Geotechnical Engineering and Pavement Design Report

N35(8)1,2,4 and N5045(1)1,2,4

Sweetwater, Arizona

Contract No. A16PC00088

Task Order No. A16PD00654

Project No. 65165267

February 13, 2017

Registered Professional Engineer (Civil)
CERTIFICATE NO.
43838
RAMON
PADILLA
Date Signed 2/13/17
ARIZONA, U.S.A.
Expires 3-31-2018

Prepared for:
United States Department of the Interior
Bureau of Indian Affairs

Prepared by:
Terracon Consultants, Inc.
Farmington NM & Tempe AZ

February 13, 2017

United States Department of the Interior
Bureau of Indian Affairs
Navajo Regional Office, Branch of Acquisition
P.O. Box 1060
Gallup, New Mexico 87305

Attn: Ms. Ella Dempsey

Re: **Geotechnical Engineering and Pavement Design Report**
Roadway Sampling and Testing
N35(8)1,2,4 and N5045(1)1,2,4
Sweetwater, Arizona
Contract No. A16PC00088
Task Order No. A16PD00654
Terracon Project No. 65165267

Dear Ms. Dempsey:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical and pavement engineering services for the above referenced project. These services were performed in general accordance with our proposal titled Proposal for Geotechnical and Pavement Engineering Services, Roadway Sampling and Testing, N35(8)1,2,4 and N5045(1)1,2,4, Sweetwater, Arizona (Terracon Proposal No. P69165033, Revision 1 dated August 18, 2016). This geotechnical engineering and pavement design report presents the results of the subsurface exploration and provides geotechnical and pavement engineering recommendations concerning the design and construction of pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Registered Professional Engineer (Civil) CERTIFICATE NO. 43838 RAMON PADILLA Date Signed 2/13/17 ARIZONA, U.S.A. Expires 3-31-2018

Kirk D. Jackson, E.I.T.
Staff Geotechnical Engineer

Ramon Padilla, P.E.
Geotechnical Project Manager

APR Review: Donald R. Clark, P.E.

Copies to: Addressee (1 via email)

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List of Abbreviations

AASHTO ..... American Association of State Highway and Transportation
ABC ..... Aggregate Base Course
AC ..... Asphalt Concrete
ARAC ..... Asphalt-Rubber Asphalt Concrete
ADT ..... Average Daily Traffic
ADOT ..... Arizona Department of Transportation
ADWR ..... Arizona Department of Water Resources
ASTM ..... American Society for Testing and Materials

ESAL ..... Equivalent Single 18-kip Axle Loads

GI ..... AASHTO Group Index

M_R ..... Resilient Modulus

PI ..... Plasticity Index
psi ..... Pounds per square inch
PSI ..... Present Serviceability Index

R-Value ..... Resistance Value

SAMI ..... Strain Attenuating Membrane Interlayer
SN ..... Structural Number
SPT ..... Standard Penetration Test

USCS ..... Unified Soil Classification System

GEOTECHNICAL AND PAVEMENT DESIGN REPORT
ROADWAY SAMPLING AND TESTING
N35(8)1,2,4 AND N5045(1)1,2,4
SWEETWATER, ARIZONA

Contract No. A16PC00088, Task Order No. A16PD00654
Terracon Project No. 65165267
February 13, 2017

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering and pavement design services performed for N35(8)1,2,4 and N5045(1)1,2,4 near Sweetwater, Arizona. The purpose of this project is to construct asphalt pavement on the existing unpaved roadways. The purpose of our engineering services is to provide information and geotechnical and pavement engineering recommendations relative to:

- subgrade soil conditions
- earthwork
- pavement design sections
- material specifications

Our geotechnical engineering scope of work for the subsurface exploration of this project included the following:

- 54 test borings and 12 test pits (designated as B1 through B66)
- 11 seismic refraction survey lines in anticipated cut areas
- 17 field electrical resistivity survey lines at proposed corrugated steel pipe culverts

In addition, our geotechnical engineering services included laboratory testing, geotechnical and pavement engineering analyses, and the preparation of this report. The project Site Vicinity Map and Boring Locations diagrams along with the boring / test pit logs and seismic survey results are included in Appendix A of this report (as Exhibits A-1 through A-74 and A-S1A through A-S9).

The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices. Design worksheets for the engineering analyses and pavement design are included in Appendix C.

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site Location	See the Site Vicinity Map, Exhibit A-1 in Appendix A.
Site Layout	See the Site Vicinity Map and Boring Locations Plans, Exhibits A-1 through A-6 in Appendix A.
Pavement	Evaluation of subgrade soil conditions and pavement design recommendations have been requested for the approximate 12.9 kilometers (8.0 miles) section of BIA Routes N35 and N5045.
Design Information	The following traffic data was provided for the planned pavement thickness design on the project: n Existing ADT (2011): 238 n Annual Growth Rate: 2% n Percent Trucks: 1% n Percent Buses: 1% n Design Life: 20 years from 2016 Typical roadway widths: n Driving Lane Width: 3.3 meters n Shoulder Width: 1.5 meters
Grading	Based on the grading plans for BIA Route N35 provided with the RFP, minimal cuts and fills up to +/-1 meter are anticipated to achieve finished grades for a majority of the alignment, with sparse areas of cuts and fills up to approximately +/-6 meters. A grading plan was not available for BIA Route N5045 at the time of our report preparation.

2.2 Site Description

ITEM	DESCRIPTION
Location	The project is comprised of approximately 12.9 kilometers (8.0 miles) of proposed roadway improvements located in the vicinity of Sweetwater, Arizona. The proposed BIA Route N35 alignment begins at Station 21+441.45 and ends at Station 33+880.00, and this alignment length is approximately 12.4 kilometers (7.7 miles). The proposed BIA Route N5045 begins at Station 0+000.00 and ends at Station 0+503.02, and this alignment length is approximately 0.5 kilometers (0.3 miles).
Existing Improvements	The project site consists of the existing unpaved BIA Routes N35 and N5045. Areas surrounding the existing roadways consist of relatively undeveloped land.

ITEM	DESCRIPTION
Current Ground Cover	The existing N35 and N5045 roadways consist of graded unpaved roads. The alignment of the proposed roadway improvements generally extends along the existing roads. However, some portions of the proposed alignment extend off of the existing road and onto native desert land.
Existing Topography	The existing topography is generally relatively flat with some changes in elevation due to existing washes and hills.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The project area is located in the Colorado Plateau physiographic province ([1]Cooley, 1967) of the North American Cordillera ([2]Stern, et al, 1979) of the southwestern United States. The Colorado Plateau province is situated between the Rocky Mountains to the east, and the Basin and Range physiographic province to the southwest. Formed during middle and late Tertiary time (100 to 15 million years ago), the Colorado Plateau is characterized by alternating cliffs and slopes formed as a result of different rates of erosion on resistant and weak sedimentary rocks. Ledges, cliffs or rock benches formed of resistant beds of sandstone and limestone are separated by slopes, valleys, and badlands carved on the weaker intervening shaley strata. The entire province has similar rock formations, which have nearly horizontal bedding or which are inclined slightly to the southwest. The entire plateau drains to the Colorado River.

The physiographic features within the province are related to their distance from the Colorado River and to the amount of downcutting caused by erosional processes. In areas adjacent to the Colorado River, canyon lands are developed extensively. In the areas surrounding the canyon lands and in part of the uplands adjoining the canyon rims, rock terraces form a series of platforms and high cliffs that include Marble Platform, Coconino Plateau, Echo Cliffs, Black Mesa, and Defiance Plateau. In the southern part of the province beyond the belt of rock terraces, the relief is rather subdued and broad slopes and low mesa-like features predominate.

Specific geologic conditions along the alignment are described by the USGS as follows:

- The eastern portion of the alignment includes undivided Quaternary surficial deposits. This geologic unit is described as unconsolidated to strongly consolidated alluvial and eolian deposits. This unit includes: coarse, poorly sorted alluvial fan and terrace deposits on middle and upper piedmonts and along large drainages; sand, silt and clay on alluvial plains and playas; and wind-blown sand deposits.

[1] Cooley, M.E., 1967, ***Arizona Highway Geologic Map***, Arizona Geological Society.
[2] Stern, C.W., et al, 1979, ***Geological Evolution of North America***, John Wiley & Sons, Santa Barbara, California.

- The center portion of the alignment includes the Morrison Formation. This geologic unit is described as commonly cliff-forming, cross-bedded sandstone lenses alternating with slope-forming siltstone, mudstone and shale. Colors are highly variable, and include greenish gray, reddish brown, pink, white, and purple. Sands were deposited by braided streams with finer sediment representing overbank or lacustrine deposits.

- The western portion of the alignment includes the San Rafael Group. This geologic unit is described as commonly cross-bedded, ledge-forming sandstone and slope-forming siltstone. Rock typically has a striped red and white aspect. The Carmel Formation and Entrada Sandstone are prominent members of this group.

3.2 Subsurface Soil Conditions

Specific conditions encountered at each boring/test-pit location are indicated on the individual boring/test-pit logs included in Appendix A of this report. The project included 54 test borings and 12 test pits. Stratification boundaries on the boring/test-pit logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. The results of the field and laboratory testing generally indicated similar subsurface conditions and similar engineering characteristics at the boring and test pit locations.

Based on conditions encountered in the borings, subsurface subgrade conditions for the majority of the alignment generally included deposits of silty sand, poorly graded sand with silt, and poorly graded sand with isolated occurrences of sandy lean clay, sandy silty clay, and sandy silt. Laboratory test results of samples obtained from the field exploration indicate the subgrade soil along the alignment mainly exhibited non-plastic to low plasticity characteristics. Field penetration test results indicate that the near surface subgrade soils had variable relative densities in the very loose to very dense range.

The AASHTO soil classification method was used to classify the site soils based on the results of the laboratory testing. The AASHTO soil classification included determining a soil Group Classification, Group Index (GI) values, and General Ratings as Subgrade. The AASHTO soil classification for each boring location is summarized in the following table:

SUBGRADE SOIL CLASSIFICATION								
Boring No.	**Depth (m)**	**% Passing US No. 200 Sieve**	**Liquid Limit (LL)**	**Plasticity Index (PI)**	**USCS Classification**	**AASHTO Group Index**	**AASHTO Classification**	**AASHTO General Rating as Subgrade**
B1	0 - 1.5	11	0	0	SP-SM	0	A-2-4	Excellent to Good
B2	0 - 1.5	54	34	12	CL	4	A-6	Fair to Poor
B3	0 - 1.5	38	0	0	SM	0	A-4	Fair
B4	0 - 1.5	19	0	0	SM	0	A-2-4	Excellent to Good
B5	0 - 1.5	23	0	0	SM	0	A-2-4	Excellent to Good

SUBGRADE SOIL CLASSIFICATION								
Boring No.	**Depth (m)**	**% Passing US No. 200 Sieve**	**Liquid Limit (LL)**	**Plasticity Index (PI)**	**USCS Classification**	**AASHTO Group Index**	**AASHTO Classification**	**AASHTO General Rating as Subgrade**
B5	1.5-1.8	16	0	0	SM	0	A-2-4	Excellent to Good
B6	0 - 1.5	10	0	0	SP-SM	0	A-3	Excellent to Good
B7	0 - 1.5	11	0	0	SP-SM	0	A-2-4	Excellent to Good
B8	0 - 1.5	15	0	0	SM	0	A-2-4	Excellent to Good
B9	0 - 1.5	8	0	0	SP-SM	0	A-3	Excellent to Good
B9	2.7-3.2	12	0	0	SP-SM	0	A-2-4	Excellent to Good
B10	0 - 1.5	34	0	0	SM	0	A-2-4	Excellent to Good
B11	0 - 1.5	15	0	0	SM	0	A-2-4	Excellent to Good
B12	0 - 1.5	14	0	0	SM	0	A-2-4	Excellent to Good
B13	0 - 1.5	17	0	0	SM	0	A-2-4	Excellent to Good
B14	0 - 1.5	16	0	0	SM	0	A-2-4	Excellent to Good
B15	0 - 1.5	9	0	0	SP-SM	0	A-3	Excellent to Good
B16	0 - 1.5	33	0	0	SM	0	A-2-4	Excellent to Good
B17	1.5 - 3	13	0	0	SM	0	A-2-4	Excellent to Good
B18	0 - 1.5	15	0	0	SM	0	A-2-4	Excellent to Good
B19	0 - 1.5	22	0	0	SM	0	A-2-4	Excellent to Good
B20	0 - 1.5	15	0	0	SM	0	A-2-4	Excellent to Good
B21	0 - 1.2	33	0	0	SM	0	A-2-4	Excellent to Good
B21	1.2-3.6	22	0	0	SM	0	A-2-4	Excellent to Good
B22	0 - 1.5	19	0	0	SM	0	A-2-4	Excellent to Good
B23	0 - 1.5	23	0	0	SM	0	A-2-4	Excellent to Good
B24	0.3-1.8	17	0	0	SM	0	A-2-4	Excellent to Good
B25	0 - 1.5	39	0	0	SM	0	A-4	Fair
B26	0 - 1.5	16	0	0	SM	0	A-2-4	Excellent to Good
B27	0 - 1.5	63	24	7	CL-ML	2	A-4	Fair
B28	0 - 1.5	3	0	0	SP	0	A-3	Excellent to Good
B29	0 - 1.5	16	0	0	SM	0	A-2-4	Excellent to Good
B30	0 - 1.5	12	0	0	SM	0	A-2-4	Excellent to Good
B31	0 - 1.5	18	0	0	SM	0	A-2-4	Excellent to Good
B32	0 - 1.5	16	0	0	SM	0	A-2-4	Excellent to Good
B33	0 - 1.5	14	0	0	SM	0	A-2-4	Excellent to Good
B34	0 - 0.9	17	0	0	SM	0	A-2-4	Excellent to Good
B35	0 - 1.5	12	0	0	SP-SM	0	A-2-4	Excellent to Good
B36	0 - 1.5	6	0	0	SP-SM	0	A-3	Excellent to Good
B37	0 - 1.5	19	0	0	SM	0	A-2-4	Excellent to Good
B38	0 - 1.5	7	0	0	SP-SM	0	A-3	Excellent to Good
B39	0 - 1.5	18	0	0	SM	0	A-2-4	Excellent to Good
B40	0 - 1.5	14	0	0	SM	0	A-2-4	Excellent to Good
B41	0 - 1.5	6	0	0	SP-SM	0	A-3	Excellent to Good
B42	0 - 1.5	19	0	0	SM	0	A-2-4	Excellent to Good
B43	0 - 1.5	19	0	0	SM	0	A-2-4	Excellent to Good
B44	0 - 1.5	14	0	0	SM	0	A-2-4	Excellent to Good

SUBGRADE SOIL CLASSIFICATION								
Boring No.	**Depth (m)**	**% Passing US No. 200 Sieve**	**Liquid Limit (LL)**	**Plasticity Index (PI)**	**USCS Classification**	**AASHTO Group Index**	**AASHTO Classification**	**AASHTO General Rating as Subgrade**
B45	0 - 1.5	11	0	0	SP-SM	0	A-2-4	Excellent to Good
B46	0 - 1.5	14	0	0	SM	0	A-2-4	Excellent to Good
B47	0 - 1.5	24	0	0	SM	0	A-2-4	Excellent to Good
B48	0 - 1.2	17	0	0	SM	0	A-2-4	Excellent to Good
B48	1.2-2.7	32	0	0	SM	0	A-2-4	Excellent to Good
B49	0 - 1.5	50	0	0	ML	0	A-4	Fair
B49	2.4-3	30	0	0	SM	0	A-2-4	Excellent to Good
B50	0 - 1.5	24	0	0	SM	0	A-2-4	Excellent to Good
B51	0 - 1.5	4	0	0	SP	0	A-3	Excellent to Good
B52	0 - 1.5	6	0	0	SP-SM	0	A-3	Excellent to Good
B53	0 - 1.5	4	0	0	SP	0	A-3	Excellent to Good
B54	0 - 1.5	17	0	0	SM	0	A-2-4	Excellent to Good
B55	0 - 1.5	7	0	0	SP-SM	0	A-3	Excellent to Good
B56	0 - 1.5	6	0	0	SP-SM	0	A-3	Excellent to Good
B57	0 - 1.5	12	0	0	SP-SM	0	A-2-4	Excellent to Good
B58	0 - 1.5	4	0	0	SP	0	A-3	Excellent to Good
B59	0 - 1.5	11	0	0	SP-SM	0	A-2-4	Excellent to Good
B60	0 - 1.5	7	0	0	SP-SM	0	A-3	Excellent to Good
B61	0 - 1.5	21	0	0	SM	0	A-2-4	Excellent to Good
B62	0 - 1.5	11	0	0	SP-SM	0	A-2-4	Excellent to Good
B63	0 - 1.5	9	0	0	SP-SM	0	A-3	Excellent to Good
B64	0 - 1.5	6	0	0	SP-SM	0	A-3	Excellent to Good
B65	0 - 1.5	18	0	0	SM	0	A-2-4	Excellent to Good
B66	0 - 1.5	22	0	0	SM	0	A-2-4	Excellent to Good

Based on the laboratory test results, the majority of the roadway subgrade soils classify as either types A-2-4 or A-3 based on the American Association of State Highway and Transportation Officials (AASHTO) soil classification system. As exceptions, the laboratory testing indicated isolated occurrences of soil types A-4 and A-6 as noted on the above table. Based on these classifications, the pavement subgrade materials are considered to generally have good to excellent support characteristics. Based on the AASHTO Group Index values, the subgrade soils are generally considered uniform along the alignment.

3.3 Seismic Refraction Survey

Due to anticipated roadway cuts, seismic refraction survey lines were performed at 9 locations along the proposed roadway alignment in order to further evaluate the subsurface soil/rock conditions. A total of 11 seismic refraction survey lines were performed with 1 line at each of the 9 locations along the alignment and a second transverse line at the location of Seismic Refraction Survey Lines S1 and S7. The seismic refraction survey lines were designated as S-1A, S-1B, S-2,

S-3, S-4, S-5, S-6, S-7A, S-7B, S-8, and S-9. The seismic refraction surveys were performed from October 17 through October 21, 2016 with a two-man crew equipped with a 24 channel seismograph, 12 geophones and a computer to record and to store field data. The spacing between geophones was set at 5 feet with a total line length of 60 feet. Forward, intermediate and reverse seismic traverses were performed along each of the survey lines at the site. Field data obtained was reduced with the SeisImager software program to generate appropriate time-distance curves. The seismograph equipment used for the seismic refraction survey was an ES-3000 manufactured by Geometrics. The approximate locations of the seismic survey lines are shown on Exhibits A-3 through A-6 in Appendix A.

The seismic refraction method of field exploration consists of measuring (at known points along the surface of the ground) the travel time of compressional waves (p-waves) generated by an impulsive energy source, recorded by a detector (geophone). The field data recorded consists of the time it takes the compressional wave to travel from the source to the detectors, and the distance between the detector and the source. Depending upon the hardness and depth of subsurface materials, the travel time of the compressional waves are shortened and refracted quicker as the material becomes harder with depth. One limitation of the seismic refraction method is that the rock layers must increase in density with depth in order to be mapped. While the method is ideally suited for determining the depth to bedrock, the method cannot image rock units of lower density that underlie higher density rock units.

The data obtained from our field exploration was evaluated and interpreted using Snell's law to determine the compressional wave velocities of each strata. From these interpretations, the depth to various strata was determined along the alignment of each of the traverses. The interpretation of the seismic survey line results are shown on Exhibits A-S1a through A-S9 in Appendix A.

The seismic refraction surveys were performed to help assess the excavation characteristics and/or the rippability of potentially shallow bedrock. The compressional wave velocities interpreted from the seismic surveys were compared to data published by Caterpillar (2000) in their Handbook of Ripping to estimate the rippability of the materials with standard Caterpillar equipment. Based upon the Caterpillar reference and our experience, we anticipate the following levels of excavation characteristics and/or rippability for the planned roadway cuts:

Test Line	Sub-surface Layer	Approx. Top Depth meters (ft)	Approx. Bottom Depth meters (ft)	Approx. P-Wave Velocity m/sec (ft/sec)	Anticipated Excavating Equipment and Rippability Based on a Caterpillar Ripper and Seismic Velocity*
S1A, Parallel to Alignment, Approx. Sta. 23+998	1	0	2.1 (7)	294 (966)	Conventional
	2	2.1 (7)	5.2 (17)	681 (2,235)	Conventional for very dense soils
	3	5.2 (17)	---	1,003 (3,292)	Rippable with CAT D8R/D8T

Test Line	Sub-surface Layer	Approx. Top Depth meters (ft)	Approx. Bottom Depth meters (ft)	Approx. P-Wave Velocity m/sec (ft/sec)	Anticipated Excavating Equipment and Rippability Based on a Caterpillar Ripper and Seismic Velocity*
S1B, Perpendicular to Alignment, Approx. Sta. 23+998	1	0	2.1 (7)	273 (895)	Conventional
	2	2.1 (7)	5.2 (17)	619 (2,031)	Conventional for very dense soils
	3	5.2 (17)	---	1,328 (4,357)	Rippable with CAT D8R/D8T
S2, Parallel to Alignment, Approx. Sta. 24+311	1	0	1.5 (5)	373 (1,223)	Conventional
	2	1.5 (5)	---	503 (1,650)	Conventional
S3, Parallel to Alignment, Approx. Sta. 24+449	1	0	1.8 (6)	367 (1,204)	Conventional
	2	1.8 (6)	---	475 (1,557)	Conventional
S4, Parallel to Alignment, Approx. Sta. 24+695	1	0	1.2 (4)	353 (1,158)	Conventional
	2	1.2 (4)	---	394 (1,292)	Conventional
S5, Parallel to Alignment, Approx. Sta. 24+850	1	0	2.1 (7)	375 (1,229)	Conventional
	2	2.1 (7)	---	493 (1,619)	Conventional
S6, Parallel to Alignment, Approx. Sta. 25+490	1	0	2.4 (8)	392 (1,286)	Conventional
	2	2.4 (8)	---	855 (2,804)	Rippable with CAT D8R/D8T
S7A, Perpendicular to Alignment, Approx. Sta. 25+680	1	0	1.2 (4)	444 (1,456)	Conventional
	2	1.2 (4)	4.6 (15)	1,073 (3,521)	Rippable with CAT D8R/D8T
	3	4.6 (15)	---	1,897 (6,225)	Rippable with CAT D8 to D9
S7B, Parallel to Alignment, Approx. Sta. 25+680	1	0	1.5 (5)	504 (1,653)	Conventional
	2	1.5 (5)	4 (13)	924 (3,030)	Rippable with CAT D8R/D8T
	3	4 (13)	---	1,593 (5,228)	Rippable with CAT D8 to D9
S8, Parallel to Alignment, Approx. Sta. 30+423	1	0	1.5 (5)	417 (1,368)	Conventional
	2	1.5 (5)	---	737 (2,418)	Conventional for very dense soils

Test Line	Sub-surface Layer	Approx. Top Depth meters (ft)	Approx. Bottom Depth meters (ft)	Approx. P-Wave Velocity m/sec (ft/sec)	Anticipated Excavating Equipment and Rippability Based on a Caterpillar Ripper and Seismic Velocity*
S9, Parallel to Alignment, Approx. Sta. 30+622	1	0	1.5 (5)	379 (1,245)	Conventional
	2	1.5 (5)	---	732 (2,403)	Conventional for very dense soils

3.4 Field Electrical Resistivity Test Results

From October 17 through October 21, 2016, a total of 17 field electrical resistivity surveys were performed in general accordance with ASTM Test Method G57, and IEEE Std. 81, using the Wenner Four-Electrode Method. The soil resistivity tests were performed at the locations identified on the attached Site Plan and Boring Locations diagrams, Exhibits A-2 through A-6. The Wenner arrangement (equal electrode spacing) was used with "a" spacings as shown in the table below. The "a" spacing is generally considered to be the depth of influence of the test.

Results of the soil resistivity measurements are presented in the following table:

Location	"a" spacing meters (feet)	Measured Resistance (ohms)	Average Resistivity (ohm-ft)	Average Resistivity (ohm-cm)
RL-21+500	0.6 (2)	19.8	249	7,580
	1.2 (4)	7.55	190	5,781
	1.8 (6)	5.83	220	6,696
	2.4 (8)	3.63	182	5,559
RL-23+572	0.6 (2)	22	276	8,422
	1.2 (4)	15.1	379	11,561
	1.8 (6)	12.3	463	14,126
	2.4 (8)	9.16	460	14,027
RL-23+870	0.6 (2)	37.6	472	14,394
	1.2 (4)	19.9	500	15,237
	1.8 (6)	12.3	463	14,126
	2.4 (8)	8.55	430	13,093
RL-24+140	0.6 (2)	32.6	409	12,480
	1.2 (4)	13.8	347	10,566
	1.8 (6)	9.63	363	11,060
	2.4 (8)	6.48	326	9,923
RL-24+370	0.6 (2)	48.5	609	18,567
	1.2 (4)	17.4	437	13,322
	1.8 (6)	11.1	418	12,748
	2.4 (8)	7.5	377	11,485
RL-24+550	0.6 (2)	41.4	520	15,849

Location	"a" spacing meters (feet)	Measured Resistance (ohms)	Average Resistivity (ohm-ft)	Average Resistivity (ohm-cm)
	1.2 (4)	22.5	565	17,227
	1.8 (6)	12.5	471	14,356
	2.4 (8)	8.72	438	13,353
RL-24+735	0.6 (2)	57	716	21,821
	1.2 (4)	20.6	517	15,773
	1.8 (6)	14	528	16,079
	2.4 (8)	11.7	588	17,916
RL-24+960	0.6 (2)	45.3	569	17,342
	1.2 (4)	26.4	663	20,213
	1.8 (6)	20.9	788	24,003
	2.4 (8)	12	603	18,376
RL-25+115	0.6 (2)	52.5	659	20,099
	1.2 (4)	18.2	457	13,935
	1.8 (6)	10.6	399	12,174
	2.4 (8)	6.15	309	9,418
RL-24+250	0.6 (2)	7.48	94	2,864
	1.2 (4)	5.37	135	4,112
	1.8 (6)	2.08	78	2,389
	2.4 (8)	1.23	62	1,884
RL-25+320	0.6 (2)	26.3	330	10,068
	1.2 (4)	12.5	314	9,571
	1.8 (6)	7.41	279	8,510
	2.4 (8)	5.49	276	8,407
RL-25+560	0.6 (2)	36.9	463	14,126
	1.2 (4)	10.1	254	7,733
	1.8 (6)	4.48	169	5,145
	2.4 (8)	5.07	255	7,764
RL-25+792	0.6 (2)	52.8	663	20,213
	1.2 (4)	13.6	342	10,413
	1.8 (6)	8.34	314	9,578
	2.4 (8)	5.39	271	8,254
RL-25+010	0.6 (2)	24.2	304	9,264
	1.2 (4)	9.6	241	7,350
	1.8 (6)	4.25	160	4,881
	2.4 (8)	2.37	119	3,629
RL-25+240	0.6 (2)	42.6	535	16,309
	1.2 (4)	21.4	538	16,385
	1.8 (6)	14.8	558	16,998
	2.4 (8)	9.87	496	15,114
RL-25+180	0.6 (2)	35.8	450	13,705

Location	"a" spacing meters (feet)	Measured Resistance (ohms)	Average Resistivity (ohm-ft)	Average Resistivity (ohm-cm)
	1.2 (4)	14.7	369	11,255
	1.8 (6)	7.88	297	9,050
	2.4 (8)	4.96	249	7,595
RL-25+320	0.6 (2)	41.5	521	15,887
	1.2 (4)	13.1	329	10,030
	1.8 (6)	8.97	338	10,302
	2.4 (8)	2.21	111	3,384

3.5 Corrosion Characteristics

Laboratory test results performed on on-site soils indicated soluble sulfate contents ranging from 25 to 330 parts per million (ppm) and chloride contents ranging from 25 to 208 ppm. As an exception, one isolated occurrence indicated a sulfate content of 2,420 ppm at the location of Boring B9. Based on the American Concrete Institute (ACI) Design Manual, Section 318, Chapter 4 (ACI 318), this concentration of sulfate is generally anticipated to result in a low sulfate exposure to concrete placed at the site. Therefore, American Society for Testing and Materials (ASTM) Type I/II portland cement is considered suitable for concrete along the project alignment.

Laboratory test results performed on on-site soils indicated saturated (minimum) resistivity values ranging from 1,077 to 7,566 ohm-centimeters, and pH values ranging from 8.2 to 9.9. These values in conjunction with the results of the sulfate and chloride testing should be used to determine potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Refer to Appendix B, for the complete results of the corrosivity testing conducted on the site soils in conjunction with this geotechnical exploration. The corrosion information presented is specific to the samples tested. If the actual soils that will be in contact with the structures at the site are different than those tested, then additional corrosion testing should be performed. Terracon is not a corrosion engineer, and our scope of work was limited to performing corrosion laboratory tests on selected samples and presenting these results. A qualified corrosion engineer should be consulted if corrosion of underground utilities and structures is a concern.

3.6 Laboratory Test Results

A total of 45 expansion tests were performed on the subgrade samples. The expansion tests indicated the site soils exhibited a low expansion potentials. The samples tested either exhibited an expansion potential of less than 1.5% or exhibited collapse potentials of less than 1.5%. As exceptions, one test indicated an expansion potential of approximately 2.6% and one test indicated a collapse potential of approximately 2.9%. The overall expansion potential average of the samples tested was approximately 0%.

The results of the laboratory testing including the correlated R-Values (correlated in accordance with the ADOT Preliminary Engineering and Design Manual procedures) and tested R-Value are summarized in the following table:

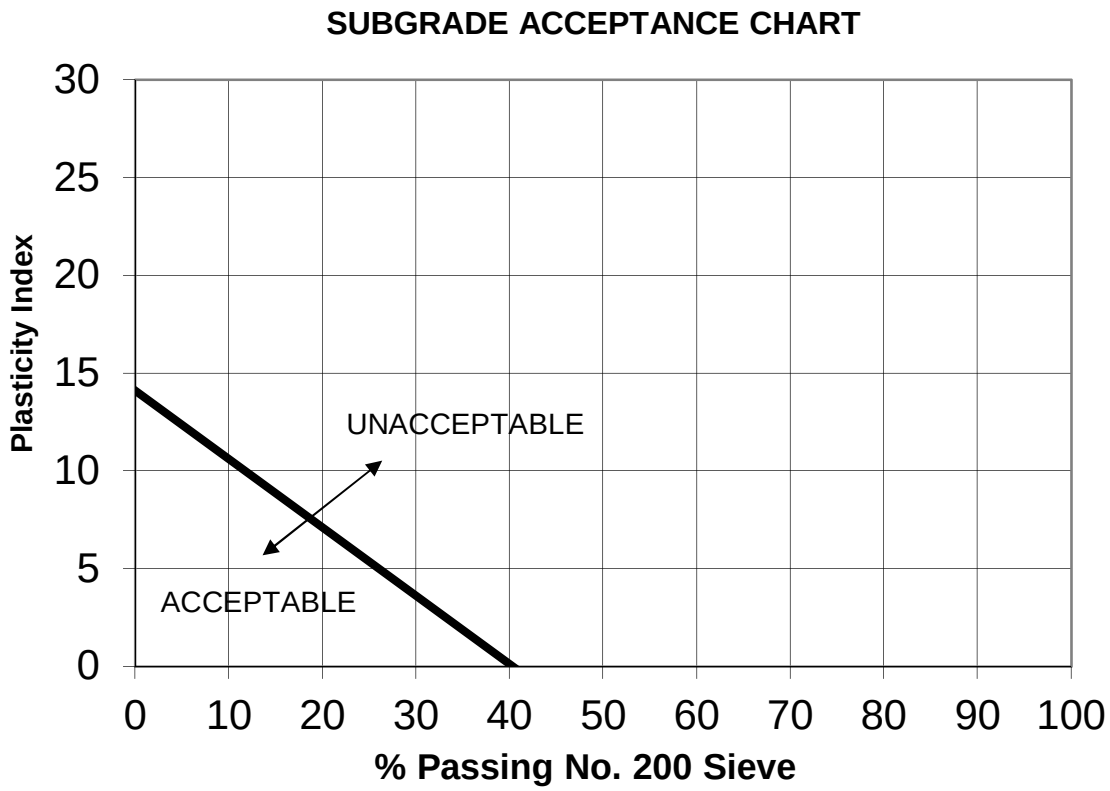
SUMMARY OF CORRELATED AND TESTED R-VALUES						
Boring No.	**Depth Meters**	**LL**	**PI**	**-#200**	**R-Value Tested**	**R-Value Correlated**
B1	0 – 1.5	0	0	11	--	85.6
B2	0 – 1.5	34	12	54	8.5	29.6
B3	0 – 1.5	0	0	38	28.1	59.1
B4	0 – 1.5	0	0	19	--	76.7
B5	0 – 1.5	0	0	23	--	73.2
B5	1.5 – 2	0	0	16	--	80.2
B6	0 – 1.5	0	0	10	--	87.4
B7	0 – 1.5	0	0	11	--	85.4
B8	0 – 1.5	0	0	15	69	81.5
B9	0 – 1.5	0	0	8	--	89.6
B9	2.7 – 3.2	0	0	12	--	84.9
B10	0 – 1.5	0	0	34	56	62.4
B11	0 – 1.5	0	0	15	--	81.5
B12	0 – 1.5	0	0	14	--	82.3
B13	0 – 1.5	0	0	17	--	79.5
B14	0 – 1.5	0	0	16	--	80.3
B15	0 – 1.5	0	0	9	--	88.7
B16	0 – 1.5	0	0	33	64	63.4
B17	1.5 – 3	0	0	13	--	83.7
B18	0 – 1.5	0	0	15	--	80.8
B19	0 – 1.5	0	0	22	69	73.8
B20	0 – 1.5	0	0	15	--	81.2
B21	0 – 1.2	0	0	33	64	63.3
B21	1.2 – 3.6	0	0	22	--	74.3
B22	0 – 1.5	0	0	19	--	77.4
B23	0 – 1.5	0	0	23	--	72.5
B24	0.3 – 1.8	0	0	17	--	79.5
B25	0 – 1.5	0	0	39	66	58.0
B26	0 – 1.5	0	0	16	--	80.6
B27	0 – 1.5	24	7	63	60	31.8
B28	0 – 1.5	0	0	3	--	95.6
B29	0 – 1.5	0	0	16	--	80.3
B30	0 – 1.5	0	0	12	--	84.4
B31	0 – 1.5	0	0	18	66	78.4
B32	0 – 1.5	0	0	16	--	79.9
B33	0 – 1.5	0	0	14	--	82.5
B34	0 – 0.9	0	0	17	54	79.6
B35	0 – 1.5	0	0	12	--	85.1
B36	0 – 1.5	0	0	6	--	91.6
B37	0 – 1.5	0	0	19	--	76.7

SUMMARY OF CORRELATED AND TESTED R-VALUES						
Boring No.	**Depth Meters**	**LL**	**PI**	**-#200**	**R-Value Tested**	**R-Value Correlated**
B38	0 – 1.5	0	0	7	--	91.2
B39	0 – 1.5	0	0	18	59	78.2
B40	0 – 1.5	0	0	14	--	82.4
B41	0 – 1.5	0	0	6	--	91.5
B42	0 – 1.5	0	0	19	--	77.4
B43	0 – 1.5	0	0	19	--	76.6
B44	0 – 1.5	0	0	14	74	83.0
B45	0 – 1.5	0	0	11	--	85.3
B46	0 – 1.5	0	0	14	--	82.4
B47	0 – 1.5	0	0	24	71	71.5
B48	0 – 1.2	0	0	17	--	79.5
B48	1.2 – 2.7	0	0	32	--	64.7
B49	0 – 1.5	0	0	50	--	50.0
B49	2.4 – 3	0	0	30	--	65.8
B50	0 – 1.5	0	0	24	70	71.8
B51	0 – 1.5	0	0	4	--	94.1
B52	0 – 1.5	0	0	6	--	91.8
B53	0 – 1.5	0	0	4	--	95.1
B54	0 – 1.5	0	0	17	63	78.6
B55	0 – 1.5	0	0	7	--	90.9
B56	0 – 1.5	0	0	6	--	92.6
B57	0 – 1.5	0	0	12	77	85.2
B58	0 – 1.5	0	0	4	--	95.1
B59	0 – 1.5	0	0	11	--	85.7
B60	0 – 1.5	0	0	7	--	91.1
B61	0 – 1.5	0	0	21	42	74.3
B62	0 – 1.5	0	0	11	--	85.9
B63	0 – 1.5	0	0	9	--	88.5
B64	0 – 1.5	0	0	6	--	91.6
B65	0 – 1.5	0	0	18	27	77.6
B66	0 – 1.5	0	0	22	71	73.6

3.7 Acceptable and Unacceptable Pavement Subgrade Soils

As previously mentioned, the pavement subgrade materials are considered to have good to excellent support characteristics along the majority of the proposed roadway alignment. As an exception, a few isolated occurrences of subgrade soils with fair to poor subgrade support characteristics were encountered at the locations of Borings B2, B27 and B49. Subgrade soils with fair to poor subgrade support characteristics are unsuitable (or unacceptable) for the support of the recommended pavement sections and should be over-excavated and removed from the top 3 feet of subgrade soils beneath proposed pavement areas. These unacceptable soils should be replaced with engineered (compacted) fill subgrade soils with good to excellent support characteristics. Based on ADOT criteria outlined in the Materials Preliminary Engineering and Design Manual, the following subgrade acceptance chart was developed to

outline acceptable and unacceptable subgrade soils based on soil strength (R-value) correlations. Based on the pavement design recommendations presented in this report, the following subgrade acceptance chart was prepared to assist during construction in identifying suitable (or acceptable) subgrade soils for the proposed roadway:



3.8 Earthwork Factors

Earthwork factors were estimated based on the results of the field density test results from both ring samples and from using a Troxler nuclear density gauge, as well as from past experience with similar soils. The shrinkage factors are based on a comparison of the in-situ dry densities from nuclear density test results to the density bulk samples compacted to 95 percent of the maximum dry density determined in accordance with standard Proctor criteria, ASTM D698.

Earthwork factors along with the results of our field and laboratory testing are presented in following table. The results indicate individual shrink/swell values which vary from about 20 percent shrink to 15 percent swell with an average value of approximately 6 percent shrink. Overall, 6 percent shrink is recommended for soils which are excavated and recompacted on-site to a minimum 95 percent of the maximum dry density determined by standard Proctor criteria. The shrink values would be anticipated to be slightly higher for any soils compacted to 100 percent of standard Proctor density.

Location		Field Test		Lab Test		95% Proctor Dry Density		Shrink / Swell at 95% Compaction (1)
Boring / Test Pit No.	Sample Depth	Dry Density		Proctor Dry Density				
	Meters	kg/m³	(pcf)	kg/m³	(pcf)	kg/m³	(pcf)	(%)
B1	0.6 – 0.9	1,618	(101)	1,780	(111.1)	1,691	(105.5)	4.3
B2	1.2 – 1.5	1,826	(114)	1,780	(111.1)	1,691	(105.5)	-8.0
B3	0.3 – 0.6	1,618	(101)	1,780	(111.1)	1,691	(105.5)	4.3
B4	1.5 – 1.8	1,538	(96)	1,831	(114.3)	1,739	(108.6)	11.6
B5	0.6 – 0.9	1,586	(99)	1,831	(114.3)	1,739	(108.6)	8.8
B6	1.5 – 1.8	1,506	(94)	1,831	(114.3)	1,739	(108.6)	13.4
B7	0.6 – 0.9	1,570	(98)	1,831	(114.3)	1,739	(108.6)	9.7
B8	1.5 – 1.8	1,842	(115)	1,802	(112.5)	1,712	(106.9)	-7.6
B9	0.3 – 0.6	1,682	(105)	1,802	(112.5)	1,712	(106.9)	1.8
B10	1.5 – 1.8	1,458	(91)	1,802	(112.5)	1,712	(106.9)	14.9
B11	0.3 – 0.6	1,426	(89)	1,802	(112.5)	1,712	(106.9)	16.7
B12	0 – 0.3	1,490	(93)	1,768	(110.4)	1,680	(104.9)	11.3
B12	0 – 0.3	1,554	(97)	1,768	(110.4)	1,680	(104.9)	7.5
B12	0.6 – 0.9	1,570	(98)	1,768	(110.4)	1,680	(104.9)	6.6
B12	0.6 – 0.9	1,490	(93)	1,768	(110.4)	1,680	(104.9)	11.3
B13	0.6 – 0.9	1,650	(103)	1,768	(110.4)	1,680	(104.9)	1.8
B14	1.5 – 1.8	1,570	(98)	1,653	(103.2)	1,570	(98.0)	0.0
B15	0 – 0.3	1,634	(102)	1,653	(103.2)	1,570	(98.0)	-4.0
B15	0 – 0.3	1,618	(101)	1,653	(103.2)	1,570	(98.0)	-3.0
B15	0.9 – 1.2	1,602	(100)	1,653	(103.2)	1,570	(98.0)	-2.0
B15	0.9 – 1.2	1,602	(100)	1,653	(103.2)	1,570	(98.0)	-2.0
B16	1.5 – 1.8	1,746	(109)	1,802	(112.5)	1,712	(106.9)	-2.0
B17	0 – 0.3	1,602	(100)	1,738	(108.5)	1,651	(103.1)	3.0
B17	0 – 0.3	1,586	(99)	1,738	(108.5)	1,651	(103.1)	4.0
B17	0.5 – 0.8	1,538	(96)	1,738	(108.5)	1,651	(103.1)	6.9
B17	0.5 – 0.8	1,554	(97)	1,738	(108.5)	1,651	(103.1)	5.9
B18	0 – 0.3	1,618	(101)	1,738	(108.5)	1,651	(103.1)	2.0
B18	0 – 0.3	1,618	(101)	1,738	(108.5)	1,651	(103.1)	2.0
B18	0.6 – 0.9	1,602	(100)	1,738	(108.5)	1,651	(103.1)	3.0
B18	0.6 – 0.9	1,618	(101)	1,738	(108.5)	1,651	(103.1)	2.0
B19	0 – 0.3	1,618	(101)	1,738	(108.5)	1,651	(103.1)	2.0

Location		Field Test		Lab Test		95% Proctor Dry Density		Shrink / Swell at 95% Compaction (1)
Boring / Test Pit No.	Sample Depth	Dry Density		Proctor Dry Density				
	Meters	kg/m³	(pcf)	kg/m³	(pcf)	kg/m³	(pcf)	(%)
B19	0 – 0.3	1,586	(99)	1,738	(108.5)	1,651	(103.1)	4.0
B19	0.9 – 1.2	1,474	(92)	1,738	(108.5)	1,651	(103.1)	10.7
B19	0.9 – 1.2	1,474	(92)	1,738	(108.5)	1,651	(103.1)	10.7
B20	1.5 – 1.8	1,602	(100)	1,762	(110.0)	1,674	(104.5)	4.3
B21	0 – 0.3	1,554	(97)	1,762	(110.0)	1,674	(104.5)	7.2
B21	0 – 0.3	1,554	(97)	1,762	(110.0)	1,674	(104.5)	7.2
B21	0.8 – 1.1	1,458	(91)	1,762	(110.0)	1,674	(104.5)	12.9
B21	0.8 – 1.1	1,458	(91)	1,762	(110.0)	1,674	(104.5)	12.9
B22	0 – 0.3	1,602	(100)	1,762	(110.0)	1,674	(104.5)	4.3
B22	0 – 0.3	1,522	(95)	1,762	(110.0)	1,674	(104.5)	9.1
B22	0.6 – 0.9	1,506	(94)	1,762	(110.0)	1,674	(104.5)	10.0
B22	0.6 – 0.9	1,586	(99)	1,762	(110.0)	1,674	(104.5)	5.3
B23	0 – 0.3	1,634	(102)	1,762	(110.0)	1,674	(104.5)	2.4
B23	0 – 0.3	1,426	(89)	1,762	(110.0)	1,674	(104.5)	14.8
B23	0.5 – 0.8	1,426	(89)	1,762	(110.0)	1,674	(104.5)	14.8
B23	0.5 – 0.8	1,650	(103)	1,762	(110.0)	1,674	(104.5)	1.4
B24	0 – 0.3	1,522	(95)	1,877	(117.2)	1,783	(111.3)	14.7
B24	0 – 0.3	1,570	(98)	1,877	(117.2)	1,783	(111.3)	12.0
B25	0.6 – 0.9	1,538	(96)	1,794	(112.0)	1,704	(106.4)	9.8
B26	1.5 – 1.8	1,618	(101)	1,794	(112.0)	1,704	(106.4)	5.1
B27	0.6 – 0.9	1,730	(108)	1,794	(112.0)	1,704	(106.4)	-1.5
B28	1.5 – 1.8	1,570	(98)	1,794	(112.0)	1,704	(106.4)	7.9
B29	0.6 – 0.9	1,618	(101)	1,716	(107.1)	1,630	(101.7)	0.7
B30	1.5 – 1.8	1,570	(98)	1,716	(107.1)	1,630	(101.7)	3.7
B31	0.6 – 0.9	1,666	(104)	1,716	(107.1)	1,630	(101.7)	-2.2
B33	0.6 – 0.9	1,570	(98)	1,716	(107.1)	1,630	(101.7)	3.7
B35	0.6 – 0.9	1,746	(109)	1,879	(117.3)	1,785	(111.4)	2.2
B37	0.6 – 0.9	1,746	(109)	1,842	(115.0)	1,750	(109.3)	0.2
B39	0.6 – 0.9	1,458	(91)	1,842	(115.0)	1,750	(109.3)	16.7
B40	1.5 – 1.8	1,666	(104)	1,884	(117.6)	1,790	(111.7)	6.9
B42	1.5 – 1.8	1,634	(102)	1,884	(117.6)	1,790	(111.7)	8.7
B43	0.6 – 0.9	1,778	(111)	1,794	(112.0)	1,704	(106.4)	-4.3

Location		Field Test		Lab Test		95% Proctor Dry Density		Shrink / Swell at 95% Compaction (1)
Boring / Test Pit No.	Sample Depth	Dry Density		Proctor Dry Density				
	Meters	kg/m³	(pcf)	kg/m³	(pcf)	kg/m³	(pcf)	(%)
B45	0.6 – 0.9	1,778	(111)	1,794	(112.0)	1,704	(106.4)	-4.3
B46	1.5 – 1.8	1,634	(102)	1,799	(112.3)	1,709	(106.7)	4.4
B47	0 – 0.3	1,490	(93)	1,799	(112.3)	1,709	(106.7)	12.8
B47	0 – 0.3	1,362	(85)	1,799	(112.3)	1,709	(106.7)	20.3
B47	0.5 – 0.8	1,378	(86)	1,799	(112.3)	1,709	(106.7)	19.4
B47	0.5 – 0.8	1,490	(93)	1,799	(112.3)	1,709	(106.7)	12.8
B48	0 – 0.3	1,602	(100)	1,823	(113.8)	1,732	(108.1)	7.5
B48	0 – 0.3	1,602	(100)	1,823	(113.8)	1,732	(108.1)	7.5
B48	0.9 – 1.2	1,522	(95)	1,823	(113.8)	1,732	(108.1)	12.1
B48	0.9 – 1.2	1,522	(95)	1,823	(113.8)	1,732	(108.1)	12.1
B49	0 – 0.3	1,538	(96)	1,823	(113.8)	1,732	(108.1)	11.2
B49	0 – 0.3	1,538	(96)	1,823	(113.8)	1,732	(108.1)	11.2
B49	0.6 – 0.9	1,538	(96)	1,823	(113.8)	1,732	(108.1)	11.2
B49	0.6 – 0.9	1,538	(96)	1,823	(113.8)	1,732	(108.1)	11.2
B50	1.5 – 1.8	1,666	(104)	1,784	(111.4)	1,695	(105.8)	1.7
B51	0.6 – 0.9	1,810	(113)	1,784	(111.4)	1,695	(105.8)	-6.8
B52	1.5 – 1.8	1,634	(102)	1,784	(111.4)	1,695	(105.8)	3.6
B53	0.6 – 0.9	1,634	(102)	1,775	(110.8)	1,686	(105.3)	3.1
B54	1.5 – 1.8	1,602	(100)	1,775	(110.8)	1,686	(105.3)	5.0
B57	0.6 – 0.9	1,730	(108)	1,754	(109.5)	1,666	(104.0)	-3.8
B59	0.6 – 0.9	1,922	(120)	1,754	(109.5)	1,666	(104.0)	-15.4
B63	0.6 – 0.9	1,650	(103)	1,828	(114.1)	1,736	(108.4)	5.0
B65	0.6 – 0.9	1,650	(103)	1,828	(114.1)	1,736	(108.4)	5.0
B66	1.5 – 1.8	1,506	(94)	1,812	(113.1)	1,721	(107.4)	12.5

Overall Average Shrink / Swell:	**5.8**

(1) Positive values are shrink and negative values are swell.

3.9 Groundwater Conditions

Groundwater was not observed in any test boring at the time of field exploration, nor when checked upon completion of drilling. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Based on information obtained from the Arizona Department of Water Resources – Groundwater Data website (https://gisweb.azwater.gov/waterresourcedata/GWSI.aspx), the depth to groundwater was measured in 1959 at approximately 61 meters (or 200 feet) below the ground surface (approximate elevation of 1,634 meters (or 5,360 feet) above mean sea level) at an Arizona Department of Water Resources (ADWR) monitored well site (Local I.D.: 09 020-07.70X09.20) located approximately one half mile northeast of the site.

4.0 PAVEMENT THICKNESS DESIGN

4.1 Design Traffic Analyses

Existing traffic data for the project was included in the Request for Proposal (RFP) dated August 25, 2016, and includes the following:

- Existing (2-way) Average Daily Traffic (ADT) (2011): 238
- Annual Growth Rate: 2%
- Percent Trucks: 1%
- Percent Buses: 1%
- Design Life: 20 years from 2016

Typical Roadway Widths

- Driving Lane Width: 3.3 meters
- Shoulder Width: 1.5 meters

Using this growth rate, the calculated ADT for 2016 is 263 vehicles. Using the percent trucks and percent busses provided, the following base year traffic data was calculated:

- Autos: 257 vehicles per day in 2016
- Trucks: 3 vehicles per day in 2016
- Buses: 3 vehicles per day in 2016

These vehicle classifications can generally be classified using the AASHTO design procedures. In order to utilize this information in the pavement design procedure, an engineering analysis was completed to convert the traffic data into Equivalent (18-kip) Single Axle Loads (ESALs) in accordance with AASHTO criteria.

Based on the AASHTO 1993 Guide, the following load equivalency truck factors were used for determination of the ESALs:

BIA Description	AASHTO Description	Class	Traffic Equivalency Factor
Autos	Passenger Cars	2	0.0008
Buses	Buses	4	0.6806
Trucks	5+ Axle Tractor Semi Trailer	9	2.3719

The 2016 AADT was projected with the growth rate provided in order to estimate the 2036 AADT. The AADT was converted to ESAL's using the noted vehicle percentages and other design (truck, directional and lane) factors and summed over the design period. The analyses was performed for a 20 year design period. The projected AADTs and total design ESALs estimated for pavement design are shown in the following table.

Roadway	2016 AADT	2036 AADT	% D Factor	% Lane Factor	% Growth	Design ESALs
N35 and N5045	263	383	50	100	2	41,613

%D – Directional Factor = 50% for two-lane roadways.
% Lane Factor = Percentage of ESALs in the Design Lane.

Detailed traffic analyses for the project are included on the Design Traffic Analysis Worksheet, Exhibit C-1 in Appendix C.

4.2 Pavement Subgrade Parameters

The design resilient modulus (M_R) for the pavement analyses was determined in accordance with the procedures of the ADOT Preliminary Engineering and Design Manual. The methodology uses data from actual R-value tests as well as R-value data correlated with sieve and plasticity results. Based on the results of the laboratory testing and our analyses of the AASHTO Group Index data, the subgrade conditions along the alignment are considered uniform, therefore a single design R-value was used along the entire length of the roadway.

Samples of subgrade materials were tested for sieve analysis and plasticity index. In addition, R-value testing was performed on selected samples. The calculated mean R-value determined from the analyses is 74.2. A Seasonal Variation Factor (SVF) of 1.8 was assigned for the project based on Figure 202.02-1 of the ADOT Pavement Engineering and Design Manual. The manual provides SVF values for nearby locations with similar elevations. The R_{MEAN} value, combined with a Seasonal Variation Factor of 1.8 results in the maximum resilient modulus (M_R) allowed of 26,000 pounds per square inch (psi). The project R_{MEAN} obtained from the laboratory test results is presented in Appendix C.

4.3 Pavement Design Parameters

Analyses for the pavement design of the project have been based on the procedures of AASHTO as modified by the Arizona Department of Transportation. For purposes of the pavement design for the project, the roadway has been classified as a "Local" road in accordance with Table 202.04-1 of the ADOT Pavement Preliminary Engineering and Design Manual. Based on this classification and other data outlined in this report, the following design parameters, as determined by the procedures outlined in the ADOT manual, were utilized for pavement engineering analyses and the determination of design alternatives for the project:

Design Parameter		Per ADOT Design Method
Design ESALs		41,613
Mean R-value		74.2
Design Resilient Modulus of Subgrade (psi)		26,000
Level of Reliability		75%
Standard Normal Deviate		-0.674
Standard Deviation		0.35
Initial PSI		4.0
Terminal PSI		2.4
ΔPSI		1.6
Layer Structural Coefficients	Asphalt Concrete (AC)	0.44
	Asphalt Rubber AC (ARAC)	0.44*
	Aggregate Base (ABC)	0.14
Seasonal Variation Factor		1.8
Drainage Coefficient for ABC layer (fair)		1.0
Calculated Flexible Pavement Structural Number (SN)		1.05
* See discussion on Layer Structural Coefficients for AC and ARAC in Section 4.4 of this report.		

4.4 Pavement Thickness Design Recommendations

Design calculations for the project incorporating the parameters outlined above are shown in Appendix C. The design calculations resulted in a calculated minimum Structural Number (SN) of 1.05 as outlined above. However, the ADOT Preliminary Engineering and Design Manual, Table 202.04-1 recommends a minimum SN of 1.35 and a minimum asphalt concrete thickness of 2 inches for local roadways with ESALs less than 100,000 and an ADT less than 500. Accordingly, a minimum SN of 1.35 was utilized to determine pavement thickness alternatives for this project.

Various alternatives have been considered to achieve the 20-year design life of the pavement including conventional asphalt concrete (AC) and Asphalt-Rubber Asphalt Concrete (ARAC)

with varying thicknesses. These various options are all designed to meet the minimum required SN of 1.35 for a 20-year design life.

Note on ARAC: A structural coefficient of 0.44 was used for both ARAC and AC. However, ARAC is anticipated to provide superior performance in cracking and aging characteristics when compared to AC. Because of these superior characteristics, a greater structural coefficient can sometimes be used for the upper portion of the ARAC layer. With all the pavement structural sections having a structural number greater than the minimum required, a structural coefficient greater than 0.44 was not used for ARAC.

