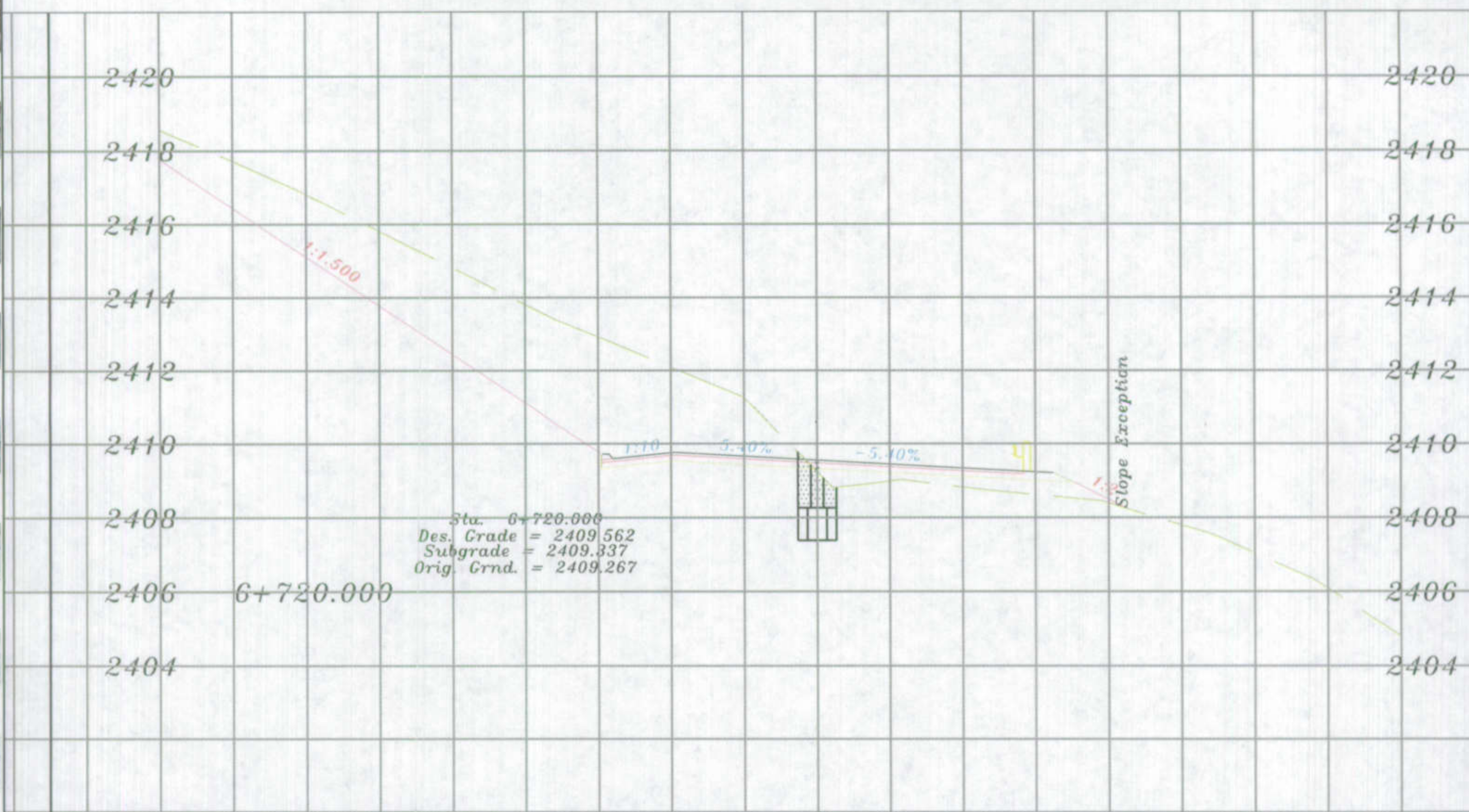
Drawn By: C. Landon	Date: January 2004
Project No.: 35321	Filename: Figure C.11



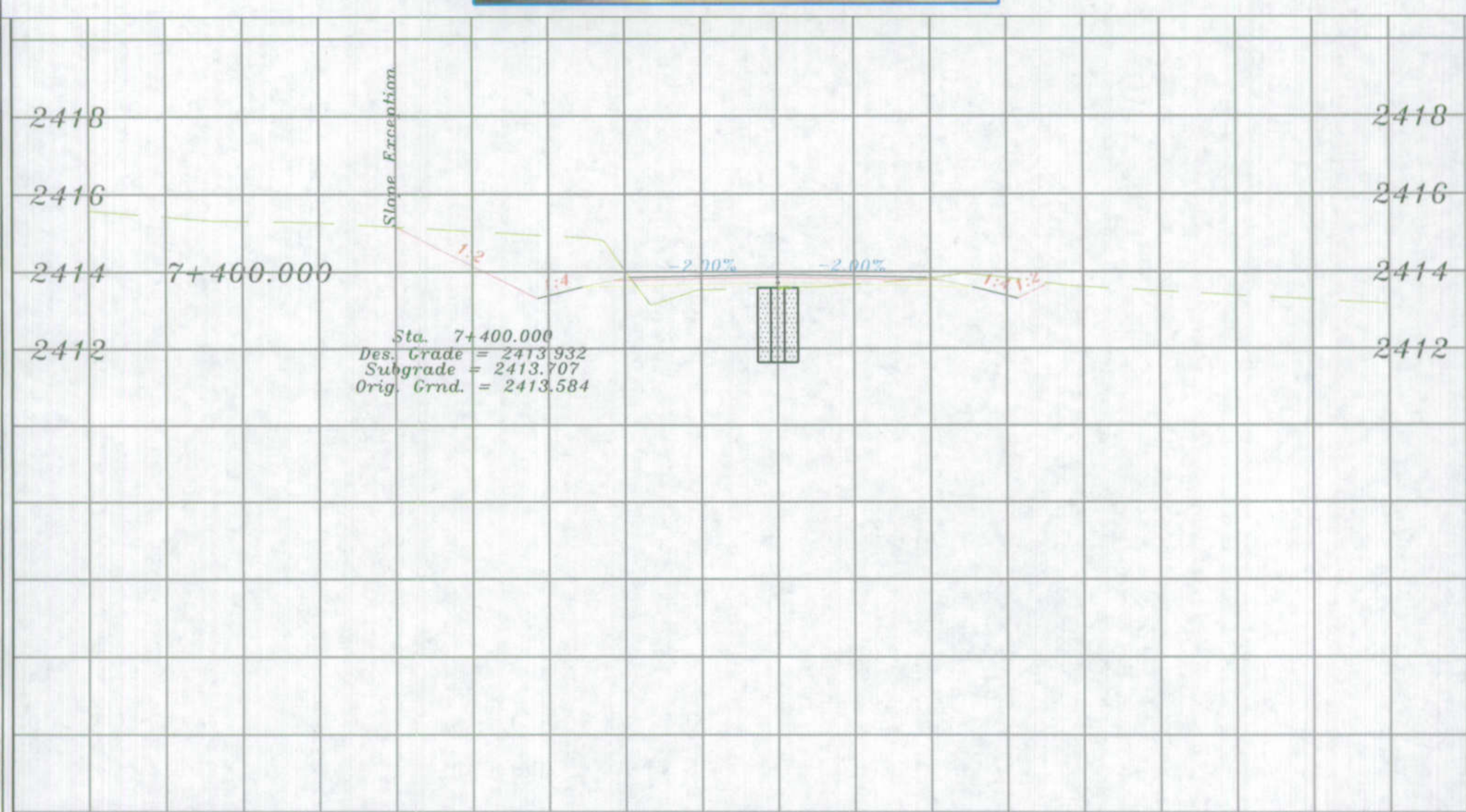
KLEINFELDER

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

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



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		

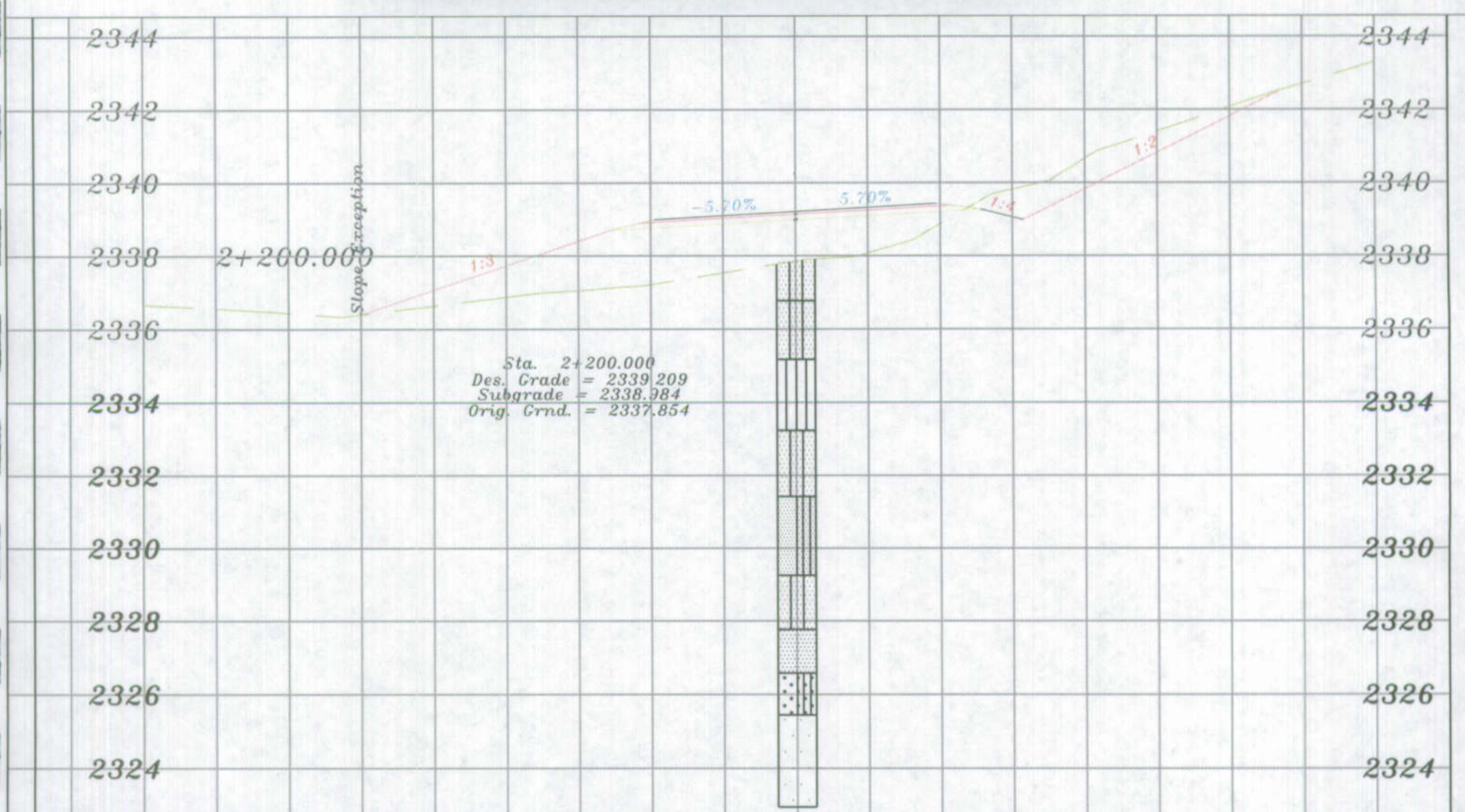


KLEINFELDER

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

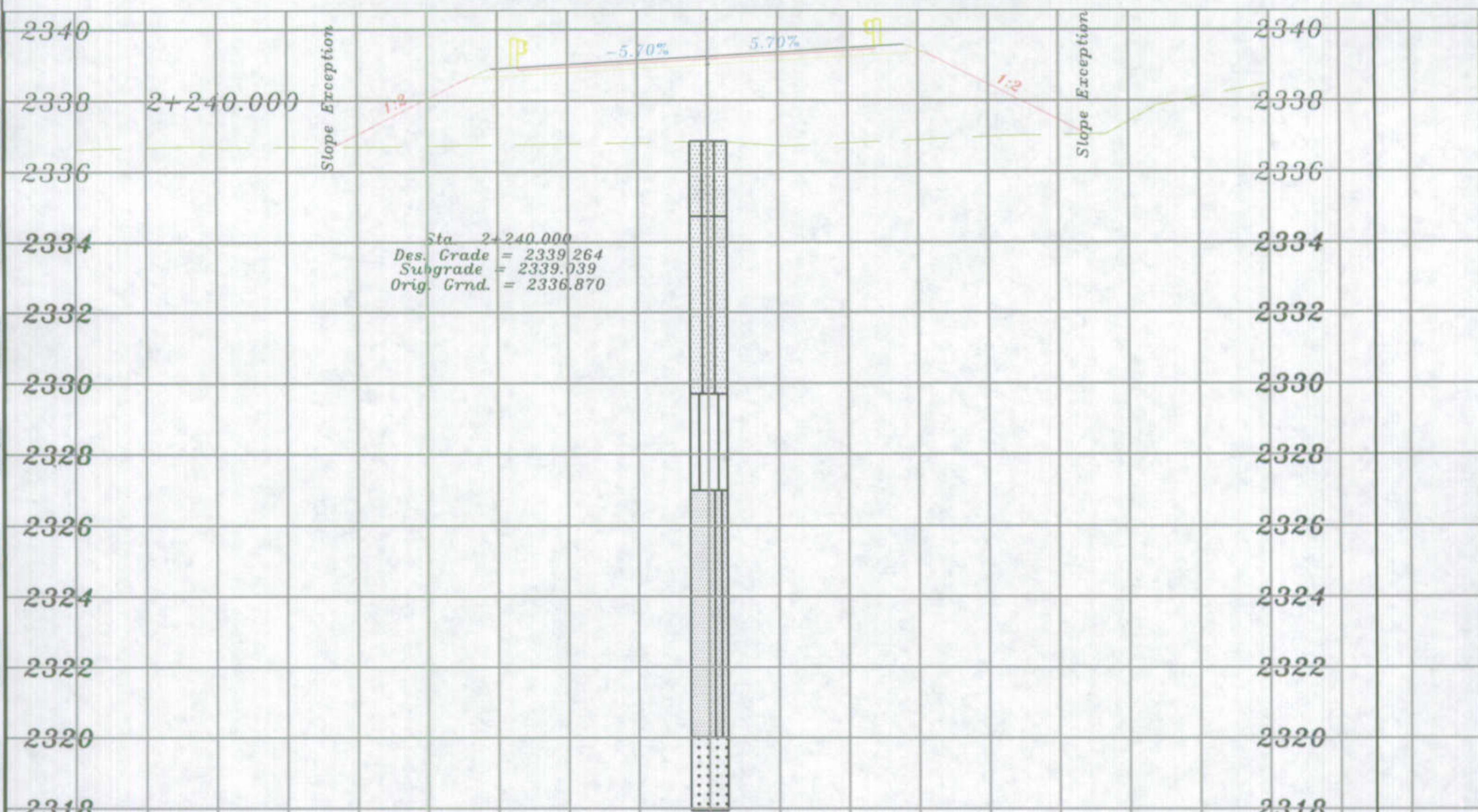


KLEINFELDER

BORING PROFILE
Boring BR-1 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.15

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

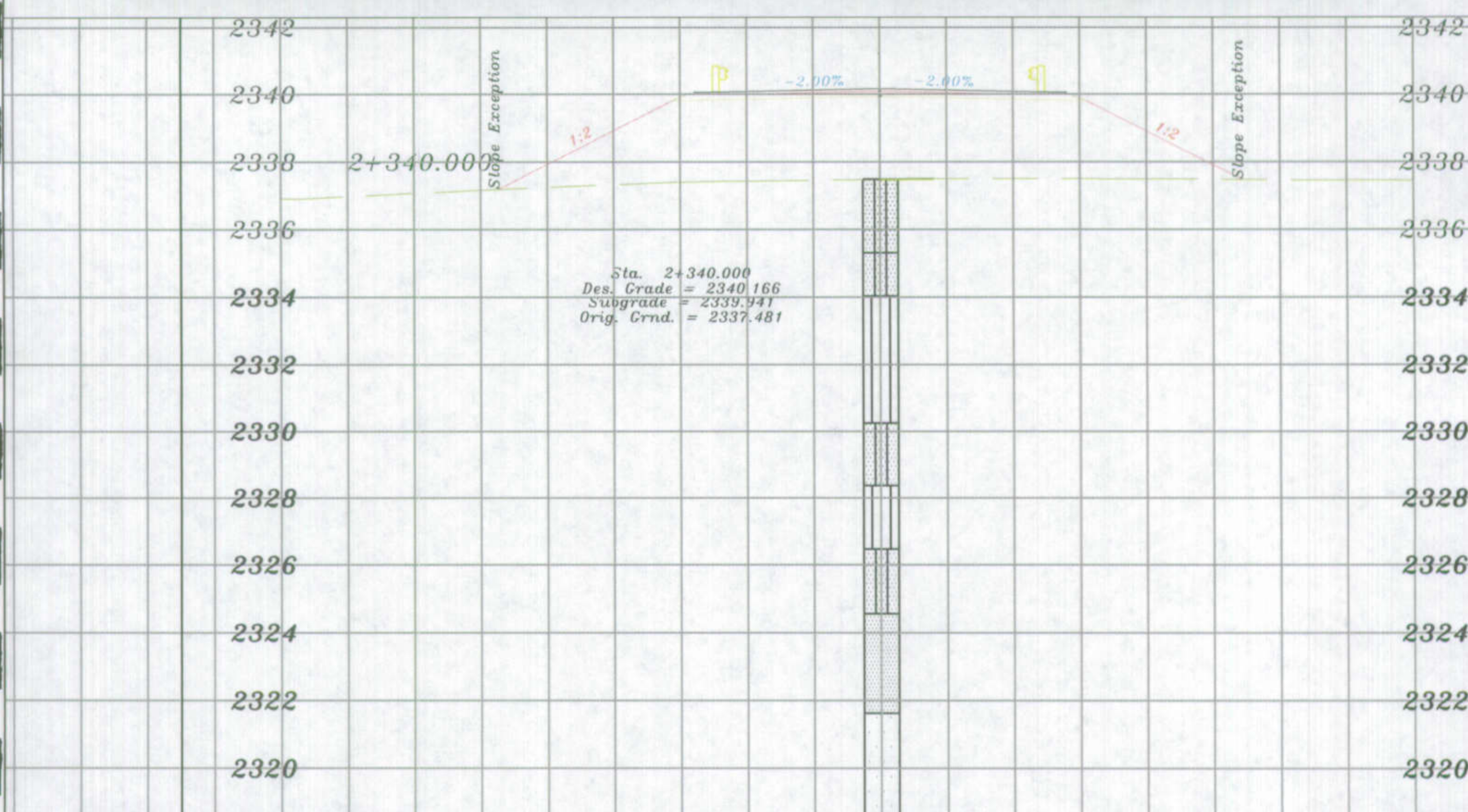


KLEINFELDER

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

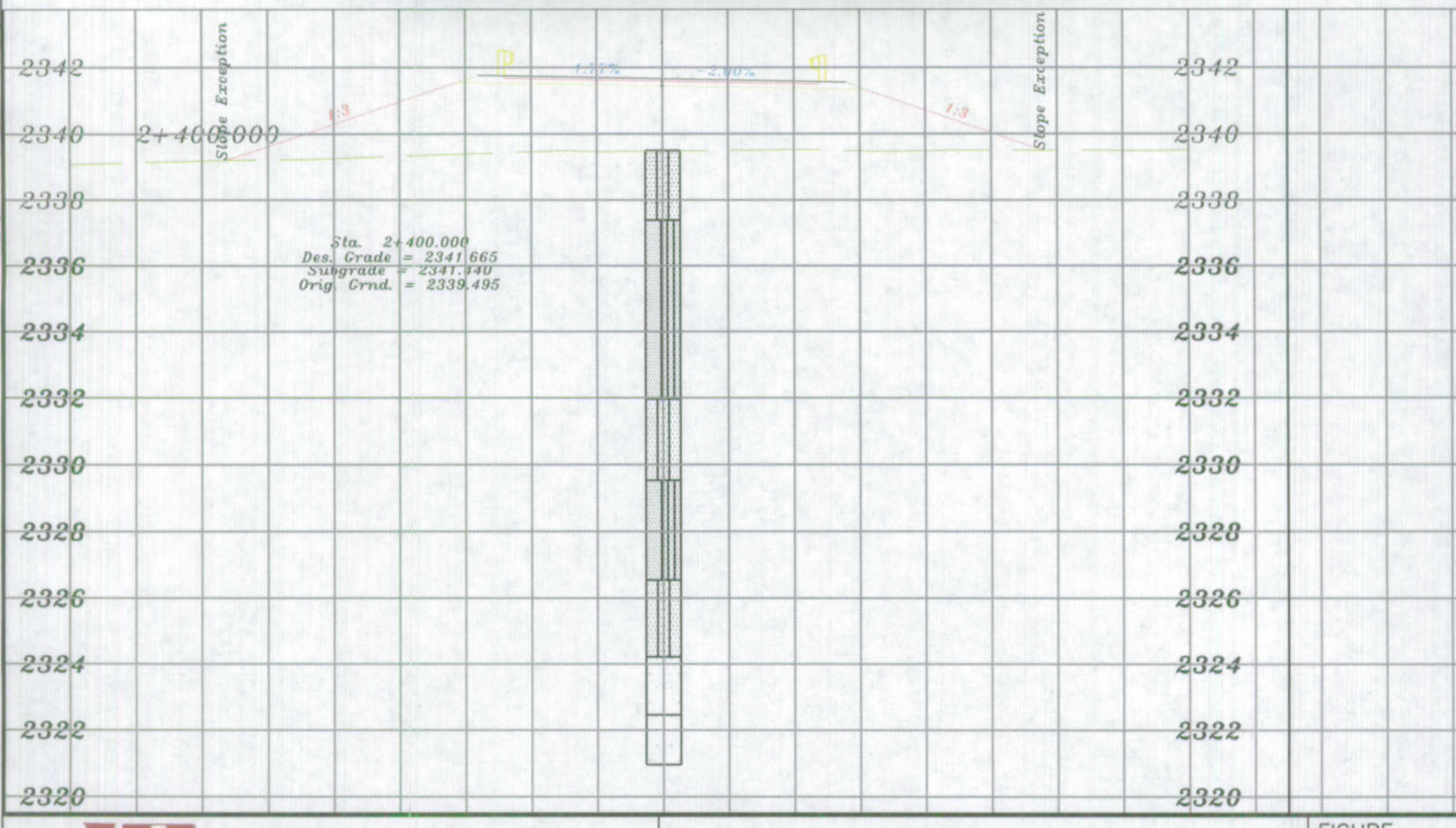
BORING PROFILE
Boring BR-2 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.16



KLEINFELDER

Drawn By: C. Landon	Date: January 2004	**BORING PROFILE** **Boring BR-3 Profile** **New Mexico Hwy. 126** **Cuba - La Cueva, New Mexico**	FIGURE **C.17**
Project No.: 35321	Filename: Figure C.17		

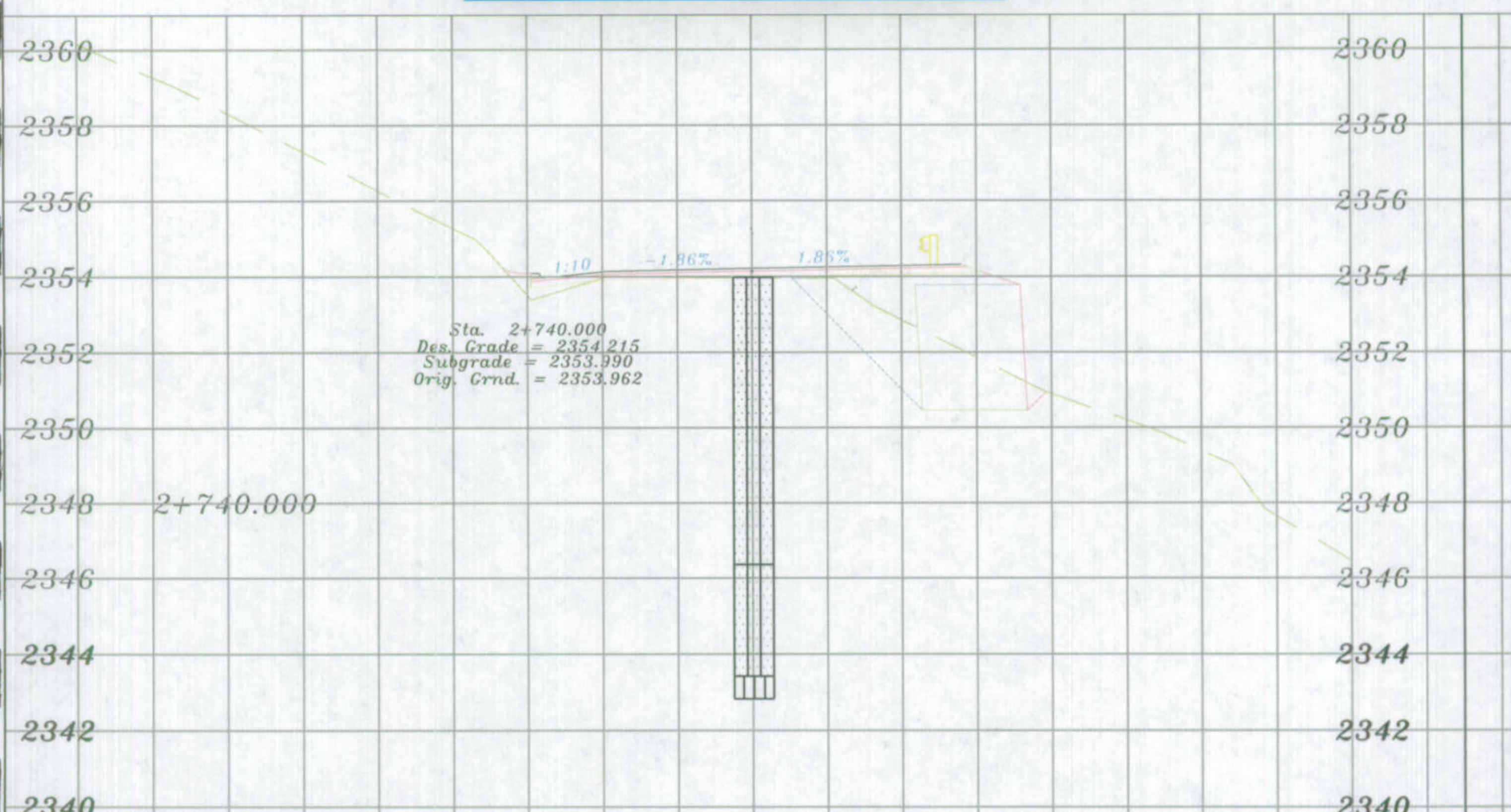


KLEINFELDER

BORING PROFILE
Boring BR-4 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.18

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

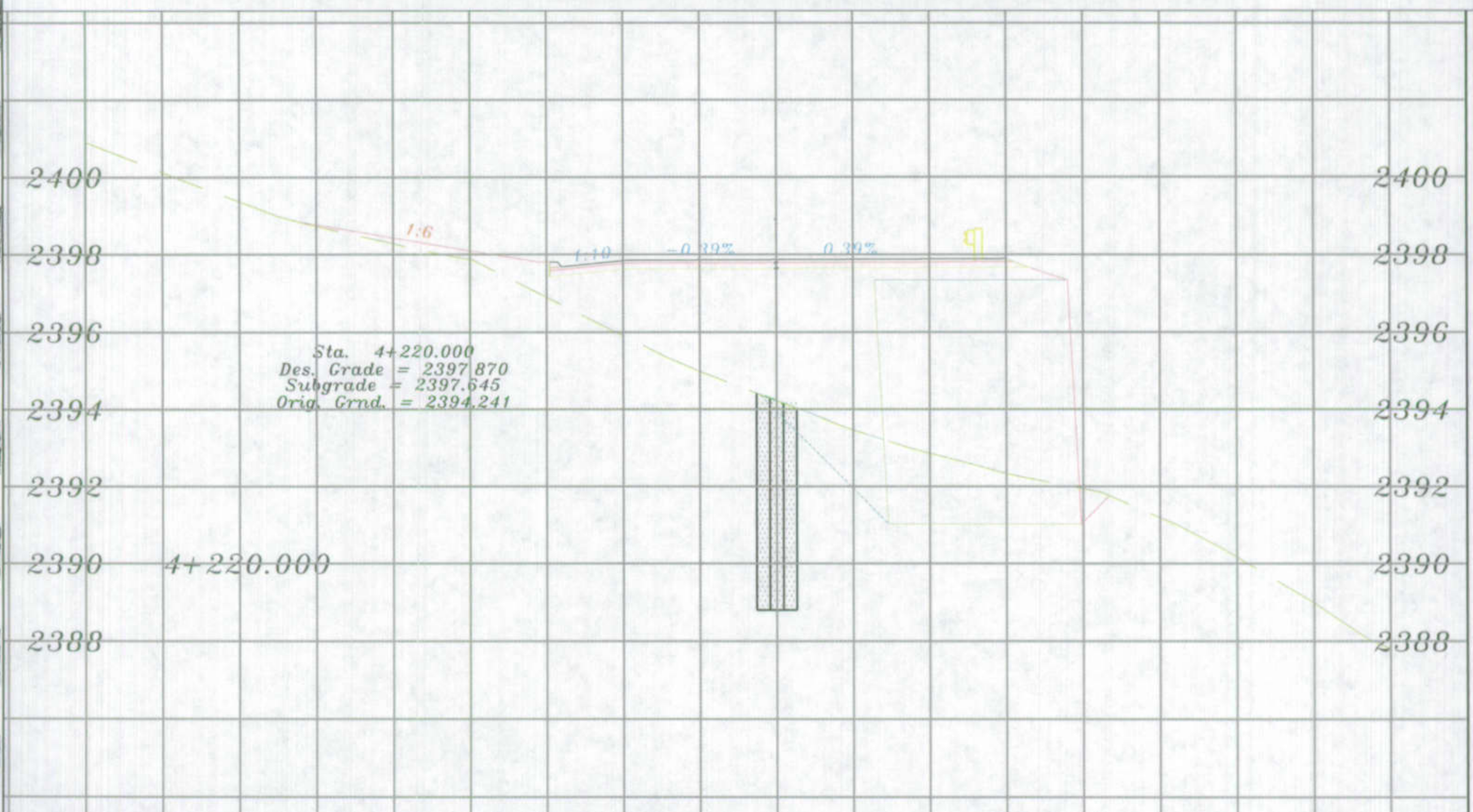


KLEINFELDER

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

BORING PROFILE
Boring MSE-1 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.19

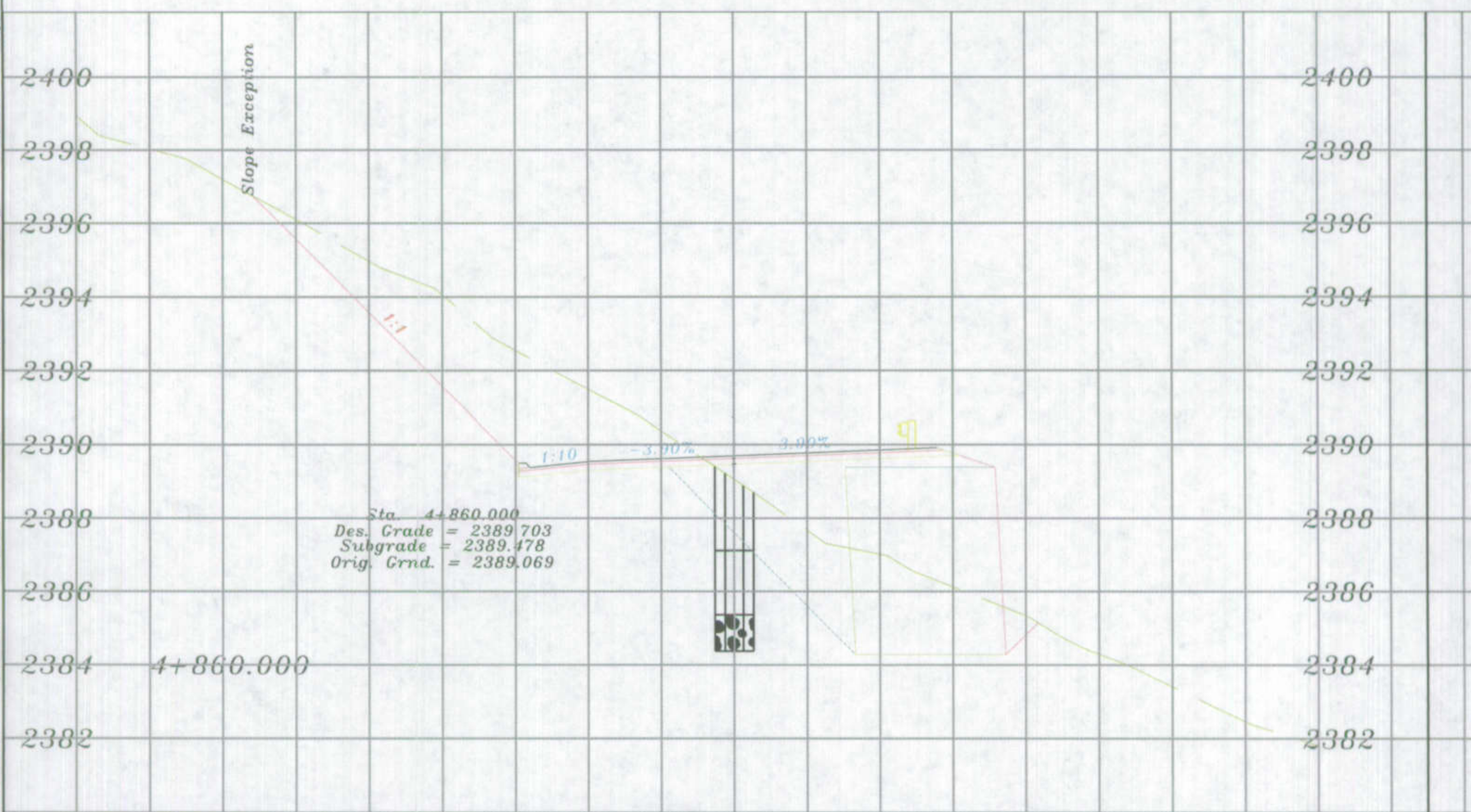


KLEINFELDER

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

BORING PROFILE
Boring MSE-2 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.20

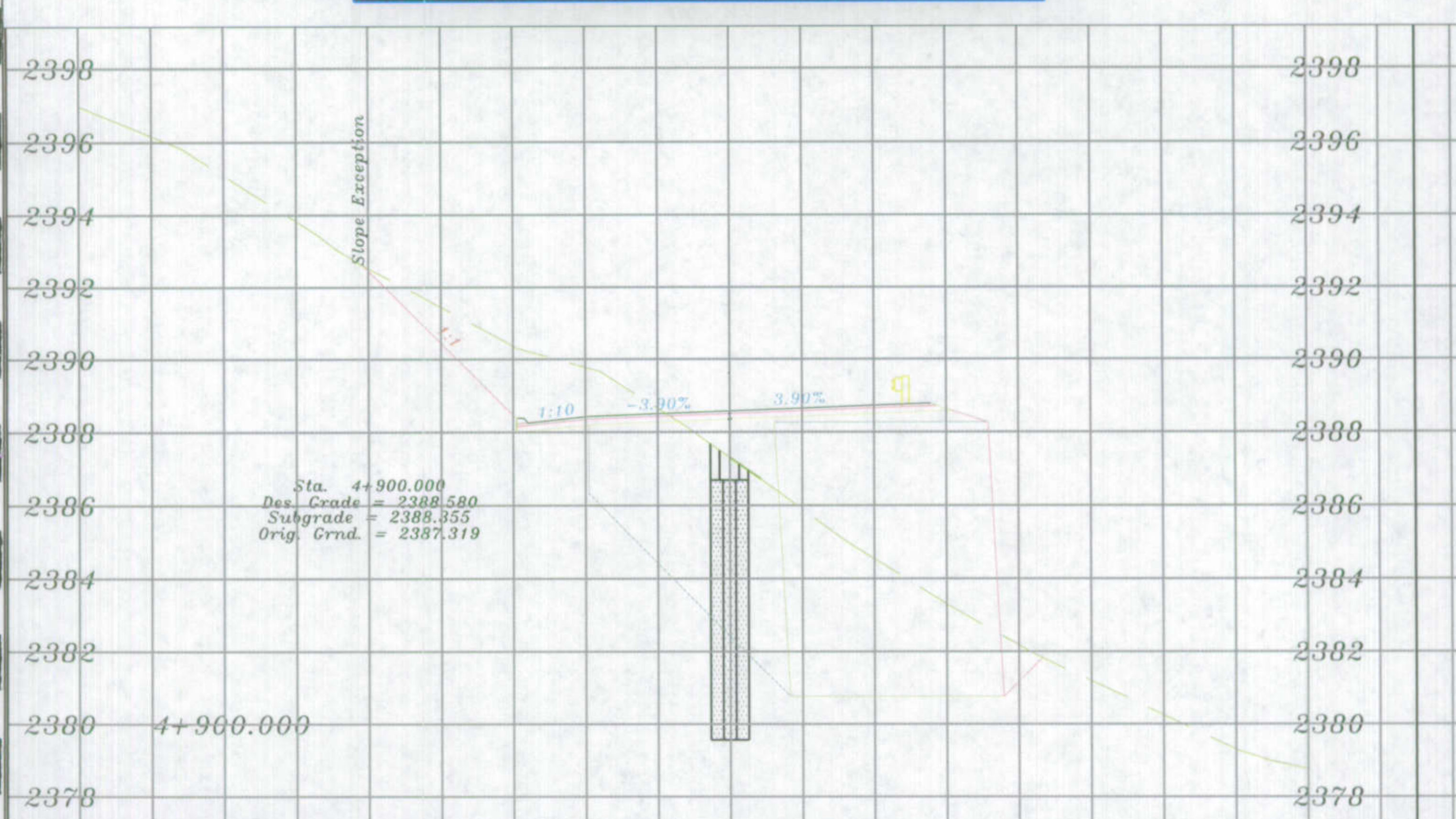


KLEINFELDER

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

BORING PROFILE
Boring MSE-3 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.21

