GEOTECHNICAL ENGINEERING REPORT
MCWILLIAMS ROAD IMPROVEMENTS
AZTEC, NEW MEXICO

Submitted To:

R. Clayton Harrison, P.E.
CHC Engineers, LLC
50 Valley Court
Durango, Colorado 81301

Submitted By:

GEOMAT Inc.
915 Malta Avenue
Farmington, New Mexico 87401

November 28, 2023
GEOMAT Project 222-4126

GEOMAT INC.
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November 28, 2023

R. Clayton Harrison, P.E.
CHC Engineers, LLC
50 Valley Court
Durango, Colorado 81301

RE: Geotechnical Engineering Report
McWilliams Road Improvements
Aztec, New Mexico
GEOMAT Project No. 222-4126

GEOMAT Inc. (GEOMAT) has completed the geotechnical engineering exploration for the McWilliams Road Improvements Project located in Aztec, New Mexico. This study was performed in general accordance with our Proposal No. 212-12-10, dated December 8, 2021.

The results of our engineering study, including the geotechnical recommendations, site plan, boring records, and laboratory test results are attached. Based on the geotechnical engineering analyses, subsurface exploration, and laboratory test results, the site is considered suitable for the proposed roadway improvements. Other design and construction details, based upon geotechnical conditions, are presented in the report.

We have appreciated being of service to you in the geotechnical engineering phase of this project. If you have any questions concerning this report, please contact us.

Sincerely yours,

GEOMAT Inc.

Douglas N. Hood
Staff Professional

Matthew J. Cramer, P.E.
President

Copies to: Addressee (1) (via E-mail)

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

GEOTECHNICAL ENGINEERING REPORT
MCWILLIAMS ROAD IMPROVEMENTS PROJECT
AZTEC, NEW MEXICO
GEOMAT PROJECT NO. 222-4126

INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the proposed McWilliams Road Improvements Project located in Aztec, New Mexico, as shown on the Site Plan in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations about:

- subsurface soil conditions
- groundwater conditions
- pavement design
- drainage

The opinions and recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and experience with similar soil conditions, structures, and our understanding of the proposed project as stated below.

PROPOSED CONSTRUCTION

We understand the project will consist of the improvement of approximately 2,200 feet of McWilliams Road and approximately 100 feet of Jaquez Road, which is currently gravel surfaced with curb and gutter, and sidewalk. West of the intersection of Jaquez Road, ground surfacing of the roadway becomes native materials with no curb and gutter or sidewalk. Improvements will consist of surfacing of the roads with asphalt concrete. We understand that the traffic volume data for the roadway will be provided to us by others and that no significant cuts/fills will be required to achieve final site grades.

SITE EXPLORATION

Our scope of services performed for this project included a site reconnaissance by a staff engineer, a subsurface exploration program, laboratory testing, and engineering analyses.

Field Exploration:

Subsurface conditions at the site were explored on July 29, 2022 by drilling six (6) exploratory borings to the planned depth of five (5) feet below existing ground surface (bgs.) at the approximate locations shown on the Site Plan in Appendix A.

The borings were advanced using a CME-55 truck-mounted drill rig with continuous-flight, 7.25-inch O.D. hollow-stem auger. The borings were continuously monitored by a staff professional from our office who examined and classified the subsurface materials encountered, obtained representative samples, observed groundwater conditions, and maintained a continuous log of each boring.

Representative bulk samples of the subsurface materials were obtained. Groundwater evaluations were made in each boring at the time of the site exploration. Soils were classified in accordance with the Unified Soil Classification System described in Appendix A. Boring logs were prepared and are presented in Appendix A.

Laboratory Testing:

Samples retrieved during the field exploration were transported to our laboratory for further evaluation. At that time, the field descriptions were confirmed or modified as necessary, and laboratory tests were performed to evaluate the engineering properties of the subsurface materials.