Based on the information provided, our assumptions noted above, and in accordance with ADOT pavement design procedure, the following pavement structure alternatives have been developed for consideration by the BIA for this project:

Alternative	Roadway	Pavement Thickness in Millimeters (inches)			
		AC	ARAC	AB Class 2	Total
A	N35 and N5045	51mm (2”)	---	102mm (4”)	152mm (6”)
B	N35 and N5045	---	51mm (2”)	102mm (4”)	152mm (6”)
C	N35 and N5045	76mm (3”)	---	102mm (4”)	178mm (7”)
D	N35 and N5045	---	76mm (3”)	102mm (4”)	178mm (7”)
E	N35 and N5045	102mm (4”)	---	---	102mm (4”)
F	N35 and N5045	---	102mm (4”)	---	102mm (4”)

4.5 Life Cycle and Engineering Analyses of Pavement Alternatives

Based on the objective of meeting a SN of 1.35 over a 20-year design life, the following table provides recommended alternatives that can be considered for the project. Each alternative provides for the initial improvement recommendation along with anticipated global maintenance and overlay work that would theoretically be required to maintain the minimum level of serviceability in future years. For each initial improvement recommendation, we have calculated the average SN that would be achieved and have related that to an expected design life based on the pavement analyses that have been completed for the project.

ALTERNATIVE PAVEMENT CONSTRUCTION RECOMMENDATIONS				
Alt.	**Initial (Current Year) Improvement Recommendations**	**Structural Number**	**Design Life (years)[1]**	**Expected Maintenance (20-year Design Life)**
A	51 millimeters (mm) AC Over 102 mm ABC (2 inches AC Over 4 inches ABC)	1.44	20	Chip Seal at 5 years 51 mm (2 in) Overlay at 10 years[2] Chip Seal at 15 years
B	51 mm ARAC Over 102 mm ABC (2 inches ARAC Over 4 inches ABC)	1.44	20	Chip Seal at 5 years 51 mm (2 in) Overlay at 10 years[2] Chip Seal at 15 years
C	76 mm AC Over 102 mm ABC (3 inches AC Over 4 inches ABC)	1.84	20	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years
D	76 mm ARAC Over 102 mm ABC (3 inches ARAC Over 4 inches ABC)	1.84	20	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years
E	102 mm AC Over Compacted Subgrade (4 inches AC Over Compacted Subgrade)	1.76	20	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years
F	102 mm ARAC Over Compacted Subgrade (4 inches ARAC Over Compacted Subgrade)	1.76	20	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years

Notes:
1. The design life is based a minimum SN of 1.35 according to ADOT recommends for rural local main roadways.
2. A scrub seal is recommended beneath the overlay to seal existing cracks in the roadway surface.
3. The above pavement sections are based on the assumption that the subgrade soil and existing AC will be stable prior to construction of the new pavement section.

Each of the six alternatives has advantages and disadvantages. A description of each alternative and the various aspects unique to each of these is outlined as follows

- **Alternative A— 51 mm (2 inches) AC Over 102 mm (4 inches) ABC:** This alternative is the simplest approach and would include 51 mm (2 inches) of a conventional Asphalt Concrete (AC) over 102 mm (4 inches) of Aggregate Base Course (ABC). Alternative A would be anticipated to support the traffic load expected during a 20-year design life; however, this pavement would likely begin experiencing cracking within the first 2 to 3 years, which would require crack sealing and other maintenance measures at an earlier stage than the other alternatives. Additional maintenance anticipated to support a 20-year design life would include a chip seal coat at 5 years, a scrub seal and 51 mm (2 inch) AC overlay at 10 years, 10 years, and a chip seal coat at 15 years as summarized in the table above.

- **Alternative B—51 mm (2 inches) ARAC Over 102 mm (4 inches) ABC:** This alternative would include 51 mm (2 inches) of Asphalt-Rubber Asphalt Concrete (ARAC) over 102 mm (4 inches) of ABC. Alternative B would be anticipated to support the traffic load expected during a 20-year design life; however, this pavement would likely begin

experiencing cracking within the first 3 to 5 years, which would require crack sealing and other maintenance measures at an earlier stage than Alternatives C and D. Additional maintenance anticipated to support a 20-year design life would include a chip seal coat at 5 years, a scrub seal and 51 mm (2-inch) AC overlay at 10 years, and a chip seal coat at 15 years as summarized in the table above. The use of ARAC typically increases the ability of the pavement to withstand cracking. Therefore, the use of ARAC would likely require reduced maintenance over the design life of the pavement over conventional AC as presented in Alternative A.

- **Alternative C—76 mm (3 inches) AC Over 102 mm (4 inches) ABC:** This alternative would include 76 mm (3 inches) of a conventional Asphalt Concrete (AC) over 102 mm (4 inches) of Aggregate Base Course (ABC). Alternative C would be anticipated to support the traffic load expected during a 20-year design life, would likely begin experiencing cracking at a later date than Alternatives A and B, and would not require an overlay. Additional maintenance needed to support a 20-year design life would include a chip seal coat at 5 years, 10 years, and 15 years as summarized in the table above.

- **Alternative D—76 mm (3 inches) ARAC Over 102 mm (4 inches) ABC:** This alternative would include 76 mm (3 inches) of Asphalt-Rubber Asphalt Concrete (ARAC) over 102 mm (4 inches) of ABC. Alternative D would be anticipated to support the traffic load expected during a 20-year design life would likely begin experiencing cracking at a later date than Alternatives A and B, and would not require an overlay. Additional maintenance anticipated to support a 20-year design life would include a chip seal coat at 5 years, 10 years, and 15 years as summarized in the table above. The use of ARAC typically increases the ability of the pavement to withstand cracking. Therefore, the use of ARAC would likely require reduced maintenance over the design life of the pavement over conventional AC as presented in Alternative C.

- **Alternative E—102 mm (4 inches) AC Over Compacted Subgrade:** This alternative would include 102 mm (4 inches) of Asphalt Concrete (AC) over compacted subgrade. Alternative E would be anticipated to support the traffic load expected during a 20-year design life would likely begin experiencing cracking at a later date than Alternatives A through D, and would not require an overlay. Additional maintenance anticipated to support a 20-year design life would include a chip seal coat at 5 years, 10 years, and 15 years as summarized in the table above.

- **Alternative F—102 mm (4 inches) ARAC Over Compacted Subgrade:** This alternative would include 102 mm (4 inches) of Asphalt-Rubber Asphalt Concrete (ARAC) over compacted subgrade. Alternative F would be anticipated to support the traffic load expected during a 20-year design life would likely begin experiencing cracking at a later date than Alternatives A through D, and would not require an overlay. Additional maintenance anticipated to support a 20-year design life would include a chip seal coat at 5 years, 10 years, and 15 years as summarized in the table above. The use

of ARAC typically increases the ability of the pavement to withstand cracking. Therefore, the use of ARAC would likely require reduced maintenance over the design life of the pavement over conventional AC as presented in Alternative E.

4.6 Preliminary Economic Evaluation of Pavement Alternatives

An economic evaluation of estimated initial and life cycle project costs have been developed for each of the pavement alternatives outlined in this report. This economic evaluation has been developed for comparison between the alternatives and for the selection of the preferred alternative for the project.

Unit costs for the initial construction recommendations and the costs for the expected preventative and global maintenance programs have been estimated based upon prevailing local prices, cost data obtained from RS Means Site Work Cost Data (2016), and experience with similar construction strategies. The actual unit costs for the project may vary from those used in our analysis due to location and local material costs. The estimated unit costs for construction and maintenance activities used for this evaluation are as follows:

- Clear and Grub ..... $1.82/ m^2 ($1.52/ yd^2)
- Finish Grading ..... $0.63/ m^2 ($0.53/ yd^2)
- AC ..... $2.17/ m^2/ cm ($4.62/ yd^2/ in)
- ARAC ..... $2.44/ m^2/ cm ($5.18/ yd^2/ in)
- ABC ..... $0.52/ m^2/ cm ($1.11/ yd^2/ in)
- Scrub and Chip Seal ..... $4.48/ m^2 ($3.75/ yd^2)

Our economic analysis for each alternative has been based on per lane kilometer (mile) costs. The life cycle cost analyses for each alternative includes the estimation of initial construction costs, maintenance over the design life (20 years), and salvage value at the end of the predicted useful life. Maintenance costs in the analysis include estimated periodic preventative procedures and periodic global surface treatments and costs experienced by ADOT and local practice. All costs which could potentially be expended over the life of each pavement alternative have been converted to Present Worth, using factors based upon an interest rate of five percent. Projected Average Annual Costs for each alternative have been based upon a 20-year Capital Recovery Factor. The results of our economic analyses are presented on Exhibits C-4 and C-5 in Appendix C.

The following table summarizes the initial costs per alternative and the average annual cost per lane mile including the anticipated pavement maintenance and rehabilitation costs.

PRELIMINARY PAVEMENT LIFE CYCLE COST SUMMARY

Alt.	Initial Pavement Improvements (millimeters)	Initial Pavement Improvements (inches)	Anticipated Pavement Maintenance (20-year Design Life)	Total Initial Cost	Average Annual Cost for Life Cycle (per lane mile)	Average Annual Cost for Life Cycle (per lane kilometer)
A	51 mm AC Over 102 mm ABC	2 inches AC Over 4 inches ABC	Chip Seal at 5 years 2" Overlay at 10 years Chip Seal at 15 years	$110,875	$18,691	$11,614
B	51 inches ARAC Over 102 mm ABC	2 inches ARAC Over 4 inches ABC	Chip Seal at 5 years 2" Overlay at 10 years Chip Seal at 15 years	$118,760	$18,920	$11,756
C	76 mm AC Over 102 mm ABC	3 inches AC Over 4 inches ABC	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years	$143,400	$16,986	$10,555
D	76 mm ARAC Over 102 mm ABC	3 inches ARAC Over 4 inches ABC	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years	$155,227	$17,489	$10,867
E	102 mm AC Over Compacted Subgrade	4 inches AC Over Compacted Subgrade	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years	$144,667	$17,074	$10,609
F	102 mm ARAC Over Compacted Subgrade	4 inches ARAC Over Compacted Subgrade	Chip Seal at 5 years Chip Seal at 10 years Chip Seal at 15 years	$160,436	$17,852	$11,093

As can be seen in the table above, Alternative A has the lowest initial cost and Alternative C has the lowest life cycle cost. Although Alternative F has the highest initial cost, it requires less maintenance and does not require an overlay, which results in a lower average annual cost when compared to alternatives A and B. All 6 alternatives are within $2,000 for their annual cost per lane kilometer (mile).

Since Terracon has no control over the cost of labor, materials, equipment or services furnished by a potential contractor, a contractor's method of determining prices, or over competitive bidding or market conditions, the estimated costs provided in this report have been made on the basis of our experience and represents our best judgment as an experienced and qualified professional engineer, familiar with the construction industry. Terracon cannot and does not guarantee that proposals, bids or actual project or construction cost will not vary from the estimated values provided in this report. Additionally, these costs do not include the additional costs for other aspects of the project such as traffic control and striping.

4.7 Recommended Pavement Alternative

In consideration of projected initial and life cycle costs, the technical advantages and disadvantages of each of the pavement alternatives, and the expected future expenditures for pavement maintenance, we recommend the BIA consider implementation of Alternative C or E for this project. The BIA should decide on the preferred alternative by considering the advantages and disadvantages, projected maintenance, cost considerations, and other factors. Terracon is available to assist in your consideration of the alternatives and selection of the preferred alternative for the project.

5.0 MATERIALS DESIGN

5.1 Materials Specifications

We understand that the BIA will prepare a set of construction plans and specifications for the project. We further understand that the BIA will likely utilize specifications based the metric version of the Federal Projects specification FP-14 Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects.

Based on the recommendations for the pavement alternatives outlined in this report, and pending the final determination of the actual design alternative, the following table provides recommended specifications that should be included in the contract documents. The table refers to the applicable specification based on the FP-14 unless otherwise noted.

FP-14 Specification	Specification Title	Comments/ Recommendations
201	Clearing and Grubbing	
202	Additional Clearing and Grubbing	
203	Removal of Structures and Obstructions	
204	Excavation and Embankment	All fills placed on the project should be compacted to a minimum of 95% of the maximum density determined in accordance with ASTM D698 and moisture conditioned to within ±3% of the optimum moisture content.
209	Structure Excavation and Backfill	
212	Linear Grading	The depth of subgrade scarification and re-compaction should be a minimum depth of 10 inches. All subgrade on the project should be compacted to a minimum of 95% of the maximum density determined in accordance with ASTM D698 and moisture conditioned to within ±3% of the optimum moisture content.
301	Untreated Aggregate Courses	

FP-14 Specification	Specification Title	Comments/ Recommendations
401	Asphalt Concrete	A 12.5mm (½-inch) and/or 19mm (¾-inch) Asphalt Mix is recommended for the asphalt concrete on this project. Lift thicknesses of 12.5mm (½-inch) asphalt gyratory mix should be a minimum of 51mm (2-inches) and maximum of 76mm (3-inches). Lift thicknesses of 19mm (¾-inch) asphalt gyratory mix should be a minimum of 76mm (3-inches) and maximum of 114mm (4.5-inches).
703	Aggregate	Aggregate Base Course on the project should conform to the Grading Designation D(Base) requirements of Table 703-2.
413[1]	Asphaltic Concrete (Asphalt-Rubber)	--
408[2]	Shoulder Buildup	Existing site soils are suitable for use as shoulder buildup. If imported materials are to be used, they should have 100% passing the 1½" Sieve, 20 to 80% passing the ½" Sieve, 2 to 35% passing the No. 200 Sieve, and should have a Plasticity Index no greater than 10. Subgrade acceptance chart should be used for subgrade soils placed within the upper 3 feet beneath proposed pavements.

The following notes are based on ADOT 2008 Standards Specifications for Road and Bridge Construction to complement the FP-14 Specifications.

Note: [1]Refers to items listed in the ADOT Standard Specifications

Note: [2]Refers to items listed in the ADOT Special Provisions

Neither the FP-14 nor ADOT have a specification for construction of a scrub seal. In the event that Alternative A or B is implemented, we are available to assist in the development of a specification for this particular item. We are also available to assist in the review and development of the final specifications for the project once the final design section alternatives are determined.

5.2 Site Preparation and Earthwork

We recommend that all site preparation and earthwork on the project be undertaken under the applicable portions of FP-14 Specifications 201, 202, 203, 204, 209, and 212. Recommended changes to these specifications as outlined in the preceding table should be included in the specific specifications or special provisions for the project.

Construction of fill slopes should be in accordance with Section 204.13 of the FP-14 Standard Specifications. Cut and fill slopes at the site are recommended to be constructed at a 3H:1V (horizontal:vertical) or flatter slope. Slopes constructed at slope inclinations steeper than 3H:1V should have surface erosion measures considered in the design. The face of all slopes should be compacted to the minimum specification for fill embankments. Fill slopes can be over-built and trimmed to expose a compacted slope surface.

Should any wet, soft or otherwise loose or disturbed soils be encountered during site grading, these soils should be removed and replaced with properly moisture-conditioned and compacted soils in accordance with Section 209 of the FP-14 Standard Specifications.

6.0 GENERAL COMMENTS

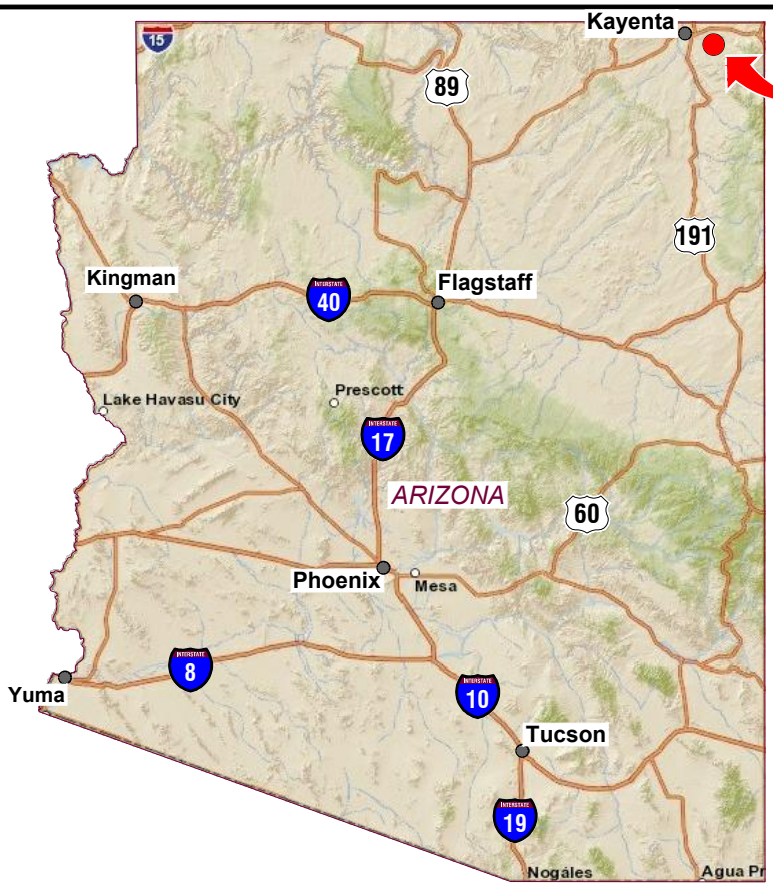
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

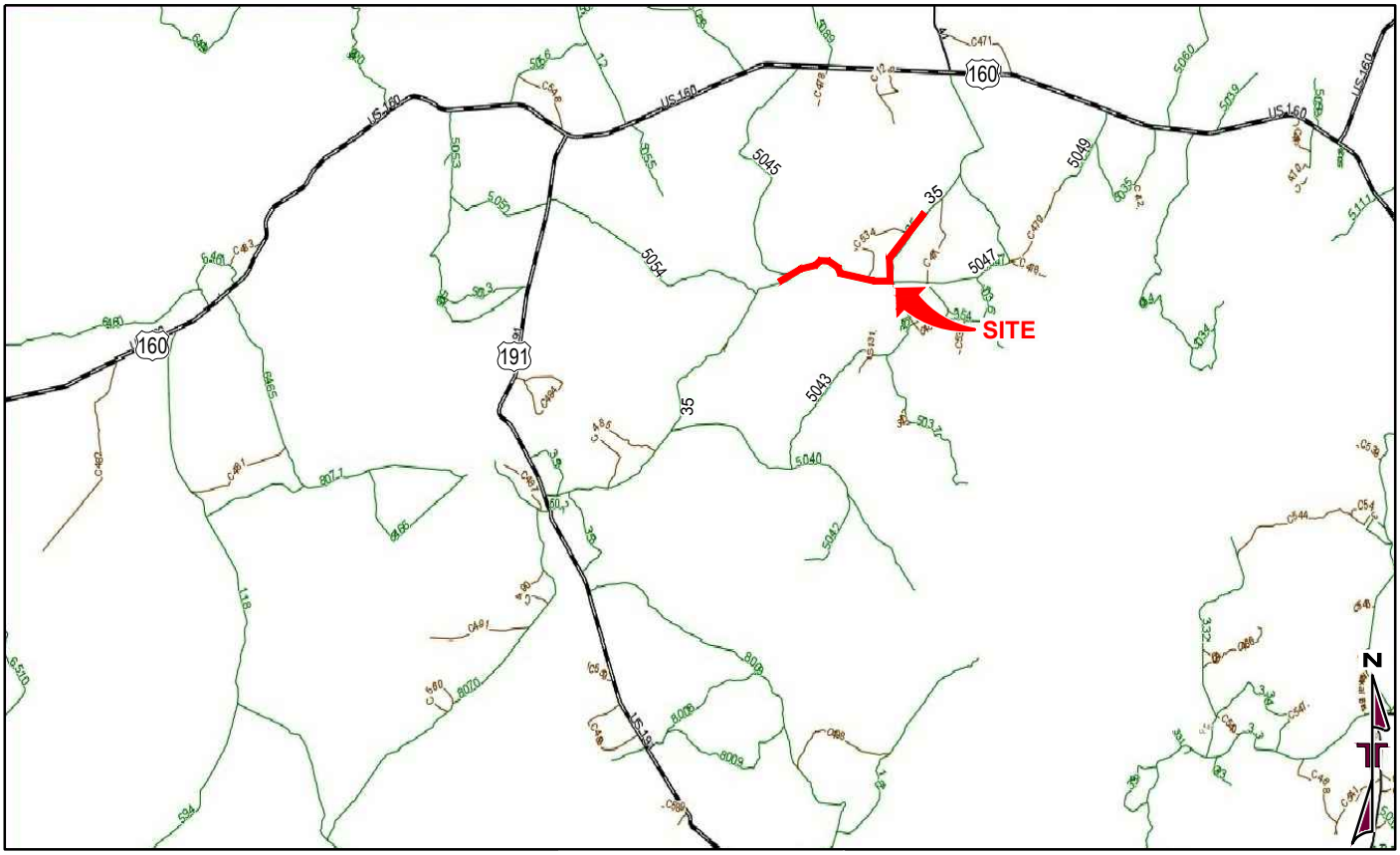
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical and pavement engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION





VICINITY MAPS

NOT TO SCALE

Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	SITE LOCATION MAP
Drawn By: KLJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: RP	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/15/2016		EXHIBIT A-1

END PROJECT
≈ STA. 33+880

PROJECT BEGIN
≈ STA. 21+441

Route 35

Route 5045

Route 5047

B1 B2 B3 B4 B5 B6 B66 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20 B21 B22 B23 B24 B25 B26 B27 B28 B29 B30 B31 B32 B33 B34 B35 B36 B37 B38 B39 B40 B41 B42 B43 B44 B45 B46 B47 B48 B49 B50 B51 B52 B53 B54 B55 B56 B57 B58 B59 B60 B61 B62 B63 B64 B65

S-1A & S-1B S-2 S-3 S-4 S-5 S-6 S-7A & S-7B S-8 S-9

RL-21+506 RL-23+572 RL-23+870 RL-24+140 RL-24+370 RL-24+550 RL-24+735 RL-24+960 RL-25+115 RL-25+230 RL-25+250 RL-25+300 RL-25+560 RL-25+792 RL-26+010 RL-26+240 RL-27+180 RL-30+320

N

0 1000' 2000'
APPROXIMATE SCALE

NOTE: SITE IMAGES FROM GOOGLE EARTH, PRO, AND GOOGLE ONLINE MAPS, 2016

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE FIELD ELECTRICAL RESISTIVITY LINE
- APPROXIMATE SEISMIC SURVEY LINE LOCATION

Project Mngr: RP	Project No. 65165267
Drawn By: KLJ	Scale: AS SHOWN
Checked By: RP	File No. 65165267.DWG
Approved By: DRC	Date: 11/21/2016

Terracon
Consulting Engineers and Scientists
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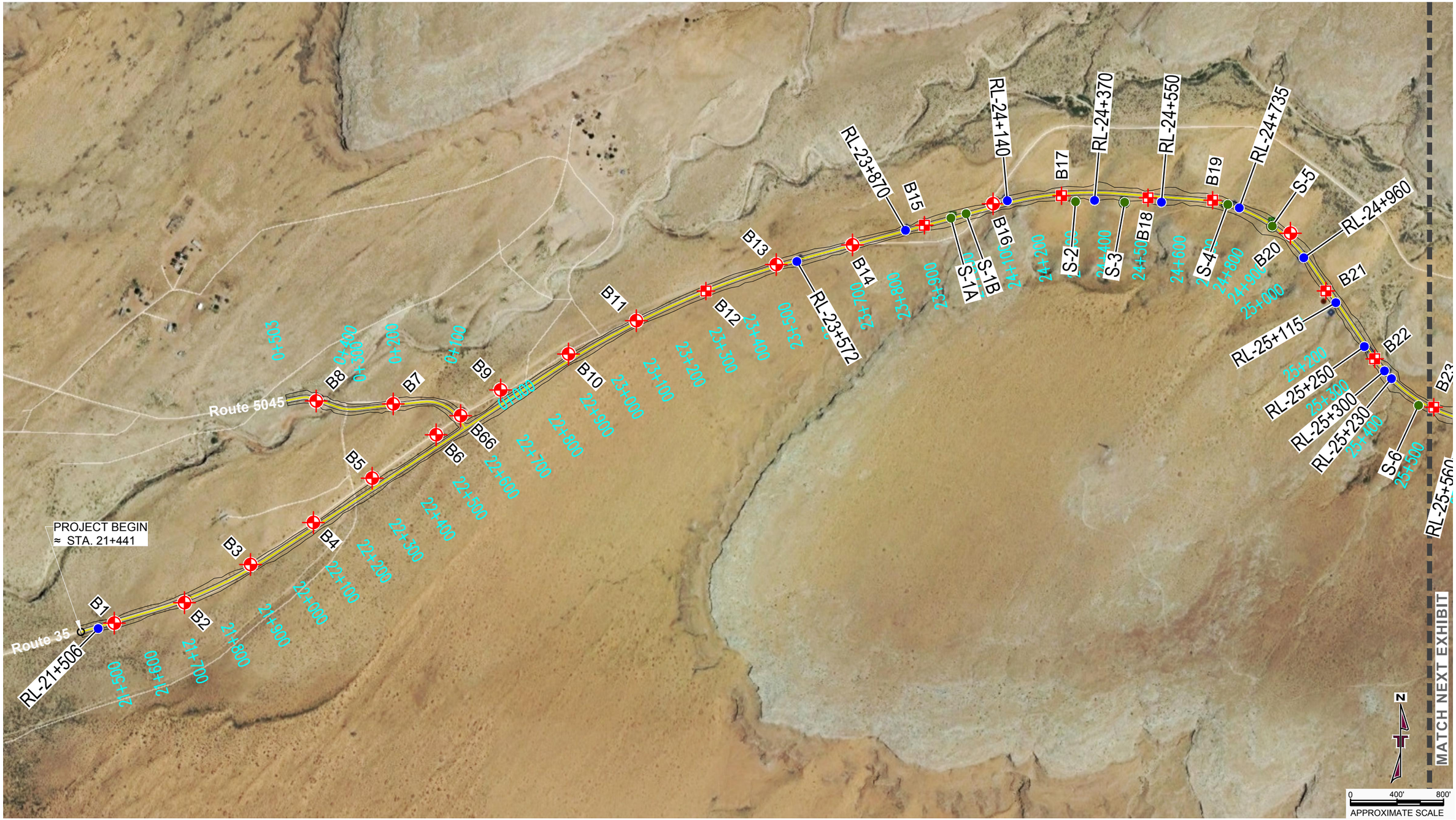
SITE WITH BORING LOCATIONS

N35(8)1,2,4 and N5045(1)1,2,4

SWEETWATER, ARIZONA

EXHIBIT

A-2



NOTE: SITE IMAGES FROM GOOGLE EARTH, PRO, AND GOOGLE ONLINE MAPS, 2016

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE FIELD ELECTRICAL RESISTIVITY LINE
- APPROXIMATE SEISMIC SURVEY LINE LOCATION

Project Mngr:	RP
Drawn By:	KLJ
Checked By:	RP
Approved By:	DRC

Project No.	65165267
Scale:	AS SHOWN
File No.	65165267.DWG
Date:	11/21/2016

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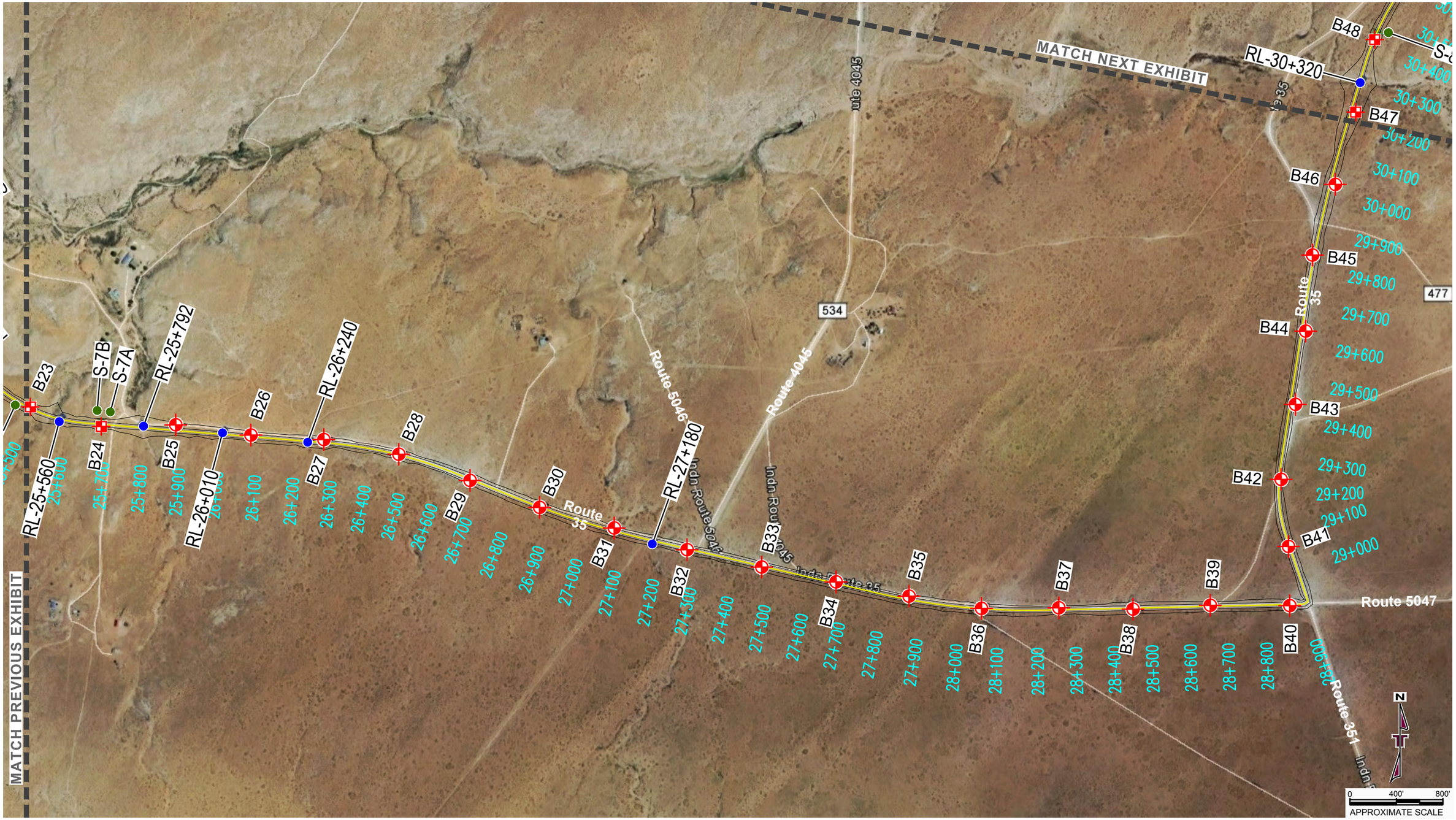
EXPLORATION LOCATION MAP

N35(8)1,2,4 and N5045(1)1,2,4

SWEETWATER, ARIZONA

EXHIBIT

A-3



NOTE: SITE IMAGES FROM GOOGLE EARTH, PRO, AND GOOGLE ONLINE MAPS, 2016

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE FIELD ELECTRICAL RESISTIVITY LINE
- APPROXIMATE SEISMIC SURVEY LINE LOCATION

Project Mngr: RP	Project No. 65165267
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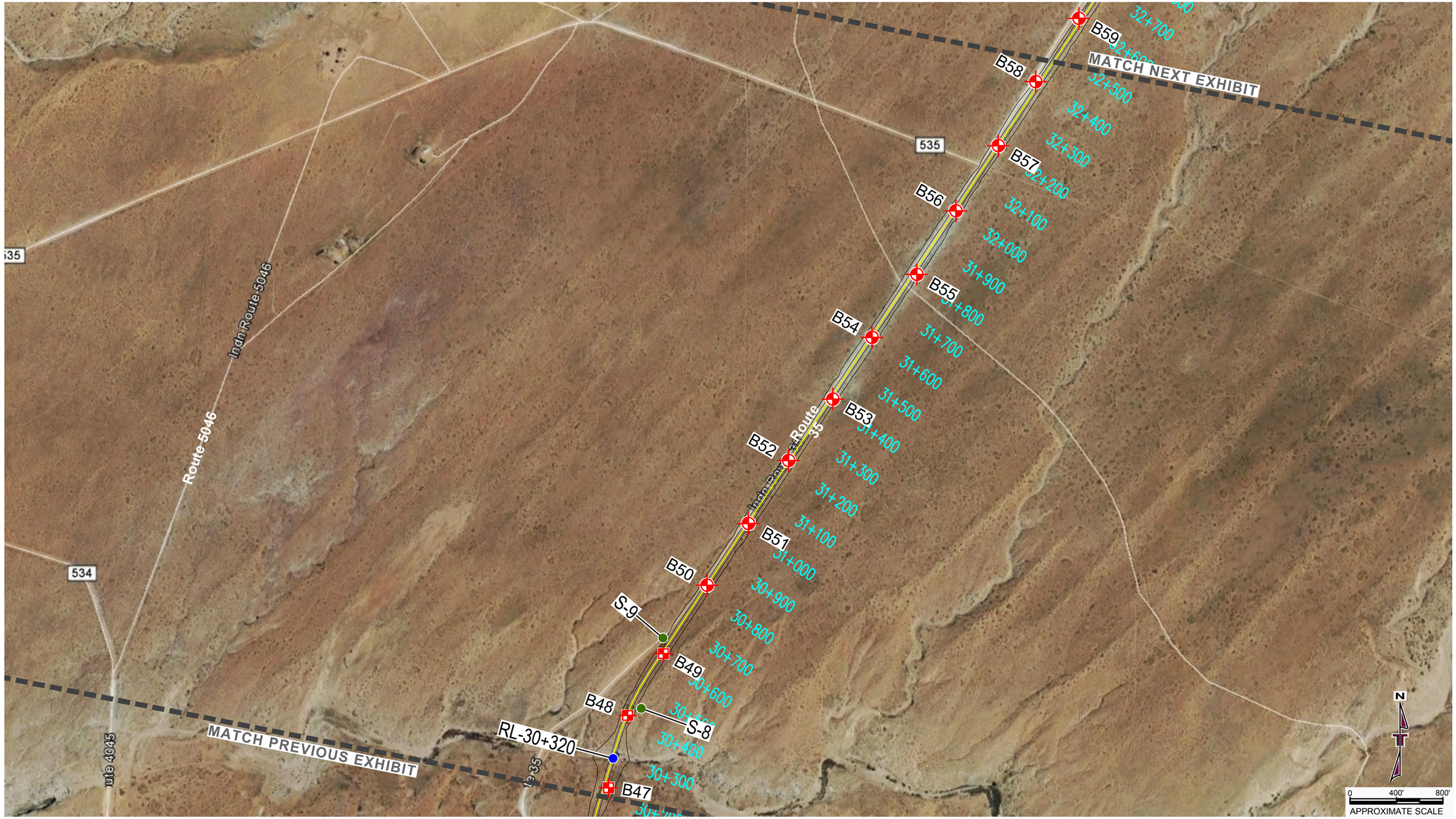
EXPLORATION LOCATION MAP

N35(8)1,2,4 and N5045(1)1,2,4

SWEETWATER, ARIZONA

EXHIBIT

A-4



LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE FIELD ELECTRICAL RESISTIVITY LINE
- APPROXIMATE SEISMIC SURVEY LINE LOCATION

NOTE: SITE IMAGES FROM GOOGLE EARTH, PRO, AND GOOGLE ONLINE MAPS, 2016

Project Mngr:	RP
Drawn By:	KLJ
Checked By:	RP
Approved By:	DRC
Project No.	65165267
Scale:	AS SHOWN
File No.	65165267.DWG
Date:	11/21/2016

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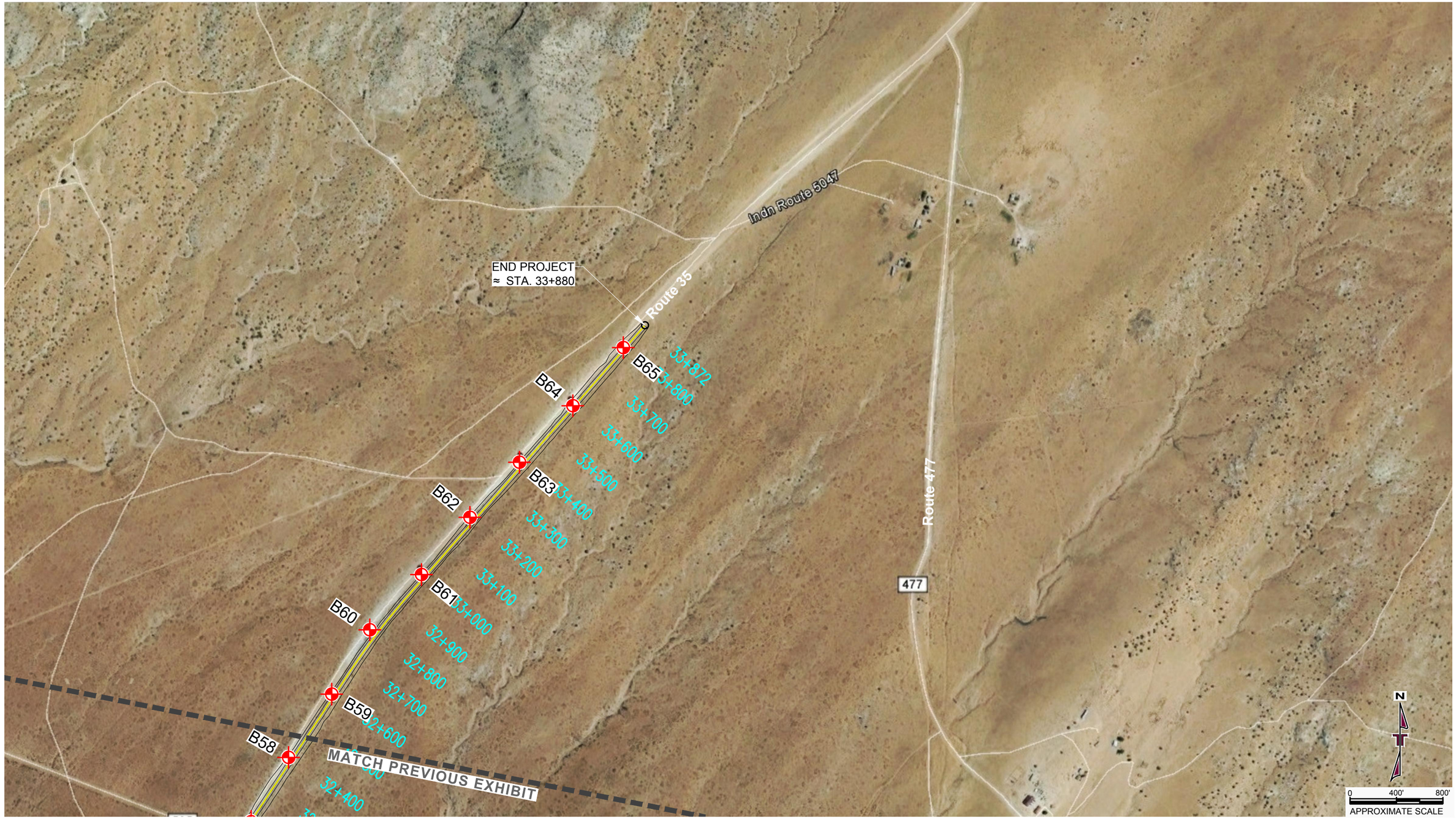
EXPLORATION LOCATION MAP

N35(8)1,2,4 and N5045(1)1,2,4
SWEETWATER, ARIZONA

EXHIBIT
A-5



LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE TEST PIT LOCATION
- APPROXIMATE FIELD ELECTRICAL RESISTIVITY LINE
- APPROXIMATE SEISMIC SURVEY LINE LOCATION

NOTE: SITE IMAGES FROM GOOGLE EARTH, PRO, AND GOOGLE ONLINE MAPS, 2016

Project Mngr: RP	Project No. 65165267
Drawn By: KLJ	Scale: AS SHOWN
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Terracon
Consulting Engineers and Scientists
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EXPLORATION LOCATION MAP

N35(8)1,2,4 and N5045(1)1,2,4

SWEETWATER, ARIZONA

EXHIBIT

A-6

Field Exploration Description

A total of 54 test borings were drilled to depths of 0.9 to 3.2 meters (3 to 10½ feet) below the ground surface at the site on October 3 through October 5, 2016. A total of 12 test pits were excavated to depths of 1.8 to 3 meters (6 to 10 feet) below the ground surface at the site on October 17 and 18, 2016. Nuclear density testing at various depths was performed in the test pits. Each boring and test pit were backfilled with auger/excavation cuttings at the completion of the field exploration.

With the exception of B18, B46 and B47, the majority of the field explorations were performed within the proposed roadway alignment. At the location of B18, the test pit location was offset slightly to near the edge of the proposed roadway alignment due to hillside terrain and difficult access. At the location of B46, the boring was offset slightly to near the edge of the proposed roadway alignment due to loose surface sand and difficult access. At the location of B47, the test pit location was offset slightly to near the edge of the proposed roadway alignment due to wash terrain and difficult access.

A total of 17 field measurements of soil resistivity were performed on October 19, 2016, in general accordance with ASTM Test Method G 57, and IEEE std. 81, using the Wenner Four-Electrode Method. The soil resistivity tests were conducted at the locations identified on the attached Site Plan and Boring Locations diagrams, Exhibits A-1 through A-5.

A total of 11 seismic refraction test lines were completed to assess the excavation characteristics of shallow bedrock. The surveys were completed from October 17 through October 21, 2106. The test line locations, identified as S-1 through S-9, are depicted on the attached Site Plan and Boring Locations diagrams, Exhibits A-1 through A-5.

The approximate location of the borings, test pits, seismic survey lines, and field electrical resistivity lines are shown on the attached Site Plan and Boring Locations diagrams, Exhibits A-2 through A-5.

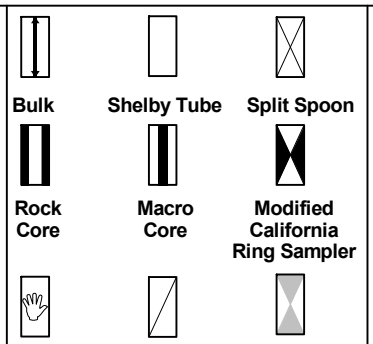
A continuous lithologic log of each boring and test pit was recorded by the field geologist during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving ring-lined barrel samplers in general accordance with ASTM Standards. Penetration resistance measurements were obtained by driving the ring-lined barrel samplers into the subsurface materials with a 63.5 kilogram (140-pound) automatic hammer falling 76 centimeters (30 inches). The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered. Bulk samples of subsurface materials were also obtained from the auger cuttings.

Groundwater conditions were evaluated in the borings at the time of site exploration.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

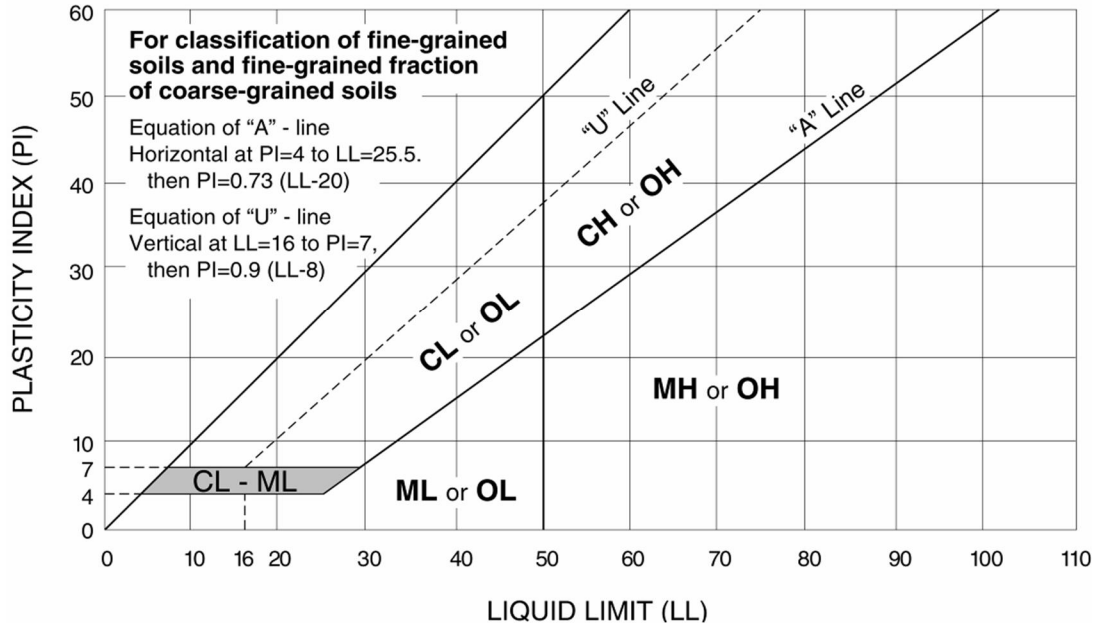
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



BORING LOG NO. B1

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84419° Longitude: -109.46707°

Surface Elev.: 1577.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), brown, very loose to loose									
				3-4		10	101	NP	11
	1								
1.98 1575.1				1-1-2 N=3					
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-10

BORING LOG NO. B2

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84467° Longitude: -109.46501°

Surface Elev.: 1580.8 (m)

DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SANDY LEAN CLAY (CL), light brown, stiff					4-5-6 N=11					
		1							34-22-12	54
hard					18-25		14	114		
		2								
2.59	1578.3									
2.90 **SEDIMENTARY BEDROCK - SANDSTONE**, tan, strong cementation, highly to moderately weathered	1577.9				50/5"					
Boring Terminated at 2.90 Meters										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-11

BORING LOG NO. B3

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84556° Longitude: -109.46307°

Surface Elev.: 1582.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), reddish-brown, very loose to loose									
				6-9		3	101		
	1							NP	38
1.98 1580.1				1-2-2 N=4					
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-12

BORING LOG NO. B4

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84656° Longitude: -109.46122°

Surface Elev.: 1585.4 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), reddish-brown, very loose to loose	1			1-2-2 N=4				NP	19
1.83 1583.5				2-2		6	96		
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-13

BORING LOG NO. B5

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8476° Longitude: -109.45949°

Surface Elev.: 1587.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), light brown, very loose									
				3-3		4	99	NP	23
	1								
				1-1-2 N=3				NP	16
	2								
medium dense				3-5-6 N=11					
3.20 1583.8	3								
Boring Terminated at 3.20 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-14

BORING LOG NO. B6

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84862° Longitude: -109.45761°

Surface Elev.: 1586.6 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						4-4-5 N=9					
			1							NP	10
	1.83	1584.8				4-5		2	94		

POORLY GRADED SAND WITH SILT (SP-SM), light brown, loose

Boring Terminated at 1.83 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-15

BORING LOG NO. B7

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84935° Longitude: -109.45887°

Surface Elev.: 1585.7 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH SILT (SP-SM), medium dense									
						7-11		9	98	NP	11
			1								
		very dense				32-50/3"					
	1.98	1583.7									
		Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-16

BORING LOG NO. B8

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84942° Longitude: -109.46114°

Surface Elev.: 1581.0 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						2-3-10 N=13					
			1							NP	15
	1.83	1579.1				22-29		1	115		

SILTY SAND (SM), light brown, medium dense

Boring Terminated at 1.83 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-17

BORING LOG NO. B9

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84968° Longitude: -109.45572°

Surface Elev.: 1586.7 (m)

DEPTH	ELEVATION (m)	GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						3-5		5	105		
										NP	8
			1			1-2-2 N=4					
			2								
3.20	1583.5		3			1-2-2 N=4				NP	12

POORLY GRADED SAND WITH SILT (SP-SM), light brown, loose

Boring Terminated at 3.20 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-18

BORING LOG NO. B10

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85053° Longitude: -109.45373°

Surface Elev.: 1589.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, very loose to loose									
	1			1-1-1 N=2				NP	34
1.83 1587.1				5-9		2	91		
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-19

BORING LOG NO. B11

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85131° Longitude: -109.45173°

Surface Elev.: 1589.9 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), light brown, loose									
				7-8		3	89		
	1							NP	15
1.98 1587.9				4-4-4 N=8					
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/3/2016 Boring Completed: 10/3/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-20

TEST PIT LOG NO. B12

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85201° Longitude: -109.44969°

Surface Elev.: 1594.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND, tan to brown, slightly red tint	1				93.4/2.0 97.2/2.4 97.9/2.0 93.3/1.9			NP	14
	2								
3.05 1591.0	3								
Test Pit Terminated at 3.05 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-21

BORING LOG NO. B13

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85263° Longitude: -109.44762°

Surface Elev.: 1596.2 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), brown, very loose to loose									
						5-5		4	103	NP	17
			1								
	1.83	1594.4				1-1-2 N=3					
		Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-22

BORING LOG NO. B14

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8531° Longitude: -109.44538°

Surface Elev.: 1601.1 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), reddish-brown, very loose									
				1-1-1 N=2					
	1							NP	16
1.83 1599.3				2-3		5	98		
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-23

TEST PIT LOG NO. B15

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85356° Longitude: -109.44327°

Surface Elev.: 1608.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), trace gravel in upper 3 to 4 inches	1				102.3/0.9 100.5/1.4 99.9/3.6 99.8/4.9			NP	9
very loose, increased moisture	2							NP	
3.05 1605.0	3								
Test Pit Terminated at 3.05 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016	Test Pit Completed: 10/18/2016
Excavator: CAT 320	Operator: D&S Drilling
Project No.: 65165267	Exhibit: A-24

BORING LOG NO. B16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85395° Longitude: -109.4415°

Surface Elev.: 1606.1 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), reddish-brown, very loose									
	1			1-1-1 N=2				NP	33
medium dense				5-13		14	109		
1.83 1604.2									
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-25

TEST PIT LOG NO. B17

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85427° Longitude: -109.43888°

Surface Elev.: 1614.8 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown to red-brown	1				100.1/1.5 99.1/1.5 95.6/2.6 96.7/1.6				
	2							NP	13
3.05 1611.8	3								
Test Pit Terminated at 3.05 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-26

TEST PIT LOG NO. B18

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85403° Longitude: -109.43673°

Surface Elev.: 1610.8 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown to red-brown	1				100.7/2.3 101.2/2.7 100.3/3.5 101.6/2.3			NP	15
	2								
3.05 1607.7	3								
Test Pit Terminated at 3.05 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-27

TEST PIT LOG NO. B19

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85405° Longitude: -109.43452°

Surface Elev.: 1615.9 (m)

DEPTH ELEVATION (m)

DEPTH (m)	SAMPLE TYPE	Nuclear FDT DD (pcf)/MC (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		100.5/1.1		
		99.2/1.3	NP	22
		91.7/3.8		
2		92.3/3.8		
3				

SILTY SAND (SM), brown to red-brown

3.05 1612.8

Test Pit Terminated at 3.05 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-28

BORING LOG NO. B20

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85336° Longitude: -109.43253°

Surface Elev.: 1615.1 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), light brown, loose									
						2-2-2/0"					
			1							NP	15
						6-9		4	100		
	1.98	1613.2									
		Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-29

TEST PIT LOG NO. B21

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.852° Longitude: -109.43149°

Surface Elev.: 1619.4 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), brown to red-brown						97.4/1.9 96.9/2.4 91.0/2.9 91.3/3.0			NP	33
	1.22	1618.2	1								
	POORLY GRADED SAND WITH SILT (SP-SM), gray		2							NP	22
	3.05	1616.4	3								
	Test Pit Terminated at 3.05 Meters										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-30

TEST PIT LOG NO. B22

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85041° Longitude: -109.43005°

Surface Elev.: 1622.1 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), red-brown	1				99.6/2.3 94.6/3.0 94.1/3.7 98.7/2.3			NP	19
	3.05	1619.1	2								
		Test Pit Terminated at 3.05 Meters	3								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-31

TEST PIT LOG NO. B23

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84925° Longitude: -109.42832°

Surface Elev.: 1632.5 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, very loose	1				102.4/2.2 88.9/5.2 88.8/5.0 103.2/1.7			NP	23
	2								
3.05 1629.4	3								
Test Pit Terminated at 3.05 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/18/2016 | Test Pit Completed: 10/18/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-32

TEST PIT LOG NO. B24

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84884° Longitude: -109.42617°

Surface Elev.: 1635.0 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), red-brown						94.8/1.9 98.2/1.8				
	0.30	1634.7									
	SILTY GRAVEL WITH SAND (SM), red-brown to gray, with bedrock boulders throughout		1							NP	17
	1.83	1633.2									
	Backhoe Bucket at 1.83 Meters										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/17/2016 | Test Pit Completed: 10/17/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-33

BORING LOG NO. B25

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84883° Longitude: -109.42406°

Surface Elev.: 1637.1 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), reddish-brown, loose to medium dense									
	1			6-9		9	96	NP	39
				5-5-7 N=12					
1.98 1635.1									
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-34

BORING LOG NO. B26

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84858° Longitude: -109.42185°

Surface Elev.: 1646.3 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), light brown, medium dense									
				5-5-7 N=12					
	1							NP	16
1.83 1644.5				9-15		6	101		
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-35

BORING LOG NO. B27

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84847° Longitude: -109.41971°

Surface Elev.: 1650.5 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			1			6-16		17	108	24-17-7	63
	1.68	1648.8				50/4"					

SANDY SILTY CLAY (CL-ML), reddish-brown, very stiff to hard

Boring Terminated at 1.68 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-36

BORING LOG NO. B28

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84813° Longitude: -109.41751°

Surface Elev.: 1657.6 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND (SP), light gray, very dense, moderate cementation, highly weathered sandstone									
			1			15-30-50/3"				NP	3
	1.68	1655.9				50/5"		2	98		
		Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-37

BORING LOG NO. B29

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84751° Longitude: -109.41541°

Surface Elev.: 1663.6 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, loose to medium dense									
	1			8-9		5	101	NP	16
				4-4-6 N=10					
1.98 1661.6									
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-38

BORING LOG NO. B30

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84687° Longitude: -109.41337°

Surface Elev.: 1666.3 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), light brown to light gray, dense to very dense									
						5-16-23 N=39					
			1							NP	12
	1.68	1664.7				50/5"		4	98		
		Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-39

BORING LOG NO. B31

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84638° Longitude: -109.41118°

Surface Elev.: 1668.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, medium dense									
	1			11-21		8	104	NP	18
1.68 very dense 1666.3				50/5"					
Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-40

BORING LOG NO. B32

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84586° Longitude: -109.40905°

Surface Elev.: 1671.7 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), light brown, dense to very dense									
				12-23-23 N=46					
	1							NP	16
1.68 moderate cementation 1670.0				50/1"					
Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-41

BORING LOG NO. B33

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84554° Longitude: -109.4069°

Surface Elev.: 1674.5 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), light brown to tan, very dense											
						28-50/3"		8	98	NP	14
			1								
	1.68	1672.9				50/5"					
Boring Terminated at 1.68 Meters											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-42

BORING LOG NO. B34

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8451° Longitude: -109.40467°

Surface Elev.: 1680.0 (m)

DEPTH	ELEVATION (m)	GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), light gray, very dense, weak cementation								NP	17
0.76	1679.2					21-50/5"					
0.91	1679.1	**SEDIMENTARY BEDROCK - SANDSTONE**									
		Auger Refusal at 0.91 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-43

BORING LOG NO. B35

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84476° Longitude: -109.40253°

Surface Elev.: 1684.8 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), tan to brown, very dense	1			23-50/4"		3	109	NP	12
				26-50/3"					
1.83 1683.0									
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-44

BORING LOG NO. B36

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84447° Longitude: -109.4004°

Surface Elev.: 1689.8 (m)

DEPTH	ELEVATION (m)	GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), light gray, very dense, weak cementation						9-17-43 N=60					
			1							NP	6
1.22	1688.6										
SEDIMENTARY BEDROCK - SANDSTONE, gray, highly to moderately weathered											
1.68	1688.1					50/3"		3			
Boring Terminated at 1.68 Meters											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-45

BORING LOG NO. B37

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84448° Longitude: -109.39813°