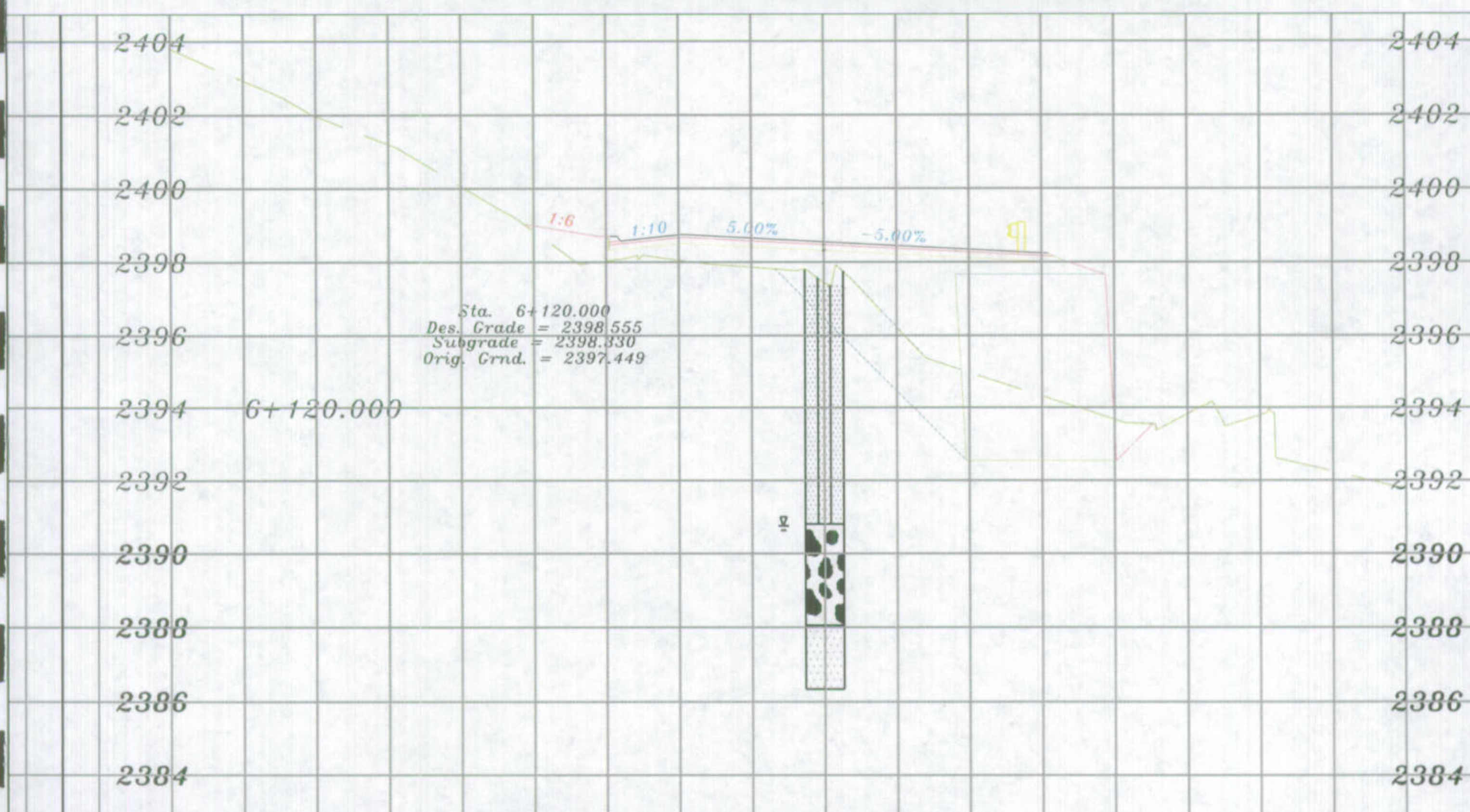


KLEINFELDER

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

BORING PROFILE
Boring MSE-4 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.22

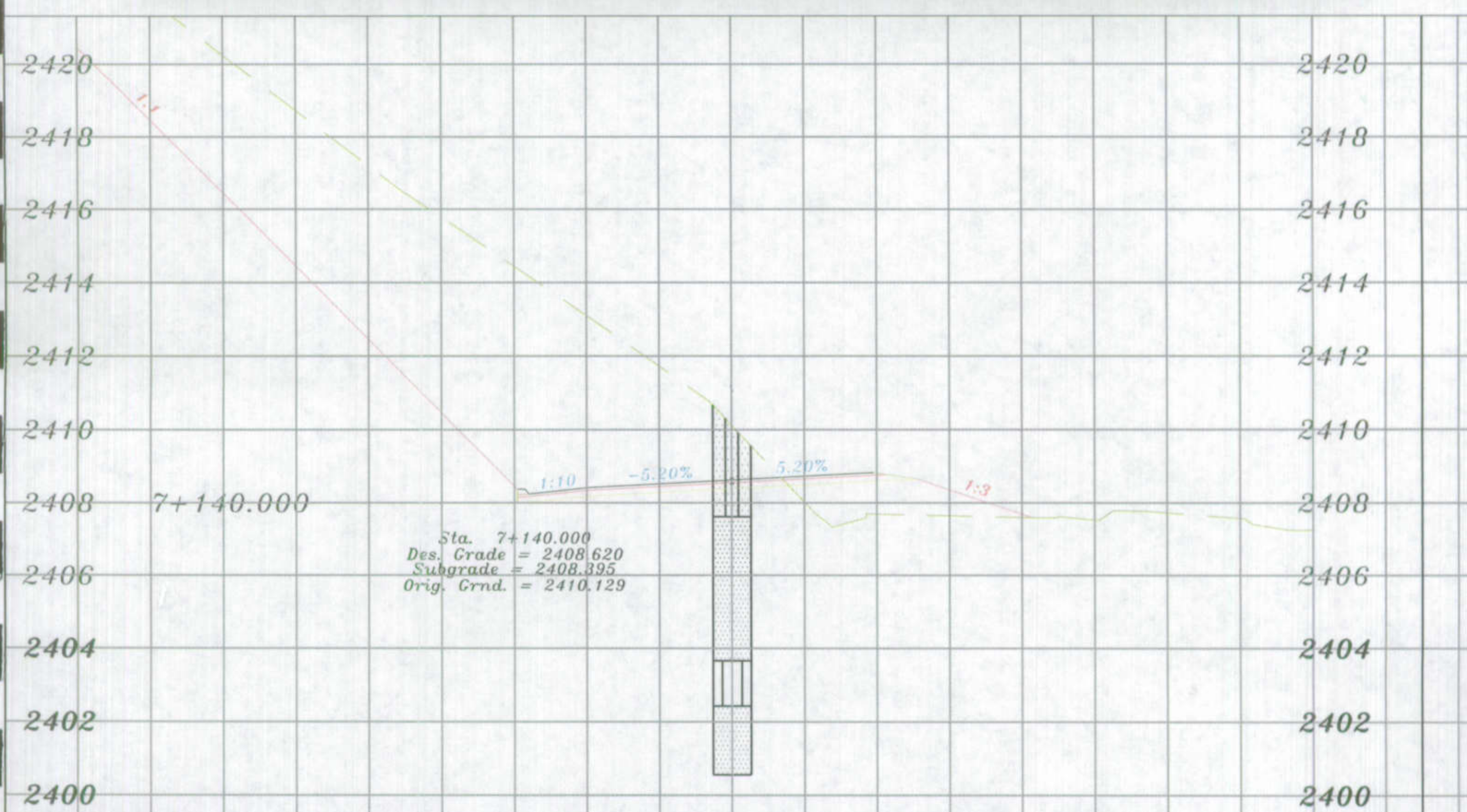


KLEINFELDER

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

BORING PROFILE
Boring MSE-5 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.23

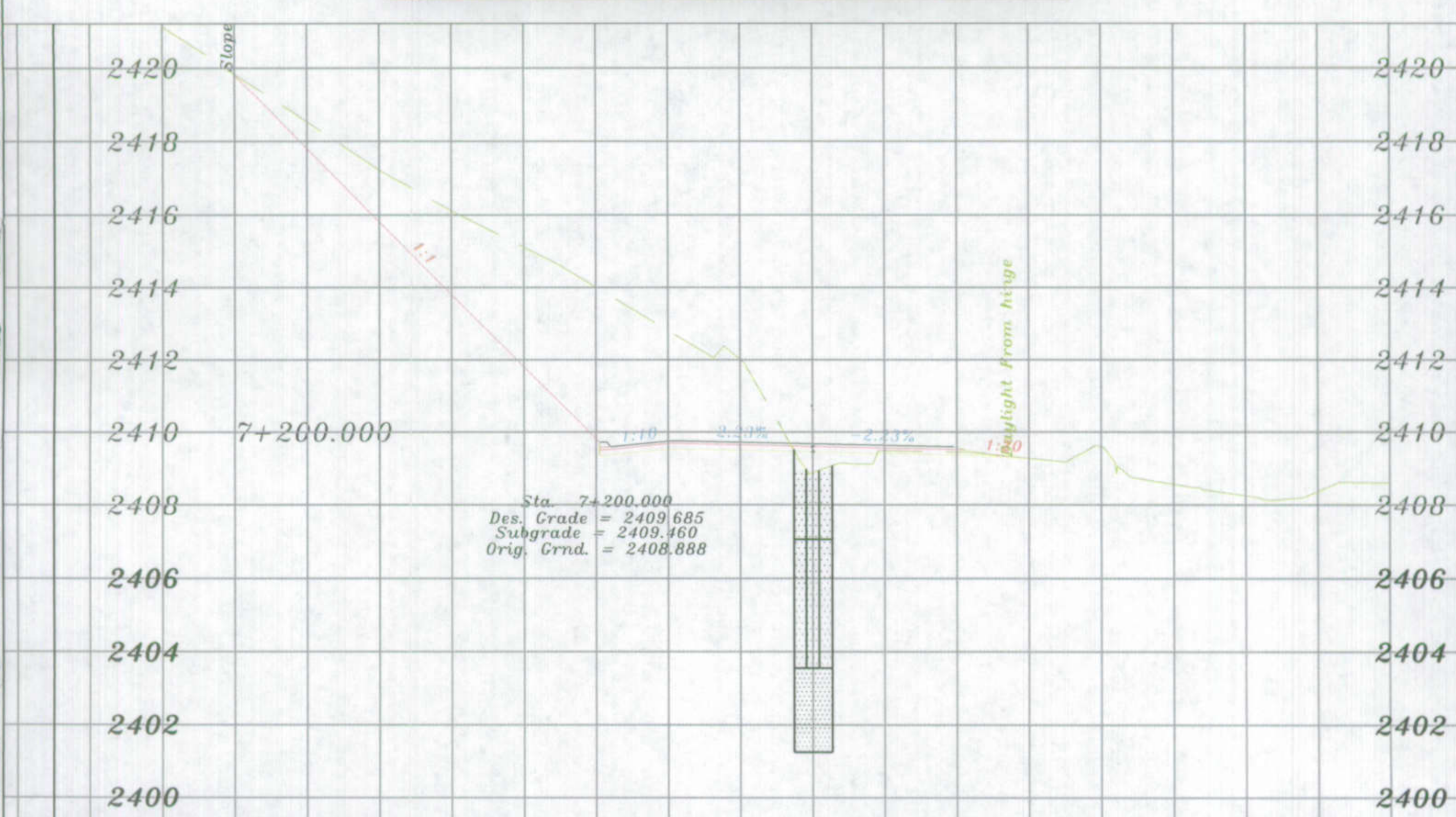


KLEINFELDER

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

BORING PROFILE
Boring MSE-6 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.24

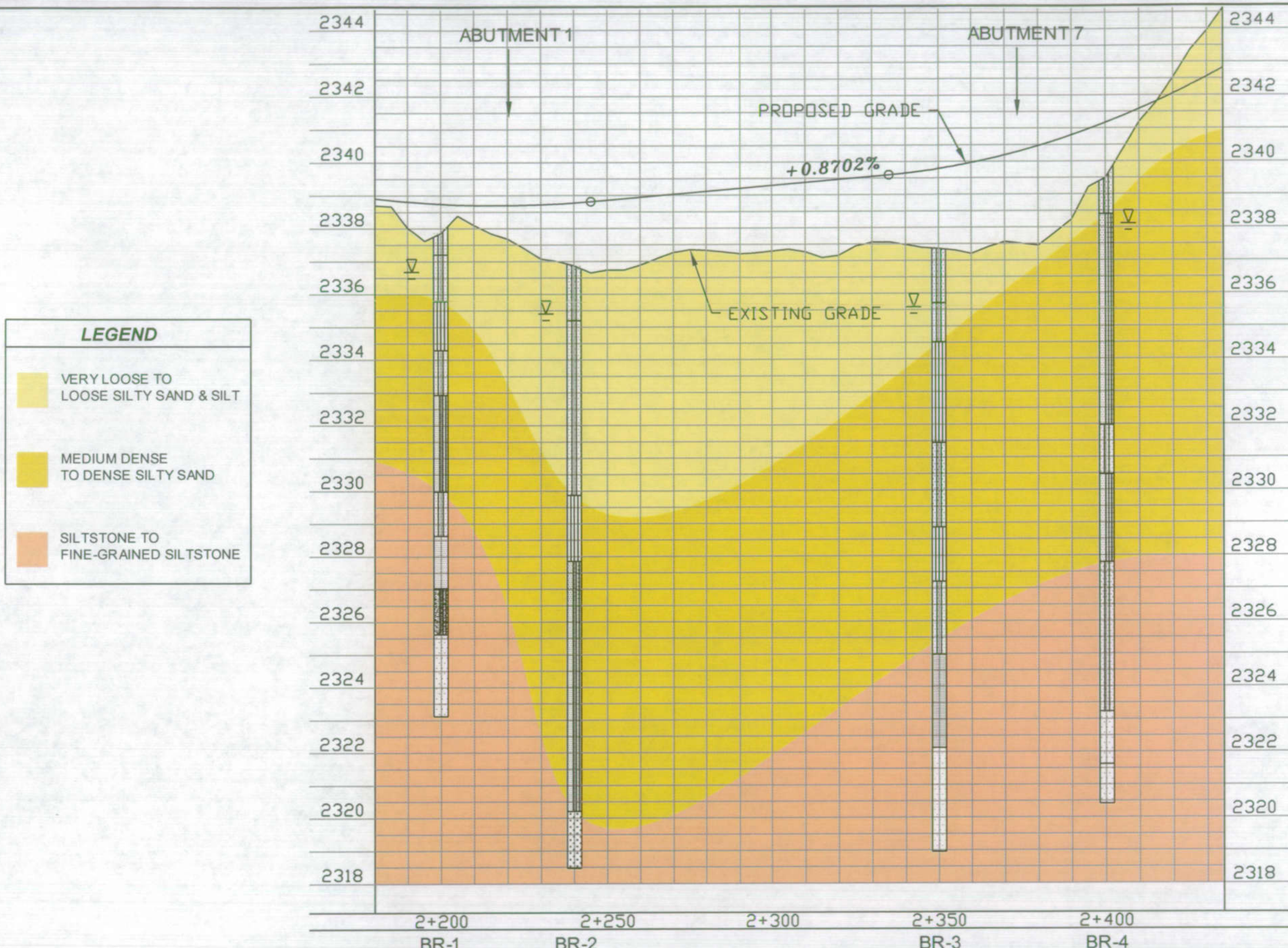


KLEINFELDER

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

BORING PROFILE
Boring MSE-7 Profile
New Mexico Hwy. 126
Cuba - La Cueva, New Mexico

FIGURE
C.25



KLEINFELDER

Drawn By: C. Landon | Date: January 2004
Project No.: 35321 | Filename: Figure C.26

SUBSURFACE PROFILE - BRIDGE AREA
Borings BR-1, BR-2, BR-3, & BR-4
New Mexico Highway 126
Cuba - La Cueva, New Mexico

FIGURE
C.26

Appendix D

APPENDIX D
Laboratory Test Results

SUMMARY OF GEOTECHNICAL PROPERTIES

Project NM SH 126 / NM Forest Hwy 12 **Location** Cuba - La Cueva, NM
Project Number 35321

Boring Number	Depth of top of sample m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Cumulative Percent Passing										Percent Moisture
		USCS	AASHTO	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")	38.1 mm (1 1/2")	
B-1	0.5 (1.5)	GM	A-1-b	NP	NV	15	19	29	51	56	60	60	64	85	100	14.4%
B-2	0 (0)	SM	A-4(0)	--	--	38	47	62	87	93	99	100	100	100	100	13.9%
B-3	0 (0)	SM	A-2-4(0)	NP	NV	25	34	52	76	85	92	97	100	100	100	12.6%
B-4	0.5 (1.5)	SM	A-1-b	--	--	19	24	35	60	72	84	86	89	100	100	21.4%
B-5	0.5 (1.5)	SM	A-4(0)	NP	NV	37	50	64	86	99	100	100	100	100	100	7.9%
B-6	0 (0)	SM	A-2-4(0)	NP	NV	27	37	52	79	87	96	96	100	100	100	7.0%
B-6	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.3%
B-6	3 (10)	SM	A-1-b	NP	NV	15	22	35	62	73	81	84	100	100	100	4.1%
B-6	4.6 (15)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.7%
B-6	6.1 (20)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.4%
B-6	7.6 (25)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.9%
B-7	0 (0)	SM	A-2-4(0)	NP	NV	26	39	55	76	84	91	93	94	100	100	11.3%
B-7	1.5 (5)	SM	A-2-4(0)	--	--	23	35	52	82	90	97	100	100	100	100	5.6%
B-8	0 (0)	SM	A-4(0)	NP	NV	40	48	59	83	92	99	100	100	100	100	6.2%
B-8	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.9%
B-8	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.2%
B-8	4.6 (15)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.1%
B-8	5.5 (18)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.9%
B-9	0 (0)	ML	A-4(0)	NP	NV	66	75	83	96	98	99	100	100	100	100	4.7%
B-9	2.7 (9)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.6%

Figure D.1

SUMMARY OF GEOTECHNICAL PROPERTIES

Project NM SH 126 / NM Forest Hwy 12 **Location** Cuba - La Cueva, NM
Project Number 35321

Boring Number	Depth of top of sample m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Cumulative Percent Passing										Percent Moisture
		USCS	AASHTO	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")	38.1 mm (1 1/2")	
B-10	1.4 (4.5)	SM	A-2-4(0)	--	--	27	34	48	74	83	91	96	100	100	100	4.9%
B-11	0 (0)	SM	A-2-4(0)	NP	NV	29	36	49	75	83	91	94	96	100	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)	SM	A-4(0)	NP	NV	38	45	54	72	83	98	98	100	100	100	9.3%
B-13	0.5 (1.5)	SM	A-2-4(0)	NP	NV	34	43	56	80	89	97	100	100	100	100	20.5%
BR-1	2.6 (8.5)	--	--	NP	NV	--	--	--	--	--	--	--	--	--	--	--
BR-1	4.1 (13.5)	SM	A-2-4(0)	--	--	31	40	47	63	69	80	82	91	95	100	30.5%
BR-1	7.2 (23.5)	SM	A-2-4(0)	--	--	30	38	50	72	79	84	88	92	97	100	32.6%
BR-1	10.2 (33.5)	SP-SM	A-1-b	--	--	11	16	27	57	70	85	92	100	100	100	15.7%
BR-1	11.7 (38.5)	--	--	--	--	26	--	--	--	--	--	--	--	--	--	10.5%
BR-1	14.8 (48.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.7%
BR-2	1.5 (5)	SM	A-1-b	NP	NV	21	29	44	74	84	99	100	100	100	100	26.8%
BR-2	6.1 (20)	SM	A-4(0)	--	--	41	50	66	94	98	100	100	100	100	100	34.9%
BR-2	12.2 (40)	SP-SM	A-1-b	--	--	11	16	30	59	73	87	91	94	100	100	23.4%
BR-3	4.6 (15)	ML	A-4(0)	--	--	54	64	74	91	95	98	99	100	100	100	43.8%
BR-4	2.7 (9)	SM	A-1-b	--	--	20	32	50	80	90	96	98	100	100	100	41.2%
BR-4	5.8 (19)	SM	A-1-b	--	--	16	23	37	68	81	92	96	98	100	100	29.9%
BR-4	14.9 (49)	SM	A-2-4(0)	--	--	31	39	54	67	74	82	88	97	100	100	20.6%

Figure D.2

SUMMARY OF GEOTECHNICAL PROPERTIES

Project NM SH 126 / NM Forest Hwy 12 **Location** Cuba - La Cueva, NM
Project Number 35321

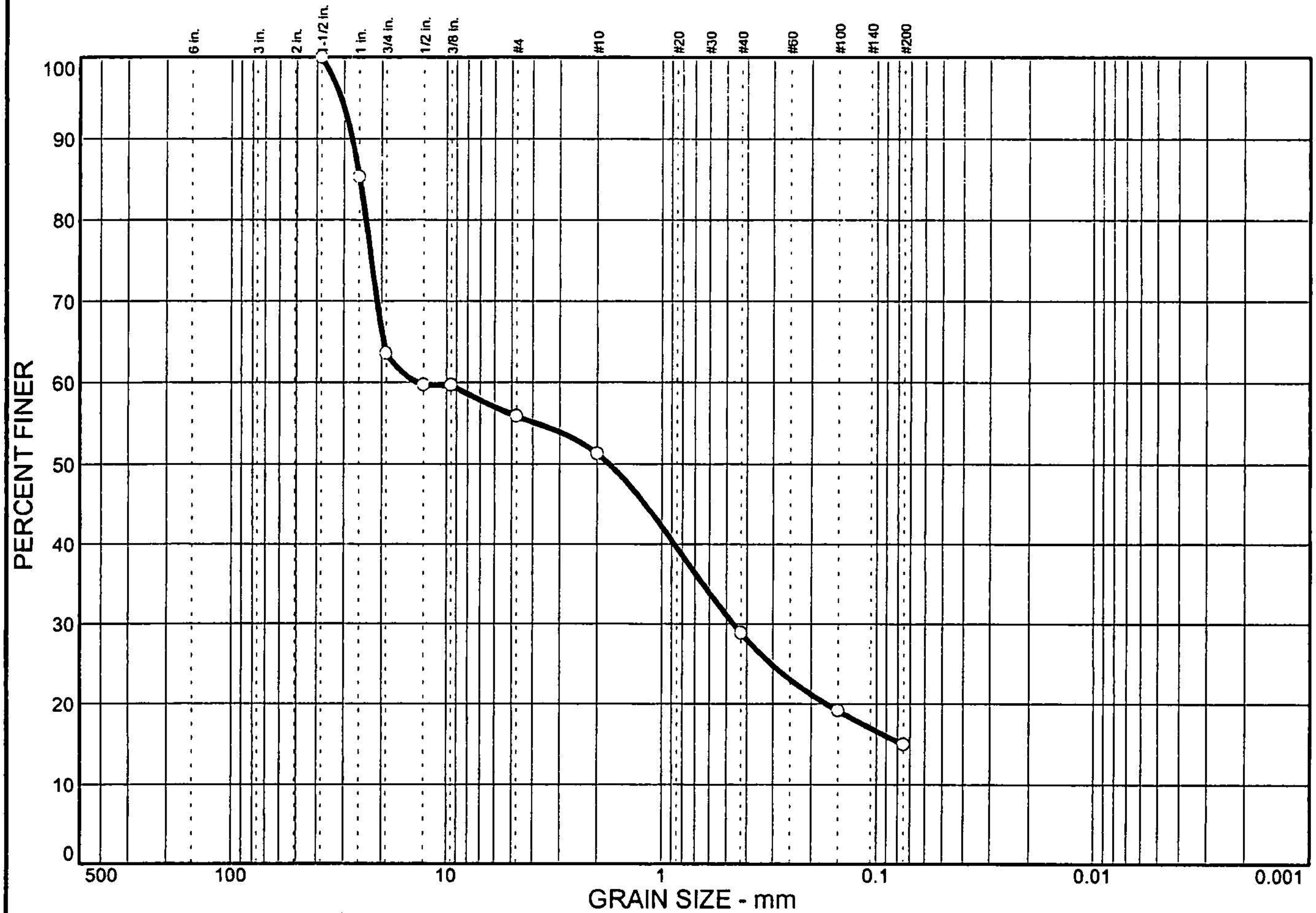
Boring Number	Depth of top of sample m (ft.)	Soil Classification		Atterberg Limits		Sieve Analysis - Cumulative Percent Passing										Percent Moisture
		USCS	AASHTO	PI	LL	0.075 mm (#200)	0.150 mm (#100)	0.425 mm (#40)	2.000 mm (#10)	4.750 mm (#4)	9.525 mm (3/8")	12.7 mm (1/2")	19.05 mm (3/4")	25.4 mm (1")	38.1 mm (1 1/2")	
BR-4	16.5 (54)	--	--	--	--	73	--	--	--	--	--	--	--	--	--	13.9%
MSE-1	0 (0)	GM	A-1-b	NP	NV	16	23	33	48	57	73	82	92	100	100	4.4%
MSE-1	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.6%
MSE-1	3 (10)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.4%
MSE-2	0 (0)	SM	A-1-b	--	--	21	29	41	68	78	87	91	96	100	100	3.5%
MSE-3	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.4%
MSE-3	4.6 (15)	GM	A-1-a	--	--	15	20	28	40	50	55	61	64	100	100	6.9%
MSE-4	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.9%
MSE-4	4.3 (14)	SM	A-4(0)	--	--	36	51	69	93	98	99	100	100	100	100	24.4%
MSE-5	0 (0)	SM	A-1-b	--	--	18	22	31	50	67	90	95	100	100	100	4.4%
MSE-5	1.5 (5)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.1%
MSE-5	3 (10)	GM	A-1-a	--	--	15	18	26	44	59	75	82	97	100	100	4.1%
MSE-6	0 (0)	SM	A-1-b	--	--	23	29	39	59	72	84	91	98	100	100	10.1%
MSE-6	1.2 (4)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.4%
MSE-6	4.3 (14)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.5%
MSE-7	0 (0)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.1%
MSE-7	1.2 (4)	SM	A-1-b	--	--	20	23	29	45	56	69	71	84	100	100	11.6%

Reviewed By: Taya Retterer

KLEINFELDER

Figure D.3

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	44.1	40.9	15.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2 in.	100.0		
1 in.	85.3		
3/4 in.	63.6		
1/2 in.	59.7		
3/8 in.	59.7		
#4	55.9		
#10	51.3		
#40	28.9		
#100	19.2		
#200	15.0		

* (no specification provided)

Soil Description

Silty gravel with sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 25.3 D_{60}= 13.5 D_{50}= 1.76
D_{30}= 0.461 D_{15}= 0.0750 D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

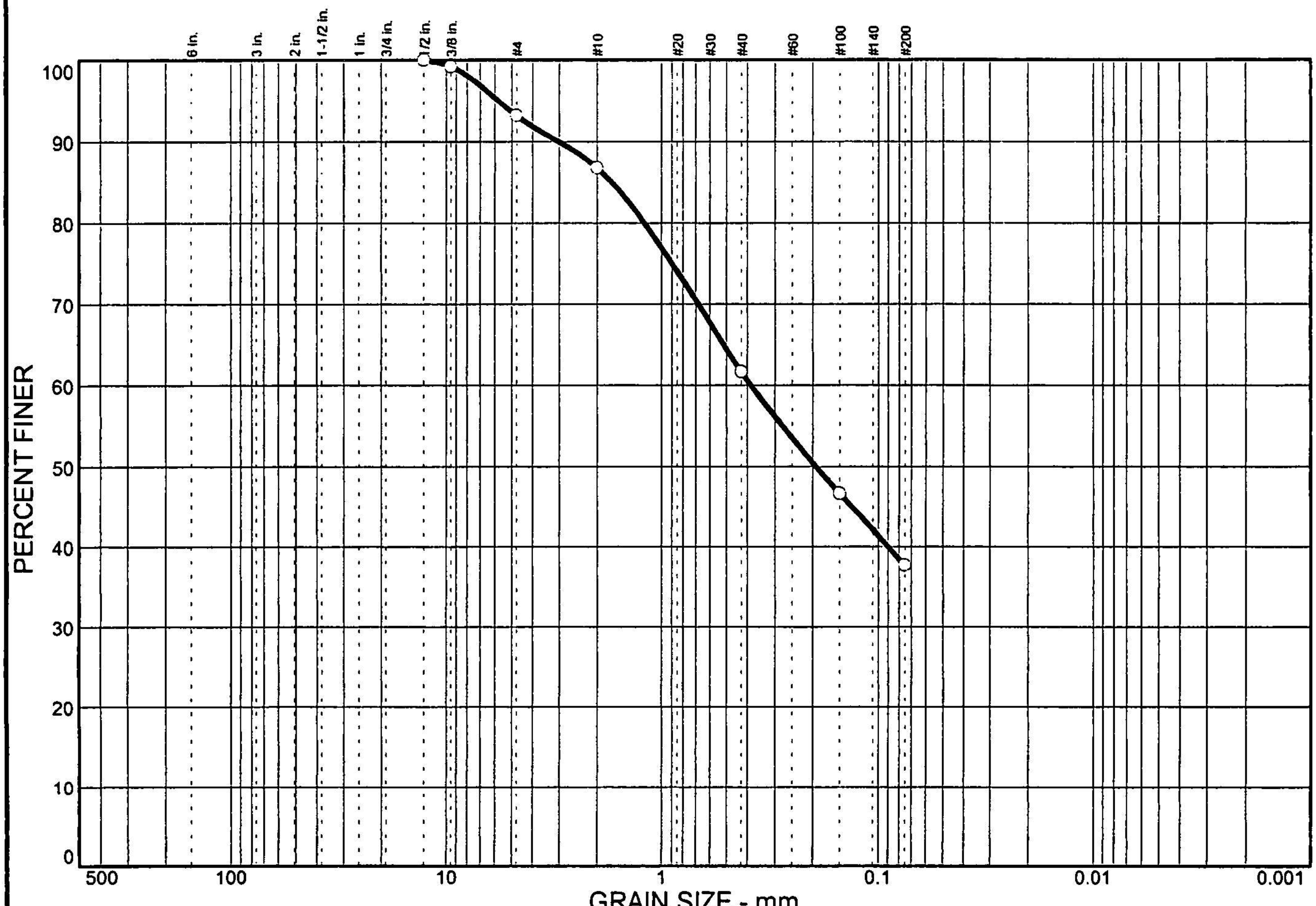
Remarks

Sample No.: 03-227-1 **Source of Sample:** B-01, 0.5 m (1.5 ft.) **Date:** 11/10/03
Location: B-1 **Elev./Depth:** 0.5 m (1.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.4

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	6.8	55.5	37.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.2		
#4	93.2		
#10	86.8		
#40	61.7		
#100	46.7		
#200	37.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.70 D_{60}= 0.383 D_{50}= 0.193
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

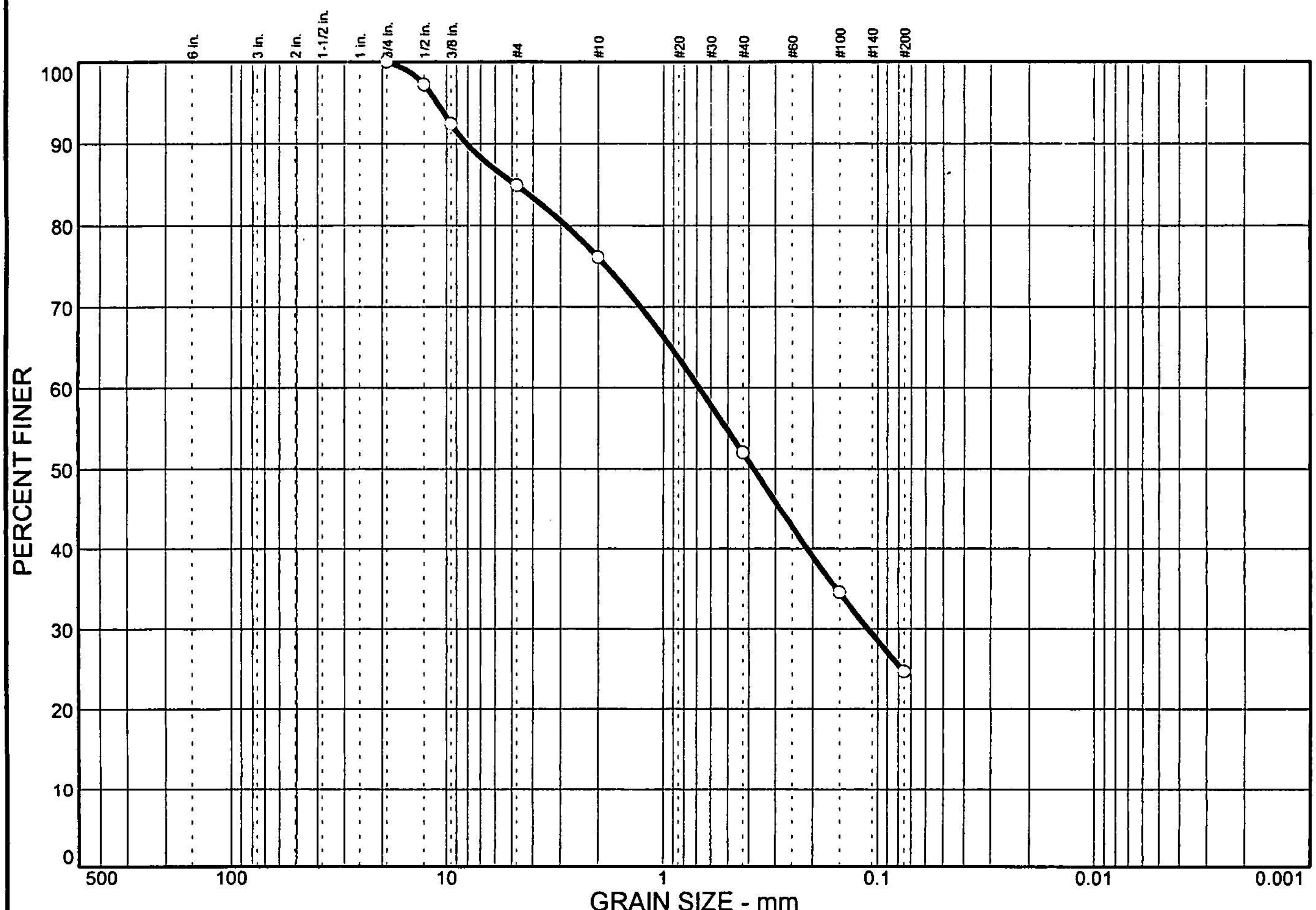
Remarks

Sample No.: 03-227-2 **Source of Sample:** B-02, 0 m (0 ft.) **Date:** 11-10-03
Location: B-2 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.5

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	15.1	60.2	24.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	97.2		
3/8 in.	92.4		
#4	84.9		
#10	76.1		
#40	52.0		
#100	34.5		
#200	24.7		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 4.81 D_{60}= 0.678 D_{50}= 0.379
D_{30}= 0.110 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

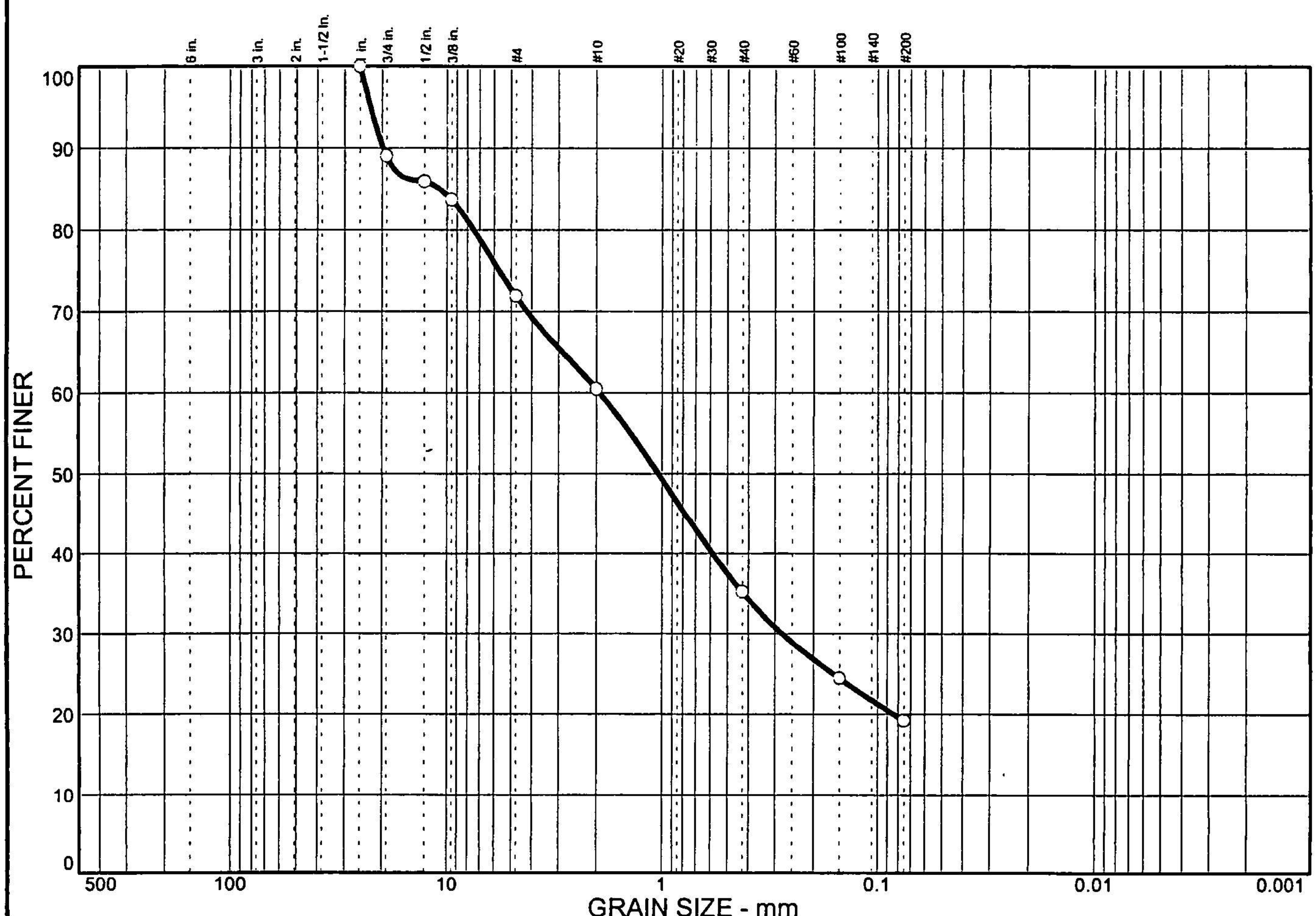
Remarks

Sample No.: 03-227-3 **Source of Sample:** B-03, 0 m (0 ft.) **Date:** 11-10-03
Location: B-3 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.6

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	28.1	52.7	19.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	89.0		
1/2 in.	85.9		
3/8 in.	83.7		
#4	71.9		
#10	60.5		
#40	35.2		
#100	24.5		
#200	19.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 10.8 D_{60}= 1.93 D_{50}= 1.04
D_{30}= 0.276 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

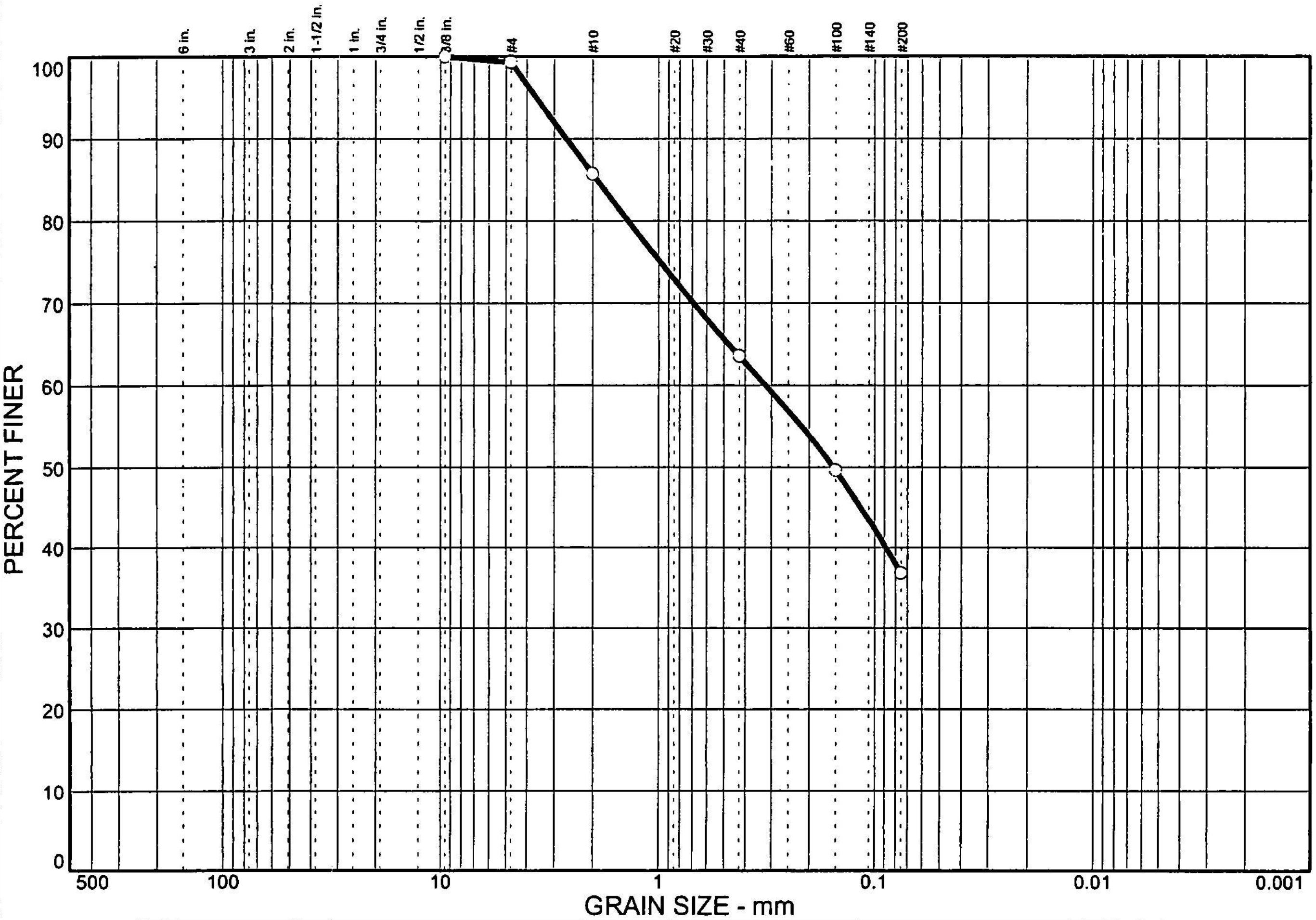
Remarks

Sample No.: 03-227-4 **Source of Sample:** B-04, 0.5 m (1.5 ft.) **Date:** 11-10-03
Location: B-4 **Elev./Depth:** 0.5 m (1.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.7