SITE CONDITIONS

The project site is located along McWilliams Road located in Aztec, New Mexico. McWilliams Road generally runs in the east-west direction. The roadway had two different surface types: east of the intersection of Jaquez Road there is gravel surfacing and west of the intersection of Jaquez Road the surface is native soils. Jaquez Road had concrete curb and gutter on both sides of the roadway throughout the entire road, while McWilliams Road had concrete cub and gutters that extended to approximately 160 feet west of Jaquez Road centerline and eastward to the intersection of Old State Highway 173. The east end of the roadway has a short, steep increasing slope from east to west, up to the intersection of Jaquez Road. Going west from the intersection, the roadway remains relatively level, then has a gradual downward slope at the west end of the roadway to the intersection of McWilliams Road and Airport Drive. The roadway generally has a combination of undeveloped land and commercial/residential structures on the north side and a combination of undeveloped land and residential buildings on the south side. There is a large storage tank west of the area of Boring B-2 and the Aztec Airport is northwest of the project site. Both the east and west ends of the roadway area bordered with residential structures. At the time of our exploration the site had vegetation on both sides of the roadways with grass, small to medium sized bushes, and small trees. At the time of exploration the roadway was wet and muddy due to a recent rain event.

The following photographs depict the site during the time of our exploration.

Drill Rig at Boring B-6,
Viewed Towards the East

Drill Rig at Boring B-4,
Viewed Towards the East

SUBSURFACE CONDITIONS

Soil Conditions:

As presented on the Boring Logs in Appendix A, in boring B-1, we encountered a thin layer of gravels and cobbles that extended to approximately ½ a foot bgs, underlain by clayey sand that extended the remaining depth of exploration of 5 feet bgs. In boring B-2, we encountered clayey sands that extended the full depth of exploration of 5 feet bgs. In boring B-3, we encountered clayey sands that extended to approximately 4 ½ feet bgs which were underlain by clayey soils that extended the remaining depth of exploration of 5 feet bgs. In boring B-4, we encountered clayey sands that extended to approximately 2 ½ feet bgs which were underlain by silty sands that extended the remaining depth of exploration of 5 feet bgs. In boring B-5, we encountered clayey sands that extended to approximately 3 ½ feet bgs which were underlain by gravels and cobbles that extended the remaining depth of exploration of 4 feet bgs, at which point auger refusal occurred on gravels and cobbles. In boring B-6, we encountered clayey sands with gravels and occasional cobbles that extended to approximately 2 ½ feet bgs, at which point auger refusal occurred on gravels and cobbles.

The sandy soils encountered were generally fine- to medium-grained, ranging from fine- to coarse-grained, and colors ranging from red to tan to brown. The sandy soils beneath the ground surface had moisture contents of slightly damp to damp. The clayey soils encountered had a color ranging from tan to white and were slightly damp.

Groundwater Conditions:

Groundwater was not encountered in the borings to the depths explored. Groundwater elevations can fluctuate over time depending upon precipitation, irrigation, runoff and infiltration of surface water. We do not have any information regarding the historical fluctuation of the groundwater level in this vicinity.

Laboratory Test Results:

Laboratory analyses of bulk samples of the sandy soils tested indicated that the that the samples have fines contents (silt- and/or clay-sized particles passing the U.S. No. 200 sieve) ranging from approximately 15 to 48 percent and plasticity indexes ranging from 10 to 17.

Results of all laboratory tests are presented in Appendix A.

OPINIONS AND RECOMMENDATIONS

Geotechnical Considerations:

The site is considered suitable for the proposed roadway improvement based on the geotechnical conditions encountered and tested for this report.

If there are any significant deviations from the assumed proposed construction mentioned at the beginning of this report, the opinions and recommendations of this report should be reviewed and confirmed/modified as necessary to reflect the final planned design conditions.

Pavement Design and Construction:

Design of pavements for the project has been based on the procedures outlined in the Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). We recommend that the new roadway be constructed as discussed later in this section.

Traffic Volume Data:

Traffic information for the proposed road section was obtained from the Farmington Metropolitan Planning Organization Traffic Count website for McWilliams Road. GEOMAT should be contacted to review our recommendations and make appropriate modifications should additional traffic information become available. The following table summarizes the traffic volume data used in our roadway design calculations.