Surface Elev.: 1691.4 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, medium dense, medium grained									
				7-8		6	109	NP	19
	1								
light brown, fine grained below 4 feet									
				4-7-11 N=18					
1.98 1689.4									
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-46

BORING LOG NO. B38

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84445° Longitude: -109.39595°

Surface Elev.: 1693.5 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						14-21-28 N=49					
			1							NP	7
	1.68	1691.8				50/1"					

POORLY GRADED SAND WITH SILT, light brown, dense to very dense, weak to moderate cementation

Boring Terminated at 1.68 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-47

BORING LOG NO. B39

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84453° Longitude: -109.39368°

Surface Elev.: 1695.5 (m)

DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), tan, medium dense										
					7-23		15	91	NP	18
1.22	1694.3	1								
SEDIMENTARY BEDROCK - SANDSTONE, tan, highly to moderately weathered										
1.68	1693.9				50/3"					
Boring Terminated at 1.68 Meters										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-48

BORING LOG NO. B40

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84452° Longitude: -109.39134°

Surface Elev.: 1698.3 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), light brown, very dense										
	0.91	1697.3				23-24-30 N=54				NP	14
	SEDIMENTARY BEDROCK - SANDSTONE, brown, highly to moderately weathered		1								
	1.83	1696.4				24-50/4"		9	104		
	Boring Terminated at 1.83 Meters										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-49

BORING LOG NO. B41

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84592° Longitude: -109.39138°

Surface Elev.: 1698.0 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense											
						41-50/5"				NP	6
			1								
						10-30-50/4"					
	1.98	1696.0									
Boring Terminated at 1.98 Meters											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-50

BORING LOG NO. B42

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8475° Longitude: -109.39159°

Surface Elev.: 1697.2 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), light brown to brown, loose									
				4-4-5 N=9					
	1							NP	19
1.68 gray, very dense 1695.5				50/6"		5	102		
Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-51

BORING LOG NO. B43

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84927° Longitude: -109.39117°

Surface Elev.: 1696.7 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND, light brown to brown, very dense, fine to medium grained sand									
				23-50/3"		6	111	NP	19
	1								
1.83 1694.8				25-50/4"					
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-52

BORING LOG NO. B44

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.851° Longitude: -109.39086°

Surface Elev.: 1693.4 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), light brown, very dense									
						16-26-37 N=63					
			1							NP	14
	1.68	1691.7				50/4"					
		Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-53

BORING LOG NO. B45

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8528° Longitude: -109.39066°

Surface Elev.: 1689.5 (m)

GRAPHIC LOG	DEPTH / ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT (SM), brown, very dense									
					16-50/5"		6	111	NP	11
		1								
	1.52 / 1688.0									
	SANDY SILTY CLAY (ML), brown, very dense				13-13-50/1"					
	1.98 / 1687.6									
	Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-54

BORING LOG NO. B46

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85444° Longitude: -109.38988°

Surface Elev.: 1689.4 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), light brown to gray, medium dense to very dense									
						5-10-17 N=27				NP	14
	1.22	1688.2	1								
		SEDIMENTARY BEDROCK - SANDSTONE, gray, weathered									
	1.83	1687.6				39-50/3"		3	102		
		Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 | Boring Completed: 10/4/2016

Drill Rig: D-50 | Driller: D&S Drilling

Project No.: 65165267 | Exhibit: A-55

TEST PIT LOG NO. B47

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85616° Longitude: -109.38922°

Surface Elev.: 1674.6 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), red-brown		1				92.8/2.5 85.4/4.3 85.7/4.5 92.7/2.5			NP	24
	1.98	1672.7									
	Test Pit Terminated at 1.98 Meters										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/17/2016	Test Pit Completed: 10/17/2016
Excavator: CAT 320	Operator: D&S Drilling
Project No.: 65165267	Exhibit: A-56

TEST PIT LOG NO. B48

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85793° Longitude: -109.38876°

Surface Elev.: 1681.2 (m)

DEPTH ELEVATION (m)

DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
				99.8/1.7				
				100.0/1.7			NP	17
1				95.3/3.4 95.4/3.1				
2							NP	32
3								

SILTY SAND (SM), red-brown, loose to medium dense

weak cementation

excavating becomes harder below 9 feet

3.05 1678.1

Test Pit Terminated at 3.05 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/17/2016 | Test Pit Completed: 10/17/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-57

TEST PIT LOG NO. B49

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.85947° Longitude: -109.3877°

Surface Elev.: 1683.4 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SANDY SILT (ML), red-brown	1				95.5/1.7 96.1/6.3 95.6/6.1 95.7/2.1			NP	50
	2.44	1681.0	2								
		SILTY SAND (SM), red-brown, weak cementation								NP	30
	3.05	1680.4	3								
		Test Pit Terminated at 3.05 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Backhoe

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Test Pit Started: 10/17/2016 | Test Pit Completed: 10/17/2016

Excavator: CAT 320 | Operator: D&S Drilling

Project No.: 65165267 | Exhibit: A-58

BORING LOG NO. B50

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.86095° Longitude: -109.38648°

Surface Elev.: 1683.4 (m)

GRAPHIC LOG	DEPTH / ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), brown, loose to medium dense									
					2-3-3/0"					
		1							NP	24
	stratified thin layers of sandy lean clay at about 5 feet.				7-12		8	104		
	1.83 / 1681.6									
	Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-59

BORING LOG NO. B51

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.86241° Longitude: -109.38526°

Surface Elev.: 1686.9 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND (SP), yellowish-brown, very dense									
						21-50/3"		4	113	NP	4
			1								
		light brown				21-50/4"					
	1.83	1685.1									
		Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 | Boring Completed: 10/4/2016

Drill Rig: D-50 | Driller: D&S Drilling

Project No.: 65165267 | Exhibit: A-60

BORING LOG NO. B52

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8639° Longitude: -109.38408°

Surface Elev.: 1690.8 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), tan, very dense									
	1			12-26-41 N=67				NP	6
1.83 1688.9				23-50/3"		2	102		
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-61

BORING LOG NO. B53

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.86535° Longitude: -109.38278°

Surface Elev.: 1694.4 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND (SP), light brown, very dense									
						34-50/5"		4	102	NP	4
			1								
	1.68	1692.7				50/4"					
		Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-62

BORING LOG NO. B54

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.86681° Longitude: -109.38162°

Surface Elev.: 1699.5 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			1			16-18-18 N=36				NP	17
						30-50/2"		3	100		
	1.83	1697.6									

SILTY SAND (SM), light brown, dense to very dense

Boring Terminated at 1.83 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-62

BORING LOG NO. B55

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.86829° Longitude: -109.3803°

Surface Elev.: 1704.6 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense, weak cementation				50/4"				NP	7
			1								
	1.83	1702.7				36-50/2"					
		Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-64

BORING LOG NO. B56

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.8698° Longitude: -109.37915°

Surface Elev.: 1709.3 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), light brown, medium dense									
				5-9-19 N=28					
	1							NP	6
1.68 very dense 1707.7				50/5"					
Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-65

BORING LOG NO. B57

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87133° Longitude: -109.3779°

Surface Elev.: 1713.4 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), tan, dense to very dense	1			24-55		3	108	NP	12
1.68 1711.8				50/5"					
Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-66

BORING LOG NO. B58

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87284° Longitude: -109.3768°

Surface Elev.: 1720.8 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND (SP), light brown, very dense									
						50/5"				NP	4
			1								
	1.68	1719.2				50/5"					
		Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-67

BORING LOG NO. B59

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87434° Longitude: -109.37552°

Surface Elev.: 1726.0 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			1			36-50/2"		4	120	NP	11
	1.68	1724.3				50/4"					

POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense, weak cementation

Boring Terminated at 1.68 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-68

BORING LOG NO. B60

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87586° Longitude: -109.3744°

Surface Elev.: 1732.7 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						21-50/4"					
			1							NP	7
	1.68	1731.0				50/5"					

POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense

Boring Terminated at 1.68 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-69

BORING LOG NO. B61

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior Gallup, New Mexico

SITE: Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87716° Longitude: -109.37288°

Surface Elev.: 1736.5 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense	1			50/5"				NP	21
1.83 1734.7				36-50/4"					
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-70

BORING LOG NO. B62

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87851° Longitude: -109.37145°

Surface Elev.: 1740.4 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH SILT (SP-SM), tan, very dense									
						26-50/4"					
			1							NP	11
	1.68	1738.7				50/5"					
		Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-71

BORING LOG NO. B63

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.87981° Longitude: -109.36999°

Surface Elev.: 1746.0 (m)

GRAPHIC LOG	DEPTH	ELEVATION (m)	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
						34-50/3"		5	103	NP	9
			1								
	1.83	1744.2				35-50/5"					

POORLY GRADED SAND WITH SILT (SP-SM), light brown, very dense

Boring Terminated at 1.83 Meters

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-72

BORING LOG NO. B64

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.88114° Longitude: -109.36842°

Surface Elev.: 1750.0 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), tan, very dense									
	1			17-24-32 N=56				NP	6
1.68 1748.3				50/4"					
Boring Terminated at 1.68 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/4/2016 Boring Completed: 10/4/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-73

BORING LOG NO. B65

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.88252° Longitude: -109.36693°

Surface Elev.: 1754.4 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, loose to medium dense	1			6-12		6	103	NP	18
1.98 1752.4				3-4-4 N=8					
Boring Terminated at 1.98 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

Project No.: 65165267 Exhibit: A-74

BORING LOG NO. B66

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

CLIENT: United States Department of the Interior
Gallup, New Mexico

SITE:
Sweetwater, Arizona

LOCATION See Exploration Plan

Latitude: 36.84907° Longitude: -109.4569°

Surface Elev.: 1587.4 (m)

DEPTH ELEVATION (m)

GRAPHIC LOG	DEPTH (m)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Nuclear FDT DD (pcf)/MC (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), brown, very loose to loose									
				1-2-3 N=5					
	1							NP	22
1.83 1585.6				2-3		2	94		
Boring Terminated at 1.83 Meters									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

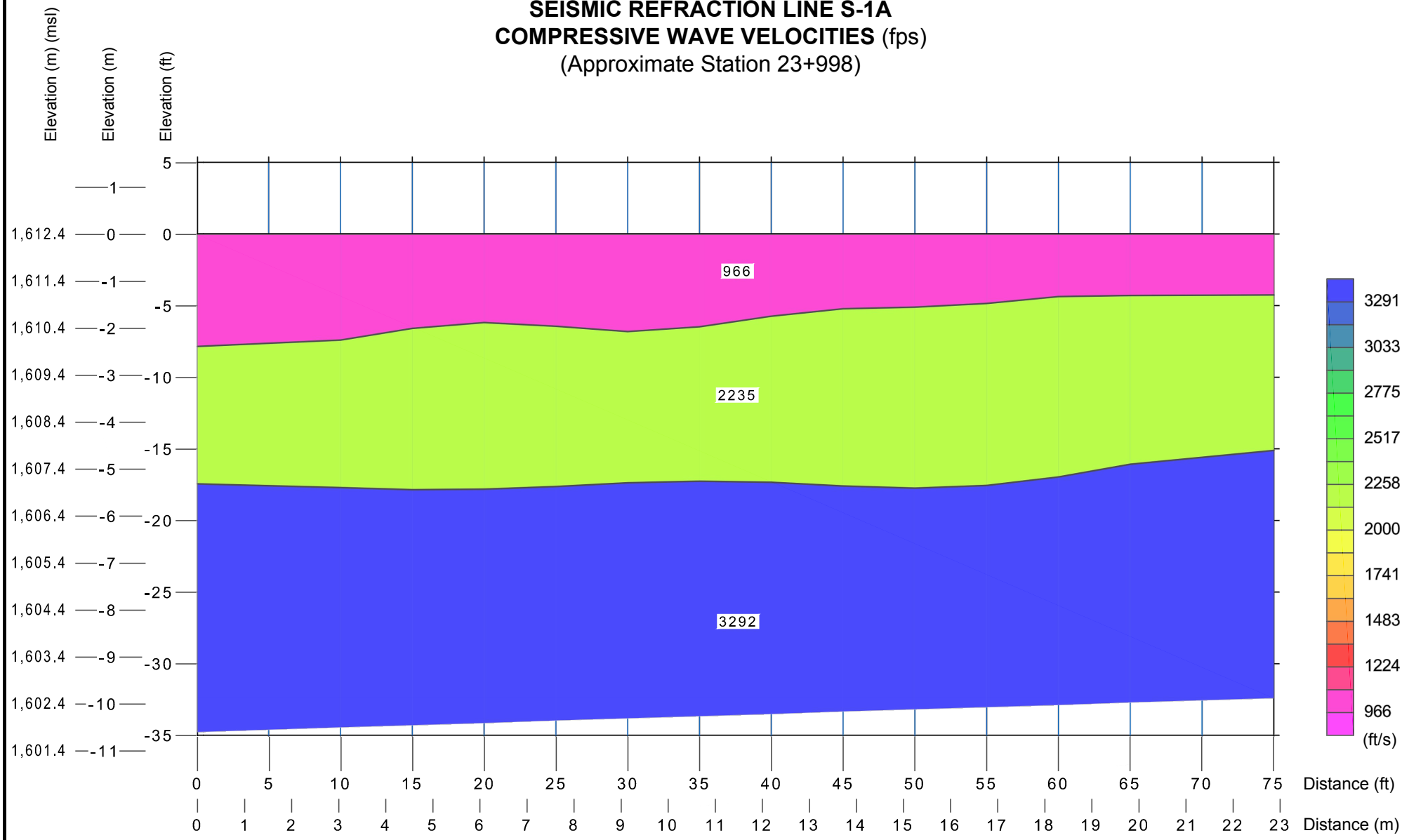
Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

Boring Started: 10/5/2016 Boring Completed: 10/5/2016

Drill Rig: D-50 Driller: D&S Drilling

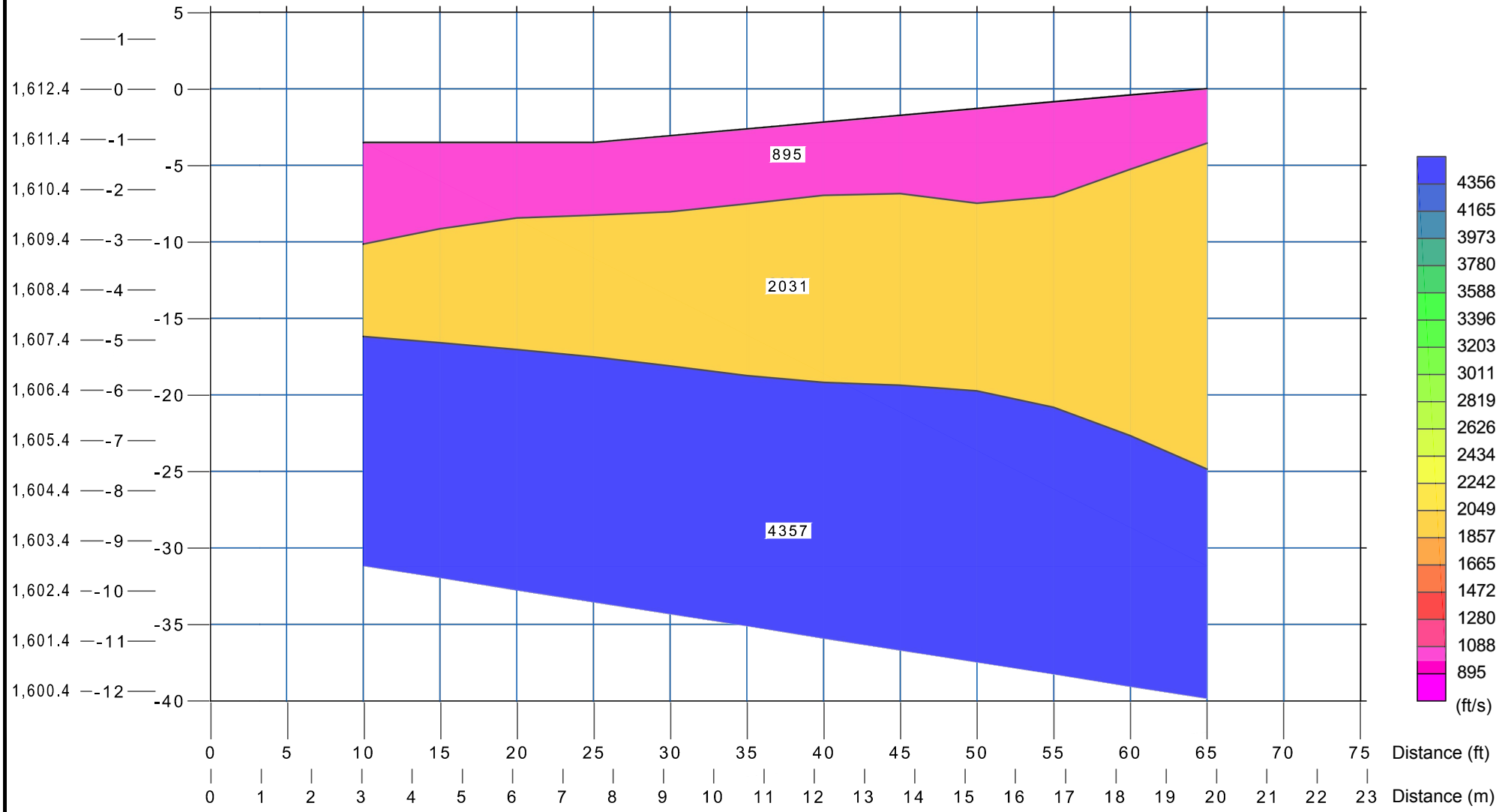
Project No.: 65165267 Exhibit: A-75

SEISMIC REFRACTION LINE S-1A
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 23+998)



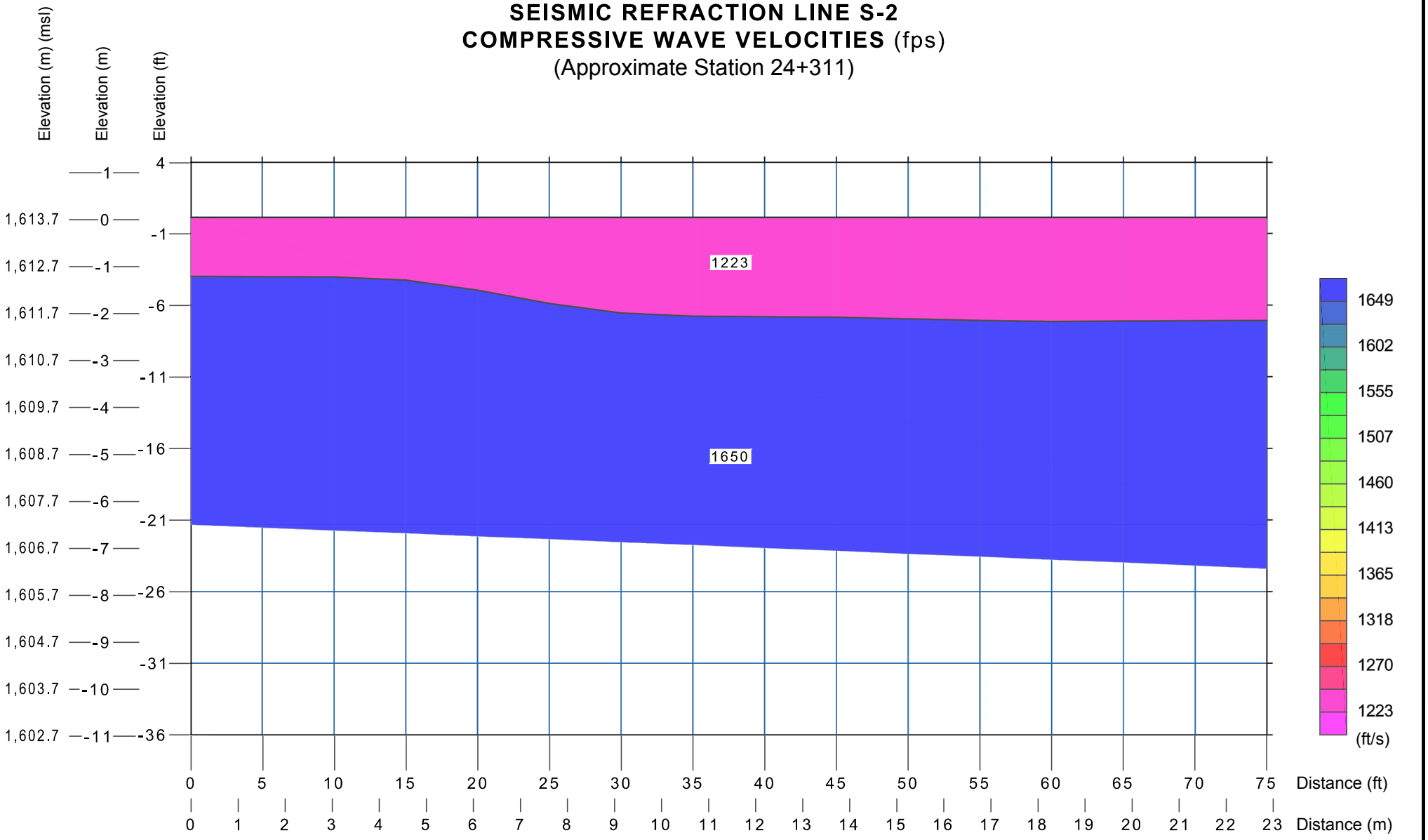
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-1A
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S1A

SEISMIC REFRACTION LINE S-1B
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 23+998)



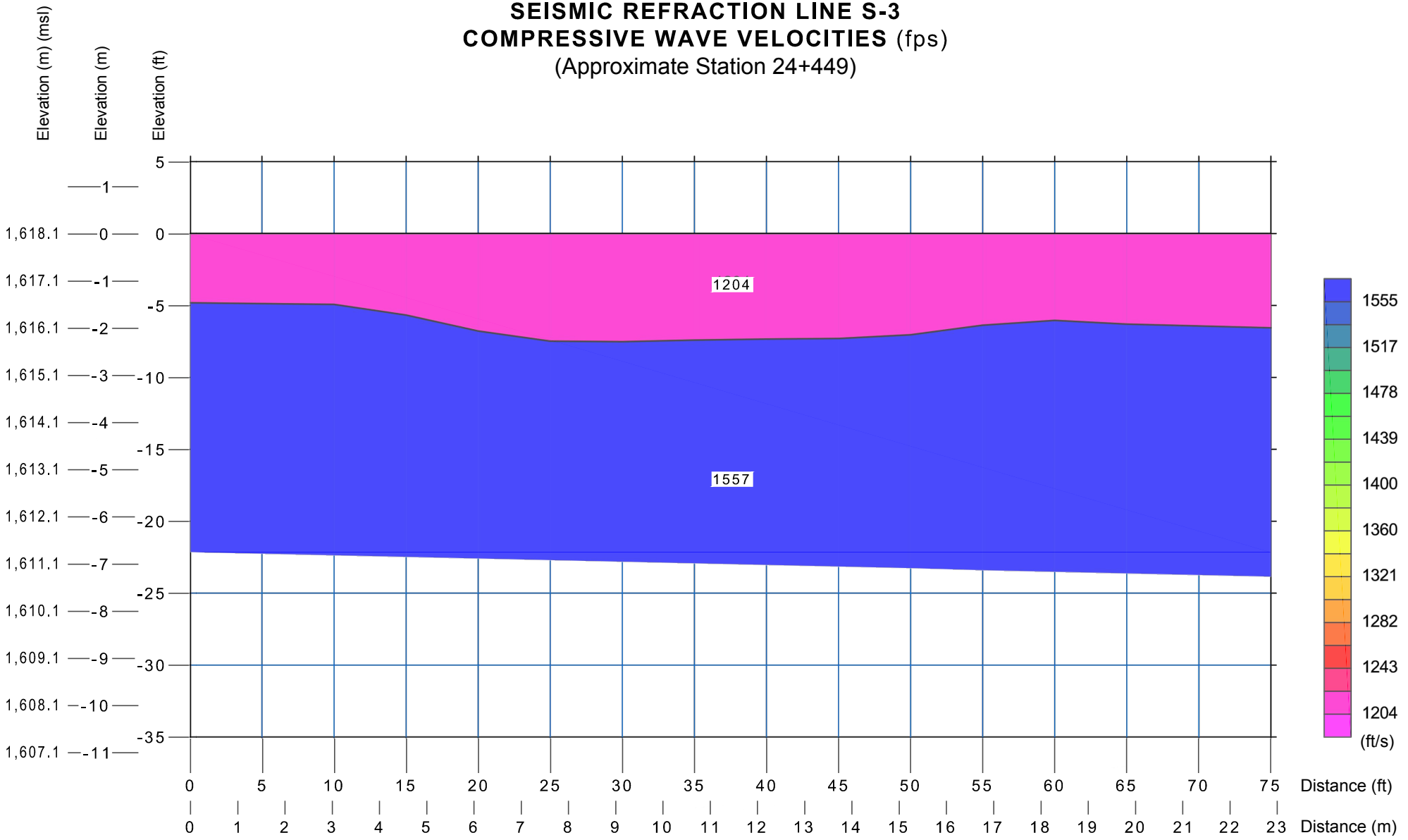
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-1B
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S1B

SEISMIC REFRACTION LINE S-2
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 24+311)



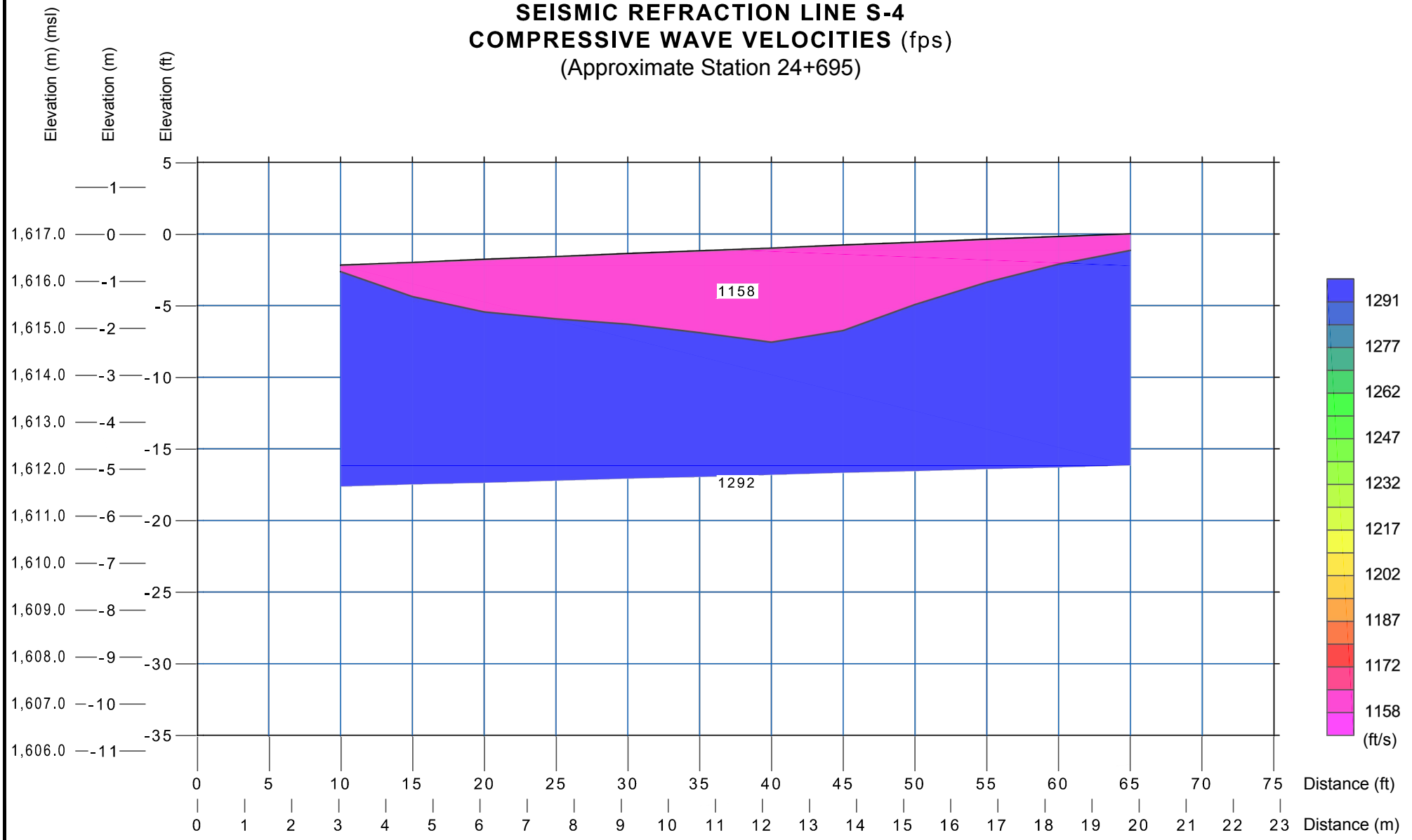
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-2
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S2

SEISMIC REFRACTION LINE S-3
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 24+449)



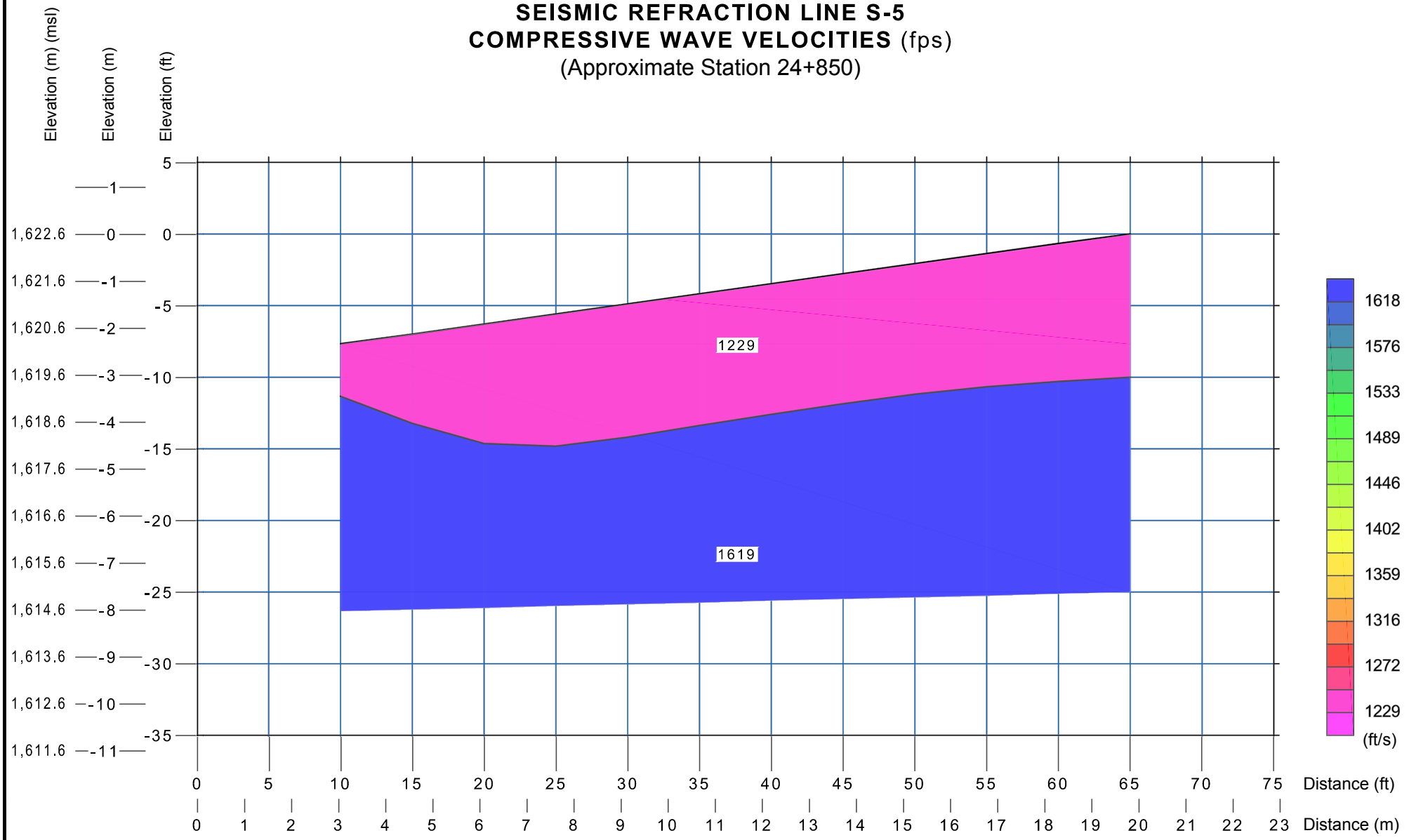
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-3
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S3

SEISMIC REFRACTION LINE S-4
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 24+695)



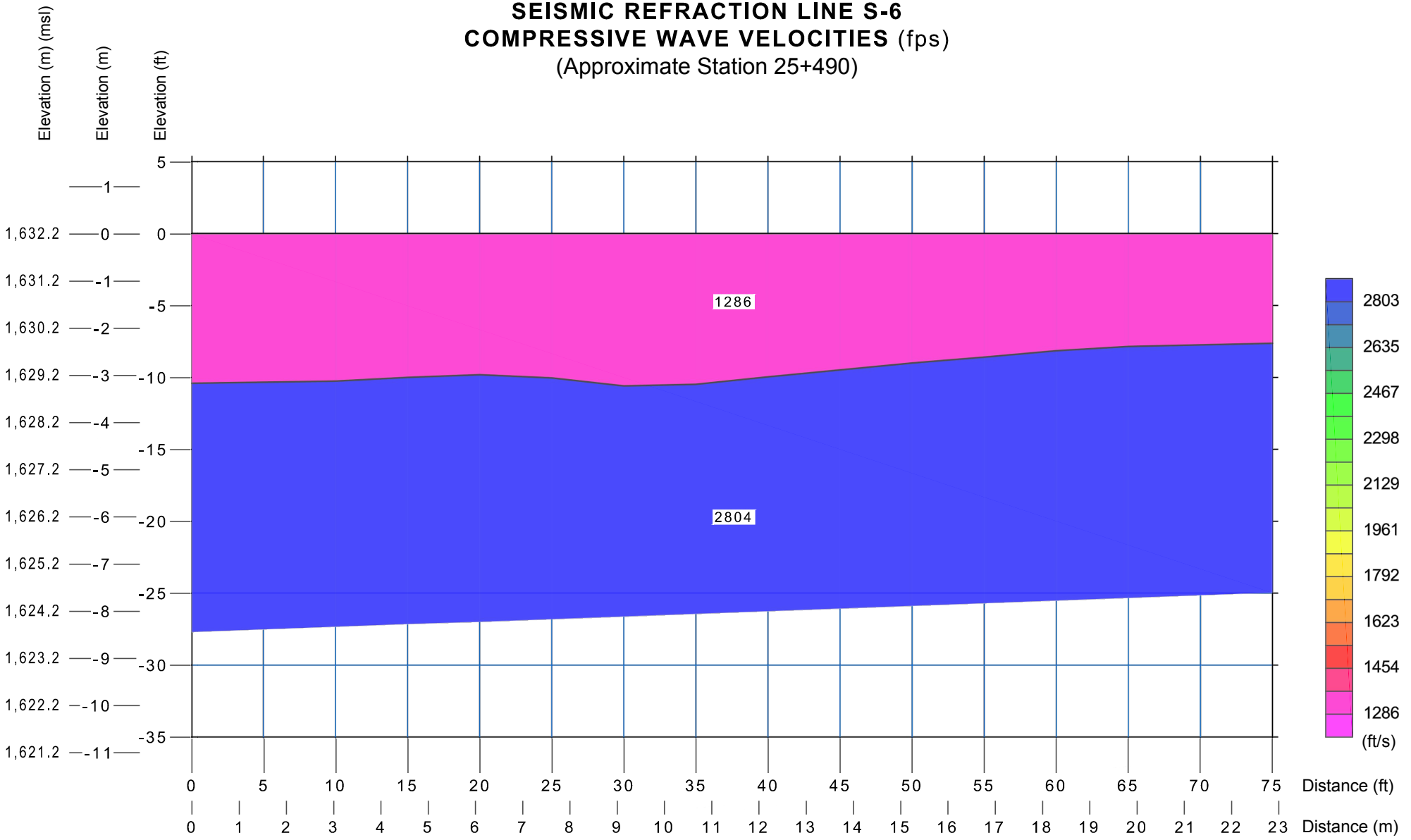
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-4
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S4

SEISMIC REFRACTION LINE S-5
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 24+850)



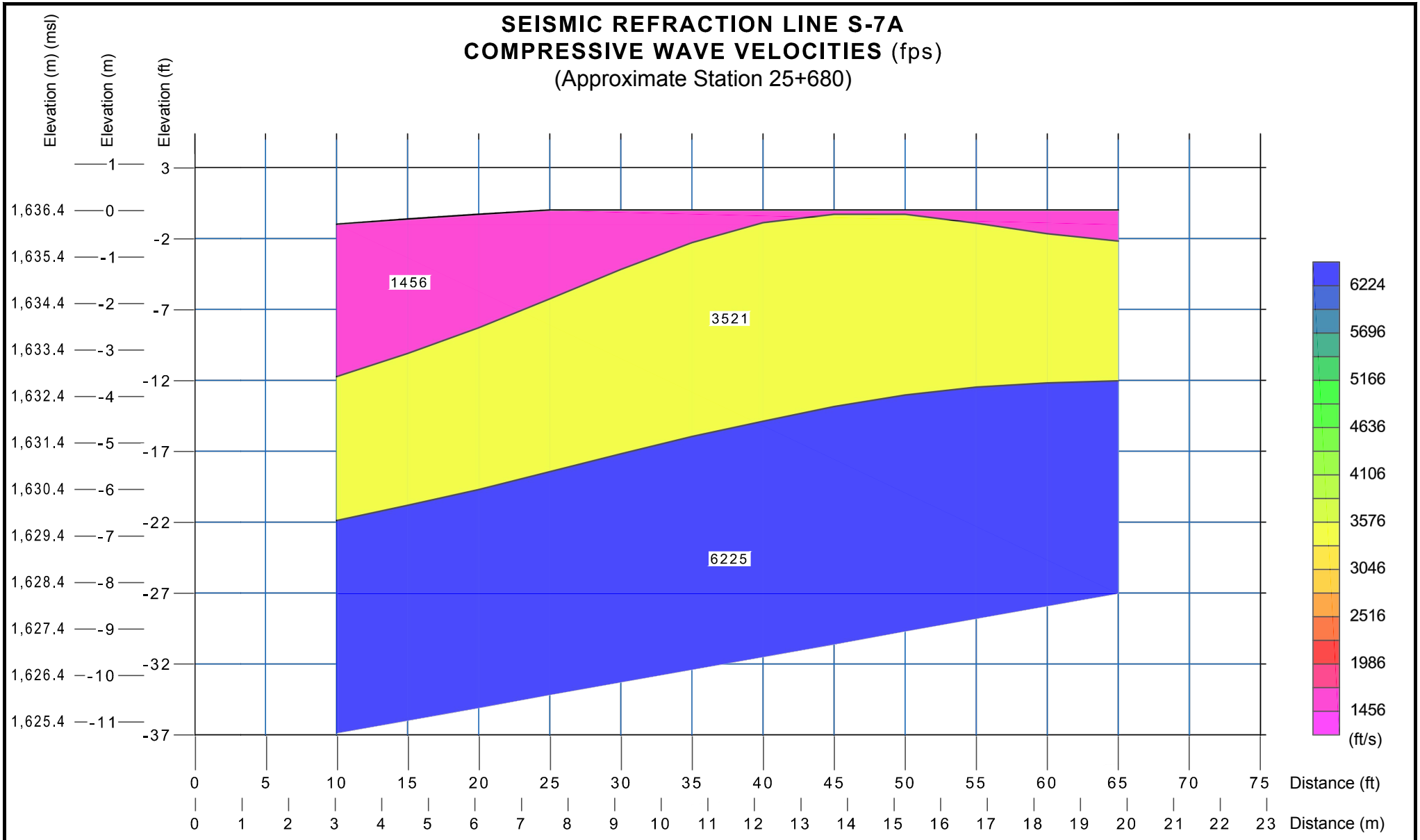
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-5
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S5

SEISMIC REFRACTION LINE S-6
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 25+490)



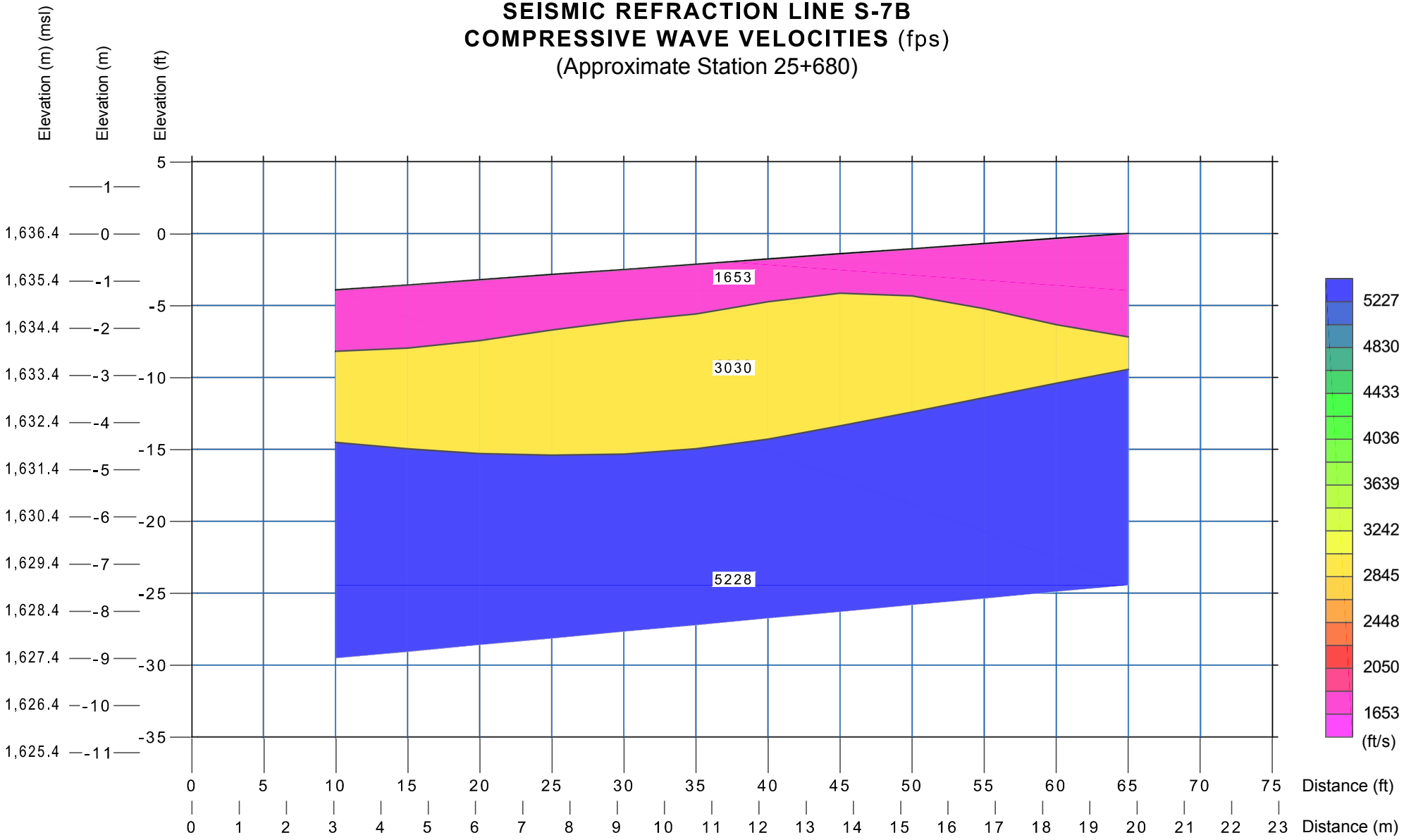
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-6
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S6

SEISMIC REFRACTION LINE S-7A
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 25+680)



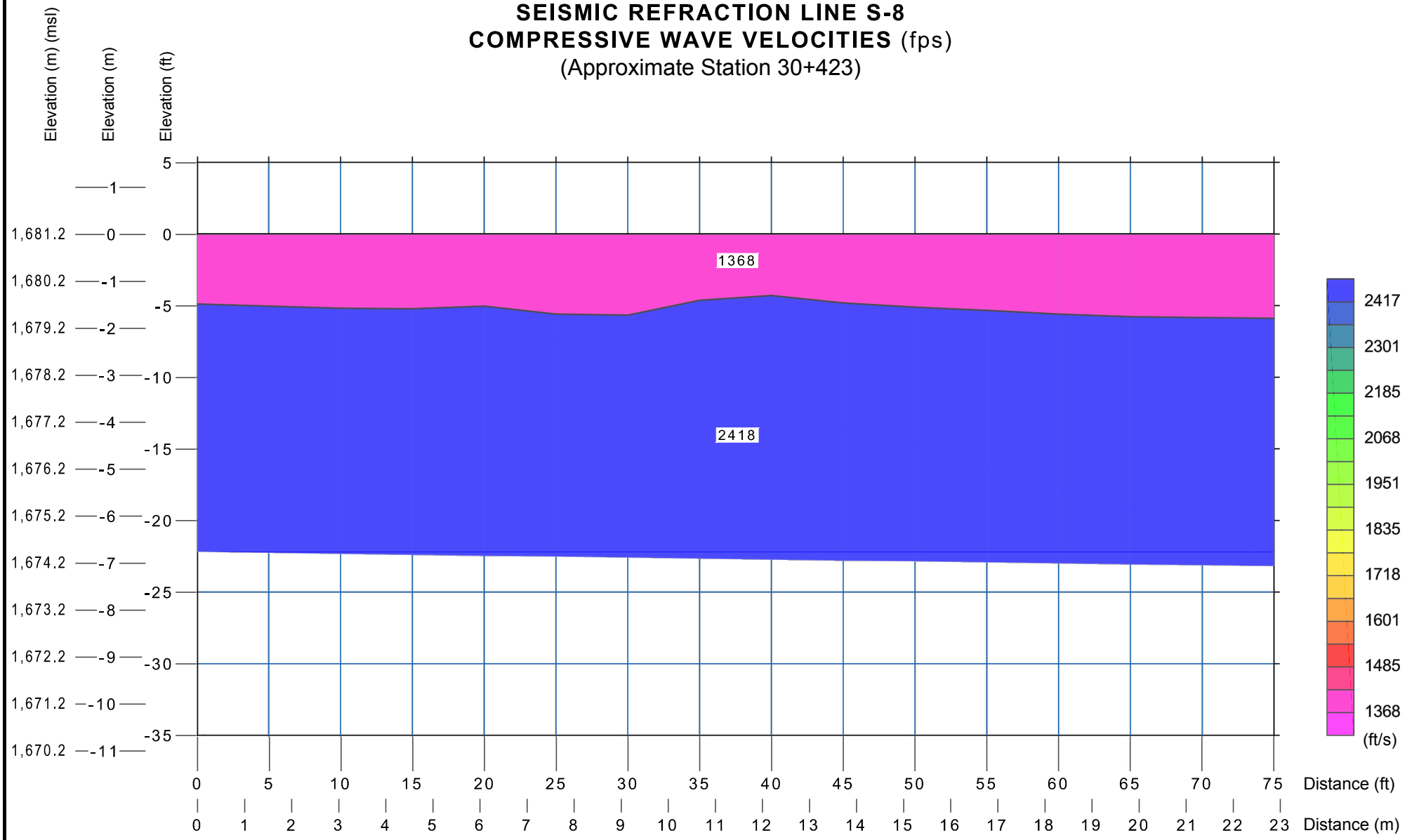
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-7A
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S7A

SEISMIC REFRACTION LINE S-7B
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 25+680)



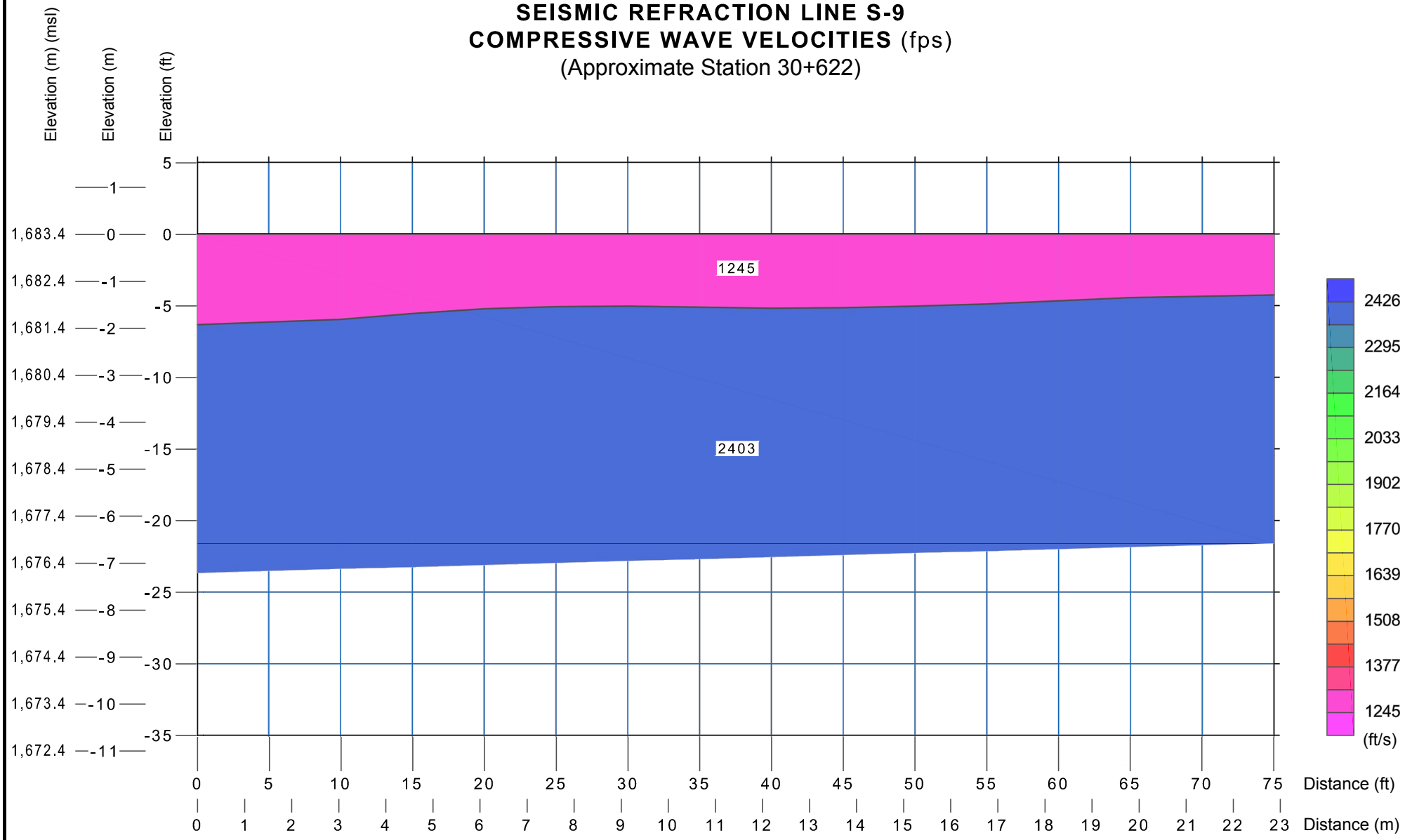
Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-7B
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S7B

SEISMIC REFRACTION LINE S-8
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 30+423)



Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-8
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S8

SEISMIC REFRACTION LINE S-9
COMPRESSIVE WAVE VELOCITIES (fps)
(Approximate Station 30+622)



Project Mngr: RP	Project No. 65165267	Terracon Consulting Engineers and Scientists	P-WAVE VELOCITY PROFILE S-9
Drawn By: DJJ	Scale: AS SHOWN	4685 South Ash Avenue, Suite H-4 Tempe, AZ 85282	N35(8)1,2,4 and N5045(1)1,2,4
Checked By: JRH	File No. 65165267.DWG	PH. (480) 897-8200 FAX. (480) 897-1133	SWEETWATER, ARIZONA
Approved By: DRC	Date: 11/19/2016		EXHIBIT A-S9

APPENDIX B

LABORATORY TESTING

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix A. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

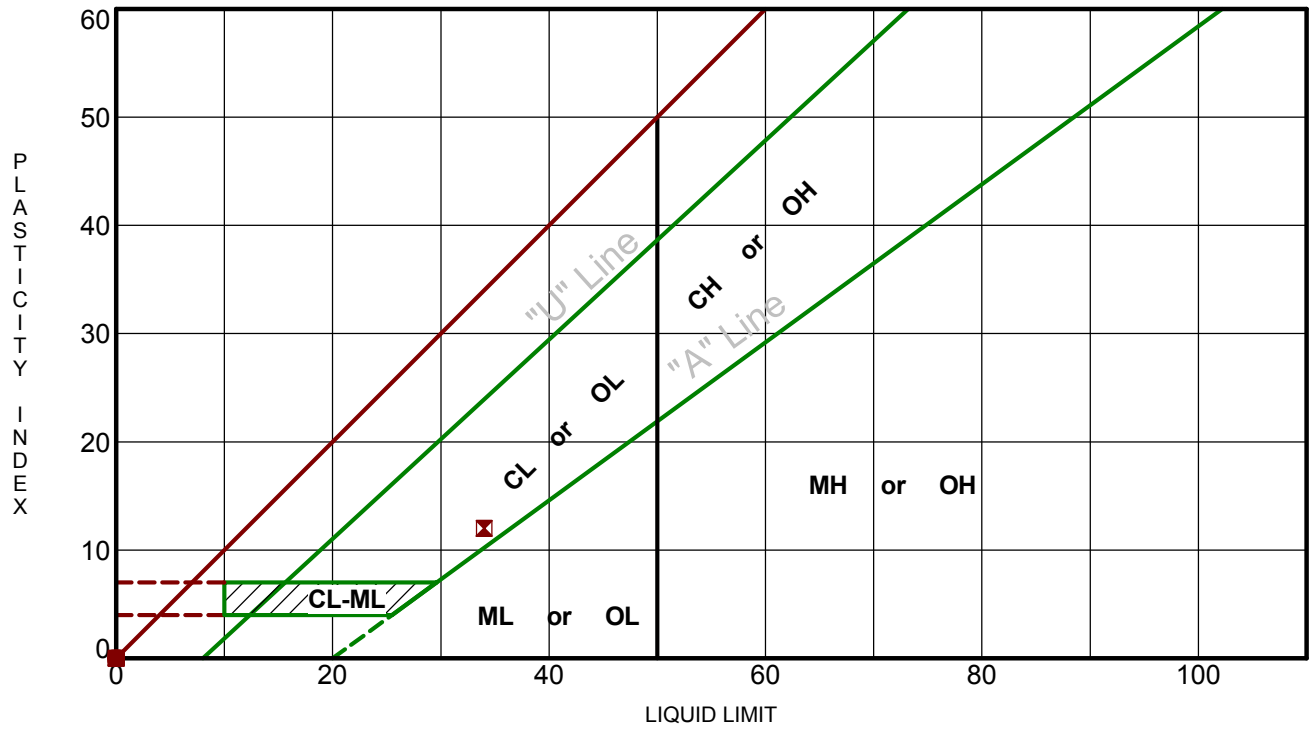
Laboratory tests were conducted on selected soil and asphalt core samples and the test results are presented in this appendix and/or the report. The laboratory test results were used for the geotechnical and pavement engineering analyses, and the development of the pavement recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Atterberg Limits
- Moisture Content
- Expansion
- pH
- Chlorides
- Moisture-Density Relationship
- Sieve Analysis
- Dry Density
- R-Value
- Soluble Sulfates
- R-Value