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.7	62.5	36.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.3		
#10	85.7		
#40	63.6		
#100	49.6		
#200	36.8		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 1.91 D_{60}= 0.319 D_{50}= 0.154
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

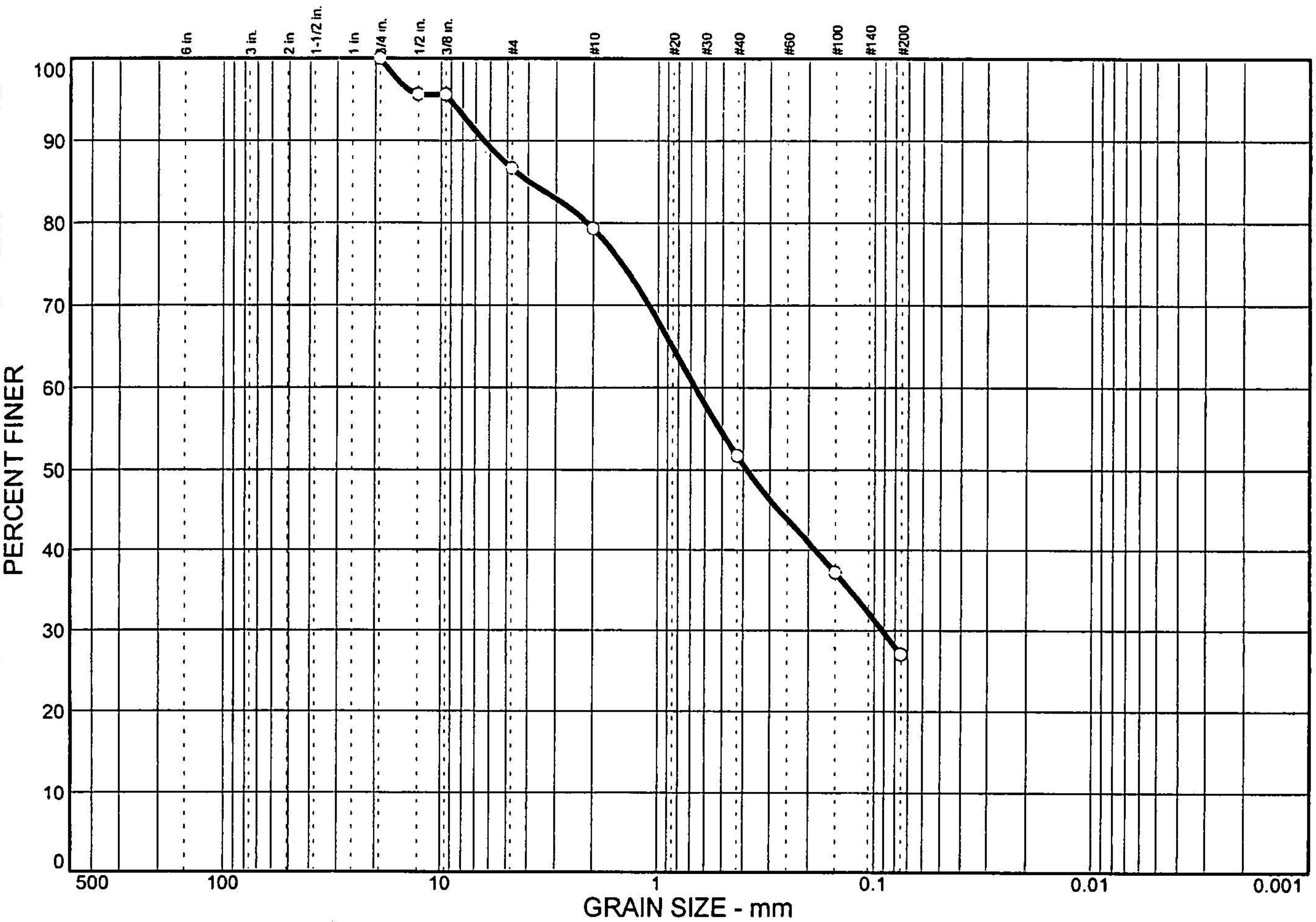
Remarks

Sample No.: 03-227-5 **Source of Sample:** B-05, 0.5 m (1.5 ft.) **Date:** 11-10-03
Location: B-5 **Elev./Depth:** 0.5 m (1.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.8

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	13.4	59.6	27.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	95.6		
3/8 in.	95.6		
#4	86.6		
#10	79.3		
#40	51.7		
#100	37.2		
#200	27.0		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 3.96 D_{60}= 0.664 D_{50}= 0.383
D_{30}= 0.0914 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

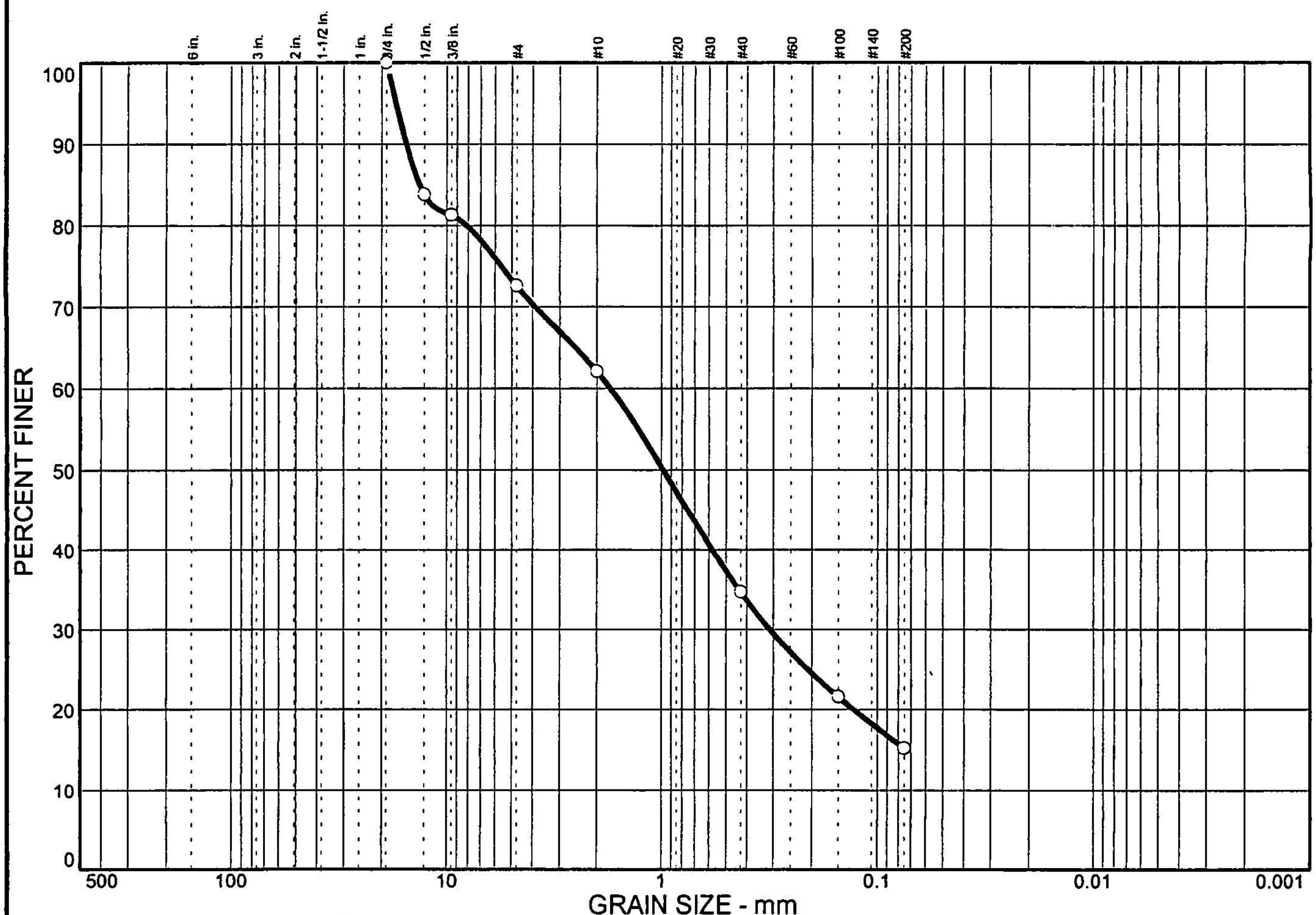
Remarks

Sample No.: 03-227-6 **Source of Sample:** B-06, 0 m (0 ft.) **Date:** 11-10-03
Location: B-6 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.9

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	27.4	57.4	15.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	83.8		
3/8 in.	81.3		
#4	72.6		
#10	62.1		
#40	34.7		
#100	21.6		
#200	15.2		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 13.3 D_{60}= 1.73 D_{50}= 0.979
D_{30}= 0.310 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

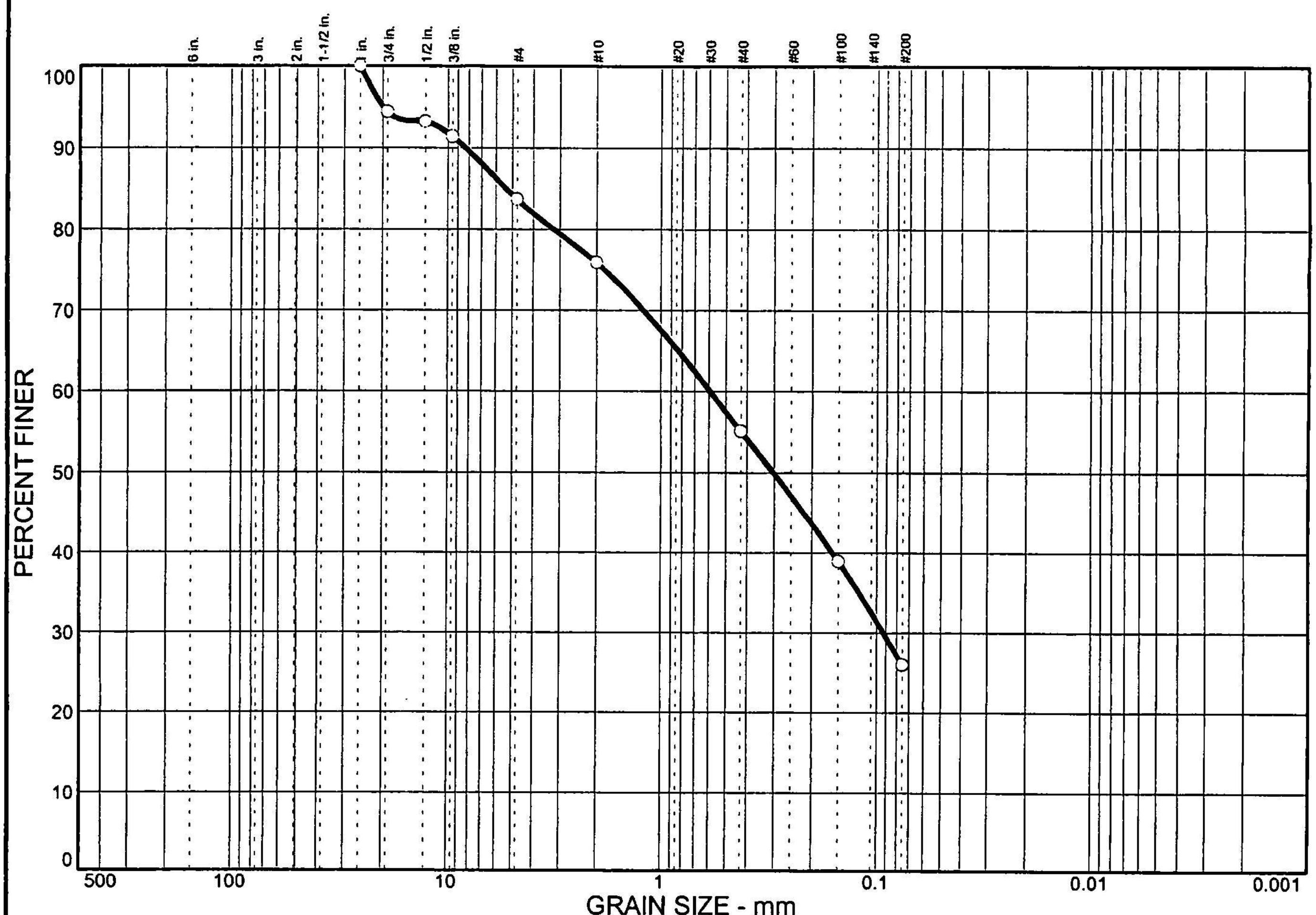
Sample No.: 03-227-8 **Source of Sample:** B-06, 3 m (10 ft.) **Date:** 11-10-03
Location: B-6 **Elev./Depth:** 3 m (10')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM

Project No: 35321 **Plate Number:** D.10

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	16.3	57.7	26.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	94.4		
1/2 in.	93.2		
3/8 in.	91.4		
#4	83.7		
#10	75.9		
#40	55.1		
#100	38.9		
#200	26.0		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 5.35 D_{60}= 0.590 D_{50}= 0.302
D_{30}= 0.0924 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

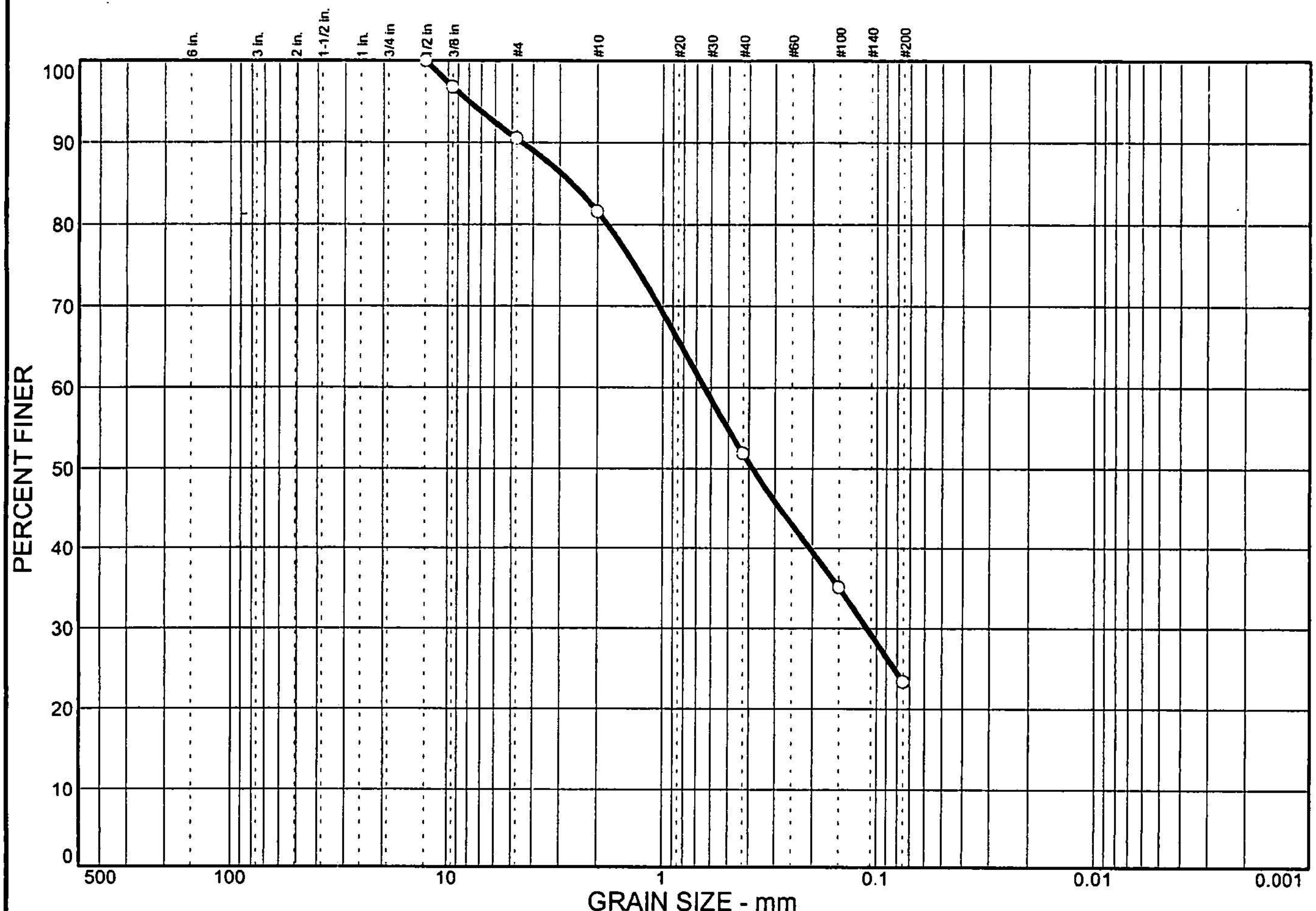
Remarks

Sample No.: 03-227-12 **Source of Sample:** B-07, 0 m (0 ft.) **Date:** 11-10-03
Location: B-7 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.11

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	9.5	67.1	23.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	96.8		
#4	90.5		
#10	81.6		
#40	51.9		
#100	35.1		
#200	23.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.62 D_{60}= 0.641 D_{50}= 0.382
D_{30}= 0.110 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

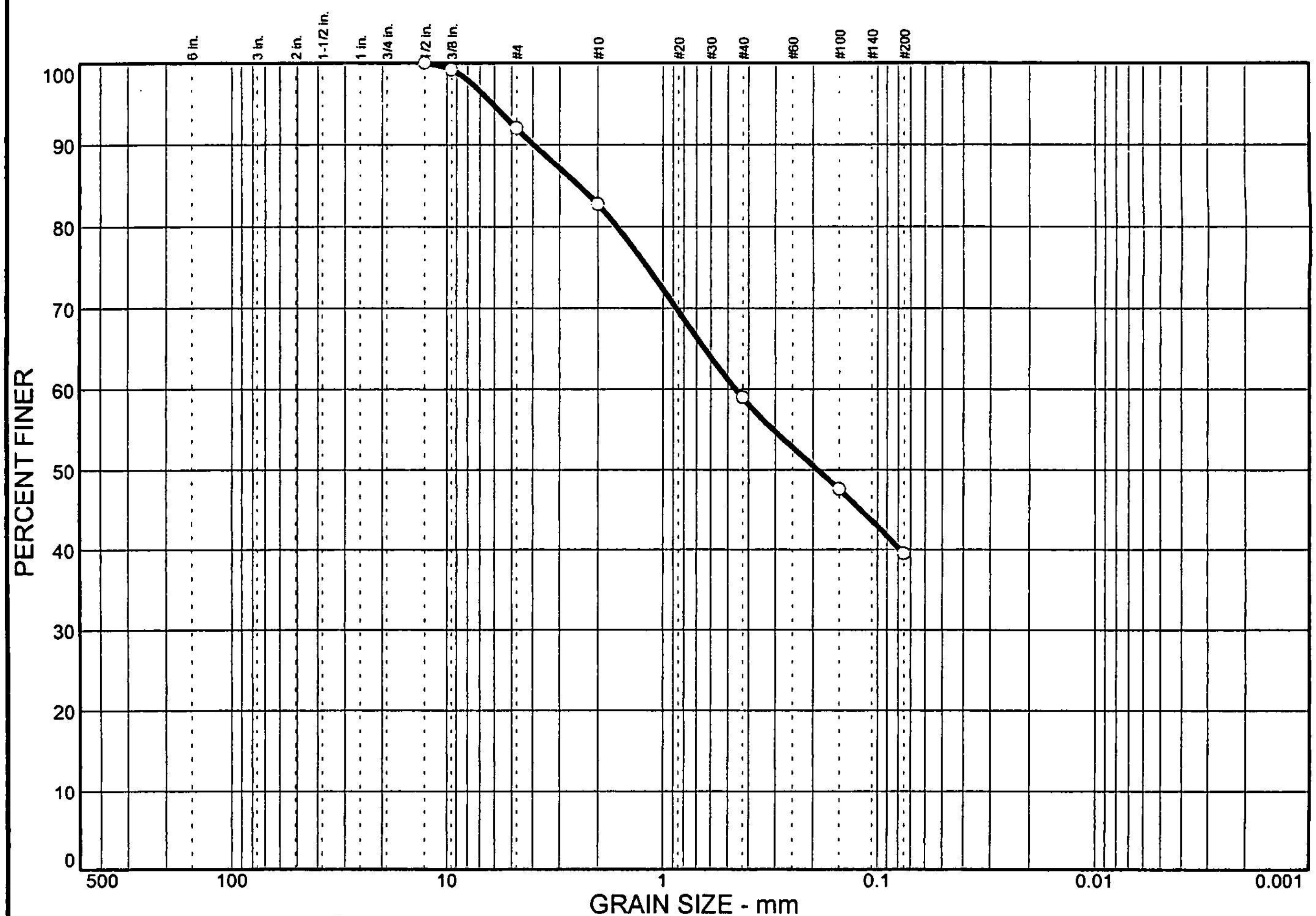
Remarks

Sample No.: 03-227-13 **Source of Sample:** B-07, 1.5 m (5 ft.) **Date:** 11-10-03
Location: B-7 **Elev./Depth:** 1.5 m (5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.12

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	8.0	52.5	39.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.2		
#4	92.0		
#10	82.7		
#40	59.0		
#100	47.6		
#200	39.5		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 2.44 D_{60}= 0.457 D_{50}= 0.189
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Sample No.: 03-227-14 **Source of Sample:** B-08, 0 m (0 ft.) **Date:** 11-10-03
Location: B-8 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.13

Particle Size Distribution Report

% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.8	32.5	65.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.5		
#4	98.2		
#10	95.8		
#40	83.2		
#100	75.1		
#200	65.7		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.531 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

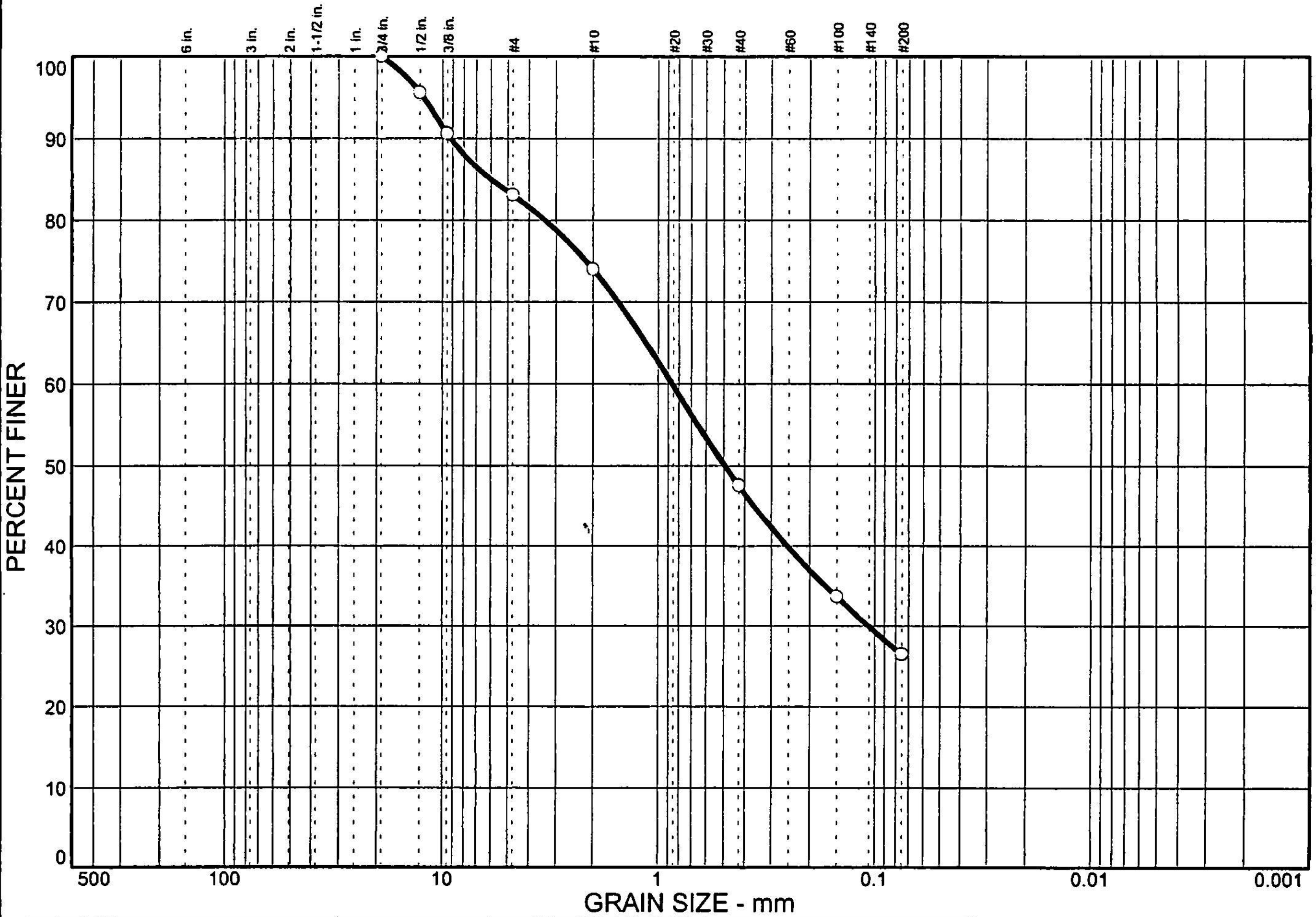
Remarks

Sample No.: 03-245-1 **Source of Sample:** B-09, 0 m (0 ft.) **Date:** 11-21-03
Location: B-9 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.14

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	16.9	56.6	26.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	95.6		
3/8 in.	90.6		
#4	83.1		
#10	74.0		
#40	47.6		
#100	33.7		
#200	26.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 5.95 D_{60}= 0.859 D_{50}= 0.491
D_{30}= 0.106 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: 03-245-23 **Source of Sample:** B-10, 1.4 m (4.5 ft.) **Date:** 11-24-03
Location: B-10 **Elev./Depth:** 1.4 m (4.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.15

Particle Size Distribution Report

% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	16.8	54.3	28.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	96.5		
1/2 in.	93.8		
3/8 in.	91.2		
#4	83.2		
#10	75.2		
#40	49.5		
#100	36.1		
#200	28.9		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 5.60 D_{60}= 0.774 D_{50}= 0.438
D_{30}= 0.0836 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

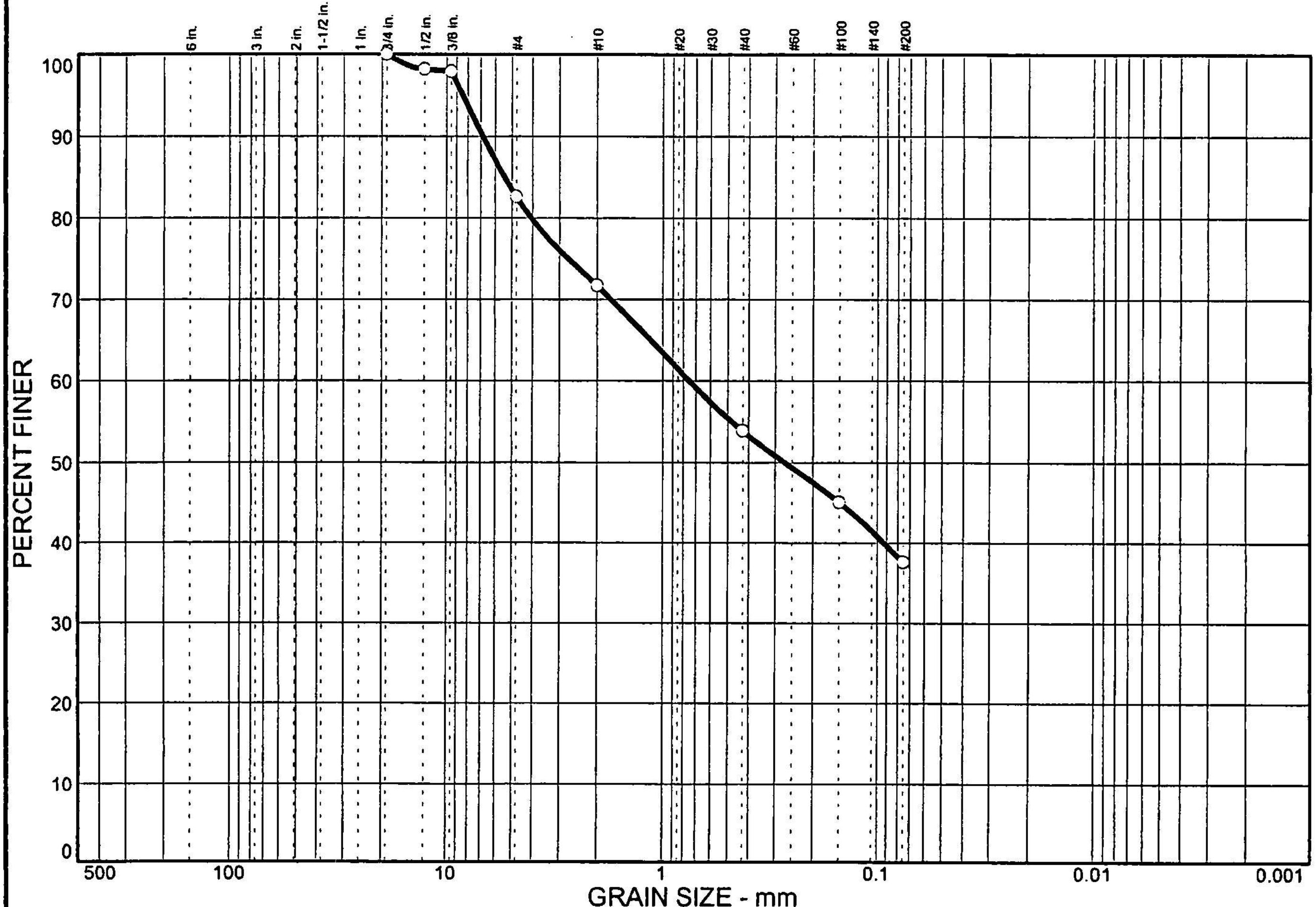
Remarks

Sample No.: 03-227-21 **Source of Sample:** B-11, 0 m (0 ft.) **Date:** 11-10-03
Location: B-11 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.16

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	17.4	45.0	37.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	98.2		
3/8 in.	97.9		
#4	82.6		
#10	71.7		
#40	53.9		
#100	45.1		
#200	37.6		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 5.40 D_{60}= 0.748 D_{50}= 0.269
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

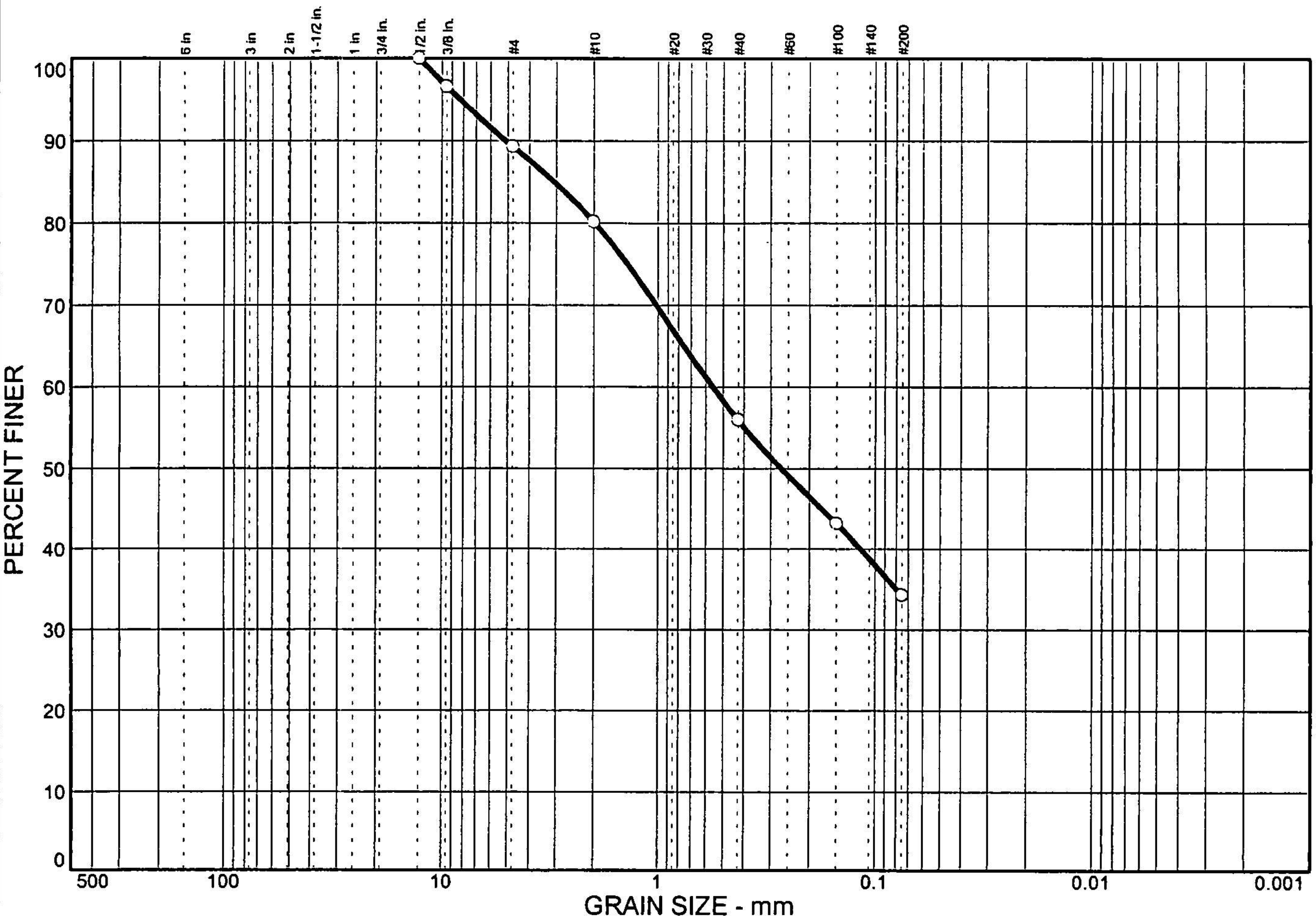
Remarks

Sample No.: 03-227-19 **Source of Sample:** B-12, 0 m (0 ft.) **Date:** 11-10-03
Location: B-12 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.17

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.7	55.0	34.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	96.6		
#4	89.3		
#10	80.2		
#40	56.0		
#100	43.2		
#200	34.3		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 3.05 D_{60}= 0.554 D_{50}= 0.267
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

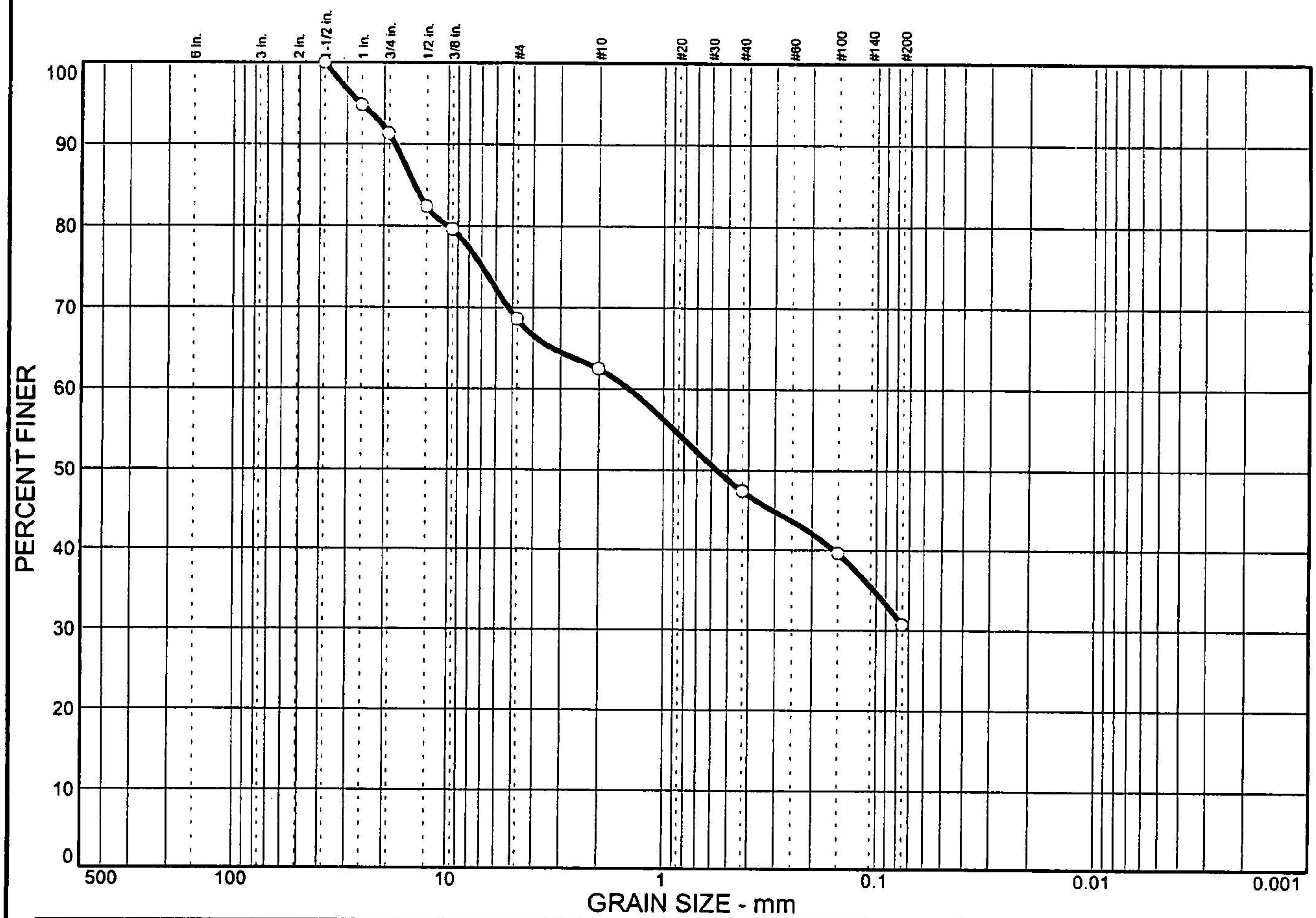
Remarks

Sample No.: 03-227-20 **Source of Sample:** B-13, 0.5 m (1.5 ft.) **Date:** 11-10-03
Location: B-13 **Elev./Depth:** 0.5 m (1.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.18