McWilliams Road Traffic Volume Data	
Year	**Average Daily Traffic (vehicles/day)**
2020	2,526
2019	3,243
2018	3,205
2017	3,161
2016	-
2015	3,083

R-Value Test Results:

Based upon the results of the gradation and plasticity index tests, an estimated R-value of 26 was used for the design. Any fill materials, native or imported, that may be required to achieve final site grades should have a minimum R-value of 26.

Recommended Pavement Sections:

We are presenting options for flexible (asphalt) pavement sections. The following table contains the design parameters used in our analysis based upon the information available to us.

Parameter	Value Used in Analysis
Design Life	20 years
Average Daily Traffic	3,050 vehicles/day (1,525 per lane/direction)
Percent Truck Traffic	2% (1.4 Truck Factor)
Design Equivalent Single Axle Loads (ESAL)	390,000
Reliability	80%
Annual Traffic Growth Rate	2%
Overall Deviation	0.5
Subgrade Soil	R-Value = 26 (estimated M_R = 15,585 psi)
Initial Serviceability (P_o)	4.50
Terminal Serviceability (P_t)	2.00
Asphalt Structural Coefficient	0.44
Base Course Structural Coefficient	0.13
Base Course Drainage Coefficient	1.0

The recommended pavement sections are presented in the following table.

Recommended Pavement Sections		
Option	**Hot Mix Asphalt** (inches)	**Aggregate Base Course** (inches)
Asphalt/Base Course	3.0	6.0

Construction Recommendations for Asphalt Pavements:

In areas to be paved, the exposed ground surface should be scarified to a minimum depth of 12 inches and moisture conditioned as necessary to bring the upper 1.0 foot to within ± 2 percent of optimum moisture content and compacted to a minimum of 95 percent of ASTM D1557 maximum dry density prior to placement of fill or construction of pavement sections.

After preparation of the pavement subgrade, the areas to be paved should be proof-rolled under the observation of a representative of GEOMAT. The proof-rolling should be conducted utilizing a fully loaded, single axle water truck with a minimum 2,000-gallon capacity or other vehicle that will provide an equivalent weight on the subgrade. The proof-rolling should consist of driving the truck across all the areas to be paved with asphalt at a slow speed (less than 5 mph) and observing any deflections or distress caused to the subgrade. Areas that show distress should be repaired by

removing and replacing the soft material with suitable fill.

Aggregate base course should conform to Section 303 of the NMDOT specifications for Type I or II Base Course.

Aggregate base course should be placed in lifts not exceeding 6 inches and should be compacted to a minimum of 95% Modified Proctor density (ASTM D1557), within a moisture content range of 4 percent below, to 2 percent above optimum. In any areas where base course thickness exceeds 6 inches, the material should be placed and compacted in two or more lifts of equal thickness.

If the hot-mix asphalt (HMA) is placed in more than one mat, the surface of each underlying mat should be treated with a tack coat immediately prior to placement of the subsequent mat of hot-mix asphalt.

Asphalt concrete should be obtained from an engineer-approved mix design prepared in accordance with NMDOT specifications. The hot-mix paving should be placed and compacted in accordance with NMDOT specifications. HMA should be either an SP-III or SP-IV mix complying with the requirements of section 416, Minor Paving of the current NMDOT Specifications. HMA lift thicknesses should comply with the following:

HMA Lift Thicknesses		
HMA Type	**Minimum Thickness (inches)**	**Maximum Thickness (inches)**
SP-III	2.5	3.5
SP-IV	1.5	3.0

General Pavement Considerations:

The performance of the recommended pavement sections can be enhanced by minimizing excess moisture that can reach the subgrade soils. The following recommendations should be considered at minimum:

1. Site grading at a minimum 2% grade away from the pavements.
2. Compaction of any utility trenches to the same criteria as the pavement subgrade.

The recommended pavement sections are considered minimal sections based on the anticipated traffic volumes and the subgrade conditions encountered during our exploration. They are expected to perform adequately when used in conjunction with preventive maintenance and good drainage. Preventive maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment.