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	B1	0 - 5	NP	NP	NP	11	SP-SM	POORLY GRADED SAND with SILT
⊠	B2	0 - 5	34	22	12	54	CL	SANDY LEAN CLAY
▲	B3	0 - 5	NP	NP	NP	38	SM	SILTY SAND
★	B4	0 - 5	NP	NP	NP	19	SM	SILTY SAND
⊙	B5	0 - 5	NP	NP	NP	23	SM	SILTY SAND
✿	B5	5 - 6.5	NP	NP	NP	16	SM	SILTY SAND
○	B6	0 - 5	NP	NP	NP	10	SP-SM	POORLY GRADED SAND with SILT
△	B7	0 - 5	NP	NP	NP	11	SP-SM	POORLY GRADED SAND with SILT
⊗	B8	0 - 5	NP	NP	NP	15	SM	SILTY SAND
⊕	B9	0 - 5	NP	NP	NP	8	SP-SM	POORLY GRADED SAND with SILT
□	B9	9 - 10.5	NP	NP	NP	12	SP-SM	POORLY GRADED SAND with SILT
⊛	B10	0 - 5	NP	NP	NP	34	SM	SILTY SAND
◕	B11	0 - 5	NP	NP	NP	15	SM	SILTY SAND
☆	B12	0 - 5	NP	NP	NP	14	SM	SILTY SAND
❀	B13	0 - 5	NP	NP	NP	17	SM	SILTY SAND
■	B14	0 - 5	NP	NP	NP	16	SM	SILTY SAND
◆	B15	0 - 5	NP	NP	NP	9	SP-SM	POORLY GRADED SAND with SILT
◇	B15	5	NP	NP	NP			
✕	B16	0 - 5	NP	NP	NP	33	SM	SILTY SAND
✖	B17	5 - 10	NP	NP	NP	13	SM	SILTY SAND

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

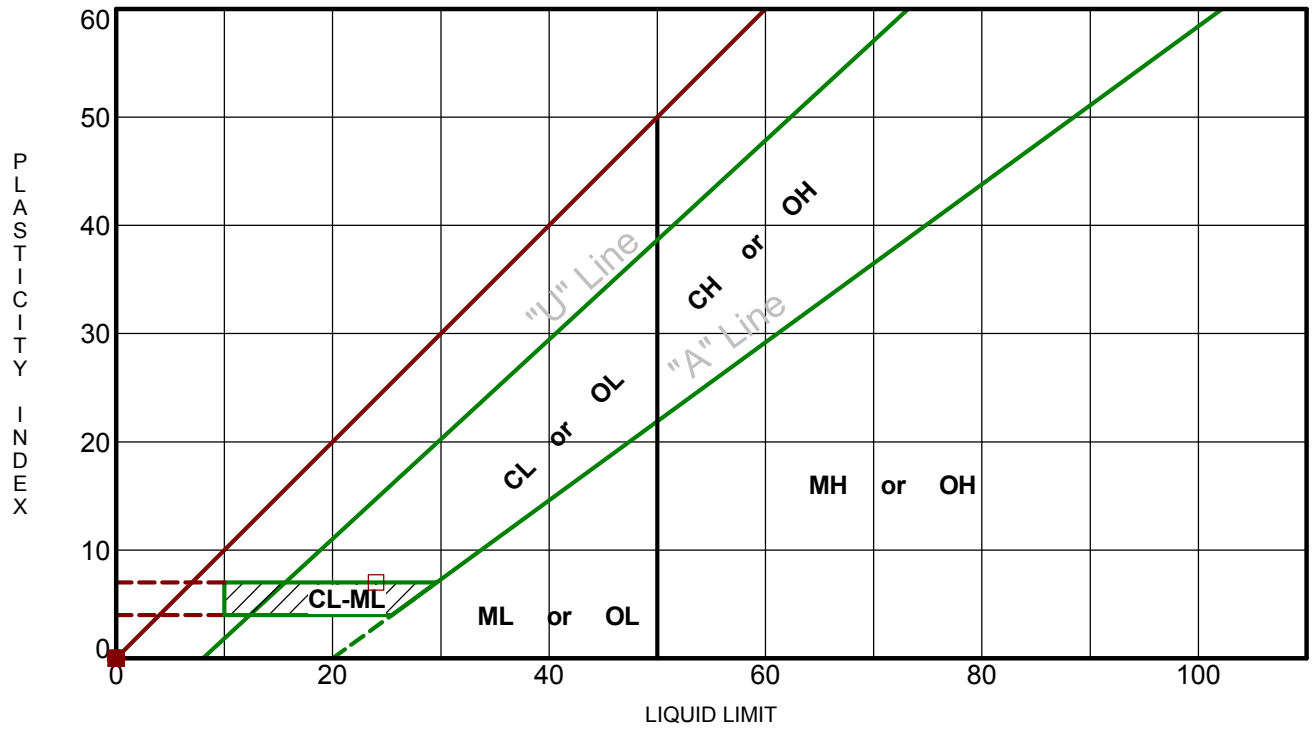
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-2

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B18	0 - 5	NP	NP	NP	15	SM	SILTY SAND
B19	0 - 5	NP	NP	NP	22	SM	SILTY SAND
B20	0 - 5	NP	NP	NP	15	SM	SILTY SAND
B21	0 - 4	NP	NP	NP	33	SM	SILTY SAND
B21	4 - 10	NP	NP	NP	22	SM	SILTY SAND
B22	0 - 5	NP	NP	NP	19	SM	SILTY SAND
B23	0 - 5	NP	NP	NP	23	SM	SILTY SAND
B24	1 - 6	NP	NP	NP	17	SM	SILTY SAND
B25	0 - 5	NP	NP	NP	39	SM	SILTY SAND
B26	0 - 5	NP	NP	NP	16	SM	SILTY SAND
B27	0 - 5	24	17	7	63	CL-ML	SANDY SILTY CLAY
B28	0 - 5	NP	NP	NP	3	SP	POORLY GRADED SAND
B29	0 - 5	NP	NP	NP	16	SM	SILTY SAND
B30	0 - 5	NP	NP	NP	12	SM	SILTY SAND
B31	0 - 5	NP	NP	NP	18	SM	SILTY SAND
B32	0 - 5	NP	NP	NP	16	SM	SILTY SAND
B33	0 - 5	NP	NP	NP	14	SM	SILTY SAND
B34	0 - 3	NP	NP	NP	17	SM	SILTY SAND
B35	0 - 5	NP	NP	NP	12	SP-SM	POORLY GRADED SAND with SILT
B36	0 - 5	NP	NP	NP	6	SP-SM	POORLY GRADED SAND with SILT

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

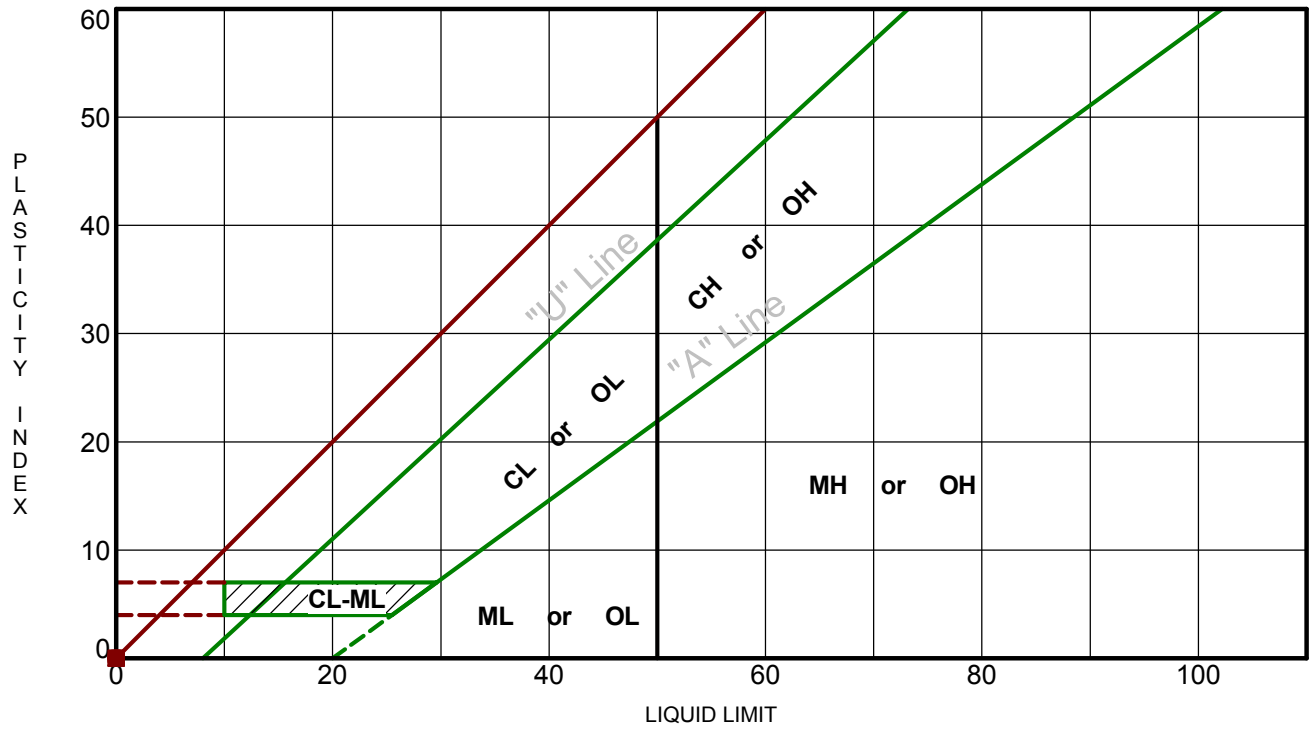
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-3

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B37	0 - 5	NP	NP	NP	19	SM	SILTY SAND
B38	0 - 5	NP	NP	NP	7	SP-SM	POORLY GRADED SAND with SILT
B39	0 - 5	NP	NP	NP	18	SM	SILTY SAND
B40	0 - 5	NP	NP	NP	14	SM	SILTY SAND
B41	0 - 5	NP	NP	NP	6	SP-SM	POORLY GRADED SAND with SILT
B42	0 - 5	NP	NP	NP	19	SM	SILTY SAND
B43	0 - 5	NP	NP	NP	19	SM	SILTY SAND
B44	0 - 5	NP	NP	NP	14	SM	SILTY SAND
B45	0 - 5	NP	NP	NP	11	SP-SM	POORLY GRADED SAND with SILT
B46	0 - 5	NP	NP	NP	14	SM	SILTY SAND
B47	0 - 5	NP	NP	NP	24	SM	SILTY SAND
B48	0 - 4	NP	NP	NP	17	SM	SILTY SAND
B48	4 - 9	NP	NP	NP	32	SM	SILTY SAND
B49	0 - 5	NP	NP	NP	50	ML	SANDY SILT
B49	8 - 10	NP	NP	NP	30	SM	SILTY SAND
B50	0 - 5	NP	NP	NP	24	SM	SILTY SAND
B51	0 - 5	NP	NP	NP	4	SP	POORLY GRADED SAND
B52	0 - 5	NP	NP	NP	6	SP-SM	POORLY GRADED SAND with SILT
B53	0 - 5	NP	NP	NP	4	SP	POORLY GRADED SAND
B54	0 - 5	NP	NP	NP	17	SM	SILTY SAND

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

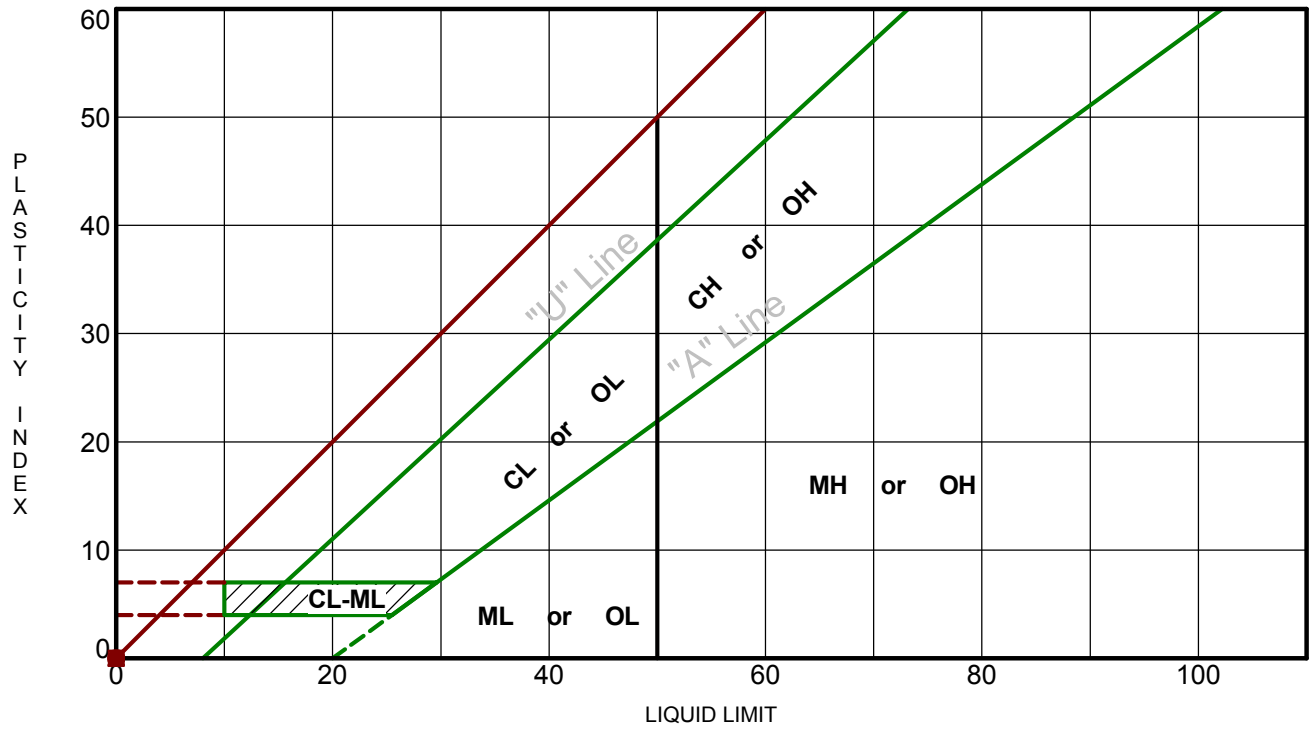
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-4

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B55	0 - 5	NP	NP	NP	7	SP-SM	POORLY GRADED SAND with SILT
B56	0 - 5	NP	NP	NP	6	SP-SM	POORLY GRADED SAND with SILT
B57	0 - 5	NP	NP	NP	12	SP-SM	POORLY GRADED SAND with SILT
B58	0 - 5	NP	NP	NP	4	SP	POORLY GRADED SAND
B59	0 - 5	NP	NP	NP	11	SP-SM	POORLY GRADED SAND with SILT
B60	0 - 5	NP	NP	NP	7	SP-SM	POORLY GRADED SAND with SILT
B61	0 - 5	NP	NP	NP	21	SM	SILTY SAND
B62	0 - 5	NP	NP	NP	11	SP-SM	POORLY GRADED SAND with SILT
B63	0 - 5	NP	NP	NP	9	SP-SM	POORLY GRADED SAND with SILT
B64	0 - 5	NP	NP	NP	6	SP-SM	POORLY GRADED SAND with SILT
B65	0 - 5	NP	NP	NP	18	SM	SILTY SAND
B66	0 - 5	NP	NP	NP	22	SM	SILTY SAND

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

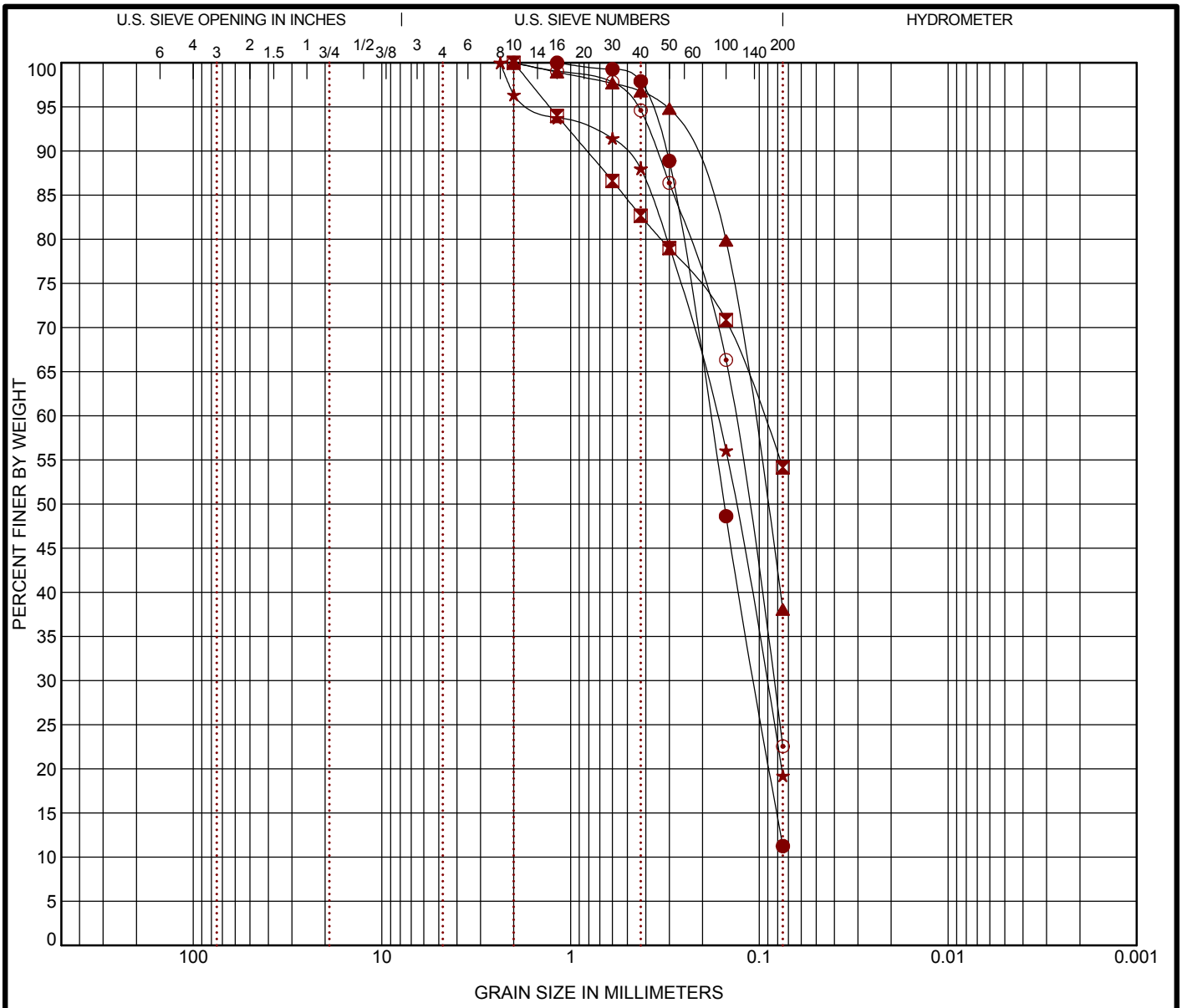
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-5

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B1	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.84	2.49
⊠	B2	0 - 5	SANDY LEAN CLAY (CL)		34	22	12		
▲	B3	0 - 5	SILTY SAND (SM)		NP	NP	NP		
★	B4	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊙	B5	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B1	0 - 5	1.18	0.182	0.106		0.0	88.8	11.2		
⊠	B2	0 - 5	2	0.096			0.0	45.8	54.2		
▲	B3	0 - 5	2	0.108			0.0	61.9	38.1		
★	B4	0 - 5	2.36	0.169	0.092		0.0	80.8	19.2		
⊙	B5	0 - 5	2	0.136	0.084		0.0	77.4	22.6		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

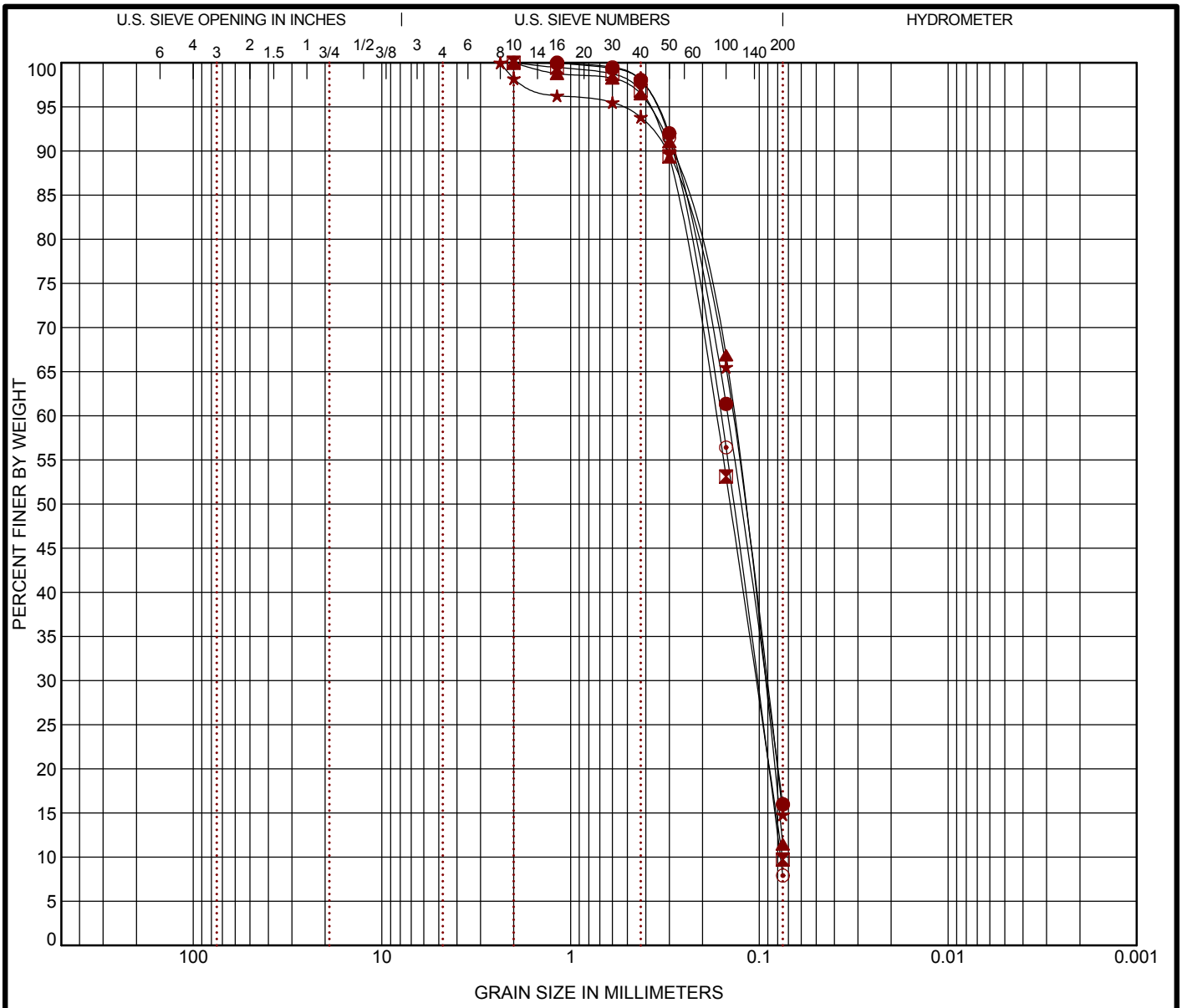
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-6

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B5	5 - 6.5	SILTY SAND (SM)		NP	NP	NP		
B6	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.83	2.27
B7	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.88	1.87
B8	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B9	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.85	2.08

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B5	5 - 6.5	1.18	0.147	0.093		0.0	84.0	16.0		
B6	0 - 5	2	0.171	0.104	0.075	0.0	90.3	9.7		
B7	0 - 5	2	0.138	0.095		0.0	88.5	11.5		
B8	0 - 5	2.36	0.139	0.092		0.0	85.2	14.8		
B9	0 - 5	2	0.161	0.103	0.077	0.0	92.1	7.9		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

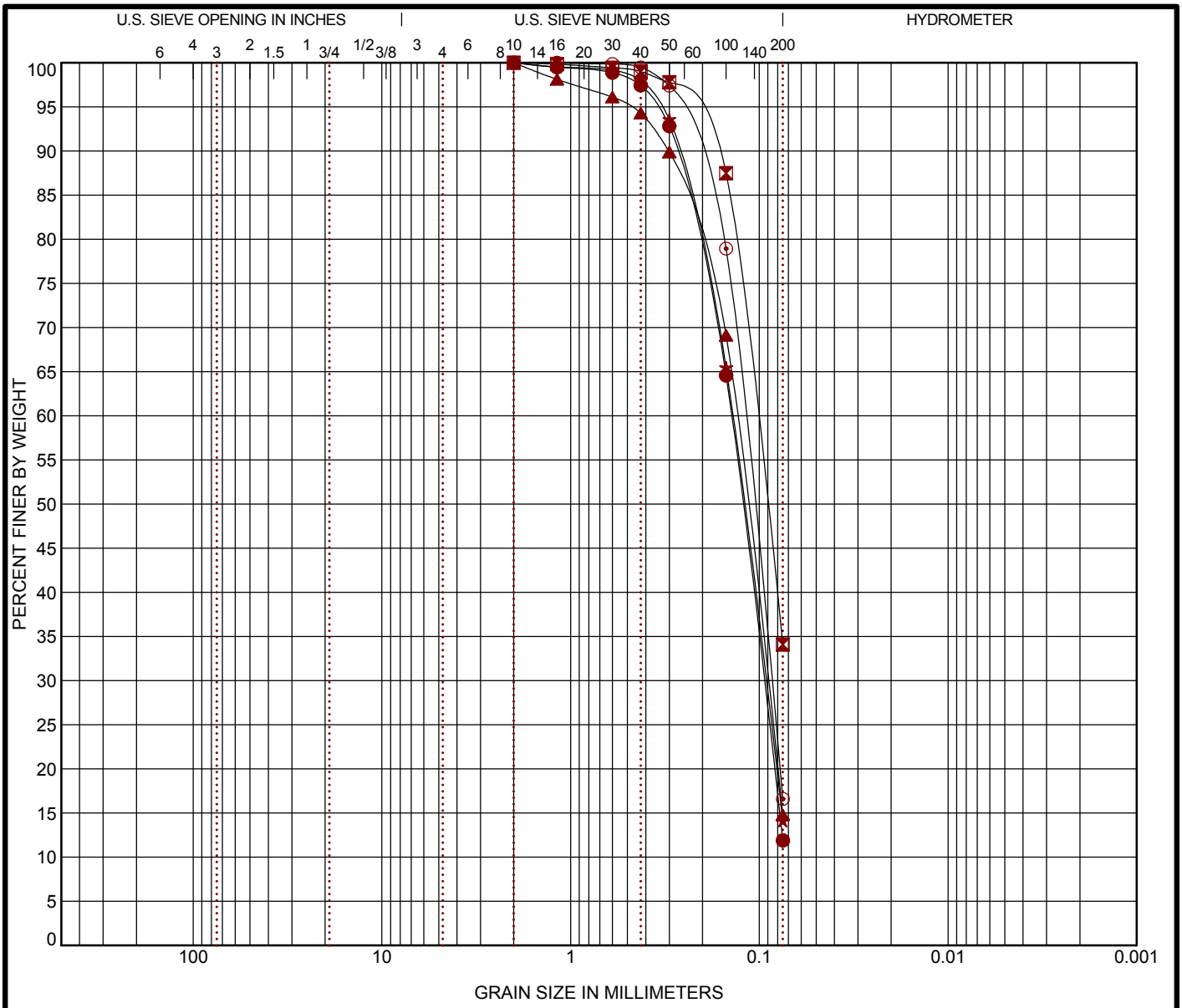
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-7

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B9	9 - 10.5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.88	1.93
B10	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B11	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B12	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B13	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B9	9 - 10.5	2	0.141	0.095		0.0	88.1	11.9		
B10	0 - 5	2	0.105			0.0	65.9	34.1		
B11	0 - 5	2	0.134	0.091		0.0	85.2	14.8		
B12	0 - 5	2	0.139	0.093		0.0	85.9	14.1		
B13	0 - 5	1.18	0.122	0.087		0.0	83.4	16.6		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

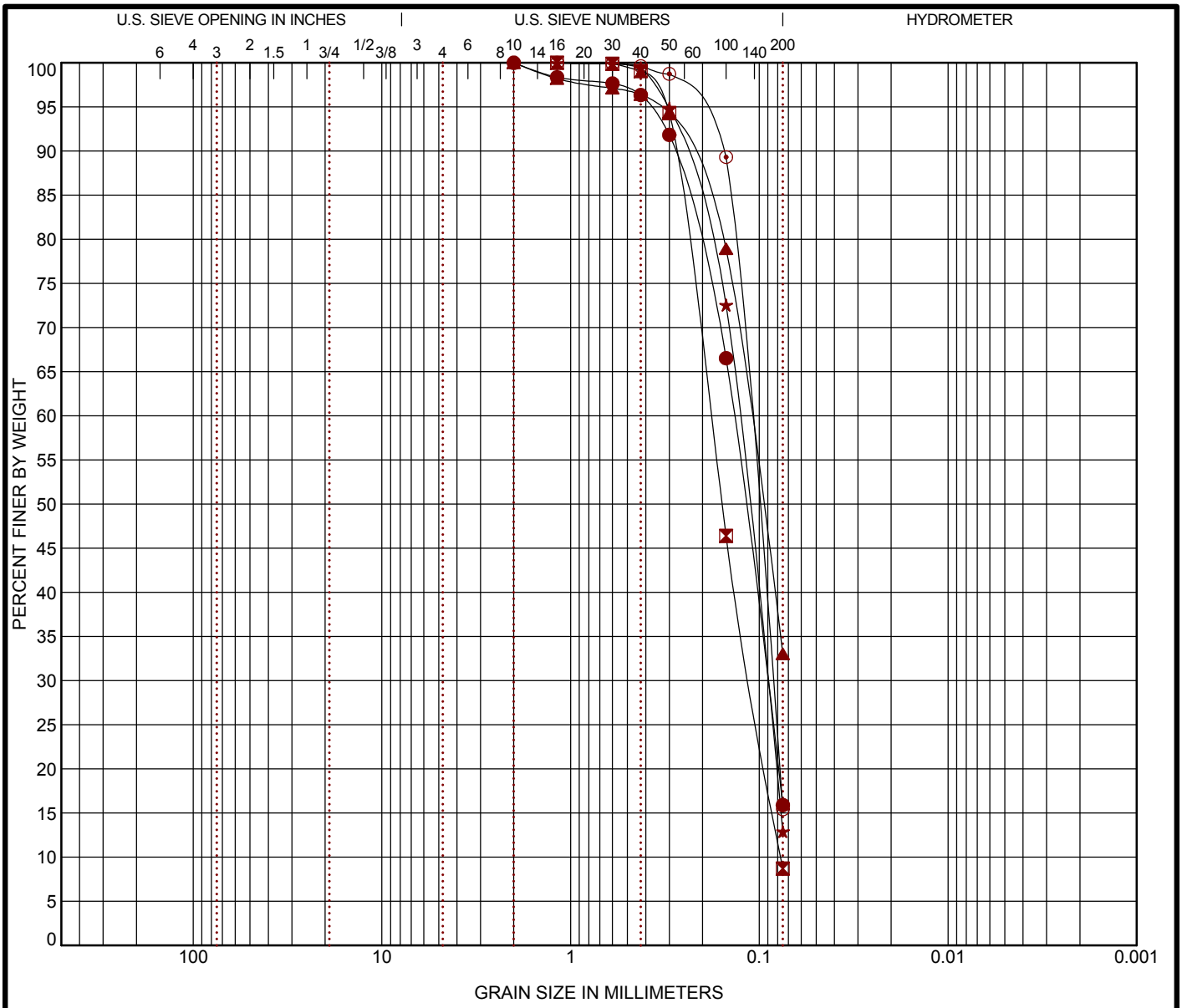
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-8

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B14	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊠	B15	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.88	2.38
▲	B16	0 - 5	SILTY SAND (SM)		NP	NP	NP		
★	B17	5 - 10	SILTY SAND (SM)		NP	NP	NP		
⊙	B18	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B14	0 - 5	2	0.137	0.091		0.0	84.1	15.9		
⊠	B15	0 - 5	1.18	0.183	0.111	0.077	0.0	91.3	8.7		
▲	B16	0 - 5	2	0.113			0.0	67.0	33.0		
★	B17	5 - 10	2	0.13	0.091		0.0	87.1	12.9		
⊙	B18	0 - 5	1.18	0.114	0.086		0.0	84.6	15.4		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

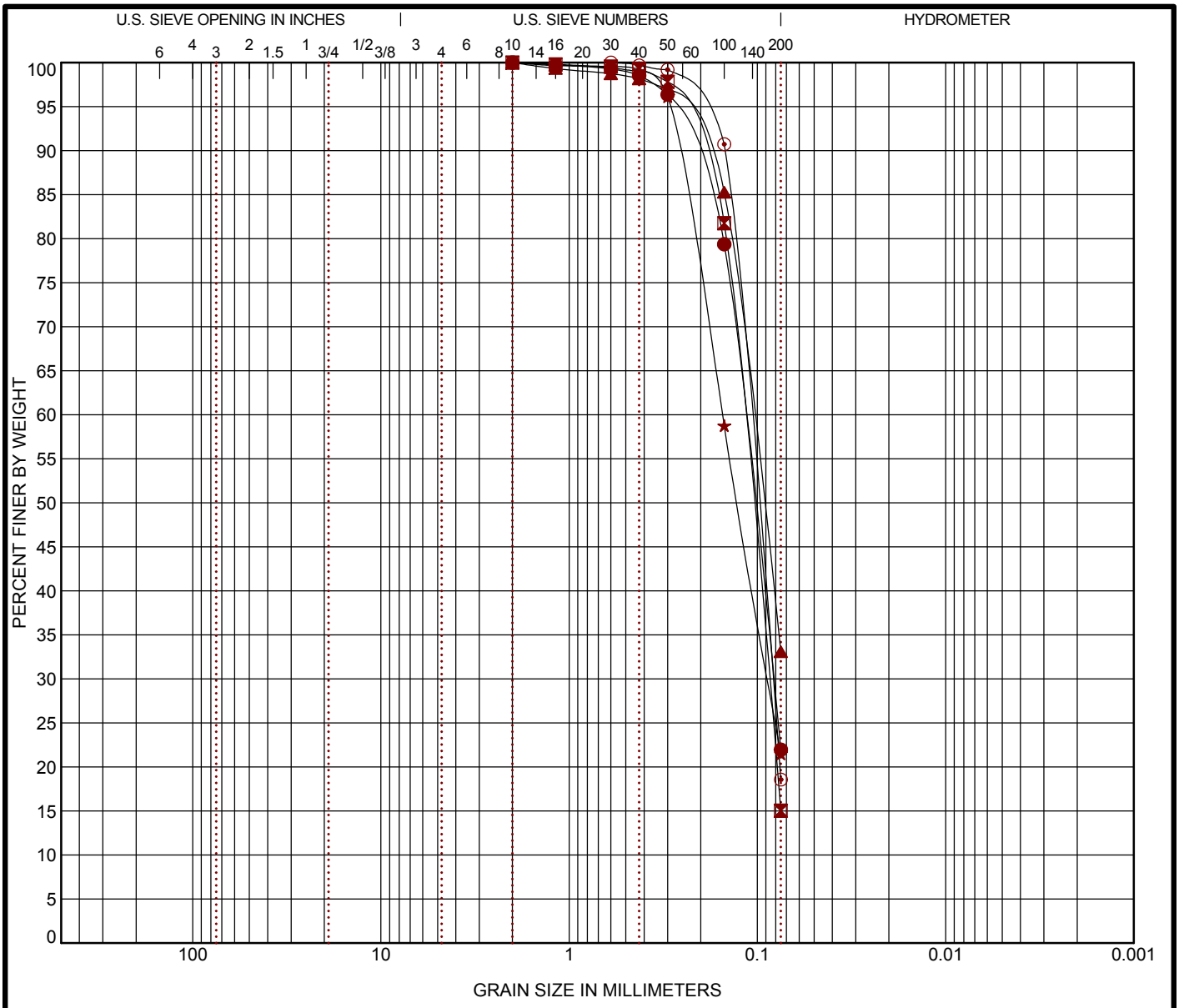
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-9

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B19	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B20	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B21	0 - 4	SILTY SAND (SM)		NP	NP	NP		
B21	4 - 10	SILTY SAND (SM)		NP	NP	NP		
B22	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B19	0 - 5	2	0.119	0.083		0.0	78.0	22.0		
B20	0 - 5	2	0.12	0.088		0.0	85.0	15.0		
B21	0 - 4	2	0.107			0.0	66.9	33.1		
B21	4 - 10	2	0.153	0.088		0.0	78.5	21.5		
B22	0 - 5	0.6	0.112	0.084		0.0	81.4	18.6		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

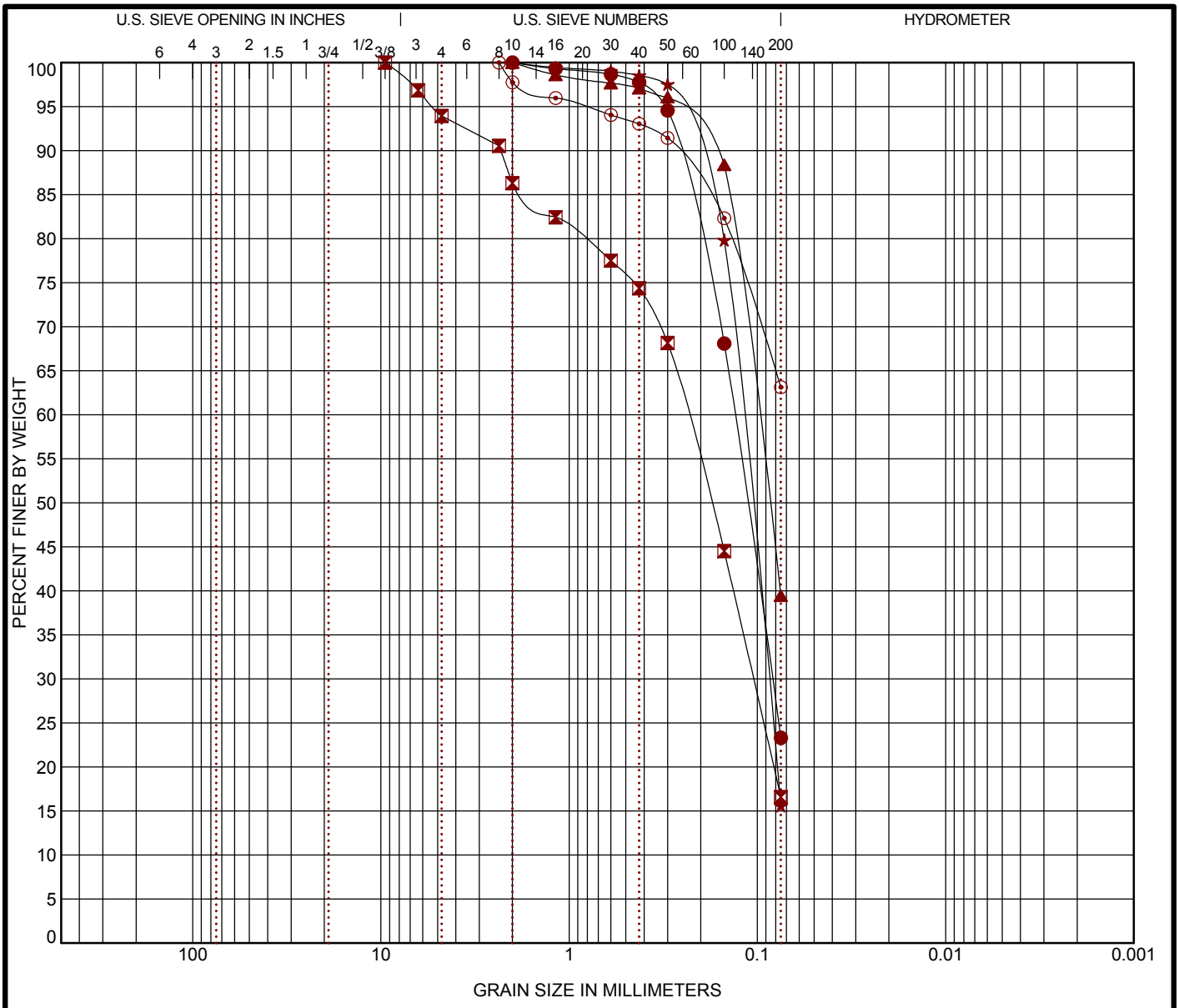
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-10

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B23	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊠	B24	1 - 6	SILTY SAND (SM)		NP	NP	NP		
▲	B25	0 - 5	SILTY SAND (SM)		NP	NP	NP		
★	B26	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊙	B27	0 - 5	SANDY SILTY CLAY (CL-ML)		24	17	7		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B23	0 - 5	2	0.132	0.083		0.0	76.7	23.3		
⊠	B24	1 - 6	9.5	0.236	0.105		6.1	77.4	16.6		
▲	B25	0 - 5	2	0.1			0.0	60.5	39.5		
★	B26	0 - 5	2	0.121	0.088		0.0	84.4	15.6		
⊙	B27	0 - 5	2.36				0.0	36.9	63.1		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

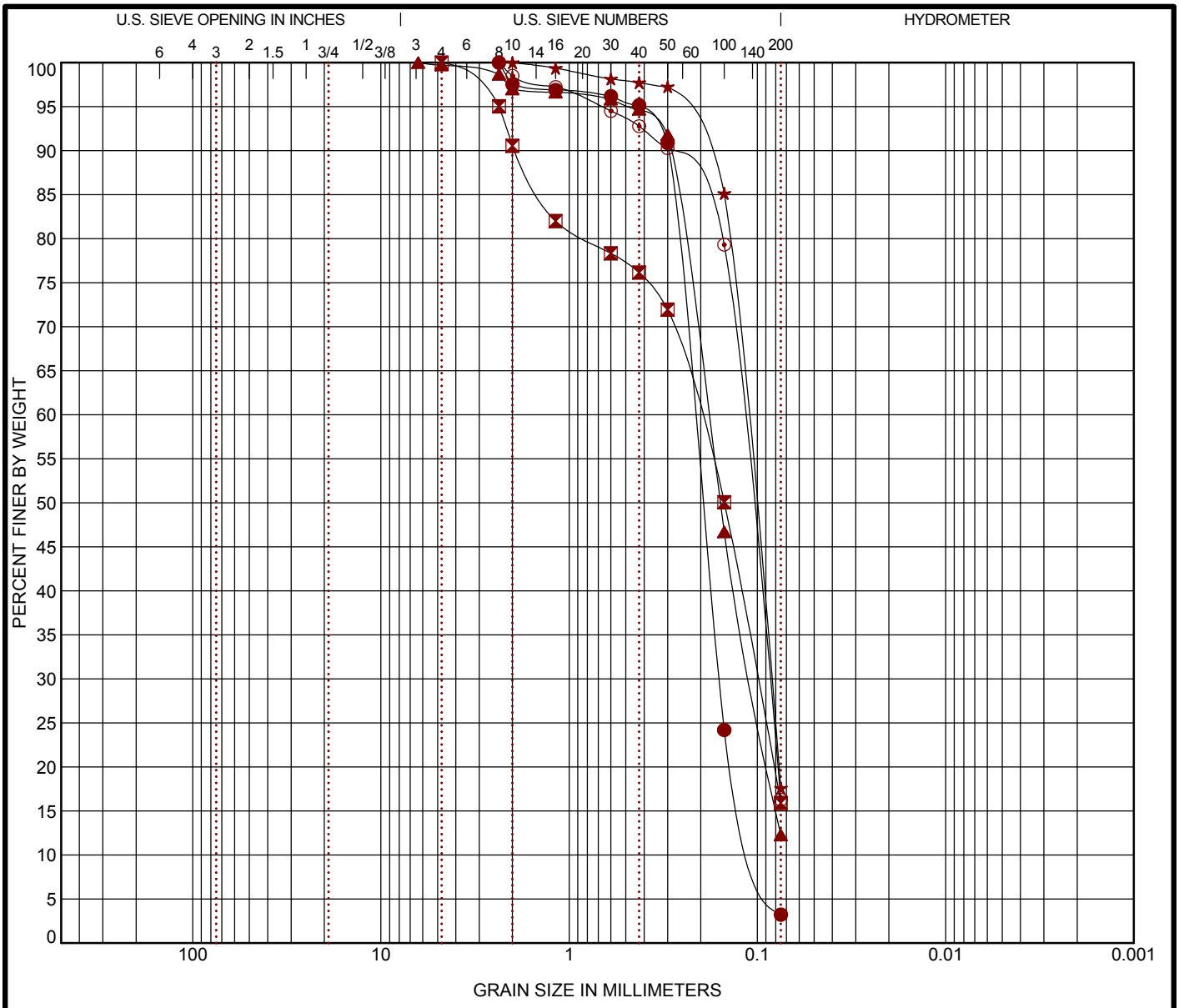
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-11

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● B28	0 - 5	POORLY GRADED SAND (SP)		NP	NP	NP	1.24	2.32
⊠ B29	0 - 5	SILTY SAND (SM)		NP	NP	NP		
▲ B30	0 - 5	SILTY SAND (SM)		NP	NP	NP	0.87	2.57
★ B31	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊙ B32	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
● B28	0 - 5	2.36	0.218	0.159	0.094	0.0	96.8	3.2		
⊠ B29	0 - 5	4.75	0.206	0.1		0.0	84.1	15.9		
▲ B30	0 - 5	6.35	0.184	0.107		0.3	87.4	12.3		
★ B31	0 - 5	2	0.116	0.085		0.0	82.4	17.6		
⊙ B32	0 - 5	2.36	0.121	0.087		0.0	83.7	16.3		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

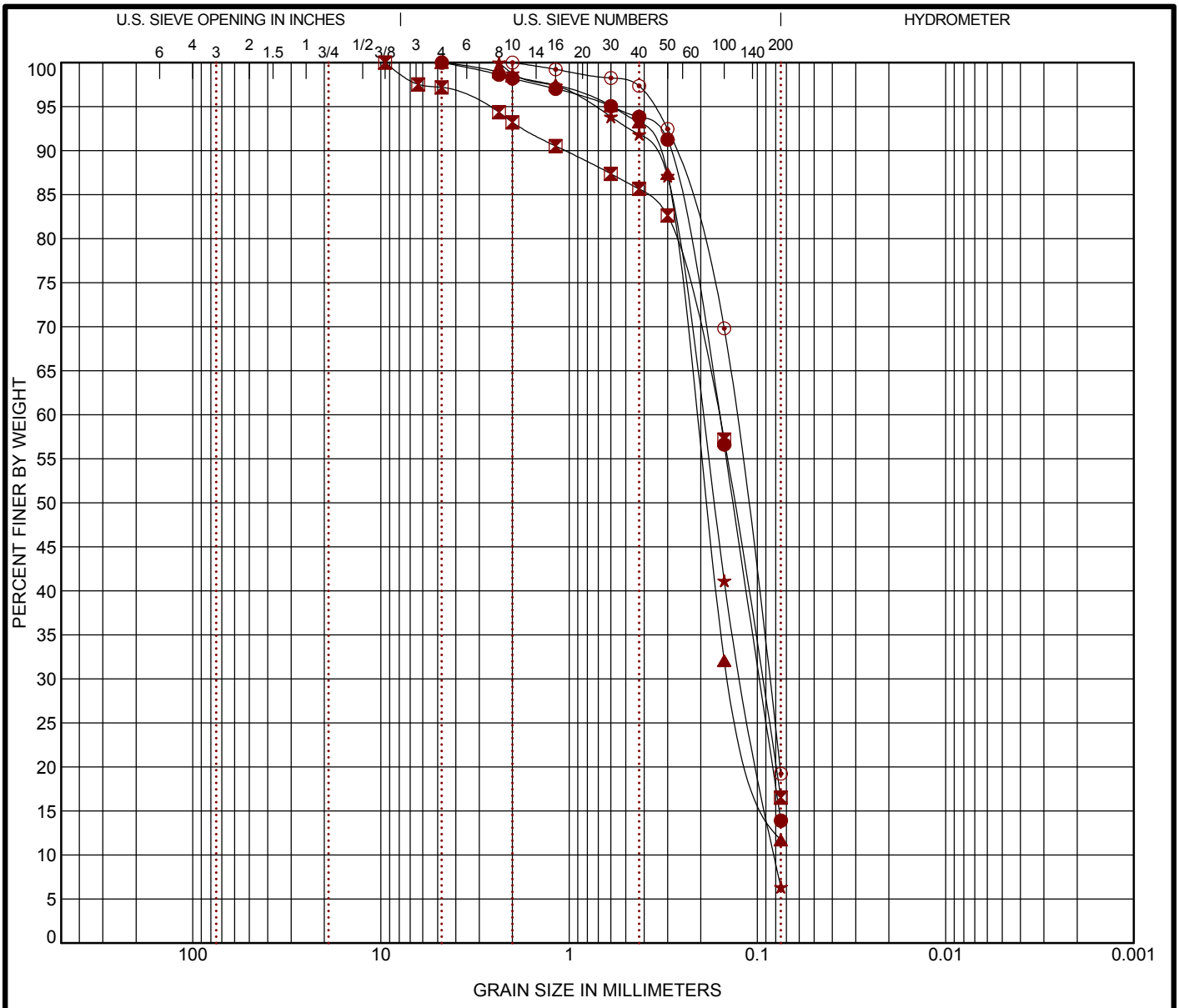
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-12

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B33	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊠	B34	0 - 3	SILTY SAND (SM)		NP	NP	NP		
▲	B35	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.30	3.01
★	B36	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.90	2.47
⊙	B37	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B33	0 - 5	4.75	0.161	0.097		0.0	86.1	13.9		
⊠	B34	0 - 3	9.5	0.162	0.094		2.8	80.7	16.5		
▲	B35	0 - 5	4.75	0.213	0.14		0.0	88.3	11.7		
★	B36	0 - 5	2.36	0.199	0.12	0.081	0.0	93.6	6.4		
⊙	B37	0 - 5	2	0.131	0.087		0.0	80.8	19.2		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

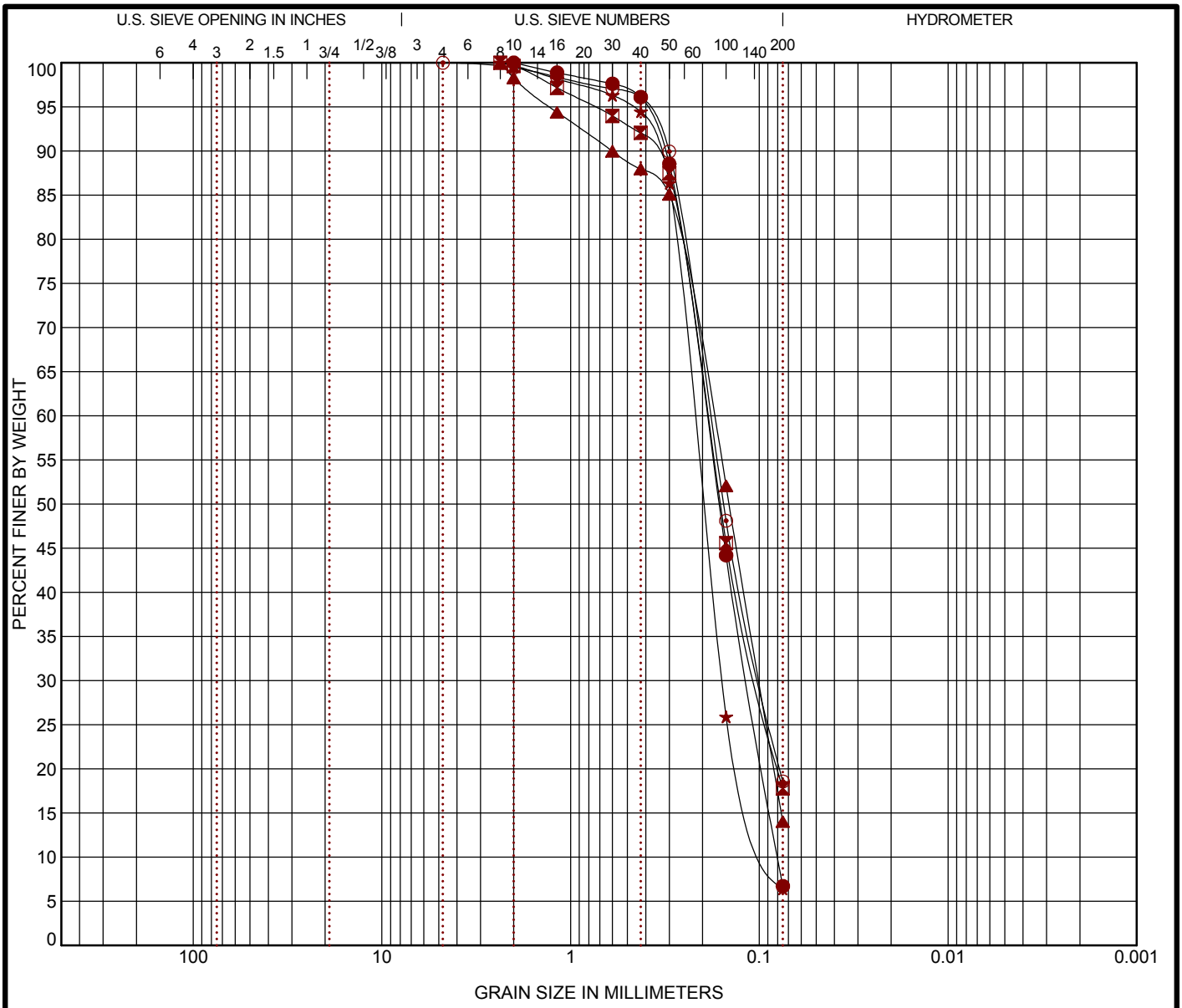
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-13

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B38	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.87	2.41
⊠	B39	0 - 5	SILTY SAND (SM)		NP	NP	NP		
▲	B40	0 - 5	SILTY SAND (SM)		NP	NP	NP		
★	B41	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.31	2.60
⊙	B42	0 - 5	SILTY SAND (SM)		NP	NP	NP		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B38	0 - 5	2	0.192	0.115	0.08	0.0	93.3	6.7		
⊠	B39	0 - 5	2.36	0.19	0.102		0.0	82.2	17.8		
▲	B40	0 - 5	2.36	0.177	0.1		0.0	86.0	14.0		
★	B41	0 - 5	2.36	0.222	0.157	0.085	0.0	93.6	6.4		
⊙	B42	0 - 5	4.75	0.183	0.098		0.0	81.4	18.6		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