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	31.4	37.9	30.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2 in.	100.0		
1 in.	94.8		
3/4 in.	91.3		
1/2 in.	82.4		
3/8 in.	79.6		
#4	68.6		
#10	62.5		
#40	47.4		
#100	39.6		
#200	30.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 14.5 D_{60}= 1.45 D_{50}= 0.561
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

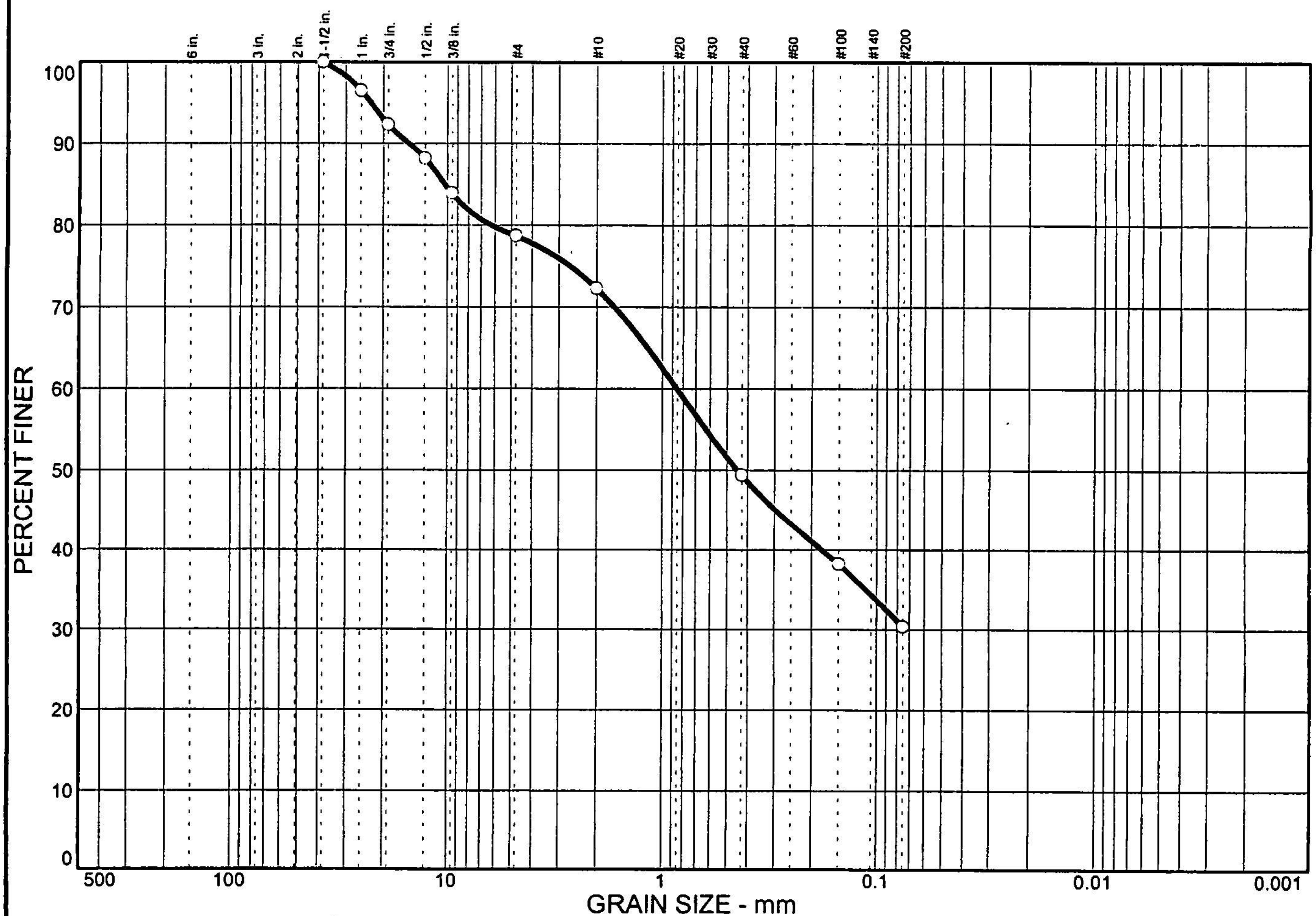
Remarks

Sample No.: 03-245-3 **Source of Sample:** BR-1, 4.1 m (13.5 ft.) **Date:** 11-21-03
Location: BR-1 **Elev./Depth:** 4.1 m (13.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.19

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	21.3	48.3	30.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2 in.	100.0		
1 in.	96.5		
3/4 in.	92.3		
1/2 in.	88.2		
3/8 in.	83.9		
#4	78.7		
#10	72.3		
#40	49.4		
#100	38.2		
#200	30.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 10.3 D_{60}= 0.854 D_{50}= 0.444
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

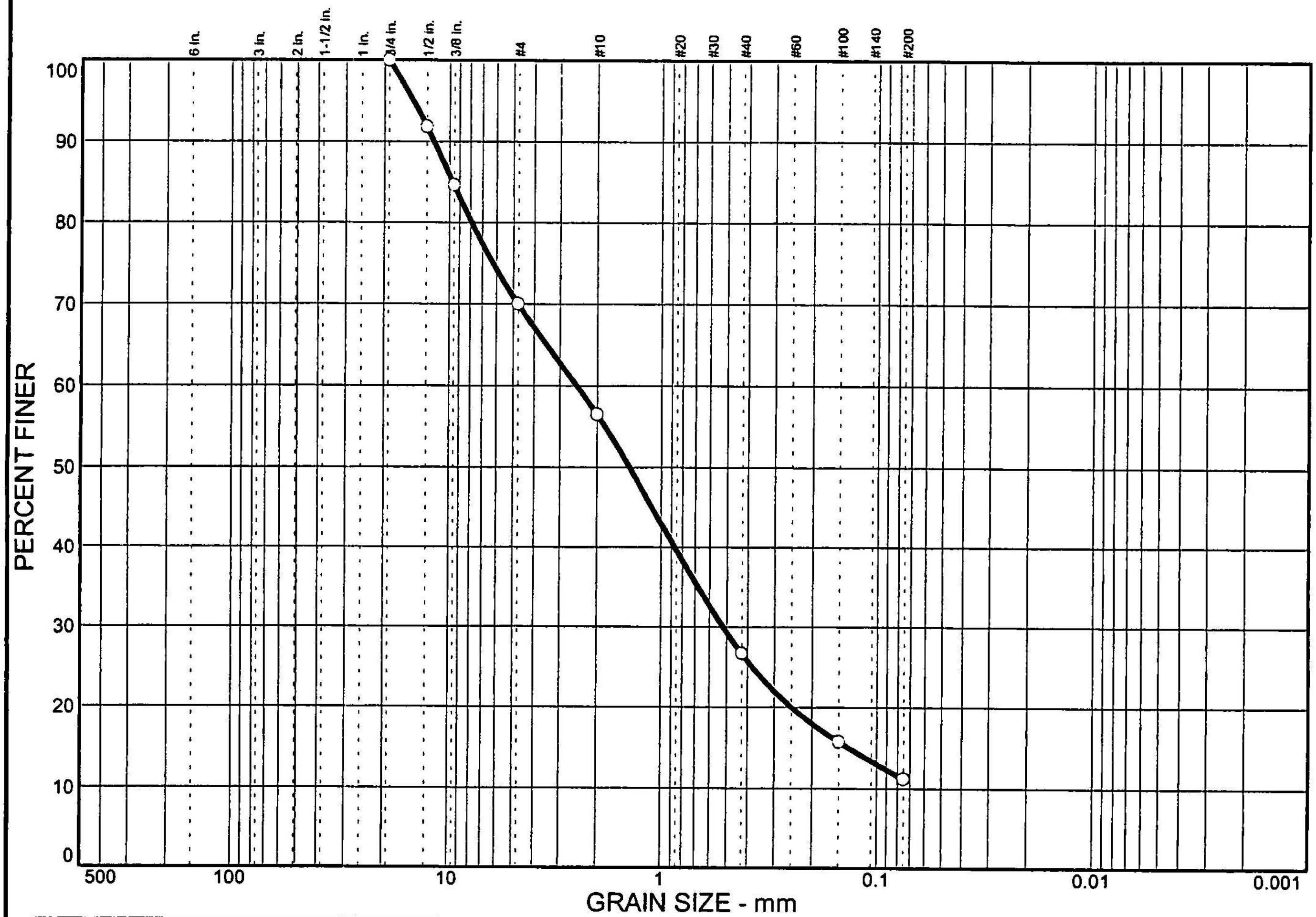
Remarks

Sample No.: 03-245-4 **Source of Sample:** BR-1, 7.2 m (23.5 ft.) **Date:** 11-24-03
Location: BR-1 **Elev./Depth:** 7.2 m (23.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.20

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	30.0	58.8	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	91.8		
3/8 in.	84.6		
#4	70.0		
#10	56.5		
#40	26.7		
#100	15.8		
#200	11.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 9.68 D_{60}= 2.48 D_{50}= 1.41
D_{30}= 0.519 D_{15}= 0.134 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

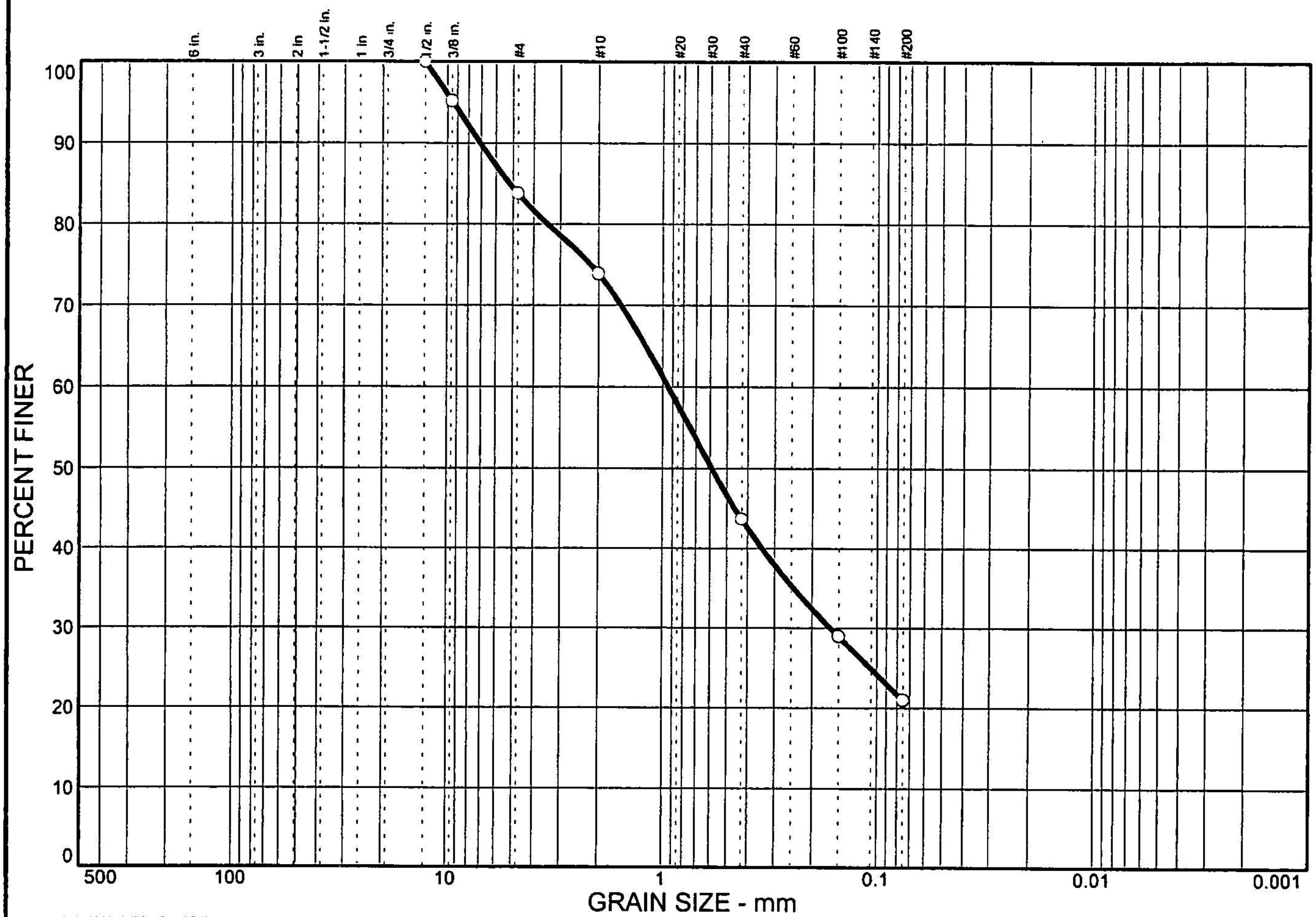
Remarks

Sample No.: 03-245-5 **Source of Sample:** BR-1, 10.2 m (33.5 ft.) **Date:** 11-24-03
Location: BR-1 **Elev./Depth:** 10.2 m (33.5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.21

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	16.2	62.8	21.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	95.2		
#4	83.8		
#10	73.9		
#40	43.7		
#100	29.0		
#200	21.0		

* (no specification provided)

Soil Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 5.17 D_{60}= 0.940 D_{50}= 0.587
D_{30}= 0.163 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

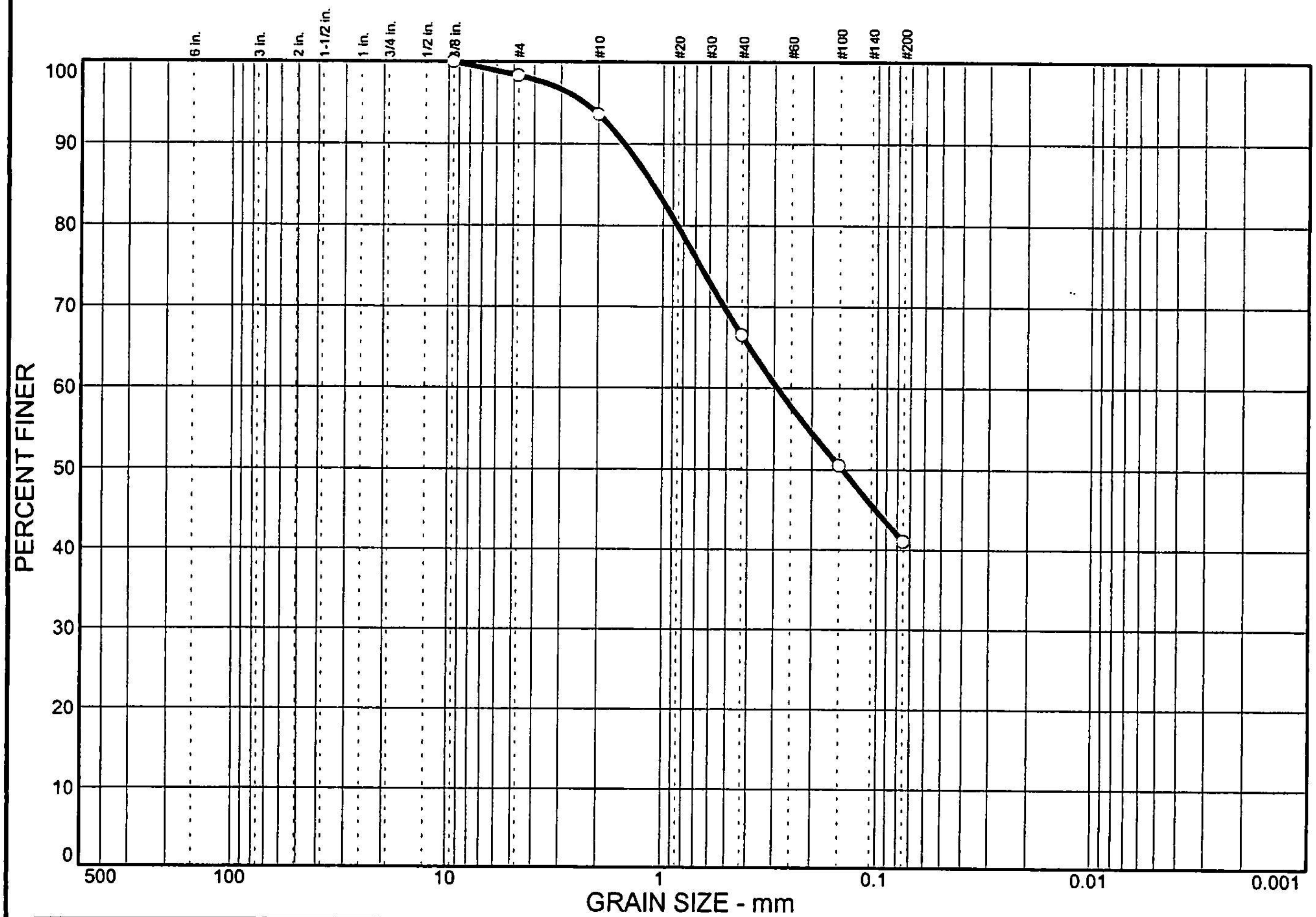
Remarks

Sample No.: 03-227-25 **Source of Sample:** BR-2, 1.5 m (5 ft.) **Date:** 11-10-03
Location: BR-2 **Elev./Depth:** 1.5 m (5')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.22

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.7	57.3	41.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	98.3		
#10	93.6		
#40	66.5		
#100	50.5		
#200	41.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.11 D_{60}= 0.289 D_{50}= 0.145
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

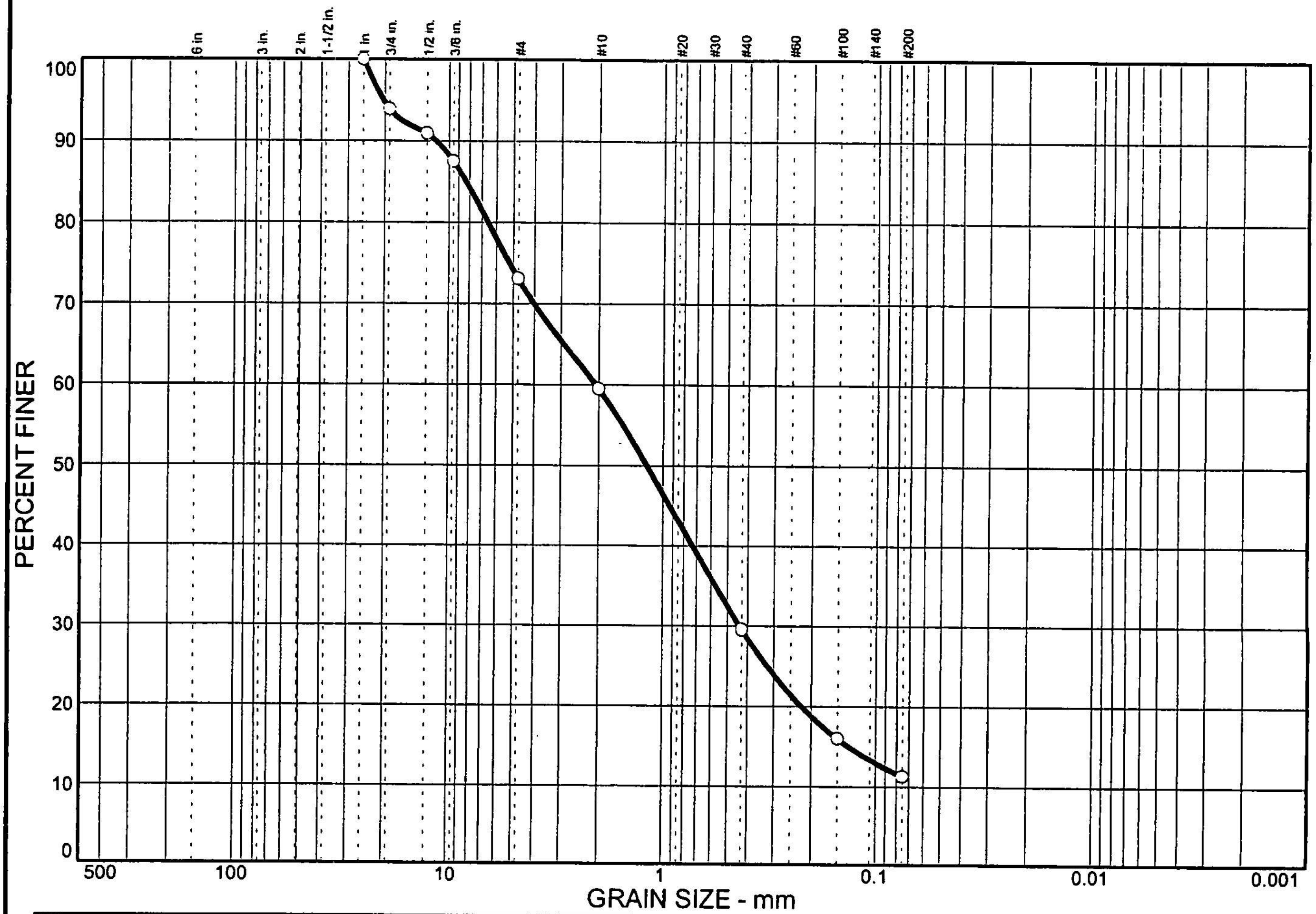
Remarks

Sample No.: 03-227-26 **Source of Sample:** BR-2, 6.1 m (20 ft.) **Date:** 11-10-03
Location: BR-2 **Elev./Depth:** 6.1 m (20')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.23

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	26.9	61.8	11.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	93.9		
1/2 in.	90.9		
3/8 in.	87.5		
#4	73.1		
#10	59.5		
#40	29.6		
#100	16.0		
#200	11.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 8.29 D_{60}= 2.06 D_{50}= 1.19
D_{30}= 0.435 D_{15}= 0.133 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

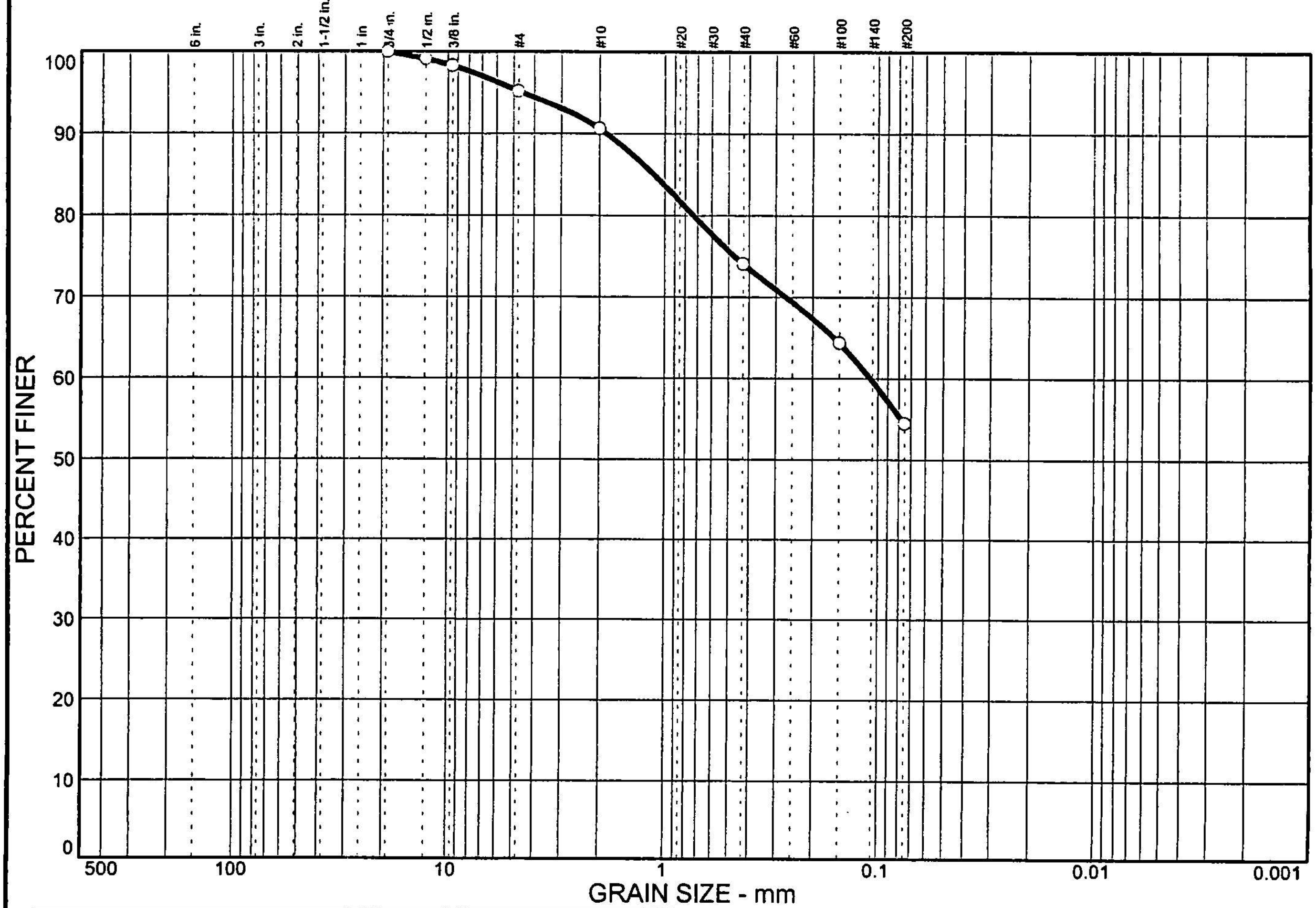
Remarks

Sample No.: 03-227-27 **Source of Sample:** BR-2, 12.2 m (40 ft.) **Date:** 11-10-03
Location: BR-2 **Elev./Depth:** 12.2 m (40')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.24

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.8	40.7	54.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	99.1		
3/8 in.	98.3		
#4	95.2		
#10	90.6		
#40	74.1		
#100	64.4		
#200	54.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.12 D_{60}= 0.108 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

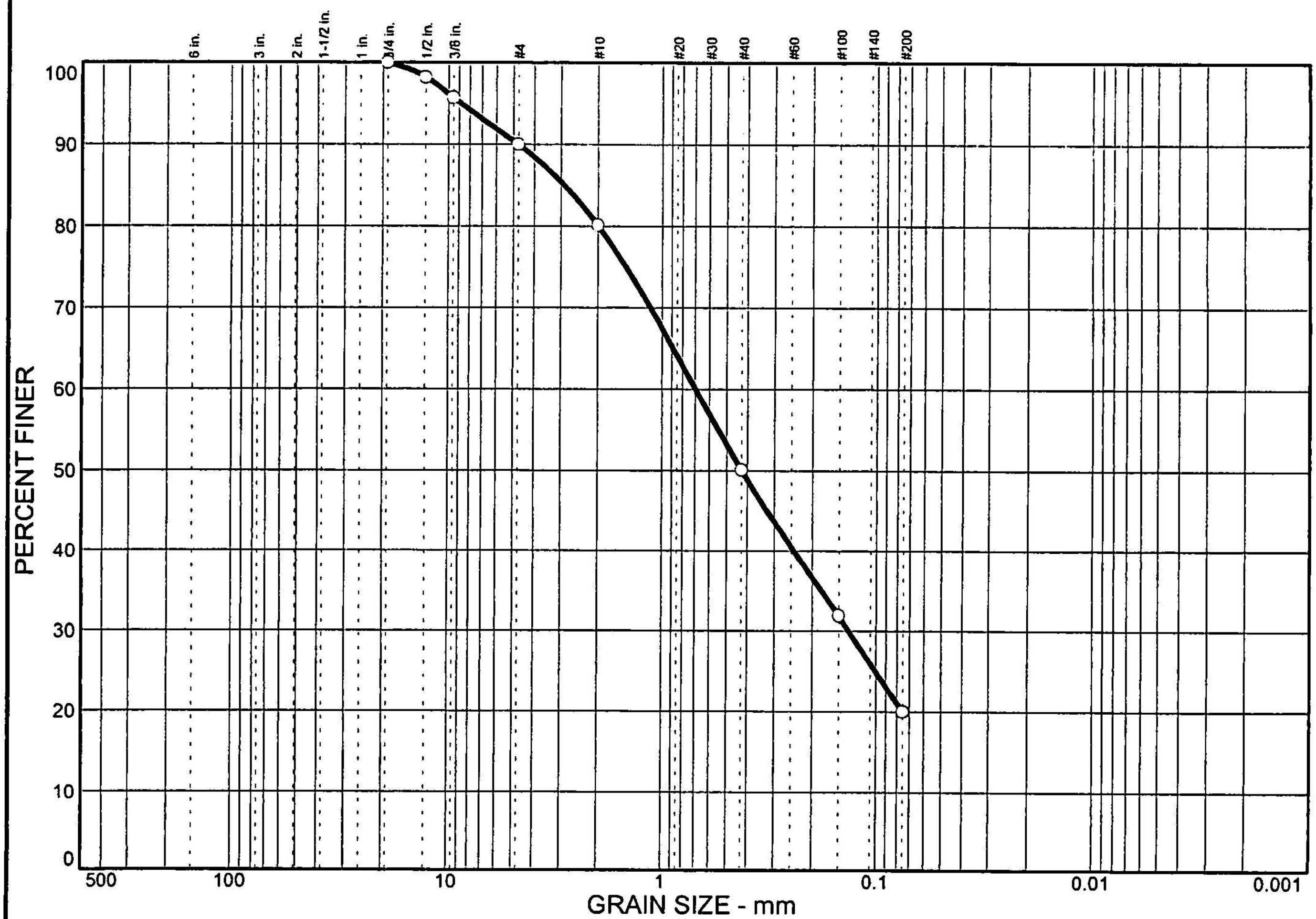
Remarks

Sample No.: 03-227-28 **Source of Sample:** BR-3, 4.6 m (15 ft.) **Date:** 11-10-03
Location: BR-3 **Elev./Depth:** 4.6 m (15')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.25

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.0	70.0	20.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	98.2		
3/8 in.	95.7		
#4	90.0		
#10	80.1		
#40	50.1		
#100	31.9		
#200	20.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.88 D_{60}= 0.694 D_{50}= 0.423
D_{30}= 0.134 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

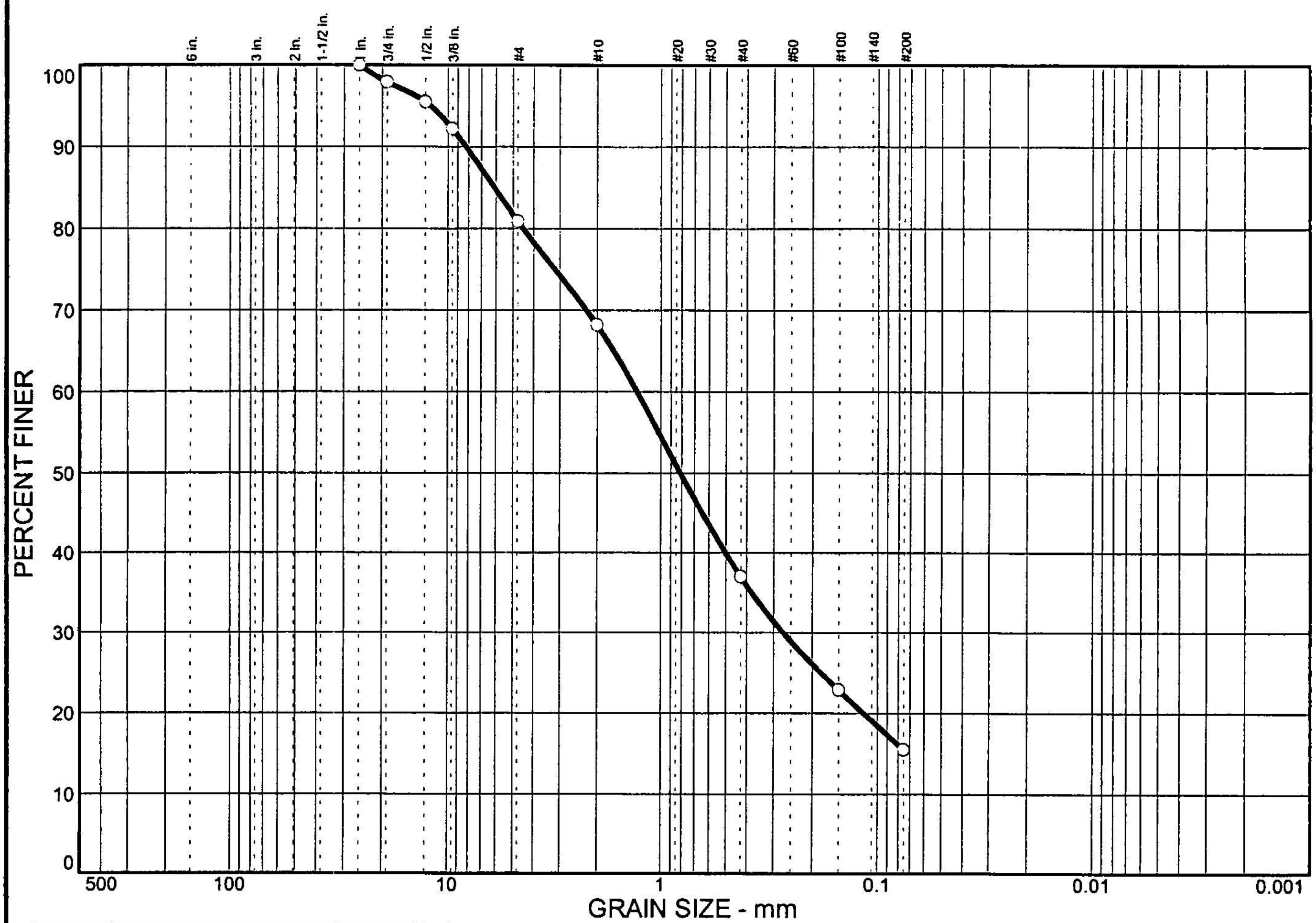
Remarks

Sample No.: 03-245-8 **Source of Sample:** BR-4, 2.7 m (9 ft.) **Date:** 11-24-03
Location: BR-4 **Elev./Depth:** 2.7 m (9')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.26

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	19.1	65.4	15.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	97.9		
1/2 in.	95.5		
3/8 in.	92.2		
#4	80.9		
#10	68.2		
#40	37.0		
#100	22.9		
#200	15.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 6.09 D_{60}= 1.30 D_{50}= 0.811
D_{30}= 0.270 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

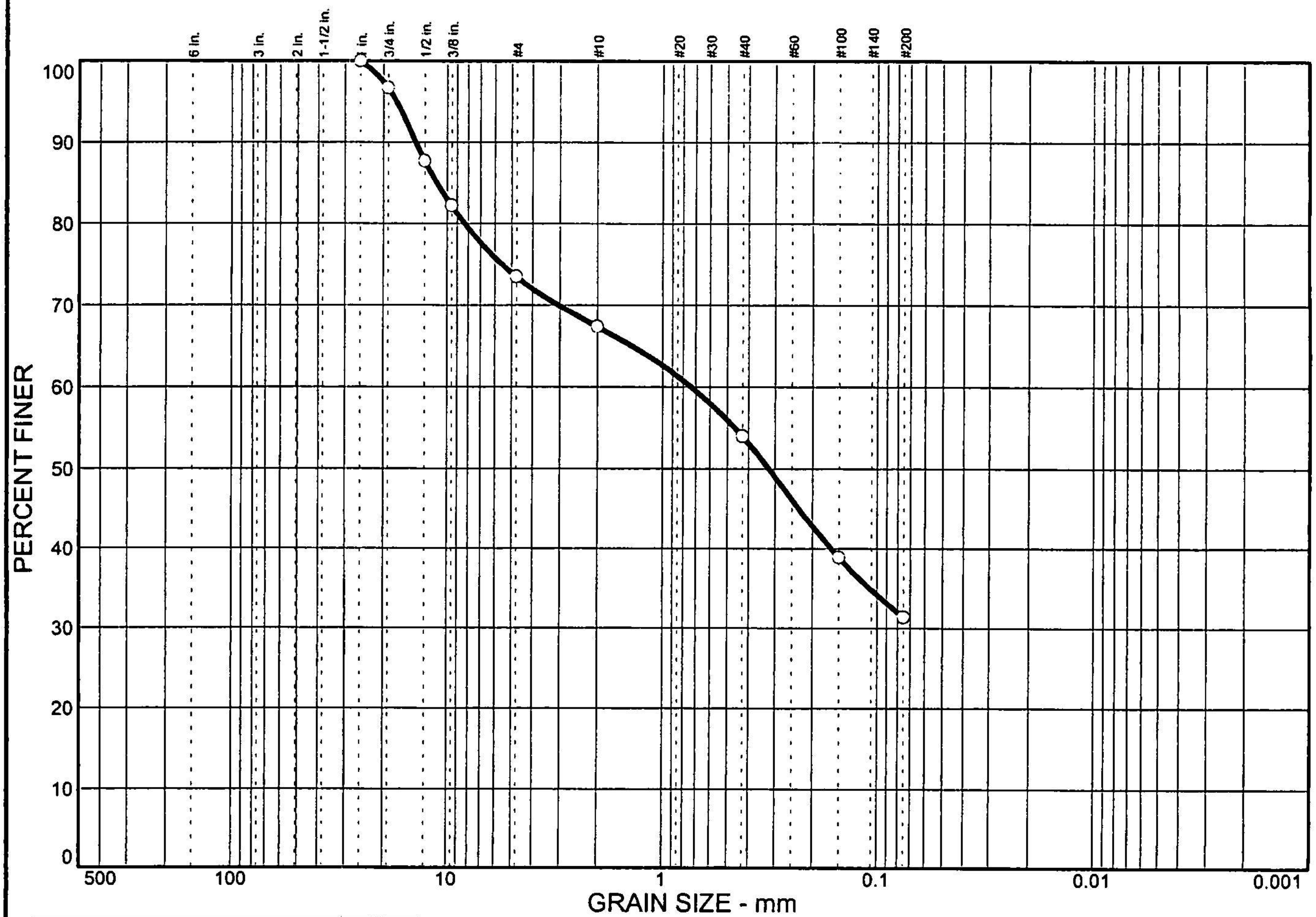
Remarks

Sample No.: 03-245-9 **Source of Sample:** BR-4, 5.8 m (19 ft.) **Date:** 11-24-03
Location: BR-4 **Elev./Depth:** 5.8 m (19')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.27

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	26.5	42.1	31.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	96.7		
1/2 in.	87.7		
3/8 in.	82.2		
#4	73.5		
#10	67.4		
#40	54.0		
#100	38.9		
#200	31.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 11.1 D_{60}= 0.729 D_{50}= 0.320
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