Compliance:

The opinions and recommendations given in this report are confirmation dependent and depend upon compliance with earthwork recommendations. To assess compliance, observation and testing should be performed by GEOMAT. GEOMAT cannot be held liable, in any manner, if the necessary observation and testing to confirm the conditions we have inferred to exist is not performed.

GENERAL COMMENTS

It is recommended that GEOMAT be retained to provide a general review of final design plans and specifications in order to confirm that grading and pavement recommendations in this report have been interpreted and implemented. In the event that any changes of the proposed project are planned, the opinions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

GEOMAT should also be retained to provide services during excavation, grading, and construction phases of the work. Observation of excavations should be performed prior to placement of pavement sections to confirm that satisfactory materials are present and is considered a necessary part of continuing geotechnical engineering services for the project. Construction testing, including field and laboratory evaluation of fill, backfill, and pavement materials, should be performed to determine whether applicable project requirements have been met.

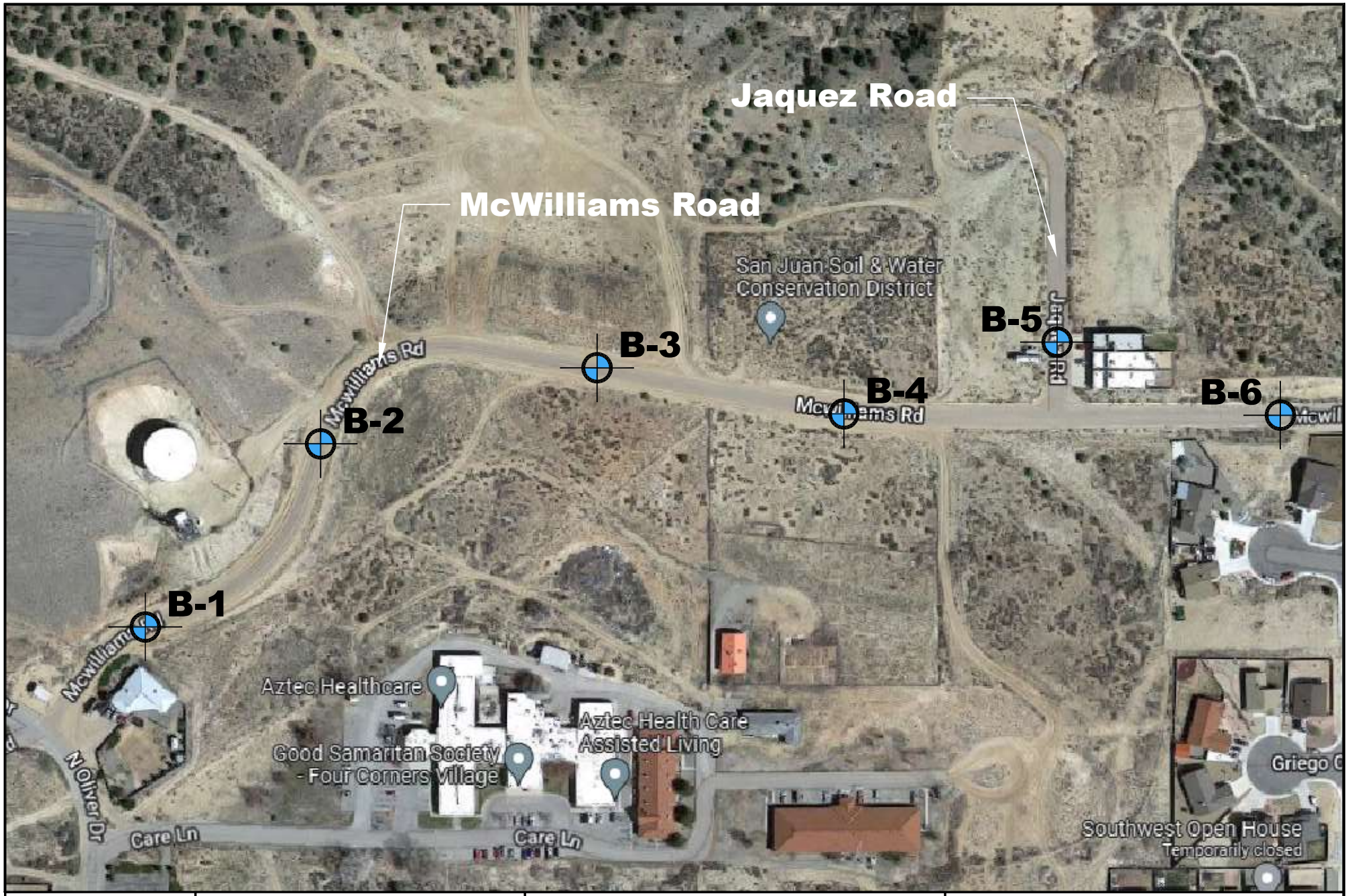
The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the location of test borings may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities at the same time. No warranty, express or implied, is intended or made. We prepared the report as an aid in design of the proposed project. This report is not a bidding document. Any contractor reviewing this report must draw his own conclusions regarding site conditions and specific construction equipment and techniques to be used on this project.