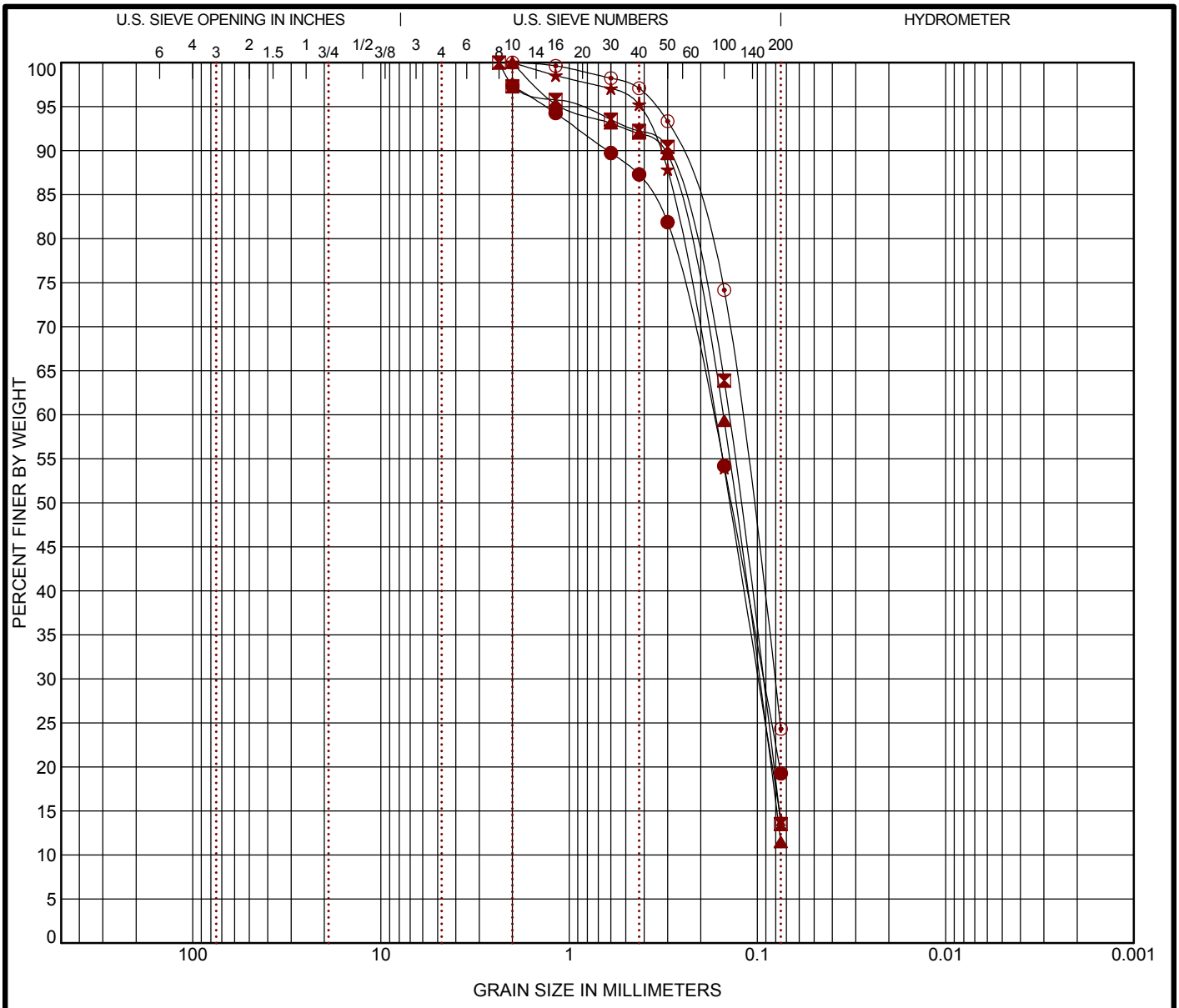
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-14

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B43	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B44	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B45	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.86	2.07
B46	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B47	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B43	0 - 5	2	0.173	0.093		0.0	78.1	19.3		
B44	0 - 5	2.36	0.142	0.094		0.0	86.5	13.5		
B45	0 - 5	2	0.152	0.098		0.0	88.5	11.5		
B46	0 - 5	2	0.17	0.099		0.0	86.0	14.0		
B47	0 - 5	2	0.123	0.081		0.0	75.7	24.3		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

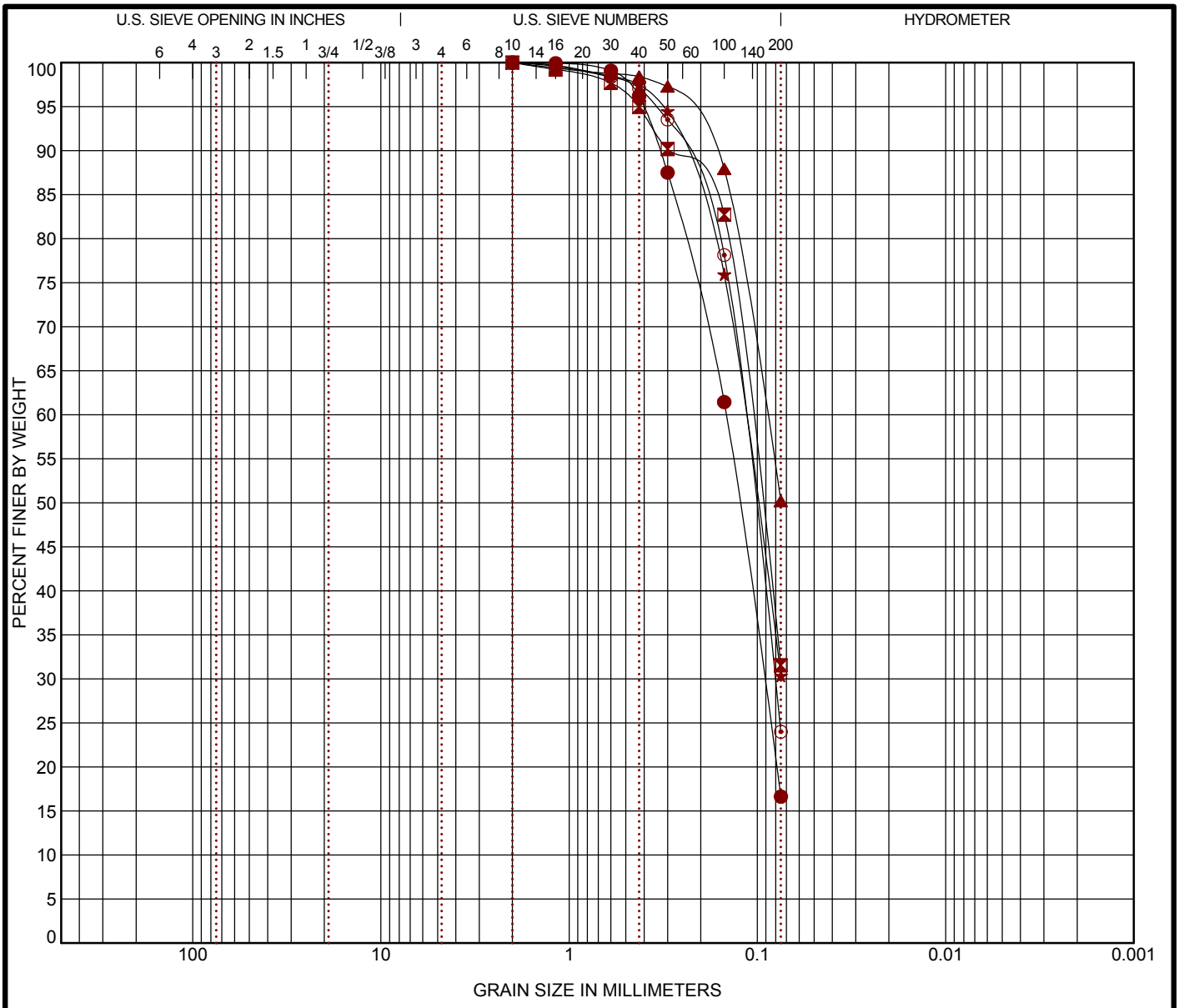
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-15

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B48	0 - 4	SILTY SAND (SM)		NP	NP	NP		
⊠	B48	4 - 9	SILTY SAND (SM)		NP	NP	NP		
▲	B49	0 - 5	SANDY SILT (ML)		NP	NP	NP		
★	B49	8 - 10	SILTY SAND (SM)		NP	NP	NP		
⊙	B50	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B48	0 - 4	2	0.147	0.092		0.0	83.4	16.6		
⊠	B48	4 - 9	2	0.11			0.0	68.5	31.5		
▲	B49	0 - 5	2	0.09			0.0	49.8	50.2		
★	B49	8 - 10	2	0.118			0.0	69.7	30.3		
⊙	B50	0 - 5	2	0.119	0.081		0.0	76.0	24.0		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

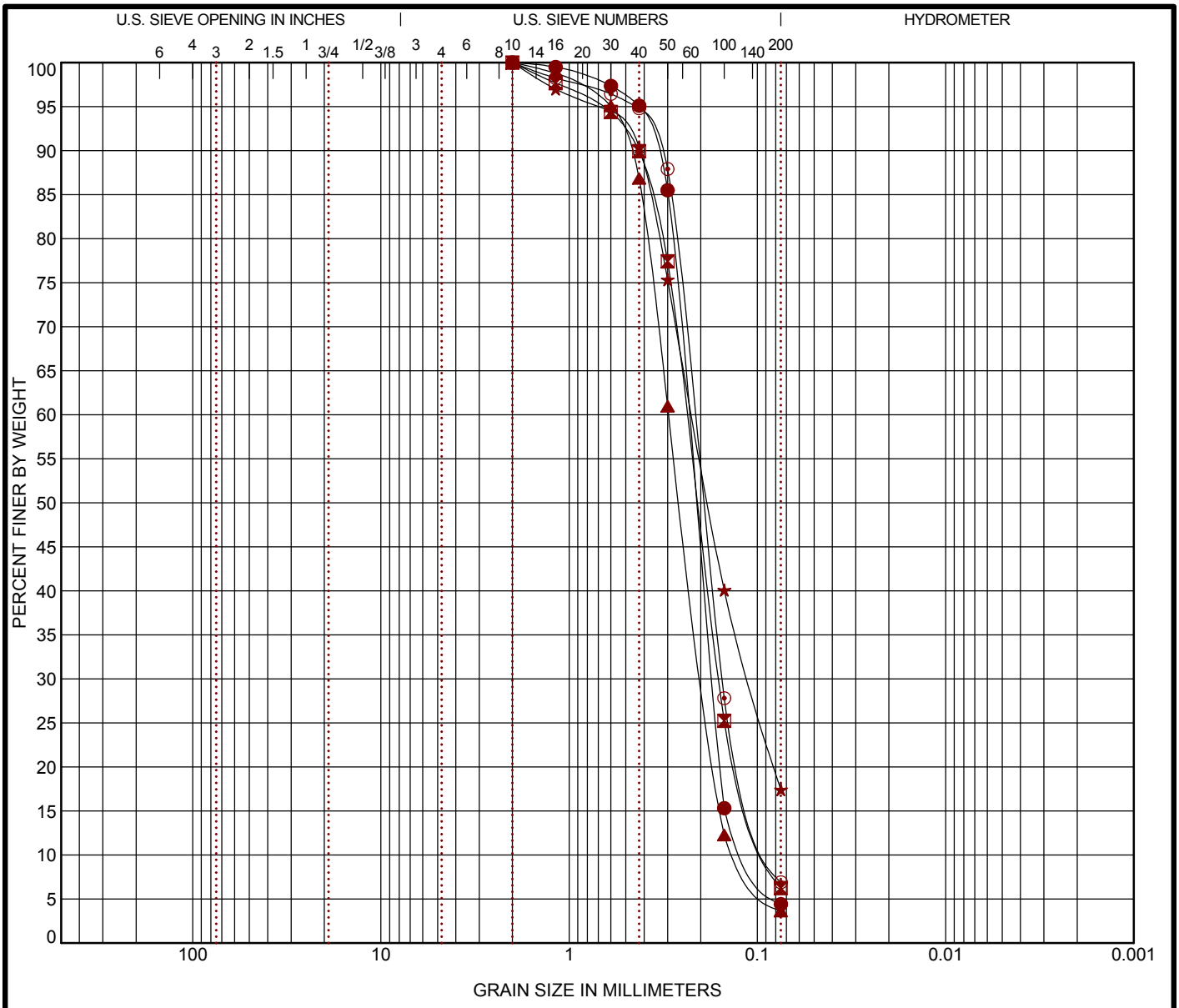
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-16

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B51	0 - 5	POORLY GRADED SAND (SP)		NP	NP	NP	1.20	2.18
⊠	B52	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.25	2.77
▲	B53	0 - 5	POORLY GRADED SAND (SP)		NP	NP	NP	1.01	2.37
★	B54	0 - 5	SILTY SAND (SM)		NP	NP	NP		
⊙	B55	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.31	2.62

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B51	0 - 5	2	0.233	0.173	0.107	0.0	95.6	4.4		
⊠	B52	0 - 5	2	0.238	0.16	0.086	0.0	93.8	6.2		
▲	B53	0 - 5	2	0.296	0.193	0.125	0.0	96.4	3.6		
★	B54	0 - 5	2	0.222	0.11		0.0	82.6	17.4		
⊙	B55	0 - 5	2	0.217	0.154	0.083	0.0	93.1	6.9		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

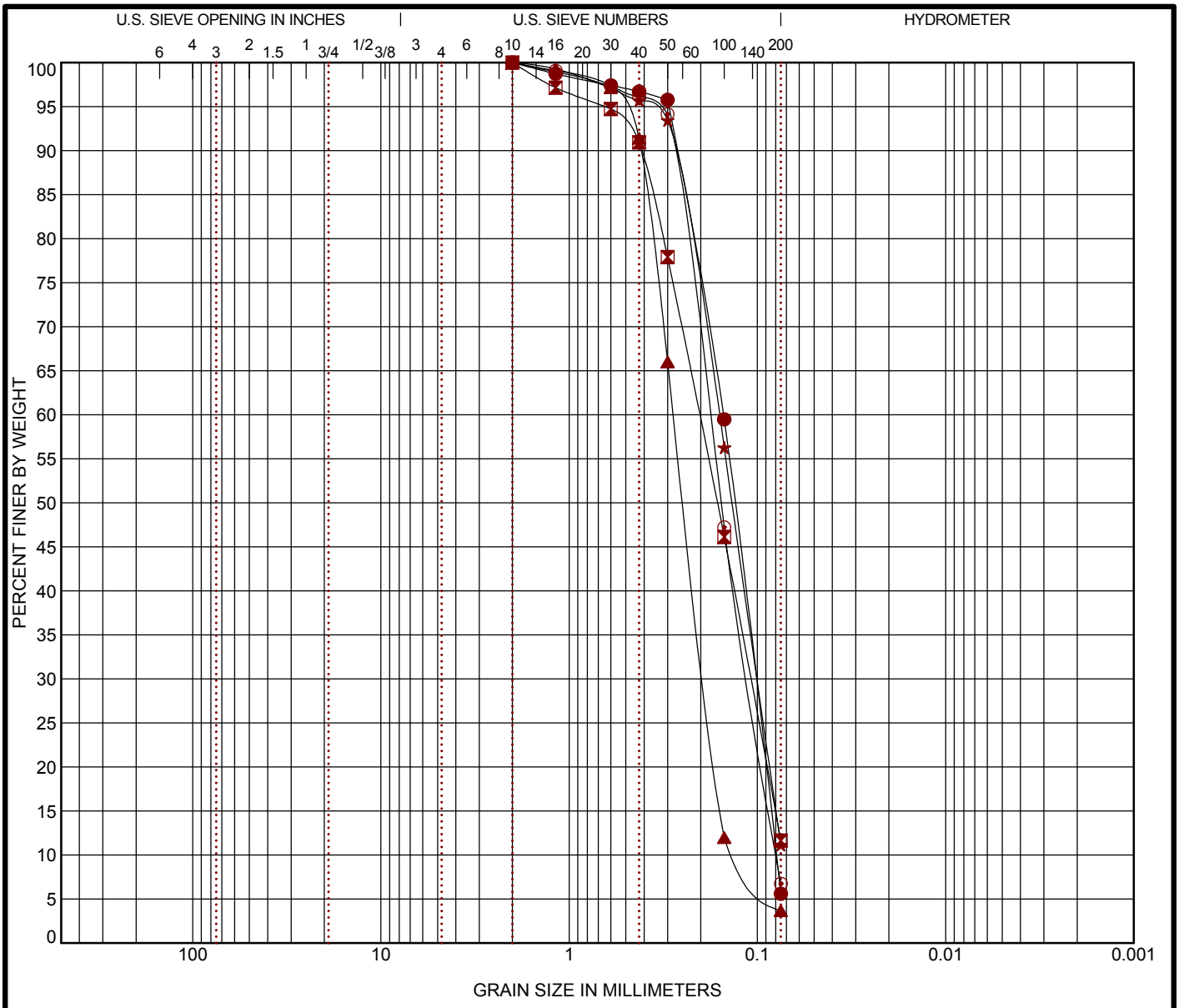
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-17

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B56	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.88	1.91
B57	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.80	2.80
B58	0 - 5	POORLY GRADED SAND (SP)		NP	NP	NP	1.01	2.18
B59	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.85	2.18
B60	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.87	2.28

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B56	0 - 5	2	0.151	0.103	0.079	0.0	94.4	5.6		
B57	0 - 5	2	0.203	0.108		0.0	88.4	11.6		
B58	0 - 5	2	0.278	0.189	0.127	0.0	96.3	3.7		
B59	0 - 5	2	0.161	0.1		0.0	88.9	11.1		
B60	0 - 5	2	0.181	0.112	0.079	0.0	93.3	6.7		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

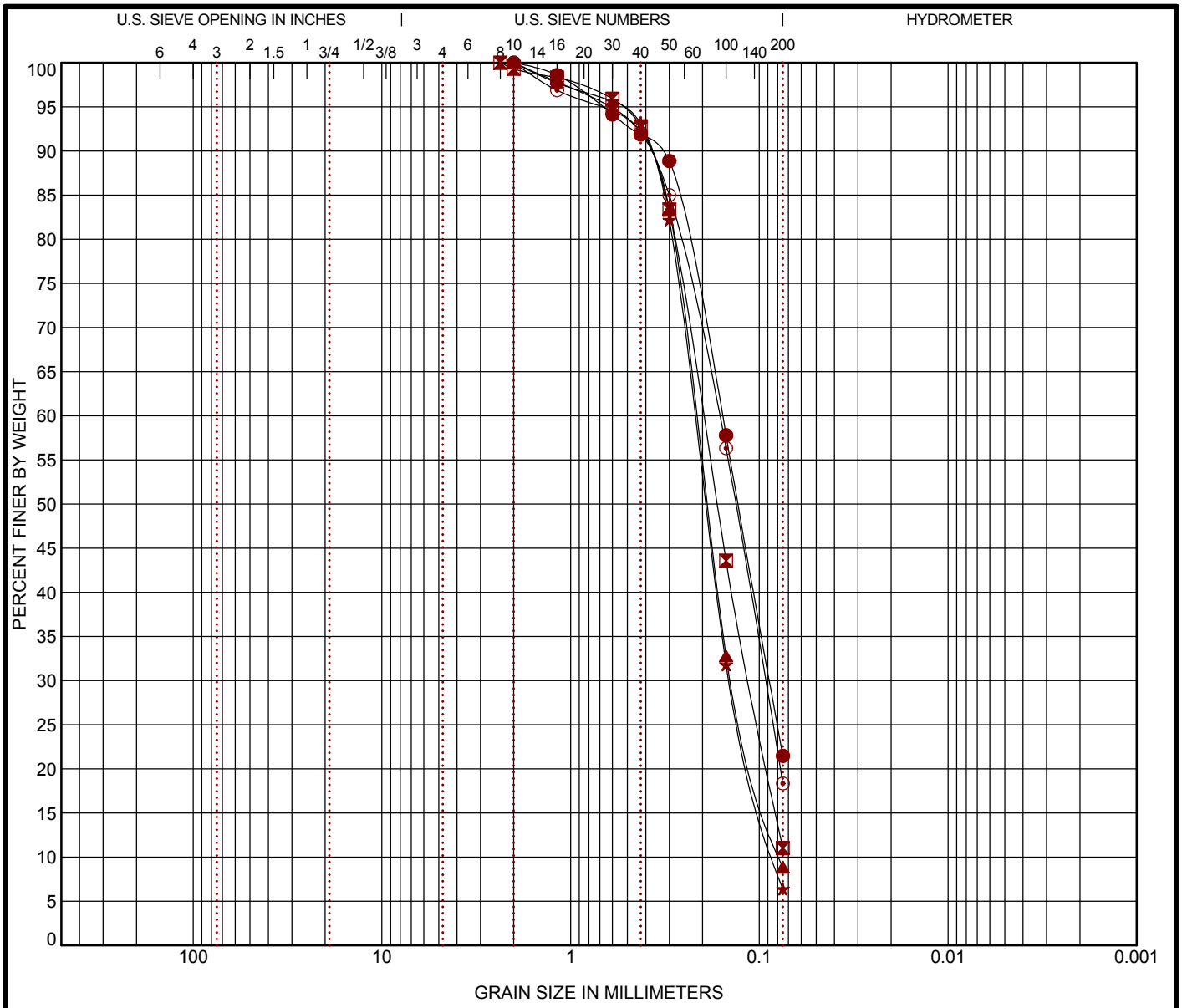
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B61	0 - 5	SILTY SAND (SM)		NP	NP	NP		
B62	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	0.86	2.72
B63	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.13	2.81
B64	0 - 5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.12	2.67
B65	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B61	0 - 5	2	0.158	0.088		0.0	78.5	21.5		
B62	0 - 5	2.36	0.2	0.112		0.0	89.0	11.0		
B63	0 - 5	2	0.218	0.138	0.078	0.0	91.2	8.8		
B64	0 - 5	2	0.221	0.143	0.083	0.0	93.6	6.4		
B65	0 - 5	2	0.164	0.093		0.0	81.7	18.3		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

PROJECT NUMBER: 65165267

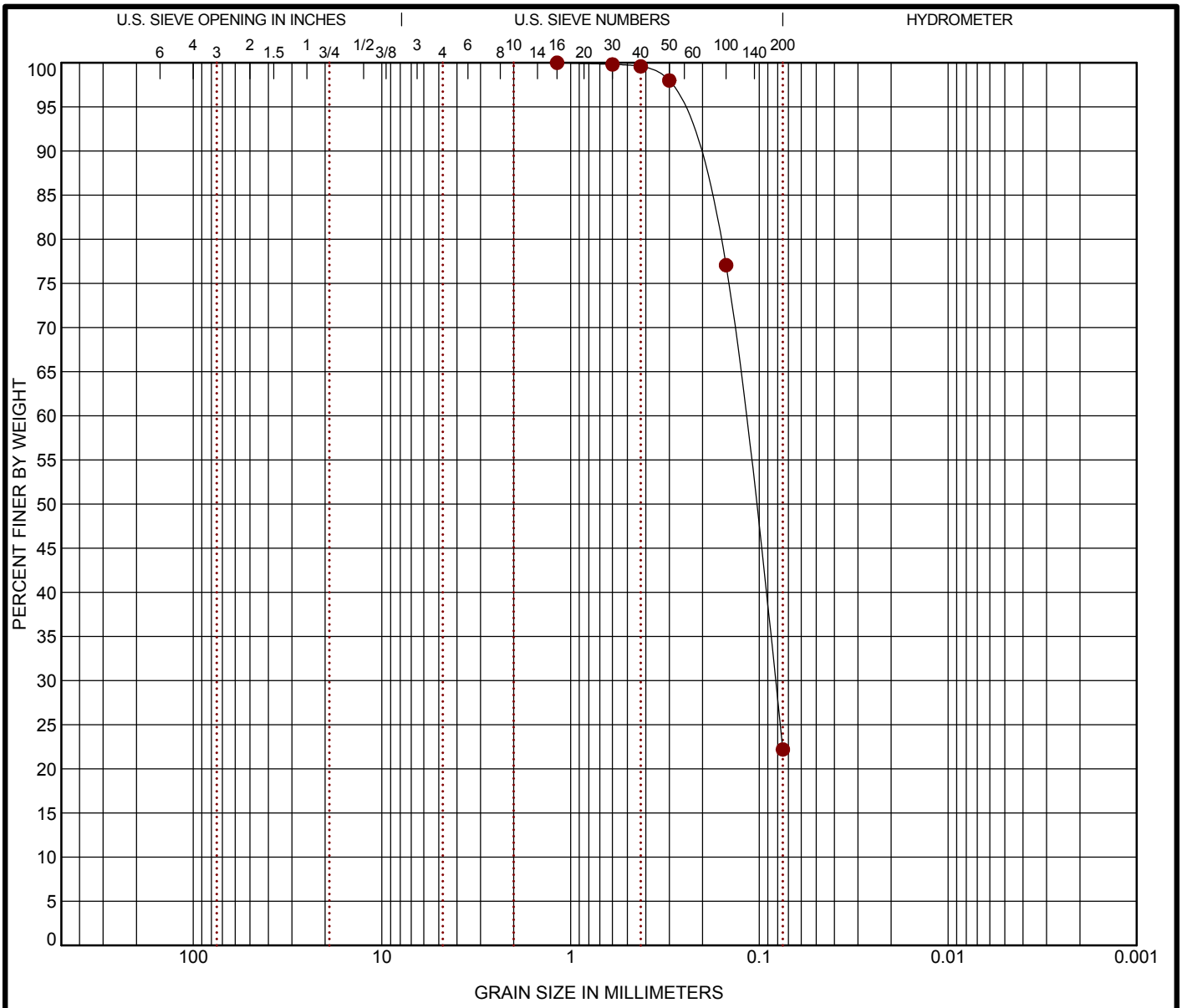
CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-19

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 65165267.GPJ TERRACON2015.GDT 11/18/16

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B66	0 - 5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
B66	0 - 5	1.18	0.121	0.083		0.0	77.8	22.2		

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

PROJECT NUMBER: 65165267

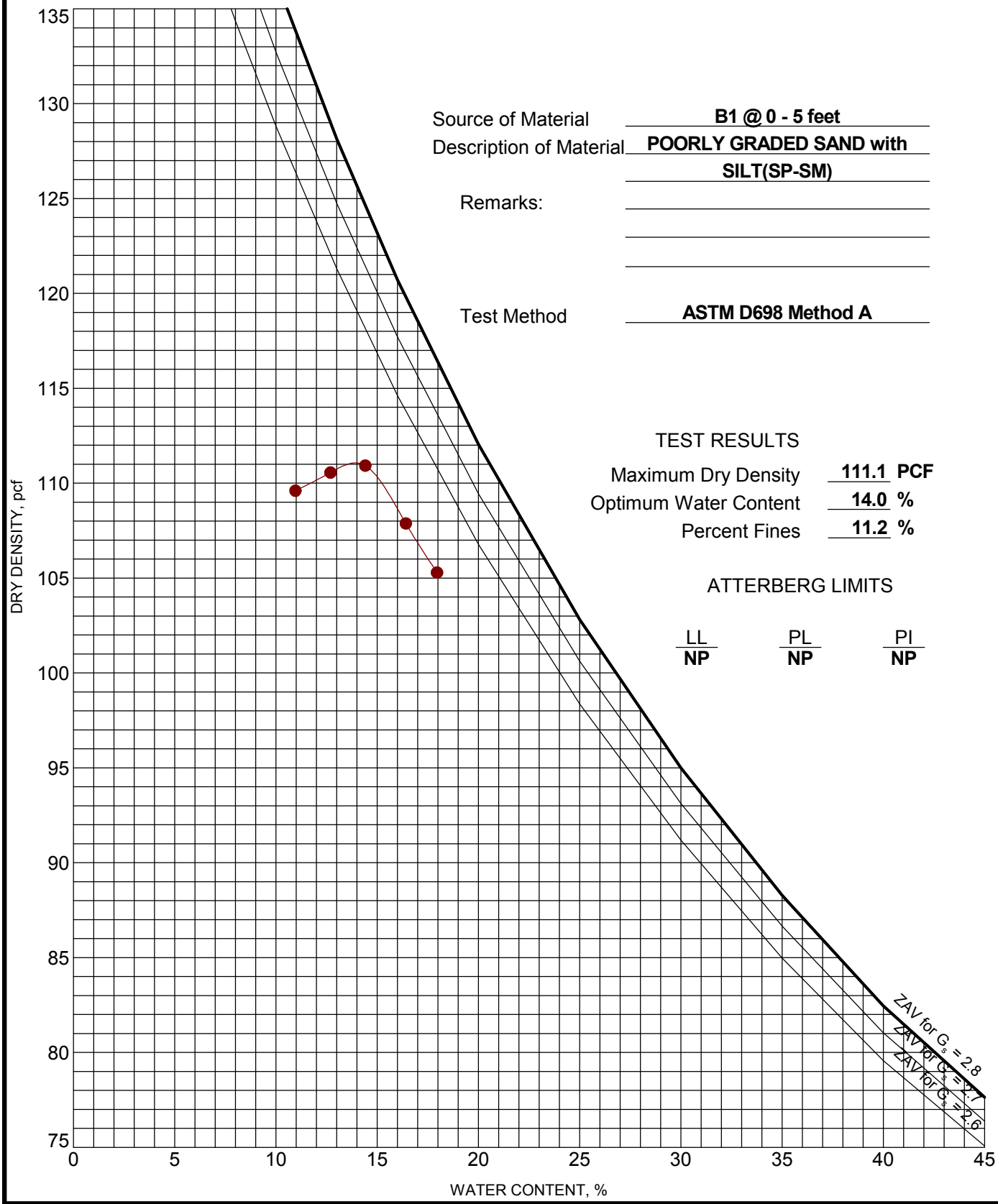
CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-20

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 65165267.GPJ TERRACON2015.GDT 11/18/16

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B1 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND with SILT(SP-SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**111.1**	**PCF**
Optimum Water Content	**14.0**	**%**
Percent Fines	**11.2**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

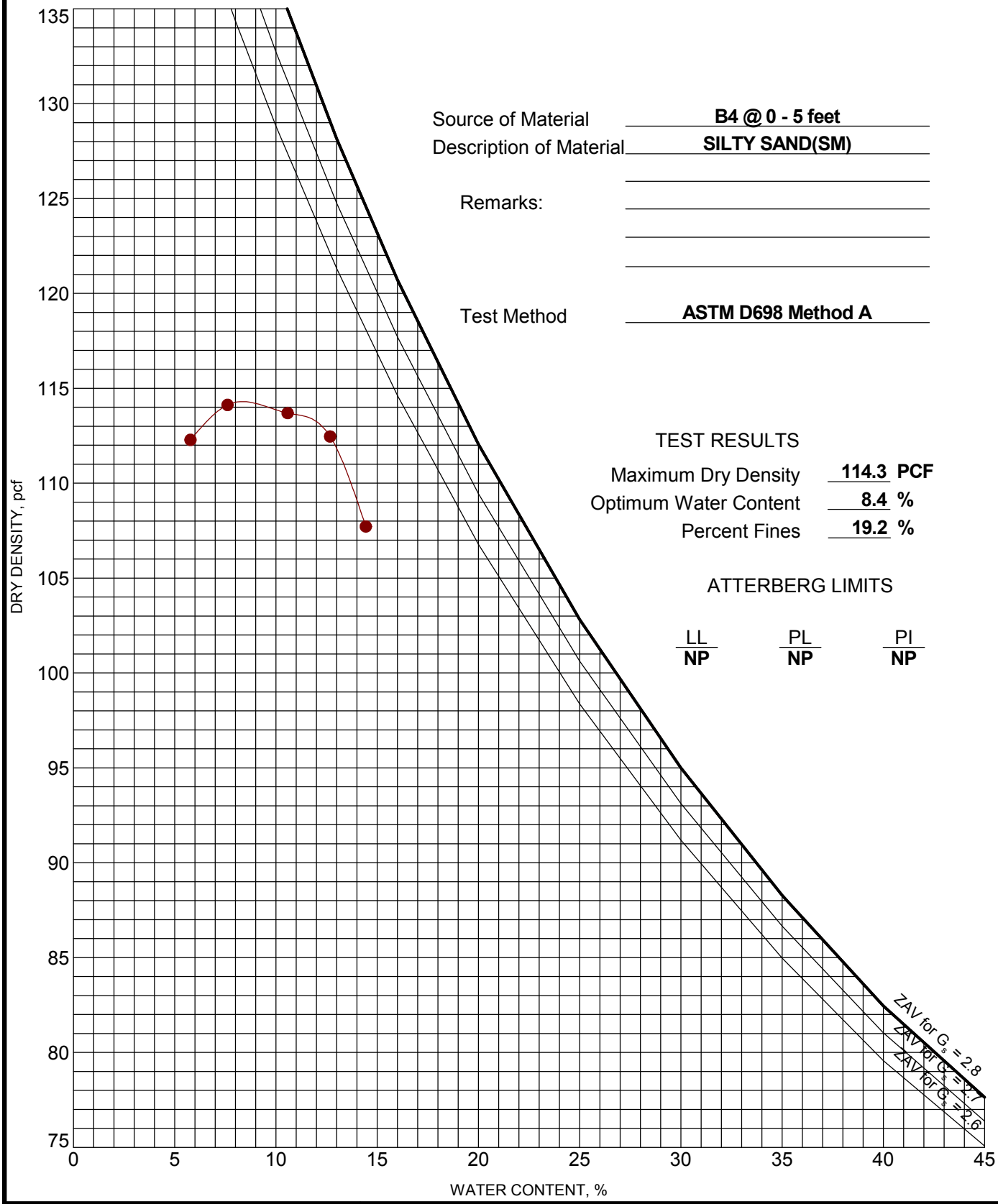
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-21

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B4 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**114.3**	**PCF**
Optimum Water Content	**8.4**	**%**
Percent Fines	**19.2**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

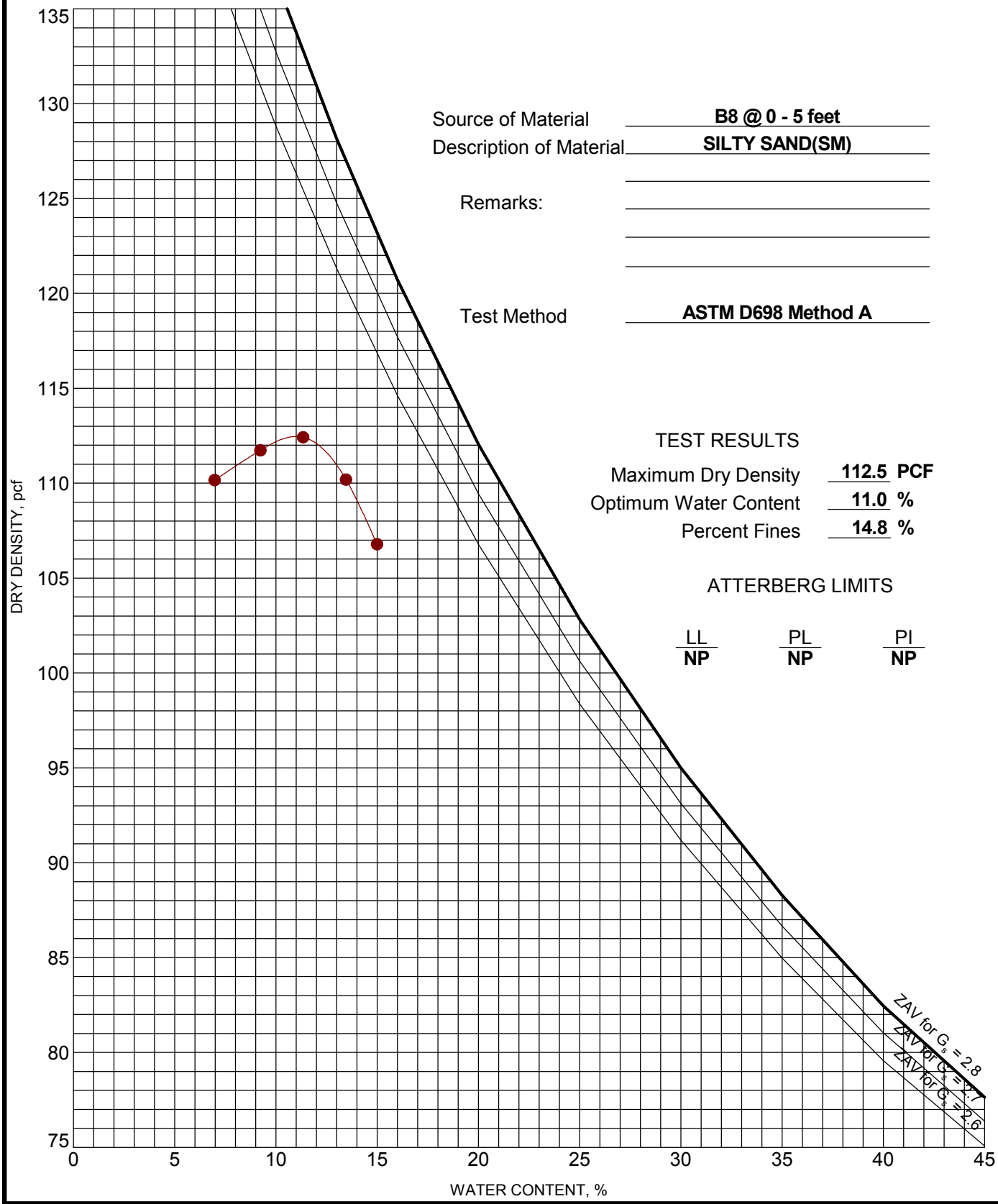
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-22

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B8 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**112.5**	**PCF**
Optimum Water Content	**11.0**	**%**
Percent Fines	**14.8**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

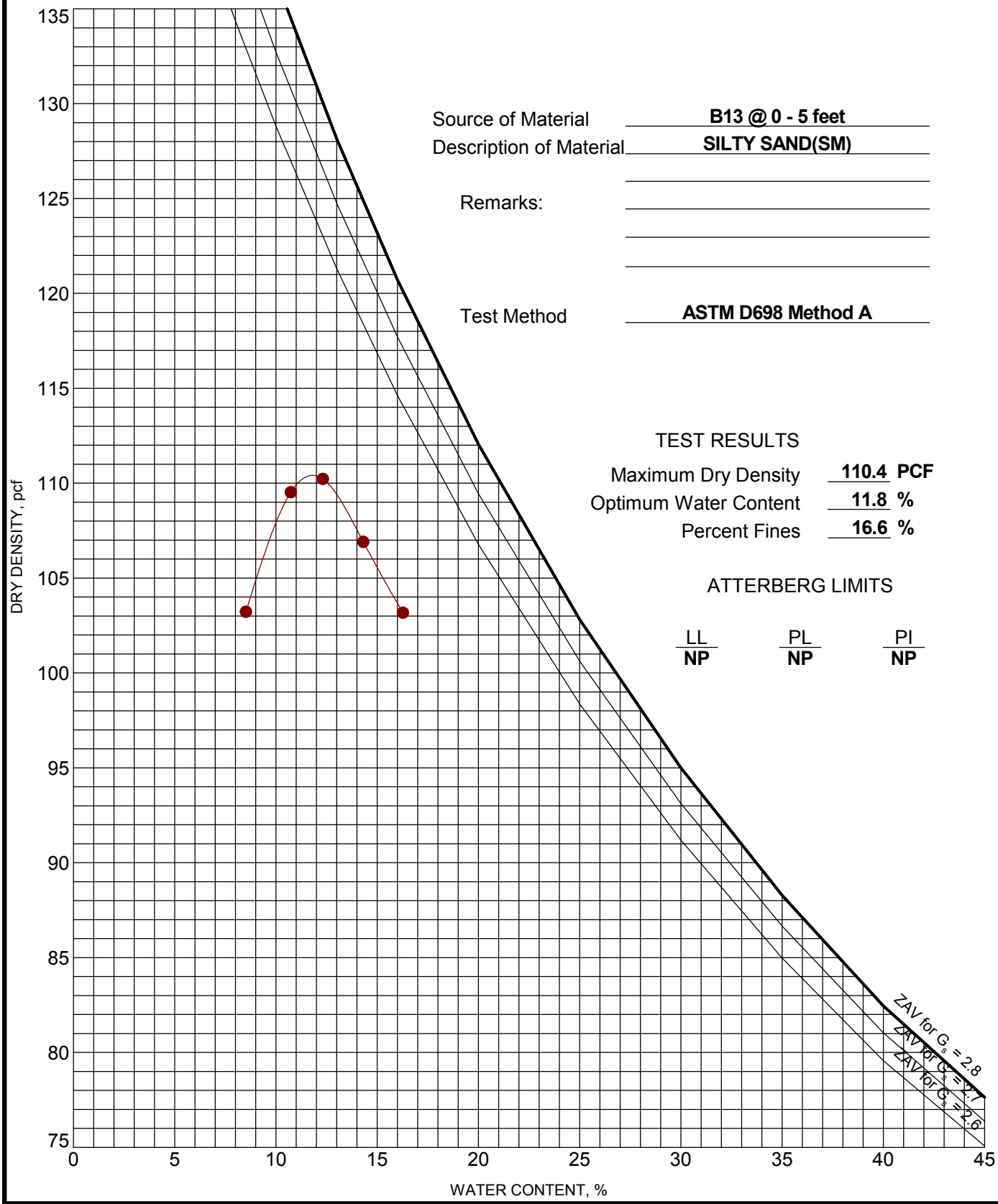
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-23

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B13 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**110.4**	**PCF**
Optimum Water Content	**11.8**	**%**
Percent Fines	**16.6**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

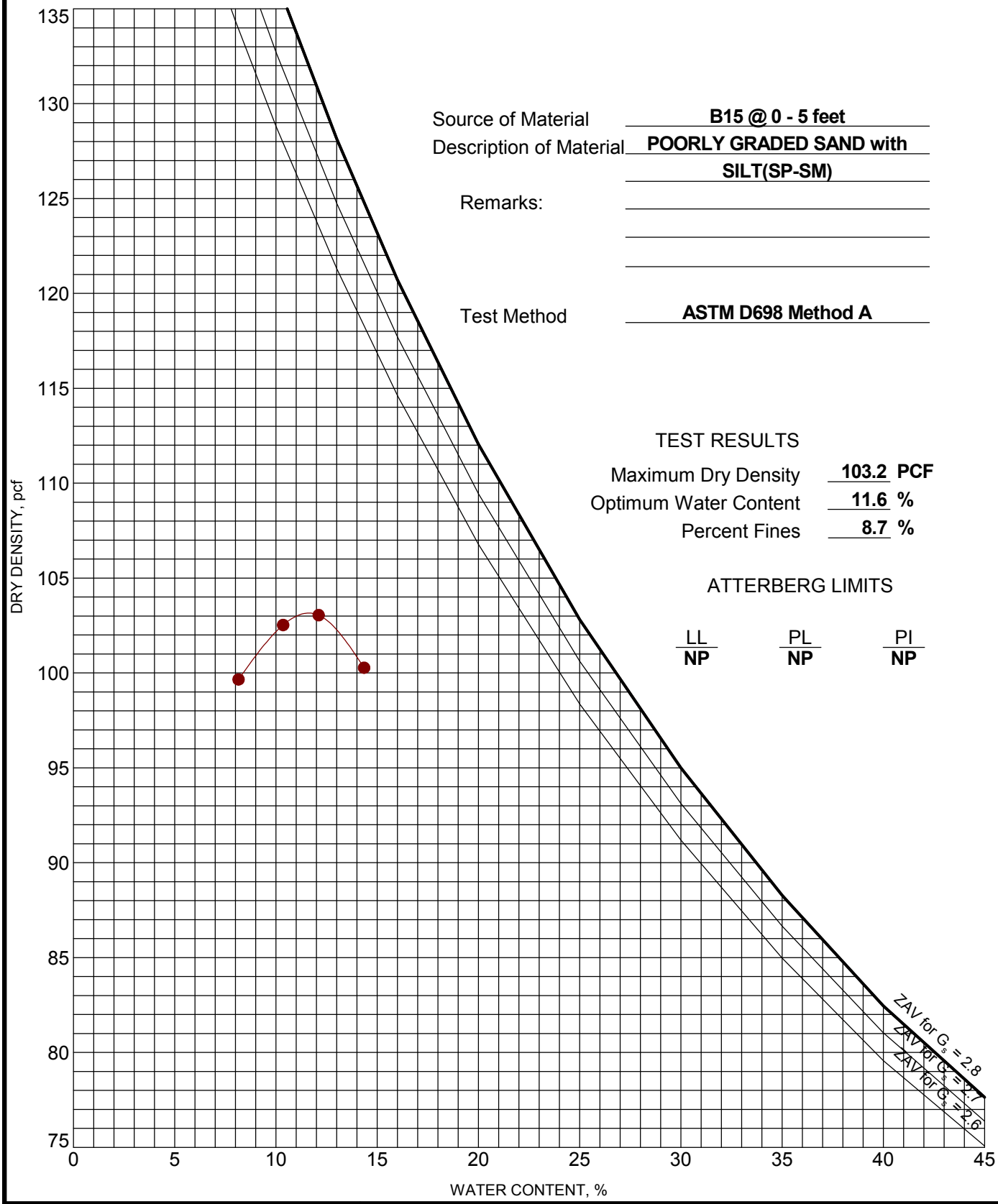
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-24

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B15 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND with SILT(SP-SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**103.2**	**PCF**
Optimum Water Content	**11.6**	**%**
Percent Fines	**8.7**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

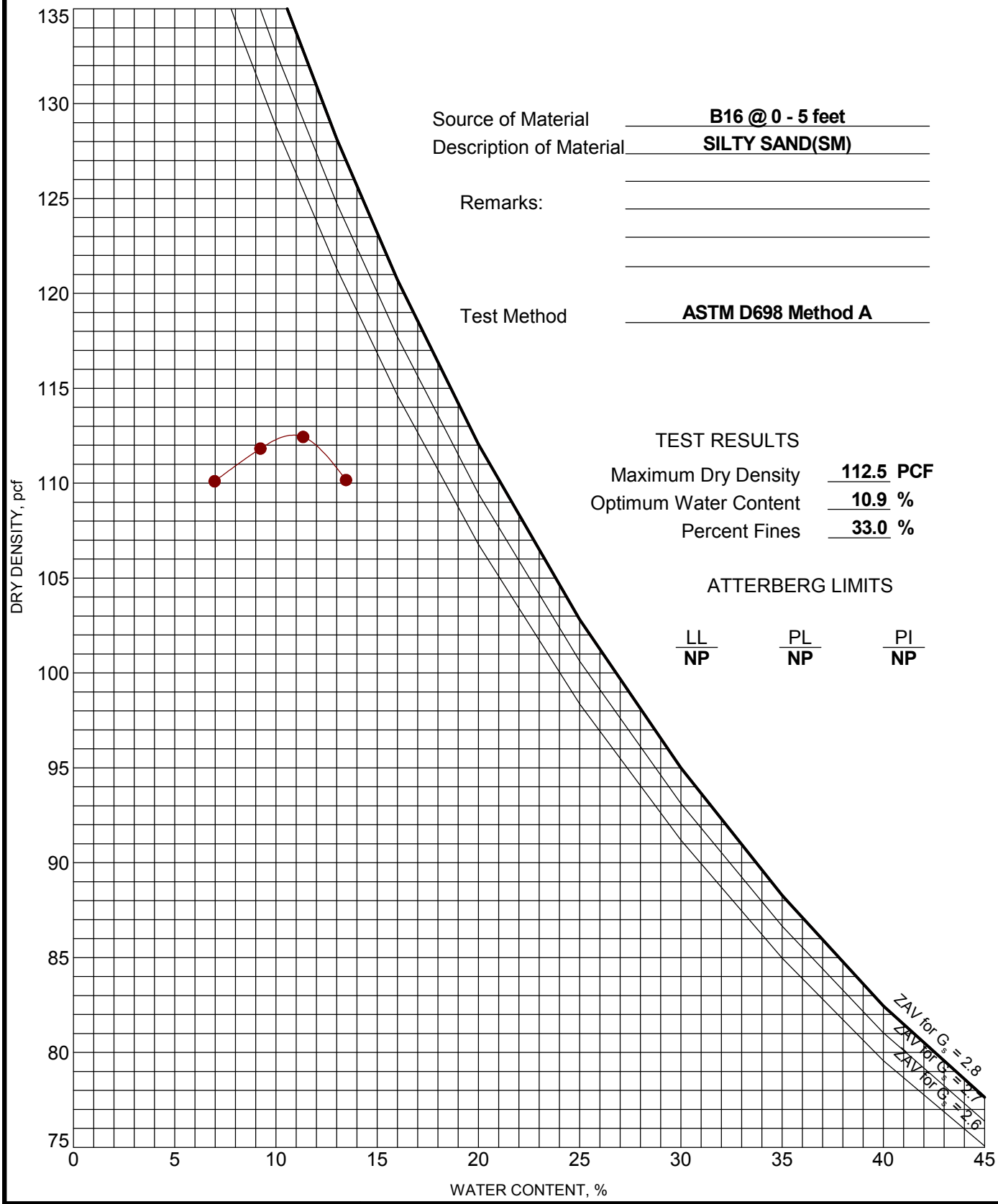
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-25

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B16 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**112.5**	**PCF**
Optimum Water Content	**10.9**	**%**
Percent Fines	**33.0**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

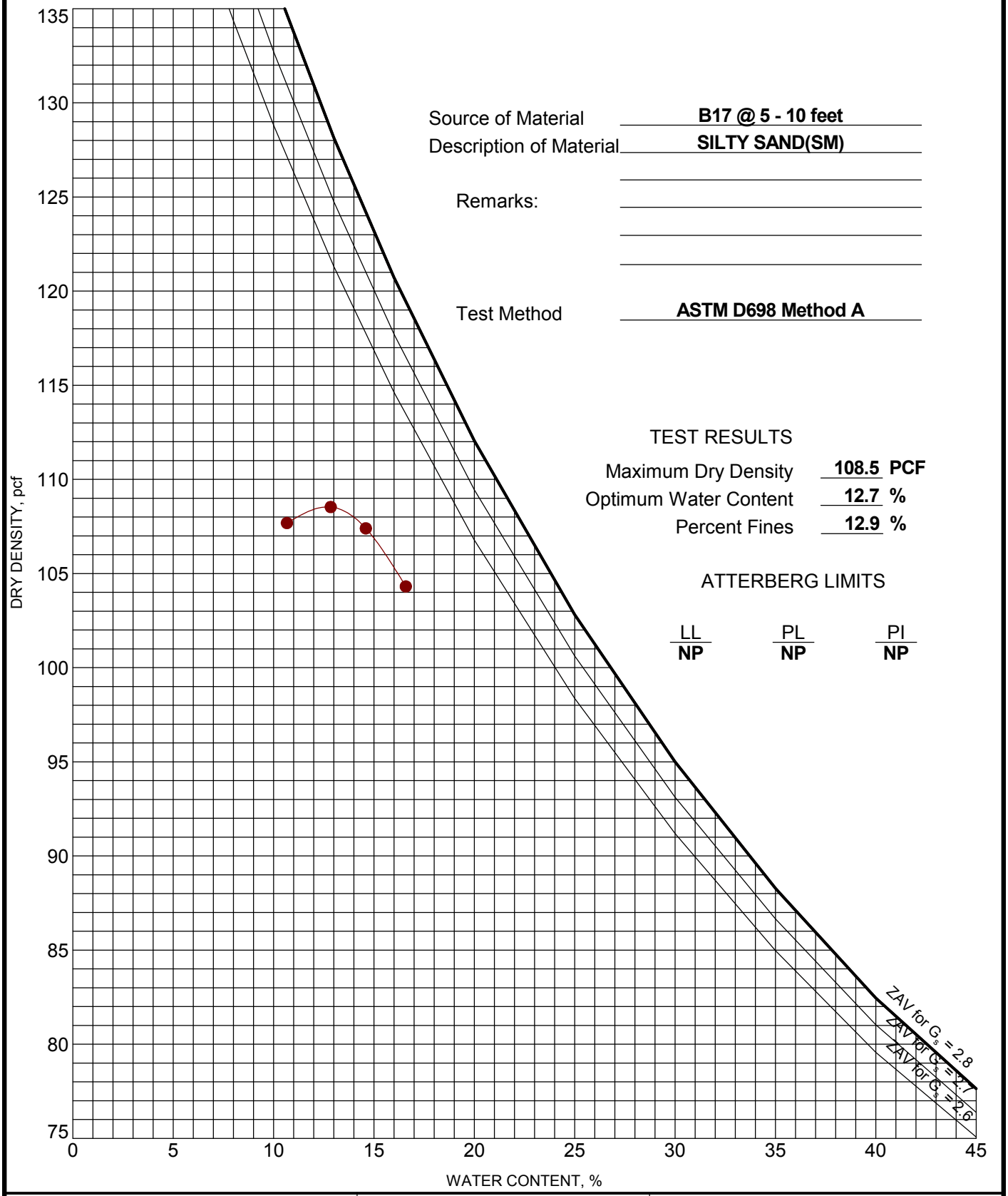
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-26

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B17 @ 5 - 10 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**108.5**	**PCF**
Optimum Water Content	**12.7**	**%**
Percent Fines	**12.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

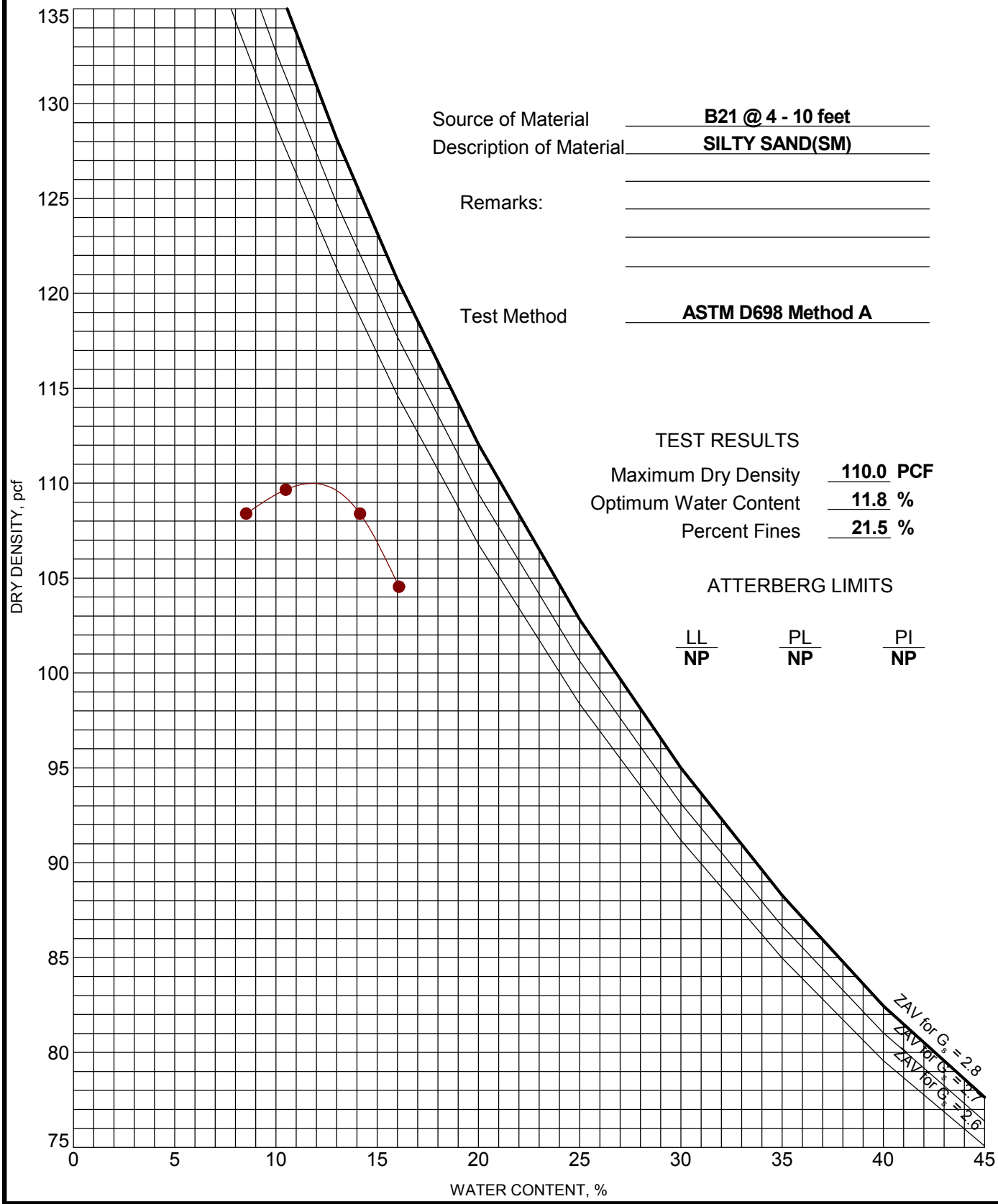
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-27