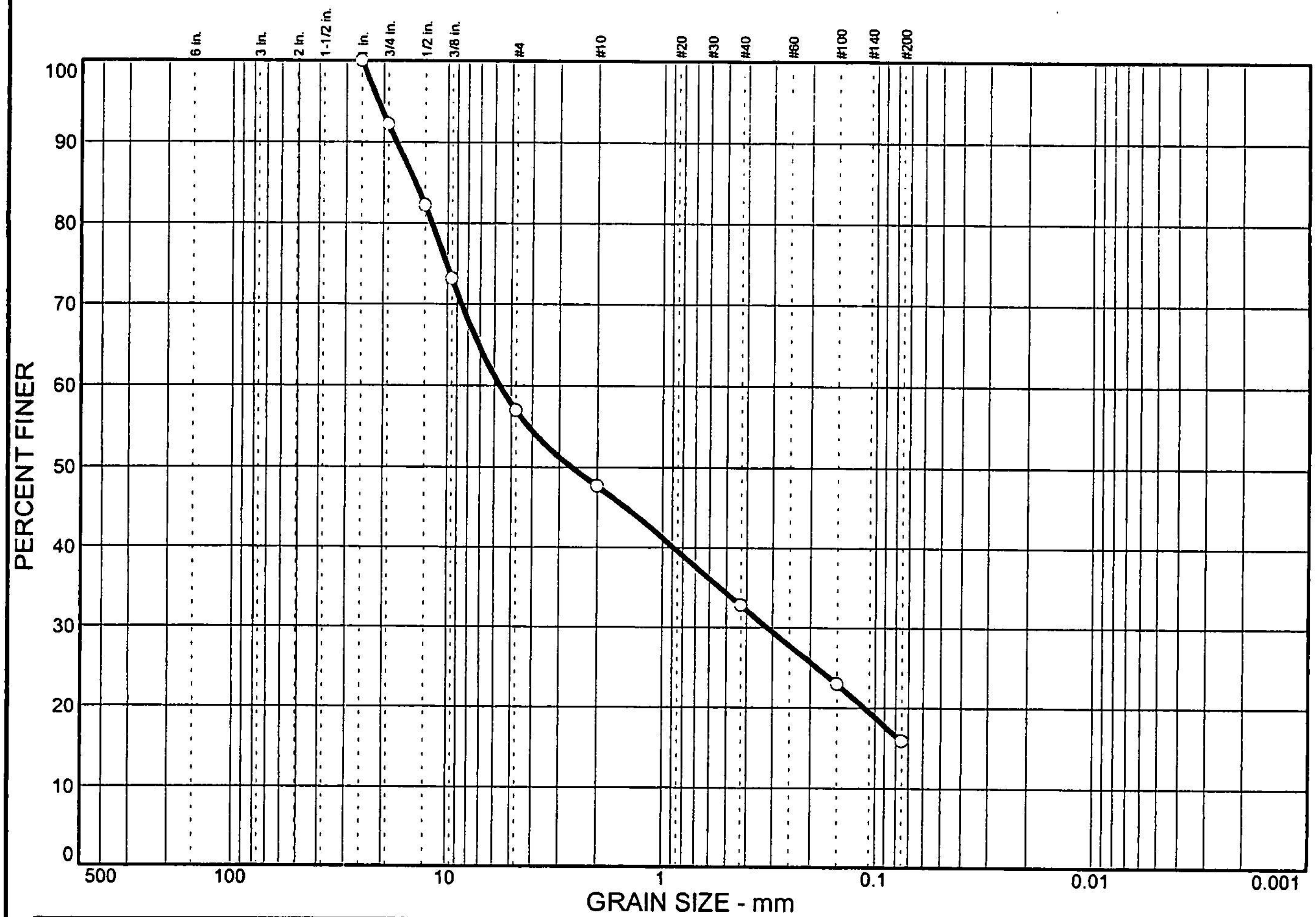
Remarks

Sample No.: 03-245-12 **Source of Sample:** BR-4, 14.9 m (49 ft.) **Date:** 11-24-03
Location: BR-4 **Elev./Depth:** 14.9 m (49')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.28

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	43.0	41.1	15.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	92.2		
1/2 in.	82.2		
3/8 in.	73.2		
#4	57.0		
#10	47.7		
#40	32.8		
#100	23.0		
#200	15.9		

* (no specification provided)

Soil Description

Silty gravel with sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 14.1 D_{60}= 5.63 D_{50}= 2.61
D_{30}= 0.316 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

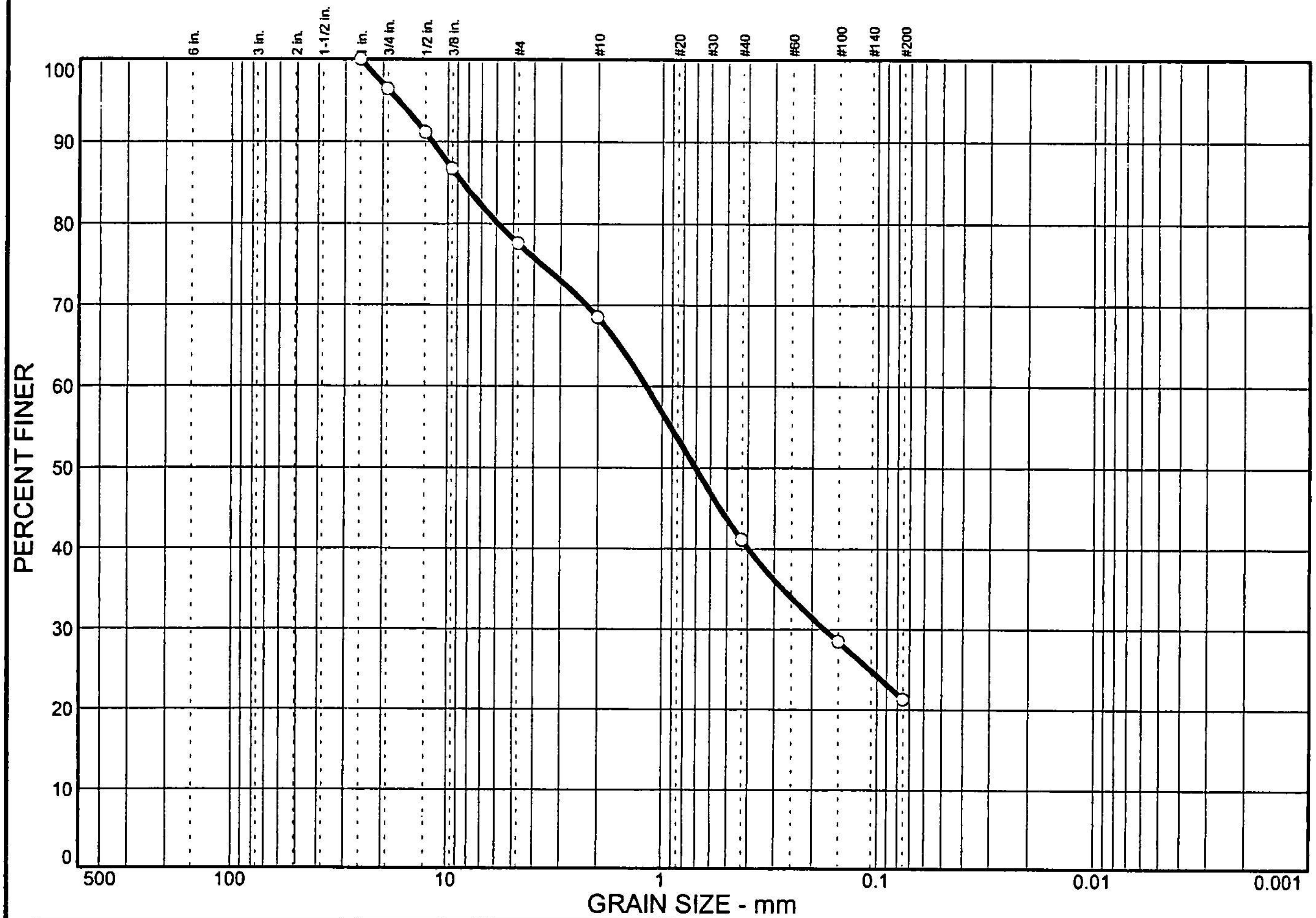
Remarks

Sample No.: 03-227-29 **Source of Sample:** MSE-1, 0 m (0 ft.) **Date:** 11-10-03
Location: MSE-1 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.29

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	22.4	56.3	21.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	96.4		
1/2 in.	91.1		
3/8 in.	86.7		
#4	77.6		
#10	68.5		
#40	41.1		
#100	28.5		
#200	21.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 8.50 D_{60}= 1.19 D_{50}= 0.702
D_{30}= 0.173 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

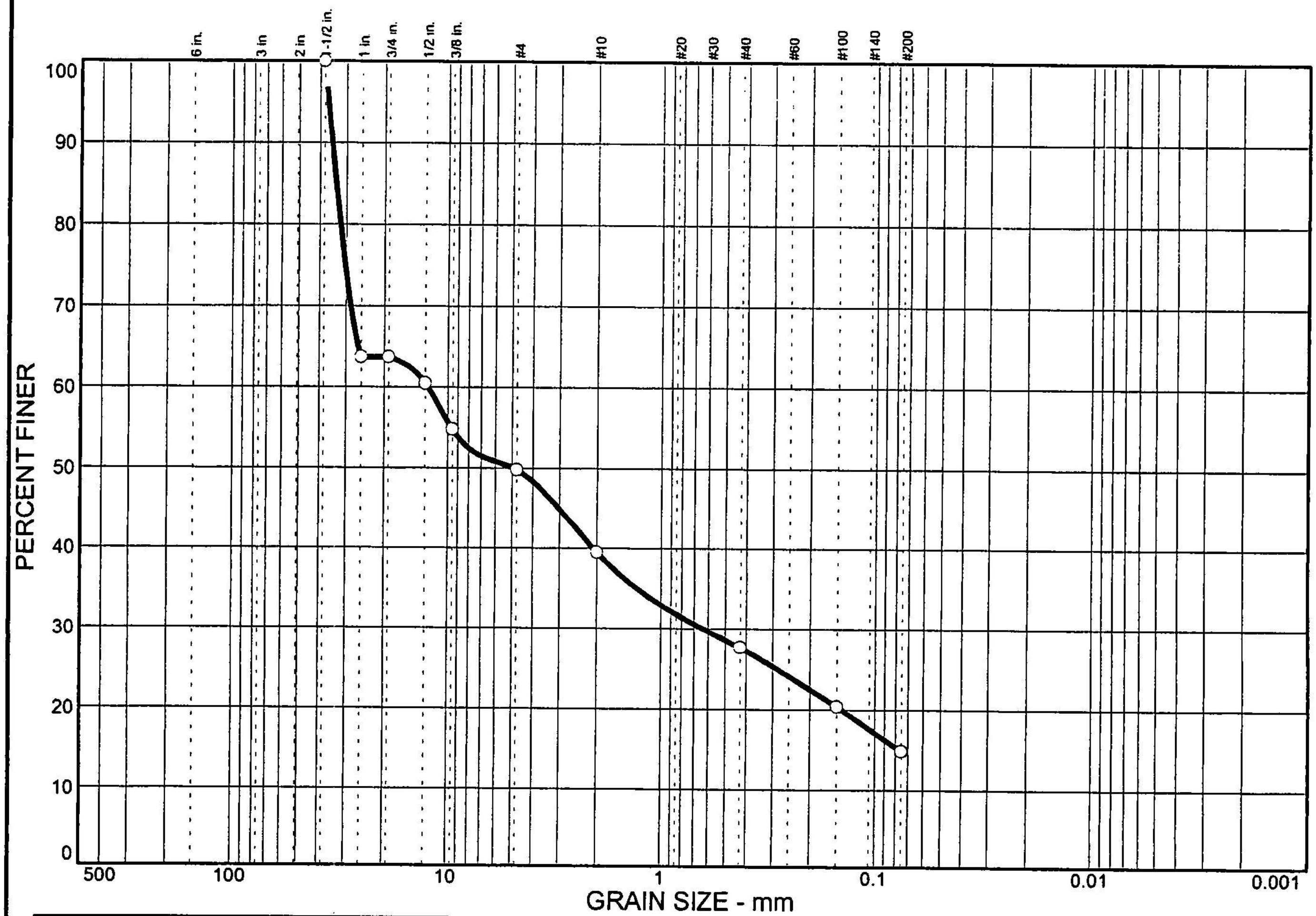
Remarks

Sample No.: 03-245-13 **Source of Sample:** MSE-2, 0 m (0 ft.) **Date:** 11-24-03
Location: MSE-2 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.30

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	50.2	34.9	14.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2 in.	100.0		
1 in.	63.7		
3/4 in.	63.7		
1/2 in.	60.5		
3/8 in.	54.8		
#4	49.8		
#10	39.5		
#40	27.7		
#100	20.4		
#200	14.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 33.4 D_{60}= 12.3 D_{50}= 4.91
D_{30}= 0.630 D_{15}= 0.0759 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

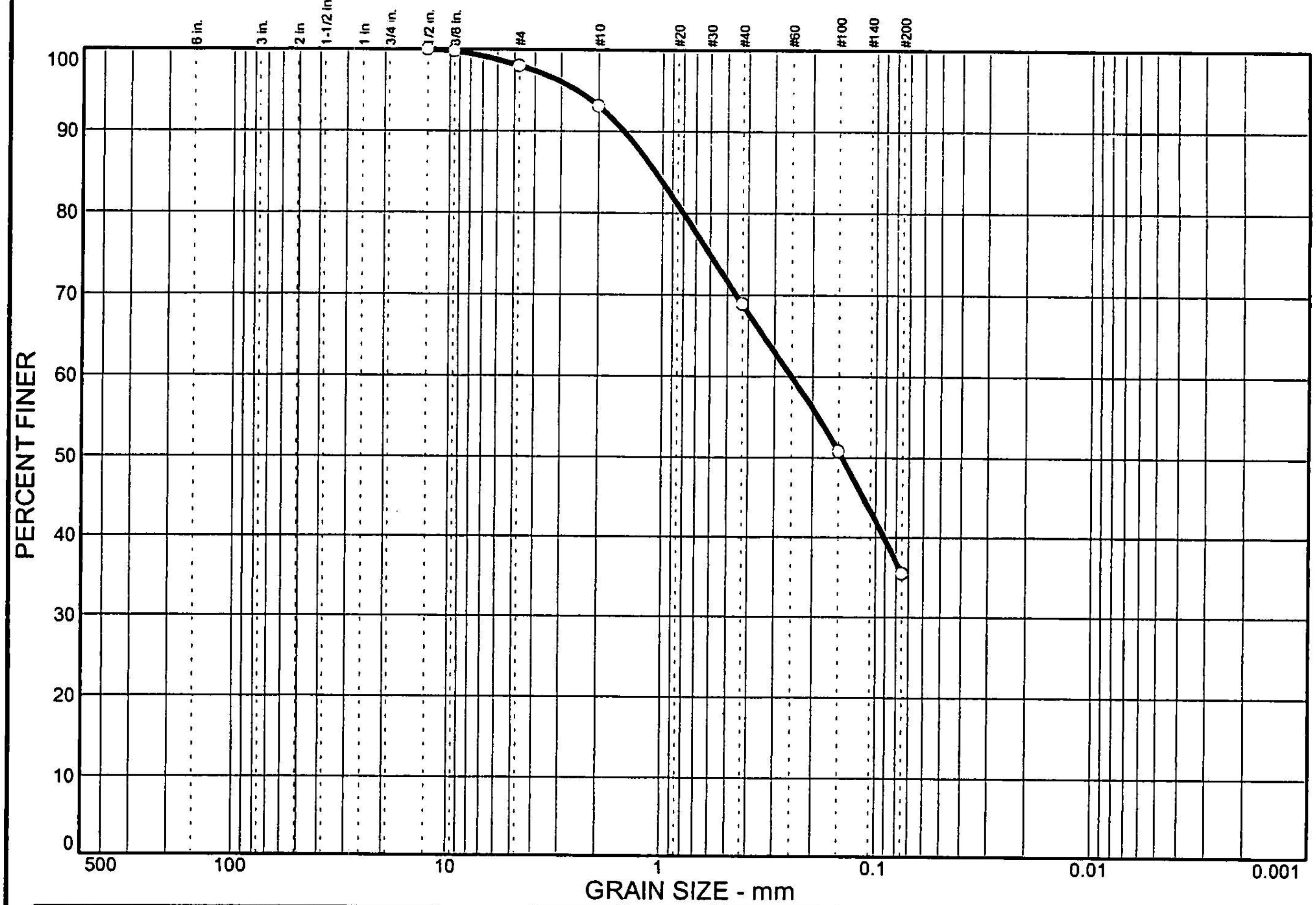
Remarks

Sample No.: 03-245-15 **Source of Sample:** MSE-3, 4.6 m (15 ft.) **Date:** 11-24-03
Location: MSE-3 **Elev./Depth:** 4.6 m (15')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.31

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	2.0	62.5	35.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.8		
#4	98.0		
#10	93.1		
#40	68.9		
#100	50.8		
#200	35.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.08 D_{60}= 0.249 D_{50}= 0.144
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

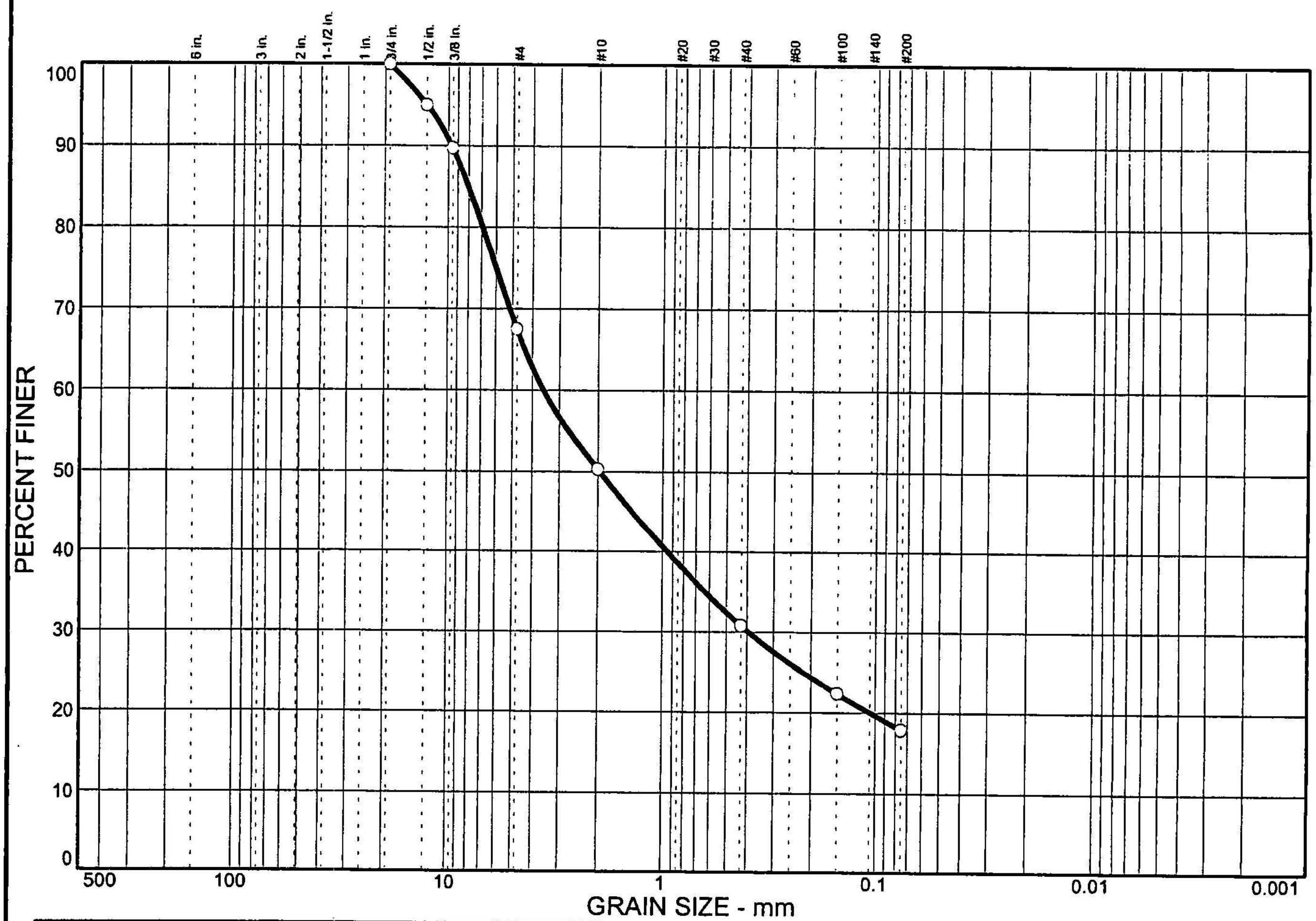
Remarks

Sample No.: 03-245-17 **Source of Sample:** MSE-4, 4.3 m (14 ft.) **Date:** 11-24-03
Location: MSE-4 **Elev./Depth:** 4.3 m (14')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.32

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	32.5	49.6	17.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	95.0		
3/8 in.	89.7		
#4	67.5		
#10	50.3		
#40	30.8		
#100	22.4		
#200	17.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 8.04 D_{60}= 3.54 D_{50}= 1.96
D_{30}= 0.391 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

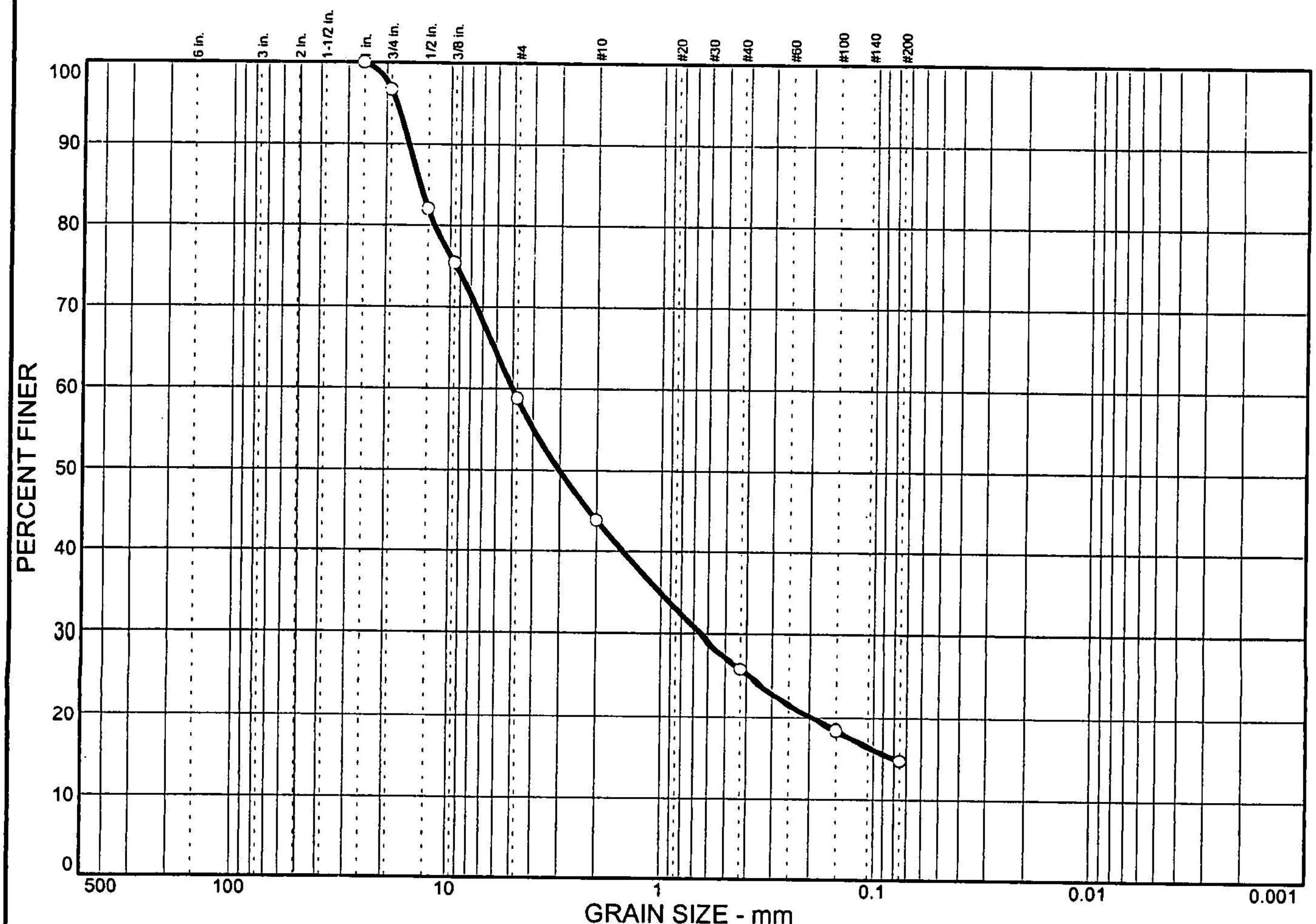
Remarks

Sample No.: 03-227-32 **Source of Sample:** MSE-5, 0 m (0 ft.) **Date:** 11-10-03
Location: MSE-5 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.33

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	41.2	44.0	14.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	96.7		
1/2 in.	82.0		
3/8 in.	75.4		
#4	58.8		
#10	43.9		
#40	26.0		
#100	18.5		
#200	14.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 13.8 D_{60}= 5.00 D_{50}= 3.01
D_{30}= 0.643 D_{15}= 0.0780 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

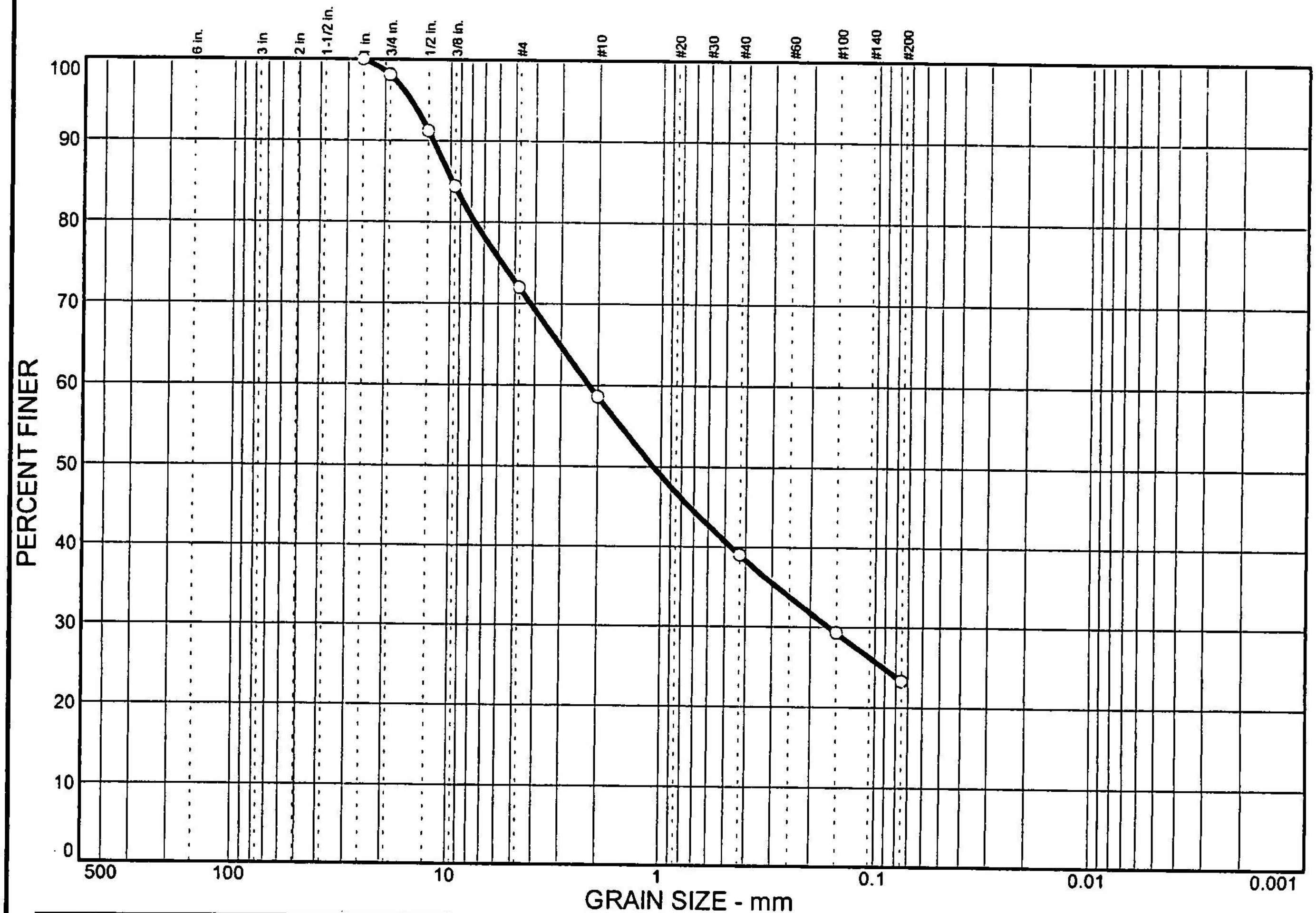
Remarks

Sample No.: 03-227-34 **Source of Sample:** MSE-5, 3 m (10 ft.) **Date:** 11-10-03
Location: MSE-5 **Elev./Depth:** 3 m (10')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.34

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	28.0	48.7	23.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	98.1		
1/2 in.	91.2		
3/8 in.	84.4		
#4	72.0		
#10	58.6		
#40	39.0		
#100	29.3		
#200	23.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 9.78 D_{60}= 2.20 D_{50}= 1.08
D_{30}= 0.163 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

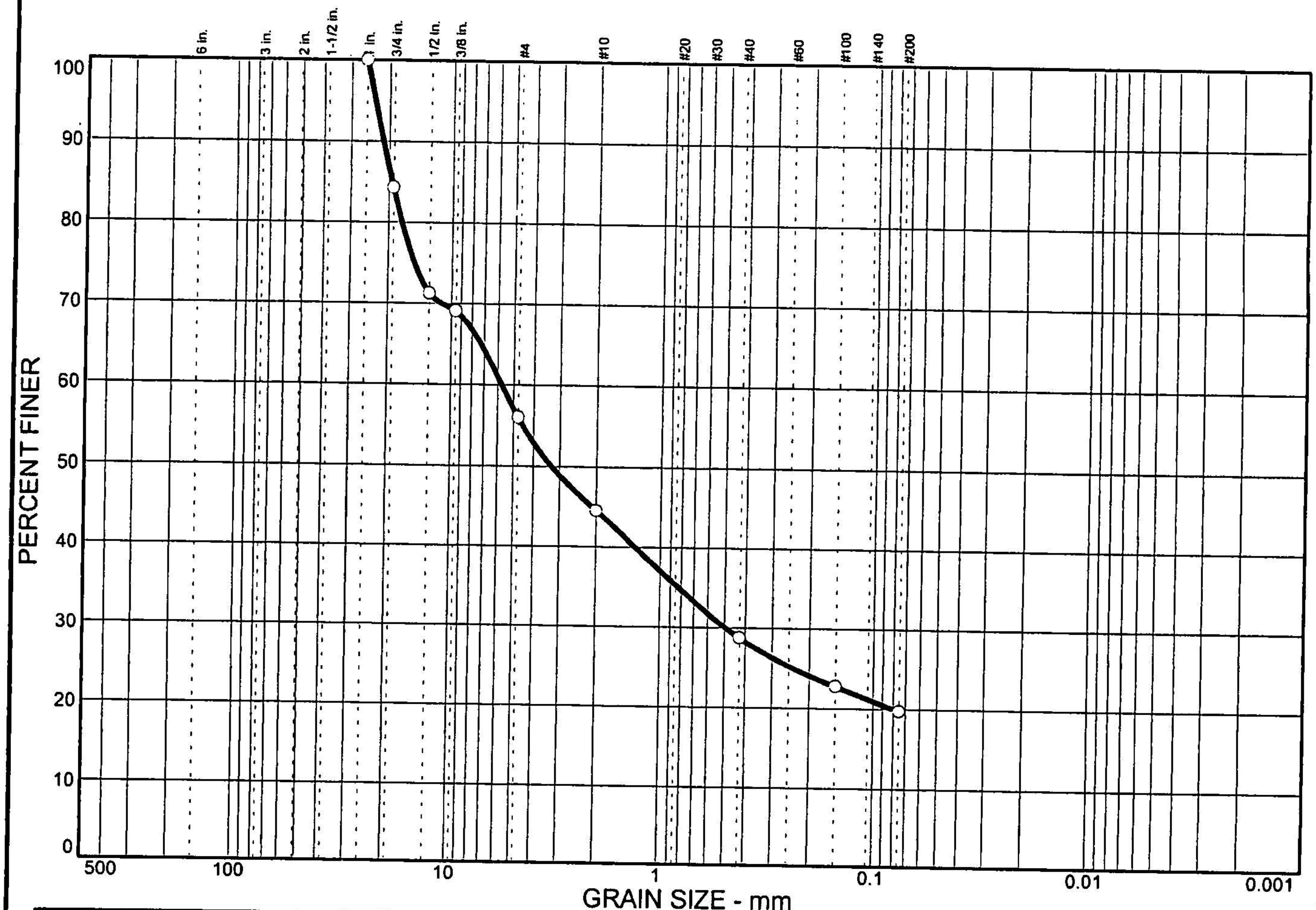
Remarks

Sample No.: 03-245-18 **Source of Sample:** MSE-6, 0 m (0 ft.) **Date:** 11-24-03
Location: MSE-6 **Elev./Depth:** 0 m (0')

KLEINFELDER, INC.

Client:
Project: NM SH 126, Cuba - La Cueva NM
Project No: 35321 **Plate Number:** D.35

Particle Size Distribution Report



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	44.0	36.2	19.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	84.3		
1/2 in.	71.3		
3/8 in.	69.1		
#4	56.0		
#10	44.6		
#40	28.8		
#100	22.8		
#200	19.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 19.3 D_{60}= 5.73 D_{50}= 3.26

D_{30}= 0.491 D_{15}= D_{10}=

C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: 03-245-22 **Source of Sample:** MSE-7, 1.2 m (4 ft.) **Date:** 11-24-03

Location: MSE-7 **Elev./Depth:** 1.2 m (4')

KLEINFELDER, INC.