This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. This report has also not addressed any geologic hazards that may exist on or near the site.

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

Appendix A



Approximate Not to Scale	SITE PLAN Boring Locations (approximate) GEOMAT Project No. 222-4126 Date of Exploration: July 29,2022	PROJECT McWilliams Road Improvements Aztec, New Mexico

GEOMAT INC.

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Farmington, NM 87401
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Boring B-1

Project Name: McWilliams Road Improvements
Project Number: 222-4126
Client: CHC Engineers, LLC
Site Location: Aztec, New Mexico
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk sample from auger cuttings
Hammer Weight: N/A
Hammer Fall: N/A

Date Drilled: 7/29/2022
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: DH
Remarks: None

Laboratory Results				Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)							
							GP			Gravel and Cobbles with silty sand, tan/brown, fine-to coarse-grained, moist
	48	17			A		SC		1 2 3 4 5	Clayey SAND, red/tan to tan/brown, fine- to coarse-grained, trace gravel, slighly damp to damp
									6 7	Total Depth 5 feet

A = Auger Cuttings R = Ring-Lined Barrel Sampler SS = Split Spoon GRAB = Manual Grab Sample D = Disturbed Bulk Sample SH = Shelby Tube Sampler

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Boring B-2

Project Name: McWilliams Road Improvements
Project Number: 222-4126
Client: CHC Engineers, LLC
Site Location: Aztec, New Mexico
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk sample from auger cuttings
Hammer Weight: N/A
Hammer Fall: N/A

Date Drilled: 7/29/2022
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: DH
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
					GRAB		SC		1	Clayey SAND, tan, fine- to medium-grained, moist
									2	
									3	red/brown, slightly damp to damp
					GRAB				4	
									5	brown
									6	Total Depth 5 feet
									7	

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Boring B-3

Project Name: McWilliams Road Improvements
Project Number: 222-4126
Client: CHC Engineers, LLC
Site Location: Aztec, New Mexico
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk sample from auger cuttings
Hammer Weight: N/A
Hammer Fall: N/A

Date Drilled: 7/29/2022
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: DH
Remarks: None

Laboratory Results				Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)							
	43	14			GRAB		SC		1 2 3 4	Clayey SAND, red/brown/tan, fine- to medium-grained, moist slightly damp to damp
					GRAB		CL		5	Lean CLAY, white/tan, slightly damp
									6 7	Total Depth 5 feet

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Boring B-4

Project Name: McWilliams Road Improvements
Project Number: 222-4126
Client: CHC Engineers, LLC
Site Location: Aztec, New Mexico
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk sample from auger cuttings
Hammer Weight: N/A
Hammer Fall: N/A

Date Drilled: 7/29/2022
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: DH
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
					GRAB		SC		1 2	Clayey SAND, tan/brown, fine- to medium-grained, moist organic debirs, slightly damp to damp
					GRAB		SM		3 4 5	Silty SAND, tan, fine- to medium-grained, slightly damp
									6 7	Total Depth 5 feet