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B21 @ 4 - 10 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**110.0**	**PCF**
Optimum Water Content	**11.8**	**%**
Percent Fines	**21.5**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

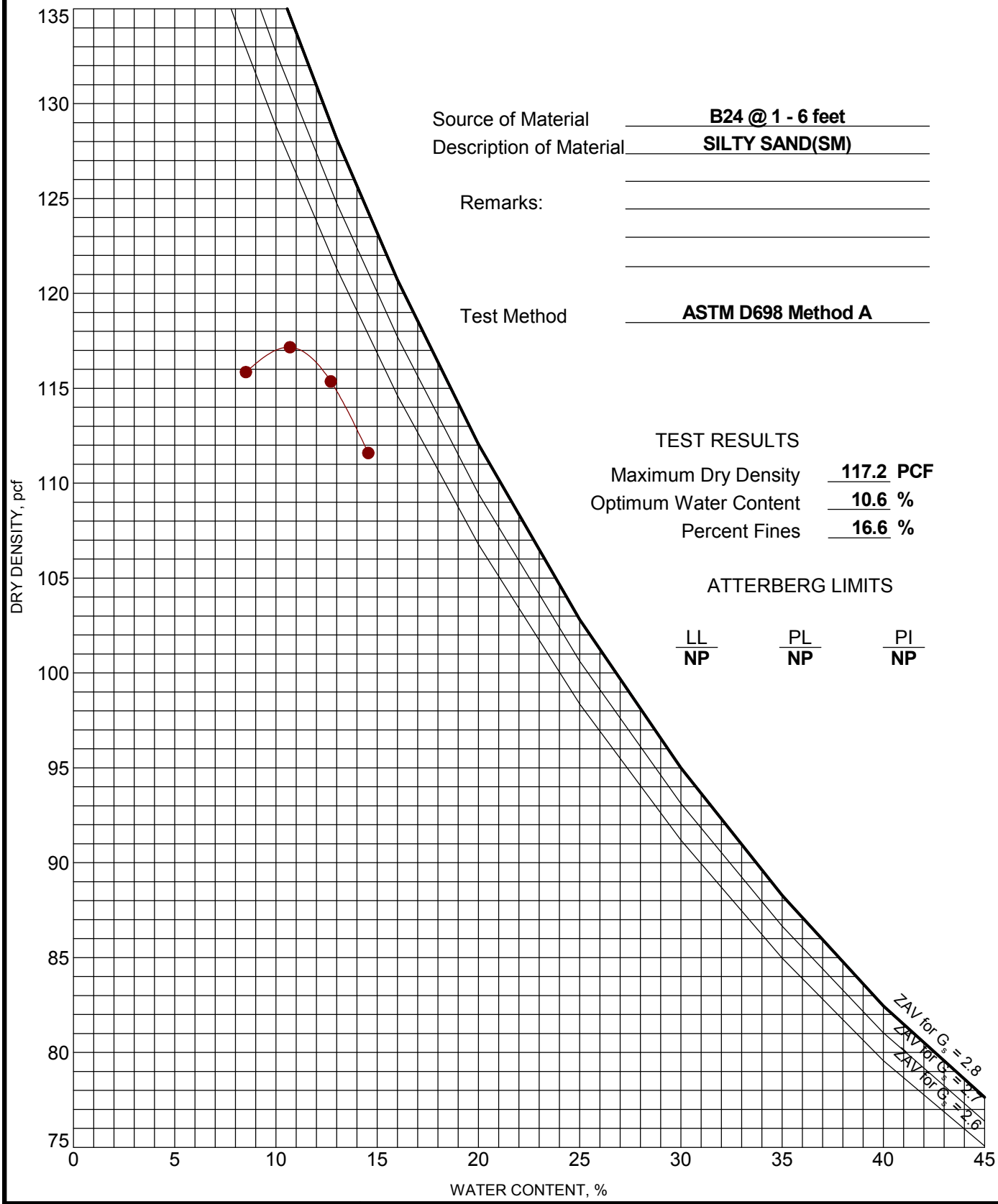
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-28

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B24 @ 1 - 6 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**117.2**	**PCF**
Optimum Water Content	**10.6**	**%**
Percent Fines	**16.6**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

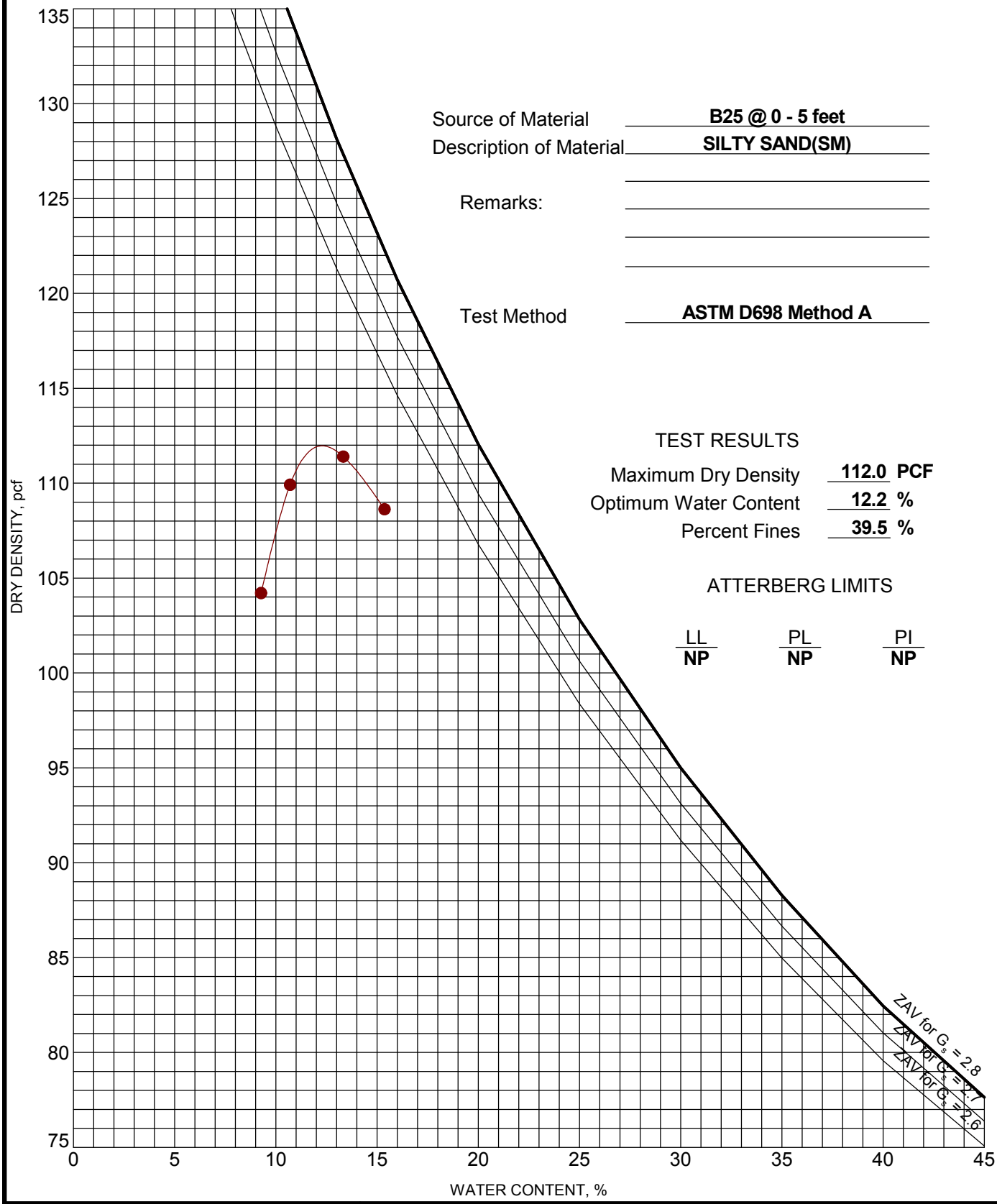
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-29

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B25 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**112.0**	**PCF**
Optimum Water Content	**12.2**	**%**
Percent Fines	**39.5**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ

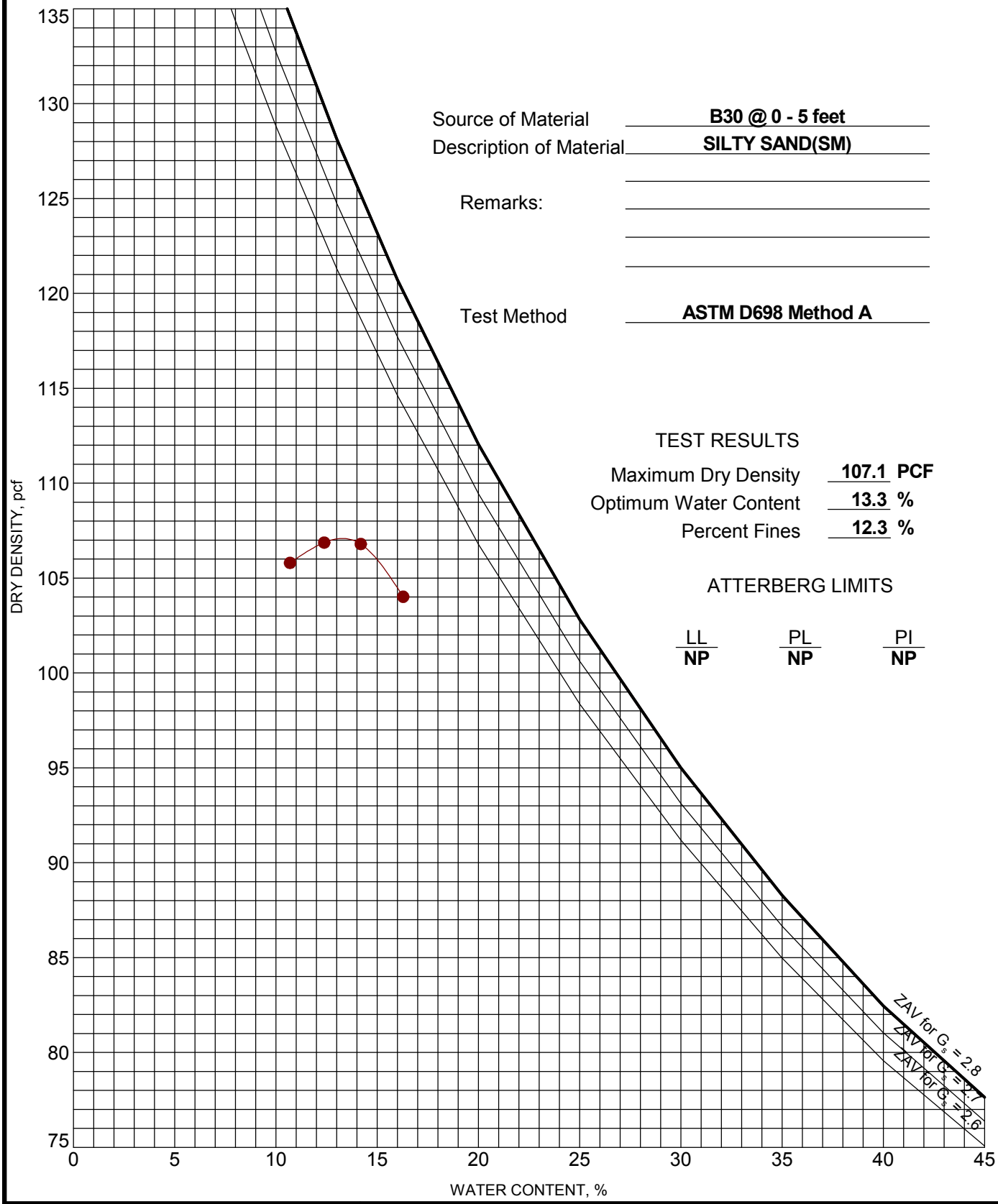
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-30

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B30 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**107.1**	**PCF**
Optimum Water Content	**13.3**	**%**
Percent Fines	**12.3**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

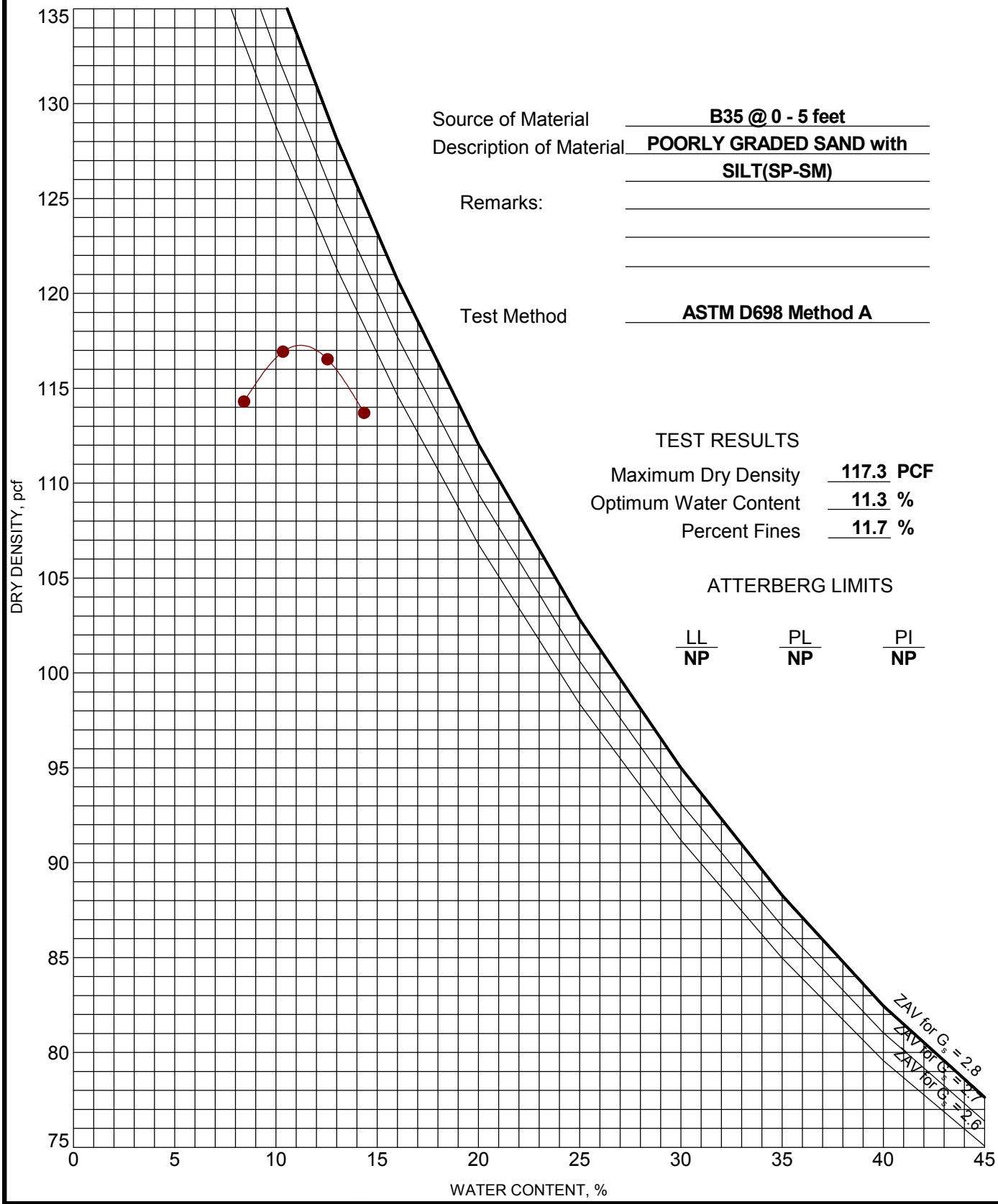
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-31

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B35 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND with SILT(SP-SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**117.3 PCF**
Optimum Water Content	**11.3 %**
Percent Fines	**11.7 %**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

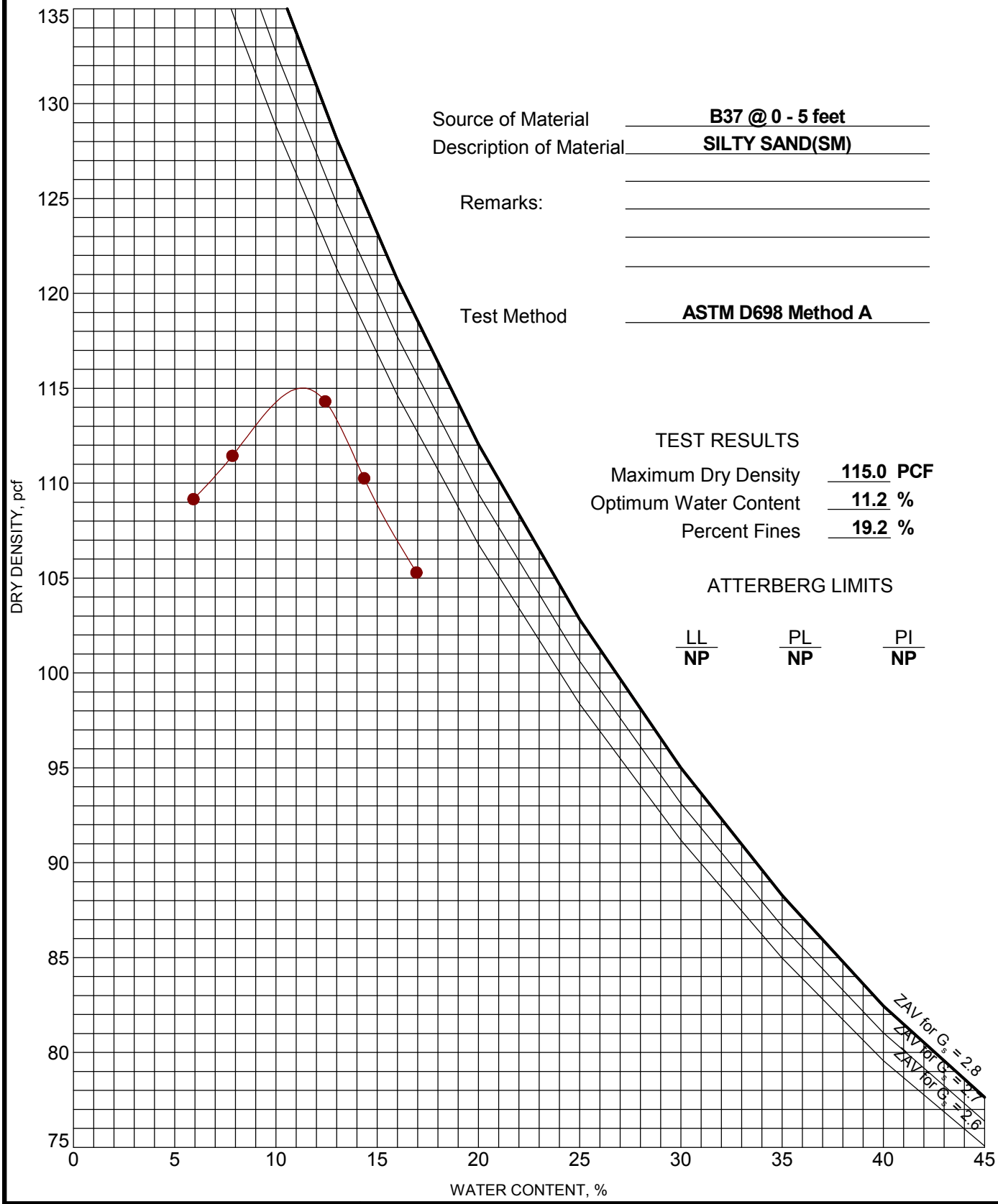
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-32

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B37 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**115.0**	**PCF**
Optimum Water Content	**11.2**	**%**
Percent Fines	**19.2**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

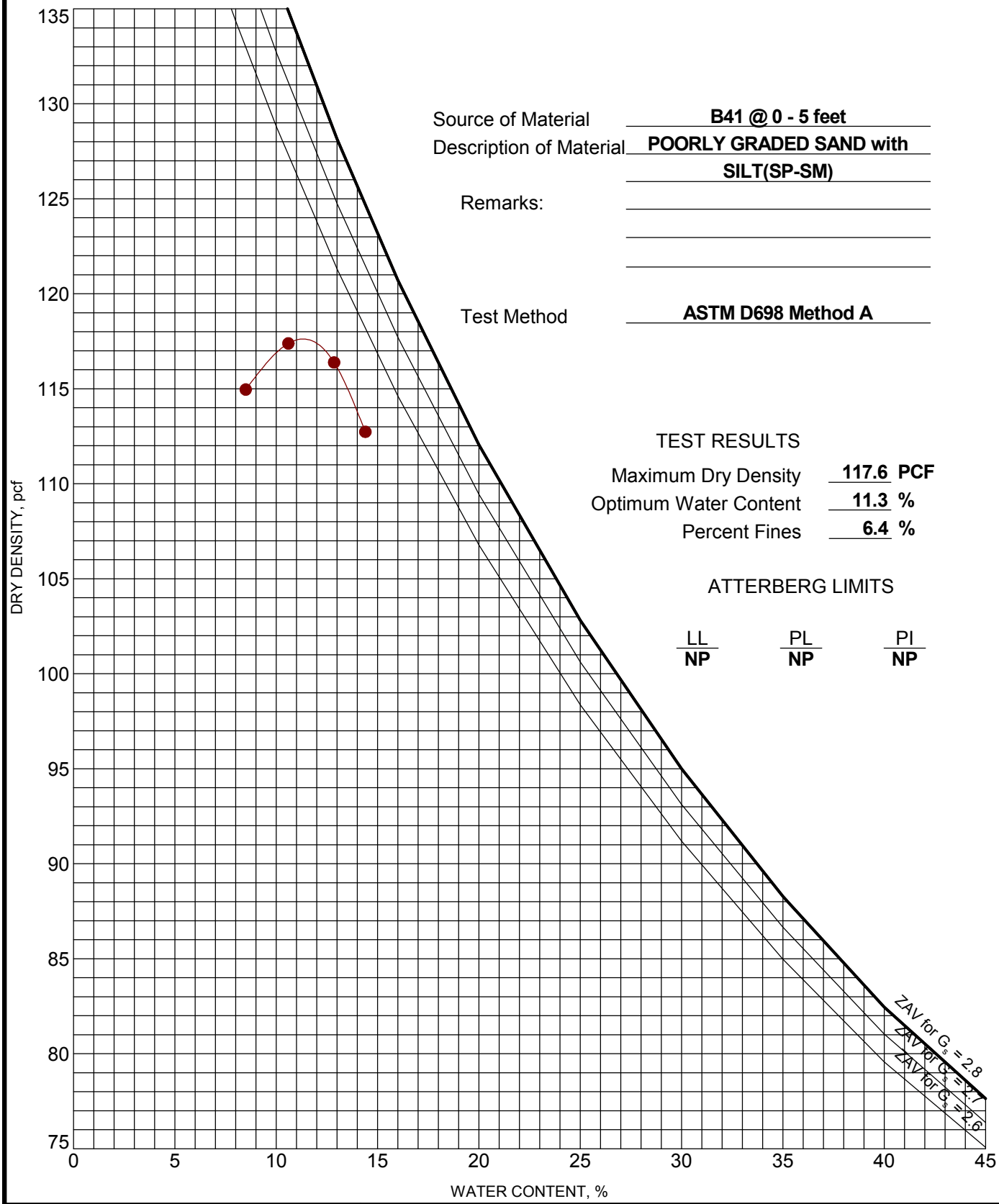
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-33

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B41 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND with SILT(SP-SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**117.6**	**PCF**
Optimum Water Content	**11.3**	**%**
Percent Fines	**6.4**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

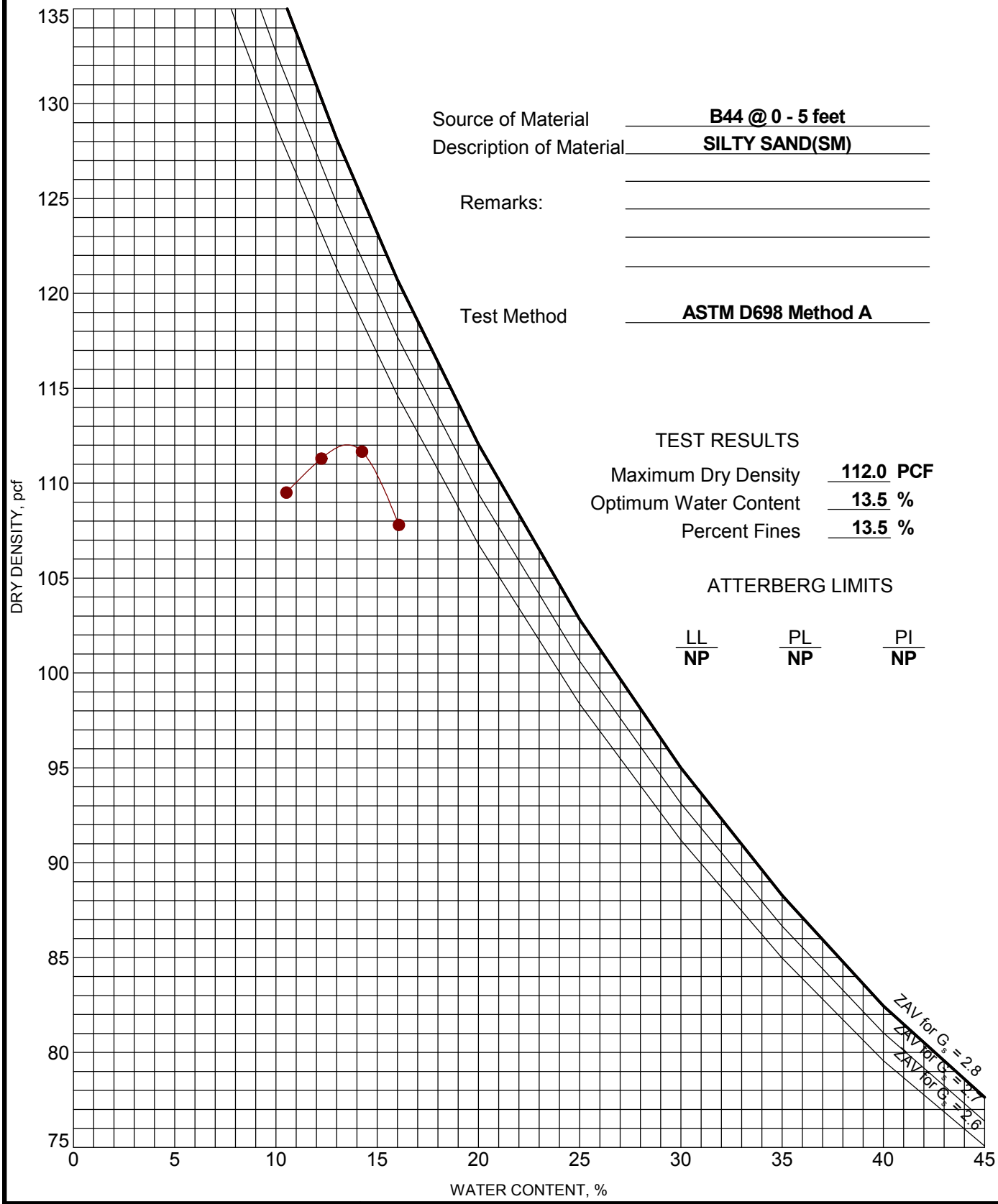
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-34

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B44 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**112.0**	**PCF**
Optimum Water Content	**13.5**	**%**
Percent Fines	**13.5**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

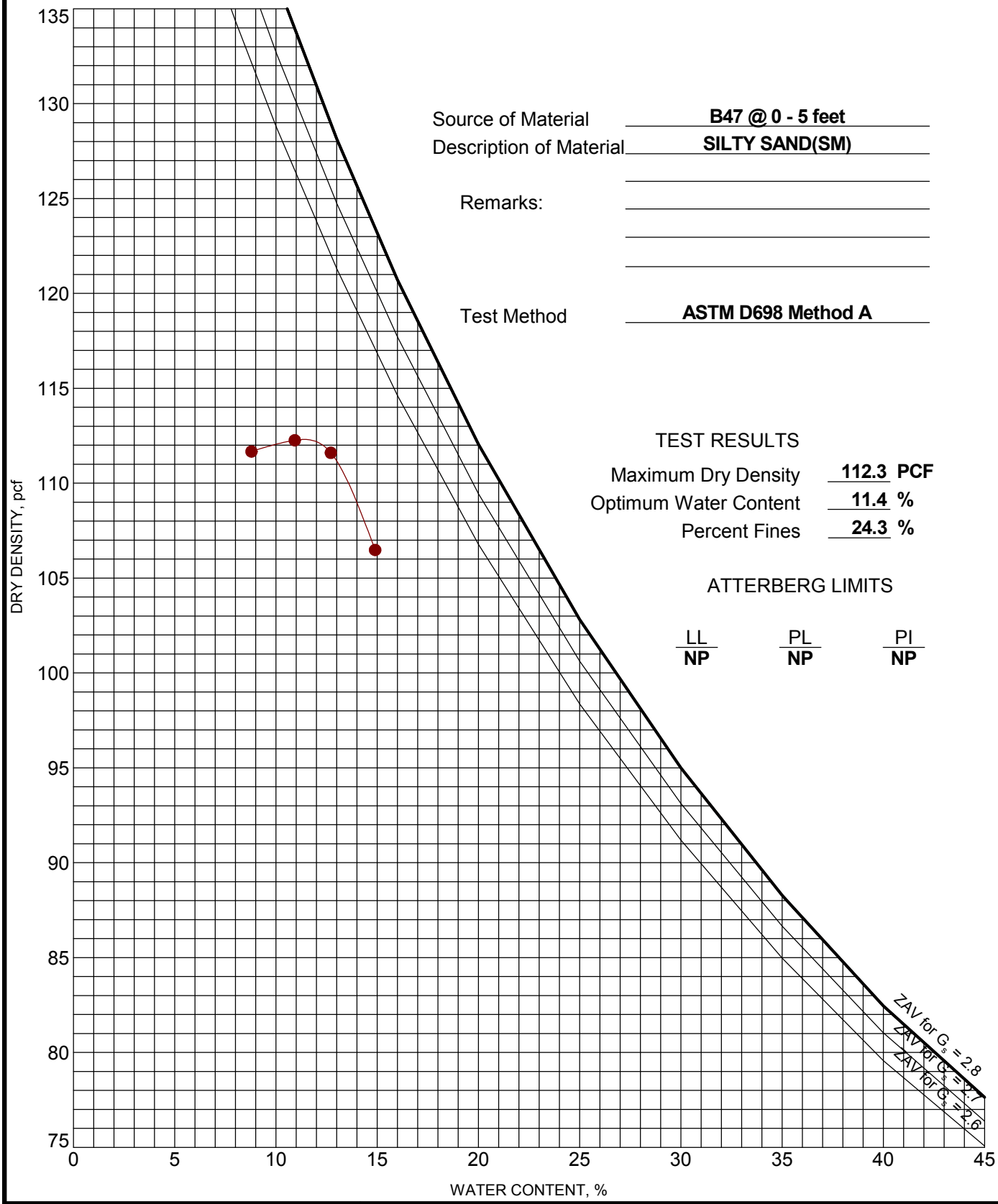
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-35

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B47 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**112.3**	**PCF**
Optimum Water Content	**11.4**	**%**
Percent Fines	**24.3**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

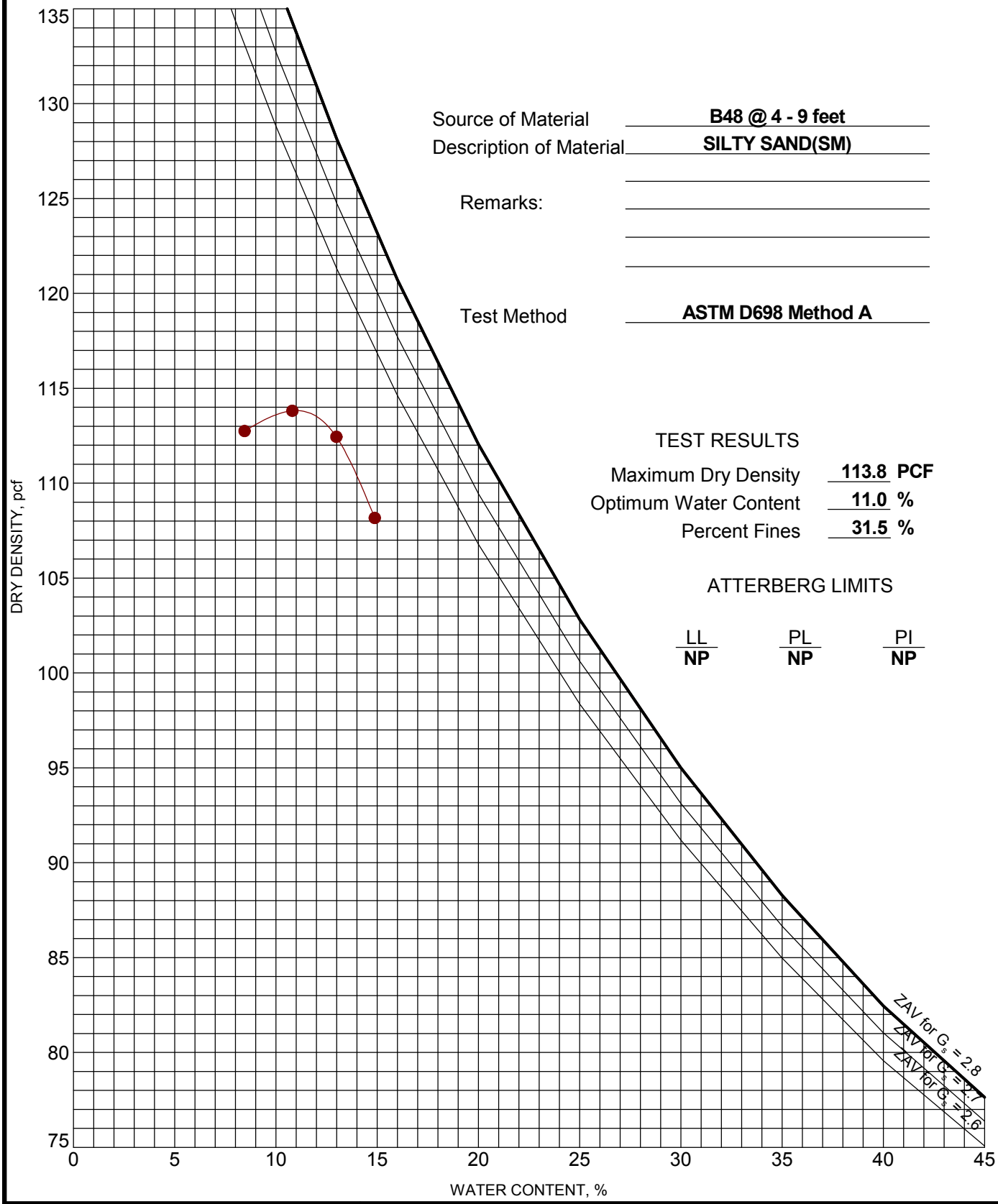
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-36

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B48 @ 4 - 9 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**113.8**	**PCF**
Optimum Water Content	**11.0**	**%**
Percent Fines	**31.5**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

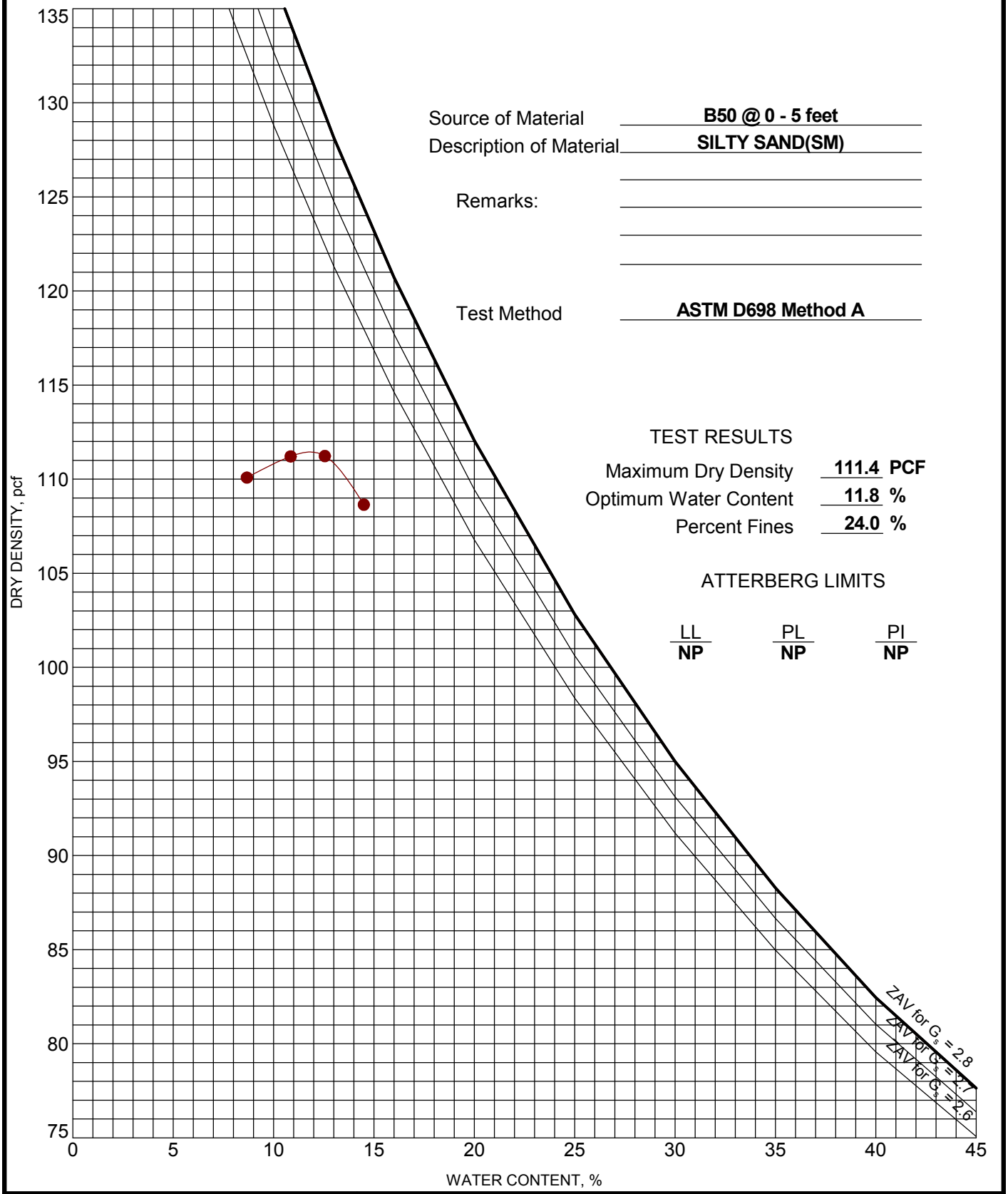
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-37

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B50 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**111.4**	**PCF**
Optimum Water Content	**11.8**	**%**
Percent Fines	**24.0**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

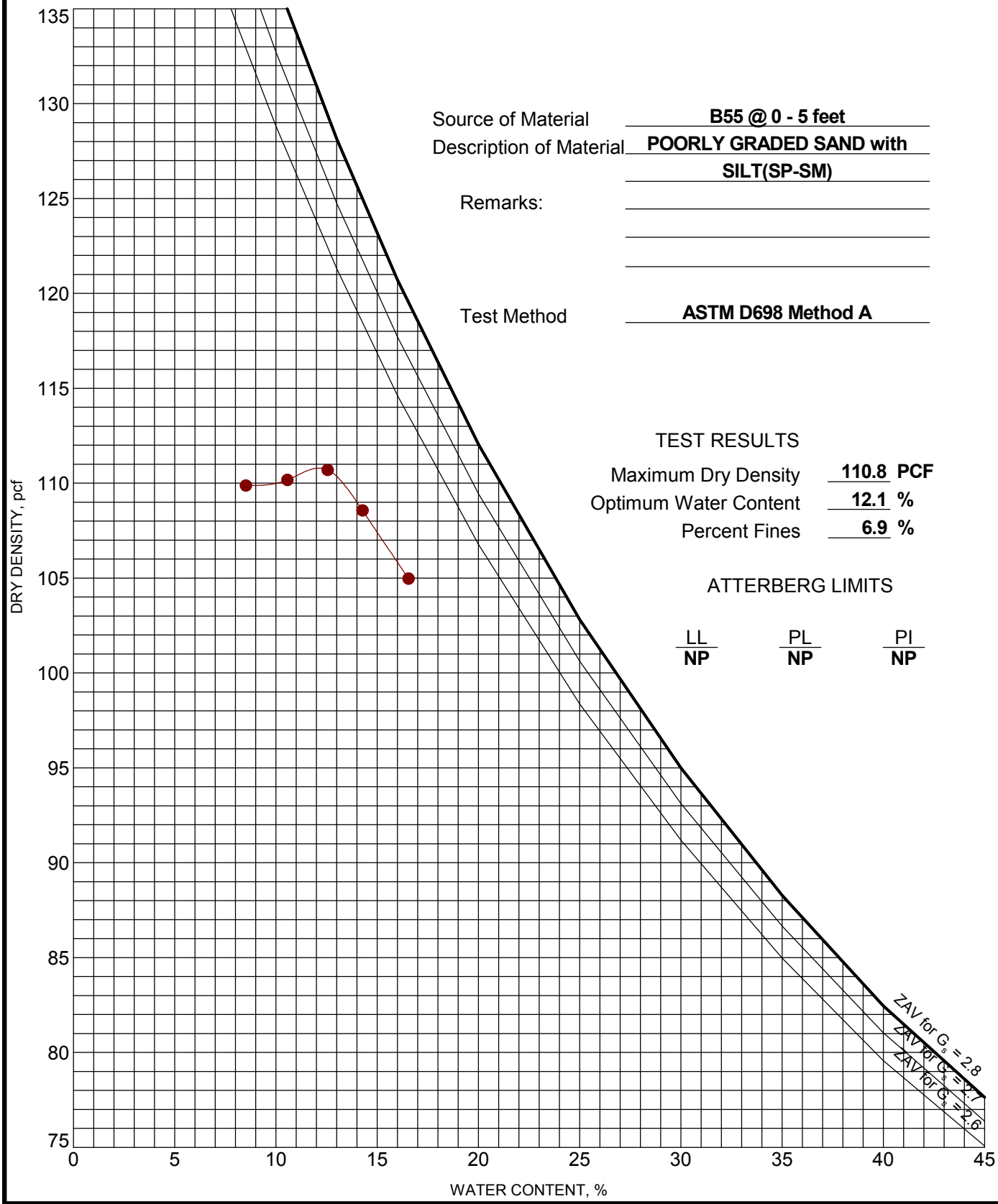
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-38

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B55 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND with SILT(SP-SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**110.8**	**PCF**
Optimum Water Content	**12.1**	**%**
Percent Fines	**6.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

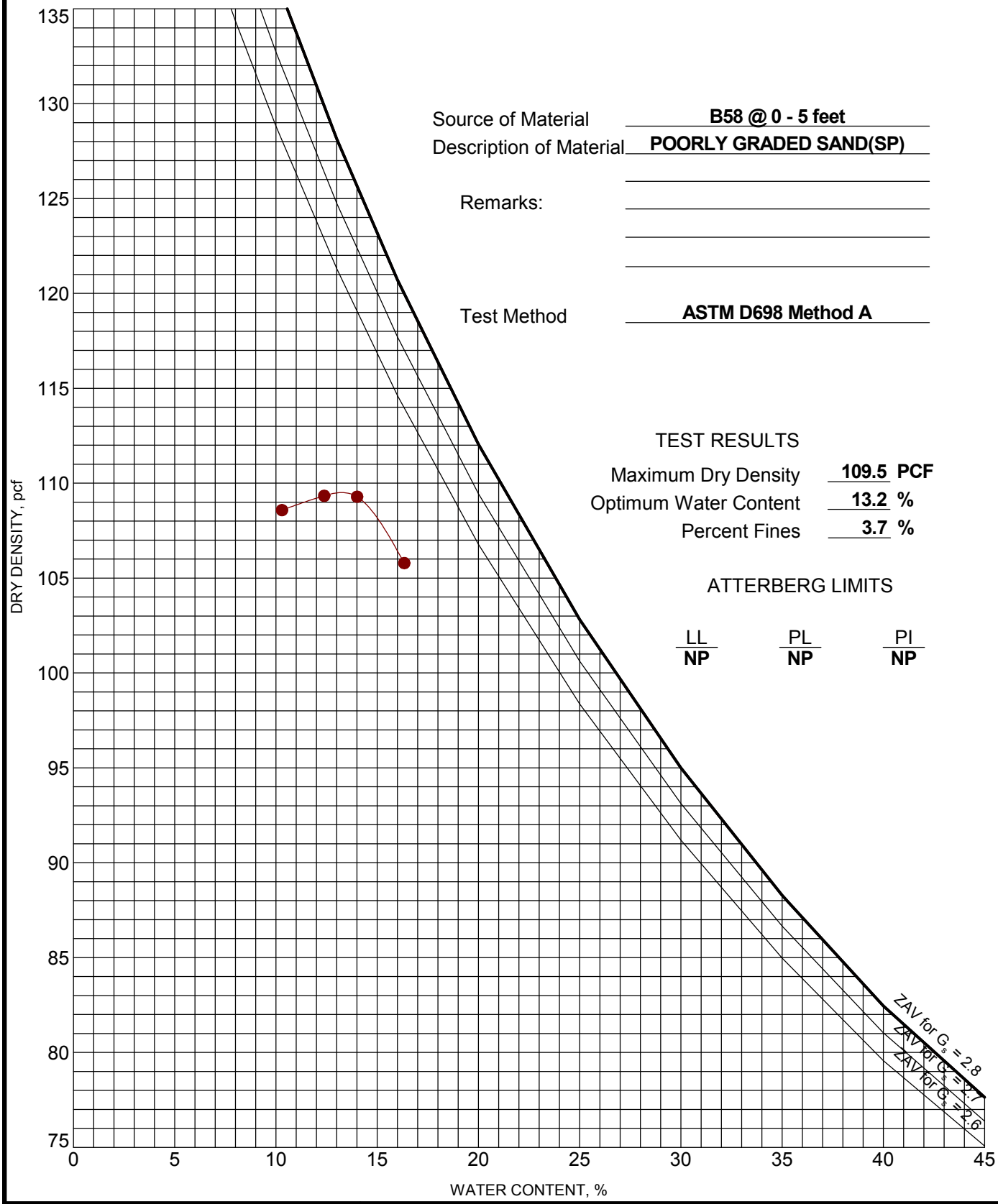
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-39

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B58 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND(SP)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**109.5** PCF
Optimum Water Content	**13.2** %
Percent Fines	**3.7** %

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

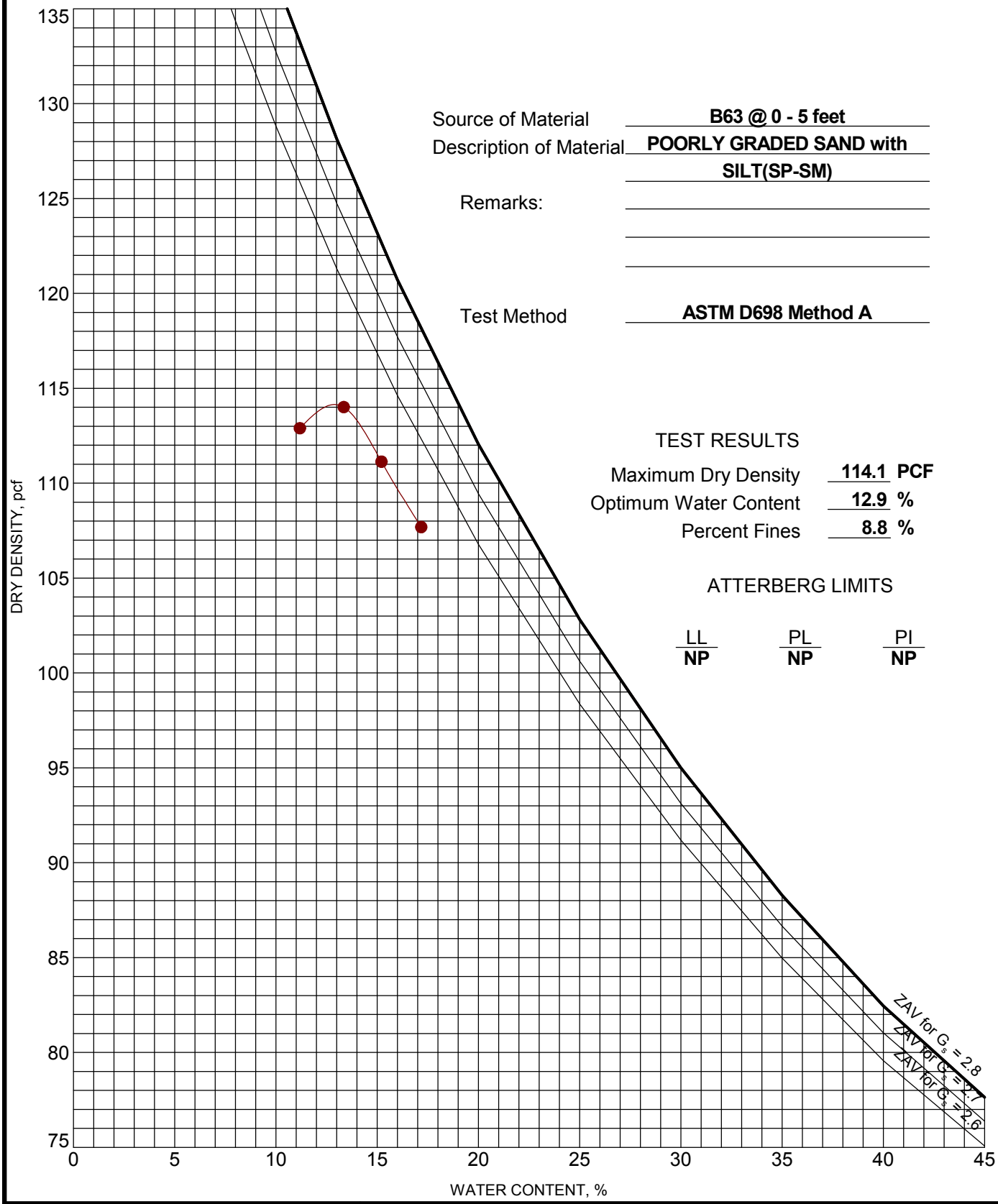
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-40

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B63 @ 0 - 5 feet**

Description of Material: **POORLY GRADED SAND with SILT(SP-SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**114.1**	**PCF**
Optimum Water Content	**12.9**	**%**
Percent Fines	**8.8**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

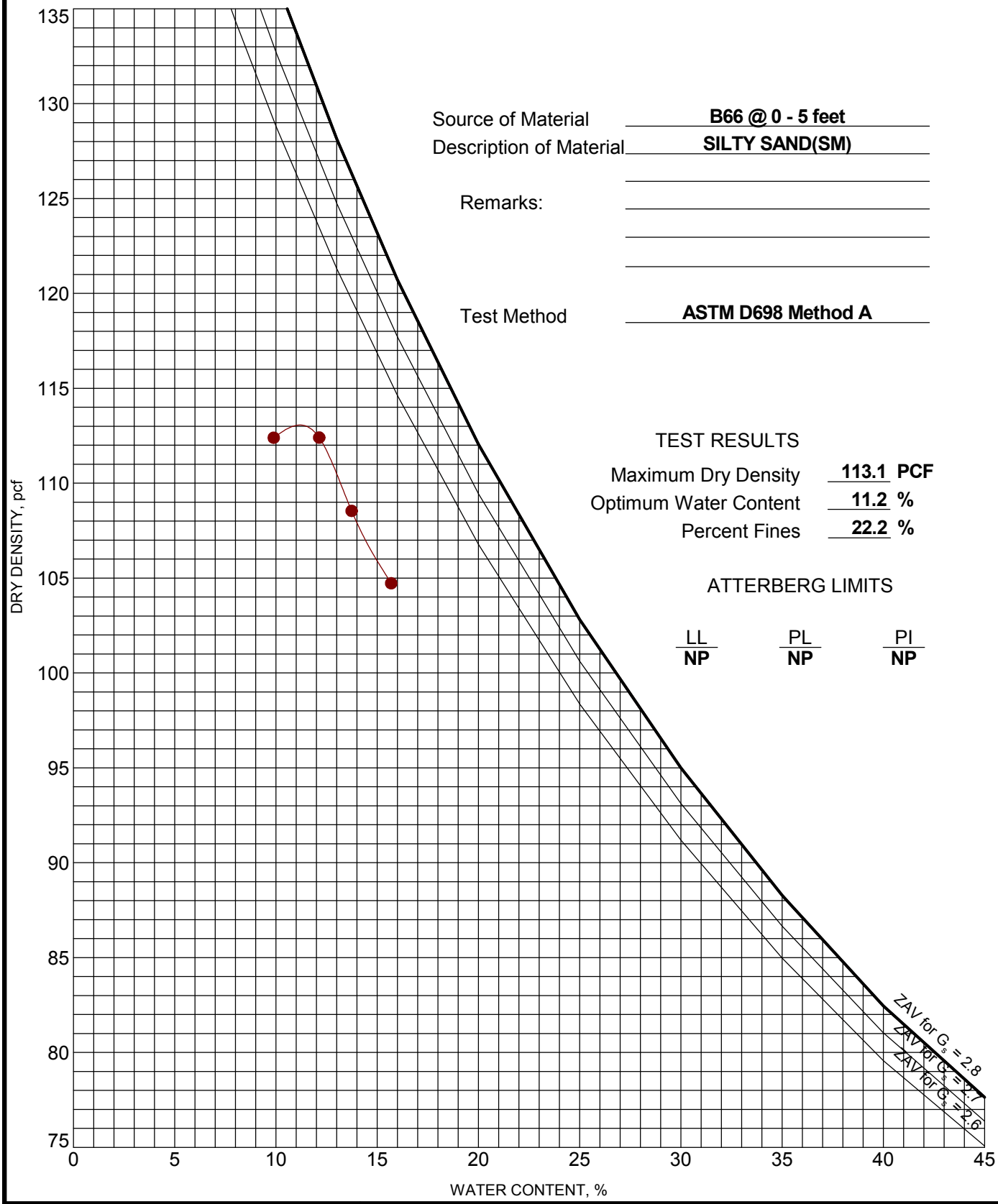
PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-41

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B66 @ 0 - 5 feet**

Description of Material: **SILTY SAND(SM)**

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**113.1** PCF
Optimum Water Content	**11.2** %
Percent Fines	**22.2** %

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 65165267.GPJ TERRACON2012.GDT 11/18/16