Client:

Project: NM SH 126, Cuba - La Cueva NM

Project No: 35321 **Plate Number:** D.36

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

LOCATION B–1 (0'–3')

SOIL TYPE GM (A–1–b)

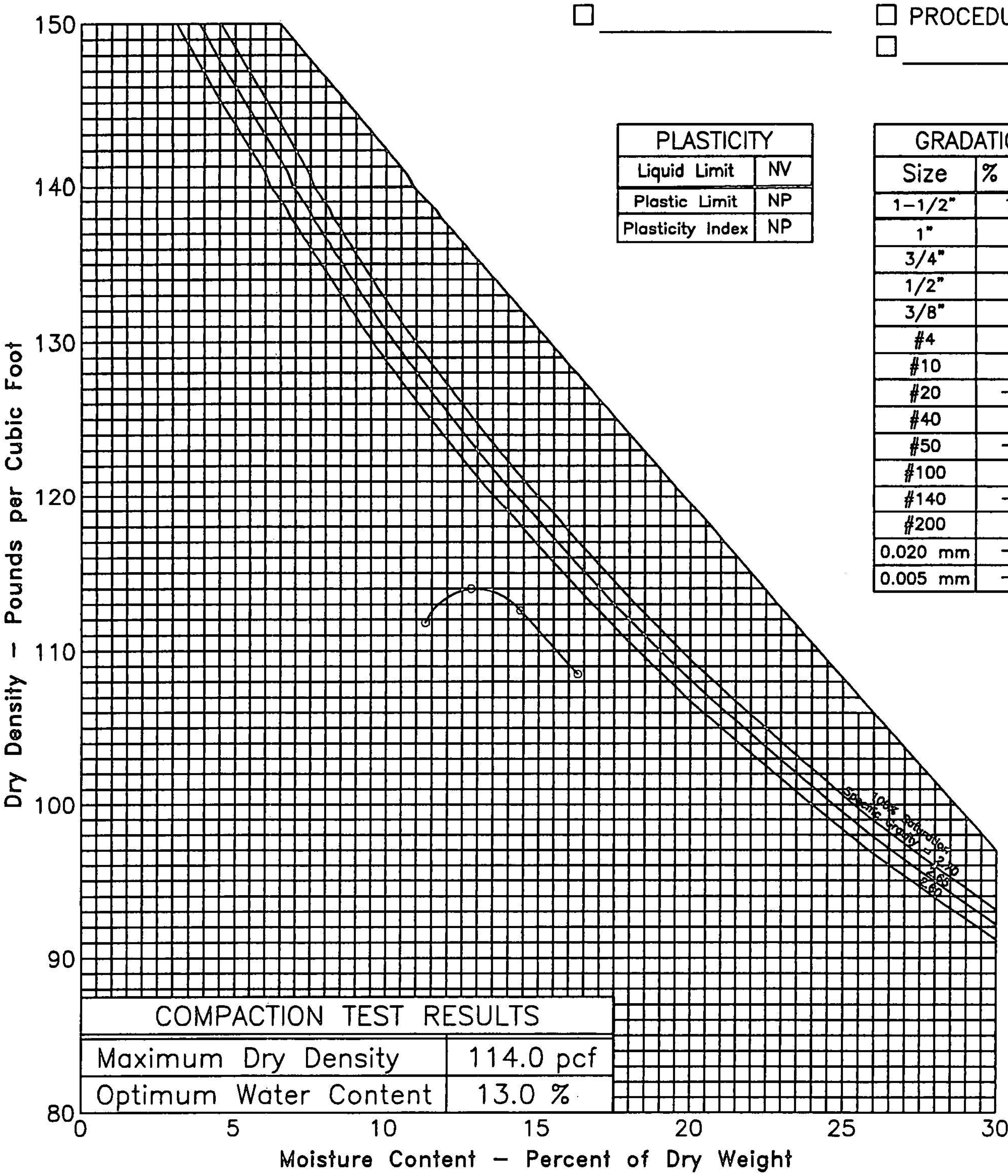
TEST METHOD:

- ☐ 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.37

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

LOCATION B-3 (0-3')

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

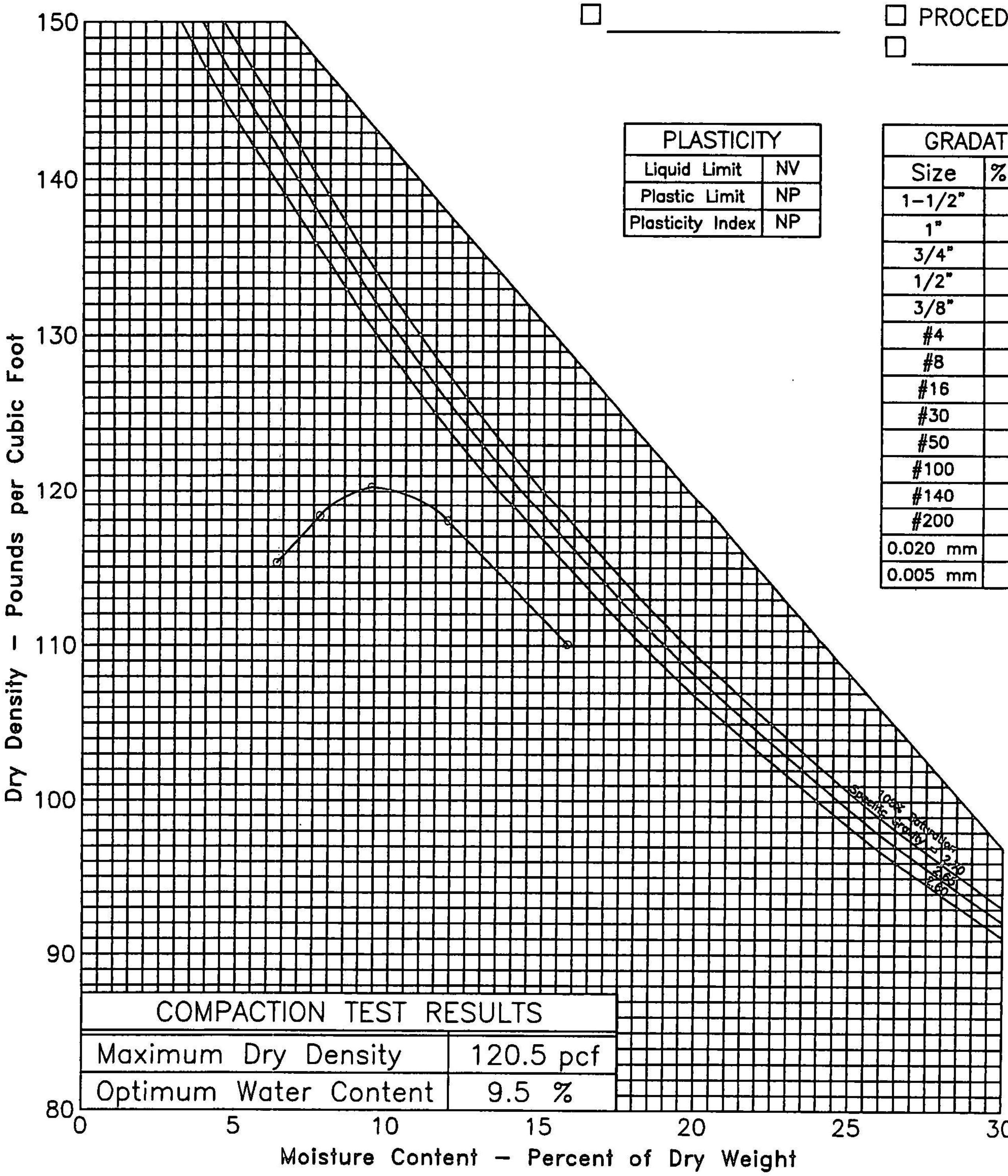
TEST METHOD:

- ☐ 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: FN: PROCTOR
PROJECT NO. 35321 DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.38

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

LOCATION B-5 (0-5')

SOIL TYPE SM (A-4(0))

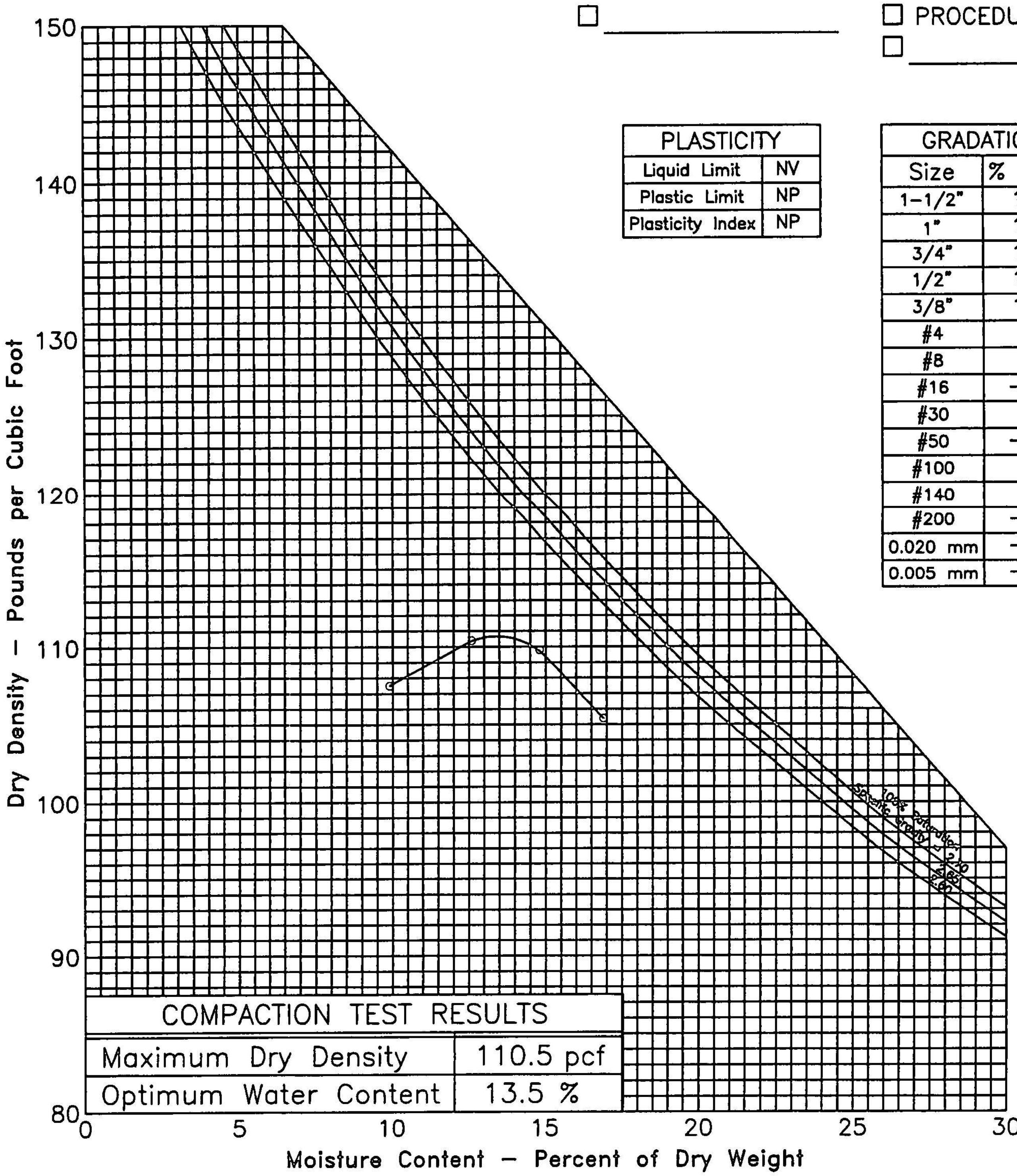
TEST METHOD:

☐ 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:

PROJECT NO. 35321

FN: PROCTOR

DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.39

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))

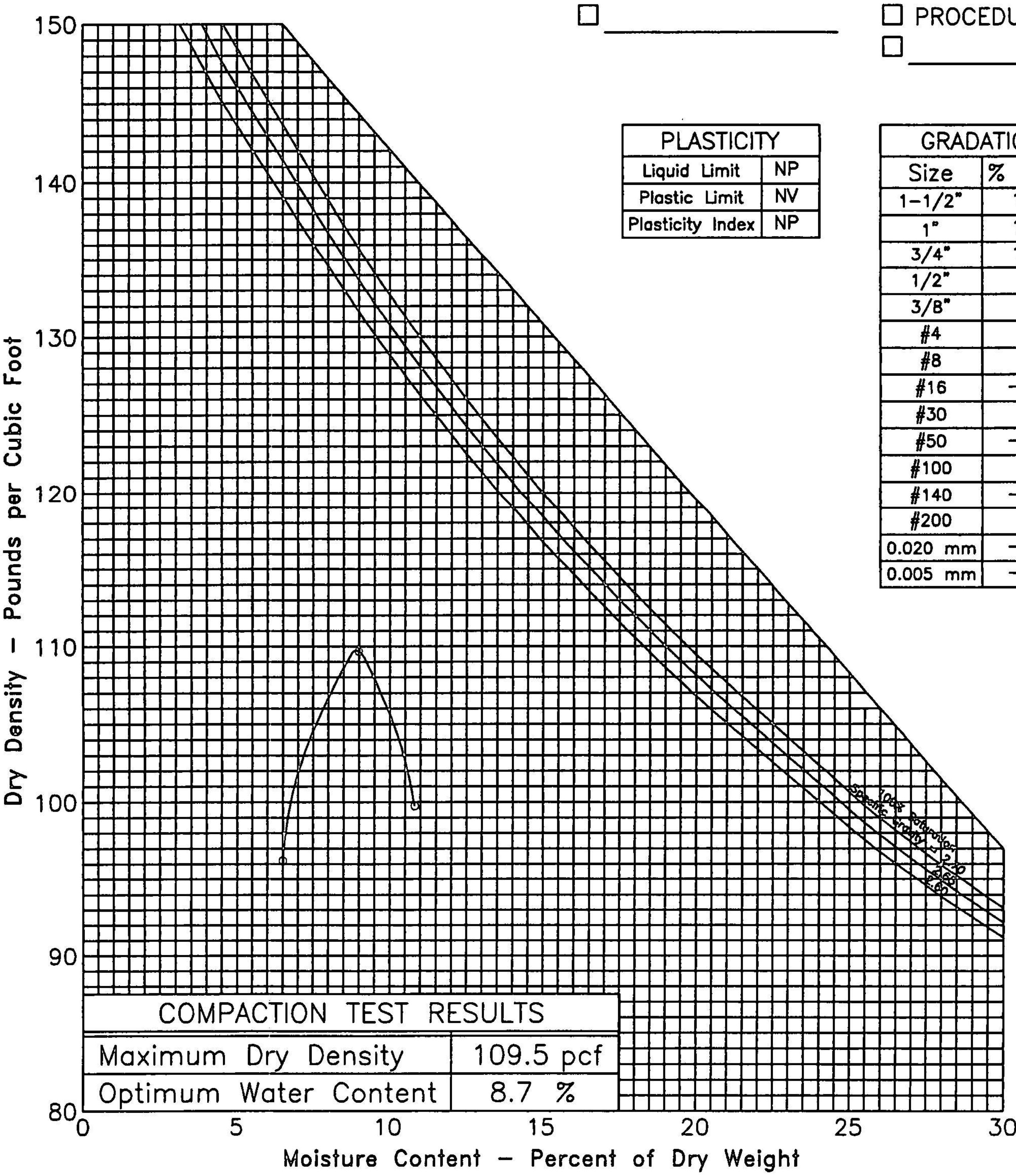
TEST METHOD:

- ☐ 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: | FN: PROCTOR

PROJECT NO. 35321 | DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.40

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))

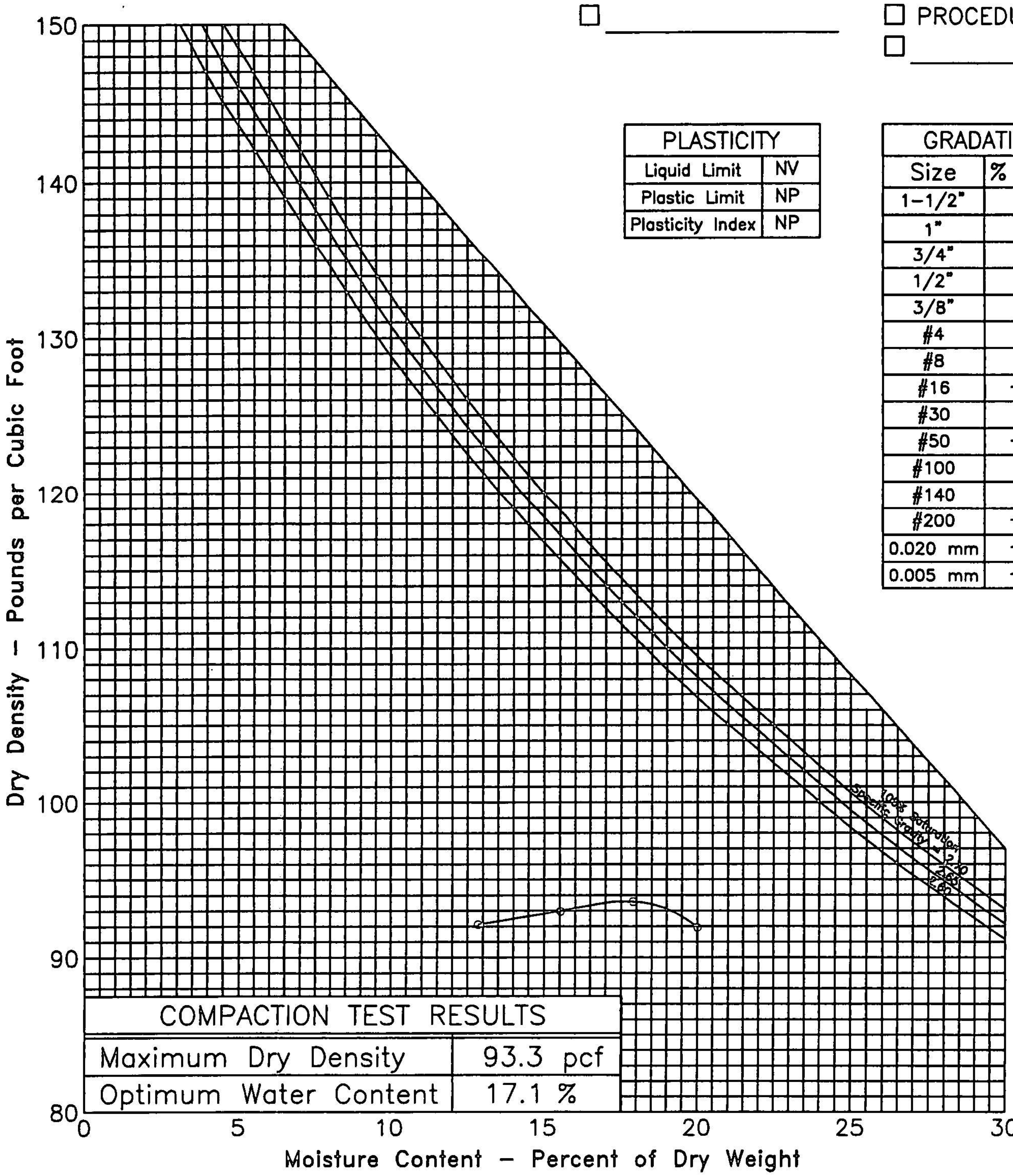
TEST METHOD:

- ☐ 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: | FN: PROCTOR
PROJECT NO. 35321 | DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.41

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

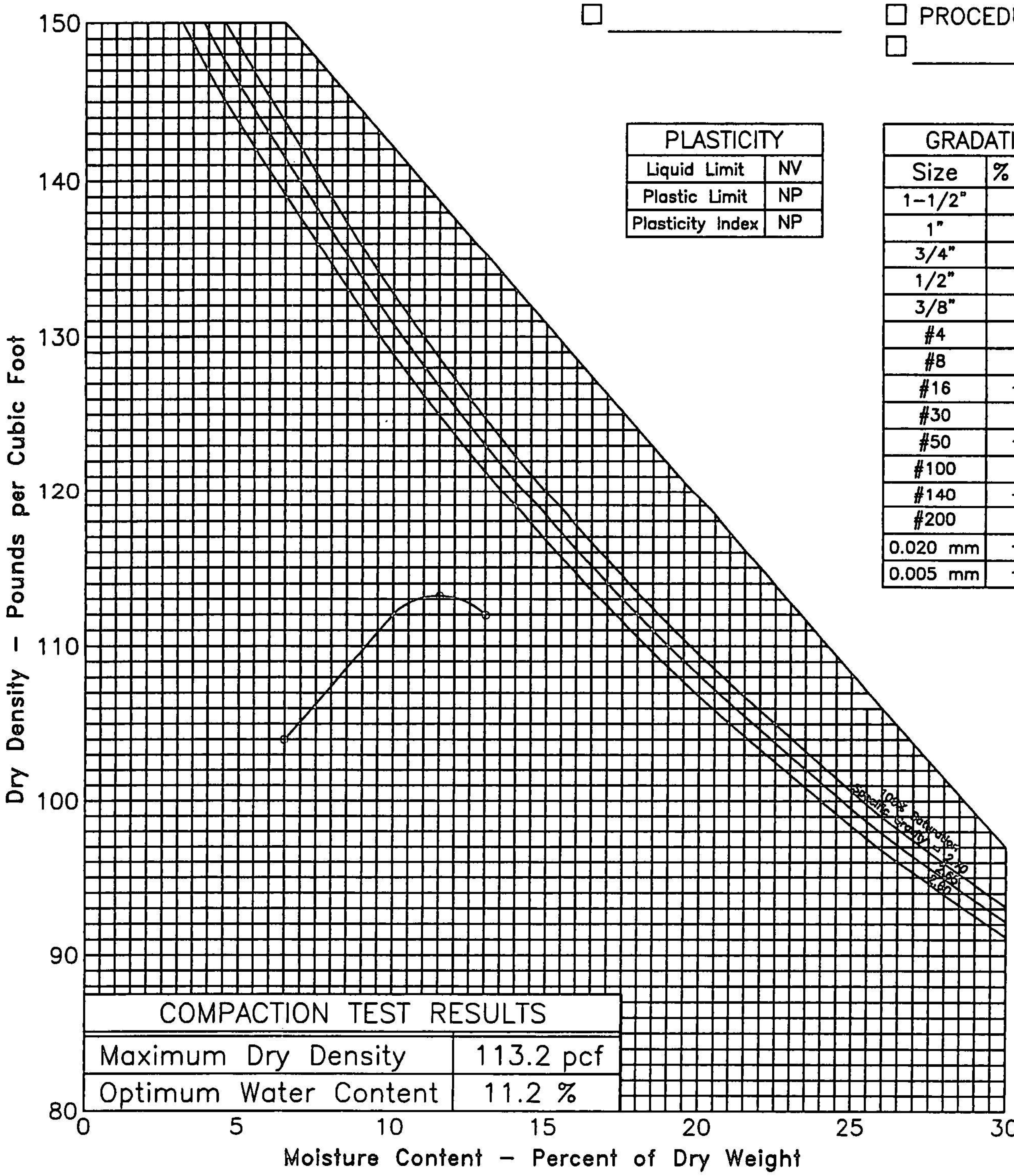
LOCATION B-8, 0 m (0 ft.)

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

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.42

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

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

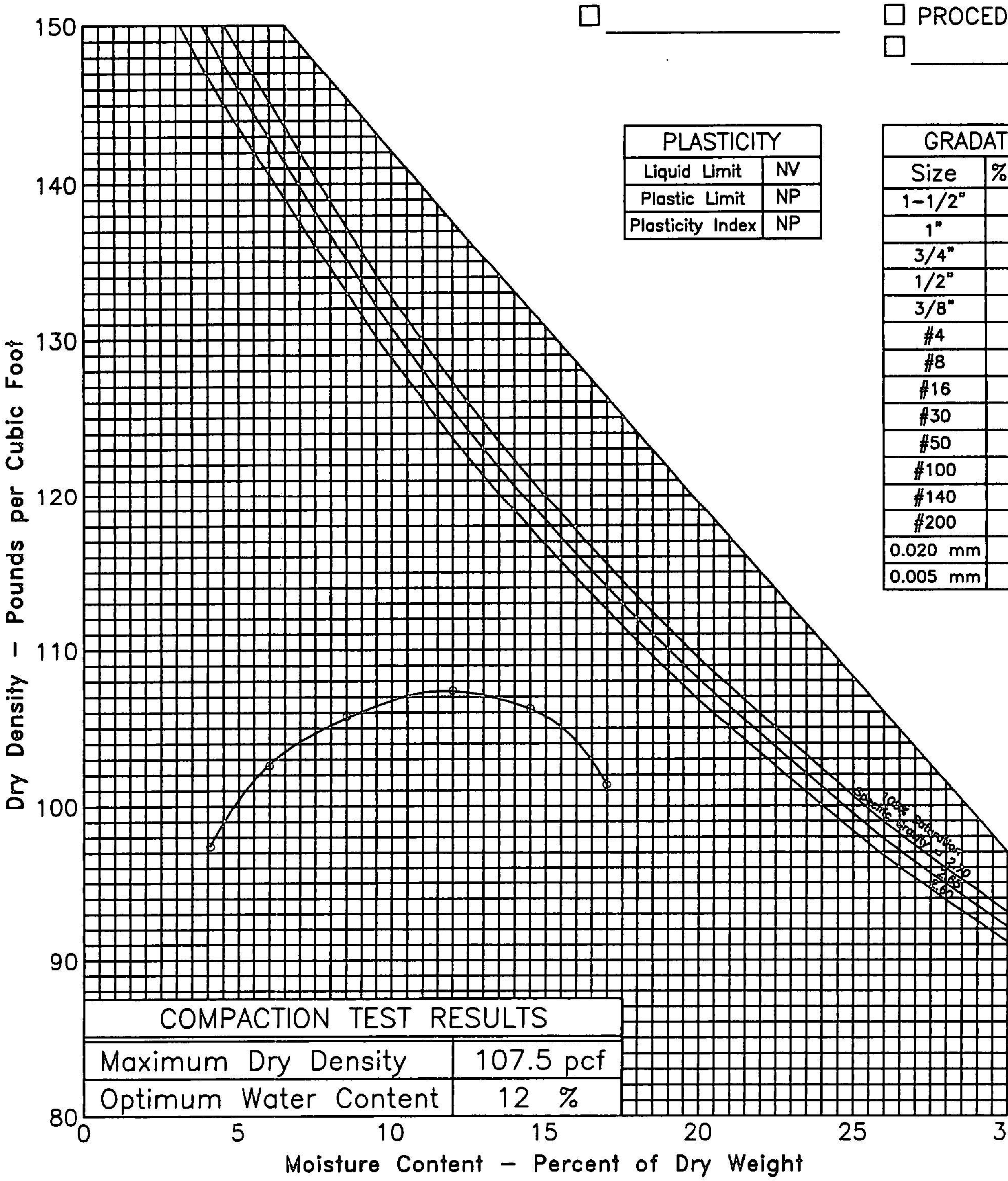
SOIL TYPE ML (A-4(0))

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

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE
D.43

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

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

SOIL TYPE SM

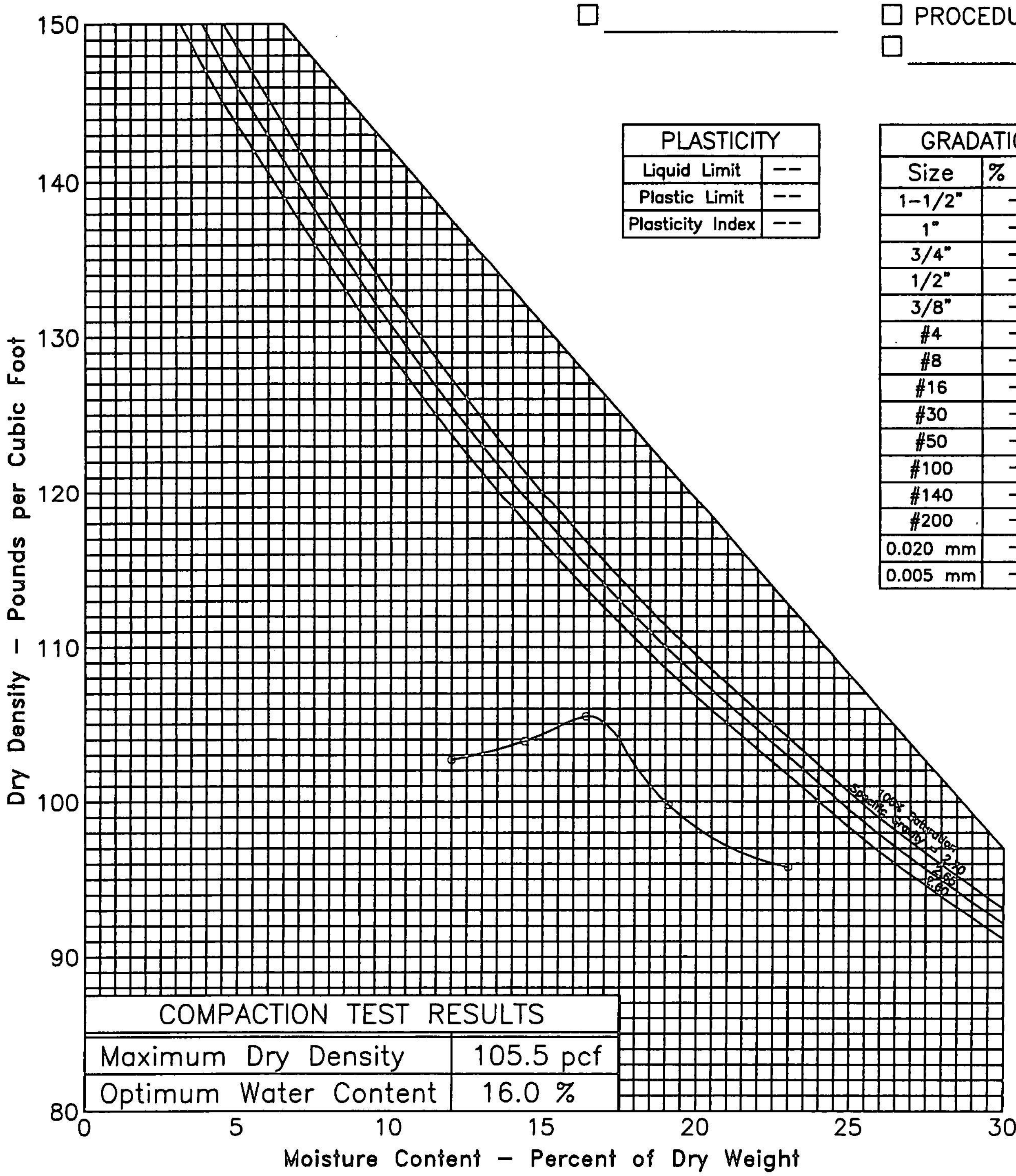
TEST METHOD:

☐ 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.44

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))

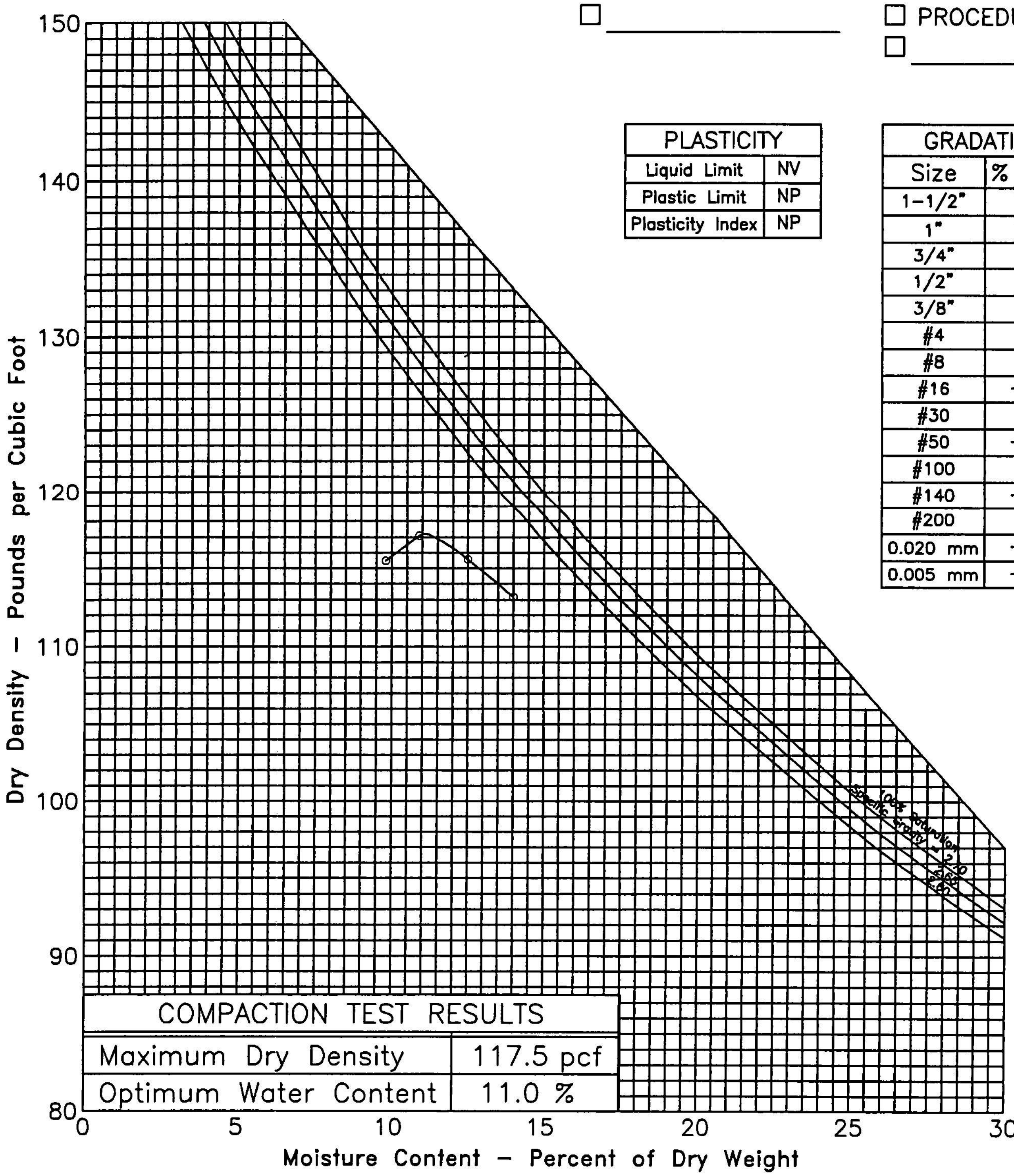
TEST METHOD:

- ☐ 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.45

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))

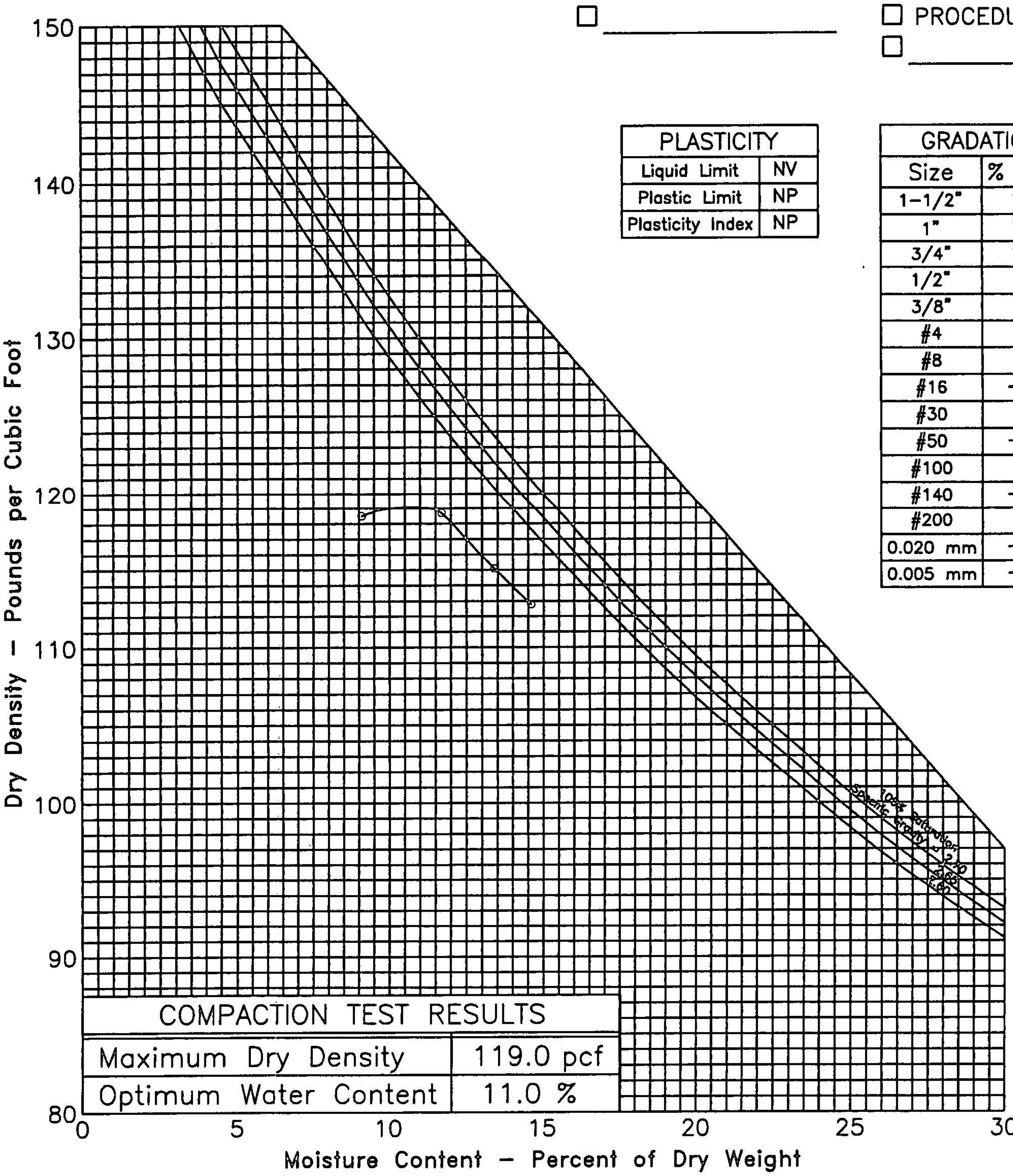
TEST METHOD:

- ☐ 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:	FN: PROCTOR
PROJECT NO. 35321	DATE: 11/03

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE

D.46

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)

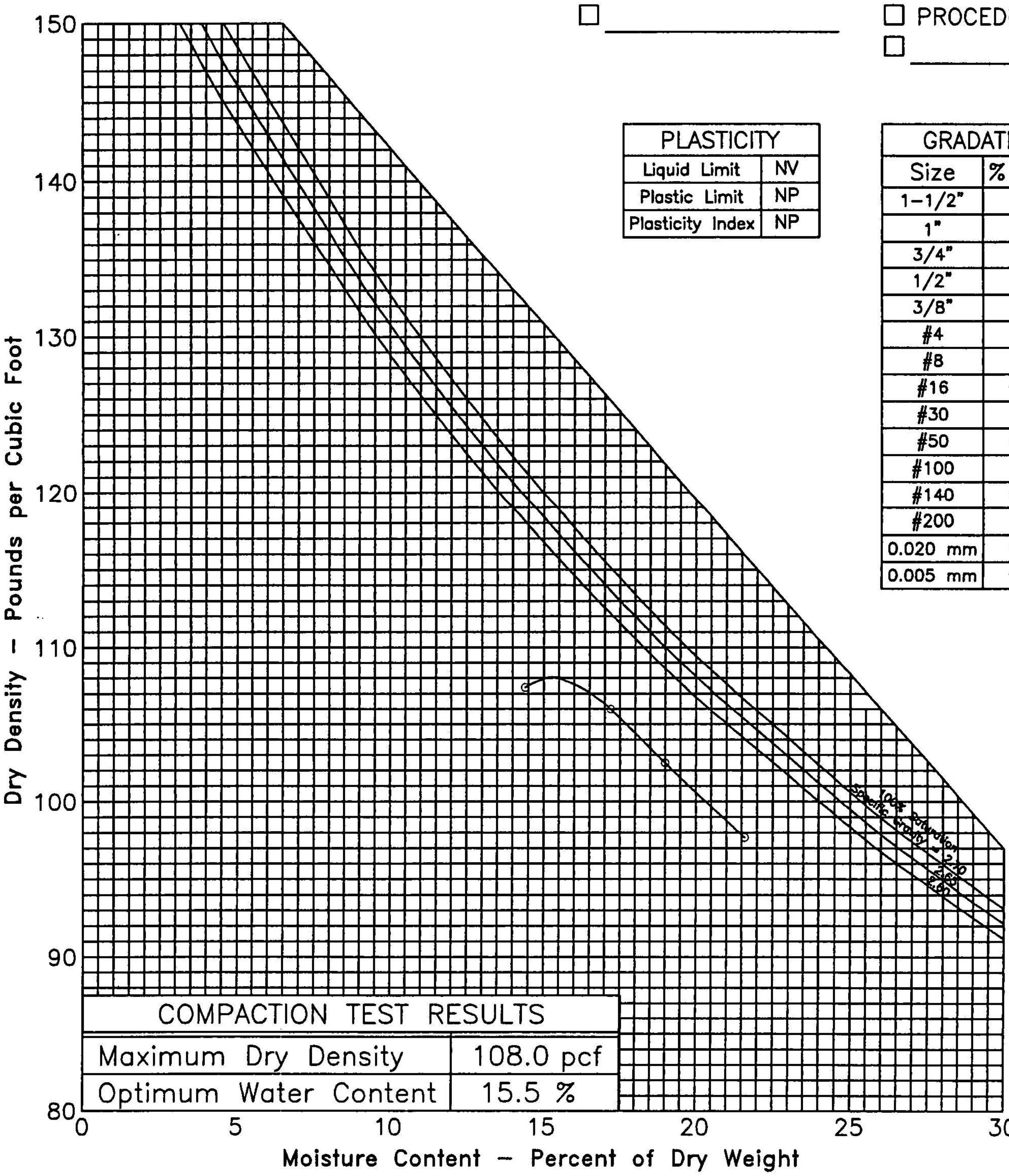
TEST METHOD:

- ☐ 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.47

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)

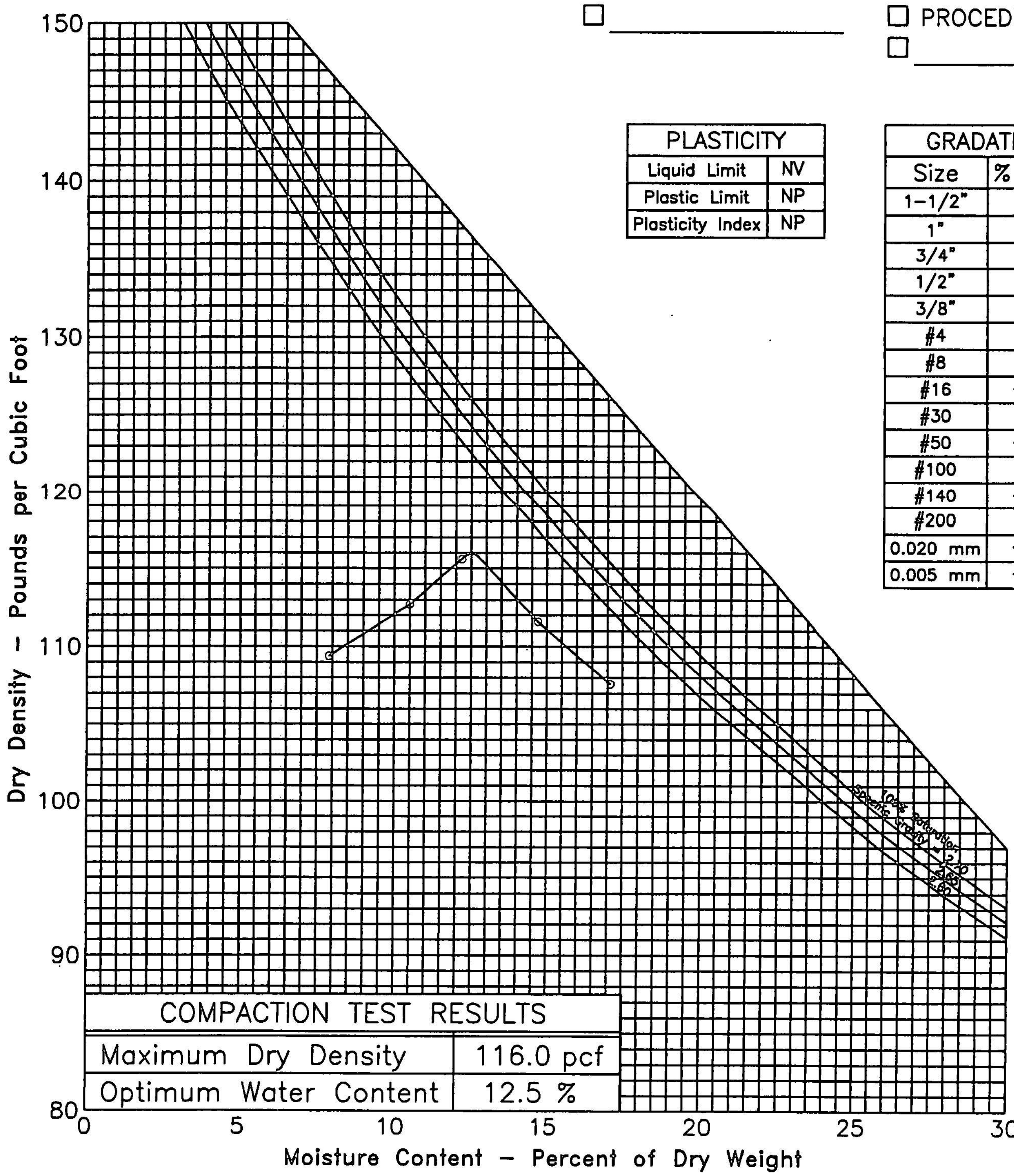
TEST METHOD:

- ☐ 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

MODIFIED PROCTOR TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.48

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

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 ---

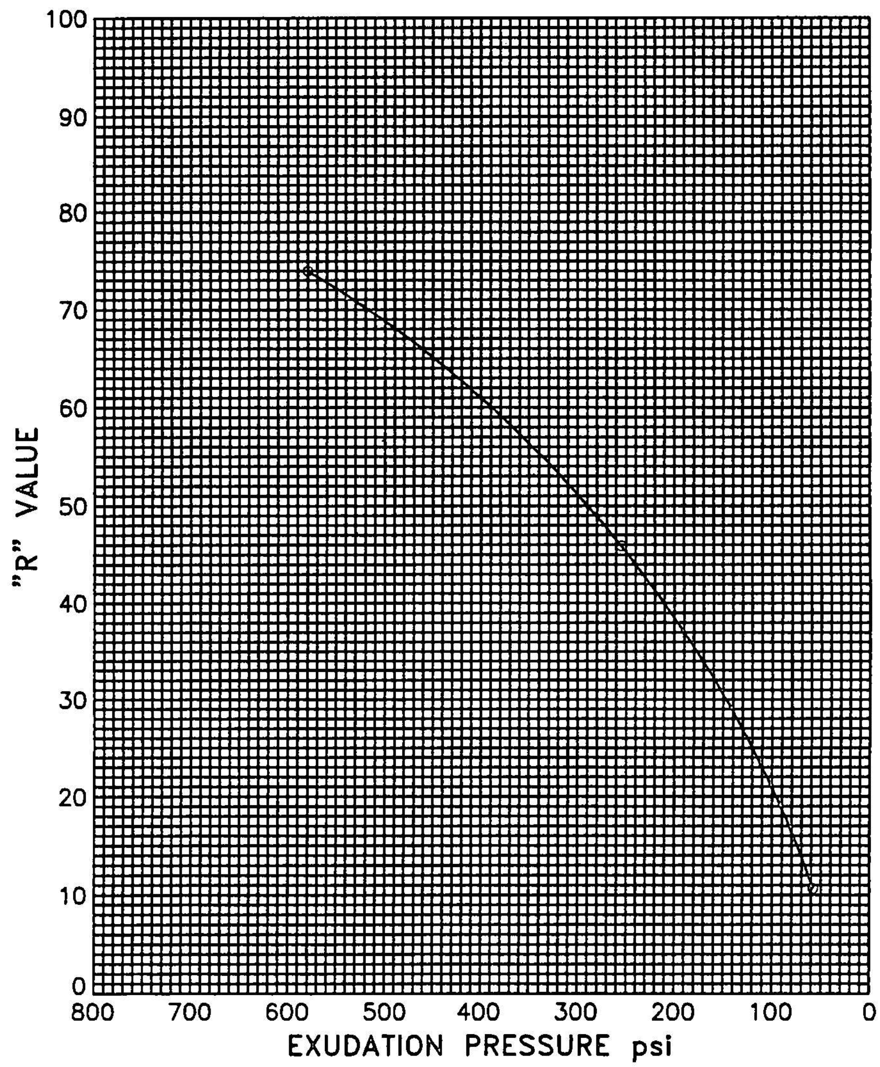
"R" VALUE @ 300 PSI EXUDATION PRESSURE 51

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	HVEEM TEST CUBA LACUEVA NEW MEXICO PARSONS BRINKERHOFF	FIGURE D.49
PROJECT NO. 35321	DATE: 11/03		

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 --

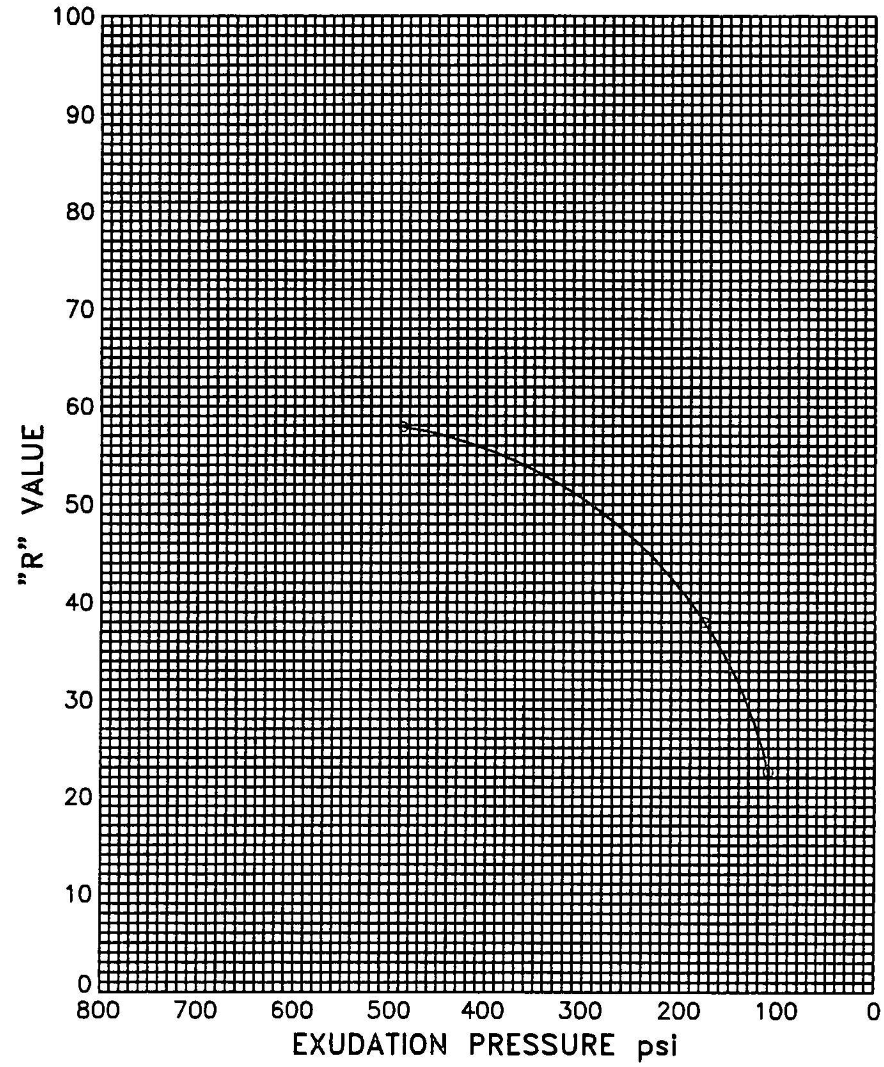
"R" VALUE @ 300 PSI EXUDATION PRESSURE 51

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
PROJECT NO. 35321	DATE: 11/03

HVEEM TEST

CUBA LACUEVA
NEW MEXICO
PARSONS BRINKERHOFF

FIGURE D.50

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		
STABIL–OMETER	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 --

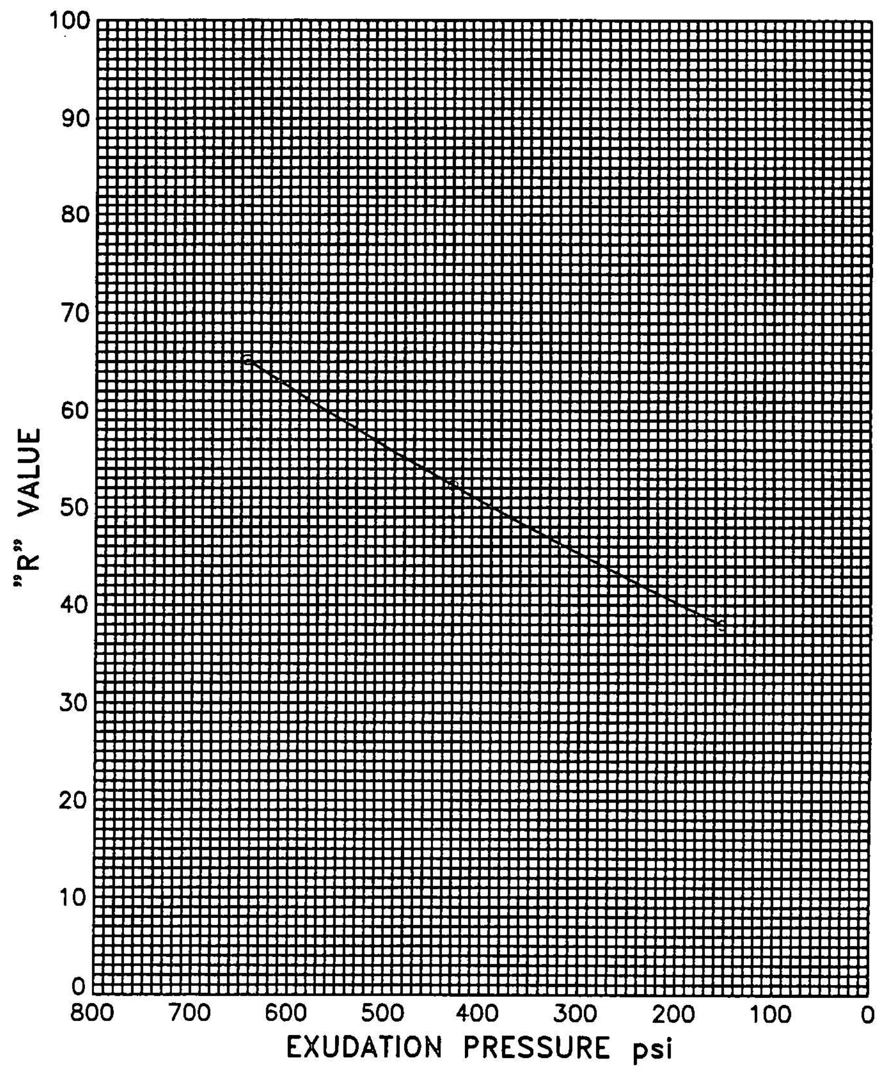
"R" VALUE @ 300 PSI EXUDATION PRESSURE 45

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.51

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 --

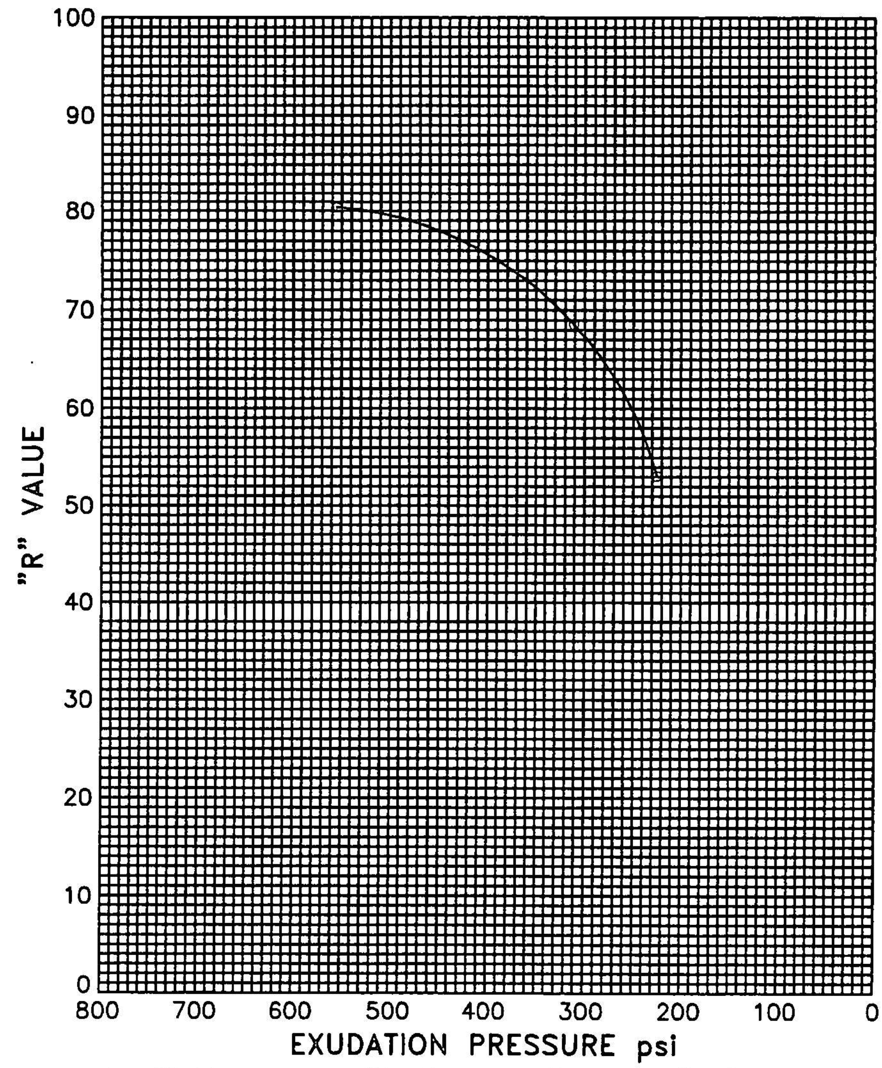
"R" VALUE @ 300 PSI EXUDATION PRESSURE 67

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.52

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 --

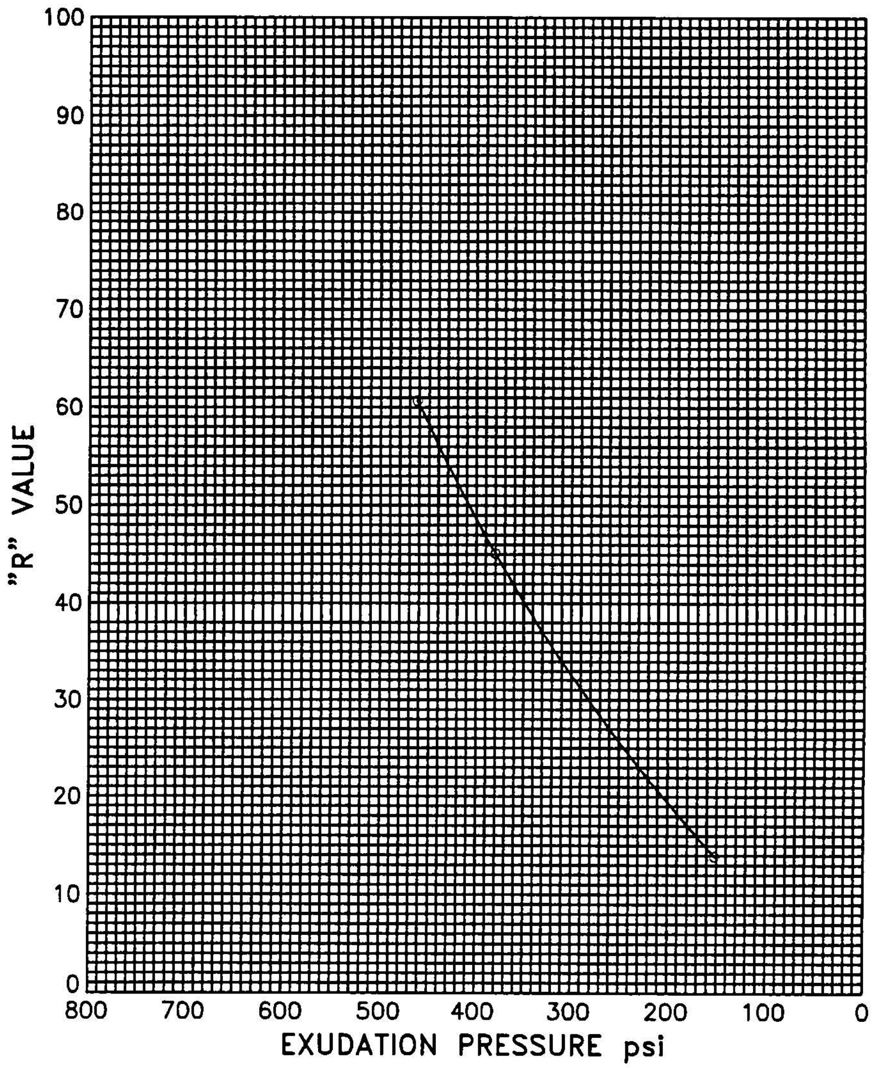
"R" VALUE @ 300 PSI EXUDATION PRESSURE 32

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.53

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 ---

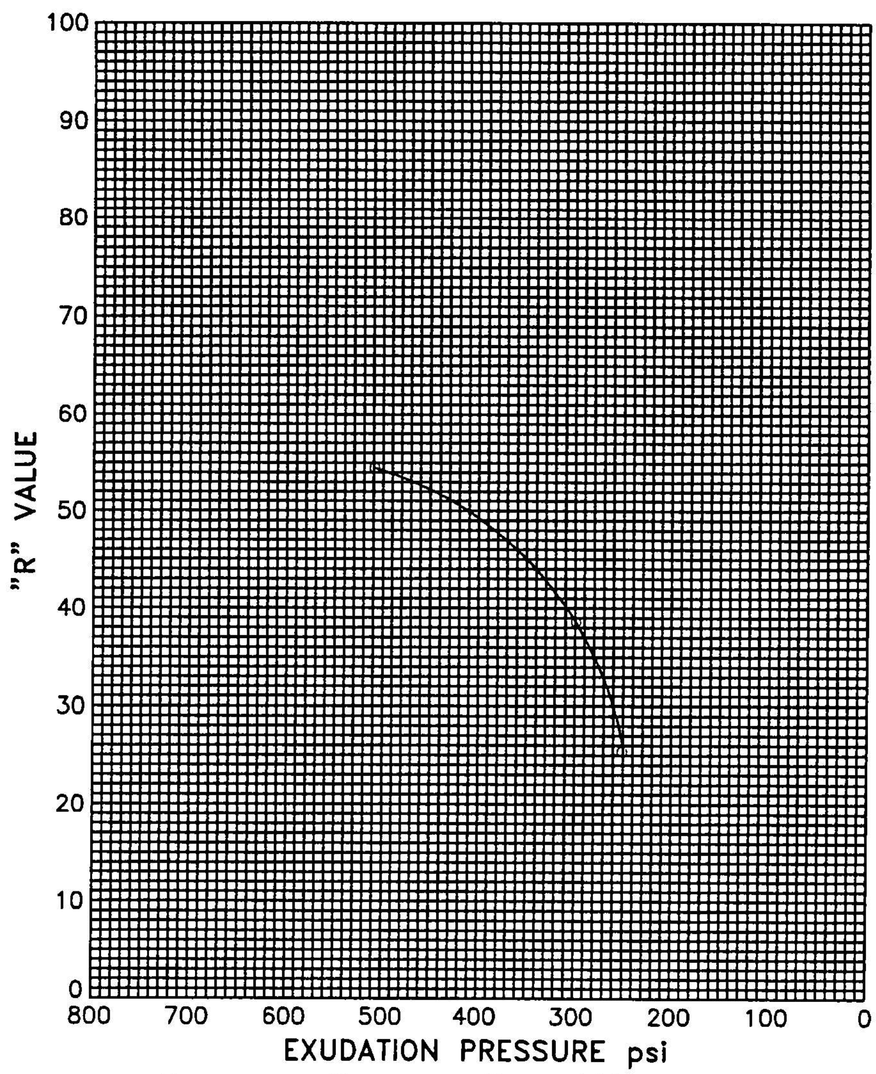
"R" VALUE @ 300 PSI EXUDATION PRESSURE 39

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.54

Sample: B–13, 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 %	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 --

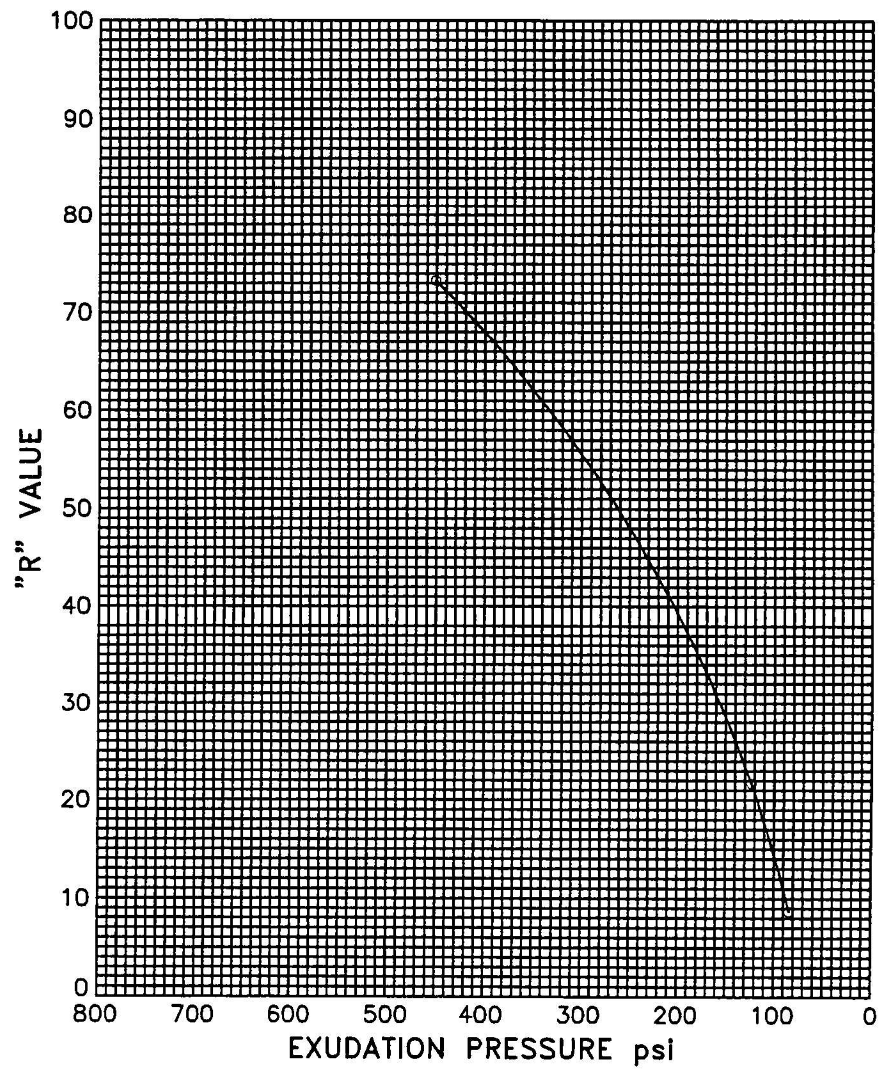
"R" VALUE @ 300 PSI EXUDATION PRESSURE 56

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	HVEEM TEST CUBA LACUEVA NEW MEXICO PARSONS BRINKERHOFF	FIGURE D.55
PROJECT NO. 35321	DATE: 11/03		

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

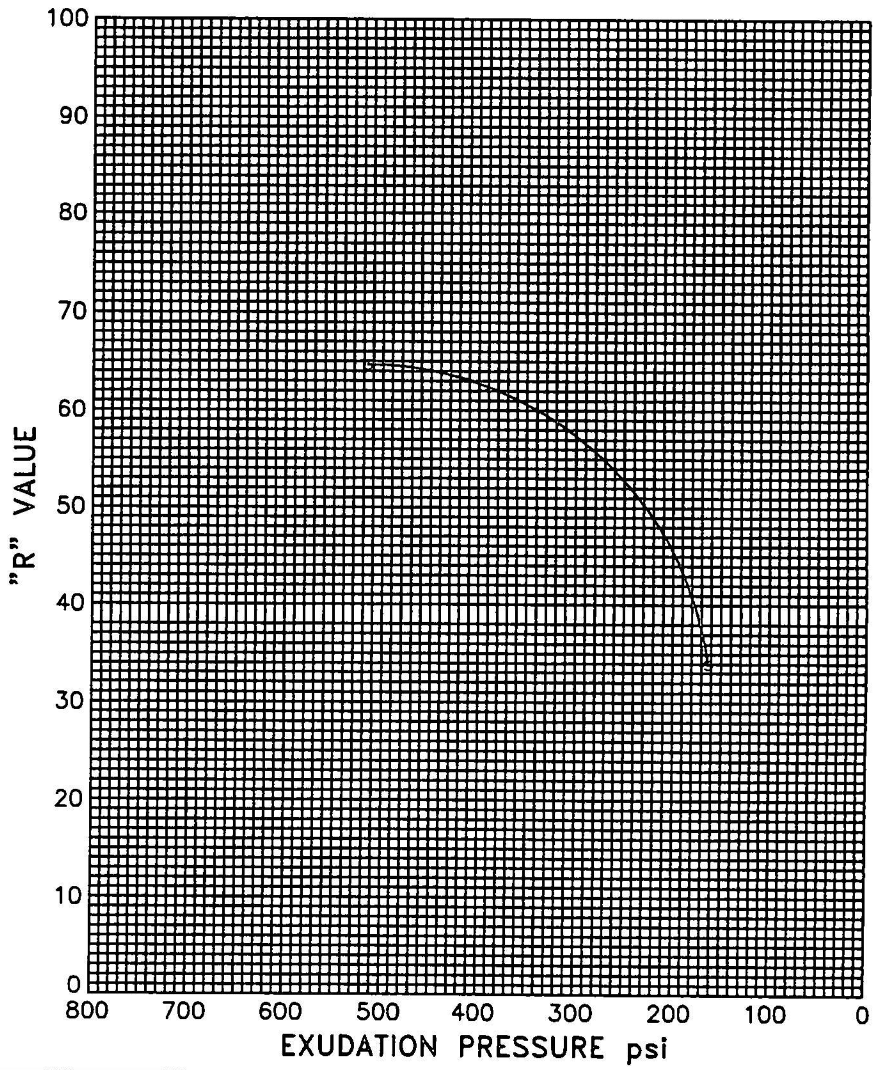
TEST SPECIMEN		A	B	C	D	E
DATE TESTED		11/17/03	11/17/03	11/17/03		
SPECIMEN FABRICATION	Compacted Air Pressure psi	--	--	--		
	Initial Moisture %	--	--	--		
	Moisture at Compaction %	13.3	16.0	14.7		
	Briquette Height in.	2.5	2.5	2.5		
	Density, dry pcf	108.3	103.7	103.4		
EXUDATION PRESSURE psi		516	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.56

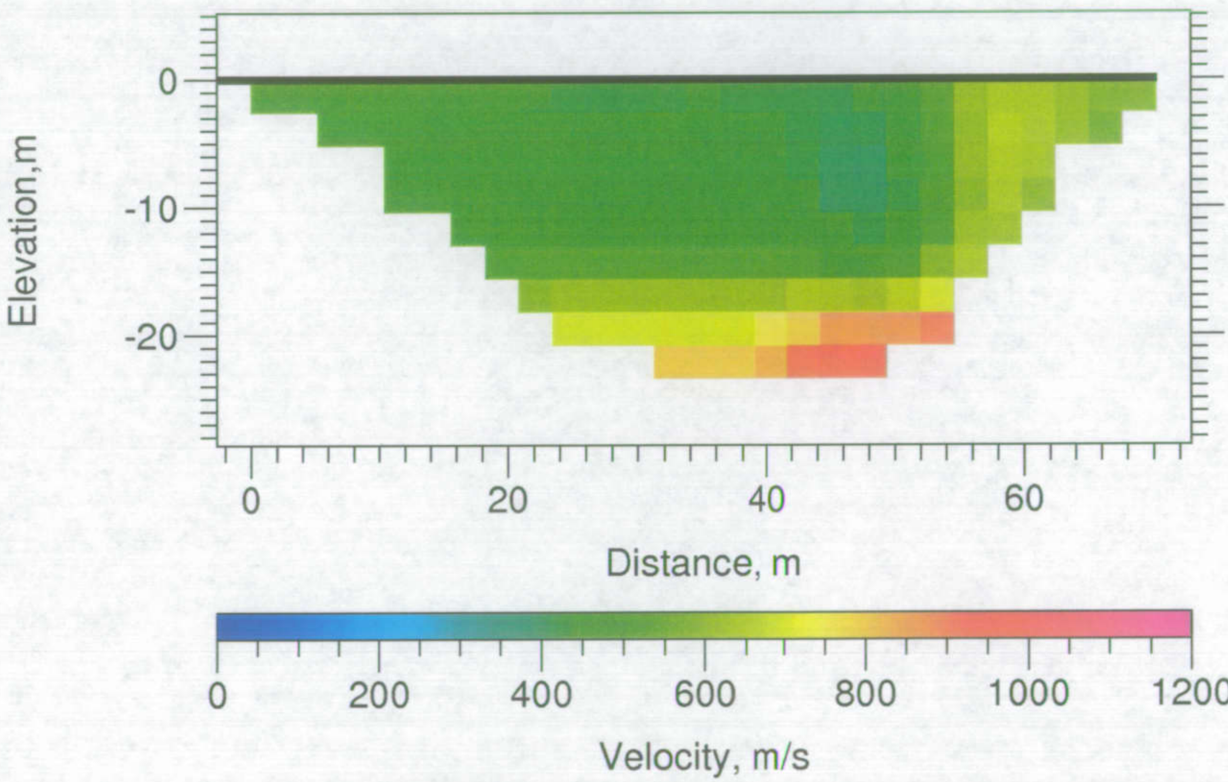
Appendix E

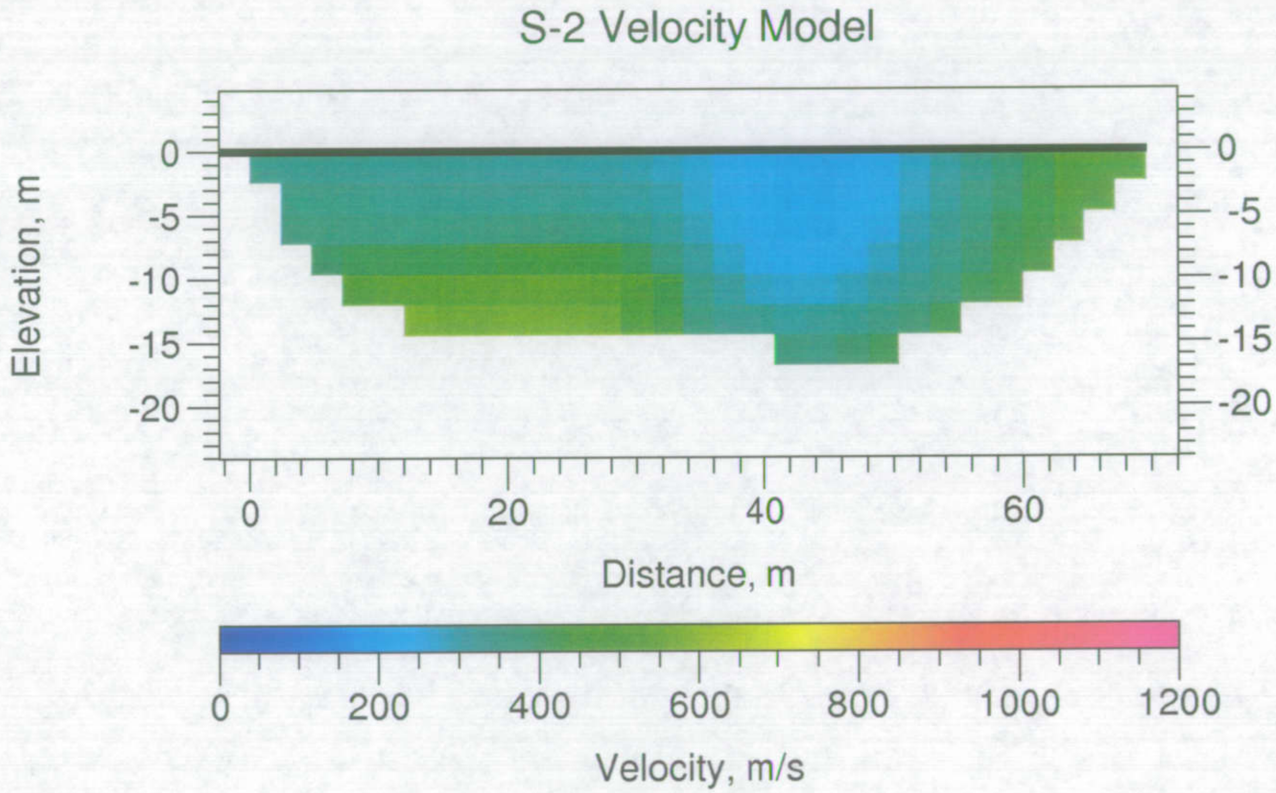
APPENDIX E
Seismic Refraction Test Results

Table 1. Summary of depth to higher velocity layers, the corresponding compression wave velocities, and observations on the velocity models from seismic refraction surveys conducted on eleven lines along the proposed Cuba-LaCueva road alignment.

Survey line	Approximate depth to highest velocity layer [m]	Compression wave velocity		Summary
		[m/sec]	[ft/sec]	High = velocities greater than 1200 m/sec Moderately high = velocities in the range of 850 to 1200 m/sec Low = velocities less than 850 m/sec Note that these definitions are valid for this project only.
S-1	21	1000	3281	A layer of high velocity at an approximate depth of 21 m, overlain by a thin layer with velocity of 700 m/sec.
S-2	12	500	1640	Very soft layer with a velocity in the range of 200 to 400 m/sec, to an approximate depth of 15 m.
S-3	10	950	3117	Mostly soft soil with low velocities to a depth of 20 m, with small outcrop of high velocity layer at an approximate depth of 10 m.
S-4	10	900	2953	Predominantly soft soil with low velocities. Very small outcrop of moderately high velocity layer at an approximate depth of 10 m.
S-5	22	1200	3937	A high velocity layer at a depth of about 22 m, overlain by soft layers with low velocities.
S-6	18	1200	3937	High velocity layer at a depth of about 18 m on the right side of the survey line. Other layers are soft with low velocities.
S-7	13	1200	3937	High velocity layer at a depth of about 13 m, overlain by layers with velocities of 500 and 700 m/sec.
S-8	17	850	2789	Predominantly soft soil with velocity of 200 m/sec to a depth of 12 m. Very thin layer of moderately high velocity at a depth of about 17 m at central zone.
S-9	8	1000	3281	An outcrop of high velocity at the surface on the right side of the survey line. High velocity soil at a depth of 8 m overlain by layers with velocities ranging from 200 to 700 m/sec.
S-10	18	1200	3937	High velocity soil at a depth of about 18 m on one side of the survey line overlain by layers with velocities ranging from 400 to 700 m/sec.
S-11	20	700	2297	Predominantly soft layers with velocities in the range of 200 to 700 m/sec.