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Boring B-5

Project Name: McWilliams Road Improvements
Project Number: 222-4126
Client: CHC Engineers, LLC
Site Location: Aztec, New Mexico
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk sample from auger cuttings
Hammer Weight: N/A
Hammer Fall: N/A

Date Drilled: 7/29/2022
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: DH
Remarks: None

Laboratory Results: Dry Density (pcf)	Laboratory Results: % Passing #200 Sieve	Laboratory Results: Plasticity Index	Laboratory Results: Moisture Content (%)	Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
					GRAB		SC		1 2 3	Clayey SAND with gravel, tan/brown, fine- to coarse-grained, slightly damp to damp occasional cobble
							GP		4	Gravels and Cobbles
									5 6 7	Auger Refusal due to Gravels and Cobbles Total Depth 4 feet

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Boring B-6

Project Name: McWilliams Road Improvements
Project Number: 222-4126
Client: CHC Engineers, LLC
Site Location: Aztec, New Mexico
Rig Type: CME-55
Drilling Method: 7.25" O.D. Hollow Stem Auger
Sampling Method: Bulk sample from auger cuttings
Hammer Weight: N/A
Hammer Fall: N/A

Date Drilled: 7/29/2022
Latitude: Not Determined
Longitude: Not Determined
Elevation: Not Determined
Boring Location: See Site Plan
Groundwater Depth: None Encountered
Logged By: DH
Remarks: None

Laboratory Results				Blows per 6"	Sample Type & Length (in)	Symbol	Material Type	Soil Symbol	Depth (ft)	Soil Description
Dry Density (pcf)	% Passing #200 Sieve	Plasticity Index	Moisture Content (%)							
	15	10			A		SC		1	Clayey SAND with gravels, red/brown, mosit
									2	tan/brown, slightly damp to damp occasional cobble
									3	Auger Refusal due to Gravel and Cobbles Total Depth 2 ½ feet
									4	
									5	
									6	
									7	

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UNIFIED SOIL CLASSIFICATION SYSTEM					CONSISTENCY OR RELATIVE DENSITY CRITERIA
Major Divisions			Group Symbols	Typical Names	
Coarse-Grained Soils More than 50% retained on No. 200 sieve	**Gravels** 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Standard Penetration Test Density of Granular Soils
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Penetration Resistance, N (blows/ft.) / Relative Density
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures	0-4 Very Loose
			GC	Clayey gravels, gravel-sand-clay mixtures	5-10 Loose
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines	11-30 Medium Dense
			SP	Poorly graded sands and gravelly sands, little or no fines	31-50 Dense
		Sands with Fines	SM	Silty sands, sand-silt mixtures	>50 Very Dense
			SC	Clayey sands, sand-clay mixtures	Standard Penetration Test Density of Fine-Grained Soils
Fine-Grained Soils 50% or more passes No. 200 sieve	**Silts and Clays** Liquid Limit 50 or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Penetration Resistance, N (blows/ft.) / Consistency / Unconfined Compressive Strength (Tons/ft2)
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	<2 Very Soft <0.25
			OL	Organic silts and organic silty clays of low plasticity	2-4 Soft 0.25-0.50
	Silts and Clays Liquid Limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous free sands or silts, elastic silts	4-8 Firm 0.50-1.00
			CH	Inorganic clays of high plasticity, fat clays	8-15 Stiff 1.00-2.00
			OH	Organic clays of medium to high plasticity	15-30 Very Stiff 2.00-4.00
Highly Organic Soils			PT	Peat, mucic & other highly organic soils	>30 Hard >4.0

U.S. Standard Sieve Sizes

>12"	12"	3"	3/4"	#4	#10	#40	#200

Boulders	Cobbles	Gravel		Sand			Silt or Clay
		coarse	fine	coarse	medium	fine	

MOISTURE CONDITIONS

Dry	Absence of moist, dusty, dry to the touch
Slightly Damp	Below optimum moisture content for compaction
Moist	Near optimum moisture content, will moisten the hand
Very Moist	Above optimum moisture content
Wet	Visible free water, below water table

MATERIAL QUANTITY

trace	0-5%
few	5-10%
little	10-25%
some	25-45%
mostly	50-100%

OTHER SYMBOLS

R Ring Sample
S SPT Sample
B Bulk Sample
▼ Ground Water

BASIC LOG FORMAT:

Group name, Group symbol, (grain size), color, moisture, consistency or relative density. Additional comments: odor, presence of roots, mica, gypsum, coarse particles, etc.