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon

4685 S Ash Ave Ste H-4
Tempe, AZ

PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-42

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI 50	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
B1	0.0 - 5.0	SP-SM			11	NP	NP	NP	106	11.8	100	-1.0		9.9	1436	303	150	
B1	2.0 - 3.0	SP-SM	101	10					101	10.4	100	0.8						1, 2
B2	0.0 - 5.0	CL			54	34	22	12										
B2	4.0 - 5.0	CL	114	14					114	13.7	500	0.5						1, 2
B3	0.0 - 5.0	SM			38	NP	NP	NP										
B3	1.0 - 2.0	SM	101	3					101	3.1	100	0.7						1, 2
B4	0.0 - 5.0	SM			19	NP	NP	NP	110	8.0	100	0.0						
B4	5.0 - 6.0	SM	96	6														1, 2
B5	0.0 - 5.0	SM			23	NP	NP	NP						8.4	1746	330	38	
B5	2.0 - 3.0	SM	99	4					99	4.4	100	0.3						1, 2
B5	5.0 - 6.5	SM			16	NP	NP	NP										
B6	0.0 - 5.0	SP-SM			10	NP	NP	NP										
B6	5.0 - 6.0	SP-SM	94	2					94	1.9	500	0.6						1, 2
B7	0.0 - 5.0	SP-SM			11	NP	NP	NP										
B7	2.0 - 3.0	SP-SM	98	9					98	8.5	100	0.6						1, 2
B8	0.0 - 5.0	SM			15	NP	NP	NP	107	8.9	100	0.0						
B8	5.0 - 6.0	SM	115	1														1, 2
B9	0.0 - 5.0	SP-SM			8	NP	NP	NP						8.6	1077	2420	37	
B9	1.0 - 2.0	SP-SM	105	5					105	5.4	100	0.6						1, 2
B9	9.0 - 10.5	SP-SM			12	NP	NP	NP										
B10	0.0 - 5.0	SM			34	NP	NP	NP										
B10	5.0 - 6.0	SM	91	2					91	1.7	500	0.8						1, 2
B11	0.0 - 5.0	SM			15	NP	NP	NP										
B11	1.0 - 2.0	SM	89	3					89	3.3	100	1.3						1, 2
B12	0.0 - 5.0	SM			14	NP	NP	NP										

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ
PH. 480-897-8200 FAX. 480-897-1133

PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-43

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI 50	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
B13	0.0 - 5.0	SM			17	NP	NP	NP	105	9.8	10	0.0		9.1	6693	61	47	
B13	2.0 - 3.0	SM	103	4					103	3.6	100	-0.3						1, 2
B14	0.0 - 5.0	SM			16	NP	NP	NP										
B14	5.0 - 6.0	SM	98	5														1, 2
B15	0.0 - 5.0	SP-SM			9	NP	NP	NP	98	9.7	100	0.0						
B15	-					NP	NP	NP										
B16	0.0 - 5.0	SM			33	NP	NP	NP	107	8.9	100	0.3		9.0	6169	52	45	
B16	5.0 - 6.0	SM	109	14					109	14.2	500	-0.5						1, 2
B17	5.0 - 10.0	SM			13	NP	NP	NP	103	10.8	100	0.2						
B18	0.0 - 5.0	SM			15	NP	NP	NP										
B19	0.0 - 5.0	SM			22	NP	NP	NP										
B20	0.0 - 5.0	SM			15	NP	NP	NP						9.0	7372	33	25	
B20	5.0 - 6.5	SM	100	4														1, 2
B21	0.0 - 4.0	SM			33	NP	NP	NP										
B21	4.0 - 10.0	SM			22	NP	NP	NP	14	9.7	100	0.1						
B22	0.0 - 5.0	SM			19	NP	NP	NP										
B23	0.0 - 5.0	SM			23	NP	NP	NP										
B24	1.0 - 6.0	SM			17	NP	NP	NP	111	8.4	100	0.0						
B25	0.0 - 5.0	SM			39	NP	NP	NP	106	10.4	100	0.0		9.6	3201	85	50	
B25	2.0 - 3.0	SM	96	9					96	8.8	100	-2.9						1, 2
B26	0.0 - 5.0	SM			16	NP	NP	NP						9.3	6305	47	38	
B26	5.0 - 6.0	SM	101	6					101	6.0	500	-0.3						1, 2
B27	0.0 - 5.0	CL-ML			63	24	17	7						9.5	3007	83	55	
B27	2.0 - 3.0	CL-ML	108	17					108	16.7	100	-0.4						1, 2
B28	0.0 - 5.0	SP			3	NP	NP	NP										

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ
PH. 480-897-8200 FAX. 480-897-1133

PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-44

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI 50	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
B28	5.0 - 5.4	SP	98	2														1, 2
B29	0.0 - 5.0	SM			16	NP	NP	NP										
B29	2.0 - 3.0	SM	101	5					101	5.1	100	-1.3						1, 2
B30	0.0 - 5.0	SM			12	NP	NP	NP	102	11.2	100	-0.4						
B30	5.0 - 5.4	SM	98	4														1, 2
B31	0.0 - 5.0	SM			18	NP	NP	NP										
B31	2.0 - 3.0	SM	104	8					104	8.1	100	-0.5						1, 2
B32	0.0 - 5.0	SM			16	NP	NP	NP						8.4		69	38	
B33	0.0 - 5.0	SM			14	NP	NP	NP										
B33	2.0 - 2.8	SM	98	8														1, 2
B34	0.0 - 3.0	SM			17	NP	NP	NP										
B35	0.0 - 5.0	SP-SM			12	NP	NP	NP	111	9.3	100	-0.5						
B35	2.0 - 2.9	SP-SM	109	3					109	3.1	100	-0.6						1, 2
B36	0.0 - 5.0	SP-SM			6	NP	NP	NP								77	25	
B36	5.0 - 5.3			3														2
B37	0.0 - 5.0	SM			19	NP	NP	NP	110	8.2	100	0.5						
B37	2.0 - 3.0	SM	109	6					109	6.2	100	0.4						1, 2
B38	0.0 - 5.0	SP-SM			7	NP	NP	NP										
B39	0.0 - 5.0	SM			18	NP	NP	NP										
B39	2.0 - 3.0	SM	91	15					91	15.1	100	-1.4						1, 2
B40	0.0 - 5.0	SM			14	NP	NP	NP								28	50	
B40	5.0 - 5.9		104	9														1, 2
B41	0.0 - 5.0	SP-SM			6	NP	NP	NP	112	9.4	100	-1.3						
B42	0.0 - 5.0	SM			19	NP	NP	NP										
B42	5.0 - 5.5	SM	102	5														1, 2

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ
PH. 480-897-8200 FAX. 480-897-1133

PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-45

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI_{50}	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
B43	0.0 - 5.0	SM			19	NP	NP	NP								41	40	
B43	2.0 - 2.8	SM	111	6														1, 2
B44	0.0 - 5.0	SM			14	NP	NP	NP	106	11.5	100	-1.2						
B45	0.0 - 5.0	SP-SM			11	NP	NP	NP										
B45	2.0 - 2.9	SM	111	6														1, 2
B46	0.0 - 5.0	SM			14	NP	NP	NP								41	40	
B46	5.0 - 5.8		102	3														1, 2
B47	0.0 - 5.0	SM			24	NP	NP	NP	107	9.4	100	-0.1						
B48	0.0 - 4.0	SM			17	NP	NP	NP										
B48	4.0 - 9.0	SM			32	NP	NP	NP	108	9.2	100	0.1						
B49	0.0 - 5.0	ML			50	NP	NP	NP										
B49	8.0 - 10.0	SM			30	NP	NP	NP										
B50	0.0 - 5.0	SM			24	NP	NP	NP	106	9.8	100	0.3				77	25	
B50	5.0 - 6.0	SM	104	8					104	7.7	500	2.6						1, 2
B51	0.0 - 5.0	SP			4	NP	NP	NP										
B51	2.0 - 2.8	SP	113	4														1, 2
B52	0.0 - 5.0	SP-SM			6	NP	NP	NP								57	50	
B52	5.0 - 5.8	SP-SM	102	2														1, 2
B53	0.0 - 5.0	SP			4	NP	NP	NP										
B53	2.0 - 2.9	SP	102	4														1, 2
B54	0.0 - 5.0	SM			17	NP	NP	NP										
B54	5.0 - 5.7	SM	100	3														1, 2
B55	0.0 - 5.0	SP-SM			7	NP	NP	NP	105	10.0	100	0.9				28	48	
B56	0.0 - 5.0	SP-SM			6	NP	NP	NP										
B57	0.0 - 5.0	SP-SM			12	NP	NP	NP										

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ
PH. 480-897-8200 FAX. 480-897-1133

PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

EXHIBIT: B-46

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI 50	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
B57	2.0 - 3.0	SP-SM	108	3					108	2.9	100	-0.3						1, 2
B58	0.0 - 5.0	SP			4	NP	NP	NP	104	11.1	100	0.4				41	27	
B59	0.0 - 5.0	SP-SM			11	NP	NP	NP										
B59	2.0 - 2.9	SP-SM	120	4														1, 2
B60	0.0 - 5.0	SP-SM			7	NP	NP	NP								41	45	
B61	0.0 - 5.0	SM			21	NP	NP	NP										
B62	0.0 - 5.0	SP-SM			11	NP	NP	NP										
B63	0.0 - 5.0	SP-SM			9	NP	NP	NP	110	9.6	100	0.0				77	75	
B63	2.0 - 2.8	SP-SM	103	5														1, 2
B64	0.0 - 5.0	SP-SM			6	NP	NP	NP										
B65	0.0 - 5.0	SM			18	NP	NP	NP								28	55	
B65	2.0 - 3.0	SM	103	6					103	6.3	100	0.2						1, 2
B66	0.0 - 5.0	SM			22	NP	NP	NP	106	7.6	100	-0.5				41	208	
B66	5.0 - 6.0	SM	94	2					94	2.0	500	-0.5						1, 2
RL21+500	0.5 - 1.5	SM												8.5	3783	57	45	2
RL23+870	0.5 - 1.5	SM												8.8	6111	66	38	2
RL24+370	0.5 - 1.5	SM												8.6	5820	58	50	2
RL24+735	0.5 - 1.5	SM												8.6	7566	33	25	2
RL26+010	0.0 - 0.5	SM												8.2	5529	69	38	2
RL26+010	-	SM												8.2	4850	63	37	2
RL26+240	0.5 - 1.5	SM												9.1	5675	55	38	2
RL30+320	0.5 - 1.5	SM												8.3	7178	55	25	2

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: N35(8)1,2,4 and N5045(1)1,2,4

SITE: Sweetwater, Arizona

Terracon
4685 S Ash Ave Ste H-4
Tempe, AZ
PH. 480-897-8200 FAX. 480-897-1133

PROJECT NUMBER: 65165267

CLIENT: United States Department of the Interior
Gallup, New Mexico

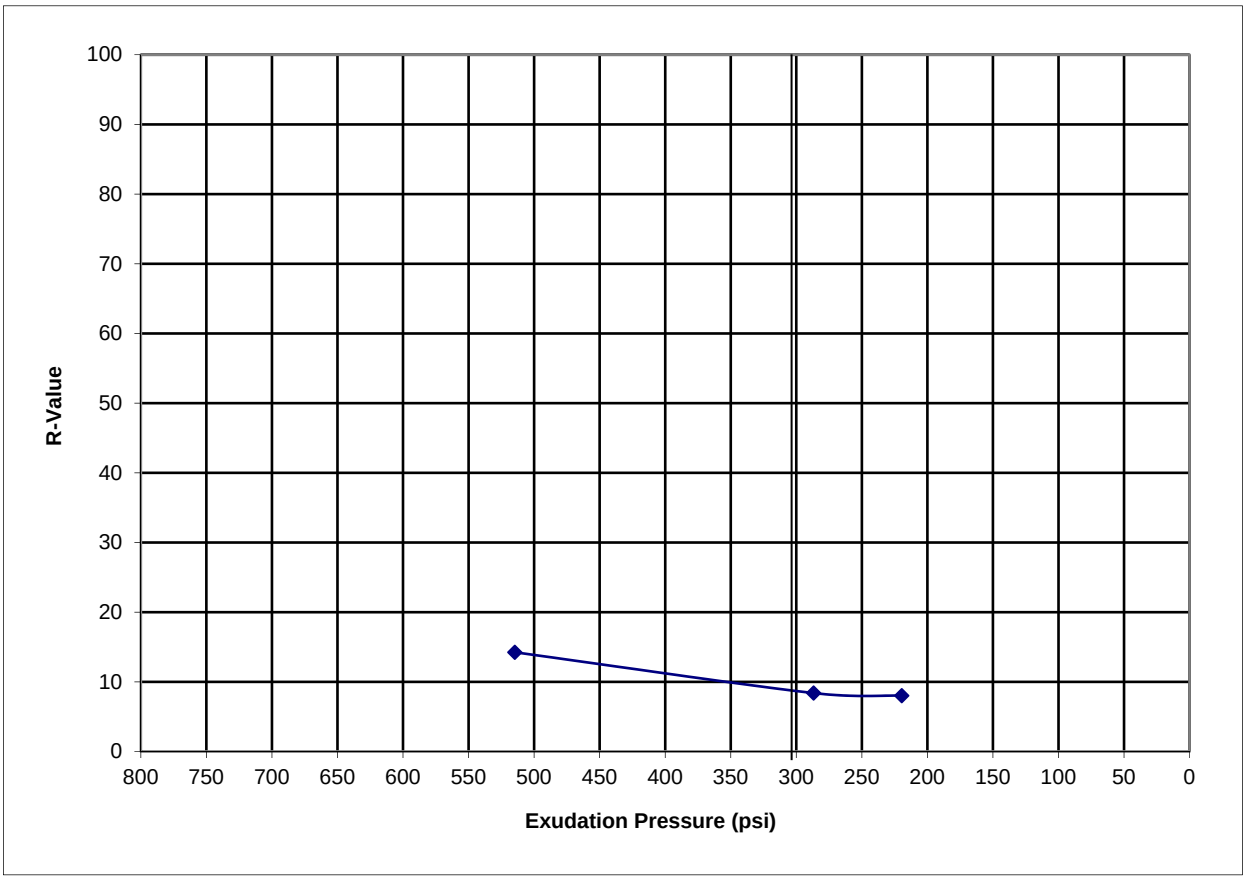
EXHIBIT: B-47

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Sandy Lean Clay	**LAB NO:**	
SAMPLE SOURCE:	B-2 @ 0'-5'	**DATE RECEIVED:**	11/02/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	23.1%	20.5%	17.9%
Compaction Pressure (psi)	*	75	150
Specimen Height (inches)	2.61	2.50	2.44
Dry Density (pcf)	102.8	107.3	112.3
Horiz. Pres. @ 1000lbs (psi)	65.0	60.0	53.0
Horiz. Pres. @ 2000lbs (psi)	140.0	140.0	128.0
Displacement	4.55	3.90	3.54
Expansion Pressure (psi)	0.4	0.7	2.2
Exudation Pressure (psi)	220	287	515
R Value	8	8	14

* HAND TAMPED



AASHTO R18

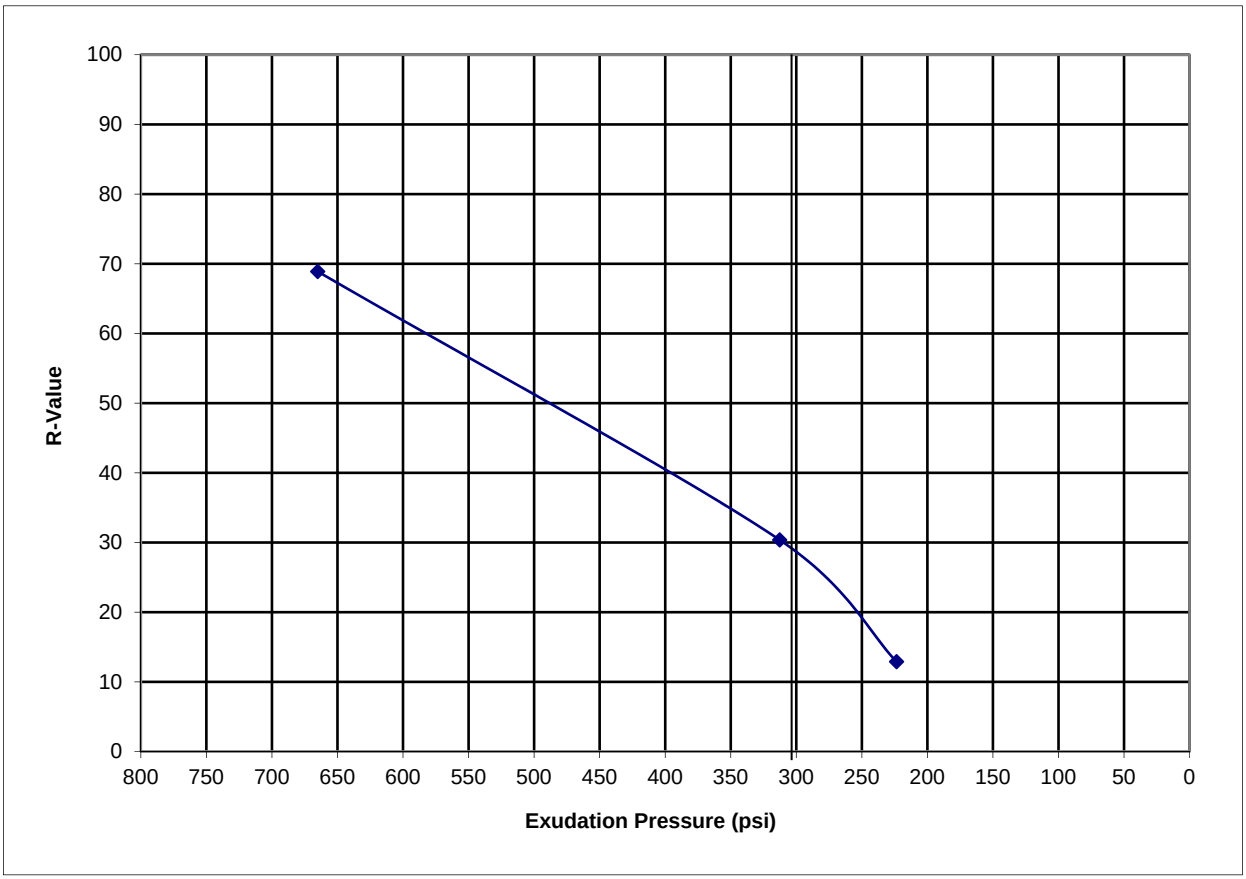
R Value at 300 PSI = 8.5

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-3 @ 0'-5'	**DATE RECEIVED:**	11/02/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	14.0%	12.3%	10.6%
Compaction Pressure (psi)	*	100	350
Specimen Height (inches)	2.52	2.48	2.40
Dry Density (pcf)	117.9	121.6	124.6
Horiz. Pres. @ 1000lbs (psi)	57.0	44.0	18.0
Horiz. Pres. @ 2000lbs (psi)	123.0	87.0	33.0
Displacement	5.08	4.81	3.94
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	224	313	665
R Value	13	30	69

* HAND TAMPED



AASHTO R18

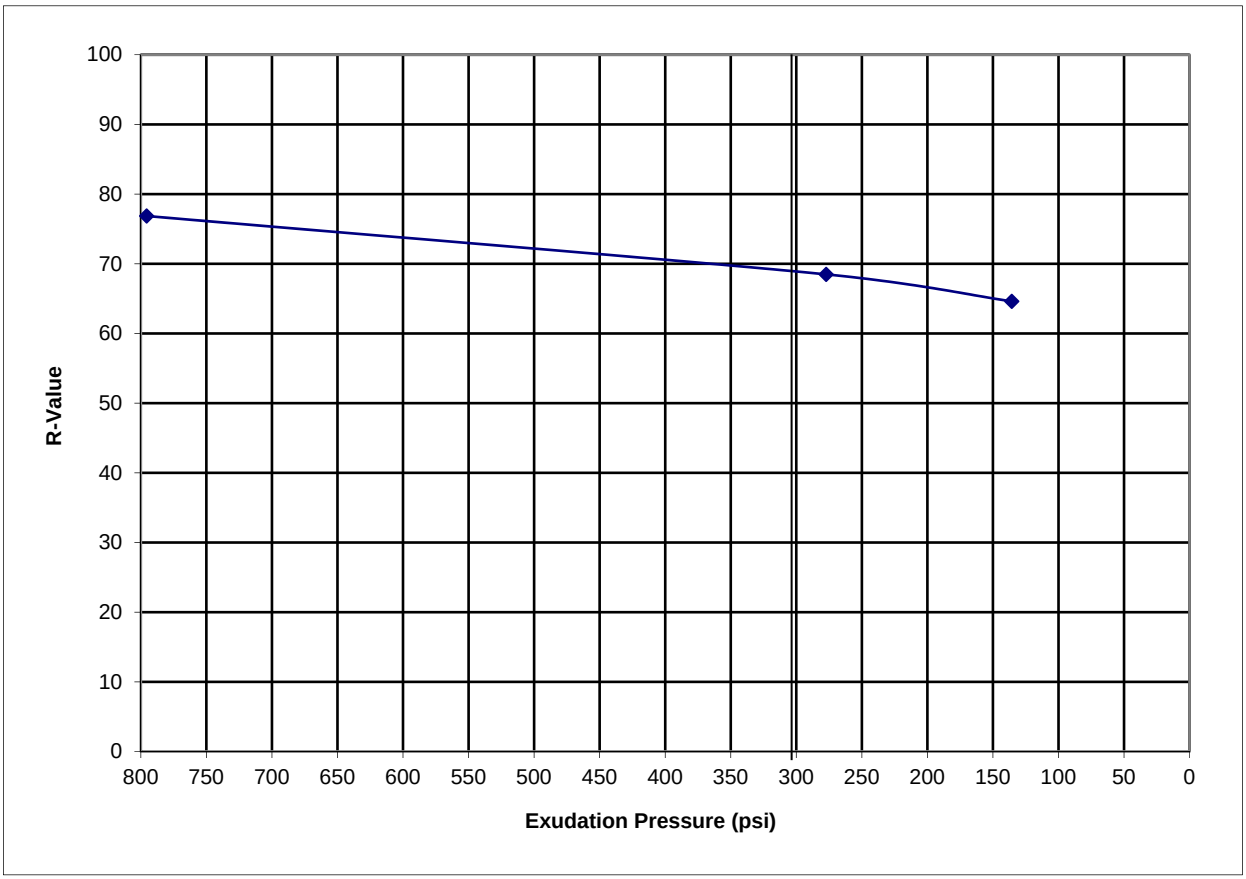
R Value at 300 PSI = 28.1

Exhibit B-49

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-8 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	12.4%	11.5%	10.7%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.55	2.50	2.50
Dry Density (pcf)	115.0	116.9	117.7
Horiz. Pres. @ 1000lbs (psi)	22.0	19.0	15.0
Horiz. Pres. @ 2000lbs (psi)	39.0	35.0	26.0
Displacement	4.25	4.11	3.88
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	136	277	796
R Value	65	68	77



AASHTO R18

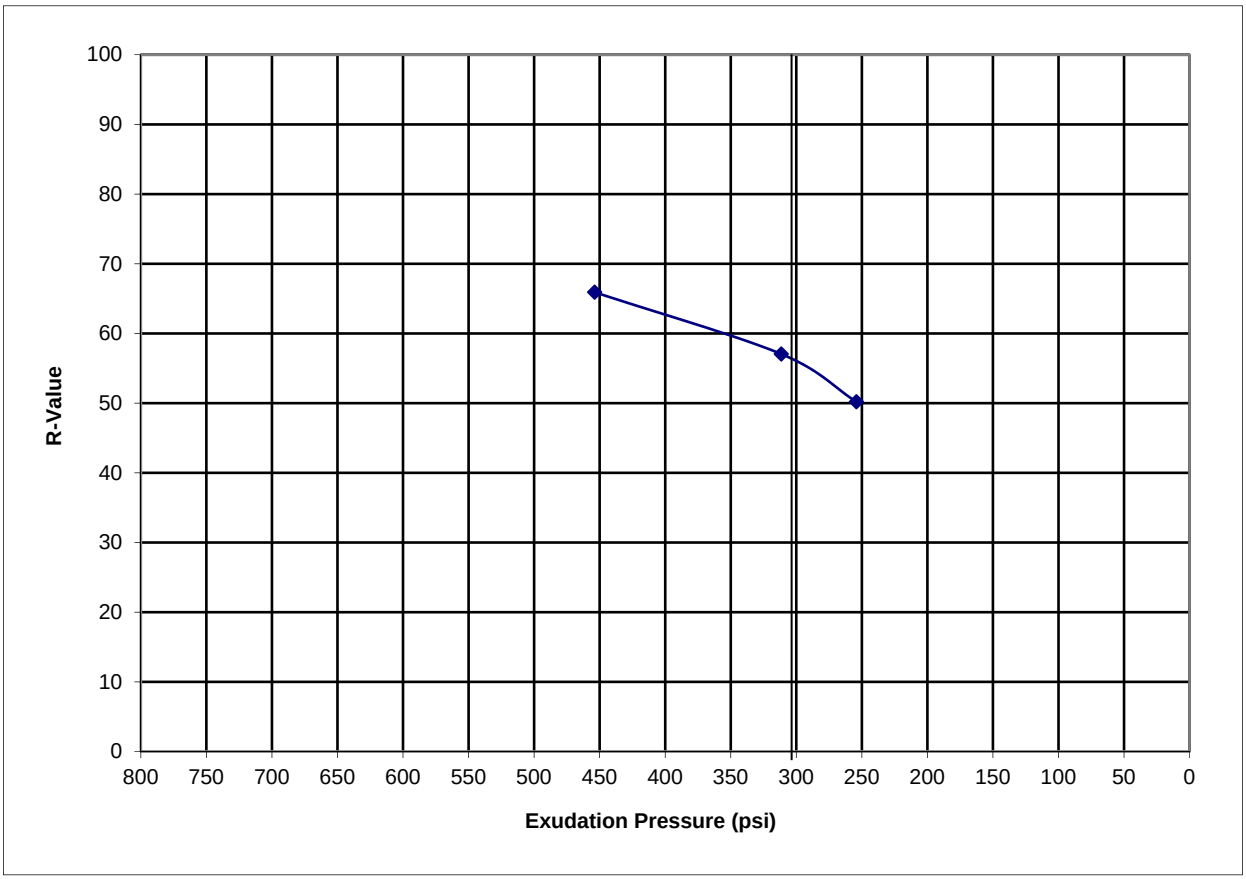
R Value at 300 PSI = 69

Exhibit B-50

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-10 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	14.4%	13.6%	12.8%
Compaction Pressure (psi)	150	250	350
Specimen Height (inches)	2.55	2.58	2.62
Dry Density (pcf)	107.7	110.1	112.1
Horiz. Pres. @ 1000lbs (psi)	28.0	25.0	21.0
Horiz. Pres. @ 2000lbs (psi)	54.0	48.0	39.0
Displacement	4.87	4.76	4.53
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	254	311	454
R Value	50	57	66



AASHTO R18

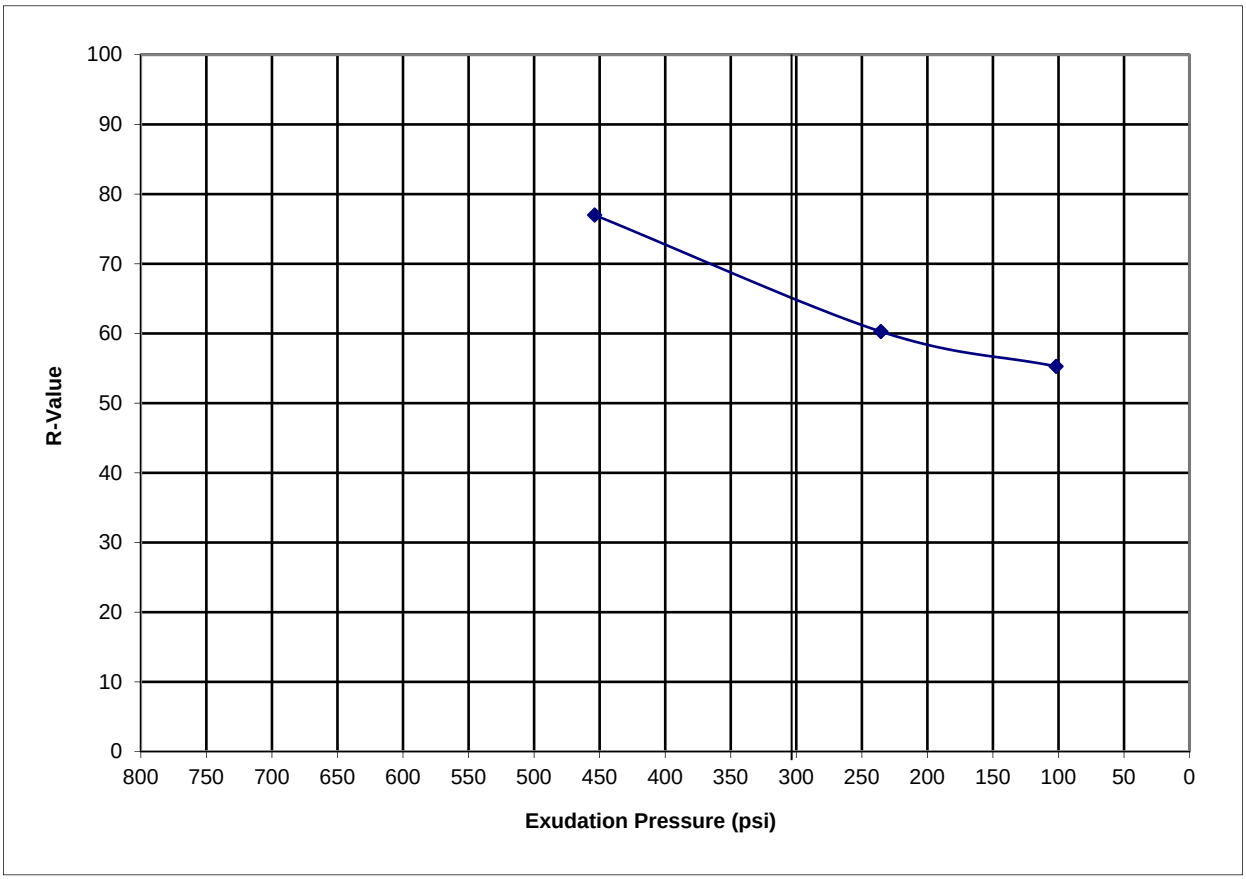
R Value at 300 PSI = 56

Exhibit B-51

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-16 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	12.6%	11.8%	11.0%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.50	2.46	2.49
Dry Density (pcf)	117.4	119.1	119.9
Horiz. Pres. @ 1000lbs (psi)	27.0	23.0	15.0
Horiz. Pres. @ 2000lbs (psi)	48.0	38.0	26.0
Displacement	4.72	5.29	3.85
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	102	235	454
R Value	55	60	77



AASHTO R18

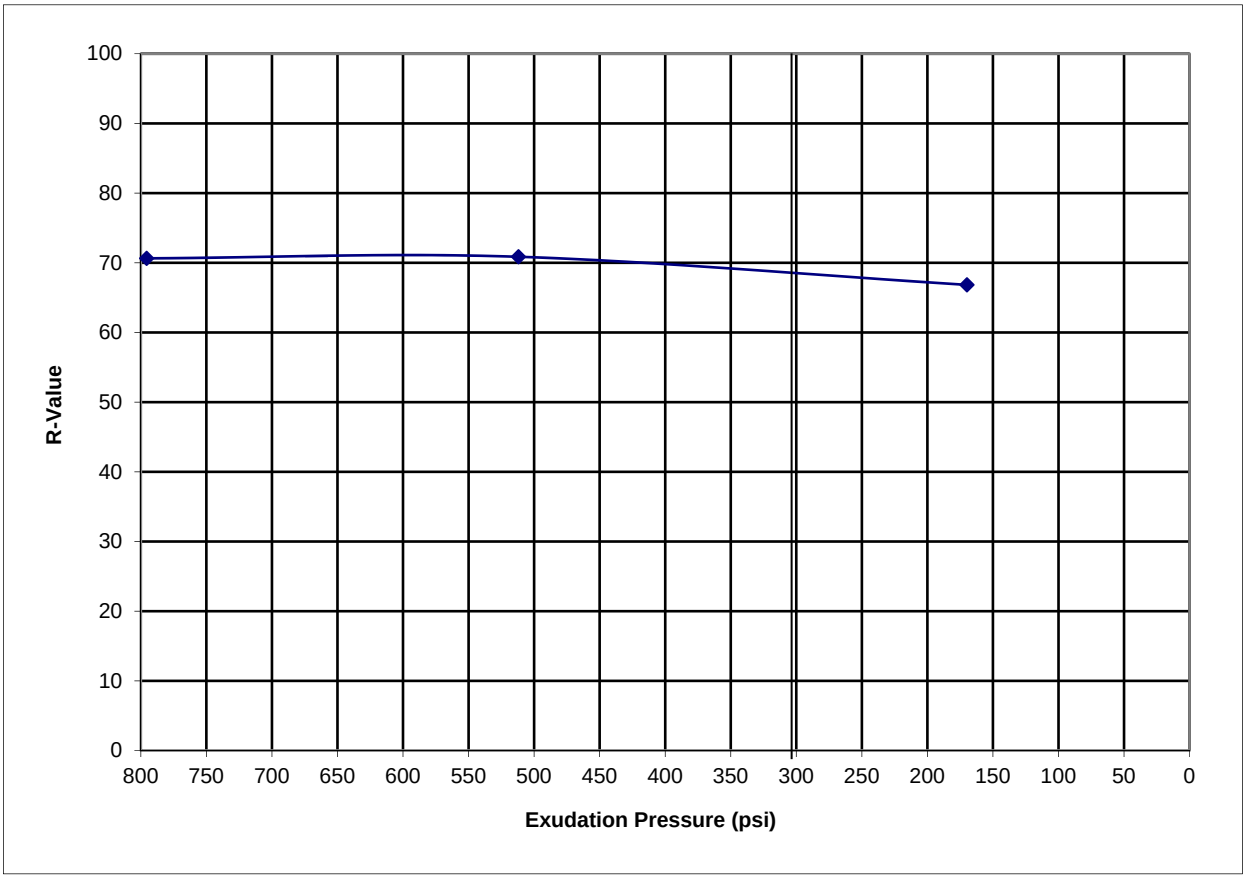
R Value at 300 PSI = 64.1

Exhibit B-52

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-19 @ 0'-5'	**DATE RECEIVED:**	11/11/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	12.4%	12.0%	11.6%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.48	2.46	2.51
Dry Density (pcf)	114.5	115.7	114.9
Horiz. Pres. @ 1000lbs (psi)	22.0	19.0	19.0
Horiz. Pres. @ 2000lbs (psi)	39.0	34.0	33.0
Displacement	3.85	3.81	4.00
Expansion Pressure (psi)	0.0	0.3	0.7
Exudation Pressure (psi)	170	512	796
R Value	67	71	71



AASHTO R18

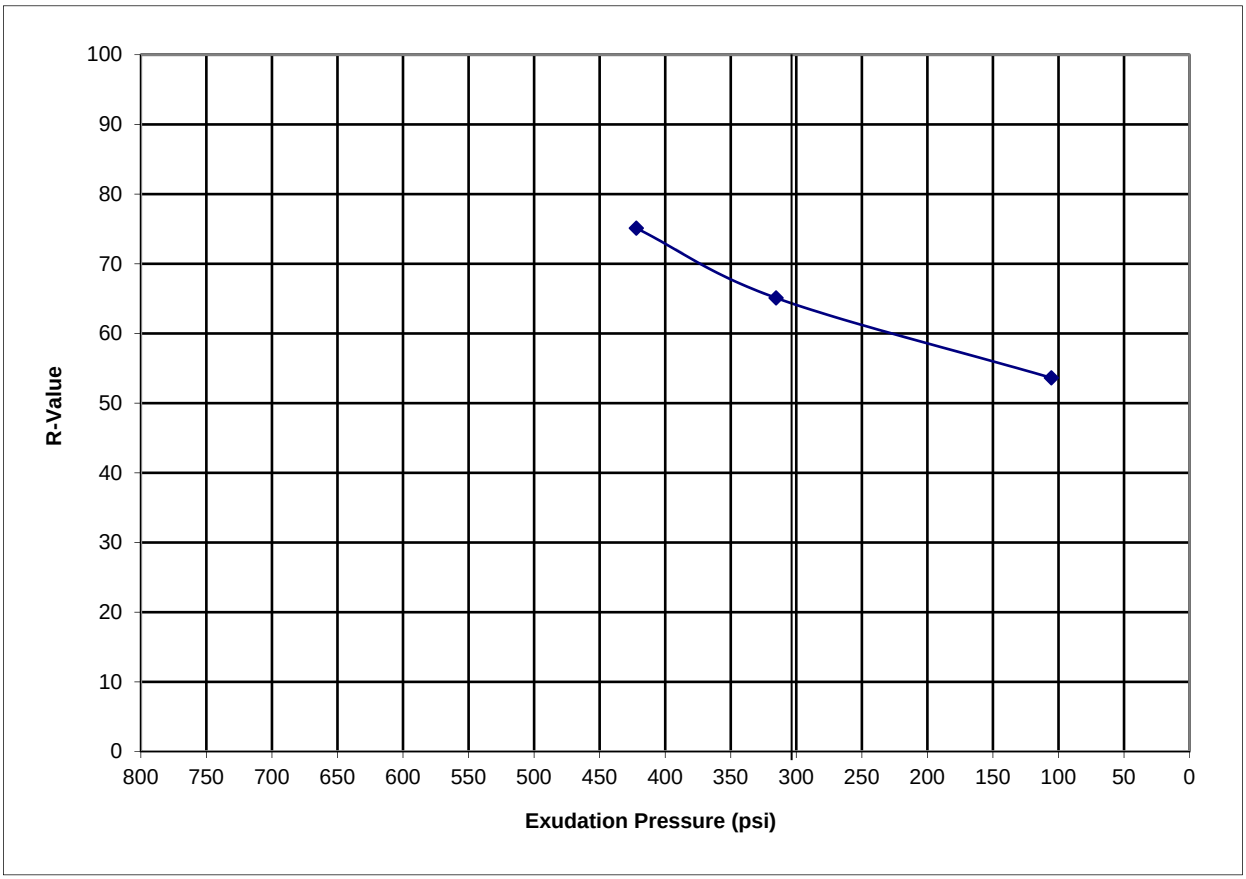
R Value at 300 PSI = 69

Exhibit B-53

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-21 @ 0'-5'	**DATE RECEIVED:**	11/11/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.4%	12.6%	11.7%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.52	2.51	2.60
Dry Density (pcf)	113.8	115.3	115.9
Horiz. Pres. @ 1000lbs (psi)	29.0	23.0	18.0
Horiz. Pres. @ 2000lbs (psi)	51.0	41.0	31.0
Displacement	4.62	3.89	3.82
Expansion Pressure (psi)	0.0	0.1	0.8
Exudation Pressure (psi)	105	315	422
R Value	54	65	75



AASHTO R18

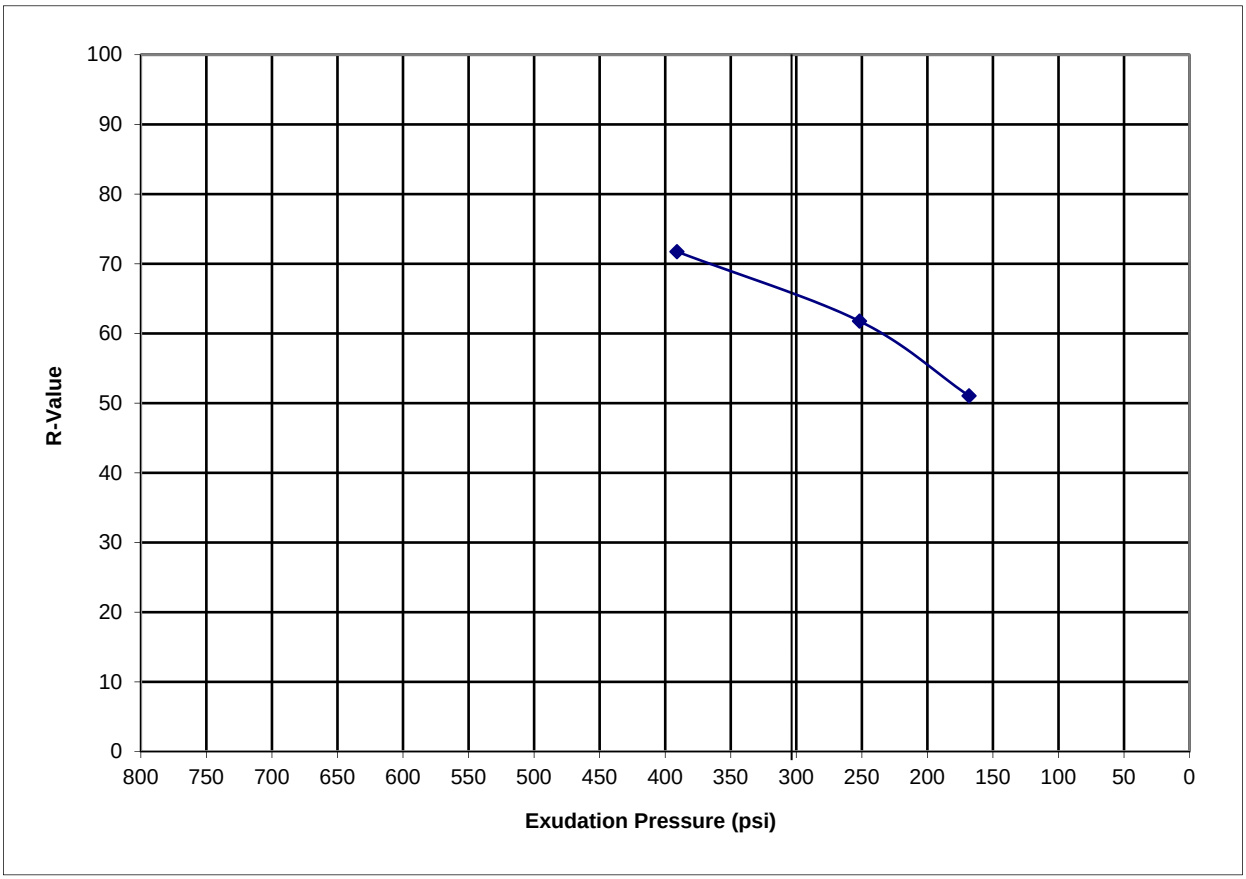
R Value at 300 PSI = 64

Exhibit B-54

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-25 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.3%	12.4%	11.6%
Compaction Pressure (psi)	325	350	350
Specimen Height (inches)	2.51	2.59	2.59
Dry Density (pcf)	113.9	115.3	117.0
Horiz. Pres. @ 1000lbs (psi)	30.0	23.0	20.0
Horiz. Pres. @ 2000lbs (psi)	52.0	43.0	34.0
Displacement	4.98	4.61	4.00
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	168	252	391
R Value	51	62	72



AASHTO R18

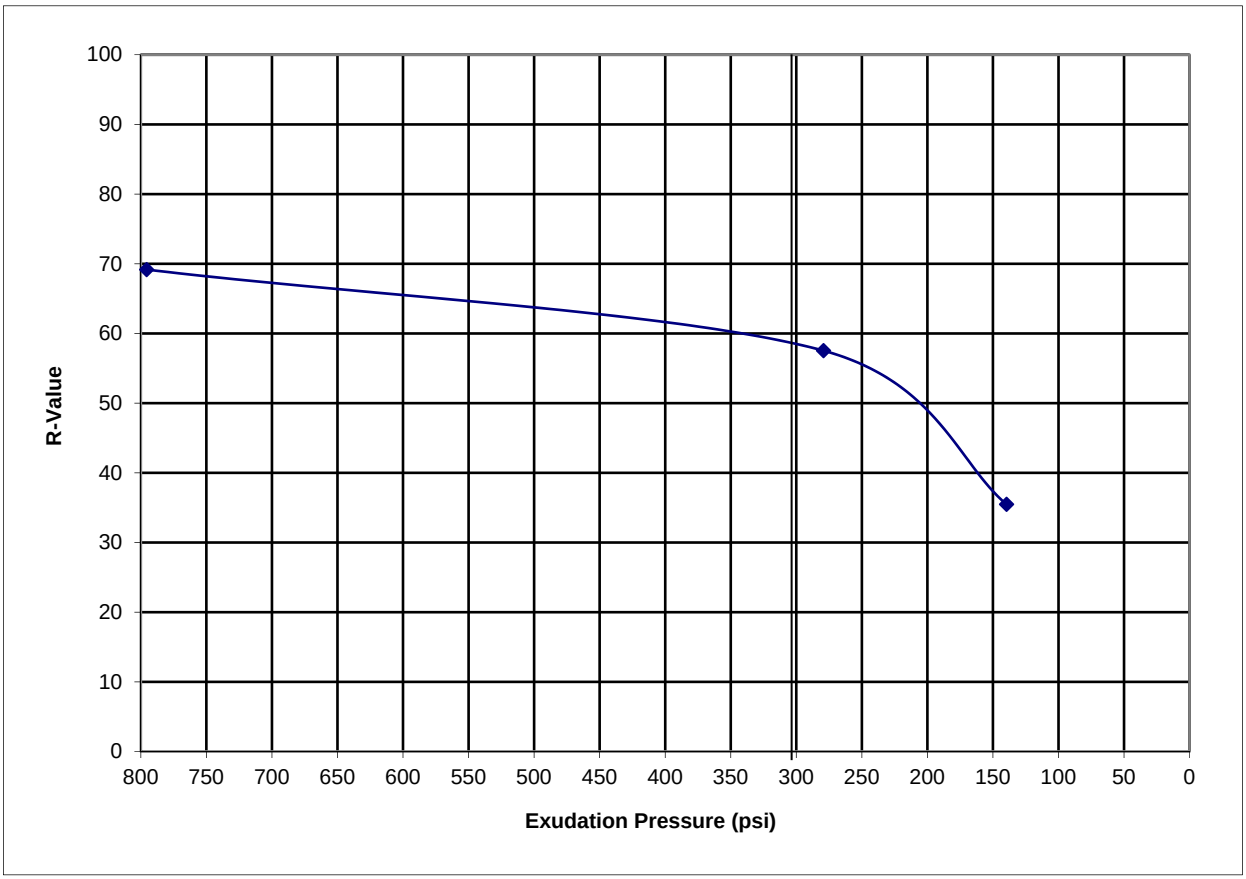
R Value at 300 PSI = 66

Exhibit B-55

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Sandy Silty Clay	**LAB NO:**	
SAMPLE SOURCE:	B-27 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	11.2%	10.4%	9.5%
Compaction Pressure (psi)	150	350	350
Specimen Height (inches)	2.42	2.47	2.54
Dry Density (pcf)	126.1	127.2	126.7
Horiz. Pres. @ 1000lbs (psi)	39.0	25.0	19.0
Horiz. Pres. @ 2000lbs (psi)	81.0	50.0	35.0
Displacement	4.09	4.06	3.98
Expansion Pressure (psi)	0.0	0.0	2.8
Exudation Pressure (psi)	140	279	796
R Value	35	58	69



AASHTO R18

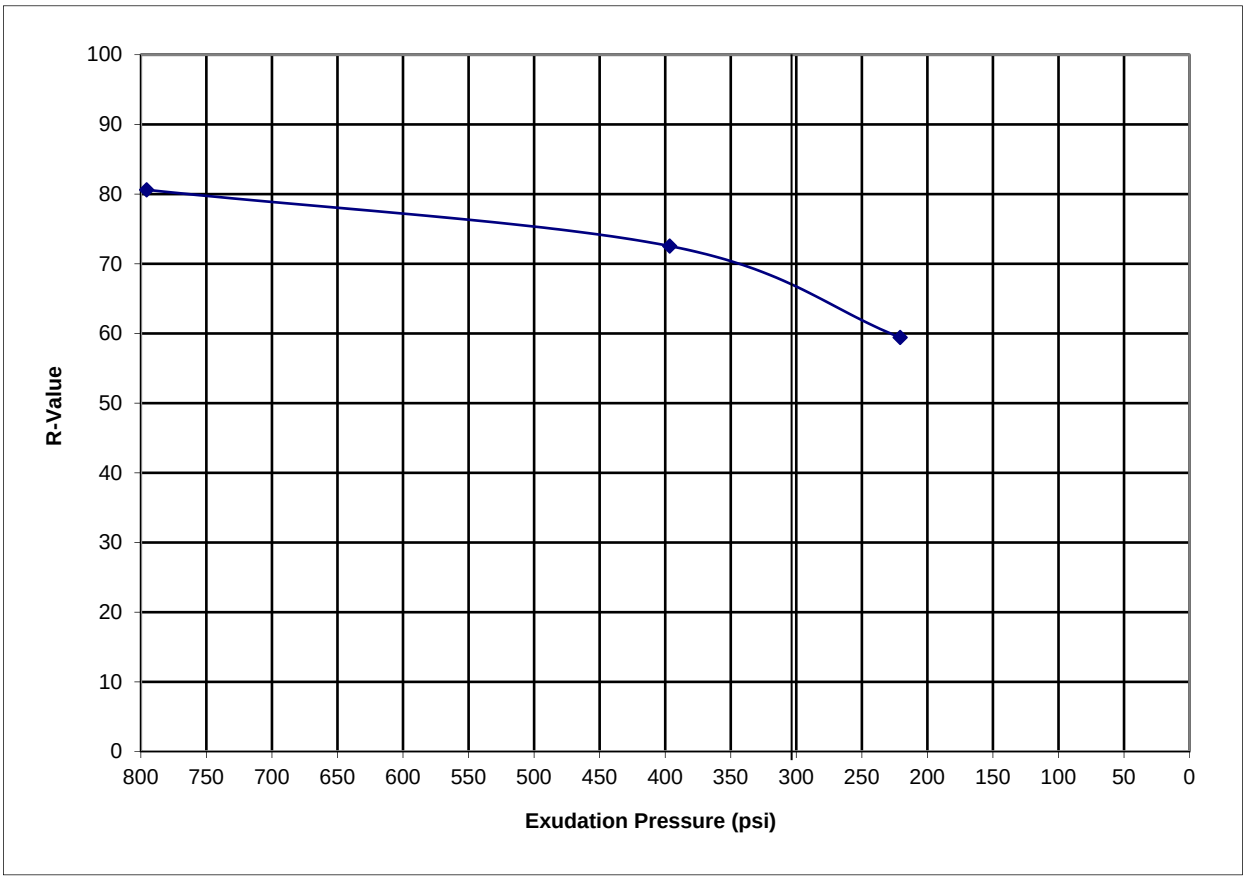
R Value at 300 PSI = 60

Exhibit B-56

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-31 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	11.9%	11.1%	10.2%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.51	2.51	2.51
Dry Density (pcf)	117.4	118.6	119.0
Horiz. Pres. @ 1000lbs (psi)	25.0	17.0	12.0
Horiz. Pres. @ 2000lbs (psi)	44.0	30.0	21.0
Displacement	4.50	4.10	3.98
Expansion Pressure (psi)	0.0	0.0	0.8
Exudation Pressure (psi)	221	397	796
R Value	59	73	81



AASHTO R18

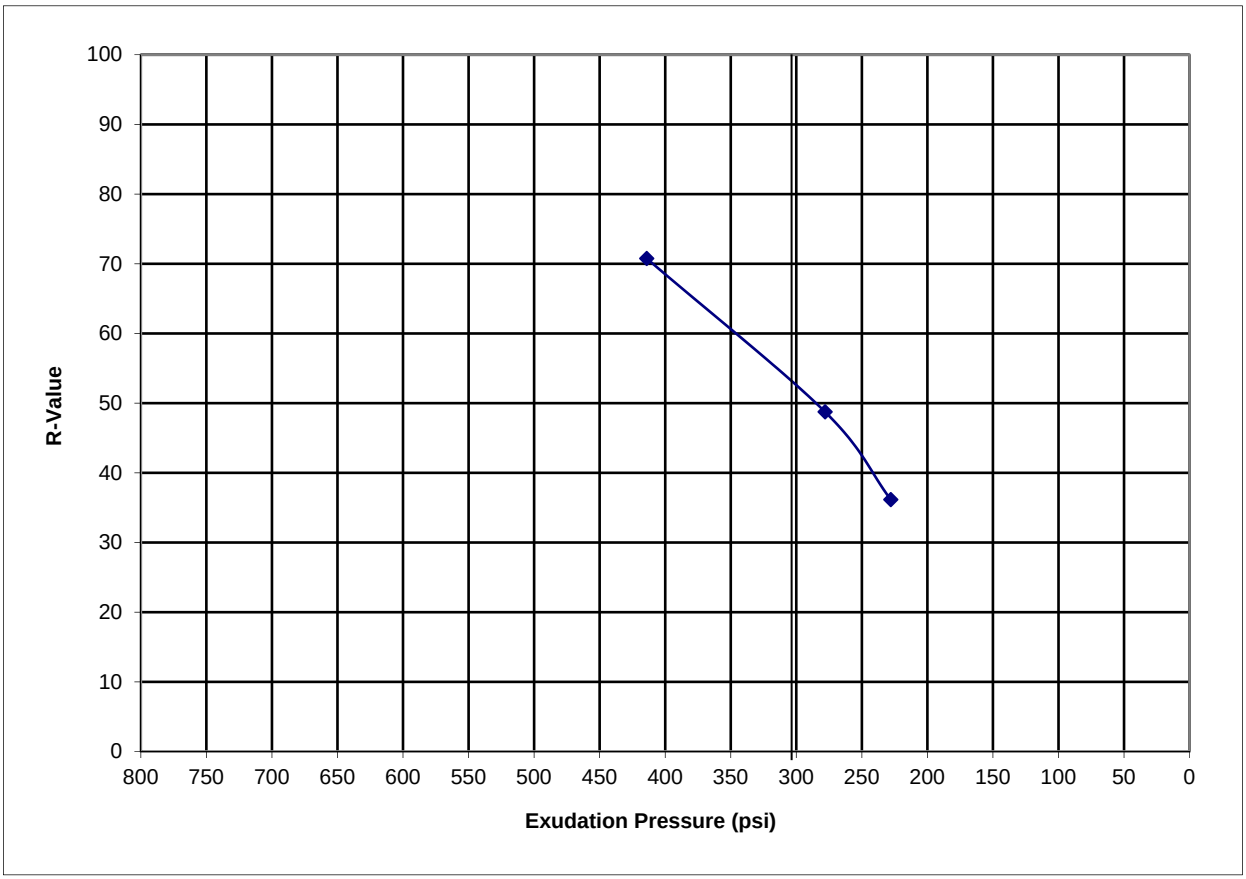
R Value at 300 PSI = 66

Exhibit B-57

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-34 @ 0'-5'	**DATE RECEIVED:**	11/04/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.1%	12.2%	11.4%
Compaction Pressure (psi)	175	300	350
Specimen Height (inches)	2.49	2.46	2.52
Dry Density (pcf)	118.6	120.5	121.2
Horiz. Pres. @ 1000lbs (psi)	38.0	29.0	17.0
Horiz. Pres. @ 2000lbs (psi)	76.0	57.0	31.0
Displacement	4.88	4.75	4.30
Expansion Pressure (psi)	0.0	0.1	1.7
Exudation Pressure (psi)	228	278	414
R Value	36	49	71