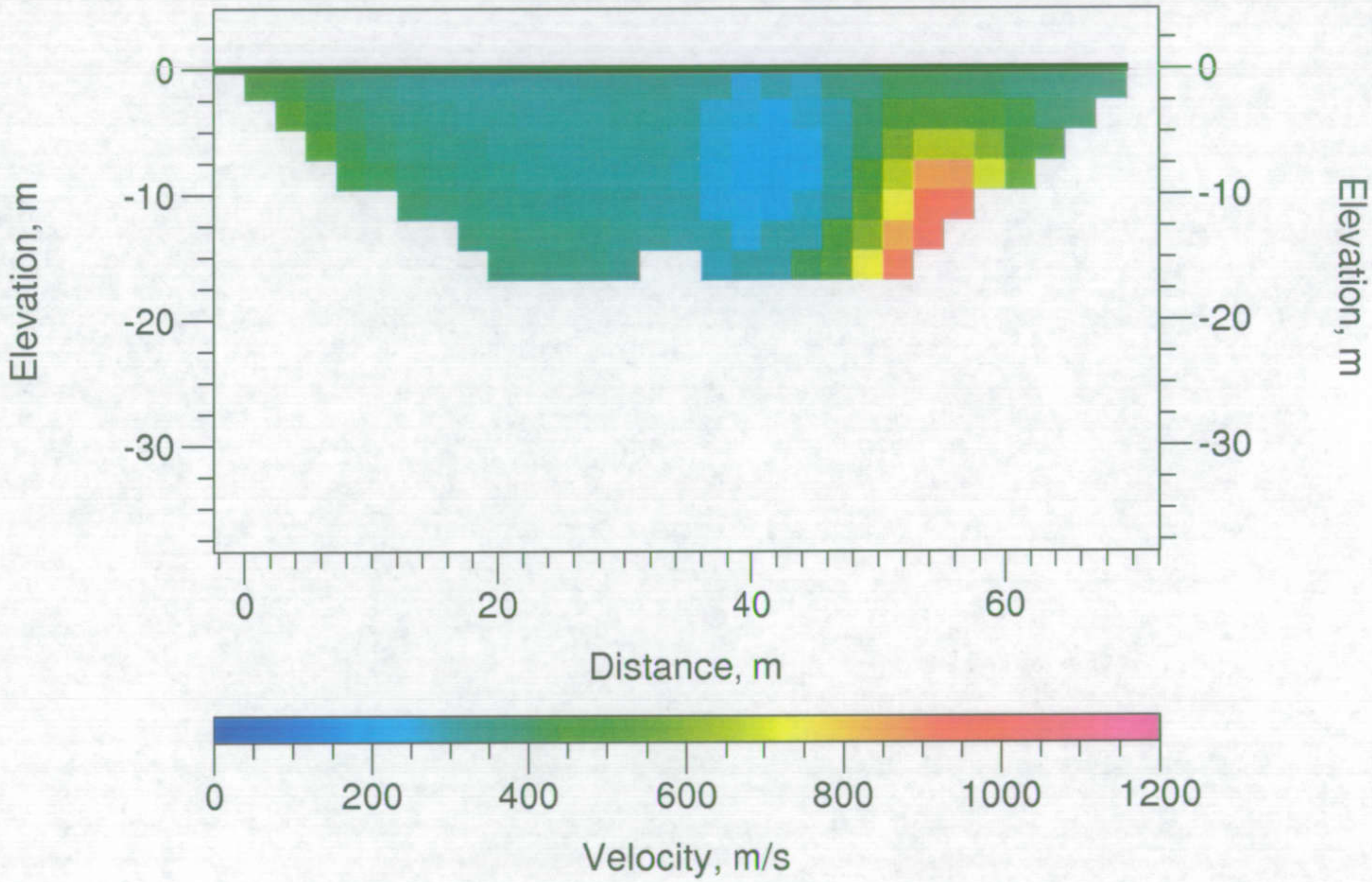
S-1 Velocity Model

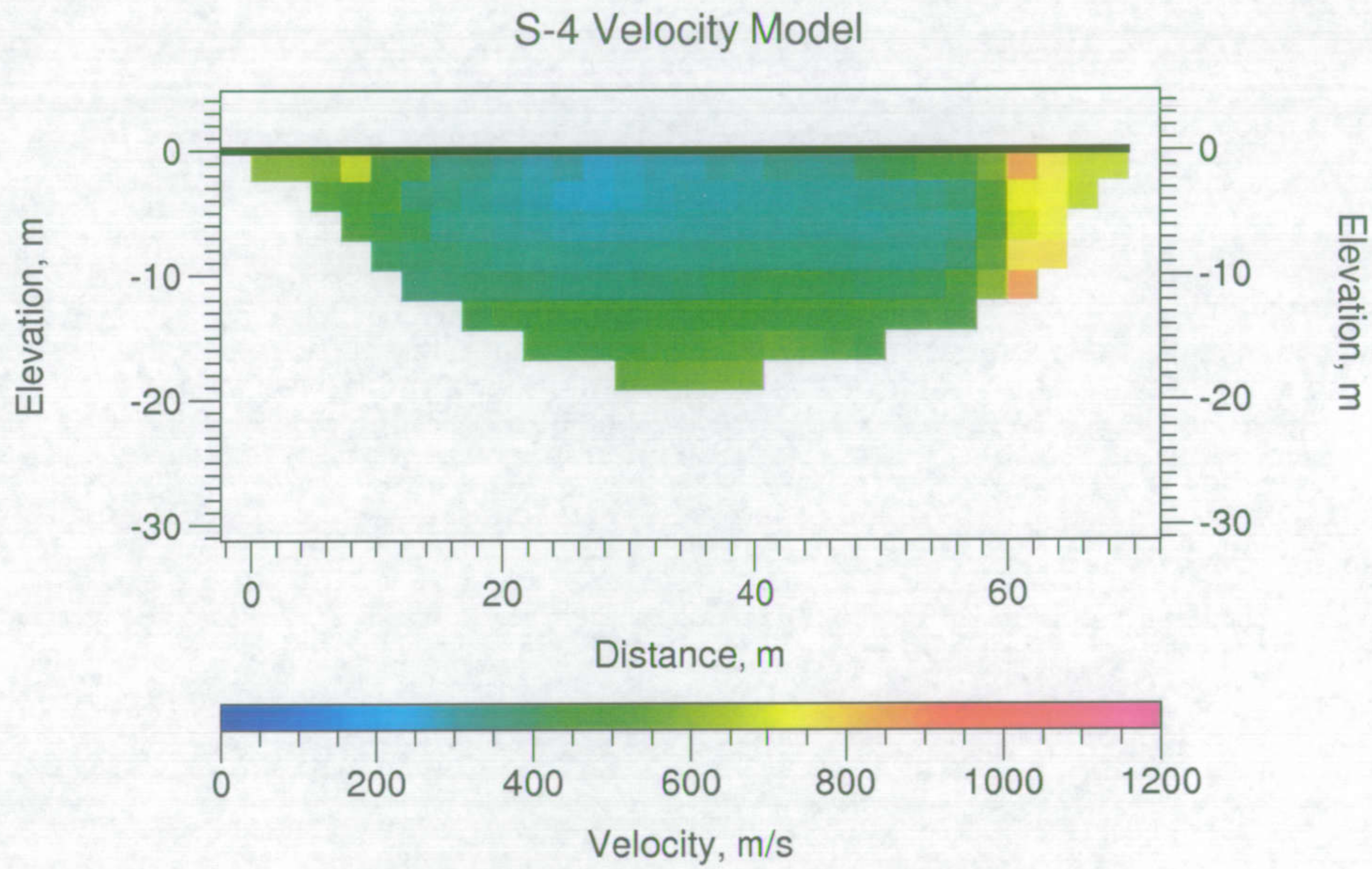


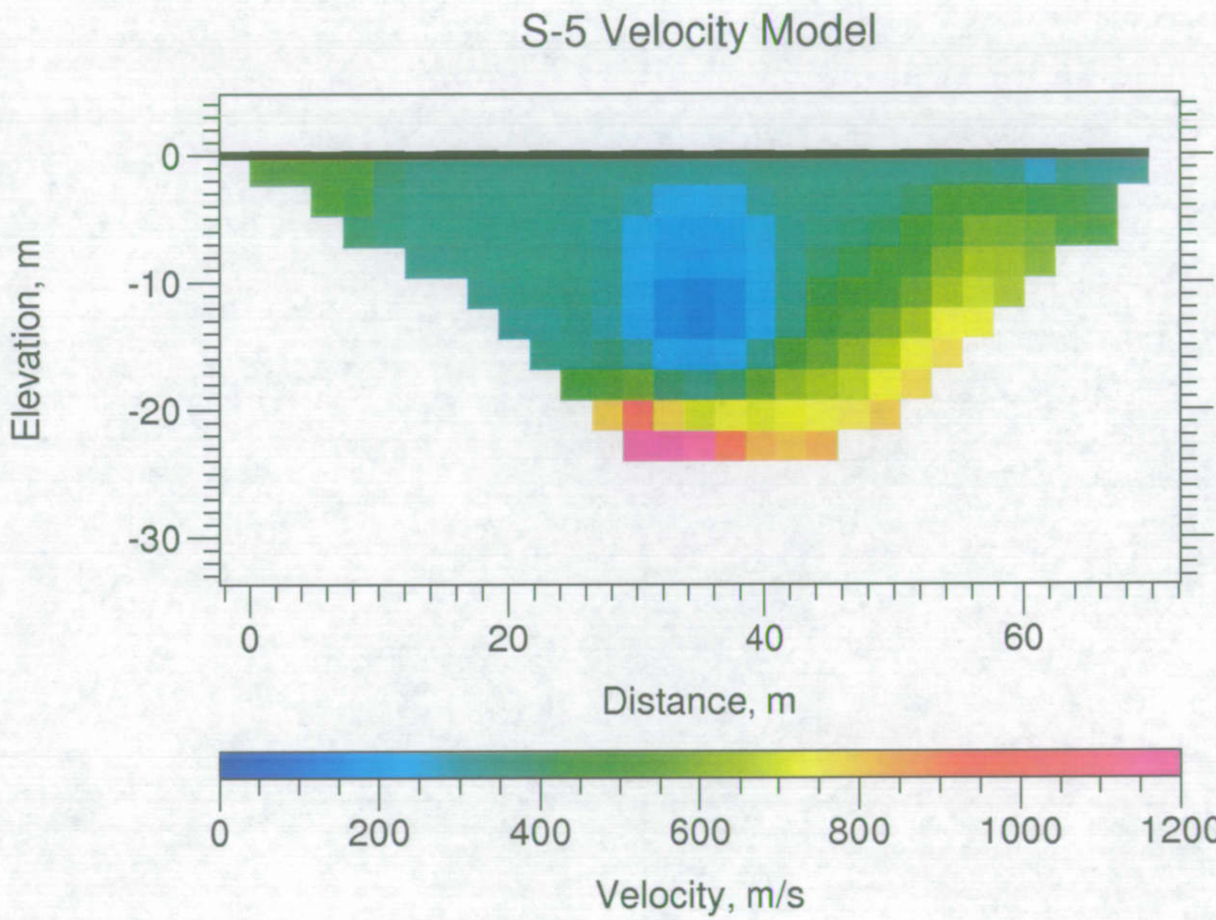


S-2 Velocity Model
Elevation, m
0
-5
-10
-15
-20
Elevation, m
0
20
40
60
Distance, m
0
200
400
600
800
1000
1200
Velocity, m/s

S-3 Velocity Model

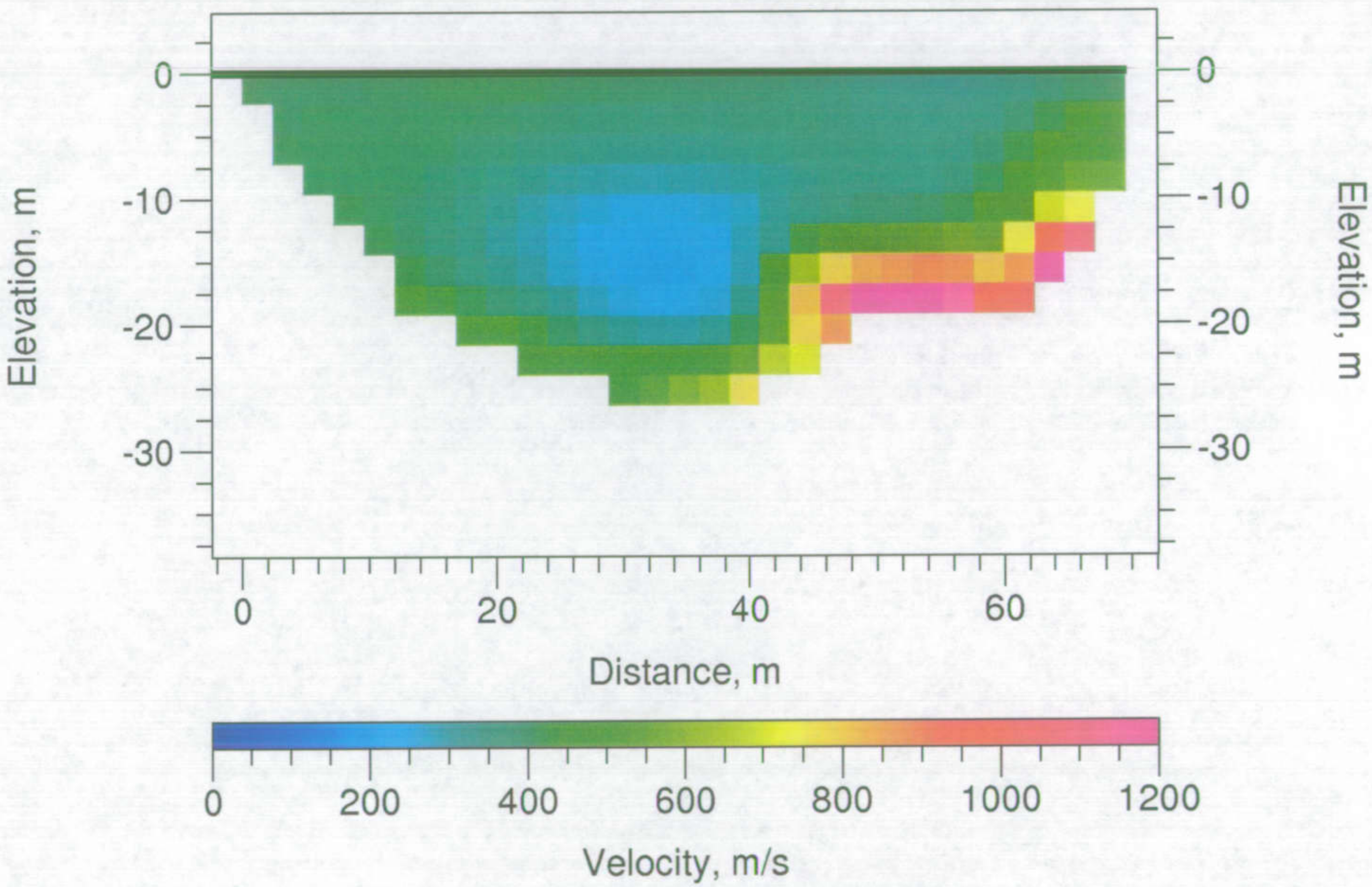


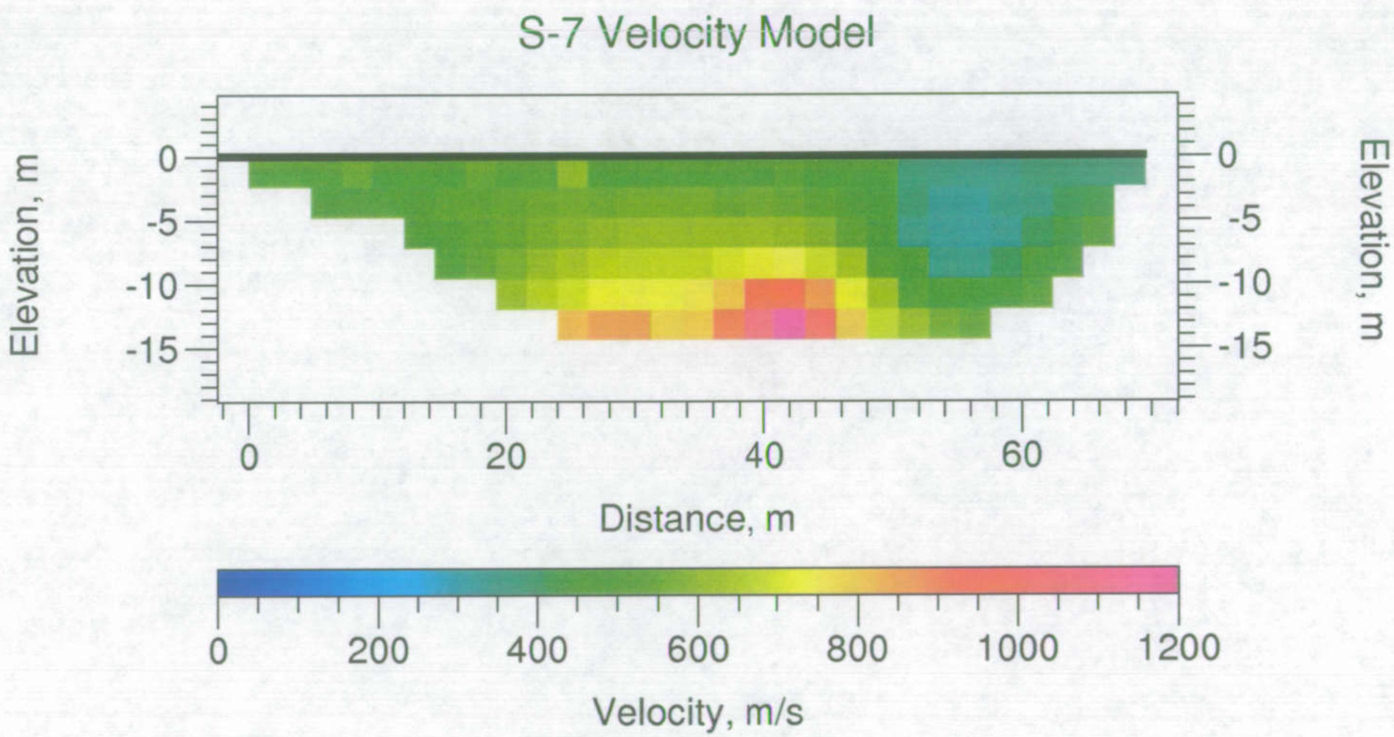

S-4 Velocity Model
Elevation, m
0
-10
-20
-30
Distance, m
0
20
40
60
0
200
400
600
800
1000
1200
Velocity, m/s



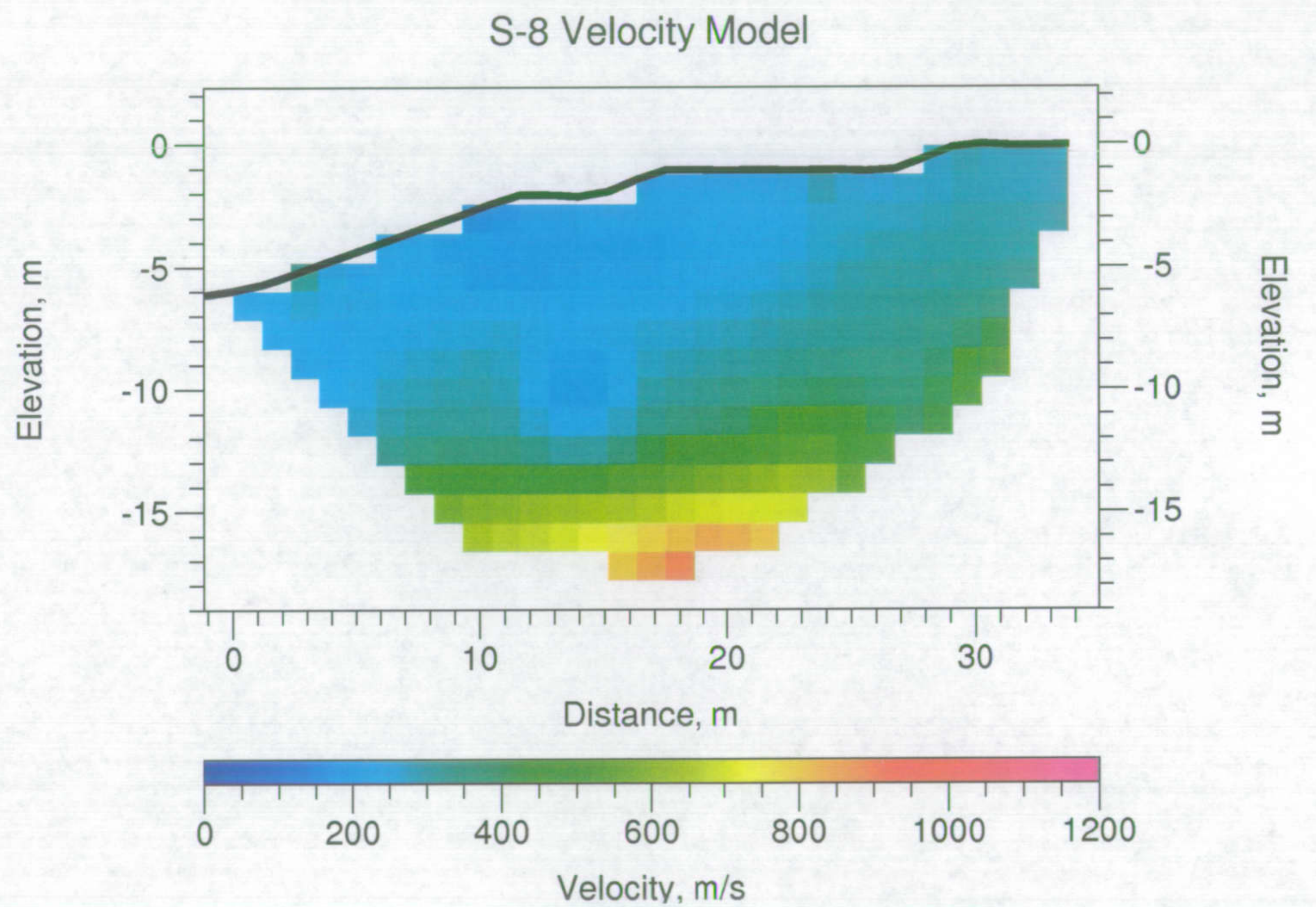
S-5 Velocity Model
Elevation, m
Elevation, m
0
-10
-20
-30
0
20
40
60
Distance, m
0
200
400
600
800
1000
1200
Velocity, m/s

S-6 Velocity Model

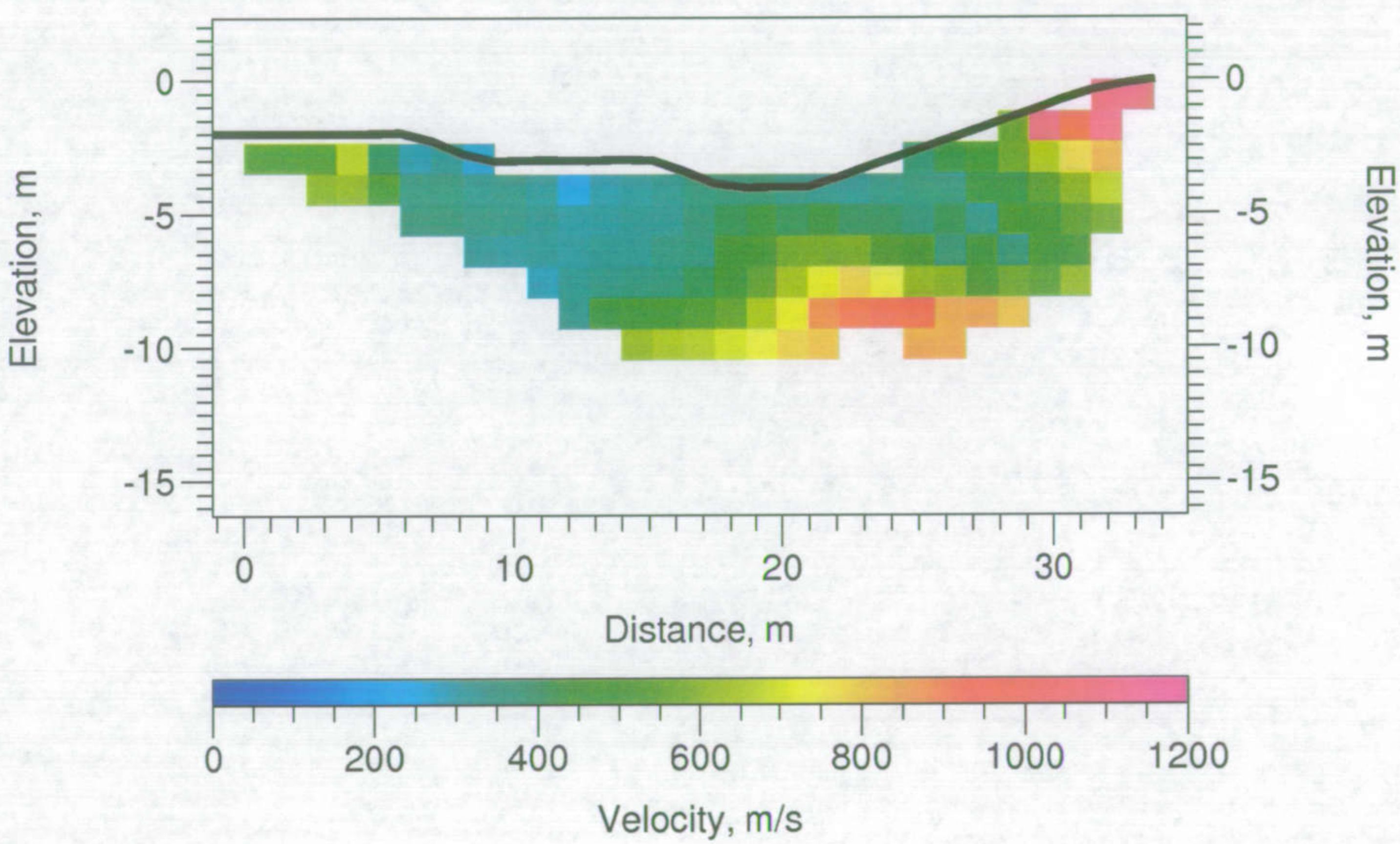


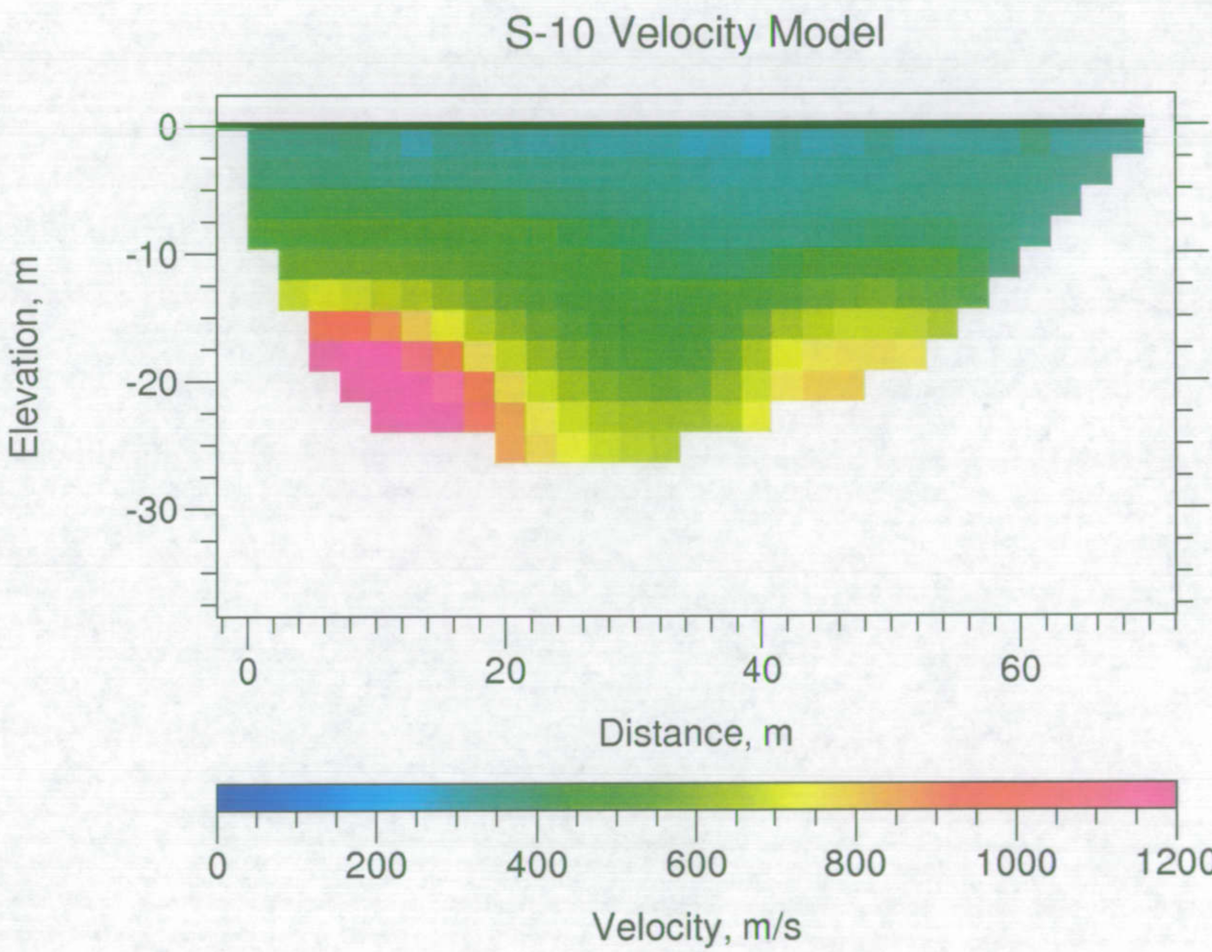


S-7 Velocity Model
Elevation, m
0
-5
-10
-15
0
20
40
60
Distance, m
0
200
400
600
800
1000
1200
Velocity, m/s

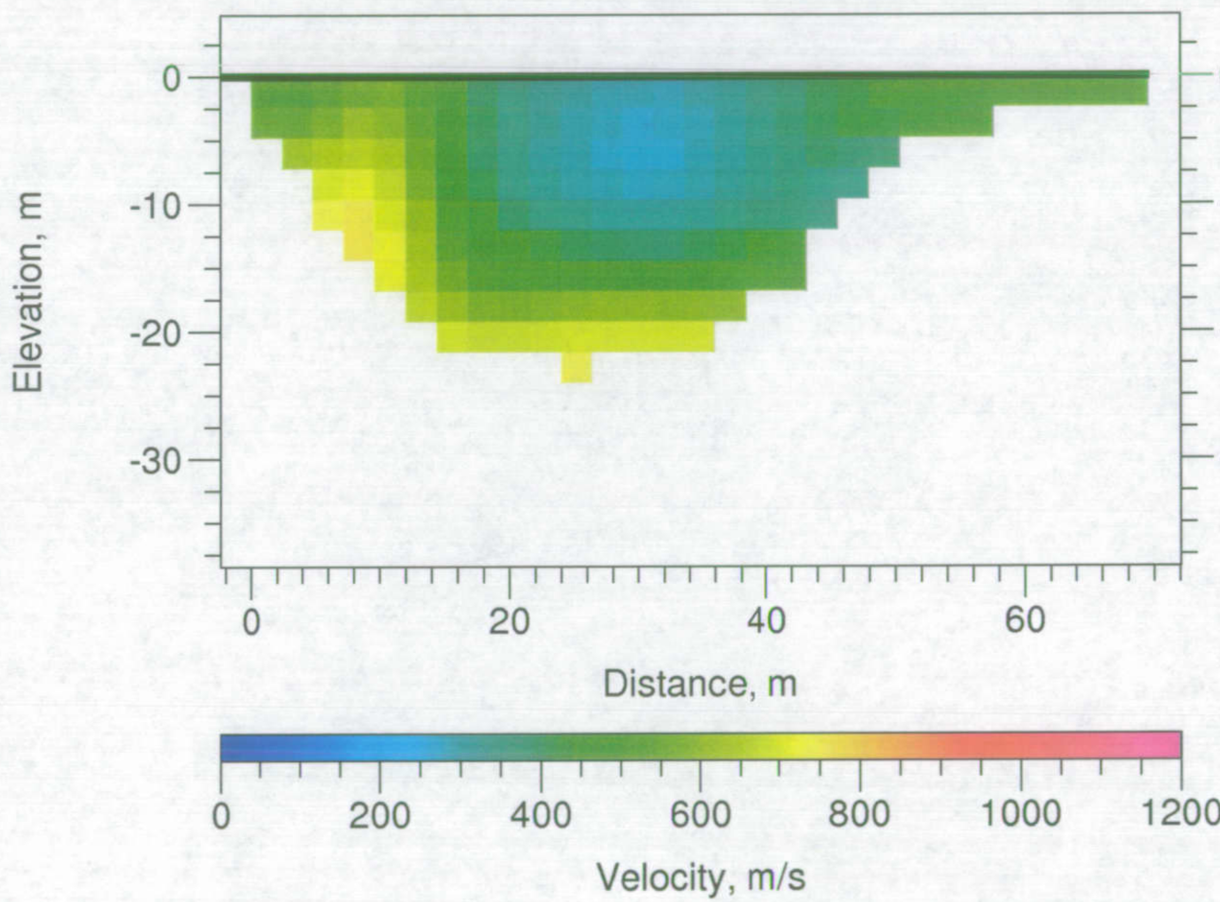

S-8 Velocity Model
Elevation, m
0
-5
-10
-15
Elevation, m
0
-5
-10
-15
0
10
20
30
Distance, m
0
200
400
600
800
1000
1200
Velocity, m/s

S-9 Velocity Model




S-10 Velocity Model
Elevation, m
Elevation, m
0
-10
-20
-30
0
20
40
60
Distance, m
0
200
400
600
800
1000
1200
Velocity, m/s

S-11 Velocity Model



Appendix F

APPENDIX F
Pavement Design Calculations

KLEINFELDER

PROJECT NM SH 126 PROJECT NO. 35321
SUBJECT Pavement Design BY T. Ritter DATE 3/19/4
Fenton Lake / Cuba - La Cueva REVIEWED BY JPL DATE 4/8/04

Objective: Determine design parameters for a pavement design and to complete a design for HMA over ABC.

Given:

From Lab test Results:

Boring	R-value
B-1	51
B-3	51
B-5	45
MSE-1	57
B-10	67
B-11	32
B-12	39
B-13	56

From RFP documents and client correspondance:
- Design life = 25 years
- 2002 ADT = 389 vehicles
- 2026 ADT = 811 vehicles
- growth rate = 2%
- structural coeff. for HMA = 0.44
- structural coeff. for ABC = 0.14
- Reliability = 75%
- Initial Serviceability = 4.2
- Terminal Serviceability = 2.5
- Standard Deviation = 0.49
- Directional Split = 0.60

from FHWA: Minimum Pavement section 3" HMA over 6" ABC

Assume:
1. 2% truck traffic divided as follows 0.5% single-tandem-tandem
 0.5% single-single-tandem
 1% single-tandem
2. 98% private vehicles divided as follows 50% cars
 48% small trucks
3. An average value of "R" - ½(standard deviation), will be used as the design R-value. If the subgrade is weaker a minimum of 24" will be removed and replaced prior to placing the ABC and HMA.

Solution: Using Pavement Analysis Software (PAS 5.0) by Am. Concrete Pavement Association (ACPA) based on 1993 AASHTO Design Guide.

Traffic Loading: 389 vehicles with 2% growth

1-lane 60% yields 239 vehicles

0.5%	s-t-t	= 1	per day
0.5%	s-s-t	= 1	per day
1.0%	s-t	= 2	per day
50%	cars	= 120	per day
48%	p-u	= 115	per day

Based on PAS 5.0, design ESAL's = 108,595 for flexible
(see sheet 2)

03-19-2004

State: NM
Agency: FHWA - Central Lands
Company:
Contractor:
Engineer: TR

Job Number: 35321

Location: NM SH 126
NM FH 12
Fenton Lake - Cuba/La Cu

MMMMMMMMMMMMMMMMMMMMMMMM Traffic Conversion To E 18's MMMMMMMMMMMMMMMMMMMMMMMMM

E 18 CONVERSION FROM VEHICLE DATA
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

Estimated: Rigid Depth = 6.00 Structural Number = 2.60 Pt = 2.50
Annual Growth Rate = 2.00
Design Life = 25.00

MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

VEHICLE	AXLE	LOAD	TM	NUMBER/(D,M,Y)		VEHICLE	AXLE	LOAD	TM	NUMBER/(D,M,Y)	
MMMMMMM	MMMM	MMMMM	M	MMMMMMMMMMM	MM	MMMMMMM	MMMM	MMMMM	M	MMMMMMMMMMM	MM
	F-	2.00	1			ZDDD?	F-	12.00	1		
Z/oDD	M-	0.00	0			Zo3 3	M-	0.00	0		
ToMo>	R-	2.00	1	120	D	ToADOO>	R-	34.00	2	1	D
	F-	2.00	1			ZDDDD?	F-	12.00	1		
Zo3DDD	M-	0.00	0			Zo3 3	M-	16.00	1		
ToOMo>	R-	5.00	1	115	D	ToAODOO>	R-	34.00	2	1	D
ZDD?	F-	10.00	0			ZDDDDD?	F-	12.00	1		
Zo3 3	M-	0.00	0			Zo3 3	M-	34.00	2		
ToADO>	R-	24.00	0	0	D	ToAOODOO>	R-	34.00	2	2	D

MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

Rigid E 18's	Flexible E18's
153,555	108,595

MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

key: F-Front M-Middle R-Rear Axle
1-Singe 2-Tandem 3-Tridem Axle
D-Day M-Month Y-Year

Originator: T. Ritter Date: 3/19/4

Checker: [signature] Date: 4/8/04

KLEINFELDER

PROJECT NM SH 126 PROJECT NO. 35321
SUBJECT Pavement Design BY T. R[illegible] DATE 3/19/4
REVIEWED BY [illegible] DATE 4/6/04

Solution cont:

Determine average - ½ std deviation of R-value

average = 49.75
standard deviation = 11

average - ½ std deviation = 44 R-value

Using PAS 5.0, an R-value = 44, resilient mod = 6.77 kN/cm² (9819 psi)
(see sheet 4)

Using calculated values and given values with the PAS 5.0 program. (see sheet 5)

the flexible pavement section should be

76 mm (3 inches) HMA (hot mix asphalt) over
152 mm (6 inches) ABC (aggregate base course)

the minimum section provides a SN = 2.16, which is greater than the required = 1.97, (see sheet 5)
for a 2.16 the resilient modulus can be reduced to 7,741 psi, see sheet 6, which corresponds to an R-value = 37 (see sheet 7)

Therefore, Assumption 3 can be modified to
If the subgrade soil has a R-value < 37
(resilient modulus < 5.38 kN/cm² (7,741 psi)).

Shortcut to

G:\Geotech\EngrProg\Pas5\PAS.EXE

Ready

Help Screen for the Resilient Modulus

Empirical relationships have been developed between the CBR (California Bearing Ratio) value (using dynamic compaction), the R-value, and the in-situ resilient modulus of the soil.

CBR Value: ____	R-Value: 44.0
or	
Resilient Modulus, psi:	Resilient Modulus, psi: 9,819

Subgrade Resilient Modulus: 9,819 psi

The correlations used in this program were developed under NCHRP Project 128, "Evaluation of AASHO Interim Guide for the Design of Pavement Structures." This study found a non-linear relationship between resilient modulus and CBR or R-Value. Although equation 1.5.1 of the AASHTO Guide suggests a relationship of 1500 * CBR for the resilient modulus of the subgrade, this correlation is only valid for fine-grained soils with low CBR values. Other studies (Indiana, Ohio) have shown a correlations as low as 800 * CBR, and ranging from 750 to 3,000 times the CBR value. This range agrees with the correlation established in NCHRP Project 128.

F1:Help F2:List(*) F9:SolveFor F10:ClrField Esc:Back F8:Report ALT-X:E

Originator: T. Ritter Date: 3/19/4

Checker: [signature] Date: 4/8/4

03-19-2004

State: NM
Agency: FHWA - Central Lands
Company:
Contractor:
Engineer: TR

Job Number: 35321
Location: NM SH 126
NM FH 12
Fenton Lake - Cuba/La Cu

============================ Flexible Analysis ============================

Structural Number	=	1.97	
Design E 18's	=	108,595	
Reliability	=	75.00	percent
Overall Deviation	=	0.49	
Resilient Modulus	=	9,818.6	psi
Initial Serviceability	=	4.20	
Terminal Serviceability	=	2.50	

← calc of needed SN

Layer Number	Layer Coefficient == a (i) ==	Drainage Coefficient ==== Cd ===	Layer Thickness === t ===	a(i)*Cd*t =========
1 HMA	0.44	1.00	3.00	1.32
2 ABC	0.14	1.00	6.00	0.84
3				
4				
5				
6				

} Minimum pavement section

=========
Total SN = 2.16

Originator: T. Rutt Date: 3/9/4

Checker: [signature] Date: 4/8/4

03-19-2004

State: NM
Agency: FHWA - Central Lands
Company:
Contractor:
Engineer: TR

Job Number: 35321
Location: NM SH 126
NM FH 12
Fenton Lake - Cuba/La Cu

========================= Flexible Analysis =========================

Structural Number	=	2.16	
Design E 18's	=	108,595	
Reliability	=	75.00	percent
Overall Deviation	=	0.49	
Resilient Modulus	=	7,740.8	psi ← back calc of Resilient modulus
Initial Serviceability	=	4.20	
Terminal Serviceablity	=	2.50	

Layer Number ======	Layer Coefficient == a (i) ==	Drainage Coefficient ==== Cd ===	Layer Thickness === t ===	a(i)*Cd*t =========
1 HMA	0.44	1.00	3.00	1.32
2 ABC	0.14	1.00	6.00	0.84
3				
4				
5				
6				
				=========
			Total SN =	2.16

Originator: T. Ritter Date: 3/19/4

Checker: SEL Date: 4/6/04

Shortcut to

G:\Geotech\EngrProg\Pas5\PAS.EXE

Ready

Help Screen for the Resilient Modulus

Empirical relationships have been developed between the CBR (California Bearing Ratio) value (using dynamic compaction), the R-value, and the in-situ resilient modulus of the soil.

CBR Value: ______ or R-Value: 37.0

Resilient Modulus, psi: Resilient Modulus, psi: 7,720

Subgrade Resilient Modulus: 7,720 psi

The correlations used in this program were developed under NCHRP Project 128, "Evaluation of AASHO Interim Guide for the Design of Pavement Structures." This study found a non-linear relationship between resilient modulus and CBR or R-Value. Although equation 1.5.1 of the AASHTO Guide suggests a relationship of 1500 * CBR for the resilient modulus of the subgrade, this correlation is only valid for fine-grained soils with low CBR values. Other studies (Indiana, Ohio) have shown a correlations as low as 800 * CBR, and ranging from 750 to 3,000 times the CBR value. This range agrees with the correlation established in NCHRP Project 128.

F1:Help F2:List(*) F9:SolveFor F10:ClrField Esc:Back F8:Report ALT-X:Exit

Originator: T. Ritter Date: 3/9/4

Checker: [signature] Date: 4/8/04

Appendix G

APPENDIX G

APPLICATION FOR AUTHORIZATION TO USE

NEW MEXICO STATE HIGHWAY 126, NEW MEXICO FOREST HIGHWAY 126 – CUBA-LACUEVA, NM
(project name)

35321
(project job number)

4/13/04
(date)

Kleinfelder, Inc.
8300 Jefferson, NE, Suite B
Albuquerque, NM 87113
(505) 344-7373 Fax (505) 344-1711

To whom it may concern:

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Applicant agrees to accept the contractual terms and conditions between Kleinfelder, Inc. and Wilson & Company originally negotiated for preparation of this document. Use of this document without permission releases Kleinfelder, Inc. from any liability that may arise from use of this report.

To be Completed by Applicant

____
(company name)

____
(address)

____
(city, state, zip)

__________ __________
(telephone) *(FAX)*

By: ______________________

Title: ______________________

Date: ______________________

For Kleinfelder, Inc.'s use only

_______ approved for re-use with additional fee of $ __________

_______ disapproved, report needs to be updated

By: ______________________
(Kleinfelder, Inc. project manager)

Date: ______________________