EXAMPLE:

SILTY SAND w/trace silt (SM-SP), Brown, loose to med. Dense, fine to medium grained, damp

UNIFIED SOIL CLASSIFICATION SYSTEM

TEST DRILLING EQUIPMENT & PROCEDURES

Description of Subsurface Exploration Methods

Drilling Equipment – Truck-mounted drill rigs powered with gasoline or diesel engines are used in advancing test borings. Drilling through soil or softer rock is performed with hollow-stem auger or continuous flight auger. Carbide insert teeth are normally used on bits to penetrate soft rock or very strongly cemented soils which require blasting or very heavy equipment for excavation. Where refusal is experienced in auger drilling, the holes are sometimes advanced with tricone gear bits and NX rods using water or air as a drilling fluid.

Coring Equipment – Portable electric core drills are used when recovery of asphalt or concrete cores is necessary. The core drill is equipped with either a 4" or 6" diameter diamond core barrel. Water is generally used as a drilling fluid to facilitate cooling and removal of cuttings from the annulus.

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

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

Appendix B

LAB NO.	BORING / TEST PIT	SAMPLE DEPTH (ft)	SIEVE ANALYSIS, CUMULATIVE PERCENT PASSING														ATTERBERG LIMITS			R-Value *	CLASSIFICATION
			1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 10	No. 16	No. 30	No. 40	No. 50	No. 100	No. 200	LL	PL	PI		
9340	B-1	1 to 5	100	100	100	99	98	96	94	93	90	85	82	78	71	48	32	15	17	26	Clayey **SAND** (SC)
9341	B-3	2	100	100	100	100	99	99	99	98	98	93	89	84	75	43	27	13	14	32	Clayey **SAND** (SC)
9342	B-6	0 to 2.5	100	97	91	82	75	67	62	61	57	46	40	34	25	15	24	14	10	55	Clayey **SAND** with gravel (SC)

NLL = No Liquid Limit

NPL = No Plastic Limit

NP = Non-Plastic

*Correlated R-Value based on results of sieve analysis and plasticity index tests (Table 202.02-3 from ADOT Preliminary Engineering and Design Manual dated March, 1989)

GEOMAT INC.

SUMMARY OF SOIL TESTS

Project	McWilliams Road Improvements
Job No.	222-4126
Location	Aztec, New Mexico
Date of Exploration	July 29, 2022

LABORATORY TESTING PROCEDURES

Laboratory testing is performed by trained personnel in our accredited laboratory or may be subcontracted by GEOMAT through a qualified outside laboratory if necessary. Actual types and quantities of tests performed for any project will be dependent upon subsurface conditions encountered and specific design requirements.

The following is an abbreviated table of laboratory testing that may be performed by GEOMAT with the applicable standards listed. Testing for a specific project may include all or a selected subset of the laboratory work listed. Laboratory testing beyond those listed may be available and could be incorporated into the project scope at the discretion of GEOMAT.

PROCEDURE	ASTM	AASHTO
Moisture Content	ASTM D2216	AASHTO T 265
Sieve Analysis	ASTM C136	AASHTO T 27
Fines Content	ASTM D1140	T 11
Hydrometer	ASTM D422	T 88
Atterberg Limits	ASTM D4318	AASHTO T 89/T 90
Soil Compression/Expansion	ASTM D2435	T 216
Soil Classification	ASTM D2487	M 145
Direct Shear	ASTM D3080	T 236
Unconfined Compressive Strength of Soils	ASTM D2166	T 208
Unconfined Compressive Strength of Rock Cores	ASTM D4543	-

Appendix C

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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