AASHTO R18

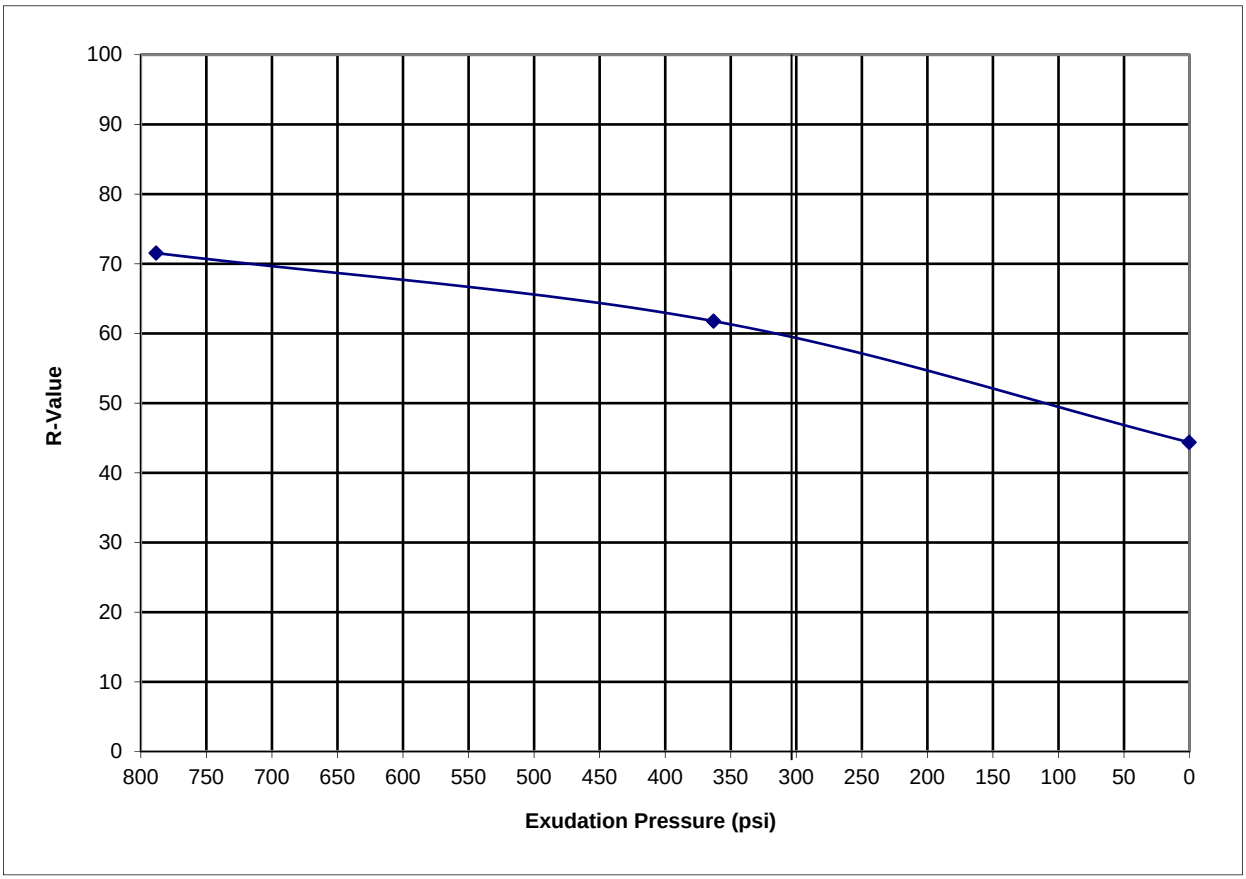
R Value at 300 PSI = 54

Exhibit B-58

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-39 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.9%	13.0%	12.2%
Compaction Pressure (psi)	250	350	250
Specimen Height (inches)	2.48	2.48	2.54
Dry Density (pcf)	119.4	120.5	120.0
Horiz. Pres. @ 1000lbs (psi)	31.0	22.0	16.0
Horiz. Pres. @ 2000lbs (psi)	65.0	41.0	30.0
Displacement	4.58	4.49	4.31
Expansion Pressure (psi)	0.0	1.0	4.5
Exudation Pressure (psi)	0	363	788
R Value	44	62	72



AASHTO R18

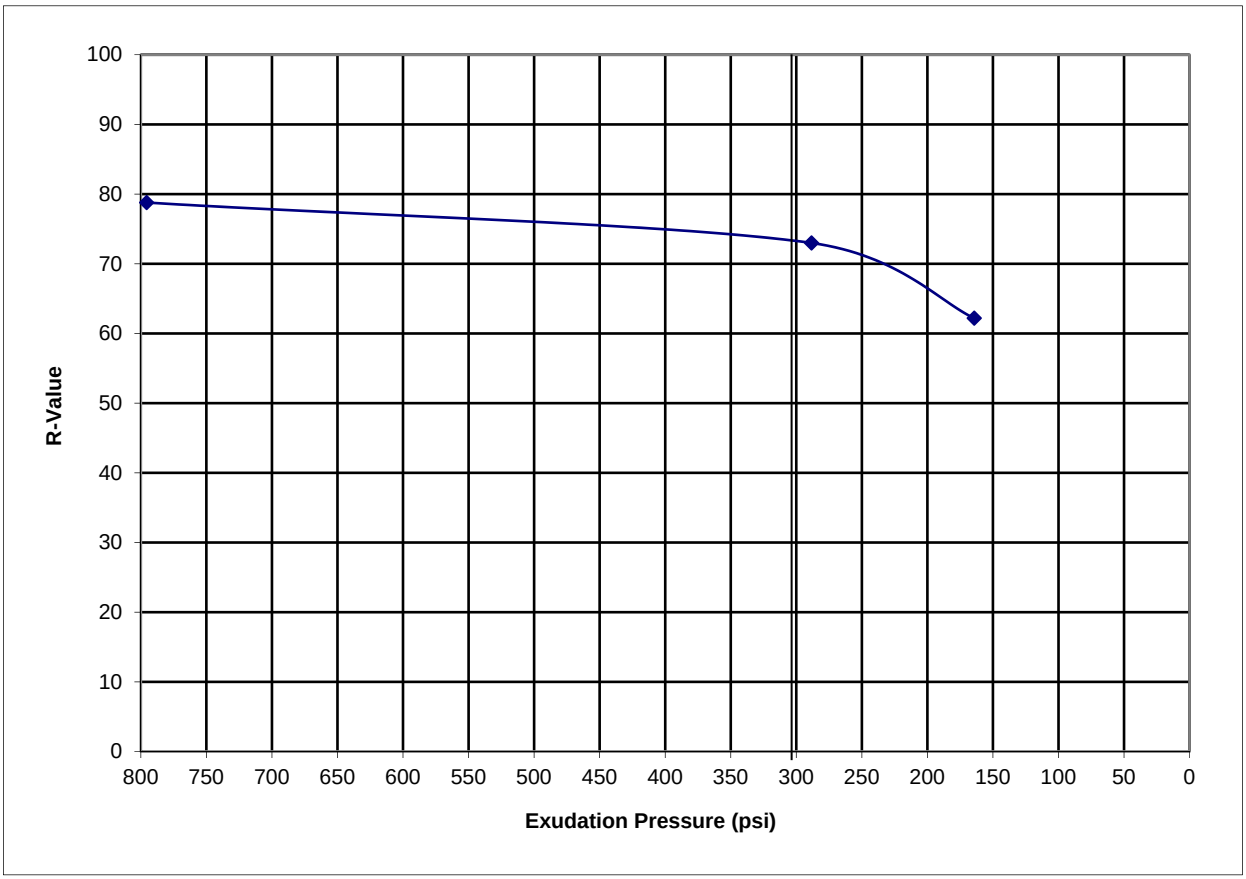
R Value at 300 PSI = 59

Exhibit B-59

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-44 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.8%	12.9%	12.1%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.53	2.51	2.53
Dry Density (pcf)	115.0	115.9	116.7
Horiz. Pres. @ 1000lbs (psi)	24.0	17.0	14.0
Horiz. Pres. @ 2000lbs (psi)	40.0	29.0	23.0
Displacement	4.56	4.18	4.01
Expansion Pressure (psi)	0.0	0.0	0.9
Exudation Pressure (psi)	164	288	796
R Value	62	73	79



AASHTO R18

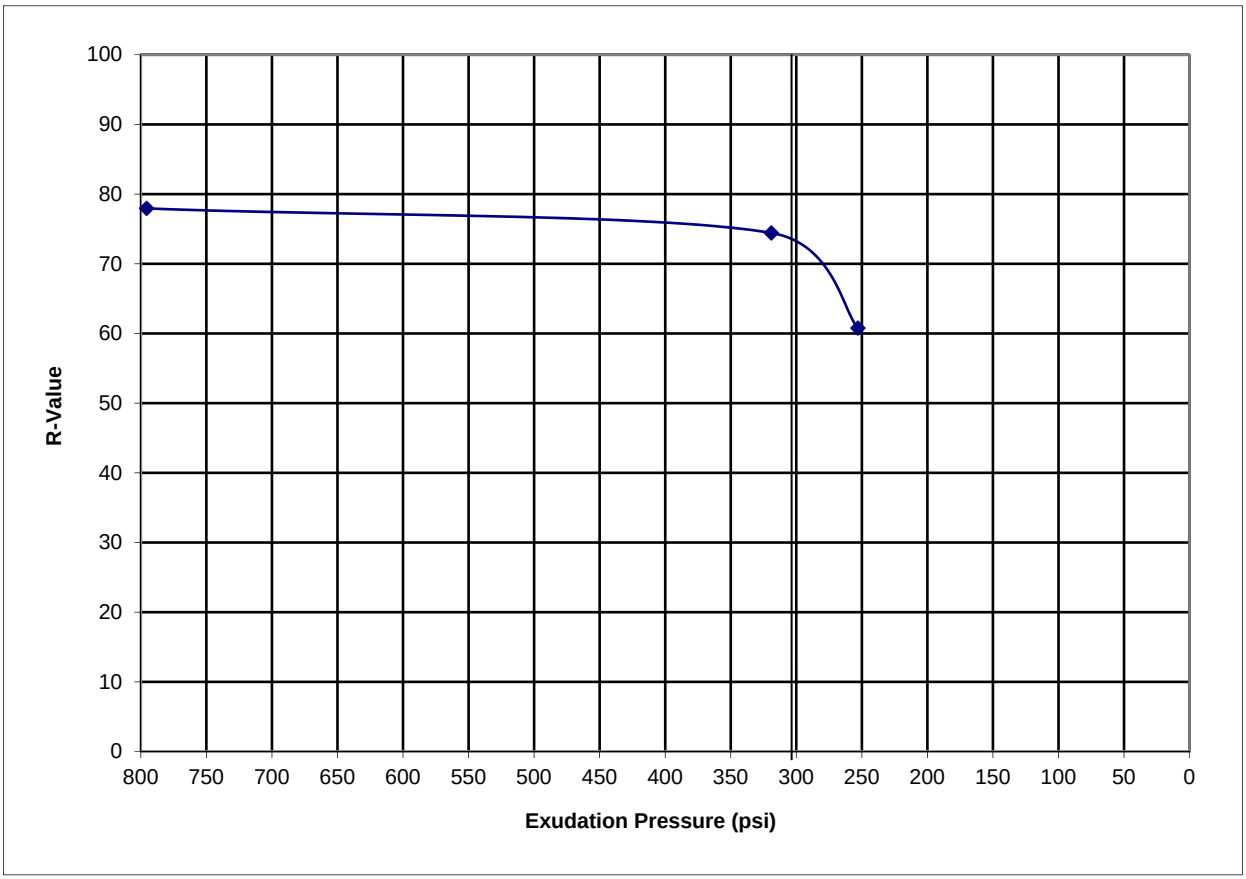
R Value at 300 PSI = 74

Exhibit B-60

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-47 @ 0'-5'	**DATE RECEIVED:**	11/11/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	12.6%	11.8%	11.3%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.53	2.50	2.50
Dry Density (pcf)	115.8	117.5	117.7
Horiz. Pres. @ 1000lbs (psi)	24.0	16.0	14.0
Horiz. Pres. @ 2000lbs (psi)	43.0	28.0	25.0
Displacement	4.39	4.05	3.82
Expansion Pressure (psi)	0.0	0.0	0.8
Exudation Pressure (psi)	253	319	796
R Value	61	74	78



AASHTO R18

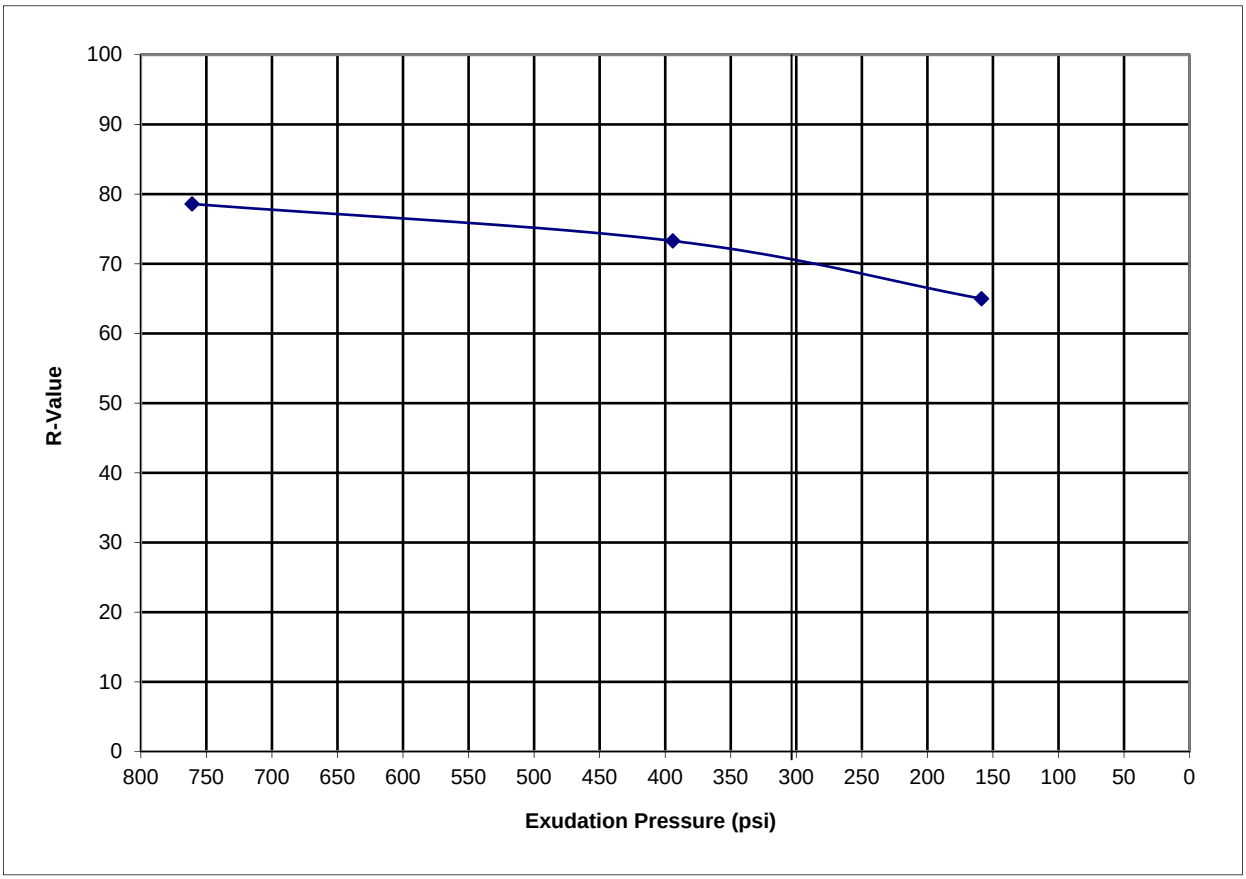
R Value at 300 PSI = 71

Exhibit B-61

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-50 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.0%	12.1%	11.7%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.55	2.48	2.51
Dry Density (pcf)	114.7	116.6	116.7
Horiz. Pres. @ 1000lbs (psi)	22.0	17.0	14.0
Horiz. Pres. @ 2000lbs (psi)	39.0	30.0	24.0
Displacement	4.18	3.95	3.86
Expansion Pressure (psi)	0.0	0.0	0.7
Exudation Pressure (psi)	159	394	761
R Value	65	73	79



AASHTO R18

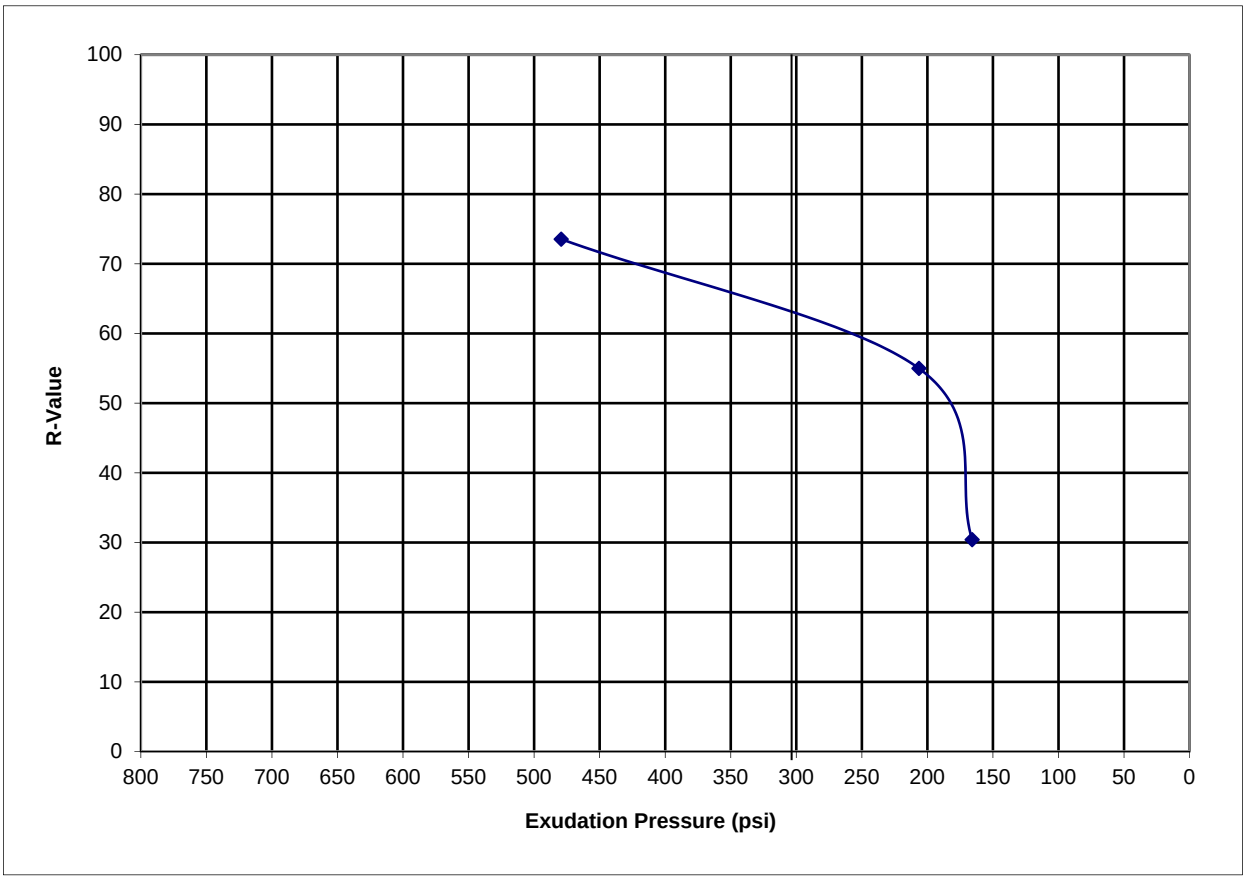
R Value at 300 PSI = 70

Exhibit B-62

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-54 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.0%	12.2%	11.3%
Compaction Pressure (psi)	125	350	350
Specimen Height (inches)	2.46	2.41	2.49
Dry Density (pcf)	121.0	122.3	122.5
Horiz. Pres. @ 1000lbs (psi)	45.0	27.0	18.0
Horiz. Pres. @ 2000lbs (psi)	85.0	51.0	30.0
Displacement	5.05	4.00	3.90
Expansion Pressure (psi)	0.0	0.0	0.9
Exudation Pressure (psi)	166	206	479
R Value	30	55	74



AASHTO R18

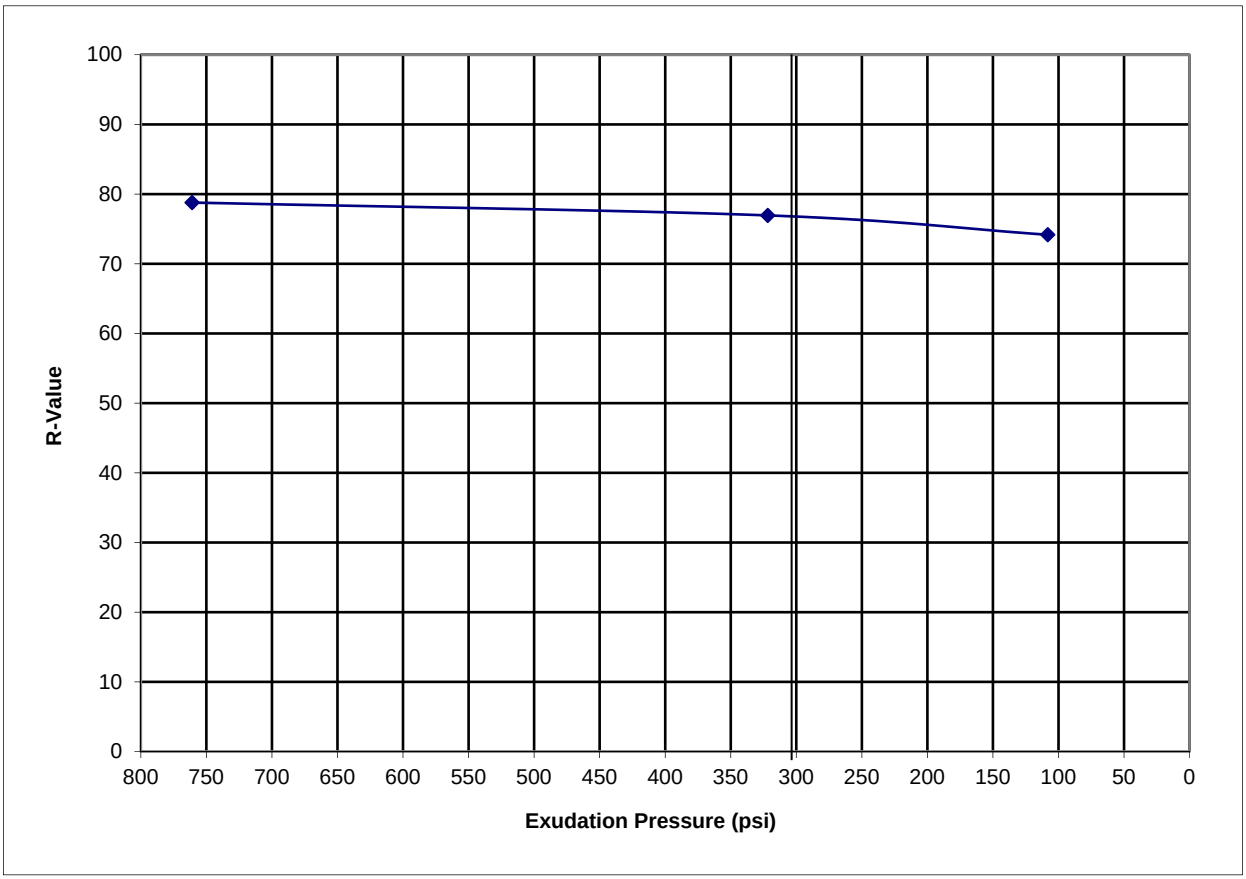
R Value at 300 PSI = 63

Exhibit B-63

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Poorly Graded Sand	**LAB NO:**	
SAMPLE SOURCE:	B-57 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	12.8%	11.9%	11.5%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.52	2.58	2.58
Dry Density (pcf)	117.4	117.3	116.8
Horiz. Pres. @ 1000lbs (psi)	16.0	15.0	14.0
Horiz. Pres. @ 2000lbs (psi)	27.0	26.0	24.0
Displacement	4.29	4.19	4.14
Expansion Pressure (psi)	0.0	0.0	0.5
Exudation Pressure (psi)	108	322	761
R Value	74	77	79



AASHTO R18

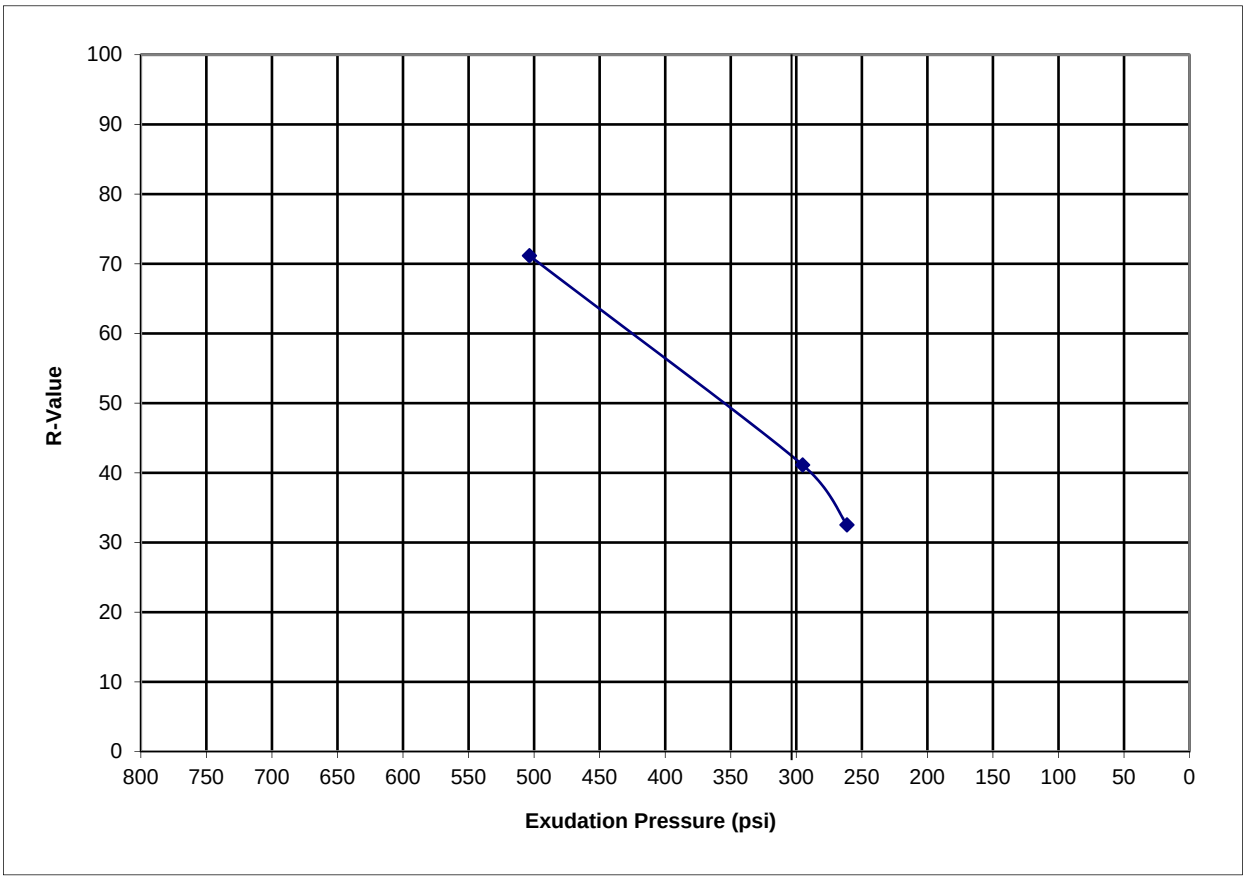
R Value at 300 PSI = 77

Exhibit B-64

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Poorly Graded Sand	**LAB NO:**	
SAMPLE SOURCE:	B-61 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	14.1%	13.3%	12.4%
Compaction Pressure (psi)	150	300	350
Specimen Height (inches)	2.48	2.47	2.39
Dry Density (pcf)	117.3	119.0	119.8
Horiz. Pres. @ 1000lbs (psi)	41.0	34.0	16.0
Horiz. Pres. @ 2000lbs (psi)	83.0	69.0	28.0
Displacement	4.81	4.72	4.29
Expansion Pressure (psi)	0.0	0.0	2.6
Exudation Pressure (psi)	261	295	504
R Value	33	41	71



AASHTO R18

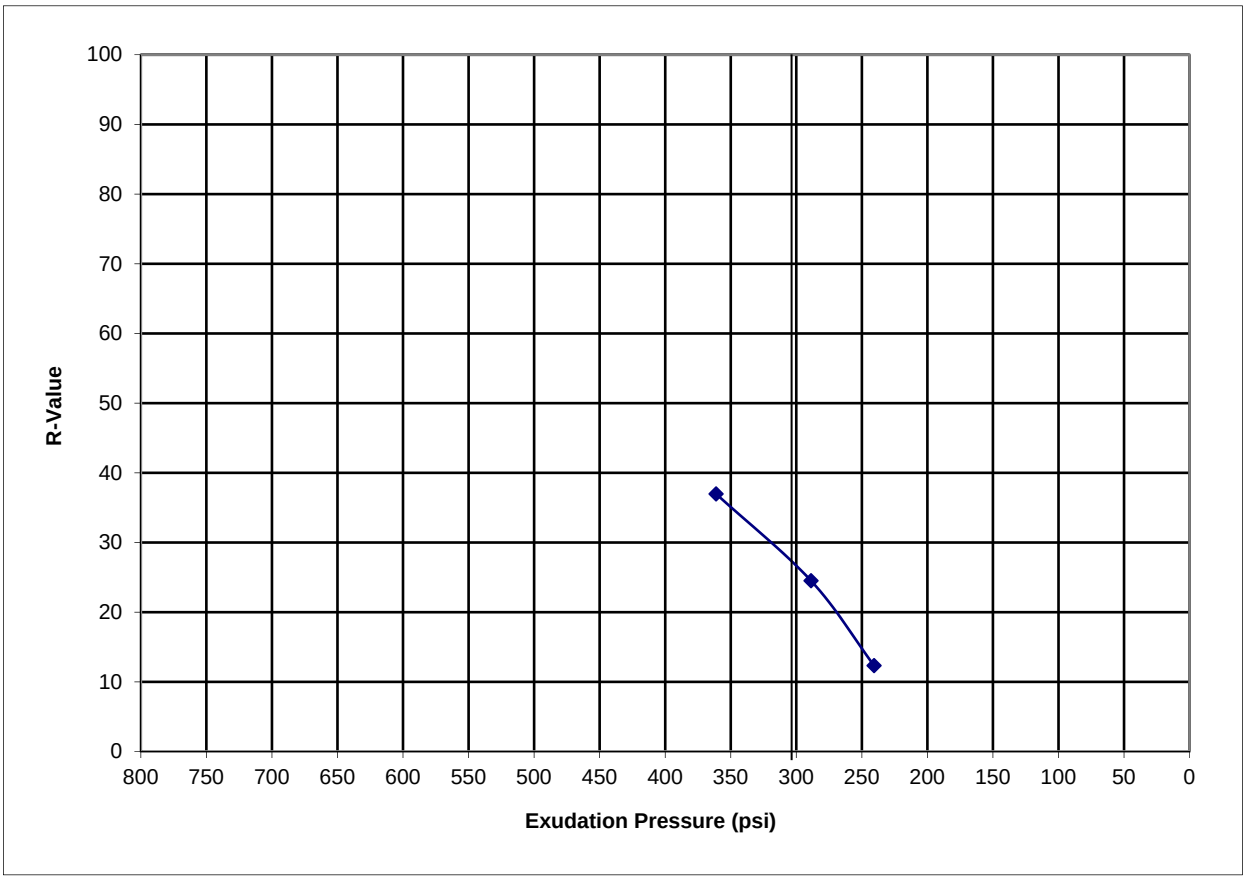
R Value at 300 PSI = 42

Exhibit B-65

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-65 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	13.0%	12.1%	11.3%
Compaction Pressure (psi)	75	100	150
Specimen Height (inches)	2.52	2.49	2.42
Dry Density (pcf)	120.8	122.9	124.9
Horiz. Pres. @ 1000lbs (psi)	53.0	46.0	36.0
Horiz. Pres. @ 2000lbs (psi)	127.0	103.0	79.0
Displacement	4.62	4.26	4.03
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	241	289	361
R Value	12	25	37



AASHTO R18

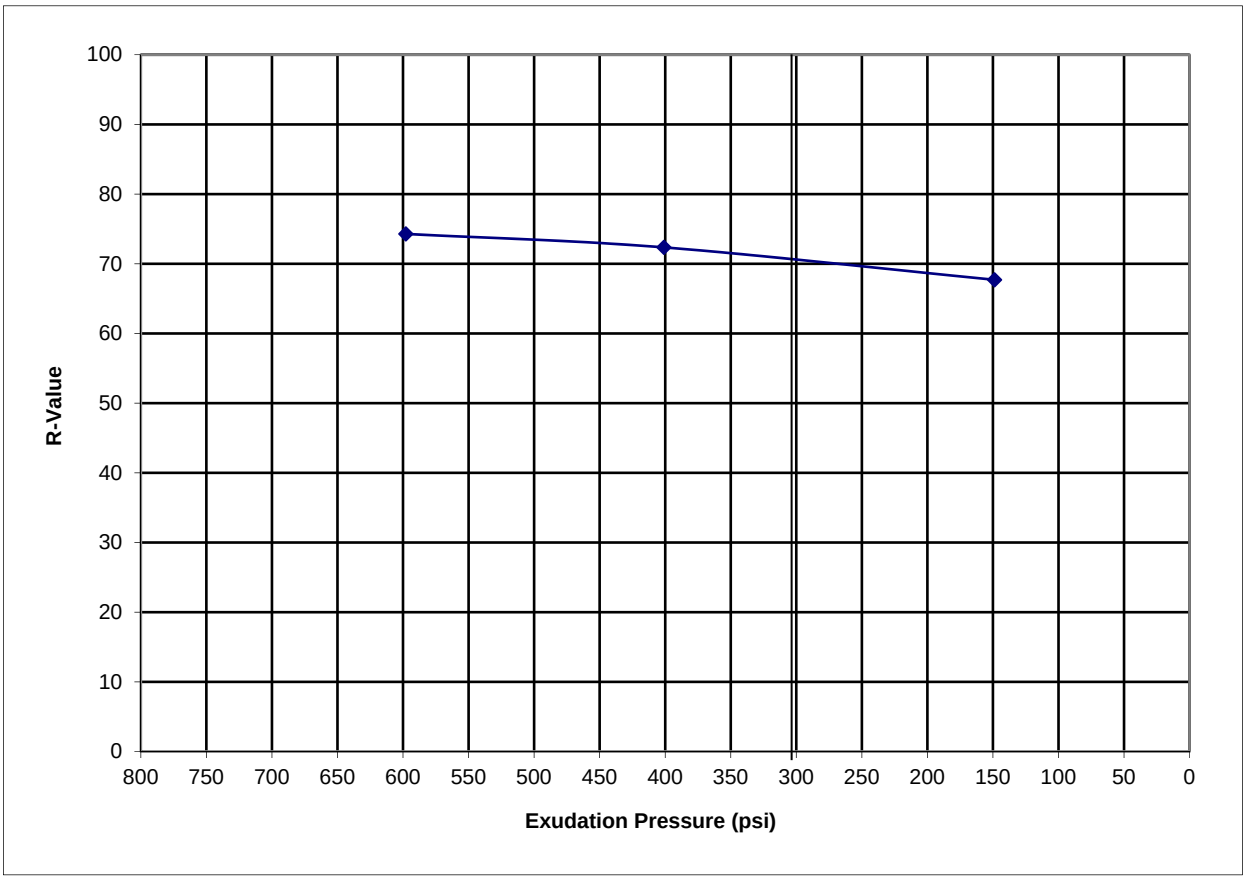
R Value at 300 PSI = 27

Exhibit B-66

PROJECT:	BIA N35	**JOB NO:**	65165267
LOCATION:	Sweetwater, AZ	**WORK ORDER NO:**	65165267
MATERIAL:	Silty Sand	**LAB NO:**	
SAMPLE SOURCE:	B-66 @ 0'-5'	**DATE RECEIVED:**	11/07/16

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	**A**	**B**	**C**
Moisture Content	10.2%	9.8%	9.4%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.54	2.49	2.50
Dry Density (pcf)	117.8	119.3	119.7
Horiz. Pres. @ 1000lbs (psi)	20.0	17.0	16.0
Horiz. Pres. @ 2000lbs (psi)	35.0	30.0	28.0
Displacement	4.26	4.14	4.08
Expansion Pressure (psi)	0.0	0.0	0.1
Exudation Pressure (psi)	149	401	598
R Value	68	72	74



AASHTO R18

R Value at 300 PSI = 71

Exhibit B-67

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/17/16
Report Date: 10/19/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/14/2016 **Lab No.: 16-0940**

Results of Resistivity Analysis

Sample Number				
Sample Location	B-1	B-5	B-9	B-13
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, AWWA 4500 H	9.92	8.35	8.61	9.07
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	303	330	2420	61
Chlorides, ASTM D 512, (mg/kg)	150	38	37	47
Resistivity, ASTM G 57, (ohm-cm)	1436	1746	1077	6693

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

Exhibit B-68

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/17/16
Report Date: 10/19/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/14/2016 **Lab No.: 16-0940**

Results of Resistivity Analysis

Sample Number				
Sample Location	B-16	B-20	B-25	B-26
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, AWWA 4500 H	8.99	8.98	9.58	9.26
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	52	33	85	47
Chlorides, AST, D 512, (mg/kg)	45	25	50	38
Resistivity, ASTM G 57, (ohm-cm)	6169	7372	3201	6305

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

Exhibit B-69

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/17/16
Report Date: 10/19/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/14/2016 **Lab No.: 16-0940**

Results of Resistivity Analysis

Sample Number	
Sample Location	B-27
Sample Depth (ft.)	0.0-5.0
pH Analysis, AWWA 4500 H	9.47
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	83
Chlorides, ASTM D 512, (mg/kg)	55
Resistivity, ASTM G 57, (ohm-cm)	3007

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

Exhibit B-70

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/24/16
Report Date: 10/25/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/20/2016 **Lab No.: 16-0962**

Results of Soluble Salt Analysis

Sample Number	
Sample Location	B-32
Sample Depth (ft.)	0.0-5.0
pH Analysis, AWWA 4500 H	8.37
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	69
Chlorides, ASTM D 512, (mg/kg)	38

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/24/16
Report Date: 10/25/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/20/2016 **Lab No.: 16-0962**

Results of Soluble Salt Analysis

Sample Number				
Sample Location	B-36	B-40	B-43	B-46
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	77	28	41	41
Chlorides, ASTM D 512, (mg/kg)	25	50	40	35

Analzed By:

Kurt D. Ergun
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/24/16
Report Date: 10/25/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/20/2016 **Lab No.: 16-0962**

Results of Soluble Salt Analysis

Sample Number				
Sample Location	B-50	B-55	B-58	B-60
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	77	28	41	41
Chlorides, ASTM D 512, (mg/kg)	25	48	27	45

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/24/16
Report Date: 10/25/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/20/2016 **Lab No.: 16-0962**

Results of Soluble Salt Analysis

Sample Number			
Sample Location	B-63	B-65	B-66
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	77	28	41
Chlorides, ASTM D 512, (mg/kg)	75	55	208

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/24/16
Report Date: 10/25/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/20/2016 **Lab No.: 16-0962**

Results of Soluble Salt Analysis

Sample Number	
Sample Location	B-52
Sample Depth (ft.)	0.0-5.0
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	57
Chlorides, ASTM D 512, (mg/kg)	50

Analzed By:

Kurt D. Ergun
Chemist

Exhibit B-75

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/31/16
Report Date: 11/07/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/28/2016 **Lab No.: 16-0988**

Results of Resistivity Analysis

Sample Number				
Sample Location	RL-23+870	RL-24+370	RL-24+735	RL-26+010
Sample Depth (ft.)	0.5-1.5	0.5-1.5	0.5-1.5	0.0-.5
pH Analysis, AWWA 4500 H	8.80	8.57	8.40	8.18
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	66	58	47	69
Chlorides, ASTM D 512, (mg/kg)	38	50	50	38
Resistivity, ASTM G 57, (ohm-cm)	6111	5820	5335	5529

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 10/31/16
Report Date: 11/07/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 10/28/2016 **Lab No.: 16-0988**

Results of Resistivity Analysis

Sample Number	
Sample Location	RL-30+320
Sample Depth (ft.)	0.5-1.5
pH Analysis, AWWA 4500 H	8.32
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	55
Chlorides, ASTM D 512, (mg/kg)	25
Resistivity, ASTM G 57, (ohm-cm)	7178

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

Exhibit B-77

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 11/12/16
Report Date: 11/13/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 11/10/2016 **Lab No.: 16-0988**

Results of Resistivity Analysis

Sample Number				
Sample Location	RL-21+500	RL-24+370	RL-24+735	RL-26+010
Sample Depth (ft.)	0.5-1.5	0.5-1.5	0.5-1.5	0.0-.5
pH Analysis, AWWA 4500 H	8.46	8.48	8.64	8.18
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	57	36	33	63
Chlorides, ASTM D 512, (mg/kg)	45	25	25	37
Resistivity, ASTM G 57, (ohm-cm)	3783	6499	7566	4850

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: 69165033
Service Date: 11/12/16
Report Date: 11/13/16
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

United States of the Interior
Gallup, New Mexico

Project

N35
Sweetwater, Arizona

Sample Submitted By: Terracon (69) **Date Received:** 11/10/2016 **Lab No.: 16-0988**

Results of Resistivity Analysis

Sample Number	
Sample Location	RL-26+240
Sample Depth (ft.)	0.5-1.5
pH Analysis, AWWA 4500 H	9.13
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	55
Chlorides, ASTM D 512, (mg/kg)	38
Resistivity, ASTM G 57, (ohm-cm)	5675

Analzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

APPENDIX C

ENGINEERING

AND DESIGN CALCULATIONS

Design Traffic Analysis

Spreadsheet To Calculate Traffic for Pavement Design

- Traffic Analysis is based upon procedures by AASHTO Design of Pavement Structures (1993)
- Average Daily Traffic (ADT) is required along with annual growth rate
- Lane factor adjusts design lane traffic for 1, 2, 4 or 6 lanes
- All ESAL (Truck) Factors are 18-kip equivalents per vehicle

Initial Data

PROJECT DATA

Project name:	BIA N35 and N5045
Location:	Sweetwater, AZ
Terracon Project No.	65165267

STREET DATA

Street Name	N35 and N5045
Current Average Daily Traffic (ADT)	263
Design Period (years)	20
Annual Growth Rate (%)	2.00%
Number of Traffic Lanes (2, 4 or 6)	2

Equivalent 18-kip Axle Load Analysis

Vehicle Type	Current Daily Traffic	Annual No. of Vehicles	ESAL Factor	Growth Factor	Equivalent Axle Loads
Passenger Cars	257	93,805	0.0008	24.30	1,823
Buses	3	1,095	0.6806	24.30	18,108
Single Unit Trucks					
Panel and Pickup Trucks		0	0.0122	24.30	0
Other 2-Axle/4-Tire Trucks		0	0.0052	24.30	0
2-Axle/6-Tire		0	0.1890	24.30	0
3 or more Axle Trucks		0	0.1303	24.30	0
All Single Unit Trucks	0	0			0
Tractor Semi-Trailers					
3 Axle Tractor Semi-Trailers		0	0.8646	24.30	0
4 Axle Tractor Semi-Trailers		0	0.6560	24.30	0
5 + Tractor Semi-Trailers	3.0	1,095	2.3790	24.30	63,295
All Tractor Semi-Trailers	3	1,095			63,295
Double Trailer Combinations					
5 Axle Double Trailers		0	2.3187	24.30	0
6 + Axle Double Trailers		0	2.3187	24.30	0
All Double Trailer Combniations	0	0			0
Truck Trailer Combinations					
3 Axle Truck-Trailers		0	0.0152	24.30	0
4 Axle Truck-Trailers		0	0.0152	24.30	0
5 + Axle Truck Trailers		0	0.5317	24.30	0
All Truck-Trailer Combinations	0	0			0
All Vehicles	263.0	95,995			83,226

Traffic Summary

TOTALS

Equivalent Axle Loads (EAL's)	**83,226**
Lane Factor	**0.50**
Design Equivalent Axle Loads	**41,613**
Design Traffic Number (DTN)	**6**

Design Resilient Modulus Analysis

Project Data

PROJECT NAME, LOCATION and SEASONAL VARIATION FACTOR

Project Name:	BIA N35 and N5045
Location:	Sweetwater, AZ
Seasonal Variation Factor:	1.8

Laboratory Test Data

Boring No. Point ID	Boring Location	Depth (ft)	LL	PI	-#200	Laboratory R-Value	Correlated R-Value
B-1	N35	0 - 5	0	0	11		85.6
B-2	N35	0 - 5	34	12	54	8.5	29.6
B-3	N35	0 - 5	0	0	38	28.1	59.1
B-4	N35	0 - 5	0	0	19		76.7
B-5	N35	0 - 5	0	0	23		73.2
B-5	N35	5 - 6.5	0	0	16		80.2
B-6	N35	0 - 5	0	0	10		87.4
B-7	N5045	0 - 5	0	0	11		85.4
B-8	N5045	0 - 5	0	0	15	69	81.5
B-9	N35	0 - 5	0	0	8		89.6
B-9	N35	9 - 10.5	0	0	12		84.9
B-10	N35	0 - 5	0	0	34	56	62.4
B-11	N35	0 - 5	0	0	15		81.5
B-12	N35	0 - 5	0	0	14		82.3
B-13	N35	0 - 5	0	0	17		79.5
B-14	N35	0 - 5	0	0	16		80.3
B-15	N35	0 - 5	0	0	9		88.7
B-16	N35	0 - 5	0	0	33	64	63.4
B-17	N35	5 - 10	0	0	13		83.7
B-18	N35	0 - 5	0	0	15		80.8
B-19	N35	0 - 5	0	0	22	69	73.8
B-20	N35	0 - 5	0	0	15		81.2
B-21	N35	0 - 4	0	0	33	64	63.3
B-21	N35	4 - 12	0	0	22		74.3
B-22	N35	0 - 5	0	0	19		77.4
B-23	N35	0 - 5	0	0	23		72.5
B-24	N35	1 - 6	0	0	17		79.5
B-25	N35	0 - 5	0	0	39	66	58.0
B-26	N35	0 - 5	0	0	16		80.6
B-27	N35	0 - 5	24	7	63	60	31.8
B-28	N35	0 - 5	0	0	3		95.6
B-29	N35	0 - 5	0	0	16		80.3
B-30	N35	0 - 5	0	0	12		84.4

B-31	N35	0 - 5	0	0	18	66	78.4
B-32	N35	0 - 5	0	0	16		79.9
B-33	N35	0 - 5	0	0	14		82.5
B-34	N35	0 - 3	0	0	17	54	79.6
B-35	N35	0 - 5	0	0	12		85.1
B-36	N35	0 - 5	0	0	6		91.6
B-37	N35	0 - 5	0	0	19		76.7
B-38	N35	0 - 5	0	0	7		91.2
B-39	N35	0 - 5	0	0	18	59	78.2
B-40	N35	0 - 5	0	0	14		82.4
B-41	N35	0 - 5	0	0	6		91.5
B-42	N35	0 - 5	0	0	19		77.4
B-43	N35	0 - 5	0	0	19		76.6
B-44	N35	0 - 5	0	0	14	74	83.0
B-45	N35	0 - 5	0	0	11		85.3
B-46	N35	0 - 5	0	0	14		82.4
B-47	N35	0 - 5	0	0	24	71	71.5
B-48	N35	0 - 4	0	0	17		79.5
B-48	N35	4 - 9	0	0	32		64.7
B-49	N35	0 - 5	0	0	50		50.0
B-49	N35	8 - 10	0	0	30		65.8
B-50	N35	0 - 5	0	0	24	70	71.8
B-51	N35	0 - 5	0	0	4		94.1
B-52	N35	0 - 5	0	0	6		91.8
B-53	N35	0 - 5	0	0	4		95.1
B-54	N35	0 - 5	0	0	17	63	78.6
B-55	N35	0 - 5	0	0	7		90.9
B-56	N35	0 - 5	0	0	6		92.6
B-57	N35	0 - 5	0	0	12	77	85.2
B-58	N35	0 - 5	0	0	4		95.1
B-59	N35	0 - 5	0	0	11		85.7
B-60	N35	0 - 5	0	0	7		91.1
B-61	N35	0 - 5	0	0	21	42	74.3
B-62	N35	0 - 5	0	0	11		85.9
B-63	N35	0 - 5	0	0	9		88.5
B-64	N35	0 - 5	0	0	6		91.6
B-65	N35	0 - 5	0	0	18	27	77.6
B-66	N35	0 - 5	0	0	22	71	73.6
							96

Mean R-Value and Modulus Calculations

Number of Laboratory Tested R-Values:	20	(Nt)
Average of Laboratory Tested R-Value Results:	57.93	(Rt)
Standard Deviation of Laboratory Tested R-Values:	17.99	(SDt)
Number of Correlated R-Value:	71	(Nc)
Average of Correlated R-Value Results:	78.94	(Rc)

Standard Deviation of Correlated R-Values:	12.49 (SDc)
Adjusted Average of Correlated R-Values:	76.45 (Rc)

Calculation for Mean R-Value:

$$R_{mean} = \frac{N_t' R_t' SD_c^2 + N_c' R_c' SD_t^2}{N_t' SD_c^2 + N_c' SD_t^2}$$

R_{mean} =	**74.2**
Seasonal Variation Factor for Project Location=	**1.8**
Design Resilient Modulus M_r (adjusted for SVF)=	**26,000** psi

Flexible Pavement Design Analysis

Design Criteria

PROJECT DATA

Pavement Designation	N35 and N5045
Design Life (years)	20
Equivalent Axle Loads/Day	6
Total EAL's	41,613
Seasonal Variation Factor	1.8
Reliability	75%
Overall Standard Deviation	0.35

SUBGRADE CONDITIONS

Mean R-Value, R_{Mean}	74.2
Resilient Modulus MR (psi)	37,159
Design Modulus (psi)	26,000

SERVICEABILITY

Initial Design Serviceability Index	4.0
Terminal Design Serviceability Index	2.4

LAYER COEFFICIENTS	Structural	Drainage
Asphalt Concrete Surface Course	0.44	N/A
Aggregate Base Course	0.14	0.92

Design Calculations

Target Structural Number SN: **1.05**

Alternative	Recommended Pavement Section Thickness Inches				Total Structural Number	D Structural Number
	Asphalt Concrete Surface	Aggregate Base Course	Mechanically Stabilized Aggregate	Total		
A	4.0			4.0	1.76	0.71
B	2.0	4.0		6.0	1.40	0.35
C	3.0	4.0		7.0	1.84	0.79

Pavement Life Cycle Cost Analysis

- Based upon ADOT Procedures and assumed maintenance schedules
- Initial costs are based upon bid tabs of regional ADOT projects or other local costs
- Life cycle costs are for comparative purposes only and are not for estimation of project costs

Project Data

Project Name	BIA N35	Interest Rate	5%
Project Number	65165267	Analysis Period (yr.)	20
Roadway	N35 and N504		

Pavement Alternatives:	A	B	C	D
Clear and Grub	1	1	1	1
Finish Grading	1	1	1	1
ABC (in.)	4	4	4	4
ARAC (in.)		2		3
AC (in.)	2		3	
Initial Costs (per lane mile)				
Clear and Grub	10,836	10,836	10,836	10,836
Finish Grading	3,731	3,731	3,731	3,731
ABC (in.)	31,258	31,258	31,258	31,258
ARAC (in.)	0	72,934	0	109,402
AC (in.)	65,050	0	97,574	0
Total Initial Cost (PW):	**$ 110,875**	**$ 118,760**	**$ 143,400**	**$ 155,227**
Maintenance Costs (per lane mile)				
Maintenance Cost	1,000	500	1,000	500
Number of Years Performed	8	8	8	8
Maintenance Cost (Chip Seal)	26,400	26,400	26,400	26,400
Number of Years Performed	2	2	3	3
Total Maintenance Cost (PW):	**$ 60,800**	**$ 56,800**	**$ 87,200**	**$ 83,200**
2" AC Overlay Rehabilitation and Scrub Seal Cost (per lane mile)				
Year 10	75,886	75,886		
Total Rehabilitation Cost (PW):	**$ 75,886**	**$ 75,886**	**$ -**	**$ -**
Salvage Value (per lane mile)				
Percent of Initial Cost	35%	35%	35%	35%
Salvage Value at End of Life Cycle	38,806	41,566	50,190	54,329
Total Salvage Value (PW):	**$ 14,626**	**$ 15,666**	**$ 18,916**	**$ 20,476**
Life Cycle Costs (per lane mile)				
Initial Costs	$ 110,875	$ 118,760	$ 143,400	$ 155,227
Maintenance & Rehabilitation Costs	136,686	132,686	87,200	83,200
Salvage Value	14,626	15,666	18,916	20,476
Total Present Worth	**232,935**	**235,780**	**211,684**	**217,951**
Average Annual Cost	**$ 18,691**	**$ 18,920**	**$ 16,986**	**$ 17,489**

Pavement Life Cycle Cost Analysis

- Based upon ADOT Procedures and assumed maintenance schedules
- Initial costs are based upon bid tabs of regional ADOT projects or other local costs
- Life cycle costs are for comparative purposes only and are not for estimation of project costs

Project Data

Project Name	BIA N35	Interest Rate	5%
Project Number	65165267	Analysis Period (yr.)	20
Roadway	N35 and N504		

Pavement Alternatives:	E	F		
Clear and Grub	1	1		
Finish Grading	1	1		
ABC (in.)				
ARAC (in.)		4		
AC (in.)	4			
Initial Costs (per lane mile)				
Clear and Grub	10,836	10,836	0	0
Finish Grading	3,731	3,731	0	0
ABC (in.)	0	0	0	0
ARAC (in.)	0	145,869	0	0
AC (in.)	130,099	0	0	0
Total Initial Cost (PW):	**$ 144,667**	**$ 160,436**	**$ -**	**$ -**
Maintenance Costs (per lane mile)				
Maintenance Cost	1,000	500	1,000	500
Number of Years Performed	8	8		
Maintenance Cost (Chip Seal)	26,400	26,400	26,400	26,400
Number of Years Performed	3	3		
Total Maintenance Cost (PW):	**$ 87,200**	**$ 83,200**	**$ -**	**$ -**
2" AC Overlay Rehabilitation and Scrub Seal Cost (per lane mile)				
Year 10				
Total Rehabilitation Cost (PW):	**$ -**	**$ -**	**$ -**	**$ -**
Salvage Value (per lane mile)				
Percent of Initial Cost	35%	35%	35%	35%
Salvage Value at End of Life Cycle	50,633	56,153	0	0
Total Salvage Value (PW):	**$ 19,083**	**$ 21,163**	**$ -**	**$ -**
Life Cycle Costs (per lane mile)				
Initial Costs	$ 144,667	$ 160,436	$ -	$ -
Maintenance & Rehabilitation Costs	87,200	83,200	0	0
Salvage Value	19,083	21,163	0	0
Total Present Worth	**212,784**	**222,473**	**0**	**0**
Average Annual Cost	**$ 17,074**	**$ 17,852**	**$ -**	**$ -**